MAINE DEPARTMENT INLAND FISHERIES AND WILDLIFE ENDANGERED SPECIES ACT SECTION 7CONSULTATION

PROGRAMMATIC BIOLOGICAL OPINION

Lead Action Agency:	Federal Highway Administration and the U.S. Army Corps of Engineers
Activity:	General activities that involve work in streams and are required for the construction, preservation, and/or maintenance of the State transportation system in Maine.
Consultation Conducted By:	U.S. Fish and Wildlife Service, Maine Fish and Wildlife Service Complex, Maine Field Office [05E1ME00-2016-F-0510]

Approved by: ______________________ 1/23/17

Anna Harris, Project Leader — Date

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Acronyms

AMM or AMMs	Avoidance and Minimization Measures
AWA	anti-washout admixture
BA	Biological Assessment
BFW	Bankfull width
BMP or BMPs	Best Management Practices
BO	Biological Opinion
CH	Atlantic salmon designated critical habitat
CM	Conservation Measure
CMP	corrugated metal pipe
Corps	U.S. Army Corps of Engineers
cSEL	cumulative sound exposure level
CSM	culvert streambed material
dB	decibel
FHWA	Federal Highway Administration
FHWG	Fisheries Hydroacoustic Working Group
FPS	feet per second
GOM DPS	Gulf of Maine Distinct Population Segment
HU or HUs	habitat units
ILF	In-Lieu Fee
M	migration (one of the physical and biological features)
MaineDOT	Maine Department of Transportation
MTA	Maine Turnpike Authority
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NTU	nephelometric turbidity units
MDMR	Maine Department of Marine Resources
OHWM	Ordinary High Water Mark
PAH or PAHs	polycyclic aromatic hydrocarbons
PBA	Programmatic Biological Assessment
PBO	Programmatic Biological Opinion
PBF or PBFs	physical and biological features
PCE or PCEs	primary constituent elements
Proponents	Maine Department of Transportation and Maine Turnpike Authority
RMS	root mean squared
SEL	sound exposure level
Service	U.S. Fish and Wildlife Service
SEWPCP	Soil Erosion and Water Pollution Control Plan
SHRP2	Strategic Highway Research Program 2
SHRU	salmon habitat recovery unit
SPCC Plan	Spill Prevention, Control and Countermeasures Plan
SPL	sound pressure level
SR	spawning and rearing (one of the physical and biological features)
TSS	total suspended solids
USASAC	U.S. Atlantic Salmon Assessment Committee

USGS	U.S. Geological Survey
WSDOT	Washington State Department of Transportation
YOY	young-of-the-year

1. INTRODUCTION

1.1 Programmatic Consultation Process

This programmatic consultation creates a streamlined and transparent process. The efficiencies will be realized by the Proponents (the Maine Department of Transportation [MaineDOT] and the Maine Turnpike Authority [MTA]); the Action Agencies (the Federal Highway Administration [FHWA] and the U.S. Army Corps of Engineers [Corps]); and the U.S. Fish and Wildlife Service (Service). Unless otherwise decided, the FHWA will be the lead Federal action agency for section 7 consultation for all federally funded projects under this programmatic and the Corps will be the lead Federal action agency for section 7 consultation for all non-federally funded projects under this programmatic. The MaineDOT is leading the development of a User's Guide that will instruct all parties on the specifics for project submittals, reviews, Take tracking, monitoring, and annual reporting. A key item in the process will be early coordination on anticipated projects seeking programmatic coverage. The MaineDOT, the MTA, the FHWA, and the Corps will have regular discussions with the Service in advance of project submittals regarding project scope and programmatic coverage. The applicants and Action Agencies will have design standards and Avoidance and Minimization Measures (AMMs) to incorporate during planning and project development, including insertion into any Corps issued permits as nondiscretionary special conditions. The applicants and Action Agencies will submit project details to the Service using a standard reporting form. The form will capture relevant site-specific information, AMMs, potential take, and restoration benefits, supporting the Service's consistency review. When the required information is provided and the project qualifies for programmatic coverage, informal consultations will be completed within 14 days and formal consultations will be completed within 30 days. Early coordination is the key to ensuring these timeframes are attained.

1.2 Adaptive Management

The Proponents, the Action Agencies, and the Service will apply adaptive management strategies throughout the effective lifetime of this consultation. Incorporating new information on the effects of the action and the function of the program will allow the Proponents, Action Agencies, and the Service to ensure that effects of the proposed actions are effectively minimized and that the programmatic is consistent with stated efficiency and conservation goals. Changes to this consultation will be considered on an annual basis, but they may also occur at any time that Proponents, Action Agencies, and the Service agree it is appropriate. At the annual meeting, the Proponents, Action Agencies, and the Service will discuss existing monitoring protocols, avoidance and minimization measures (AMMs) and other commitments and assumptions made herein to ensure this programmatic consultation is being implemented successfully and appropriately.

Use of the habitat connectivity design and the stream crossing design monitoring protocol (see Appendix B) are examples of how new information could result in changes to the program. The habitat connectivity design concept relies heavily on published references and guidance. If monitoring demonstrates that portions of these references are not performing as expected, the design premise can be altered to account for these noted conditions.

The Proponents, Action Agencies, and the Service will conduct an annual program review. The Proponents and Action Agencies will generate an annual report for submittal to the Service. This report will summarize program use and Take for the reporting year (for the sake of this PBO, "year" refers to the calendar year, January 1 to December 31), the Service review timelines, monitoring information that may inform potential effect assumptions, and implementation of mitigation activities. In addition to the annual review, standard consultation reinitiation conditions (e.g., new information on species or effects) apply. The annual meeting will serve as the regular forum for all parties to discuss program changes and the need for reinitiation of consultation. Every five years, the effective period of the programmatic consultation will be renewed upon mutual agreement from the Proponents, Action Agencies, and the Service. This renewal will be facilitated through the issuance of a letter by the Service and will not require the creation of a new Opinion, unless reinitiation is deemed necessary.

1.3 Consultation History

- Fall 2013–Atlantic Salmon Programmatic Consultation process initiated by the MaineDOT.
- March 31 and April 1, 2015–SHRP2 Eco-Logical Workshop with the FHWA (Resource Center, Headquarters and Division), the Corps, the Service, the MaineDOT, and the National Marine Fisheries Service (NMFS). Developed a draft consultation schedule.
- April 2015–The FHWA, the MaineDOT, the Service, and the NMFS met and developed Tier 1, 2 and 3 priority areas, based on known species or critical habitat presence, known barriers, and active recovery or production efforts. Draft maps were developed and subsequently sent out for review by the FHWA, the Service, the NMFS, and the four federally recognized tribes in Maine.
- August 26 and 27, 2015–The FHWA (Resource Center and Division), the Corps, the MaineDOT, and the Service met to discuss programmatic needs and further develop consultation schedule.
- February 12 and 25, 2016–The FHWA, the MaineDOT, and the Service (Regional Office and Maine Field Office) met to discuss urgency of programmatic and emphasize importance of having an aggressive schedule.
- June 8, 2016–The FHWA, the Corps, and the MaineDOT initiated formal section 7 consultation. The letter indicated that while requesting initiation of formal consultation, there were still some information gaps regarding stream habitat connectivity design that needed to be addressed.
- August 5, 2016–The Service responded to June 8, 2016 letter requesting initiation of formal section 7 consultation. The Service indicated that they expect to provide a final biological opinion by October 22, 2016. The Service also indicated several information gaps in the Programmatic Biological Assessment (PBA) that needed to be addressed.
- August–October 2016–The FHWA, the Corps, and the MaineDOT held weekly meetings to discuss schedule, progress, and review the supplemental information[1] requested by the Service in their August 5, 2016 letter.

[1] The supplemental information requested by the Service has been incorporated into this Biological Opinion and will also be incorporated into the User's Guide.

- September 12, 2016–The FHWA, the Corps, and the MaineDOT responded to the Service August 5, 2016 letter, addressing the information gaps. The FHWA, the Corps, and the MaineDOT also requested input on the draft Turbidity Monitoring Protocol, Hydroacoustic Monitoring Protocol, and the Post-Project Monitoring Protocol.
- September 23 and October 3, 2016–The Service responded to the FHWA, the Corps, and the MaineDOT with their comments on the Turbidity Monitoring Protocol, Hydroacoustic Monitoring Protocol, and the Post-Project Monitoring Protocol.

1.4 Biological Opinion

This Programmatic Biological Opinion (PBO) presents the Service's review of the status of Atlantic salmon, the condition of designated critical habitat, and the environmental baseline for the action area, as well as our analyses of all the effects of the actions as proposed and the cumulative effects (50 CFR 402.14(g), *Federal Register* 1986, 19957; as amended by *Federal Register* 1989, 40350; *Federal Register* 2008, 76287; *Federal Register* 2009a, 20423; *Federal Register* 2015, 26844). For the jeopardy analysis, the Service analyzed these combined factors to conclude whether the proposed action could appreciably reduce Atlantic salmon likelihood of survival and recovery as well as affecting an adverse modification to critical habitat.

This PBO is based on the following resources:

- information provided in the FHWA/Corps initiation letter requesting formal consultation and the accompanying Biological Assessment report;
  - Final Endangered Status for a Distinct Population Segment of Anadromous Atlantic Salmon (*Salmo salar*) in the Gulf of Maine (*Federal Register* 2000, 69459);
- Status Review for Anadromous Atlantic Salmon (*Salmo salar*) in the United States (Fay et al. 2006);
- Determination of Endangered Status for the Gulf of Maine Distinct Population Segment of Atlantic salmon; Final Rule (*Federal Register* 2009b, 29300);
  - Designation of Critical Habitat for Atlantic Salmon Gulf of Maine Distinct Population segment (*Federal Register* 2009b, 29300; and *Federal Register* 2009c, 39903);
- additional information regarding potential project effects submitted by the MaineDOT and the FHWA after the initiation of consultation;
- field investigation;
- previous MaineDOT practices;
- meetings and telephone conversations; and
- scientific literature.

A complete administrative record of this consultation will be maintained by the Service's Maine Field Office in East Orland, Maine. The Service log number is 05E1ME00-2016-F-0510.

2. DESCRIPTION OF THE PROPOSED ACTION

2.1 Introduction

A Federal action means all activities or programs of any kind authorized, funded, or carried out, in whole or in part, by Federal agencies in the United States or upon the high seas (50 CFR 402.02 [*Federal Register* 1986, 19957; as amended by *Federal Register* 2008, 76286; and *Federal Register* 2009a, 20422]).

2.2 Projects Included in this Programmatic Consultation

This section provides a concise summary of the eight general activity categories that the Proponents may conduct that involve in-water work. The Biological Assessment (BA) described the eight categories in detail. Table 1 summarizes the estimated annual number of projects by general activity category and further identifies numbers in Tier 1 and Tier 2 areas. Also, the approximate number of projects that will occur in waters where Atlantic salmon may occur or within Atlantic salmon critical habitat are identified because the Tier classes do not define this. The objective behind the Tier classification was to prioritize fish passage facilitation and not to describe where Atlantic salmon and critical habitat occur.

Section 2.4 also consolidates into seven core activities those specific actions that "May Affect" Atlantic salmon and critical habitat and that may occur in one or more of the eight general activity categories described in the BA. This consolidation highlights the project activities that are most relevant to the effects analysis.

2.3 General Activity Categories

2.3.1 Stream Crossing Structure Replacement

This category describes two types of replacement, structures less than or equal to 20 feet wide (culverts) and structures greater than 20 feet wide (bridges). The Proponents predict 20 culvert replacements and 15 bridge replacements seeking coverage through this consultation annually (Table 1). These size classes for replacement activities may cause different effects to Atlantic salmon. Construction durations, timing, and activities may be influenced by water depth and channel width. Generally, both culvert and bridge replacements will require removal of an existing structure as well as cofferdam installation, dewatering, diversion, and fish exclusion. Demolition and removal work is described in more detail in Section 2.3.2 Bridge Removal. How the structures function for fish passage following construction is also a consideration for Atlantic salmon. Table 2 summarizes design criteria for programmatic projects. The BA provides detailed information regarding crossing design (habitat connectivity design and hydraulic design), fish passage, and post-construction monitoring (Appendix B).

Table 1: Number of Annual General Construction Projects

General Construction Activity	No. Projects per year	*SHRU: Penobscot Bay*		*SHRU: Downeast*		*SHRU: Merrymeeting Bay*		Within CH and no Atlantic salmon Presence[2]	Within CH and Potential for Atlantic salmon Presence	Not Within CH and Unlikely Atlantic salmon Presence
		Tier 1	Tier 2	Tier 1	Tier 2	Tier 1	Tier 2			
Stream Crossing Structure Replacement:										
-Culvert Replacement	20	4	3	3	3	4	3	9[3]	7	4
-Bridge Replacement	15	3	2	3	2	3	2	8	5	2
Bridge Removal	1	0	0	0	0	0	0	0	1[4]	0
Culvert End:										
-Extension	5	2	1	1	0	1	0	3	2	0
-Reset	10	3	1	2	1	2	1	5	3	2
Bridge Scour Countermeasure	3	1[5]		1		1		0	3	0
Bridge Maintenance										
-Grout Bag	3	1		1		1		1	2	0
-Concrete Repair	1	1		0		0		0	1	0
Temporary Access*	15	5		5		5		8	5	2
Slipline/Invert Line	3	0	1	0	1	0	1	0	3	0
Geotechnical Drilling*	15	3	2	3	2	3	2	8	5	2
TOTAL	**61**							**26 (43%)**	**27 (44%)**	**8 (13%)**

*Temporary Access and Geotechnical Drilling have been broken out into their own separate general construction activities, however, these two activities are always a component of another general construction activity and therefore, do not contribute to the total estimated projects to be processed under this Programmatic.

[2] Based on past history and a review of upcoming projects, the Proponents assume that there are no anticipated projects that will occur outside of designated critical habitat where there is Atlantic salmon presence.

[3] The number of projects is broken down into three groups: (1) projects within designated critical habitat but not within expected Atlantic salmon presence, (2) projects within designated critical habitat and with the potential for Atlantic salmon presence, and (3) projects not within designated critical habitat and where Atlantic salmon presence is unlikely. The last column in this Table accounts for areas that have a low potential for or low likelihood of Atlantic salmon presence. However, they have not been included as a 'no effect' determination because while Atlantic salmon access exists, occurrence is unlikely based on habitat conditions.

[4] After a Proponent review of upcoming projects, no bridge removal projects are currently planned. However, based on past history, it is likely that one bridge removal project could occur annually. Therefore, an assumption is being made that one bridge removal project will occur per year and will occur within designated critical habitat and in an area where Atlantic salmon are present (reasonable worst case scenario).

[5] The Tier 1 and Tier 2 cells for this activity have been merged. For this general construction activity (and other general construction activities that have merged Tier 1 and Tier 2 cells), there is no difference in the proposed AMMs, conservation measures, or construction means and methods from Tier 1 and Tier 2, and therefore, no further breakdown is necessary.

Table 2: Fish Passage Design Criteria

Stream Crossing Structure Replacements	Minimum Width (culvert or between bridge abutments)	Design	Mitigation
Tier 1	1.2 BFW	Habitat Connectivity Design	No
Tier 2	BFW	Hydraulic Design	Yes

Once the work area is dewatered, channel excavation will be required in some cases. Culvert replacements will follow this general sequence:

1. Install erosion and spill control measures;
2. Clear vegetation;
3. Install cofferdam, diversions/bypass,
4. Remove fish;
5. Dewater work area;
6. Remove existing culvert;
7. Excavate and place fill for foundation of new culvert;
8. Place new culvert;
9. Construct riprap scour pad at inlet and outlet;
10. Place culvert streambed material (CSM) into the new structure and over riprap scour pads;
11. Wash fine sediment material into new CSM to establish seal to prevent subsurface flow; and
12. Remove cofferdams, diversions/bypass, and restore flow to channel.

Bridge replacements will follow slightly different sequencing based on the size of the structure to be removed and constructed, construction techniques, and the width and depth of the waterbody. Also if the new bridge is on a different alignment from the old bridge, the demolition of the old bridge may occur following construction of the new bridge to support the movement of traffic during construction. If the new bridge is on the same alignment as the existing bridge, a temporary bridge to support traffic flow may be necessary. The general work sequence is as follows:

1. Install erosion and spill control measures;
2. Clear vegetation;
3. Construct temporary equipment access and detour bridge (if necessary);
4. Demolish existing bridge;
5. Install cofferdam;
6. Remove fish;
7. Dewater work area;
8. Construct bridge foundation, abutments, etc.;
9. Construct bridge superstructure (girders, deck, rails, etc.);

10. Place riprap armoring where necessary; and
11. Restore flow to channel and remove temporary access, detour bridges, cofferdams.

Specific to Atlantic salmon, key differences between the two size classes of structure replacements include duration of in-water work, timing of work, types of cofferdams used, how much of the channel is spanned by the cofferdam, if pile driving for the permanent structure will be necessary, and if temporary equipment access via causeways, driving in water, or temporary bridges or traffic detour bridges will be necessary (Table 3). The Proponents made a conservative assumption for estimating potential effects that pile supported trestles would be necessary on all bridge replacement projects. Riprap placement for new abutment protection will not encroach on the new channel width. Banks may be constructed within the riprap for structures that are 1.2 times the BFW in Tier 1 areas.

Table 3: Structure Replacement Key Differences

	Culvert Replacement	Bridge Replacement
Typical in-water work construction duration	3 to 60 days	75 to 250 days
In-water work timing	July 15 to September 30	July 15 to April 15
Type of cofferdams used	Sandbags (95% of the time) and Sheetpile (5% of the time)	Sandbags (40% of the time) and Sheetpile (60% of the time)
Estimated project percentage with channel spanning cofferdams	100%	None
Pile driving for permanent structure possible?	No	Yes, 50% of the time
Type of temporary access used	None	Pile Supported Trestles (100% of the time) and Causeways w/Pile Supported Trestles (25% of the time)

The Proponents use two primary abutment designs for new bridges: integral abutments and vertical abutments. The majority (80 percent) of projects use integral abutments. Integral abutments are founded on piles that are driven to bedrock or a specified depth. After the piles are driven, a concrete abutment is cast as the foundation for the bridge deck. Vertical abutments are founded on ledge or placed on a spread footing. If founded on ledge, excavation down to ledge is necessary, along with cleaning and flattening the ledge to ensure the abutment is properly founded. To flatten the ledge, a hoe ram may be used to remove ledge to a consistent elevation. A spread footing foundation requires a large mass of concrete to be placed at approximately six feet below the thalweg of the stream, therefore requiring substantial excavation.

Bridge supports may consist of spread footings, pile bents, or drilled shafts. Spread footings generally require streambed excavation within a cofferdam prior to pouring the cast in place concrete piers. Depending on depth to bedrock and other factors, additional reinforcement with up to 20 driven H-piles may be necessary. Pile bents consist of a series of multiple piles aligned with the stream flow and used to support the bridge. A typical pile bent contains up to seven piles that vary from 18-inch to 30-inch diameter steel pipe piles.

Drilled shafts are installed by rotating a large steel tube inside a larger containment tube to seat the shaft into the bedrock to act as a solid foundation. Drilling operations do not take place until the larger containment tube is in place. The drilled shafts have cutting teeth and are drilled into the substrate and bedrock. Water is required inside the shaft for the drilling process; this water and the material (grindings and sediments) from inside the shaft will be pumped out, the water filtered and returned into the stream, and the sediment will be placed onto an upland area to avoid water sedimentation. Drilled shafts range from 24 inches to 9 feet in diameter.

Generally, bridge replacements will require a longer in-water work period (extending outside the preferred in-water work window for Atlantic salmon), temporary equipment access and traffic detour bridges, and if either concrete spread footing piers or pile bent construction is utilized, impact pile driving for the permanent structure. Additional details on the core activities associated with this general activity are provided in Section 2.4.

2.3.2 Bridge Removal

This category as described in the BA is specific to removing a bridge and not replacing it. However, the techniques described also apply to when bridges are removed for replacement. In addition to the 15 total number of bridge replacements described above and although none have yet been planned, the Proponents predict one bridge removal seeking coverage through this consultation annually (Table 1). Demolition timing and duration will vary based on the size of the structure being removed (Table 4). Demolition of stacked rock abutments and piers can take up to two days per structural element. Demolition of cast in place concrete abutments and piers that contain rebar can take up to a week (5 work days) per abutment or pier if they are approximately 25 feet tall or less. If they are taller than 25 feet, demolition may take up to two weeks (10 work days) per abutment or pier. The Proponents estimate bridge removal will take a maximum of 30 days.

Bridge removal consists of dismantling the structure in stages, with specific steps depending on the type of bridge. Generally, bridge replacements will require a longer in-water work period (extending outside the preferred in-water work window for Atlantic salmon) and temporary equipment access via causeways, driving in water, or temporary bridges. The bridge superstructure (deck, rails, girders, etc.) is removed first, with the work occurring above waterline and with debris containment measures in place. Bridge abutments are generally located within the stream channel and they are removed by excavating and breaking the concrete into pieces with a hoe ram. When this abutment demolition occurs in waters where Atlantic salmon are potentially present, it is conducted within a dewatered cofferdam and the debris is contained. If the bridge is supported on piles, the piles are removed in three potential ways: direct pull, vibratory extraction, or cutting below the substrate with a saw. Pulling a pile may generate higher levels of turbidity than the other two options. If pulling is the chosen method, the work will be completed using a BMP specifically for minimizing turbidity, such as a turbidity curtain. Underwater blasting is not allowed when Atlantic salmon are potentially present.

If the bridge is supported on concrete piers, a hoe ram is used to break up the concrete into pieces small enough to be removed with an excavator. Pier and pile removal is not conducted within a cofferdam but all bridge debris is contained inside a turbidity curtain and is removed from the channel and properly disposed of. Typical sequencing is shown below.

1. Install erosion and spill control measures;
2. Clear vegetation;
3. Construct temporary equipment access;
4. Remove existing bridge deck, then abutments and piers;
5. Install cofferdam around abutment (if in water and Atlantic salmon are present);
6. Remove abutments and piers;
7. Place CSM below bankfull elevation where abutments were removed;
8. Stabilize stream banks; and
9. Remove cofferdams (if in water and Atlantic salmon are present) and temporary equipment access.

Table 4: Bridge Removal Summary

	Removal Support Type	Estimated Work Duration	Work in De-watered Area?	Time of Year	Temporary Work Access?
Removal Using a Hoe Ram	Removal of Stacked Rock: 1. Abutments; and 2. Piers	1-2 days per structural element (up to 30 days for total structure)	1. Yes, if Atlantic salmon are present 2. No	Standard in-water work window (July 15 to September 30)	Yes
	Removal of Cast-in-place Concrete: 1. Abutments; and 2. Piers (less than 25 ft. tall)	Up to 1 week[6] per structural element (up to 30 days for total structure)	1. Yes, if Atlantic salmon are present 2. No	Standard in-water work window (July 15 to September 30)	Yes
	Removal of Cast-in-place Concrete: 1. Abutments; and 2. Piers (greater than 25 ft. tall)	Up to 2 weeks[7] per structural element (up to 30 days for total structure)	1. Yes, if Atlantic salmon are present 2. No	Standard in-water work window (July 15 to September 30)	Yes
	Removal of Support Piles (via direct pull, vibratory extraction, or saw cutting)	1-2 days per structural element (up to 30 days for total structure)	No	Standard in-water work window (July 15 to September 30)	Yes

[6] 1 week=5 days (approximately)
[7] 2 weeks=10 days (approximately)

2.3.3 Culvert End Reset/Extension

End resets and extensions are two types of culvert repair intended to extend the operational life of two- to ten-foot diameter culverts. The Proponents anticipate seeking programmatic coverage for 15 of these repairs annually (Table 1). Resets involve repairing culverts where they have separated by tying in a new section. Ten culvert end resets are proposed annually. Extensions consist of adding a new section of pipe to a culvert that is not long enough to support stable slopes. The Proponents are limiting extensions under this programmatic to a total of eight feet. Five culvert end extensions are proposed annually. Extensions and resets can occur at the inlet and/or outlet end of the culvert.

Specific to Atlantic salmon, this general work category is of concern because of potential effects to fish passage. Culvert extensions may worsen fish passage. When extensions occur in Tier 1 or Tier 2 areas, compensatory mitigation will be provided through the in-lieu fee (ILF) program or another mitigation approach that is part of the program. In 2015, the MaineDOT, the FHWA, the Corps, and the Service discussed mitigation strategies for the programmatic consultation. There was general agreement that no compensatory mitigation would be required for culvert resets in Tier 1 or Tier 2 areas since these types of projects are minor and have no additional impacts to Atlantic salmon habitat compared to when the culvert was initially installed. Additionally, approximately 15 percent of inlet extensions require minor (up to 25 feet) stream realignment. To minimize potential effects to fish passage, realignment design will ensure that:

1. The width of the relocated channel will match that of the pre-existing width;
2. Channel depths will match that of the pre-existing stream section;
3. CSM will be placed along the bottom of the reconstructed stream channel to re-establish stream substrate; and
4. Riprap placement in the stream will be minimized to that necessary for erosion/scour prevention and embedded and covered with natural substrate material.

This work involves similar construction sequencing as culvert replacements, although the repairs require a shorter work duration (a maximum of two days) and will occur within the standard in-water work window (Table 5). The repairs occur within a dewatered cofferdam.

Table 5: Culvert End Reset/Extension Summary

	Estimated No. of Projects (Annually)	Estimated Work Duration	Work in De-watered Area?	Time of Year Allowed	Other
Culvert End Reset	10 (no mitigation proposed)	2 days maximum	Yes	Standard in-water work window (July 15 to September 30)	No stream realignment necessary
Culvert Extension	5 (allowed only with mitigation)	2 days maximum	Yes	Standard in-water work window (July 15 to September 30)	1. Minor stream alignment (approx. 25 percent) likely 2. Extensions are limited to 8 ft.

2.3.4 Bridge Scour Countermeasure

This category consists of one scour countermeasure, the installation of concrete cable mats. Concrete mats consist of rows of concrete blocks linked together with stainless steel cables. The Proponents estimate that three of these projects will seek programmatic coverage annually (Table 1). Concrete cable mat installation requires less streambed excavation than riprap and therefore is preferred by the Proponents over riprap installation.

Concrete mats are installed within a dewatered work area so the first five steps of culvert replacement sequencing occur prior to excavating the streambed. The Proponents assume cofferdams are necessary for all of the installations and they will be constructed to accommodate fish passage during construction at low flows for each project. The duration of the installation depends on the size of the area the mats are covering, typically averaging 5,000 square feet (Table 6). Full channel blocking cofferdams are not anticipated for any scour countermeasure projects. The mats typically extend abutment to abutment, are attached to each abutment with grout, and are then buried beneath natural streambed material. The streambed material is only placed in areas where it does not raise the profile above the existing levels. This may result in varying depths of natural material, especially around the abutments where the mats cannot be embedded. A low flow channel will be installed and channel bottom contours will be maintained on all scour countermeasure projects.

Specific to Atlantic salmon, this general work category is of concern because of potential effects to fish passage and habitat function. When concrete mats are placed in Tier 1 or Tier 2 areas, compensatory mitigation will be provided through the ILF program or another mitigation approach that is part of the program.

Table 6: Bridge Scour Countermeasures Summary

Estimated Work Duration	Average Size of Cable Mats (sq. ft.)	Work in De-watered Area?	Commitments
15 to 30 days	5,000	Yes, but no channel-blocking cofferdams anticipated	1. Standard in-water work window (July 15 to September 30); 2. Low flow channel installed; and 3. Mitigation will be provided in Tier 1 and Tier 2 areas

2.3.5 Bridge Maintenance (Grout Bag Installation and Concrete Repair)

This category consists of two activities, grout bag installation or replenishment for scour prevention and concrete repair. The grout bag work is of short duration (within three hours) and occurs in the wetted channel (Table 7). Grout is pumped through pipes handled by divers to either replenish existing bags or install new ones along bridge walls, abutments, or piers. The Proponents anticipate that three grout bag projects will seek programmatic coverage annually (Table 1). When in-stream flows at the work site are less than one foot per second (FPS), a turbidity curtain will be deployed and fish will be evacuated from the area within the curtain. The grout slurry will be applied at a rate of two cubic yards per hour and an anti-washout admixture (AWA) will be mixed with the grout prior to application to reduce the potential for elevated pH levels downstream.

Concrete repair on piers and abutments will occur within a dewatered work area if below water. Other concrete repair, such as beam or deck repair will occur from falsework mounted to the bridge or on the bridge deck or from ladders set in the channel. The Proponents estimate that one project annually will require some concrete repair below water and equipment access via a causeway or pile-supported work platform (Table 1). All work for these activities will occur within the standard in-water work window (Table 7).

Table 7: Bridge Maintenance Summary

Activity	Estimated No. of Projects Annually	Estimated Work Duration	Work in De-watered Area?	Temporary Access Needed?	Time of Year Allowed
Grout Bag Installation	3	3 hours	No	No	Standard in-water work window (July 15 to September 30)
Concrete Repair	1	2 to 30 days	Yes, if repair work occurring in water	Yes	Standard in-water work window (July 15 to September 30)

2.3.6 Temporary Work Access

This general category was already mentioned in previous category descriptions. It consists of equipment access in water, causeway construction in water depths of less than six feet or pile-supported work platforms. Temporary access for equipment is anticipated for bridge replacement, bridge removal, geotechnical drilling related to two bridge replacements annually, and bridge repair activities. Bridge replacements may also require temporary pile-supported bridges to direct traffic onto while the bridge construction occurs. Detour bridges will be channel-spanning while work access bridges may only extend partly into the channel. Generally, all projects that involve temporary work access will utilize some sort of pile supported trestle. Approximately 25 percent of projects that involve temporary work access will also use a causeway for access.

Causeways consist of clean rock placed on geotextile fabric with an excavator. These materials are intended to minimize erosion, turbidity, and streambed disturbance during equipment operation. No causeways will be placed in or near Atlantic salmon spawning habitat and the causeway area will occupy no more than 25 percent of BFW. Causeway rock and geotextile fabric are removed after access is no longer needed. Tracked excavators may enter the water for access on five bridge replacements annually. The duration of this activity is generally less than 30 minutes and the amount of work and duration does not justify the creation of a causeway. This activity will not occur in or near Atlantic salmon spawning habitat.

The Proponents may also utilize barges as temporary access during construction. Barges can only be used when there is adequate boat access and water depth. Barges are primarily used to ferry items (i.e., construction materials and equipment) from access points within the project limits. Barges are not typically stationary for the duration of a project. Barge use is infrequent for activities addressed in this programmatic. The Proponents estimate that one project every other year will require the use of barges for temporary access.

A summary of the estimated annual number of various access methods, average area, and duration that they will be in place is provided in Table 8. Temporary work access construction related to bridge replacements may occur from July 15 to April 15 otherwise it will occur within the standard in-water work window in habitat with potential Atlantic presence. Pile driving will be discussed in more detail in the Core Activity section.

Table 8: Temporary Access Summary

Activity	Causeways		Pile-supported Work Trestles		Pile-supported Traffic Detours	
	Average Area (sq. ft.)	Average Duration (days)	Average no. of piles	Average Duration (days)	Average no. of piles	Average Duration (days)
Bridge replacements (11 projects annually)	1,500	75 to 250	30	75 to 250	10	75 to 250
Bridge removals (1 project annually)	1,500	10 to 30	N/A	N/A	N/A	N/A
Bridge maintenance (1 project annually)	1,000	2 to 30	15	2 to 30	N/A	N/A
Geotechnical drilling (2 projects annually)	1,000	2 to 30	15	2 to 30	N/A	N/A

*This estimate was made by assuming a 30-foot-wide, 50 feet long causeway=1,500 square feet

2.3.7 Invert Line and Slipline Rehabilitation

This general category describes two methods to rehabilitate deteriorating metal culverts. This generally results in prolonged functional life of undersized culverts. Due to fish passage concerns, these actions will not occur in Tier 1 areas and where they will occur (in Tier 2 areas only), measures reviewed and preapproved by the Service to improve fish passage will be incorporated (e.g., weirs). In Tier 2 areas, compensatory mitigation through the ILF program or another mitigation approach that is part of the program will be provided. The Proponents anticipate that three invert line/slipline rehabilitation projects will seek programmatic coverage annually (Table 1).

Both invert line and slipline techniques follow similar construction sequencing as culvert replacements. The work duration will be 10 to 25 days and will occur within the standard in-water work window (Table 9). The repairs occur within a dewatered cofferdam. Unlike culvert extensions, stream realignment is not necessary. Prior to lining, the culvert is cleaned and patched with grout.

Invert line repair consists of lining the bottom of the culvert with reinforced concrete at depths ranging from three to five inches and applying a sealant. Sliplining involves inserting either a high density polyethylene liner or a slightly smaller diameter CMP within the existing pipe. Remaining gaps between the liner and the pipe are filled with grout. Riprap aprons will then be installed to prevent scour and the riprap will be embedded into the stream channel, after minor excavation, so it does not act as a barrier to fish passage. Depending on the stream conditions associated with culvert rehabilitation, the liner and weir installation may also include constructing stilling pools in the stream at the downstream end of the culvert to dissipate flow energy and further facilitate fish passage. This could require streambed excavation within 50 feet of the culvert outlet.

Table 9: Invert Line and Slipline Rehabilitation Summary

Tier 1	Tier 2	Estimated Work Duration	Time of Year Allowed
Not allowed	3 projects allowed annually, with mitigation. Will be designed with measures to improve fish passage.	10 to 25 days	Standard in-water work window (July 15 to September 30)

2.3.8 Geotechnical Drilling

Geotechnical sampling and testing determines soil and substrate characteristics and topographical surveys. This general activity addresses drilling in the streambed. The drilling consists of case wash borings, advancing a maximum, four-inch diameter steel case downward in five- or six-foot intervals. The case is advanced using a small (20 pound) drop weight. A small diameter drill string is used to wash the substrate out of the casing. This process results in core samples and is repeated to the desired depth of the sample. Drilling fluid is not required. The time to drill a single test hole will vary depending on the substrate material, but the average period for an entire drilling operation is approximately eight hours (Table 10). Geotechnical drilling may be necessary in advance of stream crossing structure replacement and scour countermeasure projects. For culvert replacements, the drilling generally occurs adjacent to the stream. In water drilling is required for bridge replacement projects that are planning an in-water support element and scour countermeasure projects. This is estimated to be a total of 15 projects per year. A maximum of two of these events will require temporary in-water access for the drilling equipment.

Geotechnical sampling that does not require a trestle or causeway will be conducted at any time of year. If construction of a temporary work trestle or stone causeway is necessary, it will be conducted within the July 15 to September 30 in-water work window where Atlantic salmon are present.

Table 10: Geotechnical Drilling Summary

Estimated No. of Projects (Annually)	Estimated Work Duration	Temporary Access Needed?	Time of Year Allowed
15	8 hours	2 projects annually	Any time of year, unless temporary access is needed. Then, the work will be conducted within the standard in-water work window (July 15 to September 30).

2.3.9 Urgency Projects

Projects that qualify as urgency projects include projects that will follow the activity descriptions stated above. The urgency project category of projects is primarily designed to create a separate process for projects that do not qualify for an emergency consultation but are still in urgent need of work. An example of one of these projects includes a failing culvert end along a two lane interstate highway that causes traffic to be limited to one lane. This project does not result in an emergency, but poses a safety risk and fixing the project is an urgent situation for the Proponents. These projects are infrequent and are not likely to change the annual project estimates made in Table 1 because they are a subset of anticipated projects listed in Table 1.

2.4 Core Activities

Core activities represent a set of project-related actions that are commonly used construction practices used during many of the General Activity Categories described above in sections 2.2.2.1 through 2.2.2.9 and in the BA. The seven core activities (cofferdam work area isolation; fish evacuation from work area; streamflow bypass installation, removal and rewatering; pile driving/removal (vibratory and impact); hoe ram pier and abutment demolition; culvert/channel modification; and general in-channel work) are described below. The below descriptions provide summary information used in the Effects of the Action (Section 6.0).

2.4.1 Cofferdam Work Area Isolation

Work area isolation consists of separating a construction area from flowing water through a process of cofferdam installation, flow bypass (if necessary), removing fish, and dewatering. Fish removal and flow bypass is described in more detail in subsequent sections. Work area isolation can be necessary for all general work categories except Temporary Work Access and Geotechnical Drilling. Any work requiring streambed excavation will be isolated from flowing water. Additionally, any work in highly erosive substrates (clay) will be conducted within cofferdams to minimize turbidity.

The Proponents will install either sheet pile or sandbag cofferdams. Sandbag cofferdams consist either of small sandbags installed by hand or industrial sized sandbags installed with an excavator. Both types of sandbag cofferdams are placed on plastic sheeting at the upstream end of the work zone first. Sandbag cofferdams are preferred in water depths of less than six feet. Of the 58 projects expected to require work area isolation annually, 46 may use sandbag cofferdams. Additionally, of the 58 projects, 38 may require a flow bypass and will be channel spanning (35 using sandbag cofferdams and 3 using sheetpile cofferdams). The Proponents assume that all culvert replacement (20), slipline/invert line (3), and culvert end reset and extension (15) projects will require channel spanning cofferdams. Typically, the work area within sandbag cofferdams will range from 500 to 4,000 square feet. Sandbag cofferdams may be in place up to 250 days, depending on the main construction activity (Table 11).

Sheet pile cofferdams are typically used in deeper water and are most commonly associated with bridge replacement projects. Sheet piles are installed in pairs using a vibratory hammer. If the sheet pile is installed on a ledge, the contractor may cut the bottom of the sheets to fit the contour of the ledge and build a frame system to hold the sheet piles in place. Of the 58 projects expected to require work area isolation annually, 12 may use sheet pile cofferdams. Three sheet pile cofferdams may be channel spanning and they may be in place from 1 to 60 days. Typically, the work area within sheet pile cofferdams will be between 500 and 4,000 square feet (Table 11), conceptually similar to the work area within sandbag cofferdams.

Table 11: Annual Sandbag and Sheetpile Cofferdam Summary[8]

General Activity	No. of Projects w/Sheetpile Cofferdams	No. of Projects w/Sandbag Cofferdams	Average de-watered work area (sq. ft.)
Culvert replacement	1*	19*	1,500
Bridge replacement	9	6	4,000
Bridge removal	0	1	4,000
Scour countermeasure	0	3	4,000
Culvert end reset/ extension	1*	14*	1,500
Bridge maintenance	0	1	500
Slipline/ invert line	1*	2*	1,500
TOTAL	**12**	**46**	**-**

*These cofferdams will be channel spanning.

From past project information, the Proponents estimate that sandbags are used 95 percent of the time and sheet pile cofferdams are used 5 percent of the time for culvert replacements. For bridge replacements, sheet pile cofferdams are used 60 percent of the time and sandbags are used 40 percent of the time. The increase in use of sheet pile cofferdams for large bridges is due to the increased water depths (greater than six feet) at larger crossings. Sheetpile cofferdams used for culvert replacements are anticipated to span the stream and sheetpiles used for bridge replacements will not span the stream.

After fish evacuation occurs in the isolated work area, dewatering occurs by pumping the water to a sediment basin/filter basin that will filter much of the suspended sediments out of the water and allow the water to flow through a vegetated buffer prior to entering the stream. If necessary, pumps will continue to operate to maintain the dewatered work area. Sheet pile cofferdams typically require a concrete seal around the bottom of the sheets.

2.4.2 Fish Evacuation from Work Area

Fish evacuation from the work area occurs on any project requiring work area dewatering where Atlantic salmon are potentially present. Additionally, two grout bag installations per year may deploy a turbidity curtain and although the work area will not be dewatered, fish will be evacuated by seining or use of an electrofisher if the water depth is less than two feet prior to the work commencing. The number of projects and anticipated dewatered areas are summarized in Table 11. The Proponents follow standard protocols as detailed in their Atlantic Salmon Evacuation Plan and Disinfection Procedures, which are intended to minimize harm to Atlantic salmon while emphasizing staff safety.

[8] Assumption for culvert replacement, culvert end resent/extension, and slipline/invert line is that the typical cofferdam dimensions are 10 feet by 150 feet. Assumption for bridge replacement, bridge removal and scour countermeasure is that the typical cofferdam dimensions are 20 feet by 100 feet at each abutment. Assumption for bridge maintenance is that the typical cofferdam dimensions are 5 feet by 100 feet.

If water depths within the cofferdam are less than two feet, the fish evacuation will occur prior to dewatering; this depth represents a safe water level for those operating the electro-fishing system as well as a maximum depth that a comprehensive evacuation can be completed. A seine will first be used to 'herd' fish out of the work area. Then an electro-fishing system is used to stun any fish still left in the work area, collect them, and move them into adjacent habitat. Fish are moved primarily upstream of the project area. If stream depths are greater than or equal to two feet, cofferdams must be installed and then dewatered to less than two feet deep prior to fish evacuation.

2.4.3 Streamflow Bypass Installation, Removal and Rewatering

If a cofferdam is channel-spanning, the Proponents maintain flow in the stream channel either by installing a bypass pump or a diversion channel. Bypass pumps are utilized in approximately 90 percent of these situations. The Proponents anticipate that 38 projects will require channel-spanning cofferdams (35 sandbags and 3 sheetpile). Approximately 34 (90 percent of total) will use a pump bypass annually. The use of a diversion channel is limited by the topography and construction constraints of the site, where steeply sloped areas prevent channel creation at the appropriate width and elevation. A bypass system consists of pumps and hoses to transport water from upstream to downstream of the cofferdam. The pump intake is screened and protected to prevent juvenile Atlantic salmon entrainment and impingement. Plastic sheeting and geotextile fabric are used at the discharge point to minimize turbidity. This system does not support fish passage while in operation.

Bypass channels are temporary channels constructed from plastic sheeting lining and sandbag or other barrier reinforcement (to establish banks). Two projects a year are anticipated to use these to maintain streamflow. Section III(F)3 in the MaineDOT BMP Manual (MaineDOT 2008) has sizing guidance for bypass channels. The Proponents provide streamflow data to the Contractor to ensure appropriate dimensions to carry flow. Approximately ten percent of the time, bypass channels will support fish passage during project construction.

Following construction, to restore flow to the permanent channel the cofferdam is removed. Cofferdams that are placed across the entire stream are removed as follows:

1. The diversion pump system (if applicable) will be stopped and the upstream cofferdam will slowly be breached. The first flush of dirty water will be captured by the downstream "dirty water" pump, which will pump the water into the sediment treatment system;
2. When the water clarity behind the remaining intact cofferdam is visually similar, that dam will be breached;
3. The remainder of the upstream cofferdam and the diversion pump system or the temporary diversion channel will be removed; and
4. Sandbag cofferdams will be removed by hand, if they are small, or by an excavator working from the stream banks if they are the large industrial-sized sandbags.

Cofferdams that aren't channel-spanning will be removed in a similar sequential pattern. Cofferdams will slowly be breached, allowed to fill with water, and then either fully removed or cut off at or just below substrate level. Should there be a cofferdam failure during removal, all areas of temporary waterway or wetland fill will be restored to their original contour and character upon completion of the project.

2.4.4 Pile Driving/Removal (Vibratory and Impact)

Impact pile driving and vibratory pile installation and removal are proposed for the programmatic consultation. Vibratory pile installation is considered an impact minimization measure for Atlantic salmon because it does not result in injurious underwater noise levels. Accordingly, rather than installing sheet pile cofferdams with an impact hammer, the Proponents will exclusively use a vibratory hammer. A vibratory hammer will also be used to remove sheet pile cofferdams. The Proponents estimate 12 projects annually will utilize sheet pile cofferdams (Table 11).

Vibratory methods will also be used as much as possible for H- and pipe pile installations specific to temporary work platforms, detour bridges and permanent bridges. For load-bearing structures, it is not possible to exclusively use vibratory hammers to reach required pile tip elevations. Therefore, an impact pile driver must proof the piles for proper resistance. Pile removal related to temporary work platforms, detour bridges, and permanent bridges may involve a vibratory driver, depending on substrate composition and pile type, depth and condition. Other methods for pile removal include direct pull with an excavator or cutting them off below the surface. Direct pulling may result in temporary turbidity-related effects to Atlantic salmon. This will be minimized through the use of a turbidity curtain.

Impact pile driving will occur during temporary work trestle and detour bridge construction and for permanent bridge construction. Temporary structures will be supported on either H- or round pipe piles. Impact pile driving for permanent bridges will occur for integral abutment, spread footing, and pile bent construction. Piles required for temporary structures are shown in Table 10. Permanent structure pile estimates are shown in Table 12.

Table 12: Pile Estimate for Permanent Bridge Supports

Bridge Support Type	Maximum Number of Piles Per Bridge Supports	Pile Type
Integral Abutment	7 per bent	Pipe pile
Spread Footing	20	H-pile
Pile Bent	7 per bent	Pipe pile

Because impact pile driving can create injurious underwater noise, round piles will not exceed 30-inch diameter and H-piles will not be larger than 14-inch diameter. In-water use of an impact hammer will be subject to the July 15 to April 15 work window to avoid impacts to smolts and minimize impacts to migrating adult Atlantic salmon. This pile driving will also be limited to daytime hours when fish migration is less active. During all impact pile driving, bubble curtains will be utilized to minimize hydroacoustic effects. Additionally, hydroacoustic monitoring of pile driving will occur in accordance with the Hydroacoustic Monitoring protocol and Template.

2.4.5 Hoe ram Pier and Abutment Demolition

A hoe ram is often used to demolish concrete bridge piers and abutments. Concrete piers typically consist of large rebar cages, so a hoe ram may be required to break the piers apart. Hoe rams use a series of impacts with the breaker portion of the machinery to break the concrete up into smaller pieces (four to five foot lengths) that can be removed. The hoe ram is typically attached to the arm of an excavator. Pier demolition with a hoe ram will occur in flowing water and a turbidity curtain will be used.

Abutment demolition will occur within a dewatered cofferdam. Standard cofferdam installation, fish evacuation, and dewatering will occur prior to hoe ram operation. Hoe ram operation in-water will result in large pieces of concrete falling into the channel. These will be extracted by hand if pieces are small enough and using an excavator for larger pieces. Some monitoring data from Caltrans has indicated that hoe ram use in-water may result in similar hydroacoustic effects as impact pile driving. Because abutment demolition will occur in a dewatered environment, hydroacoustic effects are not expected.

2.4.6 Culvert/Channel Modification

This core activity addresses temporary and permanent culvert and channel modifications that may result in adverse effects to Atlantic salmon and/or critical habitat. Temporary modification in this core activity consists of causeway construction for equipment access. Causeways may be constructed for bridge replacement, removal, and maintenance (concrete repair), as well as geotechnical drilling. Causeway placement will occur in the wetted channel. A temporary stone causeway consists of placing large, clean, non-erodible material with an excavator onto geotextile fabric. Stone causeways typically extend into the stream to the extent necessary to facilitate construction. To minimize their impacts on critical habitat and fish passage, the Proponents will limit causeway length to extend no more than 25 percent of the BFW of the stream. Stone causeways will not be placed in or near areas that support Atlantic salmon spawning habitat.

Permanent modification in this core activity consists of concrete mat installation for scour protection, culvert extension, culvert invert/slipline rehabilitation, and culvert replacement. This work will occur within dewatered cofferdams. Concrete mats typically extend from abutment to abutment, forming hardened surfaces that resist erosional forces and do not function like a natural streambed. Culvert extensions, invert/slipline rehabilitation, and replacements may result in structures that do not support natural stream processes.

2.4.7 General In-channel Work

This core activity summarizes general work conducted within stream channels that hasn't been captured in other core activities and is not anticipated to result in adverse effects to Atlantic salmon and critical habitat. Work that has the potential to generate significant turbidity is conducted in a dewatered environment, with other work conducted in the wetted channel. Table 13 summaries the work items in this category and indicates which general activities they occur as a part of and whether they may occur in the wetted and/or dewatered channel.

Table 13: Summary Table of General In-channel Work

General In-channel Work	General Activity Category During Which Work Could Occur*	Work Environment Where Could Occur	
		Dewatered	In Wetted Channel
Streambed Excavation	A, B, C, D, G	Yes	No
Minor In-channel Fill Placement	A, C, E,G	Yes	Yes
Bridge Superstructure/Abutment Demolition and Pile Cutting	A,B	Yes**	Yes***
Heavy Equipment Operation	A,B,C,D,E,F,G,H	Yes	Yes

*A=Stream Crossing Structure Replacement, B=Bridge Removal, C=Culvert End Reset/Extension, D=Bridge Scour Countermeasures, E=Bridge Maintenance, F=Temporary Work Access, G=Invert/Slipline, H=Geotechnical Drilling
**Abutment demo only.
***Pile cutting only.

Streambed Excavation. All streambed excavation covered programmatically will occur in a dewatered environment, including the excavation necessary for bridge abutment and foundation construction, abutment removal, culvert installation and removal, riprap installation, concrete mat installation, stream realignment for culvert extension, and culvert repair. For bridge foundation construction, streambed excavation for spread footing supports will occur within a cofferdam. If vertical abutments are founded on a ledge, a hoe ram may be required to level the ledge. Drilled shaft construction involves excavation via drilling within an isolation casing where drill spoils and water is properly contained. Excavation will not be necessary for pile bent foundations.

Minor In-channel Fill Placement. Fill placement for this category is not expected to significantly modify stream channel function. These activities represent fill amounts that are small, minimized, or covered by fill that mimics natural streambed material. It includes placement of new bridge abutments and piers, riprap for culvert replacement, extension and reset, riprap for bridge replacement, grout bags, CSM, and natural streambed materials. Bridge abutments and piers will not result in a net increase of in-channel fill. Riprap will be placed as inlet and outlet protection for culvert replacement and culvert end reset and extension, and will be buried with natural streambed material. Riprap is also used to ensure the long-term stability of bridge abutments. Bridge height and abutment depths will determine the amount of riprap needed. The riprap is placed along the length of the abutment and can extend up to 20 feet in front of the abutment. To minimize the effects of the riprap placement on habitat, the Proponents will embed riprap aprons and abutment protection and cover the riprap with CSM. Grout bag placement will be limited to three projects per year and will be confined to existing bridge abutments and spread footing piers. Grout bags typically do not extend further than four feet into the stream channel from the abutment or pier. CSM will mimic surrounding substrate conditions, and will be applied following culvert replacements in Tier 1 areas and as a natural layer over riprap.

Bridge Superstructure/Abutment Demolition and Pile Cutting. This activity can occur as part of a stand-alone bridge removal or for bridge replacement. The Contractor must submit a demolition plan to the Proponents for approval prior to the start of demolition. Demolition will begin by the Contractor installing containment, such as tarps or falsework, prior to removing the bridge deck. The bridge deck will likely be cut into pieces that will be lifted away from the river with an excavator. If the bridge is supported by piles, they may be removed by using a vibratory extractor, an excavator for direct pulling, or they can be cut flush below substrate using an underwater saw. Abutment removal will occur within a dewatered cofferdam and the work will include breaking the abutment into large pieces with a hoe ram and removing the pieces with an excavator.

Heavy Equipment Operation. In-water equipment operation may consist of a tracked excavator which may need to enter or cross a flowing stream on less than five percent of the Proponents' stream crossing projects. This is only necessary when equipment can't reach from bank-to-bank. The will be limited to streams with cobble, rock, or ledge bottoms. Excavators will not enter or cross streams in spawning habitat. Geotechnical drilling will require in-water drilling operations using a maximum, four-inch diameter drilling casing. This work may occur from a work platform, a bank, or a barge. This work is typically completed within eight hours.

2.5 Excluded Actions

The following actions are specifically excluded from programmatic coverage and will require individual consultation. The following actions have been highlighted to provide for additional clarity:

1. Culvert extensions greater than eight feet total at upstream and/or downstream ends of culverts in Tier 1 and Tier 2 priority areas.
2. Causeways placed in or near potential spawning habitat.
3. Invert line and slipline projects in Tier 1 areas.
4. Underwater blasting where Atlantic salmon could be present.

Other excluded actions and AMMs are listed and identified in Appendix A.

2.6 Action Area

The action area is defined as all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action (50 CFR 402.02). This PBO covers eight general activity categories that involve work in streams and are required for the construction, preservation, and/or maintenance of the State transportation system in Maine. The eight activities could occur anywhere throughout the state within the estimated inland range of the Gulf of Maine Distinct Population Segment (GOM DPS) of Atlantic salmon and designated critical habitat (see Figures 1 and 2). The action area includes all perennial freshwater streams and watersheds above the head of tide in the State of Maine.

Figure 1: Range of GOM DPS Segment of Atlantic salmon

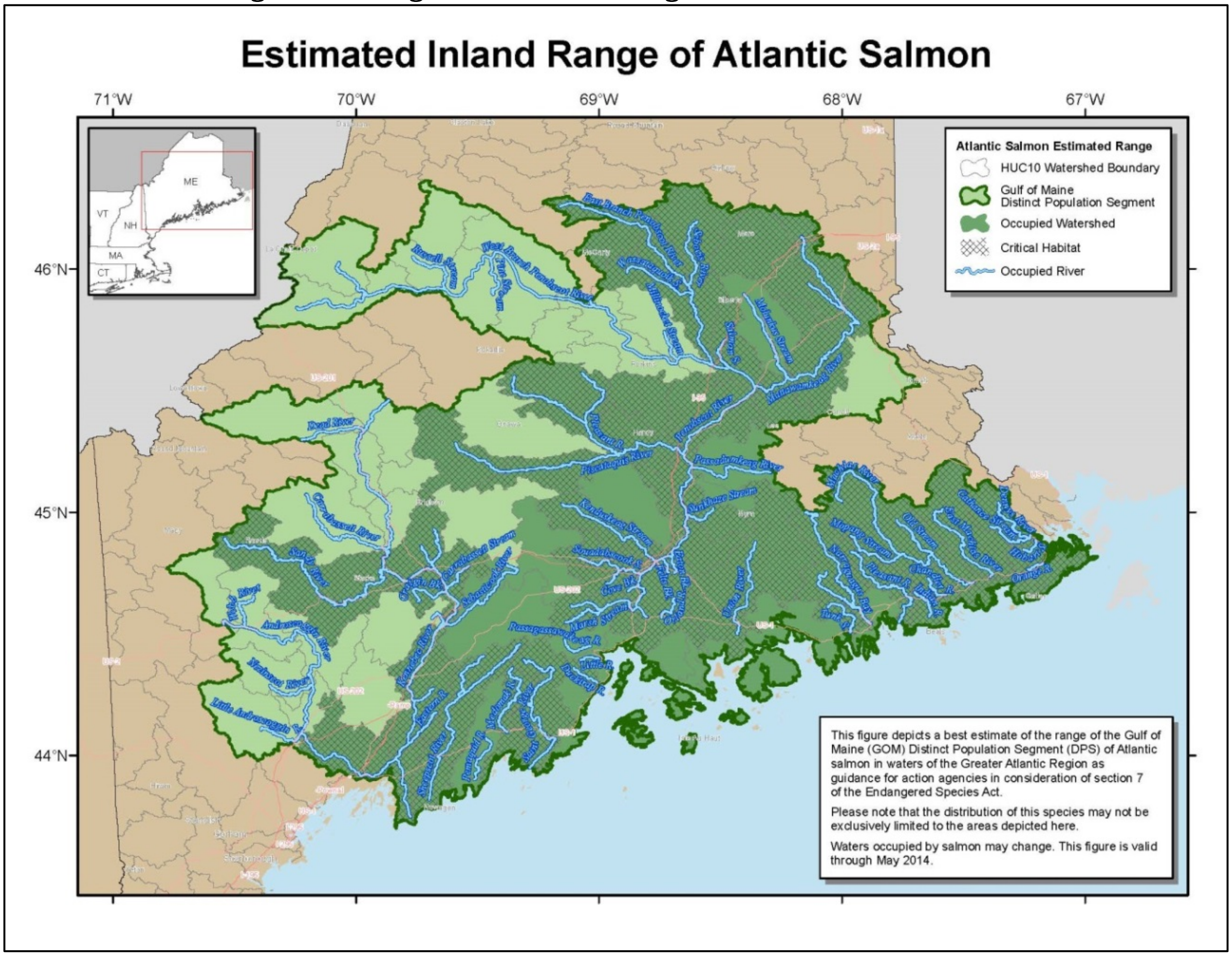
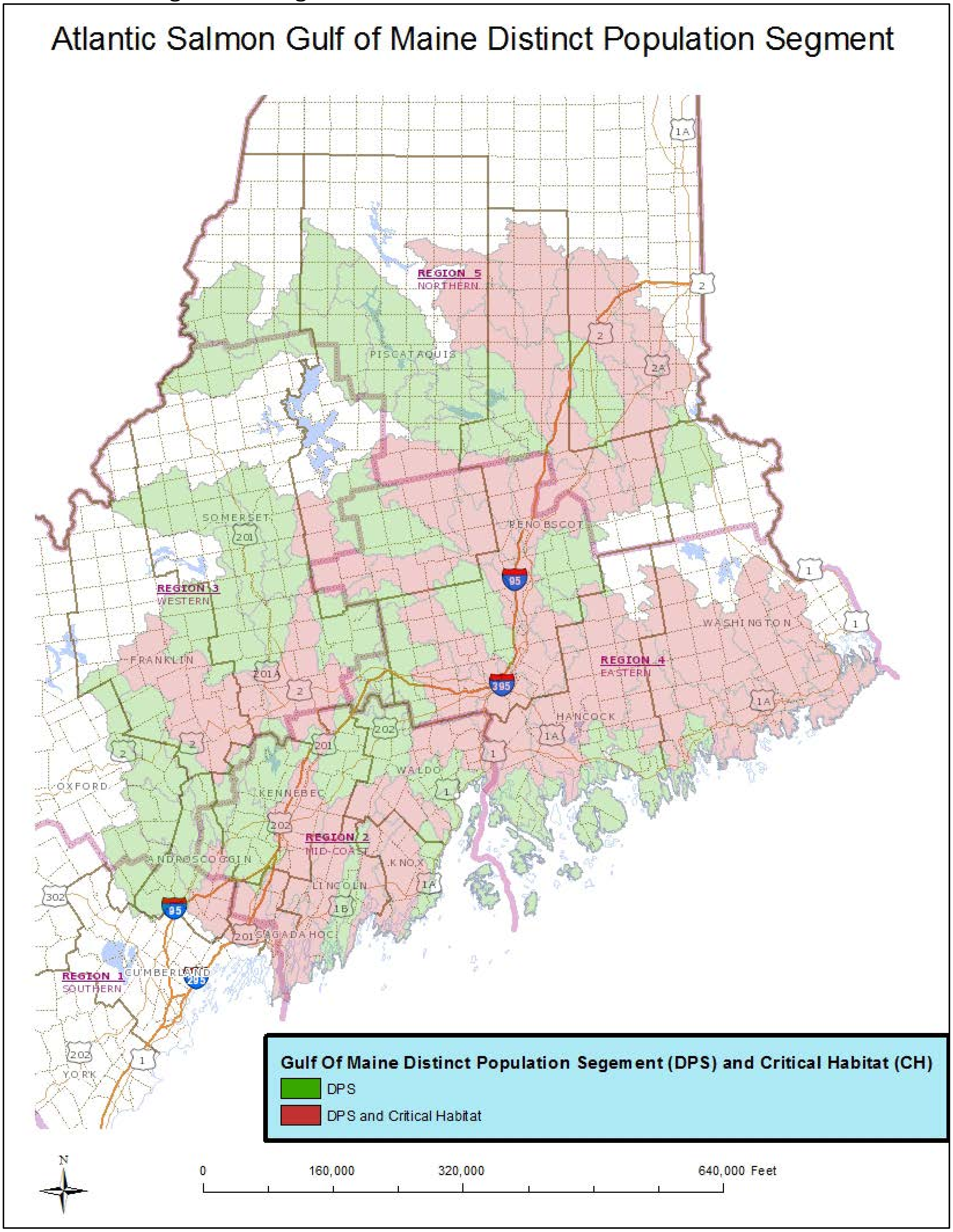


Figure 2: Designated CH for the GOM DPS of Atlantic salmon



In delineating the action area, the Proponents evaluated the farthest reaching extent of effects from sedimentation, underwater noise, stream channel effects, and access to habitat. The effects from sediment transport can extend up to 1,000 feet downstream. Underwater noise impacts from impact pile driving and hoe ram operation could extend, under a worst-case scenario, up to 1.3 miles from the source. However, sound pressure waves from the vast majority of projects would encounter a landmass before extending to this distance. For this reason, the analysis focuses on a smaller area, assuming noise impacts would generally extend up to 0.6 miles from the source in river channels. The beneficial effects from replacing a structure with a structure that passes fish will extend 100 to 6,110 linear feet upstream. This number was calculated using the Services' barrier survey database layer in ArcMap. Beneficial effects could extend much farther upstream if improved fish passage through multiple culvert replacements allows access to a large watershed or if previously impounded waters are allowed to return to normal flows and natural stream channels. As a result, the maximum extent of the action area for activities covered by this consultation is 6,110 feet upstream and 0.6 miles downstream of projects.

2.7 Compensatory Mitigation and Conservation Measures

The Proponents will use compensatory mitigation to offset certain unavoidable adverse effects that are likely to occur from activities addressed under this PBO. The Proponents may choose to provide compensation through design and implementation of their own mitigation project or they may elect to pay into the ILF program that is currently in development. The Proponents will provide mitigation for four activities that are proposed as a part of this PBO:

- Stream crossing replacements with widths less than 1.2 bankfull width (BFW) but greater than 1.0 BFW in Tier 2 priority areas;
- Culvert end extensions in Tier 1 and 2 priority areas;
- Bridge scour countermeasures in Tier 1 and 2 priority areas; and
- Invert line and slip line culvert rehabilitations in Tier 2 priority areas (note: invert line and slip line culvert rehabilitations are not allowed in Tier 1 priority areas).

The Atlantic salmon specific ILF program is intended to provide a vehicle for Statewide restoration and conservation. The Corps is leading the ILF creation in partnership with the Conservation Fund. Compensation ratios, habitat values, service areas, documentation requirements, and administrative provisions for the Atlantic salmon ILF program will be determined via collaborative establishment of the mitigation instrument. The goals and objectives of the ILF program are as follows:

a. Provide an alternative to permittee-responsible compensatory mitigation that will effectively increase the DPS population and/or restore Atlantic salmon habitat functions and values lost through permitted impacts;
b. Substantially increase the extent and quality of restoration, enhancement, and protection of protected Atlantic salmon natural resources over that typically achieved by permittee-responsible mitigation for activities that impact Atlantic salmon and their habitat;
c. Reduce the extent of cumulative adverse impacts to aquatic resources that are considered protected Atlantic salmon habitat under the ESA;
d. Provide project applicants greater flexibility in compensating for adverse impacts to Atlantic

salmon; and

e. Achieve ecological success on a biophysical region basis by directing in-lieu fees to federally protected Atlantic salmon and their habitat that are appropriate to the geographic service area, and by integrating in-lieu fee projects with other conservation activities whenever possible.

If the Proponents elect to implement a mitigation project outside of the ILF, the projects will be designed to replace any lost habitat function at a one-to-one minimum, resulting in no net loss or a net gain. They will be designed to support the same outcomes for Atlantic salmon and CH as the ILF program. Examples could include replacement of a stream crossing using habitat connectivity design or habitat enhancements using approved methods such as installation of large wood. These projects must be reviewed and approved by the Service and completed within one year of construction completion of the project requiring mitigation. Permittee responsible mitigation projects could require separate consultation for their short-term effects on Atlantic salmon and CH, despite their long-term benefits.

The two mitigation mechanisms allow for further opportunities to provide recovery based projects for Atlantic salmon. The ILF program will provide an opportunity for recovery projects that previously lacked funding to apply to the fund and implement these important projects. Separate mitigation projects will also provide opportunities for expedited fish barrier removal in support of species recovery. This compensatory mitigation program is the first of its kind for Atlantic salmon in Maine and will help ensure that adverse effects are properly offset.

All projects receiving coverage through the programmatic consultation that trigger mitigation must fulfill that obligation using an approach described. The requirement can either be a monetary contribution, when the ILF program is available, or sizing and design criteria in Tier 1 priority areas. This is in recognition of a potential time delay between the issuance of the PBO and the finalization of the ILF program.

3. STATUS OF THE SPECIES AND CRITICAL HABITAT

3.1 Species Life History

Atlantic salmon have a complex life history that includes territorial rearing in freshwater streams to extensive feeding migrations on the high seas. During their life cycle, Atlantic salmon go through several distinct phases that are identified by specific changes in behavior, physiology, morphology, and habitat requirements.

Adult Atlantic salmon return to rivers from the sea and migrate to their natal stream to spawn; a small percentage (one to two percent) of returning adults in Maine will stray to a new river. Adult Atlantic salmon ascend the rivers beginning in the spring and continuing into the fall. 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 1997b). Early migration is an adaptive trait that ensures adults have sufficient time to effectively reach spawning areas despite the occurrence of temporarily unfavorable conditions that naturally occur within rivers (Bjornn and Reiser 1991). Atlantic salmon that return in early spring spend nearly five months in the river before spawning, often seeking cool water refuge (e.g., deep pools, springs, and mouths of smaller tributaries) during the summer months.

In the fall, female Atlantic salmon selected sites for spawning in rivers. Spawning sites are positioned within flowing water, particularly where upwelling of groundwater occurs, allowing for percolation of water through the gravel (Danie et al. 1984). These sites are most often positioned at the head of a riffle (Beland et al. 1982); the tail of a pool; or the upstream edge of a gravel bar where water depth is decreasing, water velocity is increasing (McLaughlin and Knight 1987, White 1942), and hydraulic head allows for permeation of water through the redd (a gravel depression where eggs are deposited). Female Atlantic salmon use their caudal fin to scour or dig redds. This digging behavior also serves to clean the substrate of fine sediments that can embed the cobble and gravel substrates needed for spawning and consequently reduce egg survival (Gibson 1993).

One or more males fertilize the eggs that the female deposits in the redd (Jordan and Beland 1981). The female then continues digging upstream of the last deposition site, burying the fertilized eggs with clean gravel. A single female may create several redds before depositing all of her eggs. Female anadromous Atlantic salmon produce a total of 1,500 to 1,800 eggs per kilogram of body weight, yielding an average of 7,500 eggs per two sea-winter female (an adult female that has spent two winters at sea before returning to spawn) (Baum and Meister 1971). After spawning, Atlantic salmon may either return to sea immediately or remain in fresh water until the following spring before returning to the sea (Fay et al. 2006). From 1996 to 2011, approximately 1.3 percent of the "naturally-reared" adults (fish originating from natural spawning or hatchery fry) in the Penobscot River were repeat spawners (U.S. Atlantic Salmon Assessment Committee [USASAC] 2012).

Embryos develop in redds for a period of 175 to 195 days, hatching in late March or April (Danie et al. 1984). Newly hatched Atlantic salmon, referred to as larval fry, alevin, or sac fry, remain in the redd for approximately six weeks after hatching and are nourished by their yolk sac (Gustafson-Greenwood and Moring 1991). Survival from the egg to fry stage in Maine is estimated to range from 15 to 35 percent (Jordan and Beland 1981). Survival rates of eggs and larvae are a function of stream gradient, overwinter temperatures, interstitial flow, predation, disease, and competition (Bley and Moring 1988). Once larval fry emerge from the gravel and begin active feeding, they are referred to as fry. The majority of fry (greater than 95 percent) emerge from redds at night (Gustafson-Marjanen and Dowse 1983). When fry reach approximately 1.5 inches to 2.75 inches (4 to 7 centimeters) in length, the young Atlantic salmon are termed parr[9] (Danie et al. 1984). Parr have eight to eleven pigmented vertical bands on their sides that are believed to serve as camouflage (Baum 1997). A territorial behavior, first apparent during the fry stage, grows more pronounced during the parr stage, as the parr actively defend territories (Allen 1940, Kalleberg 1958, Danie et al. 1984).

[9] Throughout this programmatic consultation, the terms parr and juvenile will be used interchangeably. Parr is a form of juvenile Atlantic salmon. Since the Proponents are not proposing activities that will result in effects to eggs, fry and smolts (due to the time-of-year restrictions and avoidance of suitable spawning areas), the term juvenile will essentially mean parr.

Most parr remain in the river for two to three years before undergoing smoltification, the process in which parr go through physiological changes in order to transition from a freshwater environment to a saltwater marine environment. Some male parr may not go through smoltification and will become sexually mature and participate in spawning with sea-run adult females. These males are referred to as precocious parr. First year parr are often characterized as being small parr or 0+ parr approximately 1.75 to 2.75 inches (4 to 7 centimeters long), whereas second and third year parr are characterized as large parr greater than 2.75 inches long (7 centimeters [Haines 1992]). Parr growth is a function of water temperature (Elliott 1991); parr density (Randall 1982); photoperiod (Lundqvist 1980); interaction with other fish, birds, and mammals (Bjornn and Reiser 1991); and food supply (Swansburg et al. 2002).

Parr movement may be quite limited in the winter (Cunjak 1988, Heggenes 1990); however, movement in the winter does occur (Hiscock et al. 2002) and is often necessary, as ice formation reduces total habitat availability (Whalen et al. 1999). Parr have been documented using riverine, lake, and estuarine habitats; incorporating opportunistic and active feeding strategies; defending territories from competitors, including other parr; and congregating together in small schools to actively pursue prey (Gibson 1993, Marschall et al.1998, Pepper 1976, Pepper et al. 1984, Hutchings 1986, Erkinaro et al. 1998, Halvorsen and Svenning 2000, O'Connell and Ash 1993, Erkinaro et al. 1995, Dempson et al. 1996, Klemetsen et al. 2003).

In a parr's second or third spring (age one or age two, respectively), when it has grown to approximately 5 to 6 inches in length, (12.5 to 15.0 centimeters) a series of physiological, morphological, and behavioral changes occur (Schaffer and Elson 1975). This process, called smoltification, prepares the parr for migration to the ocean and life in salt water. In Maine, the vast majority of naturally reared parr remain in fresh water for two years (90 percent or more) with the balance remaining for either one or three years (USASAC 2005). In order for parr to undergo smoltification, they must reach a critical size of approximately 4 inches (10 centimeters) total length at the end of the previous growing season (Hoar 1988). During the smoltification process, parr markings fade and the body becomes streamlined and silvery with a pronounced fork in the tail. Naturally reared smolts in Maine range in size from approximately 5.25 to 6.75 inches (13 to 17 centimeters), and most smolts enter the sea during May to begin their first ocean migration (USASAC 2004). During this migration, smolts must contend with changes in salinity, water temperature, pH, dissolved oxygen, pollution levels, and various predator assemblages.

The physiological changes that occur during smoltification prepare the fish for the dramatic change in osmoregulatory needs that come with the transition from a fresh to a salt water habitat (Ruggles 1980, Bley 1987, McCormick and Saunders 1987, McCormick et al. 1998). 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. Given that smolts undergo smoltification while they are still in the river, they are pre-adapted to make a direct entry into seawater with minimal acclimation (McCormick et al. 1998). This pre-adaptation to seawater is necessary under some circumstances where there is very little transition zone between freshwater and the marine environment.

The spring migration of post-smolts out of the coastal environment is generally rapid, within several tidal cycles, and follows a direct route (Hyvarinen et al. 2006, Lacroix and McCurdy 1996, Lacroix et al. 2004). Post-smolts generally travel out of coastal systems on the ebb tide and may be delayed by flood tides (Hyvarinen et al. 2006, Lacroix and McCurdy 1996, Lacroix et al. 2004, Lacroix and Knox 2005). Lacroix and McCurdy (1996), however, found that postsmolts exhibit active, directed swimming in areas with strong tidal currents. Studies in the Bay of Fundy and Passamaquoddy Bay suggest that post-smolts aggregate together and move near the coast in "common corridors" and that post-smolt movement is closely related to surface currents in the bay (Hyvarinen et al. 2006, Lacroix and McCurdy 1996, Lacroix et al. 2004). European post-smolts tend to use the open ocean for a nursery zone, while North American post smolts appear to have a more near-shore distribution (Friedland et al. 2003). Post-smolt distribution may reflect water temperatures (Reddin and Shearer 1987) or the major surface current vectors (Lacroix and Knox 2005). Post-smolts live mainly on the surface of the water column and form shoals, possibly of fish from the same river (Shelton et al. 1997).

Some Atlantic salmon may remain at sea for another year or more before maturing. After their second winter at sea, the Atlantic salmon over-winter in the area of the Grand Banks before returning to their natal rivers to spawn (Reddin and Shearer 1987). Reddin and Friedland (1993) found immature adults located along the coasts of Newfoundland, Labrador, and Greenland, and in the Labrador and Irminger Sea in the later summer and autumn.

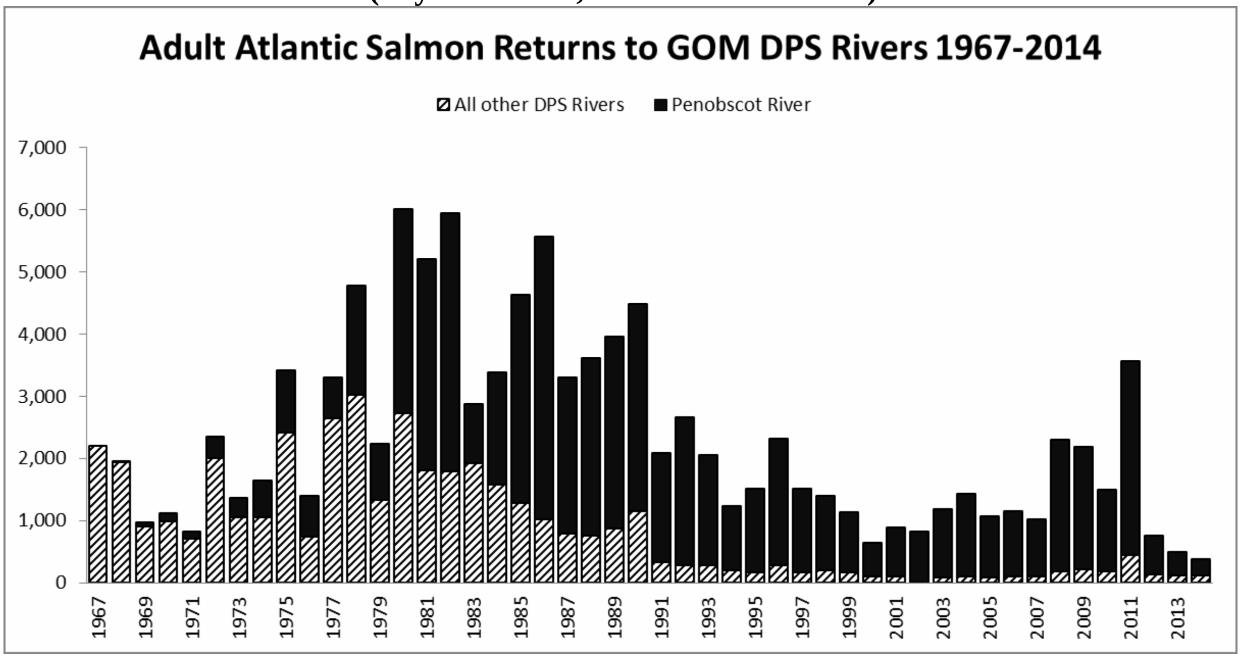
3.2 Status of the Species

The abundance of Atlantic salmon has been generally declining since the 1800s (Fay et al. 2006). Data sets tracking adult abundance are not available throughout this entire time period; however, a comprehensive time series of adult returns of Atlantic salmon dating back to 1967 exists (Fay et al. 2006, USASAC 2001–2014, Figure 3). It is important to note that contemporary abundance levels of Atlantic salmon are several orders of magnitude lower than historical abundance estimates. For example, Foster and Atkins (1869) estimated that roughly 100,000 adult Atlantic salmon returned to the Penobscot River alone before the river was dammed, whereas contemporary estimates of abundance for the entire Atlantic salmon GOM DPS have rarely exceeded 5,000 individuals in any given year since 1967 (Fay et al. 2006, USASAC 2010). Contemporary abundance estimates are informative in considering the conservation status of the Atlantic salmon today.

After a period of population growth in the 1970s, adult returns of Atlantic salmon declined steadily between the early 1980s and the early 2000s but have been increasing again over the last few years. The population growth observed in the 1970s is likely attributable to favorable marine survival and increases in hatchery capacity, particularly from the construction of Green Lake National Fish Hatchery in 1974. Marine survival remained relatively high throughout the 1980s, and Atlantic salmon populations remained relatively stable until the early 1990s. In the early 1990s marine survival rates decreased, leading to the declining trend in adult abundance observed throughout 1990s and early 2000s.

Adult Atlantic salmon returns have been very low for many years and remain extremely low in terms of adult abundance in the wild. Further, the majority of all adults return to a single river, the Penobscot, which accounted for more than 90 percent of all adult returns to the GOM DPS between 2000 and 2014. Of the 3,125 adult returns to the Penobscot River in 2011, the majority are the result of smolt stocking; and only a small portion were naturally-reared. The 2011 return number represents the highest value since 1990, however, the subsequent two years reflects a continuing, and dramatic multi-decadal decline with 624 returns in 2012 and 381 returns in 2013. The 2013 returns represent the lowest value

Figure 3: Adult Atlantic salmon Returns to the GOM DPS Rivers between 1967 and 2013 (Fay et al. 2006, USASAC 2001-2014).



since the early 1970s, and that trend continued into 2014, where the total adult returns were 261. However, 2015 data, although incomplete at this time, indicates this declining trend is currently reversed with more than 750 adults counted.

The term naturally-reared includes fish originating from both natural spawning and from stocked hatchery fry (USASAC 2012). Hatchery fry are included as naturally-reared because hatchery fry are not marked and, therefore, cannot be distinguished from fish produced through natural spawning. Because of the extensive amount of fry stocking that takes place in an effort to recover Atlantic salmon, it is possible that a substantial number of fish counted as naturally reared were actually stocked as hatchery fry. Low abundances of both hatchery-origin and naturally-reared adult Atlantic salmon returns to Maine demonstrate continued poor marine survival. Declines in hatchery-origin adult returns are less sharp because of the ongoing effects of consistent hatchery supplementation of smolts. Nearly all of the hatchery-reared smolts are released into the Penobscot River–554,000 smolts in 2011 (USASAC 2012). In contrast, the number of returning naturally-reared adults continues at low levels due to poor marine survival. In conclusion, the abundance of Atlantic salmon has been low and either stable or declining over the past several decades. The proportion of fish that are of natural origin is very small (approximately 6 percent over the last 10 years) but appears stable. The conservation hatchery program has assisted in slowing the decline and helping to stabilize populations at low levels.

However, stocking of hatchery products has not contributed to an increase in the overall abundance of Atlantic salmon and as yet has not been able to increase the naturally reared component. Continued reliance on the conservation hatchery program could prevent extinction but will not allow recovery of the Atlantic salmon, which must be accomplished through by increases in naturally reared fish.

3.3 Critical Habitat

Corresponding with the June 19, 2009 endangered listing, the NMFS designated critical habitat for the Atlantic salmon (*Federal Register* 2009b, 29300) (Figure 1). The final rule was revised on August 10, 2009 (*Federal Register* 2009c, 39003). In this revision, designated critical habitat for the expanded Atlantic salmon GOM DPS was reduced to exclude trust and fee holdings of the Penobscot Indian Nation.

The three Salmon Habitat Recovery Units (SHRUs) resemble, with some differences, the hydrologic unit code (HUC) 10[10] basin divisions for the GOM DPS (Figure 2). The Merrymeeting Bay SHRU incorporates two large basins, the Androscoggin and Kennebec, and extends east to include the St. George watershed. The Penobscot Bay SHRU includes the entire Penobscot basin and extends west to include the Ducktrap watershed and extends east to include the Bagaduce watershed. The Downeast Coastal SHRU includes all the small- to medium-sized coastal watersheds extending east of the Penobscot SHRU to include the Dennys River watershed.

The designation of critical habitat for Atlantic salmon uses the term primary constituent element (PCE). The new critical habitat regulations (*Federal Register* 2016, 7214) replace this term with physical or biological features (PBFs). The shift in terminology does not change the approach used in conducting a 'destruction or adverse modification' analysis, which is the same regardless of whether the original designation identified PCEs or PBFs. In this PBO, we use the term PBF to mean PCE. The status of Atlantic salmon critical habitat in the GOM DPS is important for two reasons: a) because it affects the viability of the listed species within the action area at the time of the consultation; and b) because those habitat areas designated "critical" provide PBFs essential for the conservation (i.e., recovery) of the species. The complex life cycles exhibited by Atlantic salmon give rise to complex habitat needs, particularly during the freshwater phase (Fay et al. 2006). Spawning gravels must be a certain size and free of sediment to allow successful incubation of the eggs. Eggs also require cool, clean, and well-oxygenated waters for proper development. Juveniles need abundant food sources, including insects, crustaceans, and other small fish. They need places to hide from predators (mostly birds and larger fish), such as under logs, root wads, and boulders in the stream, as well as beneath overhanging vegetation.

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[10] The U.S. Geological Survey and Water Resource Council developed the Hydrologic Unit Code (HUC) system to facilitate the geographic classification of surface water drainages based on topography and surface flow. The system divides drainages in the U.S. into six nested levels. Drainages are assigned a numbered code that reflects the level of classification. At level 4 is HUC 8, which represents a sub-basin, and level 5 is HUC 10, which represents a watershed. The numbers 8 and 10 reflect the number of digits in the code. As the drainage becomes smaller, the length of code gets longer.

They also need places to seek refuge from periodic high flows (side channels and off-channel areas) and from warm summer water temperatures (coldwater springs and deep pools). Returning adults generally do not feed in fresh water but instead rely on limited energy stores to migrate, mature, and spawn. Like juveniles, they also require cool water and places to rest and hide from predators. During all life stages, Atlantic salmon require cool water that is free of contaminants. They also need migratory corridors with adequate passage conditions (timing, water quality, and water quantity) to allow access to the various habitats required to complete their life cycle.

The physical and biological features of the two PBFs for Atlantic salmon critical habitat are as follows:

Physical and biological features of spawning and rearing (SR):

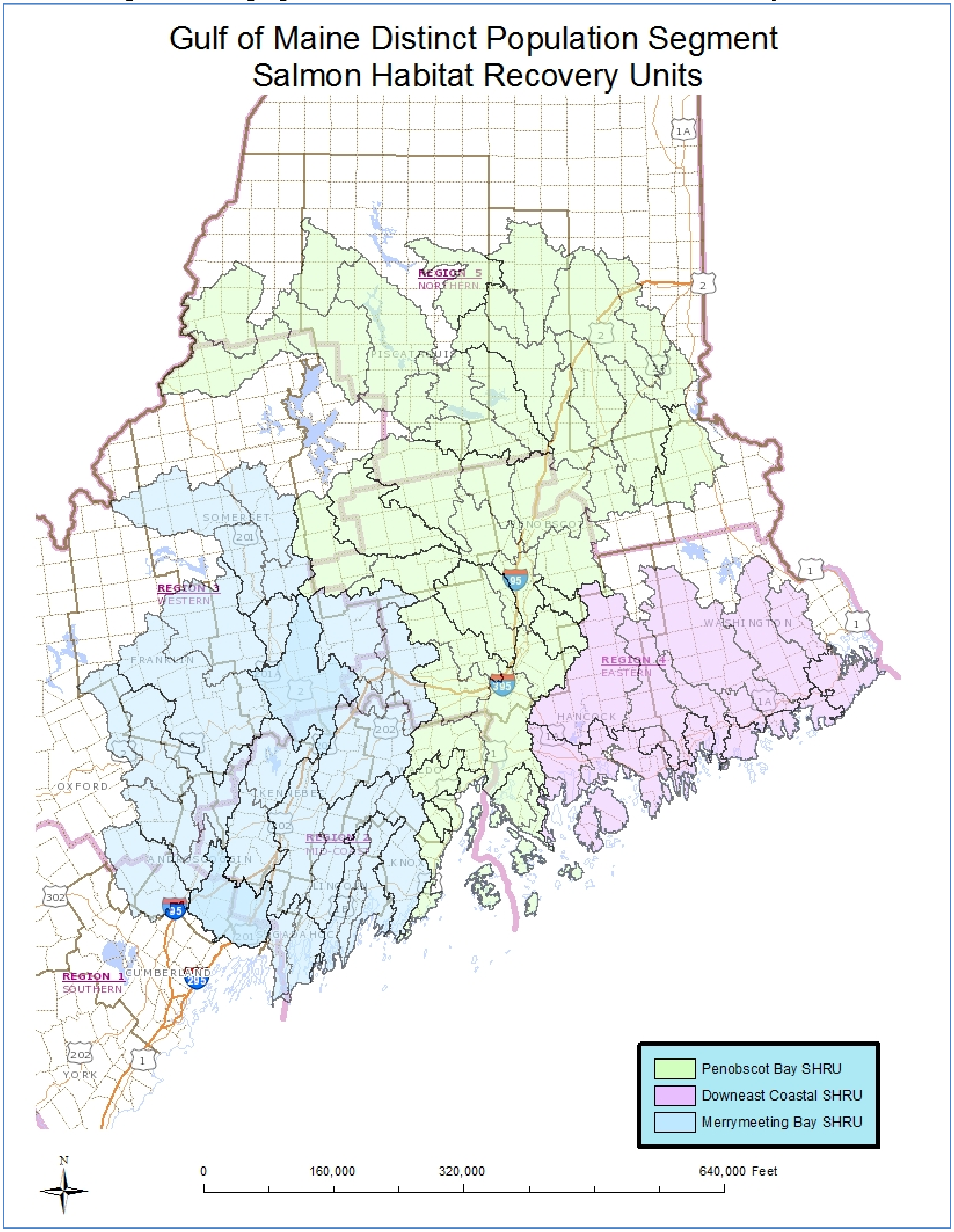
- SR 1. Deep, oxygenated pools and cover (e.g., boulders, woody debris, vegetation, etc.), near freshwater spawning sites, necessary to support adult migrants during the summer while they await spawning in the fall.
- SR 2. Freshwater spawning sites that contain clean, permeable gravel and cobble substrate with oxygenated water and cool water temperatures to support spawning activity, egg incubation, and larval development.
- SR 3. Freshwater spawning and rearing sites with clean, permeable gravel and cobble substrate with oxygenated water and cool water temperatures to support emergence, territorial development and feeding activities of Atlantic salmon fry.
- SR 4. Freshwater rearing sites with space to accommodate growth and survival of Atlantic salmon parr.
- SR 5. Freshwater rearing sites with a combination of river, stream, and lake habitats that accommodate parrs' ability to occupy many niches and maximize parr production.
- SR 6. Freshwater rearing sites with cool, oxygenated water to support growth and survival of Atlantic salmon parr.
- SR 7. Freshwater rearing sites with diverse food resources to support growth and survival of Atlantic salmon parr.

Physical and biological features of migration (M):

- M 1. Freshwater and estuary migratory sites free from physical and biological barriers that delay or prevent access of adult Atlantic salmon seeking spawning grounds needed to support recovered populations.
- M 2. Freshwater and estuary migration sites with pool, lake, and in-stream habitat that provide cool, oxygenated water and cover items (e.g., boulders, woody debris, and vegetation) to serve as temporary holding and resting areas during upstream migration of adult Atlantic salmon.
- M 3. Freshwater and estuary migration sites with abundant, diverse native fish communities to serve as a protective buffer against predation.

- M 4. Freshwater and estuary migration sites free from physical and biological barriers that delay or prevent emigration of smolts to the marine environment.
- M 5. Freshwater and estuary migration sites with sufficiently cool water temperatures and water flows that coincide with diurnal cues to stimulate smolt migration
- M 6. Freshwater migration sites with water chemistry needed to support sea water adaptation of smolts.

Figure 5: Geographic Extent of Atlantic salmon Habitat Recovery Units



3.4 Status of the Critical Habitat

In describing critical habitat for the Atlantic salmon, the NMFS divided the DPS range into three SHRUs. The three SHRUs include the geographic areas known as Downeast Coastal, Penobscot Bay, and Merrymeeting Bay. The SHRU delineations were designed by the NMFS to 1) ensure that a recovered population has widespread geographic distribution to help maintain genetic variability and 2) provide protection from demographic and environmental variation. A widespread distribution of Atlantic salmon across the three SHRUs will provide a greater probability of population sustainability in the future, as will be needed to achieve species recovery.

Habitat areas designated as critical habitat within each SHRU are described in terms of habitat units (HU). The quantity of Atlantic salmon HUs were estimated through the use of a GIS-based Atlantic salmon rearing habitat model (Wright et al. 2008). One HU represents 1,076 square feet (100 square meters) of Atlantic salmon rearing habitat. For each SHRU, the NMFS determined that there were sufficient habitat units available within the currently occupied habitat to achieve recovery objectives in the future; therefore, no unoccupied habitat at the HUC-10 watershed scale was designated as critical habitat (Table 14). A brief historical description for each SHRU, as well as contemporary CH designations and special management considerations, are provided below.

Table 14: Total Estimated Habitat Units (HUs) that are Suitable and Accessible (from Draft Atlantic salmon Recovery Plan)

SHRU	Total Estimated HUs	Estimated Suitable and Accessible HUs
Penobscot Bay	389,126	6,820 (2% of total HU)
Merrymeeting Bay	352,064	7,035 (2% of total HU)
Downeast	60,656	23,316 (39% of total HU)
Total	801,846	37,171 (5 % of total HU)

In summary, the June 19, 2009, final Atlantic salmon CH designation (as revised on August 10, 2009, *Federal Register* 2009c, 39903) identifies 45 specific areas occupied by Atlantic salmon that comprise approximately 12,134 miles (19,527.8 kilometers) of perennial river, stream, and estuary habitat and 496 square miles (1,284.6 square kilometers) of lake habitat within the range of the Atlantic salmon where the physical and biological features essential to the conservation of the species occur. Within the Atlantic salmon occupied range, approximately 779 miles (1,253.6 kilometers) of river, stream, and estuary habitat and approximately 62 square miles (160.6 square kilometers) of lake habitat have been excluded from CH pursuant to section 4(b)(2) of the ESA. Approximately 7.3 square miles (19,311 square kilometers, 42 percent) of this historical habitat is thought to be occupied now (*Federal Register* 2009b, 29300; *Federal Register* 2009c, 39903).

3.4.1 Downeast Coastal SHRU

The Downeast Coastal SHRU encompasses fourteen HUC-10 watersheds covering approximately 1,847,698 acres (7,477.4 hectares) within Washington and Hancock Counties. In this SHRU there are approximately 59,066 HUs of rearing habitat for Atlantic salmon among approximately 3,744 miles (6,025.4 kilometers) of rivers, lakes and streams. Of the 59,066 units of 25 rearing habitat, approximately 53,400 units of habitat in eleven HUC-10 watersheds are currently considered occupied by Atlantic salmon. The Downeast SHRU has enough HUs available within the occupied range that, in a restored state (e.g., improved habitat connectivity or improved habitat quality), the Downeast SHRU could satisfy recovery objectives as described in the final rule for critical habitat (*Federal Register* 2009b, 29300). Certain Tribal and military lands within the Downeast Coastal SHRU are excluded from critical habitat designation.

3.4.2 Penobscot Bay SHRU

The Penobscot Bay SHRU, approximately 54,942,705 acres (22,234,523.9 hectares) in area, contains approximately 315,574 units of Atlantic salmon rearing habitat among approximately 10,813 miles (17,402.0 kilometers) of rivers, lakes and streams. Of the 315,574 rearing HUs (in 46 HUC-10 watersheds), approximately 211,000 units are currently considered occupied (in 28 HUC-10 watersheds). Three HUC-10 watersheds–*Molunkus Stream*, *Passadumkeag River*, and *Belfast Bay*–are excluded from critical habitat designation due to economic impact. Certain tribal lands within the Penobscot Bay SHRU are also excluded from critical habitat designation.

3.4.3 Merrymeeting Bay SHRU

The Merrymeeting Bay SHRU is approximately 6,651,620 acres (2,691,815.1 hectares) in area and contains approximately 339,182 Atlantic salmon rearing HUs located among approximately 3,690 miles (5938.5 kilometers) of historically accessible rivers, lakes and streams. Of the 339,182 rearing HUs, approximately 136,000 HUs are currently considered occupied. There are 45 HUC-10 watersheds in this SHRU, but only nine are currently considered occupied. Lands controlled by the Department of Defense within the *Little Androscoggin* HUC 10 and the *Sandy River* HUC-10 are excluded as critical habitat.

3.5 Priority Restoration Tiers

There are many different factors that can define the priority of a watershed for restoration. The process described below represents qualifiers that make a watershed a priority area for the purpose of this consultation.

The MaineDOT, the FHWA, the NMFS, the Maine Department of Marine Resources (MDMR), and the Service met on April 14, 2015 to discuss creating priority watersheds for Atlantic salmon recovery. The parties discussed the active restoration programs and the current distribution of Atlantic salmon in the GOM DPs. The discussions led to the idea for arranging in tiers the priority areas in all of the HUC-10 watersheds within the GOM DPs. The rationale for each of the tier priority areas is explained in the sections below. Table 2-4, Table 2-5 and Table 2-6 in the PBA list each watershed and its corresponding tier priority within a SHRU. Additionally, Figure 2-7, Figure 2-8 and Figure 2-9 in the PBA illustrate the geographic locations of the tier watersheds in each SHRU.

The purpose of defining priority areas was to focus efforts of project design and construction AMMs to areas that are priorities for Atlantic salmon recovery or that may be occupied by

Atlantic salmon. This will maximize the conservation efforts and efficient use of project funding in areas that have both Proponent and species recovery priorities. If recovery programs and species distribution change throughout the term of this programmatic consultation, the Proponents and Action Agencies will adopt any new scheme developed by the Service. This document is intended to be dynamic throughout its term and mirror Atlantic salmon recovery priorities.

As stated in the PBA, and during the above referenced April 14, 2015 meeting, Tier 3 priority areas were also defined as those watersheds not meeting the definition of Tier 1 or Tier 2 but still within the range of the GOM DPS of Atlantic salmon. Projects occurring in Tier 3 areas will not result in effects to Atlantic salmon or Atlantic salmon CH. Therefore, the Proponents and Action Agencies are not including Tier 3 projects in this programmatic consultation.

3.5.1 Tier 1 Priority Areas

Tier 1 priority areas are the highest priority recovery watersheds. These watersheds contain active recovery programs and have known Atlantic salmon occurrences. Generally, these watersheds contain the highest quality Atlantic salmon habitat. A total of 41 watersheds were determined to be within Tier 1 priority areas (approximately 46.6 percent of the HUC-10 watersheds within the GOM DPS). Of the 41 watersheds listed within the Tier 1 priority areas, 37 are within Atlantic salmon designated critical habitat.

For the purposes of analysis, it is assumed that all Tier 1 areas are potentially occupied by a life stage of Atlantic salmon. Site specific presence expectations will be refined when the projects are submitted for review.

3.5.2 Tier 2 Priority Areas

Tier 2 priority areas are those watersheds where recovery actions are not active, but may be related to proximal recovery programs located in Tier 1 priority areas. These watersheds may also contain important populations of cover species that are important for Atlantic salmon recovery. These watersheds are not expected to have substantial numbers of Atlantic salmon in any life stage. These watersheds are currently of lower recovery importance as compared to Tier 1 priority areas. A total of 19 watersheds were determined to be within Tier 2 priority areas (approximately 21.6 percent of the HUC-10 watersheds within the GOM DPS). Of the 19 watersheds listed within the Tier 2 priority areas, 9 are within Atlantic salmon designated critical habitat.

4. ENVIRONMENTAL BASELINE

According to the ESA section 7 Consultation Handbook (Service and NMFS 1998), a Biological Opinion includes an environmental baseline section. This is “an analysis of the effects of past and ongoing human and natural factors leading to the current status of the species, its habitat (including designated CH), and ecosystem, within the action area. The environmental baseline is a "snapshot" of a species' health at a specified point in time and does not include the effects of the action under review in the consultation” (Service and NMFS1998).

In the BA, the Proponents defined the environmental baseline as the range of the GOM DPS of Atlantic salmon because the range is wholly contained within the action area. This BO covers potential projects in all SHRUs and areas of critical habitat. Therefore, the discussion of the range-wide status provides the environmental baseline description for the proposed action.

5. EFFECTS OF THE ACTION

The effects of the action refers to the direct and indirect effects of an action on the species or critical habitat, together with the effects of other activities that are interrelated or interdependent with that action, that will be added to the environmental baseline (50 CFR 402.02). Indirect effects are those that are caused by the proposed action and are later in time, but still are reasonably certain to occur.

Section 2.0 provided an overview of programmatic activities and estimated annual frequencies and durations where appropriate. Table 1 takes the general project activities totals and estimates how many will occur in areas that overlap with Atlantic salmon and critical habitat. Of the 61 estimated annual projects, 27 (44 percent) may occur in waters within critical habitat and where Atlantic salmon are likely to be present; 26 (43 percent) may occur in waters within critical habitat and where Atlantic salmon are not present; and 8 (13 percent) may occur in waters outside of critical habitat and where Atlantic salmon presence is unlikely (Table 1). Atlantic salmon are only likely to occur within areas designated as critical habitat. Therefore, the estimated number of projects seeking programmatic coverage annually is 61.

5.1 Effects of the Action on Atlantic Salmon

Despite the diverse range of activities proposed, the impacts they generate can be distilled into a limited array of potential impacts. The impacts that are described include elevated turbidity/sediment transport (A), underwater noise (B), temporary migration/movement barrier (C), fish handling and relocation (D), impingement/entrainment (E), water quality impact (e.g., pollutants) (F), habitat/critical habitat alteration (G), and permanent migration/movement barrier (H). These impacts will be verified during the early coordination process prior to project-specific submittals. The extent of each of these effects is described below, based upon the assumptions articulated in the Description of the Proposed Action Section.

The effects analysis discusses the effects on Atlantic salmon adults and juveniles. Since the Proponents are not proposing activities that will result in effects to eggs, fry and smolts (due to time-of-year restrictions and avoidance of suitable spawning areas), the term juvenile used in this section specifically relates to parr.

5.1.1 Elevated Turbidity/Sediment Transport

Pulses of elevated suspended sediment will occur episodically for individual projects and the primary activities that contribute to sediment and turbidity increases in Atlantic salmon habitat include clearing and grading near streams and in-water work. Although these effects are temporary and will be minimized through the use of AMMs (including but not limited to the implementation of a Soil Erosion and Water Pollution Control Plan (SEWPCP), revegetating exposed soils, providing “dirty water” treatment, conducting work within a cofferdam, and limiting in-water activities where a clay substrate exists), complete avoidance of sedimentation and turbidity increases is not usually achievable. Generally, activities that are conducted below the OHWM result in less turbidity if work is performed in isolation from the flowing water. All work requiring streambed excavation will occur within a dewatered cofferdam. Demolition of bridge abutments will also occur within a cofferdam. This recognizes that while cofferdams are used to minimize turbidity, there are also short-term turbidity increases when cofferdams are installed and removed. Short-term (two hours or less) turbidity pulses typically result from placing or removing cofferdams and from reintroducing water into the dewatered work area where exposed soils are suspended.

It is possible to minimize turbidity effects when conducting work outside of a cofferdam. Examples include work in gravel or bedrock substrate and work that has a very short duration in-stream work component, like operating heavy equipment, placing limited riprap, geotechnical drilling, grout bag installation or causeway construction.

The effects of increased suspended solids on salmonids depend on the extent, duration, timing, and frequency of increased sediment levels at the place where it will occur (Bash et al. 2001). Newcombe and Jensen (1996) completed a literature review of 80 publications. Referenced literature assessed impacts from suspended sediment on multiple salmonid and non-salmonid species. They analyzed the findings pertaining to effects of suspended sediment exposure, measured in concentrations (milligrams per liter) on juvenile and adult salmonids and calculated a severity of ill-effects (SE) score. The score was then used to predict species response at concentrations and durations. Depending on the level of these parameters, sedimentation can cause lethal, sublethal, and behavioral effects in juvenile and adult salmonids. The parameters shown below represent their findings and are the thresholds at which the effects can be anticipated.

Behavioral response–The range of turbidity releases expected to result in behavioral reactions ranging from a startle response to avoidance.

- 1-20 milligrams per liter for 1 hour
- 1 milligrams per liter for 24 hours

Sublethal effects–The ranges of turbidity releases expected to result in sublethal effects including stress, reduction in feeding rates, and increased respiration rates.

- 20-22,026 milligrams per liter for 1 hour
- One milligrams per liter for six days

Potential mortality–A higher range of releases has the potential to result in reduced growth rates, increased predation, and fish mortality.

- Greater than 22,026 milligrams per liter for one hour
- Seven milligrams per liter for 30 months

While these thresholds are helpful in predicting effects on Atlantic salmon from the project activities, real-time monitoring during transportation construction is typically conducted by measuring turbidity in nephelometric turbidity units (NTU). Laboratory methods are necessary to determine sediment concentration levels in milligrams per liter. NTU is a measurement of light refraction and it varies with the size and composition of suspended material. The ratio between NTU and milligrams per liter will vary (typically less than 10 to 1) but turbidity is commonly used as an approximate indicator of suspended sediment (Department of Fisheries and Oceans Canada [DFO] 2000). The Proponents propose to conduct both turbidity and suspended sediment monitoring to supplement existing information and confirm assumptions made about intensity of effects on Atlantic salmon.

Robertson et al. (2006) found adverse effects to juvenile Atlantic salmon from short-term increases in suspended sediment at levels as low as 15 NTU in vitro. 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). Increased turbidity associated with activities proposed in this programmatic consultation is not expected to reach concentration levels above 30 NTU above background for more than a few hours at a time and not for more than a total of four hours per day, for a maximum of a three-day period.

Avoidance of turbid areas is the typical behavioral response, which can mean that Atlantic salmon are displaced from their preferred habitats in order to seek areas with less suspended sediment. The Service expects that adult Atlantic salmon have a greater capacity to avoid turbid waters than juvenile Atlantic salmon, as adults are not trying to maintain and control a territory. Consequently, it is anticipated that effects to adult Atlantic salmon temporarily exposed to elevated turbidity levels will be minimized due to their mobility capabilities. Effects will be limited to temporary displacement; i.e., they are likely to avoid sublethal exposure. Because the duration of increased turbidity events will be limited to a few hours per day, temporary displacement of adults is not expected to significantly disrupt normal behavioral patterns. Additionally, actions covered by this programmatic consultation will not affect adult Atlantic salmon sheltering in holding pools. Therefore, effects to adult Atlantic salmon from increased turbidity are considered insignificant and discountable.

Rearing juvenile Atlantic salmon may be present at all times within assumed occupied habitat so a timing restriction will reduce, but not eliminate, the potential for exposure of juvenile Atlantic salmon to increased suspended sediment. Juvenile Atlantic salmon may seek cover in place or move to less turbid habitat. For those seeking cover in place, they are more likely to be exposed to construction-related turbidity. We expect behavioral and sublethal effects to juvenile Atlantic salmon from some activities covered in this programmatic consultation. Behavioral effects to juvenile Atlantic salmon will be moderated by the short duration of exposure (maximum of four hours per day) and the small areas affected. Displacement from habitat for this duration, depending on the size of the area affected, may flush juvenile Atlantic salmon from preferred cover, resulting in an increased predation risk. Sublethal effects may also occur to juvenile Atlantic salmon that do not avoid the area of elevated turbidity include reduction in feeding rates, stress, elevated blood sugars, gill flaring, and coughing (Berg and Northcote 1985, Servizi and Martens 1991, Spence et al. 1996). Turbid water may also affect Atlantic salmon juvenile's ability to avoid predators. The short duration of elevated turbidity will moderate the effect but juvenile Atlantic salmon may be exposed to increased predation and elevated stress for up to four hours a day and within 1000 feet of cofferdam installation and removal. According to the MaineDOT, these pulses may range between 3 and 30 NTU above background and will be of short duration (one to two hours per event Particle size affects how long sediment is suspended in the water column. Turbidity effects to juveniles are discussed in more detail and how it relates to specific project types in the following paragraphs.

For projects constructed in the wet and on coarse substrates, the increase in turbidity is expected to be negligible. For short-duration projects constructed in the wet, even on non-course substrates, the increase in turbidity is also expected to be negligible. Pipe pile and H-pile installation (vibratory and impact) and removal (vibratory or cutting), tracked excavator operation on bedrock or cobble, bridge demolition outside of a cofferdam (with turbidity curtain in place), riprap installation for bridge and bank protection, causeway installation and removal may create pulses of small (4 to 20 NTU) increases in turbidity up to 100 feet downstream of the activity for up to four hours per day. Breaking of concrete portions of the existing bridge structure during bridge demolition typically results in concrete pieces that are larger than one foot in diameter though some smaller pieces and fine particles would also be expected to break off, slightly increasing turbidity. These small increases in turbidity for short durations and within small areas should limit potential effects to behavioral effects on adult and juvenile Atlantic salmon. The behavioral effect expected is temporary displacement and is not expected to significantly disrupt normal behavioral patterns or to an extent that creates a likelihood of injury (gill abrasion and/or reduced respiratory function). The Service believes these effects will be insignificant and discountable.

Geotechnical drilling will be conducted with a small diameter drill (typically a four-inch diameter) within a casing for isolation from flowing water. Small pulses of sediment will be generated by setting and removing the casing from the substrate. Turbidity from this activity is expected to be minor, localized and should quickly dissipate within 100 feet of the drill site. Effects to Atlantic salmon are expected to be insignificant and discountable specific to elevated turbidity generated by geotechnical drilling.

Isolation of the stream construction area with a cofferdam is an important conservation measure intended to minimize construction-related adverse effects to Atlantic salmon and their habitat created by turbid water discharge and sedimentation, which would otherwise occur if streambed excavation occurred in a flowing stream. Core activities included in this work include sandbag and sheet pile cofferdam installation and removal, stream diversion via pump bypass and channel bypass, fish evacuation, and cofferdam dewatering. Most of the General Activities require cofferdam use including bridge and culvert replacement, bridge removal, scour countermeasures, bridge maintenance, culvert end reset/extension, and slipline/invert line.

Elevated turbidity of up to 30 NTU above background could extend a maximum of 1,000 feet downstream of the work area for up to two hours during each activity related cofferdam use; i.e., cofferdam installation, stream diversion, dewatering, cofferdam removal, and re-watering, for a maximum of four hours per day over a maximum 3-day period. Juvenile Atlantic salmon will be exposed to pulses of increased sediment/turbidity during construction of cofferdams and when sediment is generated by dewatering and re-watering work areas resulting in adverse behavioral and sublethal effects to juvenile Atlantic salmon. Juvenile Atlantic salmon may also be briefly exposed to increased turbidity prior to their evacuation from the isolated work area before it is dewatered. Behavioral effects to juvenile Atlantic salmon from increased turbidity may result in potential adverse effects, especially when the affect area could extend up to 1,000 feet downstream of the activity. Behavioral and sub-lethal effects to juvenile Atlantic salmon present within 1,000 feet downstream of cofferdam installation and removal are expected to cause take to juvenile Atlantic salmon in the form of harassment.

We can't accurately predict the number of exposed juvenile Atlantic salmon that will experience adverse effects from suspended sediment. Therefore we will use a reasonable worst-case scenario, the estimated physical extent of elevated turbidity (a habitat surrogate) to quantify the effects of elevated suspended sediment on Atlantic salmon (Table 16).

Stream specific parr densities vary between streams and between habitats within the same streams and in past consultations, take estimates have been derived from two possible sources. First, stream specific parr densities may be derived from catch per unit effort (total catch divided by the sum of an observable measure of effort associated with the catch, typically over a specific time period [CPUE]) surveys completed by resource agencies (primarily the MDMR). These survey efforts are processed to produce an estimate of parr density for each HU. Use of this parameter is preferred as it relates to stream specific data. When stream specific information is not available, the Service has created a model that predicts stream quality and stream widths that has been related to potential parr density at all perennial streams in the GOM DPs. These density estimates range from 0 to 10.7 parr per HU (Wright et al. 2008). In two MaineDOT projects with high quality Atlantic salmon rearing habitat and stream specific information, the parr densities were found through surveys to be 3.5 and 5.6 parr per HU. The Service believes it is reasonable to assume that density for parr in streams containing Atlantic salmon juveniles across the range of this BO is 5 parr per HU. A take estimate will be developed for each project with potential adverse effects to Atlantic salmon. The MaineDOT will track the take numbers to ensure that the estimates function as an accurate representation of potential parr densities.

Fifty-eight projects are expected to require work area isolation annually (Table 15), of which 25[11] will occur where Atlantic salmon are potentially present. Table 16 estimates the downstream area of temporary effect from elevated turbidity using the cofferdam dimensions and assumed 1,000-foot downstream distance and Table 17 presents the total potential Atlantic salmon HUs and juvenile Atlantic salmon adversely affected by cofferdam installation/removal.

[11] 25=7 culvert replacements, 5 bridge replacements, 1 bridge removal, 3 scour countermeasures, 5 culvert end resets/extensions, 1 bridge maintenance (concrete repair), and 3 slipline/invert line.

Table 15: Summary of Annual Projects and Cofferdam Use/Dimensions

Activity	Total No. of Projects Needing Cofferdams Annually	No. of Sandbag Cofferdams	No. of Sheetpile Cofferdams	Average Cofferdam Area (sq. ft.) Per Project	Total Est. Area of Impact (sq. ft.) Annually	Total Est. Area of Impact to CH (w/ Atlantic salmon Presence) (sq. ft.) Annually[12]	Total Est. Area of Impact to CH (no Atlantic salmon Presence) (sq. ft.) Annually[13]
Stream Crossing Replacements: -Culvert Repl. -Bridge Repl.	20 15	19 6	1 9	1,500[14] 4,000[15]	30,000 60,000	13,200 26,400	12,900 25,800
Bridge Removal	1	1	0	4,000[16]	4,000	4,000	0
Bridge Scour Countermeasure	3	3	0	4,000[17]	12,000	5,280	5,160
Culvert End Resets and Extensions	15	14	1	1,500[18]	22,500	9,900	9,675
Bridge Maintenance	1	1	0	500	500	500	500
Slipline/Invert Line	3	2	1	1,500[19]	4,500	1,980	1,935
TOTALS	**58**	**46**	**12**			**61,260**	**55,970**

[12] These numbers were obtained by multiplying the 'total estimated area of impact annually' number by 44 percent (from Table 1).
[13] These numbers were obtained by multiplying the 'total estimated area of impact annually' number by 43 percent (from Table 1).
[14] Assumption is the average de-watered area is 10 feet by 150 feet
[15] Assumption is the average de-watered area is 20 feet by 100 feet at each abutment
[16] Similar assumption as bridge replacements
[17] Similar assumption as bridge replacements
[18] Similar assumption as culvert replacements
[19] Similar assumption as culvert replacements

Table 16: Downstream Turbidity Effects from Cofferdam Installation/Removal

		Direct Impact Area (sq. ft.)				Downstream Impact Area (sq. ft.)			
Core Activity with Significant Elevated Turbidity and Sediment Transport Effects	**No. of Projects Annually**	**Average per project**	**Total Annually**	**Total Within CH and no Atlantic salmon Presence Annually**	**Total Within CH and Potential for Atlantic salmon Presence Annually**	**Average per project[20]**	**Total Annually**	**Total Within CH and no Atlantic salmon Presence Annually**	**Total Within CH and Potential for Atlantic salmon Presence Annually**
Cofferdam Work Area Isolation: • Br. Maint. • Culv. Repl., Ext./Reset, and Slip/Invert Line • Br. Repl., Br. Rem., and Scour Countermeasures	1 38 19 - Σ 58[21]	500[22], 1,500[23] 4,000[24]	500, 57,000 76,000 Σ 133,500	55,970	**61,260**	5,000 10,000 20,000	5,000 380,000 380,000 Σ 765,000	328,950	**336,600**

Table 17: Total Potential Atlantic salmon HUs/Juveniles Adversely Affected by Cofferdam Installation/Removal

Total Annual Area in sq. ft. (from Table 16)	Total Annual Area in sq. meters	Total Annual HUs*	Total Annual Atlantic salmon Juveniles Adversely Affected**
397,860	36,962	370	1,850

*HU=1,076 square feet (100 square meters).
**Assumed 5 parr (juveniles) per HU.

Direct pulling piles may result in levels of turbidity above background, depending on the number of piles to be removed. This activity will be conducted with turbidity reducing measures in place such as turbidity curtains. Turbidity curtains will encircle the pile and isolate the water around it. Turbidity curtains will be left in place until the suspended sediment settles and therefore won't result in downstream effects. Atlantic salmon could be trapped within the curtain, exposing them to elevated turbidity while the pile is being removed. This exposure is expected to be limited to juvenile Atlantic salmon. Due to their size, adult Atlantic salmon will be more visible and the

[20] Elevated turbidity could extend a maximum of 1,000' downstream of the work area for up to an hour during cofferdam installation and an hour during cofferdam removal and re-watering. (5' x 1,000' = 5,000 sq. ft.; 10' x 1,000' = 10,000 sq. ft.; 20' x 1,000' = 20,000 sq. ft.)
[21] 58 = 20 culvert replacements, 15 bridge replacements, 1 bridge removal, 3 bridge scour countermeasure, 15 culvert end reset/extension, 1 bridge maintenance, and 3 slipline/invert line projects estimated annually.
[22] 500 sq. ft. (5' x 100') is estimated for bridge maintenance projects
[23] 1,500 sq. ft. (10' x 150') is estimated for culvert replacements, culvert end resets/extensions, and slipline/invert lines.
[24] 4,000 s sq. ft. (20' x 100' at each abutment) is estimated for bridge replacements, bridge removals, and bridge scour countermeasures.

Proponents will avoid surrounding them in the curtain. The estimated annual number of projects requiring pipe or H-pile direct-pull removal in CH/ Atlantic salmon areas is 5, with an average number of 14 piles per project. A contractor could reasonably remove 15 piles per day and the turbidity curtain is likely to be in place for 15 minutes per pile removal. Any individual juvenile Atlantic salmon trapped inside of the turbidity curtain will experience elevated turbidity up to 30 NTU above background resulting in take in the form of harassment, associated with sublethal effects such as elevated stress and increased respiration rates (Table 18). The turbidity curtains will encompass approximately 25 square feet.

Table 18: Downstream Turbidity Effects from Pile Removal and Total Potential Atlantic salmon HUs/Juveniles Adversely Affected by Pile Removal Annually

Core Activity with Significant Elevated Turbidity and Sediment Transport Effects	No. of Projects Annually (within CH and with Potential Atlantic salmon presence)	Average No. Piles Removed per Project	Total No. Piles Removed Annually	Average Area of Turbidity Effect (sq. ft.)	Total Area of Turbidity Effect Annually (sq. ft.)	Total HUs* Annually	Total Annual Atlantic salmon Juveniles Adversely Affected**
Pile Removal (Direct Pulling of Piles) from Temporary Access/Bridges	5	14	70	25	1,750	1.6	8

*HU=1,076 square feet (100 square meters).
**Assumed 5 parr (juvenile Atlantic salmon) per unit.

The Proponents will test extent of sediment plume assumptions by implementing a turbidity monitoring program as part of this programmatic consultation. Annual monitoring results will be summarized in an annual report and the Proponents and the Service will apply the data and any other pertinent new information when determining if adjustments to affected areas are necessary.

In summary, activities covered within this consultation may cause temporary elevated turbidity above background conditions. Specifically, the elevated turbidity concentration levels expected range from 3 to 30 NTU above background, based on limited monitoring data. The duration of these “pulses” will not extend for more than a few hours at a time and for over four hours per day, for more than a three day period. These concentrations and durations will not result in Atlantic salmon exposure that could cause mortality. Behavioral effects to adult Atlantic salmon are expected to be insignificant and discountable, primarily due to the short duration of exposure and the small habitat area from which individuals may be temporarily displaced. Sublethal effects are not expected to occur to adult Atlantic salmon because they not territorial and are considered more mobile than juvenile Atlantic salmon and can avoid the area of elevated turbidity.

Elevated turbidity is expected to cause short-term, adverse behavioral and physical effects to juvenile Atlantic salmon. Adverse behavioral effects to juvenile Atlantic salmon are attributed to those individuals that are flushed from preferred cover that may be exposed to increased predation. Sublethal effects may occur to juvenile Atlantic salmon because some individuals may shelter in place and as a result will be exposed to levels of turbidity that may cause elevated stress and coughing. Take in the form of harassment may occur to juvenile Atlantic salmon exposed to turbidity during cofferdam installation, removal, work area rewatering, and within a turbidity curtain during direct-pulling of piles. These effects are quantified by estimating the total annual area experiencing elevated turbidity annually and calculating juvenile Atlantic salmon fish density (Tables 17 and 18).

5.1.2 Underwater Noise

The General Activities that are expected to exceed injurious and behavioral effects thresholds on juvenile and adult Atlantic salmon as a result of underwater noise include Bridge Replacement and Removal which either require impact pile driving (pipe or H-pile) or in-water hoe ram demolition. Impact pile driving can be necessary for both permanent bridge construction and temporary work platforms and traffic detour bridges.

High levels of underwater sound can injure or kill fish and cause alterations in behavior (Turnpenny et al. 1994, Turnpenny and Nedwell 1994, Popper 2003, Hastings and Popper 2005). Death from barotrauma can be instantaneous or delayed up to several days after exposure. 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 periods of under pressure and overpressure, respectively (Caltrans 2015). Even in the absence of mortality, elevated noise levels can cause sublethal injuries. Fish suffering damage to hearing organs may suffer equilibrium problems, and may have a reduced ability to detect predators and prey (Turnpenny et al. 1994, Hastings et al. 1996).

Adverse effects on survival and fitness can occur even in the absence of overt injury. Exposure to elevated noise levels can cause a temporary shift in hearing sensitivity (referred to as a temporary threshold shift), decreasing sensory capability for periods lasting from hours to days (Turnpenny et al. 1994, Hastings et al. 1996). Popper et al. (2005) found temporary threshold shifts in hearing sensitivity after exposure to cumulative sound exposure levels (SELs) of 184 decibels (dB). Temporary threshold shifts result in adverse effects such as reduced survival, growth, and reproduction of the affected fish by increasing the risk of predation and reducing foraging or spawning success. Data for direct effects to Atlantic salmon are not available. The data collected on salmonid species is specific to salmonids from the west coast of the United States. This data represents the best available information for hydroacoustic effects to Atlantic salmon and is adopted for the purposes of evaluation of acoustic impacts in this BO.

West coast representatives from the NMFS, the Service, the FHWA, and the Washington State Department of Transportation (WSDOT) agreed to interim criteria to minimize potential impacts to fish (Fisheries Hydroacoustic Working Group [FHWG] 2008). The interim criteria include peak sound pressure level (SPL) and SEL injury threshold limits of:

- **Peak SPL**: levels at or above 206 dB from a single hammer strike likely results in the onset of physical injury.
- **SEL**: cumulative levels at or above 187 dB for fish sizes of 2 grams or greater, or 183 dB for fish smaller than 2 grams. The Proponents will avoid impacts to fry (fish less than 2 grams) so the 183 cSEL limit will not be applied to the analysis.

In assessing pile driving behavioral effects at several west coast projects, the National Oceanic and Atmospheric Administration (NOAA) Fisheries employed a 150 dB root mean square (RMS) criterion. The NOAA Fisheries also suggests that noise exposure of 150 dB RMS will not always produce behavioral modifications or that any behavioral modifications will result in an effect, only that a behavioral response is possible. Behavioral responses could range from a temporary startle to avoidance of an area, or an altered behavior in the presence of predators.

Sound pressure naturally attenuates as the sounds waves move further from the source. The NMFS created a pile driving calculator to help calculate the extent of pile driving effects (NMFS 2012). The pile driving calculator will be used to estimate the extent of hydroacoustic effects for this programmatic consultation.

A vibratory hammer will be used as much as possible to drive the piles. However, to ensure that the pile will be able to support the weight of construction equipment or to overcome difficult substrates, the pile may be driven to required depths with an impact hammer. The Proponents will use an attenuation device such as a bubble curtain for all impact pile driving and impact pile driving will be limited to daylight hours when Atlantic salmon migration/movement is limited.

The Proponents will construct up to thirteen projects per year with in-water, impact pile driving within Atlantic salmon critical habitat and eight of these projects will occur where Atlantic salmon are potentially present (Table 1). Impact pile driving will primarily occur on bridge replacement projects. Pile-supported work trestles will also be necessary for one bridge maintenance project and up to two geotechnical drilling projects annually. Twelve projects (four where Atlantic salmon are potentially present) will have up to 91, 30-inch diameter maximum, steel piles each; and one project (where Atlantic salmon are potentially present) will have up to twenty-five, 14-inch diameter maximum, H-piles[25] (Table 19). The Proponents assume five, 30-inch steel piles or five, 14-inch H-piles are driven per day and 250 pile strikes per pile. Assuming a 10 dB noise reduction from applying a bubble curtain, the NMFS calculator predicts injurious levels of sound using the peak SPL and cumulative SEL injury thresholds out to approximately 13 and 177 feet respectively from 30-inch piles and approximately 10 and 177 feet for 14-inch piles.

[25] The 91, 30-inch diameter maximum steel piles and 25, 14-inch diameter H-piles per project assumption is based on past project history.

Table 19: Annual Impact Pile Driving Estimates

No. of projects within CH and with potential Atlantic salmon presence	No. of projects requiring pile driving for temporary trestle/traffic maintenance/max no. of piles	No. of projects requiring permanent pile bents[26]/max no. of piles per project	No. of projects requiring spread footing pier/max no. of piles per project	Max no. of piles driven annually
8	8/14	3/7	1/25	158

The behavioral threshold of 150 dB RMS would be exceeded up to 3,281 feet (0.62 mile) from the piles. These zones would extend from the locations of impact pile driving for a maximum of 19 days, assuming an average of 5 piles per day installed. Assuming a channel width of 150 feet, an individual project could expose approximately 53,100 square feet of channel to injurious levels of underwater sound, and roughly 984,300 square feet of channel to noise levels above the behavioral threshold. This is a reasonable worst-case scenario for an individual project covered under this PBO. The implementation of eight in-water pile driving projects of this magnitude would expose approximately 424,800 square feet of channel to injurious levels and 9.9 miles of disturbance levels of underwater sound per year. The vast majority of covered projects will have smaller injury and disturbance zones because of fewer and smaller diameter piles installed and geomorphic features (curves, gravel bars, etc.) that limit the extent of noise impacts.

Impact pile driving will occur episodically throughout the in-water work windows. Most Atlantic salmon would likely avoid areas of the river channel where noise exceeds the disturbance threshold, resulting in temporary behavioral effects such as delayed migration and reduced foraging. This is not expected to result in adverse effects because there will be breaks throughout each day where impact pile driving is not occurring and no pile driving will occur during the night, when migration is most active.

Sublethal adverse effects to juvenile and adult Atlantic salmon may occur within the zone of injury. We expect these will be limited to effects such as temporary threshold shifts from underwater noise within 177 feet of pile driving. Physical injury from barotrauma, while possible, is not expected because of the relatively small pile sizes and associated minimal area of injury (Table 20).

Table 20: Impact Pile Driving Estimated Extent of Injury and Behavioral Threshold Exceedance

Maximum No. of Piles per 24 hour period	Total No. of Strikes per day (avg. 250 strikes per pile)	Behavioral Threshold Exceedance Area per day (sq. ft.)	Injury Threshold Exceedance area per day (sq. ft.)	Injury Threshold Exceedance area (sq. ft.) per year
5	1,250	984,300*	53,100*	424,800

*Assumed 10 dB of reduction from bubble curtain use

There is sparse data on noise levels from hoe ram demolition. Limited information from WSDOT's Manette Bridge project (Escude 2013) suggests in-water (not isolated within a

[26] Note that 1 pile bent is estimated to use approximately 7 piles. Therefore, 1 permanent pile bent is assumed per year.

dewatered cofferdam) hoe ram demolition may exceed injurious sound thresholds. Hydroacoustic monitoring data from bridge demolition conducted by Caltrans at Ten Mile Bridge (Pommerenck and Rodkin 2010) also suggests that hoe ram activity at or below the water line can 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 factors. As a conservative approach, for the five projects proposed to include hoe ram demolition and that have the potential for Atlantic salmon presence annually, we will apply the same isopleths as the 30-inch diameter piles over an estimated duration of 19 days, resulting in the same zones of injurious and behavioral effects as impact pile driving (Table 21).

Table 21: Hoe Ram Estimated Extent of Injury and Behavioral Threshold Exceedance

Hoe Ram Demolition Projects Per Year (within CH and with Potential Atlantic salmon Presence)	Behavioral Threshold Exceedance Area per day (sq. ft.)	Injury Threshold Exceedance area per day (sq. ft.)	Injury Threshold Exceedance area (sq. ft.) per year
5	984,300*	53,100*	265,500

*Assumed 10 dB of reduction from bubble curtain use

In summary, in-water impact pile driving is likely to exceed injurious and behavioral underwater noise thresholds for fish. It is possible that in-water hoe ram bridge demolition may exceed injurious and behavioral underwater noise thresholds for fish. Adult and juvenile Atlantic salmon will be exposed to these noise thresholds. Behavioral effects are expected to range from a startle response to temporary delayed migration and potential avoidance of the ensonified area. The effects to migration will be minimized by limiting the work to daylight hours and by the intermittent nature of the work. Adult and juvenile Atlantic salmon will be exposed to injurious sound levels. These sound levels are expected to result in sublethal and adverse effects to fish occurring in the ensonified (injurious) area during the work (Table 22). Take in the form of harassment from temporary threshold shifts (temporary reduction in hearing sensitivity), could reduce predator avoidance in juvenile Atlantic salmon and reduce foraging success. Take in the form of harassment from temporary threshold shifts could reduce foraging or spawning success in adult Atlantic salmon. Fish exposed to these effects are expected to recover as hair cells regenerate within minutes to weeks of the pile driving event.

Table 22: Total Annual Area of Injurious Threshold Exceedance

Total Annual (sq. ft.) from Table 20 and 21	Total Annual (sq. meters)	Total Annual HUs*	Total Annual Atlantic salmon Juveniles Adversely Affected**	Total Annual Atlantic salmon Adults Adversely Affected***
690,300	64,130	641	3,205	10

*HU=1,076 square feet (100 square meters).
**Assumed 5 parr (juvenile Atlantic salmon) per unit.
***Conservatively estimated an average of 1 adult Atlantic salmon will occur per project, though this is likely an overestimate due to the low number of sea-run adult returns in most of the drainages in the GOM DPs.

To determine the accuracy specific to the estimated ensonified areas which are based on multiple assumptions, the Proponents will conduct hydroacoustic monitoring per the Hydroacoustic Monitoring Template (Appendix F) on projects with impact pile driving or in-water hoe ram demolition in Atlantic salmon waters.

5.1.3 Temporary Migration/Movement Barrier

Cofferdam Work Area Isolation is the Core Activity that is most likely to cause a temporary barrier to Atlantic salmon migration and movement. Cofferdams are proposed for most General Activities occurring within Atlantic salmon waters (Table 11). Projects with cofferdams that are not channel-spanning, mostly involving work on larger streams (bridge repair, demolition, and construction) will retain fish passage in the open portion of the channel. Bridge scour countermeasure projects will also use partial-spanning cofferdams. Projects with partial-spanning cofferdams will result in temporary flow and depth modifications but will not create complete barriers. Similarly, temporary causeways for equipment access will reduce the migratory/movement path by up to 25 percent. These activities will be limited to a July 15 to April 15 work window and thus will avoid any effects to outmigrating smolts. By providing a migration/movement pathway, effects to adult and rearing juvenile Atlantic salmon will be insignificant and discountable. Other in-channel work outside of a cofferdam such as bridge demolition, geotechnical drilling, vibratory pile installation and removal, equipment operation, other pile removal, may increase in-water disturbance levels, but not to a degree to create a barrier to movement. Behavioral effects such as avoiding the immediate work area could result from these activities but effects to adult and rearing juvenile Atlantic salmon migration and movement will be insignificant and discountable.

Impact pile driving and hoe ram demolition may also create a partial temporary movement and migration barrier, especially within the injury threshold isopleths. This barrier effect would be in place during impact pile driving and in-water hoe ram demolition events in Atlantic salmon waters, which are expected to occur five times each, annually. Impact pile-driving will occur episodically during the work day in 20 to 60 minute increments with one to two hours breaks in between as the contractor moves between piles. Hoe ram demolition is also intermittent with shut downs throughout the day to pick up concrete debris. Based on the proposed timing of this work (July 15 to April 15), it could affect adult spawning migration and rearing juvenile movement. Because both activities will be limited during daylight hours, when Atlantic salmon migration and movement is less active and due to the intermittent nature of this work, it will allow for some movement, unlike channel-spanning cofferdams. April 15 to July 15 is the most active window for adult Atlantic salmon migration, and all in-water work will not occur during this time. Because of the time of year and time of day restrictions, temporary movement barrier effects resulting from impact pile driving will be insignificant and discountable to juvenile and adult Atlantic salmon.

Cofferdams that are channel-spanning will have a temporary adverse effect on Atlantic salmon movement because as long as they are in place (1 to 60 days), they will form a complete barrier. Channel-spanning cofferdams are proposed for in-water work in smaller streams such as culvert replacement and repair activities. The proposed July 15 to September 30 work window will avoid the smolt outmigration and adult Atlantic salmon spawning migration when they move from holding pools to spawning grounds. This will limit effects from channel-spanning cofferdams to rearing juvenile Atlantic salmon movement.

Juvenile Atlantic salmon rear in freshwater streams for up to four years before undergoing smoltification and commencing ocean migration. While rearing, they will move within streams in search of new feeding locations and more suitable micro-climates, utilizing different habitats for seasonal survival. In the low flow period, juvenile Atlantic salmon remain mobile, foraging and sheltering from predators. Temporarily blocking these migrations and movements could have varying effects. It may result in increased densities in preferred habitats by limiting dispersion to less densely populated habitat. This may result in decreased fitness. Juvenile Atlantic salmon may also be seeking cooler water in the headwaters of stream systems during the warmer months that coincide with the July 15 to September 30 standard in-water work window. Cofferdams may inhibit access to this cooler water, exposing Atlantic salmon to warmer water temperatures and decreased fitness. Loss of the ability to freely migrate may also make juvenile Atlantic salmon more subject to predation. Fifteen projects annually will include channel-spanning cofferdams and will result in adverse effects and therefore take in the form of harassment to rearing juvenile Atlantic salmon by restricting movement. This assumes that all culvert replacement, extensions/resets, and invert/slipline projects predicted annually within Atlantic salmon waters will implement channel-spanning cofferdams. Most streams where channel-spanning cofferdams will be placed are smaller streams, likely 20 feet wide or less. Parr moving during the work-window for cofferdam installation (July 15 to September 30) are most likely moving upstream to reach cooler waters and could be expected to attempt to move through the area with the cofferdam from up to 0.9 miles downstream (Table 23).

Table 23: Total Annual Number of Atlantic salmon Parr Adversely Affected by Channel-spanning Cofferdams

Projects with Channel-spanning Cofferdams Per Year (within CH and with Potential Atlantic salmon Presence)	Total Annual (sq. feet)	Total Annual (sq. meters)	Total Annual HUs*	Total Annual Atlantic salmon Juveniles Adversely Affected**
15	84,840	7882	79	395

*HU=1,076 square feet (100 square meters).
**Assumed 5 parr (juvenile Atlantic salmon) per unit.

In summary, impact pile driving, partially-spanning cofferdams, and other in-water work activities may result in temporary disturbance, flow and depth alteration, or partial migration pathway obstructions for adult and juvenile Atlantic salmon. These effects will be reduced by the timing and duration of the work and by preserving a migration corridor through restricting the size of the work area. Effects on migration from these activities will be insignificant and discountable. Channel-spanning cofferdams will create temporary, but complete, barriers to Atlantic salmon movement. The timing of this work (July 15 to September 30) will avoid critical migration periods but will prevent juvenile Atlantic salmon from moving between preferred rearing habitats. This may result in Take in the form of harassment from potential reduced fitness and increased predation because their ability to move to more favorable habitat will be temporarily restricted.

5.1.4 Fish Handling, Relocation, and Entrapment

Capturing and handling Atlantic salmon can cause physiological stress and possibly physical injury or death, including cardiac or respiratory failure from electrofishing (Snyder 2003). Studies show all aspects of fish handling, such as electrofishing, dip-netting, time out of water, and data collection (e.g., measuring and weighing), are stressful and can lead to immediate or delayed mortality (Murphy and Willis 1996). Clement and Cunjak (2010) found a low incidence and severity of injuries to juvenile Atlantic salmon from electrofishing in New Brunswick, but injuries were more prevalent in larger juveniles. The sublethal effects associated with electrofishing and relocation, other than physical injury, remain largely unknown, though they likely include disruption and interruption of normal behavior through relocation and decreased predation avoidance due to temporary incapacitation if individuals are not observed and removed from the water. Direct mortality may occur when fish are handled roughly or kept out of the water for extended periods. The MDMR usually handles a few thousand juvenile Atlantic salmon each year while electrofishing. Recorded mortalities are generally less than two percent of fish captured (Service 2011) and are predominately young-of-the-year (YOY) Atlantic salmon (parr during their first year after hatching). Adverse effects from handling adult Atlantic salmon may occur in very low numbers because most adults will be herded from the work area prior to draw down and handling. In past years, the MaineDOT has had a maximum of one project per year in which incidental take from pursuing and trapping adult Atlantic salmon resulted from an action. Density numbers for adult Atlantic salmon are not available. Past BOs issued by the Service in Maine assumed a maximum of two adult Atlantic salmon would be handled in the rare instance it is necessary. Therefore, it is expected that the Proponents would handle a maximum of two adult Atlantic salmon a year. Fish handling protocols are expected to avoid lethal take to adult Atlantic salmon.

Delayed fish mortality is often associated with a disease epizootic, which generally occurs from 24 hours to 14 days after handling. If a fish is injured during handling, disease may develop within a few hours or days. Examples of injuries which can lead to disease problems are loss of mucus, loss of scales, damage to the integument, and internal damage. Internal injuries occur when fish are not properly restrained or not sedated during handling.

To minimize dewatering-related fish stranding inside the cofferdam, the MaineDOT or the MTA (or approved consultants) will capture and remove as many Atlantic salmon and other fish species as possible. The Proponents will conduct evacuation procedures according to the MaineDOT's Atlantic Salmon Evacuation Plan and Disinfection Procedures (Appendix G) to minimize the amount of Atlantic salmon juveniles subject to stranding. Mortality is expected for any juvenile Atlantic salmon that remain in the substrate following dewatering.

During dewatering, stranding does not always lead directly to mortality, as juvenile fish can survive for several hours in the substrate after dewatering because some water always remains. However, if stranded fish are not quickly identified and removed, stranding over a longer period, removal of stream substrate for project construction, or exposure to crushing while equipment and crews are operating within the cofferdam; could result in mortality. During a field experiment conducted in cold water (less than 4.5°C/40.1°F), Saltveit et al. (2001) found that 60 percent of Atlantic salmon juveniles became stranded during 42 minutes of dewatering. After searching the substrate, about 39 percent of the stranded fish could not be found. YOY Atlantic salmon were affected more severely than older juveniles. Only about 10 percent of 1+ Atlantic salmon juveniles were stranded during daylight in water greater than 9°C (80.2°F). In general, the incidence of Atlantic salmon stranding is much lower during summer, when water temperature is relatively high compared to winter conditions. This is likely attributable to lower fish activity and greater substrate-seeking behavior during the cold season. Stranding is also higher during the day, probably because Atlantic salmon are predominantly active at night and more likely to leave substrate at night.

When capturing fish as part of evacuation procedures, equipment such as dip nets, minnow traps and seines shall be used first, as practicable. Electrofishing equipment shall be used as a final option for clearing the construction area. To minimize temperature-related handling stress to Atlantic salmon, electrofishing will not be conducted in water temperatures above 22.0°C (71.6°F, MDMR 2011). Construction and fish evacuation scheduling will need to account for possible high water temperature conditions when work is conducted within the July 15 to September 30 work window. Early morning evacuation, when water temperatures are often at their coolest daily temperature, will be prioritized. In some situations, however, construction may need to be delayed when stream temperatures exceed 22°C (71.6°F).

Handling stress and risk of injury to juvenile Atlantic salmon will be minimized by 1) ensuring minimal handling time (no data will be collected from individual Atlantic salmon other than recording capture amounts); 2) ensuring minimal time that fish are held out of the water and the stream; and 3) using transfer containers with aerated stream water at the ambient temperature. Effects to Atlantic salmon parr are summarized in Table 24. Handling of two adult Atlantic salmon may be necessary on an annual basis. Handling techniques are different for adults than for juveniles. Electrofishing cannot be used to immobilize and capture them as it results in a significantly higher risk of injury or mortality than juvenile Atlantic salmon. The MDMR has recommended and the Proponents will follow a protocol in which the adult Atlantic salmon are herded into a rubber sock and removed from the cofferdam prior to any electrofishing.

Any fish found in a cofferdam will be captured and relocated prior to the start of excavation and other in-channel work. This temporary displacement can result in significant effects because Atlantic salmon juveniles are highly territorial, therefore, if juveniles occur in the cofferdam area footprints, those relocated juveniles will have to establish new territories. This disruption to their normal behavior may put juveniles at increased risk of injury or mortality as it leaves them more vulnerable to predation, they may need to aggressively compete with other juveniles in establishing a new territory, and they may be less able to capture prey. When construction activities are finished and stream flows are returned, juveniles can re-occupy habitat.

Table 24: Total Annual Cofferdam Impact Area and Atlantic salmon Affected

Total Impact Area (sq. ft.) from Table 15	Total (sq. meters)	Total HUs*	Total Juveniles adversely affected**	Expected Juvenile Mortality From Handling***
61,260	5,691	57	285	6

*HU=1,076 square feet (100 square meters).
**Assumed 5 parr (juvenile Atlantic salmon) per unit.
***Assumed 2 percent of all fish handled. No adult Atlantic salmon mortality proposed or expected under this programmatic.

Juvenile Atlantic salmon also may be entrapped when temporary causeways are constructed for equipment access. Causeway areas will range between 1,000 and 1,500 square feet and an estimated 4 causeways will be constructed annually where Atlantic salmon may occur, for a total area affected of 6,000 square feet. Mortality and therefore take through harm is assumed for the juvenile Atlantic salmon occurring within the approximately 5.6 HUs affected annually, for a total of 28 individuals (Table 25). Adult Atlantic salmon aren't expected to remain in an area where a causeway is being built and therefore affects to adults are insignificant and discountable.

Table 25: Total Annual Causeway Impact Areas and Atlantic salmon Affected

Total Annual Impact Area (sq. ft.)	Total Annual (sq. meters)	Total Annual HUs*	Total Annual Juveniles adversely affected**
6,000	557	5.6	28

*HU=1,076 square feet (100 square meters).
**Assumed 5 parr (juvenile Atlantic salmon) per unit.

In summary, fish handling and relocation may cause direct take in the form of harassment to one adult Atlantic salmon via pursuing, capturing and relocating to adjacent habitat. It is also likely to cause take in the form of harassment to 285 Atlantic salmon juveniles by pursuing, capturing and relocating to adjacent habitat, and may cause take in the form of harm from stranding mortality, electrofishing and handling injury and mortality to 34 Atlantic salmon juveniles during cofferdam installation and causeway construction. The Proponents estimate that 25 cofferdams will be constructed annually where juvenile Atlantic salmon are likely to occur. Adult Atlantic salmon are more likely to move from the work area as construction begins and are likely to be holding in deep pools during most of the planned in- water work. Therefore, they are expected to rarely occur (two per year). Dewatered areas will range from 500 to 4,000 square feet (Table 11 and 15). Injury and mortality may be delayed or instantaneous. AMMs and standard protocols will minimize but not avoid these effects.

5.1.5 Impingement/Entrainment

Impingement and entrainment is a potential risk for juvenile Atlantic salmon at the intake during water pumping for dewatering and diversions in Atlantic salmon waters. Where cofferdams are utilized, pumping will be necessary. Approach velocities across the screen that are faster than a fish's swimming capability can overcome and may draw and hold fish against the screen surface (i.e., impingement), resulting in suffocation or physical damage to the fish (NMFS 2008). Pump intake hoses without screens or with improper screens can result in fish being drawn into the pump (entrainment) and killed. Additionally, fish can become impinged in block nets that have been positioned to prevent fish from moving into a work area. This could be an additional source of mortality associated with construction site isolation procedures, however, block nets used in a similar manner on projects in Maine have not resulted in fish entrainment (Service 2013).

The implementation of protective measures in the MaineDOT's Atlantic Salmon Evacuation Plan and Disinfection Procedures (Appendix G) and implementation of the proper pump screen size will reduce the likelihood of fish injury or mortality from interactions with the pumped diversion process to discountable. With application of procedures and AMMs, effects from impingement and entrainment to juvenile Atlantic salmon are expected to be insignificant and discountable.

5.1.6 Water Quality Impact (pollutants)

Petroleum-based materials, such as diesel fuel and oil, contain polycyclic aromatic hydrocarbons (PAHs), which can enter streams from a spill or stormwater runoff affecting Atlantic salmon individuals. PAHs can be acutely toxic to salmonids and other aquatic organisms at high exposure levels or can cause sublethal effects at lower exposures (Albers 2003, Meador et al. 2006).

All of the project activities have the potential to result in pollutant or materials releases related to general construction activities. Petroleum-based materials, such as diesel fuel and oil, can enter streams from a spill or stormwater runoff affecting Atlantic salmon individuals. All in-water excavation will take place inside of a cofferdam.

The Proponents do not allow intentional discharges of any sort in association with construction activities. However, the use of heavy equipment in or near a waterbody increases the risk of contaminants (fuel, oil, hydraulic fluid, etc.) accidentally releasing into the project site and possibly degrading habitat conditions and threatening aquatic organisms. As a component of the SEWPCP for each project, the Proponents (or their contractor) will develop and implement a Spill Prevention, Control and Countermeasures (SPCC) Plan, designed to avoid any stream impacts from hazardous chemicals associated with construction activities, such as diesel fuel, oil, lubricants, and other hazardous materials. The SPCC Plan includes the assurance that necessary BMPs will be on site and employed in the event of a hazardous materials release. Careful adherence to an approved SPCC Plan, as part of an overall SEWPCP, will make it highly unlikely that Atlantic salmon will be exposed to harmful chemicals from a spill or accident.

The Proponents will implement the specified AMMs to prevent spill incidents. The MaineDOT's Standard Specifications require that refueling, equipment maintenance, and materials storage occur at least 100 feet from a watercourse (MaineDOT 2014). All pumps will be maintained, refueled, and operated at a location consistent with the SPCC Plan and in a manner that avoids chemical or other hazardous materials getting into the stream. Depending on the nature of released material, a spill could have adverse effects to Atlantic salmon individuals should one occur. However, the Proponents will implement the specified AMMs to prevent spill incidents. Proponents will ensure proper implementation of the SPCC Plan, greatly reducing the chance of exposure of Atlantic salmon to harmful chemicals from a spill or release. Equipment operation in flowing water will be limited to 2 projects annually that may require operation of a tracked excavator. A hazardous materials release is unlikely and effects to Atlantic salmon are insignificant and discountable.

Demolition of bridge support elements such as piers may occur outside of cofferdams. This demolition will break the concrete elements into pieces for removal. This activity is not expected to have pH impacts as the concrete has been cured and in place for greater than 50 years.

The application of grout in and around grout bags can result in a rise in pH caused by the hydration of the cementitious materials in the grout, and results in the high concentrations of hydroxyl ions (OH-) going into solution in the water surrounding the work area. A significant rise in pH can kill fish; cause damage to or burn outer surfaces, including gills, eyes, and skin; and impair a fish's ability to dispose of metabolic wastes. Based on a literature review, Alabaster and Lloyd found that chronic exposure to pH values above 10 was harmful to all species studied, and salmonids were harmed at pH values above 9. A Virginia Department of Transportation study (Fitch 2003) found that high pH (greater than 9.0) resulting from grout repair projects can lead to fish kills. Fitch (2003) found that when the rate of grout application exceeded 13 cubic yards per hour, the pH downstream of the project was likely to exceed a pH of 9.0. Conversely, in streams where there was a high rate of stream flow in relation to the rate of grout application, there were minimal effects to the pH of the downstream environment (Fitch 2003).

For all grout bag projects, the grout slurry will be applied at a rate of two cubic yards per hour and an AWA will be mixed with the grout prior to application to reduce the potential for elevated pH levels downstream. For flows greater than one FPS, the proposed short work duration (less than three hours), application rates, and use of the AWA are expected to keep pH levels downstream of the work within levels that will not result in adverse effects to Atlantic salmon. Effects on juvenile and adult Atlantic salmon downstream from grout application are expected to be insignificant and discountable from pH exposure because pH levels are expected to stay below harmful levels.

When in-stream flows at the work site are less than one foot per second, a turbidity curtain will be deployed and will surround the grout bags where grout is being applied. Additionally, fish will be evacuated from the area within the curtain using seining or electrofishing if waters are less than two feet deep. When turbidity curtains are deployed for grout bag projects (one project annually); juvenile Atlantic salmon may be exposed to adverse effects. Efforts will be made to remove fish from the work area but any Atlantic salmon that remain within the curtain will be subjected to adverse effects and experience take as a result of exposure to pH levels that are potentially harmful. Due to the timing of the work during the July 15 to September 30 work window when water temperatures are typically elevated and adult Atlantic salmon are tend to hold in deep pools, the infrequency of the work (one project per year with turbidity curtain), and the likelihood of vacating the area of fish when workers enter the water, adult Atlantic salmon are not expected to be trapped within turbidity curtains. Despite these effects, the use of a turbidity curtain is still considered an AMM because low flows will decrease the opportunity for effective dilution downstream of the work area, increasing the likelihood of harmful pH levels downstream, if the turbidity curtain is not used.

In summary, effects to Atlantic salmon juveniles and adults from pollutants that may enter the water from and spills and equipment leaks will be minimized to insignificant and discountable levels through AMMs such as implementation of the SEWPCP and locating refueling and maintenance activities at least 100 feet from streams. Bridge demolition of concrete will not affect Atlantic salmon juveniles or adults because the concrete is cured and inert and will be removed from the channel. Grout application will be conducted to ensure that pH levels downstream of the activity will not reach harmful levels for Atlantic salmon juveniles and adults. This work will have insignificant and discountable effects to adult and juvenile Atlantic salmon, with the exception of one project annually conducted during low flows which would require the use of a turbidity curtain. This may result in limited direct take of juvenile Atlantic salmon during deployment of turbidity curtains, by pursuing, capturing and relocating to adjacent habitat, electrofishing and handling injury, mortality (less than two percent of fish handled), and elevated pH exposure related injury and mortality. Effects to Atlantic salmon juveniles will be limited to those occurring within the approximately 2,000 square foot area contained by the turbidity curtain on one project annually. We assume that approximately five juvenile fish will experience harassment from handling and relocation and four will realize harm from exposure to elevated pH should they evade capture within a turbidity curtain. AMMs and standard protocols will minimize but not avoid these effects.

5.1.7 Habitat Alteration

The habitat where Atlantic salmon are likely to occur is designated as critical habitat. This section focuses on impacts to Atlantic salmon from temporary and permanent habitat modifications related to in-channel fill placement and dewatering. Effects to critical habitat are discussed in Section 5.2. Permanent habitat alteration can result from culvert replacement, culvert extensions, invert/slipline, scour countermeasures (concrete mat installation), riprap placement, bridge removals and bridge replacements. Impacted areas that are restored following construction are considered temporarily impacted. Activities that may result in temporary habitat impacts include causeway construction, temporary pile installation, dewatering within a cofferdam.

Temporary. Temporary fill placement in the form of causeways or piles is not expected to result in permanent habitat degradation as the affected areas will be minimized to what is necessary and restored following use. Causeways will be limited to a maximum of 25 percent of the channel and will consist of filter fabric with a layer of clean rock on the top. The filter fabric and rock will be removed as soon as practicable. While the causeway is in place, it will exclude the area it covers from potential use by Atlantic salmon. This temporary exclusion will primarily affect rearing juvenile Atlantic salmon because causeways, temporary bridges, and cofferdams will not be placed in or near spawning habitat or potentially occupied adult Atlantic salmon holding pools. The affected habitat area will be small (between 1,000 and 1,500 square feet) with durations ranging from 2 to 250 days, and limited to 4 projects annually where Atlantic salmon likely occur. After the causeway is removed, the area will be restored to match surrounding substrate (see Table 25 for a summary of causeway impacts to Atlantic salmon). A maximum of 30 piles will be installed for temporary bridges on 12 projects annually in Atlantic salmon waters. The temporarily impacted area will be minimal. Once the piles are removed, the holes will be filled with natural substrate or allowed to fill in naturally. Based on the relatively small area affected compared to available surrounding habitat and the fact that the habitat will be restored following construction, these temporary habitat impacts will have insignificant and discountable effects on juvenile Atlantic salmon.

After cofferdams are constructed, the work area within them will be dewatered. This will make the existing habitat unavailable to Atlantic salmon. Affected areas will range from 500 to 4,000 square feet for 25 projects annually in Atlantic salmon waters. Where excavation occurs within dewatered areas, the streambed will be re-contoured and natural streambed material will be added as necessary to restore to match adjacent habitat. Temporary impacts to Atlantic salmon spawning habitat will not occur during spawning or egg incubation. Based on the relatively small area affected compared to available surrounding habitat and the fact that the habitat will be restored following construction, these temporary habitat impacts will have insignificant and discountable effects on juvenile Atlantic salmon.

Permanent. Riprap placement coincides with culvert replacements, bridge replacements, and culvert end resets and extensions. Riprap aprons are added for culvert projects to ensure that water flow will not scour around the inlet and outlet of the culvert. Aprons are typically two feet deep and extend ten feet upstream and downstream of culverts. They are intended to remain in place for the life of the crossing structure. Riprap is also used to ensure the long-term stability of bridge abutments. Bridge height and abutment depths will determine the amount of riprap needed. The riprap is placed along the length of the abutment and can extend up to 20 feet in front of the abutment. To minimize the effects of the riprap placement on habitat, the Proponents will embed riprap aprons and abutment protection and cover the riprap with CSM. This will ensure that the stream substrate retains natural functions resulting in insignificant and discountable effects.

Bridge replacements can result in artificial fill placement in the channel (piers and abutments). However, bridge replacements will retain or decrease the number of piers and abutments and will not result in a net increase of structure footprint. Bridge replacements covered programmatically will not result in a net loss of Atlantic salmon stream habitat and effects will be insignificant and discountable.

Twenty culvert replacements will occur annually. The majority of these will occur in Tier 1 areas (at least 11) and they will meet design criteria to support natural stream functions. These replacements are expected to provide beneficial effects to Atlantic salmon habitat (Section 3.0). A maximum of nine culvert replacements will occur in Tier 2 areas and these will support fish passage, but may not result in a naturally functioning channel because the culvert will not be sized to 1.2 BFW. Crossings that are less than 1.2 BFW may inhibit natural stream processes and influence long-term substrate composition inside of any stream crossing structures. Structure design that does not support natural stream processes such as large wood and boulder transport, can reduce habitat complexity in the stream. Reduced habitat complexity can lead to altered width-to-depth ratios and increase temperature fluctuations (*Federal Register* 2009b, 29300) although the extent of potential temperature fluctuation from undersized culverts is unknown. Adverse effects to stream habitat may also include downstream areas that are subject to increased water velocities and stream energy, resulting in erosion and scour pool formation.

Crossing structures less than 1.2 BFW may also have altered rearing habitat within the structure due to the lack of streambanks and channel formation. To offset habitat impacts, compensatory mitigation, through the ILF program or another mitigation approach that is part of the program, will be provided for all stream crossing replacements in Tier 2 areas that are greater than 1.0 times the BFW but less than 1.2 times the BFW. This reduction in habitat function in Tier 2 areas is most likely to adversely affect juvenile fish using the affected habitat. Lost function will affect foraging and rearing areas and not spawning habitat. Take in the form of harm is expected to be limited to rearing juvenile Atlantic salmon that occupy territories within a short distance from the crossing structure, although the exact distance where impacts will occur is difficult to measure. Assuming most of these streams will be 20-feet wide or less, and assuming a downstream impact distance of 0.25 miles, 221 HUs and therefore 1,105 parr will be affected.

Habitat loss will occur from culvert extensions and result in the loss of a maximum of eight feet of linear streambed per extension. Most culvert extensions are on culverts less than ten feet wide. A conservative estimate for habitat loss per project is 80 square feet of rearing habitat. Five culvert extension projects are estimated to occur annually in Atlantic salmon critical habitat (and Tier 1 and Tier 2 areas), including two where Atlantic salmon could be present, which will result in approximately 400 square feet of rearing habitat loss in critical habitat and 160 square feet of rearing habitat loss in Atlantic salmon waters. The annually impacted area represents a fraction of a HU and less than one juvenile Atlantic salmon will be affected based on this small impact area. Mitigation will be provided through the ILF program or another mitigation approach that is part of the program for culvert extensions occurring in Tier 1 and Tier 2 areas.

In addition to direct habitat loss from extensions, the various culvert repair activities covered in this programmatic consultation (reset and invert/slipline) may result in prolonging the life of undersized structures. This may result in similar habitat function impacts as culvert replacements at less than 1.2 BFW. Also, often, culverts that have been repaired cannot be filled with CSM or are not sized properly to maintain CSM. To offset these habitat impacts, compensatory mitigation, through the ILF program or another mitigation approach that is part of the program, will also be provided for all invert/slipline projects in Tier 2 areas. Three invert/slipline projects will occur in Atlantic salmon waters annually, none in Tier 1 areas. Three culvert resets are expected to occur in areas supporting Atlantic salmon populations. Reduction in or loss of habitat function may adversely affect rearing juvenile Atlantic salmon using the affected foraging and rearing areas. Take in the form of harm is expected to be limited to rearing juvenile Atlantic salmon that occupy territories within a short distance from the crossing structure, although like culvert replacements that will occur in Tier 2 areas as described above, the exact distance where impacts will occur is difficult to measure. Again, assuming most of these streams will be 20-feet wide or less, and assuming a downstream impact distance of 0.25 mile for a total of 6 projects (3 culvert resets and 3 culvert inverts/sliplines), 147 HUs and therefore 735 parr will be affected.

Concrete cable mats will permanently alter substrate conditions and function within their footprint, which is estimated at 5,000 square feet. Proponents estimate that three of these projects will occur annually, all within Atlantic salmon critical habitat where Atlantic salmon occur and in Tier 1 areas, therefore 15,000 square feet of impact to rearing habitat. The placement of the cable mats under the bridge structure can affect aquatic habitat function. The placement of cable mats may cause a rise in streambed and lead to stream velocity and water depth changes. The cable mats also remove the roughness of the natural streambed. Roughness lessens water velocities, creating different migratory pathways for fish and other aquatic organisms, and serves as habitat for other aquatic organisms and prey items such as invertebrates. Mitigation will be provided through the ILF program or another mitigation approach that is part of the program for concrete mats placed in Tier 1 and Tier 2 areas. The installation of three concrete cable mats annually will affect approximately 14 HUs and therefore result in Take of approximately 70 Atlantic salmon parr.

In summary, temporary habitat impacts associated with causeway and temporary bridge construction and dewatering within a cofferdam will have insignificant and discountable effects on juvenile and adult Atlantic salmon based on the small area of habitat affected compared to the surrounding habitat available and that the affected areas will be restored. Permanent habitat impacts will result in Take to juvenile Atlantic salmon in the form of harm (Table 26). The habitat alterations described will occur within rearing habitat, reducing forage quality and cover opportunities for juvenile Atlantic salmon. This is likely to result in reduced fitness and increased predation of juveniles Atlantic salmon.

Table 26: Total Annual Habitat Alteration and Atlantic salmon Affected

No. of Projects Annually and Type	Total Annual Impact Area (sq. ft.)	Total Annual HUs*	Total Annual Juveniles adversely affected**
9 culvert replacements in Tier 2 areas	237,600	221	1,105
2 culvert extensions	160	<1	<1
6 culvert resets/invert/slipline	158,400	147	735
3 concrete cable mat installations	15,000	14	70

*HU=1,076 square feet (100 square meters).
**Assumed five parr (juvenile Atlantic salmon) per unit.

Mitigation will be provided for these adverse effects through the ILF program or other mitigation projects within the program (except for culvert resets). These mitigation approaches will provide pathways and funding to complete connectivity restoration or habitat improvement projects. Funding and implementing projects that improve habitat quality or access will contribute towards species recovery.

5.1.8 Permanent Migration/Movement Barrier

The Proponents are proposing activities that may permanently adversely affect aquatic habitat connectivity. These activities include stream crossing replacements, culvert end extensions, culvert invert line/slipline rehabilitation and scour countermeasures. Bridge crossings, however, will be sized to accommodate 100-year storm flows. Sizing for these large storm flows will also allow for aquatic habitat connectivity. Due to the large variation in flow resulting from the substrates associated with large bridge crossings, fish and aquatic organisms will be able to use the habitat under these bridges just as they would use stretches of natural habitat. Bridge replacement projects will not create a permanent migration/movement barrier for Atlantic salmon.

Stream crossing structures, particularly culverts, can have adverse effects on the passage of Atlantic salmon. Reduced habitat connectivity prevents Atlantic salmon from fully using substantial amounts of freshwater habitat and changes native fish community structure by preventing or impairing access for other fish species (*Federal Register* 2009b, 29300) upstream of the crossing structure. Stream crossing design techniques for aquatic habitat connectivity are proposed in Tier 1 areas to provide a long-term beneficial effect to Atlantic salmon. Proper design of the stream substrate (using CSM) placed inside a crossing structure is important to aquatic habitat connectivity and habitat connectivity. Culverts will be designed and constructed for consistency with natural stream dimensions, profiles, and dynamics, in accordance with the following technical references: US Forest Service guide (Forest Service Stream-Simulation Working Group [FSSSWG] 2008), augmented by documents published by the states of Washington (Barnard et al. 2013), Vermont (Bates and Kirn 2009) and California (Love and Bates 2009). The Proponents are proposing to size stream crossing replacement structures to 1.2 times the BFW in areas designated as Tier 1 priority areas. This sizing will allow emulation of natural stream conditions. Eleven of the twenty culvert replacements proposed annually will occur in Tier 1 priority areas. Culvert replacements in Tier 1 areas will have beneficial effects to adult, juvenile, and smolt migration and movement.

Depending on site conditions, emulating natural stream conditions may not always be feasible. The Proponents will size stream crossing replacement structures that are equal to or greater than the BFW in designated Tier 2 priority areas. Nine of the twenty annual culvert replacements are anticipated to occur in Tier 2 areas. In these cases, the technical guidance may indicate the need for a geomorphic-based roughened channel design. This channel design will follow guidance developed between the MaineDOT and the Service. The geomorphic-based roughened channel design will support fish passage; however, it may not recreate the natural stream flow and function, per the principles outlined in U.S. Forest Service’s stream simulation design guidance (FSSSWG 2008). Riprap material required for stability will be embedded below the substrate, and CSM will be placed on the surface of the riprap. Culvert replacements in Tier 2 areas will have minor effects to adult, juvenile, and smolt outmigration and movement. Smolt outmigration is downstream and is not expected to be affected by these projects. At the majority of stream flows, movement in 1.0 BFW culverts will be similar to 1.2 BFW culverts. During elevated flows, juveniles and adults may experience delays in movements through culverts that are less than 1.2 BFW. This will result in take in the form of harm to juvenile and adult Atlantic salmon. For juveniles, Take is expected to be limited to rearing juvenile Atlantic salmon that occupy territories within a short distance from the crossing structure, although the exact distance where impacts will occur is difficult to measure. Assuming most of these streams will be 20-feet wide or less, and assuming parr might attempt to move through the affected area from up to 0.25 miles away, 221 habitat units and therefore 1,105 parr will be affected. For adult Atlantic salmon, Take will be very limited due to the low number of returning sea-run adult Atlantic salmon attempting to spawn, returning to the ocean, or moving to overwintering areas. We estimate this conservatively to be one adult Atlantic salmon per project annually.

The Proponents estimate two culvert extensions, three resets, and three invert/slipline projects will occur in CH with potential for Atlantic salmon presence annually (See Table 1). Culvert extensions will be limited to a total of eight-feet upstream and/or downstream of the existing crossing structure. Stream crossing structures that need to be extended or repaired are typically sized less than the BFW of the stream and can cause delays to fish migration. Undersized culverts result in elevated water velocities. These crossings may provide fish passage at low to moderate stream flows, but act as a barrier under moderate to high flow conditions. Extending the culvert will maintain or worsen fish passage. To minimize the overall effect from all culvert extensions in Tier 1 and Tier 2 areas, compensatory mitigation through the ILF program or another mitigation approach that is part of the program will be provided. Additionally, no invert/slipline projects will occur in Tier 1 areas and compensatory mitigation in Tier 2 areas will be provided through the ILF program or another mitigation approach that is part of the program. All invert line and slipline projects will have fish passage measures reviewed and approved by the Service included in the design inside and outside of the crossing structures to ensure that water depths and velocities allow for fish passage at a range of flows. Smolts will be able to migrate downstream through the stream crossing structures after these projects are completed therefore impacts will be insignificant. Adverse effects pertain to Atlantic salmon juveniles and adults. The effects to adult and juvenile Atlantic salmon movement are likely to result in reduced fitness due to limiting or preventing dispersion to available habitat. This will result in take in the form of harm to juvenile and adult Atlantic salmon. For juveniles, Take is expected to be limited to rearing juvenile Atlantic salmon that occupy territories within a short distance from the crossing structure, although the exact distance where impacts will occur is difficult to measure. Assuming most of these streams will be 20-feet wide or less, and assuming parr might attempt to move through the affected area from up to 0.25 miles away, culvert extensions will affect 49 HUs and 245 parr, while culvert rests/invert lines/sliplines will affect 147 habitat units and 735 parr. For adult Atlantic salmon, Take will be very limited due to the low number of returning sea-run adult Atlantic salmon attempting to spawn, returning to the ocean, or moving to overwintering areas. We estimate this conservatively to be one adult Atlantic salmon per project annually.

The placement of the concrete cable mats can affect aquatic habitat connectivity in two ways: 1) they may alter channel depth and flow conditions, creating a partial migration/movement barrier for adult and juvenile Atlantic salmon and 2) they decrease the roughness of the natural streambed, resulting in an increase in water velocities and a decrease in the number of migratory pathways. These effects on adult and juvenile Atlantic salmon movement are likely to result in reduced fitness due to limiting or preventing dispersion to available habitat. This will result in take in the form of harm to juvenile and adult Atlantic salmon. For juveniles, Take is expected to be limited to rearing juvenile Atlantic salmon that occupy territories within a short distance from the crossing structure, although the exact distance where impacts will occur is difficult to measure. Assuming most of these streams will be 20-feet wide or less, and assuming parr might attempt to move through the affected area from up to 0.25 miles away, concrete cable mat placement will affect 74 HUs and 370 parr. For adult Atlantic salmon, Take will be very limited due to the low number of returning sea-run adult Atlantic salmon attempting to spawn, returning to the ocean, or moving to overwintering areas. We estimate this conservatively to be one adult Atlantic salmon per project annually.

To summarize, the Proponents are providing activities with beneficial effects to fish movement when replacing structures within Tier 1 priority areas where the majority of culvert replacements will occur. Also, the Proponents are proposing to provide mitigation for projects that do not allow for natural fish movement. Adverse effects are expected from projects that maintain existing conditions or are less than 1.2 BFW of the natural stream (Table 27). Juvenile and adult Atlantic salmon are the life stages that will benefit the most from habitat connectivity improvements associated with Tier 1 priority area projects and mitigation efforts.

Table 27: Total Annual Habitat Alteration and Atlantic salmon Affected

No. of Projects Annually and Type	Total Annual Impact Area (sq. ft.)	Total Annual HUs*	Total Annual Juveniles adversely affected**
9 culvert replacements in Tier 2 areas	237,600	221	1,105
2 culvert extensions	52,800	49	245
6 culvert resets/invert/slipline	158,400	147	735
3 concrete cable mat installations	79,200	74	370

*HU=1,076 square feet (100 square meters).
**Assumed 5 parr (juvenile Atlantic salmon) per unit.

5.1.9 Summary of Effects to Atlantic salmon

Table 28 provides an overview of anticipated impacts to Atlantic salmon generated by all programmatic core activities.

Table 28: Summary of Programmatic Core Activities and Anticipated Impacts

Core Activity	Stressors/Impacts to Atlantic salmon Associated with Core Activities*	
	Insignificant/Discountable	Adverse Effect
1–Cofferdam Work Area Isolation	B, F, G	A, C
2–Fish Evacuation From Work Area		A, D
3–Streamflow Bypass Installation, Removal, and Rewatering	E,F	A,C
4–Pile Installation/Removal	B&C (v),F,G	A,B (i)
5–Hoe ram Pier and Abutment Demolition	A,F,G	B, C
6–Culvert/Channel Modification	A,C,E,F,G (c,p,b) H (b,c,cm,cu2,r),	G (cm,r,cu2), E (e,is)
7–General In-channel Work		
Streambed Excavation	A,F,G,H	
Minor Fill Placement	A,F,G,H	

Bridge Superstructure/Abutment Demo/Pile Cutting	A,B,C,F	
Heavy Equipment Operation	A,E,F,G	
Grout Application		F

***Stressors/Impacts:**

A. Elevated turbidity/sediment transport
B. Underwater noise
C. Temporary migration/movement barrier
D. Fish handling and relocation
E. Impingement/entrainment
F. Water quality impact (pollutants)
G. Habitat alteration
H. Permanent migration/movement barrier

***Activity Detail:**

b: bridges
c: culverts
cm: concrete mats
cu2: culverts in Tier 2, e: culvert extensions
i: impact driving; is: invert/slipline rehab
p: piles
r: riprap
v: vibratory installation

5.2 Effects of the Action on Atlantic Salmon Critical Habitat

The NMFS designated critical habitat necessary for the recovery of the GOM DPS of Atlantic salmon and defined PBFs to protect the different habitats that are important for the complex life stages of Atlantic salmon. Some of the proposed activities may adversely affect Atlantic salmon critical habitat, either temporarily or permanently. Other activities (such as bridge removals and culvert replacements in Tier 1 areas, for example) will restore critical habitat acreage and function by improving access and supporting natural stream processes. Permanent adverse critical habitat impacts will occur from bridge scour countermeasures, culvert extensions, culvert invert and slipline in Tier 2 areas, and stream crossing replacement structures less than 1.2 BFW in Tier 2 areas. All permanent adverse critical habitat impacts will be mitigated through the ILF program or other mitigation actions within the mitigation program. Therefore, the overall program is expected to result in a net benefit to Atlantic salmon critical habitat.

Habitat effects as they directly relate to species effects are discussed in Section 5.1. This section analyzes the impacts on the PBFs described in Section 3.3. The impacts described by PBF include: water quality impacts, turbidity and sedimentation, habitat alteration, and migration/movement barrier (temporary and permanent). Table 29 summarizes anticipated impacts to PBFs.

5.2.1 Insignificant and Discountable Effects

Our assumption is that programmatic activities that have only temporary impacts to CH and that occur within critical habitat where Atlantic salmon are not potentially present are not likely to adversely affect critical habitat. This is based on temporary effects not diminishing the ability of the habitat to support the conservation and recovery of the species, should Atlantic salmon occupy the habitat in the future since all of the PBFs will be restored to full function after completion of the project. This section also describes temporary effects to CH where Atlantic salmon are potentially present that are not likely to adversely affect CH. These temporary effects will result in small areas of effect within each of the SHRUs, and where the habitat function is restored once the project is completed. These effects are relevant to several PBFs so they are described here to avoid redundancy.

Sections 5.2.2 and 5.2.3 provide a detailed effects analysis by PBF, identifying project activities which occur within CH where Atlantic salmon are potentially present and that have adverse or insignificant and discountable effects.

Water Quality Impacts. As described in Section 5.1.6, the Proponents will avoid and minimize water quality impacts with proper planning and AMM implementation. Water quality effects are expected to be limited to short-duration (three hours) elevated pH below harmful levels to Atlantic salmon or potentially harmful levels contained within the immediate grout bag work area (2000 square feet) by turbidity curtains. Grout bag installation and replenishment activities are limited to three projects annually, with only one utilizing a turbidity curtain. Regardless of where programmatic activities occur within CH, they will have insignificant and discountable effects on all PBFs that address water quality (SR1, SR 2, SR 3, SR 6, M 2).

Turbidity and Sedimentation. The intensity and duration of the effects associated with turbidity and sedimentation result in measured changes of habitat preference by Atlantic salmon and sublethal effects to juvenile Atlantic salmon, but do not have residual effects on the habitat function. Turbidity releases will be temporary and within the natural seasonal fluctuations in streams, and are not expected to affect Atlantic salmon redds and spawning areas, or reduce the quality of rearing habitat. PBFs that may be affected by increased turbidity and sedimentation include SR 2, SR 3, and SR 7. The Service concludes that effects from sedimentation on CH are insignificant and discountable. Although turbidity may be elevated above background levels for short durations and within 100 to 1000 feet of the project area, no residual adverse effects to Atlantic salmon CH are expected. CH conditions will return to pre-project levels within hours of proposed activities. Additionally, turbidity may result in a temporary effect to a maximum of 370 occupied HUs annually (Table 17). Considering scale, the Penobscot SHRU contains 389,126 HUs (Table 14). Therefore, a fraction of one percent of total habitat units will experience this temporary effect annually. This scale of effects provides further support that temporary effects associated with turbidity and sedimentation on CH are insignificant and discountable, in relation to the habitat’s ability to support the conservation and recovery of Atlantic salmon.

5.2.2 Effects to the Physical and Biological Features of Spawning and Rearing (SR)

SR 1: Deep, oxygenated pools and cover (e.g., boulders, woody debris, vegetation, etc.), near freshwater spawning sites, necessary to support adult migrants during the summer while they await spawning in the fall.

This physical and biological feature is most likely to be permanently affected at bridge and culvert locations where scour pools large enough to serve as holding areas were artificially created. The Proponents will not allow activities in these areas when they may be occupied by adult Atlantic salmon as a minimization measure to the species. However, bridge and culvert replacements can potentially result in the loss of these holding pools. Undersized structures can create these pools due to increased flow velocities and stream energy. A properly sized replacement structure with CSM may result in filling a portion of the pool to recreate the stream's profile and over time, natural stream material may fill the pool as the stream restriction is relieved and the stream is subject to natural sediment transportation processes. Atlantic salmon use of these artificially created pools is currently unknown. Replacing undersized structures within CH is expected to return stream function to more natural conditions, including facilitating movement of boulders, wood and gravel. These activities will result in insignificant and discountable effects to SR 1.

SR 2: Freshwater spawning sites that contain clean, permeable gravel and cobble substrate with oxygenated water and cool water temperatures to support spawning activity, egg incubation, and larval development.

SR 3: Freshwater spawning and rearing sites with clean, permeable gravel and cobble substrate with oxygenated water and cool water temperatures to support emergence, territorial development and feeding activities of Atlantic salmon fry.

SR 2 and SR 3 are combined for this analysis as they are similar habitats that provide different important functions for Atlantic salmon. They represent areas that can be used for spawning as well as egg and alevin development. These sites are likely to be rare around transportation infrastructure. According to the MaineDOT, based on past experience over the seven years of consulting on CH effects since the 2009 listing, only one project has potentially affected known spawning areas.

Due to SR 2 and SR 3's importance for species recovery, the Proponents will avoid impacts to these areas during spawning and egg incubation periods. The Proponents will also restore any spawning areas that are temporarily affected outside of the time they are being utilized.

Due to the proposed AMMs (Appendix A), the proposed action and all activities discussed herein will result in insignificant and discountable effects to SR 2 and SR 3.

SR 4: Freshwater rearing sites with space to accommodate growth and survival of Atlantic salmon parr.

SR 5: Freshwater rearing sites with a combination of river, stream, and lake habitats that accommodate parrs' ability to occupy many niches and maximize parr production.

SR 6: Freshwater rearing sites with cool, oxygenated water to support growth and survival of Atlantic salmon parr.

SR 7: Freshwater rearing sites with diverse food resources to support growth and survival of Atlantic salmon parr.

SR 4 through SR 7 are combined when considering potential effects as they represent different aspects of rearing habitat that are important for parr (juvenile) growth. These PBFs are generalized to capture the different habitats and important functions of those habitats.

All of the activities proposed as part of the action may result in temporary and permanent effects to these habitats. Any temporary effects to these habitats when Atlantic salmon are not expected to be present are considered insignificant and discountable and will not adversely affect CH. Temporary effects to water quality and to habitat from turbidity increases are also considered insignificant and discountable to these CH PBF elements.

Some activities proposed as part of the action may result in the loss of CH due to small fill placements. Some of these fill placements are temporary and will be removed after use, allowing the CH to return to pre-project function. Temporary fill consists of piles, causeways, and cofferdams and results in impacts to rearing habitat areas ranging from 500 to 4,000 square feet that will be unavailable to juvenile Atlantic salmon temporarily during construction. This type of impact is not expected to measurably reduce the ability of CH to contribute to the survival and recovery of Atlantic salmon. Effects associated with temporary fill are insignificant and discountable to SR 4 through 7.

Permanent habitat alteration and fish passage effects from bridge scour countermeasures, culvert end extensions, invert line culvert rehabilitation, and slipline culvert rehabilitation that are less than 1.2 times the BFW in Tier 2 areas will result in significant effects to SR 4 through SR 7. Scour countermeasures will result in replacement of the stream bottom with articulated mats. Though some natural material will be placed on top of the mats to improve habitat value, the effects still represent a significant effect to the habitat's ability to properly function as CH. Habitat loss will occur from culvert extensions. This will result in the loss of a maximum of eight feet of linear streambed per extension. Most culvert extensions are on culverts less than ten feet wide. A conservative estimate for habitat loss per project is 80 square feet of rearing habitat. Five culvert extension projects are estimated to occur annually in Atlantic salmon critical habitat (and Tier 1 and Tier 2 areas), two where Atlantic salmon could be present, which will result in approximately 400 square feet of rearing habitat loss in critical habitat and 160 square feet of rearing habitat loss in Atlantic salmon waters.

Culvert end resets and extensions will not remedy undersized culverts and related reduced fish passage. The effects represent a significant effect to the habitat's ability to properly function as CH because the ability of juvenile Atlantic salmon to move between diverse rearing habitats will be limited.

Culverts that do not meet recovery standards (are less than 1.2 BFW) have the potential to affect fish passage at high flows and have the potential to influence habitat immediately above, below, and within the crossing structure. Structure design that does not support natural stream processes, such as large wood and boulder transport, can reduce habitat complexity in the stream. Reduced habitat complexity can lead to altered width-to-depth ratios and increase temperature fluctuations (*Federal Register* 2009b, 29300) although the extent of potential temperature fluctuation from undersized culverts is unknown. The function of the habitat within these culverts will be limited by the lack of banks, larger substrates, and altered flows. These effects result in limiting the habitat's ability to properly function as CH.

Activities that can lead to adverse effects to SR 4 through 7 are culvert replacements in Tier 2 areas with new structure widths that are between BFW and 1.2 times the BFW, invert line and slipline projects that are in Tier 2 areas, culvert end extensions, and bridge scour countermeasures. These adverse effects will be offset through providing mitigation through the program outlined as part of the proposed action.

5.2.3 Effects to the Physical and Biological Features of Migration (M)

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

Commitments for new structure sizing in Tier 1 areas (Table 2) will ensure that any adult Atlantic salmon seeking spawning grounds are not delayed during their migrations.

Temporary effects to this PBF may result from cofferdam placement and hydroacoustic noise during pile driving activities. The work window AMMs will ensure that the primary migratory windows for Atlantic salmon adults are avoided. Because of this, temporary effects to this M 1 in areas that may contain Atlantic salmon adults are insignificant and discountable.

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

This feature is most likely to be affected by bridge replacements and culvert replacements that have created a scour pool large enough to serve as a holding area. The Proponents have proposed not to allow activities in these areas when they may be occupied by adult Atlantic salmon as a minimization measure to the species.

The proposed actions can potentially result in the loss of these holding pools. Undersized structures can create these pools due to increased flow velocities and stream energy. A properly sized replacement structure with CSM may result in filling a portion of the pool to recreate the stream's profile and may result in natural stream material filling the pool over time as the stream restriction is relieved and the stream is subject to natural sediment transportation processes. Atlantic salmon use of these artificially created pools is currently unknown. Replacing undersized structures within CH is expected to return stream function to more natural conditions, including facilitating movement of boulders, wood and gravel. These activities will result in insignificant and discountable effects to M 2.

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

The proposed action also has the ability to affect native fish species that serve as a predation buffer for Atlantic salmon in all different life stages. A predation buffer occurs when other species of fish that act as forage for predators relieve predation pressure on Atlantic salmon. River Herring (*Alosa pseudoharengus*), smelt (*Osmerus mordax*), and American eel (*Anguilla rostrata*) are examples of anadromous and catadromous species that undergo migrations when Atlantic salmon smolts are moving towards the estuaries and open ocean. Brook trout (*Salvelinus fontinalis*), dace species (*Leuciscus leuciscus*), and white suckers (*Catostomus *commersonii*) are examples of stream resident species that serve as a prey buffer while Atlantic salmon juveniles are rearing. Restoration and maintenance of prey buffering can relieve predation pressures on Atlantic salmon. Therefore, projects that restore native fish passage in general will have a beneficial effect to Atlantic salmon CH.

The proposed action includes many measures to minimize effects to Atlantic salmon and their habitat. In turn, those same measures minimize effects to these buffer species. The fish passage improvements in Atlantic salmon habitat are also restoration activities for these species. Effects on these species are also regulated under other state and federal regulations (i.e., Maine Natural Resources Protection Act [1997], 38 MRSA 480-B; Clean Water Act; and Magnuson-Stevens Fishery Conservation and Management Act, Essential Fish Habitat Regulations).

Due to the proposed activities and existing regulations, it is unlikely that any of the proposed actions will significantly impair the ability of the species to act as a prey buffer for Atlantic salmon. Therefore, the proposed activities will result in insignificant and discountable effects to M 3.

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

Smolt migration occurs downstream (with the stream flows) toward the ocean. It is not suspected that any of the activities proposed in this action will permanently effect migration in that direction. The Proponents have also proposed work windows that avoid effects during the smolt emigration period. Therefore, the proposed activities will result in insignificant and discountable effects to M 4.

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

The activities described in this PBO that may have long-term effects on water flow and habitat complexity are invert line and slipline culvert rehabilitations, culvert end resets and extensions, and culvert replacements that are less than 1.2 times the BFW in Tier 2 areas. Structure design that does not support natural stream processes, such as large wood and boulder transport, can reduce habitat complexity in the stream. Reduced habitat complexity can lead to altered width-to-depth ratios and increase temperature fluctuations (*Federal Register* 2009b, 29300) although the extent of potential temperature fluctuation from undersized culverts is unknown. Smolts migrate downstream in the spring when cool water temperatures and high flows are expected mitigate the potential of migration disruption from altered habitat complexity. Therefore, the proposed activities will result in insignificant and discountable effects to M 5.

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

Activities proposed under this action that might have effect on water chemistry are temporary and are not likely to occur at a time when sea water adaptation of smolts is occurring. Therefore, the proposed activities will result in insignificant and discountable effects to M 6.

Table 29: Summary of PBFs and Anticipated Impacts

PBF Element	Stressors with insignificant or discountable affects	Stressors with adverse effects
SR 1	TS,WQ, THA, PHA, TM, PM	
SR 2,3	TS, WQ, THA, PHA,TM, PM	
SR 4,5,6,7	TS, WQ, THA,TM, PM (Tier 1)	PHA, PM (Tier 2)
M1	TS, WQ, THA, PM, TM, PM	
M2	TS, WQ, HA, PHA, PM (Tier 1)	
M3	TS,WQ, HA, PHA,TM, PM	
M4	TS,WQ, HA, PHA,TM, PM	
M5	TS,WQ, HA, PHA,TM, PM	
M6	TS,WQ, HA, PHA,TM, PM	

TS=elevated turbidity/sediment transport, **WQ**=water quality impact (pollutants), **THA**=temporary habitat/critical habitat alteration, **PHA**=permanent habitat/critical habitat alteration, **TM**=temporary migration/movement barrier
PM=permanent migration/movement barrier

6. CUMULATIVE EFFECTS

Cumulative effects include the effects of future state, tribal, local, and private actions that are reasonably certain to occur in the action area. Future Federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to section 7 (a)(2) of the ESA.

The programmatic action area encompasses the entire geographic range of the GOM DPS of Atlantic salmon and an extensive area of land (17,753 square miles) associated with many rivers, stream, ponds, and lakes. Hence, an array of future state, tribal, local, and private actions are likely to occur. Individual projects covered by this consultation will have much smaller action areas (a fraction of the entire range of the GOM DPS). For each individual project submittal, specific cumulative effects will be evaluated and if relevant to the outcome of this Opinion, will be briefly described in the standard reporting form.

The GOM DPS contains very little federal land. Reasonably foreseeable non-federal activities will include (but are not limited to) agriculture, forestry, municipal infrastructure maintenance, residential and commercial/industrial development, energy projects, and recreational fishing. Within each of these broad categories, a variety of actions that could affect Atlantic salmon and their habitat include water withdrawal to irrigate crops, logging roads and stream crossings, non-point source pollution from residential and commercial development, and loss of forest and other natural habitats within a watershed from development.

Blueberry and cranberry fields are irrigated using withdrawal from both surface waters and wells, an ongoing practice often with no Federal nexus. Withdrawals will increase if crop acreages increase. Reduction in stream flows from irrigation practices during the summer when stream flows are naturally low in most years can affect Atlantic salmon.

Many areas around road crossings are subject to recreational angling pressure. Atlantic salmon juveniles can be regularly caught while fishing for other sport fish. Angling also has the potential to adversely affect Atlantic salmon in locations where anglers and adult Atlantic salmon are expected to interface.

Many activities that impact streams, ponds, and wetlands require federal permits from the Corps under the Clean Water Act and Rivers and Harbors Act. Therefore, these potential future actions (State, Tribal, local, and private) that will affect Atlantic salmon and critical habitat will be subject to ESA section 7 (a)(2) consultation.

Maine's total population, as of July 2015, was 1,329,328 compared to 1,125,043 in 1980 (18.2 percent growth over 35 years). Maine's population is expected to grow by 11.5 percent through 2030 (U.S. Census Bureau 2012). Subsequently, patterns and types of land use and development are not expected to dramatically change relative to trends seen over recent decades. Activities that have affected Atlantic salmon and their habitat in recent years are expected to continue relatively unchanged, although various efforts at salmon conservation have and will continue to benefit Atlantic salmon (e.g., dam removals and riparian conservation easements).

Projects as a part of this action are not expected to increase development in the vicinities of this project for residential or commercial use.

7. ANALYTICAL FRAMEWORK FOR THE JEOPARDY AND ADVERSE MODIFICATION DETERMINATIONS

Jeopardy Determination

The following analysis relies on these four components: (1) the Status of the Species, which evaluates the rangewide condition of the listed species addressed, the factors responsible for that condition, and the species' survival and recovery needs; (2) the Environmental Baseline, which evaluates the condition of the species in the action area, the factors responsible for that condition, and the relationship of the action area to the survival and recovery of the species; (3) the Effects of the Action, which determines the direct and indirect impacts of the proposed Federal action and the effects of any interrelated or interdependent activities on the species; and (4) Cumulative Effects, which evaluates the effects of future, non-federal activities in the action area on the species.

In accordance with policy and regulation, the jeopardy determination is made by evaluating the effects of the proposed Federal action in the context of the species' current status, taking into account any cumulative effects, to determine if implementation of the proposed action is likely to cause an appreciable reduction in the likelihood of both the survival and recovery of listed species in the wild.

The jeopardy analysis in this Opinion emphasizes the rangewide survival and recovery needs of the listed species and the role of the action area in providing for those needs. It is within this context that we evaluate the significance of the proposed federal action, taken together with cumulative effects, for purposes of making the jeopardy determination.

Adverse Modification Determination

Section 7(a)(2) of the ESA requires that Federal agencies ensure that any action they authorize, fund, or carry out is not likely to destroy or to adversely modify designated critical habitat. A final rule revising the regulatory definition of "destruction or adverse modification of critical habitat" was published on February 11, 2016 (*Federal Register* 2016, 7214). The final rule became effective on March 14, 2016. The revised definition states: "Destruction or adverse modification means a direct or indirect alteration that appreciably diminishes the value of critical habitat for the conservation of a listed species. Such alterations may include, but are not limited to, those that alter the physical or biological features essential to the conservation of a species or that preclude or significantly delay development of such features."

The new critical habitat regulations (*Federal Register* 2016, 7214) discontinue use of the terms PCEs or essential features, and rely exclusively on use of the term PBFs because that term is contained in the statute. The shift in terminology does not change the approach used in conducting a ‘‘destruction or adverse modification’’ analysis, which is the same regardless of whether the original designation identified PCEs, PBFs or essential features.

Our analysis of effects to CH relies on the following four components: (1) the Status of CH, which evaluates the range-wide condition of designated CH in terms of PCEs or PBFs, the factors responsible for that condition, and the intended recovery function of the CH overall; (2) the Environmental Baseline, which evaluates the condition of the CH in the action area, the factors responsible for that condition, and the recovery role of the critical habitat in the action area; (3) the Effects of the Action, which determines the direct and indirect impacts of the proposed Federal action and the effects of any interrelated or interdependent activities on the PBFs and how that will influence the recovery role of affected critical HUs; and (4) Cumulative Effects, which evaluates the effects of future, non-federal activities in the action area on the PBFs and how that will influence the recovery role of affected critical HUs.

For purposes of making the destruction or adverse modification finding, the effects of the proposed Federal action, together with any cumulative effects, are evaluated to determine if the critical habitat rangewide would remain functional (or retain the current ability for the PBFs to be functionally re-established in areas of currently unsuitable but capable habitat) to serve its intended conservation/recovery role for the (species).

Summary of Effects

The integration and synthesis of effects is the final step in assessing the risk posed to species and CH as a result of implementing the proposed action. In this section, we add the effects of the action and the cumulative effects to the status of the species and CH, and the environmental baseline, to formulate our biological opinion as to whether the proposed action is likely to: (1) appreciably reduce the likelihood of both survival and recovery of the species in the wild by reducing its numbers, reproduction, or distribution; or (2) reduce the value of designated CH for the conservation of the species.

Summary of Current Status and Conservation Needs of Atlantic Salmon

Atlantic salmon populations have been declining in the GOM DPS since the early 1800s and the present population estimates are a great deal lower than the historic run numbers (Fay et al. 2006). The returning adults records show that numbers have somewhat stabilized at very low numbers since the late 1990s (Fay et al. 2006). Low abundances of both hatchery-origin and naturally-reared adult Atlantic salmon returns to Maine demonstrate continued poor marine survival. The abundance of Atlantic salmon in the GOM DPS has been low and either stable or declining over the past several decades. The proportion of fish that are of natural origin is very small and is continuing to decline. The conservation hatchery program has assisted in slowing the decline and helping to stabilize populations at low levels, but has not contributed to an increase in the overall abundance of Atlantic salmon and has not been able to halt the decline of the naturally reared component of the GOM DPs.

Dams, the inadequacy of existing regulatory mechanisms for dams, and low marine survival were primary factors driving the listing of the GOM DPs. Over 90 percent of rivers and streams within the GOM DPS are impacted by dams, which prevent access to suitable spawning and rearing habitat, delay migration and cause mortality from fishways, turbines and increased predation, and alter up- and downstream habitats through changes in flow, sediment transport, and altering composition of fish communities (NMFS 2016).

The NMFS identified key conservation needs through 2020 as part of their Atlantic salmon five year Action Plan (NMFS 2016). Atlantic salmon require complex and diverse habitat types and currently only eight percent of their historic freshwater habitat have unimpeded access. Restoring habitat connectivity by removing dams and undersized road crossings is essential to Atlantic salmon recovery (NMFS 2016). Improving Atlantic salmon access to thermal refugia will also improve species resiliency to climate change. Increasing smolt production is another key Atlantic salmon conservation need that is addressed through improving habitat connectivity and complexity. Removing barriers provides access to existing habitat such as summer sheltering areas and improving natural stream processes will restore habitat quality such as overwintering pools for Atlantic salmon smolts. The restoration of properly functioning ecosystems will support native and diadromous fish populations and improve the services they provide to Atlantic salmon. Additional key conservation objectives include reducing fishery mortality in Greenland and increasing marine environment survival.

Summary of Effects to Individuals

The effects of the proposed action on Atlantic salmon are both adverse and beneficial over the five year duration of this Opinion. The proposed action will temporarily expose juvenile Atlantic salmon to elevated turbidity and movement barriers, adult and juvenile Atlantic salmon to increased underwater noise, resulting in take in the form of harassment. The proposed action could also limit the movement of juvenile and adult Atlantic salmon, causing take in the form of harassment or harm. Juvenile and adult Atlantic salmon may be harmed or harassed due to fish handling and relocation activities associated with cofferdam installations. The use of cofferdams is considered an AMM, reducing the amount of turbidity/suspended sediment from in-channel work. Juvenile Atlantic salmon may be harmed or harassed due to handling and relocation or exposure to elevated pH within turbidity curtains during grout bag installation. The proposed action also may directly modify habitat through culvert extensions or concrete cable mat installation or cause indirect loss of habitat function by maintaining undersized culvert crossings (Tables 30 and 31).

Table 30: Annual and 5-year Summary of Effects on Juvenile Atlantic Salmon

Stressor	No. of Projects Annually	Annual Juvenile Atlantic salmon Affected	Type of Take	Juvenile Atlantic salmon Affected over five years
Elevated Turbidity/Sediment	25 cofferdams 5 direct pull piles	1,850 8	Harassment	9,250 40
Underwater Noise	5 Impact Pile Driving 5 Hoe Ram Demolitions	3,205	Harassment	16,025
Temporary Migration/Movement Barrier	15 projects w/channel-spanning cofferdams	395	Harassment	1,975
Fish Handling and Relocation	25 cofferdam 4 causeways	285 6 28	Harassment, Harm Lethal Harm Lethal Harm	1,425 30 140
Water Quality (Pollutants)	1 grout bag installation	5 4	Harassment Lethal Harm	25 20
Habitat Alteration	9 culvert replacements in Tier 2 areas	1,105	Harm	5,525
	2 culvert extensions	<1	Harm	<5
	6 culvert resets/invert/slipline	735	Harm	3,675
	3 concrete cable mat installations	70	Harm	350
Permanent Migration/Movement Barriers	9 culvert replacements in Tier 2 areas	1,105	Harm	5,525
	2 culvert extensions	245	Harm	1,225
	6 culvert resets/invert/slipline	735	Harm	3,675
	3 concrete cable mat installations	370	Harm	1,850

		TOTAL TAKE	**50,760**
TOTAL HARRASEMENT/HARM	**50,570**	**TOTAL LETHAL HARM**	**190**
TOTAL HARRASEMENT/HARM	**99.6%**	**TOTAL LETHAL HARM**	**0.4%**

Table 31: Annual and 5-year Summary of Effects on Adult Atlantic Salmon

Stressor	No. of Projects Annually	Annual Juvenile Atlantic salmon Affected	Type of Take	Juvenile Atlantic salmon Affected over 5 years
Underwater Noise	5 Impact Pile Driving 5 Hoe Ram Demolition	10	Harassment	50
Fish Handling and Relocation	25 cofferdams	2	Harassment	10
Permanent Migration/Movement Barriers	9 culvert replacements in Tier 2 areas	9	Harm	45
	2 culvert extensions	2	Harm	10
	6 culvert resets/invert/slipline	6	Harm	30
	3 concrete cable mat installations	3	Harm	15

		TOTAL TAKE	**160**
TOTAL HARRASEMENT/HARM	**160**	**TOTAL LETHAL HARM**	**0**
TOTAL HARRASEMENT/HARM	**100%**	**TOTAL LETHAL HARM**	**0%**

AMMs such as implementation of in-water work windows, avoidance of spawning areas during construction, and prohibiting underwater blasting when v are expected to be present are proposed as part of the action in order to avoid and minimize adverse effects to Atlantic salmon and CH. These AMMs were developed based on past consultation history, research and literature, and experience with Atlantic salmon impacts on construction projects in Maine. Since the Proponents must commit and adhere to all AMMs, this further helps to ensure we are avoiding and minimizing effects to Atlantic salmon and CH to the extent possible.

While the proposed action is expected to have adverse effects, it also includes activities such as culvert replacements in Tier 1 areas and bridge replacements and removals that will either improve or open access to numerous miles of habitat, and adverse effects to habitat will be mitigated for through the ILF program or other approved mitigation actions. Historically, mitigation for effects to Atlantic salmon has not been proposed or implemented in Maine for impacts under Section 7 consultation. These beneficial effects will address conditions currently impairing Atlantic salmon productivity over the long-term, and help offset the adverse impacts to Atlantic salmon expected from project activities, such as temporary movement restriction, temporary increases in turbidity during in-water work, and injury during fish handling. The mitigation component of this programmatic consultation is a critical aspect to furthering Atlantic salmon conservation, restoration and recovery statewide and throughout the entire GOM DPs. Through mitigation, adverse effects as a result of the proposed action can be properly offset.

Summary of Effects to Populations

Although the magnitude of several of these effects cannot be precisely determined, we do not anticipate that they will occur at levels that would reduce Atlantic salmon populations at the recovery unit scale or rangewide scale over the next five years. Approximately 27,310 juveniles are anticipated to be either harmed or harassed over 5 years through implementation of the activities described in this Opinion. The total parr estimated in the entire GOM DPS, based on the assumption of 5 parr per HU and with 389,126 HUs in Penobscot Bay, 352,064 HUs in Merrymeeting Bay, and 60,656 HUs in Downeast, is approximately 4,009,230. The estimated 27,310 juveniles "taken" by the proposed action equates to 0.7 percent of the entire estimated parr population of Atlantic salmon in the GOM DPs. Additionally, not all of this "take" results in death or loss of individuals from the populations, but as shown above in Tables 30 and 31, can result in temporary impacts that meet one of the technical definitions of "take" but do not result in mortality. For example, fish handling and holding is "take," however, results in a very small number and mortality rate for these individuals.

In a population viability context, the survival rate of juvenile Atlantic salmon is highly variable and not a primary driver of population size and viability. Adult survival is the most important driver of population viability, and the proposed action is not likely to reduce the estimated annual adult Atlantic salmon spawner population in each SHRU. Although we anticipate a continuation of the reduced reproductive rates and increased mortality rates of juveniles, those deaths are not expected to lower the estimated annual adult Atlantic salmon population or numbers in each SHRU. Each SHRU contains spawning/rearing and migration habitats that will be unaffected by the proposed action in any given year.

We do not anticipate that the proposed action will affect the distribution of Atlantic salmon in any of the SHRUs because fish passage will be enhanced in the areas prioritized for recovery, potentially increasing Atlantic salmon distribution in suitable habitat, and habitat effects are not expected to isolate groups of Atlantic salmon that are currently connected. Hydrological changes and sedimentation from proposed activities are not likely to be large enough or concentrated enough to deter a normal migration of Atlantic salmon. Therefore, we also do not expect that effects to individuals will reduce the distribution of populations in their SHRUs. Reproduction and survival in these unaffected areas are anticipated to buffer the adverse effects of the proposed action on annual Atlantic salmon population sizes. Other stressors adversely affecting juvenile and adult Atlantic salmon, as described above (sedimentation, habitat modification, and noise), result in significant disruption but not impairment of essential behaviors. For these reasons, we do not anticipate that the proposed action will result in reduced annual adult Atlantic salmon populations in any SHRU over the next five years.

Summary of Effects to the Species

Atlantic salmon reproduction would be adversely affected by the proposed action, particularly when adverse effects to rearing juveniles and to small numbers of adults occur. However, due to the small scale and largely temporary nature of impacts, the proposed action will not further depress current reproductive rates. While there will be a low level of mortality due to implementation of the project, the vast majority of "take" will not result in loss of individuals from the population and result in only a small loss of individuals that will not result in meaningful reduction in Atlantic salmon numbers. The distribution of the species will not be adversely impacted, and in fact, activities such as culvert replacements in Tier 1 areas and bridge replacements and removals that will either improve or open access to numerous miles of habitat, and adverse effects to habitat will be mitigated for through the ILF program or other approved mitigation actions will potentially expand distribution of Atlantic salmon over time.

Historically, mitigation for effects to Atlantic salmon has not been proposed or implemented in Maine for impacts under Section 7 consultation. These beneficial effects will address conditions currently impairing Atlantic salmon productivity over the long-term, and help offset the adverse impacts to Atlantic salmon expected from project activities, such as temporary movement restriction, temporary increases in turbidity during in-water work, and injury during fish handling. The mitigation component of this programmatic consultation is a critical aspect to furthering Atlantic salmon conservation, restoration and recovery statewide and throughout the entire GOM DPs. Through mitigation, adverse effects as a result of the proposed action can be properly offset and will produced a long-term improvement to habitat and an overall benefit to the species.

Summary of Effects to Critical Habitat

The effects of the action refers to the direct and indirect effects of an action on the species or critical habitat, together with the effects of other activities that are interrelated or interdependent with that action, that will be added to the environmental baseline (*Federal Register* 1986, 19957; as amended by *Federal Register* 2008, 76286; and *Federal Register* 2009a, 20423). Indirect effects are those that are caused by the proposed action and are later in time, but still are reasonably certain to occur.

When the Service evaluates the effects of a proposed action within critical habitat, we analyze the impacts to individual HUs in light of their overall contribution to the survival and recovery of Atlantic salmon within their range. Permanent migration/movement barriers in Tier 2 areas and permanent habitat/critical habitat alteration effects from bridge scour countermeasures, culvert end extensions, invert line and slipline culvert rehabilitations, and culverts that are less than 1.2 times the BFW in Tier 2 areas will result in significant and adverse effects to SR 4, SR 5, SR 6 and SR 7. To minimize the adverse effects to CH, AMMs are proposed. For example, on bridge scour countermeasures projects, concrete cable mats will be installed to match the existing channel contours and streambed material will be placed on top (AMM #61). This AMM ensures the existing streambed mimics the streambed after construction to the extent possible. Other AMMs, such as including fish passage measures in design (i.e., weirs) of invert line and slipline culvert rehabilitations, have been proposed (AMM #47) to minimize adverse effects.

Mitigation has also been proposed to offset adverse effects to CH. Compensatory mitigation through the ILF program or another mitigation approach is proposed for all bridge scour countermeasures in Tier 1 and Tier 2 areas, all stream crossing replacements in Tier 1 areas that are greater than 1.0 times the BFW but less than 1.2 times the BFW, all invert line and slipline culvert rehabilitations in Tier 2 areas, and all culvert end extensions in Tier 1 and Tier 2 areas. The mitigation component of this programmatic consultation is a critical aspect to furthering Atlantic salmon conservation, restoration and recovery statewide. Through mitigation, adverse effects to CH as a result of the proposed action can be properly offset.

We conclude the proposed action will not alter the conservation value of PBFs, namely SR 4, SR 5, SR 6 and SR 7, or critical habitat at the action area, the SHRU, and the rangewide scale.

Conclusion

The action will result in adverse effects to the species during construction. These adverse effects will result in varying types of take including behavioral modifications, reduced fitness and mortality. This take is incidental to the action and have been avoided and minimized using the many AMMs and proposed conservation measures. Adverse effects to critical habitat will primarily occur in non-tier 1 priority areas and will be offset by implementation of a mitigation program as part of the proposed action. In reaching these conclusions, the Service considered the best available scientific and commercial information regarding Atlantic salmon and the likely effects of the proposed action on this species and its critical habitat.

The proposed action will result in mostly short-term adverse effects to Atlantic salmon during construction activities. Most of these effects are relatively small in spatial and temporal scope and may be reversed upon completion of construction. For example, cofferdams will be completely removed from the stream bottom and pre-construction stream flow conditions will be returned to the dewatered construction area. The proposed action will also result in minor habitat modification within Atlantic salmon CH within Tier 2 areas.

There is a high level of certainty that the proposed action is likely to produce an overall beneficial impact for the Atlantic salmon GOM DPS and/or the recovery support function of its critical habitat. The Proponents will implement measures to limit the amount of take during construction activities. These measures generally include fish handling techniques, limited in-water construction durations, and implementation of the most up to date hydroacoustic noise minimization techniques. Stream crossing replacements represent the Proponents' greatest ability to aid in the recovery of the species through this program. Crossings that meet recovery standards are being proposed in all Tier 1 Priority areas. This will provide fully accessible crossing structures in areas where current Atlantic salmon recovery programs are occurring and are most critical to their recovery. Crossing replacements in Tier 1 will restore fully functioning critical habitat in the immediate vicinity of the replaced crossings as well as restored access to upstream functioning critical habitat.

After considering the current status of Atlantic salmon and its designated critical habitat, the action's environmental baseline, the effects of the proposed action, and the potential for future cumulative effects in the action area, it is the Service's Biological Opinion that the proposed actions in the program by the FHWA and the Corps is not likely to jeopardize the continued existence of the GOM DPS of Atlantic salmon and will not result in the destruction or adverse modification of Atlantic salmon critical habitat.

8. INCIDENTAL TAKE STATEMENT

Section 9 of the ESA prohibits the Take of endangered species without special exemption. The term Take is defined to include harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct. Harm is further defined by the Service to include an act that actually kills or injures wildlife. Such acts may include significant habitat modification or degradation that results in death or injury to a listed species by significantly impairing essential behavioral patterns, including breeding, feeding, or sheltering. The term harass is further defined by the Service as intentional or negligent actions that create the likelihood of injury to listed species by annoying it to such an extent as to significantly disrupt normal behavior patterns which include, but are not limited to, breeding, feeding or sheltering.

Incidental Take is defined as Take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. Under the terms of section 7(b)(4) and section 7(o)(2), taking that is incidental to and not intended as part of the agency action is not considered to be prohibited taking under the ESA, provided that such taking is in compliance with the terms and conditions of this Incidental Take Statement.

Amount or Extent of Take

Stream specific parr densities vary between streams and between habitats within the same streams. In past consultations, Take estimates were derived using two different approaches. One approach applies stream-specific parr densities, derived from catch per unit effort (CPUE) surveys completed by resource agencies (primarily the MDMR). These surveys result in an estimate of parr density for each HU. Stream-specific data is preferred when calculating parr density. When stream specific information is not available, the Service model is applied. It predicts stream quality and stream widths and relates it to potential parr density at all perennial streams in the GOM DPs. These density estimates range from 0 to 10.7 parr per HU (Wright et al 2012). In two MaineDOT projects with high quality Atlantic salmon rearing habitat and stream specific information, the parr densities were 3.5 and 5.6 parr per unit. The Service believes it is reasonable assume that density for parr in streams containing Atlantic salmon juveniles across the range of this PBO is 5 parr per HU. A Take estimate will be developed for each project with potential juvenile Atlantic salmon Take. For all projects processed under this PBO, these numbers will be tallied annually to ensure annual authorized incidental Take is not exceeded. The annual Take estimate is summarized in Tables 32 and 33.

Regarding adult Atlantic salmon, the Service anticipates no more than one adult will be harmed in association with cofferdam installation annually. This harm type is related to handling of a fish if trapped in a cofferdam; there will be no lethal Take of adult Atlantic salmon authorized for this action and under this programmatic consultation.

Table 32: Annual Juvenile Take Estimate for the Proposed Action

A. Stressor	B. No. of projects	C. Total area/extent of impact (sq. ft.)	D. Total annual HUs* (C in sq. meters) Divided by 100	E. Annual Juvenile Atlantic salmon Affected** (D times 5)	F. Type of Take
Elevated Turbidity/Sediment	25 cofferdams 5 direct pull piles	397,860 1,750	370 1.6	1,850 8	Harassment
	Total	**399,610**	**371.6**	**1,858**	
Underwater Noise	5 Impact Pile Driving 5 Hoe Ram Demolition	690,300	641	3,205	Harassment
Temporary Migration/Movement Barrier	15 projects w/channel-spanning cofferdams	84,840	79	395	Harassment
Fish Handling and Relocation	25 cofferdams 4 causeways	61,260 6,000	57 5.6	285 6 28	Harassment, Harm Lethal Harm Lethal Harm
Water Quality (Pollutants)	1 grout bag installation	2,000	1.9	5 4	Harassment Lethal Harm
Habitat Alteration	9 culvert replacements in Tier 2 areas	237,600	221	1,105	Harm
	2 culvert extensions	160	<1	<1	Harm
	6 culvert resets/invert/slip line	158,400	147	735	Harm
	3 concrete cable mat installations	15,000	14	70	Harm
Permanent Migration/Movement Barriers	9 culvert replacements in Tier 2 areas	237,600	221	1,105	Harm
	2 culvert extensions	52,800	49	245	Harm
	6 culvert resets/invert/slip line	158,400	147	735	Harm
	3 concrete cable mat installations	79,200	74	370	Harm

*HU=1,076 square feet (100 square meters).
**Assumed 5 parr (juvenile Atlantic salmon) per unit.

Table 33: Annual Adult Take Estimate for the Proposed Action

A. Stressor	B. No. of projects	E. Annual Adult Atlantic salmon Affected	F. Type of Take
Underwater Noise	5 Impact Pile Driving 5 Hoe Ram Demolition	10	Harassment
Fish Handling and Relocation	25 cofferdams	2	Harassment
Permanent Migration/Movement Barriers	9 culvert replacements in Tier 2 areas	9	Harm
	2 culvert extensions	2	Harm
	6 culvert resets/invert/slipline	6	Harm
	3 concrete cable mat installations	3	Harm

8.1. Reasonable and Prudent Measures

Due to the inclusion of the AMMs, the only required reasonable and prudent measure is that all AMMs as identified in Appendix A, Corps special conditions, and project descriptions as described in Section 2 of this PBO must be followed.

Conservation measures designed to avoid and minimize effects on listed species and critical habitat are integral components of the proposed action (see Section 2 for project descriptions and AMMs in Appendix A), and this proposed action is expected to be completed consistent with these measures. We have completed our effects analysis accordingly. The Service believes that due to the inclusion of the AMMs, no additional Reasonable and Prudent Measures are necessary. The AMMs described in Appendix A are nondiscretionary and must be implemented by the FHWA (or the MaineDOT and their contractors) in order for the exemption in section 7(o)(2) to apply. The FHWA has a continuing duty to regulate the activities covered by this Incidental Take Statement. The protective coverage of section 7(o)(2) will lapse if the FHWA fails to require adherence to all the terms and conditions of the Incidental Take Statement or fails to exercise that discretion as necessary to retain the oversight to ensure compliance with these terms and conditions. Further consultation may be required to determine what effect any modified action may have on listed species or designated critical habitat.

The Service considers the full application of the AMMs included as part of the proposed action description to be necessary and appropriate to minimize the amount or extent of incidental Take of the Atlantic salmon associated with the proposed action. Any deviation from the AMMs or the project descriptions stated in this PBO will be beyond the scope of this consultation and will not be exempted from the prohibition against Take as described in this Incidental Take Statement.

8.2 Terms and Conditions

In order to be exempt from the prohibitions of section 9 of the ESA, the FHWA, the MaineDOT, and all contractors must comply with the following terms and conditions, which implement the reasonable and prudent measure described above and outline the required monitoring and reporting requirements. These terms and conditions are nondiscretionary.

1. All applicable AMMS described in this PBO will be fully implemented.
2. The FHWA and the MaineDOT will generate an annual report for submittal to the Service. This report will summarize program use and Take for the reporting year (for the sake of this PBO, "year" refers to the calendar year, January 1 to December 31), the Service review timelines, monitoring information that may inform potential effect assumptions, and implementation of mitigation activities.

9. CONSERVATION RECOMMENDATIONS

Section 7(a)(1) of the Act directs federal agencies to utilize their authorities to further the purposes of the Act by carrying out conservation programs for the benefit of endangered and threatened species. Conservation recommendations are discretionary agency activities to minimize or avoid adverse effects of a proposed action on listed species or critical habitat, to help implement recovery plans, or to develop information.

In order for the Service to be kept informed of actions minimizing or avoiding adverse effects, or benefiting listed species or their habitats, the Service requests notification of the implementation of any conservation recommendations.

10. REINITATION NOTICE

This concludes formal consultation on the action(s) outlined in the request. As provided in 50 CFR 402.16 (*Federal Register* 2008, 76286), reinitiation of formal consultation is required where discretionary Federal agency involvement or control over the action has been retained (or is authorized by law) and if: 1) the amount or extent of incidental Take is exceeded; 2) new information reveals effects of the agency action that may affect listed species or critical habitat in a manner or to an extent not considered in this opinion; 3) the agency action is subsequently modified in a manner that causes an effect to the listed species or critical habitat not considered in this opinion; or 4) a new species is listed or critical habitat designated that may be affected by the action. In instances where the amount or extent of incidental Take is exceeded, any operations causing such Take must cease pending reinitiation.

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Appendix A–Avoidance and Minimization Measures

The AMMs listed in Appendix A are primarily instituted during construction in order to avoid and minimize impacts to Atlantic salmon and critical habitat. All elements of any activity will comply with the MaineDOT's Standard Specifications (MaineDOT 2014, http://maine.gov/mdot/contractors/ publications/standardspec/). Additionally, all construction practices will follow the MaineDOT: Best Management Practices for Erosion and Sedimentation Control (MaineDOT 2008). These BMPs include many filtering and sedimentation control techniques. AMMs and BMPs are measures that are considered part of the proposed action. If an AMM is not indicated for a specific Tier priority area, it should be assumed it applies to all activities in all areas. A list of AMMs was initially proposed in the PBA, but some AMMs have since been modified or added, based on new information and for additional clarification, in coordination with the MaineDOT, the FHWA, and the Corps.

AMM 1–In-water work for all activities other than bridge replacement and geotechnical sampling without temporary trestles where Atlantic salmon are expected to be present will be conducted during the low stream flow period (July 15 to September 30).

AMM 2–All in-water work on bridge replacement (greater than 20 feet) projects (and associated sub-activities, e.g., pier installation, temporary access installation, as necessary) will occur between July 15 and April 15.

AMM 3–All areas of temporary waterway or wetland fill will be restored to their original contour and character upon completion of the project. Temporary fill includes fill that received authorization and fill that mistakenly enters a resource (i.e., from slope failures, accidental broken sandbag cofferdams).

AMM 4–All in-water excavation will be conducted within a cofferdam.

AMM 5–All areas of disturbed soil will be mulched and seeded with an approved native or noninvasive herbaceous seed mix following construction and/or planted with native woody vegetation and trees appropriate during the first available planting season. In areas where there is little to no slope and erosion and invasive species establishment is unlikely, the native woody vegetation on the site will be allowed to regenerate naturally.

AMM 6–Temporary causeways placed in the riparian area will be constructed in a manner that they do not allow erosion into resources during construction. This will be reviewed and approved as a part of the SEWPCP, including review of location as well as placing a non-erodible material on the surface of the causeway.

AMM 7–Vegetation rootstock will only be removed in those areas that are subject to permanent impacts. Replanting will be completed as necessary and feasible, but may not be possible in certain situations, such as permanent impact areas, roadway clear zone, or adjacent to or under bridges.

AMM 8–To minimize the spread of noxious weeds into the riparian zone, all off-road equipment and vehicles operating from existing open and maintained roads must be cleaned prior to entering the construction site to remove all soil, seeds, vegetation, or other debris that could contain seeds or reproductive portions of plants. All equipment will be inspected prior to off-loading to ensure that they are clean.

AMM 9–During construction, any disturbed soils will be temporary stabilized with BMPs, such as straw mulch, plastic sheeting, erosions control mix, or other appropriate BMPs. Disturbed areas with erodible soil can include, but are not limited to, temporary storage piles, access ways, partially constructed slopes, etc.

AMM 10–The Proponents will hold a pre-construction meeting for each project with appropriate Environmental Field Representatives, other MaineDOT or MTA staff, and construction crew or contractor(s) to review all procedures and requirements for avoiding and minimizing effects to Atlantic salmon and to emphasize the importance of these measures for protecting Atlantic salmon and its critical habitat. The Corps, the FHWA, and the Service staff will be notified and attend these meetings as practicable.

AMM 11–The Proponents are not proposing to include any new road facilities in this PBA. A new road facility will be defined as the creation of a new road longer than 0.5 mile in length. The new creation can include new connections and realigned portions of intersections with new inputs. Highway relocations and realignments are not considered a new road facility if drainage patterns are not altered and drainage remains within the same watershed as the previous highway portion.

AMM 12–The Proponents will not affect (turbidity above background, acoustic, direct effects) spawning areas during spawning and egg incubation periods (October 1 to April 30).

AMM 13–The Proponents will not temporarily affect spawning habitat without restoration.

AMM 14–No heavy construction equipment will travel into or through any flowing streams with erodible substrate (e.g., sand, silt, and clay). Travel of heavy construction equipment into or through flowing streams and on stream substrate will only occur when the stream substrate is non-erodible (e.g., ledge, cobble) and the contractor has received approval from the MaineDOT or the MTA environmental field office staff.

AMM 15–No activities that disturb the substrate will be conducted in streams with clay substrates that include in-water work outside of a sealed cofferdam. This is due to the unpredictable nature of undesirable effects.

AMM 16–The Proponents will require any work being completed under this programmatic consultation to submit a SEWPCP for review and approval of the MaineDOT or the MTA staff prior to the start of work. The plan includes the review of the implementation of any AMMs proposed.

AMM 17–The installation of cofferdam systems encloses a work area and reduces sediment pollution generated from construction work. All in stream work will take place inside of a cofferdam except for the following sub activities: pile driving, clean riprap placement for temporary causeways, bridge pier demolition, and geotechnical drilling. In-water work in streams with a clay substrate will not occur outside of a sealed cofferdam.

AMM 18–Suspended sediment treatment will follow the procedures described in Section 3.4.2 of the PBA "Dirty Water" Treatment System.

AMM 19–For activities requiring bypass pumping in streams, stabilization techniques (such as sheets of poly) will be used to protect the stream from scour caused by the high water velocity coming from the hose(s) at the downstream end.

AMM 20–Temporary bypass systems will utilize non-erosive techniques, such as pipe or a plastic-lined channel that will accommodate the predicted peak flow rate during construction. These are reviewed as part of the contractor's SEWPCP. Predicted peak flows are provided to the contractor in the bid documents; these values are derived from the USGS regression (USGS 2015).

AMM 21–Sheet pile driving (if utilized) will be completed using a vibratory hammer.

AMM 22–All cofferdams will be fully removed from the stream immediately following completion of in-water work, minimizing delays due to high stream flows following heavy precipitation, so that fish and aquatic organism passage are not restricted any longer than necessary. If a project is not completed and there will be substantial delays in construction, cofferdams will be at least partially removed to allow passage of Atlantic salmon until construction resumes. All areas of temporary bottom disturbance will be restored to their original contour and character upon completion of the project.

AMM 23–All cofferdams will be removed using techniques to minimize turbidity releases. This includes allowing for the slow reintroduction of water into the work area and utilizing dirty water treatment systems for turbid water.

AMM 24–Bypass pumps will be sized according to the expected flows during construction. See Section III(F)3 in the MaineDOT BMP Manual (MaineDOT 2008) for guidance on pump capacity.

AMM 25–No equipment, materials, or machinery will be stored, cleaned, fueled, or repaired within any wetland or watercourse. All vehicle and equipment refueling activities will occur more than 100 feet from any water course and if not, all refueling areas will require fuel spill containment structures as per the SPCC Plan. Other construction equipment maintenance will be done at a location consistent with SPCC Plan and in a manner that avoids hazardous materials getting into the stream.

AMM 26–All pumps and generators will have appropriate spill containment structures and/or spill remediation materials available, such as absorbent pads.

AMM 27–All equipment used for in-stream work will be cleaned of external oil, grease, dirt, and mud such that turbid water does not drain to any wetland or watercourse. Any leaks or accumulations of these materials will be corrected before entering streams or areas that drain directly to streams or wetlands. All releases into surface waters or wetlands will be reported immediately to the appropriate regulatory body.

AMM 28–Any removed piling or other demolition material will be properly disposed of at a location in compliance with applicable regulatory approvals.

AMM 29–To minimize fish stranding inside the cofferdam when dewatering, the MaineDOT or MTA environmental staff or similarly qualified consultants will capture and remove as many Atlantic salmon and other fish species as possible. The MaineDOT or MTA environmental staff or similarly qualified consultants will inspect the cofferdams after placement for presence of adult Atlantic salmon. If adult Atlantic salmon are observed during active construction, all activities will cease and the MaineDOT or MTA environmental staff or similarly qualified consultants will immediately contact the Service's Maine Fish and Wildlife Complex 207/469-7300. The MaineDOT or the MTA environmental staff or similarly qualified consultants will complete a fish evacuation where water depths allow following the plan found in Appendix A of the BA. As stated in Appendix A, nets will be used to "herd" fish out of the work area to the extent practicable prior to electrofishing and cofferdam installation. This kind of fish exclusion measure can occur prior to cofferdam construction when water depths are less than <2 feet. Appropriate fish evacuation techniques in cofferdams are required for bridge pier construction. Water depths and access make these evacuations a unique situation. In these cases, the Proponents will provide project-specific fish evacuation plans to the Service prior to programmatic approval.

AMM 30–All intake pumps within fish bearing streams will have a fish screen installed, operated, and maintained. To prevent Atlantic salmon juvenile entrainment related to water diversions, the contractor will use a screen on each pump intake large enough so that the approach velocity does not exceed 6.10 meters per second (0.20 feet per second). Square or round screen face openings are not to exceed 2.38 millimeters (3/32 inch) on a diagonal. Criteria for slotted face openings will not exceed 1.75 millimeters (approximately 1/16 inch) in the narrow direction. These screen criteria follow those indicated by the NMFS (2008). Intake hoses will be regularly monitored while pumping to minimize adverse effects to Atlantic salmon.

AMM 31–Temporary causeways in stream channels will be constructed of non-erodible material, i.e., plain riprap or large riprap (per MaineDOT standard specifications) over geotextile fabric and will extend only to within 25 percent of the BFW of the stream or river.

AMM 32–The Proponents will employ the following procedure when completing grout bag repairs.

1. Apply the grout slurry at a rate of two cubic yards per hour to reduce the likelihood of elevated pH values downstream.
2. Turbidity curtains will be used when practicable (in flows less than one foot per second) to separate high pH water from the rest of the river.
3. An anti-washout admixture (AWA) will be mixed with the grout prior to application.
4. Grout will be piped into or behind grout bags.

AMM 33–As per Standard Specification 656.3.6 (e), the contractor will not place uncured concrete directly into a water body. The contractor shall not wash tools, forms, or other items in or adjacent to a water body or wetland.

AMM 34–Prior to release to a natural resource, any impounded water that has been in contact with concrete placed during construction must have a pH between 6.0 and 8.5, must be within one pH unit of the background pH level of the resource and must have a turbidity level no greater than the receiving resource. This requirement is applicable to concrete that is placed or spilled (including leakage from forms) as well as indirect contact via tools or equipment. Disposal or treatment of water not meeting release criteria shall be addressed in the SEWPCP. Discharging impounded water to the stream must take place in a manner that does not disturb the stream bottom or cause erosion. The Contractor shall be responsible for monitoring pH with a calibrated meter accurate to 0.1 units. A record of pH measurements shall be kept in the Environmental Field Representative's log. Concrete being placed as a seal in a cofferdam for bridge pier construction is considered "impounded water'.

AMM 35–Demolition and debris removal and disposal will comply with Section 202.03 of the MaineDOT's Standard Specifications. The Contractor will contain all demolition debris, including debris from wearing surface removal, saw cut slurry, dust, etc., and will not allow it to discharge to any resource. The Contractor will dispose of debris in accordance with the Maine Solid Waste Law (Title 38 M.R.S.A., Section 1301 et. seq.). The demolition plan, containment, and disposal of demolition debris will be addressed in the Contractor's SEWPCP.

AMM 36–Round pile size is limited to less than 30 inches in diameter. H-pile size is limited to less than 14 inches.

AMM 37–A vibratory hammer will be used as much as possible for all pile driving activities.

AMM 38–Pile driving will occur during the day when fish are less active and Atlantic salmon migrations are minimized.

AMM 39–Hydroacoustic monitoring will be completed for all impact pile driving using the monitoring template developed by the Fisheries Hydroacoustic Working Group and following the methods described in the Technical Guidance (Caltrans 2015).

AMM 40–A bubble curtain meeting the design criteria, as defined in the User's Guide, will be employed during all impact pile driving events. The bubble curtain design will mimic specifications for devices tested and employed for previous pile driving events.

AMM 41–In-water blasting is not allowed when Atlantic salmon could be present.

AMM 42–Permanent riprap placed in a stream below the bankfull elevation will be covered by CSM.

AMM 43–Any riprap that is placed in a stream that is not within a cofferdam will be cleaned prior to placement.

AMM 44–Cable mats used for scour protection will be backfilled with a gravel-like material between the voids. Any larger stones or streambed material excavated for the placement of the mats will then be distributed on top of the countermeasures.

AMM 45–The Proponents will not adversely affect Atlantic salmon adults sheltering in holding pools.

AMM 46–In Atlantic salmon rearing habitat, bridge replacements with piers and abutments will not result in a net increase of structure footprint. Piers and abutments will not be placed in Atlantic salmon spawning habitat.

AMM 47–All invert line and slipline projects will have fish passage measures included in the design. Fish passage measures include weirs inside and outside of the crossing structures to ensure that water depths and velocities allow for fish passage at a range of flows.

AMM 48–Invert line and slipline rehabilitation activities will not occur in Tier 1 priority areas.

AMM 49–Abutment demolitions with a hoe ram will occur inside of a dewatered cofferdam or outside of the water.

AMM 50–If piles are removed by cutting, they must be cut to one foot below the substrate level.

AMM 51–If a pile is pulled from the substrate, the work will be completed using a BMP specifically for minimizing turbidity, such as a turbidity curtain.

AMM 52–To minimize potential effects to fish passage with a culvert extension and stream realignment, design will ensure that:

1. The width of the relocated channel will match that of the pre-existing width;
2. Channel depths will match that of the pre-existing stream section;
3. CSM will be placed along the bottom of the reconstructed stream channel to re-establish stream substrate; and
4. Riprap placement in the stream will be minimized to that necessary for erosion/scour prevention and embedded and covered with natural substrate material.

AMM 55–Cofferdams that span the entire channel will not be used for bridge scour countermeasure projects.

AMM 56–Compensatory mitigation, through the ILF program or another mitigation approach that is part of the program, will be provided for all culvert end extensions occurring in Tier 1 and Tier 2 areas.

AMM 57–The Proponents are limiting culvert extensions under this programmatic to a total of eight feet.

AMM 58–Compensatory mitigation, through the ILF program or another mitigation approach that is part of the program, will be provided for all bridge scour countermeasures occurring in Tier 1 and Tier 2 areas.

AMM 59–Compensatory mitigation, through the ILF program or another mitigation approach that is part of the program, will be provided for all stream crossing replacements in Tier 2 areas that are greater than 1.0 times the BFW but less than 1.2 times the BFW.

AMM 60–Compensatory mitigation, through the ILF program or another mitigation approach that is part of the program, will be provided for all invert line and slipline projects in Tier 2 areas.

AMM 61–Bridge scour countermeasures will incorporate the following measures into project design:

1. Cable mats will be installed to match the existing channel contours;
2. A low flow channel will be added to allow adequate water depths (approximately 6 inches) during low flow periods; and
3. Stream bed material and large rocks (greater than one foot in diameter) will be placed randomly back on top of the scour countermeasures.

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Appendix B–Habitat Connectivity Design Protocol

Incorporated Design References

Culverts will be designed and constructed for consistency with natural stream dimensions, profiles, and dynamics, in accordance with the following technical references: U.S. Forest Service guide (Forest Service Stream-Simulation Working Group 2008), augmented by documents published by the states of Washington (Barnard et al. 2013), Vermont (Bates and Kirn 2009) and California (Love and Bates 2009).

Depending on site conditions, emulating natural stream conditions may not always be feasible. In these cases, the references may indicate the need for a geomorphic-based roughened channel design. The following considerations shall guide the use of this approach:

- geomorphically-based roughened channel designs shall generally be avoided and only be used when site conditions cannot be managed so as to allow for more preferred designs.
- geomorphically-based roughened channel designs completed under this Programmatic Agreement shall not create barriers to aquatic organism movement.
- geomorphically-based roughened channel designs will be submitted to the Service for pre-approval prior to using the Programmatic Agreement.

Design Amendments

These design amendments supersede the incorporated references.

1. Streambed Material Depth: Standard MaineDOT design will be for two feet of culvert streambed material (CSM) in culverts. Based on stream geomorphic assessment, the MaineDOT may adjust CSM depth up or down in accordance with the references.
2. Streambed Material Gradation: Streambed material particle gradations will be based on stream geomorphic assessments and determined according to the references. When streambed depth is greater than or equal to two feet, the lower 50 percent may have a D_{84} as large as the stable size at Q_{50}, but no larger than 50 percent of the total streambed depth.

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Appendix C–Turbidity Monitoring Protocol

MaineDOT

In-Water Construction Turbidity Monitoring Protocol

MaineDOT Environmental Office

By Eric Ham & Bradford Folta Jr.

August 2016

Abstract

When conducting in-water constructions like a bridge, culvert, or other structure, there are a number of changes made to the surrounding and immediate ecosystems. This protocol seeks to establish a baseline data set for any and all future in-water construction events with regards to turbidity. Turbidity is the suspension of particles within a fluid. An increase in suspended particles in the water leads to the water being more opaque which leads to damage of existing aquatic creatures and fauna. Turbidity can be introduced into an aquatic system a number of ways; however, due to the alteration that occurs when building a structure in-water, we will focus on turbidity associated with said construction. Turbidity from this is typically caused by run-off, exposure of sediment/soil, or debris-flow. To limit the amount of damage done by turbidity, this protocol will assist in the formation of guidelines and rules that contractors and agencies must follow when conducting in-water construction on the Maine Department of Transportation's (MaineDOT) projects.

Background & Applicability

The MaineDOT and the U.S. Fish and Wildlife Service have identified a gap within data from the Gulf of Maine Distinct Population Segment of Atlantic salmon regarding turbidity releases during in-water construction activities.

During the construction of cofferdams, Best Management Practices themselves, there are releases of turbid water into the water-body where the project work is taking place. This protocol will be used to establish baseline data to determine future limits and potential effects from these turbidity events on Atlantic salmon and critical habitat.

A state standard for turbidity NTU[1] has not been set by any Maine state agencies regarding in-water construction. The limited monitoring that has been performed, in regards to turbidity, is not an appropriate standard that can be met by each project.

In the first two years (or longer if appropriate project don't occur) after issuance of the Programmatic Biological Opinion, the MaineDOT will monitor the following in water activities:

In water activity	# of monitoring events
Sandbag Cofferdam Installation	4
Sandbag Cofferdam Removal	4
Pile Driving (includes both impact, vibro)	4
Pile/Geotech Drilling	2
Bypass Channel Installation/Initiation of flow	2
Bypass Channel Removal	2
Work Area Dewatering	4
Riprap Installation Outside of a Cofferdam	4

[1] Nephelometric Turbidity Units (NTU)-Unit of measure for Turbidity.

Definitions

Background Monitoring Point. A point, in water, that is not affected by any gross disturbance caused by the project. Background monitoring points should be collected as far upstream as right-of-way allows.

Mixing Zone. The mixing zone begins at the point where the construction discharge enters the water column and ends where the discharge has completely mixed with the said water. A mixing zone cannot be defined until a gross disturbance is witnessed on-site. It is often that this zone is outside of the MaineDOT right of way.

Required equipment

- Safety equipment (PPE[2], PFD[3], Etc.)
- Turbidity meter
- GPS unit
- Tape measure with weighted end for water depth
- Time device (Cell phone, watch)
- Turbidity Monitoring Protocol Datasheet

Required Accuracy

- Turbidity meter resolution must be within ±0.1 NTU,
- have an accuracy of: ±2 NTU for readings below 100 NTU, and
- accuracy of ±3 NTU for readings over 100 NTU.

Meter Type

NTU can be recorded with two types of Turbidity meters. Some turbidity monitors require that water samples be collected in vials and placed in a machine, while others allow for the placement of a probe in the water column that can record instantaneous readings at a set interval.

Procedure

Data will be collected before construction starts (pre-construction) to establish a baseline, and after construction has started or is in progress (syn-construction). These two collection periods work together to help better understand the stream system as a whole at the project site.

Pre-construction. Collection of a background monitoring point should be taken upstream of the proposed site as far as the right-of-way will allow. Using a tape measure, measure from one bank to the other (A→A') to determine stream width, divide the stream width by two to determine the stream center (B). Then, at stream center, take a stream depth (B→B') and divide

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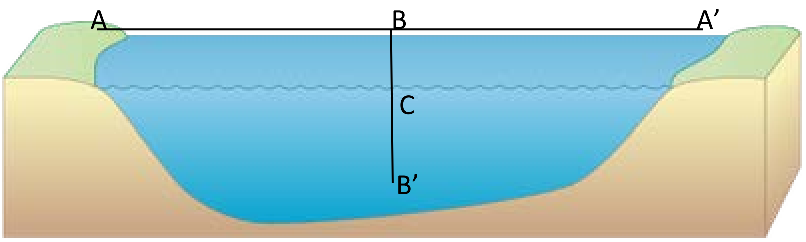
[2] PPE- Personal Protective Equipment, specifications listed in MaineDOT's PPE Protocol
[3] PFD- Personal floatation device, specifications listed in MaineDOT's PFD Protocol

that by two to determine center of water column (C). This may require a boat and other gear as needed.



$$Stream\ Center = \frac{Stream\ Width}{2} \qquad Center\ of\ water\ column = \frac{Water\ Depth}{2}$$

Figure 1. Stream Cross-section with Measurements

Depending on the device, make sure the probe or measurement device falls in the center of the water column. This can be done by measuring the device and determining where it will hang relative the water column.

Syn-construction. During construction, water monitoring should take place within the downstream right-of-way following any of these in-water activities:

In-water activity
Sandbag Cofferdam Installation
Sandbag Cofferdam Removal
Pile Driving (includes both impact, vibro)
Pile/Geotech Drilling
Bypass Channel Installation/Initiation of flow
Bypass Channel Removal
Work Area Dewatering
Riprap Installation Outside of a Cofferdam

To choose a proper monitoring site, make sure that you are positioned far enough downstream that you can capture any debris-flow or turbidity in the water. Distance from the in-water work is site specific. The point should be collected at the *mixing zone*. At the mixing zone the turbidity in question should be mixed within the water column. Measuring this point during construction should render a NTU higher than the baseline point. NTU readings should be taken in 1-minute intervals, best done with modern water-monitoring units. If different construction activities result in identical mixing zones, then the same site should be used for all monitoring activities while construction is in progress. In other instances, such as large rivers or waterways complicated by islands or shoals, different construction activities may have different mixing zones, e.g. cofferdams placed on one side of a wide river versus cofferdams placed on the opposite side. Sampling site selection should be based on the mixing zone of the activity being monitored.

Please remember all attempts should be made to monitor at the downstream point of the mixing zone. If this is not possible, then the use of multiple monitoring sites is permitted. This/These point(s) should be recorded in the report, if unable to collect the sample within the right-of-way, please note/document that in the report and explain the alternate collection sampling location used. Monitoring must occur downstream of any discharge hoses of bypass pumps or outlets of temporary sedimentation basins.

Reporting Results

To report the results, please turn in the following Turbidity Monitoring Protocol Datasheet to the Maine Department of Transportation's Environmental Division by email (button on sheet) or paper copy by Mail.

For sending by Mail:

Maine Department of Transportation
Attn: Environmental
16 State House Station
Augusta, ME 04333-0016

For E-mail/Phone:

Eric.Ham@maine.gov
207/215-7356

Turbidity Monitoring Protocol Datasheet

To be developed as part of User's Guide

Appendix D–Conversion Relationship between Nephelometric Turbidity Units into Milligrams per Liter

Conversion of Nephelometric Turbidity Units (NTU) into milligrams per liter is required since NTU is used as a surrogate for Total Suspended Solids (TSS) and can be measured immediately in the field. NTU can then be converted into TSS once the relationship between the two measurements is formed. An NTU instrument measures the particles of matter that are naturally suspended in water and these particles can be clay, silt, finely divided organic and inorganic matter, plankton, and other microscopic organisms. Turbidity is a measurement of how light scatters when it is aimed at water and bounces off the suspended particles; it is not a measurement of the particles themselves.

The NTU/TSS relationship is interpreted by linear regression analysis. The relationship between TSS and turbidity is unique to each instrument and each construction site, so instruments must be calibrated prior to field deployment. The following procedure will be used:

Step 1: Calibrate the turbidity meter according to manufacturer's instructions. Preferably a 3-point calibration is conducted with fresh calibration standards of known value, typically 0, 40 and 400 NTU. Calibration standards are available from laboratory suppliers, or the calibration can be done by laboratories that typically conduct turbidity tests.

Step 2: Obtain two 20 liter pails of water from the waterbody being worked in. The samples should be allowed to settle for approximately 1 hour or until all suspended sediment is removed from the water column.

Step 3: Prepare one kilogram slurry of fine material that is expected to be introduced to the waterbody by construction activities. Depending upon the monitoring distance downstream of the activity this may vary from fine sand to just silt and clay sizes. The slurry can be an amalgam of fines from the bed, bank and borrow.

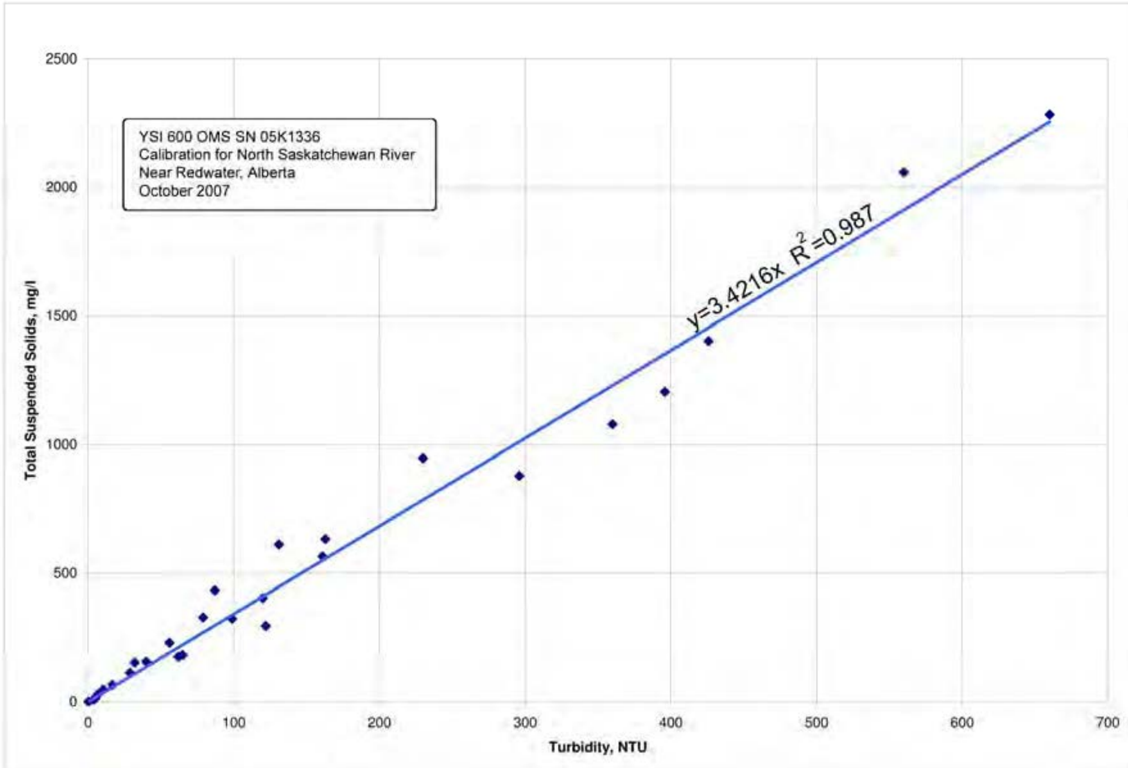
Step 4: In one of the 20 liter pails, measure and record the turbidity of the settled water. Extract a water sample for laboratory testing of TSS.

Step 5: Increase the level of suspended solids by introducing a small amount of the prepared slurry to the pail. Stir vigorously to ensure a homogeneous mixture. Measure and record the turbidity, then extract a water sample for laboratory testing. Continuous stirring may be necessary to keep sand size particles in suspension during this step.

Repeat Step 5 to obtain sufficient points to derive the NTU/TSS relationship similar to Figure 1. Ideally five points should be obtained with readings below 15 NTU and at least five additional points below 500 NTU. At least 20 samples (or more if needed) should be used in total to develop the linear relationship within an R-squared correlation coefficient of at least 0.85 (85 percent). The second pail of water can be used to temper the solution so a particular NTU reading can be obtained. Most instruments fail to respond, or 'blind', above a certain level, typically 1000 NTU for those intended for use in natural water bodies.

Turbid water samples should be sent to a qualified laboratory for TSS testing (American Society for Testing and Materials D3977 or similar). Once laboratory results have been obtained, the data can be plotted and an interpolated equation derived. This relationship is a simple straight line fit with a zero intercept unless the native waterbody has high background turbidity from chemical staining or dissolved solids, in which case the relationship will have a turbidity offset.

Figure 1. An Example TSS/NTU Relationship



Appendix E–Post-Project Monitoring Protocol

Longitudinal Profile

A longitudinal profile will be collected the first and third year after project construction. This profile will be collected following the protocols outlined in the design manuals. The only difference being that this profile may be short and targeted at parts of the profile that had changed after the project's completion.

Photos

- At a minimum, the following photos will be provided:
- Photo US of any areas that have experience down cutting or fine sediment loss.
- US from inlet of the crossing structure
- Photo looking through crossing structure
- Photos of substrate example inside of the structure at the inlet, middle, and outlet
- DS from the outlet of the crossing structure
- Photo of any DS areas that have experienced grade/substrate changes

Qualitative Measurements

Depth and velocity measures will be taken at the following locations:

- Inlet
- Middle
- Outlet
- At multiple locations on any grade control element

Low Flow Channel

- Document the presence and location of a low flow channel through the structure

The monitoring of the substrate above is qualitative. The Service may request a 'pebble count' following the U.S. Forest Service guide (Forest Service Stream-Simulation Working Group 2008) at any of the structures if the qualitative monitoring reveals any potential issues.

Literature Cited

Forest Service Stream-Simulation Working Group. 2008. Stream Simulation: An Ecological Approach to Providing Passage for Aquatic Organisms at Road-Stream Crossings. U.S. Forest Service Guide. U.S. Forest Service, National Technology and Development Program, San Dimas, California. URL: *http://www.fs.fed.us/eng/pubs/pdf/StreamSimulation/hi_res/%20FullDoc.pdf*; accessed December 27, 2016.

Appendix F–Hydroacoustic Monitoring Template

Project Name

UNDERWATER NOISE MONITORING PLAN

*****TEMPLATE*****

Replace underlined blue italic text with project information.

Blue italic text is guidance.

Plain, black text ***is template language.***

All blue italic text should be replaced or omitted for final production.

Prepared by:

Name and full contact information

Signature Block

Date

INTRODUCTION (This section will be project specific)

The *full agency name* proposes to *detailed project description*. See vicinity map (Figure 1).

Figure 1. Vicinity map of *name project*.

PROJECT AREA ***(This section will be project specific)***

Describe the location of the project, including all water bodies that are affected. Identify the U.S. Geological Survey hydrologic unit, both the name and code, where the project is located. Include detailed maps and figures, when available, relative to environmental features that influence monitoring (e.g., geology, bathymetry, etc.).

PERMIT/ESA CONDITIONS ***(This section will be project specific and is applicable only when the ESA consultation is complete or Federal/State/local permits have been issued. Each agency should modify this section to reflect the various types of permit/Endangered Species Act (ESA) conditions that they see.)***

Summarize the Federal/State/local permit conditions and the ESA requirements that relate to the underwater noise. Permit conditions include monitoring requirements, timing restrictions, etc. The ESA requirements are found in the Incidental Take Statement and Terms and Conditions sections of the biological opinion. These requirements vary between biological opinions, but can include monitoring requirements, timing restrictions, limits on cumulative sound exposure level (cSEL) at a given distance, description of the area where the thresholds must not be exceeded, the allowable number of piles driven per day, the allowable number of pile strikes per day, or a limit on the single strike SEL.

PILE INSTALLATION LOCATION ***(This section will be project specific)***

Figure 2 indicates the location of the *provide location of the structure(s) in need of pile driving*. There will be a total of *XX* piles driven as part of the *name structure(s)*.

Figure 2. Location of *name structure(s)* where pile driving activity will take place. *This information must be in enough detail to allow the reader to assess the monitoring locations.*

PILE INSTALLATION

Impact Pile Driving for Fish Consultations

Provide pile installation information. For example:

Hydroacoustic monitoring will be conducted for *XX* piles struck with an impact hammer. Piles chosen to be monitored are driven in water depths that are representative of mid-channel or typical water depths at the project location where piles will be driven.

The number of piles to be monitored will depend on a variety of factors–some projects may require that all piles be monitored, while others may require a representative sample of piles be monitored. If a sample of piles is to be monitored, provide the considerations taken and the rationale used in choosing a representative number of piles, such as, bathymetry, total number of piles to be driven, substrate type, depth of water, distance from shore, river, or stream bank, and any other considerations, as appropriate. When monitoring a subset, a minimum of five piles should be monitored. Additional monitoring to produce a representative sample may be warranted when projects are driving a large number of piles, driving multiple piles of varying diameters in differing substrates, driving different types of piles, or driving piles in widely differing depths.

Hydroacoustic monitoring of *type of pile* with impact driving will include:

- Monitoring *X piles, out of a total of Y piles driven for the project*.
- Testing sound attenuation system effectiveness.

Figure 3 indicates the location of the piles to be monitored and the approximate hydrophone locations for each pile being monitored. All hydrophones will be placed at least 3.3 feet (1 meter) below the surface. *If only one hydrophone at one distance is to be used it is acceptable for the hydrophone to be placed 33 feet (10 meters) from the pile at midwater depth. If hydrophones will be placed at more than one distance from the pile and used to calculate transmission loss over distance, water depth should be at least 13 feet (4 meters) and it is suggested that the additional hydrophone nearest the pile be placed at least 3 H from the pile where H is the water depth at the pile and at 0.7 to 0.85 H depth from the surface. In waters less than 13 feet (4 meters) deep, a single hydrophone at midwater depth is sufficient*[1]. Hydrophones will be located *X* meters from each pile with a clear acoustic line-of-sight between the pile and the hydrophone. *Additional distances measured concurrently are desirable, if possible, to estimate the site specific range to the threshold boundary. Include any additional distances or depths where hydrophones will be located. If airborne noise monitoring is required, the primary measurement microphone shall be placed 50 feet (15 meters) from the pile at least 6 feet (2 meters) above the ground or water, and shall have an unobstructed view of the length of the pile.*

1 Some projects may need or require more than one hydrophone to collect real time measurements at multiple locations or multiple distances. In these situations multiple hydrophones can be placed at midwater depths.

Figure 3. Location of the piles that will be monitored on the *name structure(s)*.

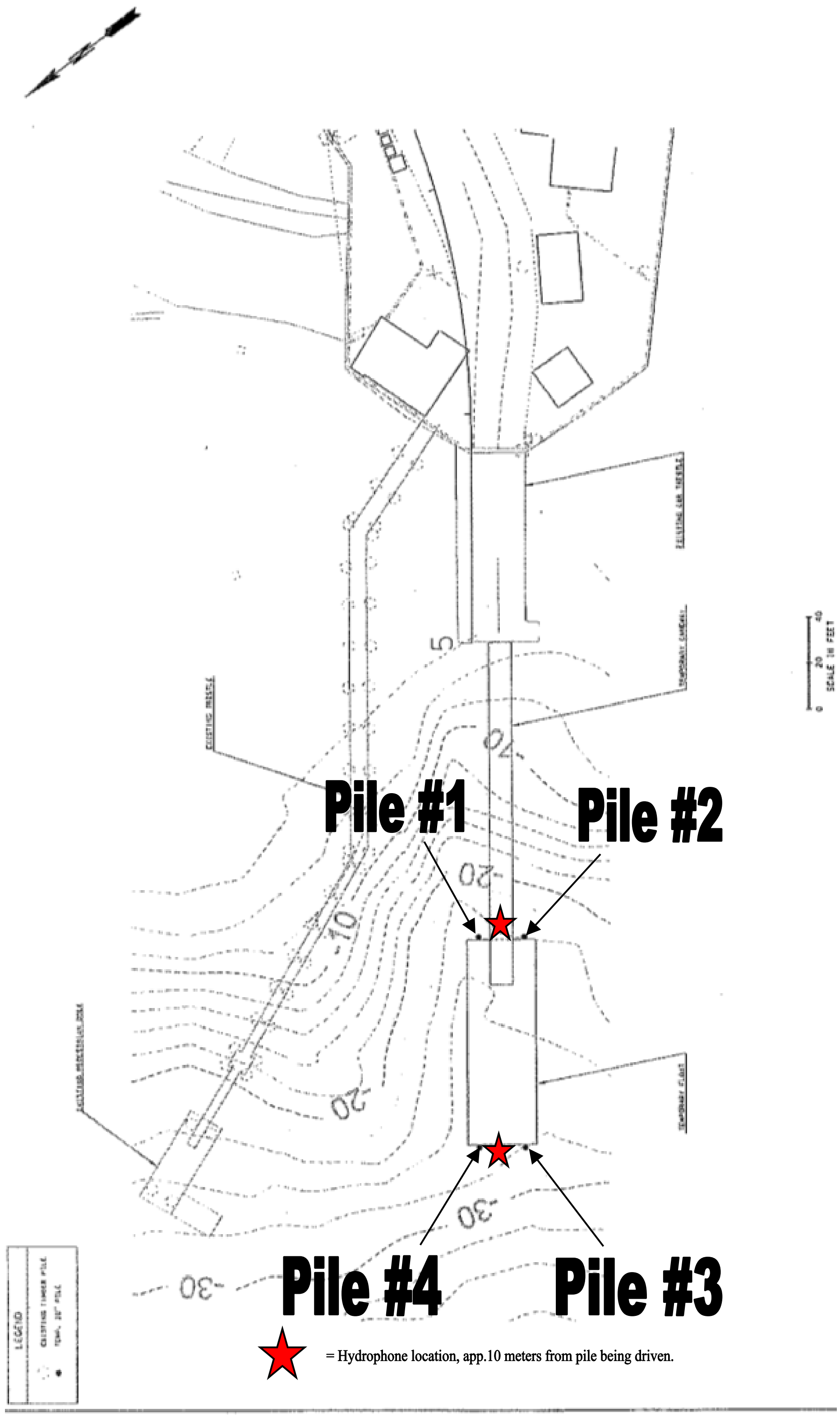


Table 1 lists the *name structure(s)* to be installed, the water depth, and the number and size of piles that will be installed.

Table 1. Depth, Number Piles to be Monitored

Structure	Water Depth	Structural Components Installed
Name structure	*X feet to X feet*	*X-XX-inch diameter type of pile*

CONTRACTOR REQUIREMENTS

The contractor will submit a detailed description of their qualifications, which must include a minimum of a bachelor's degree in a related field[2] and 3 years' experience in noise monitoring and analysis, and monitoring plan based on this template for approval by [INSERT AGENCY NAME]. A list of the contractors' proposed sound level monitoring equipment shall be included along with specifications and a description of the purpose. The measurement range in terms of amplitude (in decibels [dB] referenced to one micropascal [µPa]), sensitivity and frequency shall be stated. A minimum frequency range of 20 hertz (Hz) to 20 kilohertz (kHz) and a minimum sampling rate of 48,000 Hz will be used when monitoring. Sampling rates higher than 48 kHz are preferred. Table 2 describes the minimum requirements of the equipment to be used. In addition to the equipment selection, quality control/quality assurance procedures should be described (e.g., how will system responses be verified and how will data be managed).

Table 2. Equipment for underwater sound monitoring (hydrophone, signal amplifier, and calibrator). All have current National Institute of Standards and Technology (NIST) traceable calibration. ***This table is intended as a guideline and exact specifications can be adjusted to meet the needs of the individual project or contractors' equipment.***

Item	Specifications	Minimum Quantity	Usage
Hydrophone	*Receiving Sensitivity– -211 dB re 1 volt/µPa*	*1*	*Capture underwater sound pressures near the source and convert to voltages that can be recorded/analyzed by other equipment.*
Hydrophone	*Receiving Sensitivity– -200 dB re 1/µPa*	*1*	*Capture underwater sound pressures for background levels and convert to voltages that can be recorded/analyzed by other equipment.*

2 This can include Institute of Noise Control Engineering of the USA (INCE/USA) certification or related fields such as acoustics, physics, oceanography, geology or other physical sciences that have required coursework in physics.

Signal Conditioning Amplifier	*Amplifier Gain-* *0.1 mV/pC to 10 V/pC* *Transducer Sensitivity Range- 10-12 to 103 C/MU*	*1*	*Adjust signals from hydrophone to levels compatible with recording equipment.*
Calibrator (pistonphone-type)	*Accuracy-* *IEC 942 (1988) Class 1*	*1*	*Calibration check of hydrophone in the field.*
Digital Signal Analyzer	*Sampling Rate-* *48kHz or greater*	*1*	*Analyzes and transfers digital data to laptop hard drive.*
Microphone (free field type)	*Range- 30–120 dBA* *Sensitivity-* *-29 dB ±3 dB (0 dB=1 V/Pa)* *Wind Screen*	*1*	*Monitoring airborne sounds from pile driving activities (if not raining).*
If water velocity ~> 1m/s, Flow shield	*Open cell foam cover or functional equivalent*	*1/hydrophone*	*Eliminate flow noise contamination.*
Laptop computer *or* *Digital Audio Recorder*	*Compatible with digital signal analyzer*	*1*	*Record digital data on hard drive or digital tape.*
Real Time and Post-analysis software	*-*	*1*	*Monitor real-time signal and post-analysis of sound signals.*

To facilitate further analysis of data, full bandwidth, time-series underwater signals shall be recorded as a text file (.txt) or wave file (.wav) or similar format. Recorded data shall not use data compression algorithms or technologies (e.g. MP3, compressed wav, etc.).

METHODOLOGY

Impact Pile Driving for Fish Consultations (and ESA listed diving sea birds, if relevant)

Underwater background sound level measurements are optional, however, if desired then the National Marine Fisheries Service (NMFS) guidance should be followed (NMFS 2012a-c).

If one hydrophone at one distance is to be used it is acceptable for the hydrophone to be placed 33 feet (10 meters) from the pile and at midwater depth. If hydrophones will be placed at more than one distance from the pile it is suggested that the hydrophone nearest the pile be placed at *least 3 H from the pile where H is the water depth at the pile and 0.7 to 0.85 H depth from the surface.* The hydrophone*(s)* will be placed at *X meters* depth at a distance of *X meters* from each pile being monitored, in waters of *X meters* depth. *If water velocity is 1 meter per second or greater, 3 to 10 feet (1 to3 meters) off the bottom may be recommended for near field hydrophones and greater than 16.4 feet (5 meters) from the surface may be recommended for any far field hydrophones.* A weighted tape measure will be used to determine the depth of the water. The hydrophone*(s)* will be attached to a nylon cord, a steel chain, or other proven anti-strum features if the current is swift enough to cause strumming of the line. The nylon cord or chain will be attached to an anchor that will keep the line the appropriate distance from each pile. The nylon cord or chain will be attached to a float or tied to a static line at the surface. The distances will be measured by a tape measure, where possible, or a range-finder. The acoustic path (line of sight) between the pile and the hydrophone*(s)* should be unobstructed in all cases.

When collecting sound measurements in an area with currents (i.e., in rivers or tidally influenced areas), appropriate measures will be taken, when necessary, to ensure that the flow-induced noise at the hydrophone will not interfere with the recording and analysis of the relevant sounds (NMFS 2012a-c). As a general rule, current speeds of five feet per second (1.5 meters per second) or greater are expected to generate significant flow-induced noise, which may interfere with the detection and analysis of low-level sounds such as the sounds from a distant pile driver or background sounds. If such measures are necessary, include a description of those measures. For example:

> *If it becomes necessary to reduce the flow-induced noise at the hydrophone, a flow shield will be described and installed around the hydrophone to provide a barrier between the irregular, turbulent flow and the hydrophone. If no flow shield is used in these situations, the current velocity will be measured and a correlation between the levels of the relevant sounds (background or pile driving) and current speed will be made to determine whether the data is valid and can be included in the analysis.*

The hydrophone calibration*(s)* will be checked at the beginning of each day of monitoring activity. *The method of calibration and calibration equipment used will be described.* NIST traceable calibration forms shall be provided for all relevant monitoring equipment. Prior to the initiation of pile driving, the hydrophone will be placed at the appropriate distance and depth as described above.

The onsite inspector/contractor will inform the acoustics specialist when pile driving is about to start to ensure that the monitoring equipment is operational. Underwater sound levels will be continuously monitored during the entire duration of each pile being driven with a minimum one-third octave band frequency resolution. The wideband instantaneous absolute peak pressure and Sound Exposure Level (SEL) values of each strike, and daily cumulative SEL should be monitored in real time during construction to ensure that the project does not exceed its authorized take level. Peak and RMS pressures will be reported in dB (re:1 µPa). SEL will be reported in dB (re: 1 $\mu Pa^2 \cdot sec$). Wideband time series recording is strongly recommended during all impact pile driving.

Prior to, and during, the pile driving activity, environmental data will be gathered, such as water depth and tidal level, wave height, and other factors that could contribute to influencing the underwater sound levels (e.g. aircraft, boats, etc.). Start and stop time of each pile driving event and the time at which the bubble curtain or functional equivalent[3] is turned on and off will be logged.

The contractor or agency will provide the following information, in writing, to the contractor conducting the hydroacoustic monitoring for inclusion in the final monitoring report: a description of the substrate composition, approximate depth of significant substrate layers, hammer model and size, pile cap or cushion type, hammer energy settings and any changes to those settings during the piles being monitored, depth pile driven, blows per foot for the piles monitored, and total number of strikes to drive each pile that is monitored.

Sound Attenuation Monitoring

All monitored piles may be tested with the sound attenuation system on and off (or presence and absence) to test its effectiveness[4]. To account for varying resistance as the pile is driven; the sound attenuation device will be turned off for *(describe schedule for turning on and off)* periods during the beginning, the middle third, and near the end of the drive. After turning off the attenuation system, pile driving should not resume for at least two minutes to allow time for air bubbles to completely disperse. *For piles that require less than 5 minutes to drive, pile driving should occur for only two periods with the bubbles off, one near the beginning and once near the end of the drive.*

SIGNAL PROCESSING

Impact Pile Driving for Fish Consultations (and any Service listed, diving sea bird)

Post-analysis of the underwater pile driving sounds will include:

- Number of pile strikes per pile and per day.
- For each recorded strike (or each strike from a subset), determine the following:
    - The peak pressure, defined as the maximum absolute value of the instantaneous pressure (overpressure or underpressure).
    - The root mean squared sound pressure across 90 percent of the strikes energy ($RMS_{90\%}$).
    - Sound exposure level, measured across 90 percent of the accumulated sound energy ($SEL_{90\%}$). Calculation methodology is provided in Appendix 1.

3 A functional equivalent must function as well as or better than the attenuation device that was proposed during consultation or required by the ESA consultation or applicable permits. It must achieve the same or better sound level reductions that were used in the calculations during ESA consultation or the permitting process.

4 Note: There may be circumstances where the U.S. Fish and Wildlife Service determines that unattenuated pile driving (striking the pile with the bubble curtain turned off) would pose a significant risk of injury to species. In those situations, the Service may request that unattenuated pile driving does not occur and that hydroacoustic monitoring be conducted to determine the extent at which certain thresholds are met instead. This will need to be determined on a case by case basis for projects that may affect listed species.

- Maximum, mean, and range of the peak pressure, with, and if applicable, without attenuation.
- Maximum, mean, range, and Cumulative Distribution Function (CDF) of the $RMS_{90\%}$, both with and if applicable, without attenuation where the CDF is used to report the percentage of $RMS_{90\%}$ values above the thresholds.
- Maximum, mean, and range of the $SEL_{90\%}$, both with and if applicable, without attenuation.
- Cumulative SEL (cSEL) across all of the pile strikes. If SEL was calculated for all strikes, cSEL is estimated as indicated in Appendix 1. If SEL was calculated for a subset of strikes, cSEL is estimated as follows: cSEL = SEL_{mean} + 10*log(total # strikes).
- Where surrogate piles are monitored to represent a larger project, an estimate of the cSEL during a typical day of construction driving must be reported by summing the SEL over the expected number of pile strikes in a typical day for the larger project: cSEL = SEL_{mean} + 10*log(#strikes). The SEL_{mean} used in this calculation must correspond with the actual sound attenuation measures that will be used during construction of the larger project.
- A frequency spectrum both with and, *if applicable*, without attenuation, between a minimum of 20 and 20 kHz for up to eight successive strikes with similar sound levels.

If airborne noise monitoring is required, both A-weighted and unweighted measurements will be acquired. Broadband back-to-back RMS L_{max} (peak) and L_{eq} (average) five-minute measurements will be made over the duration of pile driving,. L_{max} measurements should be taken with a portable analyzer set for "fast" response (125 meters per second). For at least one full pile sequence of each pile size and substrate type, frequency spectrum measurements (L_{max} and L_{eq}) using a minimum resolution of one-third octave bands shall be taken to show the spectral content of the impact pile. If measuring background sound levels in the absence of construction is not possible, then report the L_{95} statistic.

ANALYSIS

Impact Pile Driving for Fish Consultations

Analysis of the data from the San Francisco-Oakland Bay Bridge Pile Installation Demonstration project (PIDP) indicated that 90 percent of the acoustic energy for most pile driving impulses occurred over a 50 to 100 millisecond period with most of the energy concentrated in the first 30 to 50 milliseconds (Caltrans et al. 2001). The RMS values computed for this project will be computed over the duration between where 5 percent and 95 percent of the energy of the pulse occurs. The SEL energy plot will assist in interpretation of the single strike waveform. The single strike SEL associated with the highest absolute peak strike along with the total number of strikes per pile and per day will be used to calculate the cumulative SEL for each pile and each 24-hour period.

In addition a waveform analysis of the individual absolute peak pile strikes will be performed to determine any changes to the waveform with the *name type of noise attenuation device*. A comparison of the frequency content with and without noise attenuation will be conducted.

Units of underwater sound pressure levels will be dB (re:1 µPa)and units of SEL will be re:1 $\mu Pa^2 sec$.

REPORTING

If sound attenuation devices are used during the monitoring, include the following text and analysis:

An analysis of the change in the waveform and sound levels with and without the *name type of noise attenuation device for impact driving* operating will be conducted.

Preliminary results for the daily monitoring activities, if required, will be submitted/reported to the primary point of contact[5] at each of the applicable agency (the NMFS or the Service [Services]) within *XX hours* after monitoring concludes for the day. In addition a final draft report including data collected and summarized from all monitoring locations will be submitted to the Services within 90 days of the completion of hydroacoustic monitoring. The results will be summarized in graphical form and include summary statistics and time histories of impact sound values for each pile. A final report will be prepared and submitted to the Services within 30 days following receipt of comments on the draft report from the Services. The report shall include:

1. Size and type of piles.
2. A detailed description of the *name type of noise attenuation device*, including design specifications *(if applicable)*.
3. The impact hammer energy rating used to drive the piles, make and model of the hammer.
4. A description of the sound monitoring equipment.
5. The distance between hydrophone*(s) or microphone(s)* and pile.
6. The depth of the hydrophone*(s)* and depth of water at hydrophone locations.
7. The distance from the pile to the water's edge.
8. The depth of water in which the pile was driven.
9. The depth into the substrate that the pile was driven.
10. The physical characteristics of the bottom substrate into which the piles were driven.
11. The total number of strikes to drive each pile and for all piles driven during a 24-hour period.
12. The underwater wideband background sound pressure level reported as the 50 percent CDF *(if applicable)*.
13. The results of the hydroacoustic monitoring, as described under Signal Processing. An example table is provided in Appendix 3 for reporting the results of the monitoring.

[5] The primary point of contact is the biologist that conducted the section 7 consultation for the Service(s). In the event that the consulting biologist is not available, communication regarding monitoring results and reports should be addressed to the manager of the consultation branch or division with a reference to the consultation title.

14. The distance at which peak, cSEL, and RMS values exceed the respective threshold values.
15. A description of any observable fish, marine mammal, or bird behavior in the immediate area will and, if possible, correlation to underwater sound levels occurring at that time.
16. *If airborne noise monitoring is required, broadband A-weighted and unweighted maximum, minimum, and average* L_{max} *and* L_{eq} *levels shall be tabulated for every pile. For each pile size and substrate type frequency spectra (one-third octave minimum frequency resolution) charts will be included to show the frequency content of* L_{max} *and* L_{eq} *signatures. The frequency content of airborne noise background levels shall also be shown. Background sound levels or* L_{95} *surrogate for background sound shall be reported.*

REFERENCES

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NMFS. 2012a. Guidance Document: Data Collection Methods to Characterize Underwater Background Sound Relevant to Marine Mammals in Coastal Nearshore Waters and Rivers of Washington and Oregon. Memorandum: NMFS Northwest Fisheries Science Center–Conservation Biology Division and Northwest Regional Office–Protected Resources Division, January 31, 2012.

NMFS. 2012b. Guidance Document: Data Collection Methods to Characterize Impact and Vibratory Pile Driving Source Levels Relevant to Marine Mammals. Memorandum: NMFS Northwest Fisheries Science Center–Conservation Biology Division and Northwest Regional Office–Protected Resources Division, January 31, 2012.

NMFS. 2012c. Guidance Document: Sound Propagation Modeling to Characterize Pile Driving Sounds Relevant to Marine Mammals. Memorandum: NMFS Northwest Fisheries Science Center–Conservation Biology Division and Northwest Regional Office–Protected Resources Division, January 31, 2012.

APPENDIX F–1

Calculation of Cumulative SEL

An estimation of individual SEL values can be calculated for each pile strike by calculating the following integral, where T is T_{90}, the period containing 90 percent of the cumulative energy of the pulse (Equation 1).

Equation 1 $$SEL = 10\log\left(\int_0^T \frac{p^2(t)}{{p_0}^2}\,dt\right) \quad dB$$

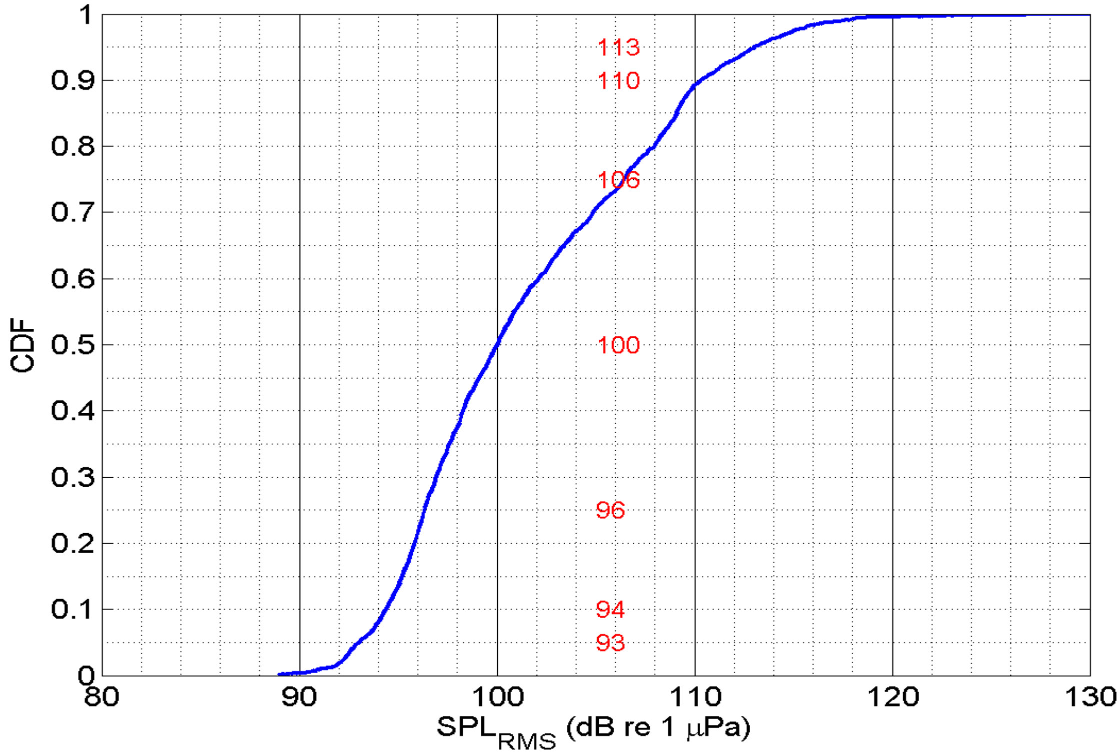
Calculating a cumulative SEL from individual SEL values cannot be accomplished simply by adding each SEL decibel level arithmetically. Because these values are logarithms they must first be converted to antilogs and then accumulated. Note, first, that if the single strike SEL is very close to a constant value (within 1 dB), then cumulative SEL=single strike SEL + 10 times log base 10 of the number of strikes (N), i.e., $10\mathrm{Log}_{10}(N)$. However if the single strike SEL varies over the sequence of strikes, then a linear sum of the energies for all the different strikes needs to be computed. This is done as follows: divide each SEL decibel level by 10 and then take the antilog. This will convert the decibels to linear units (or $uPa^2 \bullet s$). Next compute the sum of the linear units and convert this sum back into dB by taking $10\mathrm{Log}_{10}$ of the value. This will be the cumulative SEL for all of the pile strikes.

APPENDIX F–2

Calculation of a Cumulative Distribution Function and Plot for Background Sound Level Analysis

Data from three full 24-hour underwater measurement cycles (minimum) are used to calculate a 30-second Root Mean Square (RMS) value for each 30-second period for the entire dataset. The RMS should be calculated for both the full frequency range recorded as well as a separate dataset which has been passed through a high pass filter thus eliminating those frequencies below 1000 Hz. These datasets are then grouped into 24-hour periods. To determine if the data is approximately log-normal in distribution, each 24-hour period is plotted as a Probability Density Function (PDF). Each 24-hour period can be plotted on the same PDF plot. The plots should be approximately log normal in distribution and thus can be used in the further analysis. Each day of data should have an approximately Gaussian sigmoid shape, the differences between them and the ideal might be hard to spot, but the sigmoid from day to day will show noticeable variation. Data which does not approximate a log normal distribution should be excluded from further analysis.

The Cumulative Distribution Function (CDF) plot is obtained by plotting the normalized cumulative sum versus the bin location. You can also get the PDF from plotting the normalized bin count versus the bin location. The normalized bin count is obtained by dividing the count column by (number of data points multiplied by the space between 2 consecutive bins). This provides the integral of the PDF equal to 1. For instructions on creating a histogram in Microsoft Excel, see URL: *http://www.vertex42.com/ExcelArticles/mc/Histogram.html*; accessed January 23, 2017.



CDF
SPL_RMS (dB re 1 µPa)
113
110
106
100
96
94
93

APPENDIX F–3

Table 1. Example table for required information for reporting the results of hydroacoustic monitoring of pile driving.

Date and Time	Pile ID	Hammer Impact or Vibratory	# Strikes or Vibratory Seconds	Distance to Pile from Hydrophone (meters)	Water Depth (meters)		Peak (dB)			$SEL_{90\%}$ (dB)				$RMS_{90\%}$ (dB)			Notes
					At Pile	At H-phone	Max	Min	Mean	Max	Min	Mean	$cSEL_{90\%}$	Max	Min	Mean	

Appendix G–Atlantic Salmon Evacuation Plan and Disinfection Procedures

(updated 1/2013)

Qualified MaineDOT biologists will be capturing, handling, and removing fish from within cofferdams and water diversions prior to dewatering for projects where there is a concern that juvenile Atlantic salmon might be trapped within the project area. Capturing and handling juvenile Atlantic salmon causes physiological stress and can cause physical injury or mortality; to minimize these effects the following procedures will be followed by the MaineDOT during activities associated with projects in the batch consultation should Atlantic salmon be trapped during project activities:

1. An adequate number of MaineDOT Environmental Office staff will be onsite during construction and dewatering of all cofferdams and for fish salvage activities.

2. If it is possible that an adult Atlantic salmon could be present in the construction area, a visual survey of the construction area to inspect for the presence of an adult Atlantic salmon will be completed. Further precautions for adult Atlantic salmon will be followed after the visual inspection to ensure that adult Atlantic salmon are removed from the construction area prior to electrofishing.

3. The MaineDOT Environmental Office staff will follow the Maine Atlantic salmon Commission Disinfection Procedures (below).

4. Following installation of the upstream block net, fish may be hazed out (if site conditions warrant) of the proposed dewatered sections by walking seines downstream from the upstream block net location to the end of the construction site in an attempt to 'herd' fish out of the worksite. A downstream block net would then be installed and efforts to capture remaining fish with dip-nets would follow. The MaineDOT fisheries biologists experienced with construction area isolation, and competent to ensure the safe handling of all Endangered Species Act (ESA)-listed fish, will conduct or supervise the operation.

5. Install a block net or cofferdam downstream of the project site immediately after the sweep to ensure fish will not move back into the project area. The block net will be secured to the stream channel, bed, and banks until fish capture and transport activities are complete. Size and place the block net in the stream in such a way as to exclude ESA-listed juvenile salmonids expected to occur within the project vicinity at the time of construction without otherwise impinging these fish on the net. Monitor the block net once a day to ensure that it is properly functioning and free of organic accumulate.

6. Use one or a combination of the following methods to most effectively capture ESA-listed fish and minimize harm (Figure 1). Fish salvage shall proceed from the least invasive method to most invasive. Note that site conditions and other logistics may dictate the practicality of methodology used.

a) Hand Netting. Collect fish by hand or dip-nets, as the area is slowly dewatered.

b) Seining. Seine using a net with mesh of such a size as to ensure entrapment of the residing ESA-listed fish. The bottom or lead line has lead weights strung or crimped onto it to weight the net. The top or float line includes cork, polystyrene foam, or plastic floats to keep the top of the seine near the water surface. The net is attached to wood or metal poles to handle the seine. Two persons hold the seine in a vertical position above the water and perpendicular to the flow at the downstream edge of a riffle. They then thrust the poles and lead line of the seine to the stream bottom. The poles are allowed to slant downstream so that the flow forms a slight pocket in the seine. This procedure is continued from one shoreline across the width of the channel to the other shoreline so that the entire riffle is sampled. The seine is then lifted out of the water and the fish removed (Bramblett and Fausch 1991).

c) Trapping. Minnow traps (or gee-minnow traps) are net or wire enclosures that trap live fish. Fish swim through the funnel shaped openings and are guided to a narrow opening at the center of the trap. These traps are best suited for collecting juvenile fish or small adult fish in pool habitat. Traps should be baited and fished overnight. In areas of moderate to high fish densities, maximum catches in minnow traps are approached within one to two hours, with catches dropping sharply when traps are fished longer than 24 hours between checks. For bait, salmon eggs are most widely used, but hamburger, canned cat food, salmon flesh, canned corn, shrimp, and sardines have been used successfully (Magnus et al. 2006).

d) Electrofishing. Before dewatering, electrofishing will be used as the last evacuation measure following the above other means of fish capture, or if they are not practical or effective following National Marine Fisheries Service (NMFS) guidelines (NMFS 2000).

   a. Prior to the start of sampling at a new location, water temperature and conductivity measurements must be taken to evaluate electroshocker settings and adjustments.

   b. Each electrofishing session must start with all settings (voltage, pulse width, and pulse rate) set to the minimums needed to capture fish. These settings should be gradually increased only to the point where fish are immobilized and captured, and generally not allowed to exceed conductivity-based maxima indicated in the NMFS (2000) guidelines. Only direct current or pulsed direct current should be used.

   c. Electrofishing will not commence if the presence of an adult Atlantic salmon is suspected.

Figure 1. Examples of fish salvaging methods.

7. Handling of fish:

a) Juvenile Atlantic salmon will be netted (¼ inch knotless nylon) and immediately placed in a disinfected five gallon bucket filled with aerated stream water of ambient temperature.

b) Adult Atlantic salmon will be crowded into a handling device utilized by the Maine Department of Marine Resources (MDMR). The device consists of a rubber tube that is closed on one end and open on the other (Figure 2). Small holes are placed in the closed end to allow some water out but allow all of the water to drain. Any adult Atlantic salmon captured this way will be moved immediately outside of the exclusion with the handling device and will not be held.

c) All other fish species will be placed in a disinfected five gallon bucket with aerated stream water of ambient temperature and released upstream, if possible, or downstream of the project if the upstream does not contain suitable habitat, or if construction operations dictate, under the assessment by the on-site biologist.

d) Minimize the number of fish stored in each five gallon buckets used for handling bucket to prevent overcrowding.

e) Handling time will be minimized. Monitor water temperature in buckets and well-being of captured fish.

f) Release fish from the isolated reach into a pool or area that provides cover and flow refuge after fish have recovered from stress of capture. Fish release upstream of the project site is preferred as sediment impacts would not likely affect individuals upstream of the crossing, but downstream release may be necessary is upstream reach is not suitable habitat for release or if construction operations dictate.

Figure 2-'Rubber sock' for adult Atlantic salmon handling.
Photo courtesy of the MDMR.

8. If need be, all salmonids will be clearly photo-documented for identification purposes. Photos will likely not be taken of adult Atlantic salmon to ensure minimal handling time.

9. A report and any photographs of transferred Atlantic salmon will be submitted to the U.S. Fish and Wildlife Service (Service), the NMFS, the MDMR, the Maine Department of Inland Fisheries & Wildlife (MDIFW), and the appropriate action agencies (the Federal highway Administration or the Army Corps of Engineers).

Due to variability in construction timing, potential scheduling conflicts, and other potential unforeseen issues, to ensure coverage and eliminate project delays several MaineDOT employees or their designees will be available during construction and dewatering of cofferdams. The list of qualified MaineDOT Environmental staff includes:

1. Eric Ham
2. Richard Bostwick
3. Jared Stanley
4. Ryan Annis
5. Mike Clark
6. Val Derosier

In addition to the staff listed above, other Environmental staff members, including qualified fisheries consultants, may be added pending Service approval. Anyone electrofishing will be required to have experience electrofishing salmonids in Maine. The MaineDOT may solicit the aid of fisheries biologists from the Service, the NMFS or the MDMR if agency staff is available to assist at the necessary time.

Biosecurity guidelines are practical steps that can be taken to minimize the spread of unwanted organisms. The guidelines below are designed to provide direction to the MaineDOT biologists working in Maine's lakes, rivers, and streams in order to minimize the potential for spread of aquatic species, particularly invasive species. These guidelines, which were adapted from the MDIFW guidelines, have been written to separate aquatic plants, aquatic animals, and aquatic pathogens. Questions regarding proper cleaning and/or disinfection of field equipment should be addressed with the equipment's manufacturer.

I. Equipment:

Large (40 plus gallon) trashcan
Portable hand-pump sprayer for field disinfection
Large stiff bristle brush
Spray bottle
Rubbing alcohol
Nolvasan disinfectant

II. Procedures to minimize the spread of aquatic plants

1. Equipment–Visual inspection of personal and other equipment (i.e. boots/waders/gloves) with hand removal of plants before leaving area.

2. Dip nets, trapnets and leads–Aquatic plants must be removed from nets before they are moved between waters. Nets should be visually inspected on land with hand removal of plants before leaving the sampling area. After seasonal use, nets will be cleaned, thoroughly dried in direct sun or indoor storage area, and re-inspected to remove any remaining plant material. Ensure all net sections and components are thoroughly dry for a minimum of three days. When possible, clean/dry nets and leads should be used between waters.

3. Reporting Requirements–Aquatic plants of unknown species or plants known to be aquatic nuisance species should not be transported unless placed in a sealed container. Small

specimens may be transported to the Maine Department of Environmental Protection (DEP) for species identification (DEP contact: John McPhedran 207/287-2813).

4. Waters with Documented Infestations–Biological staff should be extra diligent when working on waters with known infestations to prevent the further spread of invasives. When possible, staff should minimize contact and disturbance of aquatic invasive plant beds to reduce the risks of spreading the plant within the water being sampled and elsewhere. A current list of known plant infestations is available at DEP's website: *http://www.maine.gov/dep/water/invasives/*; accessed January 23, 2017.

III. Procedures to minimize the spread of aquatic animals

1. Equipment–Personal equipment (e.g. boots, waders, or gloves) should be rinsed clean of all visible mud and aquatic debris. Any other equipment should be rinsed clean of mud and aquatic debris.
2. Dip nets, trapnets and leads–Remove as much mud and aquatic debris as possible on site. After seasonal use, trapnets should be transported to maintenance camp or other suitable location and cleaned, thoroughly dried in direct sun or indoor storage area, and re-inspected to remove any remaining material. Ensure all net sections and components are thoroughly dry for a minimum of three days. When possible, clean/dry nets and leads should be used between waters.
3. Reporting Requirements–Unknown specimens and known aquatic invasive species should be transported in sealed containers for identification. Identification of invasive aquatic species should be reported to MDIFW (contact: John Boland 207/287-5261).
4. Waters with Documented Infestations–Biological staff should be extra diligent when working on waters with known infestations to prevent the further spread of invasives. In this case, nets should be cleaned, soaked in a three percent salt brine overnight to destroy freshwater aquatic organisms, rinsed, and dried in sunlight between uses.

IV. Procedures to minimize the spread of aquatic pathogens

1. Equipment–Field equipment that comes in constant contact with stream or lake water (i.e. waders, nets, seines, gloves, shocker wand and tail, buckets, measuring boards, etc.) should be cleaned & disinfected before use between waters. Disinfection for most equipment is accomplished with a two ounce Nolvasan/gallon water solution in the large trashcan. Equipment should be allowed to set in solution for 10 minutes then rinsed thoroughly. Equipment should be sprayed with a hand-pump style sprayer and allowed to set during transit to the new water. Delicate equipment such as electronic scales, conductivity meters, thermometers, etc., should be sprayed with alcohol and allowed to air dry.

2. Dip nets, trapnets and leads–are too large to be soaked and unlikely to get reasonable disinfection with a spray system. After seasonal use, trapnets should be transported to the regional headquarters, cleaned, thoroughly dried in direct sun or indoor area, and re-inspected to remove any remaining material. Ensure all net sections and components are thoroughly dry for a minimum of three days. When possible, clean/dry nets and leads should be used between waters.

3. Reporting Requirements–Fish encountered with lesions of reportable pathogens, or unknown pathogens should be preserved in 10 percent buffered formalin for storage or sent for

immediate necropsy to the MDIFW Fish Health Laboratory. Fish with obvious signs of clinical disease should be disposed of on land, rather than returned to the water to spread the pathogen.

4. Waters with Documented Pathogens–Biological staff should be extra diligent with disinfection procedures when working on waters with known pathogen issues to prevent the further spread of the organisms.

Literature Cited

Bramblett, R.G., and K.D. Fausch. 1991. Variable fish communities and the Index of Biotic Integrity in a Western Great Plains river. Transactions of the American Fisheries Society 120:752–769.

Magnus, D.L., A.D. Brandenberger, K.F. Crabtree, K.A. Pahlke, and S.A. McPherson. 2006. Juvenile salmon capture and coded wire tagging manual. Special publication No. 06-31. Alaska Department of Fish and Game, Anchorage, Alaska. December. URL: *http://www.sf.adfg.state.ak.us/FedAidPDFs/sp06-31.pdf*; accessed March 16, 2015.

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