UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
PROGRAM PLANNING AND INTEGRATION
Silver Spring, Maryland 20910

MAY 16 2005

Mr. Reuben Yost
Project Manager
Alaska Department of Transportation and Public Facilities
6860 Glacier Highway
Juneau, Alaska 99801-7999

Re: Juneau Access Improvements, Project No. 71100
Supplemental Draft Environmental Impact Statement
Essential Fish Habitat Assessment
Steller Sea Lion Technical Report

Dear Mr. Yost:

NOAA's National Marine Fisheries Service (NMFS) has reviewed the Supplemental Draft Environmental Impact Statement (SDEIS), Essential Fish Habitat Assessment (EFHA), and Steller Sea Lion Technical Report (SSLTR) for the Juneau Access project and provides the following comments for consideration by the Alaska Department of Transportation and the Federal Highway Administration (ADOT/FHWA). NMFS has jurisdiction for conserving and protecting living marine resources under the Fish and Wildlife Coordination Act, Magnuson-Stevens Fishery Conservation and Management Act, Marine Mammal Protection Act and Endangered Species Act. These laws require NMFS to review and consult on the environmental impacts to wetlands and streams that support anadromous fish, nearshore and marine resources that support commercial and recreational fish species, as well as marine mammals and federally listed endangered species.

NMFS offers the following comments to assist ADOT/FHWA in completing the environmental review of this project. NMFS originally submitted comments on the SDEIS, EFH, and SSLTR on March 21, 2005. This letter updates those comments with additional information concerning the Katzehin Ferry Terminal.

Supplemental Draft Environmental Impact Statement (SDEIS)

The SDEIS includes analysis of ten alternatives, including the no action alternative; four

alternatives involve a road on the east side of Lynn Canal, one alternative involves a road on the west side of Lynn Canal, and four are marine transport (ferry) alternatives. NMFS analysis focuses on effects of ADOT/FHWA's preferred alternative, 2, which includes a 69-mile highway from Juneau to Skagway, with three multi-span bridges with in-stream piers, six single-span bridges, and a ferry terminal at Katzehin. The no action alternative, alternative 4C (increased conventional ferry service from Auke Bay), alternative 4A (fast vehicle ferry service from Auke Bay), and alternative 3 (road access on the west side of Lynn Canal), are also discussed. With the exception of the no action alternative, all of the alternatives would have adverse effects on EFH, although the manner and extent of effects vary considerably among alternatives.

NMFS's concern is greatest for alternatives with the potential to adversely affect Berners Bay. Berners Bay is an aquatic resource of national importance, including significant seasonal concentrations of foraging Steller sea lions, humpback whales, harbor seals and other marine mammals, and regionally important concentrations of spawning and rearing forage fish including the remaining spawning habitat for the Lynn Canal Pacific herring population. The bay is a major estuary in Lynn Canal and is defined by Point St. Mary to the north and Point Bridget to the south. One clearwater (Berners) and three glacial (Antler, Lace and Gilkey) rivers feed the bay, and eulachon spawn in the lower reaches of these rivers. Five creeks (Slate, Sawmill, Johnson, Davies, and Cowee), also drain the Berners Bay watershed. In combination, these systems provide spawning and rearing habitat for runs of eulachon; sockeye, coho, pink, and chum salmon; steelhead and cutthroat trout; and Dolly Varden char. The bay also provides habitat for halibut, shrimp, and crab.

No Action Alternative: NMFS finds the no action alternative to be the environmentally preferable alternative, as it involves no additional impacts to EFH, marine mammals, or threatened and endangered species. However, this alternative is unlikely to meet the project purpose and need to provide improved surface transportation to and from Juneau within the Lynn Canal corridor that will provide the capacity to meet transportation demand, provide flexibility and improve opportunity to travel, reduce travel times, reduce state costs, and reduce user costs.

Alternative 4C: Increased conventional ferry service from Auke Bay is the action alternative with least potential to adversely affect NMFS trust resources. No additional ferry terminals would need to be constructed and no wetlands would be filled, although some adverse effects to EFH would occur in Auke Bay as a result of reconstructing the Auke Bay ferry terminal to include a double stern berth to accommodate the two vessels necessary for north Lynn Canal service. Due to the lower speeds of conventional ferries, the risk of ship strikes of humpback whales, Steller sea lions or other marine mammals is lower than for fast vehicle ferries. EFH would be impacted at Auke Bay, temporarily during construction and permanently during operations as described in the EFH assessment.

Alternative 4A: Fast vehicle ferry service from Auke Bay is similar to Alternative 4C in terms of adverse effects to marine resources, with the additional slight risk of collisions with endangered humpback whales and possibly (but less likely) for Steller Sea lions and other marine mammals due to the speed of vessel travel.

Alternative 2, ADOT/FHWA's Preferred Alternative: Construction of the preferred alternative would require 21.9 acres of intertidal/subtidal habitat to be filled, plus the construction of three multi-span bridges with in-stream piers and six single-span bridges over anadromous rivers and streams and a ferry terminal north of the Katzehin River delta that would require dredging and breakwater construction. Effects on marine EFH from highway construction would occur from fill of intertidal habitats due to sidecasting of materials during road construction. The fill would bury all intertidal and subtidal organisms. The fill areas are generally small in size and would be expected to recolonize eventually with native species recruited from adjacent undisturbed sites. Herring spawning habitat in Berners Bay would not be impacted. Temporary barge landing sites for access to construction camps would be removed and restored. Multi-span bridges with in-stream piers would be required over the Antler, Berners/Lace Rivers and Katzahin River; single span bridges without in-stream piers would be used to cross all other anadromous fish streams. Ferry terminal construction impacts from Alternative 2 affecting marine and anadromous EFH occur from excavation and fill of intertidal and subtidal areas to construct the ferry terminal and vehicle parking areas (8.8 acres), breakwater construction, pier and pile installation for the dock, and dredging of the boat basin.

We offer the following EFH Conservation Recommendations for this alternative pursuant to Section 305(b)(4)(A) of the Magnuson-Stevens Act:

1) Realign the Berners/Lace and Antler River multi-span bridges so that they are located as far upstream as possible, minimizing the adverse effects of bridge construction and the effects on instream flows. Eulachon are important forage for federally managed fish species (as well as marine mammals) and spawn up to four miles upriver. Moving the bridge alignments upstream would decrease the amount of wetland habitat impacted, reducing effects on eulachon and Steller sea lions and other wildlife that use the mudflats, and minimizing future human impacts to the river deltas by providing additional distance between the roadway and river outlets into Berners Bay.

2) Provide compensatory mitigation sufficient to compensate for the loss of intertidal, subtidal and wetland habitats. We recommend that you develop a mitigation plan in consultation with NMFS and other resource agencies.

3) Minimize impacts of ferry terminal construction by incorporating a gap or large box culvert-type structure between the breakwater and the shore that would allow passage of juvenile salmonids during nearshore outmigration. This feature should be designed and constructed to accommodate juvenile passage at most tidal stages, except extreme low or minus tides. NMFS is providing standard recommendations for pile driving and construction of over water structures for use as general guidance in designing and constructing the Katzehin Ferry Terminal (Enclosure 2).

The SDEIS indicates that highway runoff is not expected to exceed state water quality standards in receiving waters, and that the project will adhere to BMPs that are protective of water quality (i.e., alignment has been shifted inland to the maximum extent possible to maximize the beach

buffer width, vegetated drainage ditches will be constructed, and oil-water separators will be installed and maintained at appropriate sites). Therefore, NMFS concurs that highway maintenance and operations under this alternative would not be likely to degrade EFH or adversely affect federally managed fish species.

Alternative 3: Alternative 3 would involve constructing a highway to Skagway along the west side of Lynn Canal, with a ferry connection from Berners Bay to William Henry Bay. Plans include construction of 39 miles of highway, three multi-span bridges with in-stream piers, 8 single-span bridges without instream piers, and two ferry terminals. The most significant adverse effects to living marine resources posed by this alternative are potential effects to the Lynn Canal herring population from a ferry terminal at Sawmill Cove in Berners Bay; effects to Steller sea lions, humpback whales and their prey from ferry operations across Berners Bay to William Henry Bay; and adverse effects to sensitive and productive subtidal habitats in William Henry Bay. However, this alternative could be combined with components of other alternatives to develop a blended alternative that is less damaging to EFH. If the east side road was extended to a ferry terminal north of Berners Bay with ferry service connecting to a west side terminal north of Endicott River, or terminated at a ferry terminal located south of Berners Bay, adverse impacts to Berners Bay and William Henry Bay could be avoided entirely.

As described in the SDEIS, selection of this alternative would likely require formal consultation under section 7 of the Endangered Species Act due to potential adverse direct and indirect effects to listed species from ferry terminal construction in Berners Bay and high-speed ferry operations across the bay and Lynn Canal.

Alternatives 2A, 4B, and 4D: All marine and road alternatives involving ferry terminal construction and operations in Berners Bay are likely adversely affect both Steller sea lions and humpback whales and their prey resources, and thus would likely require formal consultation with NMFS under the Endangered Species Act to ensure that the proposed action would not jeopardize the continued existence of either species.

Alternative 2A: Due to the combination of adverse effects from both road and marine impacts, especially in Berners Bay, alternative 2A has the greatest potential to impact living marine resources. NMFS' Endangered Species Act Biological Opinion prepared for the Kensington Gold project provides a complete analysis of potential direct, indirect and cumulative effects for a similar action involving ferry terminal construction and operation and vessel access across Berners Bay. NMFS anticipates that any formal consultation with ADOT/FHWA for the Juneau Access project would include analysis similar to this Biological Opinion; thus this document should be helpful to ADOT/FHWA in preparing a Biological Assessment for this project.

Essential Fish Habitat Assessment

The EFH Assessment is well written and comprehensive. The investigations of nearshore, intertidal and subtidal habitat areas potentially affected by each project alternative are thorough

and comprise a wealth of site-specific information on Lynn Canal's marine resources that will be useful for this and other projects.

ADOT on behalf of FHWA has determined that based on the scope and nature of impacts expected from the project, minimization of impacts, and the proposed mitigation measures, no substantial adverse individual or cumulative effects on EFH would occur under any project alternative. NMFS cannot concur with this determination. The SDEIS has comprehensively documented the extent of intertidal and subtidal fill, impacts from river and stream crossing, impacts from ferry terminal construction and operation and impacts from vessel operations, which would result from each alternative. All action alternatives would have adverse effects to EFH.

The Juneau Access project would adversely affect EFH in many ways: 1) construction of the marine facility at Sawmill Cove may degrade or destroy spawning habitat for Pacific herring, a species that provides forage for federally managed fish species; 2) the breakwater and boat traffic near the Sawmill Cove ferry terminal may degrade adjacent herring spawning habitat; 3) vessel traffic, noise, and changes in shoreline structure and intertidal habitat may alter the behavior of schooling adult fish and rearing juveniles in Berners Bay; 4) in-water structures and boat traffic may alter shoreline migration patterns of forage fish and juvenile salmonids, shifting the fish into areas where predation risks are greater (i.e., schooling along the edge of the breakwater, where fewer escape routes are available); and 6) vessel fuel leakage, contaminant spills, pollutant runoff and increased shoreline development of Berners Bay and Lynn Canal may impair water quality, particularly in areas where vessel activity and/or shoreline development are concentrated. Such impacts may happen alone or in tandem with other impacts. The overall effect of these stressors on forage fish resources depends on the frequency, magnitude, duration, and timing of disturbance. The extent of impacts on forage fish will also depend on the sensitivity of individual species and different life stages and whether the impacts occur alone or affect the animals as a suite of multiple stressors.

The Lynn Canal herring stock is particularly susceptible to adverse impacts from the Juneau Access Project because of the current condition of the population, its life history and its reliance on Berners Bay during all lifestages, particularly during spawning and larval development. The Lynn Canal herring population is a keystone species in the marine ecosystem of Lynn Canal. Herring are an integral component of the food web and are consumed by a wide variety of vertebrate species at different trophic levels. The Lynn Canal herring population is an important, year-round prey resource for Steller sea lions, humpback whales and other marine mammals that utilize Lynn Canal habitats. Specifically, this population supports the Steller sea lions that haul out and forage around Benjamin Island, Gran Point and Met Point. The herring are also consumed by sea lions foraging in Auke Bay during the winter months and in Berners Bay during the spring. The humpback whales commonly seen around North Pass, Shelter Island and Berners Bay feed on Lynn Canal herring and this forage fish is an important component of their diet throughout the year. Herring are also preyed upon by other fish species – during the larval and juvenile life stages, salmon, pollock, and other nearshore fish, which are also marine mammal prey resources, consume them. Further declines in the herring population could have

cascading effects on the Lynn Canal food web, with affects on the fitness of other fish, marine mammals, and seabirds.

Under Section 305(b)(4) of the Magnuson-Stevens Act, NMFS is required to provide EFH Conservation Recommendations to Federal agencies for actions that would adversely affect EFH. These recommendations may include measures to avoid, minimize, mitigate or otherwise offset adverse effects. Section 305(b)(4)(B) requires a Federal agency to provide a detailed response in writing to NMFS which includes the measures proposed for avoiding, mitigating or offsetting the impact of the activity on EFH. Our conservation recommendations for the preferred alternative are listed above under the discussion of Alternative 2. NMFS will develop conservation recommendations for the final preferred selected alternative if ADOT selects an alternative other than 2.

Threatened and Endangered Species - Section 4.1.16

ADOT/FHWA plan to provide NMFS with an updated Biological Assessment addressing the potential effects of the proposed alternative on two populations of Steller sea lions, and the North Pacific population of humpback whales with special emphasis on the North Central subpopulation of this species. This BA will consider whether the effects of the proposed action is likely to adversely affect the:

(i) Western population of Steller Sea Lions (*Eumetopias jubatus*; listed as endangered on May 5, 1997 [62 FR 30772]; critical habitat designated on August 27, 1993 [58 FR 45269])

(ii) Eastern population of Steller Sea Lions (*Eumetopias jubatus*; listed as threatened on November 26, 1990 [55 FR 40204]; critical habitat designated on August 27, 1993 [58 FR 45269])

(iii) North Pacific Humpback Whales (*Megaptera novaeangliae*) listed as endangered upon passage of the ESA of 1973 (16 U.S.C. 1531 *et seq.*)

No other listed species under NMFS jurisdiction are found in the action area, or waters adjacent to the action area. Preliminarily, FHWA has determined that Alternatives 2 through 2C would not be likely to adversely affect Steller sea lions.

NMFS review of the 1997 Draft EIS for the Juneau Access Project concluded that Steller sea lions would not be adversely affected if the following mitigation measures were followed:

- No boat launches or structures that enhance boat access would be constructed anywhere along the East Lynn Canal Highway

- Expand year-round monitoring at Gran Point and Met Point to include an assessment of human behavior around the haulouts. This study would be conducted for a period of at least three years after the highway is constructed and it should focus on whether access

from the highway is causing disturbance to sea lions. If human disturbance is documented, additional mitigation measures would be required

- ❖ Employ independent observers during construction to ensure that sea lions are not present at the Gran Point haulout. If sea lions are present at any time during construction in the Gran Point Critical Habitat Area, all work must cease and NMFS must be consulted before any further construction proceeds.

During the time since this earlier consultation occurred, ADOT has monitored Steller sea lions at Gran and Met Points in 1998 and 2002 to 2004. ADOT has also adjusted the highway alignments to minimize potential impacts to sea lions. NMFS will review the Biological Assessment once it is completed and offers the following comments on the Steller sea lion Technical Report to assist ADOT/FHWA in development of the BA.

High-speed ferries increase the risk of collisions with humpback whales and, though less likely, Steller sea lions. Alternatives that include construction and maintenance of additional ferry terminals, particularly in Berners Bay, are likely to adversely affect prey resources upon which the listed species depend (Pacific herring, eulachon and capelin), and thus could adversely affect the fitness of Steller sea lion and humpback whales.

Steller Sea Lion Technical Report

The Steller sea lion Technical Report considers the effects of construction noise, human presence and traffic noise from road construction and use, ferry terminal construction and use, and vessel traffic on Steller sea lions.

Steller sea lions from both the western and eastern distinct population segments are likely to occur in the project area. Steller sea lions branded in the western population have been observed at Benjamin Island, Gran Point and Little Island in Lynn Canal, near Berners Bay. Of 348 sightings of branded individuals, 5 animals were from the western population. Thus, few animals from the western population occur in the action area. Steller sea lions branded as pups in the eastern population at the Forrester and Hazy Island rookeries have been observed at Benjamin Island, Gran Point, Met Point, and Little Island in Lynn Canal. Between 2000 and 2004, a total of 343 branded animals from the eastern population were observed at these haulouts. Of those observed, 162 branded animals were observed at Benjamin Island (77 females, 83 males); 136 were observed at Gran Point (57 females, 80 males); 39 were observed at Little Island (14 females, 27 males); and 6 were observed at Met Point (5 females, 1 male). Of the animals observed, 105, 45, and 5 animals were observed nursing or suckling at Benjamin Island, Gran Point, and Little Island respectively. In contrast, only 5 branded animals from the western stock have been observed at these haulouts. Although no branded animals have been identified in Berners Bay, the evidence presented suggests that most of the animals using Lynn Canal including Berners Bay are from the eastern population.

Table 1, Summary of Steller Sea Lion Monitoring at Gran Point (page 2-4) should be improved with inclusion of more exact measures of sea lion abundance. The actual numbers of animals observed should be included in the table instead of the imprecise references of "few to many, many, and decreasing." NMFS also requests a copy of the video camera monitoring log data so that we are able to use these data to document any future changes in Steller sea lion abundance at the site.

On page 3-1, current estimates of the eastern stock abundance should be updated with the more recent figure of 31,028 from Angliss and Lodge, 2004 instead of the figure of 30,453 from Angliss and Lodge 2002.

The distribution of Steller sea lions within Lynn Canal should include the ephemeral haulout at the mouth of Slate Creek Cove in Berners Bay, which is used seasonally by a large number of animals during the spring eulachon run. On page 4-5, Section 4.3, Alternative 2A this site is described, and this haulout site should also be referenced in other parts of the document.

The discussion of noise should mention that increased vessel traffic in Berners Bay would increase the possibility of vessel strikes, although the probability of striking Steller sea lions would be low due to their speed and agility. The amount and effects of noise on hauled-out Steller sea lions at Gran Point and Met Point generated from avalanche control measures should be addressed.

NMFS cautions that the mitigation measures listed on page 4-11 are actually monitoring activities, the results of which should be used to develop necessary adaptive management actions and techniques that would mitigate for any adverse effects that were discovered.

The discussion of noise on page 4-63 refers to traffic noise as occurring at a level that often occurs in the natural environment. Traffic noise is not a part of the natural environment; this is really referring to noise, other than traffic, in a natural environment that is of similar level. The reference to Minke whales' tendency to be attracted to motor vessels should be further explained.

Discussion on page 4-69 refers to the proposed ferry terminal at Slate Creek Cove as being about three miles away from the haul out at Point St. Mary. However, this terminal would be close to the Slate Creek Cove haul out.

FHWA has made a preliminary determination (page 4-69) that Alternatives 2 through 2C are not likely to adversely affect Steller sea lions or critical habitat. NMFS disagrees with this for Alternative 2A for reasons described above, and concurs for Alternatives 2, 2B and 2C if the proposed mitigation measures, including adaptive management, are adopted. The proposed mitigation measure #5 for threatened and endangered species (section 5.9) should be expanded to include "...if adverse effects are identified, mitigation measures will be employed through consultation with NMFS."

Additional minor comments are listed in Enclosure 1.

Please contact Susan Walker (907-586-7646, susan.walker@noaa.gov) with any questions regarding this review.

Sincerely,

Susan Kennedy
Acting NEPA Coordinator

Enclosures

cc: Tim Haugh - FHWA, Juneau
Moira Ingle - ADNR-OHMP
Carl Schrader - ADNR-OHM
Bruce Halstead - FWS, Juneau
Chris Meade - EPA, Juneau

Enclosure 1

National Marine Fisheries Service Minor Comments for the Juneau Access Project SDEIS

EFH Assessment

Page 1-2. The process for conducting the EFH assessment is to include the EFH Assessment in the DEIS and NMFS will review and provide comments on both the NEPA document and the EFH assessment concurrently, rather than determining if the proposed action would result in substantial adverse effects and entering into an expanded consultation.

Page 4-14. The forage fish assessment can be updated with appropriate information from the Biological Opinion for the Kensington Gold project, which goes into greater depth and includes the most recent research findings for forage fish particularly in Berners Bay. NMFS will provide a copy of the Biological Opinion to ADOT.

Page 4-17. Age structured analysis is not used for forecasting herring abundance for the Lynn Canal herring population because the population's spawning biomass is chronically below the harvest threshold.

Page 4-18. Many possible reasons could contribute to the lack of recovery of the Lynn Canal herring population. The document repeatedly mentions only one possible cause, increased Steller sea lion predation, yet other possible causes exist. Most likely several factors together caused the population's decline and prevent its recovery.

Page 4-18. The extent of Lynn Canal herring spawn and spawning biomass were estimated for 2004 by ADF&G. See the Kensington Gold project Biological Opinion for these recent estimates and update this information.

Page 4-20. Add site-specific capelin data for Berners Bay as included in the Kensington Gold Biological Opinion.

Page 5-14. The effects of ferry terminal construction and operations at Katzahin River are characterized as "low." We suggest describing the effects of project components without subjective ratings.

Page 5-16. The document states that less than 2% of the spawning area for Pacific herring would be impacted by ferry terminal development. See the Kensington Gold Biological Opinion for a full discussion of the direct and indirect effects of ferry terminal development on this stock of Pacific herring. The location of the proposed Sawmill Cove ferry terminal could be more damaging to this population due to its location in the center of remnant spawning habitat.

Page 5-43. The document references "USFS 2004" regarding PAH accumulation in fish muscle tissue and ovaries. The proper citation is probably:

Johnson, L.L., Sol S.Y., Ylitalo, G.M., Hom T., French B., Olson, O.P., Collier, T.K. 1999. Reproductive injury in English sole (Pleuronectes vetulus) from the Hylebos Waterway, Commencement Bay, Washington. Journal of Ecosystem Stress and Recovery 6: 289-310.

Page 6-2. The document proposes to control runoff through drainage ditches. Runoff would be better controlled, where possible, though vegetated drainage ditches and vegetated swales.

Page 6-3. Ferry operations would incorporate BMPs to prevent and clean up fuel spills. NMFS suggests adding information on the size of anticipated spills and how large a spill (gallons) could be cleaned up with the amount of absorbent materials that would be carried on-board.

Enclosure 2

Katzehin Ferry Terminal

The Katzehin Ferry Terminal would replace intertidal and subtidal habitat to about 15 meters below the area exposed by the mean lower low tide. The terminal and associated activities could alter light, wave energy, substrate type, depth, and water quality in the project area and interfere with key ecological functions such as spawning, rearing, and refugia.

Construction and maintenance of the ferry terminal would involve driving pilings and dredging the boat basin. Both activities may also adversely affect EFH.

Recommended Conservation Measures for Ferry Terminal Design

The following conservation measures should be incorporated into project design, construction and operation of the ferry terminal to minimize adverse effects:

1. Locate over water structures in deep enough waters to avoid intertidal impacts, to minimize or preclude dredging, to minimize groundings, and to avoid displacement of submerged aquatic vegetation, as determined by a preconstruction survey.
2. Incorporate measures that increase the ambient light transmission under piers and docks. These measures include, but are not limited to the following:
   - Maximizing the height of the structure and minimizing the width of the structure to decrease the shade footprint
   - Using solar tubes, glass blocks, and/or grated metal decking to direct sunlight under the structure
   - Using reflective paint or materials (e.g., concrete or steel instead of materials that absorb light such as wood) on the underside of the dock to reflect ambient light
   - Using the fewest number of pilings necessary to support the structures to allow light into under-pier areas and minimize impacts to the substrate
   - Aligning piers, docks, and floats in north-south orientation to allow the arc of the sun to cross perpendicular to the structure and to reduce the duration of light limitation
3. Use floating breakwaters whenever possible and remove them during periods of low dock use.
4. Locate floats in deep water to avoid light limitation and grounding impacts to the intertidal zone.
5. Maintain at least 1 foot of water between the substrate and the bottom of the float at extreme low tide.
6. Conduct in-water work when managed fish species and prey species are least likely to be impacted.
7. Avoid use of treated wood timbers or pilings to the extent practicable. Use alternative materials such as untreated wood, concrete, or steel.
8. Fit all pilings and navigational aids, such as moorings and channel markers, with devices to prevent perching by piscivorous bird species.
9. Orient night lighting to avoid illumination of the surrounding waters.

The effects of pile driving would be temporary but significant. The potential adverse impacts of pile driving result from the generation of intense underwater sound pressure waves that may adversely affect EFH. These pressure waves have been shown to injure and kill fish. Injuries associated directly with pile driving are poorly studied, but include rupture of the swim bladder and internal hemorrhaging. Sound pressure levels (SPL) 100 decibels (dB) above the threshold for hearing are thought to be sufficient to damage the auditory system in many fishes.

The type and intensity of the sounds produced during pile driving depend on a variety of factors, including, but not limited to, the type and size of the pile, the firmness of the substrate into which the pile is being driven, the depth of water, and the type and size of the pile-driving hammer. SPLs are positively correlated with the size of the pile, as more energy is required to drive larger piles. Wood and concrete piles appear to produce lower sound pressures than hollow steel piles of a similar size. Hollow steel piles as small as 14 inches diameter have produced SPLs that can injure fish. Firmer substrates require more energy to drive piles and produce more intense sound pressures. Sound attenuates more rapidly with distance from the source in shallow water than it does in deep water.

Driving hollow steel piles with impact hammers produces intense, sharp spikes of sound that can easily reach levels injurious to fish. Vibratory hammers, on the other hand, produce sounds of lower intensity, with a rapid repetition rate. Thus, impact hammers may be more harmful than vibratory hammers because they produce more intense pressure waves and because the sounds produced do not elicit an avoidance response in fishes, which exposes them to those harmful pressures for longer periods.

Systems successfully designed to reduce the adverse effects of underwater SPLs on fish have included the use of air bubbles. Both confined (i.e., metal or fabric sleeve) and unconfined air bubble systems have been shown to attenuate underwater sound pressures up to 28 dB. When using an unconfined air bubble system in areas of strong currents, it is critical that the pile be fully contained within the bubble curtain. To accomplish this when designing the system, adequate airflow and ring spacing, both vertically and in terms of distance from the pile, are factors that should be considered.

Recommended Conservation Measures for Pile Driving

Install any hollow steel piles with an impact hammer from June 15 through March 15 when larval and juvenile stages of fish species with designated EFH are not present. If this is not possible, then the following measures regarding pile driving should be incorporated to minimize adverse effects:

1. Drive piles during low tide when located in intertidal and shallow subtidal areas.
2. Use a vibratory hammer when driving hollow steel piles. Under those conditions where impact hammers are required for reasons of seismic stability or substrate type, the pile should be driven as deep as possible with a vibratory hammer before using the impact hammer.

3. Monitor peak SPLs during pile driving to ensure that they do not exceed the 190 dB re:1 ΦPa threshold for injury to fish.
4. Implement measures to attenuate the sound should SPLs exceed the 180 dB re: 1 ΦPa threshold. If sound pressure levels exceed acceptable limits, implement mitigation measures. Methods to reduce the sound pressure levels include, but are not limited to, the following:
   a) Surround the pile with an air bubble curtain system or air-filled cofferdam.
   b) Because the sound produced has a direct relationship to the force used to drive the pile, use a smaller hammer to reduce the sound pressures.
   c) Use a hydraulic hammer if impact driving cannot be avoided. The force of the hammer blow can be controlled with hydraulic hammers; reducing the impact force will reduce the intensity of the resulting sound.
5. Drive piles when the current is reduced (i.e., centered around slack current) in areas of strong current to minimize the number of fish exposed to adverse levels of underwater sound.