Appendix H: Essential Fish Habitat Determination

Port of Nome Modification Feasibility Study

Nome, Alaska

Appendix H: Essential Fish Habitat Determination

US Army Corps of Engineers

Alaska District

DEPARTMENT OF THE ARMY
ALASKA DISTRICT, U.S. ARMY CORPS OF ENGINEERS
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15 January 2019

Mr. Matt Eagleton
Regional Essential Fish Habitat Coordinator
Habitat Conservation Division
National Marine Fisheries Service – Alaska Region
222 W 7th Ave, Room 552
Anchorage, AK, 99513

Dear Mr. Eagleton,

Attached please find an Essential Fish Habitat (EFH) Assessment for the U.S. Army Corps of Engineers (Corps) "Port of Nome Modifications" project at Nome, Alaska. The Corps requests a review of this document and recommendations on EFH conservation from the National Marine Fisheries Service (NMFS). The attached EFH Assessment determines that the project may have adverse, but minor and localized, effects on EFH for Pacific salmon, red king crab, and several species of Bering Sea groundfish.

The Corps looks forward to working with the NMFS on this project. Please contact Chris Floyd at Christopher.B.Floyd@usace.army.mil, or by telephone at (907) 753-2700 if you need additional information.

Sincerely,

Michael R. Salyer

Michael L. Salyer
Chief, Environmental Resources Section

ESSENTIAL FISH HABITAT ASSESSMENT

PORT OF NOME MODIFICATIONS
NOME, ALASKA

Prepared by:
U.S. ARMY ENGINEER DISTRICT, ALASKA
ENVIRONMENTAL RESOURCES SECTION

January 2019

ESSENTIAL FISH HABITAT ASSESSMENT

Port of Nome Modifications
Nome, Alaska

1. Introduction

1.1 Preface

The 1996 amendments to the Magnuson-Stevens Fishery Conservation and Management Act established the essential fish habitat (EFH) provision to identify and protect important habitats of Federally-managed marine and anadromous fish species. Federal agencies that fund, permit, or undertake activities that may adversely affect EFH are required to consult with National Marine Fisheries Service (NMFS) regarding the potential effects of their actions on EFH, and respond in writing to NMFS recommendations.

EFH is defined as those waters and substrates necessary to fish for spawning, breeding, feeding, or growth to maturity. “Waters” include aquatic areas and their associated physical, chemical, and biological properties that are used by fish, and may include aquatic areas historically used by fish where appropriate. ”Substrate” includes sediment, hard bottom, structures underlying the waters, and associated biological communities.

1.2 Project Purpose

The purpose is to improve marine infrastructure and available draft at the Port of Nome (figure 1), to reduce the congestion, operational inefficiencies, vessel damage, and risk of fuel spills that currently affect the port and limit the long-term economic viability of Nome and the surrounding region.

1.3 Project Area Description

1.3.1 General

The harbor at Nome was built where the Snake River discharges into Norton Sound (figure 2). The harbor site is on an exposed stretch of low-relief sand and gravel coastline. The seabed near the harbor is a largely featureless expanse of sand and gravel that deepens very gradually, only reaching a depth of -40 feet MLLW at a distance of about 3,000 feet offshore (figures 2 and 3).

Norton Sound is covered with sea ice from November to May, with shorefast ice forming first along the northern shore of the Sound. The seaward edge of the shorefast ice generally extends out to the 66-foot depth contour (RJW 2013), which corresponds to a distance of 2 nautical miles or more from shore (figure 2).

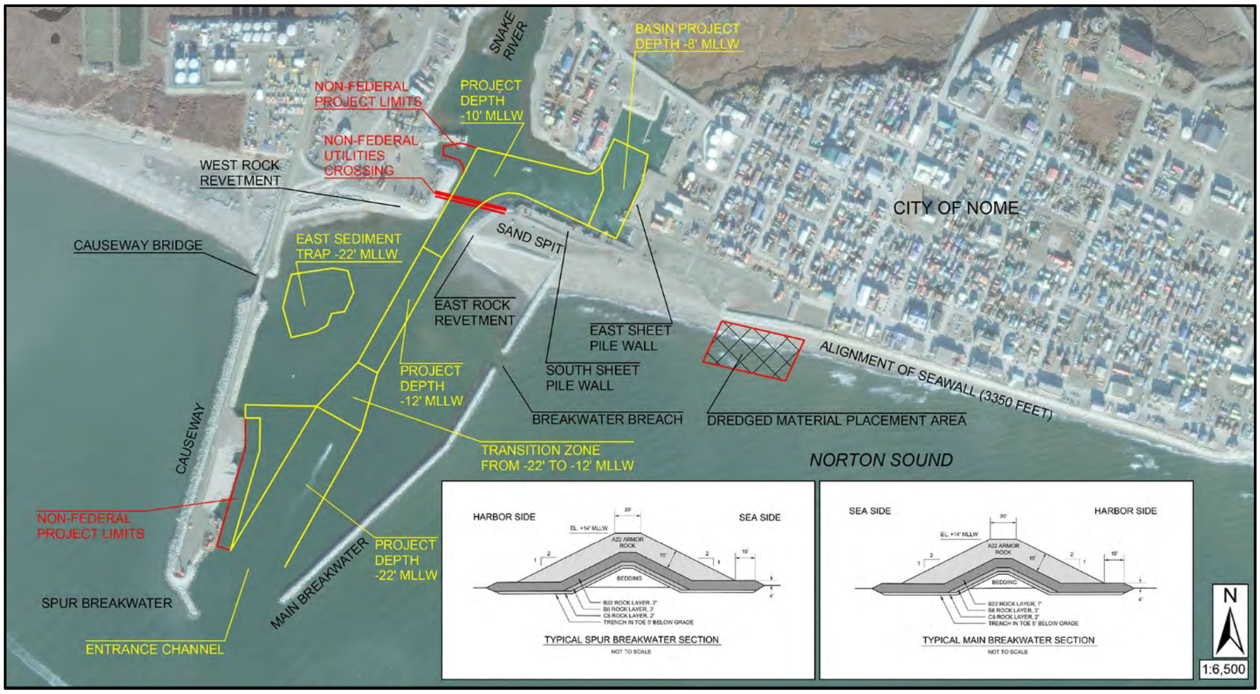

Figure 1. Existing layout of Nome harbor

The natural nearshore environment includes the continuous migration and redistribution of benthic sediments via littoral transport, as well as frequent disruption from ice scouring and storm surge. Storms are known to alter substrates to depths of about 65 feet below the surface. Studies of the general biological setting offshore of Nome describe species typical of a high-energy, sandy-gravelly coastal environment dominated by epifaunal and infaunal species such as sea stars, polychaetes, bivalves, and amphipods that are adapted to a loose, shifting substrate (RJW 2013).

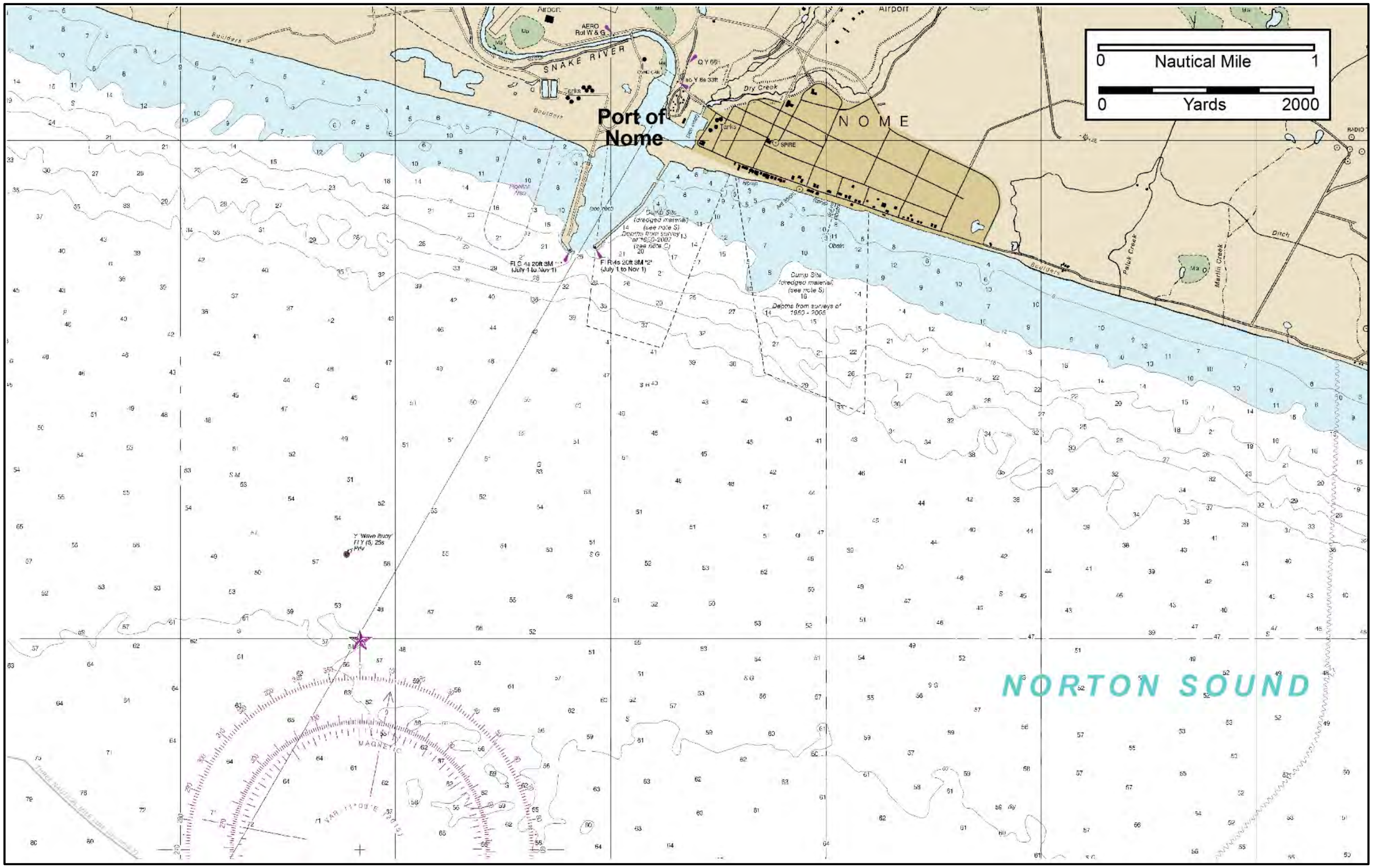

Figure 2. Excerpt from NOAA Chart 16206 showing the shallow, flat or gently-shelving hydrography near Nome; soundings are in feet.

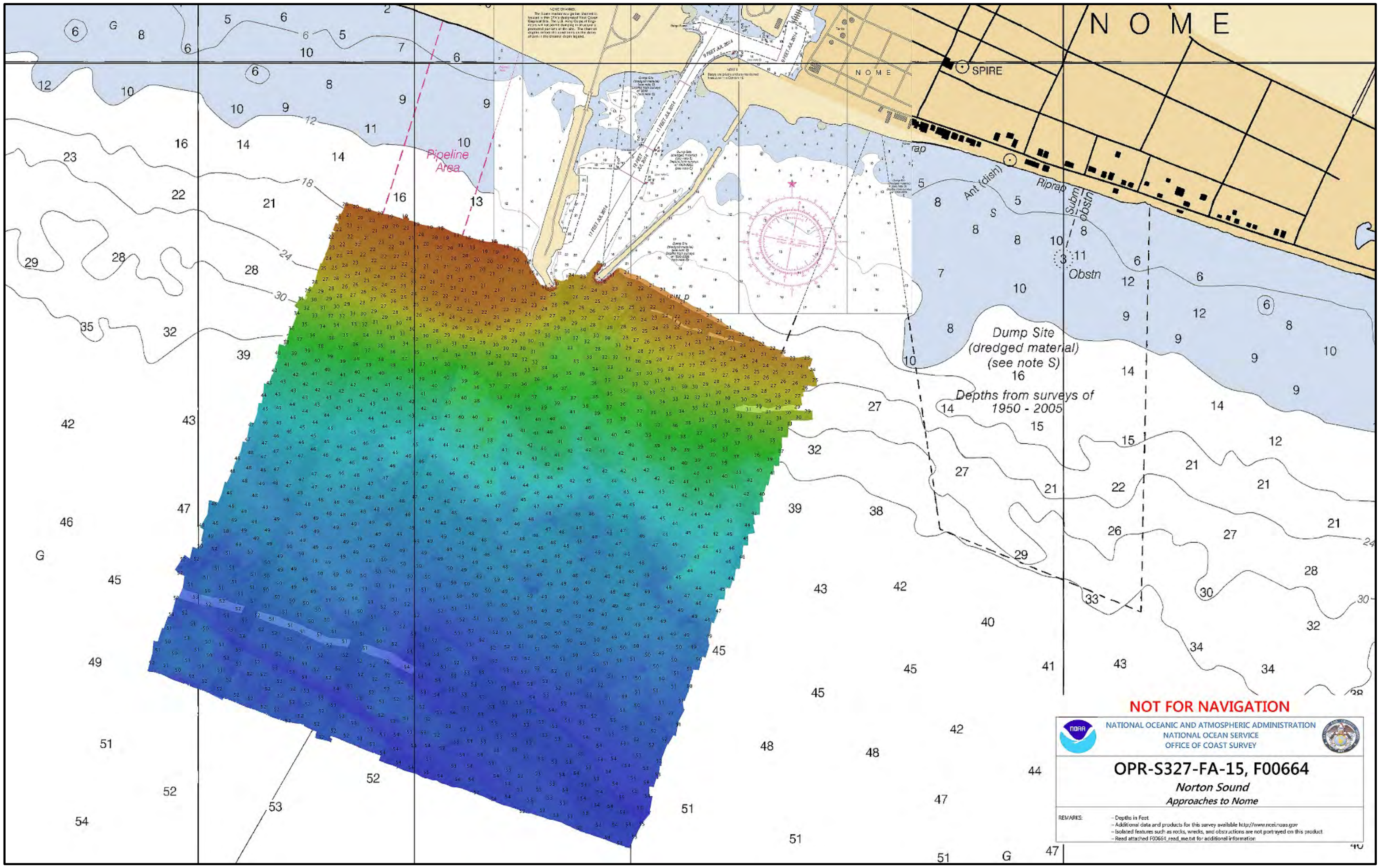

Figure 3. Graphic generated from the NOAA 2015 hydrographic survey of the approaches to the Port of Nome; soundings are in feet (NOAA 2015).

1.3.2 August 2018 survey of marine substrate

A drop-camera video survey performed at 43 locations by the Corps on 7-8 August 2018 (figure 4) tended to confirm this general view of the nearshore marine habitat. Most points within and to the immediate east and west of the outer harbor showed waves of fine sand (figures 4 and 5). Although sea conditions during the survey were very calm, with little discernable swell at the surface, the videos show a subsurface wave action visibly reworking the sand waves and re-suspending fine sediments. The water column in a broad area to the west of the causeway was so turbid that the seafloor could not be viewed by the camera resting just a few inches off the bottom (figure 4).

Areas of coarser sand, sometimes with pebbles and cobbles, were noted to the east of the breakwater, and in a known scour area off the end of the causeway (figures 3 and 4), but not west of the causeway. Given the general west-to-east littoral transport along the coastline at Nome, it is possible that these coarse deposits may result from changes to sediment transport caused by the causeway and breakwater structures.

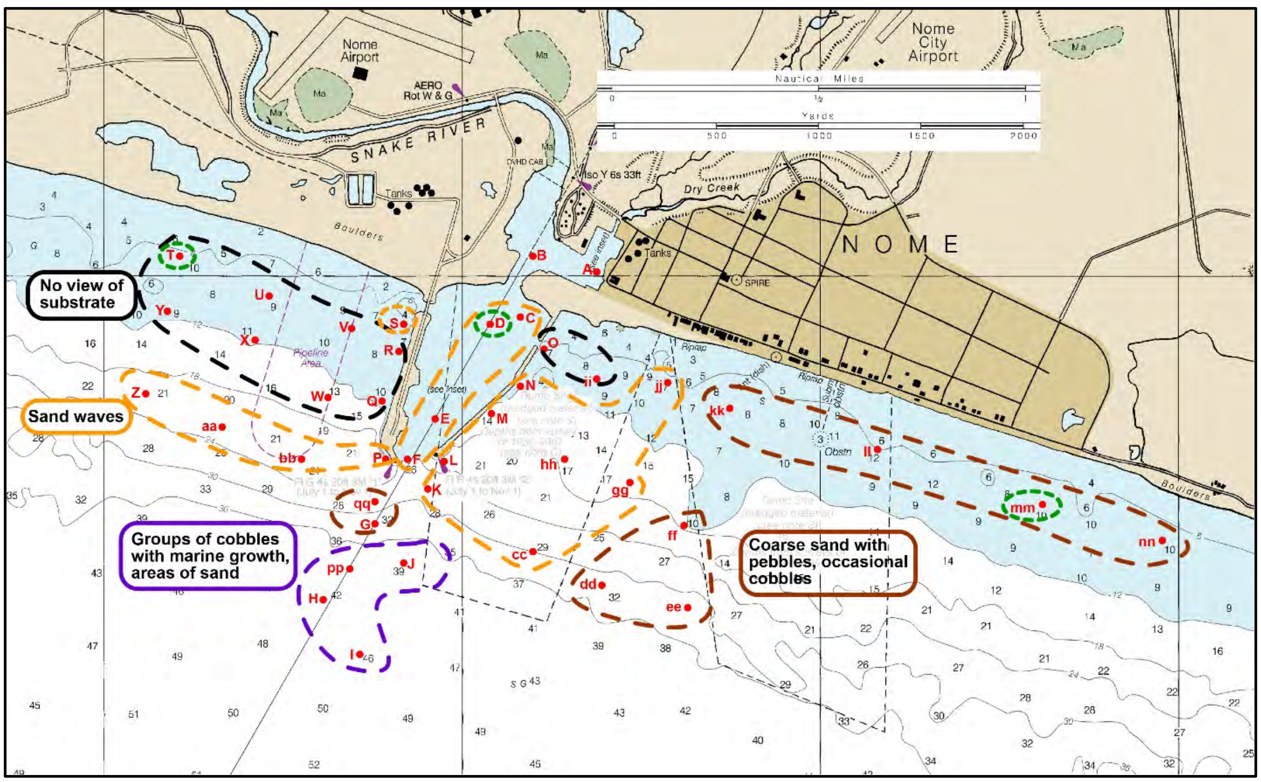

Figure 4. Conceptual groupings of substrate types observed using a drop-camera 7-8 August 2018; the red dots with alphabetical designations indicate the 43 individual observation points.

Discontinuous areas of cobbles and boulders encrusted with marine life (tentatively identified from the videos as sponges, bryozoans, small barnacles, etc.) were found at points off the end of the current causeway, roughly 3,200 to 6,000 feet from the shoreline in water depths of 40-50 feet. These points are in the general footprint of an extended causeway. The groups of cobbles were separated by swaths of sand and gravel.

Visibility at most locations was poor due to suspended material, and a heavy green cast from phytoplankton (apparent in the figure 5 photos). At many locations, much of the material in the water column appeared to be planktonic or free-swimming organisms, judging by the size and movement of the particles. Incidental sightings of larger marine organisms noted on the drop-camera videos included several fish (probably saffron cod) at points ee and ff (figures 4 and 5); several possible small squid at point gg; a sea jelly (probably *Aurelia* sp.) at point cc; unidentified 5-limbed sea stars at points aa and cc; and a possible marine worm casting on the sand surface at point M. At three widely-spaced points, the drop-camera encountered large clumps of unidentified marine plants (figures 4 and 5). The orientation and motion of the plants in the videos suggested that they were rooted to the substrate, but this could not be confirmed.

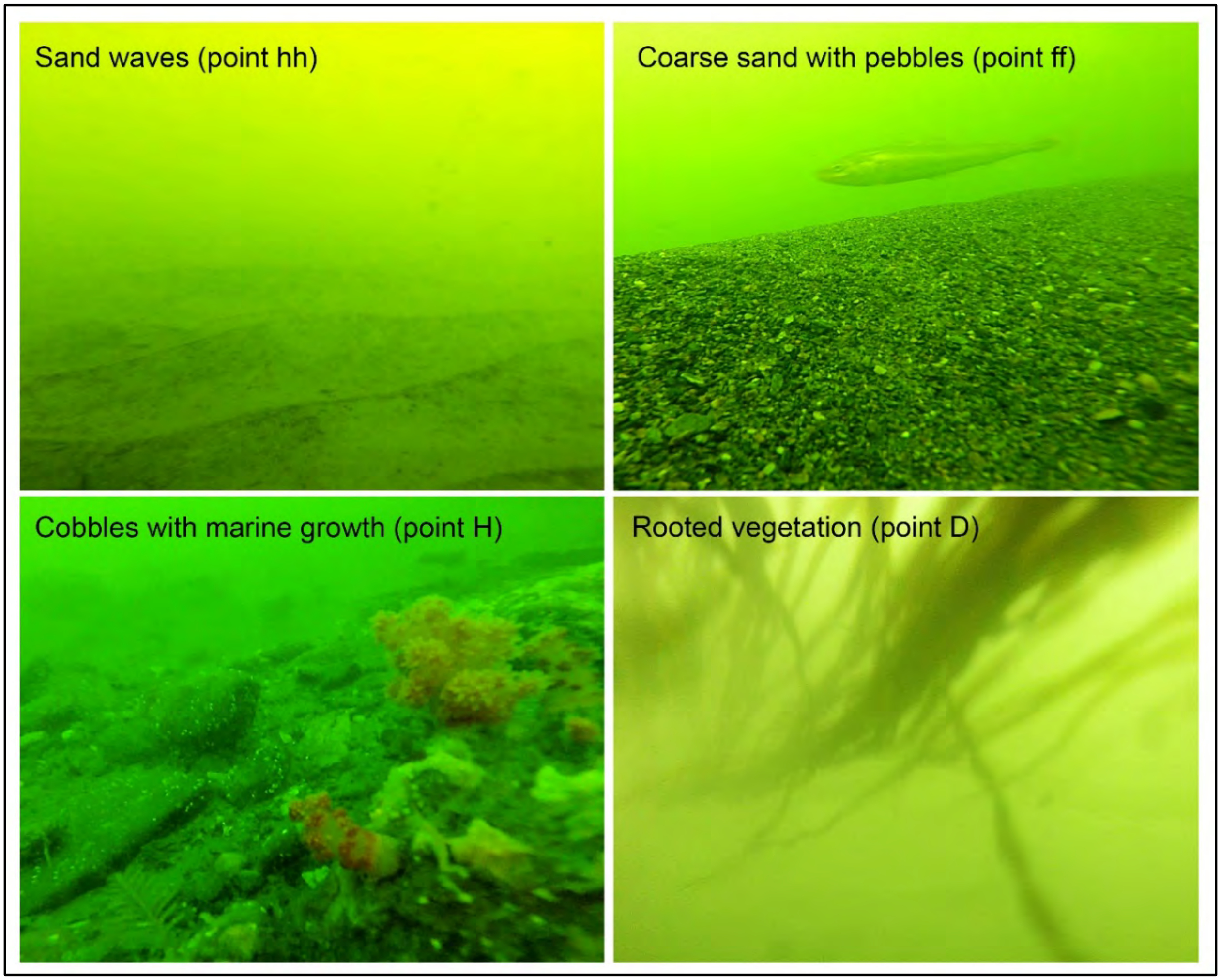

Figure 5. Representative still photos from the 7-8 August 2018 drop-camera video survey, showing the different types of substrate and seafloor features observed

The existing rubblemound causeway and breakwater at Nome represent another type of substrate within the project area that is uncommon in the Nome area: vertical rocky surfaces. Annual scouring by sea ice and a minimal tidal range presumably severely limits the extent to which intertidal marine organisms can exploit the rock surfaces, but growth of several marine algae species, including *Fucus* (a.k.a., rockweed) can be seen at numerous locations on armor stone awash or just under the water surface (figure 6). Herring reportedly spawn on these patches of *Fucus* (Charlie Lean, personal communication). Small barnacles are also widespread on the rock surfaces. Mussels grow at depth on the rock; their shells are abundant on the beach to the east of the causeway. The ice environment at Nome requires rubblemound structures to be surfaced with very large armor rock, the arrangement of which creates correspondingly large voids and channels within the structure; these are potentially useful microenvironments that organisms may exploit in unknown ways.

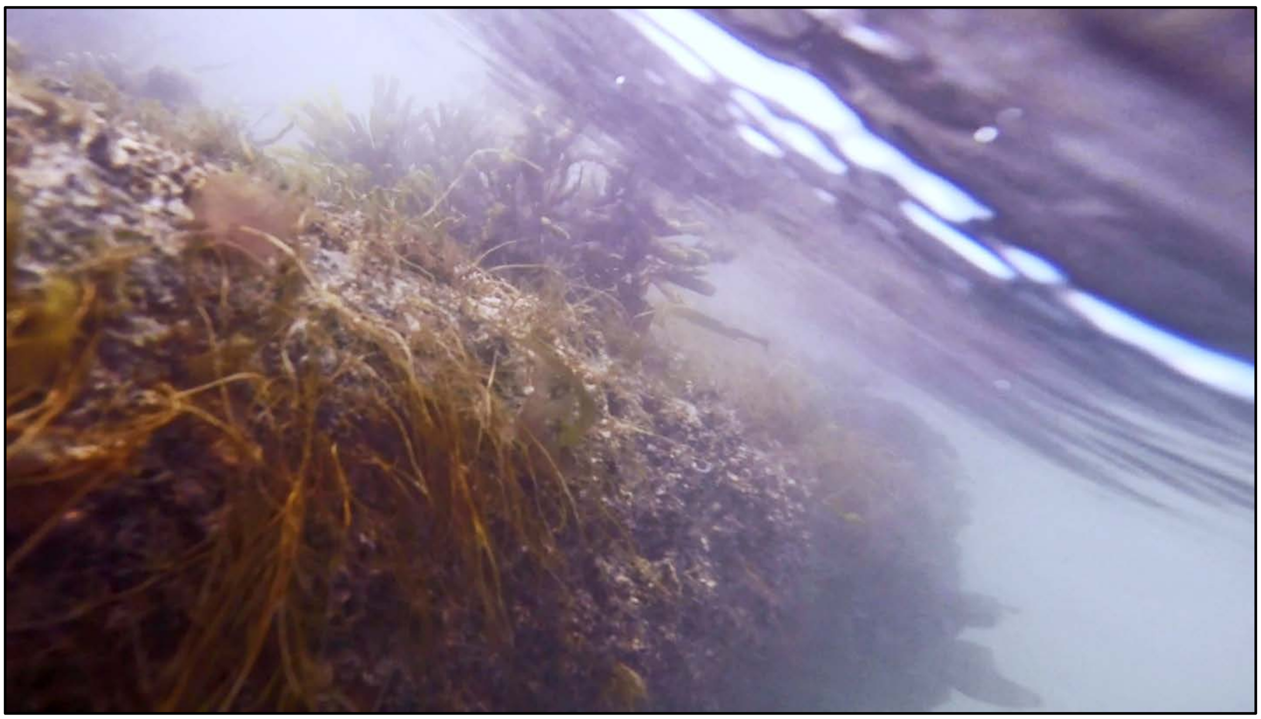

Figure 6. *Fucus*, other marine algae, and barnacles growing on causeway armor stone below the water surface (8 August 2018).

1.3.3 September 2013 beach seining

Fish and invertebrates were sampled in shallow nearshore waters near Nome by personnel from the Corps and the U.S. Fish and Wildlife Service Fairbanks Office during 16-20 September 2013. Five species of fish, and two genera of invertebrates (*Neomysis* and *Crangon* shrimp) were identified in that limited sampling effort, as summarized on figure 7 (USACE 2013).

Figure 7. Summary results of beach seining at Nome, September 2013

2. Project Description

The Corps is currently studying six construction alternatives (Alternatives 3a, 3b, 3c, 4a, 8a, and 8b; figures 8-1 through 8-6) in an effort to identify the most useful, cost-effective, and least environmentally-damaging project. From an environmental perspective, the construction alternatives are all similar to one another, differing primarily in the extent, rather than type or location, of their impacts.

Each alternative includes several modification elements:

1. The existing west rubblemound causeway (figure 1) would be lengthened into an L-shaped structure extending into deeper water; the proposed extensions range from 2,340 to 3,937 linear feet (figures 8-1 to 8-6). One to three new concrete caisson docks would be added to the causeway extension. Alternatives 3a, 4a, 8a, and 8b also add a new sheet pile bulkhead dock to the existing causeway just south of the fish passage gap.

2. The existing east rubblemound breakwater (figure 1) would be:

a. modified to a minor degree (Alternatives 3a and 3c); or

b. removed, and a new rubblemound causeway constructed, tying into shore at the same location as the existing breakwater (Alternative 4a); or

c. removed, and a new rubblemound causeway constructed, tying into shore about 600 feet to the east of the existing breakwater location (Alternatives 3b, 8a, and 8b). A new east causeway would include one or two concrete caisson docks.

3. Several areas of sea floor would be deepened by dredging to allow passage of deeper-draft vessels:

a. a new deep water basin at the end of the extended causeway would be dredged to depths of 30 to 40 feet below mean lower low water (MLLW);

b. the existing outer basin would be deepened to 25–27 feet below MLLW, from the current depth of -22 feet MLLW;

c. the existing entrance channel and mooring basin would be deepened to -12 feet MLLW, from the current depth of -10 feet MLLW.

Project construction dredging will remove roughly 700,000 to 2,000,000 cubic yards of sea floor material, depending on the alternative and design depths selected. All material to be dredged will be sampled and analyzed for physical characteristics and chemical content prior to dredging. The current assumption is that most of this material, if found suitable, will be placed for beach nourishment along the base of the Nome seawall, similar to what is currently done with the material from annual maintenance dredging at Nome. Alternate disposal methods, such as confined disposal or ocean dumping, may be necessary for material not suitable for nearshore beneficial placement.

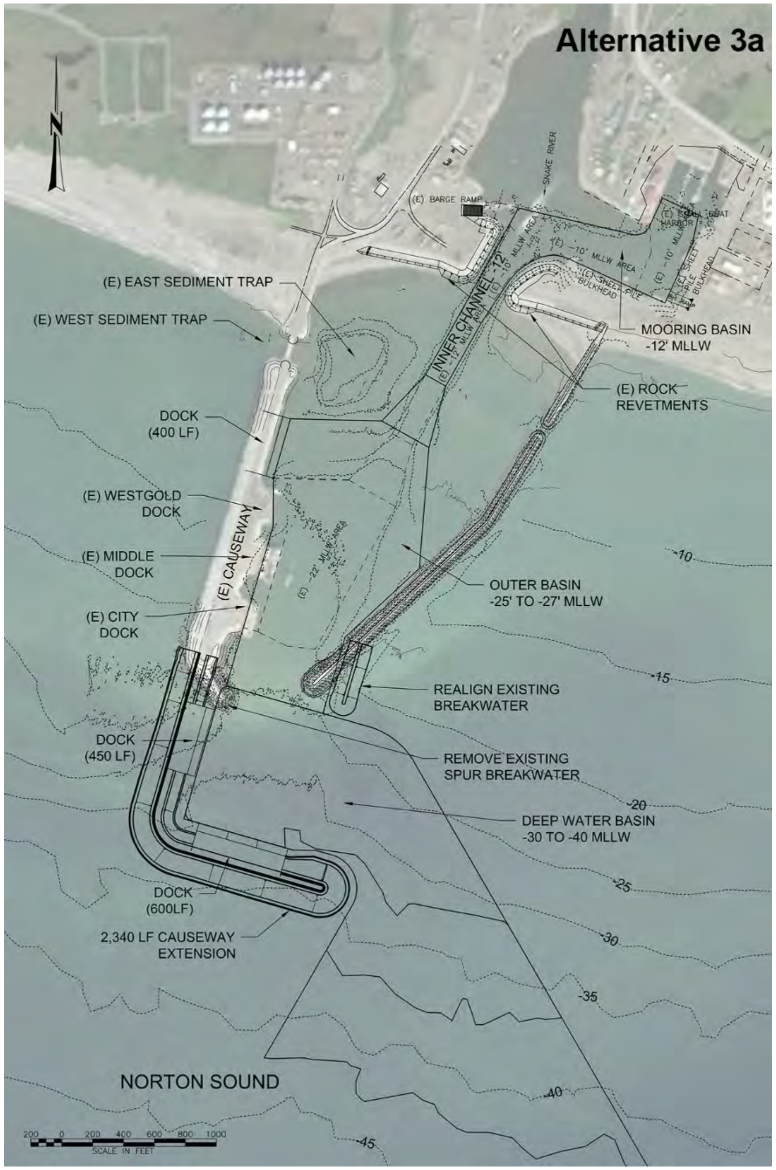

Figure 8-1. Alternative 3a

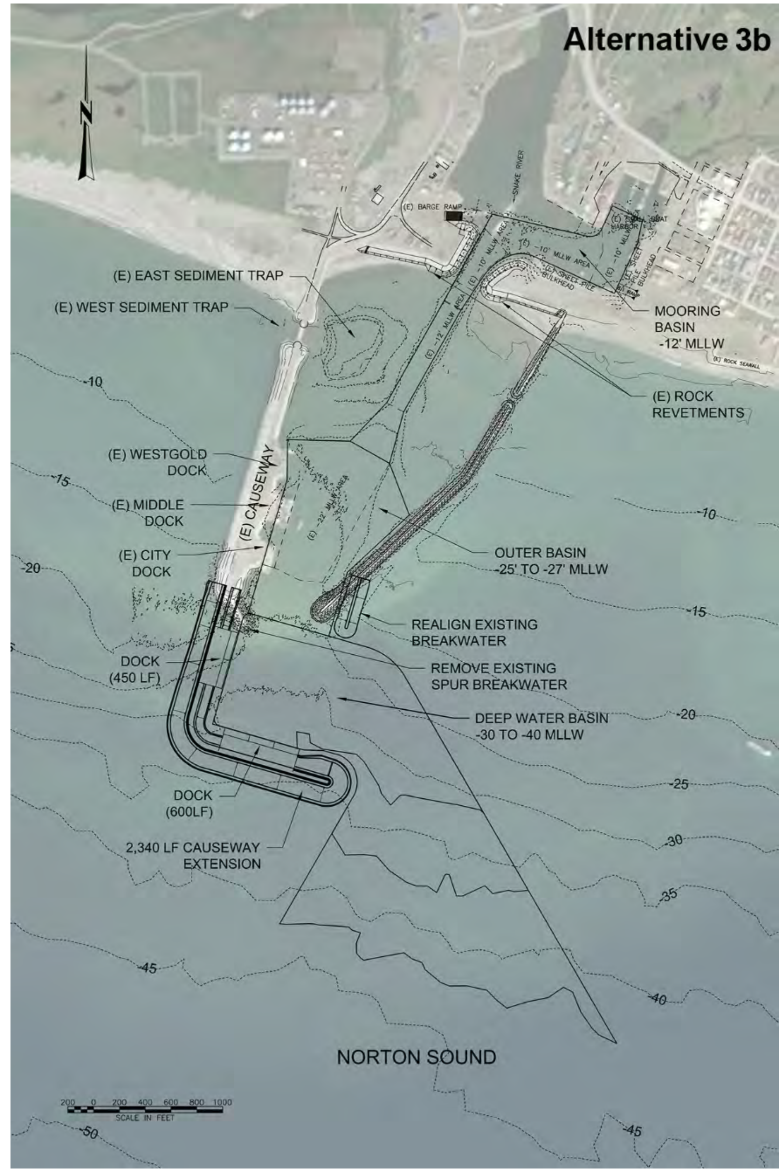

Figure 8-2. Alternative 3b

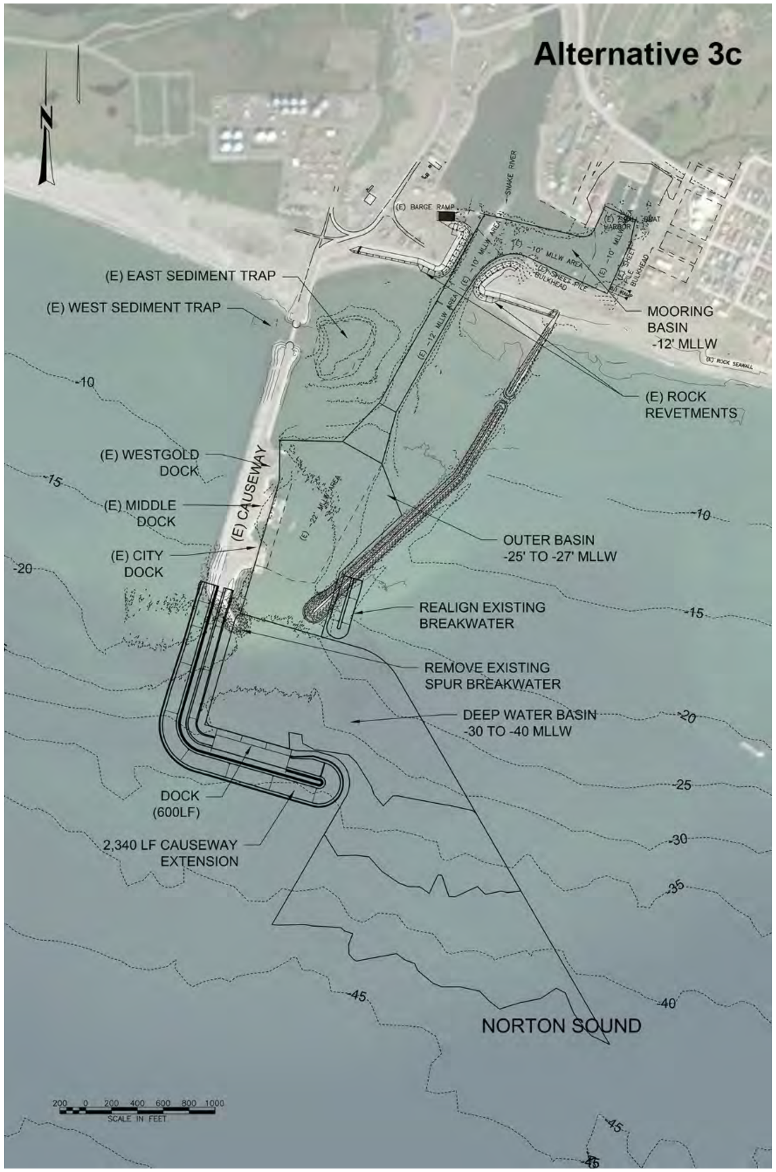

Figure 8-3. Alternative 3c

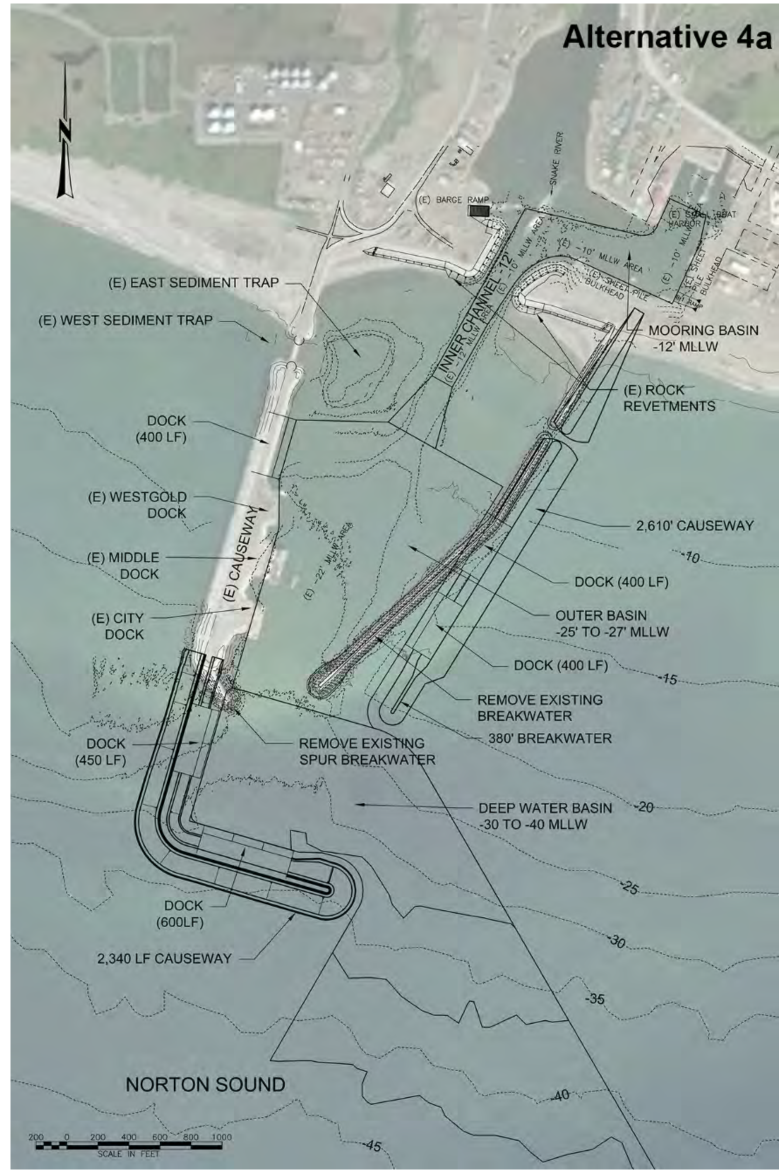

Figure 8-4. Alternative 4a

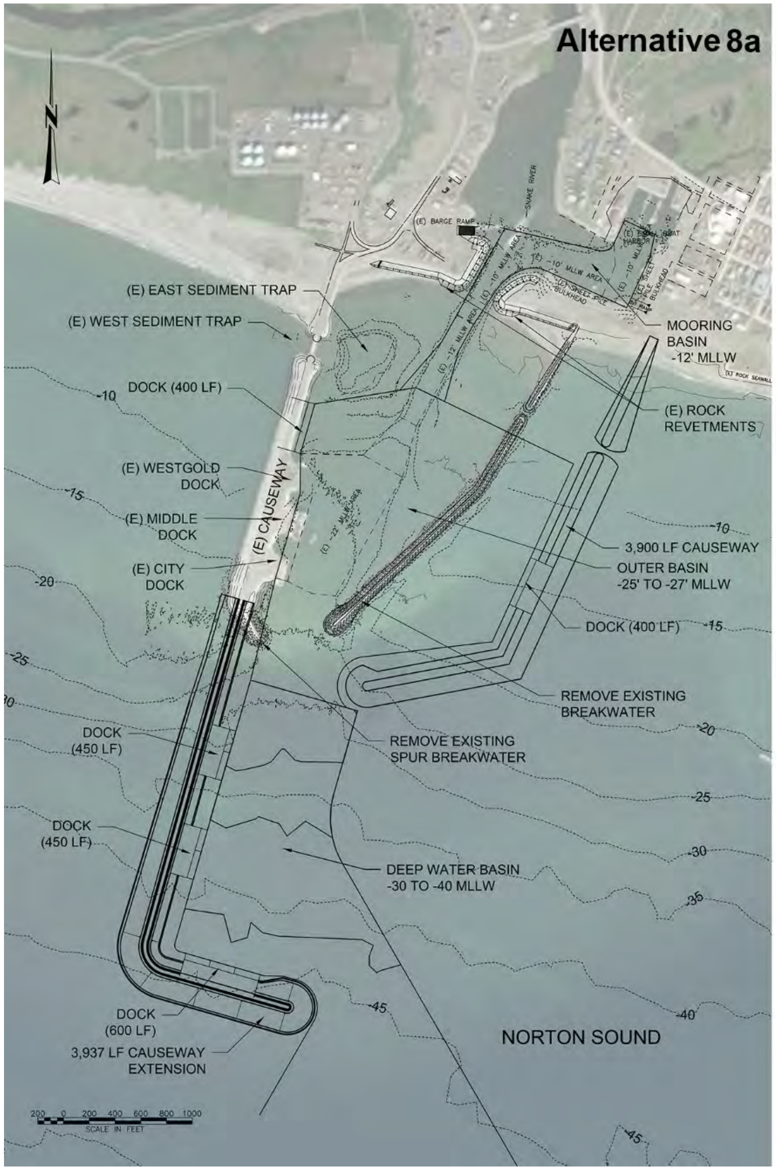

Figure 8-5. Alternative 8a

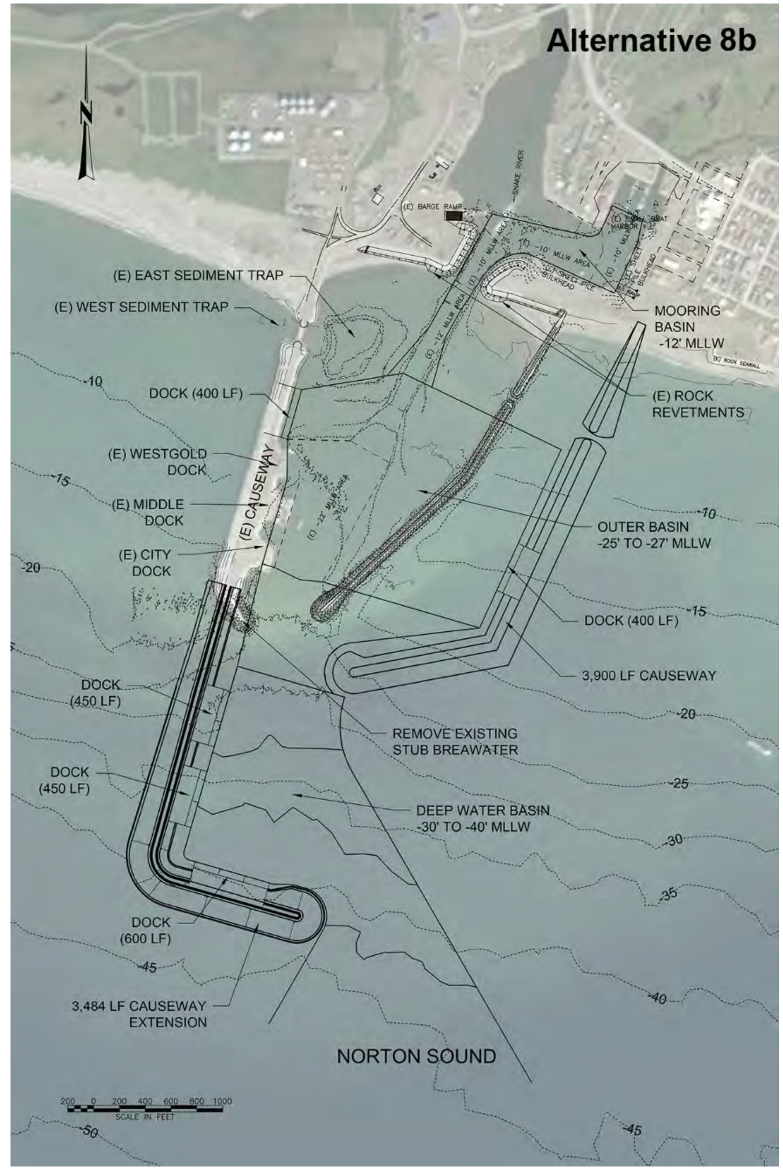

Figure 8-6. Alternative 8b

3. Essential Fish Habitat in the Project Area

The nearshore marine waters in the vicinity of Nome (defined for these purposes as western Norton Sound between Cape Nome and Sledge Island, and extending about 4 nautical miles from shore) include EFH for all five species of Pacific salmon; eight species of Bering Sea groundfish; and Bering Sea red king crab. Norton Sound shelves very gradually, and water depths at 4 nm offshore are no more than 80 feet (24 m) below MLLW (figure 2). Full descriptions of EFH, life-stages, and habitat requirements for these species are available in their respective fishery management plans (FMPs; NPFMC 2018a, NPFMC 2018b, and NPFMC 2011).

3.1 Pacific Salmon EFH

Based on EFH maps and descriptions in the Pacific salmon FMP (NPFMC 2018a), the nearshore marine waters near Nome contain EFH for the five Pacific salmon species at the following life-stages:

- Pink salmon – juvenile.
- Chum salmon – juvenile and mature.
- Sockeye salmon – juvenile.
- Coho salmon – juvenile, immature, and mature.
- Chinook salmon – juvenile.

3.1.1 Pink Salmon (*Oncorhynchus gorbuscha*)

Pink salmon are distinguished from other Pacific salmon by having a fixed 2-year life span, being the smallest of the Pacific salmon as adults, and the fact that the young migrate to sea soon after emerging from the spawning beds. Newly emerged pink salmon fry show a preference for saline water over fresh water, and schools of pink salmon fry may move quickly from the natal stream area or remain to feed along shorelines up to several weeks. Early marine schools of pink salmon fry, often in tens or hundreds of thousands of fish, tend to follow shorelines and, during the first weeks at sea, spend much of their time in shallow water of only a few centimeters deep. In many areas, pink salmon and chum salmon fry of similar age and size co-mingle in both large and small schools during early sea life (NPFMC 2018a).

Estuarine EFH for juvenile pink salmon is defined as the general distribution area for this life stage, located in estuarine areas, as identified by the salinity transition zone (ecotone) and the mean higher tide line, within nearshore waters and generally present from late April through June (NPMFC 2018a). At Nome, the estuarine habitat would include the harbor, especially where the Snake River and Dry Creek enter the harbor basin.

- Marine EFH for juvenile pink salmon is defined as the general distribution area for this life stage, located in marine waters off the coast of Alaska from the mean higher tide line to the

200-nautical mile limit of the U.S. Exclusive Economic Zone, (EEZ), including the Gulf of Alaska (GOA), Eastern Bering Sea (EBS), Chukchi Sea, and Arctic Ocean. Juvenile pink salmon distribute within coastal waters along the entire shelf (0 to 200 m) from mid-summer until December; then migrate to pelagic waters (upper 50m) of the slope (200 to 3,000 m).

3.1.2 Chum Salmon (*Oncorhynchus keta*)

After emerging from the streambed, schooling juvenile chum salmon fry migrate downstream, mostly at night, to the estuaries where they tend to feed in the intertidal grass flats and along the shore. Chums can utilize these intertidal wetlands for several months before actively migrating out of bays and into channels on the way to the outside waters. Pink salmon on the other hand tend to move more directly to more open water areas. Chum salmon utilize a wide variety of food items, including mostly invertebrates (including insects), and gelatinous species. Offshore movement of larger juveniles occurs mostly in July to September (NPFMC 2018a).

Adult chum salmon reside in the ocean for about 1 to 6 years. Throughout their range, 3-, 4-, and 5-year olds are common, but 4-, 5-, and 6-year-old chum salmon dominate the northern stocks. Chum salmon eat a variety of foods during their ocean life, e.g., amphipods, euphausiids, pteropods, copepods, fish, and squid larvae (NPFMC 2018a).

- Estuarine EFH for juvenile chum salmon is defined as the general distribution area for this life stage, located in estuarine areas, as identified by the salinity transition zone (ecotone) and the mean higher tide line, within nearshore waters from late April through June.

- Marine EFH for juvenile chum salmon is defined as the general distribution area for this life stage, located in marine waters off the coast of Alaska to approximately 50 m in depth from the mean higher tide line to the 200-nm limit of the EEZ, including the GOA, EBS, Chukchi Sea, and Arctic Ocean.

- EFH for immature and maturing adult chum salmon is defined as the general distribution area for this life stage, located in marine waters off the coast of Alaska to depths of 200 m and ranging from the mean higher tide line to the 200-nm limit of the EEZ, including the GOA, EBS, Chukchi Sea, and Arctic Ocean (NPFMC 2018a).

3.1.3 Sockeye Salmon (*Oncorhynchus nerka*)

After emergence from their natal river systems in spring or early summer, juvenile sockeye enter the marine environment where they reside for 1 to 4 years, usually 2 or 3 years, before returning to spawn. Depending on the stock, they may reside in the estuarine or nearshore environment before moving into oceanic waters. They are typically distributed in offshore waters by autumn following outmigration. During the initial marine period, yearling sockeye forage actively on a variety of organisms, apparently preferring copepods and insects, but also eating amphipods, euphausiids, and fish larvae when available. After entering the open sea during their first summer, juvenile sockeye salmon remain in a band relatively close to the coast (NPFMC 2018a).

- Estuarine EFH for juvenile sockeye salmon is defined as the general distribution area for this life stage, located in estuarine areas, as identified by the salinity transition zone (ecotone) and the mean higher tide line, within nearshore waters. Under-yearling, yearling, and older smolts occupy estuaries from March through early August.

- Marine EFH for juvenile sockeye salmon is defined as the general distribution area for this life stage, located in marine waters off the coast of Alaska to depths of 50 m and range from the mean higher tide line to the 200-nm limit of the U.S. EEZ, including the GOA, EBS, Chukchi Sea, and Arctic Ocean from mid-summer until December of their first year at sea (NPFMC 2018a).

3.1.4 Coho Salmon (*Oncorhynchus kisutch*)

After leaving fresh water, juvenile coho (also commonly called silver salmon) in Alaska spend up to 4 months in coastal waters before migrating offshore and dispersing throughout the North Pacific Ocean and Bering Sea. Marine invertebrates are the primary food when coho first enter salt water, and fish prey increase in importance as the coho grow. Most immature and maturing coho occupy upper pelagic areas in the central GOA and BS during the 12 to 14 months after leaving coastal areas. Some maturing coho also use coastal and inshore waters at this life stage, but those are likely to be smaller at maturity. The bioenergetics of growth is best in epipelagic offshore habitat where forage is abundant and sea surface temperature is between 12 and 15°C. Coho rarely use areas where sea surface temperature exceeds 15°C. Most coho remain at sea for about 16 months before returning to coastal areas and entering fresh water to spawn, although some precocious males will return to spawn after about 6 months at sea (NPFMC 2018a).

- Estuarine EFH for juvenile coho salmon is the general distribution area for this life stage, located in estuarine areas, as identified by the salinity transition zone (ecotone) and the mean higher tide line, within nearshore waters. Juvenile coho salmon require year-round rearing habitat and also migration habitat from April to November to provide access to and from the estuary.

- Marine EFH for juvenile coho salmon is the general distribution area for this life stage, located in marine waters off the coast of Alaska from the mean higher tide line to the 200-nm limit of the U.S. EEZ, including the GOA, EBS, Chukchi Sea, and Arctic Ocean.Marine juvenile coho salmon inhabit these marine waters from June to September.

- EFH for immature and maturing adult coho salmon is the general distribution area for this life stage, located in marine waters off the coast of Alaska to 200 m in depth and range from the mean higher tide line to the 200-nm limit of the U.S. EEZ, including the GOA, EBS, Chukchi Sea, and Arctic Ocean. Marine mature coho salmon inhabit pelagic marine waters in the late summer, by which time the mature fish migrate out of marine waters (NPFMC 2018a).

3.1.5 Chinook Salmon (*Oncorhynchus tshawytscha*)

Chinook salmon, also commonly called king salmon, display diverse and complex life history patterns, and use a wide range of spawning habitat. They are separated generally into two races: stream- and ocean-type fish. Stream-type fish have long freshwater residence as juveniles (1 to 2 years), migrate rapidly to oceanic habitats, enter freshwater as immature or "bright" fish, and spawn far upriver in late summer or early fall. Ocean-type fish have short, highly variable freshwater residency (lasting up to a year), extensive estuarine residency, a more coastal-oriented ocean distribution, and spawn within a few weeks of freshwater entry in the lower portions of the watershed. In Alaska, the stream-type life history predominates although ocean-type life histories have been documented in a few Alaska watersheds. Chinook salmon also have a distinctly different distribution in ocean habitats than do other species of Pacific salmon. While other species of salmon generally are surface oriented, utilizing primarily the upper 20 m, Chinook salmon tend to be at greater depths and are often associated with bottom topography (NPFMC 2018a).

Residency in freshwater and size and timing of seawater migration are highly variable amongst juvenile Chinook salmon. Ocean-type fish can migrate seaward immediately after yolk absorption. The majority of ocean-type fish migrate at 30 to 90 days after emergence, but some fish move seaward as fingerlings in the late summer of their first year, while others overwinter and migrate as yearling fish. Stream-type fish, in contrast, generally spend at least 1 year in freshwater, migrating as 1- or 2-year-old fish. After entering saltwater, Chinook juveniles disperse to oceanic feeding areas; the seaward migration of smolts is timed so that the smolts arrive in the estuary when food is plentiful. Ocean-type fish have more extended estuarine residency, tend to be more coastal oriented, and do not generally migrate as far as stream-type fish. Food in estuarine areas include epibenthic organisms, insects, and zooplankton (NPFMC 2018a).

- Estuarine EFH for juvenile Chinook salmon is defined as the general distribution area for this life stage, located in estuarine areas, as identified by the salinity transition zone (ecotone) and the mean higher tide line, within nearshore waters. Chinook salmon smolts and post-smolt juveniles may be present in these estuarine habitats from April through September.

- Marine EFH for juvenile Chinook salmon is defined as the general distribution area for this life stage, located in marine waters off the coast of Alaska from the mean higher tide line to the 200-nm limit of the EEZ, including the GOA, EBS, Chukchi Sea, and Arctic

Ocean. Juvenile marine Chinook salmon are at this life stage from April until annulus formation in January or February during their first winter at sea (NPFMC 2018a).

EFH for all Pacific salmon species includes freshwater habitat, and extends to all streams, lakes, wetlands, and other water bodies currently or historically assessable to salmon. These waters and their salmon fisheries are managed by the State of Alaska. The location of many freshwater water bodies used by salmon are contained in documents organized and maintained by the Alaska Department of Fish and Game (ADFG). Alaska Statute 16.05.870 requires ADFG to specify the various streams that are important for spawning, rearing, or migration of anadromous fishes. This is accomplished through the *Catalog of Waters Important for Spawning, Rearing or Migration of Anadromous Fishes* and the *Atlas to the Catalog of Waters Important for Spawning, Returning or Migration of Anadromous Fishes*. (NPFMC 2018a).

Figure 8 is an annotated screen shot from the ADFG's Anadromous Waters Catalog interactive mapping website (ADFG 2018). The figure points out the ADFG-cataloged salmon streams that discharge into Norton Sound between Cape Nome and Sledge Island, along with the salmon species present, and their known use of the lower reaches of those streams. The proposed project is not expected to directly impact freshwater salmon EFH; however, Snake River and Dry Creek discharge directly into Nome harbor, and portions of the inner harbor probably serve as an estuarine transition area for juvenile salmon acclimating to salt water. Salmon fry and smolt leave the Snake River freshwater habitat in the second and third week of June. Mature chum and pink salmon return to Snake River between July 4th and 25th, sockeyes from about July 20th to August 10th. Adult coho in-migrations are variable, but generally happen in a three-week period between August 5th and September 10th (Lean 2019).

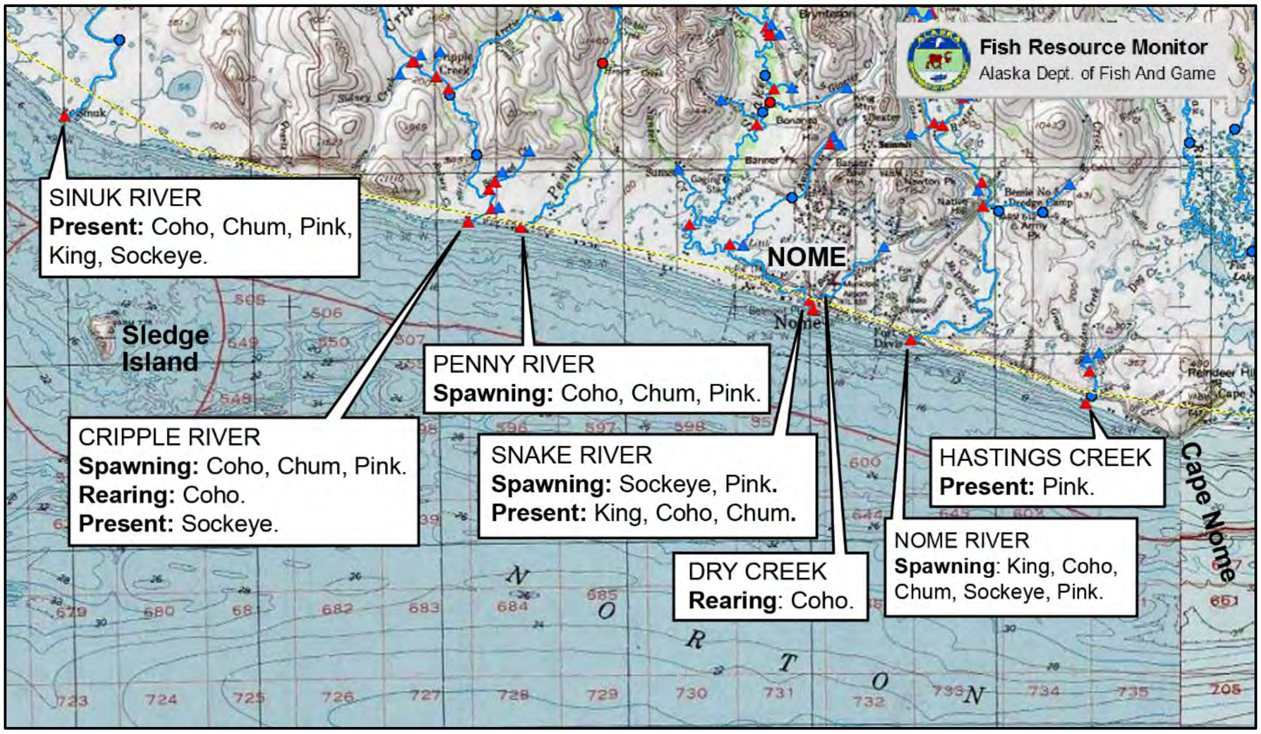

Figure 8. Streams in the vicinity of Nome known to support freshwater EFH for Pacific salmon (ADFG 2018).

3.2 Bering Sea Groundfish EFH

Based on EFH maps and descriptions in the Bering Sea/Aleutian Islands Groundfish FMP (NPFMC 2018b), the nearshore marine waters near Nome contain EFH for eight species, summarized in Table 1.

Table 1. Bering Sea Groundfish with EFH near Nome.

Species	Life-Stage	Seasons
Pacific cod	Adult	Spring, summer
Yellowfin sole	Egg, larvae, juvenile, adult	Summer
Arrowtooth flounder	Juvenile, adult	Summer
Northern rock sole	Adult	Spring, summer
Southern rock sole	Adult	Spring
Alaska plaice	Adult	Summer
Flathead sole	Juvenile, adult	Summer
Octopus	Adult	Spring

3.2.1. Pacific cod (*Gadus macrocephalus*)

Adult Pacific cod occur in depths from shoreline to 500 m. Average depth of occurrence tends to vary directly with age for at least the first few years of life, with mature fish concentrated on the outer continental shelf. Their preferred substrate is soft sediment, from mud and clay to sand. Adults are largely demersal (living close to the sea floor) and form aggregations during the peak spawning season, which extends approximately from February through April. Pacific cod eggs are demersal and adhesive. Eggs hatch in about 16 to 28 days. Pacific cod larvae undergo metamorphosis at about 25 to 35 mm. Juvenile Pacific cod start appearing in trawl surveys at a fairly small size, as small as 10 cm in the eastern Bering Sea. Pacific cod can grow to be more than a meter in length, with weights in excess of 10 kg. Adult Pacific cod in the EBS have been shown to be significant predators of snow and Tanner crab, and walleye pollock, in the eastern Bering Sea. Predators of Pacific cod include halibut, salmon shark, northern fur seals, sea lions, harbor porpoises, various whale species, and tufted puffin (NPFMC 2018b).

- EFH for adult Pacific cod is defined as the habitat-related density area for this life stage, including nearly all of the EBS shelf and slope, with highest abundances in the central and northern domains over the middle (50 to 100 m) and outer (100 to 200 m) shelf (NPFMC 2018b).

3.2.2 Yellowfin sole *(Limanda aspera)*

Adult yellowfin sole use benthic habitat and occupy separate winter spawning and summertime feeding distributions on the eastern Bering Sea shelf. From over-winter grounds near the shelf margins, adults begin a migration onto the inner shelf in April or early May each year for spawning and feeding. A protracted and variable spawning period may range from as early as late May through August occurring primarily in shallow water. The larvae remain planktonic for at least 2 to 3 months until metamorphosis occurs, usually inhabiting shallow areas. Upon settlement in nearshore areas, juveniles preferentially select sediment suitable for feeding on meiofaunal prey and burrowing for protection. Juveniles are separate from the adult population, remaining in shallow areas until they reach approximately 15 cm (NPFMC 2018b).

- EFH for yellowfin sole eggs and larvae is defined as the general distribution area for this life stage, found to the limits of inshore ichthyoplankton sampling over a widespread area.

- EFH for early juvenile yellowfin sole is defined as the general distribution area for this life stage, located in the lower portion of the water column within nearshore bays and along the inner (0 to 50 m), middle (50 to 100 m), and outer (100 to 200 m) shelf throughout the BSAI wherever there are soft substrates consisting mainly of sand. Upon settlement in nearshore areas, juveniles preferentially select sediment suitable for feeding on meiofaunal prey and burrowing for protection. Juveniles are separate from the adult population, remaining in shallow areas until they reach approximately 15 cm. Most likely are habitat generalists on abundant physical habitat.

- EFH for late juvenile yellowfin sole is defined as the general distribution area for this life stage, located in the lower portion of the water column within nearshore bays and along the inner (0 to 50 m), middle (50 to 100 m), and outer (100 to 200 m) shelf throughout the BSAI wherever there are soft substrates consisting mainly of sand.

- EFH for adult yellowfin sole is the general distribution area for this life stage, located in the lower portion of the water column within nearshore bays and along the inner (0 to 50 m), middle (50 to 100 m), and outer (100 to 200 m) shelf throughout the BSAI wherever there are soft substrates consisting mainly of sand (NPFMC 2018b).

3.2.3 Arrowtooth flounder (*Atheresthes stomias*)

Arrowtooth flounder are distributed in North American waters from central California to the eastern Bering Sea on the continental shelf and upper slope. Adults exhibit a benthic lifestyle and occupy separate winter and summer distributions on the eastern Bering Sea shelf. From over-winter grounds near the shelf margins and upper slope areas, adults begin a migration onto the middle and outer shelf in April or early May each year with the onset of warmer water temperatures. A protracted and variable spawning period may range from as early as September through March. Larvae have been found from ichthyoplankton sampling over a widespread area of the eastern Bering Sea shelf in April and May. Juveniles are separate from the adult population, remaining in shallow areas until they reach the 10 to 15 cm range. Adults are widespread mainly on the middle and outer portions of the continental shelf, feeding mainly on walleye pollock and other miscellaneous fish species when the adults attain lengths greater than 30 cm. The adults migrate to deeper waters of the shelf margin and upper continental slope to avoid extreme cold water temperatures and for spawning (NPFMC 2018b).

- EFH for late juvenile arrowtooth flounder is defined as the habitat-related density area for this life stage, located in the lower portion of the water column along the inner (0 to 50 m), middle (50 to 100 m), and outer (100 to 200 m) shelf and upper slope (200 to 500 m) throughout the BSAI wherever there are softer substrates consisting of gravel, sand, and mud.

- EFH for adult arrowtooth flounder is defined as the habitat-related density area for this life stage, located in the lower portion of the water column along the inner (0 to 50), middle (50 to 100 m), and outer (100 to 200 m) shelf and upper slope (200 to 500 m) throughout the BSAI wherever there are softer substrates consisting of gravel, sand, and mud (NPFMC 2018b).

3.2.4 Northern rock sole (*Lepidopsetta polyxystra*) and southern rock sole (*L. bilineatus*)

Two members of the genus *Lepidopsetta* are known to exist in Alaskan waters, the northern rock sole (*L. polyxstra*) and the southern rock sole (*L. bilineatus*). Resource assessment trawl surveys indicate that northern rock sole comprise more than 95% of the Bering Sea population. Adults follow a benthic lifestyle and, in the eastern Bering Sea, occupy separate winter (spawning) and summertime feeding distributions on the continental shelf. Northern rock sole spawn during the winter and early spring period of December through March. Rock sole spawning in the eastern and western Bering Sea was found to occur at depths of 125 to 250 m, close to the shelf/slope break. In the springtime, after spawning, rock sole begin actively feeding and commence a migration to the shallow waters of the continental shelf. The movement from winter/spring to summer grounds is in response to warmer temperatures in the shallow waters and the distribution of prey on the shelf seafloor. Summertime adults feed on primarily sandy substrates of the eastern Bering Sea shelf, on bivalves, polychaetes, amphipods, and miscellaneous crustaceans. Adults migrate to deeper waters of the shelf margin for spawning and to avoid extreme cold water temperatures. Predators of rock sole include Pacific cod, walleye pollock, skates, Pacific halibut, and yellowfin sole (NPFMC 2018b).

- EFH for adult rock sole (northern and southern) is defined as the general distribution area for this life stage, located in the lower portion of the water column along the inner (0 to 50 m), middle (50 to 100 m), and outer (100 to 200 m) shelf throughout the BSAI wherever there are softer substrates consisting of sand, gravel, and cobble (NPFMC 2018b).

3.2.5 Alaska plaice (*Pleuronectes quadrituberculatus*)

Adults exhibit a benthic lifestyle and live year round on the shelf and move seasonally within its limits. From over-winter grounds near the shelf margins, adults begin a migration onto the central and northern shelf of the eastern Bering Sea, primarily at depths of less than 100 m. Spawning usually occurs in March and April on hard sandy ground. Adults spend summers on sandy substrates of the eastern Bering Sea shelf, feeding on polychaetes, amphipods, and echiurids. Predators of Alaska plaice include Pacific halibut, yellowfin sole, beluga whales, and fur seals (NPFMC 2018b).

- EFH for adult Alaska plaice is defined as the general distribution area for this life stage, located in the lower portion of the water column along the inner (0 to 50 m), middle (50 to 100 m), and outer (100 to 200 m) shelf throughout the BSAI wherever there are softer substrates consisting of sand and mud (NPFMC 2018b).

3.2.6 Flathead sole (*Hippoglossoides elassodon*)

Adults exhibit a benthic lifestyle and occupy separate winter spawning and summertime feeding distributions on the eastern Bering Sea shelf and in the Gulf of Alaska. From over-winter grounds near the shelf margins, adults begin a migration onto the mid- and outer continental shelf in April or May each year for feeding. The spawning period may start as early as January but is known to occur in March and April, primarily in deeper waters near the margins of the continental shelf. Juveniles less than 2 years old do not follow the adult migration pattern, but appear to remain in shallow areas. Adults feed mainly on ophiuroids, tanner crab, osmerids, bivalves, and polychaetes; predators of flathead sole include Pacific cod, Pacific halibut, arrowtooth flounder, and larger flathead sole (NPFMC 2018b).

- EFH for early juvenile flathead sole is defined as the habitat-related density area for this life stage, located in the lower portion of the water column along the inner (0 to 50 m) and middle (50 to 100 m) shelf throughout the BSAI wherever there are softer substrates consisting of sand and mud

- EFH for late juvenile flathead sole is defined as the habitat-related density area for this life stage, located in the lower portion of the water column along the inner (0 to 50 m), middle (50 to 100 m), and outer (100 to 200 m) shelf throughout the BSAI wherever there are softer substrates consisting of sand and mud

- EFH for adult flathead sole is defined as the habitat-related density area for this life stage, located in the lower portion of the water column along the inner (0 to 50 m), middle (50 to 100 m), and outer (100 to 200 m) shelf throughout the BSAI wherever there are softer substrates consisting of sand and mud (NPFMC 2018b).

3.2.7 Octopus

There are at least seven species of octopuses currently identified from the Bering Sea, and Bering Sea octopuses are found from subtidal waters to deep areas near the outer slope. The species most abundant at depths less than 200m is the giant Pacific octopus *Enteroctopus dofleini*. Octopus are eaten by Steller sea lions, and spotted, bearded, and harbor seals, and a variety of fishes, including Pacific halibut and Pacific cod. When small, octopods eat planktonic and small benthic crustaceans (mysids, amphipods, copepods). As adults, octopus eat benthic crustaceans and molluscs. Large octopuses are also able to catch and eat benthic fishes (NPFMC 2018b).

- EFH for adult octopus is defined as the habitat-related density area for this life stage, located in demersal habitat throughout the intertidal, subtidal, shelf (0 to 200 m), and slope (200 to 2,000 m) (NPFMC 2018b).

3.3 Red King Crab (Paralithodes camtschaticus) EFH

Red king crab are widely distributed throughout the Bering Sea, typically at depths greater than 600 feet (NPFMC 2011). The Norton Sound stock of red king crab, however, appears to be separate from other stocks. Norton Sound waters are no deeper than about 110 feet (33 m), and are covered in ice for five to six months each year (RJW 2013).

Adult and subadult crabs migrate in late fall and winter from deeper offshore waters into coastal waters, where mating occurs. The crabs typically return to offshore waters as the nearshore sea ice breaks up, generally in May, when temperatures rise and salinities decrease in nearshore waters. Female crabs carry the fertilized eggs for about 11 months before they hatch, usually in April. Red king crab larvae spend 2 to 3 months in pelagic larval stages before settling to the benthic life stage. Early juveniles are solitary and are highly dependent upon coarse substrate on which to settle, such as boulders, cobble, shell hash, and living substrates such as bryozoans and stalked ascidians. Young-of-the-year crab are found at depths of 50 m or less. Late-stage juvenile crabs of 2-4 years show decreasing dependence on habitat, begin to aggregate into pods, and start the seasonal migration patterns as subadults (RJW 2013; NPFMC 2011).

Winter through-the-ice commercial and subsistence fisheries exist for red king crab at Nome, with the commercial fishery running from 15 November to 15 May, and the winter subsistence fishery from 1 December to 31 May. Both winter fisheries occur in waters less than 59 feet (18 m), inside or at the active edge of the shore fast ice (RJW 2013).

- EFH for red king crab eggs is defined as the general distribution of egg-bearing adult female crab.

- EFH has not been defined for larval or early juvenile red king crab due to insufficient information.

- EFH for late juvenile red king crab is defined as the general distribution area for this life stage, located in bottom habitats along the inner (0 to 50 m), middle (50 to 100 m), and outer shelf (100 to 200 m) wherever there are substrates consisting of rock, cobble, and gravel and biogenic structures such as boltenia, bryozoans, ascidians, and shell hash.

- EFH for adult red king crab is defined as the general distribution area for this life stage, located in bottom habitats along the nearshore (spawning aggregations) and the inner (0 to 50 m), middle (50 to 100 m), and outer shelf (100 to 200 m) throughout the BSAI wherever there are substrates consisting of sand, mud, cobble, and gravel (NPFMC 2011).

3.4 Habitat Areas of Particular Concern (HAPCs)

Habitat areas of particular concern (HAPCs) are specific sites within EFH that are of particular ecological importance to the long-term sustainability of managed species, are of a rare type, or are especially susceptible to degradation or development. HAPCs are meant to provide for greater focus of conservation and management efforts and may require additional protection from adverse effects. The NPFMC may designate specific sites as HAPCs and may develop management measures to protect habitat features within HAPCs.

There are no HAPCs designated within Norton Sound or near the project area.

4. Effects on EFH

The major in-water construction activities will consist of (1) dredging of the sea floor, (2) placement or disposal of construction dredged material, and (3) replacement of existing benthic habitat with rock structures.

Dredging activities can adversely affect benthic and water column habitats; the potential environmental effects of dredging on managed species and their habitats include:

- the direct removal and/or burial of organisms;
- increased turbidity and siltation, including light attenuation from turbidity;
- contaminant release and uptake, including nutrients, metals, and organics;
- the release of oxygen-consuming substances (e.g., chemicals and bacteria);
- entrainment;
- noise disturbances; and
- alterations to hydrodynamic regimes and physical habitat (Limpinsel et al. 2017)

Many managed species (such as the flatfish species that make up much of the groundfish listed in Table 1) forage on infaunal and bottom-dwelling organisms. Dredging may adversely affect these prey species by directly removing or burying them. Although macrobenthic communities may recover total abundance and biomass within a few month or years, their taxonomic composition and species diversity may remain different from pre-dredging for more than three to five years. Recovery of microbenthic communities in colder, high latitude environments may require even more time.

Dredging can elevate levels of suspended sediment and organic matter in the water column. The associated turbidity plumes of suspended particulates may reduce light penetration and lower the rate of photosynthesis for subaquatic vegetation. Fish may sustain gill injury and suffer reduced feeding ability if exposed to high suspended sediment levels for extended periods of time.

Dredging can also re-suspend and release nutrients and toxic substances that may then become more biologically available to aquatic organisms, or cause short-term oxygen depletion.

Depending upon the equipment used, dredges have the potential to entrain fishes and invertebrates during all life cycle phases including adults, juveniles, larvae, and eggs. Entrainment is the direct uptake of aquatic organisms caused by the suction field generated by hydraulic dredges. Benthic infauna is particularly vulnerable to entrainment by dredging although some mobile epibenthic and demersal species, such as shrimp, crabs, and fish, can be susceptible to entrainment as well. Salmonids are frequently cited in studies of fish entrainment.

The noise generated by pumps, cranes, and the mechanical action of the dredge has the ability to alter the behavior of fish and other aquatic organisms. The noise levels and frequencies produced from dredging depend on the type of dredging equipment being used, the depth and thermal variations in the surrounding water, and the topography and composition of the surrounding sea floor. It has been hypothesized that dredging-induced sound may block or delay the migration of anadromous fishes, interrupt or impair communication, or impact foraging behavior, and dredging is known to elicit an avoidance response by marine fishes. However, very little is known about effects of anthropogenic sounds on fish.

Dredging also has the potential for modifying current patterns and water circulation via alterations to substrate morphology. These alterations can cause changes in the direction or velocity of water flow, water circulation, or dimensions of the waterbody traditionally used by fish for food, shelter, or reproductive purposes (Limpinsel et al. 2017, Kelly and Ames 2018).

At the Port of Nome, the direct impacts on fish habitat from the proposed construction dredging will be somewhat lessened by the fact that much of the construction dredging will be the deepening of previously dredged navigation channels and basins, i.e., areas that have been impacted and modified in the recent past. An exception is the deep water basin to be dredged at the end of the extended causeway (figures 8-1 to 8-6), which would remove sea floor habitat that has not been previously impacted by harbor operations. Most of the proposed construction dredging will occur at depths of 45 feet below MLLW or less; the substrate within this depth contour is subject to natural disruption from storm surge and ice gouging, and regularly experiences high levels of suspended sediment from wind and wave action (RJW 2013, Kelly and Ames 2018). The operation of hydraulic and mechanical dredges during construction will introduce more sources of underwater noise in the project area than is experienced in a typical working season. Dredging to deepen the inner harbor has the potential to redistribute sediment with elevated levels of arsenic (believed to be the result of naturally-occurring minerals deposited and concentrated within the harbor by the Snake River) and anthropogenic contaminants. The hydrodynamics of the Port of Nome are dominated by the existing causeway and breakwater, and the incremental deepening of the sea floor within those structures is unlikely to significantly alter water circulation or flow.

Dredged material placement can have disruptive effects similar to that of dredging, particularly through altering existing habitat by changing water depth or substrate, smothering benthic organisms, increasing turbidity, and releasing contaminants (Limpinsel et al. 2017). For the Port of Nome project, the current plan is to place the construction dredged material for beach nourishment along the base of the Nome seawall, within the depth contour (20 to 30 feet below MLLW) that ensures that the material will be distributed along the shoreline by littoral transport. The zone between this depth contour and the shoreline is regularly disrupted by wave action and ice-grounding, experiences high turbidity levels, and is generally regarded as unable to support a significant benthic community. Placement of the dredged material in this zone is thought to be the least environmentally damaging option for handling the construction dredged material. The project dredged material will be placed for beach nourishment only if it chemically and physically suitable for unrestricted open-water placement. Some of the dredged material will probably need to be placed by bottom-dump scow rather than a hydraulic pipeline; the additional noise and movement caused by tugs and scows may cause fish to leave the area.

Placement of rubblemound structures to extend the existing causeway and modify or replace the existing breakwater have the obvious direct effect of permanently replacing the existing benthic habitat. Rock placed at and beyond the -40 foot depth contour will destroy some relatively productive habitat of marine-growth-encrusted cobbles (figures 4 and 5). Construction will create noise and disruption from the placement of rock into the water, and from the vessels supporting construction. This disruption may cause fish to leave the area, and may particularly impact migrating fish that may be trying to work their way around the causeway or breakwater. New rubblemound structures built in more southerly waters generally recruit a vigorous growth of marine organisms within a couple of years. The potential for colonization of new rocky habitat at Nome is not well understood, however, as most of what long-term colonization does occur must happen well below the intertidal zone.

4.2 Long-term effects

After construction, the expanded port facilities may result in continuing direct and indirect impacts to EFH, including increased maintenance dredging, and an increase in the size and number of vessels using the port. The intent of the completed project is to relieve congestion in the Port of Nome, allow larger vessels to dock at Nome, and improve emergency response for marine spills and vessels in distress. The observed and anticipated increase in shipping through the Bering Strait has been a cause of considerable environmental concern in the region (Kawerak 2016). The proposed project is in part a response to the increasing Bering Strait shipping traffic, and the risks and opportunities it represents. In of itself, an expanded Port of Nome is not expected to create a significant further increase in shipping traffic from the Arctic Ocean; the ability to berth larger ships is likely to attract only a handful of additional large ships through the Bering Strait each year, primarily cruise ships and vessels in distress. An expanded Port of Nome is more likely to change the size and number of vessels traveling between Nome and other Alaskan ports, using established sea lanes. Larger vessels at Nome pose a risk of larger fuel spills and improper discharges; on the other hand, larger vessels may mean fewer vessel transits to deliver the same amount of goods. A specific aim of the port modification is to allow fuel tankers to moor while transferring fuel, and reduce the current risky practice of off-shore fuel transfers. A reduction in vessel congestion within the harbor during the busy ice-free season, and the improved and more orderly moorage that the project will allow, should reduce the risk of spills and improve enforcement of discharge regulations.

Another potential and indirect long-term effect of the finished project may be to provide a base for larger fishing and processing vessels. Such vessels would be able to exploit the changing Bering Sea and Arctic Ocean fisheries in new ways, and may have a negative and unpredictable impact in EFH.

Extensions of the causeway or breakwater should not adversely affect salmon migrations as long as the fish passage breaches in those structures are kept open. An extended causeway may provide an earlier and more effective anchor for shore-fast ice, which may result in a more stable platform for winter subsistence ice-fishing, especially for red king crab. Small fishes such as smelt and saffron cod will find the earlier formation of ice a refuge from marine mammals and birds (Lean 2019).

4.3 Relative effects on EFH of the six alternatives.

The six construction alternatives discussed in Section 2 above would all effect the same environment in roughly the same ways, and would have similar impacts on EFH. The alternatives that extend the causeway farther out into waters 40-45 feet deep (alternatives 8a and 8b) would impact more of the marine-growth-encrusted cobble habitat known to exist near the port. The longer causeway alternatives would also presumably have a greater influence on the formation of shore-fast ice.

4.4 Proposed mitigation measures.

1. The Alaska Department of Fish and Game will be consulted on the timing of construction activities. The current fish habitat permit (FHP) for the annual maintenance dredging at Nome (FH13-III-0027, Amendment #3, expires 31 December 2022) states that:

- Within the [inner] harbor and entrance channel dredging will commence annually from as soon as practical after the ice goes out through June 30;

- Within the breakwater [i.e., between the causeway and breakwater] there is no closed period for dredging; and
- Dredging within and at the mouth of the entrance shall be conducted in a manner that will either allow for continuous free passage of fish, or dredging [shall be conducted] for only a 12-hour period per 24-hours.

A new, separate FHP is anticipated for the proposed construction project, but is likely to contain similar timing stipulations for the protection of migrating salmon.

2. To the extent practicable, the existing fish passages in the causeway and breakwater will be kept passable through removal of accumulated sediment as necessary. This will be of particular importance when active construction of new rubblemound structures may impair movement of fish around the causeway and breakwater. For alternatives that include replacement of the existing east breakwater with a new causeway, that new structure will also have a suitable fish passage breach, and nearshore construction will be timed to minimize impacts on migrating fish.

3. The Corps will work with the NMFS and the ADFG to develop a plan to replace cobble habitat lost to construction of the expanded port. The construction footprint of the selected alternative will be surveyed to determine the extent, nature, and density of hard bottom habitat that will be impacted.

4. The Corps will conduct a survey of submerged portions of the existing rubblemound causeway and breakwater, to gain information on how new rock structures can be expected to interact with the nearshore environment at Nome.

5. Rock for new rubblemound construction will be free of contaminants and invasive species. To the extent practicable, rock material removed from the existing rubblemound structures in the course of construction will be reused at the project site.

6. The selected contractor shall include an Oil Spill Prevention and Control Plan, and a plan for minimizing the spread of invasive species, in its Environmental Protection Plan, which is submitted to the Corps for review and approval.

5. Determination of Effect on EFH.

The proposed project will adversely affect EFH in minor, localized ways that can be largely offset through mitigation measures observed during construction, and through effective management and enforcement of spill prevention and response at the expanded port.

The Corps requests concurrence from the NMFS on this determination, and welcomes any further EFH conservation recommendations the NMFS may have to offer.

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