APPENDIX G – ESA BIOLOGICAL ASSESSMENT – USFWS

U.S. Fish and Wildlife Service

Biological Assessment – Section 7

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ACRONYMS AND ABBREVIATIONS

%	percent
μPa	microPascal
4MP	Marine Mammal Monitoring and Mitigation Plan
AAC	Alaska Administrative Code
ADEC	Alaska Department of Environmental Conservation
AHT	anchor handling tug
BA	Biological Assessment
BMP	Best Management Practice(s)
BSEE	Bureau of Safety and Environmental Enforcement
CFR	Code of Federal Regulation
CWA	Clean Water Act
DA	Department of the Army
dB	decibel
DPS	Distinct Population Segment
ESA	Endangered Species Act
ft	foot/feet
kHz	kilohertz
km	kilometer
LOC	Letter of Concurrence
m	meter(s)
m^3	cubic meters
mi	statute mile(s)
NMFS	National Marine Fisheries Service
PCE	primary constituent elements
PLP	Pebble Limited Partnership
PSO	Protected Species Observer(s)
PTS	permanent threshold shift
re	referenced at
RHA	Rivers and Harbors Act
rms	root mean square
SFS	Scientific Fishery Systems, Inc.
SPL	sound pressure level
TTS	temporary threshold shift
U.S.	United States
USCG	U.S. Coast Guard
USFWS	U.S. Fish and Wildlife Service

1. INTRODUCTION

In December 2017, the Pebble Limited Partnership (PLP) submitted an application for a Department of the Army (DA) permit for the construction of a mine and ancillary facilities, a port facility, access roads, ferry terminals, and a natural gas pipeline (Project) (Figure 1).

Construction activities which require DA authorization under Section 404 of the Clean Water Act (CWA) include the temporary and permanent discharge of dredged or fill material into waters of the U.S. Activities which require DA authorization under Section 10 of the Rivers and Harbors Act (RHA) include: construct a causeway/wharf, install two lighted navigation buoys, install two spread anchor mooring systems (one for each lightering location), and install a natural gas pipeline below the mean high water mark of the Cook Inlet, which is a navigable water of the U.S.; and construct two ferry terminals, install four mooring/navigation buoys, and install a natural gas pipeline below the ordinary high water mark of Iliamna Lake, which is a navigable water of the U.S.

Construction of the Project marine components, namely the causeway/wharf, installation of the two lighted navigation buoys, installation of the two spread anchor mooring system at lightering locations, and installation of the natural gas pipeline below the mean high water mark of the Cook Inlet could encounter species listed under the Endangered Species Act of 1973 (ESA) at locations described in this Biological Assessment (BA).

Three species (northern sea otter, Steller's eiders, and short-tailed albatross) under ESA jurisdiction of the U.S. Fish and Wildlife Service (USFWS) are evaluated in this BA on the potential and magnitude of effect of activities to each of the listed species. Activities of the proposed project that could affect the listed species include: noise from construction vessel propulsion, pile driving, and placement of fill; discharges associated with the placement of fill or trenching; collision with construction vessels; incidental spills of petroleum lubricants and fuels from the fueling and operation of construction equipment; displacement from feeding sites; and contamination effects to prey and foraging habitat. This BA also provides substantial detail on the listed species distribution, feeding, reproduction, natural mortality, designated critical habitat, and use of the proposed Action Area, all of which are necessary to conduct the detailed effects analysis.

Additional species under ESA jurisdiction of the National Marine Fisheries Service (NMFS) are addressed in a separate BA.

2. PROJECT ACTIVITIES AND ACTION AREA

2.1. Project Activities

The proposed Project will require federal authorizations for certain construction activities: DA authorization for the placement of fill under Section 404 of the CWA and construction activities in navigable waters of the U.S. under Section 10 of the RHA; Bureau of Safety and Environmental Enforcement (BSEE) authorization for the pipeline right-of-way (ROW) in Federal waters; and U.S. Coast Guard (USCG) authorization for bridges across Navigable Waters under Section 9 of the RHA. However, this BA only addresses those activities that would occur in marine waters that overlap with the historical ranges of listed species. All project construction activities addressed in this BA occurring in the marine waters of Cook Inlet below the mean high water mark will require Federal authorization. Those activities include: construct a causeway/wharf, install two lighted navigation buoys, install two spread anchor moorings systems (one at each lightering location), and install a natural gas pipeline below the mean high water mark of the Cook Inlet.

In-water port construction and lightering mooring placement would occur over two summer periods (May-September), and pipeline construction over one summer (June-August). Construction years have not been determined yet and are contingent on completion of permitting and detailed engineering design.

2.1.1. Port Construction

The marine portion of the proposed Amakdedori Port (Figure 2) is primarily comprised of a rock and earth berm access causeway/wharf (Figure 3) for mooring barges and other marine vessels. The proposed structure, which requires DA authorization under Section 10 of the RHA, is a 1,900 foot (ft) long by 500 ft wide (579 m x 152 m) causeway and wharf supporting a fuel unloading pipeline and utility lines.

The wharf will be an earth-filled sheet pile cell structure and will be constructed using a typical marine barge with crawler crane to vibrate and/or drive (impact) sheet pile segments into the seafloor. The cells will then be filled with select granular fill of rock/gravel. Wharf construction will involve the installation of 1,520 lineal ft (610 lineal m) of steel sheet piles approximately 110 ft (33.5 m) in length, with tie backs into the fill behind the sheets to provide sufficient lateral capacity. The sheet piles will be placed in approximately 15 ft (4.6 m) of water. The causeway will be constructed by infilling on top of the seabed with competent fill and rock protection for the slopes. The sheet piles will be installed using two vibratory hammers (APE 200 or similar). Estimated time to drive a pair of sheet piles ranges from 30 minutes to two hours. By assuming 4.6 lineal ft (1.4 lineal m) per pair, approximately 450 pairs are expected to be driven. Each hammer is expected to operate for six to eight hours over a 24-hour period given the need for cooling and maintenance. If bedrock or hard soil is encountered, a small diesel impact hammer (Delmag D36-32 or similar) may be necessary to anchor the last two feet (0.6 m) of piling into the ground. The impact hammer would operate up to two hours in a 24-hour period. The time estimated to complete pile driving is 90 days depending on weather contingency and the amount of hard ground encountered (requiring delays to change out hammers). All construction work would occur during the summer months.

Fill material for construction will be end dumped directly from trucks and/or transferred from shore onto a barge and placed using a clamshell bucket. The causeway will be constructed using a combination of a marine construction rig (barge and crane) to place coarse material for foundation and rip-rap protection, and land-based equipment working from shore to gradually place and compact locally sourced granular material that will be trucked to the site. Causeway fill placement will require a minimum of 135 days. Construction of the causeway and wharf will be completed over two summers from May through September.

2.1.2. Pipeline Construction

The primary energy source for the Project will be natural gas supplied via a 12-in (30.5-cm) pipeline originating near Anchor Point on the Kenai Peninsula (Figure 4). From Anchor Point the pipeline would head 104 miles (mi) (167 kilometers [km]) across Cook Inlet to a landfall at the Amakdedori Port. A fiber optic cable would be buried adjacent to the pipeline. DA authorization under Section 10 of the RHA will be required for the construction of 104 mi of 12-in pipeline below the mean high water mark.

The natural gas pipeline would be installed by directional drilling, laying the pipeline on the substrate, or trenching, using a clam shell dredge, extended reach backhoe, suction dredge, or jet sled working from barges up to 240 ft long by 60 ft wide (73.2 m x 18.3 m).

The pipe will be laid using a conventional pipe-lay barge which involves a non-motorized barge that is moved by picking up and moving the 8 to 12 anchors used to hold it in place while pipe is welded together and laid over the back of the barge. Anchor handling tugs (AHTs) will be used to reposition the anchors that keep the barge properly positioned. Pipeline construction would occur in the months of June through August of a single year and it would take approximately 30 to 40 days to install the pipe, plus an additional 30 to 60 days of pre- and post-pipe laying activities.

2.1.3. Spread Anchor Mooring Systems

The project will require the placement of anchors for mooring bulk carriers at two lightering locations (Figures 2 and 5):

1. A primary lightering location (Location A) approximately 12 mi (19 km) offshore due east of the proposed Amakdedori Port.
2. An alternative lightering location (Location B) approximately 18 mi (29 km) east-northeast of the proposed Amakdedori Port between Augustine Island and the mainland.

Both locations are outside of the northern sea otter designated critical habitat (Figure 5). The proposed mooring structures, which require DA authorization under Section 10 of the RHA, include two 2,300 ft x 1,700 ft (700 m x 520 m) spread anchor mooring systems in approximately 80 ft (25 m) of water, each consisting of 10 anchors and 6 mooring buoys. The typical spread anchor mooring system, and typical anchor arrangement designs are shown in Figure 6 and Figure 7 respectively.

Each 10-ft (3.05 m) diameter mooring buoy would be tethered by lengths of 2-in (5.1 cm) diameter chain attached to 3 gravity anchors; first to a station keeping mass anchor, typically a 3 ft x 3 ft x 3 ft (7.4 m x 7.6 m x 7.6 m) concrete block, and secondly to 2 large mass anchor connected by chain equalizers (Figure 7). The typical large mass anchor is a rock/concrete filled 40 ft x 8 ft x 8 ft (101.6 m x 20.3 m x 20.3 m) shipping container that is lowered to the sea floor. Alternatives that might be used if sea floor conditions are not suitable for gravity anchors include:

- Large spade anchors (similar to a conventional boat anchor).

- Spiral screw anchors that would be twisted into the seabed using a hydraulic drill.
- Anchors that are drilled into the seabed.

Construction of each anchor point would require approximately one day of work at the site. If a drilled anchor is required, it would take 1 to 4 hours of drilling time within the day to prepare the hole for a grouted anchor or to directly drill in the screw anchor. It would take 10 to 12 days to establish all the anchors at each lightering location, or 20 to 24 days of work for both locations. The work would be performed from a barge with support tugs and a supply vessel.

However, other than noise disturbance (e.g., rock drilling) addressed in this BA, there are no effects from this activity on ESA-listed species.

2.1.4. Navigation Buoy Placement

Two lighted navigation buoys will be placed on the reefs framing the entrance to the Amakdedori Port (Figure 4). The 3-ft (0.91 m) diameter buoys will be anchored to the reef using screw anchors twisted into the seabed or 3-ft cubed (0.91 m^3) concrete block anchors, with an anchoring design that prevents excessive anchor chain drag or swing. Heavy 2-in (5.1-cm) anchor chain will be used to keep the chain taught and prevent kinking. Placement of the buoys would take 1 day per site, or a total of 2 days.

No impacts to listed species are expected from placement of lighted navigation buoys.

2.2. Action Area

The Project Action Area is shown in Figure 8 and defined as follows:

The Action Area for the causeway and wharf construction is based on in-water construction activities and the underwater acoustical footprint due to in-water impact pile driving to the 160-decibel (dB) sound pressure level (SPL) isopleth, the harassment take threshold for sea otters that are under NMFS jurisdiction. As described in Section 2.1.1 only sheet pile will be utilized in the wharf construction. The sheet pile will be installed primarily using vibratory hammers, but the use of an impact hammer may be required for the final placement of the sheet pile. Impact installation will utilize sound mitigation such as bubble curtains to help reduce the acoustical footprint. As per the Observer Protocols for Pile Driving, Dredging and Placement of Fill Northern Sea Otter Programmatic Consultation, (Enclosure 1, USFWS 2015) the radius of the hazard area centered on the noise source is 984-ft (300-m) for both pile driving (with sound attenuation devices) and fill placement. The Action Area is defined as a 984-ft (300-m) buffer around the causeway and wharf below the mean high water mark.

The Action Area for the pipeline construction is based on the total corridor width that may experience temporary impacts due to the pipeline construction. The corridor width is driven by the maximum distance from the pipeline centerline that the anchors for the lay barge may be placed, a distance of 4,101 ft (1,250 m) on either side of the pipeline centerline, or a total corridor width of 8,202 ft (2,500 m).

The Action Area for the spread anchor mooring system is based on the physical footprint of the two mooring spreads, a 2,300 ft x 1,700 ft (700 m x 520 m) rectangle centered around the lightering locations. Anchor placement might require shallow rock drilling to place a screw anchor. Should that be necessary, PLP will choose a method that produces underwater noise levels below 160 dB re 1 µPa (microPascal) (root mean square [rms]).

The Action Area for the placement of the lighted navigation buoys is based on the area that may be disturbed during the buoy anchor placement, a circular area of 32.8 ft (10 m) centered around the buoy locations.

3. SPECIES POTENTIALLY AFFECTED

Three species of wildlife currently listed under the ESA and under the jurisdiction of USFWS, occur seasonally or year-round within the Action Area (Table 1). Northern sea otters are found along both the eastern and western shores of lower Cook Inlet, but only the population occurring along the western shore (Southwest Alaska Distinct Population Segment [DPS]) are listed. Steller's eiders from Russian and Alaskan breeding populations, winter along both shores of lower Cook Inlet. Only a small fraction (1-2 %) of the wintering birds, those that breed in Alaska, are listed (USFWS 2001). Short-tailed albatross are included because of their occurrence in the Gulf of Alaska, although there is no evidence that they occur in Cook Inlet (Piatt et al. 2006).

Table 1: USFWS-listed species occurring within the Cook Inlet Action Area.[1]

Common Name	Latin Name	ESA Status	Population
Northern Sea Otter	*Enhydra lutris kenyoni*	Threatened	Southwest Alaska DPS
Steller's Eider	*Polysticta stelleri*	Threatened	Alaska Breeding
Short-tailed Albatross	*Phoebastria albatrus*	Endangered	Worldwide

Note:
1 Obtained from the USFWS Information Planning and Consultation System website [https://ecos.fws.gov/ipac/] on October 3, 2018.

4. STATUS OF LISTED SPECIES

Three ESA-listed species under the jurisdiction of the USFWS have been identified as potentially occurring within the Action Area (Table 1). The ESA status, biological status, and use of the Action Area of each are addressed below.

4.1. Northern Sea Otter (*Enhydra lutris kenyoni*)

4.1.1. ESA Status

The Southwest Alaska DPS of the northern sea otter was listed as threatened in 2005 after the population declined an estimated 50 percent since the 1980s. This population stretches from the western shoreline of lower Cook Inlet to the western end of the Aleutian Islands. The entire range of this DPS was designated as critical habitat in 2009 (Figure 9), and a recovery plan was finalized in 2013 (USFWS 2013).

4.1.1.1. Designated Critical Habitat

As stated above, the entire range of this DPS has been designated as critical habitat. USFWS has based the critical habitat designation on four primary constituent elements (PCEs):

- PCE # 1 - Shallow (<6.6 ft [2 m] deep), rocky areas where marine predators are less likely to forage
- PCE # 2 - Nearshore (within 328.1 ft [100 m] of the high water mark) waters that might provide protection or escape from marine predators
- PCE # 3 - Kelp forests that provide protection from marine predators (waters < 65.6 ft [20 m] deep)
- PCE # 4 - Prey resources within the areas identified by PCEs 1, 2, and 3 that are present in sufficient quantity and quality to support the energetic requirements of the species

These PCEs are addressed in this BA with respect to their presence and the potential impact the Project might have on these elements.

4.1.2. Biological Status

4.1.2.1. Abundance and Trends

Recovery of the worldwide sea otter population began at the cessation of commercial harvest in 1911. Sea otter populations in the western Aleutian Islands began reaching pre-exploitation levels in the 1940s (Kenyon 1969) and remained at about equilibrium to late in the twentieth century (Estes 1990). However, while otter populations elsewhere continued to increase and reoccupy historical habitat, populations in the Aleutian Islands began to rapidly decline (Estes et al. 1998, Doroff et al. 2003, Burn and Doroff 2005), resulting in the 2005 listing under ESA. The Southwest Alaska DPS is divided into six management units — the Kodiak, Kamishak, Alaska Peninsula and the South Alaska Peninsula management units — and small portions of the Eastern Aleutian and Bristol Bay management units. The South Alaska Peninsula (-74 %), Eastern Aleutian (-56%), and Bristol Bay (-39 %) management units have all experienced significant population declines since the mid-1980s and early 1990s, while the Kodiak, Kamishak, and Alaska

Peninsula management units have remained stable or increased (Bodkin et al. 2003, Doroff et al. 2003, Burn and Doroff 2005, Estes et al. 2005, USFWS unpublished data). Overall, including the Western Aleutian management unit, the Southwest Alaska DPS declined between 43 percent and 58 percent from between approximately 94,050 and 128,650 animals in 1979 to the most recent estimate of 53,674 (USFWS 2013).

4.1.2.2. Distribution and Habitat Use

Sea otters once occurred in a near continuous distribution from central Baja California north to Alaska, along the Aleutian Islands to the Commander Islands and Kamchatka Peninsula then south to northern Japan (Kenyon 1969). By 1911, when otters were protected under the International Fur Seal Treaty, the world population had been reduced to a few remnant populations, most in Alaska. Sea otters have since recovered nearly all their former range in Alaska. The habitat includes nearshore waters inside the 328-ft (100-meter [m]) isobath, with about 80 percent use in waters less than 131 ft (40 m) deep (Bodkin and Udevitz 1999). Nearly all their foraging strategy requires diving to the seafloor, and Bodkin et al. (2004) found that 84 percent of the actual foraging occurs in waters less than 98 ft (30 m) deep. Northern sea otters feed over both rocky and soft-sediment ocean floors. Distribution in Bristol Bay and Cook Inlet may be limited by the extent of annual sea ice events (Schneider and Faro 1975), although Larned (2006) thought that Kamishak Bay sea otters remained in place despite sea ice presence.

4.1.2.3. Feeding and Prey Selection

Northern sea otters feed on a wide variety of prey (Estes and Bodkin 2002), although the diet is dominated by mollusks, crustaceans, and echinoderms (USFWS 2013). In soft-sediment substrates these otters feed largely on infaunal clam species, though when feeding at rocky substrates they prey more on urchins and mussels. Crabs, snails, and sea cucumbers are also important, but can quickly be overharvested. The diet diversity generally increases over time as abundant prey are consumed and otters are forced to feed on less preferred prey (Estes et al. 1981, Estes and Bodkin 2002), although Green and Brueggeman (1991) found male sea otters inhabiting the north side of the Alaska Peninsula subsisting on nearly a pure diet of 1- to 2-year-old mussels, indicative of an overexploitation of all food resources. There is little or no data on diet for Kamishak Bay otters; however, otters at Kachemak Bay, across Cook Inlet from Kamishak Bay, ate primarily mussels, crabs, and clams (Doroff et al. 2012).

4.1.2.4. Population Biology

Male sea otters become sexually mature at age 3, but generally cannot successfully compete for mating until age 5 or older (Garshelis 1983). Females are sexually mature at the earlier ages of 2 or 3 years (Bodkin et al. 1993). Copulation and pupping can occur at any time of the year, although there is seasonal synchronicity at some locations (Bodkin and Monson 2002). Gestation, including delayed implantation, is about 6 months, and females usually give birth to a single pup (USFWS 2013). Reproductive rates are relatively high ranging between 80 percent and 98 percent (see USFWS 2013).

Pups are dependent on their mothers for their first 6 months (USFWS 2013). Pups are born with highly buoyant natal pelage that allows them to float passively on the surface while their mothers are foraging, but, along with high lung volume to body size ratio, this prevents them from diving (Payne and Jameson 1984). After their first molt, at age 3 months, they have a limited ability to dive that increases following subsequent molts and muscle development (Thometz et al. 2015). Sea otters are considered juveniles after weaning (at approximately age 6 months) and adults at age 1.5 years (Thometz et al. 2015).

4.1.2.5. Natural Mortality

Natural mortality in sea otter populations has been difficult to quantify (USFWS 2013). Primary causes of mortality in Alaska include severe winter weather, especially when coupled with low seasonal food supply (Kenyon 1969). Sea ice events on the north side of the Alaska Peninsula have resulted in overland movements of large numbers of otters where they have become susceptible to terrestrial predators (Schneider and Faro 1975). Bald eagles (*Haliaeetus leucocephalus*) are a regular predator of pups (USFWS 2013) and killer whale (*Orcinus orca*) predation was a leading cause of sea otter decline in the Aleutians in the 1990s (Estes et al. 1998). Infectious diseases are major sources of mortality in California (Thomas and Cole 1996, Kreuder et al. 2003). Sea otter mortality is variable in the first year of life, but the annual survival rate is generally high (90 percent) after that (USFWS 2013). Maximum ages in the wild have been 22 years for females and 15 years for males (USFWS 2013).

Identified threats to recovery of this DPS include killer whale (*Orcinus orca*) predation, infectious disease, biotoxins, contaminants, oil spills, food limitation, disturbance, bycatch in fisheries, subsistence harvest, loss of habitat, and illegal take (USFWS 2013).

4.1.3. Species Use of the Action Area

As mentioned above, this BA addresses potential Project impacts to the listed population of sea otters occurring within the Action Area. This population may have originated from a remnant population at Augustine Island that survived the commercial harvest that ceased in 1911 (Calkins and Curatolo 1979). This population gradually grew to relatively high numbers by the 1960s but may have gone through some population fluctuations due to emigration to the southwest, sea ice formation, and oil related mortality (Calkins and Curatolo 1979, Mulherin et al. 2001). The 1970s population was estimated at between 1,000 and 2,000 animals (Calkins and Curatolo 1979).

Bodkin et al. (2003) surveyed Kamishak Bay in summer 2002 and estimated the population at 6,918 otters. Larned (2006) conducted monthly (January to April) aerial surveys for Steller's eiders and other marine wildlife along the coastal waters of lower Cook Inlet during 2004 and 2005 and found sea otters to be well distributed in Kamishak Bay from Oil Bay to Cape Douglas and as far offshore as the survey lines ran (to the 65.6-ft [20-m] depth contour located up to 7.5 mi [12 km] from shore). Monthly counts ranged from 1,874 to 4,000 otters. These surveys did not include the waters around Augustine Island where otters are also known to occur and did not account for otters missed by observers (often because they dove ahead of the aircraft) as did the Bodkin et al. (2003) survey. The most recent estimate for the western lower Cook Inlet is a much larger 10,737 animals based on a May 2017 survey (Garlich-Miller et al. 2018), representing a 55 percent population increase in 15 years (2002 to 2017). Marine mammal aerial surveys conducted by NMFS from 1993 to 2016 (Figure 10) and a recent (2018) incidental survey by ABR during a Pebble-sponsored fish study along the proposed pipeline route (Figure 11), coupled with the high count of otters from Garlich-Miller et al.'s (2018) May 2017 survey of western lower Cook Inlet (estimated 10,737 otters; Figure 12) clearly indicate that large numbers of sea otters inhabit Kamishak Bay year-round and range several miles offshore.

Based on benthic surveys of Kamishak Bay conducted by Stutes et al. (2018), only patches of understory kelp (e.g., *Fuscus distichus, Alaria marginata, Saccharina latissima*) occur in the portions of the Action Area that overlap sea otter critical habitat. There are no kelp forests present (surface canopy kelp such as *Eularia fistulosa*). Stutes et al. (2018) did map the habitat of Kamishak Bay, which shows that the pipeline route avoids crossing rocky reef habitat (Figure 13). Stutes et al. (2018) found a single small bed of razor clams (*Siliqua patula*) approximately 1 mi (1.6 km) south of the port, 0.2 mi (0.3 km) south of the Action Area. Also, sea otter haulout locations (if any) and pupping areas are unknown, other than May 2017 otter densities were low within the Action Area (Figure 14).

4.2. Steller's Eider (*Polysticta stelleri*)

4.2.1. ESA Status

Steller's eider is a small, bottom-foraging diving duck with breeding populations in Russia and the U.S. Because of significant population declines, the U.S. breeding population was listed as threatened in 1997 (USFWS 1997), and critical habitat was designated in 2001 (USFWS 2001). A recovery plan was finalized in 2002 (USFWS 2002).

4.2.1.1. Designated Critical Habitat

Steller's eider critical habitat has been designated in breeding areas on the Yukon-Kuskokwim Delta, staging area in the Kuskokwim Shoals, and molting areas in waters associated with the Seal Islands, Nelson Lagoon, and Izembek Lagoon in Southwestern Alaska. No critical habitat occurs within or near the Action Area.

4.2.2. Biological Status

4.2.2.1. Abundance and Trend

While the Russian Pacific population of the Steller's eider may be between 50,000 and 100,000, the U.S. breeding population may only be about 500 individuals (USFWS 2001). The Alaska breeding population experienced a significant decline in the late twentieth century (Quakenbush et al. 2002); low breeding density and great interannual variation in breeding locations make it difficult to determine whether the population is beginning to stabilize or increase. Larned (2006) estimated the number of wintering birds (January 2005 high count) on the western side of lower Cook Inlet was 4,284 birds and the eastern side was 1,247 eiders, the great majority of which originated from Russia.

4.2.2.2. Distribution and Habitat Use

Steller's eiders arrive on their Siberian and Alaskan breeding grounds in late May and early June. In Alaska, breeding is confined to the Arctic Plain, with concentrations near Barrow, although nowhere is it common (Quakenbush et al. 2002). These eiders also once nested on the Yukon-Kuskokwim Delta, but no significant breeding activity has been observed there for several decades (Kertell 1991, Flint and Herzog 1999). Steller's eiders do not nest within the vicinity of the Action Area. Males begin leaving the breeding grounds in early July, arriving at Southwest Alaska molting areas. Females remain on breeding grounds until broods have fledged, then migrate to molting areas or directly to wintering grounds farther south. Most Pacific populations of eiders molt within the lagoons along the Alaska Peninsula, especially Nelson and Izembek lagoons (Petersen 1981), although small numbers molt along the nearshore waters throughout Bristol Bay, including northern Kuskokwim Bay where about 5,000 birds have been found (Larned and Tiplady 1996, Wilson et al. 2012).

During the fall, U.S. Steller's eider populations are joined by thousands of unlisted Russian Steller's eiders along the north side of the Alaska Peninsula, where they undergo several weeks of molt (Jones 1965, Ward and Stehn 1989, Laubhan and Metzner 1999). In late November, they begin moving to overwintering areas in the Aleutian Islands, the south side of the Alaska Peninsula, Kodiak Archipelago, and Cook Inlet (Petersen 1981, USFWS 2002). Only overwintering birds occur in the Project Action Area. During April and May, nearly the entire population wintering in Alaska concentrates in Bristol and Kuskokwim bays as they wait for the sea ice to retreat and breeding ponds to thaw (USFWS 2001).

4.2.2.3. Feeding and Prey Selection

Steller's eiders are reported to consume a diverse diet of invertebrates, suggesting they are nonselective foragers (Petersen 1980, 1981; Metzner 1993; Bustnes and Systad 2001) whose main diet consists of bivalves, gastropods, and crustaceans such as crabs, shrimp, and amphipods (Vang Hirsh 1980, Goudie and Ankney 1986, Metzner 1993, Ouellet et al. 2013). Goudie and Ankney (1986) suggested that small ducks wintering in northern latitudes, such as Steller's eiders, do so at the edge of their energetic limits.

4.2.2.4. Reproduction

Steller's eiders nest on the edges of tundra ponds in Russia (Siberia) and North Slope of Alaska (and formerly the Yukon-Kuskokwim Delta). Steller's eiders begin courtship and pairing in April often while still on the spring staging grounds (Fredrickson 2001). Nest-building begins within days of arriving on the nesting grounds, with egg-laying occurring mid-June (Quakenbush and Cochrane 1993). Clutches average about six eggs, which hatch 26 to 27 days after laying the first egg (Fredrickson 2001). There are no re-nesting opportunities in the short Arctic summer. In Russia, successful females and fledglings leave the nesting grounds in late August to mid-September (Solovieva 1997). Nesting success is highly variable in Alaska, and appears related to the number of lemmings, an alternative prey for local nest predators (Quakenbush and Suydam 1999).

4.2.2.5. Natural Mortality

Maximum longevity is more than 20 years, and there is little information on major causes of Steller's eider adult mortality (Fredrickson 2001), although in Alaska, jaegers and common ravens have been identified as egg predators (Quakenbush and Suydam 1999). Presumably, red foxes (*Vulpes vulpes*) and arctic foxes (*V. lagopus*) are potential predators of both nests and nesting adults. Other identified threats include hunting, ingestion of lead shot in wetlands, changes in the marine environment that could affect their food resources, exposure to oil, and exposure to contaminants from fish processing facilities (USFWS 2002).

4.2.3. Species Use of the Action Area

Steller's eiders overwinter along the shoreline of both sides of lower Cook Inlet. During aerial surveys conducted by Larned (2001, 2006) in 2001, 2004, and 2005, substantial numbers of eiders were found at:

- Anchor Point north to Ninilchik
- Homer Spit to Anchor Point

- Kamishak Bay from Douglas River to Bruin Bay (especially Douglas River Shoals)
- Mouth of Iniskin Bay

Both Anchor Point and Kamishak Bay fall within the Action Area. Most construction activities at Anchor Point associated with the natural gas pipeline will occur during the summer months when Steller's eiders are not seasonally present. Potentially significant numbers of eiders are expected to be encountered in the Amakdedori Port area during winter (November-April). Surveys conducted by Larned (2001, 2006) found few eiders in the Amakdedori Port area proper, but birds traveling between high density wintering sites at Bruin Bay and Douglas Shoals would pass by the port site. Larned (2006) observation locations for the 2004-2005 survey can be found in Figures 15-23.

4.3. Short-tailed Albatross (*Phoebastria albatrus*)

4.3.1. ESA Status

The short-tailed albatross was listed as endangered throughout its range in 2000. Prior to the turn of the 20th century, millions of these birds had been harvested for their feathers, bringing the species to near extinction by the mid-20th century (USFWS 2008). One island alone, Torishima, supported at least 300,000 breeding pairs prior to exploitation. By 1949 there were no breeding pairs remaining on any of the 14 islands of Japan and Taiwan where they previously nested, and the species was thought to have gone extinct (Austin 1949). However, soon after this declaration, a few birds that presumably had been wandering the North Pacific during the final years of slaughter began returning to Torishima Island where eventually they formed two breeding colonies. Breeding pairs began appearing at Minami Kojima Island in the Senkaku Islands group in the early 1970s (USFWS 2008).

4.3.1.1. Designated Critical Habitat

Critical habitat has not been designated for this species largely because it is not prudent given their pelagic distribution and lack of nesting in the U.S.

4.3.2. Biological Status

4.3.2.1. Abundance and Trends

The worldwide short-tailed albatross population has grown steadily since reestablishing breeding in the early 1950s. The 2007-2008 estimated population for breeding birds was 1,114, and the subadult population estimated at 1,292, or 2,406 (USFWS 2008). More than 82 percent of the population originated from Torishima, where the colony has been growing at an annual rate of 6.5 to 8.0 percent (USFWS 2008).

4.3.2.2. Distribution and Habitat Use

Currently short-tailed albatross only nest on the Japanese-managed island of Torishima, and Minami Kojima Island located about 110 mi (177 km) northeast of Taiwan, where its ownership is under dispute by Taiwan, China, and Japan (USFWS 2008). Efforts are ongoing to establish colonies elsewhere. During the four-month non-breeding season, male adult short-tailed albatross largely travel to feeding waters of the Bering Sea and Aleutian Islands, while females are more likely to feed in Japanese and Russian waters (Suryan et al. 2007b). Juveniles and subadults, however, range a far wider area of the North Pacific, including down the U.S. west coast, before returning to their breeding colony of origin at 5 to 6 years of age.

Foraging short-tailed albatross spend most of their time in shelf waters less than 3,281 ft (1,000 m) deep, and rarely in waters deeper than 9,843 ft (3,000 m) outside Japan (Suryan et al. 2007a, USFWS 2008). These birds concentrate in upwelling areas off Japan, along the shelf breaks of the Aleutian Islands and the Gulf of Alaska, and along the edge of the Bering Sea shelf (Suryan et al. 2006, Piatt et al. 2006). Juveniles and subadults off the United States west coast also spend most their time near the continental shelf edge, while birds that have been satellite-tracked in deeper pelagic waters appear to be transiting between foraging areas (Suryan et al. 2007a).

These birds were once thought to be coastal because of their prevalence in Native midden sites from southern California to St. Lawrence Island (Murie 1959, Piatt et al. 2006). However, Piatt et al. (2006) has shown that these birds concentrate at the shelf edge and over submarine canyons, and aboriginal hunting would likely have occurred as the birds moved through the Aleutian passes and where “hotspot” upwelling sites are close enough the coast to have been reached by boat-based Native hunters.

4.3.2.3. Feeding and Prey Selection

Short-tailed albatross feed largely on squid, shrimp, and schooling fish (Hasegawa and DeGange 1982), and fish offal discarded from fishing vessels (Melvin et al. 2001). These birds feed on squid more than other species of albatross (USFWS 2008). Piatt et al. (2006) found that in Alaska, short-tailed albatross are concentrated along the shelf edges from the Gulf of Alaska through the Aleutians, and particularly along the edge of the Bering Sea shelf where upwelling brings squid to the surface, making them available to the shallow-diving albatross.

4.3.2.4. Reproduction

Short-tailed albatross currently nest only on Torishima and Minami Kojima Islands. They are slow reproducing birds that can live to 40 years of age (USFWS 2011). They begin breeding at about age 5 or 6 and lay a single egg. Slow-growing chicks are dependent on their parents until fledging at about 5 months. In all, the breeding season lasts about 8 months.

4.3.2.5. Natural Mortality

Apparently crows (*Corvus macrorhynchos*) preyed heavily on albatross chicks at Torishima prior to 1949 (Austin 1949) but are not present on the island today (USFWS 2008). Sharks and Steller’s sea eagles (*Haliaeetus pelagicus*) may occasionally take fledglings, but adult short-tailed albatross have few natural threats to survival. Monsoon rains have destroyed nesting habitat leading to chick mortality, and because Torishima is an active volcano, an eruption could have a catastrophic impact to the world population (USFWS 2008).

4.3.3. Species Use of the Action Area

More than 1,400 sighting records from Alaskan waters clearly show that short-tailed albatross concentrate along the Aleutian Islands, Bering Sea, and Gulf of Alaska shelf edges (Piatt et al. 2006; Figure 24). None of these sightings occurred in Cook Inlet. No albatross are expected to occur in the Action Area. Potential Project effects on albatross are not specifically addressed further in this BA.

5. CONSEQUENCES OF PROPOSED ACTION

Construction activities proposed by PLP in Cook Inlet have the potential to impact listed northern sea otters and Steller's eiders or their critical habitat through:

- Disturbance from construction of Amakdedori Port, the natural gas pipeline, and installation of spread anchor mooring systems, the lighted navigation buoys, and vessel maneuvering associated with construction.
- Construction vessel strike of sea otters, especially pups and ill adults, or eider collision with structures.
- Incidental spills of petroleum lubricants and fuels from fueling and operation of construction equipment.
- Foraging habitat (and prey) loss from the Amakdedori Port causeway and wharf construction.

These potential stressors – disturbance, collisions, incidental spill, foraging habitat loss – are addressed below.

5.1. Disturbance

Disturbance concerns include visual disturbance from vessel traffic at important wildlife concentration areas, such as sea otter rafting locations, and underwater noise disturbance produced by placement of fill and pile driving. These concerns are limited to sea otters as Steller's eiders are absent from the Action Area during the summer construction season and there are no records for short-tailed albatrosses in the Action Area.

Apart from any potential for damaging marine mammal hearing, loud noises can disrupt normal behaviors of marine mammals both through auditory and visual harassment. Disturbed otters may quit feeding, move away from feeding areas, display overt reactions (such as abandoning pups), or display other behaviors that expend undue energy potentially culminating in lowered fitness.

Underwater hearing ability of sea otters is significantly less than that of other marine mammals (Ghoul and Reichmuth 2014). Their ear structure suggests that there has been little change since their terrestrial origin. Unlike other marine mammals, the sea otter ear canal remains fully open and not closed as in cetaceans or reduced as in pinnipeds. Their one adaption appears to be an earflap that closes over the ear canal during diving, trapping air inside. While this mechanism would protect the inner ear, an ear canal filled with air can cause an impedance mismatch reducing sound conduction to the middle and inner ears (Wartzok and Ketten 1999). Ghoul and Reichmuth (2014) found sea otters have poor hearing sensitivity below 1 kilohertz (kHz), and best sensitivity between 2 kHz and 26 kHz, but the lowest threshold (69 dB referenced at [re] 1 µPa in meters) at between 8 kHz and 16 kHz was much higher than pinnipeds. In sum, sea otters do not appear to be particularly adapted to hearing underwater sounds, which is supported by the lack of evidence of underwater communication (Ghoul and Reichmuth 2012). Sea otters do communicate above water, especially with loud screams between separated mothers and pups (McShane et al. 1995). Ghoul and Reichmuth (2012) measured these vocalizations and found that the intensity of these calls ranged between 50 and 113 dB with SPL re 20 µPa (dB SPL re 20 µPa) and were loud enough that they can be heard by humans at distances exceeding 0.62 mi (1 km) (McShane et al. 1995). Aerial hearing in sea otters is similar to terrestrial carnivores with best sensitivity between 1.2 kHz and 27 kHz (Ghoul and Reichmuth 2014).

5.1.1. Threshold Shift

When exposed to intense sounds, the mammalian ear will protect itself by decreasing its level of sensitivity (shifting the threshold) to these sounds. Stereocilia are the sound sensing organelles of the middle and inner ear. They are the “hairs” of the specialized cells that convert sound wave energy to electrical signals. When sound intensity is low, the hairs will bend towards the incoming waves, thereby increasing sensitivity. If the sound intensity is high, the hairs will bend away in an effort to reduce wave energy damage to the sensitive organelles, which includes a reduction in sensitivity. If the sound levels are loud enough to damage the hairs, the reduction in sensitivity will remain, resulting in a shift in hearing threshold. These threshold shifts can be temporary (temporary threshold shift [TTS]) or permanent (permanent threshold shift [PTS]) (Weilgart 2007) depending on the recovery ability of the stereocilia and connecting hair cells. Over-activation of hair cells can lead to fatigue or damage that remains until cells are repaired or replaced.

Exposure to intense impulsive noises can disrupt and damage hearing mechanisms in mammals, leading to a threshold shift. However, these threshold shifts are generally temporary, as the hair cells have some ability to recover between and after the intermittent sound pulses. Long-term exposure to continuous noise, even noise of moderate intensity, can lead to a PTS. This is because the continuous wave energy does not allow hair cells to recover. If the exposure is long enough, the ability to replace damaged hair cells after the exposure has ceased is also reduced, and the threshold shift becomes permanent.

Anthropogenic sources of underwater impulsive noises that could lead to TTS in sea otters include seismic surveys, pile driving, and blasting. The only impulsive noise of concern for the Project is impact pile driving associated with construction of Amakdedori Port.

The primary underwater noise associated with the port construction is the impulsive noise from impact pile driving, continuous noise from vibratory pile driving, and continuous underwater noise emanating from anchor-handling vessels while operating dynamic positioning thrusters (cavitation noise) during laying of the gas pipeline.

Continuous sounds for small ships (including tugs) have been measured at up to 171 dB re 1 μPa (rms) at a 1-m source (broadband), and they are emitted at dominant frequencies of less than 5 kHz, and generally less than 1 kHz (Miles et al. 1987, Richardson et al. 1995, Simmonds et al. 2004). Cavitation noise is a potential source for PTS depending on the received noise level (a function of the distance the animal is to the vessel) and duration (dependent on the period animal and vessel are in proximity). There is some overlap between the hearing in sea otters and cavitation noise, as the best underwater hearing sensitivity for sea otters is between 2 kHz and 26 kHz (Ghoul and Reichmuth 2014). However, peak cavitation frequencies (<100 Hz) do not overlap with peak hearing sensitivities (>1 kHz) thereby reducing PTS risk. More importantly, sea otter exposure to continuous tug noise is limited to the dive duration. The average dive time of a northern sea otter has been measured at only 85 seconds (Bodkin et al. 2004) to 149 seconds (Wolt et al. 2012), far too short a period for the onset of PTS. Thus, hearing loss in sea otters is not of concern from the proposed continuous noise activities. In regard to other marine mammals, NMFS has determined that the likelihood of a harassment take to be so low as to be discountable (83 FR 7655), based on a lack of observed marine mammal response to thruster cavitation, which might apply to sea otters as well.

No data currently exists on the physiological effect of anthropogenic noise on sea ducks and, like sea otters, the exposure duration (limited to the short dive period) from the moving vessels is far too short to induce PTS regardless. (The USFWS has adopted impulsive underwater noise injury criteria for marbled murrelets, but no criteria have been developed for continuous noise.)

New research by Therrien (2014) suggests that ducks hear best underwater at low frequencies between 0.5 kHz and 2.86 kHz, or at frequencies similar to cavitation noise and, therefore, might be susceptible to masking. Further, dive durations for eiders are generally a minute or less (Heath et al. 2007, Evers et al. 2010) with longer rest periods between dives. Noise exposure is limited to when a dive event coincides to the short time a travel vessel is in effective hearing range.

5.1.2. Masking

Masking occurs when louder noises interfere with marine mammal vocalizations or their ability to hear natural sounds in their environment (Richardson et al. 1995), which limit their ability to communicate or avoid predation or other natural hazards. In particular, masking can prevent marine animals from hearing approaching predators. However, predation is probably not a primary mortality factor of Kamishak sea otters (although killer whales have been implicated as a mortality factor of Aleutian otters). Also, underwater noise would not contribute to increased sea otter mortality from an aerial predator such as a bald eagle, although it might for an underwater predator such as a killer whale. Still, sea otters spend the great majority of their time with their head out of the water and are likely to use visual cues more than auditory to detect approaching killer whales.

5.1.3. Chronic Disturbance

Continued exposure to low levels of noise and disturbance can lead to chronic stress, potentially further leading to stress-related responses such as immune system suppression, reproductive failure, slowed growth, and an overall decline in fitness. Chronic stress is exposure to stressors that last for days or longer, such as pile driving, but does not apply to a passing construction vessel. However, disturbance noise from a passing vessel (acute stress) can add to the overall stress budget (known as the allostatic load; Romero et al. 2009) of an individual sea otter contributing to a general distress and deleterious effects. Additional vessel passes would, of course, contribute further to the stress load.

The construction of the Project will have some additive effect to the overall anthropogenic noise budget, especially since there is little anthropogenic noise within Kamishak Bay to begin with. Construction of the causeway and wharf is expected to take place over two summers between the months of May and September. Placement of the sheet pile for the wharf construction is expected to take a total of 90 days of pile driving. Each vibratory hammer is expected to operate for six to eight hours over a 24-hour period. The impact hammer would operate up to two hours in a 24-hour period. Construction of the marine portion of the gas pipeline would occur over a 90-day period from June through August in a single summer. Anchor placement and construction of the two mooring facilities would take place over a 20 to 24 day period in a single summer. Placement of the lighted navigation buoys would take two days.

5.1.4. Relevance to the Pebble Project

PLP's proposed port construction, pipeline construction, and vessel movements directly associated with construction will contribute to existing vessel traffic noise in lower Cook Inlet and would probably be the dominant noise sources in Kamishak Bay during the two summers that construction of the port and pipeline occur. Existing vessel traffic noise in Kamishak Bay includes that of fishing and bear watching vessels. At times, the noise from these activities may temporarily disturb marine wildlife, resulting in acute stress levels and adding to the animal's overall stress budget. However, all construction would occur during the summer months when overwintering Steller's eiders are not present; thus, the remaining relevance relates to sea otters only.

Pile driving, both vibratory and impact, will occur during port construction, and for a few hours a day will significantly contribute to the anthropogenic soundscape during the 90-day pile driving window, although harassment-level impacts from both pile driving types are limited to a radius of a 984-ft (300 m) assuming attenuation devices will be used during impact driving. Noise harassment due to thruster use during pipeline construction does not rise to the level of take (and is discountable).

5.2. Vessel Strike/Structure Collision

Vessel strike concerns are usually associated with large cetaceans, such as humpback whales (*Megaptera novaeangliae*) and fin whales (*Balaenoptera physalus*), that frequent shipping lanes and are too ponderous to effectively maneuver away from fast-approaching large vessels (Laist et al. 2001, Jensen and Silber 2004). There is very little evidence of ship strike for the more agile smaller whales, dolphins, and pinnipeds. The same is true for adult sea otters, which are vigilant at the surface and can quickly dive to a safe depth at approach of a vessel. This has been particularly evident by the great difficulty in capturing agile adults using power-boats and hoop nets (Kenyon 1969). However, sea otter pups are incapable of diving their first three months of life (pre-first molt of natal pelage), and do not reach adult diving ability until age 1.5 years (Kenyon 1969, Payne and Jameson 1984, Thometz et al. 2014). Due to their large lungs relative to body size, and highly insulative natal pelage, sea otter pups (age 0-3 months) have high positive buoyancy and simply float at the surface when unattended by their mother (Payne and Jameson 1984). Pups are incapable of maneuvering away from an approaching vessel. In addition, panicked mothers can unintentionally drown pups by taking them underwater with them in an escape dive (Snow 1897). Finally, sea otters pup year-round (Kenyon 1969), so there is no particular season where small pups are not present (although pupping does peak in the summer months).

However, research to date has shown that while vessel strike is a reoccurring mortality factor across all Alaskan sea otter populations (Muto et al. 2018), it does not appear to be a significant factor. Even in California, where vessel activity is relatively high, mortality due to vessel collision is considered rare (Ames et al. 1983). Mortality data collected by the Marine Wildlife Veterinary Care and Research Center in California (https://www.wildlife.ca.gov/OSPR/Science/MWVCRC/Sea-Otter-Necropsy-Program) indicate that direct anthropogenic mortality, including vessel strike, represents only a small (approximately 5 percent) portion of the total annual mortality with disease and shark bite the primary causes.

Birds often collide with man-made structures and suffer mortality or severe injuries including concussions, internal hemorrhaging, and broken bones (Manville 2004). Birds are particularly at risk during inclement weather (Weir 1976, Russell 2005). Seabirds and sea ducks are also at increased risk as they fly at low altitudes where encounters with offshore oil platforms or large ships is possible (Anderson and Murphy 1988). Studies of Alaskan eiders have indicated that most of these birds fly at high speeds at altitudes less than 33 feet (10 m; Johnson and Richardson 1982; Day et al. 2004, 2005).

5.2.1. Relevance to the Pebble Project

While there are an estimated 10,500 sea otters currently inhabiting Kamishak Bay (Garlich-Miller et al. 2018, and Kamishak Bay-specific data provided by USFWS), a large number of which are pups, very little vessel traffic will occur during wharf and pipeline construction. All vessels, including those arriving and departing the construction areas, will travel within sea otter critical habitat at speeds less than 10 knots (<18.5 km/hr), while during actual construction, vessel traffic will be limited to barge maneuvering and anchor-handling in the immediate construction vicinity. While all age classes of otters are susceptible to high-speed vessels, only pups not yet able to dive (<3 months old) or ill adults are probably susceptible to collision from slow moving (<10 knot) barges and construction support vessels. Pup collision risk is dependent on pup density and mother attendance. Dependent pups would be most vulnerable to vessel strike when the mother is below the surface foraging. However, Laidre and Jameson (2006) found that otter dive durations during feeding bouts averaged only 55 seconds. A foraging mother would probably be aware of a slow approaching vessel soon enough to suspend feeding and retrieve her pup away from the vessel pathway.

Doroff and Badajos (2010) estimated that 2 percent of the otter population in Kachemak Bay die annually from vessel strike (speeds unknown), which would relate to about 120 otters per year, and that many of the otters likely to be struck are already ill or moribund from disease or injury. Thus, while pups at the surface are vulnerable, and would represent a portion of the potential otter mortality due to vessel strike, ill adults of all ages appear to be the group most susceptible to vessel strike. These animals represent otters that may be approaching death.

For Steller's eiders, collision is not a risk during summer construction periods as eiders are not present. However, lights or equipment located on the causeway/wharf might be encountered by wintering birds. To eliminate this risk during winter between the two construction seasons PLP agrees to remove light stanchions and other elevated structures that might pose a strike hazard to eiders.

5.3. Incidental Spills

Incidental spills, also called operational spills, resulting from the fueling and operation of construction equipment can be safely controlled at the time of release by the personnel who are present, do not have the potential to become an emergency within a short time, and are of limited quantity, exposure, and potential toxicity. They may include incidental discharges such as bilge water that might contain oils or oily detergents from deck washdown operations; releases of small volumes of hydraulic fluids, motor fuels and oils, and other fluids used in equipment operation. The accumulation of a number of small spills can lead to impaired marine waters.

5.3.1. Relevance to the Pebble Project

PLP and their construction contractors must comply with all laws and regulations related to spill prevention and preparedness or petroleum lubricants and fuel, including 40 Code of Federal Regulation (CFR) part 110, and those related to vessel-to-vessel transfer, including 33 CFR part 144. Construction operations would implement spill prevention control measures, and in the event of a spill would facilitate a rapid response and cleanup operation. Spill prevention measures include design standards, use of established procedures (for example fuel transfer procedures), regular equipment inspections and maintenance, and personnel training. They also focus on spill response by requiring pre-staged spill response equipment, preidentification of sensitive areas, personnel training, and regular spill drills. Agency inspections are also important elements of assuring spill response prevention, preparation, and readiness.

The primary issue with incidental spills is the chronic impairment of water quality, and in this case oil sheen on the bottom sediment allowing the oil to get on the fur of an otter feeding on the bottom. O'Hara and Morandin (2010) studied the effects of petroleum sheens on pelagic seabirds and found that even very small quantities of oil can change the microstructure of feathers leading to lethal thermoregulation problems in seabirds. Sea otters are also susceptible to oil fouling their fur and reducing the animal's ability to thermoregulate (Kenyon 1969, Geraci and Williams 1990). Pups are most vulnerable. Cimberg and Costa (1985) found that even lightly oiled animals spent an inordinate amount of time and energy grooming to remove the oil, and for the most part only spread it into clean areas and deeper into the fur. Geraci and Williams (1990) described the consequences as such:

> "A more extensive coating of oil would likely have tipped the balance and delivered the otters….in a tightening metabolic spiral: oil fouls the fur, reduces its insulative properties, and increases heat loss; the animal compensates by increasing its metabolic rate which, in turn, it must fuel by consuming more food; but eating gives way to vigorous grooming, and that energy squandered on spreading the oil, is not restored; body mass decreases and more heat is lost."

However, construction would not occur when eiders are present (November–April), and the amount of petroleum that could potentially be spilled during construction activities would be very small (a few gallons at most), and unlikely to lead to impairment of local sea otters.

5.4. Effects to Foraging Habitat and Prey

Both northern sea otters and Steller's eiders are primarily benthic feeders. Sessile bivalves are a major component of the otter's diet, although both also feed on crustaceans. In addition, otters feed on urchins where available. Approximately 10.7 acres (4.3 hectares) of benthic feeding habitat will be buried during the earthen causeway and wharf construction. This represents a very small fraction (<1 percent) of the approximately 580,000 acres (235,000 hectares) comprising Kamishak Bay.

All remaining benthic prey could become contaminated from incidental spills leading to bioaccumulation or biomagnification of toxins in listed species, although diesel, the most likely petroleum product that could be spilled in any sort of volume, has a low specific gravity and does not sink and, thus, rarely reaches the seafloor.

Acoustical effects to prey resources are also limited. Christian et al. (2004) studied seismic high energy impacts on male snow crabs (*Chionoecetes* sp.) and found no significant increases in physiological stress due to exposure. Given the little response of potential prey to impulsive noise, the noise associated with fill placement and pile driving is not likely to affect benthic or fish prey.

6. AVOIDANCE AND MINIMIZATION

Avoidance and minimization measures, collectively mitigation measures, are intended to limit or reduce construction-related impacts to listed species or critical habitat. Avoidance is the primary means for limiting impacts to wintering Steller eider's as these birds will not be present during the summer construction period (and there is no critical habitat for this species in the Action Area). Relative to sea otters, the primary construction elements requiring mitigation include sediment suspension and release during fill placement and pipeline trenching (potential impacts to critical habitat) and noise associated with fill placement and pile driving (direct impacts to individuals).

6.1. Mitigation Measures - Sediment Control

Construction mitigation measures for this project will follow standard construction practices, including best management practices (BMPs), to avoid or limit impacts to northern sea otter critical habitat, including: turbidity and silt curtains, clean fill, and testing of fill materials to verify a neutral range of 7.5 to 8.4 pH. In marine waters, this pH range will maximize colonization of marine organisms. Excessively alkaline or acidic fill material will not be used.

6.2. Mitigation Measures - Noise

To mitigate for noise impacts to sea otters, PLP will develop and implement a Marine Mammal Monitoring and Mitigation Plan (4MP). The plan will include the use of noise attenuating devices as required, such as bubble curtains, ramp-up procedures (soft start), and establishing 984-ft (300-m) exclusion zones around the pile driving and fill placement activities (and possibly lightering anchor placement that would require rock drilling) and employing Protected Species Observers (PSOs) to monitor these zones and initiate activity shutdown as needed to prevent harassment take of sea otters. The PSOs will follow an established set of protocols, which apply to species under both USFWS and NMFS jurisdiction, and include:

1. Protected Species Observers (PSOs) serving as observers will be in good physical condition and be able to withstand harsh weather conditions for an extended period of time. They must have vision correctable to 20-20.
2. PSOs will have the experience and ability sufficient to conduct field observations and data collection according to assigned protocols.
3. PSOs will have experience or training in field identification of marine mammals and marine mammal behavior. PSOs serving as observers will be able to accurately identify marine mammals in Alaskan waters by species.
4. PSOs must be able to accurately identify and distinguish between species of cetaceans, pinnipeds, and sea otters under field conditions.
5. PSOs serving as observers will have writing skills sufficient to prepare understandable reports of observations and technical skills to complete data entry forms accurately.
6. PSOs will work in shifts lasting no longer than 4 hours with at least a 1-hour break from marine mammal monitoring duties between shifts. PSOs will not perform PSO duties for more than 12 hours in a 24-hour period (to reduce fatigue). Note that during the 1-hour break for a PSO, a crew member can be assigned to be the observer as long as they do not have other duties at that time

and they have received instructions and tools to allow them to make marine mammal observations.

7. PSOs will be positioned such that the entire monitoring zone of activities is visible.
8. PSOs will have the ability to effectively communicate orally, by radio, and in person, with project personnel to provide real-time information on marine mammals and will have the ability and authority to order appropriate mitigation responses to avoid takes of all marine mammals.
9. The PSOs will have the following equipment to address their duties:

    a. Range finder
    b. Annotated chart and compass
    c. Inclinometer
    d. Two-way radio communication, or equivalent, with onsite project manager
    e. Appropriate personal protective equipment
    f. Daily tide tables for the project area
    g. Watch or chronometer
    h. Binoculars (7 x 50 or higher magnification) with built-in rangefinder or reticles (rangefinder may be provided separately)
    i. Handheld global positioning system
    j. A copy of the Letter of Concurrence (LOC) and all appendices, printed on waterproof paper and bound
    k. Observation Record forms printed on waterproof paper, or weatherproof electronic device allowing for required PSO data entry

10. PSOs will record observations on data forms or into electronic data sheets, electronic copies of which will be submitted to NMFS in a digital spreadsheet format on a monthly basis.
11. PSOs will have stop-work authority during pile driving, dredging, discharges of fill, or pipelaying in the event a listed-marine mammal is observed in or is determined by the PSO to be likely to enter the monitoring zone.
12. PSOs serving as observers will have no other primary duties beyond watching for, acting on, and reporting events related to marine mammals. For crew members, this mitigation measure only applies during the time the crew member must assume the duties of the PSO due to the absence of a qualified PSO.
13. PSOs will use NMFS-approved Observation Records. Observation Records will be used to record the following:

    a. Date and time that activity and observation efforts begin and end
    b. Weather parameters (e.g., percent cloud cover, percent glare, visibility) and sea state where the Beaufort Wind Force Scale will be used to determine sea-state (https://www.weather.gov/mfl/beaufort)
    c. Numbers of observed marine mammals, along with the date, time, and location of the observation
    d. The predominant sound-producing activities occurring during each marine mammal sighting
    e. Location of marine mammals, distance from observer to the marine mammal, and distance from the predominant sound-producing activity or activities to marine mammals
    f. Whether the presence of marine mammals necessitated the implementation of mitigation

measures to avoid acoustic impact, and the duration of time that normal operations were affected by the presence of marine mammals

14. Prior to commencing in-water activities, PSOs will scan waters within the monitoring zones and confirm no listed marine mammals are observed to be present within the monitoring zones for 30 minutes prior to initiation of an in-water activity. If one or more listed marine mammals are observed within the monitoring zones, no in-water activity will begin until the marine mammals exit the monitoring zones of their own accord, and the zones have remained clear of marine mammals for 30 minutes immediately prior to activity.
15. If no listed marine mammals are observed within the monitoring zone for 30 minutes, soft-start procedures will be implemented immediately prior to operational impact or vibratory driving activities to provide a chance for marine mammals to leave the monitoring zone prior to pile driving at operational power. For impact driving, a soft-start is comprised of an initial set of three strikes from the hammer at about 40 percent energy, followed by a 30-second waiting period, then two subsequent three-strike sets with associated 30-second waiting periods at the reduced energy. For vibratory pile driving, a soft-start requires pile driving operators to initiate sound from vibratory hammers for fifteen seconds at reduced energy followed by a 1 minute waiting period, with the procedure repeated two additional times. Following this soft-start procedure, impact or vibratory driving at operational power may commence provided marine mammals remain absent from the pile driving monitoring zone.
16. The PSOs will continuously monitor the monitoring zones during in-water activities for the presence of marine mammals and will order the in-water activities to immediately cease if one or more marine mammals appears likely to enter the monitoring zones.
17. In-water activities will cease immediately when the PSO indicates that marine mammals are likely to enter, or are observed within, the monitoring/exclusion zones. When a marine mammal or other protected species is observed approaching an applicable monitoring zone, the PSO on duty will immediately call or radio the operators and initiate a shutdown of in-water activities. If direct communication with the operators is not practical, the foreman/superintendent will relay the shutdown order to the equipment operators.
18. To the extent practicable, pile driving will begin as early in the day as conditions allow for effective monitoring of the entire monitoring zone (visibility greater than 984 ft [300 m] and Beaufort Sea state of 4 or less) in an attempt to complete most or all of the pile driving in a single day prior to nightfall.
19. Monitoring will take place during daylight conditions with adequate visibility (6 km or greater) and Beaufort Sea state (4 or less), starting 30 minutes before soft-start procedure begins.
20. If visibility degrades to less than 984 ft (300 m) during pile driving, pile driving of the section of sheet pile that was being driven when visibility fell below 984 ft (300 m) may continue to the target depth of that sheet pile but will not drive additional sections of piling. If pile driving is suspended (to weld on a new section, for example) when the monitoring zone is not visible, pile driving will not resume until visibility exceeds 984 ft (300 m) and the PSO has indicated that the zone has remained devoid of marine mammals for 30 minutes prior to additional pile driving.
21. If visibility degrades to less than 984 ft (300 m) during non-pile driving in-water activities, activity will cease until the monitoring zone visibility exceeds 984 ft (300 m) and the PSO has indicated that the zone has remained devoid of marine mammals for 30 minutes prior to additional activity.

22. Following a lapse of in-water activities of more than 30 minutes (due to time spent welding a new section of pipe, low visibility conditions, shutdown due to presence of marine mammals, mechanical delays or other causes), the PSO will authorize resumption of activities (using soft-start procedures for pile driving) only after the PSO provides assurance that listed marine mammals have not been present in the monitoring zones for at least 30 minutes immediately prior to resumption of operations.
23. Following shutdown of in-water activities for less than 30 minutes due to the presence of marine mammals in the monitoring zone, pile driving may commence when the PSO provides assurance that listed marine mammals were observed exiting the monitoring zones or have not been seen in the monitoring zones for 30 minutes (for cetaceans) or 15 minutes (for pinnipeds and sea otters).
24. PSOs will have immediate communication with the equipment operator (or other person in charge [PIC] if direct communication is not practical), either by radio or phone to ensure timely shutdowns to avoid takes and prevent prolonged sound exposure to marine mammals.
25. Shutdown procedures will be initiated at the PSO's direction when warranted due to the presence of marine mammals; the PSO will authorize resumption of in-water activities only when the PSO visually observes the marine mammal(s) as having left the monitoring zone, or when the PSO has not seen the animal(s) within the monitoring zone for 15 minutes (for pinnipeds and sea otters) or 30 minutes (for cetaceans).
26. PSO records associated with all marine mammals observed during in-water activities must be transmitted to NMFS and USFWS (see item 27) by the end of the calendar year during which observations were made. These records will contain the information specified in item 13.
27. A final report will be submitted to NMFS and USFWS within 90 calendar days of the completion of the project summarizing the data recorded as per measure 13 and submitted to Greg Balogh, NMFS PRD ANC supervisor, at greg.balogh@noaa.gov and Kimberly Klein, USFWS Incidental Take Coordinator, at kimberly_klein@fws.gov.
28. Though take is not authorized, if a listed marine mammal is determined by the PSO to have been disturbed, harassed, harmed, injured, or killed (e.g., a listed marine mammal(s) is injured or killed or is observed entering the monitoring zones before operations can be shut down), it must be reported to NMFS within one business day (contact listed below, item 29). These PSO records must include:

    a. Information that must be listed in the PSO report
    b. Number of listed animals affected
    c. The date and time of each event
    d. The cause of the event (e.g., Stellar sea lion approached within 10 m of an impact hammer while in operation)
    e. The time the animal(s) entered the monitoring zone, and, if known, the time it exited the zone
    f. Mitigation measures implemented prior to and after the animal entered the monitoring zone

29. If PSOs observe an injured, sick, or dead cetacean or pinniped (i.e., stranded marine mammal), they shall notify the NMFS Alaska Region Marine Mammal Stranding Network at 1-877-925-7333. The PSOs will submit photos and data that will aid NMFS in determining how to respond to the stranded animal. Data submitted to NMFS in response to stranded marine mammals will

include date/time, location of stranded marine mammal, species and number of stranded marine mammals, description of the stranded marine mammal's condition, event type (e.g., entanglement, dead, floating), and behavior of live-stranded marine mammals. In the case of a distressed or dead sea otter, the PSOs shall contact the Marine Mammals Management office of the USFWS at 1-800-362-5148.

30. In the event of an oil spill in the marine environment, the permittees shall immediately report the incident to: the U.S. Coast Guard 17th District Command Center at 907-463-2000, and NMFS AKR, Protected Resources Division Oil Spill Response Coordinator at 907-586-7630 and/or email (sadie.wright@noaa.gov).

6.3. Mitigation Measures – Vessel/Structure Collision

The following measures would be implemented to mitigate potential vessel/structure collision for northern sea otters and Steller's eiders:

- Vessel speeds will be limited to 10 knots for all Project construction vessels operating inside the northern sea otter critical habitat.
- Any light stanchions or equipment located on the causeway/wharf during the first summer of construction will be lowered or removed before winter if not in use, thereby reducing or eliminating eider collision risk.

7. DIRECT EFFECTS

7.1. Northern Sea Otter

7.1.1. Disturbance

Pile driving and fill placement can incidentally harass sea otters where underwater sound levels from hammers exceed 160 dB re 1 μPa (rms). USFWS does not recognize 120 dB re 1 μPa (rms) as the Level B threshold for continuous noise as does NMFS, largely because sea otters spend so little relative time underwater that there are no long-term exposure effects. Consequently, the 160 dB re 1 μPa (rms) threshold for sea otters applies to both impact (impulsive) and vibratory (continuous) hammer use (as well as fill placement).

A number of pile driving projects in Cook Inlet have included measurements of underwater sound pressure levels and estimations of radii to the 160-dB sea otter exposure threshold (e.g., Blackwell 2005, URS 2007, SFS 2009). Based on these and other projects, USFWS identified "hazard area" radii for various impact and vibratory pile driving scenarios and fill placement, which assumes that any listed sea otter occurring within a hazard area during active pile driving or fill placement would be acoustically harmed ("taken") under ESA. Sea otter take is also avoided by using trained protected species observers (PSOs) to monitor hazard areas and ensure no otters are present within a hazard area at activity initiation, and by initiating shut down of noise-generating activities at the approach of an otter to a hazard area. These are promulgated under the *Observer Protocols for Pile Driving, Dredging and Placement of Fill* (Enclosure 1, USFWS 2015) that were established during the Northern Sea Otter Programmatic Consultation between the USFWS and USACE (Consultation #2013-0016), and include additional monitoring procedures including ramp-up procedures, monitoring times before and after activity, observer qualifications, equipment, and recording procedures. For vibratory pile driving, impact pile driving using sound attenuation devices, and fill placement, the hazard area radius is 984 ft (300 m) in all cases. By using PSOs to effectively monitor these hazard areas and shutting down activities as needed to avoid acoustical take, PLP will limit the potential for pile driving and fill placement activities to disturb otters.

Available evidence suggests that sea otters are little disturbed by vessel noises. For example, sea otters are well accustomed to the heavy vessel traffic noise in the busy Unalaska Bay fishing port, and other ports in Alaska such as Kachemak Bay. However, sea otters in Kamishak Bay have had little exposure to vessels and may react more strongly to their presence, and the collective construction activities might temporarily displace otters from feeding or resting (rafting) areas.

Thus, given the potential for temporary noise disturbance of sea otters by several construction sources, the determination is ***May Affect, Not Likely to Adversely Affect*** for disturbance.

7.1.2. Vessel Strike

In general, vessel strike is not considered a major risk to sea otters given their mobility and, in the case of this project, the limited speed of pipeline construction barges and support vessels. Sea otter pups in their first few months of life are too buoyant to escape dive and may not be able move away from an approaching vessel, leading to injury or mortality. However, given the slow speed (<10 knots) of the vessels involved, foraging females should have sufficient time to suspend foraging activity, retrieve their pup, move it from the vessel pathway. Thus, the risk of pup mortality due to vessel strike is very low and approaches discountable (as defined in the *Endangered Species Consultation Handbook* [USFWS and NMFS 1998]).

Adult sea otters, usually those that are ill or injured, are occasionally struck by vessels, but there is no evidence that these otters are susceptible to strike from slow vessels traveling at <10 knots unless they are completely incapacitated and approaching death.

Thus, the risk of vessel strike mortality to healthy sea otters of all age classes is discountable leading to a determination of ***No Effect***.

7.1.3. Incidental Spill

Sea otters are found in shallow waters where port construction and associated incidental spills or fuel transfer spills are most likely. PLP and their construction contractors must comply with all laws and regulations related to spill prevention and preparedness for petroleum lubricants and fuel, including 40 Code CFR part 110, and those related to vessel-to-vessel transfer, including 33 CFR part 144. Construction operations would implement spill prevention control measures, and in the event of a spill would facilitate a rapid response and cleanup operation. Considering implementation of spill prevention plans the amount of potential spill (for example, small fuel transfers, leaking lubricants) would be very small and would quickly dissipate and would be insignificant relative to impairing sea otters. The determination is ***No Effect***.

7.1.4. Effects to Critical Habitat

Approximately 10.7 acres (4.3 hectares) of benthic feeding habitat will be buried during the earthen causeway and wharf construction. Although this represents a very small fraction (<1 percent) of the approximately 580,000 acres (235,000 hectares) comprising Kamishak Bay, it does represent a loss of potential foraging and escape habitat (PCEs 1, 2, and 4; Section 4.1.1.1). BMPs including placement of turbidity and silt curtains and use of clean fill within the neutral pH range of 7.5 to 8.4 will limit the extent of potential turbidity to the construction area and promote the prompt colonization of fill materials by marine organisms. There is no impact to PCE 3 as there are no kelp forests with the Action Area or Kamishak Bay (Stutes et al. 2018).

Thus, the determination for PLP's Project is ***May Affect, Not Likely to Adversely Affect*** for northern sea otter critical habitat.

7.2. Steller's Eider

7.2.1. Disturbance

Pipeline construction will occur over one summer season and port construction over two summer seasons. Direct encounters with Steller's eiders is, therefore, unlikely since they occur in the Action Area during the winter months only. (Late summer molting occurs in the lagoons along the north side of the Alaska Peninsula and at Kuskokwim Shoals at the north end of Kuskokwim Bay, and Steller's eiders do not breed anywhere in Cook Inlet.)

The determination is ***No Effect*** for disturbance to Steller's eiders.

7.2.2. Vessel/ Structure Collision

Construction vessels will not be present in the winter months when eiders are present. Therefore, there is no risk of eider collision with construction vessels. Any light stanchions or equipment located on the causeway/wharf during the first summer of construction will be lowered or removed before winter if not in use, thereby eliminating eider collision risk.

The determination is ***No Effect*** for collision risk to Steller's eiders.

7.2.3. Incidental Spill

An incidental spill during port or pipeline construction could lead to a surface sheen of oil, which, if contacted, may be sufficient to impair the ability of an sea duck to efficiently thermoregulate. However, such a spill would not occur while Steller's eiders are present in Cook Inlet and would have fully dissipated or have been cleaned up long before the arrival of overwintering birds.

Thus, for incidental oil spill the determination is ***No Effect*** due to a discountable risk (as defined in USFWS and NMFS [1998])**.**

7.2.4. Effects to Critical Habitat

Steller's eider critical habitat occurs at the Kuskokwim Shoals unit molting area, and at three molting/wintering areas along the northwest coast of the Alaska Peninsula (Izembek Lagoon, Nelson Lagoon, and Seal Island units). None of these areas would be affected by PLP's proposed construction activities in Cook Inlet. Therefore, the Project will have ***No Effect*** on Steller's eider designated critical habitat.

7.3. Short-tailed Albatross

The determination for all accounts of potential impacts (disturbance, collision, incidental spill, loss of critical habitat) is ***No Effect*** due to a lack of confirmed presence of this pelagic seabird in the Action Area (Piatt et al. 2006).

8. INDIRECT EFFECTS

Indirect effects are those that are caused by or will result from the proposed action and are later in time but are still reasonably certain to occur. Given that the port and pipeline construction are a prelude to the Pebble mine construction and operation, any activities associated with mine operation that potentially affect ESA-listed species could be construed as an indirect effect.

These mine (marine) operation activities that could affect listed species include:

- Transport of four million gallons of diesel fuel at a time (transit spill risk)
- Transfer of diesel fuel to port storage tanks (transfer incidental spill risk)
- Transport of concentrate (using large bulk carriers with sea otter pup and flying eider collision risk)
- Lightering of concentrate (using barge transport between the port and the lightering location with sea otter pup collision risk)

No other indirect effects (or interrelated effects) have been identified.

9. CUMULATIVE EFFECTS

Several projects are planned for Cook Inlet that would also contribute noise risk to local marine mammals including the Alaska Liquefied Natural Gas pipeline project and several oil and gas seismic and drilling programs planned in both upper and lower Cook Inlet. All these projects will have associated mitigation and monitoring plans designed to limit impacts to Cook Inlet listed species (and wintering eiders as needed).

10.DETERMINATION OF EFFECTS SUMMARY

A determination of effects for each species for the four evaluated risk categories is found in Table 2.

Table 2: Determination of effects for each ESA-listed species potentially occurring within PLP's proposed Action Area.

Species	Noise Disturbance	Strike/Collision	Incidental Spill	Critical Habitat	Overall
Northern Sea Otter	NLAA	NE	NE	NLAA	NLAA
Steller's Eider	NE	NE	NE	NE	NE
Short-tailed Albatross	NE	NE	NE	NE	NE

NE = No Effect
NLAA = May Affect, Not Likely to Adversely Affect

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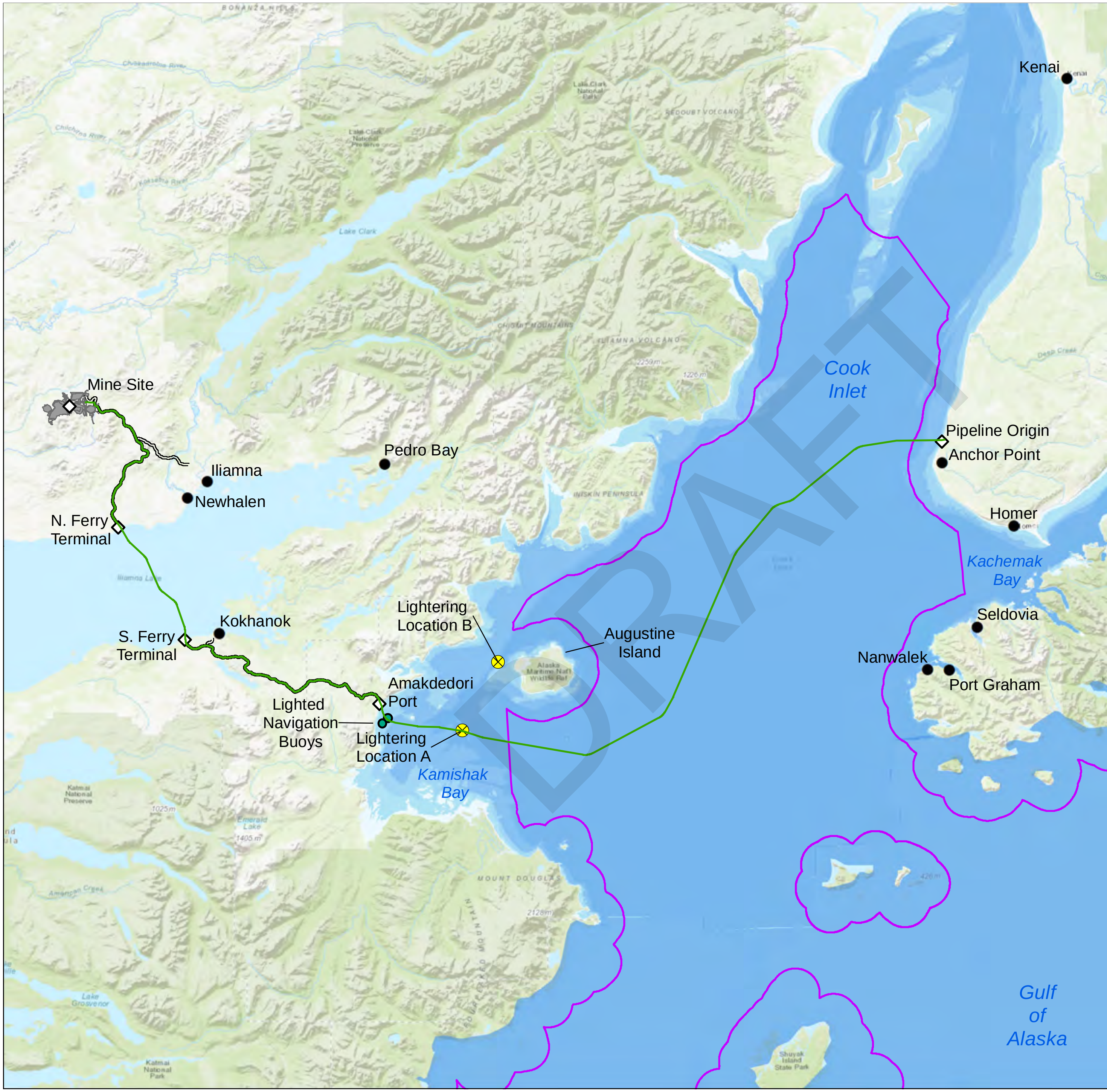
FIGURES



THE pebble PARTNERSHIP

- Project Feature
- Lightering Location
- Lighted Navigation Buoys
- Proposed Access Road
- Proposed Natural Gas Pipeline
- Outer Continental Shelf Boundary (3nm)
- Proposed Mine Site

Miles
0 10 20 30
Scale 1:1,300,000

N

NAD 1983 StatePlane Alaska 5 FIPS 5005 Feet Seward Meridian	Figure: **1**

PROJECT COMPONENTS

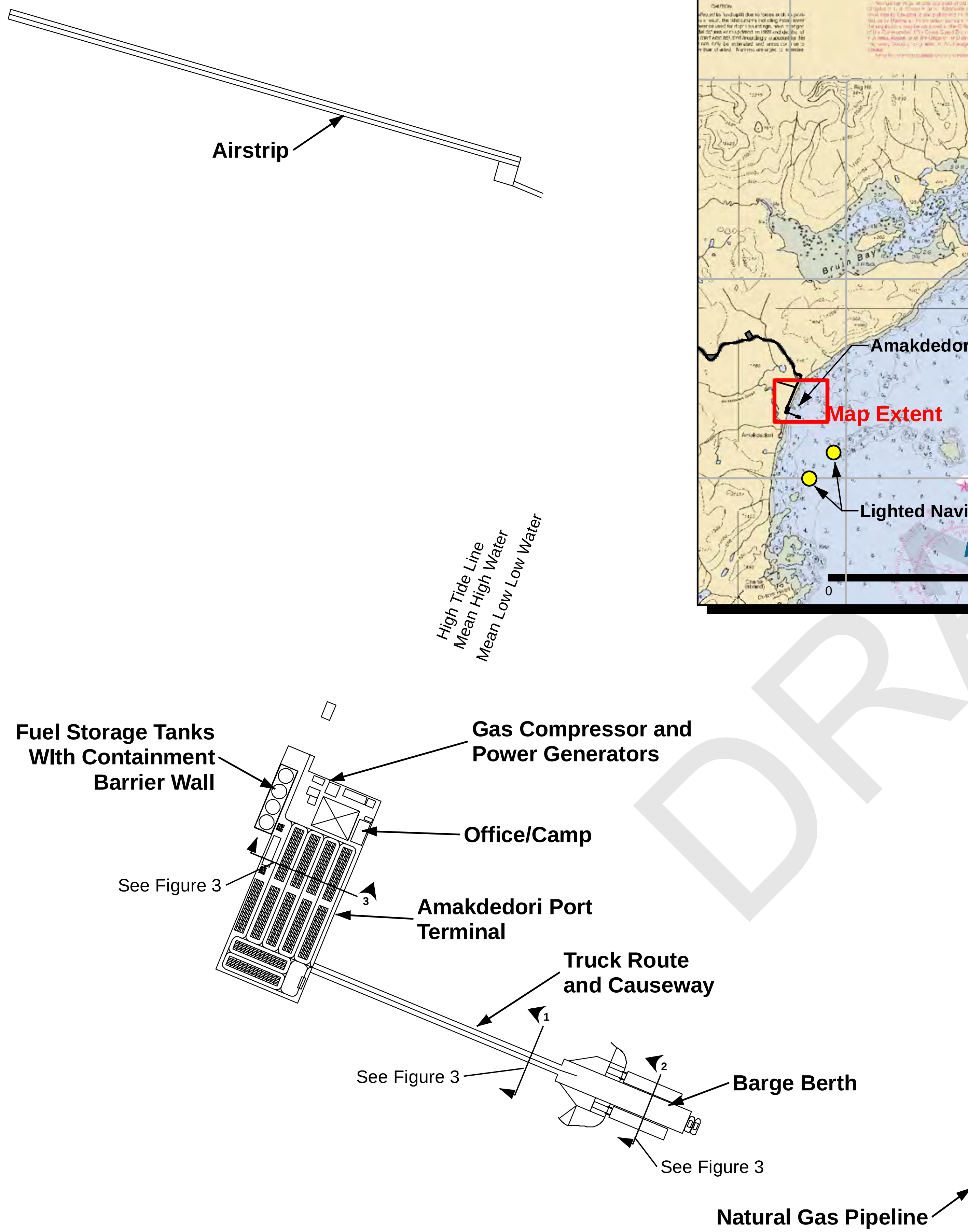
USFWS Biological Assessment

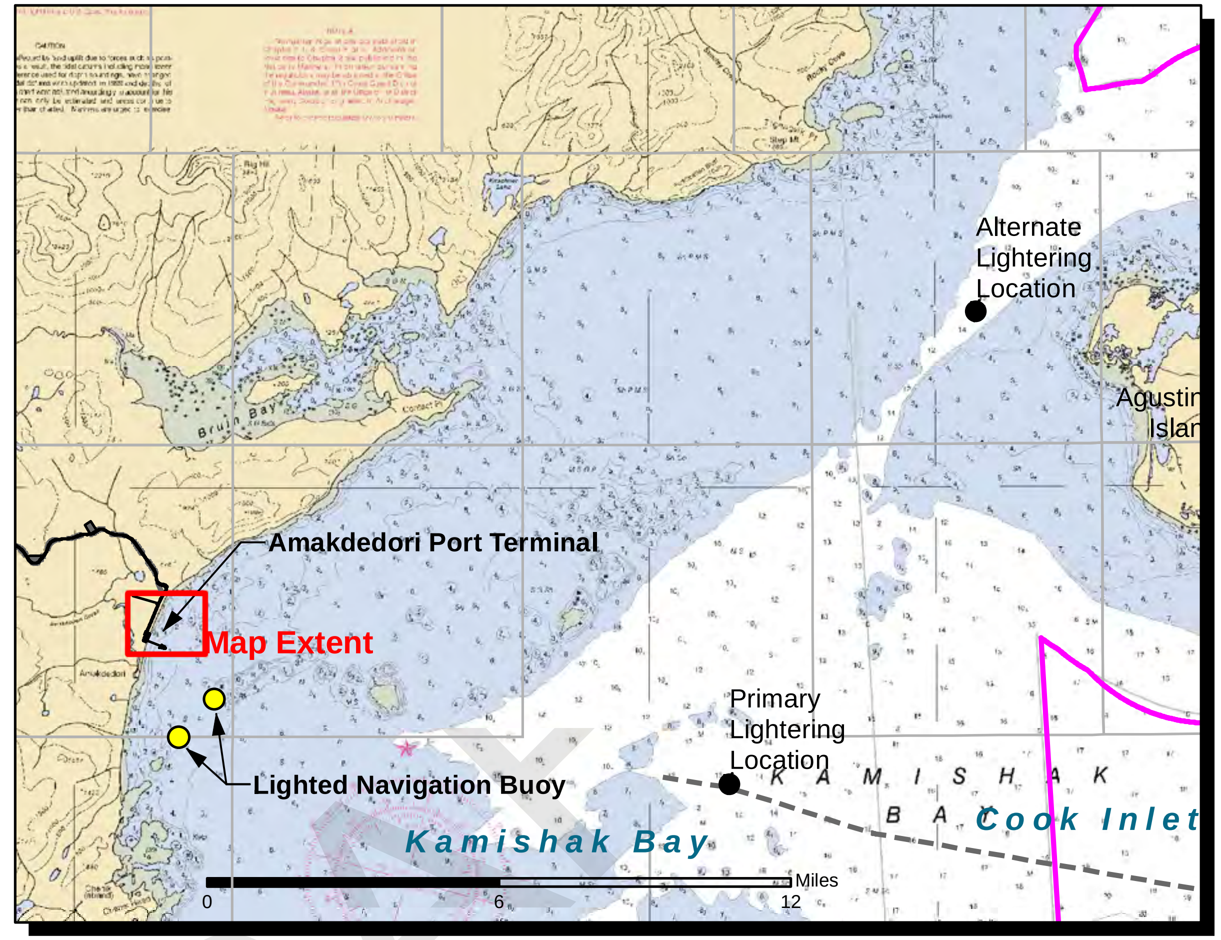
File: PLP083	Date: 12/13/2018
Revision: 08	Author: RC/OR

THE pebble PARTNERSHIP

FIGURE 2

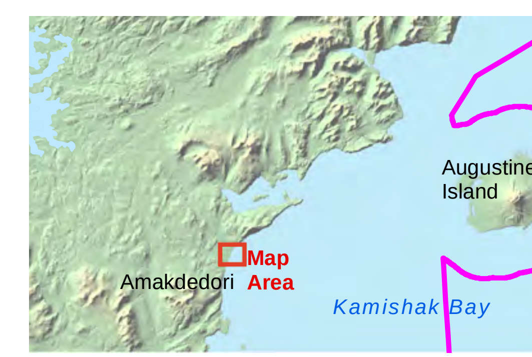
AMAKDEDORI PORT AND LIGHTERING LOCATIONS





- Amakdedori Port Site Footprint
- Primary / Alternate Lightering Locations
- Lighted Navigation Buoy
- Transportation Corridor
- Natural Gas Pipeline
- High Tide Line
- Mean High Water
- Mean Low Low Water (MLLW)
- Bathymetric Contours (Feet from MLLW)*
- Outer Continental Shelf Boundary

*Offshore contours developed from Terrasond bathymetric survey dated August 20 to 27, 2017. Elevations surveyed to geodetic datum (GEOID 99) and are shifted to mean lower low water (MLLW) level based on limited field measured tidal data. Preliminary shift between geodetic and MLLW is +8.37' (0' geodetic = 8.37' MLLW)



0 500 1,000 Feet

USFWS Biological Assessment

Scale 1:8,000

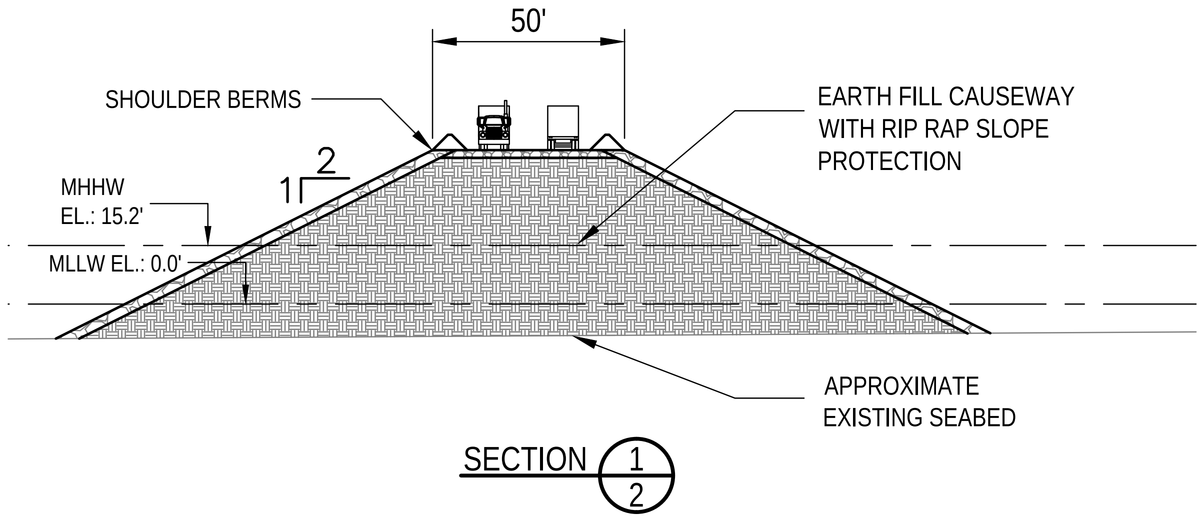
N

Alaska State Plane Zone 5 (units feet)
1983 North American Datum

File: PLP_AmakdedoriPort_Lightering_USFWS.mxd	Date: 12/14/2018
Version: x	Author: HDR

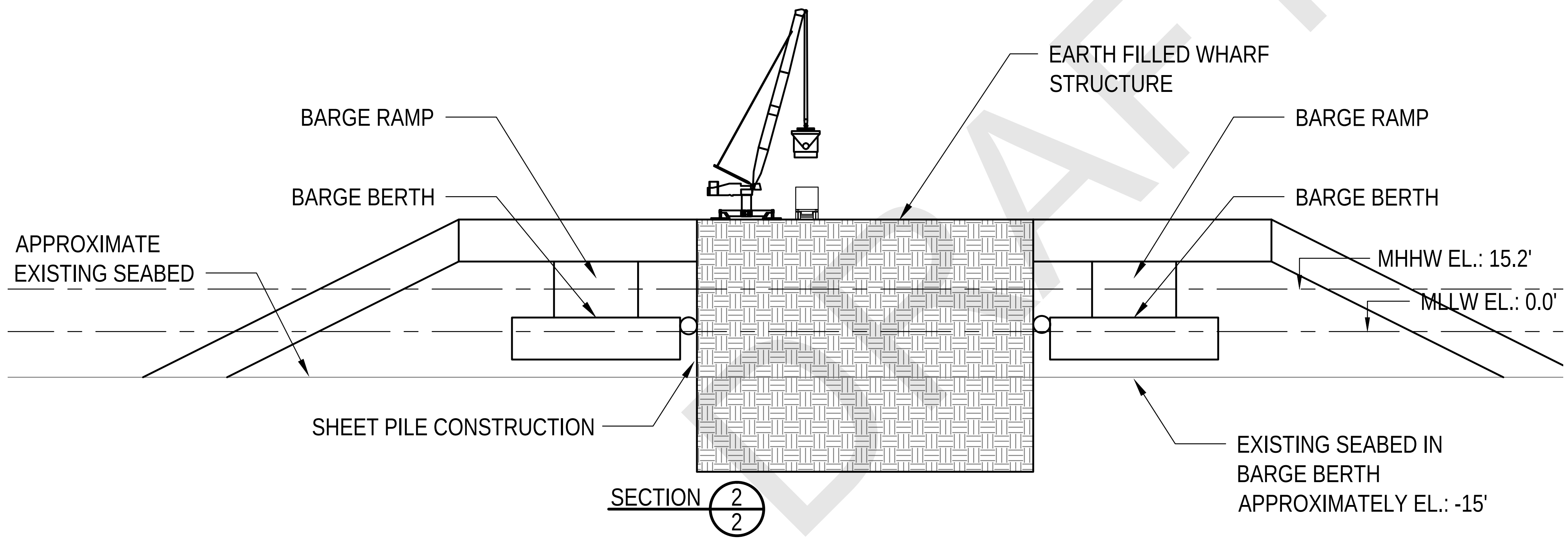
FIGURE 3

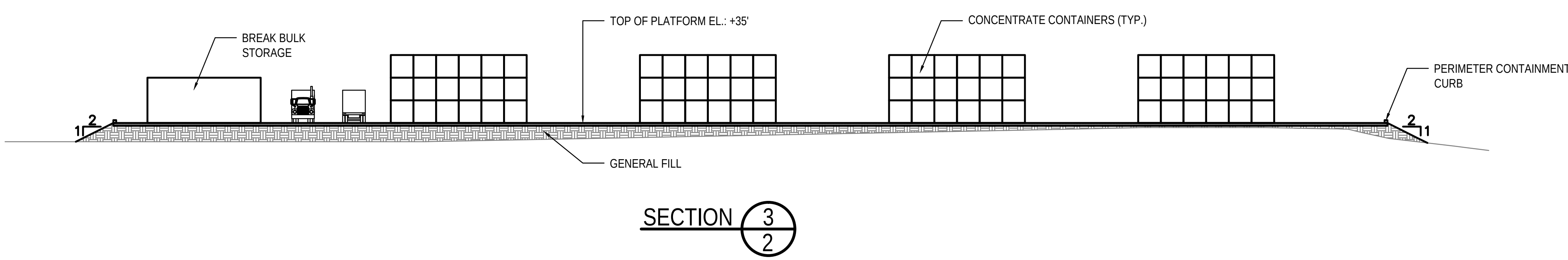
AMAKDEDORI PORT CROSS SECTIONS



NOTES:

1. DIMENSIONS IN FEET
3. HORIZONTAL DATUM TO UTM NAD83, ALASKA STATE PLANE ZONE 5, US SURVEY FEET
4. ELEVATIONS ARE IN FEET TO MEAN LOWER LOW WATER (MLLW)
5. MEAN LOWER LOW WATER (MLLW), HIGH TIDE LINE (HTL), AND MEAN HIGH WATER (MHW) ARE BASED ON USACE ALASKA DISTRICT TIDE DATA AT SELDOVIA





USFWS Biological Assessment

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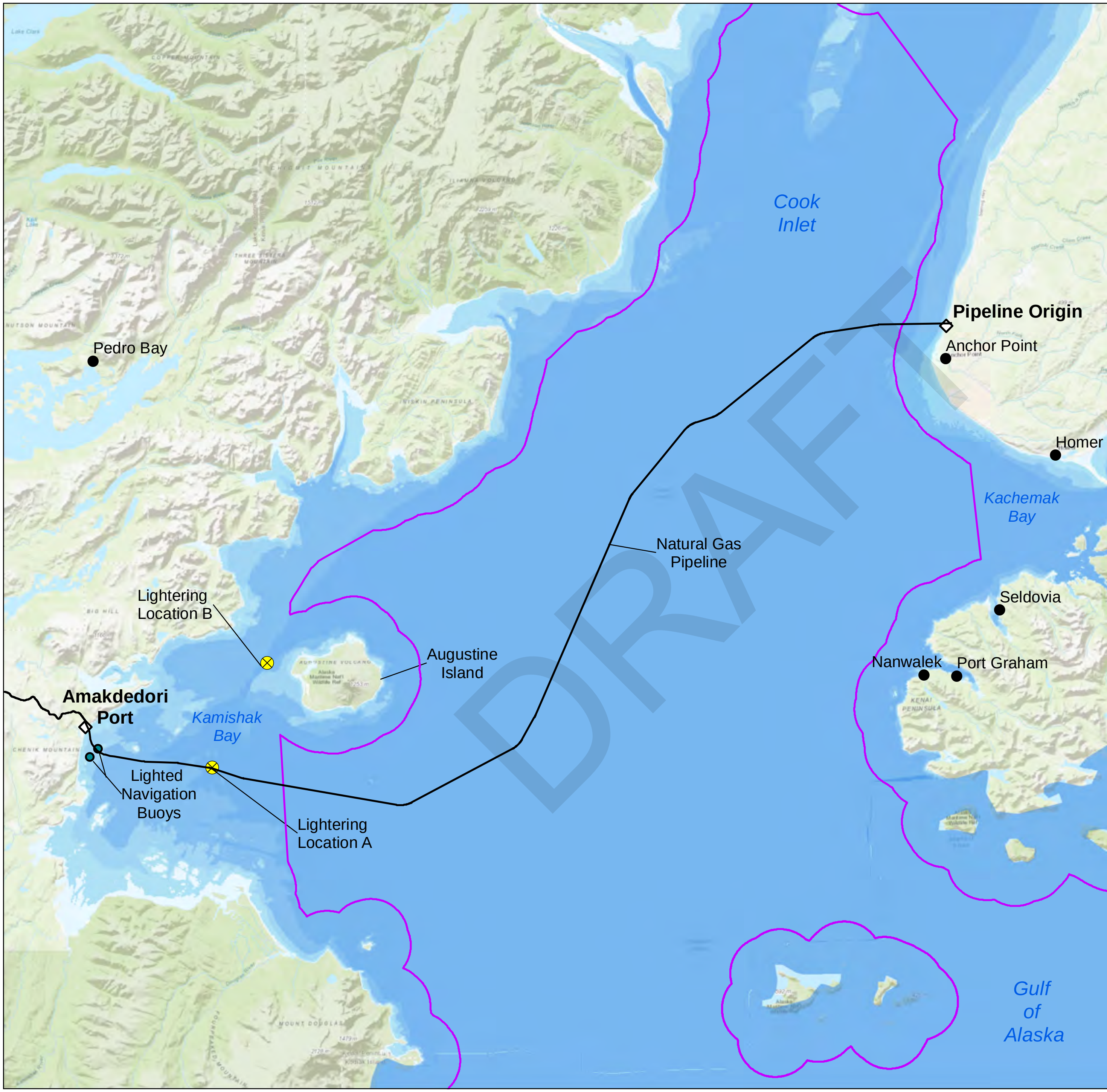


THE pebble PARTNERSHIP

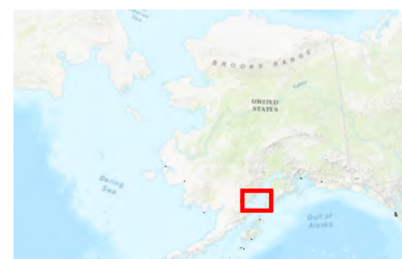
Project Feature

Lighted Navigation Buoys

Lightering Location

Proposed Natural Gas Pipeline

Outer Continental Shelf Boundary (3nm)



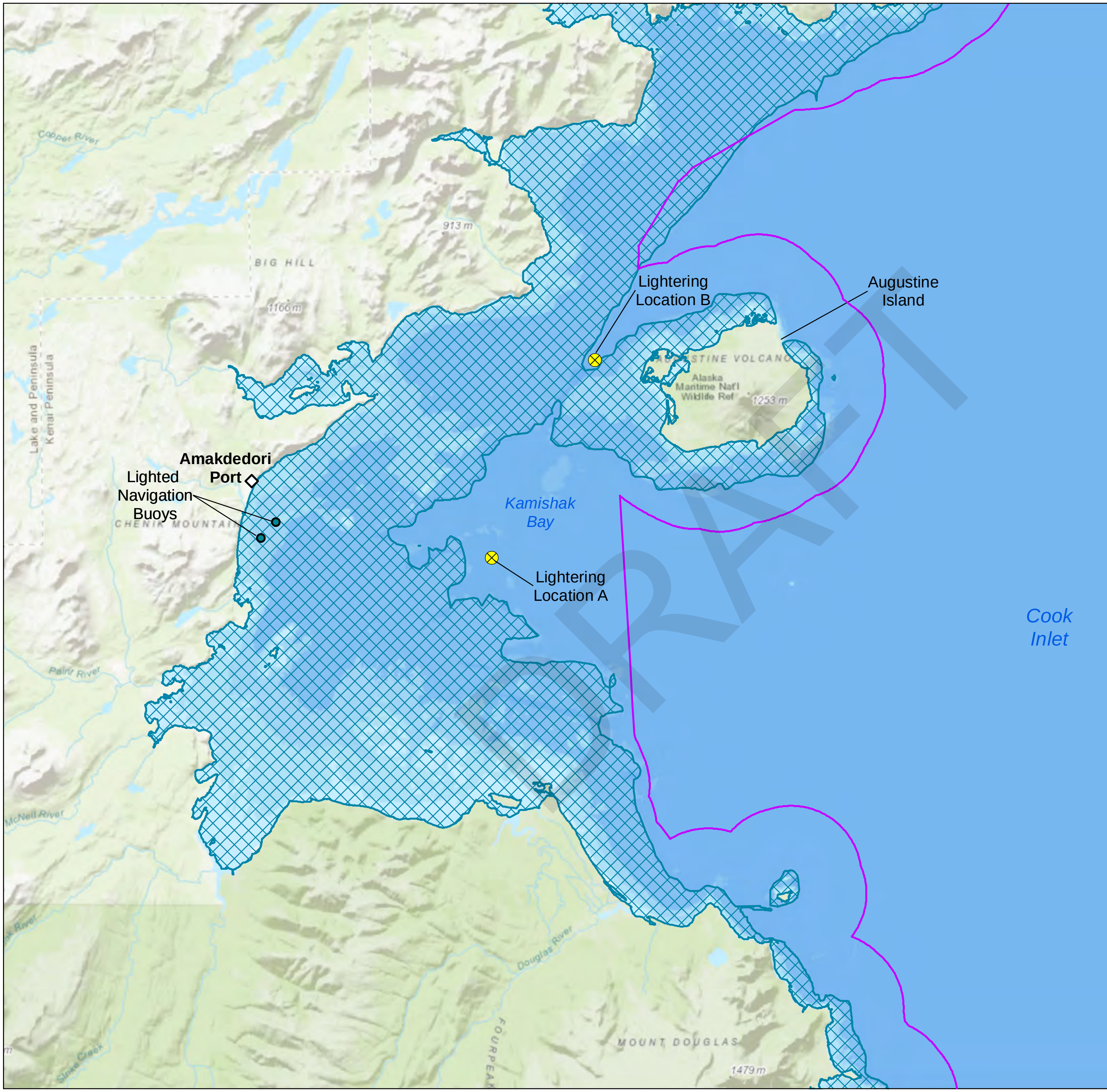
Miles
0 5 10 15 20
Scale 1:850,000
N

NAD 1983 StatePlane Alaska 5 FIPS 5005 Feet Seward Meridian	Figure: **4**

PROPOSED PIPELINE LOCATION

USFWS Biological Assessment

File: PLP044	Date: 12/12/2018
Revision: 07	Author: RC/OR

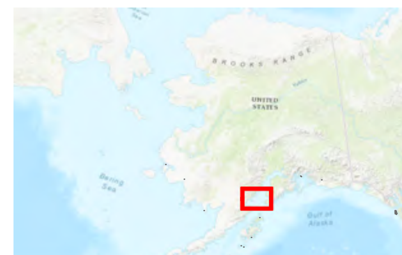


THE pebble PARTNERSHIP

- ◇ Project Feature
- Lighted Navigation Buoys
- Lightering Location
- Outer Continental Shelf Boundary (3nm)

Critical Habitat Area

- Northern Sea Otter



Miles

0 2.5 5 7.5 10 12.5

Scale 1:450,000

NAD 1983 StatePlane Alaska 5 FIPS 5005 Feet Seward Meridian	Figure: **5**

PROPOSED LIGHTERING LOCATIONS

USFWS Biological Assessment

File: PLP045	Date: 12/14/2018
Revision: 08	Author: RC/OR

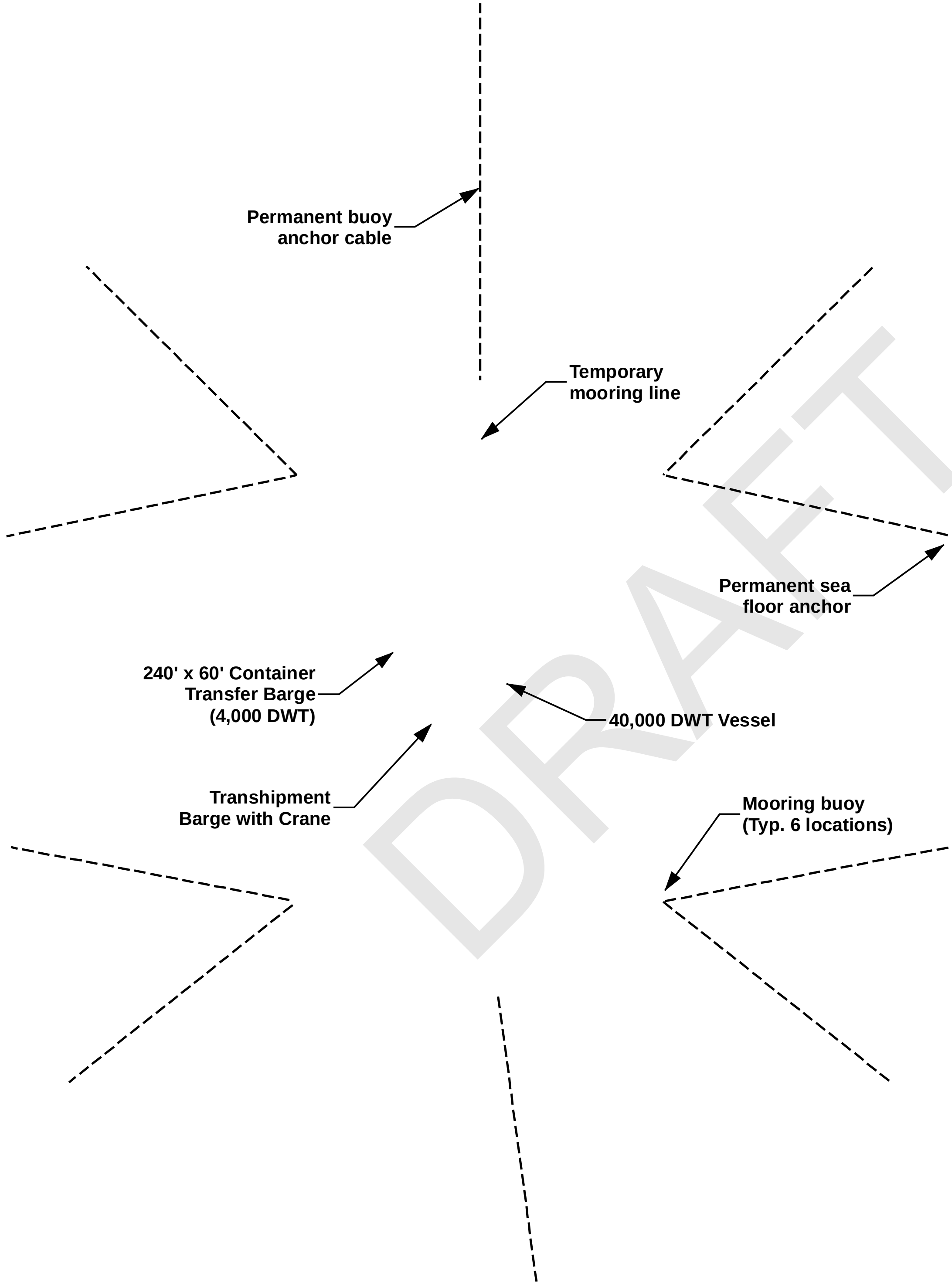


FIGURE 6

SPREAD ANCHOR MOORING SYSTEM

- 40,000 DWT Vessel
- Container Transfer Barge (4,000 DWT)
- Transhipment barge with crane
- Temporary mooring lines
- Floating mooring buoys
- Permanent buoy anchor cables
- Permanent sea floor anchors

USFWS Biological Assessment

Feet: 0 — 300 — 600

Meters: 0 — 90 — 180

N

Scale 1:3,600

Alaska State Plane Zone 5 (units feet)
1983 North American Datum

File:	Date: 12/14/2018
Version: x	Author: HDR

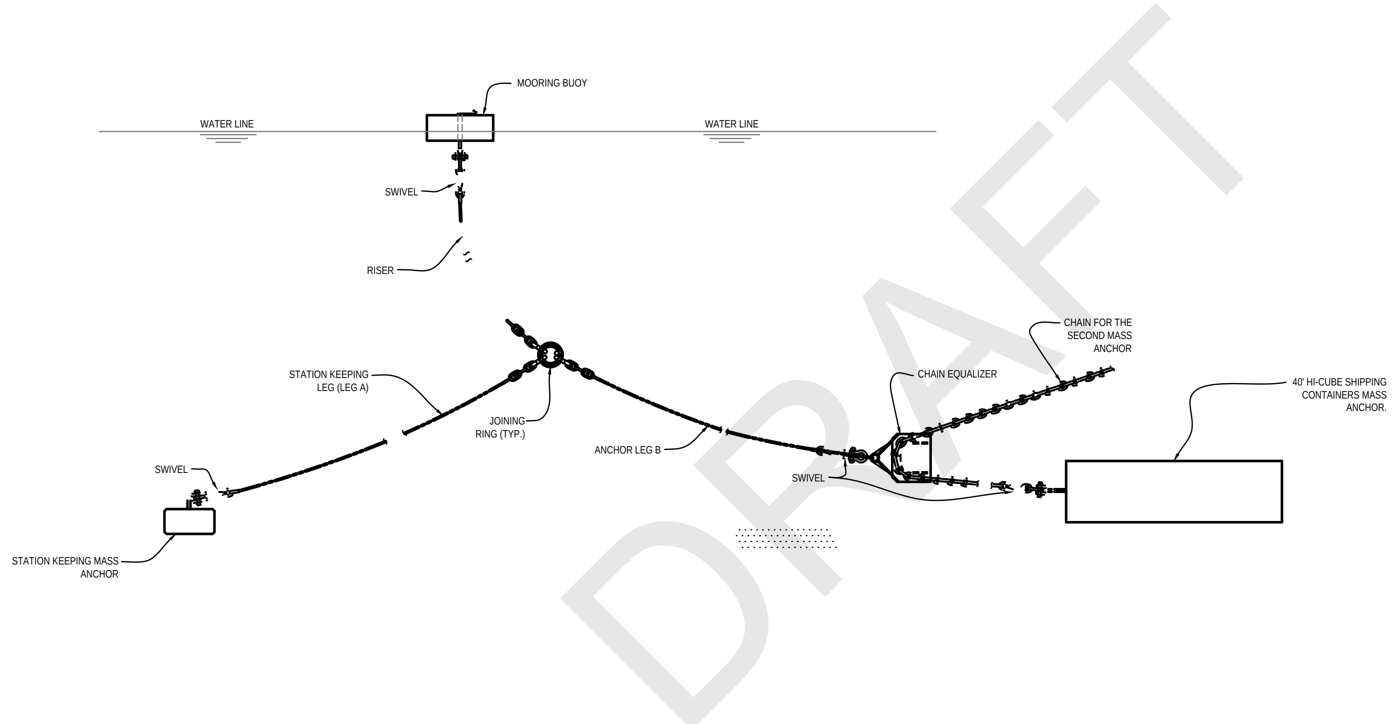
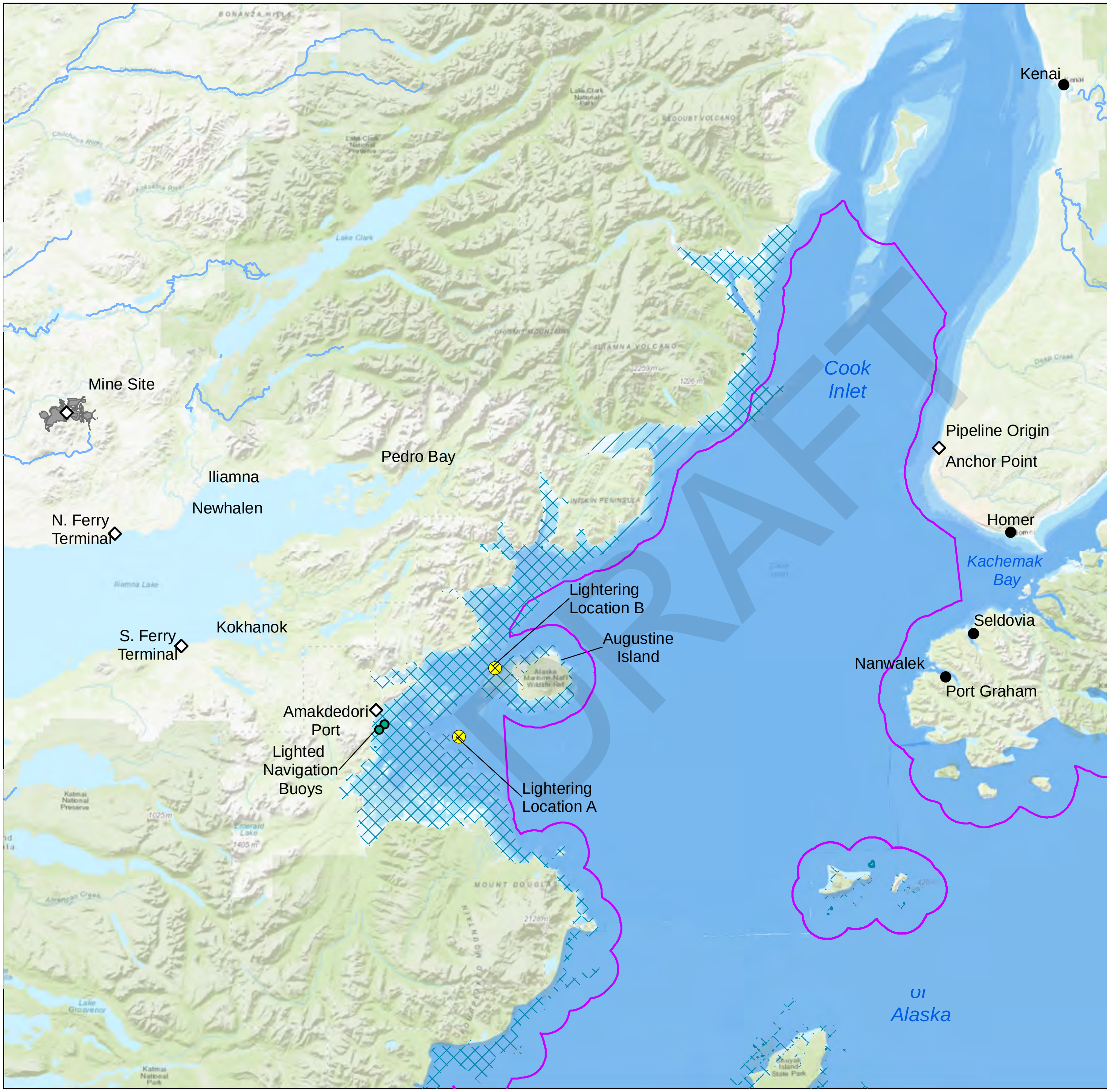


FIGURE 7

TYPICAL ANCHOR ARRANGEMENT

USFWS Biological Assessment

File:	Date: 10/1/2018
Version: x	Author: HDR



Project Feature

Lightering Location

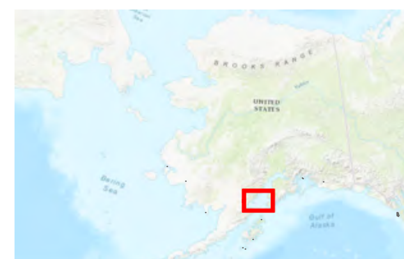
Lighted Navigation Buoys

Project Components

Outer Continental Shelf Boundary (3nm)

Action Area

Northern Sea Otter Critical Habitat



Miles

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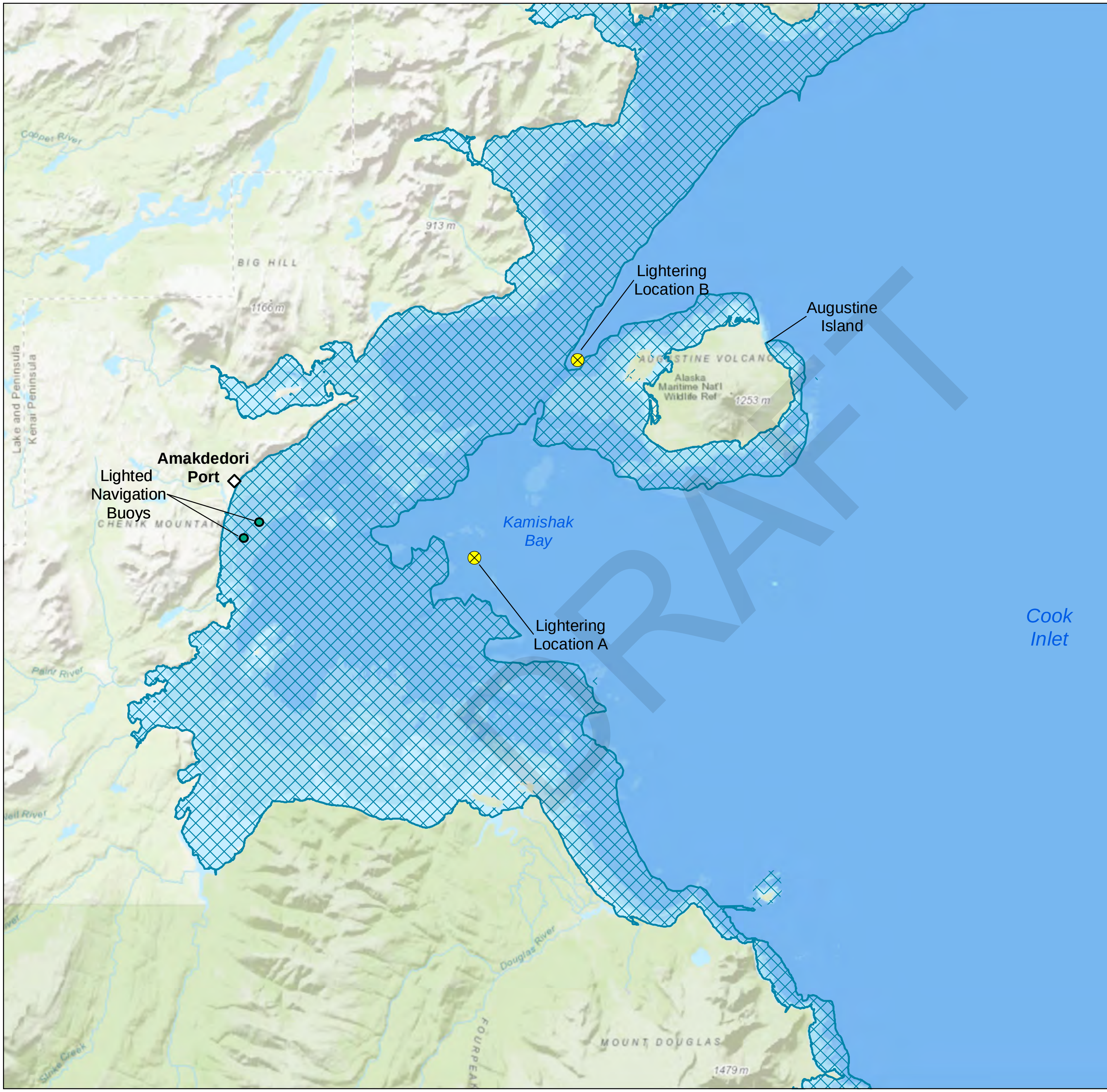
Scale 1:1,300,000

NAD 1983 StatePlane Alaska 5 FIPS 5005 Feet Seward Meridian	Figure: **8**

PROJECT ACTION AREA

USFWS Biological Assessment

File: PLP084	Date: 12/13/2018
Revision: 04	Author: RC/OR



THE pebble PARTNERSHIP

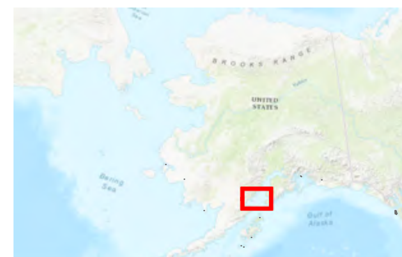
Project Feature

Lightering Location

Lighted Navigation Buoys

Action Area

Northern Sea Otter Critical Habitat Area



Miles

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Scale 1:450,000

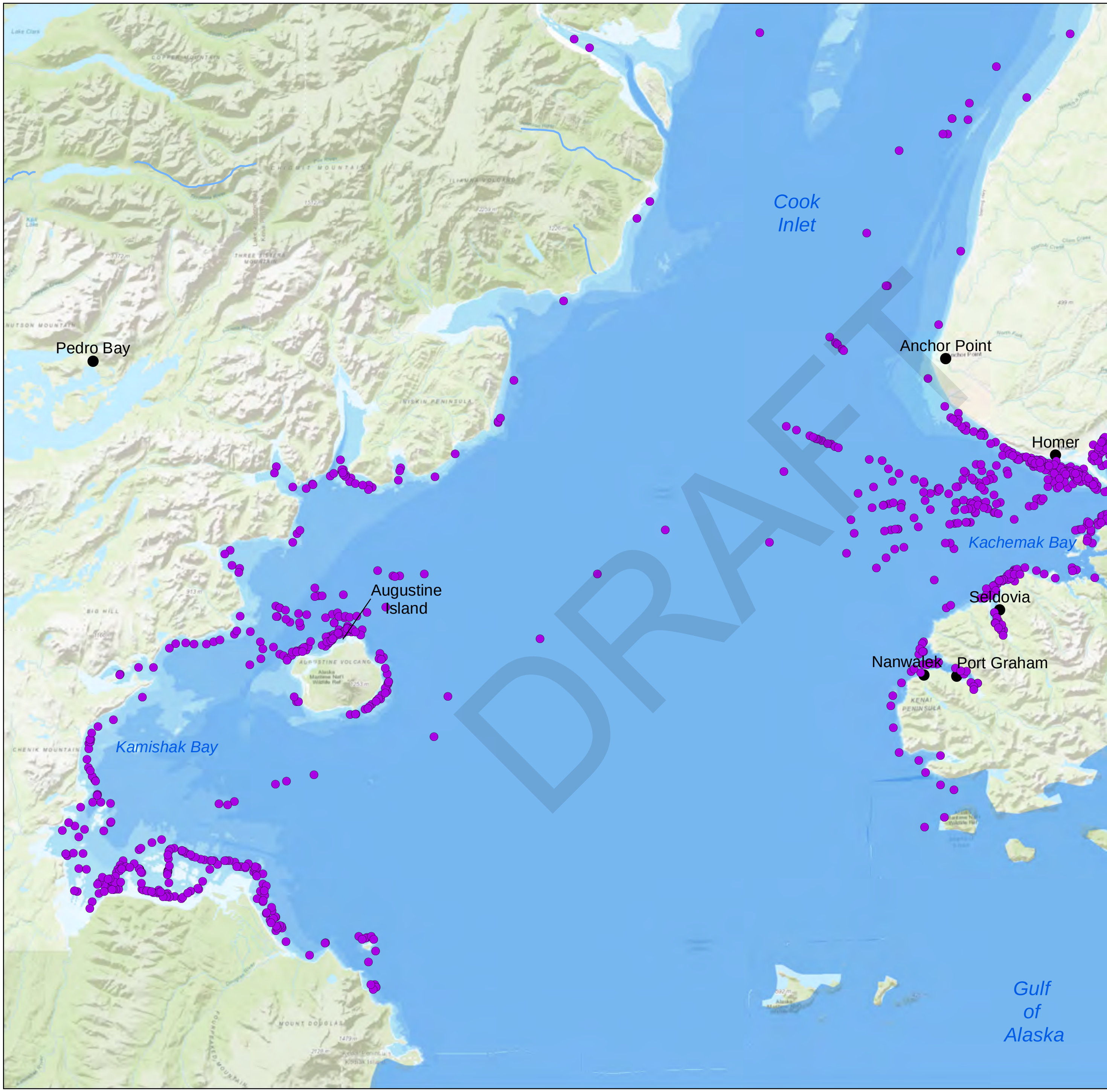
N

NAD 1983 StatePlane Alaska 5 FIPS 5005 Feet Seward Meridian	Figure: **9**

NORTHERN SEA OTTER CRITICAL HABITAT

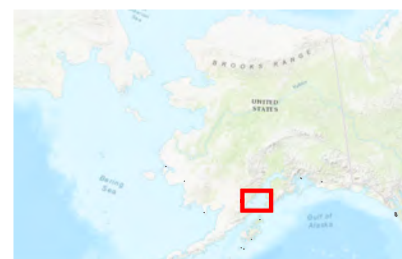
USFWS Biological Assessment

File: PLP046	Date: 12/14/2018
Revision: 06	Author: RC/OR



THE pebble PARTNERSHIP

● Northern Sea Otter



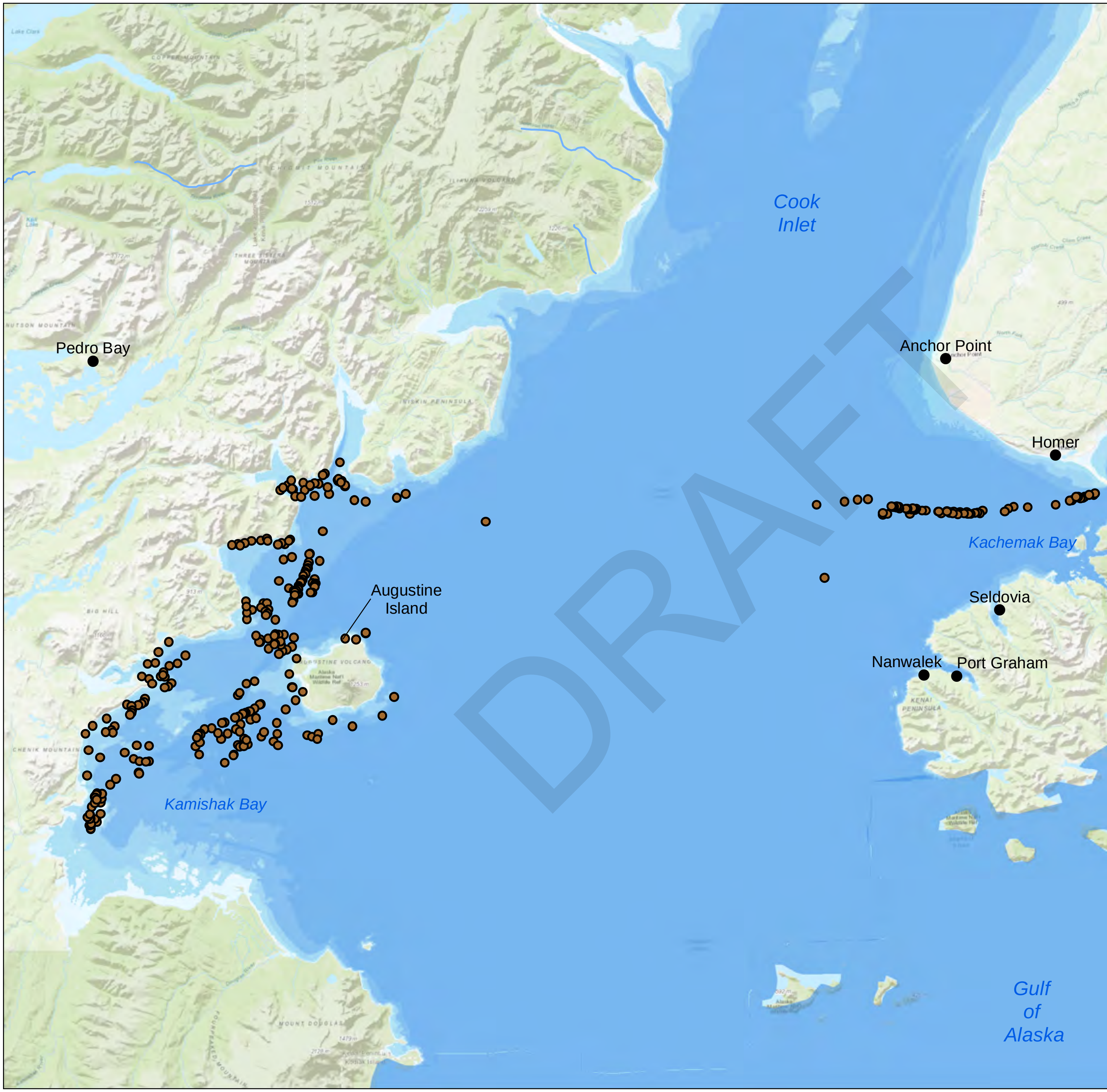
Miles
0 4 8 12 16 20
Scale 1:850,000

NAD 1983 StatePlane Alaska 5 FIPS 5005 Feet Seward Meridian	Figure: **10**

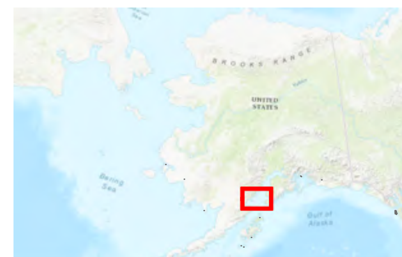
NORTHERN SEA OTTER LOCATIONS FROM NMFS SURVEYS 1993-2016

USFWS Biological Assessment

File: PLP085	Date: 10/15/2018
Revision: 02	Author: RC/OR



Northern Sea Otter



Miles

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Scale 1:850,000

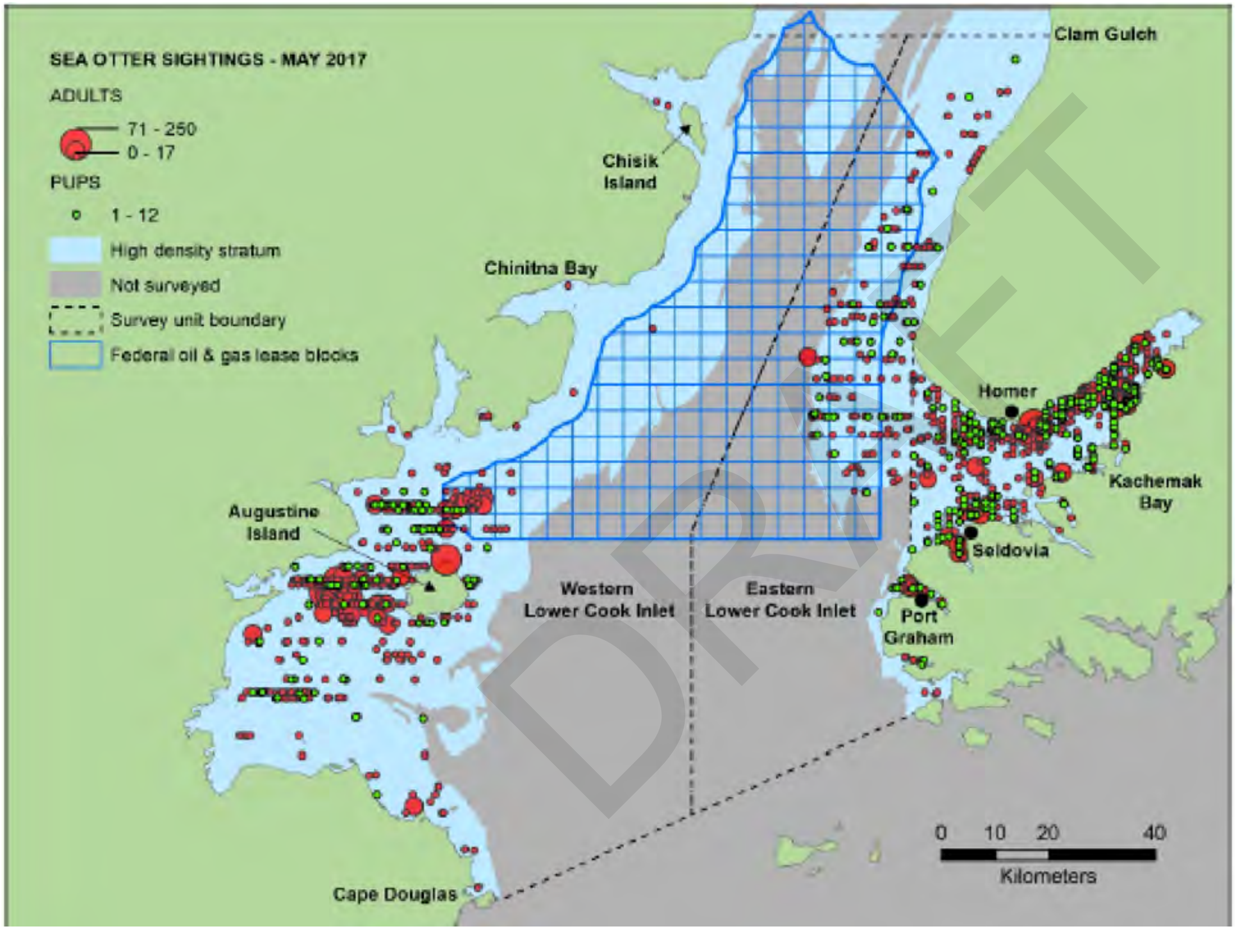
N

NAD 1983 StatePlane Alaska 5 FIPS 5005 Feet Seward Meridian	Figure: **11**

NORTHERN SEA OTTER LOCATIONS FROM ABR SURVEYS 2018

USFWS Biological Assessment

File: PLP086	Date: 9/14/2018
Revision: 01	Author: RC/OR



THE pebble PARTNERSHIP

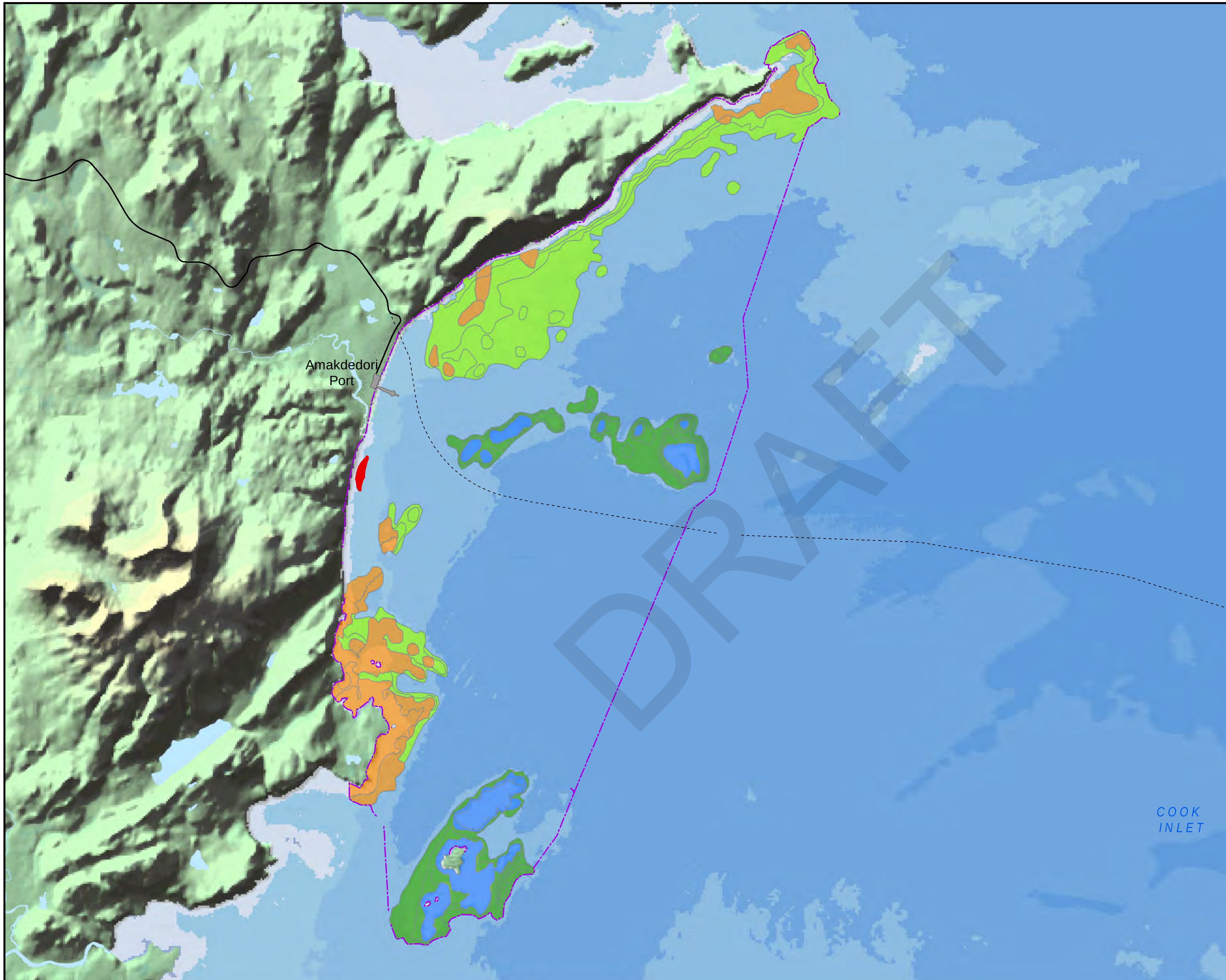
NAD 1983 StatePlane Alaska 5 FIPS 5005 Feet Seward Meridian

Figure: **12**

NORTHERN SEA OTTER LOCATIONS FROM USFWS/USGS SURVEYS 2017 (GARLICH-MILLER ET AL. 2018)

USFWS Biological Assessment

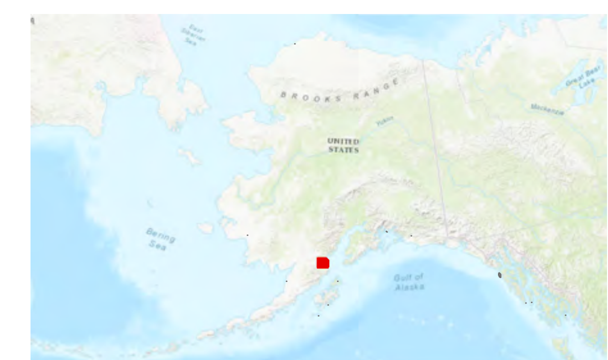
File: PLP121	Date: 12/11/2018
Revision: 02	Author: RC/OR



Proposed Transportation Corridor
Proposed Natural Gas Pipeline
Proposed Projet Footprint
Area Mapped (Stutes et al 2018)

Type, SubType, Substrate

Nearshore, Intertidal, Reef
Nearshore, Subtidal, Reef
Offshore, Intertidal, Reef
Offshore, Subtidal, Reef
Razor Clam Habitat



Miles
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Scale 1:100,000

NAD 1983 StatePlane
Alaska 5 FIPS 5005
Seward Meridian

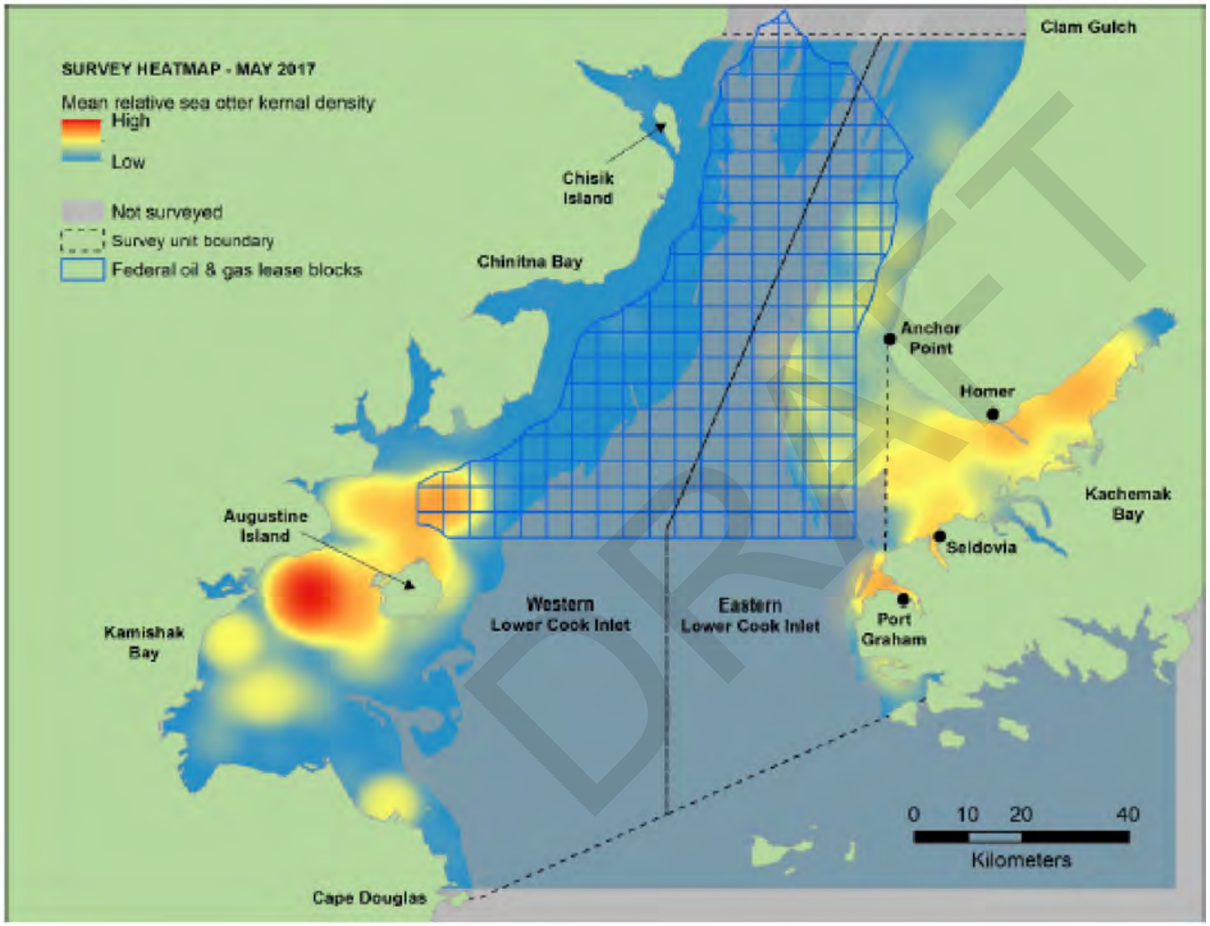
Figure: **13**

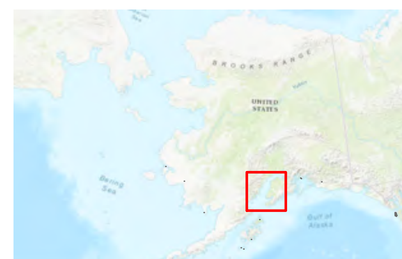
BENTHIC HABITATS

USFWS Biological Assessment
Pebble Project

File: PLP115	Date: 12/13/2018
Revision: 04	Author: RC/OR

Document Path: G:\Pebble\ARC_Proj\MXD\PLP115.mxd





NAD 1983 StatePlane Alaska 5 FIPS 5005 Feet Seward Meridian

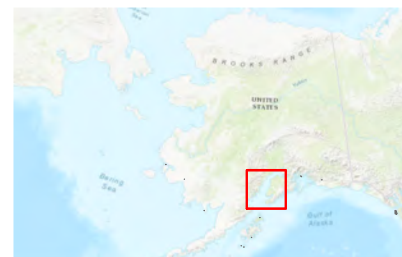
Figure: **14**

NORTHERN SEA OTTER DENSITIES FROM USFWS/USGS SURVEYS 2017 (GARLICH-MILLER ET AL. 2018)

USFWS Biological Assessment

File: PLP122	Date: 12/11/2018
Revision: 02	Author: RC/OR

THE pebble PARTNERSHIP



NAD 1983 StatePlane Alaska 5 FIPS 5005 Feet Seward Meridian

Figure: **15**

STELLER'S EIDER LOCATIONS JANUARY 2004 (LARNED 2006)

USFWS Biological Assessment

File: PLP123	Date: 12/11/2018
Revision: 02	Author: RC/OR

THE pebble PARTNERSHIP

NAD 1983 StatePlane Alaska 5 FIPS 5005 Feet Seward Meridian

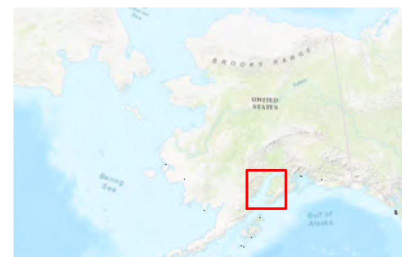
Figure: **16**

STELLER'S EIDER LOCATIONS FEBRUARY 2004 (LARNED 2006)

USFWS Biological Assessment

File: PLP124	Date: 12/11/2018
Revision: 02	Author: RC/OR

THE pebble PARTNERSHIP



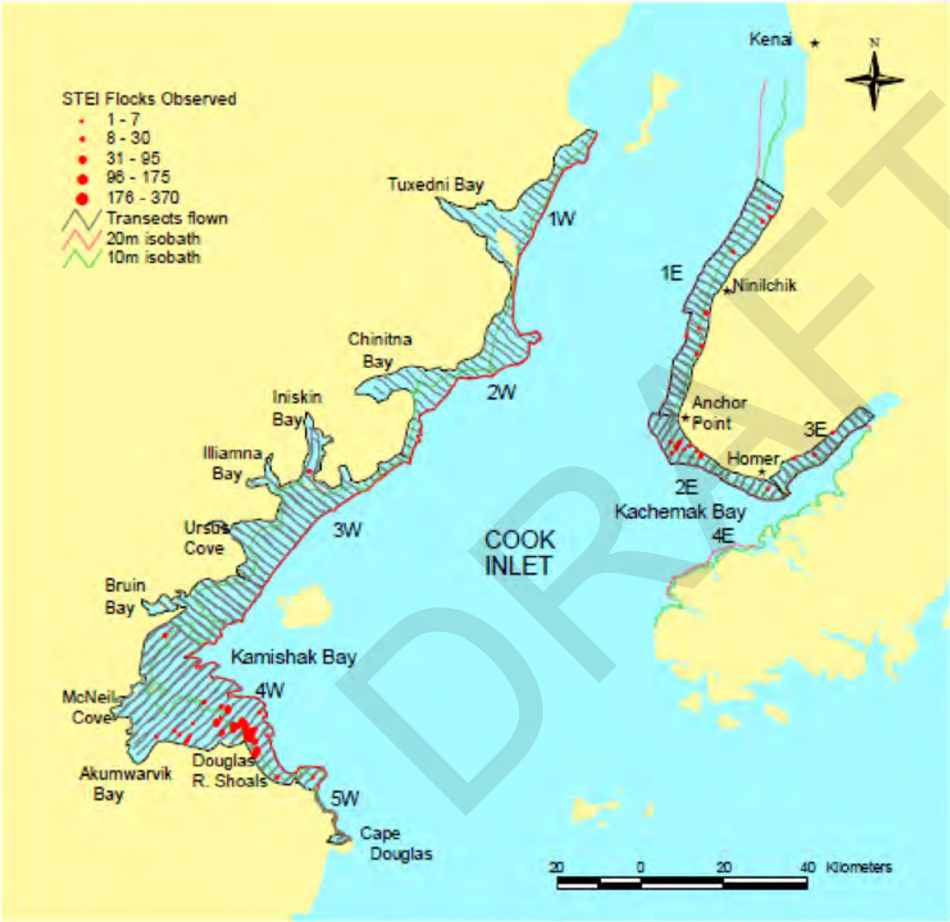
NAD 1983 StatePlane Alaska 5 FIPS 5005 Feet Seward Meridian

Figure: **17**

STELLER'S EIDER LOCATIONS MARCH 2004 (LARNED 2006)

USFWS Biological Assessment

File: PLP125	Date: 12/11/2018
Revision: 02	Author: RC/OR



THE pebble PARTNERSHIP

NAD 1983 StatePlane Alaska 5 FIPS 5005 Feet Seward Meridian	Figure: **18**

STELLER'S EIDER LOCATIONS APRIL 2004 (LARNED 2006)

USFWS Biological Assessment

File: PLP126	Date: 12/11/2018
Revision: 02	Author: RC/OR

NAD 1983 StatePlane
Alaska 5 FIPS 5005 Feet
Seward Meridian

Figure:
19

STELLER'S EIDER LOCATIONS DECEMBER 2004 (LARNED 2006)

USFWS Biological Assessment

File: PLP127	Date: 12/11/2018
Revision: 02	Author: RC/OR

THE pebble PARTNERSHIP

NAD 1983 StatePlane Alaska 5 FIPS 5005 Feet Seward Meridian

Figure: **20**

STELLER'S EIDER LOCATIONS JANUARY 2005 (LARNED 2006)

USFWS Biological Assessment

File: PLP128	Date: 12/11/2018
Revision: 02	Author: RC/OR

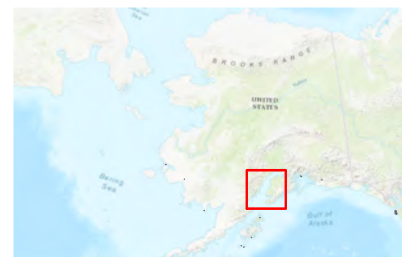
NAD 1983 StatePlane Alaska 5 FIPS 5005 Feet Seward Meridian

Figure: **21**

STELLER'S EIDER LOCATIONS FEBRUARY 2005 (LARNED 2006)

USFWS Biological Assessment

File: PLP129	Date: 12/11/2018
Revision: 02	Author: RC/OR

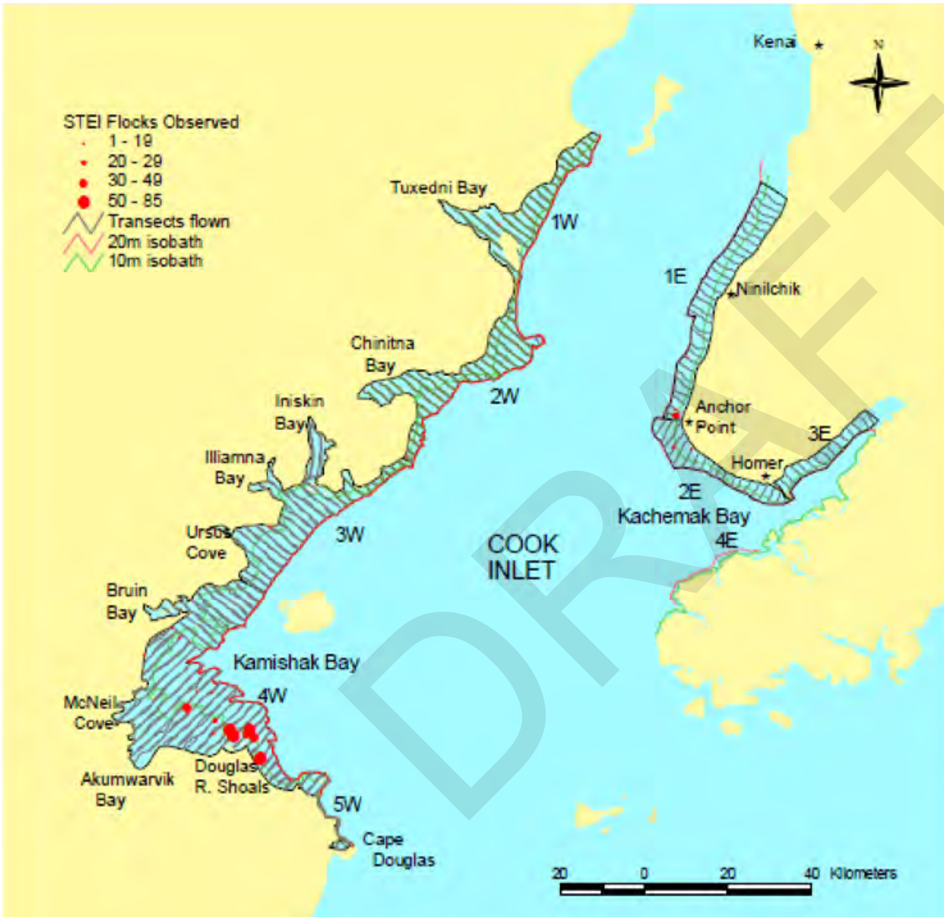


NAD 1983 StatePlane Alaska 5 FIPS 5005 Feet Seward Meridian	Figure: **22**

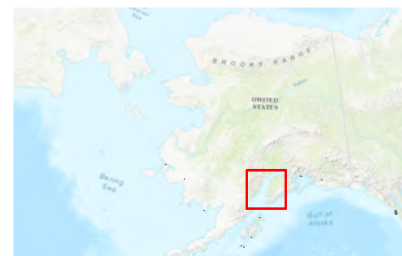
STELLER'S EIDER LOCATIONS MARCH 2005 (LARNED 2006)

USFWS Biological Assessment

File: PLP130	Date: 12/11/2018
Revision: 02	Author: RC/OR



THE pebble PARTNERSHIP



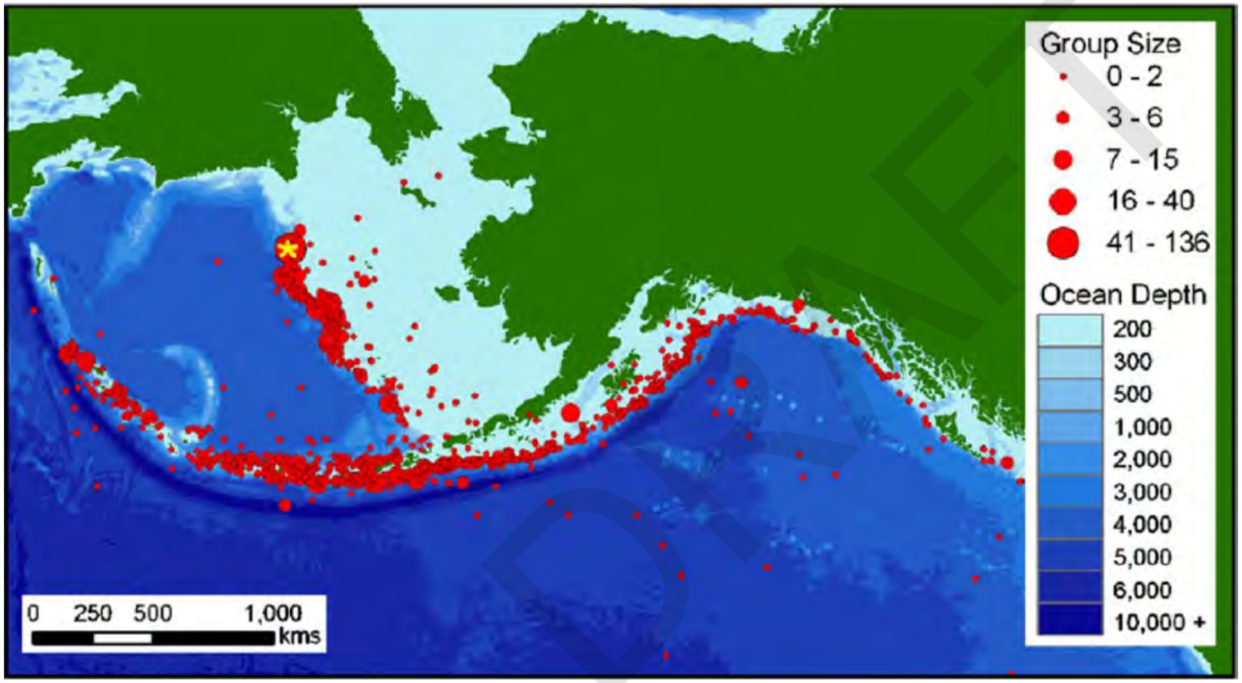
NAD 1983 StatePlane Alaska 5 FIPS 5005 Feet Seward Meridian

Figure: **23**

STELLER'S EIDER LOCATIONS APRIL 2005 (LARNED 2006)

USFWS Biological Assessment

File: PLP131	Date: 12/11/2018
Revision: 02	Author: RC/OR



NAD 1983 StatePlane Alaska 5 FIPS 5005 Feet Seward Meridian

Figure: **24**

SHORT-TAILED ALBATROSS LOCATIONS (PIATT ET AL. 2006)

USFWS Biological Assessment

File: PLP132	Date: 12/13/2018
Revision: 02	Author: RC/OR