3.25 THREATENED AND ENDANGERED SPECIES

This section covers threatened and endangered species (TES) listed under the federal Endangered Species Act (ESA) (16 United States Code [USC] Section 1531 et seq.) of 1973 that occur or are likely to occur in the Environmental Impact Statement (EIS) analysis area. The EIS analysis area includes all components of the project including the mine site, transportation and natural gas pipeline corridors, port, lightering locations, and natural gas compressor station on the Kenai Peninsula. The analysis area for TES focuses on the marine components of the project in Cook Inlet; the Pacific Ocean, including the Gulf of Alaska; and the Aleutian Islands. The EIS analysis area for TES extends to and encompasses waters in the US exclusive economic zone boundary. Terrestrial components of the project, which include the mine site, ferry terminals, terrestrial portion of the transportation and natural gas pipeline corridors, and compressor station on the Kenai Peninsula, are not discussed below because TES do not have ranges that include these terrestrial areas. In particular, TES are not known to occur around any of the proposed Newhalen, Gibraltar, or Iliamna river crossings (including all variants) for the transportation and natural gas pipeline corridors; therefore, these river crossings will not be analyzed in this section. The approximate bridge locations over the Newhalen, Gibraltar, and Iliamna rivers are shown on figures in this section, which show their distance from known TES habitats.

All project components and alternatives in the marine environment of Cook Inlet and beyond have the same analysis area. The analysis area includes all activities associated with pipeline construction, operations, maintenance/repair, and monitoring, as well as potential project-related vessel and aircraft routes. The analysis area for marine mammals includes marine waters crossed by concentrate bulk carriers traveling from Cook Inlet through Shelikof Strait and the Aleutian Islands, and marine line haul barges from Cook Inlet to West Coast ports traveling either through the Pacific Ocean, or near the coast through the Gulf of Alaska and southeast Alaska. The shipping lanes are approximately 6.4 nautical miles (7.4 miles) and include the area of ensonification from vessels during all project activities. The specific details for how the analysis area in the marine environment was determined are provided in Section 4.25, Threatened and Endangered Species.

The analysis area in Cook Inlet includes a vessel corridor from Nikiski south to Kamishak Bay and most of the western portion of lower Cook Inlet. The analysis area encompasses Kamishak Bay, and includes all marine components during all phases of the project (construction, operations, and closure). This includes installation of the natural gas pipeline, projected flight paths in and out of the airstrip at Amakdedori, and project-related vessel traffic between the port and lightering locations. The analysis area excludes eastern lower Cook Inlet, where there are well-established shipping lanes for non-project-related vessel traffic (Nuka and Pearson 2015). The analysis area does not change regardless of the alternative or variants considered, and encompasses the extent of potential project-related impacts that are reasonably expected to occur. Many wildlife species have a much larger range than the analysis area; however, this section focuses on species that have the potential to be present in the area during project construction, operations, and closure.

The ESA provides for conservation of fish, wildlife, and plant species considered to be at risk of extinction (i.e., threatened or endangered) in all or a substantial portion of their ranges; and to conserve the ecosystems and habitats on which they depend. The US Fish and Wildlife Service (USFWS) and National Marine Fisheries Service (NMFS) share regulatory authority for implementing the ESA for TES potentially affected by the project. This section provides a description of the affected environment for TES known or with a potential to occur in the analysis area based on a review of scientific literature, historical wildlife surveys conducted in the region, and wildlife surveys specifically conducted as part of the environmental baseline survey program. All marine mammals are also protected under the Marine Mammal Protection Act (MMPA). The MMPA prohibits the "take" of marine mammals in US waters by US citizens, with certain exceptions.

Marine mammal species with NMFS oversight are discussed first, followed by the marine mammal and avian species managed by the USFWS (see Appendix E, Laws, Permits, Approvals, and Consultations Required, for additional information). To analyze the potential effects that a federal action may have on a listed species, separate biological assessments for species under the jurisdiction of the USFWS and NMFS have been prepared. These biological assessments are included as Appendix G and Appendix H and are referenced in this section because they provide additional details on species occurrence and distribution for Alternative 1a.

Federally listed species (including distinct population segments [DPSs] and stocks) are included due to their known and potential occurrence in the analysis area (Table 3.25-1).

Table 3.25-1: Threatened and Endangered Species and Critical Habitat in Analysis Area

Species	Population	ESA Status	Critical Habitat[1]
Beluga Whale (*Delphinapterus leucas*)	Cook Inlet Stock	Endangered	Yes
Humpback Whale (*Megaptera novaeangliae*)	Western North Pacific DPS	Endangered	Yes (proposed)
	Mexico DPS	Threatened	Yes (proposed)
Fin Whale (*Balaenoptera physalus*)	Northeast Pacific Stock	Endangered	No
Blue Whale (*Balaenoptera musculus*)	North Pacific Stock	Endangered	No
Sperm Whale (*Physeter macrocephalus*)	North Pacific Stock	Endangered	No
Sei Whale (*Balaenoptera borealis*)	North Pacific Stock	Endangered	No
Gray Whale (*Eschrichtius robustus*)	Western North Pacific DPS	Endangered	No
North Pacific Right Whale (*Eubalaena japonica*)	Eastern North Pacific Stock	Endangered	No
Steller Sea Lion (*Eumetopias jubatus*)	Western DPS	Endangered	Yes
Northern Sea Otter (*Enhydra lutris kenyoni*)	Southwest Alaska DPS	Threatened	Yes
Steller's Eider (*Polysticta stelleri*)	Alaska breeding population	Threatened	No
Short-tailed Albatross (*Phoebastria albatrus*)	Worldwide	Endangered	No

Notes:

[1]Critical habitat for beluga whale (Cook Inlet stock) and northern sea otter (southwest Alaska DPS) has been finalized (76 Federal Register [FR] 20180; 74 FR 51988). Critical habitat for humpback whale (Mexico and Western North Pacific DPS) was proposed on October 9, 2019 (84 FR 54354) but has not been finalized. Humpback whale critical habitat for both DPSs occurs throughout the analysis area.

DPS = distinct population segments ESA = Endangered Species Act

Existing conditions also incorporate potential climate change trends. For TES, these trends include changes in habitat conditions (e.g., vegetation changes, ocean acidification), prey availability and distribution, and weather patterns (including sea ice coverage) among others.

Effects of climate change trends on marine mammal TES can be found in Section 3.23, Wildlife Values; however, climate change trends for Steller's eider are discussed below.

3.25.1 Alternative 1a

3.25.1.1 Cook Inlet Beluga Whale

Stock Identification

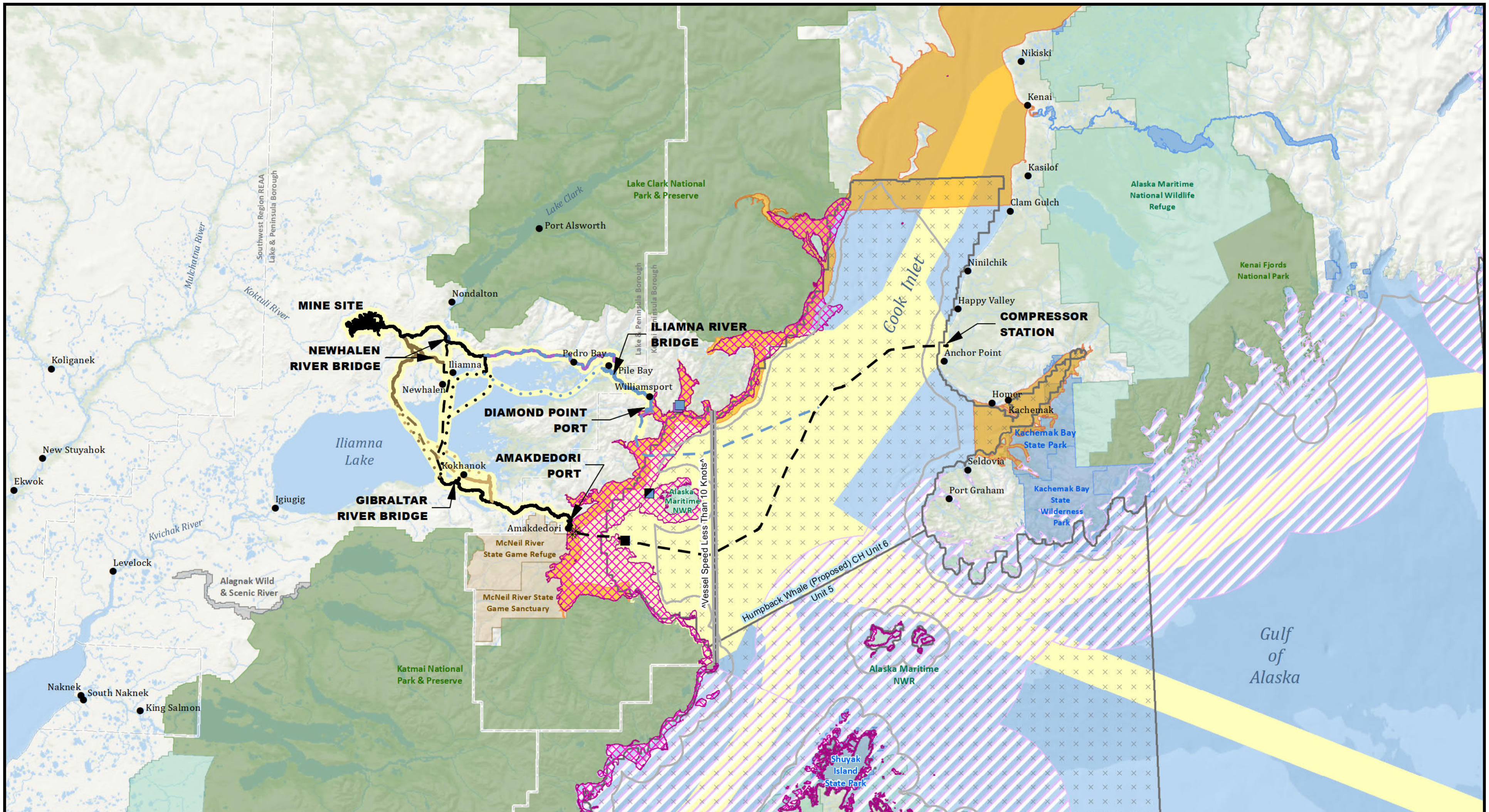
The Cook Inlet beluga whale stock (CIBS) occurs in the analysis area and is the most isolated of the five recognized beluga whale stocks (Laidre et al. 2000). The Cook Inlet beluga whale population was designated as depleted under the MMPA in 2000 (65 Federal Register [FR] 34590). In 2006, NMFS announced initiation of another Cook Inlet beluga whale status review under the ESA (71 FR 14836). NMFS issued a decision on the status review on April 20, 2007, concluding that the Cook Inlet beluga whale is a DPS and in danger of extinction throughout its range. NMFS then issued a proposed rule to list the Cook Inlet beluga whale as an endangered species (72 FR 19854). The CIBS was listed by NMFS as endangered under the ESA on October 22, 2008 (73 FR 62919). The Cook Inlet Beluga Whale Recovery Plan was published by NMFS in 2016 (NMFS 2016b) as required by the ESA, along with the Final Conservation Plan (NMFS 2008a) as required by the MMPA. According to annual aerial surveys conducted in June or July (or both) from 1993-2012 or biennial surveys conducted since 2014, the Cook Inlet beluga whale population has continued to decline at a rate of approximately -0.5 percent per year (Shelden et al. 2017). In 2016, the population estimate was 328 whales (Shelden et al. 2017). The most recent population estimate for the CIBS based on surveys from June 2018 is between 250 and 317 individuals, with a median estimate of 279 individuals (Shelden and Wade 2019). The population is estimated to be smaller and declining more quickly that previously thought. Over the most recent 10-year period (2008-2018), the estimated trend in abundance is approximately -2.3 percent per year (Shelden and Wade 2019).

Critical Habitat

NMFS announced the designation of critical habitat for the CIBS on April 8, 2011 (76 FR 20180; Figure 3.25-1). This critical habitat includes two areas: Critical Habitat Area 1 (outside of the analysis area), and Critical Habitat Area 2 (including the analysis area, which collectively encompass approximately 3,013 square miles of marine and estuarine habitat in Cook Inlet) (76 FR 20180). Cook Inlet beluga whale critical habitat is adjacent to the greatest concentration of Alaska's human population, the municipality of Anchorage (Castellote et al. 2019).

Critical Habitat Area 1 is approximately 738 square miles in area and encompasses all marine waters of Cook Inlet north of a line from Point Possession to the mouth of Three Mile Creek, including waters of the Susitna, Little Susitna, and Chickaloon rivers below mean higher high water. Critical Habitat Area 1 does not overlap with the analysis area. Critical Habitat Area 1 contains shallow tidal flats or mudflats and mouths of rivers that provide important areas for foraging, calving, molting and escape from predation. High concentrations of beluga whales are often observed in these areas from spring through fall.

Critical Habitat Area 2 consists of approximately 2,275 square miles south of Critical Habitat Area 1; includes nearshore areas along western Cook Inlet and Kachemak Bay; and overlaps the analysis area along the shores of Kamishak Bay (Figure 3.25-1). Critical Habitat Area 2 includes fall and winter foraging and transit habitat for beluga whales, as well as spring and summer habitat for smaller concentrations of beluga whales (76 FR 20180). This area consists of less-concentrated spring and summer beluga use; however, it includes known fall and winter feeding and transit areas.



Sources: PLP 2020-RFI168; PLP 2019-RFI153; NMFS 2009, 2011, 2019

US Army Corps of Engineers

10 0 10 20 30
Miles

Analysis Area

Vessel speeds would be restricted to less than 10 knots west of the 153° 15' 0" W meridian

Critical Habitat

- Cook Inlet Beluga Whale
- Humpback Whale (Proposed)
- Northern Sea Otter
- Steller Sea Lion

Action Alternatives

- Lighted Navigation Buoys
- Lightering Locations
- Ferry Routes
- Natural Gas Pipelines
- Alternative 1a
- Alternative 1
- Alternative 1 Kokhanok East Ferry Terminal Variant
- Alternative 2
- Alternative 2 Newhalen River North Crossing Variant
- Alternative 3

Other Features

- Borough Boundary
- Three Nautical Mile Line
- National Park
- National Wildlife Refuge
- Wild and Scenic River
- State Game Refuge/Sanctuary
- Alaska State Park

FEDERALLY LISTED MARINE MAMMAL CRITICAL HABITAT IN THE ANALYSIS AREA —COOK INLET

NMFS considers Primary Constituent Elements (PCEs) when designating critical habitat for TES. PCEs are the essential physical or biological features necessary for the conservation of a species on which their critical habitat is based. PCEs for the Cook Inlet beluga whale are listed below:

1. Intertidal and subtidal waters of Cook Inlet with depths less than 30 feet (mean lower low waterline), and within 5 miles of high and medium flow of anadromous fish streams
2. Primary prey species: four species of Pacific salmon (Chinook [*Oncorhynchus tshawytscha*], sockeye [*Oncorhynchus nerka*], coho [*Oncorhynchus kisutch*], and chum [*Oncorhynchus keta*]), Pacific eulachon (*Thaleichthys pacificus*), Pacific cod (*Gadus macrocephalus*), walleye pollock (*Gadus chalcogrammus*), saffron cod (*Eleginus gracilis*), and yellowfin sole (*Limanda aspera*)
3. Waters free of toxins or other agents of a type and amount harmful to Cook Inlet beluga whales
4. Unrestricted passage in or between the critical habitat areas
5. Waters with in-water noise below levels resulting in abandonment of critical habitat areas by Cook Inlet beluga whales

Habitat Use and Distribution

The CIBS remains in Cook Inlet throughout the year (Goetz et al. 2012); Rugh et al. (2010) have documented a significant northward contraction in their early summer range since the 1970s (Shelden et al. 2016; NMFS 2016b). During ice-free months, Cook Inlet beluga whales are typically concentrated near river mouths including the Susitna River Delta (the Big and Little Susitna rivers), Eagle Bay, Eklutna River, Ivan Slough, Theodore River, Lewis River, and Chickaloon Bay and River (Rugh et al. 2010); these are considered primary foraging locations for Pacific salmon species and other fish (NMFS 2008a, 2016b). All of these locations are in upper Cook Inlet, considerably north of the analysis area.

A recent passive acoustic mooring study by Castellote et al. 2016a analyzed data collected by acoustic moorings specifically designed to monitor the presence of beluga whales by recording their social and echolocation signals. The study was conducted from 2008 through 2013 at 13 locations in Cook Inlet, with three locations in lower Cook Inlet (Tuxedni Bay, Kenai River, and Homer). The study was designed to assess the seasonal distribution and foraging behavior of Cook Inlet beluga whales. The study confirmed seasonal distribution observed through aerial surveys and satellite telemetry data. During summer, beluga whale detections were higher in upper Cook Inlet, with fewer detections in those same areas during winter. Higher winter detections at Trading Bay, Kenai River, and Tuxedni Bay suggest that the species has a broader distribution in lower Cook Inlet during winter. No beluga whales were detected at Homer Spit, the southernmost site (Castellote et al. 2016a). No monitoring was conducted in Kamishak Bay, and the acoustic mooring location in Tuxedni Bay is outside of the analysis area. The study did not document beluga whales in lower Cook Inlet during summer; although they were present in winter at Kenai River and Tuxedni Bay, their presence was low compared to upper Cook Inlet and Knik Arm (Castellote et al. 2016a).

NMFS has conducted aerial surveys to estimate abundance of the beluga whale population in Cook Inlet every June, July, or during both months, from 1993 to 2012. Biennial surveys began in 2014 and have included the analysis area. Results of these surveys indicate that the majority of Cook Inlet beluga whales are concentrated in shallow areas near river mouths north of the analysis area, and do not occur as frequently in the central or southern portions of Cook Inlet (Shelden et al. 2017). The concentration of beluga whales in the northernmost portion of Cook Inlet appears to be consistent from June to October (Rugh et al. 2000, 2004, 2005, 2006, 2007).

There is evidence that most whales in the CIBS inhabit upper Cook Inlet year-round (Muto et al. 2018). However, a study of 20 satellite-tagged Cook Inlet beluga whales found that from January through March (when upper Cook Inlet is partially ice covered) most tagged whales were in lower to middle Cook Inlet (70 to 100 percent of tagged whales), from April to July they were near the Susitna River Delta (60 to 90 percent of tagged whales), and from August to December they were in the Knik and Turnagain arms (Ezer et al. 2013). Another satellite telemetry study by NMFS tracked the movements of 14 beluga whales from September 2000 through March 2003 provided additional detail on seasonal movements and habitat use. None of the tagged beluga whales in the study moved south of Chinitna Bay (Hobbs et al. 2005), which is in the northern part of the analysis area. NMFS aerial surveys have reported three beluga whale sightings, in June and July, in lower Cook Inlet since 1996 (Shelden et al. 2017).

Based on existing data, Cook Inlet beluga whales are believed to calve primarily between mid-May and mid-July and concurrently breed between late spring and early summer, primarily in upper Cook Inlet (NMFS 2016b). Beluga whales generally occur in the Beluga River, Susitna Flats, and Chickaloon Bay areas in May to July; Turnagain Arm in August; Knik Arm in September; and mid-Cook Inlet between Point Possession and Kalgin Island in January through April (Hobbs et al. 2008). In spring, the beluga whales' preferred prey species are eulachon and gadids (e.g., Pacific cod, Saffron cod, and walleye pollock). Other marine species found in the stomachs of beluga whales may be from secondary ingestion by fish that feed on polychaetes, shrimp, amphipods, mysids, and other invertebrates.

During the summer and fall, beluga whales are concentrated near the Susitna River mouth, Knik Arm, Turnagain Arm, and Chickaloon Bay (Nemeth et al. 2007) where they feed on migrating eulachon and salmon (Moore et al. 2000). They often remain stationary for many weeks or move back and forth between these areas in response to fish runs (Rugh et al. 2010). Stomach samples for beluga whales from late spring through summer contained Pacific salmon, corresponding to the timing of fish runs in the area. Five Pacific salmon species: Chinook, sockeye, coho, chum, and pink (*Onchorhyncus gorbuscha*) spawn in rivers throughout Cook Inlet (Moore et al. 2000). Overall, salmon represented the highest percentage frequency of occurrence of the prey species in Cook Inlet beluga whales' stomachs, suggesting that spring feeding principally on fat-rich fish such as salmon and eulachon in upper Cook Inlet, is very important for providing sustained energy.

In the fall as anadromous fish runs begin to decline, beluga whales return to the lower to mid-Cook Inlet to forage on resident fish species (e.g., cod and groundfish). Groundfish include Pacific staghorn sculpin (*Leptocottus armatus*), starry flounder (*Platichthys stellatus*), and yellowfin sole found in nearshore bays and estuaries. As late as October, beluga whales tagged with satellite transmitters continued to use Knik Arm, Turnagain Arm, and Chickaloon Bay, but some ranged into lower Cook Inlet south to Chinitna Bay, Tuxedni Bay, and Trading Bay (McArthur River) in the fall (Hobbs et al. 2005). Data from NMFS aerial surveys, opportunistic sighting reports, and satellite-tagged beluga whales confirm they are more widely dispersed throughout Cook Inlet during the winter months (November through April), with animals found between Kalgin Island and Point Possession. In November, beluga whales moved between Knik Arm, Turnagain Arm, and Chickaloon Bay, similar to patterns observed in September (Hobbs et al. 2005). By December, beluga whales were distributed throughout the upper to mid-Cook Inlet. From January into March, they moved as far south as Kalgin Island and slightly beyond in central offshore waters. Beluga whales also made occasional excursions into Knik Arm and Turnagain Arm in February and March despite ice cover greater than 90 percent (Hobbs et al. 2005). Stomach samples from Cook Inlet beluga whales are not available for winter months (December through March), although dive data from beluga whales tagged with satellite transmitters suggest that the whales feed in deeper waters during winter (Hobbs et al. 2005), possibly on such prey species as flatfish, cod, sculpin, and pollock.

In the northern portion of the analysis area, NMFS satellite telemetry data from September 2000 through March 2003 found that none of the 14 beluga whales tagged in the study moved south of Chinitna Bay (Hobbs et al. 2005). There are scattered records of Cook Inlet beluga whales in Iliamna and Iniskin bays (in the northern part of the analysis area), which are discussed in detail below under Alternative 2—North Road and Ferry with Downstream Dams (Figure 3.25-2). Incidental boat-based observations made by Alaska Biological Research, Inc. (ABR) in the spring and summer of 2018 (ABR 2018b-f) and aerial surveys conducted by USFWS for northern sea otters in May 2017 (Garlich-Miller et al. 2018) failed to detect any beluga whales in Kamishak Bay. No beluga whales were detected during more recent aerial surveys flown for northern sea otters in Kamishak Bay in March, May, June, and twice in October 2019 (ABR 2019a, 2019b, 2019c, 2019f). During NMFS beluga whale summer aerial surveys in recent years, there have been zero sightings of Cook Inlet beluga whales in Kamishak Bay (Shelden et al. 2017; Shelden and Wade 2019). Based on these surveys in and around Kamishak Bay in recent years, beluga whales do not appear to use Kamishak Bay, at least between spring and fall.

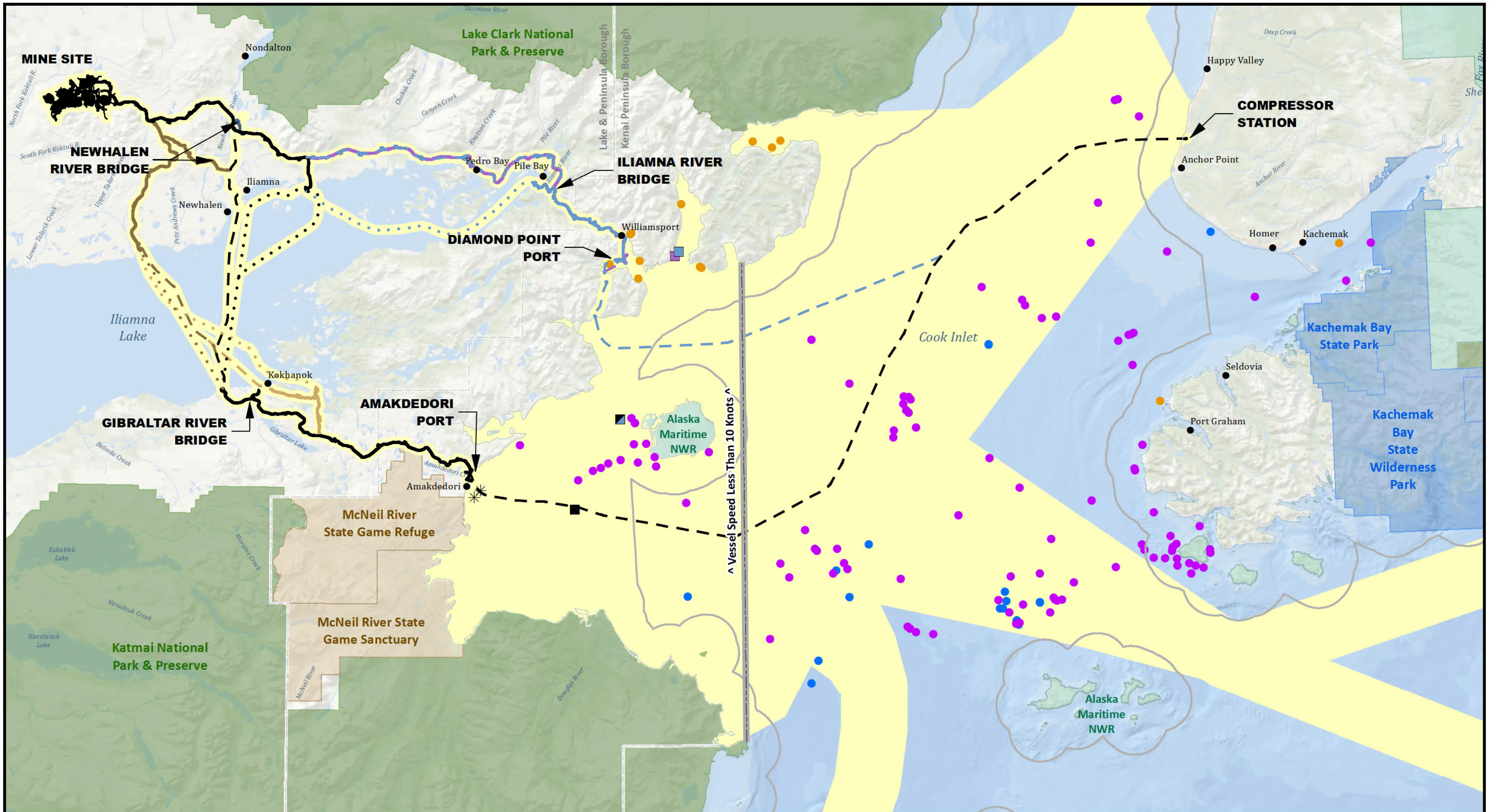
Two recent detections of beluga whales in lower Cook Inlet indicate that the species still occasionally uses the area. Four beluga whales were seen in Kachemak Bay on July 1, 2018, and beluga whales were recorded on acoustic monitors on January 20, 2019 in Port Graham (Gill *pers comm.* 2018; Castellote pers comm. 2020). These recent detections show that beluga whales still occasionally occur in lower Cook Inlet.

3.25.1.2 Humpback Whale

Stock Identification

Humpback whales were originally designated as endangered under the ESA in 1973 (35 FR 18319). In 2013, NMFS published a 90-day finding identifying the Central North Pacific population of humpback whales as a DPS under the ESA and recommended that this DPS be delisted from the ESA based on population abundance (78 FR 53391). On September 8, 2016, NMFS revised the ESA listing status of the humpback whale (81 FR 62260). NMFS divided the globally listed species into 14 DPSs under the ESA, removing the current listing for the entire species and replacing it with four endangered DPSs (Cape Verde Islands/Northwest Africa, Western North Pacific, Central America, and Arabian Sea), and one threatened DPS (Mexico). The remaining nine DPSs did not warrant listing. While humpback whales have been designated as 14 DPSs per the ESA, humpback whales are listed as one stock under the MMPA.

The Western North Pacific DPS (endangered), the Hawaii (Central North Pacific) DPS (not listed), and the Mexico DPS (threatened) are the DPSs most likely present in the Gulf of Alaska, which includes the analysis area. NMFS considered Hawaii DPS individuals to comprise 89 percent of the humpback whales present, Mexico DPS individuals to comprise 10.5 percent and the Western North Pacific DPS to comprise 0.5 percent (NMFS 2017c). However, most of the individuals that migrate to the Gulf of Alaska Cook Inlet area are likely from the Hawaii DPS, and not the Western North Pacific or Mexico DPSs (NMFS 2017c). The most recent abundance estimates for the Western North Pacific DPS are 1,066 whales, the Hawaii DPS at 11,571 whales, and the Mexico DPS at 2,806 whales (NMFS 2019).



Sources:PLP 2020-RFI168; PLP 2019-RFI153; (Beluga whale [ABR 2006 - 2012]; Gill pers. comm. 2018; Humpback whale [ABR 2018]); Rugh et al. 2005; Shelden et al. 2013, 2015, 2017; Castellote pers. comm. 2020

US Army Corps of Engineers

10 0 10

Miles

- Analysis Area
- Vessel speeds would be restricted to less than 10 knots west of the 153° 15' 0" W meridian

Species Observations

- Cook Inlet Beluga Whale
- Fin Whale
- Humpback Whale

Action Alternatives

- Lighted Navigation Buoys
- Lightering Locations
- Ferry Routes
- Natural Gas Pipelines
- Alternative 1a
- Alternative 1
- Alternative 1 Kokhanok East Ferry Terminal Variant
- Alternative 2
- Alternative 2 Newhalen River North Crossing Variant
- Alternative 3

Other Features

- Borough Boundary
- Three Nautical Mile Line
- National Park
- National Wildlife Refuge
- Alaska State Park
- State Game Refuge/Sanctuary

FEDERALLY LISTED WHALE SPECIES OBSERVATIONS IN THE ANALYSIS AREA —COOK INLET

Critical Habitat

Critical habitat for the two endangered DPSs and one threatened DPS found in US waters (Western North Pacific, Central America, and Mexico) had not been determined when the species was divided into 14 DPSs (81 FR 62260). However, on October 9, 2019, NMFS proposed critical habitat for the three federally listed DPSs that occur in US waters (84 FR 54354). No critical habitat was proposed for the Central America DPS in the analysis area. NMFS proposed critical habitat for the Mexico DPS in Unit 6 (Cook Inlet), which overlaps with the analysis area (Figure 3.25-1). The southern boundary of Unit 6 extends from Cape Douglas across the inlet to Cape Adam. The northern boundary extends north to 60°20′ N, just south of Kalgin Island (84 FR 54354). The nearshore boundary is the 3.3-foot isobath (relative to mean lower low water) and Unit 6 covers approximately 3,366 nautical square miles of marine habitat. Additionally, a small portion of critical habitat for the Western North Pacific DPS in Unit 5 (Kodiak Island Area) overlaps with the analysis area south of Cape Douglas (Figure 3.25-1). The main essential feature for humpback whale critical habitat is availability of prey defined as: prey species, primarily euphausiids and small pelagic schooling fishes of sufficient quality, abundance, and accessibility in humpback whale feeding areas to support feeding and population growth.

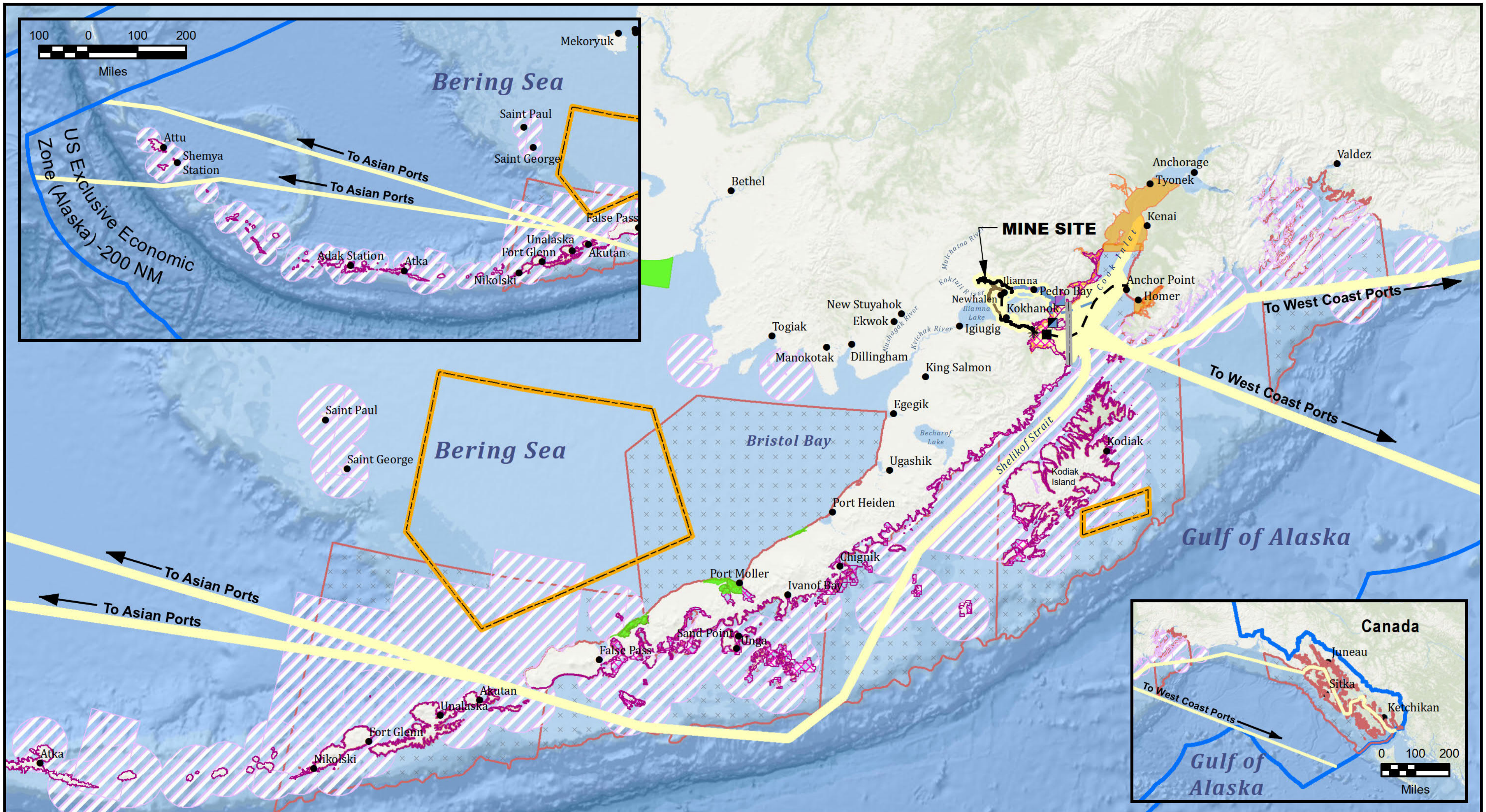
There are additional proposed humpback whale critical habitat units for both the Mexico DPS and Western North Pacific DPS along the Alaska Peninsula through the Aleutian Islands to Unimak Pass that overlap with proposed project shipping routes (84 FR 54354) (Figure 3.25-3). Proposed critical habitat also overlaps with proposed shipping routes through the Inside Passage in southeast Alaska.

Habitat Use and Distribution

Although North Pacific humpbacks primarily spend the winter mating and calving in the subtropical and tropical waters of the Northern and Southern hemispheres, they can be found in Alaskan waters year-round. In the spring, humpback whales generally migrate north and feed in the prey-rich, sub-polar waters of southern Alaska, British Columbia, and the southern Chukchi Sea. Individuals from the Western North Pacific, Hawaii, and Mexico DPSs migrate to areas near and in the analysis area; however, most of the individuals that migrate to the Gulf of Alaska and Cook Inlet area are likely from the Hawaii DPS (NMFS 2017c). The Hawaii DPS breeds in the Hawaiian Islands area and feeds in the North Pacific, particularly Southeast Alaska and northern British Columbia (Muto et al. 2018). The Western North Pacific DPS breeds in the areas of Okinawa, Japan and the Philippines, and feeds in the northern Pacific, primarily off the Russian Coast (Muto et al. 2018). The Mexican DPS breeds along the Pacific Coast of Mexico, the Baja California Peninsula, and the Revillagigedo Islands, and feeds across a broad range from California to the Aleutian Islands (Muto et al. 2018). Humpback whales from the Mexico DPS have been documented in Cook Inlet through confirmed photo-identification matching between breeding and foraging areas (NMFS 2019). Humpback whales from the Western North Pacific DPS have not been photo identified in Cook Inlet; however, their presence in the area is inferred based on their wintering areas that occur in the general region (84 FR 54354; NMFS 2019).

During summer, most of the Hawaii DPS is near the Aleutian Islands, Bering Sea, Gulf of Alaska, and Southeast Alaska/northern British Columbia areas. High densities of humpback whales commonly occur in the eastern Aleutian Islands along the north side of Unalaska Island, along the Bering Sea shelf edge, and north toward the Pribilof Islands (Muto et al. 2018).

Primary foraging areas for humpback whales in the Gulf of Alaska region are south of Cook Inlet, including the waters east of Kodiak Island (the Albatross and Portlock banks), waters along the southeastern side of Shelikof Strait, and in the bays along the northwestern shore of Kodiak Island (Ferguson et al. 2015). Humpback whales feed on small schooling fish and large zooplankton. Fish prey species in the North Pacific include Pacific herring, capelin, juvenile walleye pollock, and sand lance. Humpback also feed on eulachon, Atka mackerel, Pacific cod, saffron cod, Arctic cod, juvenile salmon, and rockfish (Hain et al. 1982).



Sources: PLP 2019-RFI153; ADNR 2010, 2018; BOEM 2018

US Army Corps of Engineers

50 0 50 100 Miles

Analysis Area

Vessel speeds would be restricted to less than 10 knots west of the 153° 15' 0" W meridian

US Exclusive Economic Zone

Critical Habitat

- Cook Inlet Beluga Whale
- Humpback Whale (Proposed)
- Northern Sea Otter
- North Pacific Right Whale
- Steller Sea Lion
- Steller's Eider

Action Alternatives

- Lightering Locations
- Natural Gas Pipelines
- Alternative 1a
- Alternative 1
- Alternative 2
- Alternative 3

CRITICAL HABITAT IN THE ANALYSIS AREA —PACIFIC OCEAN AND ALEUTIAN ISLANDS

PEBBLE PROJECT EIS

FIGURE 3.25-3

Small numbers of humpback whales occur in Cook Inlet during summer and fall (Figure 3.25-2). Humpback whales have been observed during NMFS beluga whale aerial surveys conducted in Cook Inlet from 1993 to 2016. These surveys overlapped with the analysis area; humpback whale sightings occurred near the Augustine, Barren, and Elizabeth islands (Shelden et al. 2013, 2015, 2017). NMFS beluga whale annual and biennial aerial surveys documented humpback whales while conducting surveys from the end of May through mid-June. Group sizes ranged from individual whales to groups of up to 12 whales (Shelden et al. 2013, 2015, 2017). Aerial surveys in May 2018 for northern sea otters incidentally documented several humpback whales in Kamishak Bay, including north of Augustine Island (Garlich-Miller et al. 2018). Additionally, ABR surveys in spring and summer of 2018 incidentally documented several humpback whales in Kamishak Bay southwest of Augustine Island near one of the lightering locations (ABR 2018c, 2018e; Figure 3.25-2). Aerial surveys (offshore surveys along systematic transect lines) were flown for northern sea otters in Kamishak Bay in March, May, June, and twice in October 2019 (ABR 2019a, 2019b, 2019c, 2019f). No humpback whales were incidentally detected.

Humpback whales also occur throughout the Gulf of Alaska, along the southern side of the Alaska Peninsula and the Bering Sea (Figure 3.25-4). They occur in shelf and shelf edge waters of the Gulf of Alaska and the Bering Sea, and have a potential to occur throughout the shipping routes. The majority of humpback whales are expected to be members of the non-listed Hawaii DPS, although some of the listed Mexico DPS and Western North Pacific DPS may occur in the Gulf of Alaska.

3.25.1.3 Fin Whale

Stock Identification

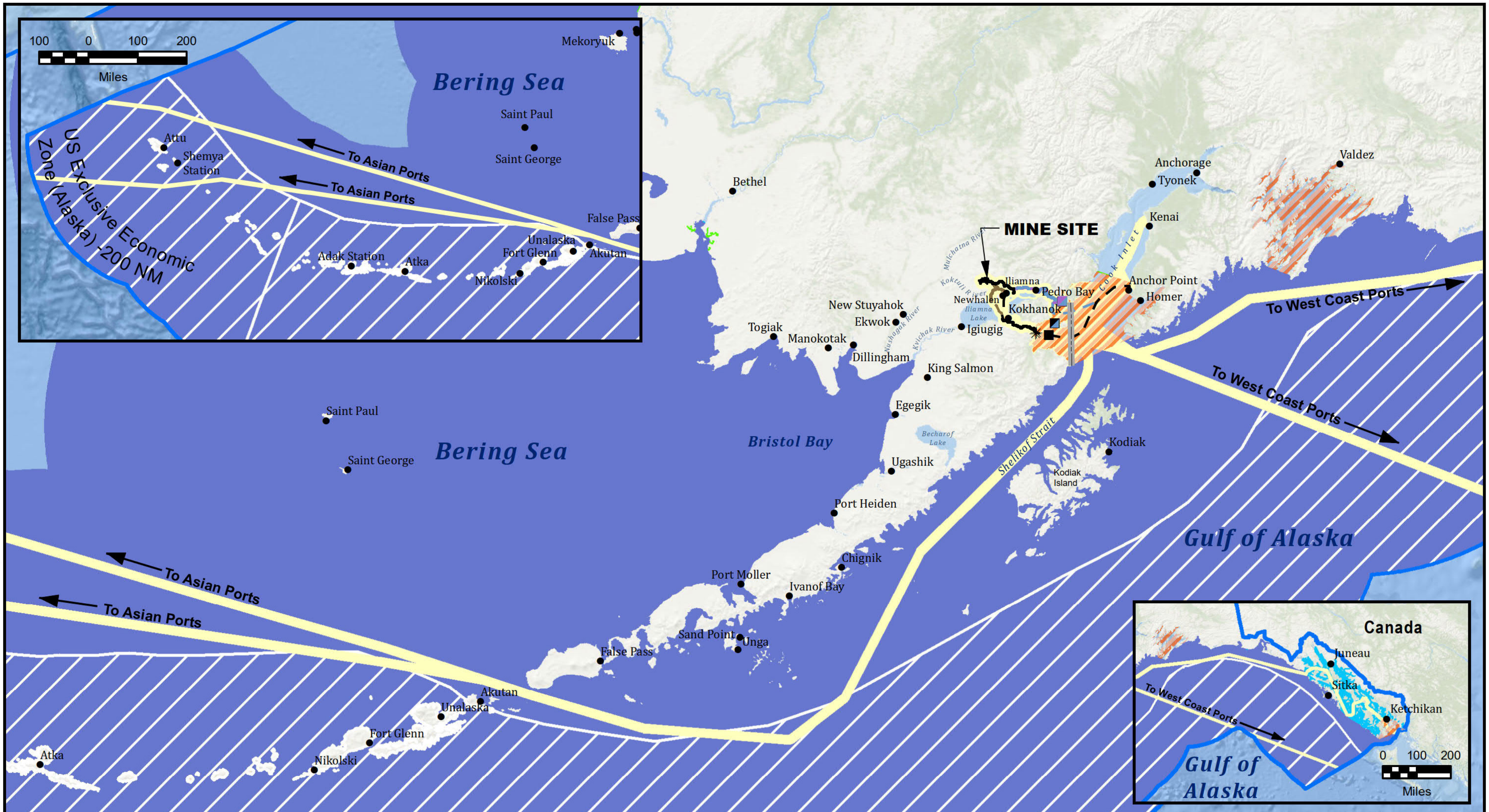
Fin whales were listed as endangered under the ESA in 1973 (35 FR 18319). For management purposes, NMFS divided fin whales in US waters into several management units or "stocks." One of these stocks, the Alaska (Northeast Pacific) stock, occurs in Alaskan waters. The Northeast Pacific stock is seasonally found off the coast of the Chukchi and Bering seas and the Gulf of Alaska during the summer (Muto et al. 2018). Fin whale surveys in the Gulf of Alaska in 2013 and 2015 estimated 3,168 fin whales (Rone et al. 2017).

Critical Habitat

Currently, no critical habitat has been designated for the fin whale.

Habitat Use and Distribution

Fin whales range across the entire North Pacific Ocean in both pelagic and shelf waters, and especially use shelf edge upwelling and mixing zones. Fin whales have been acoustically detected in the Gulf of Alaska year-round, with highest acoustic detections rates from August through December, and lowest call occurrence rates from February through July (Moore et al. 2006; Stafford et al. 2007). In July and August, fin whales concentrate in the Bering Sea/eastern Aleutian Islands area (Mizroch et al. 2009) and are regularly seen in the Gulf of Alaska (Muto et al. 2018). During the remaining months, fin whales are typically observed around the Aleutian Islands, Kodiak Island, and in the Bering Sea. Results from a study off the Kenai Peninsula and the central Aleutian Islands indicate that in the summer months, fin whales primarily inhabited the area from the Kenai Peninsula to the Shumagin Islands, and were most abundant near the Semidi Islands and Kodiak Island (Zerbini et al. 2006). In this study, all fin whales were detected south of the mouth of Cook Inlet.



Sources: PLP 2020-RFI168; PLP 2019-RFI153; ADNR 2010, 2018; BOEM 2018

US Army Corps of Engineers

Miles

Analysis Area

Vessel speeds would be restricted to less than 10 knots west of the 153° 15' 0" W meridian

US Exclusive Economic Zone

Whale Species Ranges

- Blue Whale
- Fin and Humpback Whale
- Fin Whale
- Humpback Whale
- Fin, Humpback, and North Pacific Right Whale

Action Alternatives

- Lightering Locations
- Natural Gas Pipelines
- Alternative 1a
- Alternative 1
- Alternative 2
- Alternative 3

FEDERALLY LISTED WHALE SPECIES RANGES IN THE ANALYSIS AREA —PACIFIC OCEAN AND ALEUTIAN ISLANDS

Fin whale sightings in Cook Inlet are rare and primarily on the eastern edge of the mouth of Cook Inlet (NMFS 2017b; Figure 3.25-2). NMFS beluga whale aerial surveys from 1993 through 2016 recorded 10 fin whales widely distributed offshore between Anchor Point and Cape Douglas, mostly near the mouth of Cook Inlet and south of the natural gas pipeline corridor. Surveys were conducted at the end of May to mid-June; most fin whales encountered were in groups of one to three, with one group of 13 whales located northwest of the Barren Islands (Shelden et al. 2013). Panigada et al. (2006) found water depth to be the most significant variable in describing fin whale distribution, with more than 90 percent of sightings occurring in waters deeper than 6,562 feet; the rarity of fin whales in Cook Inlet is due to the relatively shallow water depths, as fin whales prefer deeper waters.

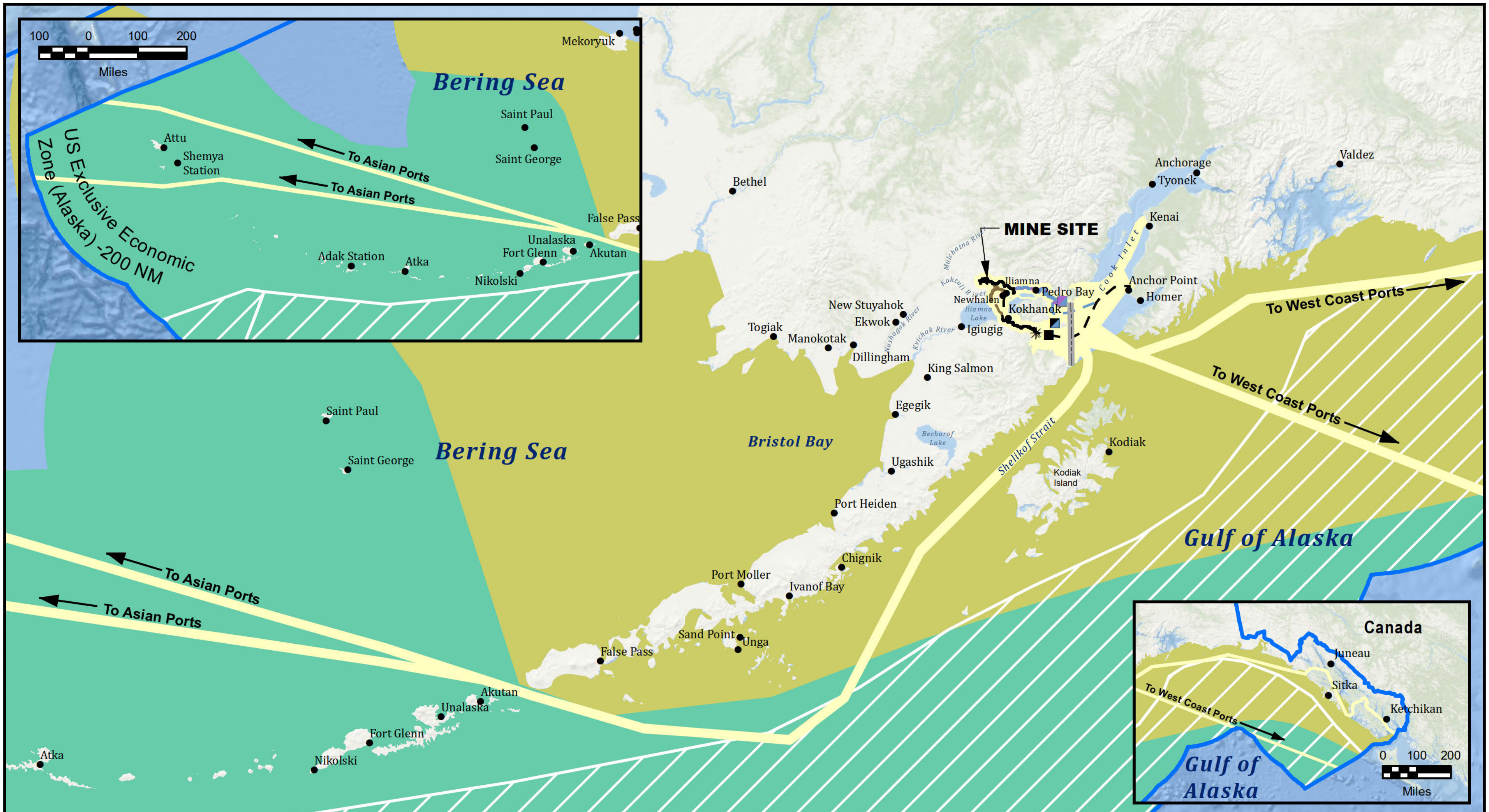
A series of aerial surveys (focusing on northern sea otters) were conducted by ABR in spring and summer of 2018, and March, May, June, and October 2019 did not incidentally detect any fin whales in Kamishak Bay (ABR 2018c, 2018e, 2019f). Fin whales also occur in similar waters to humpback whales; their range overlaps with the proposed shipping routes in the Gulf of Alaska, through Unimak Pass, and into the Bering Sea (Figure 3.25-4).

3.25.1.4 Blue, Sperm, Sei, Gray, and North Pacific Right Whales

Five endangered whale species have a potential to occur in the project shipping routes in the Pacific Ocean, including the Gulf of Alaska, along the Aleutian Islands, and in the Bering Sea (Figure 3.25-4 and Figure 3.25-5). These species do not normally occur in Cook Inlet where the majority of project-impacts are anticipated to occur, but their ranges overlap with established shipping lanes; therefore, these species are discussed collectively in this section. The North Pacific stocks of blue, sperm, and sei whales occur in the EIS analysis area, along with the Western North Pacific DPS of the gray whale and the Eastern North Pacific stock of North Pacific right whale. All five species are listed as endangered under the ESA, managed by the NMFS, and protected by the MMPA. Details of these species' abundance and trends, distribution and habitat use, feeding and prey selection, reproduction, natural mortality, threats, acoustical energy, and use of the analysis area are provided in the NMFS biological assessment (Appendix H), but are briefly summarized below.

Blue whales are the world's largest cetaceans, and both the eastern and western North Pacific populations have a potential to occur in pelagic waters in the analysis area (Figure 3.25-4). They inhabit both pelagic and self-edge waters and feed on krill. There is no designated critical habitat for blue whales. The eastern North Pacific Stock is estimated at 2,497 animals (Calambokidis et al. 2010), and there is no reliable population estimate for the western North Pacific Stock. Blue whales have been recorded in the Gulf of Alaska between Southeast Alaska and Kodiak Island; however, the number of summering whales is small. Blue whales are primarily pelagic, and have a potential to be encountered by project vessels transiting the vessel routes through the offshore waters in the Gulf of Alaska and Bering Sea.

The sperm whale is listed as federally endangered, and the North Pacific stock is known to occur along self-edge and pelagic habitats. They are more common south of the Gulf of Alaska, but move along the West Coast of the US into the Gulf of Alaska and along the Aleutians (Figure 3.25-5). Although they have been detected year-round in the Gulf of Alaska, their numbers increase in the summertime. They feed at depths primarily on squid, but also consume sharks, skates, and fish. There is no current reliable estimate of the population or abundance trends (Muto et al. 2019). There is a potential for sperm whales to be encountered in the shipping lanes that extend into pelagic offshore waters (Figure 3.25-5).



Sources: PLP 2020-RFI168; PLP 2019-RFI153; ADNR 2010, 2018; BOEM 2018

US Army Corps of Engineers

50 0 50 100
Miles

Analysis Area

Vessel speeds would be restricted to less than 10 knots west of the 153° 15' 0" W meridian

US Exclusive Economic Zone

Whale Species Ranges

- Sei Whale
- Sperm Whale
- Sperm and Western North Pacific Gray Whale

Action Alternatives

- Lightering Locations
- Natural Gas Pipelines
- Alternative 1a
- Alternative 1
- Alternative 2
- Alternative 3

FEDERALLY LISTED WHALE SPECIES RANGES IN THE ANALYSIS AREA —PACIFIC OCEAN AND ALEUTIAN ISLANDS

PEBBLE PROJECT EIS

FIGURE 3.25-5

Sei whales are listed as endangered, and no critical habitat has been designated for the species. They occur in pelagic waters over a vast area from south of the Aleutian Islands down to Baja California and across the Pacific to Japan. Their seasonal distribution is unpredictable, and there is no recent abundance estimate or population trend. They feed on schooling fish, euphausiids, copepods, and other prey. They occur in the Gulf of Alaska during the summer, but their annual presence may be irregular. Because the species is primarily pelagic in distribution, and does not occur in near-shore waters, there is a potential for sei whales to be encountered in the shipping lanes that extend into pelagic offshore waters (Figure 3.25-5).

There are two gray whale stocks with a potential to occur in the analysis area: the Eastern North Pacific DPS and the Western North Pacific DPS; the endangered Western North Pacific DPS is currently estimated at 290 (minimum 271) individuals (Cooke et al. 2017) (Figure 3.25-5). The Eastern North Pacific DPS was removed from the endangered species list, and is not discussed in this section. The Western North Pacific DPS summers outside of the analysis area in the Sea of Okhotsk and feeds off Sakhalin Island and the eastern coast of the Kamchatka Peninsula. Gray whales are primarily bottom feeders that feed in shallow continental shelf areas. The Western North Pacific DPS may follow traditional gray whale coastal migration routes that overlap with the vessel routes in the Gulf of Alaska and the Bering Sea (Figure 3.25-5).

North Pacific right whales are large baleen whales that consume zooplankton. The small eastern population (estimated around 30 individuals) occurs in waters off the coast of Alaska during the summer, and feeds in two concentrated areas (a portion of the Southeast Bering Sea north of the Alaska Peninsula and an area in the Gulf of Alaska south of Kodiak Island) that have been designated as critical habitat (73 FR 19000; Muto et al. 2019). The PCEs for the North Pacific right whale are species of large zooplankton in areas where right whales are known or believed to feed (73 FR 19000). The analysis area does not overlap with any critical habitat for North Pacific right whale; the shipping lanes along the Alaska Peninsula are the only location where the species may be encountered during project-related activities (Figure 3.25-4).

3.25.1.5 Steller Sea Lion

Stock Identification

NMFS listed the Steller sea lion as a threatened species under the ESA in 1990 (55 FR 49204). In 1997, NMFS reclassified Steller sea lions as two DPSs under the ESA, based on genetic studies and phylogeographical analyses from across the sea lions' range (62 FR 24345). The Eastern DPS (delisted in 2013 [78 FR 66139]) consists of sea lions breeding east of Cape Suckling, Alaska (144°W longitude), and the Western DPS (listed as federally endangered) consists of those animals breeding west of Cape Suckling (144°W longitude; 62 FR 24345). This EIS only discusses the Western DPS Steller sea lions, because they occur in the analysis area in lower Cook Inlet, the Gulf of Alaska, and along the Alaska Peninsula and Aleutian Islands. Sea lions in this DPS are further classified into regions for purposes of population analysis; sea lions that typically use the waters surrounding lower Cook Inlet are part of the central Gulf of Alaska region.

The Western DPS declined in abundance by about 70 percent between the late 1970s and 1990, with evidence that the decline had begun even earlier. Factors potentially contributing to this decline include: incidental take in fisheries, legal and illegal shooting, predation, contaminants, disease, and climate change (NMFS 2008b). Although Steller sea lion abundance continues to decline in the western Aleutian Islands, numbers are thought to be increasing in the eastern part of the Western DPS range (DeMaster 2011). The 2016 Stock Assessment Report lists a minimum population estimate of 50,983 for the Western DPS (Muto et al. 2018).

Critical Habitat

NMFS designated critical habitat for the Steller sea lion on August 27, 1993 (58 FR 45269). At the time of the designation, PCEs were not used to determine critical habitat, but rather, critical habitat was based on “essential habitat” or “essential features.” Essential habitat used to determine critical habitat for Steller sea lions are the physical and biological habitat features that support reproduction, foraging, rest, and refuge including terrestrial, air, and aquatic zones (58 FR 45269). Critical habitat for Steller sea lions includes:

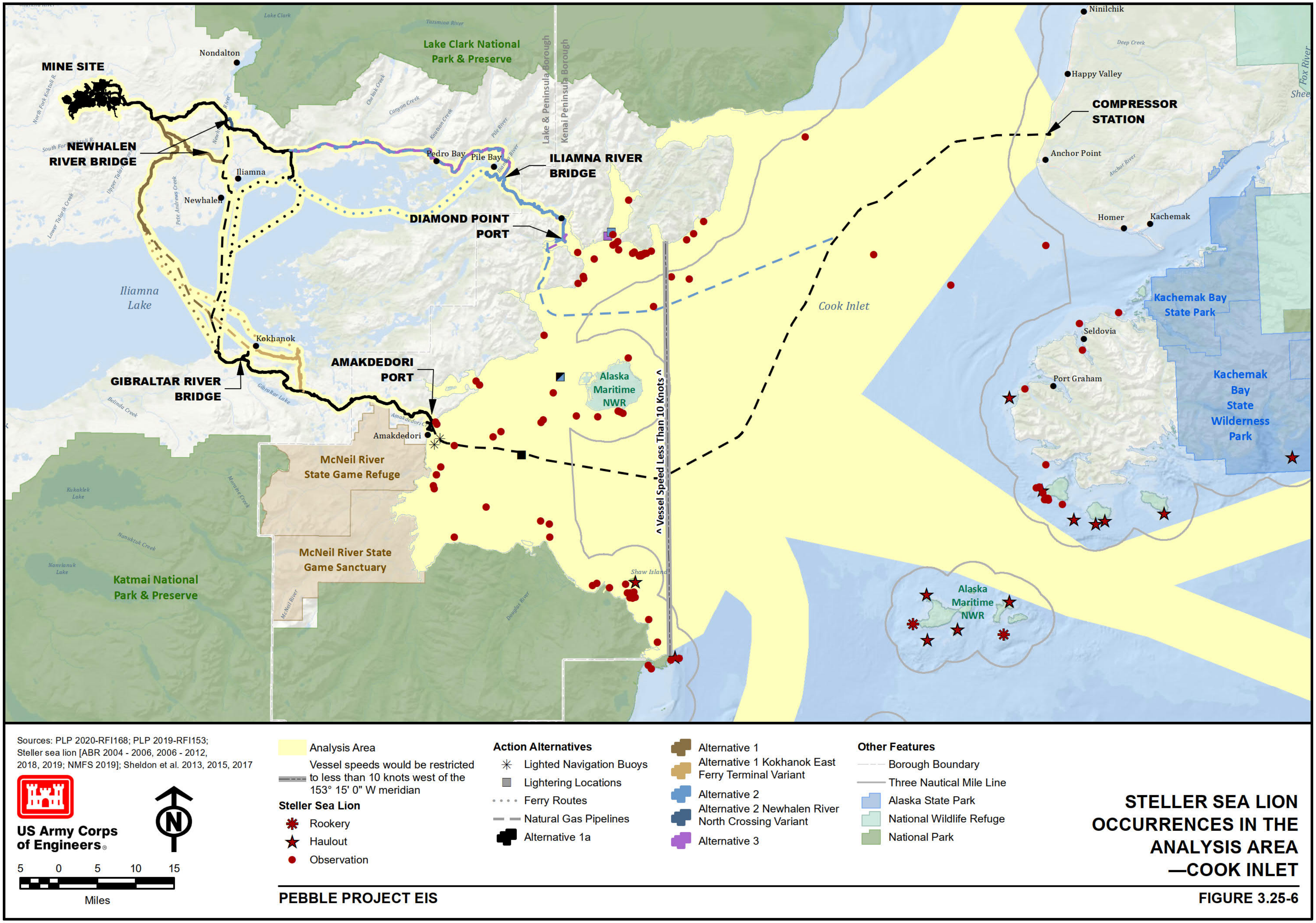
1. A terrestrial zone that extends 3,000 feet landward from the baseline or base point of each major rookery and major haulout
2. An air zone that extends 3,000 feet above the terrestrial zone, measured vertically from sea level
3. For each major rookery and haulout located west of 144°W. longitude, an aquatic zone that extends 3,000 feet seaward in State and federally managed waters from the baseline or base point of each major haulout in Alaska east of 144ºW longitude
4. An aquatic zone that extends 20 nautical miles seaward in State- and federally managed waters from the baseline or base point of each major rookery and major haulout in Alaska west of 144ºW longitude

Steller sea lion rookeries and haulouts in proximity to the analysis area are displayed in Figure 3.25-6, along with the 20-nautical-mile aquatic zone buffer.

Steller sea lion critical habitat does not occur around any of the port or lightering facilities or along the proposed natural gas pipeline and fiber-optic cable route; however, critical habitat occurs at the mouth of Cook Inlet, along the southern side of the Alaska Peninsula and along the Aleutian chain overlapping with the proposed vessel routes (Figure 3.25-6). Shaw Island, in the lower part of eastern Kamishak Bay, is recognized by NMFS as a haulout site due to the presence of many Steller sea lions (100 on June 6, 2011; 70 on June 2016) during multiple beluga whale summer aerial surveys (Shelden et al. 2013, 2017). Shaw Island is below the most direct shipping route from the mouth of Cook Inlet to Amakdedori port. Furthermore, the aquatic zone that extends 20 nautical miles seaward from major rookeries and haulouts does not include a restriction on marine traffic. Several major haulouts and rookeries south of the mouth of Cook Inlet include Ushagat Island, Sud Island, and Nagahut Rocks. Additional haulouts and rookeries are along the proposed vessel routes. Specific restrictions regarding vessel travel through designated critical habitat include a 3-nautical-mile no-entry zone around rookeries west of 144ºW. The nearest a vessel or supply barge would transit past a major haulout or rookery would be approximately 5 nautical miles.

Habitat Use and Distribution

The Western DPS of Steller sea lion habitat extends along Alaska's southern coast (NMFS 2008b), including the coastline adjacent to Amakdedori port. In Cook Inlet, Steller sea lions occur south of Anchor Point around the offshore islands, and rarely north of Nikiski (NMFS 2008b; Shelden et al. 2017). Steller sea lions were observed during NMFS beluga whale aerial surveys conducted in Cook Inlet from 1993 to 2016, with large congregations of Steller sea lions observed on land at the mouth of Cook Inlet (i.e., Elizabeth and Shaw Islands) (Shelden et al. 2013, 2016, 2017) (Figure 3.25-6). Shaw Island is on the western side of Cook Inlet, and Elizabeth Island is on the eastern edge of the mouth of Cook Inlet. Steller sea lions inhabit waters of Alaska year-round; however, large numbers of individuals may widely disperse from concentrated breeding areas and rookeries after the breeding season (late May through early July), likely to access seasonally important prey resources (Muto et al. 2018). Steller sea lions feed on a variety of demersal (i.e., bottom dwelling fish), semi-demersal, and pelagic prey, indicative of a broad spectrum of foraging behaviors likely based primarily on prey availability (NMFS 2010). Individuals from the Western DPS occur in the analysis area, because the center of abundance for the Western DPS extends from Kenai to Kiska Island (NMFS 2008b); however, there are no major haulouts in Cook Inlet.



STELLER SEA LION OCCURRENCES IN THE ANALYSIS AREA —COOK INLET

PEBBLE PROJECT EIS

FIGURE 3.25-6

Boor (2010) used the platforms of opportunity dataset to analyze seasonal patterns of at-sea sightings of Steller sea lions; this study found high encounter rates along the continent shelf break throughout the Gulf of Alaska and the Bering Sea. Gregr and Trites (2008) developed a habitat model from available datasets and determined that juvenile and female Steller sea lions in particular forage relatively close to rookeries and haulouts. These studies and others suggest two types of distribution at sea by Steller sea lions: 1) less than 12.4 miles from rookeries and haulout sites for adult females with pups, pups, and juveniles; and 2) greater than 12.4 miles areas where these and other animals may range to find optimal foraging conditions once they are no longer tied to rookeries and haulout sites for nursing and reproduction (NMFS 2010).

ABR surveys of Steller sea lions around the mouths of Iliamna and Iniskin bays from 2004 to 2008 showed consistent occurrence near the Iniskin Islands (ABR 2011d). Steller sea lions were observed hauled-out on islands near the mouths of Iliamna and Iniskin bays from January through November. Steller sea lions were concentrated in the nearshore zone during spring, especially on islands near the mouths of Iliamna and Iniskin bays; few were recorded during the offshore surveys (ABR 2011d). In winter, Steller sea lions were concentrated in the nearshore zone near the mouths of Iliamna and Iniskin bays. They were also observed throughout most of the offshore zone, with the highest concentration occurring near White Gull Island (near the mouth of Iliamna Bay) in early winter and on the Iniskin Islands in late winter. Historical Pacific herring (*Clupea harengus*) aerial surveys conducted by the Alaska Department of Fish and Game (ADF&G) in the spring (April to June of 1978 to 2002) suggest a long-standing preference for the Iniskin Islands area by Steller sea lions, with smaller numbers scattered elsewhere (ABR 2011d). In offshore waters, Steller sea lions occurred along the open coastline between Iliamna and Iniskin bays, north of Amakdedori port.

Data from ABR surveys during spring and summer 2018 in Kamishak Bay incidentally detected several Steller sea lions (ABR 2018b). These Steller sea lion observations were south and west of Augustine Island, including reefs and shoals close to Amakdedori port (Figure 3.25-6). Recent data from March, May, June, and October of 2019 aerial transect surveys (conducted by ABR for northern sea otters and to document haulout locations) detected seven Steller sea lion individuals during the May survey, with several of them hauled-out. Individuals were detected around the south side of Augustine Island and around Nordyke Island (ABR 2019b). No Steller sea lions were detected during surveys in March, June, or in October of 2019 (ABR 2019f).

On June 30, 2018, the National Park Service conduced an aerial survey of known seabird colonies in the lower portion of Kamishak Bay, from the Kamishak Islands to Cape Douglas, and incidentally recorded any marine mammals observed (Griffin 2018). They documented 50 Steller sea lions on a small island near Douglas Point, approximately 2 miles south of Shaw Island near the mouth of Cook Inlet.

Recently, ADF&G deployed satellite-linked global positioning system (GPS) and dive recording tags on seven adult female Steller sea lions in the Gulf of Alaska region to provide updated, fine-scale, understanding of their foraging habitat, and to determine the environmental factors influencing the timing and location of their behaviors (Rehberg 2020). In particular, one female was tracked from October 2019 through April 2020 across the mouth of lower Cook Inlet using areas in Kamishak Bay (Bruin Bay), around Cape Douglas, and east to Kachemak Bay, showing the wide range of the individual. Other tracked females spent time around the southern side of Shuyak Island, the Barren and Elizabeth islands, Kodiak Island, Shelikof Strait, and the Gulf of Alaska. GPS data showed that these females rarely spent time in the area of Cook Inlet that would be traversed by the natural gas pipeline corridor, apart from where it overlaps with GPS data in Kamishak Bay. Most GPS data were south of the natural gas pipeline corridor.

3.25.1.6 Northern Sea Otter

Distinct Population Segment Identification

Three sea otter DPSs are recognized in Alaska: Southcentral, Southwest, and Southeast (70 FR 46366). Two DPSs occur in Cook Inlet: the Southwest and the Southcentral. The dividing line between the two DPSs lies north-south in the middle of Cook Inlet; only the Southwest DPS occurs in the vicinity of the Amakdedori port. The Southwest DPS was listed as threatened under the ESA on August 5, 2005 (70 FR 46366) and is classified as a strategic stock under the MMPA. The Southwest DPS range extends along the western shore of lower Cook Inlet along the Alaska Peninsula and the Aleutian Islands to Attu, Bristol Bay, the Kodiak Archipelago, and the Barren Islands (70 FR 46366). The Southcentral DPS includes sea otters on the eastern side of Cook Inlet, and is not a federally listed DPS. The Southcentral DPS of sea otters is discussed in Section 3.23, Wildlife Values; this section only describes the Southwest DPS and sea otters found on the western side of Cook Inlet. The population estimate for the Southwest Alaska DPS of northern sea otters is 54,771 individuals (Muto et al. 2018).

Critical Habitat

On October 8, 2009, the USFWS designated critical habitat for the Southwest Alaska DPS divided into five management units (74 FR 51988; Figure 3.25-1). Critical habitat includes approximately 5,855 square miles, all of which are in Alaska (74 FR 51988). Critical Habitat Management Unit 5, Kamishak Bay, is the only unit that overlaps with the analysis area in Cook Inlet (Figure 3.25-1). The estimated size of Unit 5 is approximately 2,607 square miles (74 FR 51988). Critical habitat defined in Unit 5 includes the entire nearshore marine environment, ranging from the mean high tide line to the 66-foot depth contour, as well as waters up to 328 feet from the mean high tide line (74 FR 51988). The greatest proportion of the critical habitat area in the analysis area in Cook Inlet is composed of waters in the 66-foot isobath.

The PCEs of critical habitat for the Southwest DPS of northern sea otters and the status of each PCE in the analysis area are summarized below. Critical Habitat Unit 5, Kamishak Bay, Alaska Peninsula, contains all of the PCEs essential for the conservation of the Southwest Alaska DPS of northern sea otters (74 FR 51988).

1. Shallow, rocky areas where marine predators are less likely to forage, which are waters less than 7 feet in depth
2. Nearshore waters that may provide protection or escape from marine predators, which are those up to 328 feet from the mean high tide line
3. Kelp forests that provide protection from marine predators, which occur in waters less than 66 feet deep
4. Prey resources in the areas identified by PCEs 1, 2, and 3 that are sufficient enough to support the energy source requirements of the species

Additional critical habitat also encompasses the nearshore waters along the southern edge of the Alaska Peninsula around the Aleutian Islands and around Kodiak Island that would be transited past by project vessels (Figure 3.25-3). Vessel traffic would not pass inside the 66-foot depth contour and generally avoids the critical habitat.

Habitat Use and Distribution

Northern sea otters occur year-round throughout lower Cook Inlet (Garshelis 1987), which spans southwest from the North Forelands to the inlet mouth between English Bay and Cape Douglas. The Southwest DPS range is along the western shore of lower Cook Inlet and west out to Attu Island (USFWS 2014d).

Sea otters forage in nearshore waters at depths up to 131 feet in the nearshore benthos of rocky and soft-sediment communities (Marshall et al. 2014), which includes all nearshore waters of Kamishak Bay. Due to their benthic foraging, sea otter distribution is largely limited by their ability to dive to the sea floor (Bodkin et al. 2004). Bodkin et al. (2004) found that 84 percent of foraging occurs in waters less than 98 feet deep. Approximately 40 percent of sea otters' daily activity is foraging; sea otters primarily feed on benthic invertebrates, including mussels, crabs, urchins, sea cucumbers, and clams.

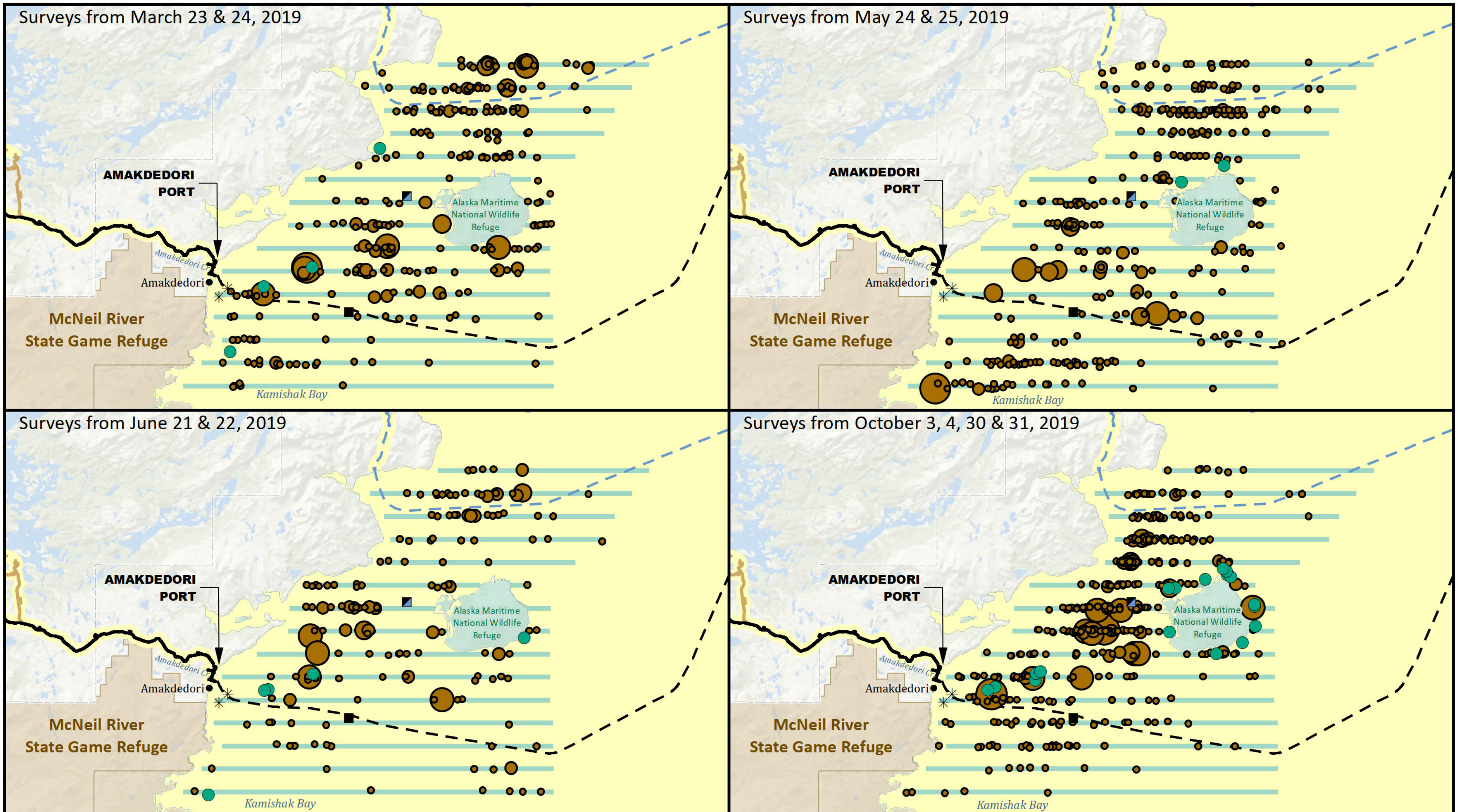
NMFS beluga whale aerial surveys have documented the presence of sea otters in the analysis area, especially in Kamishak Bay (including Augustine Island). In the greater Kamishak Bay area, groups of more than 30 animals were observed in multiple survey years (Shelden et al. 2013, 2015, 2017).

The USFWS conducted aerial surveys for northern sea otters in May 2017 in Cook Inlet that encompassed project components (i.e., Amakdedori and Diamond Point ports, the natural gas pipeline corridor, and lightering locations), Kachemak Bay, and western Cook Inlet (which includes the upper west Cook Inlet and Kamishak Bay) (Klein, pers comm 2018; Garlich-Miller et al. 2018). The highest sea otter densities were west and north of Augustine Island in Kamishak Bay. Relatively few sea otters were observed north of Kamishak Bay. The 2017 western Cook Inlet survey yielded a total western lower Cook Inlet abundance estimate of 10,737 sea otters (Garlich-Miller et al. 2018). Figures from Garlich-Miller et al. (2018) are included in Appendix H.

Project-specific northern sea otter aerial surveys were conducted in March, May, June, and twice in October of 2019 by ABR (ABR 2019a, 2019b, 2019c, 2019f). The survey area encompassed most of Kamishak Bay and stretched from Ursus Head in the north, to McNeil Cove in the south, with transect lines extending up to 31 miles offshore. Surveys on March 23 were conducted by two observers in a twin-engine fixed-wing aircraft flying 15 transects roughly perpendicular to the shoreline. Transect length varied and transects were spaced approximately 2 miles apart. Observers recorded all marine mammals within 984 feet of the aircraft flight line. A photographic survey was conducted simultaneously with the transect survey. The camera was pointed directly down and captured images every 2 seconds of an area approximately 308 by 207 feet below the aircraft, which was not visible to observers in the aircraft. An aerial haulout survey was conducted on March 24, 2019 by flying parallel to the shoreline and around islands and exposed rocks and reefs within 2 hours of low tide. It is important to note that although sea otters may haulout occasionally on land to rest, they do not have established haulout locations like pinniped species; a lack of haulout locations does not indicate a lack of sea otters using the area. Two sea otter haulouts with 104 sea otters were observed on offshore intertidal reefs in Kamishak Bay (ABR 2019a). During the March 23 and 24 survey, approximately 923 northern sea otters were counted, which included 910 individuals of unknown age and 13 juveniles (Figure 3.25-7; ABR 2019f). Sea otters were located throughout Kamishak Bay and on the south, west, and north sides of Augustine Island.

A second aerial survey was conducted on May 24, 2019 using the same methods. Photographs were taken from the underside of the aircraft in an area not visible to observers in the aircraft. A haulout survey was also conducted on May 24 with no major sea otter haulouts recorded. During the May survey 847 sea otters were counted, which included 827 individuals of unknown age and 20 juveniles (Figure 3.25-7; ABR 2019f). Sea otters were scattered throughout Kamishak Bay, with some concentrations near offshore intertidal reefs.

A third aerial survey was conducted on June 21, 2019 using the same methods previously described. Surveys documented 601 sea otters consisting of 542 individuals of unknown age and 59 juveniles (ABR 2019f). Sea otters were primarily located in the northern part of Kamishak Bay, around the west side of Augustine Island, and north of Augustine. Fewer sea otters were detected in the southern part of the survey area near McNeil Cove. During the haulout survey, one group of 150 sea otters was observed hauled-out on an offshore intertidal reef in Kamishak Bay (the same location as the March 23 survey) with an additional 155 sea otters in the water in four other locations (Figure 3.25-7).



Sources: PLP 2019-RFI153;
Northern sea otter [ABR 2019]

US Army Corps
of Engineers

5 0 5 10

Miles

Nothern Sea Otter Total Count
- 1 - 5
- 6 - 15
- 16 - 25
- 26 - 50
- 51 - 120

Analysis Area
Northern Sea Otter Haulout
2019 Sea Otter Transects

Action Alternatives
- Lighted Navigation Buoys
- Lightering Locations
- Ferry Routes
- Natural Gas Pipelines
- Alternative 1a
- Alternative 1 Kokhanok East Ferry Terminal Variant
- Alternative 2

Other Features
- Borough Boundary
- National Park
- National Wildlife Refuge
- State Game Refuge/Sanctuary

NORTHERN SEA OTTER OBSERVATIONS IN KAMISHAK BAY, 2019

PEBBLE PROJECT EIS

FIGURE 3.25-7

Two additional surveys were conducted in October 2019 using the same methods as previous surveys: an October 3, 2019 survey documented 811 sea otters consisting of 804 individuals of unknown age and 7 juveniles; and an October 30, 2019 survey documented 563 sea otters, consisting of 559 individuals of unknown age and 4 juveniles (ABR 2019f; Figure 3.25-7). The two southern most transects that included the Nordyke Islands and McNeil Cove were not surveyed on October 30, 2019 due to lack of daylight. Sea otter haulouts were similar to those used on previous surveys.

The five aerial surveys in 2019 in Kamishak Bay and around Augustine Island indicate high numbers of northern sea otters in the area with an average of 749 sea otters detected per survey. Sea otters were most numerous during the March 2019 survey, and sea otter pups were most numerous during the late June 2019 survey (ABR 2019f). An offshore intertidal reef approximately 4.5 miles east of Amakdedori port was used by more than 100 northern sea otters to haulout according to surveys in both March and June. While the May survey did not detect any hauled-out sea otters at this same location, several large rafts (i.e., floating groups of sea otters) were detected in the area during the transect surveys. Surveys in October found sea otters located in the northern part of the survey area to the west of Augustine Island. These data correlate with the same hotspots as Garlich-Miller et al. (2018). Across all surveys, the area north and west of the natural gas pipeline route contains the majority of northern sea otters detected. The primary lightering location, 12 miles east of Amakdedori port, has a lower density of northern sea otters in the immediate vicinity, compared with the alternate lightering location on the west side of Augustine Island.

To monitor populations after the *Exxon Valdez* oil spill of 1989, the National Park Service has conducted multiple northern sea otter surveys along the Katmai National Park and Preserve seashore on the southern edge of the Alaska Peninsula. Based on 2012 and 2015 aerial surveys, northern sea otter abundance appears to have stabilized following more than a decade of population growth (Coletti et al. 2018). The population in this area has fluctuated between 6,000 to more than 8,000 otters between 2008 and 2015. Sea otters in this area generally occur outside of project shipping lanes.

3.25.1.7 Steller's Eider

The Alaska population of Steller's eiders, federally listed as threatened, is the only federally listed avian species known to occur in the analysis area in Cook Inlet. This section focuses on known locations of Steller's eiders in relation to project components in Kamishak Bay and the eastern side of Cook Inlet near Anchor Point. Steller's eiders are generally present in Cook Inlet from fall through early spring, because the project is outside of the geographic breeding range for Steller's eiders and does not support the coastal tundra habitats where the species nests, a review of the species' breeding ecology is not included. The mine site, transportation corridor, and natural gas pipeline corridor (excluding the portion in Cook Inlet) lack suitable breeding, wintering, staging, molting, or foraging habitat for Steller's eider. Steller's eiders were not documented during any biological surveys at the mine site.

There are three main Steller's eider breeding populations, with the majority breeding in Russia, and a much smaller Alaska-based breeding population (USFWS 2011a, 2012a). The most recent Alaska-based breeding population estimate is 577 individuals (USFWS 2017). The Alaska-based breeding population was listed as federally threatened on June 11, 1997 (62 FR 31748). The Alaska-based breeding population nests primarily along the Arctic Coastal Plains around Utqiaġvik, with a small sub-population nesting in the Yukon-Kuskokwim Delta (Y-K Delta). USFWS designated critical habitat for Steller's eider does not occur in the analysis area (66 FR 8850). The closest critical habitat is on the northern side of the Alaska Peninsula, which would be avoided by project-related vessels traffic; therefore, critical habitat is not discussed further (Figure 3.25-3).

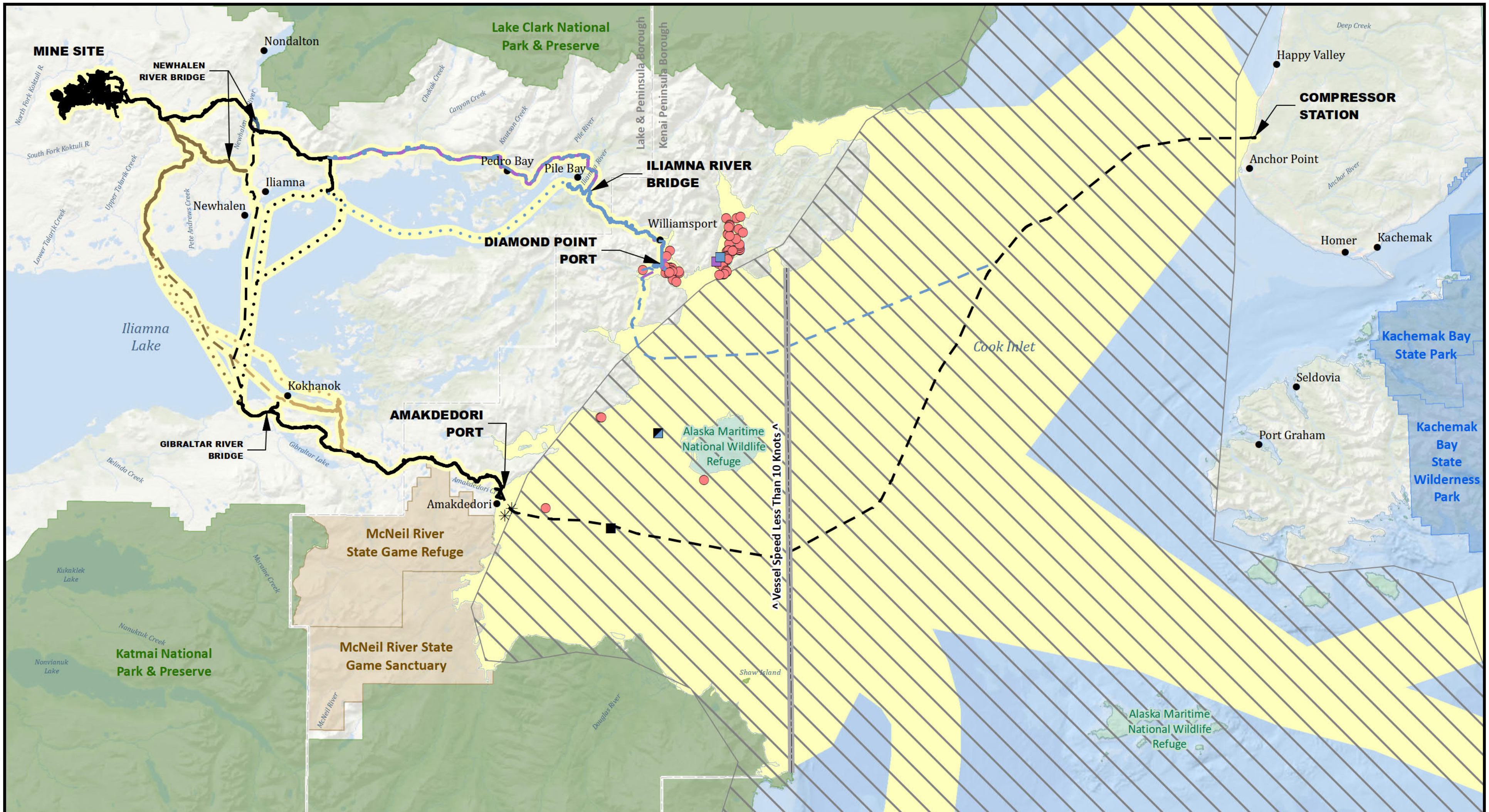
In addition to areas in Russia and the Alaska Peninsula, Steller's eiders molt and winter in nearshore waters in lower Cook Inlet, which includes the analysis area (Figure 3.25-8). Therefore, this section focuses on Steller's eiders' fall molt, winter distribution, and migration in lower Cook Inlet.

Fall Molt and Winter Distribution

Of the Steller's eiders that winter and molt in Alaska, the USFWS assumes that approximately 0.8 percent is from the listed Alaska-based breeding population (USFWS 2017). After breeding in the Arctic Coastal Plains and Y-K Delta, Steller's eiders move to marine waters, where they mix with birds from the Russian-based breeding population and undergo a 3-week flightless molt. Adult birds undergo a flightless molt in fall, with most birds molting in a few lagoons on the northern side of the Alaska Peninsula and along the western Alaska coast (USFWS 2011a). During the fall molt from late July until late October (USFWS 2002) eiders undergo a complete molt, which includes all flight feathers and renders them flightless. In a study conducted along the northern side of the Alaska Peninsula, sub-adult birds were flightless first, followed by adult males, and then adult females, with eiders maintaining spatial and temporal sex and age class separation during the flightless period (Petersen 1981). Although some Steller's eiders remain in their molting areas throughout winter, other birds disperse to coastal waters that include southern Cook Inlet. Molting and wintering Steller's eiders occur in the western part of Cook Inlet and the adjacent nearshore coastal waters, including Kamishak Bay (Figure 3.25-8). Kamishak Bay was first documented as a Steller's eider molting area in 2004 (Rosenberg 2007).

The preferred marine habitat for Steller's eider during molt and winter includes marine waters up to 30 feet deep, the associated invertebrate communities, and where present, eelgrass beds along with their associated flora and fauna (65 FR 13262). Molting areas tend to be characterized by extensive shallow areas with eelgrass beds and intertidal sand flats and mudflats. Because Steller's eiders prefer to winter in shallow waters; they are usually found within 1,200 feet of shore, except where shallows extend farther offshore in bays and lagoons, or near reefs (USFWS 2002).

An aerial and boat survey conducted in Cook Inlet during February of 1994 reported 1,363 Steller's eiders in nearshore areas of Kamishak Bay, from McNeil Cove to Iniskin Bay (Agler et al. 1995). This was the first time Steller's eiders were recorded in large numbers in Kamishak Bay. During a survey from 2004 to 2006, 24 satellite-tagged Steller's eiders captured during winter at Kodiak Island were documented molting and wintering in Kamishak Bay. Approximately 20 percent of the birds used Kamishak Bay as a molting area, and at least two birds molted during 2 consecutive years, suggesting some site fidelity. In both 2005 and 2006, an estimated minimum of 2,500 birds molted in Kamishak Bay, based on aerial photography. Most birds were associated with a large reef (Douglas River Shoals) near the southern end of Kamishak Bay, approximately 17 miles south of Amakdedori port (Rosenberg et al. 2016). During aerial transect surveys in 2005, approximately 2,000 molting Steller's eiders were observed in the Douglas River Shoals in late August and September. During winter surveys in 2005, 3,921 Steller's eiders were recorded in southern Kamishak Bay (Larned 2006). The 2004 and 2005 surveys indicate that the number of Steller's eiders in Cook Inlet increases in early winter, peaks in January and February, and then declines from early March through mid- to late April, as birds depart on spring migration for their breeding grounds (Larned 2006). Figures of Steller's eider distribution in Kamishak Bay from Larned (2006) are shown in Appendix G. The highest number of Steller's eiders recorded among multiple winter surveys was 4,284 Steller's eiders in Kamishak Bay in January 2005 (Rosenberg 2007).



Sources: PLP 2020-RFI168; PLP 2019-RFI153; (Steller's eider [ABR 2006 - 2012, 2018])

US Army Corps of Engineers®

5 0 5 10 15
Miles

Analysis Area

Vessel speeds would be restricted to less than 10 knots west of the 153° 15' 0" W meridian

Steller's Eider

Observations

Molting & Wintering Habitat

Action Alternatives

Lighted Navigation Buoys

Lightering Locations

Ferry Routes

Natural Gas Pipelines

Alternative 1a

Alternative 1

Alternative 1 Kokhanok East Ferry Terminal Variant

Alternative 2

Alternative 2 Newhalen River North Crossing Variant

Alternative 3

Other Features

Borough Boundary

National Park

National Wildlife Refuge

Alaska State Park

State Game Refuge/Sanctuary

STELLER'S EIDER OCCURRENCES IN THE ANALYSIS AREA—COOK INLET

The USFWS performed aerial surveys in August 2005 and September 2006 to document the number and distribution of molting birds in Kamishak Bay (Rosenberg 2007). Aerial surveys on August 29, 2005 resulted in an estimate of 2,225 Steller's eiders located toward the western end of Douglas Reef. Aerial surveys on September 4, 2006 had similar results, with an estimated 2,607 Steller's eiders in the same vicinity as 2005 (Rosenberg 2007). On September 10, 2006, USFWS staff traveled to Kamishak Bay via boat to capture and band molting Steller's eiders. Seventeen Steller's eiders were banded, two of which had been previously captured on Kodiak Island in Womens Bay (Rosenberg 2007). These surveys, along with those conducted by Larned (2006), confirm the importance of the Douglas River Shoals and reef area to molting and wintering Steller's eiders. Steller's eiders arrive in late August to the Douglas River Shoals area and show site fidelity.

In addition to Douglas River Shoals in the southern part of Kamishak Bay, Steller's eiders concentrate north and south of Amakdedulia Cove, with low numbers of Steller's eiders around Amakdedulia Cove. Surveys in Kamishak Bay (Larned 2006), including Amakdedulia Cove, indicated that low numbers of Steller's eiders may occasionally be found in the area during winter months. Two groups of between one and 37 Steller's eiders were observed during aerial surveys from February 11 to 16, 2004, in the area around Amakdedulia Cove (Larned 2006). Several more groups of between one and 30 Steller's eiders were observed in the same area from March 11 to 17, 2004. Only one group of between eight and 30 birds was detected during April 12 and 13, 2004, indicating that most wintering Steller's eiders had departed the area by mid-April in 2004. Surveys conducted December 4 through 8, 2004, detected several small flocks of Steller's eiders of between one and 60 birds. Surveys were repeated again from January through April 2005, with similar results of small flocks of Steller's eiders using the nearshore waters of Amakdedulia Cove (Larned 2006). Most eider flocks were closer to Bruin Bay, near the northern part of Amakdedulia Cove.

While project-specific Steller's eider surveys have not been conducted, during boat-based marine fish and invertebrate surveys on March 13, 2018 ABR incidentally documented a small group of eight Steller's eiders (four male and four females) flying approximately 5 miles offshore from the Amakdedori port site and 1 mile north of the natural gas pipeline corridor (Figure 3.25-8; Stutes 2018).

Project-specific northern sea otter aerial surveys were conducted in March, May, June, and October of 2019 by ABR (ABR 2019a, 2019b, 2019c, 2019f). The survey area encompassed most of Kamishak Bay and stretched from Ursus Head in the north, to McNeil Cove in the south, with transect lines extending up to 31 miles offshore. While surveys were focused on obtaining estimates of northern sea otters (flight heights, speeds, transect widths, and other parameters were specified for northern sea otter surveys), surveyors also looked for Steller's eiders. One flock of Steller's eiders totaling 11 birds were observed in the water near the southwestern coastline of Augustine Island during the October 30, 2019 survey (ABR 2019f; Figure 3.25-8).

Steller's eiders are known to occur on the eastern side of Cook Inlet around Anchor Point, where the natural gas pipeline would extend from Cook Inlet and connect to an existing pipeline north of Anchor Point. Survey data from Larned (2006) indicate several small flocks of less than 100 birds each winter around Anchor Point. The actual number of birds and location varies throughout the winter, often depending on the extent of the sea ice cover, but most small flocks congregate around an extensive shoal south of Anchor Point. Flocks of Steller's eiders were observed in locations ranging from Anchor Point to north of Ninilchik, with numbers of birds ranging from 1,141 in January 2005, to 2,370 in March 2001 (Larned 2006). During surveys in winter 2004 and 2005, the average monthly mean was 463 Steller's eiders in the area north of Anchor Point to Ninilchik, and 1,713 Steller's eiders in Kamishak Bay (Larned 2006). The number of eiders peaked in January and drastically decreased by early April. Groups of eiders were consistently observed around an extensive shoal south of Anchor Point. Therefore, Steller's eiders are present in both western and eastern parts of Cook Inlet during the winter months. By mid- to late April, most Steller's eiders have left Cook Inlet for their northern breeding grounds.

Migration

The path of migration for Steller's eiders to and from Cook Inlet during the fall molt and throughout the winter and early spring is not known. However, Steller's eiders' strikes on towers and powerlines at Togiak, Naknek, and King Salmon (including inland sites) indicate that there may be some overland pathway that includes Iliamna Lake (USFWS 2008b). Satellite transmitter data from 2004 to 2006 (Rosenberg et al. 2016) documented Steller's eiders molting in Kamishak Bay from mid- to late August until the middle to the end of November, and through the end of January. Prior to departure for the northern breeding grounds, Steller's eiders stage in several locations along the Alaska Peninsula. In 2005, Rosenberg et al. (2016) documented two satellite-tagged birds that staged in Kamishak Bay from March 25 to May 8. These data indicate that Kamishak Bay may be used by the same individual Steller's eiders during consecutive years, and that they use the bay for molting, wintering, and staging. The birds then fly to the north side of the Alaska Peninsula (exact route is unknown) and up the west coast of Alaska before heading to Russia, the Y-K Delta, and the Arctic Coastal Plains.

Climate Change

Potential trends from climate change on Steller's eider populations for the species' wintering and molting range have not been studied extensively. Forecasted trends related to wintering and molting areas of Steller's eiders in the analysis area are decreased levels of sea and shorefast ice in Cook Inlet, because Steller's eiders travel throughout Cook Inlet during the winter in response to varying levels of ice, warmer ocean temperatures may influence wintering and foraging locations during the non-breeding season. Ocean acidification (resulting in reduced shell-building capacity for prey species) and changes in marine ecosystems (such as a decrease in summer sea ice) may also alter the prey base for Steller's eiders (Markon et al. 2018). Current climate change trends in the analysis area include a 3.7 degree Fahrenheit increase between 1969 and 2018, which translates to warmer surface waters, ocean acidification, and an increase in algal blooms (Thoman and Walsh 2019).

Habitat changes on the breeding grounds could directly affect the number of birds in the winter range. The breeding range for the listed population of Steller's eiders on the North Slope of Alaska is considered moderately vulnerable to climate change due to potential increased rates of shoreline erosion (in part due to reduced sea ice coverage), alterations in water temperatures that alter their prey base, and a modification in nesting habitats (thermokarst ponds and adjacent upland habitats) (Liebezeit et al. 2012). Increased storm surges may result in loss of breeding habitat, increased salinity in the intertidal zone, melting of permafrost, and vegetation changes (USFWS 2016b). Additional trends include arctic waterbodies draining and drying out during summer; increased productivity in some ponds due to increased nutrient input from thawing soil and warmer days; changes in sea ice coverage; and small mammal population cycle changes (Post et al. 2009). Steller's eiders tend to nest in high lemming (*Lemmus* species) years in close proximity to nesting pomarine jaegers (*Stercorarius pomarinus*) and snowy owls (*Bubo scandiacus*); pomarine jaegers and snowy owls aggressively defend their nests from predators, which in turn protects nearby nesting Steller's eiders, and lemmings provide alternative prey for potential eider predators (Quakenbush et al. 2004). As the federally listed Alaska population of Steller's eiders breeds almost exclusively in the habitat around Utqiaġvik, there is little opportunity for the species to relocate elsewhere due to habitat loss (Liebezeit et al. 2012).

3.25.1.8 Short-tailed Albatross

The short-tailed albatross (*Phoebastria albatrus*; endangered), was considered for inclusion due to its presence in Alaskan waters in areas that overlap with proposed project shipping routes. Based on a review of biological data for the region, all components of the project and alternatives that are in Cook Inlet are outside of the current geographic range of the short-tailed albatross (Smith et al. 2017;

Suryan and Kuletz 2018; USFWS 2008c). The species is associated with the continental shelf break and slope regions of the Bering Sea (Aleutian Archipelago) and to a lesser extent, the Gulf of Alaska (Suryan and Kuletz 2018). Short-tailed albatross do not breed in the US, but forage extensively and spend considerable time in Alaskan waters in areas that would overlap with the vessel routes along the Aleutian Archipelago. The specific details of the species biology, including abundance and trends, distribution and habitat use, feeding and prey selection, reproduction, natural mortality, a map of observations, and use of Alaska waters is provided in the USFWS Biological Assessment (Appendix G). Short-tailed albatross have a pelagic distribution in Alaskan waters, including the Aleutian Islands, Bering Sea, and Gulf of Alaska. Although short-tailed albatross have not been recorded in Cook Inlet, they are included in the EIS because they may be encountered by project-related offshore vessel traffic in the Gulf of Alaska, along the Alaska Peninsula, and in the Bering Sea.

3.25.2 Alternative 1

There are no new geographical areas in the marine environment of Cook Inlet that are included in Alternative 1. The ferry route across Iliamna Lake and natural gas pipeline corridor across Iliamna Lake up to the mine access road are different; however, no federally listed species are known to occur in these areas. Under Alternative 1, there are two variants for the causeway and dock at Amakdedori port; however, these variants occur in the same geographical area as the dock for Alternative 1a detailed above. Therefore, no new baseline information is provided for any of the federally listed species with a potential to occur in the analysis area. All information for this alternative is previously addressed under Alternative 1a.

3.25.3 Alternative 2—North Road and Ferry with Downstream Dams

The Alternative 2 analysis area includes the same project components and their applicable buffers detailed at the beginning of this section, with a focus on Iliamna and Iniskin bays. Additionally, there are no lighted navigation buoys associated with the port at Diamond Point, and dredging would be necessary at Diamond Point. Additional discussion is provided where there are differences between the species' distribution (or surveys conducted for different species) from Alternative 1a.

3.25.3.1 Cook Inlet Beluga Whale

As discussed under Alternative 1a, during the summer months (when the majority of proposed construction activities in Cook Inlet would occur), the CIBS range generally contracts to the upper reaches of Cook Inlet following spawning salmon runs. However, beluga whales have been detected sporadically in the analysis area during the spring and summer. During NMFS beluga whale aerial surveys in Cook Inlet, a group of two beluga whales were seen in Iniskin Bay on June 4, 1994 (Rugh et al. 2000). NMFS aerial surveys have reported three beluga whale sightings south of Tuxedni Bay (Shelden et al. 2015). The satellite telemetry data used by NMFS from September 2000 through March 2003 provided detail on beluga whales seasonal movements and habitat use. None of the 14 beluga whales tagged in that study moved south of Chinitna Bay (Hobbs et al. 2005). ADF&G biologists have occasionally recorded beluga whales in the area of Iliamna and Iniskin bays during herring surveys (April to June) from 1978 to 2002. During herring surveys from March 26 through April 1, 1997, an ADF&G biologist recorded a group of 12 to 15 beluga whales off the mouth of Iniskin Bay (ABR 2011d). In September 2007, ADF&G biologists recorded 25 to 30 beluga whales in inner Chinitna Bay (in the northern part of the analysis area), and 12 beluga whales were seen in upper Iniskin Bay (ABR 2011d) (Figure 3.25-2). Beluga whales were documented during aerial surveys by ABR in fall 2007, when groups of up to 12 beluga whales were seen in Iliamna, Iniskin, and Chinitna bays, as well as near the Iniskin Islands (ABR 2011d). Beluga whales were also recorded along the eastern shore of Iliamna Bay in

October 2008 (ABR 2011d). Similar to Alternative 1a, CIBS Critical Habitat Area 2 overlaps with the analysis area (Figure 3.25-1).

Overall, although the CIBS range generally contracts to upper Cook Inlet during summer months following seasonal prey resources, they expand farther south during fall and winter. Although occasional sightings of small beluga whale groups have occurred during the summer months, the data illustrate that beluga whale detections mainly occur during September and October, especially in the northern part of the analysis area. However, there have been two recent detections of Cook Inlet beluga whales in lower Cook Inlet: July 2018 in Kachemak Bay, and January 2019 at Port Graham, both on the eastern side of lower Cook Inlet outside of the analysis area (Gill *pers comm.* 2018, Castellote *pers comm.* 2020).

Field-verified Project-specific northern sea otter aerial surveys were conducted in March, May, June, and twice in October of 2019 by ABR in an area that encompassed most of Kamishak Bay (ABR 2019a, 2019b, 2019c, 2019f). These aerial surveys did not include Iliamna and Iniskin bays (stopped at Urus Head) and therefore only provide coverage for part of the analysis area. Transect lines extended up to 31 miles offshore and no beluga whales were detected during these surveys.

3.25.3.2 Humpback Whale

Humpback whales have been observed in the analysis area during NMFS Cook Inlet beluga whale aerial surveys from 2000 to 2016. Although a number of humpback whale sightings occurred in mid-Cook Inlet between the Iniskin Peninsula and Kachemak Bay, most sightings occurred in the area near the Augustine, Barren, and Elizabeth islands (Shelden et al. 2013, 2016, 2017; Figure 3.25-2). Barren and Elizabeth islands would be transited past by project vessels transiting between Cook Inlet and the Gulf of Alaska. Additional boat-based surveys during the spring and summer 2018 incidentally documented several humpback whales south and west of Augustine Island (ABR 2018c, 2018e; Figure 3.25-2).

Project-specific northern sea otter aerial surveys were conducted in March, May, June, and twice in October of 2019 by ABR in an area that encompassed most of Kamishak Bay (ABR 2019a, 2019b, 2019c, 2019f). Transect lines extending up to 31 miles offshore and no humpback whales were detected during these surveys.

3.25.3.3 Fin Whale

Fin whales are rarely observed in Cook Inlet, with most sightings near the mouth of Cook Inlet (Figure 3.25-2). There are scattered infrequent historical records in Cook Inlet with the most recent in 2016 between Anchor Point and Homer.

Project-specific northern sea otter aerial surveys were conducted in March, May, June, and twice in October of 2019 by ABR in an area that encompassed most of Kamishak Bay (ABR 2019a, 2019b, 2019c, 2019f). Transect lines extending up to 31 miles offshore and no fin whales were detected during these surveys.

3.25.3.4 Blue, Sperm, Sei, Gray, and North Pacific Right Whale

The shipping routes outside of Cook Inlet would be the same for all alternatives; pertinent information regarding blue, sperm, sei, gray, and North Pacific right whales is included under Alternative 1a.

3.25.3.5 Steller Sea Lion

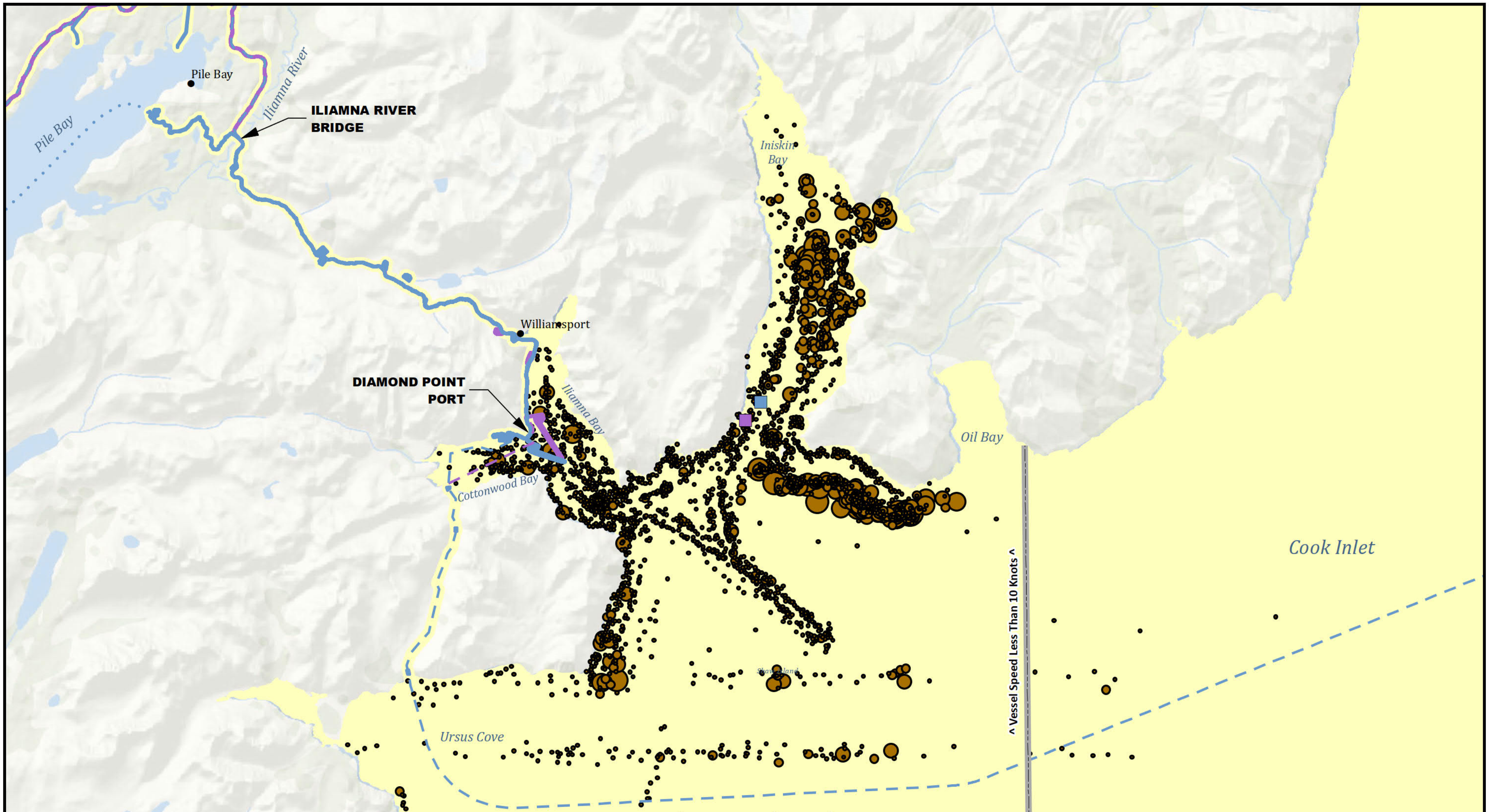
The only recognized Steller sea lion haulout in the western portion of the analysis area in Cook Inlet is Shaw Island. No haulout or rookeries are located near Iliamna or Iniskin bays (Figure 3.25-1). Sightings of large congregations of Steller sea lions during NMFS beluga whale aerial surveys have occurred on land in the mouth of Cook Inlet (e.g., Elizabeth and Shaw islands) (73 FR 62919). Elizabeth Island is located on the eastern side of the mouth of Cook Inlet and would be transited past by project-related vessel traffic.

ABR conducted boat-based surveys during spring and summer 2005 and 2006, and helicopter surveys in 2007 and 2008 in Iliamna and Iniskin bays. Surveys documented small numbers of Steller sea lions from spring to fall, with the majority of observations in April (ABR 2011d). A concentration of Steller sea lions in April (37 animals) suggests they may congregate in the area between Iniskin and Oil bays to consume spawning Pacific herring that occasionally spawn there in large numbers (ABR 2011d; Figure 3.25-6). The records of Steller sea lions show consistent occurrence in the Iniskin Islands area. Historical data from herring aerial surveys conducted by the ADF&G in the spring suggest a long-standing preference of the Iniskin Islands by Steller sea lions, with smaller numbers of animals scattered elsewhere throughout the analysis area in Cook Inlet. Steller sea lions also occurred along the coastline between Iliamna and Iniskin bays. Based on helicopter surveys conducted between 2006 and 2012, Steller sea lions were recorded in the area in most months except for June through August, suggesting the species abandons Cottonwood, Iliamna, and Iniskin bays during the summer. Their abundance in the area peaked from late March through mid-May, and then from late October through mid- or late November (ABR 2015c).

Project-specific northern sea otter aerial surveys were conducted by ABR in March, May, June, and twice in October of 2019 in an area that encompassed most of Kamishak Bay (ABR 2019a, 2019b, 2019c, 2019f). Transect lines extending up to 31 miles offshore and seven Steller sea lions were detected during surveys (Figure 3.25-6; ABR 2019b). During a haulout survey on May 24, 2019, a total of seven Steller sea lions were observed with some individuals hauled-out in one area on the south side of Augustine Island, with additional Steller sea lions observed swimming nearby (ABR 2019b). There are additional Steller sea lion haulouts, rookeries, and critical habitat that would be transited past by project-related vessel traffic along the southern edge of the Alaska Peninsula out to Unimak Pass, as previously described under Alternative 1a.

3.25.3.6 Northern Sea Otter

Sea otters were commonly observed during baseline environmental studies by ABR in Iliamna and Iniskin bays. Sea otters were recorded in Iliamna and Iniskin bays, primarily during winter, with only scattered individuals recorded during the spring and summer. Most otters were found outside Iniskin and Iliamna bays in offshore habitats and among islands at the mouths of the bays (ABR 2011d; Figure 3.25-9). Sea otters were observed moving into the sheltered bays when the sea ice decreased starting in March and were seen in higher densities offshore in the winter. Sea otters were scarce in Iniskin Bay, although several groups were recorded in the middle of Iliamna Bay during winter months (ABR 2011d). The number of sea otters observed in the protected waters of Iliamna and Iniskin bays increased from fall to mid-winter, presumably as the weather in exposed Kamishak Bay deteriorated; numbers decreased in the spring as otters began moving out into Kamishak Bay during summer, which is supported by the most recent survey data from May 2017 (Garlich-Miller et al. 2018). Aerial surveys of lower Cook Inlet documented almost no northern sea otters in Iliamna and Iniskin bays during the May 2017 survey; but instead found the highest density directly west of Augustine Island. These data suggest that the use of the marine environment associated with Alternative 2 varies seasonally, but is lowest during the spring and summer, and highest during winter. Similar to Alternative 1a, Critical Habitat Management Unit 5 coincides with the analysis area in Iliamna and Iniskin bays (Figure 3.25-1). Additional critical habitat along the southern edge of the Alaska Peninsula out to Unimak Pass that project-related vessel traffic would transit past is previously described under Alternative 1a.



Sources: PLP 2020-RFI168; PLP 2019-RFI153; Northern seaotter [ABR 2004 - 2006, 2006 - 2012, 2018, 2019]

US Army Corps of Engineers®

2 0 2 4
Miles

Northern Sea Otter Total Count

- 0 - 5
- 6 - 15
- 16 - 50
- 51 - 100
- 101 - 250
- 251 - 440

Analysis Area

Vessel speeds would be restricted to less than 10 knots west of the 153° 15' 0" W meridian

Action Alternatives

- Lightering Locations
- Ferry Routes
- Natural Gas Pipelines
- Alternative 2
- Alternative 3

NORTHERN SEA OTTER OBSERVATIONS IN ILIAMNA AND INISKIN BAYS

PEBBLE PROJECT EIS

FIGURE 3.25-9

ABR (2011d) and Garlich-Miller et al. (2018) surveys demonstrate that northern sea otters exhibit pronounced spatial patterns throughout the annual cycle, reflecting a variety of factors. These factors include habitat differences (rocky shorelines and foraging substrates along the outer coastlines and inside the mouth of the bays, and muddy shoreline and foraging substrates farther inside the bays), seasonal patterns of movement, and possibly weather-related effects. In the spring and summer, sea otters occurred primarily as scattered individual animals, both during nearshore and offshore surveys. In early winter, otters had moved closer to the mouths of Iliamna and Iniskin bays to overwinter and were widely distributed along the outer coast and in the offshore areas, with the highest densities occurring near White Gull Island and Black Reefs. Otters were scarce inside Iniskin Bay, although a few were recorded in Iliamna Bay. In late winter, otters were found along the outer coasts or inside the bays, occurred widely in offshore waters and occurred in the highest densities near the Iniskin Islands (ABR 2011d).

Project-specific northern sea otter aerial surveys were conducted by ABR in March, May, June, and twice in October of 2019 in an area that encompassed most of Kamishak Bay but did not include Iliamna or Iniskin bays (ABR 2019a, 2019b, 2019c, 2019f). Therefore, northern sea otter survey data were not obtained for the primarily lightering location or dock at Diamond Point in 2019. Transect lines extended up to 31 miles offshore and survey result details are provided above under Alternative 1a. In summary, the five aerial surveys in 2019 in Kamishak Bay and around Augustine Island recorded high numbers of northern sea otters in the area with an average of 749 sea otters detected per survey (Figure 3.25-7). The survey on June 21, 2019 documented the highest number of juveniles with 59 recorded out of 601 total otters (ABR 2019f). Northern sea otter density data from 2019 ABR surveys correlate with the same hotspots as Garlich-Miller et al. (2018). Across all surveys, the area north and west of the natural gas pipeline corridor contains the majority of northern sea otters detected. The alternate lightering location on the western side of Augustine Island also has a high density of northern sea otters.

3.25.3.7 Steller's Eider

Surveys for Steller's eiders have been conducted over the past several decades. The approximate survey window, location, number of Steller's eiders, and data source are provided in Table 3.25-2 for areas in the vicinity of Alternative 2.

Surveys conducted by ABR regularly recorded Steller's eiders in Iniskin and Iliamna bays during winter and early spring during helicopter surveys conducted from 2006 through 2008 (ABR 2011d; Figure 3.25-8). Additional helicopter-based surveys were conducted from 2009 to 2012, with the focus on nearshore marine waters from Iniskin Bay south to Bruin Bay (ABR 2015c). These additional surveys confirmed results from previous surveys, but also documented two large Steller's eider flocks between Ursus Cove and Bruin Bay along Fortification Bluff (west of Augustine Island) in December 2012 (ABR 2015c; Figure 3.25-8). Steller's eiders were found primarily in offshore waters in the middle portions of Iniskin and Iliamna bays, and occasionally in nearshore waters. Most birds occurred around a shallow shoal in the lower part of Iniskin Bay, and in the middle of the channel between Cottonwood and Iliamna bays. Generally, several hundred Steller's eiders were present in these bays from late November to early December, and through the end of March to early April. The fluctuations in Steller's eiders numbers during winter is likely related to the location and presence of sea and shorefast ice, in addition to severity and timing of fall storms, which push eiders from southern locations into more northern protected bays. Therefore, surveys conducted by Agler et al. (1995), Larned (2006), and ABR (2011d, 2015c) indicate that Iniskin and Iliamna bays provide overwintering habitat for several hundred Steller's eiders, and occasionally large groups of several thousand birds may occur in the general vicinity.

Table 3.25-2: Historical Steller's Eider Survey Information

Survey Timing	Location of Steller's Eiders	Steller's Eider Estimates	Data Source
Winter of 1994	Oil, Iniskin, and Iliamna bays	435	Agler et al. 1995
December 2004 and early spring 2005	Mouth of Iniskin Bay	160 to 435	Larned 2006
February, March, and December 2006	Iliamna, Iniskin, and Cottonwood bays	250, 240, 300	ABR 2015c
February, Early March, Late March, November, and December 2007	Iliamna, Iniskin, and Cottonwood bays	320, 676, 450, 40, 150	ABR 2015c
January, February, March, and April 2008	Iliamna and Iniskin bays	136, 172, 275, 225	ABR 2015c
February, March, April, November, and December 2009	Iliamna, Iniskin, and Cottonwood bays	350, 301, 300, 110, 170	ABR 2015c
January, Early February, Late February, and March 2010	Iliamna, Iniskin, and Cottonwood bays	193, 151, 100, 110	ABR 2015c
January, Early February, Late February, Early March, and Late March 2011	Iliamna, Iniskin, and Cottonwood bays	11, 100, 112, 75, 23	ABR 2015c
January and March 2012	Iliamna, Iniskin, and Cottonwood bays	260, 125	ABR 2015c
December 2012	Ursus Cove and Bruin Bay along Fortification Bluff (west of Augustine Island)	two flocks totaling 2,462	ABR 2015c
October 30, 2019	Augustine Island	11	ABR 2019f

Note:
ABR = Alaska Biological Research, Inc.

Project-specific northern sea otter aerial surveys were conducted in March, May, June, and October of 2019 by ABR (ABR 2019a, 2019b, 2019c, 2019f). The survey area encompassed most of Kamishak Bay and stretched from Ursus Head in the north, to McNeil Cove in the south, with transect lines extending up to 31 miles offshore. Aerial surveys did not include Iliamna or Iniskin bays. While surveys were focused on obtaining estimates of northern sea otters, surveyors also looked for Steller's eiders. One flock of Steller's eiders totaling 11 birds was observed in the water near the southwestern coastline of Augustine Island during the October 30, 2019 survey (ABR 2019f).

3.25.3.8 Short-Tailed Albatross

The information regarding habitat use and species distribution is the same as Alternative 1a and not repeated here. Short-tailed albatross are a pelagic species that do not occur in Cook Inlet, and may be incidentally encountered by project vessels traveling in established shipping lanes in the Gulf of Alaska and along the Aleutian Islands out to the exclusive economic zone.

3.25.4 Alternative 3—North Road Only

There are no new geographical areas in the marine environment of Cook Inlet that are covered by this alternative and its variants; therefore, no new information is provided for any of the federally listed species. There are minor differences in the natural gas pipeline route; the port is farther in Iliamna Bay, and there is only one lightering location for Alternative 3, compared with Alternative 2. These minor differences do not impact the baseline biological data presented under Alternative 1a, Alternative 1, and Alternative 2. Alternative 3 would use the same vessel routes as Alternative 2; therefore, no additional baseline information is included for Alternative 3, and all pertinent information for this alternative is previously described under Alternative 2.

3.26 VEGETATION

The affected environment for vegetation includes all vegetation types that may be directly or indirectly impacted during construction and operations under all project alternatives, components, and variants. Vegetation is described in terms of the extent and characteristics of predominant types. Rare or sensitive plant species and all taxa of invasive species are also discussed.

In the Environmental Impact Statement (EIS) analysis area, forests and shrublands cover lowlands and fringe riparian corridors. These often closed-canopy types transition to woodlands and dwarf shrub types over shallow soils at higher elevations. The most exposed alpine sites support dwarf alpine scrub with significant cover of lichen and bare ground. Upland forests and woodlands are dominated by white spruce (*Picea glauca*), Kenai birch (*Betula papyrifera* var. *kenaica*), and balsam poplar (*Populus balsamifera* ssp. *balsamifera*), whereas forested wetlands are most commonly dominated by black spruce (*Picea mariana*) and occasionally black cottonwood (*Populus balsamifera* ssp. *balsamifera*). Upland shrub is most commonly dominated by alder (*Alnus* spp.) with the proportion of willow (*Salix* spp.) increasing with wetter soil conditions. Across peatlands, dwarf black spruce, birch (*Betula nana*), ericaceous shrub (e.g., *Vaccinium* spp., *Empetrum nigurm*) and tussock-forming sedges co-dominate (Three Parameters Plus and HDR 2011a).

The plant species and communities described in this section are primarily based on information provided in Chapter 13 of the Environmental Baseline Document (EBD) (Three Parameters Plus and HDR 2011a), Chapter 38 of the EBD (HDR and Three Parameters Plus 2011a), and the project geographic information system (GIS) database, which reflects changes in the project area since publication of the EBD (HDR 2019i).

The affected environment for vegetation supports analysis for other biological resources addressed in this EIS, including Section 3.23, Wildlife Values, and Section 3.22, Wetlands and Other Waters/Special Aquatic Sites. Vegetation is also an important aspect of social resources (see Section 3.5, Recreation, and Section 3.9, Subsistence).

3.26.1 EIS Analysis Area

The EIS analysis area includes the area potentially affected by direct and indirect impacts from project construction and operations. The analysis area includes all four components (mine site, transportation corridor, ports, and natural gas pipeline) under each project alternative and variants; see Chapter 2, Alternatives, for an explanation and maps of alternatives, variants, and project components. The analysis area for vegetation is the same as wetlands (see Figure 3.22-1 in Section 3.22, Wetlands and Other Waters/Special Aquatic Sites, for a map of the analysis area for wetlands).

Mine Site—The analysis area includes the direct disturbance footprint buffered by 330 feet to account for fugitive dust impacts.

Transportation Corridor and Ports—The analysis area for the transportation corridor and ports includes the direct disturbance footprints buffered by 330 feet to account for fugitive dust impacts. Although the direct disturbance footprints are included for the pile-supported and caisson docks (both of which have concrete decking), lightering areas, and mooring buoys, these features are not buffered, because they are not expected to be sources of fugitive dust.

Natural Gas Pipeline—The pipeline-only natural gas pipeline corridor analysis area includes the sections where the pipeline is not co-located with the transportation corridor. These sections of the natural gas pipeline have a maximum impact width of 91 feet through Iliamna Lake, 102 to 183 feet through Cook Inlet, and 150 feet through overland areas. The overland analysis area includes the direct disturbance footprints for access roads and material sites, buffered by a 330-foot zone to account for dust impacts.

3.26.2 Analysis Methodology

3.26.2.1 Vegetation

A vegetation classification system is a hierarchical organization of types that differentiates the most generalized types by physiognomy (e.g., forest, shrub, and herbaceous) and more detailed types by diagnostic growth forms and character species (e.g., white spruce closed forest). This section describes the classification system used to describe vegetation in the analysis area, and for the impact analysis described in Section 4.26, Vegetation.

Project vegetation types were developed to provide a standardized way to discuss vegetation and summarize impacts in the analysis area. The 50 detailed project vegetation types identified from field-verified data were combined to 10 broader categories based on structural characteristics, including dominant growth form (forest, shrub, or herbaceous), tree and shrub canopy cover (woodland, open or closed), and average tree and shrub height (dwarf, low, or tall) (Three Parameters Plus and HDR 2011a; HDR and Three Parameters Plus 2011a). Reference guides to the environmental baseline study classification system, including vegetation type definitions and representative photos, are included in Chapter 13 and Chapter 38 of the EBD. A table showing the hierarchical nesting of project vegetation types in vegetation structure types is provided in Appendix K3.26.

Terminology used for the project and structural vegetation types is based on the Alaska Vegetation Classification (Viereck et al. 1992), supplemented by Wibbenmeyer et al. (1982), and modified as necessary to accommodate interpretation of available aerial imagery. Field-verified vegetation mapping covers 100 percent of Alternative 1a, Alternative 1, Alternative 2—North Road and Ferry with Downstream Dams, and Alternative 3—North Road Only. Digital vegetation mapping was completed using GIS with aerial photography at scales between 1:1,200 and 1:1,500.

The 10 vegetation structure types, applied in the characterization of vegetation in this section and in the analysis of direct and indirect impacts in Section 4.26, Vegetation, are summarized below:

- **Open/Closed Forest—**The open or closed forest type has over 10 percent cover of trees and generally includes needleleaf and deciduous forests and woodlands as well as stands of dwarf spruce at treeline or in lowland bogs. Vegetation types in this structure type are Closed White Spruce Forest, Open White Spruce Forest, White Spruce Woodland, Black Spruce Woodland, Closed Broadleaf Forest, Open Broadleaf Forest, Broadleaf Woodland, Closed Mixed Forest, Open Mixed Forest, Mixed Forest Woodland, Dwarf White Spruce Scrub, and Dwarf Black Spruce Scrub.
- **Closed Tall Shrub—**The closed tall shrub type has over 75 percent cover of shrubs with average height greater than 5 feet tall. This type generally includes broadleaf tall shrub communities. Vegetation types in this structure type are Closed Willow Tall Shrub, Closed Alder Tall Shrub, and Closed Alder-Willow Tall Shrub.
- **Open Tall Shrub—**The open tall shrub type has 25 to 75 percent cover of shrubs with average height greater than 5 feet tall. This type generally includes broadleaf tall shrub communities. Vegetation types in this structure type are Open Alder Tall Shrub, Open Alder-Willow Tall Shrub, and Open Willow Tall Shrub.
- **Closed Low Shrub—**The closed low shrub type has over 75 percent cover of shrubs ranging in height from 8 inches to 5 feet. This type generally includes broadleaf low shrub communities. Vegetation types in this structure type are Closed Willow Low Shrub, Closed Alder-Willow Low Shrub, and Closed Alder Low Shrub.

- **Open Low Shrub—**The open low shrub type has 25 to 75 percent cover of shrubs ranging in height from 8 inches to 5 feet. This type generally includes broadleaf and ericaceous low shrub communities; tussock-forming sedges (*Carex* spp. and cottongrasses (*Eriophorum* spp.) can compose a significant component of communities dominated by ericaceous shrubs. Vegetation types in this structure type are Open Sweetgale-Graminoid Bog, Open Mixed Shrub-Sedge Tussock, Open Dwarf Birch-Ericaceous Shrub Bog, Ericaceous Shrub Bog, Low Ericaceous Shrub Tundra, Open Dwarf Birch Scrub, Shrub Birch-Willow, Open Willow Low Shrub, Open Willow Low Shrub Fen, Open Alder-Willow Low Shrub, and Open Alder Low Shrub.
- **Dwarf Shrub—**The dwarf shrub type has less than 10 percent cover of trees and over 25 percent cover of shrubs less than 8 inches tall. This type generally includes tundra dominated by dwarf ericaceous shrub that may be characterized by an abundance of sedge (*Carex* spp.), lichen, or horsetail (*Equisetum* spp.) species, or a hummocky microtopography. Vegetation types in this structure type are Dwarf Ericaceous Shrub Tundra, Dwarf Ericaceous Shrub Tundra—Hummock, Dwarf Ericaceous Shrub Tundra – Equisetum, Dwarf Ericaceous Shrub Tundra—Carex, and Dwarf Ericaceous Shrub-Lichen Tundra.
- **Dry to Moist Herbaceous—**The dry to moist herbaceous type has less than 10 percent tree cover and less than 25 percent shrub cover. This type generally includes graminoid- and forb-dominated communities occurring as grasslands and sedge; or forb meadows on xeric dunes, beaches, and mesic subalpine to alpine sites. Vegetation types in this structure type are Halophytic Dry Graminoid, Bluejoint Tall Grass, Bluejoint-Herb, and Mesic Herb.
- **Wet Herbaceous—**The wet herbaceous type has less than 10 percent tree cover and less than 25 percent shrub cover. This type generally includes graminoid- and forb-dominated communities occurring as fresh or saltwater marshes, sedge meadows, fens, bogs, and peatlands on hydric sites. Vegetation types in this structure type are Halophytic Graminoid Wet Meadow, Subarctic Sedge-Moss Wet Meadow, Fresh Sedge Marsh, Fresh Herb Marsh, and Aquatic Herbaceous. The Aquatic Herbaceous type includes submerged aquatic vegetation, and represents the special aquatic site—Vegetated Shallows. The occurrence of and impacts to Vegetated Shallows are presented in Section 3.22 and Section 4.22, Wetlands and Other Waters/Special Aquatic Sites.
- **Other—**This type refers to permanently flooded habitat with less than 25 percent vegetation coverage. This type generally includes features such as oceans, lakes, rivers, and streams.

The habitat descriptions provided here are largely based on information provided in Chapter 13 and Chapter 38 of the EBD (Three Parameters Plus and HDR 2011a; HDR and Three Parameters Plus 2011a) and the associated GIS database, which reflects changes in the project since publication of the EBD; the last update to the GIS database was in November 2019. A series of tables (Table 3.26-1 through Table 3.26-10) is presented below to illustrate the proportion of each of these types in the analysis area. Values are rounded to the nearest whole acre, or nearest whole percent; apparent inconsistencies in sums are the result of rounding. The open water type is included in each table depicting vegetation but is not considered part of the affected environment for vegetation; therefore, it is not included in the calculation of impacts to vegetation (Section 4.26, Vegetation).

Rare or sensitive plant species—Confirmed or reported populations of species on the Alaska Center for Conservation Science (ACCS) rare vascular plant species list were reviewed from the online ACCS database (ACCS 2018a).

Invasive plant species—Field studies and the online Alaska Exotic Plant Information Clearinghouse (AKEPIC) database (ACCS 2018b) were reviewed for presence of invasive plant species in the analysis area.

3.26.2.2 Rare or Sensitive Plant Species

Rare or sensitive plant species are those with limited abundance, geographic distribution, and/or habitat. The ACCS curates biological and occurrence data for more than 350 vascular species of conservation concern in Alaska (ACCS 2018a; Nawrocki et al. 2013); no special state-wide protections are afforded species on this list. ACCS assigns a conservation status for a species in the state (i.e., S-rank); these regional ranks are further compiled by NatureServe, the parent organization for the network of Natural Heritage Programs and Data Centers, to assign a global conservation status (i.e., G-rank). These conservation status levels categorize risk, regardless of geographic designation, to the viability of a species on a scale of 1 to 5, where 5 is a species that is secure and not at risk for extirpation because of widespread abundance; whereas 1 indicates a critically imperiled species at very high risk of extirpation because of very few occurrences, declining populations, or extremely limited range and/or habitat. Species with state ranks between 1 and 3 are typically considered species of conservation concern.

The only documented occurrences of rare or sensitive plant species in the project area are for the Chukchi primrose (*Primula tschuktschorum*; S3). Both occurrences are in the North Fork Koktuli watershed: one approximately 2 miles west/southwest of Kaskanek Mountain and 22 miles northwest of Iliamna; and the other 40 miles west of Iliamna. Neither location occurs in the analysis area. Incidental observations of Bering Sea dock (*Rumex beringensis*; S3) were made between Newhalen and the Upper Talarik Creek; however, the voucher material collected was insufficient for taxonomic confirmation.

Ethnobotany—Ethnobotany can be described as the study of the relationship between humans and plants. For Alaska Natives, this relationship connects the knowledge of plants to the moral and spiritual values of local people (Jernigan no date). Plants and plant materials have edible, medicinal, and utilitarian use. More than 80 species of plants are harvested for consumption and use in the analysis area.

Edible Plants (Jernigan no date, Viereck 1995):

- several species of berries:
    - alpine bearberry (*Arctostaphylos alpina)*
    - Lapland cornel (*Cornus suecica)*
    - black crowberry (*Empetrum nigrum*)
    - red current (*Ribes triste*)
    - arctic raspberry (*Rubus arcticus*)
    - cloudberry (*Rubus chamaemorus*)
    - salmonberry (*Rubus spectabilis*)
    - small cranberry (*Vaccinium oxycoccos*)
    - bog blueberry (*Vaccinium uliginosum*)
    - lingonberry (*Vaccinium vitis-idaea*)
    - squashberry (*Viburnum edule*)
- alpine sweetvetch (*Hedysarum alpinum*)
- wild chives (*Allium schoenoprasum*)
- ferns (any producing a fiddlehead):

    - common ladyfern (*Athyrium filix-femina*)
    - spreading woodfern (*Dryopteris expansa*)
- wild celery, also known as:
    - cow parsnip (*Heracleum maximum*)
    - seacoast angelica (*Angelica lucida*)
- prickly rose (*Rosa acicularis*)

Medicinal Plants (Garibaldi 1999):

- Tilesius' wormwood (*Artemisia tilesii*)
- boreal yarrow (*Achillea millefolium* var. *borealis*)
- arctic sweet coltsfoot (*Petasites frigidus*)
- fireweed (*Chamerion angustifolium*)
- disc mayweed (*Matricaria discoidea*)
- American red raspberry (*Rubus idaeus*)
- arctic dock (*Rumex arcticus*)
- alpine mountainsorrel (*Oxyria digyna*)

A variety of trees and shrubs are used for smoking fish (*Alnus* ssp., *Betula nana*), basket making (*B. papyrifera* var. *kenaica* bark), boat building, sealant, and trap making (*Picea* spp. wood, resin, and roots, respectively) (Jernigan no date). See Section 3.9, Subsistence, for additional discussion on the importance of subsistence resources.

3.26.2.3 Invasive Species

Non-native species are those that are present in a given area due to the accidental or intentional introduction by humans. Not all non-native species are equally harmful. Invasive species are a subset of non-native species that have the biological capacity to establish, reproduce, and spread throughout natural communities. Executive Order 13112—Invasive Species, further defines invasive species as those whose introduction does or is likely to harm the economy, environment, or human health.

Globally, invasive species can have severe impacts on local biodiversity, community structure and function, and natural resources, with consequences to the greater ecosystem, economy, and human health (Cameron et al. 2016; Duncan et al. 2004; Molnar et al. 2008). Documented impacts of invasive species in Alaska include loss of biodiversity (Buckelew et al. 2011; Roon et al. 2016) and habitat degradation (O’Hare et al. 2006; Schrader and Hennon 2005) with projected consequences for the economy (Schwoerer 2017) and human health. Measures implemented to control invasive species, such as application of herbicides, can also affect native species (Rinella et al. 2009).

This section discusses all taxa of invasive species that occur in the analysis area, or may be introduced to the analysis area by project-related activities. Taxa considered are terrestrial plants and vertebrates, freshwater aquatic plants, and marine species. Invasive freshwater animal species are not addressed, because they have not been documented as occurring in the analysis area, nor have they been identified as candidate species of concern in this region of Alaska.

Regulatory Authority—The US Army Corps of Engineers (USACE) authority on invasive species includes Executive Order 13751—Safeguarding the Nation from the Impacts of Invasive Species (amendment to Executive Order 13112), which directs agencies to take steps to eradicate and control invasive species. Authority also falls under the National Invasive Species Act (NISA) of

1996, which amended the Nonindigenous Aquatic Nuisance Prevention and Control Act of 1990. The USACE is one of the federal members of the Aquatic Nuisance Species (ANS) Task Force, which was established by the 1990 act. Members are charged with preventing the introduction and spread of ANS and monitoring and controlling ANS. The NISA furthered ANS activities by calling for ballast water regulations; the US Coast Guard issued ballast water regulations pursuant to NISA in 2012. Applicable regulations are also listed in Appendix E.

Vectors—Vectors of dispersal may be categorized as passive and active. Actively dispersed species are capable of movement under their own power, whereas the passive dispersal of species is mediated by animals (including humans), wind, or water. Generalist species that produce abundant propagules or offspring and are capable of long-range dispersal are often the most invasive. For this reason, integrated pest management resources often focus limited resources on highly invasive species and their most probable pathways of introduction. The most probable pathways of introduction recognized for the project are: via contaminated material and equipment; via hull fouling and ballast water contamination of marine vessels; and via accidental transport of invasive terrestrial vertebrates as stowaways on boats and freshwater plants on float planes.

Terrestrial Plants—Field studies conducted in the analysis area did not provide any recorded instances of invasive plant species. A search of the AKEPIC online database for invasive plant species occurrences in Alaska shows lambsquarters (*Chenopodium album*) documented in the analysis area at the Diamond Point port. Lambsquarters is evaluated as very weakly invasive by the Invasive Ranking System for Alaska (Carlson et al. 2008); this record dates from pre-1950, and it is unknown if the population still exists (ACCS 2018b).

Reed canarygrass (*Phalaris arundinacea*), orange hawkweed (*Hieracium aurantiacum*), common dandelion (*Taraxacum officinale*), and common plantain (*Plantago major*) are documented along the road system within a mile of the analysis area on the Kenai Peninsula (ACCS 2018b). Reed canarygrass and orange hawkweed are evaluated to be extremely invasive and highly invasive, respectively; common dandelion and plantain are considered modestly and weakly invasive, respectively (Carlson et al. 2008).

Additional invasive species are documented from Port Alsworth on Lake Clark and the village of Igiugig at the outlet of Iliamna Lake. While well outside of the analysis area, these communities have navigable connections to project waters and therefore represent potential source locations for invasive plants.

The most invasive species documented from Port Alsworth are foxtail barley *(Hordeum jubatum*) and smooth brome (*Bromus inermis*); both are evaluated as moderately invasive. Additional species reported from Port Alsworth, listed in decreasing order of potential invasiveness, are: white clover (*Trifolium repens*), common dandelion (*Taraxacum officinale*), timothy (*Phleum pratense*), common sheep sorrel (*Rumex acetosella*), redroot pigweed (*Amaranthus retroflexus*), prostrate knotweed (*Polygonum aviculare*), common plantain (*Plantago major*), common chickweed (*Stellaria media*), shepherd's purse (*Capsella bursa-pastoris*), lambsquarters (*Chenopodium album*), and pineapple weed (*Matricaria discoidea*). These additional species are evaluated as modestly to very weakly invasive (Carlson et al. 2008).

The most invasive species documented from Igiugig was oxeye daisy (*Leucanthemum vulgare*), evaluated to be moderately invasive. Additional species from Igiugig, listed in decreasing order of potential invasiveness, are: creeping buttercup (*Ranunculus repens*), Kentucky bluegrass (*Poa pratensis*), fall dandelion (*Leontodon autumnalis*), common sheep sorrel (*Rumex acetosella*), common chickweed (*Stellaria media*), and pineapple weed (*Matricaria discoidea*). These additional species are evaluated as modestly to very weakly invasive (Carlson et al. 2008).

Freshwater Aquatic Plants—Waterweed (*Elodea* spp.)[1] is the first invasive freshwater aquatic plant documented in Alaska. Waterweed is not known to occur in the analysis area or project watersheds (evaluated at the Hydrologic Unit Code 10 level). Since its discovery in Chena Slough in 2009, infestations have been documented in Fairbanks, Anchorage, Matanuska-Susitna and Kenai Peninsula waterbodies, including the world's busiest floatplane base, Lake Hood (AKEPIC 2018b). Waterweed is evaluated as highly invasive (Carlson et al. 2008); an emergency quarantine was placed against the transport and trade of this plant into and across Alaska in 2014 (SOA 2014).

Plant Pathogens—Plant pathogens include a wide variety of insects and diseases that are often grouped by the part of the plant they attack; for example, leaves (defoliators) or bark (bark beetles). Although pathogen infestation is a natural condition for many plants, introduced plant pathogens are particularly damaging because the target vegetation, which did not co-evolve with the pest, is not equipped with genetic resistance; some of the introduced pathogens cause mortality of the plant; and pathogens are highly mobile organisms whose dispersal is not limited to transportation corridors (USDA 2008).

Birch are preferentially defoliated by birch leaf rollers (*Epinotia solandriana, Caloptilia alnivorella,* and *C. strictella*) and the birch leafminers (*Fenusa pumila*, *Heterarthrus nemoratus* and *Profenusa thomsoni*). Some of these species are native, but climatic conditions may favor outbreaks in some years. Leaf-rolling larvae skeletonize leaves, causing them to curl, brown, and drop prematurely; branch dieback and tree mortality sometimes occurs. The larvae of leaf-mining sawflies eat the chlorophyll, which disrupts a tree's ability to conduct photosynthesis; however, mortality has yet to be observed in Alaska, likely because the majority of damage occurs late in the summer after most tree growth has occurred (USDA 2019).

Marine Species—Marine vessels can introduce nonnative marine species by the discharge of ballast water sourced from other regions or by the inadvertent transport of fouling organisms, which can survive on submerged or wet vessel surfaces such as hulls, anchors, propellers, and sea chests (i.e., biofouling). Although invasive marine species have not been documented in the analysis area, two species are of management concern: European green crab (*Carcinus maenas*), and the carpet sea squirt (*Didemnum vexillum*). An assessment of invasion risk of non-native marine species to the Bering Sea ranked these species as posing the second and fourth highest risk for invasion, respectively (Reimer et al. 2017). The species evaluated as the first and third most invasive are the Pacific oyster (*Crassostrea gigas*) and the Mediterranean mussel (*Mytilus galloprovincialis*). These mollusks are capable of long-distance dispersal and severe habitat modification; however, they are considered a lesser threat to aquatic resources in the analysis area, because climate projections indicate no suitable habitat for reproduction in Bristol Bay and presumably Cook Inlet waters (Reimer et al. 2017).

In Alaska, three species of non-native colonial tunicates, also known as sea squirts, have been documented. Of these species, the population of carpet sea squirt first detected in 2010 and established in Whiting Harbor, Sitka, is of highest concern. Carpet sea squirt is a marine invertebrate filter-feeder capable of rapid and smothering growth over a wide range of marine habitats, including natural substrata, along exposed outer coasts, and at depths up to 266 feet. Carpet sea squirt can be moved between locations as biofouling on vessel hulls, as contaminant in ballast water, and infested aquatic farm gear or infrastructure. Transfers of shellfish stock or equipment may also play a role in spread (Cohen et al. 2011; Bullard et al. 2007; Lambert 2009).

European green crab (*Carcinus maenas*) is found in rocky intertidal and estuarine areas. Green crabs tolerate a wide range of water temperatures and salinities and prey on a wide variety of

[1] Waterweed includes both Canadian waterweed (*Elodea canadensis*) and Nuttall's waterweed (*E. nuttallii*) as these species form fertile hybrids and can be difficult to differentiate by either phenotype or genotype.

marine organisms including commercially important bivalves, gastropods, decapods, and fish (Klassen and Locke 2007). This species has not been documented in Alaska, but is experiencing a range expansion north along the coast of British Columbia. Of greatest concern to Alaska is the potential for larvae to travel north in ocean currents. Human-mediated pathways of dispersal include the aquarium and live food trades, aquaculture, and biofouling[2] of vessel hulls and ballast water (Therriault et al. 2008).

Terrestrial Vertebrate Species—Invasive terrestrial vertebrates are not known from the analysis area; however, the Norway Rat (*Rattus norvegicus*) is identified as a key species for eradication, especially on island ecosystems where migratory and resident bird populations flourish, in part due to low predator pressure. The Norway rat is currently documented from 10 Aleutian Islands and many population centers in Alaska. The Norway rat can breed year-round under favorable conditions; gestation periods are short (21 days) and litter size can reach 14. Rats are omnivores and very opportunistic predators.

Impacts from invasive species are discussed in Section 4.26, Vegetation. Additional information on invasive species trends in the western Alaska region are discussed below under Climate Change.

3.26.3 Alternative 1a

The Alternative 1a analysis area totals 20,092 acres, 18,907 acres (94 percent) of which are vegetated. The extent of the analysis area includes the direct and indirect footprints for all project components; no variants are considered under this alternative. A summary of vegetation types by project component is provided below.

3.26.3.1 Mine Site

Under Alternative 1a, the mine site analysis area is characterized by the dwarf shrub type, representing 56 percent of the area. The dwarf shrub type is dominated by ericaceous shrub and often includes a high component of lichen. Other shrub types collectively comprise 29 percent of mine site (Table 3.26-1). Forested types are not present due to the exposure and elevation of the mine site. Human-caused vegetation disturbance in the area is minimal, and appears to be limited to mineral exploration, all-terrain vehicle (ATV) trails, and campsites (Three Parameters Plus and HDR 2011a).

Table 3.26-1: Alternative 1a—Mine Site Analysis Area Vegetation Types

Vegetation Type	Acres	Percent Area
Dry to Moist Herbaceous	430	4
Wet Herbaceous	605	5
Dwarf Shrub	6,434	56
Open Low Shrub	1,730	15
Open Tall Shrub	381	3
Closed Low Shrub	184	2
Closed Tall Shrub	1,072	9
Other	482	4
Open Water	156	1
Mine Site Analysis Area	**11,472**	**100**

Source: HDR and Three Parameters Plus 2011a; HDR 2019i; Three Parameters Plus and HDR 2011a

[2] The undesirable accumulation of microorganisms, plants, algae and animals on submerged structures (especially ships' hulls).

3.26.3.2 Transportation Corridor

Under Alternative 1a, the transportation corridor includes the 35 miles of the mine access road from the mine site to the Eagle Bay ferry terminal, with a connection to the existing Iliamna/ Newhalen road system, a 28-mile crossing of Iliamna Lake to the south ferry terminal, and a 37-mile port access road between the south ferry terminal and Amakdedori port. It also includes the 1-mile Kokhanok spur road connecting the transportation corridor to the community of Kokhanok and the 0.4-mile explosives storage spur road connecting the mine site access road to a storage pad near the mine site. The transportation corridor includes the segments of the natural gas pipeline that are co-located with access roads. This alternative includes a southern crossing of the Newhalen River.

The transportation corridor analysis area is characterized by the dwarf shrub type, representing 41 percent of the area; other shrub types collectively compose 27 percent. The open/closed forest vegetation type is subdominant, representing 23 percent of the area (Table 3.26-2). Human-caused vegetation disturbance in the area is minimal, and appears to be limited to ATV trails, roads, and building pads near the village of Iliamna, Kokhanok Airport, and the shore of Iliamna Lake (Three Parameters Plus and HDR 2011a).

Table 3.26-2: Alternative 1a—Transportation Corridor Analysis Area Vegetation Types

Vegetation Type	Acres	Percent Area
Dry to Moist Herbaceous	105	1
Wet Herbaceous	152	2
Dwarf Shrub	3,063	41
Open Low Shrub	603	8
Open Tall Shrub	755	10
Closed Low Shrub	34	<1
Closed Tall Shrub	690	9
Open/Closed Forest	1,746	23
Other	112	1
Open Water	233	3
Transportation Corridor Analysis Area	**7,494**	**100**

Source: HDR and Three Parameters Plus 2011a; HDR 2019i; Three Parameters Plus and HDR 2011a

3.26.3.3 Amakdedori Port

The Amakdedori port site includes shore-based facilities at the port and an offshore area for the marine facility with caisson dock design. The Amakdedori port analysis area is dominated by the dwarf shrub type, representing 59 percent of the area. The “other” vegetation type (i.e., partially vegetated or barren land) is subdominant, representing 9 percent. Because the Amakdedori port analysis area extends into Cook Inlet, the area is composed of 10 percent open water (Table 3.26-3). No human-caused vegetation disturbance is reported at Amakdedori.

Table 3.26-3: Alternative 1a—Amakdedori Port Analysis Area Vegetation Types

Vegetation Type	Acres	Percent Area
Dry to Moist Herbaceous	10	9
Wet Herbaceous	1	1
Dwarf Shrub	70	59
Open Low Shrub	1	1
Open Tall Shrub	2	2
Closed Low Shrub	1	1
Closed Tall Shrub	5	4
Other	17	14
Open Water	12	10
Amakdedori Port Analysis Area	**118**	**100**

Source: HDR and Three Parameters Plus 2011a; HDR 2019i; Three Parameters Plus and HDR 2011a

3.26.3.4 Natural Gas Pipeline Corridor

Under Alternative 1a, the 192-mile natural gas pipeline corridor from the Kenai Peninsula to the mine site includes five main segments: 1) Cook Inlet crossing to the Amakdedori port, 2) along the port access road to Iliamna Lake, 3) across Iliamna Lake to Newhalen, 4) overland to connect with the mine access road east of the Newhalen River Crossing, and 5) along the mine access road to the mine site.

Segments of the natural gas pipeline corridor that are co-located with access roads are included in the transportation corridor analysis area. Pipeline-only segments of the natural gas pipeline (i.e., those that are not co-located with road corridors) are addressed here and include: the 1-mile Kenai Peninsula tie-in, the 104-mile Cook Inlet crossing, the 34-mile Iliamna Lake crossing, and the 35-mile alignment from the north ferry terminal to the mine site. The natural gas pipeline corridor is predominantly composed of open water, which represents 78 percent of the analysis area. Open/closed forest comprises 9 percent of the analysis area, and dwarf and open low shrub vegetation each contribute an additional 5 percent (Table 3.26-4).

Table 3.26-4: Alternative 1a—Natural Gas Pipeline Corridor Analysis Area Vegetation Types

Vegetation Type	Acres	Percent Area
Dry to Moist Herbaceous	5	1
Wet Herbaceous	2	<1
Dwarf Shrub	54	5
Open Low Shrub	46	5
Open Tall Shrub	10	1
Closed Low Shrub	2	<1
Closed Tall Shrub	8	1
Open/Closed Forest	89	9
Other	6	1
Open Water	785	78
Natural Gas Pipeline Corridor Analysis Area	**1,007**	**100**

Source: HDR and Three Parameters Plus 2011a; HDR 2019i; Three Parameters Plus and HDR 2011a

3.26.4 Alternative 1

The Alternative 1 analysis area totals 21,395 acres, 20,123 acres (94 percent) of which are vegetated. The extent of the analysis area includes the direct and indirect footprints for all project components, as well as the Summer-Only Ferry Operations, Kokhanok East Ferry Terminal, and Pile-Supported Dock variants. A summary of vegetation types by project component and applicable variants is provided below.

3.26.4.1 Mine Site

The Alternative 1 base case and Alternative 1a have the same direct disturbance footprint at the mine site; however, consideration of the Summer-Only Ferry Operations Variant under Alternative 1 increases the affected area for vegetation by 19 acres. Similar to Alternative 1a, the mine site analysis area under Alternative 1 is characterized by the dwarf shrub type, representing 56 percent of the area, with other shrub types collectively comprising 29 percent (Table 3.26-5).

Table 3.26-5: Alternative 1—Mine Site Analysis Area Vegetation Types

Vegetation Type	Acres	Percent Area
Dry to Moist Herbaceous	432	4
Wet Herbaceous	605	5
Dwarf Shrub	6,449	56
Open Low Shrub	1,730	15
Open Tall Shrub	381	3
Closed Low Shrub	184	2
Closed Tall Shrub	1,072	9
Other	482	4
Open Water	156	1
Mine Site Analysis Area	**11,491**	**100**

Source: HDR and Three Parameters Plus 2011a; HDR 2019i; Three Parameters Plus and HDR 2011a

<u>Summer-Only Ferry Operations Variant</u>

Under this variant, increased storage capacity for concentrate containers would be needed at the mine site to facilitate year-round processing operations. The addition of a container storage yard and relocation of a sewage tank pad to accommodate the storage yard increases the affected environment for vegetation at the mine site under Alternative 1. This increase is included in the mine site analysis area presented in Table 3.26-5.

3.26.4.2 Transportation Corridor

Under Alternative 1, the transportation corridor includes the 28-mile mine access road, from the mine site to the north ferry terminal on Iliamna Lake, a 19-mile ferry crossing of Iliamna Lake to the south ferry terminal west of Kokhanok, and the port access road considered under Alternative 1a. Separate spur roads included under Alternative 1 are the 9-mile Iliamna spur road from the mine access road to the existing road system supporting the communities of Iliamna and Newhalen, and the Kokhanok spur road and explosives storage spur road described under Alternative 1a.

The transportation corridor analysis area is dominated by the dwarf shrub vegetation type, which represents 45 percent of the area. Other shrub types collectively contribute an additional 30 percent with the open/closed forest vegetation type subdominant at 17 percent (Table 3.26-6).

Table 3.26-6: Alternative 1—Transportation Corridor Analysis Area Vegetation Types

Vegetation Type	Acres	Percent Area
Dry to Moist Herbaceous	127	1
Wet Herbaceous	175	2
Dwarf Shrub	3,958	45
Open Low Shrub	642	7
Open Tall Shrub	930	11
Closed Low Shrub	57	1
Closed Tall Shrub	946	11
Open/Closed Forest	1,527	17
Other	198	2
Open Water	260	3
Transportation Corridor Analysis Area	**8,820**	**100**

Source: HDR and Three Parameters Plus 2011a; HDR 2019i; Three Parameters Plus and HDR 2011a

Kokhanok East Ferry Terminal Variant

This variant considers an alternate south ferry terminal site east of the Village of Kokhanok. Under this variant a crossing of the Gibraltar River would not be required and the number of stream crossings would be reduced. The Kokhanok East Ferry Terminal Variant includes a 20-mile crossing of Iliamna Lake and a 27-mile port access road from the Kokhanok east ferry terminal to Amakdedori port. Spur roads included under this variant are the 5-mile Kokhanok spur road connecting the port access road to the community of Kokhanok, as well as the Iliamna spur road and explosives storage spur road described under Alternative 1a. Inclusion of this variant in addition to the Alternative 1 base case for the transportation corridor increases the affected environment for vegetation by 1,325 acres relative to Alternative 1a. This increased footprint is included in the Alternative 1 transportation corridor analysis area presented in Table 3.26-6.

3.26.4.3 Amakdedori Port

Alternative 1 would incorporate an earthen fill causeway and sheet pile dock design, which increases the open water portion of the analysis area to 28 percent compared to Alternative 1a. The same as Alternative 1a, the vegetation of the Amakdedori port analysis area is dominated by the dwarf shrub type, representing 48 percent of the area, with the “other” vegetation type (i.e., partially vegetated or barren land) subdominant at 9 percent (Table 3.26-7).

Table 3.26-7: Alternative 1—Amakdedori Port Analysis Area Vegetation Types

Vegetation Type	Acres	Percent Area
Dry to Moist Herbaceous	12	6
Wet Herbaceous	2	1
Dwarf Shrub	89	48
Open Low Shrub	1	1
Open Tall Shrub	3	2
Closed Low Shrub	3	2
Closed Tall Shrub	6	3
Open Water	52	28
Other	17	9
Amakdedori Port Analysis Area	**185**	**100**

Source: HDR and Three Parameters Plus 2011a; HDR 2019i; Three Parameters Plus and HDR 2011a

Summer-Only Ferry Operations Variant

To support the year-round transport of concentrate from Amakdedori, concentrate transported to the port site during the ferry's operating months would be stored in an expanded container storage yard. Expansion of this storage yard would increase the affected environment for vegetation; this increase is included in the Amakdedori port analysis area presented in Table 3.26-7.

Pile-Supported Dock Variant

Adoption of a pile-supported dock design under Alternative 1 would reduce the in-water footprint of the marine facility, but would have no change on the affected environment for vegetation.

3.26.4.4 Natural Gas Pipeline Corridor

Under Alternative 1 the 188-mile natural gas pipeline corridor from the Kenai Peninsula to the mine site includes four main segments: 1) Cook Inlet crossing to the Amakdedori port; 2) along the port access road to the south ferry terminal; 3) across Iliamna Lake to the north ferry terminal; and 4) along the mine access road to the mine site.

Segments of the natural gas pipeline corridor co-located with access roads are included in the transportation corridor analysis area. Pipeline-only segments of the natural gas pipeline are addressed here, and include: the 1-mile Kenai Peninsula tie-in, the 104-mile Cook Inlet crossing, the 19-mile Iliamna Lake crossing, and the 28-mile north ferry terminal to the mine site.

The natural gas pipeline corridor analysis area is predominantly open water, comprising 89 percent of the analysis area. Collectively, shrub vegetation types are subdominant along the transportation corridor, representing approximately 6 percent of the area (Table 3.26-8).

Table 3.26-8: Alternative 1—Natural Gas Pipeline Corridor Analysis Area Vegetation Types

Vegetation Type	Acres	Percent Area
Dry to Moist Herbaceous	6	1
Wet Herbaceous	2	<1
Dwarf Shrub	39	4
Open Low Shrub	7	1
Open Tall Shrub	3	<1
Closed Low Shrub	4	<1
Closed Tall Shrub	7	1
Open/Closed Forest	20	2
Other	8	1
Open Water	805	89
Natural Gas Pipeline Analysis Area	**900**	**100**

Source: HDR and Three Parameters Plus 2011a; HDR 2019i; Three Parameters Plus and HDR 2011a

Kokhanok East Ferry Terminal Variant

Under the Kokhanok East Ferry Terminal Variant, the natural gas pipeline alignment from the Amakdedori port would follow the port access road towards the Kokhanok east ferry terminal and the spur road into Kokhanok. From Kokhanok, it would follow an existing road alignment to the point where it leaves the shoreline to tie into the route from the Kokhanok west ferry terminal site. Construction of this variant would not change the area of the affected environment for vegetation.

3.26.5 Alternative 2—North Road and Ferry with Downstream Dams

The Alternative 2 analysis area totals 20,049 acres, 18,860 acres (94 percent) of which are vegetated. The extent of the analysis area includes the direct and indirect footprints for all project components, as well as the Summer-Only Ferry Operations, Newhalen River North Crossing, and Pile-Supported Dock variants. A summary of vegetation types by project component and applicable variants is provided below.

3.26.5.1 Mine Site

Alternative 2 incorporates an alternative downstream dam construction method for the bulk tailings storage facility and the Summer-Only Ferry Operations Variant, both of which increase the footprint of direct disturbance, and thus the affected area for vegetation at the mine site, by 115 acres relative to Alternative 1a. Similar to Alternative 1a, the mine site analysis area under Alternative 2 is characterized by the dwarf shrub type, representing 56 percent of the area, with other shrub types collectively composing 29 percent (Table 3.26-9).

Table 3.26-9: Alternative 2—Mine Site Analysis Area Vegetation Types

Vegetation Type	Acres	Percent Area
Dry to Moist Herbaceous	448	4
Wet Herbaceous	606	5
Dwarf Shrub	6,503	56
Open Low Shrub	1,737	15
Open Tall Shrub	380	3
Closed Low Shrub	184	2
Closed Tall Shrub	1,072	9
Other	502	4
Open Water	156	1
Mine Site Analysis Area	**11,587**	**100**

Source: HDR and Three Parameters Plus 2011a; HDR 2019i; Three Parameters Plus and HDR 2011a

<u>**Summer-Only Ferry Operations Variant**</u>

Under this variant, greater storage capacity for concentrate containers would be needed at the mine site to facilitate year-round processing operations. The addition of a container storage yard and relocation of a sewage tank pad to accommodate the storage yard increases the affected environment for vegetation at the mine site under Alternative 2; this increase is included in the mine site analysis area, presented in Table 3.26-9.

3.26.5.2 Transportation Corridor

The transportation corridor includes 35 miles of the mine access road from the mine site to the Eagle Bay ferry terminal on the north shore of Iliamna Lake; a 29-mile crossing of the lake to the Pile Bay ferry terminal; and an 18-mile port access road connecting the Pile Bay terminal to the Diamond Point port. This alternative includes a southern crossing of the Newhalen River.

The transportation corridor analysis area is characterized by the open/closed forest type, which represents 39 percent of the area. The dwarf shrub type is subdominant at 24 percent, with other shrub types collectively representing 27 percent (Table 3.26-10).

Table 3.26-10: Alternative 2—Transportation Corridor Analysis Area Vegetation Types

Vegetation Type	Acres	Percent Area
Dry to Moist Herbaceous	150	3
Wet Herbaceous	83	1
Dwarf Shrub	1,371	24
Open Low Shrub	513	9
Open Tall Shrub	268	5
Closed Low Shrub	41	1
Closed Tall Shrub	667	12
Open/Closed Forest	2,278	39
Open Water	177	3
Other	240	4
Transportation Corridor Analysis Area	**5,788**	**100**

Source: HDR and Three Parameters Plus 2011a; HDR 2019i; Three Parameters Plus and HDR 2011a

Summer-Only Ferry Operations Variant

To support the year-round transport of concentrate from Diamond Point, concentrate transported to the port site during the ferry's operating months would be stored in an expanded container storage yard. Because space is limited at the Diamond Point port site, this storage yard would be located in the Alternative 2 transportation corridor. This increase is included in the transportation corridor analysis area presented in Table 3.26-10.

Newhalen River North Variant

This variant includes an alternative crossing of the Newhalen River that lies to the north of the crossing location proposed for Alternative 1a. Inclusion of this variant would increase the affected environment for vegetation. This increase is included in the transportation corridor analysis area presented in Table 3.26-10.

3.26.5.3 Diamond Point Port

Alternative 2 proposes a dock with an earthen fill causeway and sheet pile jetty design placed at Diamond Point at the junction of Cottonwood and Iliamna bays. The closed and open tall shrub vegetation types are subdominant at Diamond Point port, collectively representing 33 percent of the area; the dry to moist herbaceous type is subdominant at 11 percent. Because the Diamond Point port analysis area extends into Cook Inlet, 50 percent of the analysis area is open water (Table 3.26-11). The Williamsport terminus of the Williamsport-Pile Bay Road is at the head of Iliamna Bay; otherwise, vegetation in the area is relatively undistributed.

Table 3.26-11: Alternative 2—Diamond Point Port Analysis Area Vegetation Types

Vegetation Type	Acres	Percent Area
Dry to Moist Herbaceous	27	11
Wet Herbaceous	1	1
Open Tall Shrub	33	13
Closed Tall Shrub	50	20
Other	15	6
Open Water	128	50
Diamond Point Port Analysis Area	**255**	**100**

Source: HDR and Three Parameters Plus 2011a; HDR 2019i; Three Parameters Plus and HDR 2011a

Pile-Supported Dock Variant

Adoption of a pile-supported dock design under Alternative 2 would reduce the in-water footprint of the marine facility, but would create no change on the affected environment for vegetation.

3.26.5.4 Natural Gas Pipeline Corridor

Under Alternative 3, the 164-mile natural gas pipeline corridor from the Kenai Peninsula to the mine site includes three main segments: 1) Cook Inlet crossing coming ashore at Ursus Cove; 2) north to Diamond Point port; and 3) overland to the mine site, following along the port and mine access roads with a pipeline-only segment between.

Segments of the natural gas pipeline corridor co-located with access roads are included in the transportation corridor analysis area. Pipeline-only segments of the natural gas pipeline are addressed here and include: the mine access road cut-off to Eagle Bay, the port access road cut-off to Pile Bay; Diamond Point port to Ursus Cove; and the 78-mile section from Ursus Cove across Cook Inlet to the Kenai Peninsula. The area also encompasses construction access roads to the natural gas pipeline corridor on the northern side of Iliamna Lake.

The natural gas pipeline corridor analysis area is dominated by the open/closed forest vegetation type, representing approximately 60 percent of the area; open water represents an additional 28 percent of the area (Table 3.26-12).

Table 3.26-12: Alternative 2—Natural Gas Pipeline Analysis Area Vegetation Types

Vegetation Type	Acres	Percent Area
Dry to Moist Herbaceous	33	1
Wet Herbaceous	15	1
Dwarf Shrub	41	2
Open Low Shrub	52	2
Open Tall Shrub	60	2
Closed Low Shrub	3	<1
Closed Tall Shrub	81	3
Open/Closed Forest	1,452	60
Other	17	1
Open Water	666	28
Natural Gas Pipeline Analysis Area	**2,419**	**100**

Source: HDR and Three Parameters Plus 2011a; HDR 2019i; Three Parameters Plus and HDR 2011a

3.26.6 Alternative 3—North Road Only

The Alternative 3 analysis area totals 21,219 acres, 20,077 acres (95 percent) of which are vegetated. The extent of the analysis area includes the direct and indirect footprints for all project components and the Concentrate Pipeline Variant. A summary of vegetation types by project component is provided below.

3.26.6.1 Mine Site

Alternative 3 incorporates the Concentrate Pipeline Variant, which increases the direct footprint of disturbance by 1 acre; however, because expansion the direct disturbance footprint occurs within the area of potential dust deposition, the affected area for vegetation at the mine site is not increased relative to Alternative 1a. Similar to Alternative 1a, the mine site analysis area under Alternative 3 is characterized by the dwarf shrub type, representing 56 percent of the area, with other shrub types collectively composing 29 percent (Table 3.26-13).

Table 3.26-13: Alternative 3—Mine Site Analysis Area Vegetation Types

Vegetation Type	Acres	Percent Area
Dry to Moist Herbaceous	430	4
Wet Herbaceous	605	5
Dwarf Shrub	6,434	56
Open Low Shrub	1,730	15
Open Tall Shrub	381	3
Closed Low Shrub	184	2
Closed Tall Shrub	1,072	9
Other	482	4
Open Water	156	1
Mine Site Analysis Area	**11,472**	**100**

Source: HDR and Three Parameters Plus 2011a; HDR 2019i; Three Parameters Plus and HDR 2011a

Concentrate Pipeline Variant

This variant would cause an increase to the size of the mine site by 1 acre associated with an electric pump station. This increased size is included in the analysis area for the mine site presented in Table 3.26-13.

3.26.6.2 Transportation Corridor

Under Alternative 3, the transportation corridor includes the 82-mile north access road from the mine site to the Diamond Point port on Cook Inlet. This alternative includes a slight realignment around Knutson Bay on Iliamna Lake and a southern crossing of the Newhalen River.

The transportation corridor analysis area is dominated by the open/closed forest vegetation type, which represents 57 percent of the area. The dwarf shrub type is subdominant in the transportation corridor, representing approximately 16 percent of the area; other shrub types collectively cover 19 percent (Table 3.26-14).

Table 3.26-14: Alternative 3—Transportation Corridor Analysis Area Vegetation Types

Vegetation Type	Acres	Percent Area
Dry to Moist Herbaceous	159	2
Wet Herbaceous	112	1
Dwarf Shrub	1,360	16
Open Low Shrub	577	7
Open Tall Shrub	276	3
Closed Low Shrub	41	<1
Closed Tall Shrub	776	9
Open/Closed Forest	5,027	57
Other	172	2
Open Water	256	3
Transportation Corridor Analysis Area	**8,757**	**100**

Source: HDR and Three Parameters Plus 2011a; HDR 2019i; Three Parameters Plus and HDR 2011a

Concentrate Pipeline Variant

This variant would slightly increase the road corridor width due to the co-location of the concentrate pipeline and the optional return water pipeline in a single trench with the natural gas pipeline at the toe of the road corridor embankment. Construction of the concentrate pipeline would increase the average width of the road corridor by less than 10 percent; construction of the concentrate and water return pipelines would increase the average width of the road corridor by less than 3 feet under typical construction and relative to Alternative 3. The length would be the same as the 82-mile overland portion of the natural gas pipeline. An intermediate booster station would be sited along the road alignment. This estimated increase in footprint is included in the analysis area presented in Table 3.26-14.

3.26.6.3 Port

Alternative 3 proposes a caisson dock design at a port location north of Diamond Point on Iliamna Bay. The closed and open tall shrub vegetation types are subdominant at the port, collectively representing 40 percent of the area. Because the port analysis area extends into Iliamna Bay, 58 percent of the analysis area is open water (Table 3.26-15).

Table 3.26-15: Alternative 3—Port Analysis Area Vegetation Types

Vegetation Type	Acres	Percent Area
Dwarf Shrub	<1	<1
Open Low Shrub	<1	<1
Open Tall Shrub	13	8
Closed Tall Shrub	51	32
Other	3	2
Open Water	92	58
Port Analysis Area	**160**	**100**

Source: HDR and Three Parameters Plus 2011a; HDR 2019i; Three Parameters Plus and HDR 2011a

Concentrate Pipeline Variant

Construction of the Concentrate Pipeline Variant would not change the area of the affected environment for vegetation in the Diamond Point port analysis area.

3.26.6.4 Natural Gas Pipeline Corridor

The natural gas pipeline corridor under Alternative 3 follows the same general route from the Kenai Peninsula to the mine site as that for Alternative 2; however, due to greater co-location of the natural gas pipeline with the road corridor, much of the alignment is within the analysis area for the Alternative 3 transportation corridor. Pipeline-only segments of the natural gas pipeline are addressed here and include: the 8-mile segment from the port to Ursus Cove; and the 78-mile section from Ursus Cove across Cook Inlet to the Kenai Peninsula.

The natural gas pipeline corridor analysis area is predominantly open water, representing 77 percent of the area. Collectively, shrub vegetation types are subdominant along the natural gas pipeline corridor, representing approximately 17 percent of the area (Table 3.26-16).

Table 3.26-16: Alternative 3—Natural Gas Pipeline Corridor Analysis Area Vegetation Types

Vegetation Type	Acres	Percent Area
Dry to Moist Herbaceous	31	4
Wet Herbaceous	<1	<1
Dwarf Shrub	27	3
Open Low Shrub	25	3
Open Tall Shrub	51	6
Closed Low Shrub	3	<1
Closed Tall Shrub	44	5
Open/Closed Forest	3	<1
Other	7	1
Open Water	638	77
Natural Gas Pipeline Analysis Area	**830**	**100**

Source: HDR and Three Parameters Plus 2011a; HDR 2019i; Three Parameters Plus and HDR 2011a

3.26.7 Climate Change

Climate change is currently affecting vegetation in the analysis area and throughout Alaska. Observed and predicted effects include changes in plant phenology (Wolken et al. 2011), changes in vegetation community composition from impacts to hydrology, and changes in fire regimes (Calef et al. 2015). Climate models predict that the Bristol Bay region will experience rapid ecological change during the next 100 years. Computer models for climate change consider future “cliomes,” areas where temperature and precipitation reflect certain assemblages of wildlife and vegetation. Bristol Bay’s current cliome, “boreal forest with coastal influence and intermixed grass and tundra,” is expected to shift north, and largely disappear by 2090 (ANTHC 2018). It may be replaced by “prairie and grasslands,” a cliome that does not currently occur in Alaska and is characteristic of southeastern Alberta in Canada (SNAP and EWHALE 2012).

Invasive species risk analysis for the Bering Sea cites new patterns vessel traffic, ballast water exchange, and rising ocean temperatures as the factors likely to increase the rate of introductions and render habitat more suitable for the establishment of non-native marine species (Reimer et al. 2017). Habitat suitability modeling identifies suitable year-round habitat for between 33 and 35 non-native species under the current climate with between 37 to 60 percent of Bering Sea Shelf habitat to become more suitable under mid-century climate conditions (Reimer et al. 2017).

Bristol Bay residents (ANTHC 2018) report changes in vegetation trends due to warmer and wetter conditions, including rapid tree growth and range expansion; new coastal wetlands; and spread of invasive plant species. An inventory of invasive plants conducted in 18 communities in western Alaska between 2012 and 2014 showed a total of 20 invasive plant species found, including the highly invasive rugosa rose (*Rosa rugosa*), found in Chignik Lagoon (Robinette 2015). In addition to documenting the presence of invasive plants, community members were asked about their observations and concerns about vegetation changes near their communities. The most frequently identified concern was linked to increased shrubs, particularly alder, and the potential changes to berry harvest areas. Similar to the Robinette (2015) study, residents in the vicinity of the analysis area report replacement of the tundra and shrub vegetation types by alder and willow shrub over the last decades. In 2013, Nondalton residents reported additional outbreaks of spruce bark beetle and aphids on the Nushagak River (ANTHC 2018).

Higher temperatures are predicted to increase the spread of invasive plant species. Modeled current and future range for 16 invasive plant species with a high to extremely high invasion potential, show. The scenarios modeled showed all 16 species to have current potential ranges in Alaska (Bella 2009). Notably, these predicted ranges exceed the current known species occurrences, indicating that the species are not yet filling their current predicted potential range. Future predicted scenarios show potential invasion ranges in Alaska for all species included. Although only nine of these invasive species are currently found in Alaska and none of the species modeled have been documented in the analysis area, suitable habitat was identified in the same ecoregion as the project for all the evaluated species.