

In reply, refer to:
WAES

June 11, 2001

Ryan Winn
Regulatory Branch
U.S. Army Engineer District, Alaska
P.O. Box 898
Anchorage, Alaska 99506-0898

Subject: Biological Opinion regarding the effects of the proposed bulk fuel storage facility consolidation and construction at Chignik Lagoon, Alaska, on the Threatened Steller's Eider (*Polysticta stelleri*).

Dear Mr. Winn:

The enclosed document transmits the Fish and Wildlife Service's biological opinion based on our review of the proposed construction and consolidation of bulk fuel storage facilities at Chignik Lagoon, Alaska, and its effects on the Steller's eider (*Polysticta stelleri*) in accordance with section 7 of the Endangered Species Act (Act) of 1973, as amended (16 U.S.C. 1531 et seq.). This letter provides only a summary of the findings included in the Biological Opinion. A complete discussion of the effects analyses is provided in the Biological Opinion.

This Biological Opinion is based on information provided in the Preliminary Design Report and Construction Cost Estimate for Consolidation and Renovation of Fuel Storage and Handling Facilities in the Community of Chignik Lagoon (Alaska Energy and Engineering, Inc 2000), Fish and Wildlife Service distribution and abundance survey data (Larned 2000) and other information available in our files and from experts. The complete administrative record for this consultation is on file at the Ecological Services Anchorage Field Office.

On April 23, 2001, we received an April 13, 2001, general permit pre-construction notification from the U.S. Army Corps of Engineers (ACOE) for our evaluation. The Service began informally consulting on this project on May 3, 2001. In the subsequent two weeks, the Service reviewed the project with Alaska Energy and Engineering, Inc., the Alaska Energy Authority, the ACOE, the U.S. Coast Guard, the Environmental Protection Agency, and the Alaska Department of Environmental Conservation. Despite concerted efforts by the Service and the applicant and its representatives, it was not possible to completely eliminate, through project modifications, all adverse effects that may arise from the proposed project. Hence, we determined that the construction of the Chignik Lagoon fuel storage facility was likely to

adversely affect and was beyond the scope of the Service's informal consultation process; we recommended on May 29, 2001, that formal consultation be initiated. Formal consultation was initiated on May 30, 2001. In recognition of the fact that the consolidation of fuel storage and deliveries represents a substantial improvement over the existing fuel storage and handling procedures, the Service made the unusual commitment to the applicant to complete the Biological Opinion in a time frame that would allow construction to proceed this season. Consequently, the usual 145-day time frame was shortened to less than 25 days.

After reviewing all available information on the location, timing of construction, and facility operation, along with the anticipated effects of the proposed action and the best available information on the status, distribution, and life history of the Steller's eider, it is the Service's biological opinion that the action, as proposed, is not likely to jeopardize the continued existence of the species.

Evaluation of prevailing climatic and marine conditions in Chignik Lagoon indicates that a worst-case discharge would be unlikely to result in a take that exceeds 264 Steller's eiders, or eight individuals of the Alaska breeding population. We expect that adequate spill response, natural spill dispersal, and evaporation of spilled product would preclude take beyond that level.

This Biological Opinion includes Reasonable and Prudent Measures and Terms and Conditions that the Service believes will minimize the impacts of incidental take of Steller's eiders resulting from the proposed project. In order to be exempt from the prohibitions of section 9 of the ESA, the ACOE must require the applicant to comply with the terms and conditions, which implement the reasonable and prudent measures.

If you have any questions concerning this biological opinion, please contact Field Supervisor Ann Rappoport at (907) 271-2787, or lead Endangered Species Biologist Greg Balogh at (907) 271-2778.

Sincerely,

Ann G. Rappoport
Field Supervisor

Enclosure

cc: Angela Gregorio, Village of Chignik Lagoon
Al Ewing, Denali Commissioner
Chris Mello, Alaska Energy Authority
Steve Stassel, Alaska Energy and Engineering, Inc.

BIOLOGICAL OPINION

DESCRIPTION OF PROPOSED ACTION

The Village of Chignik Lagoon proposes to consolidate community fuel storage needs into two facilities: the existing code-compliant Lake and Peninsula School District (LPSD) facility with a storage capacity of 25,100 gallons of diesel fuel, and a new facility with a gross storage capacity of 58,100 gallons of diesel fuel and 17,500 gallons of gasoline. The new facility will include a gasoline dispensing facility consisting of a 4,000-gallon double wall fire rated dispensing tank with a single product dispenser. The combined gross storage capacity of the two facilities will be 100,700 gallons, roughly a 6-month supply of community heating, power generation, and transportation fuel requirements. The project will involve the renovation of the existing Lake and Peninsula School District tank farm, the construction of a new storage facility, and the installation of a fill and transfer pipeline between the two facilities. The consolidated fuel storage facilities will replace 13 existing tank farms, many of which are non-code compliant or in need of repair, located throughout the community, and will be accessible to an ocean-going fuel barge, thereby reducing the cost of fuel and increasing the reliability of deliveries for the community.

The proposed construction site is located along the shore of Chignik Lagoon. A sheet pile bulkhead will be constructed to provide a level area for construction extending to the mean higher high water level. The top of the sheet pile wall and the top of the containment dike will be at an elevation of 18 feet; the 100-year storm surge flood elevation at this site is 17.8 feet. The finished floor elevation inside the dike will be 15.3 feet, and the base of the bulkhead will intersect the shoreline about 1.5 feet below the high tide line. This project will involve a discharge of approximately 13.5 cubic yards of fill material below the high tide line of Chignik Lagoon over an area of approximately 0.011 acre.

Minor tank and piping modifications will be performed and existing tanks will be inspected internally and externally, sandblasted and re-painted at the LPSD tank farm. These tanks will remain in their present location on the existing treated timber foundations. All tanks at the new facility will be single wall horizontal welded steel, labeled in accordance with UL 142, and installed on concrete footings and anchored to resist flotation. Each tank at the new facility will be isolated from other tanks within the same secondary containment. The new dispensing tank will be double wall fire rated horizontal welded steel labeled in accordance with UL 2085 and equipped with steel saddle and skid foundation. The marine header of the new tank farm fill manifolds and the LPSD tank farm fill pipeline will be located inside the new secondary containment dike. Approximately 1,200 feet of 3-inch fill/transfer pipeline will be installed to connect the new facility with the LPSD facility. All but approximately 200 feet of the pipeline will be below ground. A bulk fuel transfer area with secondary containment will be provided at

the tank farm to allow portable tanks and fuel trucks to be filled with diesel fuel from the community storage tanks.

All tanks will be equipped with flanged valve connections, pressure/vacuum whistle vents, emergency vents, and level gauges. All tanks, piping and dispensing pumps will be fail-safe engineered to prevent accidental fuel discharge. Additional spill prevention measures to be incorporated in the facility include cathodic protection for piping, impervious containment area under the full area of each storage tank, continuous secondary containment, regularly scheduled facility and response equipment inspections, and annual personnel response training and drills. All transfer and dispensing pumps will be submersible style and will be equipped with anti-siphon valves.

A sheet pile bulkhead will be constructed to protect the northern, western, and eastern faces of the tank farm from wave forces and scour. A heavy-timber wall dike with a membrane liner on top of the earthen pad and centered inside the sheet pile bulkhead walls will provide secondary containment. The secondary containment dike will be sized to contain 115% of the contents of the largest tank within it plus 15 inches of freeboard for precipitation. The dike will be lined with a membrane liner compatible with both diesel fuel and gasoline. A non-woven geotextile fabric will be installed above and below the liner to prevent puncture and damage and a 4-inch deep layer of gravel cover will be placed over the liner. A protective sheet metal cover will be installed over the liner on the interior dike walls.

The Village Council will be responsible for management of both the new community tank farm and the existing LPSD tank farm. Given that the two facilities are interconnected, one set of regulatory documents will be prepared including: an Operations Manual and Letter of Intent in accordance with Coast Guard regulations (33 CFR 154), a Spill Prevention Control and Countermeasure Plan in accordance with Environmental Protection Agency regulations (40 CFR 112), and a single Facility Response Plan with agency cross-referencing will be submitted to both the EPA and the Coast Guard. Spill response gear will be acquired and four portable 2,200-gallon tanks will be dedicated to spill contingency storage.

The Chignik Lagoon Village Council agrees, as per a June 8, 2001, voice mail from Angela Gregorio, Chignik Lagoon Village Council Administrator, and subsequent conversation between Laura Stepanoff, Village President, and Ann Rappoport, U.S. Fish and Wildlife Service, to incorporate the following spill prevention and response measures into the project description in order to minimize affects to Steller's eiders as a result of the proposed project. As appropriate, these measures will become part of the Facility Operations Manual, the Spill Prevention Control and Countermeasure Plan, and the Facility Response Plan.

1. No fuel deliveries will be accepted during the time that eiders are present in Chignik Lagoon. This time period is estimated to be between November 1 (or as soon as eiders are observed in Chignik Lagoon, whichever comes first) and March 30. In the event that environmental conditions or emergency necessitates fuel delivery within this time period the applicant shall contact the Service. The

Service will evaluate the situation on a site and time-specific basis and determine the appropriate action.

2. Fuel barges delivering fuel to the Chignik Lagoon bulk fuel storage facility will be required to deploy containment or sorbent booms as appropriate or other fuel containment or spill prevention devices during all fuel transfer operations between the supply vessel and the facility. Booms should be deployed such that they fully encircle the supply barge while maintaining its ability to contain spilled fuel equal to the total capacity of the largest storage tank on the re-supply vessel.
3. Sufficient oil discharge response equipment including the means of deploying and anchoring boom will be maintained *on site* to prevent a worst-case discharge volume of oil originating from the new community tank farm, the LPSD facility, or during ship-to-shore fuel transfer from entering areas of eider concentrations regardless of the presence or absence of birds.
4. All equipment required to implement the Facility Response Plan will be obtained and an oil spill response drill will be performed no later than 15 days before receipt of the first fuel delivery.
5. Weather and safety permitting, response equipment will be deployed and response personnel will be mobilized *at the spill site* within 1 hour of the detection of a spill.
6. A qualified individual will be identified who will be responsible for coordinating and conducting annual oil spill response drills for scenarios including discharge events occurring during flood, ebb and slack tides.
7. The Service, Denali Commission and applicant will endeavor to implement boat or aerial surveys to precisely delineate Steller's eider distribution in the action area thereby allowing for improved oil spill response planning. Weather permitting, the surveys would be conducted by a qualified individual between November 15, 2001, and March 31, 2002, according to accepted Service protocol. The area to be surveyed (the action area) would be that area potentially impacted by an oil discharge in one tidal cycle based on average wind speed and direction and average current speed and direction for both ebb and flood tides. Within 30 days of survey completion, the information from individual surveys shall be provided to the Service.

STATUS OF THE SPECIES

Species Description

The Steller's eider is the smallest of the eiders. The average weight of adult male and female Steller's eiders is 1.94 pounds (Bellrose 1980). Adult male Steller's eiders in breeding plumage have a black back, white shoulders, and a chestnut brown breast and belly. The males have a white head with black eye patches; they also have a black chin patch and a small greenish patch on the back of the head. Females and juveniles are mottled dark brown.

Life History

Longevity

Steller's eiders are long lived, with documented life spans in the wild of up to 21 years and 4 months. Other ages recorded for this species in the wild are 20 years-4 months, 19 years-3 months, and 16 years (Chris Dau, pers. comm. 2000).

Energetics

Goudie and Ankney (1986) suggest that small-bodied sea ducks such as harlequin (*Histrionicus histrionicus*) and long-tailed ducks (*Clangula hyemalis*) that winter at northern latitudes do so near the limits of their energetic threshold. These species have little flexibility in regards to caloric consumption or reliance of caloric reserves. Under this life history strategy, such species are vulnerable to perturbations within their winter habitat. Because the Steller's eider is relatively small-bodied, being intermediate in size to the harlequin and long-tailed ducks (Bellrose 1980), and because it overlaps with harlequins and long-tailed ducks in its choice of foraging areas and prey items, the species may, like the harlequin and long-tailed ducks, exist near its energetic limits. Unlike other larger eiders, Steller's eiders must continue to feed upon reaching their nesting areas to build up enough energy reserves to breed (D. Solovieva, pers. comm. 2000). In addition, female Steller's eiders must continue to feed during incubation. Spectacled eiders, a larger bodied sea duck apparently do not exist so close to their energetic threshold; they arrive on the nesting grounds fit enough to fast through egg laying and incubation.

Age to Maturity

Bellrose (1987) indicated that sexual maturity in Steller's eiders is probably deferred to the second year.

Reproductive Strategy

Johnsgard (1994) indicated that pair formation for most sea ducks occurs in fall and spring. Metzner (1993) hypothesized that Steller's eiders at Izembek Lagoon and Cold Bay pair in the spring because they were apparently too preoccupied with feeding during the fall and winter to form pair bonds. The length of time that Steller's eiders remain paired is unknown. However,

long-term pair bonds have been documented in other ducks (Bengtson 1972, Savard 1985, as in Cooke et al. 2000).

Pairs of Steller's eiders arrive at Point Barrow as early as June 5 (Bent 1987). While nesting, Steller's eiders often occupy shallow coastal wetlands in association with tundra (Bent 1987, Quakenbush et al. 1995, Solovieva 1997), although we have records of aerial observations of Steller's eider pairs well inland on the Arctic Coastal Plain. This species establishes nests near shallow ponds or lakes, usually close to water.

Clutch size ranges from 2 to 10 eggs (Bent 1987, Bellrose 1987, Quakenbush et al. 1995). The average clutch size of successful nests near Barrow is reported as 4.6 (n = 8). Solovieva (1997) found that clutch size for Steller's eiders on the Lena Delta varied between 5 and 8 eggs with an average of 6.1 (n = 32). Nesting success near Barrow (percent of nests where eggs hatch) is variable (Quakenbush et al., 1995). In 1991, 5 of 6 nests hatched while in 1993, only 4 of 20 nests hatched. During some years, the species apparently does not even attempt to nest near Barrow (Quakenbush et al., 1995).

Recruitment

Steller's eider recruitment rate (the percentage of fledged birds that reach sexual maturity) is unknown. However, there is limited information regarding Steller's eider fledging rate. Near Barrow, 83.3 percent (5 of 6) of Steller's eiders nests with eggs hatched in 1991, 20.0 percent (4 of 20) hatched in 1993 (Quakenbush et al. 1995), and 15 percent (3 of 20) hatched in 2000 (Philip Martin, Fish and Wildlife Service, pers. comm., 2000). In other years, Steller's eiders did not even attempt to breed near Barrow (Quakenbush et al. (1995). We conclude that the annual recruitment rate for this species is likely variable.

Seasonal Distribution Patterns

Banded and Satellite-Tagged Alaskan Breeding Birds: Little is known of the distribution of Alaska breeding Steller's eiders outside of the breeding season. A few band recoveries indicate that birds that breed near Barrow undergo molt in Izembek lagoon. Two of three Steller's eiders captured near Barrow and implanted with satellite-transmitters spent the molting season on the Kuskokwim shoals, while the third molted near the Seal Islands (Philip Martin, U.S. Fish and Wildlife Service, pers. comm., 2000). Both birds that molted at Kuskokwim Shoals moved on to Bechevin Bay, while the bird that molted near the Seal Islands moved west to Nelson Lagoon and then to Izembek Lagoon.

Breeding Distribution: The exact historical breeding range of the Alaska-breeding population of Steller's eiders is not clear. The historical breeding range may have extended discontinuously from the eastern Aleutian Islands to the western and northern Alaska coasts, possibly as far east as the Canadian border. In more recent times, breeding occurred in two general areas, the Arctic Coastal Plain, and western Alaska, primarily on the Y-K Delta. Currently, Steller's eiders breed on the western Arctic Coastal Plain in northern Alaska, from approximately Point Lay east to Prudhoe Bay, and in extremely low numbers on the Y-K Delta.

On the Arctic Coastal Plain, anecdotal historical records indicate that the species occurred from Wainwright east, nearly to the Alaska-Canada border (Anderson 1913; Brooks 1915). There are very few nesting records from the eastern Arctic Coastal Plain, however, so it is unknown if the species commonly nested there or not. Currently, the species predominantly breeds on the western Arctic Coastal Plain, in the northern half of the National Petroleum Reserve - Alaska (NPR-A). The majority of sightings in the last decade have occurred east of the mouth of the Utukok River, west of the Colville River, and within 90 km (56 mi) of the coast. Within this extensive area, Steller's eiders generally breed at very low densities.

The Steller's eider was considered to be a locally common breeder in the intertidal, central Y-K Delta by naturalists early in the 1900s (Murie 1924; Conover 1926; Gillham 1941; Brandt 1943), but the bird was reported to breed in only a few locations. By the 1960s or 70s, the species had become extremely rare on the Y-K Delta, and only six nests have been found in the 1990s (Flint and Herzog 1999). Given the paucity of early recorded observations, only subjective estimates can be made of the Steller's eider's historical abundance or distribution on the Y-K Delta.

A few Steller's eiders were reportedly found nesting in other locations in western Alaska, including the Aleutian Islands in the 1870s and 80s (Gabrielson and Lincoln 1959), Alaska Peninsula in the 1880s or 90s (Murie and Scheffer 1959), Seward Peninsula in the 1870s (Portenko 1989), and on Saint Lawrence Island as recently as the 1950s (Fay and Cade 1959). It is unknown how regularly these areas were used or whether the species ever nested in intervening areas.

Post-Breeding Distribution and Fall Migration: Following breeding, males and some females with failed nests depart their Russian nesting area and return to marine waters (Solovieva 1997). We know little of Steller's eiders use of marine waters adjacent to Alaska's Arctic Coastal Plain and along the west and southwest coast of Alaska during late summer and fall migration. Historical observations made by Murdoch (1885 as in Bent 1987) indicate that birds that have bred near Point Barrow begin to return to the coast from the first to the middle of July. In addition, he indicated that they disappear from the Barrow area from the first to the middle of August. Steller's eiders arrived at St. Michael around 21 September (Bent 1987). Late dates of departure were as follows: Point Barrow, September 17; St. Michael, October 5; and Ugashik, November 28 (Bent 1987).

Over 15,000 Steller's eiders were observed on September 27, 1996, in Kuskokwim Bay (Larned and Tiplady 1996). Most (nearly 14,000) were located along the mainland side of barrier islands while about 1,100 were detected further offshore. Despite this species' apparent preference for near shore habitats, several groups were detected over 10 kilometers (km) from shore and two groups were over 30 km from shore.

In late summer and fall, large numbers of Steller's eiders molt in a few lagoons located on the north side of the Alaska Peninsula (i.e., Izembek and Nelson Lagoon/Port Moller Complex, Seal Islands) (Petersen 1980 & 1981). Recent observations of over 15,000 Steller's eiders in Kuskokwim Bay, and the observation of two out of three satellite-tagged birds from Barrow

molting there suggests that Kuskokwim Bay may also be a notable molting area for this species and for the listed entity (Larned and Tiplady 1996; Philip Martin, Service, pers. comm. 2000). Following the molt, large numbers of Steller's eiders are known to over winter in near shore marine waters of the Alaska Peninsula, Aleutian Islands, Kodiak Archipelago, and the Kenai Peninsula (e.g., within Kachemak Bay).

Molt Distribution: After breeding, Steller's eiders move to marine waters where they undergo a flightless molt for about 3 weeks. The majority is thought to molt in four areas along the Alaska Peninsula: Izembek Lagoon (Metzner 1993; Dau 1999a; Laubhan and Metzner 1999), Nelson Lagoon, Herendeen Bay, and Port Moller (Gill et al. 1981; Petersen 1981; Dau 1999a). Additionally, smaller numbers are known or thought to molt in a number of other locations along the western Alaska coast, around islands in the Bering Sea, along the coast of Bristol Bay, and in smaller lagoons along the Alaska Peninsula (Swarth 1934; Dick and Dick 1971; Petersen and Sigman 1977; Wilk et al. 1986; Dau 1987; Petersen et al. 1991; Day et al. 1995; Dau 1999a).

Winter Distribution: Following the molt many, but not all, Steller's eiders disperse from major molting areas to other portions of the Alaska Peninsula and Aleutian Islands. Winter ice formation often temporarily forces birds out of shallow protected areas such as Izembek and Nelson Lagoons. During the winter, this species congregates in select near shore waters throughout the Alaska Peninsula and the Aleutian Islands, around Nunivak Island, the Pribilof Islands, the Kodiak Archipelago, and in Kachemak Bay (Larned 2000b Bent 1987, Agler et al. 1994, Larned and Zwiefelhofer 1995).

In a recent survey, Larned (2000a) did not see Steller's eiders along most of the surveyed Alaska Peninsula coastline during winter. Most of the birds were concentrated within relatively small portions of the coastal waters. Much of the population that is detected during spring migration was not detected on this survey. We conclude that either the survey failed to detect many birds in the survey area, or many Steller's eiders are wintering further west in the Aleutian Islands and/or along the south side of the Alaska Peninsula. We suspect the latter.

Spring Migration: In the spring, Steller's eiders form large flocks along the north side of the Alaska Peninsula and move east and north (Larned et al. 1993, Larned 1998, Larned 2000b). Spring migration usually includes movement along the coast, although birds may take shortcuts across water bodies such as Bristol Bay (William Larned, Fish and Wildlife Service, pers. com. 2000). Interestingly, despite our many daytime aerial surveys, Steller's eiders have never been observed during migratory flights (William Larned pers. com. 2000). Larned (1998) concluded that Steller's eiders show strong site fidelity to favored habitats during migration, where they congregate in large numbers to feed before continuing their northward migration.

The number of Steller's eiders observed in each site during migration surveys should be considered a minimum estimate of the number of eiders that actually use these sites during migration. These data represent eider use during a snapshot in time, when in reality, a stream of eiders likely flows into and out of these sites throughout the migration season. The spring migration survey was not intended to document the intensity of use of any particular site by

Steller's eiders, but was designed to monitor the entire population of Steller's eiders and other sea ducks during the spring migration.

Because the spring Steller's eider aerial survey was not intended to quantify use of any particular area by Steller's eiders during spring migration, care must be taken in interpreting the results with this purpose in mind. For example, Steller's eider use of habitat near Ugashik and Egegik Bays was documented in 1992, 1993, 1997, and 1998 (Larned et al. 1993, Larned 1998). However, in 2000, no Steller's eiders were observed there (Larned 2000b). In fact, no Steller's eiders were observed from the Cinder River Sanctuary to Cape Constantine; an expanse of approximately 110 miles of coastline which encompasses these bays and which has had several thousand Steller's eiders documented in previous years (Larned et al. 1993, Larned 1998). However, 15,000 Steller's eiders were observed south of this area and were distributed between Port Heiden and Port Moller (Larned 2000b). Three days later, about 43,000 Steller's eiders were observed south of Port Moller (Larned 2000b). The birds were, in essence, stacking up behind Port Moller, or were otherwise phenologically late in their migration relative to the previous few years. Regardless, survey results from that year suggested low use of habitats north of Port Moller, even though the birds that were counted south of Port Moller presumably used those more northerly habitats following the conclusion of the spring aerial survey.

Several areas receive consistent use by Steller's eiders during spring migration, including Bechevin Bay, Morzhovoi Bay, Izembek Lagoon, Nelson Lagoon/Port Moller Complex, Cape Seniavin, Seal Islands, Port Heiden, Cinder River State Critical Habitat Area, Ugashik Bay, Egegik Bay, Kulukak Bay, Togiak Bay, Nanwak Bay, Kuskokwim Bay, Goodnews Bay, and the south side of Nunivak Island (Larned et al. 1993, Larned 1998, and Larned 2000b).

Summer Distribution in Southern Alaska: A small number of Steller's eiders are known to remain along the Alaska Peninsula and Kachemak Bay during the summer; approximately 100 have been observed in Kachemak Bay while a few may spend the summer at Izembek Lagoon (Chris Dau, U.S. Fish and Wildlife Service, pers. comm. 2000).

Site Fidelity

Steller's eiders appear to show site fidelity at different spatial scales during different times of the year. There is good evidence of fidelity to molting sites in this species. About 95 percent of recaptured molting Steller's eiders are recaptured at the same site at which they were banded (Flint et al. 2000). Flocks of Steller's eiders make repeated use of certain areas between years (Larned 1998), although it is unknown to what extent individuals display repeated use of these areas.

Female philopatry to breeding grounds in waterfowl species is high. Female waterfowl tend to return to the area where they hatched for their first nesting effort, and subsequently tend to return to the same area to breed in the following years (Anderson et al. 1992). Despite having had only a few opportunities to observe Steller's eiders breeding on the Y-K Delta, we have observed philopatry displayed by a female Steller's eider there; one individual chose nest sites in two

consecutive years that were about 124 m apart (Paul Flint, U. S. Geological Service, Biological Resource Division, pers. comm. 1999). Banding data from the Barrow area suggests some level of site fidelity for Steller's eiders breeding there as well (Quakenbush et al. 1995; Martin, Service, Ecological Service, Fairbanks, pers. comm. 2000). Natal philopatry has not been observed in Steller's eiders nesting in Russia (D. Solovieva, Zoological Institute, Russian Academy of Science, pers. comm. 2000).

Further evidence of breeding site fidelity is found in other sea ducks. Female spectacled eiders did not move between general nesting areas (coastal versus interior) between years (Scribner et al. 2000). In addition, mitochondrial DNA analysis indicates that female spectacled eiders tend to return to their natal breeding area once they are recruited to the breeding population (Scribner et al. 2000). Natal, breeding, and winter philopatry in other sea ducks has also been documented (Dow and Fredga 1983, Savard and Eadie 1989, Robertsen 1997, Robertson et al. 1999).

Limited observations suggest repeated use of winter habitats by Steller's eiders (LGL 2000a, LGL 2000b), although we do not know if these observations indicate repeated use of winter habitats by the same birds (which would indicate site fidelity for wintering habitat). However, site fidelity has been observed in wintering harlequin ducks; they showed strong site fidelity for short stretches (5 km) of coastline (Cooke et al. 2000). Robertson et al. (1999) concluded that strong site tenacity suggests that local knowledge of an area is valuable and may help ensure high survival of individuals remaining in a familiar site. They suggest that site fidelity would be expected of long-lived species that are sensitive to adult mortality and depend, at least in part, upon habitat stability for survival.

Population Structure

Genetic analysis of vertebrate populations suggests that there are often genetic gradients or differences that correspond to the geographic distribution of the species (Lande and Barrowclough 1987). The Alaska breeding population of Steller's eiders may contain unique geographic sub-populations because of: 1) the distance between breeding populations on the Yukon-Kuskokwim Delta and the Arctic Coastal Plain (approximately 500 miles), and 2) the anticipated site fidelity of nesting adult females (Anderson et al. 1992). The similarly distributed North Slope and Yukon-Kuskokwim Delta populations of spectacled eiders possess distinct mitochondrial DNA markers, implying limited maternal gene flow between these two areas for that species (Scribner et al. 2000).

Food Habits

Steller's eiders employ a variety of foraging strategies that include diving to a maximum depth of at least 30 feet, bill dipping, body tipping, and gleaning from the surface of water, plants, and mud. During the fall and winter, Steller's eiders forage on a variety of invertebrates that are found in near-shore marine waters (Metzner 1993, Petersen 1981, Bustnes et al. 2000). Esophageal contents from 152 Steller's eiders collected at Izembek Lagoon, Kinzarof Lagoon, and Cold Bay, Alaska, indicate Steller's eiders forage on a wide variety of invertebrates

(Metzner 1993). According to Metzner (1993), marine invertebrates accounted for the majority of the Steller's eider diet (92%, aggregate dry weight). In addition, occurrence of shell-free prey (e.g., Crustacea, Polychaeta) predominated, compared to that of food items with shells (Metzner 1993). Metzner (1993) concluded that Steller's eiders were opportunistic generalists, foraging primarily on fauna associated with eelgrass beds in Izembek Lagoon and Kinzarof Lagoon, and infauna, epibenthos, and highly mobile fauna. During molt, Steller's eiders were found to have consumed blue mussel (*Mytilus edulis*), other bivalves (e.g., *Macoma balthica*), and amphipods (a small crustacean). They were also found to have consumed more blue mussels while growing wing-feathers (Petersen 1981).

In northern Norway, 31 species were identified as Steller's eider winter food items; 13 species of gastropods (68.4% of total number of items), 4 species of bivalves (18.5%); 12 species of crustaceans (13%); and 2 species of echinoderms (0.1%) (Bustnes et al. 2000). Juveniles sampled in this study fed more on crustaceans (x = 61% aggregate wet weight) than did adults (x = 26% aggregate wet weight). Examination of female Steller's eiders found dead near Barrow had consumed mostly Chironomid larvae, which are the predominant macrobenthic invertebrate in arctic tundra ponds (Quakenbush et al. 1995).

Predators

Predators of Steller's eiders include snowy owls (*Nyctea scandiaca*), short-eared owls (*Asio flammeus*), peregrine falcons (*Falco peregrinus*), gyrfalcon (*Falco rusticolus*), pomarine jaegers (*Stercorarius pomarinus*), rough-legged hawks (*Buteo lagopus*), common raven (*Corvus corax*), glaucous gulls (*Larus hyperboreus*), arctic fox (*Alopex lagopus*), and red fox (*Vulpes vulpes*). Quackenbush et al. (1995) reported 5 adult male and 3 adult female Steller's eiders taken by avian predators in 4 years near Barrow. Predators included: peregrine falcons, gyrfalcons, and snowy owls. In addition, pomarine jaegers preyed on Steller's eider eggs. On the Yukon-Kuskokwim Delta, Steller's eider nests have been destroyed by gulls (Paul Flint, pers. comm., 1999).

Population Dynamics

Population Size

Yukon-Kuskokwim Delta: Estimating the size of the Steller's eider breeding population in Alaska has proved difficult. Due to the low counts and high variation in counts between years during systematic surveys, an accurate/precise statistical estimate is unavailable. Aerial surveys, which included the Yukon-Kuskokwim Delta but did not include the Arctic Coastal Plain, indicate that the population sizes of eiders (*Polysticta stelleri* and *Somateria* spp.) had declined by 90% since 1957 (Hodges et al. 1996). For the 1950s and early 1960s, the upper limit of the population, excluding the North Slope, had been estimated to be approximately 3,500 pairs (Kertell 1991). Kertell noted, however, that the population might have been smaller due to the potential restriction of nesting Steller's eiders to specific habitats. Kertell (1991) concluded that the Steller's eider had been extirpated from the Yukon-Kuskokwim Delta prior to 1990.

Since publication of Kertell (1991), a few pairs of Steller's eiders have nested on the Yukon-Kuskokwim Delta (Table 1) (Paul Flint, pers. comm. 1999). In no single year have biologists found more than three nests there, despite extensive ground-based nest search efforts in good spectacled eider breeding habitat.

Table 1. Recent sightings of Steller’s eiders on the Yukon-Kuskokwim Delta (Paul Flint pers. comm. 1999)

Year	General Location	Number of Pair	Nest Detected	Number of Eggs	Fate of Nest
1994	Kashunuk River near Hock Slough	1	1	7	Destroyed by Gulls
1996	Tutakoke River	1	1	6	Unknown
1997	Tutakoke River	2	0	NA	NA
1997	Kashunuk River	1	1	6	Hatched
1998	Tutakoke River; Kashunuk River	2;1	2; 1	Unk.; 7	Destroyed; Hatched

NA-Not Applicable

Unk.-Unknown

Arctic Coastal Plain: Aerial breeding pair surveys have been conducted on the Arctic Coastal Plain of Alaska for a number of years at two different times during the Steller’s eider nesting process. Mallek and King (1999) and Brackney and King (1995) (Table 2) report on surveys that are designed for optimal population estimates for the greatest number of breeding waterfowl species on the Arctic coastal Plain. Larned and Balogh (1996) report on annual aerial surveys conducted since 1992 that are designed to provide optimal population estimates for spectacled eiders. Quakenbush et al. (1995) report on ground surveys conducted specifically for Steller’s eiders around Barrow from 1991-1994. Laing (1995) has conducted helicopter based brood surveys around Barrow and south of Barrow. ABR (1999) conducted intensive aerial surveys within the Barrow Triangle area; surveys that, when compared to concurrent ground surveys, may be used to help derive an aerial survey visibility correction factor. Martin and Obritschkewitsch, (Service, unpub. info) conducted such concurrent ground surveys during two different years and derived two quite different visibility correction factors based upon each year’s data. Despite attacking the problem of Steller’s eider population estimation from many different angles, our collective efforts have shed little light on which method results in the best estimate and what the best population point estimate actually is. The problem of population estimation lies largely with the fact that the species is spread across a huge landscape at very low densities. In addition, we acknowledge that the number of Steller’s eiders present on the Arctic Coastal Plain may fluctuate dramatically from year to year for reasons that are unclear to us.

However, it is the opinion of the biologists that are most intimately familiar with the species on its Arctic Coastal Plain nesting grounds that the breeding population there is best described as numbering in the hundreds, or perhaps in the very low thousands.

Table 2. Aerial population estimates from aerial breeding pair surveys (Mallek and King 1999).

Year	Location	Number Seen	Population Estimate	95% Confidence Interval
1989	ACP	NI	2,002	NI
1990	ACP	NI	534	NI
1991	ACP	NI	1,118	NI
1992	ACP	NI	954	NI
1993	ACP	NI	1,313	NI
1994	ACP	NI	2,524	NI
1995	ACP	NI	931	NI
1996	ACP	NI	2,543	NI
1997	ACP	NI	1,295	NI
1998	ACP	NI	281	NI
1999	ACP	NI	1,250	NI

ACP-Arctic Coastal Plain

NI-Not indicated

Table 3. Aerial population estimates for Arctic Coastal Plain (1992-2000).

Year	Location	Number Seen	Population Estimate	95% Confidence Interval	Researcher(s)
1992	ACP	0	0	NA	Larned and Balogh (1996)
1993	ACP	11	263	11-713	Larned and Balogh (1996)
1994	ACP	4	91	4-215	Larned and Balogh (1996)
1995	ACP	14	322	14-725	Larned and Balogh (1996)
1996	ACP	0	0	NA	Larned and Balogh (1996)
1997	ACP	8	189	8-432	Larned et al. (1999)
1998	ACP	0	NA	NA	Larned et al. (1999)
1999	ACP	31	NI	NI	Larned pers. comm. 2000
2000	ACP	0	NA	NA	Larned pers. comm. 2000

ACP-Arctic coastal plain

NA-Not Applicable

NI-Not Indicated

Population Variability

Variability in the abundance of the Alaska breeding population of Steller's eiders is not well understood. The sampling errors around our population estimates are large enough to obscure relatively large annual population fluctuations. However, ground-based efforts in the Barrow area suggest that local breeding populations there fluctuate dramatically (Quakenbush et al. 1995). Indeed, during some years, Steller's eiders completely forego nesting in this area.

Population Stability

The Steller's eider is a relatively long-lived species. Such species do not typically display highly variable populations. That Steller's eiders completely forego nesting in some years near Barrow is consistent with the reproductive strategy for a long-lived species (Begon and Mortimer 1986). However, mortality factors may be undermining this species' ability to maintain a stable

population. The population of Steller's eiders molting and wintering along the Alaska Peninsula appears to be declining (Flint et al. 2000, Larned 2000a). In addition, comparison of banding data from 1975 -1981 to that from 1991-1997 indicates a reduction in Steller's eider survival over time (Flint et al, 2000). If population models for other waterfowl may be applied to this species, the observed reduction in annual survival over time would have a substantial negative effect on population dynamics (Schmutz et al. 1997, Flint et al. 2000). If this decline is caused by something in the marine environment, it is reasonable to conclude that the Alaska breeding population and Asia breeding population are being affected similarly.

Status and Distribution

Reasons for Listing

The Alaska breeding population of Steller's eiders was listed as a threatened species on June 11, 1997 (62 FR 31748) (Fish and Wildlife Service 1997). It was listed due to 1) its recognition as a distinct vertebrate population segment, 2) a substantial decrease in the species' nesting range in Alaska, 3) a reduction in the number of Steller's eiders nesting in Alaska, and 4) the vulnerability of the remaining breeding population to extirpation (Fish and Wildlife Service 1997).

Habitat Loss: The direct and indirect effects of future gas/oil development within the National Petroleum Reserve-Alaska, and future village expansion (e.g., at Barrow), were cited as potential threats to the Steller's eider (Fish and Wildlife Service 1997). Within the marine distribution of Steller's eiders, perceived threats include marine transport, commercial fishing, and environmental pollutants (Fish and Wildlife Service 1997).

Hunting: Although not cited as a cause in the decline of Steller's eiders, the take of this species by subsistence hunters was cited as a threat to the population of Steller's eiders near Barrow in the final rule (Fish and Wildlife Service 1997). However, the gathering of subsistence harvest information similar to that collected from Natives on the Y-K Delta has met with resistance from Natives on the Arctic Coastal Plain.

Predation: Increased predation by arctic foxes (*Alopex lagopus*) resulting from the concurrent crash of goose populations is cited as a possible contributing factor to the decline of the Steller's eider on the Yukon-Kuskokwim Delta (Fish and Wildlife Service 1997). The potential for increased predation near villages resulting from the villages' associated gull and raven populations was also cited as a potential threat to this species (Fish and Wildlife Service 1997).

Lead Poisoning: The presence of lead shot in the nesting environment on the Yukon-Kuskokwim Delta was cited as a continuing potential threat to the Steller's eider. The Service is progressing in its efforts to enforce a nationwide ban on lead shot on the Arctic Coastal Plain (Fish and Wildlife Service 1997).

Ecosystem Change: Direct and indirect changes in the marine ecosystem caused by increasing populations of Pacific walrus (*Odobenus rosmarus*), gray whale (*Eschrichtius robustus*), and sea otter (*Enhydra lutris*), were cited as potential causes of the decline of Steller's eiders. Subsequent declines in sea otter populations (65 FR 67343) and continuing declines in Steller's eider populations suggest that otters were not responsible for a decline in eider numbers. In addition, changes in the commercial fishing industry were also cited as perhaps causing a change in the marine ecosystem with possible effects upon eiders (Fish and Wildlife Service 1997). However, we are unaware of any link between changes in the marine environment and contraction of the eider's breeding range in Alaska (Fish and Wildlife Service 1997).

Range-wide Trend

Populations of Steller's eiders molting and wintering along the Alaska Peninsula have declined since the 1960s (Kertell 1991), and appear to be in continued decline (Flint et al. 2000, Larned 2000b). The imprecision of our breeding ground estimates precludes us from detecting any but the most obvious population trends. However, if a marine-based threat is causing a decline in the world population of Steller's eiders, then it seems reasonable to conclude that the Alaska breeding population may also be affected by such a threat.

New Threats

Chronic Petroleum Spills: The chronic release of petroleum products near large concentrations of Steller's eiders is not a new threat as much as it is a newly realized threat. The gregarious behavior of Steller's eiders during a spill event may result in acute and/or chronic toxicity in large numbers of birds.

A life-history strategy of long life and low annual reproductive effort would be expected to evolve under conditions of predictable and stable non-breeding environments (Sterns 1992). The life history strategy of the Steller's eider seems to fit this model. That is, the Steller's eider is long-lived, has low annual recruitment, and winters in apparently productive and reasonably stable near-shore marine environments. Because the Steller's eider is relatively small bodied and winters at northern latitudes, it may do so near the limits of its energetic threshold. Harlequin ducks and long-tailed ducks have been found to exist near their energetic limit in such climates (Goudie and Ankney 1986), and the Steller's eider is intermediate in size to these two species. Therefore, environmental perturbations that reduce prey availability or increase the species energetic needs may result in harm. Fuels and oils are toxic to Steller's eiders' prey (e.g., amphipods and snails) (Newey and Seed 1995 as in Glegg et al. 1999, Finley et al. 1999), and to the species itself (Holmes et al. 1978, Holmes et al. 1979, McEwan and Whitehead 1980, Leighton et al. 1983, Holmes 1984, Leighton 1993, Rocke et al. 1984, Yamato et al. 1996, Glegg et al. 1999, Trust et al. 2000, Esler et al. 2000). Therefore, we believe that spilled petroleum is likely to adversely affect Steller's eiders.

Increased Risk of Lead Poisoning: Because this species continues feeding near the nesting site before and during incubation (D. Solovieva pers. comm.2000), it may be subjected to an

increased risk of exposure to lead shot consumption than are waterfowl species that forego feeding at this time. Spectacled eiders do not seem to engage in feeding activities as much as Steller's eiders once breeding has commenced, however, spectacled eiders have been observed to have higher rates of exposure to lead than any species sampled on the Y-K Delta (Flint *et al.* 1997). The proportion of spectacled eiders on the Yukon-Kuskokwim Delta's lower Kashunuk River drainage that contained lead shot in their gizzards was high (11.6%, N = 112) compared to other waterfowl in the lower 48 states from 1938-1954 (8.7%, N = 5,088) and from 1977-1979 (8.0%, N = 12,880). Blood analyses of spectacled eiders indicated elevated levels of lead in 13% of pre-nesting females, 25.3% of females during hatch, and 35.8% of females during brood rearing. Nine of 43 spectacled eider broods (20.9%) contained one or more ducklings exposed to lead by 30 days after hatch (Flint *et al.* 1997). Thus, if spectacled eiders have experienced population level effects on the Y-K Delta due to lead poisoning, then Steller's eiders may have experienced similar, or even greater lead-induced effects.

Collisions with Manmade Structures: Steller's eiders have been documented to collide with wires and other structures. During a 4-year period near Barrow, one adult Steller's eider female was documented to have died from striking a wire and another adult Steller's eider was suspected to have died from striking a radio tower (Quakenbush *et al.*, 1995). In addition, large numbers of Steller's eiders are known to have collided with communication towers in the wintering area along the Alaska Peninsula. Finally, we have had at least one report from a fishery observer of Steller's eiders becoming both injured and dying due to striking a fishing vessel. The actual number of birds injured and killed through collisions with manmade structures is likely higher. We believe that many injured and killed birds go undetected, unreported, or become scavenged before humans detect them.

Stochastic Events: The small population size of the Steller's eiders on the Yukon-Kuskokwim Delta and the Arctic Coastal Plain, may put them at risk of the deleterious effects of demographic and environmental stochasticity. Demographic stochasticity refers to random events that affect the survival and reproduction of individuals (Goodman 1987) (e.g., shifts in sex ratios, striking wires, being shot, oil/fuel spills). Environmental stochasticity is due to random, or at least unpredictable, changes in factors such as weather, food supply, and populations of predators (Shaffer 1987). As discussed by Gilpen (1987), small populations will have difficulty surviving the combined effects of demographic and environmental stochasticity. The risk of local extirpation is probably highest for Steller's eiders nesting on the Y-K Delta due to the low number of birds that breed there.

The world population of Steller's eiders is probably not at high risk of extinction due to environmental stochasticity alone, but local groups of wintering birds may be vulnerable to starvation due to stochastic events (e.g., unusually heavy ice cover in their feeding habitats).

Allee Effect: Allee effect refers to the destabilizing tendency associated with inverse density-dependence as it relates to population size and birth rate. One form of this occurs when the ability to find a mate is diminished (Begon and Mortimer 1986). For example, if the sex ratio of a population significantly shifts from a normal condition for a species, the ability of adults to

produce young may diminish. For the Steller’s eider, the higher mortality rate of males (Flint et al. 2000) may result in a lower number of pairs returning to nest (i.e., adult females unable to find a mate are effectively removed from the breeding population).

The annual survival rate for Steller’s eiders molting and wintering in Alaska is estimated to be 0.899 ± 0.032 (\pm SE) for females and 0.765 ± 0.044 (\pm SE) for males (Flint et al, 2000). At this estimated annual survival rate, about 39 percent of the females of a cohort will reach 10 years of age, while only about 7 percent of the males will survive for 10 years.

The observed difference in annual survival between sexes may be manifesting itself in the skewed sex ratio of Steller’s eiders observed during the winter of 1999/2000. Female Steller’s eiders notably out-numbered males on winter surveys of three areas during January, February, and March (LGL 2000a, LGL 2000b). In waters off Unalaska and False Pass, female Steller’s eiders comprised 63 and 69 percent, respectively, of Steller’s eiders observed (N = 2,053 and 114 respectively) (John Burns, pers. com. 2000, LGL 2000b). At Akutan Harbor, the combined female to male sex ratio for all surveys was approximately 3 to 1 (n = 590) (LGL 2000b). Furthermore, band recoveries reported by Dau et al. (2000) also suggest a shift in Steller’s eider sex ratios through time (Table 4). This observation is in stark contrast to that which is typical for many other Anatinae, where an excess of males is the norm (Johnsgard 1994). If this excess of females exists throughout the species range (as opposed to just at the three locations for which we have data) then the biased sex ratio may have implications regarding reproductive potential. Although our limited observations and Dau et al’s (2000) banding data suggest that a biased sex ratio exists for this species, our information comes from only a few locations within the species wintering range. We do not know if this biased sex ratio exists range wide, or what may be causing it.

Table 4. Shifting sex ratio of Steller’s eiders at sample area No. 1 in Izembek Lagoon. Data used are from Dau et al. (2000).

Years	Female	Male	Sample Size	Percent Male
1961-1966	271	566	837	68%
1968	60	85	145	59%
1974-1981	3576	2197	5773	38%
1991-1997	5971	708	6679	11%

Analysis of the Species Likely to be Affected

In summary, decreasing numbers rangewide, highly variable reproductive success, low annual recruitment, deferred sexual maturity, skewed sex ratios, winter distribution patterns, and suggested fidelity for wintering habitats all combine to make the Steller’s eider vulnerable to the effects of the proposed construction of a tank farm in Chignik Lagoon. Adverse effects may occur due to the release of petroleum into the waters of Chignik Lagoon.

Critical habitat was designated for the Steller's eider on February 2, 2001; however, critical habitat for this species does not occur within the action area of the project.

ENVIRONMENTAL BASELINE

Regulations implementing the Act (50 CFR '402.02) define the environmental baseline as the past and present impacts of all Federal, State, or private actions and other human activities in the action area *to the listed species*. Also included in the environmental baseline are the anticipated impacts of all proposed Federal projects in the action area *to the listed species* that have undergone section 7 consultation, and the impacts of State and private actions that are contemporaneous with the consultation in progress. The action area includes all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action. Following is a description of past and present human activities in the action area that are impacting Steller's eiders.

Status of the Species within the Action Area

The proposed project and its corresponding action area are located within wintering habitat of the Steller's eider. In addition, migrating Steller's eiders are also anticipated to use the site during migration. Surveys conducted during the winter of 1999/2000 reported at least 868 Steller's eiders in Chignik Lagoon in February (Larned 2000b). More than half (484) of the eiders in Chignik Lagoon during the February 2000 survey were within 2500m of the proposed project site, and thirty percent (264) were in the Packer's Creek/Packer's Point area within 800m of the future tank farm. While a subsequent survey in March 2000 indicated concentrations of eiders off Packer's Point, data recording equipment failures resulted in an incomplete picture of spring use of Chignik Lagoon by this species.

The number of Steller's eiders in the action area of the proposed project that are actually of the listed entity will be estimated by assuming that 3.0 percent of all Steller's eiders observed there are from the Alaska breeding population. This estimate derives from the assumption that Steller's eiders from the Alaska population are randomly distributed amongst the total population of Steller's eiders over wintering in Alaska. The percentage estimate was calculated using the total estimated number of over wintering Steller's eiders from the three most recent spring migration surveys (82,560 birds) (Larned 2000b), and the highest estimate of nesting Alaskan birds (2,524 birds) (Table 2).

The high estimate for Steller's eiders breeding in Alaska is being used so we do not inadvertently underestimate the total number present (i.e., underestimate the number at risk). We recognize that gender related behaviors during pairing and a tendency towards site tenacity may result in some distributional differences between genders of this species. In general, we expect that it is more likely that male Steller's eiders fledged from Alaskan breeding grounds may occur anywhere within the species range, but that female Steller's eiders may tend to congregate within

some small subset of the species entire winter range. We have no data supporting or refuting this supposition.

Factors Affecting Species Environment within the Action Area

Petroleum Spills: We have little data regarding the frequency and volumes of petroleum spills that have occurred in Chignik Lagoon. Fuel is currently delivered in bulk to the deep-water port in Chignik Bay. Deliveries to Chignik Lagoon are then made in smaller quantities aboard small vessels and fishing boats. Since 1997, nine fuel spills were recorded in Chignik Bay averaging 72.5 gallons (Day and Pritchard 2000). A review of harbor-based oil spills in Alaska reveals that 49 percent of all spills with known causes resulted from operator error, including one massive release of 500 gallons in Chignik Bay (Day and Pritchard 2000). A continuation of the current method of fuel transfer and delivery to Chignik Lagoon will likely result in chronic contamination of eider habitat resulting from non-code-compliant procedures.

Hunting: We do not have data on whether subsistence hunters within the action area take Steller's eiders.

EFFECTS OF THE ACTION

This section addresses the direct and indirect effects of the action on the species or its critical habitat. Effects will be evaluated together with those of other activities that are interrelated or interdependent with the action. These effects will then be added to the environmental baseline in determining the proposed action's effects to the species or its critical habitat (51 FR 19958; 50 CFR Part 402). Indirect effects are those that are caused by the proposed action and are later in time, but still are reasonably certain to occur. In this case, the action is the proposed construction and operation of a bulk fuel facility at Chignik Lagoon, Alaska.

Assumptions

This effects analysis is based on the best available information on the proposed action, on the environmental conditions within the action area, and on the status, life history and distribution of the Steller's eider. Where data was unavailable, we erred on the side of species conservation when making assumptions, as directed by the Act.

We have little information on the home range size of Steller's eiders during winter, however we do have such data for the harlequin duck, a species that is similar in size and foraging behavior, and seems to use habitat types similar to that used by Steller's eiders. Harlequin ducks seem to have both a resident and transient component to their population (Robertson 1997, Robertson et al. 1999). In addition, winter resident harlequin ducks use very specific stretches of shoreline (Robertson et al. 1999). Resident birds typically remained within a 5 km area, eliciting selection preferences for certain habitat types or locations. For example, a female that was observed 22 times over the winter was never seen outside a 1,100-meter stretch of shoreline, and 18 of the 22

sightings were within a 320-meter section of shoreline (Robertson et al. 1999). However, juvenile and unpaired male harlequin ducks seem to be much more mobile (Robertson et al. 1999), and periodic counts of males at a particular location on any day may represent only a portion of the males that use that habitat. The transient juvenile and unpaired male component of the population moves between areas of suitable habitat beyond a distance of 5 km (Robertson et al. 1999). However, once these males establish a pair bond, they remain with the females in traditional use areas. We do not know if similar site fidelity patterns are exhibited by Steller's eiders, but evidence at molting sites (Flint 2000) and preliminary evidence at overwintering sites, suggests that Steller's eiders show high site fidelity at overwintering sites, at least within one winter season (Philip Martin, FWS, pers. comm., Paul Flint, USGS, pers. comm.). Whether Steller's eiders show fidelity to overwintering sites between years has not been investigated

The effects of displacement on wintering Steller's eiders in Alaska have not been investigated. However, over-winter starvation resulting from displacement from feeding areas is thought to be a contributing factor to mass mortality of common eiders in the Wadden Sea (Camphuysen 2000). Thus, eiders displaced by habitat destruction or contamination resulting from tank farm construction may not be able to simply relocate without being harmed.

We are assuming that 3.0 percent of all Steller's eiders observed on the wintering grounds in Alaska are from the Alaska breeding population. This estimate derives from our three most recent spring migration surveys for our total population estimate (82,560 birds) (Larned 2000b), and the highest point estimate of nesting Alaskan birds (2,524 birds) (Table 2). We recognize that there is some bias in this estimate because both population estimates are negatively biased (both are conservative estimates). However, we do not know which individual estimate (wintering population or breeding population) has the greater negative bias. Thus, it is estimated that 26 of all eiders wintering in Chignik Lagoon, 15 of those eiders observed within 2500m of the project site, and eight found within 800m of the proposed tank farm are of the Alaska breeding population.

Factors to be Considered

Proximity of the Action

The proximity of the action to the species must be determined in evaluating the direct and indirect effects of the proposed action. As such, defining the action area of a proposed action is basic to analyzing the effects of the action. The action area should be determined based on consideration of all direct and indirect effects of the proposed agency action [50 CFR 402.02 and 402.14(h)(2)]. For the proposed tank farm project, the action area includes all areas that may be affected directly or indirectly by construction and operation of the tank farm. This area includes areas that may be affected by interrelated or interdependent activities. Thus, the direct areas to be affected by the construction of the tank farm coincide with the footprint of the project. In addition, the area at risk of exposure to petroleum spills due to the presence of the tank farm, are also considered to be part of the action area.

Determining the area at risk due to petroleum spills is difficult. Currents and prevailing winds associated with the location of the project must be considered because they may influence the size and shape of an area that may be affected by a discharge. Specific information on climatic and marine conditions in Chignik Lagoon is lacking. Along the southern side of the Alaska Peninsula, prevailing ocean currents flow westward; however, tidal velocities, eddy effects, and wind speed and direction may affect local conditions. Eelgrass is abundant in Chignik Lagoon, indicating that tidal and current velocities are low. The Lagoon receives high volumes of freshwater input from Chignik River, at the head of the Lagoon, and from numerous other creeks draining the surrounding watersheds. A main channel, which is tidally influenced, flows into the Lagoon from its 0.5 mile entrance, and is approximately 30 feet deep (Whitney, per. Comm., 2001). Wind direction in Chignik Lagoon is most likely controlled by topography, depending on weather systems dominating the region. During the winter, when eiders are present in the Lagoon, wind flows from the north towards the Alaska Peninsula, and then follows the topographical features around Black Lake and Chignik Lake to enter Chignik Lagoon from a northeasterly direction. The average speed of surface winds in Kodiak and Sand Point, where we have site-specific climate data, are 9.2 knots and 12.0 knots, respectively (Brower et al. 1988). We averaged wind velocities at these two sites to arrive at an annual average wind speed of 10.6 knots for Chignik Lagoon. Given the low energy nature of the lagoon and the influence of Chignik River, we assume that oil movement on the water is driven predominantly by wind.

We acknowledge that our wind and tidal current information for Chignik Lagoon is preliminary. With time, we will likely obtain better data pertaining to these two parameters. If such new data significantly alters the size, shape, or placement of the action area and changes our estimate of expected take, we will reinitiate consultation on this project.

The action area of the proposed project is the footprint of the tank farm plus the maximum distance that the oil will drift with the current during one tidal cycle. There is a 6-hour period between high and low tide in Alaska, and a slack tide of about an hour on either side of high and low tide with negligible tidal movement. Thus the duration of tidal movement between high and low tide is approximately 4 hours. Currents generated at the water surface from wind are approximately 3 percent of the wind speed (U.S. Fish and Wildlife Service, unpub. info.). At a wind speed of 10.6 knots (12.19 miles per hour), a spill will move approximately 32 feet per minute. Consequently, the spill may move approximately 1.5 miles in 4 hours pushed by wind alone, and there will be about 65 percent of the material remaining at that time (Attachment 1). Thus, the action area of the project includes the footprint of the tank farm plus all marine waters within 1.5 miles north and east of the project site.

Distribution

The geographic area of the proposed tank farm project coincides with habitat used by wintering and migrating Steller's eiders.

Timing

The construction of the proposed tank farm is anticipated to occur during the summer while Steller's eiders are not present. However, the proposed tank farm will be operating while Steller's eiders are present in the area.

Nature of the Effect

Construction of the tank farm will not result in the direct loss of Steller's eider habitat. Indirect effects arise from the anticipated accidental release of petroleum products from the tank farm. As previously discussed, petroleum releases can adversely effect the Steller's eider through either contamination of feathers, direct consumption of petroleum (e.g., during preening), contamination of food resources, or reduction in prey availability.

Duration

The potential for accidental releases of petroleum to adversely affect Steller's eiders is anticipated to exist for as long as the tank farm is in operation.

The accidental release of petroleum into the habitat of this species may have both an immediate and lingering adverse effect. As discussed previously, oiling of birds may result in sickness or death, depending on the degree of exposure. Petroleum products released into the marine environment can also have adverse effects that last from several months to several years. Anticipated adverse effects range from changes in prey abundance, distribution, and diversity, to the ingestion of chronic toxic levels of petroleum.

Disturbance Frequency

We have little information that would allow us to predict disturbance frequency. Construction of the tank farm represents a one-time disturbance event; however, we lack information regarding timing and frequency of fuel spills.

Disturbance Severity

Steller's eiders show high fidelity for specific molting sites within lagoons (Flint et al. 2000). Preliminary evidence suggests that Steller's eiders show high wintering site fidelity, at least within one season (Philip Martin, FWS, pers. comm., Paul Flint, USGS, pers. comm.). High levels of wintering site fidelity have been found for other species of sea ducks (Robertson et al. 1999, 2000, Cooke et al. 2000). Laubhan and Metzner (1999) demonstrated that molting concentrations of Steller's eiders found in lagoons along the north side of the Alaska Peninsula disperse during the winter. Further, they suggest that ice conditions may displace Steller's eiders from preferred locations (Laubhan and Metzner 1999). The combination of this displacement and the fact that foraging was the dominant behavior of eiders during winter (Laubhan and Metzner 1999), suggests that suitable wintering habitat may be limited for Steller's eiders. In fact, over-winter starvation resulting from displacement from feeding areas is thought to be a contributing factor to mass mortality of common eiders in the Wadden Sea (Camphuysen 2000), suggesting that, in some cases, alternative foraging areas of sufficient quality are not available for wintering eiders. In short, eiders displaced by oil spills and activities associated with oil spill response may not be able to simply relocate without being harmed.

Analyses for Effects of the Action

Beneficial Effects

Beneficial effects are those effects of an action that are wholly positive, without any adverse effects, on a listed species or designated critical habitat. Although the construction and operation of the tank farm will have no wholly beneficial effect on the Steller's eider, the

consolidation of fuel storage into two code compliant facilities and the delivery of fuel to the Chignik Lagoon facilities by a professional operator represent improvements over the current situation. Additionally, measures have been incorporated into the project design that will likely minimize its affect on this threatened species. Such measures include: limiting fuel deliveries to times when Steller's eiders are not present in Chignik Lagoon, requiring fuel delivery vessels to deploy boom during fuel transfer operations, on site storage of spill response equipment, and integration of follow up Steller's eider survey data in spill response planning.

Direct Effects

The construction of the tank farm will not result in a permanent loss of near-shore habitat that is known to be used by wintering Steller's eiders.

Indirect Effects

Chignik Lagoon eiders may be negatively impacted by fuel spills originating from the new fuel facility, from the existing LPSD fuel facility (via Packer's Creek), or during ship-to-shore transfer of fuel. As agreed upon by the Chignik Lagoon Village Council, the Village will not accept fuel deliveries during the time that eiders are present in the Lagoon, all fuel delivery vessels will be required to deploy appropriate containment devices during fuel transfer operations, and fuel response personnel will be mobilized and equipment, which will be maintained *on site*, will be deployed within 1 hour of the detection of a spill. These modifications to the project will minimize the likelihood that eiders will be directly oiled in the event of a spill. However, considering that equipment failure and operator error were cited most frequently as the causes of fuel spills in harbors (Day and Pritchard 2000), a worst-case discharge from either facility or during fuel transfer cannot be ruled out as a possibility.

Indirect effects to Steller's eiders resulting from the operation of the proposed tank farm arise from direct contact with spilled petroleum and from the contamination of foraging habitat. Eiders may ingest mollusks and marine crustaceans that have been contaminated with, and may be bio-accumulating (Rand and Petrocelli 1985) petroleum and may suffer reduced foraging opportunities if petroleum contamination reduces prey availability.

Based on prevailing climatic conditions and eider distribution in Chignik Lagoon, we conclude that eiders most at risk during an oil spill are those concentrated within 1.5 miles north and east of the project site. The concentration of large volumes of oil at this site resulting from the construction of the tank farm presents a risk to eiders of massive discharges of oil into Chignik Lagoon. Because we estimate that 3.0 percent of the Steller's eiders in the wintering population also belong to the Alaska breeding population, and because we know that at least 264 Steller's eiders use waters immediately adjacent to the proposed tank farm site, we estimate that approximately seven Steller's eider belonging to the listed entity may be taken through the indirect effects of this proposed action.

Interrelated and Interdependent Actions

The location and operation of the new bulk fuel tank farm will influence the timing of deliveries and total volume of single deliveries to Chignik Lagoon. Instead of frequent small deliveries by fishing boats and other small vessels, fuel will be delivered in large quantities during one or two deliveries per year. Thus, although the total number of releases is likely to decrease, the tank farm may increase the average volume discharged in single events and may extend the spatial distribution of discharges to include the navigation route into the Lagoon. Potential adverse effects resulting from bulk fuel transport into the area must be included in our analysis of the effects of the proposed action.

Based on prevailing climatic conditions and eider distribution in Chignik Lagoon, we conclude that eiders most at risk from oil spills originating from delivery vessels are those concentrated within 1.5 miles north and east of the project site. Of the 264 birds observed in the waters immediately adjacent to the proposed tank farm site, we estimate that approximately seven belong to the listed Alaska breeding population.

Species' Response to Proposed Action

Numbers of Individuals in the Action Area Affected

Limited surveys have indicated that at least 264 Steller's eiders use waters that are within the action area that is likely to be affected by a discharge of fuel associated with this proposed project. We believe that our estimates of numbers of birds using these waters are conservative because they do not include any of the birds that use these waters during spring and fall migration. In addition, our limited surveys represent just a few snapshots in time. It is likely that our limited observations do not represent the maximum number of eiders that use these waters.

Sensitivity to Change

Steller's eiders behavior changes with changing environmental conditions. At times, they have been observed to forage in close proximity to human structures/habitation. They have also been observed foraging and resting adjacent to docks. However, we have observed that they move and maintain a distance of at least 100 meters from humans themselves. As such, we do not anticipate total abandonment of areas due to the physical presence of structures associated with the proposed project.

Resilience

We have little information suggesting what sort of resilience to perturbations is inherent in this species. We do note, however, that the world population has declined by 80% since the 1940's, from 1,000,000 (Tugarinov 1941 as in Solovieva 1997) to 200,000 in 1994 (Solovieva 1997). Extensive banding efforts and aerial survey efforts over the past decade indicate that the trend for the world population continues to be negative (Flint et al. 2000, Larned 2000). As such, the

Steller's eider does not appear to be resilient enough to overcome the mortality factors causing its decline. Whether this lack of resilience is due to low fecundity, low recruitment, or excessive adult mortality is unknown.

Steller's eiders exhibit a sex ratio that is atypical for sea ducks (See Allee effect). Whatever may be causing this observed shortage of males may in turn be affecting this species resilience to perturbations.

Recovery Rate

The natural recovery rate of Steller's eiders is not known. Recovery rate is a relative response and is tied, in large part, to traits of the species' life history. In general, long-lived species with low annual fecundity should have a relatively slow recovery rate compared to short-lived species with high annual fecundity. Given the Steller's eider's observed low fecundity (i.e., small clutch sizes, high variability in nesting attempts, and generally low nest success (Quakenbush et al. 1995, D. Solovieva pers. com. 2000)), the recovery rate for this species may be quite slow. Unnaturally high mortality of breeding adults may even prevent recovery of this species.

CUMULATIVE EFFECTS

Cumulative effects include the effects of future State, tribal, local or private actions that are reasonably certain to occur in the action area considered in this biological opinion. Future Federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to section 7 of the Act.

Fisheries conducted in near shore waters may impact this animal. The potential for conflict is especially high where large numbers of this species congregate to molt. At this time, information regarding potential conflicts is not available. However, scientists in Lithuania observed that Steller's eiders are susceptible to entanglement in gill nets (Zydelis and Skeiveris 1997). Therefore, any fishery employing gill nets in waters that are also being concurrently used by Steller's eiders may result in harm to this species. It is unknown to what extent Steller's eiders are endangered by derelict gear from such net-based near-shore fisheries, but we assume that there is some risk of birds becoming entangled in such gear. Fishing vessels operating with bright lights near shore during adverse weather conditions may cause Steller's eider mortality by inducing collisions between the vessel and flying, disoriented Steller's eiders.

CONCLUSION

After reviewing the current status of the Alaskan breeding population of Steller's eider, the environmental baseline for the action area, the cumulative effects, and the effects of the proposed action, it is the Service's biological opinion that the action, as proposed, is not likely to jeopardize the continued existence of the species. In addition, we do not believe that this action is likely to result in the adverse modification of Steller's eider critical habitat.

The regulations (51 FR 19958) that implement section 7(a)(2) of the Act define "jeopardize the continued existence of" as "to engage in an action that reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species." We have concluded that the proposed action is not likely to jeopardize the continued existence of the Alaska breeding population of Steller's eiders or adversely modify or destroy critical habitat. However, we do recognize that adverse impacts may occur primarily due to the destruction of wintering habitat, changes in distribution and size of petroleum contamination, and through the effect of spilled petroleum on eiders and on their prey. We reviewed all available information on the location, timing of construction, and operation of the completed facility along with the anticipated effects of the proposed action; the best available information on the status, distribution, and life history of the listed Steller's eider. We believe that this project, with regards to the threat of petroleum contamination, represents a substantial improvement over the status quo. Were it not for the inevitable threat of a spill in association with the presence of any tank farm, we could even consider this project to be a conservation benefit for the species.

We have concluded that it is not reasonable to assume that a significant component of the Alaska breeding population of Steller's eiders will occur within the action area of this proposed project (we estimate that eight birds of the listed entity would be affected by this project in a worst-case scenario). While it is impossible to predict accurately the potential risk of the proposed action to the Alaska breeding population of Steller's eiders, and we cannot fully discount that a catastrophic event could occur, we do not believe that such a chain of events is reasonably certain to occur. If future information indicates that a disproportionately high percentage of birds of the listed entity use the waters affected by this project, then it is incumbent upon the U.S. Army Corps of Engineers to reinitiate consultation on this project.

INCIDENTAL TAKE STATEMENT

Section 9 of the ESA and Federal regulation pursuant to section 4(d) of the ESA prohibit the take of endangered and threatened species, respectively, without special exemption. Take is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct. Harm is further defined by the U.S. Fish and Wildlife Service to include significant habitat modification or degradation that results in death or injury to listed species by significantly impairing essential behavioral patterns, including breeding, feeding, or sheltering. Harass is defined by the U.S. Fish and Wildlife Service as intentional or negligent actions that create the likelihood of injury to listed species to such an extent as to significantly disrupt normal behavior patterns which include, but are not limited to, breeding, feeding, or sheltering. Incidental take is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. Under the terms of section 7(b)(4) and 7(o)(2), taking that is incidental to and not intended as part of the agency action is not considered to be

prohibited taking under the ESA provided that such taking is in compliance with the terms and conditions of this Incidental Take Statement.

The measures described below are non-discretionary, and must be undertaken by the ACOE so that they become binding conditions of any grant or permit issued to an applicant, as appropriate, for the exemption in section 7(o)(2) to apply. The ACOE has a continuing duty to regulate the activity covered by this incidental take statement. If the ACOE (1) fails to assume and implement the terms and conditions or (2) fails to require the applicant to adhere to the terms and conditions of the incidental take statement through enforceable terms that are added to the permit or grant document, the protective coverage of section 7(o)(2) may lapse. In order to monitor the impact of the incidental take, the ACOE or applicant must report the progress of the action and its impact on the species to us as specified in the incidental take statement [50 CFR 402.14(I)(3)]. The following reasonable and prudent measures, as well as their associated terms and conditions, should significantly minimize such taking.

The Fish and Wildlife Service will not refer the incidental take of any migratory bird or bald eagle for prosecution under the Migratory Bird Treaty Act of 1918, as amended (16 U.S.C. §§ 703-712), or the Bald and Golden Eagle Protection Act of 1940, as amended (16 U.S.C. §§ 668-668d), if such take is in compliance with the terms and conditions (including amount and/or number) specified herein.

AMOUNT OR EXTENT OF TAKE

We anticipate that incidental take of Steller's eiders will be difficult to document because: 1) the level of threat due to contamination by spilled petroleum product which is due to the construction of the proposed Chignik tank farm is difficult to quantify; 2) the proposed Chignik tank farm is replacing existing fuel facilities which are probably more apt to leak and experience catastrophic failure, creating a situation where construction of the new facility, while it poses a threat, actually represents a net benefit to the species; 3) Steller's eiders that are exposed to petroleum levels that are not immediately lethal may not die near the location of contact; 4) Steller's eiders exposed to sub-lethal, but harmful levels of petroleum will not exhibit readily apparent signs of toxicity; 5) impacts to prey abundance and distribution from released petroleum products will not be readily apparent; 6) the extent to which petroleum contamination can be attributed to the proposed action will be difficult or impossible to determine, and 7) the number of Steller's eiders belonging to the Alaska breeding population at this site is unknown.

We believe that a worst-case scenario is represented by a catastrophic tank failure that would result in a release into marine waters of petroleum products equal in volume to the capacity of the largest tank in the tank farm. We believe that this worst-case scenario is unlikely to result in a take that exceeds 264 Steller's eiders, the number of eiders that have been observed within about 800 m of the facility. This represents about 30 percent of the Steller's eiders using all of Chignik Lagoon. We expect that adequate spill response, natural spill dispersal, and evaporation of spilled product would preclude take beyond that level. Furthermore, we expect that about 3% of these birds will be of the listed entity. Therefore, we estimate that no more than eight birds of

the listed entity will be taken as a result of activities associated with this facility throughout the entire time in which it is in operation. We anticipate that this take will be in the form of direct lethal take or harm through contamination of bird plumage by spilled product, or indirect take through contamination of eider prey items.

REASONABLE AND PRUDENT MEASURES

The U.S. Fish and Wildlife Service believes the following reasonable and prudent measures are necessary and appropriate to minimize impacts of incidental take of Steller's eiders:

1. The ACOE shall minimize the potential for impacts to Steller's eiders during construction of the tank farm
2. The ACOE shall minimize the potential for impacts to Steller's eiders during operation of the tank farm.

TERMS AND CONDITIONS

In order to be exempt from the prohibitions of section 9 of the ESA, ACOE must comply with the following terms and conditions, which implement the reasonable and prudent measures described above and outline required reporting/monitoring requirements. These terms and conditions are non-discretionary.

1. The following terms and conditions shall implement Reasonable and Prudent Measure No. 1 (The ACOE shall minimize the potential for impacts to Steller's eiders during construction of the tank farm.).
 - 1.1. The ACOE shall prohibit the applicant from commencing construction activities until after the Steller's eiders' departure in the spring and from continuing them after the eiders arrive in the fall. These dates are estimated to be November 1 (or as soon as eiders are observed in Chignik Lagoon, whichever comes first) for arrival and March 30 for their departure. If construction activities are anticipated to extend into the prohibited time period, the applicant shall contact the Service. The Service will evaluate the situation and determine the appropriate action. The applicant shall immediately notify the Ecological Services Anchorage Field Office (271-2888) of the presence of any Steller's eiders observed in the vicinity of the project area during construction.
2. The following terms and conditions shall implement Reasonable and Prudent Measure No. 2 (The ACOE shall minimize the potential for impacts to Steller's eiders during operation of the tank farm).
 - 2.1. The ACOE shall require the applicant to develop a Facility Response Plan in consultation with the Service and in accordance with Environmental Protection Agency regulations 40 CFR 112.20 and U.S. Coast Guard regulations 33 CFR 154, 155 and 156.

- 2.2. The ACOE shall require the applicant to submit the final Facility Response Plan to the Service for review and concurrence no fewer than 45 days before receipt of the first fuel delivery to the facility.

REINITIATION AND CLOSING STATEMENT

This concludes formal consultation on the proposed action. As provided in 50 CFR §402.16, reinitiation of formal consultation is required where discretionary Federal agency involvement or control over the action has been retained (or is authorized by law) and if: (1) the amount or extent of incidental take is exceeded; (2) new information reveals effects of the action that may affect listed species or critical habitat in a manner or to an extent not considered in this biological opinion; (3) the agency action is subsequently modified in a manner that causes an effect to the listed species or critical habitat not considered in this biological opinion; or (4) a new species not covered by this opinion is listed or critical habitat designated that may be affected by this action.

In instances where the amount or extent of incidental take is exceeded, any operations causing such take should cease pending reinitiation.

If you have any questions concerning this biological opinion, please contact Field Supervisor Ann Rappoport at (907) 271-2787, or lead Endangered Species Biologist Greg Balogh at (907) 271-2778.

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Attachment 1. Spill Scenarios-Oil budget Tables

Oil name = Diesel Fuel Oil (Alaska)

API = 38.8;

Water Temperature - 40 degrees F

Total Amount of Oil Released = 1,000 gallons

Pour Point = -33 degrees F

Wave Height = Computed from Winds

Wind Speed - Constant at 5 knots

Hours Into Spill	Released Gallons	Evaporated Percent	Remaining Percent	Hours Into Spill	Released Gallons	Evaporated Percent	Remaining Percent
1	1,000	13	87	54	1,000	60	40
2	1,000	23	77	60	1,000	61	39
4	1,000	31	69	66	1,000	61	39
6	1,000	36	64	72	1,000	62	38
8	1,000	39	61	78	1,000	63	37
10	1,000	41	59	84	1,000	63	37
12	1,000	43	57	90	1,000	64	36
18	1,000	48	52	96	1,000	64	36
24	1,000	51	49	102	1,000	65	35
30	1,000	54	46	108	1,000	65	35
36	1,000	56	44	114	1,000	65	35
42	1,000	58	42	120	1,000	66	34
48	1,000	59	41				

Wind Speed = Constant at 10 knots

Hours Into Spill	Released Gallons	Evaporated Percent	Dispersed Percent	Remaining Percent
1	1,000	8	1	91
2	1,000	14	2	84
4	1,000	20	3	76
6	1,000	24	5	71
8	1,000	27	7	66
10	1,000	29	9	62
12	1,000	31	10	59
18	1,000	34	15	50
24	1,000	37	20	43
30	1,000	39	25	35
36	1,000	41	30	29
42	1,000	43	35	22
48	1,000	44	40	16
54	1,000	45	44	11

Wind Speed = Constant at 15 knots

Hours Into Spill	Released Gallons	Evaporated Percent	Dispersed Percent	Remaining Percent
1	1,000	10	3	88
2	1,000	16	6	78
4	1,000	23	12	65
6	1,000	27	19	55
8	1,000	29	25	46
10	1,000	31	31	38
12	1,000	32	38	30
18	1,000	35	54	10