U.S. DEPARTMENT OF
HOMELAND SECURITY

United States Coast Guard

BIOLOGICAL ASSESSMENT OF THE ALASKA FEDERAL/STATE PREPAREDNESS PLAN FOR RESPONSE TO OIL & HAZARDOUS SUBSTANCE DISCHARGES/RELEASES (UNIFIED PLAN) FINAL

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Acronyms

ACIA	Arctic Climate Impact Assessment
ADEC	Alaska Department of Environmental Conservation
ADF&G	Alaska Department of Fish and Game
AMNWR	Alaska Maritime National Wildlife Refuge
ARRT	Alaska Regional Response Team
ATV	all-terrain vehicle
BA	biological assessment
BMP	best management practice
BO	biological opinion
CAS	Chemical Abstracts Service
CBS	Chukchi and Bering Seas (polar bear stock)
CDV	canine distemper virus
CFR	Code of Federal Regulations
CWA	Clean Water Act
CWT	coded wire tag
DPS	distinct population segment
EEZ	exclusive economic zone
EPA	US Environmental Protection Agency
ESA	Endangered Species Act
ESI	Environmental Sensitivity Index
ESU	evolutionarily significant unit
FOSC	federal on-scene coordinator
FR	Federal Register
GNIS	Geographic Names Information System
GOA	Gulf of Alaska
GRS	geographic response strategies
GT	gross ton
IPCC	Intergovernmental Panel on Climate Change
IAP	incident action plan
ICS	Incident Command System

IUCN	International Union for Conservation of Nature
IWC	International Whaling Commission
LAA	likely to adversely affect
LC50	concentration that is lethal to 50% of an exposed population
LCR	Lower Columbia River
MCR	Middle Columbia River
MLLW	mean lower low water
MMC	Marine Mammal Commission
MMPA	Marine Mammal Protection Act
MMS	Minerals Management Service
MOA	memorandum of agreement
MU	management unit
NCP	National Contingency Plan
NL	not listed
NLAA	not likely to adversely affect
NMFS	National Marine Fisheries Service
NMML	National Marine Mammal Laboratory
NOAA	National Oceanic and Atmospheric Administration
NPDES	National Pollutant Discharge Elimination System
NPS	National Parks Service
NWR	National Wildlife Refuge
OPR	Office of Protected Resources
OSC	on-scene coordinator
PAH	polycyclic aromatic hydrocarbon
PCB	polychlorinated biphenyl
PCE	primary constituent element
PDV	phocine distemper virus
PNW	Pacific Northwest
POTW	publically owned treatment works
ppm	parts per million
psi	pounds per square inch
PSP	paralytic shellfish poisoning

PWS	Prince William Sound
RP	responsible party
SBS	Southern Beaufort Sea
SCP	subarea contingency plan
SMART	Special Monitoring of Applied Response Technologies
SPLASH	Structure of Populations, Levels of Abundance, and Status of Humpback
SSC	scientific support coordinator
SSD	species sensitivity distribution
STAR	spill tactics for Alaska responders
TEK	traditional ecological knowledge
UCR	Upper Columbia River
USCG	US Coast Guard
USFWS	US Fish and Wildlife Service
UV	ultraviolet
WISGS	Walrus Islands State Game Sanctuary
Y-K Delta	Yukon-Kuskokwim Delta

Executive Summary

ES.1 INTRODUCTION

This biological assessment (BA) evaluates the potential for adverse effects on species and habitats protected under the Endangered Species Act (ESA) from implementation of the *Alaska Federal/State Preparedness Plan for Response to Oil and Hazardous Substance Discharges/Releases* (EPA et al., 2010) (hereafter referred to as the Unified Plan). The Unified Plan provides a strategy for a coordinated, multi-jurisdictional emergency response to a discharge of oil or hazardous substances within the boundaries of the State of Alaska and its surrounding waters. This BA focuses on the elements of the Unified Plan (EPA et al., 2010) that may affect protected species and critical habitats. The effects evaluated are those associated with the specific countermeasures used to mitigate the risks from the spilled material during an emergency response, and not the material itself. For the purpose of the Unified Plan consultation, the State of Alaska and its contiguous waters, to the extent of the exclusive economic zone (EEZ), constitute the action area.

The Unified Plan is jointly prepared by the US Coast Guard (USCG), US Environmental Protection Agency (EPA), Alaska Department of Environmental Conservation (ADEC), and additional members of the Alaska Regional Response Team (ARRT) (ARRT, 2013).[1] EPA and USCG are the federal agencies responsible for implementation of the Unified Plan (EPA et al., 2010) and, as such, are the action agencies that will use this BA to support consultation with the US Fish and Wildlife Service (USFWS) and the National Oceanic and Atmospheric Administration (NOAA) National Marine Fisheries Service (NMFS) (NOAA Fisheries) under the authority of Section 7 of the ESA.

Thirty-five endangered or threatened species (including distinct population segments [DPS] or evolutionarily significant units [ESUs]) that are present in Alaska and its adjacent waters are evaluated in this BA. In addition, three candidate species are evaluated, as well as one species for which candidate status was vacated in October 2013.[2] The numbers of species and DPSs (or ESUs) in each protected category as of December 2013 are summarized as follows:

- **Marine mammals –** ten endangered, five threatened, and one candidate
- **Birds –** two endangered, two threatened, and one candidate
- **Fish –** one endangered, ten threatened, and one candidate

[1] A list of the current ARRT members is provided on the ARRT website (ARRT, 2013).

[2] The Kittlitz's murrelet was designated as a candidate species during the preparation of the BA. On 3 October 2013, USFWS issued a determination finding that listing the Kittlitz's murrelet was not currently warranted (78 FR 61764, 2013). This listing determination was published during finalization of the BA. Therefore, the Kittlitz's murrelet has been included in the BA, but an effects determination has not been made because listing under ESA is not imminent.

- **Reptiles –** two endangered and two threatened
- **Plants –** one endangered

Critical habitat (i.e., legally designated geographic areas that have features considered essential for the viability of an endangered species) that is present within the action area is also evaluated in this BA. Critical habitat has been designated for Cook Inlet beluga whale, North Pacific right whale, Steller sea lion, northern sea otter, Steller's eider, and spectacled eider.[3]

ES.2 Description of the Potential Response Actions

Section 2 describes the response actions implemented during emergency spill response that may result in adverse effects to sensitive species or critical habitat (Table ES-1). Mechanical countermeasures are the primary response actions and are intended to deflect, exclude, or contain and recover oil or other spilled material before it can come into contact with and impact ecological resources. Non-mechanical countermeasures include actions that alter the physical or chemical properties of the spilled material (specifically petroleum or oil-like materials) such that the options for recovery are improved, or the overall impacts of spilled material that cannot be recovered are potentially reduced. Although non-mechanical countermeasures may increase the potential for response-related environmental impacts for some species, these impacts are expected to be less severe and of shorter duration than allowing the spilled material to reach sensitive areas.

The federal on-scene coordinator (FOSC) is responsible for all decisions regarding the selection and implementation of a response action; however, the use of non-mechanical countermeasures requires special consideration and approval procedures, including consultation with federal natural resource trustee agencies. For use of chemical dispersants in the absence of pre-authorization, concurrence from the incident-specific regional response team is also required.

Table ES-1. Potential response actions

Potential Response Action	Description of Response Action
Mechanical countermeasures	Deflection and containment phase: • Booming • Constructing barriers, dams, pits, and trenches • Culvert blocking

[3] Critical habitat for the polar bear was designated on 7 December 2010 (75 FR 76086, 2010); however, on 10 January 2013, the US District Court for the District of Alaska issued an order vacating the rule designating critical habitat for the polar bear (US District Court District of Alaska, 2013). Therefore, at this time, there is no critical habitat designated for the polar bear.

Potential Response Action	Description of Response Action
	Recovery phase: • Skimming • Vacuuming • Sorption
	Removal/cleanup phase: • Flushing and flooding • Steam cleaning and sand blasting • Mechanical cleaning of sand • Removing contaminated soil, sediment, vegetation, or natural debris
Non-mechanical countermeasures and monitoring	• Application of approved chemical dispersants by vessel or aircraft • *In situ* burning • Application of other chemical agents (e.g., solidifiers and fire foam) • Application of biodegradative organisms or nutrient stimulants to enhance biodegradation • Required real-time efficacy monitoring with specialized equipment
Tracking and surveillance	• The use of aircraft, vessels, all-terrain vehicles, or heavy machinery • Installation of buoys • Sample collection
Waste management	• Waste handling and storage • Waste transport • Waste treatment and/or disposal • Decontamination
Wildlife protection	• Recovery of contaminated carcasses to prevent contamination of other wildlife • Wildlife deterrents (i.e., hazing) • Pre-emptive capture and relocation of uncontaminated wildlife • Capture and treatment of contaminated wildlife, and subsequent release, if appropriate • Strategic avoidance
Natural attenuation	No action; allow affected habitat to recover naturally and monitor results

Response activities that are performed for almost all spill events are tracking and surveillance, deflection and containment (usually booming) and waste management. Tracking and surveillance is designed to delineate the extent of spilled material and locate sensitive resources. Waste management activities are conducted for the storage and transfer of waste materials generated during the spill response. Wildlife protection response actions may be implemented if wildlife is threatened by exposure to a spilled material. The only response action potentially associated with natural attenuation is monitoring.

Each of the response actions has characteristics that may introduce potential stressors into the environment. Section 2 describes the likely effects that each type of response action may have on the environment, along with best management practices that may be implemented to mitigate the effects of those actions.

ES.3 ENVIRONMENTAL BASELINE FOR PROTECTED SPECIES AND HABITATS

For the purpose of evaluating a response action under the Unified Plan, the baseline condition assumes the occurrence of a spill, as well as the interaction of species and their habitats under the condition of a spill. The purpose of Section 3 is to present the baseline conditions for the protected species and designated critical habitats within the action area and to provide a setting within which potential interactions between response actions and protected species and habitats could take place. For each listed or candidate species, this section includes a discussion of species status, spatial and temporal distribution, population status, habitat requirements within the potentially affected area, presence of critical habitat, a description of the essential habitat characteristics, and current stressors or threats (Table ES-2). To provide context, Section 3 discusses the historical frequency, size (volume) and timing of spills in Alaska.

Table ES-2. Protected species status, habitats, and distribution

Protected Species	Status	Habitat Type in Potentially Affected Area	Critical Habitat?	Geographic Location
Marine Mammals				
Beluga whale (*Delphinapterus leucas)* – Cook Inlet DPS	E	nearshore, open water (including polynyas)	yes	Cook Inlet
Blue whale (*Balaenoptera musculus)*	E	open water	no	Aleutian Islands, Bering Sea, GOA
Bowhead whale (*Balaena mysticetus)*	E	open water, ice edge	no	Bering Sea, Beaufort Sea, Chukchi Sea
Fin whale (*Balaenoptera physalus)*	E	open water	no	Bering Sea, Beaufort Sea, Chukchi Sea, GOA, Aleutian Islands
Gray whale (*Eschrichtius robustus*) –Western North Pacific stock	E	nearshore, open water	no	Okhotsk Sea, Sakhalin Island, Russia, South China Sea (Potentially: Bering and Chukchi Seas, Aleutian Islands, GOA)
Humpback whale (*Megaptera novaeangliae)*	E	open water, nearshore	no	Bering Sea, Aleutian Islands, Kodiak Island, PWS, GOA including Inside Passage, Chukchi Sea, western Beaufort Sea
North Pacific right whale (*Eubalaena japonica)*	E	open water	yes	Bering Sea, Aleutian Islands, GOA
Sei whale (*Balaenoptera borealis)*	E	open water	no	Bering Sea, Aleutian Islands, GOA
Sperm whale (*Physeter macrocephalus)*	E	open water, ice edge	no	Bering Sea, Aleutian Islands, GOA
Steller sea lion (*Eumetopias jubatus) – western population*	E	shoreline, nearshore, open water	yes	Bering Sea, PWS, Kodiak Island, Aleutian Islands, GOA
Steller sea lion (*E. jubatus) – eastern population*[a]	T	shoreline, nearshore, open water	yes	GOA, Southeast Alaska
Polar bear (*Ursus maritimus*)	T	terrestrial, shoreline, nearshore, ice	no[b]	Bering Sea, Beaufort Sea, Chukchi Sea, North Slope, western Alaska
Northern sea otter (*Enhydra lutris kenyoni*) – southwest Alaska DPS	T	shoreline, nearshore	yes	Aleutian Islands, Bristol Bay, Alaska Peninsula, Kodiak Island, Pribilof Islands
Pacific walrus (*Odobenus rosmarus,* ssp. *divergens*)	C[c]	shoreline, nearshore, open water, ice	no	Chukchi Sea, Bering Sea, Bristol Bay
Ringed seal (*Phoca hispida)*	T	nearshore, open water, ice	no	Chukchi Sea, Beaufort Sea
Bearded seal (*Erignathus barbatus)*	T	nearshore, open water, ice	no	Chukchi Sea, Beaufort Sea, Bering Sea

Protected Species	Status	Habitat Type in Potentially Affected Area	Critical Habitat?	Geographic Location
Birds				
Eskimo curlew (*Numenius borealis*)	E	terrestrial (tundra)	no	Arctic, although likely extinct
Short-tailed albatross (*Phoebastria albatrus*)	E	open water	no	Aleutian Islands, Bering Sea, GOA
Spectacled eider (*Somateria fischeri*)	T	shoreline, tidal marsh/delta, nearshore, open water, ice	yes	Beaufort Sea, Bering Sea, Arctic coastal plain, Y-K Delta
Steller's eider (*Polysticta stelleri*) – Alaska breeding population	T	tidal marsh/delta, nearshore, open water	yes	Bering Sea, Alaska Peninsula, Aleutian Islands, Kodiak Island, Cook Inlet, Arctic coastal plain, Y-K Delta
Kittlitz's murrelet (*Brachyramphus brevirostris*)	NL[d]	shoreline, nearshore, open water (including polynyas and leads)	no	Alaska Peninsula, Aleutian Island, Glacier Bay, Kenai Peninsula, Kodiak Island, Point Lay, PWS, Seward Peninsula, Yakutat Bay
Yellow-billed loon (*Gavia adamsii*)	C[c]	riverine/riparian, lake/wetland/bog, nearshore, open water	no	Aleutian Islands, Kodiak Island, Seward Peninsula, Southeast Alaska, St. Lawrence Island, Arctic coastal plain
Fish				
Chinook salmon (*Oncorhynchus tshawytscha*) – Lower Columbia River ESU	T	open water, nearshore	no	GOA
Chinook salmon (*O. tshawytscha*) – Upper Columbia River, spring run ESU	E	open water, nearshore	no	GOA
Chinook salmon (*O. tshawytscha*) – Puget Sound ESU	T	open water, nearshore	no	GOA
Chinook salmon (*O. tshawytscha*) – Snake River, fall run ESU	T	open water, nearshore	no	GOA
Chinook salmon (*O. tshawytscha*) – Snake River, spring/summer run ESU	T	open water, nearshore	no	GOA, Bering Sea
Chinook salmon (*O. tshawytscha*) – Upper Willamette River ESU	T	open water, nearshore	no	GOA, Bering Sea
Coho salmon (*Oncorhynchus kisutch*) – Lower Columbia River ESU	T	open water, nearshore	no	GOA, Aleutian Islands, Bering Sea (north to Point Hope), Southeast Alaska
Steelhead trout (*Oncorhynchus mykiss*) – Lower Columbia River DPS	T	open water, nearshore	no	GOA, Aleutian Islands

Protected Species	Status	Habitat Type in Potentially Affected Area	Critical Habitat?	Geographic Location
Steelhead trout (*O. mykiss*) – Middle Columbia River DPS	T	open water, nearshore	no	GOA, Aleutian Islands
Steelhead trout (*O. mykiss*) – Snake River basin DPS	T	open water, nearshore	no	GOA, Aleutian Islands
Steelhead trout (*O. mykiss*) – Upper Columbia River DPS	T	open water, nearshore	no	GOA, Aleutian Islands
Pacific herring (*Clupea pallasi*) --Southeast Alaska DPS	C	open water, nearshore	no	GOA, Aleutian Islands, Bering Sea, Southeast Alaska
Reptiles				
Leatherback sea turtle (*Dermochelys coriacea*)	E	open water	no[e]	GOA
Loggerhead turtle (*Caretta caretta*)	E	open water	no[e]	GOA
Green turtle (*Chelonia mydas*)	T	open water	no	GOA
Olive Ridley turtle (*Lepidochelys olivacea*)	T	open water	no	GOA
Plants				
Aleutian shield fern (*Polystichum aleuticum*)	E	terrestrial	no	Adak Island

[a] The eastern population of Steller sea lion is currently proposed for delisting (NMFS, 2012a).

[b] On 10 January 2013, the US District Court for the District of Alaska issued an order vacating the rule designating critical habitat for the polar bear. Therefore, at this time, there is no critical habitat designated for the polar bear (US District Court District of Alaska, 2013).

[c] The Pacific walrus and yellow-billed loon have been designated as candidate species. A 12 July 2011 court settlement agreement established that USFWS would either submit a proposed rule to list the species as candidate species, or issue a not-warranted finding. The dates of submittal established in the settlement agreement are October 2014 for the yellow-billed loon and October 2017 for the Pacific walrus (US District Court for the District of Columbia, 2011).

[d] The Kittlitz's murrelet was designated as a candidate species during the preparation of the BA. On 3 October 2013, USFWS issued a determination finding that listing the Kittlitz's murrelet was not currently warranted (78 FR 61764, 2013). This listing determination was published during finalization of the BA. Therefore, the Kittlitz's murrelet has been included in the BA, but an effects determination has not been made because listing under ESA is not imminent.

[e] Critical habitat has been designated for leatherback sea turtles (77 FR 4170, 2012) and proposed for loggerhead turtles (78 FR 43006, 2013) outside of Alaska.

BA – biological assessment
C – candidate
DPS – distinct population segment
E – endangered
ESA – Endangered Species Act
ESU – evolutionarily significant unit
GOA – Gulf of Alaska
NL – not listed
T – threatened
USFWS – US Fish and Wildlife Service

ES.4 POSSIBLE EFFECTS ON PROTECTED SPECIES AND CRITICAL HABITATS

Section 4 evaluates the potential effects of spill response actions and provides a determination of the likelihood of an ESA-listed species or critical habitat being adversely affected by an emergency response action. Section 4 also describes the elements of the Unified Plan (including best management practices [BMPs] that may be implemented to further minimize the impacts, should a spill occur) that are designed to protect listed species and critical habitats from the incidental potentially adverse effects associated with response activities.

Effects associated with response actions are discussed for each species by category of effect as follows:

- Physical or behavioral disturbance (e.g., physical disruption, behavioral response)
- Exposure to contaminants (e.g., exposure to dispersants, dispersed oil, or airborne particulates or residues from an *in situ* burn)
- Exclusion from resources (e.g., lack of access to breeding, foraging, or refuge areas)
- Habitat degradation or loss (e.g., change in air, sediment, or water quality or areal extent of a specific habitat)
- Direct injury (e.g., ship or vehicle strikes, hypothermia from exposure to dispersants or dispersed oil)

Considerations that were made in the determination of whether or not an ESA-listed or candidate species or critical habitat might be adversely affected by a response action included: 1) the presence of the species (spatial and temporal) in the action area, 2) the likelihood of interaction, 3) the stressor(s) introduced by the action, 4) the vulnerability of species to the stressor, and 5) the potential mitigation of any adverse effects by decisions made or protective actions implemented during a response.

As discussed in Section 4, the protection of sensitive species and habitats is one of the highest priorities of a response action. However, the possibility remains that an ESA-listed species or designated critical habitat could be adversely affected by response activities during implementation of the Unified Plan. The effects with the greatest consequence to mammal and bird species are physical injury or death from entanglement with equipment or from ship strike or hypothermia resulting from degradation of insulating capabilities following exposure to dispersants and dispersed oil for sea otter, polar bear, and birds. Other effects with adverse consequences include the following:

- Lung damage from inhalation of smoke from *in situ* burning
- Abandonment of maternal polar bear dens as a result of disturbance
- Mortality of juvenile or small walruses from stampeding following disturbance

- Disturbance of species' normal feeding or breeding activities resulting from vessel traffic during spill response
- Significant alteration of the local food web through sublethal effects on sensitive species

The impacts cited above (e.g., reduced thermoregulation due to dispersant exposure) are likely to be less than those caused by oil alone due to the sheer volume and areal extent of untreated oil spills relative to dispersed oil spills (NRC, 2005), as well as the expectation that chemical dispersants can render oil less sticky, thereby decreasing the oiling of wildlife fur or plumage (CDC and ATSDR, 2010; Lessard and Demarco, 2000). Nonetheless, the application of chemical dispersants could result in severe impacts in the form of ship strikes by response vessels or reduced thermoregulation as a result of direct contact with dispersants during or immediately after dispersant application (i.e., before dispersed oil dilutes into the water column) (Duerr et al., 2011).

Fish are likely to be adversely affected by response actions. The actions with the highest potential for effects for salmonids, which would be of low-magnitude and temporary in duration, include water quality degradation from the use of dispersants, and alteration of the food web through use of dispersants. Pacific herring could be significantly impacted by the use of chemical dispersants, which have been found to cause mortality in herring embryos when mixed with crude oil (Lee et al., 2011b).

Plants (i.e., Aleutian shield fern) and reptiles (i.e., sea turtles) are unlikely to be exposed to a response action because of their rarity or isolation away from areas where spills may occur and thus would not likely be adversely affected by any emergency response action.

Indirect effects are not likely for most species (particularly those that feed over large areas or on a variety of species); in certain instances, however, effects on prey could lead to long-term impacts on species. For example, the Pacific walrus has a diet largely limited to bivalves and other epibenthic invertebrates (although they sometimes ingest benthic infauna [e.g., worms] or fish [e.g., cod]). Because bivalve larvae and epibenthic invertebrates tend to be sensitive to dispersed oil[4] (Clark et al., 2001; Gulec et al., 1997; Mitchell and Holdway, 2000), long-term, indirect impacts on the prey of Pacific walrus are possible.

Section 5 describes cumulative effects, which are defined in 50 Code of Federal Regulations (CFR) 402.02 of the ESA as effects that are likely to occur as a result of future private, municipal, borough, state, or Native activities within the area of the current federal action that is being assessed. The following non-federal actions were identified as reasonably likely to occur in the foreseeable future: subsistence harvest of protected species, state management of commercial fisheries, sport fishing, commercial

[4] More so than adult invertebrates or fish which make up the diet of other large marine mammals (e.g., Steller sea lions)

or private vessel / aircraft use or passage, commercial or residential development, and permitted wastewater and stormwater discharges. Although not directly connected to specific private or state-controlled activities, the potential effects of climate change are discussed because of the additive effect on protected species. There is the potential for significant habitat alteration in Alaska because of the decline in sea ice associated with climate change.

ES.5 Results of the Effects Determination

Section 6 presents a summary of determination regarding whether a particular ESA-listed species, evaluated at the individual level[5], or critical habitat is expected to be adversely affected by a response action. Determinations were stated as: 1) likely to adversely affect (LAA), 2) may affect, but not likely to adversely affect (NLAA), or 3) no effect.

Table ES-3 presents the determination of effects and rationale for the ESA-listed species and critical habitat considered in this BA. A conclusion of "may affect, NLAA" was reached if an interaction between an ESA-listed species and a response action was considered extremely unlikely, or if critical habitat was unlikely to be affected. A conclusion of "LAA" was reached in cases where any possibility of "take" (including harm or harassment) of a single individual was greater than zero. If there is very low likelihood for both an interaction and an adverse effect, a conclusion of "no effect" was reached.

As presented in Tables ES-3, a determination of "LAA" was reached for 10 species of marine mammals, 3 species of birds, and 3 species of fish. A determination of "may affect, NLAA" was reached for 6 species of marine mammals, 2 species of birds, and 1 species of fish. The determination for reptiles and plants was "no effect."

A determination of "LAA" was reached for critical habitat for the Cook Inlet beluga whale, Steller sea lion (western and eastern populations), Northern sea otter, spectacled eider, and Steller's eider. A "may affect, NLAA" determination was reached for critical habitat for the North Pacific right whale.

[5] For the purpose of this BA, the term "individual level" is in reference to any impact on a species that would lead to reduced survival, growth, or reproduction.

Table ES-3. Summary of determination of effects

Protected Species or DPS	Determination	Rationale
Marine mammals		
Beluga whale (*Delphinapterus leucas* – Cook Inlet DPS	LAA	• Species is present year round in a geographically restricted area in Cook Inlet that has the greatest level of anthropogenic activity in Alaska. • Increased level of anthropogenic noise may temporarily impact the ability to communicate and disrupt essential behaviors. • Potential ship strikes from fast-moving vessels could result in injury. • Frequent petroleum product spills occurred in Cook Inlet between January 1995 and August 2012. • Exposure to dispersants and dispersed oil could result in sublethal effects (see Appendix B).
	LAA (CH)	• Response operations may restrict passage within or between critical habitat areas. • Exposure to dispersants and dispersed oil could result in a reduction in some prey species (see Appendix B). • Noise levels from response activities could cause behavioral disturbance.
Blue whale (*Balaenoptera musculus)*	may affect, NLAA	• Extensive home range, preference for open water (i.e., offshore) habitat, and seasonal presence in Alaska minimize potential for exposure to oil spill response activities. • Vessel noise during response activities is not likely to have adverse physical or behavioral impact.
Bowhead whale (*Balaena mysticetus)*	LAA	• Year-round presence in Arctic waters in areas with ongoing anthropogenic activity increases likelihood of exposure to response activities. • Exclusion from polynyas and leads, particularly during winter and migration periods, caused by response activities could result in physical harm. • Increased level of anthropogenic noise may temporarily impact the ability to communicate and disrupt essential behaviors. • Potential ship strikes from fast-moving vessels or entanglement could result in injury. • Exposure to dispersants and dispersed oil could result in sublethal effects (see Appendix B).
Fin whale (*Balaenoptera physalus)*	may affect, NLAA	• Extensive home range and preference for deep water minimizes the potential for exposure to oil spill response activities. • As a deep-ocean species, fin whales spend more than half of their time at depths from 50 m to greater than 225 m, thereby minimizing their exposure to response activities.
Gray whale (*Eschrichtius robustus*) – WNP stock	may affect, NLAA	• Low likelihood of presence during response activities because the area is outside the primary home range for this stock of gray whale. • Low likelihood of seasonal presence of a small number of WNP gray whales in Alaska.

Protected Species or DPS	Determination	Rationale
Humpback whale (*Megaptera novaeangliae)*	LAA	• Increased level of anthropogenic noise may temporarily impact the ability to communicate and disrupt essential behaviors. • Potential ship strikes from fast-moving vessels or entanglement could result in injury. • Dispersed oil may foul baleen plates, temporarily reducing filtration efficiency and impacting the ability to feed. • Ingestion of or dermal contact with dispersed oil may result in sublethal effects (see Appendix B).
North Pacific right whale (*Eubalaena japonica)*	may affect, NLAA	• Low likelihood of seasonal presence in Alaska minimizes the potential for exposure to oil spill response actions. • Oil spills in the open ocean, where right whales may be present are infrequent (6 in 17 years), making an encounter with oil spill response actions unlikely.
	may affect, NLAA (CH)	• Historical oil spills in critical habitat have been infrequent, with only 1 small (1,000 gal.) spill in 17 years.
Sei whale (*Balaenoptera borealis)*	may affect, NLAA	• Extensive open-ocean habitat, high mobility, and seasonal presence in Alaska minimize the potential for exposure to oil spill response activities. • Spills in the open ocean where sei whales are present are infrequent and of small volume (2 spills of ≤ 350 gal. in 17 years), making an encounter with oil spill response actions extremely unlikely.
Sperm whale (*Physeter macrocephalus)*	may affect, NLAA	• Low population density in Alaska and feeding habits (i.e., deep diving) reduce the potential for exposure to surface response activities. • Spills in the open ocean, where sperm whales are present are infrequent and of small volume (2 spills of ≤ 350 gal. in 17 years), making an encounter with oil spill response actions extremely unlikely.
Steller sea lion (*Eumetopias jubatus)* – western population	LAA	• Present throughout Alaska waters increases likelihood of exposure to response activities. • A stampede would likely result in injury, mortality, and abandonment of pups, and injury to animals of other life stages. • Potential sublethal effects may occur from inhaling particulates from *in situ* burn and exposure to dispersants or dispersed oil (see Appendix B). • Dermal exposure to dispersants and dispersed oil could result in sublethal effects (see Appendix B), although exposures and effects are expected to be short-term.
	LAA (CH)	• Potential exists for disturbances to resting, breeding, rearing, and feeding individuals due to mechanical removal of oil with heavy equipment; such disturbances may include abandonment of haulouts or rookeries.

Protected Species or DPS	Determination	Rationale
Steller sea lion (*E. jubatus)* – eastern population	LAA	• Present throughout Alaska waters increases likelihood of exposure to response activities. • A stampede would likely result in injury, mortality, and abandonment of pups, and injury to animals in other life stages. • Potential sublethal effects may occur from inhaling particulates from *in situ* burns and exposure to dispersants or dispersed oil (see Appendix B). • Dermal exposure to dispersants and dispersed oil could result in sublethal effects (see Appendix B), although exposures and effects are expected to be short-term.
	LAA (CH)	• Potential exists for disturbances to resting, breeding, rearing, and feeding individuals due to mechanical removal of oil with heavy equipment; such disturbances may include abandonment of haulouts or rookeries.
Polar bear (*Ursus maritimus*)	LAA	• Injury and/or mortality may result from encounters with security personnel (i.e., bear guards) stationed during a response action. • Ingestion of petroleum hydrocarbons may occur during grooming or consumption of contaminated prey (e.g., seals exposed to dispersed oil). • Disturbances near den sites could cause a female to abandon the den, resulting in cub mortality from hypothermia or predation. • Man-made in-water obstructions or other disturbances that force bears to alter swimming courses may result in stress and increased energy output, reducing their overall fitness, particularly if the disturbance also displaces their marine mammal prey (i.e., seals). • Dermal exposure to dispersants and dispersed oil could result in sublethal effects (see Appendix B), although exposures and effects are expected to be short-term.
Northern sea otter (*Enhydra lutris kenyoni*) – southwest Alaska DPS	LAA	• Encountering dispersed oil would likely result in fouling of fur causing a reduction in the ability of otters to thermoregulate, resulting in hypothermia; ingestion of dispersed oil while cleaning pelage could result in sublethal effects. • Sublethal effects to eyes, mucus membranes, or lungs may occur from exposure to dispersants or dispersed oil.
	LAA (CH)	• Removal of kelp in critical habitat that provides protection from marine predators and other essential functions may occur.
Pacific walrus (*Odobenus rosmarus,* ssp. *divergens*)	LAA	• Year-round presence in the Bering and Chukchi Seas increases likelihood of encounters with response activities. • A stampede caused by response activities would likely result in injury, mortality and abandonment of pups, and injury to animals of other life stages. • Disturbance of animals at haulouts or rookeries may occur due to response activities. • Potential sublethal effects may occur through inhaling particulates from *in situ* burn and exposure to dispersants or dispersed oil (see Appendix B). • Potential for alteration of prey (e.g., bivalves) based on use of dispersants.

Protected Species or DPS	Determination	Rationale
Ringed seal (*Phoca hispida spp. hispida)*	LAA	• Year-round presence in the Chukchi and Beaufort Seas increases likelihood of encounters with response activities. • Disturbances resulting in exclusion from haulouts and subnivean lairs used for resting, nursing pups, and protection from predators could result in harm if animals are forced to locate resources and refuge elsewhere. • Potential sublethal effects may occur through inhaling particulates from *in situ* burn and exposure to dispersants or dispersed oil (see Appendix B).
Bearded seal (*Erignathus barbatus ssp. nauticus)*	LAA	• Year-round presence in the Bering, Chukchi, and Beaufort Seas increases likelihood of encounters with response activities. • Disturbances resulting in exclusion from haulouts and subnivean lairs used for resting, nursing pups, and protection from predators could result in harm if animals are forced to locate resources and refuge elsewhere. • Potential sublethal effects may occur through inhaling particulates from *in situ* burn and exposure to dispersants or dispersed oil (see Appendix B).
Birds		
Eskimo curlew (*Numenius borealis*)	may affect, NLAA	• Current population status is unknown and this species is considered potentially extinct in Alaska.
Short-tailed albatross (*Phoebastria albatrus*)	may affect, NLAA	• Year-round presence in Alaska • This highly mobile species does not breed, nest, or undergo molting in Alaska. • Species congregate in open ocean and at the edge of the continental shelf, where fewer oil spills are expected to occur.
Spectacled eider (*Somateria fischeri*)	LAA	• Disturbance by terrestrial response activities during the breeding season could result in nest abandonment, destruction of nests, and disruption of other essential behaviors, such as feeding and sheltering. • Response activities may result in exclusion of molting (i.e., flightless) eiders from feeding and sheltering habitat. • Exposure to dispersants or dispersed oil may reduce the thermoregulatory ability of eider feathers resulting in hypothermia • Exposure to particulates generated by *in situ* burning could result in adverse effects on molting eiders that are unable to avoid the response actions.
	LAA (CH)	• Removal of upland soil and vegetation in critical habitat and nesting areas would likely reduce the available nesting sites and feeding areas during molting periods. • Flushing of marine shorelines could result in displacement of and/or thermal stress to benthic organisms, reducing the eider prey base until those communities could recover. • Exposure of sensitive prey species and life stages (e.g., larval bivalves) during certain seasons (e.g., May through July) and in certain areas (e.g., Norton Sound or near Barrow, AK) may result in indirect impacts to eiders that selectively eat such species.

Protected Species or DPS	Determination	Rationale
Steller's eider (*Polysticta stelleri*) – Alaska breeding population	LAA	• Disturbance by terrestrial response activities during the breeding season could result in nest abandonment, destruction of nests, and disruption of other essential behaviors, such as feeding and sheltering. • Response activities may result in exclusion of molting (i.e., flightless) eiders from feeding and sheltering habitat. • Exposure to dispersants or dispersed oil may reduce the thermoregulatory ability of eider feathers resulting in hypothermia • Exposure to particulates generated by *in situ* burning could result in adverse effects on molting eiders that are unable to avoid the response actions.
	LAA (CH)	• Removal of upland soil and vegetation in critical habitat and nesting areas would likely reduce the available nesting sites and feeding areas during molting periods. • Flushing of marine shorelines could result in displacement of and/or thermal stress to benthic organisms, reducing the eider prey base until those communities could recover. • Exposure of sensitive prey species and life stages (e.g., larval bivalves) may result in indirect impacts to eiders that selectively eat such species.
Yellow-billed loon (*Gavia adamsii*)	LAA	• Exposure to response activities may occur in nesting areas within the National Petroleum Reserve. • Disturbance from response activities during the breeding season could result in nest abandonment, destruction of undiscovered nests, and disruption of other essential behaviors, such as feeding and sheltering. • Historically, spills have occurred frequently in the summer range in Southeast Alaska and the Aleutian Islands. • Exposure to dispersants or dispersed oil may foul feathers and reduce the thermoregulatory ability of loons.
Fish		
Chinook salmon (*Oncorhynchus tshawytscha*) – PNW protected stocks	LAA	• Nearshore response activities, such as vegetation removal, beach cleaning, and booming, could cause physical displacement of salmonids. • Habitat degradation and alteration of the food web could result from to changes in water quality caused by dispersant use, dispersed oil, or burnt residues from *in situ* burning. • Sublethal effects in salmon could occur from exposure to dispersants or dispersed oil if these materials were discharged in the vicinity of the nearshore (see Appendix B).
Coho salmon (*Oncorhynchus kisutch*) – Lower Columbia River ESU		
Steelhead trout (*Oncorhynchus mykiss)* – PNW protected stocks	may affect, NLAA	• No spawning occurs in Alaska, the species is present in Aleutian Islands and GOA during part of its life cycle. • Habitat use studies conducted in Alaska suggest low likelihood of exposure.

Protected Species or DPS	Determination	Rationale
Pacific herring (*Clupea pallasi*)	LAA	• Presence at a sensitive life stage (juvenile) in nearshore and coastal waters of Alaska increases susceptibility to response activities in those areas. • Physical disturbance to spawning habitat (e.g., flushing and flooding or shoreline with hot/warm water) could occur when eggs are present. • Acute mortality of larval or embryonic individuals could be caused by exposure to hot/warm water used for cleaning and dispersed oil (see Appendix B). • Habitat degradation and alteration of the food web could result from to changes in water quality caused by dispersant use, dispersed oil, or burnt residues from *in situ* burning. • Exposure to dispersants and dispersed oil could result in acute mortality, particularly in embryonic and larval herring.
Reptiles and Plants		
Leatherback sea turtle (*Dermochelys coriacea*)	No effect	• Reptiles are rare in Alaska waters.
Loggerhead sea turtle (*Caretta caretta*)		
Green sea turtle (*Chelonia mydas*)		
Olive Ridley turtle (*Lepidochelys olivacea*)		
Aleutian shield fern (*Polystichum aleuticum*)	No effect	• Aleutian shield fern is present in an isolated location where oil spill response action would not take place.

CH – critical habitat
DPS – distinct population segment
ESU – evolutionarily significant unit
GOA – Gulf of Alaska
LAA – likely to adversely affect
NLAA – not likely to adversely affect
NMFS – National Marine Fisheries Services
PNW – Pacific Northwest
WNP – Western North Pacific

1 Introduction

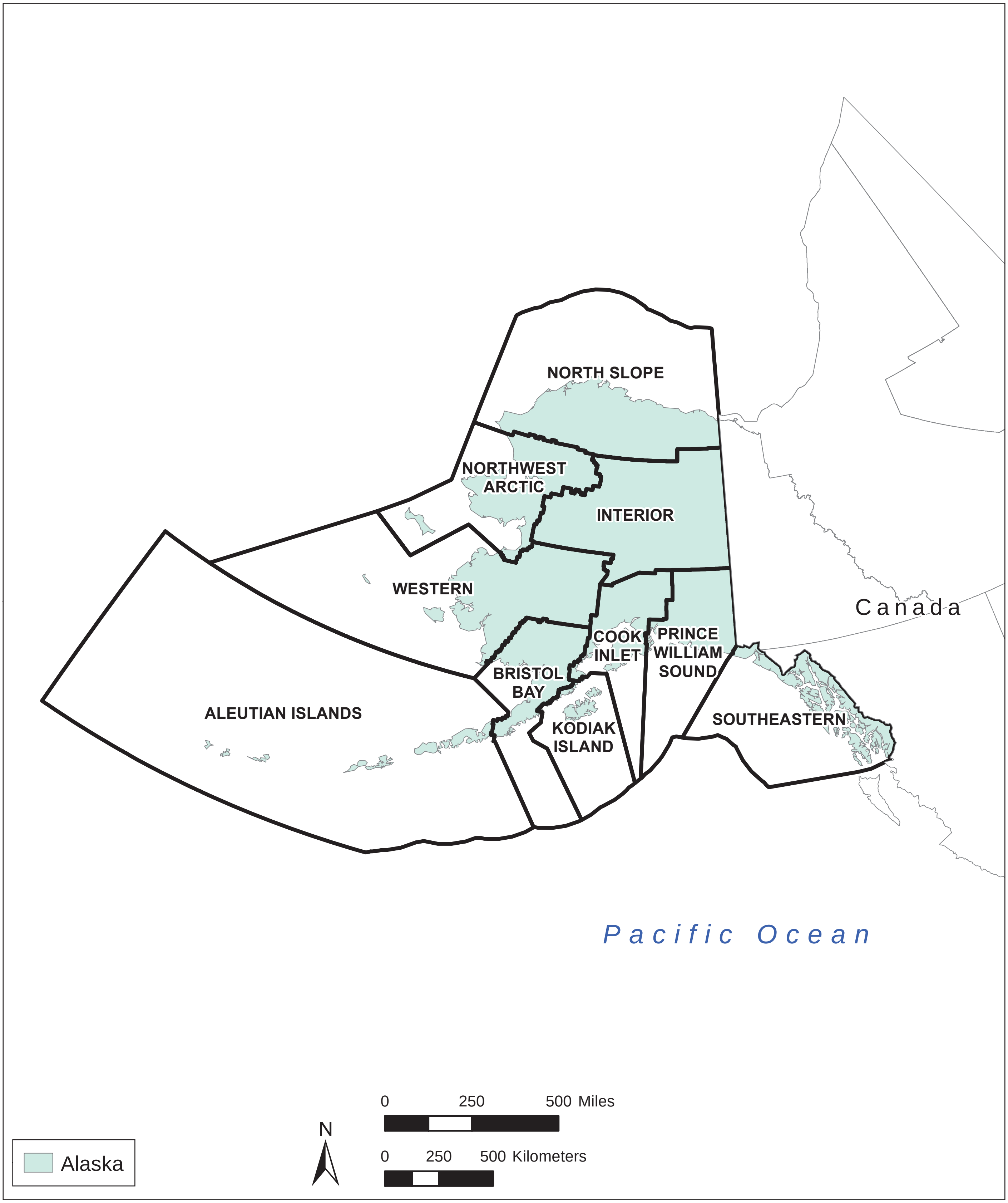
This biological assessment (BA) evaluates the potential for adverse effects on species and habitats protected under the Endangered Species Act (ESA) from implementation of the *Alaska Federal/State Preparedness Plan for Response to Oil and Hazardous Substance Discharges/Releases* (EPA et al., 2010), hereafter referred to as the Unified Plan. The Unified Plan provides a strategy for a coordinated, multi-jurisdictional emergency response to a discharge of oil or hazardous substances within the boundaries of the State of Alaska and its surrounding waters, extending to the limits of the exclusive economic zone (EEZ).[6] The Unified Plan, jointly prepared by the US Coast Guard (USCG), US Environmental Protection Agency (EPA), Alaska Department of Environmental Conservation (ADEC), and members of the Alaska Regional Response Team (ARRT),[7] represents a regional contingency plan, as required under the National Oil and Hazardous Substances Pollution Contingency Plan (National Contingency Plan [NCP]); it also fulfills state requirements for emergency response planning.

EPA and USCG are the federal agencies responsible for the implementation of the Unified Plan (EPA et al., 2010) and, as such, are the action agencies that will use this BA to support consultation with the US Fish and Wildlife Service (USFWS) and the National Oceanic and Atmospheric Administration (NOAA) Fisheries Service, hereafter referred to collectively as the Services, under the authority of Section 7 of the ESA.

The scope of this BA includes the elements of the Unified Plan (EPA et al., 2010), as updated in January 2010, that authorize or otherwise allow for actions or planning processes that lead to decisions to initiate actions that may affect protected species and habitats. The effects evaluated in this BA are those associated with the specific countermeasures used to mitigate the risks from spilled material during an emergency response but not those effects associated with the spilled material itself. For the purpose of the Unified Plan consultation, the State of Alaska and its contiguous waters, to the extent of the EEZ, constitute the action area for this BA (Figure 1-1).

[6] The EEZ includes waters up to approximately 200 nautical miles offshore; the first 3 miles are under shared federal and state jurisdiction.

[7] The ARRT is chaired by USCG and EPA and ADEC is the lead state agency; additional members include the US Department of Defense, US Department of the Interior (representing USFWS, Bureau of Land Management, Bureau of Ocean Energy Management, Bureau of Safety and Environmental Enforcement, Bureau of Indian Affairs, National Park Service and Office of Environmental Policy and Compliance), US Department of Commerce (representing NOAA Fisheries Service and National Weather Service), Federal Emergency Management Agency, US Department of Health and Human Services, US Department of Justice, US Department of Agriculture (US Forest Service), US Department of Labor (Occupational Safety and Health Administration), US Department of Energy, US Department of Transportation, General Services Administration, Alaska Department of Fish and Game (ADF&G), Alaska Department of Natural Resources, Alaska Department of Public Safety, and Alaska Department of Law.



Wind Ward LLC environmental

Data sources: ESRI, Canada Centre for Cadastral Management, and Alaska State Geo-Spatial Data Clearinghouse

Figure 1-1. Alaska Unified Plan Subareas

1.1 RESPONSE PLANNING UNDER THE UNIFIED PLAN

Spill response planning in Alaska is accomplished through the development of a series of inter-related plans, for which the NCP provides the overarching framework and sets up procedures that are designed to minimize the imminent threat to human health or the environment from an uncontrolled release of oil or other hazardous substances.

The Unified Plan (EPA et al., 2010) uses the framework and priorities set forth in the NCP and applies them in a regional context (i.e., Alaska). The Unified Plan contains both administrative and technical guidance for all members of the response community to follow during emergency response to a spill. This guidance is organized as a series of annexes (A through Z), each with supporting appendices (Appendix A of this BA provides a list of the topics included in each annex and the structure of the Incident Command System [ICS]). Administrative guidance in the Unified Plan establishes how the spill response will be organized, managed, and funded; technical guidance addresses countermeasures that have been approved for use as part of the response.

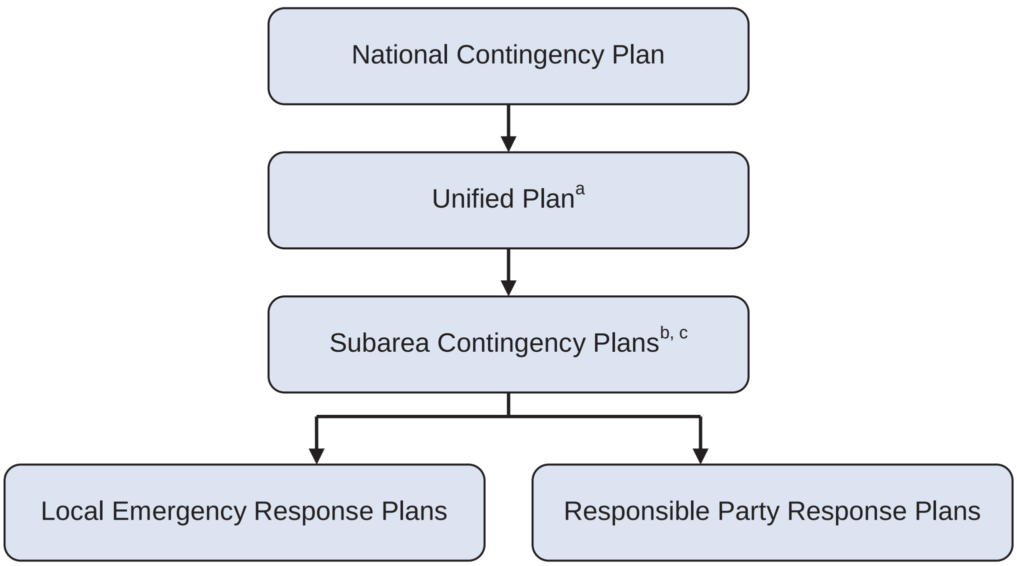
Mechanical countermeasures are the main focus of emergency spill response under the Unified Plan (EPA et al., 2010); however, most of the details regarding the selection and implementation of a response are provided in supplemental documents (e.g., Nuka Research, 2006; Alaska Clean Seas, 2010; API et al., 2001; NOAA et al., 2010) that were prepared in response to or in support of the Unified Plan.[8] The Unified Plan also incorporates guidance on the use of non-mechanical countermeasures (i.e., the application of dispersants or other chemical agents and *in situ* burning) and responses (i.e., wildlife protection) because of their greater potential for adverse effects. The Unified Plan further describes the decision process leading to the selection of a non-mechanical countermeasure in order to support the evaluation of tradeoffs associated with implementation (i.e., magnitude of environmental harm versus benefit) (additional detail is provided in Section 1.1.2).

The Unified Plan (EPA et al., 2010) is supplemented by 10 subarea contingency plans (SCPs), which provide greater detail for local response planning in large inland and coastal areas of Alaska (Figure 1-1). The SCPs set resource protection priorities and incorporate key provisions of local government emergency response plans and applicable information from responsible party (RP) spill response plans. These SCPs are updated regularly, and the updates are reviewed and approved by ARRT to maintain consistency with the Unified Plan. The SCPs also include site-specific geographic response strategies (GRS) developed by multi-stakeholder work groups, including the Services, to protect specific sensitive resources at specific locations within each subarea. Sensitive resources are broadly defined to include human and cultural resources, as well as species and habitats of concern (i.e., not just ESA-listed resources). Updates are available for review by the Services to determine if additional consultation under ESA

[8] A more complete list of documents describing mechanical countermeasures and their uses can be found in Annex N of the Unified Plan.

Section 7 is required in response to the addition of new elements (i.e., technologies or species) not considered as part of the consultation conducted for the Unified Plan. GRS incorporate elements of emergency response actions that are intended to minimize impacts on listed species and critical habitats from both the actions and the spilled material. The development of GRS is an ongoing effort; not all are complete at the time that this BA is being published. Final, draft, and proposed GRS are available on the ADEC Geographic and Response Strategies for Alaska website.[9]

The final level of response planning occurs at the local level and includes vessel- and facility-specific plans. The hierarchy and relationships among the various Alaska spill response plans are provided in Figure 1-2.



a Incorporates requirements of State Master Plan, Alaska Regional Contingency Plan, and Federal Area Plan guidance.

b Includes plans for Cook Inlet, Bristol Bay, North Slope, Kodiak Island, Aleutian Islands, Southeast Alaska, Prince William Sound, western Alaska, Northwest Arctic, and interior Alaska.

c Includes geographic response strategies, when completed, for sensitive areas within each of the 10 subareas.

Figure 1-2. Integrated oil and hazardous substance spill response planning

The selection and implementation of site-specific response strategies are ultimately at the discretion of the Unified Command (i.e., the team of on-scene coordinators [OSCs] that represents the RP and federal, state, and [potentially] local agencies), following the guidance in the Unified Plan (EPA et al., 2010) and in consultation with other members of the response community. Guidance on the structure of this response organization, including a flowchart showing the relationship among response organizations, is provided in Appendix A. The coordination of spill response planning and implementation with the requirements of ESA is also addressed in the Unified Plan (discussed further in Section 1.1.2).

[9] http://dec.alaska.gov/spar/perp/

In the event of an unplanned release of oil or hazardous materials to the environment, emergency response actions are implemented to achieve the following objectives:

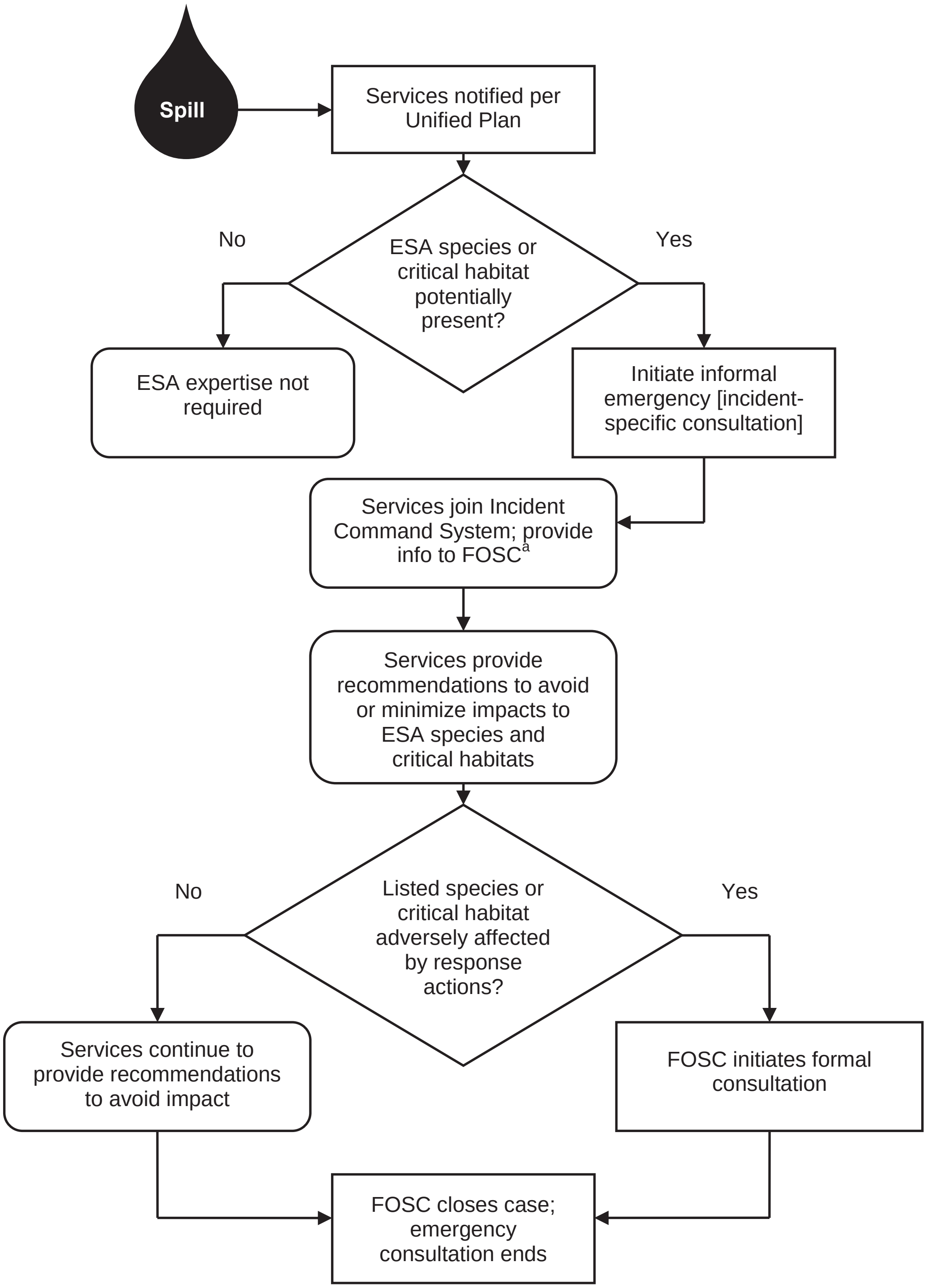
- Human safety and welfare (including the protection of economic resources)
- Control and minimization of the release of oil or hazardous substances
- Environmental protection (including ESA-listed species and habitats)
- Containment, cleanup, and disposal of the spilled material

The Unified Command is responsible for selecting, prioritizing, and implementing the actions that will meet these goals. The selection of the response action (or actions) for a given spill is dependent on a number of factors, including the nature and magnitude of the spill, weather, timing, location, accessibility, resources at risk, and likely fate and effects of the material released. Every response strategy has uncertainties, along with potential environmental tradeoffs that are evaluated as part of the action selection process. Response decisions are made using the best information available, with the knowledge that the initial understanding of the event may be incomplete. During a spill, responses are modified as environmental conditions change or additional information becomes available. The spill response community relies on training and exercises to make the uncertainties manageable. This emergency spill response training, a requirement of the Unified Plan, is expected to assist decision-making in the face of uncertainty and to ensure that at-risk environmental resources, such as ESA-listed species and habitats, are properly protected within the scope of resources available or mobilized during an emergency spill response.

1.1.1 Coordination of Response Activities with ESA

An interagency memorandum of agreement (MOA) among EPA, USCG, and the Services (EPA et al., 2001) is included as part of the Unified Plan (EPA et al., 2010) to provide greater protection of ESA species and critical habitats during an emergency response. The MOA specifies when and how the Services will be engaged and addresses the roles and responsibilities of each agency during the pre-spill planning activities, spill response, and post-spill activities. The goal of the MOA is to provide a framework to avoid or minimize adverse effects to ESA-listed species and critical habitats from the implementation of the Unified Plan; however, the MOA also describes the procedures for addressing potential impacts to an ESA-listed species or critical habitat should they occur.

Prior to a spill, the Services participate in the development of response methods that are incorporated into the Unified Plan (EPA et al., 2010) and guidance documents and in periodic response training. As members of the ARRT, the Services review all SCPs that guide area-specific responses. The Services also provide input into site-specific strategies to protect species by participating in the GRS work groups. Once a spill has occurred, the Services are notified and, representatives of the Services join the Incident Command System to advise the FOSC with regard to the development of an incident action plan (IAP) and to provide real-time input on necessary modifications to protective measures as conditions change. Should response activities cause an adverse effect to a listed species or critical habitat, the Services provide documentation of the injuries that occurred, the recommendations that were made, and the results that will be used as part of a subsequent emergency formal consultation process (see 50 CFR 402.05) that will be conducted after the spill response is completed. A determination of whether or not the impacts from the response action jeopardized the survival and recovery of the species is documented in a post-spill biological opinion (BO) prepared by the Services. Figure 1-3 illustrates the coordination that occurs during a response action.



Note: Adapted from EPA (2001)

[a] Federal On-Scene Coordinator.

Figure 1-3. Coordination between response planning and implementation and ESA

1.1.2 Decision Process for Use of Non-Mechanical Countermeasures

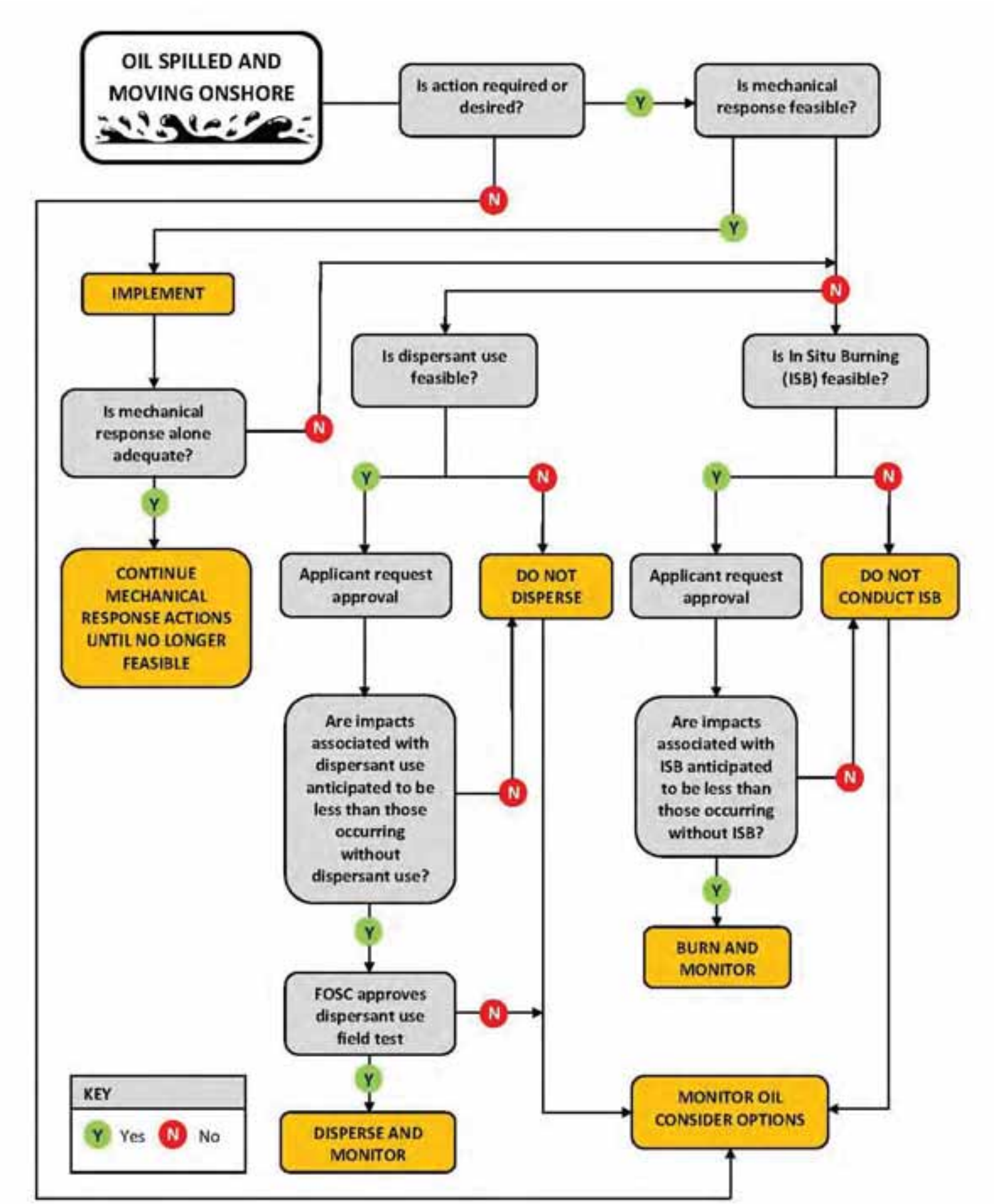
Spill responses in Alaska can be hampered by a number of factors (e.g., the distance between the spill and response equipment and personnel, access, weather, sea conditions, and topography). Dispersants or *in situ* burning can serve as methods for mitigating the impacts of oil when response options with mechanical countermeasures are limited and the risk of environmental harm from the oil is great. The use of dispersants and *in situ* burning as countermeasures for oil spills requires an additional decision-making process under the Unified Plan (EPA et al., 2010) (Annex F).

Decisions regarding the use of dispersants must take into account the resources at risk, the size of the spill, the physico-chemical properties of the type of oil spilled, the feasibility of the response actions, and site-specific conditions (e.g., weather, sea state, the presence of ice). The overarching criterion for decision-making is that dispersed oil will be less harmful than non-dispersed oil.

As of the writing of this BA, dispersants are not pre-authorized for use anywhere in Alaska. A new dispersant use and pre-authorization policy has been drafted (included in Appendix A), agreed to by all required signatories under the NCP (40 CFR 300.910), and is in the process of mandatory federal-to-tribal government consultation and State of Alaska public comment process before it can be finalized (target date of April 2014) and go into effect 24 months hence. The intent of the new draft pre-authorization policy is to:

- Provide an administrative tool to ensure well-regulated availability of the supplies and equipment necessary to respond quickly and effectively to oil spills
- Include safeguards such that pre-authorization:
  - Applies only within the first 96 hours of a spill
  - Applies only to crude oil spills from tank vessels not bound to/from a US port(s) (i.e., non-innocent passage)
  - Applies to well-defined, risk-based zone consisting of tanker traffic areas through which crude oil is shipped
- Require emergency consultation with the Services prior to the application
- Ensure development of avoidance areas within each of the five affected subareas wherein dispersant approval protocols will follow the case-by-case procedure.
- Ensure deployability of robust dispersant efficacy monitoring (i.e., special monitoring of applied response technologies [SMART] Tier I-III) capabilities within a prescribed time window

In the absence of pre-authorization, the FOSC must formally request to use dispersants anywhere in Alaska's waters. The FOSC works with the RP, NOAA's scientific support coordinator (SSC), the Environmental Unit of incident command, and other resource agencies to complete a comprehensive, detailed checklist and application and submit them to the incident-specific ARRT for expedited approval. This request documents the conditions under which the dispersant would be applied and the environmental tradeoffs associated with the decision. The ARRT considers each request on a case-by-case basis. The EPA representative to the ARRT must concur, modify, or reject the request. If State of Alaska waters or interests are involved or threatened by the spill, the state's representative to the ARRT must also concur, modify, or reject the request. EPA and State of Alaska representatives must be in agreement as to the disposition of the FOSC's dispersant use request. The Services are consulted throughout the decision-making process via the emergency consultation process identified in the MOA (EPA et al., 2001). Figure 1-4 illustrates this decision process.



Source: Developed by ARRT July 2012

Figure 1-4. Conceptual decision process for *in situ* burning or dispersant use under the Unified Plan

Subsea dispersant use is not a component of potential response actions identified in the Alaska Unified Plan because it was not conceived of as a response option until the Deepwater Horizon spill in the Gulf of Mexico in 2010. The draft oil dispersant authorization plan, (which will replace Appendix I in Annex F, once approved [approval anticipated for April 2014]; the draft language is included in Appendix A to this BA) indicates any request for subsea dispersant use will be considered using the process for case-by-case dispersant use authorization, with requirements for emergency ESA Section 7 consultation and effectiveness monitoring. As more information and conclusive science becomes available on the subsea application of dispsersants, the potential impacts of this response method and any recommended mitigative measures will be further analyzed and evaluated and appropriately incorporated into the Alaska Unified Plan.

Decision-making regarding *in situ* burning should take into account the same information as considered for dispersant use (described above and also described in Revision 1 to the *In situ burning guidelines for Alaska* included in Annex F to the Unified Plan) (EPA et al., 2010; ADEC et al., 2008). Burning may be considered if mechanical countermeasures are ineffective and burning is feasible and can be conducted at a safe distance from populated areas or sensitive resources. *In situ* burning is included as part of the emergency consultation process with the Services, who provide recommendations regarding how to avoid or minimize impacts to ESA species or critical habitats from burning oil or burning activities.

No other non-mechanical countermeasures have been approved for use in Alaska; any proposal would require approval by ARRT, of which the Services are members.

1.2 Species and Critical Habitats Addressed in Unified Plan 1.2 Consultation

The 35 species currently (as of December 2013) listed as endangered[10] or threatened[11] (including distinct population segments [DPS] or evolutionarily significant units [ESUs]) that are present in Alaska and its adjacent waters are evaluated in this BA (Table 1-1). Three candidate[12] species are also included, as well as one species for which the candidate status was vacated in October 2013[13]. Critical habitat[14] that has been

[10] Endangered species are those species that are in danger of extinction within the foreseeable future throughout all or a significant portion of their range.

[11] Threatened species are those species that are likely to become endangered within the foreseeable future.

[12] Candidate species are those species for which there is sufficient information to justify their proposal for inclusion on the federal threatened and endangered species list.

[13] The Kittlitz's murrelet was designated as a candidate species during the preparation of the BA. On 3 October 2013, USFWS issued a determination finding that listing the Kittlitz's murrelet was not currently warranted (78 FR 61764, 2013). This listing determination was published during finalization of the BA. Therefore, the Kittlitz's murrelet has been included in the BA, but an effects determination has not been made because listing under ESA is not imminent.

designated within the action area is also evaluated in this BA and identified in Table 1-1.

Table 1-1. Protected species and habitats evaluated in the Unified Plan biological assessment

Protected Species	Status	Critical Habitat?
Marine Mammals		
Beluga whale (*Delphinapterus leucas)* – Cook Inlet DPS	E	yes
Blue whale (*Balaenoptera musculus)*	E	no
Bowhead whale (*Balaena mysticetus)*	E	no
Fin whale (*Balaenoptera physalus)*	E	no
Gray whale (*Eschrichtius robustus*) – Western North Pacific stock	E	no
Humpback whale (*Megaptera novaeangliae)*	E	no
North Pacific right whale (*Eubalaena japonica)*	E	yes
Sei whale (*Balaenoptera borealis)*	E	no
Sperm whale (*Physeter macrocephalus)*	E	no
Steller sea lion (*Eumetopias jubatus)* – western population	E	yes
Steller sea lion (*E. jubatus)* – eastern population[a]	T	yes
Polar bear (*Ursus maritimus*)	T	no[b]
Northern sea otter (*Enhydra lutris kenyoni*) – southwest Alaska DPS	T	yes
Pacific walrus (*Odobenus rosmarus,* ssp. *divergens*)	C[c]	no
Ringed seal (*Phoca hispida)*	T	no
Bearded seal (*Erignathus barbatus)*	T	no
Birds		
Eskimo curlew (*Numenius borealis*)	E	no
Short-tailed albatross (*Phoebastria albatrus*)	E	no
Spectacled eider (*Somateria fischeri*)	T	yes
Steller's eider (*Polysticta stelleri*) – Alaska breeding population	T	yes
Kittlitz's murrelet (*Brachyramphus brevirostris*)	NL[d]	no
Yellow-billed loon (*Gavia adamsii*)	C[c]	no
Fish		
Chinook salmon (*Oncorhynchus tshawytscha*) – Lower Columbia River ESU	T	no
Chinook salmon (*O. tshawytscha*) – Upper Columbia River, spring run ESU	E	no
Chinook salmon (*O. tshawytscha*) – Puget Sound ESU	T	no

[14] Critical habitat is a pre-determined, legally designated geographical area occupied by the species that contains physical or biological features deemed important to the conservation of the species or other features that may require special management considerations or protection.

Protected Species	Status	Critical Habitat?
Chinook salmon (*O. tshawytscha*) – Snake River fall run ESU	T	no
Chinook salmon (*O. tshawytscha*) – Snake River, spring/summer run ESU	T	no
Chinook salmon (*O. tshawytscha*) – Upper Willamette River ESU	T	no
Coho salmon (*Oncorhynchus kisutch*) – Lower Columbia River ESU	T	no
Steelhead trout (*Oncorhynchus mykiss*) – Lower Columbia River DPS	T	no
Steelhead trout (*O. mykiss*) – Middle Columbia River DPS	T	no
Steelhead trout (*O. mykiss*) – Snake River basin DPS	T	no
Steelhead trout (*O. mykiss*) – Upper Columbia River DPS)	T	no
Pacific herring (*Clupea pallasi*) – Southeast Alaska DPS	C	no
Reptiles		
Leatherback sea turtle (*Dermochelys coriacea*)	E	no[e]
Loggerhead turtle (*Caretta caretta*)	E	no[e]
Green turtle (*Chelonia mydas*)	T	no
Olive Ridley turtle (*Lepidochelys olivacea*)	T	no
Plants		
Aleutian shield fern (*Polystichum aleuticum*)	E	no

[a] The eastern population of Steller sea lion is currently proposed for delisting (NMFS, 2012a).

[b] On 10 January 2013, the US District Court for the District of Alaska issued an order vacating and remanding to the Service the 7 December 2010, Final Rule designating critical habitat for the polar bear. Therefore, there is currently no critical habitat designated for the polar bear (US District Court District of Alaska, 2013).

[c] The Pacific walrus and yellow-billed loon have been designated as candidate species. A 12 July 2011 court settlement agreement established that USFWS would either submit a proposed rule to list the species, or issue a not-warranted finding. The dates of submittal established in the settlement agreement are October 2014 for the yellow-billed loon and October 2017 for the Pacific walrus (US District Court for the District of Columbia, 2011).

[d] The Kittlitz's murrelet was designated as a candidate species during the preparation of the BA. On 3 October 2013, USFWS issued a determination finding that listing the Kittlitz's murrelet is not currently warranted (78 FR 61764, 2013). This listing determination was published during finalization of the BA. Therefore, the Kittlitz's murrelet has been included in the BA but an effects determination has not been made because listing under ESA is not imminent.

[e] Critical habitat has been designated for leatherback sea turtles (77 FR 4170, 2012) and proposed for loggerhead turtles (78 FR 43006, 2013) outside of Alaska.

BA – biological assessment
C – candidate
DPS – distinct population segment
E – endangered
ESA – Endangered Species Act
ESU – evolutionarily significant unit
NL – not listed
T – threatened

2 Description of Potential Response Actions

Emergency spill response has three primary phases: control, recovery, and cleanup. Spill responses applicable to these phases are generally categorized as mechanical or non-mechanical countermeasures. Supporting activities include reconnaissance, monitoring, and wildlife protection based on deterrence or capture. All components of a response action incorporate best management practices (BMPs) that help to avoid or minimize the impacts of response actions to ESA-listed species and critical habitats. It is the FOSCs role to ensure that appropriate BMPs are implemented during response actions.

Natural attenuation (i.e., the lessening of impacts through evaporation, weathering, natural dispersal, or biodegradation) represents a no-action scenario (but may include the activities of initial reconnaissance and long-term monitoring to assess the consequences of natural attenuation).

The spill response strategy employed depends on several factors, such as the type and amount of material spilled; the proximity of the spill to the shore, populated areas, or important resources; and sea and weather conditions. In the case of a petroleum release, the selection of an appropriate response will vary depending on whether the product is refined or crude oil because the chemical characteristics of the material will influence the success of the countermeasure.

2.1 Mechanical Countermeasures

Mechanical countermeasures are primary response actions that are intended to deflect, exclude, or contain oil or other spilled material before it can further impact ecological and cultural resources. Mechanical countermeasures include:

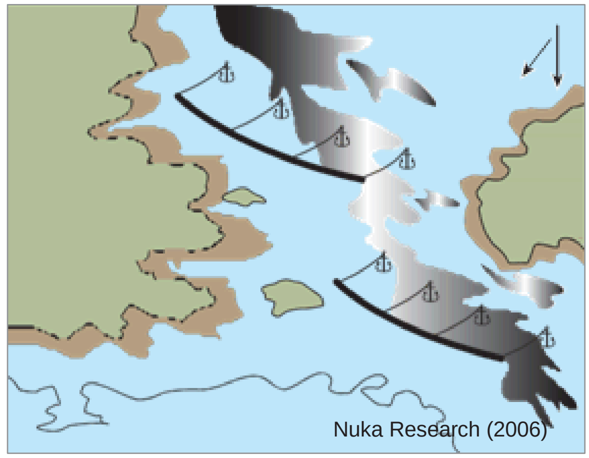
- Deflection and containment
  - Booming
  - Constructing barriers, dams, pits, and trenches
  - Culvert blocking
- Recovery
  - Skimming / vacuuming
  - Sorption
- Removal / cleanup
  - Removal
  - Vegetation removal and disposal
  - Flushing and flooding

- Steaming and sandblasting

2.1.1 Deflection and containment

Deflection or containment actions may involve deploying booms or constructing structures, such as earthen berms, on land to contain and collect a spilled material. In upland environments, the placement and configuration of controls is often based on detailed drainage patterns and topography. In coastal environments, the mapping or modeling of winds, currents, and tidal patterns, in conjunction with real-time observations, supports the placement and configuration of booms and sorbents.

Booming – A boom is a floating barrier that is used to divert (either into or away from an area) or contain buoyant spilled materials in aquatic environments (i.e., open water, nearshore, rivers, and lakes). Fire booms are used to concentrate spilled oil during an *in situ* burn.



Deflection booming

The use of defensive or containment booms is one of the first response actions called for in the GRS (ARRT, 2012). Boom designs are specific to the environment in which they will be used; however, booms are less effective in conditions of rough water, high winds, fast currents, or broken ice (Stevens and Aurand, 2008; NOAA et al., 2010).

Boom systems consist of floating boom sections (which may include hanging curtains), buoys, and an anchoring system. Configurations vary according to the site-specific conditions and purpose (e.g., containment versus deflection). Deployment typically involves the use of one or more large vessels and / or small work boats with associated crew(s). Shoreside workers and heavy machinery on barges or piers may also be used if boom ends are anchored onshore. In open water, booms are typically deployed between two vessels in order to concentrate the spilled substance or oil slick for recovery actions (e.g., skimming). Alaska Clean Seas (2010), ADEC's spill tactics for Alaska responders (STAR) manual (Nuka Research, 2006), and the Arctic spill response field guide (EPPR, 1998) provide in-depth descriptions of booming response actions.

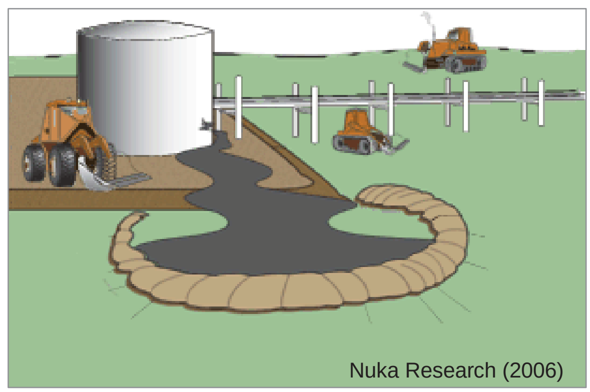
Booms require frequent tending and adjustment to stay in position over the course of their use and thus require the periodic or continuous presence of a work vessel (or other equipment) and crew to be effective.

The physical displacement or destruction of benthic invertebrate and plant communities may occur at boom anchor points, although the impacts are typically localized (NOAA et al., 2010). The use of existing in-water fixtures such as buoys, dolphins, docks, or deadmen (i.e., buried materials that can be used as anchors) and onshore fixtures such as piers, when available, minimizes these impacts. Untended booms may also impact benthic habitats if the booms are allowed to run aground or tangle with kelp or other aquatic vegetation. Monitoring and the periodic readjustment of deployed booms are carried out during booming to prevent these impacts.

Seabirds and small marine mammals might use booms as resting perches and thus be exposed to spilled material that adheres to the booms. The operation of vessels or heavy machinery during booming could disturb or injure populations of marine mammals or seabirds as a result of the presence of people, production of noise, or direct contact (e.g., accidental ship strikes). In some cases (e.g., booming in shallow water), the presence of a boom may prevent an animal's access to a specific resource; however, booming in shallow water will not likely prevent the movements of protected species, inasmuch as they are able to fly over or swim under booms and hanging curtains.

Disturbances during booming are minimized through the use of biological constraints such as the establishment of buffer zones around sensitive species or critical habitats, and the use of timing windows. Limiting vessel speeds and monitoring for the presence of marine mammals and seabirds reduce disturbance and the likelihood of ship strikes or entanglement. Monitoring and tending the boom during deployment and operation are also key to minimizing potential impacts.

Constructing Barriers, Dams, Pits, and Trenches – Filter fences, berms, dams, pits, and trenches are used to divert or contain spilled materials in upland, riparian, or sea ice environments. These physical barriers are typically used in conjunction with skimming or other recovery techniques (e.g., sorbents, vacuuming). Alaska Clean Seas (2010), ADEC's STAR manual (Nuka Research, 2006), and the Arctic spill response field guide (EPPR, 1998) provide in-depth descriptions of these response actions.



Berming

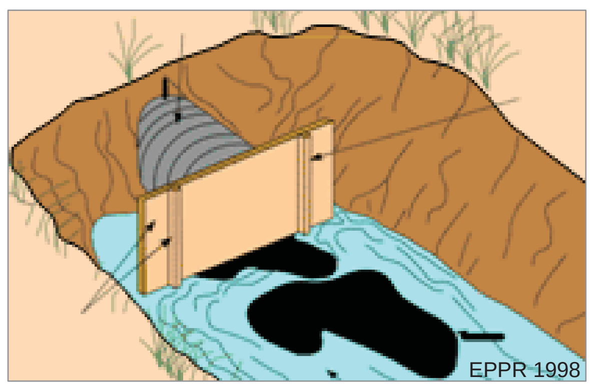
The construction of these physical structures typically requires the use of heavy machinery (or hand construction, depending on location) to install man-made materials (e.g., filter fences, sand bags, air- or water-filled seal booms) or place natural substrates (e.g., soil, snow, ice rubble). If water flow from a bermed area is necessary, an underflow culvert or overflow weir may be included in the construction of a berm or dam. There is also activity associated with construction as equipment and personnel are mobilized to and from the site.

Disturbance of soil and vegetation, compaction of soil, impact on permafrost, and noise are all possible adverse effects associated with the construction of these physical structures in upland and riparian environments. The disturbance of soil or the trampling, compaction, or removal of vegetation can increase soil erosion. The impact on permafrost can significantly alter the landscape by inducing thermokarsting (Alaska Clean Seas, 2010), an erosive process in Arctic landscapes. Construction noise may disturb sensitive species. Natural materials (e.g., soil) used for the construction of dams and berms might be contaminated with the spill material and require additional handling and disposal. Constructed structures could prevent a species' access to a resource, and the operation of vehicles can result in direct injury if an animal is struck.

Although in most cases upland habitats will be restored following a spill response, there may be some permanent loss or degradation of habitat and subsequent loss of ecological services provided by the habitat and communities that would normally be found there.

Minimizing the footprint for materials staging, equipment storage, or vehicle parking will help minimize soil disturbance. Permafrost damage can be partially mitigated by reducing foot and vehicle traffic, when possible, and by using plywood, rig mats, or Dura-Mats™ to distribute pressure over a greater area. Berms and dams can be lined with reinforced plastic sheeting or geotextile to prevent the contamination of the surrounding soil or other construction materials (e.g., snow). Locating and observing animals in the vicinity of the response action, establishing a buffer zone, and minimizing vehicle speeds are practices that can be implemented to minimize disturbance and potential harm to ESA-listed species. If necessary, trained personnel (operating under a federal permit) may deter wildlife in the vicinity of the response action.

Culvert Blocking – Open culverts present a potential route for spilled material to enter otherwise unaffected areas. In order to eliminate this threat, culverts may be blocked with a temporary or permanent fixture (e.g., plywood, plug, plastic sheeting, sandbags). Culvert blocking may also be achieved through the use of deflection booming (as discussed above) near the culvert. Wildlife and habitat impacts associated with culvert blocking are similar to those for berming or trenching, albeit on a smaller scale. Disturbance or potential interaction with wildlife is mitigated as discussed above.



Culvert blocking

2.1.2 Recovery

The recovery of spilled oil is often an important component of an oil spill response action and is typically carried out in conjunction with containment, diversion, deflection, and / or removal actions (Nuka Research, 2006). In the case of uncontaminated petroleum products, recovered material is reprocessed and refined for commercial use. Several technologies or processes, including skimmers, vacuums, sorbent materials, and manual or mechanical removal, may be used in recovery, depending on the environment in which the spill occurred, the nature and amount of the material spilled, and the behavior of the material following release. Highly refined petroleum products such as gasoline, diesel, and kerosene tend to evaporate from the water very quickly, even during winter months. A significant portion of any crude oil spill in open water will also evaporate if the crude oil is not recovered within the first 24 to 48 hours after a spill (NOAA et al., 2010). However, in sub-freezing temperatures, when ice pack is present, spilled oil will evaporate more slowly than oil spilled in open water (Potter et al., 2012). Overall, recovery efforts in open water tend to have limited effectiveness; recovery rates can range from 5 to 30% (MMS, 2010).

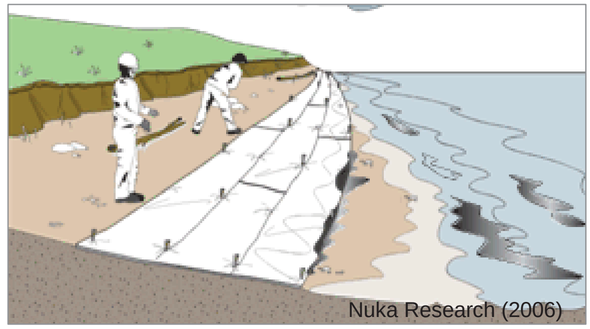
Skimming/Vacuuming – Skimmers are mechanical devices that collect oil or other floating contaminants at the water's surface through suction or sorption. They are designed to minimize the intake of water and maximize the uptake of spilled material but often generate wastewater that requires additional space (on land or shipboard) for storage and treatment. The efficiency of skimmers is limited if the water is rough; if aquatic vegetation, floating debris, or ice is present; or if the floating material is too viscous.

Rope mop skimmer

Vacuums may be small, portable units or truck / vessel-mounted units used to remove pooled or stranded material (typically oil), regardless of the viscosity. Large amounts of water may be entrained during the vacuuming of floating material and require storage, treatment, and disposal.

Skimming may entrain plankton, larval fish, and invertebrates that are present at or near the water's surface; vacuuming, rather than skimming, is usually performed to recover more-limited volumes of spilled material but may also entrain plankton. Wastewater and recovered material may be stored onboard the work vessel, on an adjacent barge, or onshore for treatment or transport and disposal. The handling, transport, and storage of wastewater and recovered product may disturb soil or sediment in upland or shoreline habitats through the use of heavy equipment, vehicles, and / or vessels to transport these materials to treatment or refining facilities, as well as through the placement of the material to be stored, depending on the area required for storage.

Sorption – Sorbents collect spilled materials, particularly petroleum or similar products, through either adsorption (adherence to the sorbent surface) or absorption (penetration of the pores of the sorbent). Natural and mineral sorbents include peat moss, straw, snow, and clay. Synthetic sorbents are inert and insoluble materials that are generally manufactured in particulate form and are designed to be spread over an oil slick or deployed as sheets, rolls, pillows, or booms. They are typically deployed by hand or machine to the spilled material (either floating or on land) and are removed and replaced once coated or saturated. In the case of oil spills, the sorbed material is recovered from the coated / saturated sorbents to the degree practicable. Used sorbents require collection, handling, and offsite hazardous waste disposal.



Passive sorbents along shoreline

The operation of vessels or heavy machinery during any of these recovery actions may disturb or injure populations of marine mammals or seabirds through the presence of people, production of noise, or direct contact (e.g., accidental ship strikes or vehicle collisions). Disturbances are minimized by monitoring for the presence and behavior of wildlife; through the use of buffer zones around sensitive species or critical habitats; the implementation of timing windows; the tending of equipment and materials; and the limiting of vessel speeds.

2.1.3 Removal/cleanup

A response action may include the manual or mechanical removal of spilled material, contaminated soil, sediment, vegetation, or debris in upland (including shorelines) and nearshore environments. Shorelines or streams that are in the path of a spill may be subject to the pre-emptive removal of debris (e.g., large logs or root balls) to minimize the retention of a spilled material and its subsequent release over time.

Removal may also be augmented by flushing or otherwise washing surfaces (including large vegetation) to which spilled materials have adhered. Flushing or related responses are used in conjunction with containment and recovery actions. Chemicals may also be used to assist in the removal or release of spilled materials (particularly oil) from surfaces; however, no chemicals are currently approved by the ARRT for use in this manner.

Removal—Manual removal is conducted using hand tools (e.g., rakes, shovels, scrapers). Material is collected in containers that are typically transported by vehicle to a storage area for later disposal. Mechanical removal relies on heavy equipment (e.g., bulldozers, backhoes) and is usually implemented when the spill area / debris size exceeds the capacity of manual removal.


Oil Spill Solutions (2012)

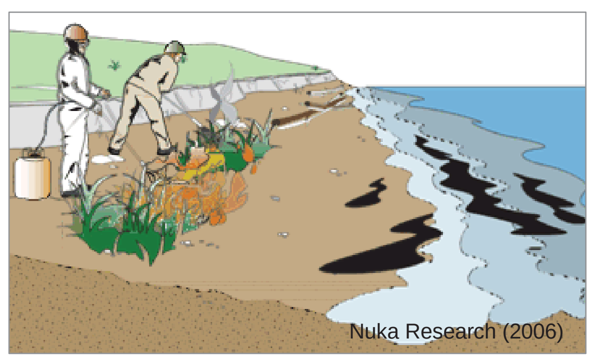
Manual removal of spilled material

The removal of contaminated soil or sediment, either by hand or with machinery, has an impact on associated habitats. The operation of vessels or heavy machinery during any of these actions may disturb or injure populations of marine mammals or seabirds through the presence of people, production of noise, or direct contact (e.g., accidental vehicle strikes).

Disturbances can be minimized using BMPs, such as establishing buffer zones around sensitive species or critical habitats, using timing windows, limiting vessel or vehicle speeds, and monitoring for the presence of animals. Habitat restoration in areas where soil or sediment has been removed can minimize the loss of habitat; however, there may be some permanent loss or degradation of habitat and subsequent loss of ecological services.

The removal of debris (particularly large, woody debris) can cause a loss in ecosystem function because of the debris's role in providing refuge, foraging habitat, shoreline stabilization, and shading (thermoregulation). The loss of these functions can be minimized by the replacement of naturally occurring debris following a spill, such that habitat complexity and ecosystem functions are restored.

Vegetation Removal and Disposal – Aquatic, shoreline, or riparian vegetation that has been heavily contaminated by a spilled product may be a continuing threat to organisms that either forage on that vegetation or use it as habitat. Vegetation can be removed either manually or mechanically. The heavier the machinery used, the greater the soil or sediment compaction and noise produced, although foot traffic by workers will also cause some compaction.


Nuka Research (2006)

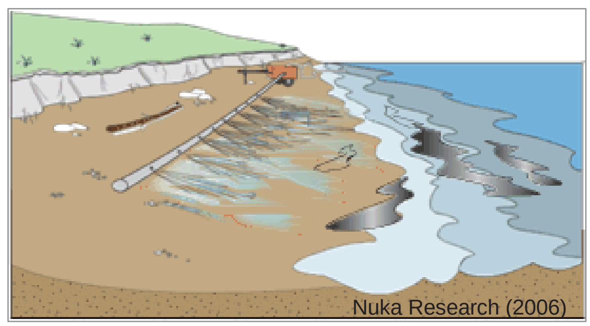
Manual vegetation removal by burning

The removal of vegetation (aquatic or terrestrial) reduces habitat (e.g., refuge, spawning) and forage for a number of species. In environments that are prone to erosion (e.g., wetlands, mud flats, fine-grained sand beaches), removal may accelerate hydraulic and thermal erosion.

Contaminated vegetation also requires handling and disposal, which may increase the use of workers and equipment on a site. If onsite burning is used to dispose of vegetation, the ensuing heat may permanently alter the substrate, and air quality will be degraded during the burning. The section below on *in situ* burning provides more detail on this subject.

The effects of vegetation removal can be mitigated through replanting and habitat restoration, although there will be a delay during recovery in replacing the ecological function provided by vegetation, which will take one or more growing seasons.

Flushing and Flooding – Flushing and flooding are response actions that rely on hydraulic action to remove a spilled material from a solid or semi-solid surface (e.g., rocks, bulkhead, cobble beach), so that the material can be contained and collected. Water can be heated to enhance the removal process. These actions are typically applied in shoreline habitats.



Flooding

Flushing involves forcing large quantities of ambient or supplied water at pressure (ranging from < 50 to 1,000 pounds per square inch [psi]) through sediment (NMFS, 2003) or across surfaces to move hydrophobic contaminants into a containment area. Flooding involves the use of very large quantities of water to flush a spilled product from the sediment to the surface into a containment area. Booms can be used to contain or direct the spilled material washed from the sediment collection areas. Skimmers and sorbent materials can be used to collect the resulting floating material. The potential adverse effects of booming, sorbent materials, skimming, vessel traffic, foot traffic (i.e., for installing materials on the shoreline), and noise are discussed in sections above. The remobilization of spilled material can lead to contamination if the material escapes containment. Species that live in the sediment in areas where flushing or flooding actions are conducted may be displaced, injured, or killed from predation, thermal shock (if the water is heated), or the pressure of the water itself. In addition, if flushing is used with fine-grained sediment (e.g., fine-grained sand), this action may erode upper intertidal sediment, resulting in sedimentation in lower intertidal areas and the subsequent suffocation and smothering of benthic organisms.

The use of warm or hot water for flushing will likely cause heat stress in shoreline communities (NOAA et al., 2010). Flushing and flooding systems that use ambient water can inadvertently entrain plankton and larval fish as water is pumped into the system, with a resulting high likelihood of organism mortality.

The use of cold water for flushing along with lower water pressures can minimize stress to shoreline communities. The use of booms around intake pumps can reduce the entrainment of plankton found in the uppermost portion of the water column. Placing the intake in deeper water may also be effective.


Oil Spill Solutions (2012)

Steam cleaning

Steam Cleaning or Sandblasting—In the event that a constructed or low-value shoreline habitat is contaminated by a floating product, steam cleaning or sandblasting may be used to remove the product from rocky substrates. This process is very limited in scope but nonetheless effective for oil recovery. Biota living in areas treated in this manner will likely be destroyed by the high heat, pressure, and / or abrasion.

2.2 NON-MECHANICAL COUNTERMEASURES

Non-mechanical countermeasures are actions that alter the physical or chemical properties of the spilled material (i.e., petroleum or oil-like materials) such that the options for recovery are improved or the overall impacts of spilled material that cannot be recovered are potentially reduced. Several non-mechanical countermeasures may introduce response-related environmental impacts, and, accordingly, are subject to ARRT approval prior to implementation.

Non-mechanical countermeasures include:

- Application of approved dispersants[15]
- Application of other chemical agents (e.g., solidifiers, herding agents,[16] and fire foam)
- Application of biodegradative organisms or nutrient stimulants to enhance natural biodegradation
- *In situ* burning

Currently, dispersant application and *in situ* burning are the two non-mechanical countermeasures approved for oil spill response under the Unified Plan (EPA et al.,

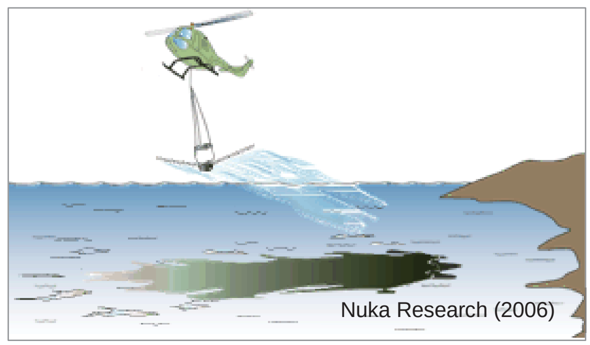
[15] Dispersants are not pre-authorized for use anywhere in Alaska. A new dispersant pre-authorization policy has been drafted (included in Appendix A) and is pending final approval as of December 2013.

[16] Currently, there are no surface-collecting agents on the NCP product schedule, although NOAA (2010) has identified these agents as potentially appropriate for oil spill response actions.

2010). As mandated by the NCP, both of these countermeasures must be accompanied by appropriate efficacy monitoring using SMART protocols.

Subpart J of the NCP directs EPA to prepare a product schedule of dispersants or other chemicals or substances that may be used to remove or control oil discharges (currently, no products have been developed or approved for hazardous materials). Only two dispersant formulations from EPA's product schedule, Corexit® EC9500A and Corexit® EC9527A (hereafter referred to as Corexit® 9500 and Corexit® 9527), are currently available for use in Alaska. Use of these dispersants requires authorization from ARRT (see Section 1.1.2) and the use of Corexit® 9527 is restricted to existing stocks and will be phased out[17]. Other chemicals that are currently available for use during an oil spill (i.e., those listed on the NCP product schedule) would require ARRT approval. Protocols for the development and proposal of other chemical or biological agents for review and approval by the ARRT are described in the Unified Plan (EPA et al., 2010).

2.2.1 Chemical dispersants



Dispersant application

Chemical dispersants are mixtures of surfactants and hydrocarbon-based solvents that alter the spatial distribution, chemical fate, and physical transport of spilled oil in aquatic environments. The application of chemical dispersants in marine environments as a response action is restricted to spilled petroleum or other oil-carried or oil-like contaminants. Dispersant use requires ARRT approval on a case-by-case basis, except in the case of immediate risk of the ignition or inhalation of volatile and poisonous constituents of oil.[18] The use of chemical dispersant as a response option is reserved for occasions when resources are at risk and other response actions are either not feasible or not adequate to contain or control the spill because of field conditions (e.g., remote location, lack of access) (EPA et al., 2010).

The purpose of chemical dispersants is to reduce the concentration of oil at the surface of the water by breaking the oil into emulsified droplets that can be suspended and distributed (and thus diluted and degraded) throughout the water column. This dilution of oil likely reduces wildlife exposure to oil at the sea surface (NRC, 2005); dispersed oil is also less likely to wash ashore in sensitive coastal areas. However, the use of dispersants represents a tradeoff in exposure because invertebrates and larval

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[17] As of December 2013, existing stock of Corexit® 9527 is presumed depleted.

[18] Spilled oil products may contain poisonous and flammable volatile organic compounds, and oil dispersal is an option to reduce the immediate risk of ignition or inhalation. The FOSC may be empowered to use dispersants without obtaining outside consent or consultation under circumstances presenting a hazard to human life (40 CFR 300.910(d)).

column (at least until greater dilution or biodegradation is achieved, which occurs over the course of hours to days [for dilution]or months [for biodegradation]). Additional details on the properties, toxicity, and fate and transport of dispersants when applied to oil are presented in Appendix B.

Dispersants are applied to the oil's surface via either vessel-mounted equipment or aerial spraying. Subsurface application, as was performed for the Deepwater Horizon spill in the Gulf of Mexico, is not addressed as part of this consultation. The effectiveness of dispersants is dependent upon the amount of time that has elapsed since the spill (oil weathering), surface oil thickness, oil viscosity, water depth, salinity, temperature, and sea conditions (NRC, 2005). However, recent studies have indicated that dispersants are effective in Arctic conditions (Potter et al., 2012; Sørstrøm et al., 2010; Brandvik et al., 2010; MMS, 2010). Dispersants require physical mixing for optimum effect. The mixing can be intentionally induced (use of propeller wash in broken ice conditions) by the sea state. Although wave action is reduced in areas covered by sea ice, the vertical movement of segmented ice floes has been shown to sufficiently disperse treated oil spills in a manner similar to that of wave action (Potter et al., 2012).

Efficacy of applied dispersant can be assessed in a variety of ways. The NCP describes three levels of SMART monitoring:

- **Tier I—A** trained observer, flying over the oil slick and using photographic job aids or advanced remote sensing instruments, assesses dispersant efficacy and reports results to the incident command post. This is the minimum level of monitoring required for dispersant use nationally.
- **Tier II—**Real-time empirical data is gathered from the treated slick. A sampling team on a boat uses a monitoring instrument to continuously monitor for dispersed oil 1 m under the dispersant-treated slick and reports the results to the incident command post. Water samples are also taken for later analysis at the laboratory.
- **Tier III—**Expanded real-time empirical data is gathered from the treated slick to determine where the dispersed oil goes and what happens to it. Similar to Tier II, a sampling team(s) uses at least two monitoring instruments to monitor the water at several depths, often from the center of the slick. A portable water laboratory provides data for water temperature, pH, conductivity, dissolved oxygen, and turbidity. Results are reported to the incident command post.

There are a total of 21 dispersants listed on the January 2012 NCP product schedule. The use of these dispersants requires ARRT approval (EPA et al., 2010). The formulations for Corexit® 9500 and Corexit® 9527[19], which are the two dispersants that have been available for use in Alaska are provided in Table 2-1.

Table 2-1. Corexit® 9500 and Corexit® 9527 dispersant formulations

Chemical Constituent	Chemical Type	CAS No.
Propylene glycol	solvent	57-55-6
2-Butoxy ethanol[a]	solvent	111-76-2
Sodium dioctyl-sulfosuccinate	surfactant	577-11-7
Sorbitan monooleate	surfactant	1338-43-8
Polysorbate 80	detergent/surfactant	9005-65-6
Polysorbate 85	surfactant	9005-70-3
1-(2-Butoxy-1-methylethoxy)-2-propanol	solvent	29911-28-2
Petroleum distillates, hydro-treated, light	solvent	64742-47-8

[a] This chemical is not included in the formulation of Corexit® 9500.

CAS – Chemical Abstracts Service

Vessels used during the application and monitoring of dispersants may disturb or injure populations of marine mammals and seabirds through the presence of people, production of noise, or direct contact (e.g., ship strikes). Dispersants and dispersed oil may also diminish or eliminate the insulating properties of the feathers or fur of exposed wildlife by altering their ability to trap air (Duerr et al., 2011). Because of their toxicity to plankton and larval fish, dispersants and dispersed oil can also reduce the populations of prey that support fish and wildlife protected under the ESA (Rico-Martinez et al., 2013; Ortmann et al., 2012).

Dispersant use guidelines prohibit the spraying of these mixtures directly over aggregations of fish, birds, or marine mammals. The impacts of dispersant application (e.g., disturbance, dispersant contact) can be minimized through the provision of appropriate wildlife observers in aircraft; establishing buffer zones around sensitive species; and limiting vessel speeds. Monitoring for the presence of animals (marine mammals and seabirds) can further reduce disturbance and likelihood of ship strikes.

The primary potential impacts associated with the application of dispersants are direct toxicity of the dispersant and/or dispersed oil to exposed prey organisms (i.e., plankton and larval fish) and hypothermia due to a loss of insulating oils and disruption of feather structure (e.g., Duerr et al., 2011). Although not documented in marine mammals, direct contact with dispersants or dispersed oil has been speculated to irritate eye tissues, and aspiration may result in chemical pneumonia (CDC and ATSDR, 2010). Depending on the formulation and application rate, dispersant toxicity will vary; however, toxicity is expected to be acute (rather than chronic) because of the

[19] Corexit® 9527 is no longer being manufactured; however, existing inventories can continue to be used until depleted. Stockpiles may be depleted as of the writing of this BA, but that information could not be corroborated.

rapid rate at which dilution occurs after application (Gallaway et al., 2012; NOAA, 2012b) (Appendix B).

2.2.2 Other chemical or biological mixtures

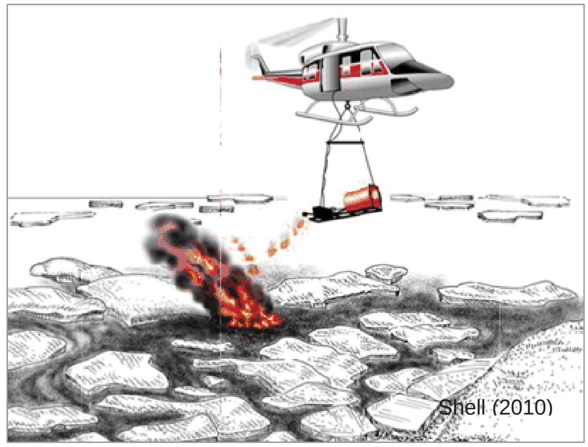
Other types of chemicals that are listed in the NCP product schedule and may be applied to spilled oil in the environment are those that change the physical or chemical properties of the oil in order to enhance collection, treatment, or biodegradation. None of these chemical or biological agents are currently approved for use in Alaska. These chemicals and their potential uses include:

- **Emulsion-separation agents—**Separate emulsified mixture into oil and water phases to reduce waste volume requiring treatment; typically used with skimming or in wastewater storage tanks; also can be applied to emulsified oil slicks on the water's surface prior to dispersant application to break the emulsion and make the oil more dispersible
- **Surface-collecting agents (herders)—**Collect and thicken oil layer to enhance recovery; typically used with skimming
- **Solidifiers—**Change oil from a liquid to a solid to prevent remobilization, penetration into a substrate, or further spreading; typically used as part of a shoreline response action
- **Surface-flushing agents—**Soften or lift oil from substrate (or vegetation) to enhance flushing; may be used along shorelines or in shallow, vegetated nearshore areas
- **Nutrients—**Enhance microbial degradation of light-to-medium oils spilled on land or in shoreline areas
- **Microbes—**Augment hydrocarbon-degrading microbes on land or in shoreline areas

The NCP product schedule addresses the toxicity of these products based on several laboratory toxicity tests that used fish and invertebrates under standardized conditions; mammalian or avian toxicity is not addressed. The exposure of ESA-listed species to chemical and biological agents (or food exposed to these agents) may be prevented or reduced through the use of wildlife protection measures, including deterrence (Section 2.7.1).

2.2.3 *In situ* burning

In situ burning is a response action used to address spilled oil in either aquatic or terrestrial habitats. According to the Alaska *in situ* burning guidelines jointly developed by ADEC, EPA, and USCG (2008) (included in the Unified Plan as Appendix II to Annex F), burning can be conducted if, "mechanical containment and recovery by themselves are incapable of controlling the oil spill, burning is feasible, and the burn will lie a safe distance from populated areas." The FOSC has the authority to authorize *in situ* burning on a case-by-case basis after obtaining concurrence from the EPA and ADEC representatives to the ARRT.[20] A review checklist is included in the *in situ* burning guidelines to facilitate the decision process. The checklist includes the following steps:



***In situ* burning**

1. Review the completed Application to Burn Plan (Appendix A to the *In Situ* Burn Guidelines developed by ADEC, EPA, and USCG (2008))
2. Determine the feasibility of burning
3. Determine whether burn may be conducted at a safe distance from population areas
4. Determine whether environmental and other considerations will be adequately addressed
5. Review consultations and requests for authorization
6. Make a decision on whether to authorize burn

The use of *in situ* burning as a response action requires ARRT approval (EPA et al., 2010) and is a valuable tool to quickly remove oil from open water or upland areas and prevent it from reaching sensitive habitats or populations. Burning is considered "feasible" when spilled oil can be ignited and remain ignited until the oil has been consumed. The burning of weathered or emulsified oils is typically infeasible because they are not likely to continue burning once ignited. This is due to the emulsion of oil with water, as well as the rapid evaporation of flammable, volatile oil components. Sea and wind conditions also affect the feasibility of *in situ* burning.

Typically, a heat-resistant fire booming system or berm is used to contain oil prior to burning; the oil is then ignited from an aerial source (i.e., helicopter-suspended torch)

[20] Concurrence from DOI and US Department of Commerce (DOC) natural resource trustees will be obtained when practicable.

(Alaska Clean Seas, 2010). Concentrated oil is better able to remain ignited, and oil trapped between sea ice floes is often sufficiently concentrated so that further containment measures may not be necessary prior to an *in situ* burn (Potter et al., 2012).

The burning of oil produces both airborne and residual solids and air monitoring must be conducted during the burn operation (ADEC et al., 2008). Smoke and burnt residue may have different effects in different locations due to their divergent chemical composition, fate, and transport. Species that will be most affected by thermal impacts of in-water burning are those that are found at the water's surface (e.g., surfacing marine mammals, birds, plankton, small invertebrates, and larval fish) and those that are directly exposed to the residues that settle on the bottom (i.e., benthic organisms). Terrestrial burning affects the soil or other substrate where the burning takes place. In both environments, the smoke from burning introduces particulates that may be inhaled and embedded in lung tissue. Smoke may also reduce visibility, affecting those animals that rely on sight for navigation.

For *in situ* burning operations, SMART protocols include deploying one or more air quality monitoring teams with specialized portable equipment downwind of the burn at sensitive locations, such as population centers. Teams begin sampling before the burn to collect background baseline air quality data. After the burn starts, the teams continue sampling for particulate concentration trends, recording them both manually at fixed intervals and automatically, and report results to the incident command post.

In addition to the formation of solid particulates, pyrogenic PAHs, which may have a higher mutagenicity than the original PAH components in oil (Sheppard et al., 1983), are emitted during *in situ* burning. However, the amount of PAHs in oil is often reduced by > 99% during *in situ* burning (ADEC et al., 2008). ADEC also states (2008) that the volatile components of oil that are not burned are likely to evaporate and cause acute responses in exposed humans or wildlife; *in situ* burning effectively destroy these volatile components. Other gaseous components of potential concern, such as carbon monoxide, nitrogen oxides, and sulfur dioxide, were either not measured above detectable limits or were below National Ambient Air Quality Standards during various controlled burns (ADEC et al., 2008).

Burn residues, which are also composed of mutagenic PAHs, have been shown to be as mutagenic as weathered crude oil and somewhat more mutagenic than fresh crude oil, but much less mutagenic than aerially deposited smoke particulates and PAHs (Sheppard et al., 1983). Therefore, residues produced after *in situ* burning represent a trade-off between exposures to surface oiling over a large area or exposures to residues (of a greatly reduced volume and areal extent relative to pre-burn oil) in the water column or in benthic habitats (ADEC et al., 2008).

If conducted in shallow marine areas and wetlands, burning of oil may lead to the destruction of aquatic vegetation, resulting in the loss of nursery and foraging habitat and potentially to increased erosion. If an *in situ* burn is conducted in a stream or lake environment, substantial loss of vegetation may result. If the root structure of an area is also destroyed, an increase in erosion, decrease in available nutrients, and likely degradation of habitat through sedimentation and altered channel morphology may occur.

The communities potentially affected by upland burning include vegetation, soil microbes, burrowing invertebrates, small mammals, and nesting species. The long-term effects of burning will depend on the habitat and vegetation present. The burning of fire-tolerant herbaceous grasses and shrubs will be less damaging than the burning of fire-intolerant species. Many tree species can be damaged by burning, even when performed to only a small extent, because of an increased chance of infection (Zengel et al., 1998). High heat in the terrestrial environment is not buffered as well as in the aquatic environment, and fire may cause damage in deeper soil. Highly organic soils (i.e., those containing high concentrations of peat) can be "severely impacted" by burning (Zengel et al., 1998). In addition, the removal of vegetation from uplands soil could result in increased overland erosion and the sedimentation of receiving waters. Sedimentation may degrade fish spawning habitat in these waters, potentially leading to a reduction in prey species abundance. Impacts on permafrost from high heat may lead to thermal and hydraulic erosion (i.e., thermokarsts).

Preparation and monitoring for an *in situ* burn may involve the use of heavy machinery, vehicles or vessels, aircraft, and / or response personnel. The operation of vessels or heavy machinery during burning may disturb or injure populations of aquatic or semi-aquatic mammals and / or birds through the presence of people, production of noise, or direct contact (e.g., ship strikes and vehicle contact). Disturbance can be minimized through the use of biological constraints, such as the establishment of buffer zones around sensitive species, animals in sensitive life stages, or critical habitats; the use of timing windows; the limiting of vessel or vehicle speeds; and monitoring for the presence of animals (i.e., aquatic mammals and birds).

2.3 Best Management Practices

During an emergency response, BMPs are implemented to further minimize the impacts of components of the action. It is ultimately the responsibility of the FOSC to ensure BMPs are appropriately implemented (EPA et al., 2010). BMPs address the species life stage and habitat sensitivity to disturbance under the actual conditions at the time of the emergency. BMPs are implemented depending on the affected resource identified in the SCPs and the GRS (ARRT, 2012). GRS are map-based strategies that have been developed by a multi-stakeholder work group and are designed to save time in identifying sensitive areas for priority protection during the critical first few hours of a spill response. They show responders where sensitive areas are located and where to implement protective measures, particularly booming or other actions to control a spill. These site-specific strategies are intended to be flexible and allow the spill responders to modify them, as necessary, to fit prevailing conditions at the time of a spill. The strategies developed for the selected sites focus on minimizing environmental damage, creating the smallest footprint possible to support the response operation, and selecting equipment deployment sites that will not cause more damage than the spilled material.

The following additional BMPs are likely to be implemented:

- Monitoring for the presence and behavior of ESA-listed species during response activities
- Minimizing the incursion of spill-response vessels or machinery into areas of animal activity or critical habitat
- Notifying pilots and vessel operators to maintain specified distances from aggregations of animals sensitive to disturbance
- Anchoring vessels and booms using in-water fixtures such as buoys, dolphins, docks, or onshore anchors to minimize benthic impacts
- Tending and periodically adjusting deployed booms or other equipment to prevent entanglement and bottom-scouring impacts
- Deploying passive hazing devices to deter animals from perching on oiled booms or other in-water equipment
- Minimizing foot and vehicle traffic in areas of sensitive soil (including permafrost) or vegetation

Ongoing coordination with wildlife resource agencies, including the Services, during all on-the-ground activities further ensures that BMPs are targeted on the resources at risk and reflect the actual conditions during the emergency response.

The implementation of BMPs reduces the likelihood of impacts from an emergency response on ESA-listed species and habitats. When warranted and permitted by the USFWS or NOAA Fisheries, wildlife deterrence or capture and release may be conducted to help ensure the survival of animals in imminent danger of encountering spilled material (most likely oil).

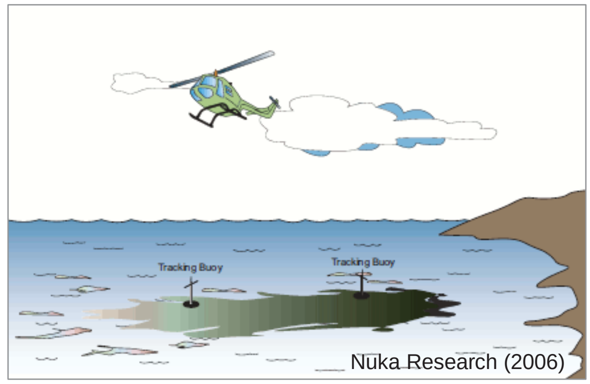
Examples of the BMPs that are included in response guidance and various GRS (ARRT, 2012) are provided in Appendix C.

2.4 NATURAL ATTENUATION

Natural attenuation relies on existing physical, chemical, and biological processes to dilute or degrade a spilled material so that it poses minimal harm to human health or the environment during the recovery period. In some instances, it may be more protective to allow an affected habitat to recover naturally following exposure to a spilled material, without any action apart from monitoring. In these cases, allowing oil or other spilled material to naturally disperse or degrade over time may cause less harm than the response action itself. Typically, this option is selected when there are few species of concern present and the spilled material will rapidly degrade, disperse, or evaporate; the spill has occurred in a high-energy environment; or the spill is very small.

2.5 TRACKING AND SURVEILLANCE

Tracking and surveillance (e.g., aerial reconnaissance) is performed for almost all spill events for which a response is planned. These activities are conducted in order to visually and electronically assess the field conditions and extent of a spill and to project, through computational modeling, the future movements of the spill. Information is also gathered on the location and movement of sensitive wildlife.



Tracking

Nuka Research (2006) identifies two tracking tactics: plume delineation on land and discharge tracking on the water. Each is used to determine the size, shape, and trajectory of a spill, as well as the resources required to appropriately control the spilled material so as to reduce ecological and economic impacts. On land, it is easier to map a plume of spilled material and predict its trajectory. Actions may involve land transport or aerial surveillance. The location of a plume can be validated through the use of monitoring equipment (e.g., photo ionization detection). To monitor deep soil, excavation equipment may be required.

For spills on the water, aerial surveillance is typically used to visually inspect a spill. In addition, infrared remote sensing and other non-invasive imaging technologies can be used during aerial surveillance to facilitate location, trajectory, and density mapping, including under ice. In some instances, buoy-based systems that move through a spill on the water and electronically track the position and direction of the material's movement may be deployed. Additional in-water tracking may be conducted by means of vessels. Material sampled by operators of these vessels can be analyzed for current spill conditions (i.e., extent of oil weathering).

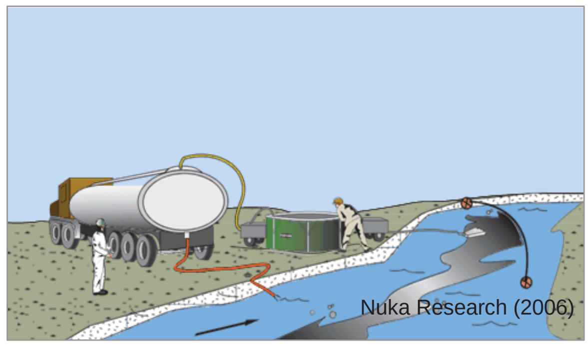
The trajectory of a plume and wildlife movement is tracked over time. Information gathered during tracking and surveillance helps support the development of an IAP, wildlife protection measures, and other BMPs.

The use of aircraft, sea vessels, and all-terrain vehicles (ATVs) or heavy machinery may adversely impact habitat and wildlife in the terrestrial and aquatic environments. These effects, as well as BMPs for reducing such effects, are detailed in previous sections. The benefits of tracking a spill are expected to far outweigh any potential adverse effects caused by reconnaissance.

2.6 WASTE MANAGEMENT

Waste handling and associated activities are common to all response actions apart from natural attenuation. Response actions produce large volumes of waste (e.g., contaminated soils, used sorbents, personal protection equipment) that must be handled, stored, decontaminated, transported, and / or disposed of properly. Protocols that comply with state and federal regulations are in place for the storage and transfer of all solid, hazardous, or petroleum wastes that may be generated during recovery and cleanup activities in order to minimize the reintroduction of wastes into the environment and protect habitats, endangered species, and response workers.

2.6.1 Waste handling and storage



Waste recovery and tank storage

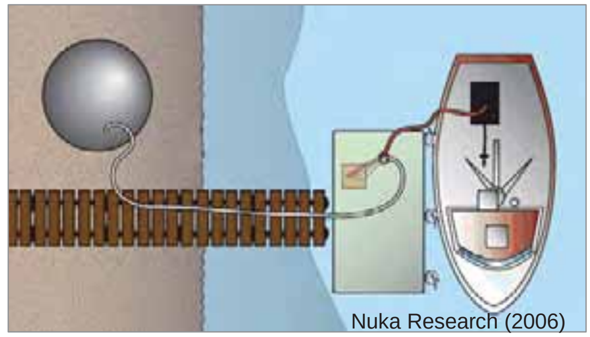
Waste handling and storage are required throughout a spill response. Materials (e.g., soil, sediment, and snow) used to construct diversion and exclusion or containment structures may be contaminated by the spilled material due to leaching or other processes, generating additional wastes to be handled and disposed of properly. Some spilled materials may be pumped or suctioned directly into storage tanks or drums for the purpose of either recovery or treatment and disposal. Pumping and suctioning usually entrain large volumes of water that must also be stored and treated. In the case of viscous oils, reheating might be required prior to pumping.

Land storage of wastes (e.g., in barrels, tanks, or piles) prior to disposal might contribute to soil compaction or other habitat modification at a spill site. These effects can be minimized by limiting pumping or suctioning to conditions under which it would entrain the least amount of water, using chemical agents to reduce the volume of water requiring treatment, reducing the storage footprint, and using the least sensitive onsite location to store wastes.

Accidental spills may occur during waste handling. The impacts of such spills can be reduced through implementation of standard hazardous material protocols (e.g., having engineering controls in place, isolating the storage / handling area, covering work areas with plastic sheets).

2.6.2 Waste transport

The handling, transport, and disposal of wastes require the use of heavy machinery and vessel or overland transport. Accidental release is possible during the handling and storage of wastes, as mentioned above, as well as during transport. Extreme weather or other conditions may increase the likelihood of an accidental release during handling or transport. An accidental spill (e.g., transport vehicle accident) may also pose a threat of ignition and / or explosion. Burning may produce particulate and / or toxic gas emissions.



Vessel transport and transfer to tank

It is possible that the volume of waste produced by the response operations will exceed the capacity of local waste receivers. In this event, disposal at multiple sites will be required. There are also some wastes (e.g., oil emulsions, oily water, and hazardous wastes) that cannot be treated in Alaska and must be transported to the contiguous United States. In these cases, longer transport distances could increase the possibility of spills or other accidents.

Impacts can be reduced through the implementation of standard hazardous material protocols and by planning for the timely and safe transport of wastes.

2.6.3 Waste treatment and/or disposal

Under ideal conditions, spilled products can be recovered and reused, reducing the wastes generated by a response action. For example, recovered oil can be refined into low-grade fuel or other petroleum products (ITOPF, 2010). Some chemical agents can separate oil from water or other materials, allowing the volume of wastewater that requires treatment or disposal to be reduced. Although no chemical agents are currently pre-approved for such use in Alaska, they may be proposed on a case-by-case basis.

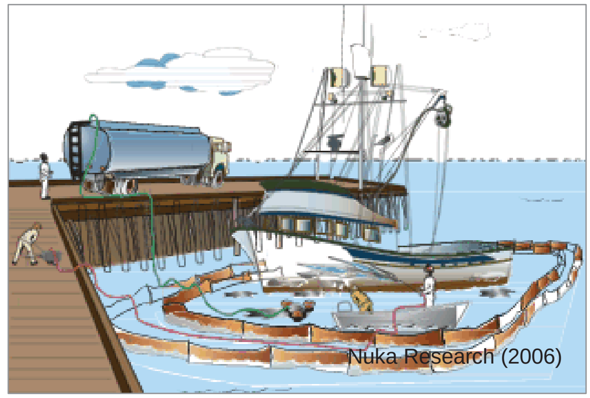

Oil reprocessing

Oil collected from aquatic habitats will be mixed with water and require separation and decanting prior to disposal; such decanting may take place on board a work vessel or be conducted at an upland location or facility. Decanted water may contain small amounts of dissolved oil constituents or consist of an oil-water emulsion but must meet water quality standards prior to discharge.

Waste disposal involves either direct disposal (i.e., without treatment) or treatment and then disposal. Wastes can be incinerated (onsite or offsite), but any incineration of waste in Alaska is subject to ADEC regulations.

2.6.4 Decontamination

During an oil spill response action, all personnel, hand tools, equipment, vehicles, and vessels must be decontaminated in a manner that does not reintroduce oily wastes into the natural environment. The decontamination process involves a multi-stage flushing procedure that removes and collects such wastes. The wastes are then stored and treated in accordance with state and federal regulations.



Vessel decontamination

Of primary concern is the reintroduction of oily waste and contaminated materials into the natural environment during the decontamination procedure. The use of engineered controls (e.g., berms, booms, plastic sheeting, tarps) reduces the risk of the accidental release of contaminated materials.

2.7 WILDLIFE PROTECTION

Wildlife protection responses are actions that could be implemented should wildlife be threatened by exposure to a spilled material (Alaska Clean Seas, 2010). Wildlife protection is conducted by trained personnel under a federal permit and may involve:

- Use of wildlife deterrents (i.e., hazing)
- Pre-emptive capture and relocation of uncontaminated wildlife
- Capture and treatment of contaminated wildlife, and subsequent release, if appropriate
- Recovery of contaminated carcasses to prevent the recontamination of other wildlife

Under the Unified Plan (EPA et al., 2010), wildlife might be deterred from entering an area impacted by a spill in order to prevent them from becoming contaminated or captured and treated after they have been exposed or injured. Animals might also be captured and temporarily held or relocated (i.e., preemptively captured) to prevent them from being exposed to spilled material. Although returning captured animals to the wild is the ultimate goal, not all captured animals may be able to be released following holding or treatment due to injuries received from exposure to spilled products. Guidelines that address procedures and decision criteria have been developed by the ARRT Wildlife Protection Working Group in accordance with the NCP and approved by the ARRT (see Annex G of the Unified Plan (EPA et al., 2010)).

2.7.1 Deterrence

The devices and methods associated with wildlife deterrence (i.e., hazing) can be grouped into the following general categories: visual, auditory, combinations of visual and auditory, and exclusionary. Methods can include the installation of balloons, reflector tape, snow fencing, or electric fencing; the use of horns, alarms, propane exploder cannons, pistols with caps, screamers, or bangers; or the firing of shotguns with cracker shells, rubber bullets, or bean bags (Alaska Clean Seas, 2010).

The selection of the appropriate deterrent depends on the species involved, the surrounding environment, and the spill situation. Often the method(s) require frightening animals to keep them away from a contaminated area. In many cases, the animals must be deterred repeatedly and frequently because of behavioral patterns or acclimation to the disturbance.

Birds are typically deterred using visual and auditory methods, although birds may also be herded by boat or aircraft (Alyeska Pipeline Service, 2008). The results of bird deterrence tend to be more successful in winter or during non-migratory periods. Migrating birds have a strong tendency to return to staging areas, even if those areas are contaminated. If migrating birds can be dissuaded from entering an area, but no suitable alternative habitats are available, they could be subject to stress or even mortality. Breeding birds are the most difficult to deter; the inability to influence strong instinctual behaviors may result in the mortality of both adults and young without the implementation of additional wildlife protection methods (i.e., capture).

Terrestrial mammals are typically successfully deterred through the use of visual or auditory hazing methods, the infliction of pain (i.e., rubber bullets), or the use of exclusion techniques, including fencing or netting.

It can be difficult to deter marine mammals from entering a spill area. Auditory or visual techniques have had some limited success with marine mammals; however, some animals can habituate to noise and other distractions (this is particularly true for sea otters). Capturing and relocating marine mammals or herding them through the use of loud noises have proven to be the most effective methods. Attempts to haze marine mammals, such as sea lions, from a rookery or haulout area may create panic that could lead to injury or death as a result of stampeding. This can be a particular concern for pups, which can experience higher mortality rates as a result for either being crushed by adults or separated from their mothers.

The primary factor to be considered when applying these techniques is the risk to the animal contacting the oil or hazardous materials. The risks associated with extreme stress or shock from hazing may outweigh an animal's potential for injury from chemical exposure. Wildlife protection measures are evaluated on a case-by-case basis, accounting for the risk of chemical exposure, resulting stress or injury, long-term effectiveness (both in terms of deterrence and survival of the animals), and labor involved.

Overall, the success of deterrence techniques could be low and could result in some level of wildlife mortality. Nonetheless, the potential risks associated with deterrence are usually more acceptable than those associated with allowing wildlife populations to be subject to contamination.

2.7.2 Capture or pre-emptive capture

A capture and release plan must be in place prior to the capture of wildlife (EPA et al., 2010). Capture and release plans focus on reducing the holding times of and stress to wildlife. Holding and release sites are also identified in these plans. In addition, capture and release plans help ensure that appropriate equipment is on hand to handle and transport animals safely and efficiently, which serves to minimize stress to the animals.

Capture teams evaluate site-specific conditions and develop strategies to suit the terrain and target species. Any effective capture of animals should occur swiftly with minimal pursuit and noise, use correct techniques based on the species pursued and local conditions, and expose the animals to the least amount of stress. The most common capture techniques involve the use of dip nets, tangle nets, net guns, and mist nets.

Animals exposed to spilled materials are captured alive and taken to treatment centers for cleaning; some can be rehabilitated and subsequently released. However, there may be mortality after arrival at a treatment center due to the chemical exposure or stresses associated with captivity and/or treatment. The proportion of animals brought to a treatment center that are eventually released varies; and there is a low survival rate among the animals released (EPA, 1999). Therefore, every effort should be made to prevent animals from becoming exposed to spills of oil or other hazardous substances.

The pre-emptive capture of wildlife, particularly those that are difficult to haze, may be conducted for those individuals that have a very high likelihood of being exposed to the spilled material (USFWS, 2010a). Capture causes physical stress on wildlife and can result in serious health impacts, including shock and suppressed immune function. For example, during capture and transport, some mammals are susceptible to fungal and bacterial infections that can be more harmful than the oil (EPA 1999) or other spilled product. Pre-emptive capture is not feasible for species that are not easily caught because it is time and labor intensive, and human safety is a concern. The only species contemplated for pre-emptive capture is the sea otter.

Although wildlife protection measures, if implemented, are part of a response action, any injury to an ESA-listed species is not considered incidental to the response action; rather, this event occurs under a permit that specifically allows for the deterrence, capture, rehabilitation, and release of the animals.[21] These activities are conducted only

[21] Examples of wildlife protection permits that are issued by ADF&G include Permit FG05-III-0012: Hazing, capture, stabilization, and rehabilitation of birds; Permit FG05-III-0013: Hazing terrestrial mammals; and Permit FG-05-III-0014: Stabilization, transport and disposition of large terrestrial mammals (Alaska Clean Seas, 2010). Federal permits are also issued by USFWS and/or NMFS for such protection measures of federally listed species of birds and mammals (Alaska Clean Seas, 2010).

by personnel who have been trained in wildlife protection protocols. By definition, wildlife protection measures constitute harassment (at a minimum) of species that are listed as threatened or endangered under ESA.

Other wildlife protection measures (e.g., establishing buffer zones, observation) that do not involve deterrence or capture are included as part of the individual response action BMPs and are described in the previous sections. Additional, *ad hoc*, protective measures can also be identified by the Services during the spill response as part of the emergency consultation.

2.8 SUMMARY

Table 2-2 summarizes the types of response actions that may be used in the various habitats that are present in Alaska. Table 2-3 lists the likely effects that each type of response action may have on the environment. The linkages among habitats, protected species, and response actions will be used as the basis for the evaluation of the potential effects associated with implementation of the Unified Plan (EPA et al., 2010).

Table 2-2. Response actions appropriate for specific habitat types

Response Action	Habitat						
	Terrestrial	Riverine/Lake/ Riparian	Wetland	Shoreline	Nearshore	Open Water	Sea Ice
Mechanical Countermeasures							
Deflection/Containment							
Booming		X	X		X	X	
Berming	X	X[a]		X			X
Trenching	X	X[a]		X			X
Culvert blocking		X	X				
Recovery of Spilled Material							
Skimming		X	X		X	X	
Vacuuming	X			X			X
Sorbing	X	X	X	X	X	X	X
Removal/Cleanup							
Contaminated substrate removal	X	X	X	X			X
Contaminated vegetation removal	X	X	X	X	X		
Flushing and flooding				X			
Non-Mechanical Countermeasures and Monitoring							
Dispersal[b]			X[c,d]		X[d]	X	X
In situ burning[b]	X	X	X	X	X	X	X

Response Action	Habitat						
	Terrestrial	Riverine/Lake/ Riparian	Wetland	Shoreline	Nearshore	Open Water	Sea Ice
Other Response Actions							
Natural attenuation	X	X	X	X	X	X	X
Supporting Actions							
Tracking and surveillance	X	X	X	X	X	X	X
Solid waste management	X	X	X	X	X	X	X
Wildlife protection	X	X	X	X	X	X	X

[a] Limited to riparian zone.
[b] *In situ* burning and use of chemical or biological agents as part of the response action require prior approval.
[c] No dispersants are currently formulated for use in freshwater.
[d] Not recommended for use in areas near protected resources.

Table 2-3. Response actions, components, and effects evaluated in the Unified Plan BA

Response Action	Components	Potential Effects on the Environment	Mitigating BMPs
Mechanical Countermeasures			
Deflection/Containment			
Booming	boom deployment	loss of wildlife access to essential resources (e.g., food, refuge, nesting area); exposure of perching birds or marine mammals to oiled boom; destruction of benthic habitat/organisms by anchors	monitor wildlife; establish buffer zones; arrange booms to minimize restrictions to wildlife; deter birds or mammals from perching; anchor booms onshore or from pre-existing anchors (including vessels)
	boom tending, involving small watercraft and personnel	wildlife disturbance by noise and presence of people	monitor wildlife; establish buffer zones
Berms, dams, or other barriers; pits and trenches	use of heavy equipment	habitat disturbance or destruction; wildlife disturbance	monitor wildlife; establish buffer zones; minimize traffic; avoid sensitive soil; use plastic sheeting or other material to avoid contamination of soil, beach sediment, or snow
	manual construction/placement of components	habitat disturbance or destruction; loss of aquatic organisms (if conducted in streams, wetlands, or intertidal areas); wildlife disturbance; restriction of wildlife access to resources	monitor wildlife; establish buffer zones; construct barriers from non-native material when available; use plywood or other material to reduce soil compaction; configure structures to minimize restriction of wildlife; remove structures once action is completed
Culvert blocking	placement of plug, replumbing of outlet	wildlife disturbance; alteration of stream hydrology; obstruction to migration or general movement	monitor wildlife; establish buffer zones; remove structures once action is completed
Recovery of Spilled Material			
Skimming/vacuuming	deployment and operation of skimming/vacuuming equipment	entrainment of plankton; entanglement of marine mammals or birds; wildlife disturbance	monitor wildlife; establish buffer zones; exclude larger water column species through use of restricted intake; tend in-water equipment.
	placement and use of pumps, hoses, and other equipment	habitat and wildlife disturbance	monitor wildlife; establish buffer zones
Sorbents	placement and use of sorbent materials (e.g., pads, rolls, beads)	habitat and wildlife disturbance; smothering or entanglement	monitor wildlife; establish buffer zones; tend/replace sorbent materials

Response Action	Components	Potential Effects on the Environment	Mitigating BMPs
Removal/Cleanup			
Removal	removal of contaminated soil/sediment	loss of habitat; possible destabilization of shoreline or benthic habitat	monitor wildlife; establish buffer zones; backfill and stabilize excavated areas
Cleaning	on-scene processing of soil or sand that removes oil/tar balls and return of cleaned material to beach	habitat and wildlife disturbance; erosion from foot and vehicle traffic	monitor for wildlife; establish buffer zones; return soil or sediment to existing elevation and slope; stabilize material to reduce erosion.
Vegetation or woody debris removal	removal of vegetation or woody debris	loss of forage or habitat; possible destabilization of shoreline or benthic habitat	monitor wildlife; establish buffer zone; remove contaminated vegetation or woody debris only when leaving in place would likely result in ingestion or further oiling of sensitive habitat; minimize damage to root structures by cutting oiled stalks when possible
	disposal of vegetation or woody debris	degradation of air quality (if burning used); habitat disturbance from stockpiling of contaminated vegetation or storage of waste and waste containers or burning	monitor wildlife; establish buffer zone; conduct open burning away from sensitive species or habitats; remove wastes in a timely manner; minimize the production of waste to the maximum extent practicable
Flushing/flooding	remobilize oil for collection	physical displacement of benthic organisms or vegetation; thermal stress and mortality of aquatic organisms (if heated water used)	monitor wildlife; establish buffer zone; use low-pressure and ambient water temperature where benthic organisms and vegetation are to be protected to minimize stress or displacement; monitor and adjust booms, as needed
Non-Mechanical Countermeasures			
Dispersants	application of chemical agent	degradation of water quality; changes in prey base from potential toxicity; acute exposure to petroleum constituents due to changes in solubility/bioavailability; acute exposure to surfactants; loss of insulation in fur-bearing or feathered animals, potential for embryo toxicity in birds	monitor wildlife; establish buffer zone; use in water with adequate volume for dilution; apply only under conditions known to be successful; use only chemicals that are approved for use in Alaska waters; deter animals, if necessary
In situ burning	use of accelerants and ignition materials; burning; smoke plume	degradation of air quality; loss of habitat; smothering from residues (aquatic); destruction of surface oil micro-organisms and nutrients during on-land burning	monitor wildlife; establish buffer zone; deter animals as necessary
Bioremediation	application of biological organisms to consume the oil	bioactivity may deplete oxygen from the water; possible uptake and concentration of petroleum constituents into marine food chain	requires evaluation and approval by the ARRT prior to use; currently not approved

Response Action	Components	Potential Effects on the Environment	Mitigating BMPs
Actions Common to All Responses			
Spill tracking/ monitoring	flyovers, installation of buoys or communication infrastructure, water sample collection	habitat disturbance or destruction (e.g., soil compaction, erosion from truck or foot traffic); wildlife disturbance (e.g., noise from vessels or aircraft, presence of people); wildlife injury (from ship or vehicle strikes)	monitor wildlife; establish buffer zone; minimize traffic as much as possible
Mobilization/ demobilization	mobilization of equipment and personnel to and from the site	habitat disturbance or destruction (e.g., soil compaction, erosion from truck or foot traffic); wildlife disturbance (e.g., noise, presence of people); wildlife injury (from ship strikes)	monitor wildlife; establish buffer zone; minimize traffic as much as possible and use plywood or other material to reduce compaction
Waste handling, treatment, and disposal	collection, storage, and removal of contaminated media (e.g., soil, sediment, debris); decontamination of vessels/vehicles; oil/water separation, treatment	soil/sediment compaction from vehicles and personnel; habitat disturbance or loss from storage of waste and waste containers; wildlife disturbance from noise or presence of people	monitor wildlife; establish buffer zone; minimize traffic and need for storage as much as possible and use plywood or other material to reduce compaction; remove waste in a timely manner
Other Response Actions			
Natural attenuation (with monitoring)	long-term monitoring	wildlife disturbance from presence of people and equipment	minimize presence of people and equipment

ARRT – Alaska Regional Response Team
BA – biological assessment
BMP – best management practice

3 Environmental Baseline

For the purpose of evaluating a response action under the Unified Plan, the baseline condition assumes the occurrence of a spill (e.g., crude oil, diesel fuel), as well as the interaction of species and their habitats under the condition of a spill. Thus, the baseline condition under which the Unified Plan is implemented encompasses the current level of emergency response in Alaska, the physical environment in which responses are likely to take place, the habitats (including critical habitats) within those environments that are used by ESA-listed species, the current distribution and abundance of ESA-listed species, and the conditions and stressors that currently affect the status of those species and habitats.

As outlined in Section 1, the framework of the Unified Plan provides for an implementation that is specifically tailored to the spilled material, the geographic location of the spill, the volume of material spilled, and the ecological receptors (i.e., humans, habitat and/or wildlife) that may be impacted by the spill. Any spill countermeasure that would be taken is assumed to have been selected after careful deliberation, and any planning of response actions must also consider the No Action alternative. The No Action alternative implies that the hazardous material will be allowed to freely spread, weather, and come into contact with sensitive habitat (Section 3.3) or wildlife (Section 3.4) and is a viable option if any response to a spill would potentially increase, rather than diminish, the impacts related to the spill.

The following subsections present information on spill response in Alaska, the effects of climate change on baseline conditions related to both habitat and species, the types of habitats used by ESA-listed species, and the status of protected populations and habitats, including current stressors. This information will be used to identify the additional effects on listed species and habitats created through the implementation of the Unified Plan during an emergency response.

3.1 Spill Response in Alaska

Emergency response to accidental spills in Alaska is directly linked to Alaska's transportation system and, more specifically, to areas of industrial or commercial activity (either land- or sea-based activities). Navigation hazards, mechanical failures, and human error have contributed to accidental spills in ports, harbors, shipping lanes or other transportation corridors, urban areas, fishing grounds, fuel transport and storage areas, oil and gas fields, pipeline routes, military bases, and mining areas.

3.1.1 Historical responses

Spills that occur in areas of state jurisdiction are tracked by ADEC, and spill records have been consistently compiled since mid-1995. In 2007, ADEC published a report that summarized spill data for the entire state and SCP area for the 10-year period from 1995 to 2005 (ADEC, 2007a). Statewide, there were more than 23,000 spills to any environment (i.e., marine, freshwater, upland, or containment) in 10 years. The average annual spill volume was about 600,000 gal.; the average individual spill volume was approximately 240 gal. Refined petroleum products (primarily diesel) accounted for more than 80% of the reported spills but represented only 44% of the total volume spilled. Process water[22] from oil and gas exploration or production and mining accounted for 3% of the reported spills but represented 31% of the volume spilled. Hazardous substances (typically ammonia or antifreeze) accounted for 24% of the volume spilled over the 10-year period. The greatest number of the spills (to any receiving environment) occurred in the Cook Inlet (~5,800), North Slope (~4,500), Interior (~4,200), and Southeast Alaska (~3,900) SCP regions. Most (> 86%) of these spills were associated with upland facilities and did not represent an uncontrolled release to a water body. Table 3-1 in Appendix D provides a summary of the characteristics of historical spills, by SCP area, from 1995 to 2005 for all spills (any volume, any receiving environment) based on ADEC's report (ADEC, 2007a).

In its report, ADEC (2007a) noted several trends over the 10-year period. Most spills were associated with population centers or areas that had oil and gas exploration, mining, or fishing activity. Diesel was the product most likely to be spilled, and the vast majority (74%) of the spills were associated with vessels or other facilities that were not required to have an approved spill prevention and contingency plan. Process water (from either oil or gas exploration or mining) was also spilled frequently. Spills occurred year-round but were more frequent during winter through early spring in the North Slope and during spring through early fall in most coastal areas.

The ADEC spill database (ADEC, 2012) was provided in its entirety by the state for use in this BA. These data were augmented with records from NOAA's incident response database (NOAA OR&R, 2012), which describes responses outside of state waters. The final compiled database is provided as Appendix D. These data are summarized in this section, with an overall focus on response actions that occurred in marine waters where the ESA-listed species being evaluated in this BA would most likely encounter a response action. In terms of quantity, the focus was on spills > 100 gal. However, NOAA records that indicated that a release was prevented because of a response action are also included because it is the response actions that are being evaluated in this BA.[23]

A summary of the updated response history for spills >100 gal. to marine waters by subarea and material type is provided in Table 3-1; Figure 3-1 shows the location, size, and season that each of these spills occurred. The types of materials spilled include crude oil, non-crude oil (i.e., refined petroleum products, typically diesel fuel), hazardous substances (e.g., drilling muds, antifreeze, and other industrial chemicals),

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[22] Process water can contain many substances besides water. Process water created during oil or gas exploration can include sea water, gelling substances, oil, gas, and sand. Process water from mining operations can contain dissolved metals or mineral slurries.

[23] ADEC records are assumed to be associated with a response action.

extremely hazardous substances (typically ammonia), and process water. Spills that occurred in the Interior Alaska SCP area are not included in the summary because they did not involve marine waters.

Table 3-1. Summary of marine waters spill history for the period from 1995 to 2012

Subarea	Total Number of Spills > 100 gal.	Total Volume (Largest Single Spill) (gal.)	Average Spill Size (gal.)	Materials Spilled[a]	Facilities Associated with Spills
Aleutian Islands	81	1,164,614 (321,052)	14,378	**fuel oil, diesel**, bunker fuel, aviation fuel, gasoline	vessels, canneries, petroleum storage facilities, airport
Bristol Bay	7	7,190 (3,000)	1,027	**diesel**, gasoline, used oil, aviation fuel	power plants, petroleum storage facilities, vessels, canneries, heating oil tanks for public facilities or homes
Cook Inlet	28	22,706 (8,270)	811	**ammonia**, jet fuel, diesel, process water	oil exploration and production facilities, chemical manufacturing facilities, pipelines, gas stations, airports, railroad, military facilities, vessels
Kodiak Island	46	48,068 (8,000)	1,045	**diesel**, hydraulic oil, aviation fuel, gasoline	vessels, petroleum storage facilities, logging operations, military facilities
North Slope	7	9,825 (6,300)	1,404	**drilling mud**, process water, crude oil, diesel, ethylene glycol	oil exploration and production facilities, pipelines, vehicles, public facilities, power plants, airfield, petroleum storage facilities
Northwest Arctic	2	1,897 (1,000)	949	**diesel**, gasoline, process water, propylene glycol	mining facilities, petroleum storage facilities, power plants, public facilities, homes
Prince William Sound	43	74,970 (35,000)	1,743	**diesel**, crude oil, oily ballast water, process water, fuel oil	vessels, pipelines, refinery, crude oil terminal, petroleum storage facilities, power plants, homes, vehicles, military facilities
Southeast Alaska	182	148,725 (24,000)	817	**diesel**, fuel oil, process water, hydraulic oil	vessels, petroleum storage facilities, homes, mining facilities, log processing facilities, power plants, pipelines, airport
Western Alaska	6	5,010 (3,000)	835	**diesel**, gasoline, used oil, aviation fuel, hydraulic oil	petroleum storage facilities, vessels, homes, power plants, gas stations, mining facilities

Note: The data summarized in Table 3-1 was compiled from ADEC (ADEC, 2012) and NOAA (NOAA OR&R, 2012) data. A compilation of the data is provided in Appendix D.

[a] Bold identifies the material that comprised the largest spill.

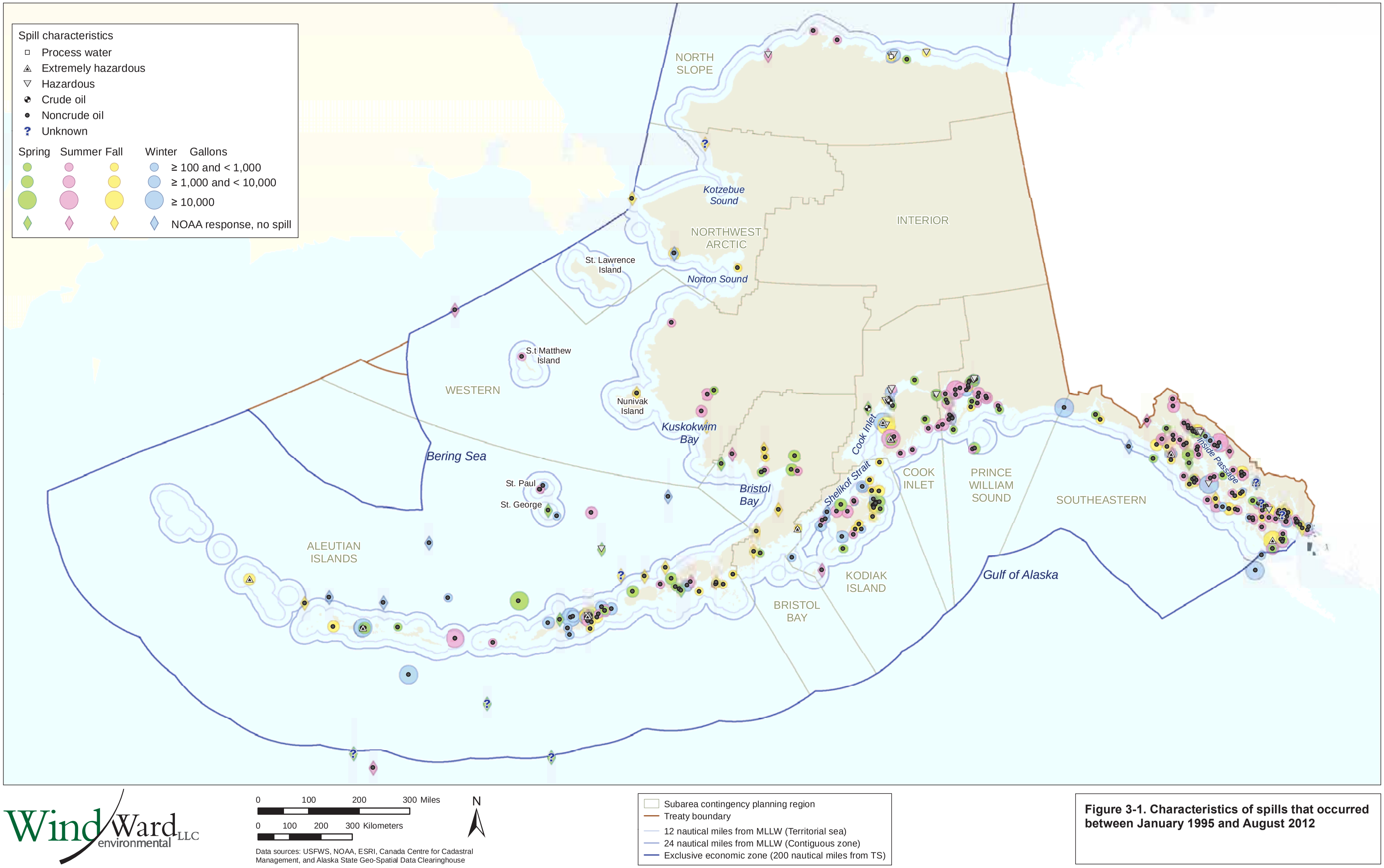


Figure 3-1. Characteristics of spills that occurred between January 1995 and August 2012

Figures 3-2 and 3-3 show the number and total volume of spills per year, respectively, for all subareas with marine waters for the period of June 1995 to July 2012. As shown in the figures, the spill frequency and volume are highly variable. No temporal trends are apparent; the number of spills per year ranged from approximately 10 to 35 spills for the combined subareas. Two years stand out as having the greatest volume of spilled material recorded: 2004 (the year of the merchant vessel [M / V] *Selendang Ayu* fuel spill in the Aleutian Islands) and 2010 (the year of two petroleum tank farm releases of diesel in the Aleutian Islands). However, there are some discernible spatial trends.

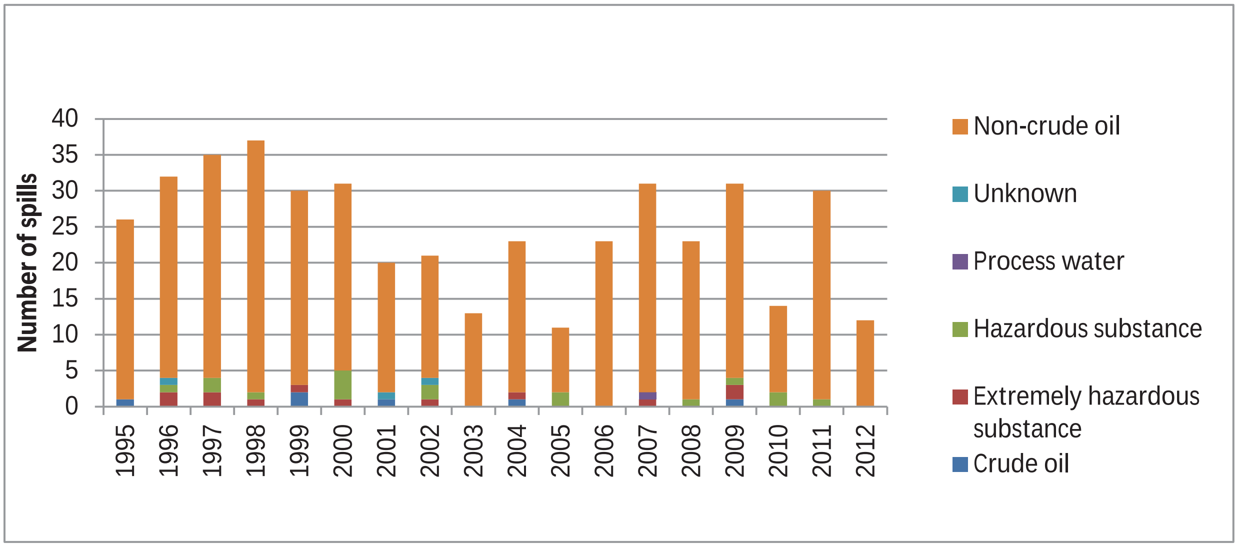


Figure 3-2. Number and type of spills to marine waters per year (1995 to 2012)

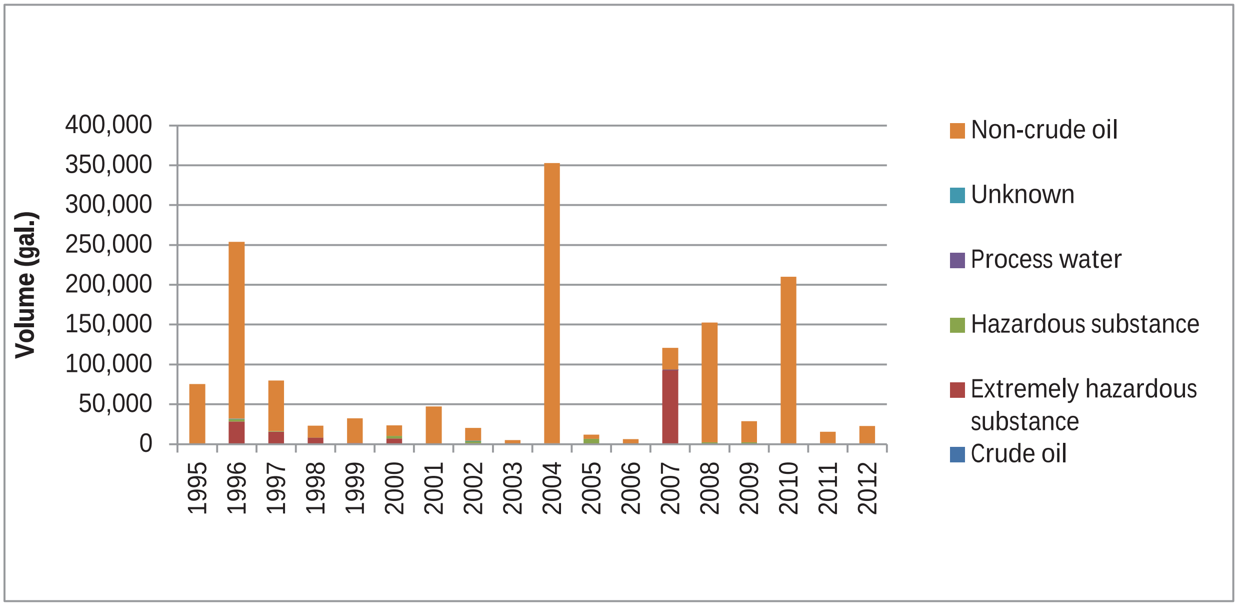


Figure 3-3. Volume and type of spills to marine waters per year (1995 to 2012)

Figures 3-4 and 3-5 show the number and total volume of spills, respectively, by subarea. The greatest number of spills to marine waters occurred in Southeast Alaska, following by the Aleutian Islands, Kodiak Islands, and Prince William Sound (PWS). In all of these areas, diesel was the primary material released to the marine environment. Crude oil was spilled only in Cook Inlet (four times; two additional response actions prevented spills); individual volumes for these crude oil spills ranged from 100 to 500 gal. Volumes for other spilled materials across all subareas averaged 3,300 gal. and were as high as approximately 320,000 gal. (*Selendang Ayu* diesel spilled in the Aleutian Islands).

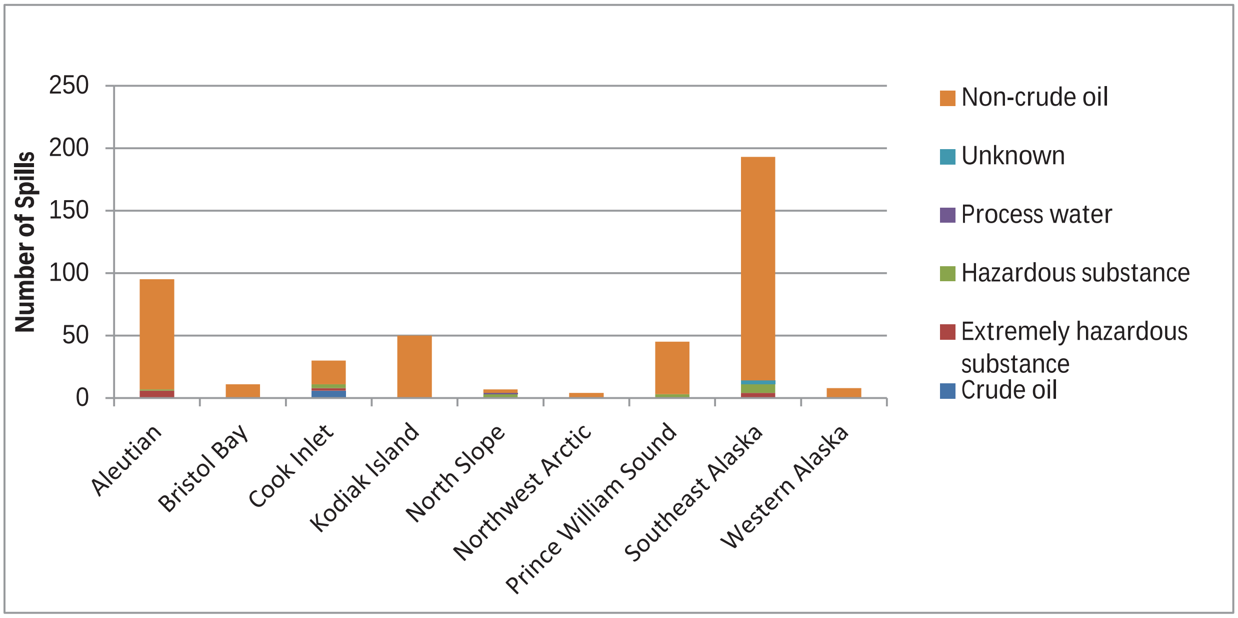


Figure 3-4. Number and type of spills to marine waters > 100 gal. by subarea (1995 to 2012)

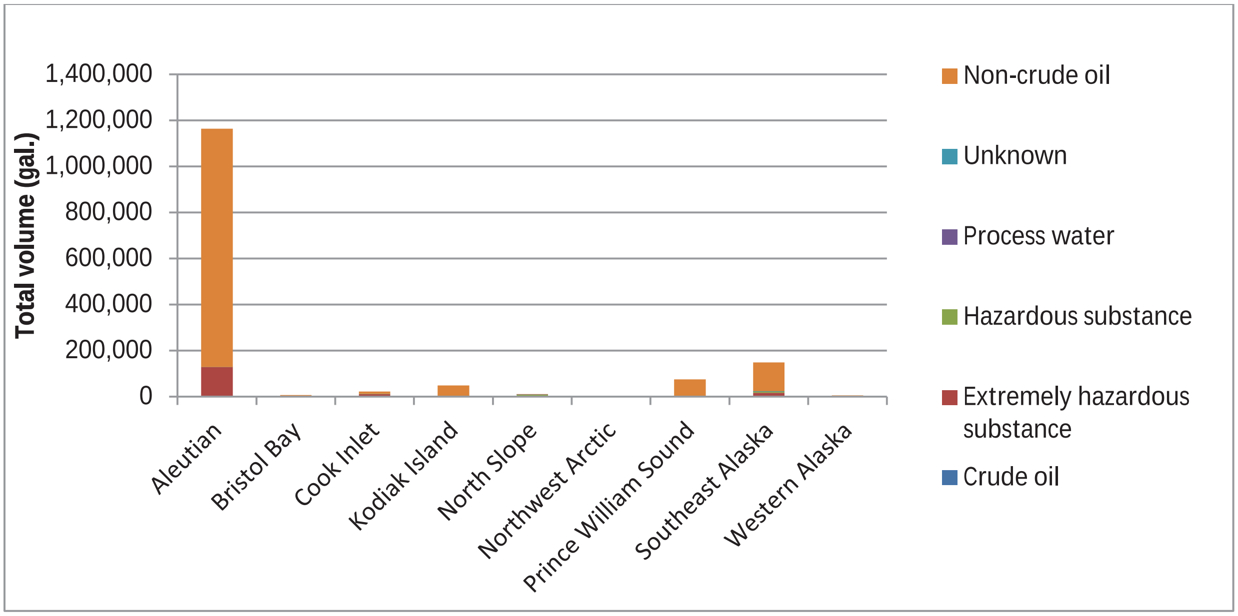


Figure 3-5. Volume and type of spills to marine waters > 100 gal. by subarea (1995 to 2012)

Spills to marine waters occurred year-round (Figure 3-6) but the timing of spills was affected by the seasons when human activities (e.g., commercial fishing, oil and gas exploration, mining, recreation / tourism, shipping, etc.) occurred in different regions in Alaska. In Bristol Bay and Western Alaska, spills occurred from mid-to-late spring through early fall. In the North Slope, spills occurred between February and October. Spills in other areas of Alaska occurred year-round but peaked in the summer in Southeast Alaska and in the fall / winter in the Aleutian and Kodiak Islands.

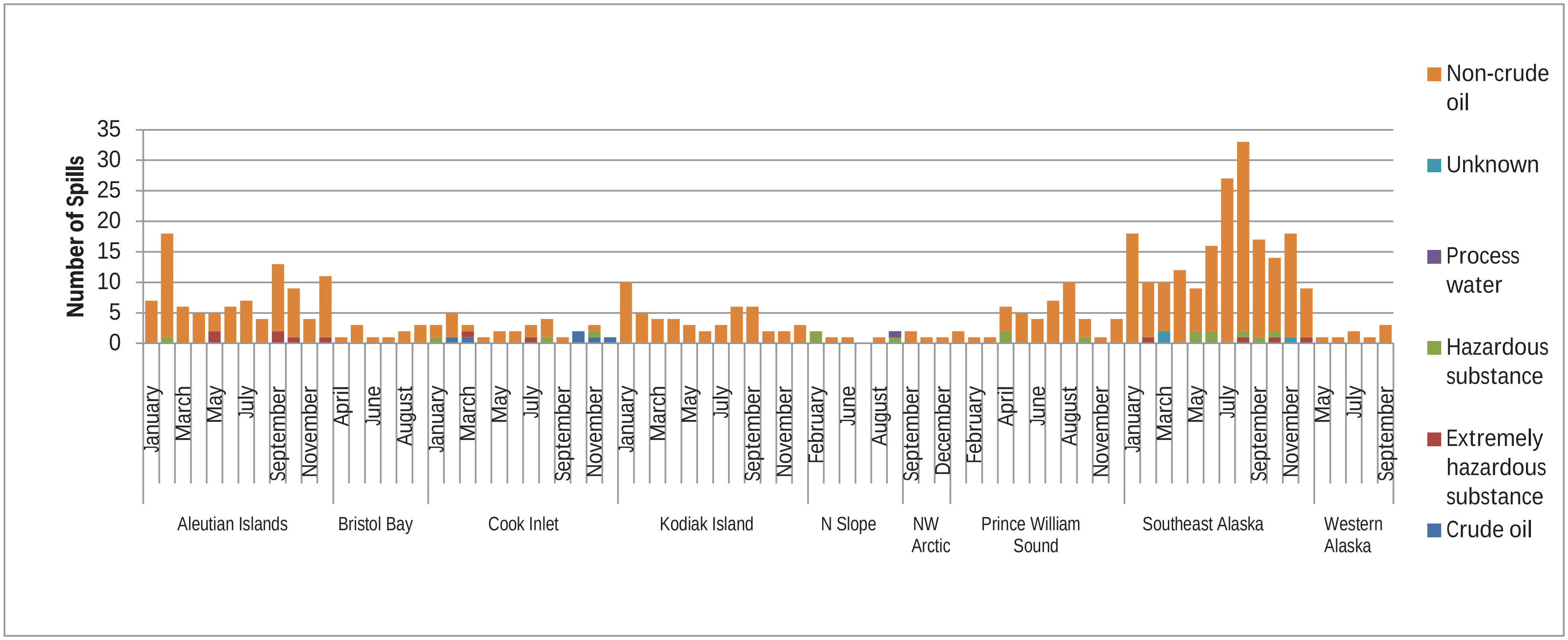


Figure 3-6. Number of spills to marine waters > 100 gal. and material type by subarea and month (1995 to 2012)

3.1.2 Future emergency responses

Although the history of marine spills in Alaska is not a predictor of the frequency or location of future spills, the overall trends established by historical spills are likely to be maintained given the continued growth in Alaska (especially in population centers), the proposed expansion of oil and gas exploration and mining in specific areas of Alaska (most notably the North Slope, Northwest Arctic, Western Alaska, and Cook Inlet), and continued commercial fishing in Alaska waters. SCPs each contain a section describing scenarios (worst case, maximum most probable case, and average most probable case) that are specific to their regions (ARRT, 2012) and guide in the planning for future responses.

Marine traffic studies that have been completed for several areas in Alaska (i.e., Southeast Alaska, Cook Inlet, and the Aleutian Islands), indicate the potential for an increase in marine spills. A vessel traffic study for Southeast Alaska (Nuka Research, 2012) estimated that the amount of large vessel traffic (particularly cargo barges, cruise ships, and tankers) in the Dixon Entrance could double.[24] This increase is due, in part, to the planned expansion of port facilities in British Columbia (i.e., Prince Rupert and Kitimat) in response to increases in Canadian mining and oil production.

The Cook Inlet maritime risk assessment (Glosten, 2012) projected near-term (2015 to 2020) annual spill rates based on historical spill rates (1995 to 2010) and a marine traffic study of vessels that are larger than 300 gross ton (GT) or have an oil-carrying capacity of > 10,000 gal. (fishing vessels, small tour boats, and military or research vessels were not included). Based on historical spill rates, a baseline annual spill rate was calculated at 3.4 spills per year (no size is implied); a near-term future spill rate was estimated to be 3.9 spills per year. The authors (Glosten, 2012) also noted that there was a possibility of increased gas carrier and cargo traffic because of gas development in Cook Inlet and the potential construction of a gas pipeline. The authors accounted for regulatory changes that could mitigate the likelihood of future spills (e.g., mandated double hulls on tankers and tank barges by 2015; an air emission-mandated switch to diesel fuels and away from bunker fuels) in their estimate of a future spill rate.

The National Response Center Transportation Research Board developed a risk assessment approach for evaluating spills in the Aleutian Islands (TRB, 2008) as a result of the damages awarded following the *Selendang Ayu* spill in 2004. A major shipping route from the northwestern United States to northern Asia traverses the Aleutian Islands; approximately 4,500 commercial vessels travel through Unimak Pass annually. Commercial shipping along this route has been growing at a rate of 5% per year and is expected to continue at that rate. The subsequent risk assessment (DNV and ERM, 2010) estimated an 11% increase in the spill rate (from 8.7 to 9.6 spills per year) over 25 years.

[24] The Dixon Entrance is a strait along the Pacific coast at the boundary between the United States and Canada, leading into the inland waters of Southeast Alaska.

Most accidents were predicted to take place in the approach to Dutch Harbor, Unimak Pass, and Akutan Pass.

Oil and gas exploration, particularly on the North Slope, could also increase, with a resulting increase in spills in the Arctic. As of 2010, there were more than 5,000 exploratory and production wells and drill pads; more than 500 mi of roads; 28 production plants, gas processing facilities, seawater treatment plants, and power plants; and approximately 1,000 mi of pipeline associated with the oil and gas industry on the North Slope and in the Beaufort and Chukchi Seas (Nuka Research, 2010). Development and production activities on the North Slope are planned to continue for at least another 50 years (Nuka Research, 2010). Approximately 44 spills per year associated with oil and gas infrastructure occurred between 1995 and 2012 (1.7 spills per million barrels of oil produced); however, only a small fraction of these spills (less than 1 spill per year or an estimated 0.026 spills per million barrels) resulted in a release to marine waters (most were to tundra or gravel pads) (Nuka Research, 2010). Based on historical spill information, most spills are very small (< 100 gal.), and spilled materials are usually a combination of oil, natural gas, and water.

Approximately 16.5 billion barrels of oil have been produced on the North Slope since 1977 (EIA, 2012); production rates have been declining and were at approximately 560,000 barrels per day in 2011 (down from about 2 million barrels per day in 1988). Estimates of technically recoverable oil range from 6 billion barrels (for existing reserves under production) to approximately 35 billion barrels (based on optimistic projections). Assuming that extraction takes place over approximately 40 years (~2050), daily production rates could drop below current rates (to around 400,000 barrels per day) or increase at least four-fold (to approximately 2.4 million barrels per day). This equates to a projected estimate of 4 to 23 spills to marine waters per year, depending on future production rates.

3.2 GLOBAL CLIMATE CHANGE

A discussion of global climate change is included in the BA because climate change has the potential to significantly alter the conditions under which all human and ecological activities exist. The Intergovernmental Panel on Climate Change (IPCC) defines "climate change" as a statistically significant and persistent difference over a period of decades or longer in one or more properties of climate (e.g., temperature, precipitation), which may or may not be due to human activities (IPCC, 2007). General consensus over the current state of climate change has been reached based on an examination of multiple lines of evidence: ocean acidification; increases in air temperature, sea level elevation, and precipitation; changes in species distributions; and, perhaps most important to Alaska species; a decrease in the extent (spatial and temporal) of sea ice and destabilization of permafrost.

Changes in climate affect the timing, availability, and condition of habitats and food for all species that are present in Alaska either year-round or seasonally. The potential for habitat alteration in Alaska as a result of climate change is significant. According to the IPCC (2007), the extent of sea ice in the Arctic has declined by 2.1 to 3.3% per decade since 1978. For species such as polar bear, bowhead whale, bearded seal, and ringed seal, the existence and persistence of sea ice is essential for habitat functionality. Other species such as walrus and spectacled eider also use sea ice intermittently and may be adversely affected by changes in the location, timing, density, and persistence of sea ice (Tynan and DeMaster, 1997). Changes in sea ice regimes can lead to shifting species distributions (i.e., toward colder northern regions) and reduced habitat availability and connectivity for protected species with larger home ranges (e.g., polar bear) (Hunter et al., 2010). Models of sea ice melt and associated ecological changes predict that significant adverse effects could occur in polar regions as a result of climate change (Hunter et al., 2010). A recent study (Sigler et al., 2011) suggests the changes will occur slowly over a long period of time and that ecological impacts will vary substantially between species.

The food web that supports most species that are of concern for this BA is highly dependent on the production and abundance of plankton in Alaska waters. Plankton respond to the influx of nutrients and light that occurs on a seasonal basis. Phytoplankton blooms support zooplankton, which then feed larval fish, invertebrates, and, subsequently, marine birds and mammals. Ice melt may be a source of nutrient input to Arctic waters (NOAA, 2007), and ice affects the amount of sunlight that reaches the ocean's surface. Accordingly, the extent and duration of sea ice affects the timing, magnitude, and duration of spring phytoplankton blooms (Stabeno et al., 2001).

If the amount and duration of sea ice continues to decline as a result of climate change, as is projected (IPCC, 2007), access to previously inaccessible areas of Alaska's Arctic waters might be possible, and areas that currently have limited, seasonal accessibility might be accessible year-round. This, in turn, would likely result in an increase in the amount of vessel traffic associated with oil exploration, cargo transport, research, or fishing in these areas. Any new or added vessel traffic will increase the probability of spills that could adversely affect wildlife.

3.3 DESCRIPTION OF HABITATS WITHIN THE ACTION AREA

Alaska and its adjacent waters are characterized by a diverse array of arctic, boreal, and temperate ecosystems composed of terrestrial and aquatic habitats. For the purpose of this BA, habitat types are identified based on their importance in the distribution of species of concern and the various response actions that could be selected for use in those habitats. Habitat designations in this BA include:

- Terrestrial (including tundra)
- Riverine / lacustrine (i.e., rivers, streams, and lakes and their associated riparian habitats)
- Wetland / bogs

- Shoreline (in marine environments from mean lower low water [MLLW] to 1,000 yds [914 m] inland from the highest tide mark [the farthest extent of USCG upland jurisdiction])
- Nearshore (in marine environments from MLLW to 20 m deep or 100 m offshore, whichever is greater)
- Offshore / open water (> 20 m deep or > 100 m offshore to the EEZ boundary)
- Sea ice (including leads [large fractures in the ice] and polynyas [areas of open water within the ice])

Table 3-2 provides a list of protected species and their associated habitats.

Table 3-2. Protected species and associated habitats

Protected Species	Habitat Type
Marine Mammals	
Beluga whale (*Delphinapterus leucas)* – Cook Inlet DPS	nearshore, open water, sea ice (polynyas)
Blue whale (*Balaenoptera musculus)*	open water
Bowhead whale (*Balaena mysticetus)*	open water, sea ice (polynyas and leads)
Fin whale (*Balaenoptera physalus)*	open water
Gray whale (*Eschrichtius robustus*) – Western North Pacific stock	nearshore, open water
Humpback whale (*Megaptera novaeangliae)*	nearshore, open water
Sperm whale (*Physeter macrocephalus)*	open water
North Pacific right whale (*Eubalaena japonica)*	open water
Sei whale (*Balaenoptera borealis)*	open water
Steller sea lion (*Eumetopias jubatus)* – *western population*	shoreline, nearshore, open water
Steller sea lion (*E. jubatus)* – *eastern population*	shoreline, nearshore, open water
Polar bear (*Ursus maritimus*)	terrestrial, shoreline, nearshore, sea ice
Northern sea otter (*Enhydra lutris kenyoni*) – southwest Alaska DPS	shoreline, nearshore
Pacific walrus (*Odobenus rosmarus* ssp. *divergens*)	shoreline, nearshore, open water, sea ice
Ringed seal (*Phoca hispida)*	nearshore, open water, sea ice
Bearded seal (*Erignathus barbatus)*	nearshore, open water, sea ice
Birds	
Eskimo curlew (*Numenius borealis*)	terrestrial (tundra), riparian, shoreline
Short-tailed albatross (*Phoebastria albatrus*)	open water
Spectacled eider (*Somateria fischeri*)	terrestrial (tundra), lakes, nearshore, open water, sea ice (polynyas)

Protected Species	Habitat Type
Steller's eider (*Polysticta stelleri*) – Alaska breeding population	terrestrial (tundra), lakes, nearshore, open water
Kittlitz's murrelet (*Brachyramphus brevirostris*)[b]	terrestrial, nearshore, open water
Yellow-billed loon (*Gavia adamsii*)	riparian, lakes, nearshore, open water
Fish	
Chinook salmon (Lower Columbia River ESU) (*Oncorhynchus tshawytscha*)	nearshore, open water
Chinook salmon (Upper Columbia River spring run ESU) (*O. tshawytscha*)	nearshore, open water
Chinook salmon (Puget Sound ESU) (*O. tshawytscha*)	nearshore, open water
Chinook salmon (Snake River fall run ESU) (*O. tshawytscha*)	nearshore, open water
Chinook salmon (Snake River spring/summer run ESU) (*O. tshawytscha*)	nearshore, open water
Coho salmon (Lower Columbia River ESU) (*O. kisutch*)	nearshore, open water
Steelhead trout (Lower Columbia River ESU) (*O. mykiss)*	nearshore, open water
Steelhead trout (Middle Columbia River ESU) (*O. mykiss)*	nearshore, open water
Steelhead trout (Snake River basin ESU) (*O. mykiss*)	nearshore, open water
Steelhead trout (Upper Columbia River ESU) (*O. mykiss*)	nearshore, open water
Pacific herring (Southeast Alaska) (*Clupea pallasi*)	nearshore, open water
Reptiles	
Leatherback sea turtle (*Dermochelys coriacea*)	open water
Loggerhead turtle (*Caretta caretta*)	open water
Green turtle (*Chelonia mydas*)	open water
Olive Ridley turtle (*Lepidochelys olivacea*)	open water
Plants	
Aleutian shield fern (*Polystichum aleuticum*)	terrestrial

Source: NOAA Fisheries (2013), USFWS (2011b)

[a] The eastern population of Steller sea lion is currently proposed for delisting (NMFS, 2012a).

[b] The Kittlitz's murrelet was designated as a candidate species during the preparation of the BA. On 3 October 2013, USFWS issued a determination finding that listing the Kittlitz's murrelet was not currently warranted (78 FR 61764, 2013). This listing determination was published during finalization of the BA. Therefore, the Kittlitz's murrelet has been included in the BA, but an effects determination has not been made because listing under ESA is not imminent.

DPS – distinct population segment

ESU – evolutionarily significant unit

3.3.1 Terrestrial habitats

Terrestrial habitats in Alaska include forests, areas of exposed bedrock, rocky cliffs, grasslands, and tundra. These habitats are home to species that can tolerate low annual temperatures and highly variable precipitation, often in the form of snow. Forests are typically dominated by conifers, deciduous trees, mosses, and lichens. Tundra is found primarily in the Arctic (although it can also occur in the alpine zones of mountains); it is mostly composed of decaying organic material underlain by permanently frozen mineral soils (i.e., permafrost). Heaths, sedges, mosses, lichens, and wildflowers are typical tundra vegetation, inasmuch as the shallow soil and extreme environment cannot support trees or larger plants. In the brief Arctic or alpine summers, the upper layer of ice melts, forming bogs, small ponds, and wetlands (alpine tundra tends to have fewer water features than does Arctic tundra because of its increased capacity for drainage). Tundra is important habitat for breeding waterfowl and shorebirds (Alaska Wildlife Action Plan, Appendix 5.2; ADF&G, 2006b).

3.3.2 Riverine/lacustrine and riparian habitats

Alaska has a complex system of riverine, lacustrine, and riparian habitats[25] as a result of the significant year-round precipitation and snow melt during the summer months. According to the USGS Geographic Names Information System (GNIS), the State of Alaska has more than 9,500 named rivers and more than 3,300 named lakes (USGS, 2012). Riverine, lacustrine, and riparian habitats are important for many fish species, as well as bird and mammal species.

3.3.3 Wetlands

Wetlands, which are common in Alaska due to heavy precipitation and the presence of soil that has limited permeability or drainage, provide important breeding habitat for many fish and migratory bird species. Vegetation associated with wetlands is uniquely adapted to the permanent or seasonal saturated conditions. Bogs and fens (collectively known as peatlands) are wetlands that are characterized by highly organic soil, limited drainage, and, in the case of bogs, lower pH (the pH of fens can range widely). Water might not be visible at the surface of a bog, and in fact, some bog surfaces can appear fairly dry during the peak of the growing season when the water table is low. In the Arctic, snow melt in the summer is often the source of the water in bogs. Marshes contain seasonal, open-water features and often form adjacent to lakes, streams, and coastal bays. Marshes are also characterized by saturated soil, as the marshes receive water from adjacent surface water bodies or groundwater; the marsh is generally not very acidic. Peatlands, marshes, and wooded swamps are also present in Alaska coastal areas.

3.3.4 Shoreline

The shoreline is defined as the area between MLLW and 1,000 yds (914 m) inland from the highest tide mark (i.e., furthest extent of USCG upland jurisdiction) along a marine or estuarine body of water. According to the Alaska Coastal Management Program (which is no longer active), Alaska's coastline is approximately 44,000 mi long (ADNR, 2006). The physical and biological characteristics of shorelines in Alaska are highly

[25] Riverine habitat is associated with flowing water bodies (e.g., rivers, streams); lacustrine habitat is associated with lakes. Riparian habitat is the vegetated shoreline of both types of water features.

variable. NOAA's Environmental Sensitivity Index (ESI) maps (NOAA OR&R, 2008) define many subcategories of shoreline habitat types that are present in Alaska (Table 3-3).

Table 3-3. Shoreline habitat types potentially present in Alaska

Habitat Type	Habitat
Exposed	rocky shores; exposed rocky banks
	solid man-made structures
	rocky cliffs with boulder talus base
	wave-cut platforms in bedrock, mud, or clay
	scarps and steep slopes in clay or sand
	sand beaches (fine-, medium-, or coarse-grained)
	tundra cliffs
	mixed sand and gravel beaches
	gravel beaches (can include pebbles, cobbles, or boulders)
	riprap (man-made)
	exposed tidal flats
Sheltered	sheltered scarps in bedrock, mud, or clay; sheltered rocky shores (impermeable)
	sheltered, solid man-made structures; sheltered rocky shores (permeable)
	sheltered rocky rubble shores
	riprap (man-made)
	peat shorelines
	sheltered tidal flats
	vegetated low banks
	saltwater and brackish marshes
	freshwater marshes
	scrub-shrub wetlands
	inundated low-lying tundra

Based on: NOAA OR&R (2008)

Shoreline habitat characteristics are strongly influenced by adjacent landforms and water bodies and are used by both terrestrial and aquatic species. The shoreline, including the intertidal zone, is also the area where marine plants (including kelp and sea grasses) receive sufficient sunlight to create both habitat and food for other species.

3.3.5 Nearshore

For the purpose of this BA, the coastal nearshore is defined as the area between MLLW and 20 m deep or 100 m offshore, whichever is greater, including estuaries and river deltas. This area is strongly influenced by tides and nearshore currents. Nearshore habitats are highly productive and are used as areas of refuge, feeding, and breeding by many species of concern. Some nearshore areas, such those in the Beaufort and Chukchi Seas, are covered in ice for the majority of the year (MMS, 2007).

3.3.6 Open water

Open water is defined as the area adjacent to the coast that is more than 20 m deep or greater than 100 m offshore to the EEZ boundary. In Alaska, open water habitat is typically referenced based on geographic or oceanographic features (e.g., Bristol Bay, Cook Inlet, PWS, Beaufort Sea). Alaska is surrounded by the North Pacific Ocean to the south and the Arctic Ocean to the north. The Gulf of Alaska (GOA) and the Bering Sea represent major subregions within the North Pacific Ocean; the Beaufort and Chukchi Seas are subregions of the Arctic Ocean. These subregions include the water over the continental shelf and the deep water past the continental shelf (collectively, the pelagic regions).

The Beaufort Sea has a narrow continental shelf that extends as far as 80 km (50 mi off the coast (NOAA, 2011). The shelf has an average water depth of approximately 37 m (120 ft). The water depth in the Beaufort Sea reaches a maximum of approximately 3,810 m (12, 500 ft) (NOAA, 2011). The Chukchi Sea is shallow, with an average depth of approximately 40 to 50 m (130 to 164 ft) and a shelf that is approximately 480 km (300 mi) wide. The maximum water depth in the Chukchi Sea outbound of the shelf is approximately 975 m (3,200 ft). Depths on the continental shelf in the GOA can be as great as 200 m (660 ft) (US Navy, 2011), and the width of the shelf ranges from approximately 6 to 200 km (4 to 125 miles). Depths in the GOA past the shelf range from 130 m to more than 3,660 m (430 ft to more than 12,000 ft) (US Navy, 2011). The Bering Sea has a broad shelf, the majority of which is less than 150 m (~500 ft) deep (NASA, 2012). Depths in the Bering Sea beyond the shelf reach more than 3,500 m (11,000 ft) (NASA, 2012).

The continental shelf provides some of the most important open water habitats in Alaska. These areas serve as rich feeding grounds and migratory pathways for a wide variety of marine mammals, fish, and invertebrates.

3.3.7 Sea ice

Sea ice is frozen sea water and a dominant seasonal feature along the Alaska continental shelf that provides vital habitat to marine mammals and birds (e.g., polar bears, walruses, seals, and eiders), as well as to marine plants and micro-organisms. There are several types of ice cover in Alaska. Shorefast ice is a solid ice cover that is attached to land and to the bottom of the sea along the shallow continental shelf. Pack ice is not attached to land and can move but remains in a solid sheet. Leads and pressure ridges can form in both shorefast and pack ice. Leads are cracks that form in sea ice as a result of wind, exposing long stretches of open water (Wadhams, 2003). Although leads will usually refreeze, they are the first points to break when ice is under additional stress. Broken ice is also common and forms when cracks and leads do not refreeze. Persistent areas of open water (i.e., polynyas) can also form within the ice as a result of a number of oceanographic and meteorological conditions. Sea ice provides habitat for wildlife that hunt or travel on the ice cover. Melting ice is associated with phytoplankton blooms that support marine food webs at northern latitudes (Wadhams, 2003; Thomas and Dieckmann, 2010). Polynyas and leading ice edges are also used by birds and marine mammals.

Marine ecosystems are sensitive to changes in sea ice, particularly the timing and duration of ice melt and ice formation. Sea ice cover and conditions are controlled by a complex feedback process between atmospheric and oceanic factors (e.g., atmospheric temperature, water temperature, water chemistry) that determine the annual cycle of ice formation and ice melt (Kinnard et al., 2011; Thomas and Dieckmann, 2010). Historically, sea ice cover is greatest in the winter months when temperatures are lowest (NOAA, 2011). In some locations, the sea ice melts in the summer; in other locations, it remains intact year-round. Sea ice that does not melt during the summer or over multiple summers is referred to as multi-year ice. Overall, the ice in the northern hemisphere has been shrinking at a rate of 3.4% per decade since the 1980s due to rising global temperatures, with higher negative trends in Arctic regions during the summer and autumn (Comiso and Nishio, 2008; cited in Kinnard et al., 2011). Late-summer multi-year sea ice in the Arctic has been shrinking at a rate of 8.6% per decade. In the Arctic, the onset of ice melt typically begins in mid-June (Wadhams, 2003), although the time of year varies by location and has been occurring earlier in recent years due to the thinning of first-year ice (i.e., ice formed during the previous autumn / winter) (Stroeve et al., 2011).

3.4 Current Status of Protected Species and Habitat

The following subsections describe the current statuses of protected species and their critical habitats, including key stressors that affect their recovery. Common geographic areas that are referenced in the descriptions of species distributions in Alaska are shown in Figure 3-7.

Figure 3-7. Geographic reference map

Data sources: ESRI, Canada Centre for Cadastral Management, and Alaska State Geo-Spatial Data Clearinghouse

Prepared by MTY, 05/08/12; Map #5213; W:\Projects\06-60-01 US Coast Guard\Data\GIS\Biological Assessment\Maps and Analysis

Protected marine mammals, birds, and plants commonly found in Alaska, its waters, and designated critical habitat are described in the following subsections, with particular attention to areas of species' vulnerability that might be adversely affected following a response action. The following topics are discussed for each species:

- Spatial / temporal distribution of protected species (by life stage) and critical habitats
- Population status
- Habitat requirements (e.g., breeding, foraging, refuge)
- Current stressors / threats, both natural and anthropogenic

3.4.1 Marine mammals

This section summarizes information on 15 species of marine mammals (i.e., 9 whale and 2 seal species; sea lion; polar bear; sea otter; and walrus); source documents provide further detail. Protected marine mammals and their general habitats are identified in Table 3-4.

Table 3-4. Marine mammal presence by habitat type

Protected Species	Habitat						
	Terrestrial	Riverine/ Lake/ Riparian	Wetland	Shoreline	Nearshore	Open Water	Sea Ice
Beluga whale					X	X	X[a]
Blue whale						X	
Bowhead whale						X	X[a]
Fin whale						X	
Western North Pacific gray whale					X	X	
Humpback whale					X	X	
Sperm whale						X	X[b]
North Pacific right whale						X	
Sei whale						X	
Steller sea lion				X	X	X	
Polar bear	X			X	X		X
Northern sea otter				X	X		

Protected Species	Habitat						
	Terrestrial	Riverine/ Lake/ Riparian	Wetland	Shoreline	Nearshore	Open Water	Sea Ice
Pacific walrus				X	X	X	X
Ringed seal					X	X	X
Bearded seal					X	X	X

[a] Open water, including polynyas and/or leads.

[b] Older, adult males use the pack ice edge as habitat (Best, 1987).

3.4.1.1 Beluga whale – Cook Inlet distinct population segment

Beluga whales (*Delphinapterus leucas*) are relatively small (3.7 to 4.3 m [12 to 14 ft] in length), odontocete (toothed) whales. They are extremely social and are often found in pods ranging from 10 to a few hundred individuals and led by a dominant female (NMFS, 2008a). They are reported to have excellent hearing and acute vision and are very vocal (NMFS, 2008a). Beluga whales use acoustic signals to communicate, navigate, locate prey, and sense their environment (Richardson et al., 1995).

Beluga whale

3.4.1.1.1 Distribution and critical habitat

Beluga whales are found in the Arctic and Subarctic oceans in fjords, estuaries, and shallow water. With the exception of the southeast panhandle and Aleutian Islands, beluga whales are present along all Alaska coasts (NMFS, 2008a). Their seasonal distribution is dependent on factors such as ice cover, tides, prey access, temperature, and human presence (Lowry, 1985; cited in NMFS, 2008a).

NOAA Fisheries Service recognizes five beluga whale stocks in US waters: the Beaufort Sea, eastern Chukchi Sea, eastern Bering Sea, Bristol Bay, and Cook Inlet stocks. Some populations migrate seasonally over long distances, but the Cook Inlet stock remains in the inlet year-round (Hansen and Hubbard, 1999; Rugh et al., 2000; Hobbs et al., 2005; NMFS, 2008a). Of the five stocks in US waters, only the Cook Inlet stock is found south of the Alaska Peninsula; genetic analyses indicate that this stock is the most isolated of the five (O'Corry-Crowe and Lowry, 1997; O'Corry-Crowe et al., 2002; both cited in NMFS, 2008a).

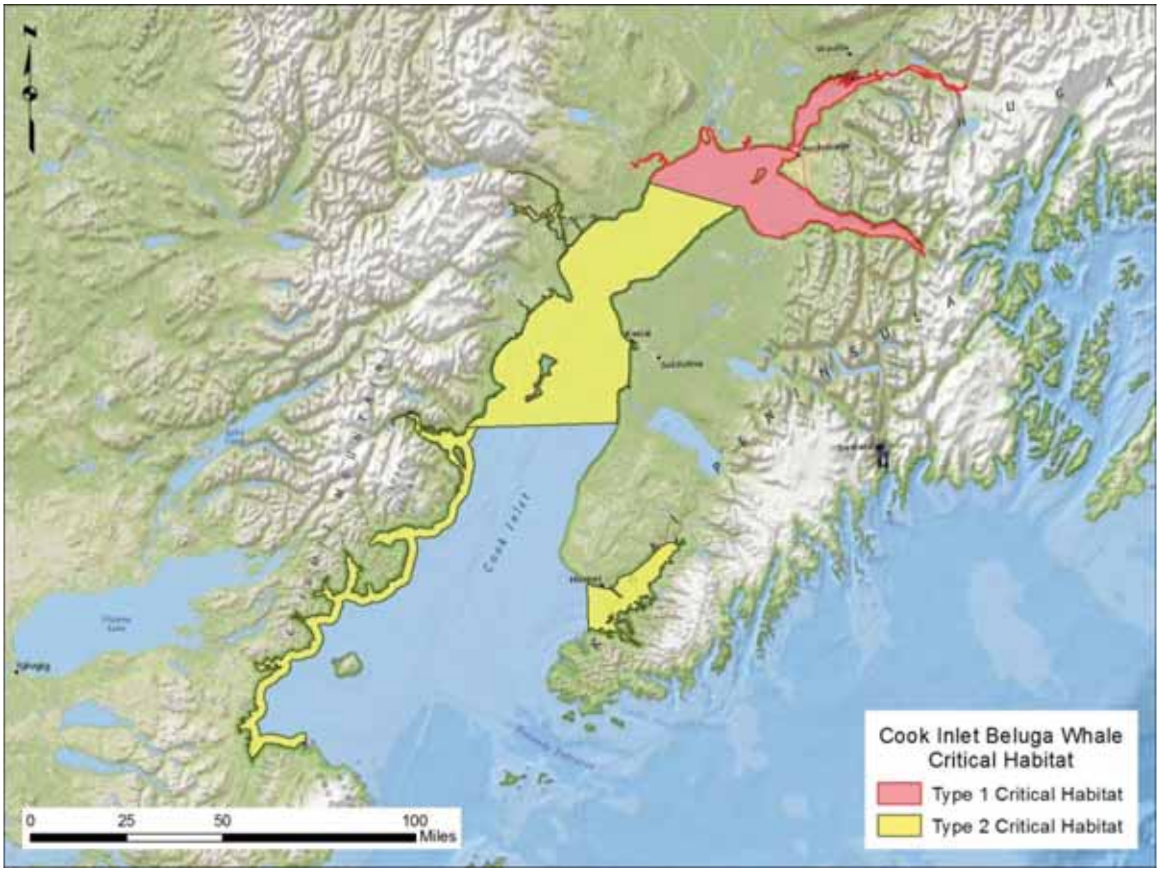
The National Marine Fisheries Service (NMFS) considers the Cook Inlet beluga whale to be a DPS. The Cook Inlet beluga whale was listed as endangered in 2008 (73 FR 62919, 2008) and is considered to be a depleted stock under the Marine Mammal Protection

Act (MMPA). Inasmuch as the Cook Inlet DPS is the only ESA–listed beluga whale stock, the following discussion specifically addresses this DPS.

As part of the Cook Inlet beluga whale conservation strategy, NMFS (2008a) stratified the Cook Inlet beluga whale's habitat into three types based on use:

- **Type 1 critical habitat –** Spring through fall foraging and nursery habitat in the upper inlet. This habitat is considered the most valuable, and its location makes it vulnerable to anthropogenic impacts. Type 1 habitat has numerous rivers with anadromous fish runs and shallow habitat that is also used by beluga whales for molting or predator avoidance. Given the importance of this habitat to Cook Inlet beluga whales, NMFS (2008a) has concluded that "activities that restrict or deter access to Type 1 habitat could reduce beluga whale calving success, impair their ability to secure prey, and increase their susceptibility to predation by killer whales" and that aggregations of beluga whales in Type 1 habitat are "predisposed to harm from such events as oil spills."
- **Type 2 critical habitat** – Fall and winter concentration areas with limited spring foraging areas. This habitat is generally south of Type 1 habitat and includes nearshore and offshore waters of the mid- to upper-inlet and nearshore waters of the lower inlet. Type 2 habitat is believed to be important for fall and winter feeding (Hobbs et al., 2005, NMFS unpublished data; both cited in NMFS, 2008a), so these areas could be important for winter survival.
- **Type 3 critical habitat –** Encompasses the remaining Cook Inlet beluga whale range. Historical data and traditional ecological knowledge (TEK) indicate that Type 3 habitats were previously used by Cook Inlet beluga whales, so these areas will likely become important again if the population recovers.

The locations of the Type 1 and Type 2 critical habitats within Cook Inlet are shown on Figure 3-8.



Data source: NOAA Fisheries (2013)

Figure 3-8.Cook Inlet beluga whale critical habitat

Critical habitat for the Cook Inlet beluga whale DPS (i.e., Types 1 and 2 critical habitat) was designated in 2011 (76 FR 20180, 2011). The Port of Anchorage[26] was excluded from critical habitat due to its importance to national security; the Eagle River Flats Range on Joint Base Elmendorf-Richardson[27] was also excluded due to protective measures included in the existing Department of Defense Integrated Natural Resource Management Plan.

[26] All waters off the Port of Anchorage that are east of a line that connects Cairn Point (61°15.4′ N, 149°52.8′ W) and Point MacKenzie (61°14.3′ N, 149°59.2′ W) and north of a line that connects Point MacKenzie and the north bank of the mouth of Ship Creek (61°13.6′ N, 149°53.8′ W) are excluded from the beluga's critical habitat designation.

[27] All property and overlying waters of Joint Base Elmendorf-Richardson between mean higher high water and mean high water are excluded from the critical habitat designation.

The primary constituent elements (PCEs) that comprise critical habitat and are essential to the conservation of the Cook Inlet beluga whale are:

- Intertidal and subtidal waters of Cook Inlet with depths < 30 ft MLLW and within 5 mi of high- and medium-flow anadromous fish streams
- Abundant primary prey species consisting of four species of Pacific salmon (i.e., Chinook, sockeye, chum, and coho), Pacific eulachon, Pacific cod, walleye pollock, saffron cod, and yellowfin sole
- Waters free of toxins or other agents of a type and amount harmful to Cook Inlet beluga whales
- Unrestricted passage within or between the critical habitat areas
- In-water noise levels below thresholds that could result in the abandonment of critical habitat areas by Cook Inlet beluga whales

3.4.1.1.2 Population status

NMFS has conducted aerial surveys to count Cook Inlet beluga whales every year since 1993; beginning in 1994, methods were implemented to also estimate the number of whales missed by the aerial surveys. The most recent survey yielded a population estimate of 284 individuals as of June 2011 (Hobbs et al., 2011). This estimate represents a continued decline since 2008, when the population was estimated to be 375 individuals (Hobbs and Shelden, 2008). Adjusted abundance estimates made since 1999 show a statistically significant decline, with an average rate of decline of 1.7% (standard error = 0.9) per year (Hobbs et al., 2011).

3.4.1.1.3 Habitat requirements

Beluga whales are opportunistic carnivores but are primarily piscivorous (NMFS, 2008a). Eulachon and salmon are seasonally important prey species; Cook Inlet beluga whales rely on spring eulachon and salmon runs in summer and autumn. Numerous studies reviewed by NMFS (2008a) indicate that beluga whales need these seasonal abundances of high-calorie prey to build fat reserves in preparation for winter.

Beluga whale distribution within Cook Inlet fluctuates as the whales move to exploit changing prey distributions, with the whales aggregating near river and stream mouths that support salmon runs. In the winter, the Cook Inlet DPS tends to leave the coastal zones and move to mid-inlet water (NMFS, 2008a). Cook Inlet beluga whales also need shallow river systems and mudflats as refuge from their only natural predators, orca whales. Shallow and nearshore waters near certain tributary streams are considered to be essential habitat for Cook Inlet beluga whales. Little is known about the habitat requirements of breeding and calving beluga whales, but it is suspected that fresher and warmer coastal water are important for ideal calving grounds (NMFS, 2008a). Shallow, warmer waters also benefit newborn calves, because their blubber is not as thick as that of an adult (Katona et al., 1983; Calkins, 1989; both cited in NMFS, 2009b).

Cook Inlet beluga whales use shallow river channels and deltas for foraging and predator evasion. After reviewing multiple studies on beluga whale distribution, NMFS defined the spatial extent of important shallow water habitats for beluga whales as being within the 9.1-m (30-ft) depth contour and within 8 km (5 mi) of medium- and high-flow-accumulation rivers (74 FR 63080, 2009). This area in Cook Inlet has been designated as Type 1 critical habitat for beluga whales.

3.4.1.1.4 Current stressors and threats

NMFS (2008a) identified the natural threat of stranding and the anthropogenic threat of prey reduction as having a high impact on the recovery of the Cook Inlet beluga whale population. Threats identified as having potential moderate impacts on the recovery of the stock are predation, bycatch or entanglement by commercial fishing gear, habitat loss from coastal development, ship strikes by small vessels, and research-related disturbance. The effects of pollution and oil and gas development are not known.

Distribution

- Cook Inlet

Habitats

- Nearshore (including river deltas)
- Open water
- Sea ice (polynyas)

Vulnerabilities

- Disturbance (noise)
- Competition for/loss of prey resources
- Habitat loss
- Injury/death (ship strike)

A small population in a contracted area is far more vulnerable to a variety of threats (2008). Losses of individuals from stranding, predation, or disease have the potential to exert population-level effects. The seasonal presence of key prey species, which are also of commercial interest, make beluga whales vulnerable to natural stock fluctuations and competition for prey. Anthropogenic disturbances that cause beluga whales to abandon their summer feeding grounds could affect winter survival rates.

3.4.1.2 Blue whale

The blue whale (*Balaenoptera musculus*), a mysticete (baleen) whale, is the largest mammal ever known to have inhabited Earth. The largest blue whale on record was seen off the coast of Japan in 1959 and measured 27.1 m (89 ft) in total length (J. Gilpatrick, pers. comm., cited in Reeves et al., 1998). Blue whales in the northern hemisphere tend to be smaller than those in the southern hemisphere, and females are generally larger than males (Reeves et al., 1998). Blue whales are most often observed in pairs, but will also travel alone or in small groups (MarineBio, 2012a).

Blue whale

The blue whale was originally listed as endangered in 1970 under the Endangered Species Preservation Act (35 FR 18319, 1970), the precursor to the ESA. Because the blue whale is an endangered species under the ESA, it is, by default, also considered to be depleted by the MMPA. The International Whaling Commission (IWC) banned commercial hunting of the blue whale in 1966, before the species was listed under the ESA; a recovery plan was released in 1998 (Reeves et al., 1998).

3.4.1.2.1 Distribution and critical habitat

Blue whales are known to be present in every ocean except the Arctic Ocean, and NMFS recognizes three distinct subspecies: *B. m. musculus,* in the Northern Hemisphere; *B. m. intermedia,* in the Antarctic; and *B. m. brevicauda,* in the sub-Antarctic zone of the southern Indian Ocean and southwestern Pacific Ocean (Ichihara, 1966; cited in Reeves et al., 1998). At least five subpopulations of blue whales are found in the North Pacific: southern Japan, northern Japan/Kurlis/Kamchatka Peninsula, Aleutian Islands, eastern GOA, and California/Mexico (Reeves et al., 1998). It is unclear to what extent these stocks intermix or where or when they do so. In the GOA and off the coast of British Columbia, only 15 sightings occurred from 1997 to 2009 (Calambokidis et al., 2009; cited in NMFS, 2011g). Few (possibly unreliable) sightings occurred as far north as the Chukchi Sea (Yochem and Leatherwood, 1985; Rice, 1986; Rice pers. comm 1997; all cited in Reeves et al., 1998). Blue whales are assumed to migrate seasonally, depending on their food requirements (Reeves et al., 1998).

Alaska populations (Figure 3-9) of blue whales are believed to travel north in the spring to access the higher-density zooplankton blooms and south toward Hawaii in the fall to take advantage of warmer waters for breeding (Reeves et al., 1998; NMFS, 2006a). Therefore, blue whales are only present in Alaska waters during their non-breeding season.

Data source: NOAA Fisheries (2013)

Figure 3-9. Blue whale distribution in Alaska

Critical habitat is not required for species listed under the ESA prior to 1978. Thus, because the blue whale was originally listed as endangered in 1970 under the Endangered Species Preservation Act (35 FR 18319, 1970), no critical habitat for the blue whale has been designated.

3.4.1.2.2 Population status

North Pacific blue whales were previously estimated at 33% of historical carrying capacity (i.e., 1,600 animals out of a 4,900 carrying capacity) (Mizroch et al., 1984; cited in NMFS, 2006a). Based on a rough estimate, approximately 6,000 blue whales inhabited the eastern North Pacific (i.e., California to Alaska) in 1924 (Rice, 1974; cited in Reeves et al., 1998). NOAA Fisheries considers the North Pacific blue whale population to be composed of the eastern and central stocks based on distinct stereotypic vocalizations (Stafford et al., 2001; Stafford, 2003; both cited in Allen and Angliss, 2011). Both the eastern and central stocks are present in Alaska waters. The best current estimate of the eastern stock, which ranges from the northern GOA to the eastern tropical Pacific, is 2,497 individuals (Allen and Angliss, 2011). No current estimate of the central stock, which ranges from the Aleutian Islands to Hawaii, is available because no individuals were observed during the 1993 to 1998 aerial surveys or during the 1994 and 2002 shipboard surveys (Allen and Angliss, 2011).

Records of the numbers of blue whales hunted, both commercially and illegally, have given researchers clues to their historical abundance. Between 1910 and 1965, commercial whalers killed an approximate total of 9,500 blue whales in the North Pacific (NMFS, 2006a; Ohsumi and Wada, 1972, cited in Reeves et al., 1998).

3.4.1.2.3 Habitat requirements

Blue whales are found in a variety of marine environments. They inhabit and feed in open water, both offshore coastal regions and open ocean areas, and are frequently found on the continental shelf (Calambokidis et al., 1990; Fiedler et al., 1998; both cited in Reeves et al., 1998) and far offshore in deep water (Wade and Friedrichsen, 1979; cited in Reeves et al., 1998). The primary prey of North Pacific blue whales is krill (small euphausiid crustaceans, specifically *Euphausia pacifica*, several *Thysanoëssa* species, and *Nematoscelis megalops)* (Rice, 1986; cited in Reeves et al., 1998). The stomach contents of some whales have been found to contain a mixture of euphausiids and copepods or amphipods (Nemoto, 1957; Nemoto and Kawamura, 1977; both cited in Reeves et al., 1998), but the copepods and amphipods could have been ingested incidentally (Reeves et al., 1998). Blue whales are frequently found along the edges of continental shelves and in upwelling regions, where phytoplankton and krill concentrations are more concentrated (Bailey et al., 2009; Reilly and Thayer, 1990; Schoenherr, 1991; all cited in US Navy, 2011). Ocean conditions, such as surface chlorophyll-*a* levels and sea-surface temperatures, are indicative of blue whale habitat quality (Burtenshaw et al., 2004). Females with calves are routinely observed in the Gulf of California from December to March, leading to the belief that the area is used for nursing and calving (Sears, 1990; cited in Reeves et al., 1998).

3.4.1.2.4 Current stressors and threats

As reviewed by NMFS (2011g; Reeves et al., 1998), the greatest threats to the blue whale population are vessel strikes, fishing gear entanglements, habitat degradation resulting in reduced zooplankton availability, noise disturbance, and illegal hunting. The waters around California have been the site of a fair number of ship strikes to blue whales. Between 1980 and 1993, four to six blue whales died as a result of collisions with ships (Barlow, 1995, cited in Reeves et al., 1998; Barlow et al., 1997). From 1988 to 2007, 21 blue whale carcasses were reported along the California coast, several of which had large scars on their dorsal areas, likely a result of ship strikes (Berman-Kowalewski et al., 2010; cited in NMFS, 2011g).

Occurrence/Distribution

- Aleutian Islands
- Bering Sea
- GOA

Habitats

- Open water

Vulnerabilities

- Disturbance (noise)
- Injury/death (ship-strike, gear entanglement)
- Habitat degradation resulting in reduction in food base

There exists no tangible evidence of blue whales taken in fishing gear, but the body of a whale that is entangled or killed offshore might never drift ashore, making it nearly impossible to document such events (Reeves et al., 1998). In addition, a blue whale could become entangled and carry fishing gear with it for an extended period of time, reducing the animal's reproductive success or possibly causing mortality.

Increasing anthropogenic underwater noise in oceans is a concern for blue whales (Reeves et al., 1998; NMFS, 2006a). Noise disturbance can cause behavioral responses, route alteration, or stress among blue whales.

The hunting and poaching of blue whales has long been a concern and remains so today inasmuch as it directly relates to the continuation of this species. Areas that once had abundant numbers of blue whales, such as Japan and the Aleutian Islands, have been greatly depleted (Miyashita et al., 1995, cited in Reeves et al., 1998; Stewart et al., 1987). Russian sources describe illegal catches that occurred after blue whales had been protected from whaling by the IWC (Zemsky and Sazhinov, 1982; cited in Reeves et al., 1998).

Lesser threats to the blue whale population are disease or parasites, predation, and contaminants. Blue whales can be infected with the *Crassicauda boopis* nematode, which is suspected of causing renal failure in fin whales and ultimately death (Baylis, 1928, cited in NMFS, 2011g; Lambertsen, 1992). Orcas are known to attack blue whales (Sears, 1990; Tarpy, 1979; both cited in Reeves et al., 1998), but the mortality rate from such events is unknown (Reeves et al., 1998). Because blue whales are planktivorous, they are less susceptible than piscivorous baleen whales to the accumulation of contaminants in their tissues (Reeves et al., 1998).

3.4.1.3 Bowhead whale

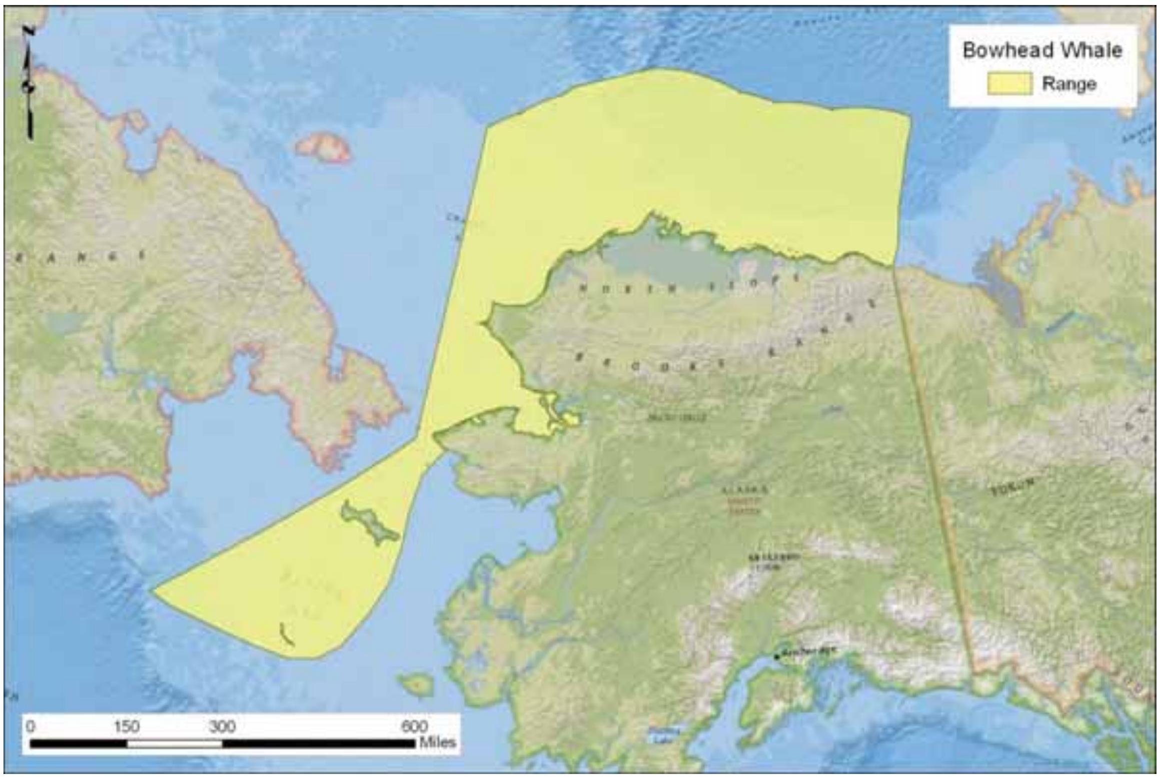
The bowhead whale (*Balaena mysticetus*) is one of the most important subsistence species to the Inupiat people and has been for roughly 2,000 years (Moore et al., 2010). Bowhead whales are medium-sized mysticete whales that feed on zooplankton. Their large heads, which are approximately 30 to 40% of their body length, are morphologically adapted to break through sea ice to create breathing holes (NOAA, 2011). Bowhead whales travel in variably sized groups but frequently congregate into large feeding aggregations (NMFS, 2006a). Bowhead whales use acoustics for communication and navigation.

Bowhead whale

As with most endangered whales, bowhead populations were greatly reduced through intense commercial harvest. They were listed as endangered under the precursor to the ESA in 1970 (35 FR 18319, 1970) and thus are considered depleted under the MMPA. There are no critical habitat designations for this species, nor has a recovery plan been developed.

3.4.1.3.1 Distribution and critical habitat

The bowhead whale is a circumpolar Arctic species that historically has been distributed throughout Arctic waters in the northern hemisphere (NMFS, 2002). Four stocks are recognized by the IWC, two in the North Atlantic and two in the North Pacific (Allen and Angliss, 2013). The Bering Sea stock, also known as the Western Arctic stock or the Bering-Chukchi-Beaufort stock, in the North Pacific is the only stock present in Alaska waters (Figure 3-10), so all further discussion focuses on this stock.



Data source: NOAA Fisheries (2013)

Figure 3-10. Bowhead whale distribution in Alaska

The Bering Sea stock is generally located between 60°N and 75°N in the western Arctic Basin (Braham and Rice, 1984; Moore and Reeves, 1993, cited in Allen and Angliss, 2011). The stock is seasonally transient, migrating through the Chukchi Sea between overwintering areas in the northern Bering Sea and summer habitats in the Beaufort Sea (Braham et al., 1980; Moore and Reeves, 1993; both cited in Allen and Angliss, 2011). Bowhead whales observed near Barrow, Alaska, during the summer indicate that there are potentially important feeding grounds in the Beaufort Sea (Moore, 1992; Lowry et al., 2004; Moore and Demaster, 200, cited in Allen and Angliss, 2011), while sightings in the Bering and Chukchi Seas during the summer are believed to represent the expanding distribution of the Bering Sea stock (Rugh et al., 2003; cited in Allen and Angliss, 2011).

Bowhead whales migrate in pulses in the spring and have been observed to send scouts ahead of the pod to check ice conditions (NSB, 1981; cited in NMFS, 2002). While migrating, they can travel under solid ice (up to several miles) and can break through thinner ice (approx. 18 cm [7 in.] thick) to breathe (George et al., 1989; cited in NMFS, 2002). Calves are born during the spring migration, from April through early June (Koski et al., 1993; cited in NMFS, 2002), probably in the Chukchi Sea (NMFS, 2006b). Fall migration is not as hurried a process as spring migration; bowhead whales have been observed to take their time in the fall, using staging areas for food resources or social purposes (Bodfish, cited in NSB, 1981; MMS, 1995; both cited in NMFS, 2002). TEK indicates that bowhead whales will migrate inside the barrier islands if fall storm sea ice is too close to the coast, although none of the aerial surveys conducted from 1980 to 1995 documented bowhead whales migrating between Cross Island and the shore (Long, pers. comm 1996, Miller et al., 1996; both cited in NMFS, 2002).

There is no designated critical habitat listed for the bowhead whale. Critical habitat is not required for species listed under the ESA prior to 1978, and the bowhead whale was originally listed as endangered in 1970 under the Endangered Species Preservation Act (35 FR 18319, 1970).

3.4.1.3.2 Population status

Commercial whaling in the late 19th and early 20th centuries greatly reduced the Bering Sea stock of bowhead whales. The Bering Sea stock was estimated to consist of between 10,400 and 23,000 individuals in the early 19th century but is believed to have been reduced to a few thousand individuals by end of the early 20th century through commercial whaling (Woodby and Botkin, 1993; cited in Allen and Angliss, 2011). The IWC's recognized estimate for the Bering Sea stock in 1995 was 7,992 bowhead whales; in 1996, another estimate placed the number at 8,200 individuals (International Whaling Commission, 1996; cited in NMFS, 2002). The most recent abundance estimate, based on surveys conducted in 2001, is 10,545 individuals (Zeh and Punt, 2004; cited in Allen and Angliss, 2011). A preliminary estimate based on aerial photographs and capture/recapture work in 2003 and 2004 was 11,836 individuals (Koski et al., 2008; cited in Allen and Angliss, 2011). In 2001, 121 calves were counted among the Bering Sea stock. This was the greatest number ever officially recorded for this stock, suggesting that the stock is experiencing a steady recovery (George et al., 2004; cited in NMFS, 2006b). According to Allen and Angliss (2011), the Bering Sea bowhead whale stock has been increasing in recent years and could be approaching its carrying capacity.

3.4.1.3.3 Habitat requirements

In the winter, bowhead whales congregate along the ice front and in polynyas and leads in the central and western Bering Sea (Moore and Reeves, 1993, cited in NMFS, 2002; Quakenbush et al., 2010b). While migrating, bowhead whales generally remain in water that is less than 50 m (164 ft) deep (Treacy, 1991, 1992, 1994; all cited in NMFS, 2002). Bowheads have been observed to feed in shallow, coastal water, at depths of 4.6 to 6.0 m (15 to 20 ft) and distances of 457 m (1,500 ft) offshore (NMFS, 2002). An evaluation of habitat use by bowhead whales in the Beaufort and Chukchi Seas documented that the greatest densities of bowheads were at depths ranging from 40 to 200 m (131 to 656 ft) (Koski and Miller, 2009).

Zooplankton, specifically copepods, mysids, isopods, amphipods, and euphausiids, are the primary prey for bowhead whales (Lowry 1993, cited in NMFS, 2002; Moore et al., 2010). Bowhead whale feeding has been observed east of Point Barrow and north of Harrison Bay in the Canadian Beaufort Sea (Ljungblad et al., 1987; cited in NMFS, 2002), inside the Beaufort Sea Barrier Islands near Kaktovik, Alaska (Richardson and Tomson, 1999; cited in NMFS, 2002), and near Barrow, Alaska (Moore et al., 2010). Bowhead whales exhibit temporal and spatial segregation by size class. Subadult bowhead whales are not physiologically adapted to dive as deep or as long as adults, so they tend to stay in shallower coastal waters (< 20 m) to feed. Adults and mothers with calves tend to select deeper waters for feeding and traveling. Bowhead whales are also segregated by size during migration, with small subadults going first, followed by adults and mothers with calves (Koski and Miller, 2009).

Bowhead whales tend to select waters nearer the shore at times when the ice is thin or moderate and the slope of the continental shelf during periods of heavy ice. Because bowhead whale distribution is related to sea ice cover, any variations in ice coverage associated with climate change could alter bowhead whale distribution and migration patterns over time (Koski and Miller, 2009).

3.4.1.3.4 Current stressors and threats

Threats to the Bering Sea stock of bowhead whales include subsistence harvest, noise disturbance, commercial fishing, ship strikes, exposure to oil, disease, and predation (NMFS, 2002).

Distribution

- Bering Sea
- Beaufort Sea
- Chukchi Sea

Habitats

- Nearshore
- Open water
- Sea ice (edges, polynyas, leads)

Vulnerabilities

- Disturbance (noise)
- Injury/death (ship strike, hunting, fishing gear entanglement)
- Exposure (contaminants)
- Disease or predation

Alaska Natives have harvested bowhead whales for subsistence for at least 2,000 years, and the practice continues today (NMFS, 2002). On average, Alaska Native subsistence hunters take 0.1 to 0.5% of the population every year, although the number harvested per year varies (Philo et al., 1993; cited in Allen and Angliss, 2011). Alaska Native subsistence hunters retrieve about 65% of struck whales (Suydam et al., 2009; cited in Allen and Angliss, 2011), but the mortality of and injuries to struck but lost whales are unknown. The mean annual reported subsistence harvest for the Bering Sea bowhead whale stock for the 5-year period from 2004 to 2008, including Alaska Native, Russian, and Canadian harvests, was 41.2 individuals (Allen and Angliss, 2011).

Although studies on baleen whale hearing are lacking, it is reasonable to assume that the range of their calls approximates the range of their hearing. Studies indicate that bowhead whales are sensitive to sound from offshore drilling platforms and seismic surveys (Richardson and Malme, 1993; cited in Allen and Angliss, 2011) and will actively avoid vessels that approach rapidly and directly (Richardson and Malme, 1993; cited in Allen and Angliss, 2011). The distances at which bowhead whales will detect and respond to noise are poorly documented in the available studies (NMFS, 2002). Commercial fishing interactions have been documented for Bering Sea bowhead whales, though the average annual entanglement rate is unknown (Allen and Angliss, 2011).

3.4.1.4 Fin whale

Fin whales (*Balaenoptera physalus*) are the world's second largest whale species by length (NMFS, 2010a). This mysticete (i.e., baleen whale) practices lunge-feeding, during which the whale engulfs large amounts of water and prey and then filters it through baleen plates (Goldbogen et al., 2006). During feeding, the fin whale's pleated throat and chest expand to hold food and seawater, giving it a tadpole-like appearance (NMFS, 2010a, b). The

Fin whale

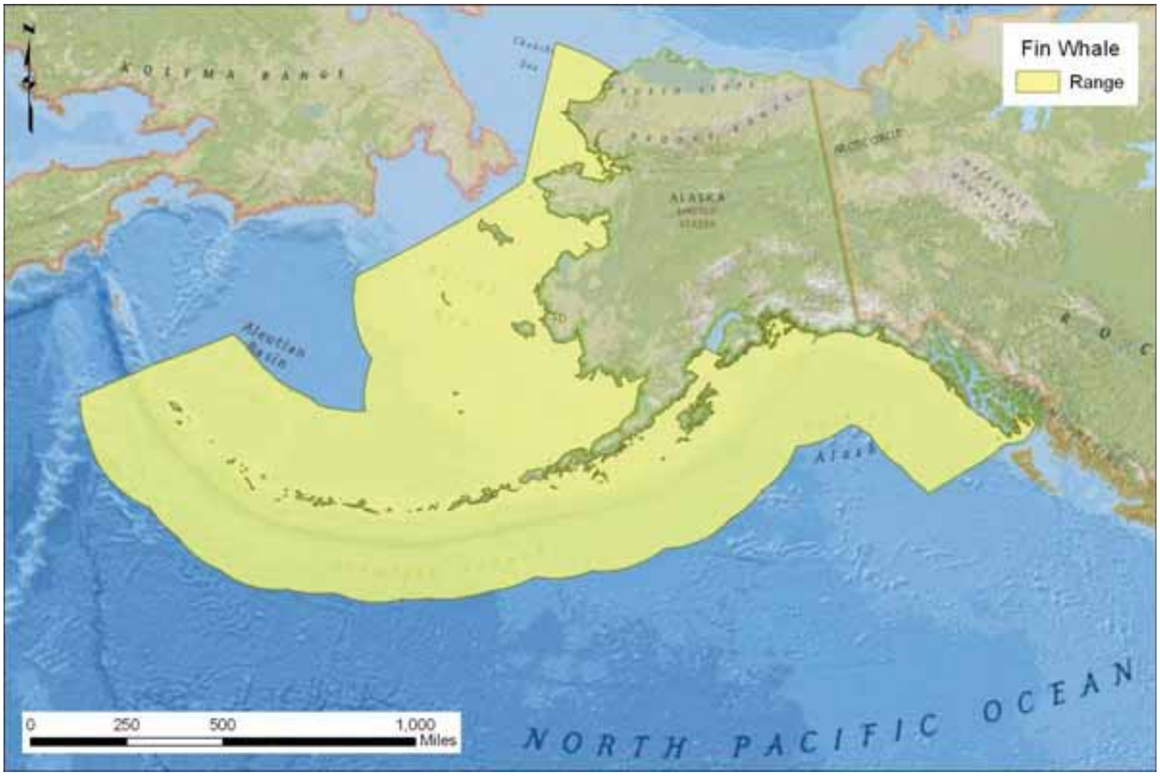
similarity in appearance of the fin whale to the Bryde's whale and sei whale contributes to the confusion in determining the distribution of the species (NMFS, 2010a). These whales are found individually, in small groups of 2 to 7, or in some instances in larger pods that include as many as 20 individuals. Fin whales have interbred with blue whales in the North Atlantic and North Pacific (Bérubé and Aguilar, 1998; Doroshenko, 1970; both cited in NMFS, 2010a).

Historical whaling practices greatly depleted the global population of fin whales; from 1904 to 1979, the total reported catch was close to three-quarters of a million whales (International Whaling Commission, 1995; cited in NMFS, 2010a). The fin whale was listed as endangered under the precursor to the ESA in 1970 (35 FR 18319, 1970) and thus is considered depleted under the MMPA. Although there is very little data pertaining to this species, a recovery plan was created in 2010 (NMFS, 2010a).

3.4.1.4.1 Distribution and critical habitat

Fin whales are well distributed in all oceans except the Arctic Ocean (NMFS, 2010a). The fin whale stock structure is uncertain. The IWC recognizes one stock of fin whale in the North Pacific, and NMFS recognizes three stocks for management purposes: Alaska (Northeast Pacific), Washington / Oregon / California, and Hawaii (Allen and Angliss, 2011). Mizroch et al. (Moore et al., 2000, cited in Allen and Angliss, 2011) suggest that the currently recognized stock structure needs to be reviewed and updated to reflect current data.

Fin whales migrate seasonally with euphausiid food resources: high latitudes in the summer and low latitudes in the winter. Most populations probably migrate thousands of kilometers a year (NMFS, 2010a), although fin whales have been observed in the Bering Sea and the GOA year-round, which suggests a resident population (Mizroch et al., 1999; cited in US Navy, 2011). Overall, the fin whale population in Alaska waters is greater between May and October, when prey are abundant (NMFS, 2010a). During this time, high densities of fin whales are present in the northern GOA and southern Bering Sea (Figure 3-11), feeding and traveling through passes in the Aleutian Islands (Reeves et al., 1985; cited in NMFS, 2010a). Estimates of fin whale abundance in the Bering Sea have been almost five times greater in the central eastern region than in the southeastern region, where most sightings occur along a highly productive shelf break (Moore et al., 2002; cited in Allen and Angliss, 2011). In the winter, sightings occur off the west coast of the United States and Hawaii (Angliss and Outlaw, 2005).



Data source: NOAA Fisheries (2013)

Figure 3-11. Fin whale seasonal distribution in Alaska

There is no critical habitat listed for the fin whale. Critical habitat is not required for species listed under the ESA prior to 1978, and the fin whale was originally listed as endangered in 1970 under the Endangered Species Preservation Act (35 FR 18319, 1970), the precursor to the ESA.

3.4.1.4.2 Population status

No reliable historical or current estimates for the North Pacific fin whale population are available (Allen and Angliss, 2011). All estimates of population and growth should be interpreted with caution because they are likely based on limited information and crude statistical analyses (NMFS, 2010a). Before whaling began, the fin whale population of the North Pacific is estimated to have been between 42,000 and 45,000 individuals, based on catch data and a population model (Ohsumi and Wada, 1974; cited in NMFS, 2006a). A 1999 survey in the central eastern Bering Sea and a 2000 survey in the southeastern Bering Sea yielded provisional estimates of 3,368 and 683 fin whales, respectively (Moore et al., 2002; cited in Allen and Angliss, 2011). Surveys conducted in 1984 and 1994 failed to produce any fin whale observations in the vicinity of the Aleutian Islands; but in 2004, during the Structure of Populations, Levels of Abundance, and Status of Humpback (SPLASH) whale stocks survey, large numbers of fin whales were observed in the GOA (NMFS, 2010a). A 2003 cetacean survey in Shelikof Strait, Cook Inlet, PWS, and the shelf between Kodiak and Montague Island (Waite et al., 2003;

cited in US Navy, 2011) reported observations of 165 fin whales, with an average group size of 2.9 individuals. From 2001 to 2003, coastal waters between Kenai Peninsula and Amchitka Pass were surveyed in July and August, during which 276 fin whales were sighted, resulting in an estimate of 1,652 individuals in the area (Zerbini et al., 2006; cited in Allen and Angliss, 2011). In 2003, it was estimated that fin whale populations had increased 4.8% since 1987 (Zerbini et al., 2006; cited in NMFS, 2010a).

3.4.1.4.3 Habitat requirements

Fin whales are drawn to areas where prey gather (regardless of water depth), such as mixing zones between coastal and oceanic waters (roughly the 200-m isobath) (NMFS, 2010a). Fin whales feed intensively at high latitudes during the summer but greatly reduce their feeding efforts at lower latitudes during the winter (NMFS, 2010a). They are a temperate species, generally avoiding tropical zones (NMFS, 2010a). Summer habitat is variable, ranging from waters immediately offshore (Rice, 1974; cited in NMFS, 2010a) to continental shelves or slopes in the ocean (Gregr and Trites, 2001; Reeves et al., 2002; both cited in US Navy, 2011). The main prey of the fin whale are euphausiids (i.e., *Euphausia pacifica* and *Thysanöessa* species); large copepods (*Calanus cristatus*); and schooling fish, such as herring, pollock, and capelin (Nemoto, 1970; Kawamura, 1982; both cited in NMFS, 2010a). Fin whale distribution is largely related to seasonal and annual variations in prey availability (Ingebrigtsen, 1929; Jonsgård, 1966a, b; all cited in NMFS, 2010a). In the Gulf of California, fin whales compete with Bryde's whales for food resources (NMFS, 2010a).

Diving is a key aspect of whale behavior that highlights the importance of the deep ocean environment for fin whales. Various studies on fin whale populations around the world (US Navy, 2011; Croll et al., 2001; Goldbogen et al., 2006; Panigada et al., 2003) have reported a broad range of diving depths and durations, from depths of less than 50 m to a maximum of 600 m and durations of 4 minutes to nearly 17 minutes, with typical durations ranging between 4 and 7 minutes. Based on research conducted by Goldbogen et al. (2006), fin whales spend approximately 44% of their time at depths of less than 50 m, 23% of their time at depths of 50 to 225 m, and 33% of their time at depths greater than 225 m.

3.4.1.4.4 Current stressors and threats

Distribution

- Bering Sea
- Beaufort Sea
- Chukchi Sea
- GOA
- Aleutian Islands

Habitats

- Nearshore
- Open water

Vulnerabilities

- Disturbance (noise)
- Injury/death (ship strike, hunting, fishing gear entanglement)
- Reduced prey base
- Exposure (contaminants, disease)

According to NMFS (2010a), the greatest potential threats to the fin whale population are ship strikes, loss of prey as a result of climate and ecosystem change, and harvest. Ship strikes are a constant threat to many whale species, and any increase in the level of vessel traffic in whale habitats will result in a greater risk or whale injury and mortality (NMFS, 2010a). A 2004 review of the NMFS ship strike database identified 292 strikes to large whales; 75 (26%) of which were fin whales (Jensen and Silber, 2004; cited in NMFS, 2010a). Overfishing and global climate change are both factors in the reduction of the fin whale's prey (NMFS, 2010a), which affects population recovery. The commercial hunting of fin whales from 1947 to 1987 resulted in a harvest of 46,000 whales in the North Pacific (Barlow et al., 1997; cited in NMFS, 2010a). Fin whale hunting continues today. In Greenland, they are harvested for subsistence. Iceland has continued to hunt fin whales since 2006, when it formally objected to the IWC's whaling ban (NMFS, 2010a). Japan continues to hunt fin whales as part of a scientific whaling program, and since 2007/2008 has had a goal of harvesting 50 whales per year (International Whaling Commission, 2006; Nishiwaki et al., 2006; both cited in NMFS, 2011g).

Less severe threats to the fin whale population include anthropogenic noise, contaminants and pollutants, fishery interactions, ice entrapment, and disease. The influence of noise on fin whale movement, communication, social behavior, and stress levels is unknown (NMFS, 2010a). Fin whales can become entrapped or entangled in inshore fishing gear. Offshore entanglement and death related to trawling occur in the GOA (NMFS, 2006a), and similar events are likely to have happened elsewhere; in 1999, a fin whale in the GOA was killed during a pollock fishing trawl (NMFS, 2006a). In the North Atlantic, injury and/or suffocation from entrapment under ice is a factor in fin whale mortality, but this is not known to have happened in the North Pacific (NMFS, 2010a). Finally, the nematode *Crassicauda boopis* is believed to cause renal failure and subsequent death among fin whales and could hinder population recovery (Lambertsen, 1983, 1992; both cited in NMFS, 2010a).

3.4.1.5 Western North Pacific Gray whale

Gray whale

Gray whales (*Eschrichtius robustus*) are bottom-feeding baleen whales found in the North Pacific Ocean. There are two geographically distinct populations of gray whales, also thought to be genetically distinct: the Western North Pacific (WNP) stock and the Eastern North Pacific (ENP) stock (Carretta et al., 2013). The WNP stock is listed under the ESA as endangered; the ENP stock was delisted in 1994 (NOAA Fisheries, 2013).

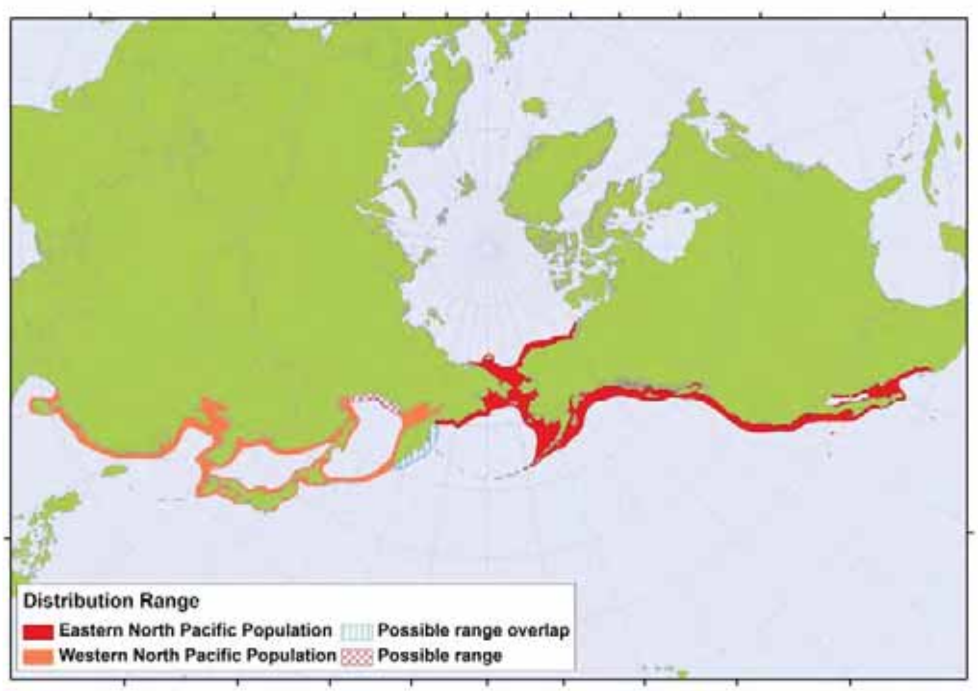
For the purpose of this BA, the WNP stock is the population assessed. However, there is limited knowledge of the life history and biology of the WNP stock, even though the ENP stock has been well-studied (Weller et al., 2002). Although the geographic distributions of the ENP and WNP stocks generally do not overlap, there is recent evidence (e.g., photographic records) of exchange between the two populations (Weller et al., 2012). Assuming the WNP and ENP stocks share similar characteristics and behaviors, the abundance of information on the ENP stock provides insight to the WNP stock, particularly if individuals of the WNP stock have a potential presence in Alaska waters.

Annually, gray whales migrate 10,000 to 14,000 miles roundtrip from sub-tropical breeding grounds to high-latitude feeding grounds in the Arctic and Subarctic (ADF&G, 2008; Weller et al., 2002). They generally travel alone or in small groups of three individuals, although they have been observed in larger groups (ADF&G, 2008). Little is known about the distribution of WNP gray whales and their migratory and breeding patterns due to their highly depleted population. The general migration path of the WNP stock ranges from the South China Sea along the Asian coast to Sakhalin Island in Russia (Carretta et al., 2013). Although migration patterns can vary widely, the ENP stock migrates between the coasts of northeastern Alaska and Baja California, Mexico. Calving generally occurs between December and February, prior to the northbound migration, during which calves are weaned during summer feeding (Carretta et al., 2013).

Unlike other mysticetes, gray whales primarily forage for benthic fauna in sea-floor sediment in shallow, nearshore areas rather than filtering their prey from the water column (Nerini, 1984). They feed by suctioning and filtering the surface layers of sediment through coarse baleen as they roll and skim along the ocean floor, leaving behind shallow depressions and plumes of disturbed sediment (Nerini, 1984).

3.4.1.5.1 Distribution and critical habitat

Historically, the WNP stock has been distributed along the shallow, coastal waters of Russia, Japan, North Korea, South Korea, and China. The present-day population is believed to be confined to the South China Sea in winter and the west central Okhotsk Sea, off the northeastern coast of Sakhalin Island, Russia, from summer to autumn. Breeding grounds of the WNP stock have not been confirmed but are believed to be in the South China Sea (Weller et al., 2002). The ENP gray whales inhabit similar coastal areas off the west coast of North America, from breeding grounds off Baja California to feeding grounds as far north as the Bering Strait (Figure 3-12).



Source: IUCN (2011)

Figure 3-12. Geographic distribution of gray whales (both WNP and ENP stocks)

In Alaska waters, the numbers of gray whales are greatest from mid-April through November. The highest densities of gray whales during these months have been noted in the shallow waters of the northern and western areas of the Bering Sea, along Bristol Bay; near St. Lawrence Island, in the southern Chukchi Sea; and more recently, in the Beaufort Sea on the northern coast of Alaska (Moore et al., 2007; Allen and Angliss, 2012). Sightings have also been reported in the Gulf of Alaska near Sitka and Kodiak Island (Moore et al., 2003; Calambokidis et al., 2002). Although the majority of gray whales present in Alaska waters belong to the ENP stock, recent photographs have documented 12 WNP individuals migrating from Sakhalin Island to Vancouver Island on the eastern Pacific coast (Weller et al., 2012). ENP gray whales in the Pacific Northwest catalog (i.e., subpopulation) are approximately 5.6% of the total estimated ENP stock; of 74 ENP individuals in this catalog, 8.1% were identified as WNP individuals (Weller et al., 2012). The frequency of these sightings relative to the total population suggests that the two stocks likely have more exchange than previously thought (Weller et al., 2012). More focused research on the migratory routes of North Pacific gray whales has been conducted in recent years using photo identification and genetic data. The results of these studies have confirmed that the WNP stock migrates to the eastern North Pacific. Vladimirov et al. (2012) provides a map showing documented migration routes for the WNP stock.

No critical habitat is designated for either the WNP or ENP stocks because the original listing under the ESA was prior to 1978.

3.4.1.5.2 Population status

The populations of both WNP and ENP gray whales were heavily depleted by commercial whaling activities from the mid-1800s to the early 1900s (ADF&G, 2008). By 1910, an estimated 1,000 to 1,500 WNP gray whales remained and exploitation continued (Berzin et al., 1991; cited in Weller et al., 2012). In 1947, the IWC granted gray whales full protection against commercial whaling operations (ADF&G, 2008), and gray whales were later listed as endangered under the ESA of 1973 (NOAA Fisheries, 2013).

The ENP stock increased steadily until it reached a stable level in the 1990s. In 1994, the ENP gray whale was the first marine mammal delisted from the ESA. As of 2008, IUCN declared ENP gray whales to be a species of least concern. The current population estimate of the ENP gray whales is approximately 19,000 individuals (Carretta et al., 2013). The WNP stock of gray whales continues to be listed as endangered. The most current (2008) population estimate of WNP gray whales was 130 non-calf individuals (Bradford et al., 2008).

3.4.1.5.3 Habitat requirements

As bottom-feeders, gray whales require shallow coastal waters with dense and diverse benthic invertebrate communities during the summer months. The primary feeding ground of the WNP stock is off the northeastern coast of Sakhalin Island, Russia in the Okhotsk Sea. The feeding grounds of the ENP stock in the Bering and Chukchi Seas are on the continental shelf, where waters are < 50 to 60 m (164 to 197 ft) deep (Nerini, 1984; ADF&G, 2008). In these areas, they feed on a variety of amphipods, decapods, and other small invertebrates (Nerini, 1984). These shallow feeding grounds also provide protected habitat where calves are weaned and become independent (Carretta et al., 2013). Gray whales forage widely and opportunistically within their migratory ranges, but the summer feeding

Distribution

- Okhotsk Sea
- Sakhalin Island, Russia
- South China Sea
- Potential: Bering and Chukchi Seas, Aleutian Islands, GOA

Habitats

- Nearshore
- Open water

Vulnerabilities

- Disturbance (noise)
- Injury/death (ship strike, poaching, fishing gear entanglement)
- Exposure to bioaccumulative chemicals
- Reduced prey base

grounds provide the majority of their of the food consumed, as evidenced by the higher body mass, fat content, and blubber thickness observed in southbound gray whales (Rice and Wolman, 1971; cited in Tilbury et al., 2002). Changes in Arctic climate, such as ocean acidification and the reduction in sea ice cover, along with a growing population and shifts in the benthic food supply will likely result in a shift in the location and extent of their feeding grounds. Observed shifts in ENP gray whale abundance in summer feeding grounds have been correlated with changes in prey abundance (Moore et al., 2003; Moore et al., 2007; Rugh et al., 1999). A decrease in benthic productivity in the Chirikov Basin near St. Lawrence Island and increased gray whale population size are factors thought to have contributed to the high number of gray whale mortalities in 1999/2000 and a shift in feeding ranges in subsequent years. Although not abundant in these regions, WNP gray whales would be expected to be similarly affected by similar changes in their environment.

3.4.1.5.4 Current stressors and threats

Commercial whaling no longer poses a threat to ENP gray whales; however, subsistence whaling is allowed, with an estimated annual take of 123 whales based on data from 2006 to 2010 and annually capped by the IWC at 140 whales (Carretta et al., 2013). The annual take of WNP gray whales is undetermined (Weller et al., 2002). Aside from subsistence hunting, both populations (the WNP in particular) remain vulnerable to the impacts of other human activities. Fishing gear entanglement, ship strikes, illegal hunts, habitat degradation, disturbance from ecotourism, and anthropogenic noise are among the threats to gray whale populations (NOAA Fisheries, 2013). Total human-caused accidental ENP gray whale mortality from 2006 to 2010 was reported as 15 individuals (Carretta et al., 2013). Vessel noise from commercial and industrial activity is an anthropogenic stressor that has been shown to cause a range of behavioral responses (e.g., changes in swimming speed and direction, calling rates, call structure) in gray whales (Moore and Clarke, 2002). Gray whales are also likely to encounter vessel traffic in their breeding grounds and other locations along their migration route, which are destinations for whale watching, ecotourism, and scientific research (Moore and Clarke, 2002).

Offshore oil and gas development activities are sources of other anthropogenic noise (e.g., dredging, drilling, construction, air traffic) and can release persistent, bioaccumulative contaminants (e.g., PAHs) during oil spills (Moore and Clarke, 2002; Tilbury et al., 2002). The primary feeding strategy of gray whales increases their potential exposure to contaminants that become associated with sediment and benthic organisms (e.g., oil) after being released by offshore oil and gas exploration activities (Tilbury et al., 2002). Exposure to these contaminants would be greatest during the summer feeding in Alaska waters, when gray whales and their young consume the greatest amount of food.

As a severely depleted population, the WNP stock is more susceptible to the deleterious effects of these stressors than is the ENP stock. In recent years, the physical condition and number of individual WPN gray whales have deteriorated due to natural or anthropogenic shifts in prey availability, changes in habitat quality, physiological responses to stress, or disease (Weller et al., 2002).

3.4.1.6 Humpback whale

Humpback whale

The humpback whale (*Megaptera novaeangliae*) is a large mysticete, reaching lengths of 18 m (60 ft) at maturity (Winn and Reichley, 1985; cited in NMFS, 1991). Three stocks of humpback whales are recognized in the North Pacific Ocean: Western North Pacific, Central North Pacific, and Eastern North Pacific stocks (Calambokidis et al., 1997; Baker et al., 1998, cited in US Navy, 2011). Humpback whales, like many marine mammals, use acoustic signals to communicate, navigate, locate prey, and sense their environment (NMFS, 1991, 2011f; US Navy, 2008, 2011). Humpback whales are known to form small groups that occasionally aggregate for long periods of time in areas of concentrated food (NMFS, 2011f). Worldwide, there are thought to be about 13 stocks that winter in sub-tropical waters in lower latitudes (NMFS, 1991); however, this BA addresses only the North Pacific stocks.

Humpback whales were listed as endangered in 1970 under the precursor to the ESA (35 FR 18319, 1970) and thus are also considered to be depleted under the MMPA. A humpback whale recovery plan was published in 1991 (NMFS, 1991), and the most recent NMFS ESA status review was conducted in 2009 (NMFS, 2009b).

3.4.1.6.1 Distribution and critical habitat

The humpback whale is found in oceans worldwide, migrating between northern and temperate waters. In the North Pacific, they are present in Alaska waters during the months of April through January. Their summer migration to northern feeding grounds happens in April and May (Consiglieri et al., 1982; Straley, 1990; US Navy, 2006; all cited in US Navy, 2011). Although most whales migrate south during the winter, year-round observations of humpback whales in the southern portion of Southeast Alaska have been reported. Studies reviewed by NMFS (Nemoto, 1957; Tomilin, 1967; Johnson and Wolman, 1984; all cited in NMFS, 1991) reported that humpback whales in the northern hemisphere summer between 40° and 75° latitude, where food productivity is greater than in southern latitudes. These studies also reported that the summer range of humpback whales in the North Pacific includes Pacific Rim coastal and inland waters from Point Conception, California, north to the GOA and the Bering

Sea and west along the Aleutian Islands to the Kamchatka Peninsula and south into the Sea of Okhotsk. Humpbacks summer as far north as the Beaufort and Chukchi Seas, although in smaller numbers (Allen and Angliss, 2011).

The summer ranges of the western and central humpback whale stocks overlap, and both are found in Alaska waters (Figure 3-13). However, the western stock winters in south Asia (i.e., the islands south of Japan, including the Ryukyu, Bonin, and northern Mariana Islands), and the central stock spends the winter off the main islands of Hawaii (Allen and Angliss, 2011). The winter migration to tropical breeding grounds occurs in November and December (Consiglieri et al., 1982; Straley, 1990; US Navy, 2006; all cited in US Navy, 2011). Waters in wintering grounds are generally less productive with respect to prey, but the warmer temperatures are necessary for calving. A small number of humpback whales are known to be present in the GOA year-round (US Navy, 2006; cited in US Navy, 2011).

Data source: NOAA Fisheries interactive range map of NMFS managed species (2013)

Figure 3-13. Humpback whale range in Alaska

Humpback whales are regularly sighted in Alaska waters. In Southeast Alaska, they are found in the Inside Passage, from Yakutat Bay to Queen Charlotte Sound, from May through December (NMFS, 1991). In south-central Alaska, they are frequently sighted in PWS, off the coast of Kodiak Island, and along the southern coast of the Alaska Peninsula (NMFS, 1991). Sightings of humpback whales in the central-eastern Bering Sea have co-occurred with sightings of a pod of orcas and a large school of Arctic cod southwest of St. Lawrence Island (NMFS, 2006a, 2008b). The southern Chukchi Sea along the Chukchi Peninsula is likely the northernmost extent of the humpback whale's range (Nikulin, 1946; Berzin and Rovnin, 1966; both cited in NMFS, 1991). Within these water bodies, humpback whales will most likely be found over and along the edges of continental shelves and around oceanic basins, where populations of prey concentrate. When migrating, these whales will be found in deeper, pelagic waters.

There is no designated critical habitat for the humpback whale because the original listing under the ESA was prior to 1978.

3.4.1.6.2 Population status

Commercial exploitation greatly reduced the humpback whale population in the 20th century (Allen and Angliss, 2011). The species is thought to be the fourth most historically depleted large cetacean worldwide, after the northern right whale, blue whale, and bowhead whale (NMFS, 1991). The pre-commercial whaling population was estimated to constitute more than 125,000 individuals, with approximately 15,000 in the North Pacific (NMFS, 1991). During the 19th century, American whaling was responsible for the deaths of between 14,000 and 18,000 whales; during the 20th century, the harvest in the North Pacific was estimated to be about 28,000 whales (Rice, 1978, cited in Best, 1987; NMFS, 1991). From 1961 to 1971, the former Soviet Union illegally harvested 6,793 individuals, mostly from the GOA and Bering Sea (Doroshenko, 2000; cited in NMFS, 2006a). The increase in abundance of North Pacific humpbacks is consistent with a moderate rate of recovery for a previously severely depleted population (Calambokidis et al., 2008).

SPLASH surveys of the North Pacific began in 2002 in order to better understand stock dynamics (NMFS, 2006a); the most recent SPLASH population estimate for humpback whales in the North Pacific was 21,808 individuals (Barlow et al., 2011; cited in Allen and Angliss, 2011). The SPLASH estimate represents a 6.8% annual increase over the 39 years since commercial whaling ceased (Calambokidis et al., 2008). Other analyses (Allen and Angliss, 2011) suggest that the population in Southeast Alaska/northern British Columbia ranges between 2,883 and 6,414 individuals; and in PWS, 315 humpback whales have been cataloged using photo identification (von Ziegesar and Matkin, 1986; von Ziegesar et al., 2004; both cited in Allen and Angliss, 2011; Waite et al., 1999). Surveys conducted from 2001 to 2003 (Zerbini et al., 2006; cited in Allen and Angliss, 2011) resulted in an estimate of 2,644 individuals in the central GOA and eastern Aleutian Islands.

3.4.1.6.3 Habitat requirements

Humpback whales are present in waters over continental shelves and along their edges, and around oceanic islands (Balcomb and Nichols, 1978; Whitehead, 1987; both cited in NMFS, 1991). The winter distribution reflects areas of greater prey abundance, which are related to oceanographic factors such as upwelling, converging currents, and other factors characteristic of fjords, channels, continental shelves and their edges, and offshore banks (NMFS, 1991).

Humpback whales follow their prey and are known to have the most diverse feeding behaviors of all the baleen whales, which include bubble netting, herding prey by maneuvering, using the water surface as a barrier, feeding in formation, synchronized feeding lunges, and short- and long-term cooperation between individuals (Ingebrigtsen, 1929; Jurasz and Jurasz, 1979; Watkins and Schevill, 1979; Hain et al., 1982; Weinrich, 1983; Baker, 1985; Baker and Herman, 1985; Hays et al., 1985; Winn and Reichley, 1985; D'Vincent et al., 1985; all cited in NMFS, 1991). The majority of humpback whale feeding occurs during the summer in northern latitudes (NMFS, 1991). Their summer habitats tend to be closer to shore and include major coastal embayments and channels; however, they have also been observed to summer offshore in the GOA (Brueggeman et al., 1987, 1988; cited in NMFS, 1991). Feeding grounds tend to be shallow banks or ledges with high sea floor relief (Payne et al., 1990; Hamazaki, 2002; cited in US Navy, 2011).

Major prey species for humpback whales include small schooling fish and large zooplankton, primarily krill (Nemoto, 1957, 1959, 1970; Klumov, 1963; Krieger and Wing, 1984, 1986; Tomilin, 1967; all cited in NMFS, 1991). Fish prey species consist of Pacific herring, juvenile walleye, pollock, capelin, and sand lance (Bryant et al., 1981; Baker et al., 1985; Krieger and Wing, 1984, 1986; Perry et al., 1985; Dolphin, 1987; all cited in NMFS, 1991; NMFS, 2006a).

Diving is a key aspect of whale behavior and highlights the importance of the deep oceanic environment for humpback whales. North Pacific humpback whale dive times are typically less than 5 minutes but occasionally last up to 10 minutes (US Navy, 2011). Most of their prey base is located within 300 m of the surface, and humpback whales spend most of their dive time between 92 and 120 m deep (NMFS, 2011f), although they are known to dive as deep as 500 m (US Navy, 2011).

3.4.1.6.4 Current stressors and threats

As reported by NMFS (1991), major threats to the humpback whale population include entanglement in fishing gear, ship strikes, and noise disturbance. The legal hunting of humpback whales, including for subsistence, is no longer allowed in North America (NMFS, 1991), but poaching is still an issue.

Entanglement in fishing gear is the most frequent human-related cause of injury and death among humpback whales (NMFS, 1991). Netting can be easily broken by a swimming humpback, but lead and anchor ropes are stronger and can cause serious injury. Entanglements in Southeast Alaska are common; it is estimated that 52 to 78% of Southeast Alaska humpback whales have been non-lethally entangled at some time in their lives (Neilson et al., 2009).

Distribution

- Bering Sea
- Aleutian Islands
- Kodiak Island
- PWS
- GOA
- Southeast Alaska
- Chukchi Sea
- Beaufort Sea

Habitats

- Nearshore
- Open water

Vulnerabilities

- Disturbance (noise)
- Injury/death (ship strike, poaching, fishing gear entanglement)
- Exposure to bioaccumulative chemicals
- Reduced prey base

From 2003 to 2007, there were 86 incidents of human-related North Pacific stock humpback whale mortalities, 54 of which involved commercial fishing gear (Allen and Angliss, 2011). Ship strikes are an increasing threat to humpback whales, as well as many other whale species (NMFS, 1991). Humpback feeding grounds are located within major shipping lanes off the west coast of the United States. At least five humpback whales in Southeast Alaska were observed to have large dents and gashes on their upper bodies as a result of ship strikes (NMFS, 1991). Calves and juveniles are more vulnerable to ship strikes because they are smaller, more difficult to see, and spend more time at the surface (Herman et al., 1980; Mobley et al., 1999, cited in US Navy, 2011). Noise disturbance from ships, aircraft, coastal development, industrial activities, and research can have adverse effects on humpback whale behaviors such as resting, feeding, nursing, mating, calving, and migrating (NMFS, 1991). Humpback whales generally avoid busy or noisy areas, but some will approach or circle boats, especially fishing and whale-watching boats (NMFS, 1991).

Lesser potential threats to humpback whale populations include pathogens, habitat degradation due to chemical pollutants, competition with fisheries for prey, and predation.

The giant spirurid nematode (*Crassicauda boopis*) parasite can cause severe morbidity (e.g., extensive and severe mesenteric arteritis, complete occlusion of the blood vessels that drain the kidneys, congestive kidney failure) and mortality among humpback whales (NMFS, 1991; Lambertsen, 1992). Between December 1987 and January 1998, paralytic shellfish poisoning (PSP) was responsible for the deaths of 14 humpback whales in Cape Cod Bay (Geraci et al., 1989; cited in NMFS, 1991). Although this is the only known occurrence of PSP in humpback whales, dinoflagellates similar to those that caused the PSP in Cape Cod are found in Alaska waters.

Habitat degradation from chemical pollutants is a worldwide concern with respect to the survival of humpback whales, although the extent and severity of the impacts are not well documented (NMFS, 1991). Pollutants of concern include, but are not limited to, organochlorine pesticides, heavy metals, and polychlorinated biphenyls (PCBs) (NMFS, 1991).

Orca and shark attacks on humpback whales have been documented in several areas of the North Pacific. In Southeast Alaska waters, orca attacks on humpback whales have been observed, although the two species have also been observed feeding together without predatory interactions (Dolphin, 1987; cited in NMFS, 1991). In the western North Atlantic, 14% of identified humpback whales have old wounds and scars on their flukes from orca encounters (Katona et al., 1988; cited in NMFS, 1991); and unsuccessful orca attacks are speculated to be the source of bite marks found on some juvenile humpback whales (NMFS, 1991).

3.4.1.7 North Pacific right whale

North Pacific right whale

The North Pacific right whale (*Eubalaena japonica*), is a large, slow-swimming mysticete that shares its genus with two other right whale species, the North Atlantic and Southern Hemisphere right whales (*E. glacialis* and *E. australis*, respectively). These three subspecies are genetically distinct populations. The right whale's body is dark grey and rotund, similar in shape and appearance to that of the bowhead whale, but with a smaller head. North Pacific right whales, like many marine mammals, use acoustic signals to communicate, navigate, locate prey, and sense their environment (NMFS, 2006c; US Navy, 2011; Richardson et al., 1995). They most often travel in small groups, ranging from about 3 to 13 individuals, but they also congregate in coastal areas (Allen and Angliss, 2011).

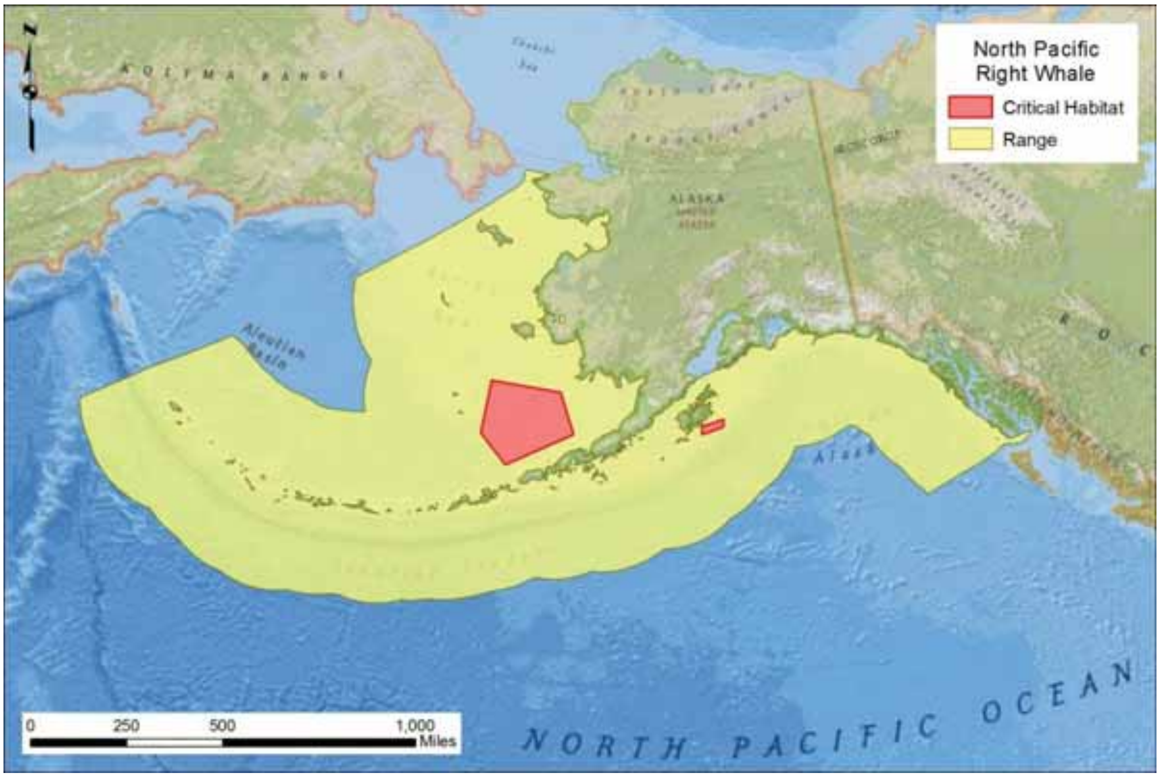
North Pacific right whales are considered the rarest of all large whale species and among the rarest of all marine mammal species. They were listed as endangered under the precursor to the ESA in 1970 (35 FR 18319, 1970) as the "northern right whale," and the endangered listing continued under the ESA beginning in 1973. The northern right whale was listed as two separate endangered species by NMFS in 2006 (71 FR 38277, 2006): the North Pacific right whale and the North Atlantic right whale. As these were considered new listings, NMFS designated critical habitat (73 FR 19000, 2008) for the species, as required by the ESA. As the North Pacific right whale is listed as endangered under the ESA it is, by default, considered depleted under the MMPA. There are two stocks of the North Pacific right whale, western and eastern; this BA is only applicable to the eastern stock.

3.4.1.7.1 Distribution and critical habitat

Records of sightings, captures, and strandings show that the North Pacific right whale historically ranged throughout the northern Pacific Ocean, north of latitude 35°N, with important concentrations in the GOA, eastern Aleutian Islands, south-central Bering Sea, Okhotsk Sea, and coastal Japan (Braham and Rice, 1984; Clapham et al., 2004; Shelden et al., 2005). The eastern population of North Pacific right whales used major feeding grounds that covered virtually the entire GOA, waters adjacent to the Aleutian Islands, and much of the Bering Sea south of 60°N (Clapham et al., 2004; Scarff, 1986; Shelden et al., 2005). However, recent work by Josephson et al. (2008; cited in Allen and Angliss, 2011) indicates that the species actually have been infrequently encountered in the central northern Pacific Ocean, indicating a latitudinally bimodal distribution. North Pacific right whales have been observed since 1969 in the summer ranging from the sub-Arctic Bering Sea and Sea of Okhotsk in the north to Hawaii and Baja California in the south (Allen and Angliss, 2011). Sightings that occurred as far south as Hawaii and Mexico are probably extralimital (Brownell et al., 2001). While the current range of North Pacific right whales is likely considerably smaller than their historical range, there have not been sufficient survey efforts throughout their historical range to determine which, if any, areas have been abandoned or not yet rediscovered (Clapham et al., 2004). Acoustic surveys and additional sightings confirm North Pacific right whales in the southeastern Bering Sea from May into December, and in the GOA in August and September (Munger et al. 2003, cited in Clapham et al., 2006; Waite et al., 2003; Mellinger et al., 2004, cited in Wade et al., 2011). These whales are drawn to areas where prey populations congregate and seem to prefer the middle to outer portion of the continental shelf in water depths between 50 and 80 m but are also known to be present in deeper waters ranging from 250 to 1,700 m (Allen and Angliss, 2011). Right whales are typically found individually or traveling in small slow-moving groups.

No calving grounds have been identified for the North Pacific right whale (Scarff, 1986). The species' migratory patterns are also unknown, though seasonal patterns are apparent in historical data, with whales summering in the GOA and Bering Sea (Braham and Rice, 1984; Scarff, 1986; Clapham et al., 2004; Shelden et al., 2005). As noted by Clapham et al. (2006), there are very few winter observations of right whales in the North Pacific.

Critical habitat was designated for the eastern North Pacific right whale in 2008 (73 FR 19000, 2008) within the GOA and Bering Sea. The sole PCE of critical habitat for this species is aggregations of copepods (specifically *Calanus marshallae*, *Neocalanus cristatus*, and *N. plumchris*) and the euphausiid *Thysanoessa raschii*, in areas of the North Pacific Ocean in which eastern North Pacific right whales are known or believed to feed. Critical habitat encompasses two areas designated based on simple geographic coordinates[28] (Figure 3-14) where eastern North Pacific right whales have been consistently sighted in spring and summer, indicating feeding areas with suitable prey densities. Both critical habitat areas are completely within waters of the United States and its EEZ.



Data source: NMFS (73 FR 19000, 2008)

Figure 3-14. North Pacific right whale range in Alaska and designated critical habitat

3.4.1.7.2 Population status

The western North Pacific right whale stock, which is found in the EEZ of Japan, Russia, and China, is significantly larger than the eastern North Pacific right whale stock (Miyashita and Kato, 1998, cited in NMFS, 2006c; Brownell et al., 2001). Both western and eastern stocks were depleted by commercial whaling and illegal Soviet harvests in the 1960s, which severely reduced the eastern North Pacific stock's prospects for recovery (Brownell et al., 2001). The western North Pacific stock is estimated to include between 400 and 2,108 whales, and appears to be large enough to sustain reproduction

[28] Within the Gulf of Alaska, critical habitat encompasses an area delineated by a series of straight lines connecting the following coordinates in the order listed: 57° 03′ N/153° 00′ W, 57° 18′ N/151° 30′ W, 57° 00′ N/151° 30′ W, 56° 45′ N/153° 00′ W, and returning to 57° 03′ N/153 00′ W. Within the Bering Sea, critical habitat encompasses an area delineated by a series of straight lines connecting the following coordinates in the order listed: 58° 00′ N/168° 00′ W, 58° 00′ N/163° 00′ W, 56° 30′ N/161° 45′ W, 55° 00′ N/166° 00′ W, 56° 00′ N/168° 00′ W and returning to 58° 00′ N/168° 00′ W.

(Miyashita and Kato, 1998; cited in NMFS, 2006c). Prior to 1996, a reliable size estimate of the population of eastern North Pacific right whale was unavailable; the population was considered essentially extinct because no females with calves had been confirmed since 1900 (Allen and Angliss, 2012). Using photographic and genotype data collected since 1996, the eastern North Pacific stock is currently estimated at 31 individuals (Wade et al., 2010; Allen and Angliss, 2012), and recent juvenile sightings (Goddard and Rugh, 1998; LeDuc, 2004; Wade et al., 2006; all cited in NMFS, 2006c) are the first to occur in more than a century (Brownell et al., 2001).

3.4.1.7.3 Habitat requirements

As reviewed by Shelden et al. (2005), habitat selection is often associated with features influencing the abundance and availability of zooplankton and copepod prey. North Pacific right whales likely require dense prey aggregations for efficient foraging, similar to those recorded for North Atlantic right whales (Baumgartner and Mate, 2003; cited in Clapham et al., 2006). Thus, North Pacific right whales require habitats where the physical and biological oceanography combine to promote high productivity and aggregation of copepods into patches of sufficient density (Clapham et al., 2006).

Diving is a key aspect of whale behavior that highlights the importance of the deep oceanic environment and the surface environment for North Pacific right whales. Information describing right whale diving behavior is limited. North Atlantic right whales are known to dive for 5 to 15 or more minutes; the average depth of a dive is strongly related to the depth of copepod prey abundance, or roughly between 80 and 175 m (US Navy, 2011).

The North Pacific right whale's habitat requirements for breeding and calving are unidentified, as the past and present locations are completely unknown.

3.4.1.7.4 Current stressors and threats

As reviewed by NMFS (2006c), current stressors and threats include the potential for habitat degradation, disease, vessel collisions, and entanglement in fishing gear. As the North Pacific right whale population is very small and relatively unstudied due to rarity, many of the threats to other baleen whales are assumed to affect right whales similarly. It is also important to note that, because of the rarity of North Pacific right whales, even low levels of interactions with humans could be significant.

Distribution

- Bering Sea
- Aleutian Islands
- GOA

Habitats

- Open water

Vulnerabilities

- Disturbance (noise)
- Exposure (contaminants, marine debris, disease)
- Direct injury (ship strike, hunting, fishing gear entanglements)
- Habitat degradation

Oil development in areas the North Pacific right whale inhabits introduces potential stressors, including ingestion of contaminated prey, potential skin and eye irritation, inhaling toxic fumes, and abandoning contaminated feeding habitat (Geraci, 1990; O'Shea and Brownell, 1994; Loughlin, 1994; all cited in NMFS, 2006c). In addition, noise pollution associated with oil development can disrupt feeding, mating, or nursing behavior, although the effects of noise on the behavior and distribution of right whales are unknown.

Very little is known about disease in or predation on right whales. Skin lesions have been observed on right whales in recent years (Marx et al., 1999; Pettis et al., 2004; both cited in NMFS, 2006c), but the origins and significance of these wounds are unknown.

Ship strikes and entanglements pose a risk to North Pacific right whales, but the rarity and scattered distribution of the species make it impossible to accurately assess this threat (NMFS, 2006c). The proximity of Unimak Pass, a high-volume shipping lane between the GOA and the Bering Sea, to North Pacific right whale critical habitat suggests that ship strikes might be a threat to North Pacific right whales (NMFS, 2006c). Extensive fisheries in the eastern Bering Sea also suggest that entanglements in fishing gear are possible, although they appear to be uncommon (NMFS, 2006c).

3.4.1.8 Sei whale

Sei whale

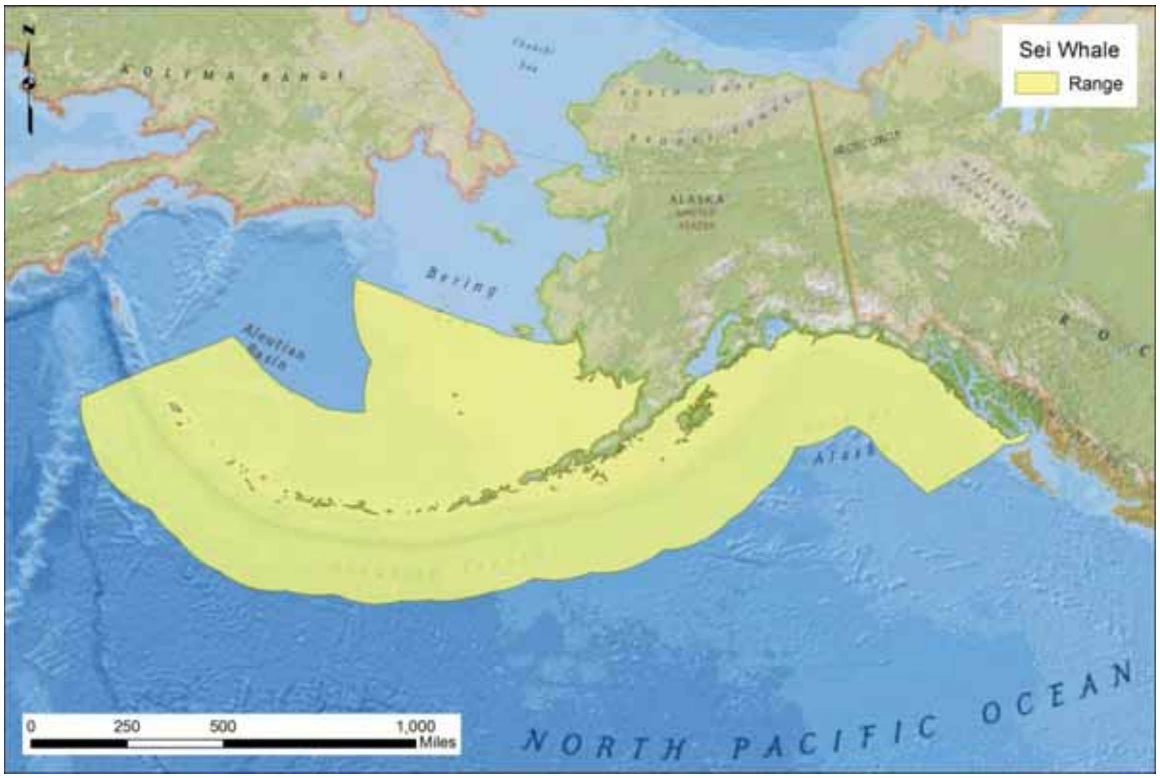
The sei whale (*Balaenoptera borealis*) is a subpolar mysticete that is difficult to distinguish from its close relatives, Bryde's whale (*B. edeni/brydei*), Omura's whale (*B.a omurai*), and the fin whale (*B. physalus*) (NMFS, 2011h). Sei whales range in size from 40 to 60 ft in length and weigh up to 100,000 lbs. The very fine bristles of the sei whale's baleen plate have been cited as the most reliable feature that distinguishes it from other *Balaenoptera* species (Mead, 1977; cited in NMFS, 2011h).They are typically observed in groups of 2 to 5 individuals but have been known to gathered in groups of the thousands during migration or if food is abundant (MarineBio, 2012b).

Two subspecies of sei whale have been identified but not yet confirmed by empirical evidence: the northern sei whale, *B. borealis borealis*; and the southern sei whale, *B. borealis schlegii* (Rice, 1998; cited in NMFS, 2011h). Because these subspecies have not yet been confirmed, this BA discusses the sei whale population as a whole.

Sei whales were originally listed as endangered under the Endangered Species Protection Act (35 FR 18319, 1970) in 1970. Because sei whales are listed as endangered under the ESA they are, by default, considered depleted under the MMPA.

3.4.1.8.1 Distribution and critical habitat

Sei whales are distributed globally between 60°N and 60°S and are found in the North Atlantic and North Pacific Oceans, as well as in the southern hemisphere (NMFS, 2011h) (Figure 3-15). Although sei whales are circumpolar, their distribution generally centers around temperate waters. Sei whales are known to migrate towards the pole during the summer for feeding opportunities and then winter in warmer temperate or subtropical waters (Horwood, 1987; Jefferson et al., 2008; both cited in NMFS, 2011h). They are highly mobile, and despite a lack of definitive information on residency, there is no indication that any population remains in a particular area throughout the year (NMFS, 2011h). Although population structures are not well defined, sei whales are commonly discussed according to ocean basin, and the North Pacific Ocean stock range includes Alaska waters. North Pacific sei whales are found throughout temperate waters north of 40°N. In the waters off Alaska, North Pacific sei whales have been observed mainly south of the Aleutian Islands (Nasu, 1974, cited in NMFS, 2011h; Leatherwood et al., 1982), in the vicinity of Kodiak National Wildlife Refuge (NWR) (USFWS, 2012b), with additional groups potentially observed in the northern and western Bering Sea between July and September (Masaki, 1977; cited in NMFS, 2011h). However, the abundance of sei whales in Alaska waters has not been reported and is assumed to be fewer than 100 individuals based on the small estimated population sizes of the Hawaiian stock and the eastern stock in California, Oregon, and Washington waters (Carretta et al., 2013). The southern distribution of sei whales ranges from Baja California, Mexico, to Japan and Korea (Andrews, 1916; Horwood, 1987; both cited in NMFS, 2011h). There is no designated critical habitat for the sei whale because the original listing under the ESA was prior to 1978.



Data source: NOAA Fisheries (2013)

Figure 3-15. Sei whale range in Alaska

3.4.1.8.2 Population status

Sei whales have been listed as endangered under the ESA (35 FR 18319, 1970) since its passage in 1973. The MMPA assesses population abundance and trends at the stock level and so provides the best available population estimates. The North Pacific population of adult sei whales is estimated to have declined from 42,000 to 8,600 whales between 1963 and 1974 (Tillman, 1977; cited in NMFS, 2011h). The 2010 assessment of the eastern North Pacific stock (east of longitude 180°) (Carretta et al., 2011) places the population estimate at a minimum of 83 whales, with no available data on population trends. Hakamada et al. (2004; cited in Reilly et al., 2008) estimated a population of 4,100 sei whales in one area of the western Pacific, but Reilly et al. (2008) stated that attempts to extrapolate an estimate of the entire western North Pacific population from this number have been considered unacceptable.

3.4.1.8.3 Habitat requirements

Studies in both the North Pacific and North Atlantic have demonstrated a strong connection between the presence of sei whales and ocean fronts and eddies (Nasu, 1966, cited in NMFS, 2011h; Nemoto and Kawamura, 1977, cited in Reeves et al., 1998; Skov et al., 2008). Such oceanographic features likely concentrate prey, which is then exploited by foraging sei whales. It is also possible that sei whales use currents during large-scale movements or migrations (Olsen et al., 2009; cited in NMFS, 2011h). Sei whales are generally found in deep water areas, often over the continental slope, shelf breaks, and deep ocean basins located between banks (NMFS, 2011h). Sei whales feed upon a variety of prey species, from copepods and euphasids to pelagic squid and fish the size of adult mackerels (Nemoto and Kawamura, 1977; Kawamura, 1982; both cited in NMFS, 2011h). Flinn et al. (2002) and Tamura et al. (2009; cited in NMFS, 2011h) documented a variety of prey species in the stomach contents of commercially harvested whales and found that the prevalence of certain prey varied both within and between years, indicating that sei whales are opportunistic feeders with flexible diets. They capture their prey by gulping or skimming and prefer to feed at dawn (NOAA Fisheries, 2013).

Diving is a key aspect of whale behavior that highlights the importance of the deep oceanic environment for sei whales. Information on sei whale diving behavior is limited. According to the MarineBio Conservation Society (2012b), sei whales are not deep divers; rarely diving deeper than 300 m, and remain under water for 5 to 10 minutes at a time.

3.4.1.8.4 Current stressors and threats

As reported by NMFS (2011h), the potential threats to sei whales and their severity are unknown, as are the relative impacts of these threats on the recovery of the species. These potential threats include anthropogenic noise related to ships, oil and gas development, and military sonar and explosives. Threats believed to pose a low risk include entanglement in fishing gear, noise associated with offshore energy developments, vessel interaction, contaminants and pollutants, disease, interaction with marine debris, research-related disturbance, predation and natural mortality, and competition with other species (including humans) for prey resources. Hunting and possible loss of or changes in habitat associated with climate and ecosystem change are believed to pose a moderate risk.

Distribution

- Bering Sea
- Aleutian Islands
- GOA

Habitats

- Open water

Vulnerabilities

- Disturbance (noise)
- Exposure (bioaccumulative contaminants, marine debris)
- Injury/death (ship strike, hunting, fishing gear entanglements)
- Reduced prey base

Although targeted hunts for sei whales are now rare, commercial exploitation was responsible for their initial depletion. The IWC instituted a moratorium on the commercial harvest of whales in 1986, but Japan continues to harvest North Pacific sei whales through its special permit scientific whaling program. Because the most recent comprehensive IWC assessment of North Pacific sei whale stocks was conducted in 1975, NMFS (2011h) has stated that Japanese scientific whaling is being "conducted in the absence of reliable and agreed estimates on abundance and trend of this population." The lack of current information is particularly relevant because there might be multiple sei whale stocks within the North Pacific, some of which might be disproportionately affected by the Japanese harvest. The 1975 IWC assessment concluded that the decline from 42,000 whales in 1963 to 8,600 whales in 1974 was attributable to intensive exploitation in the North Pacific (Tillman, 1977; cited in NMFS, 2011h). Although Japan did not harvest any sei whales between 1985 and 1988, sei whales have been a target species for Japanese whaling in recent years, and 592 individuals were harvested between 1988 and 2009 (International Whaling Commission, 2010; cited in NMFS, 2011h). Sei whale meat was found in Japanese markets in 1998 and 2004, confirming NMFS's (2011h) position that the moratorium on commercial whaling cannot be assumed to fully protect sei whales.

Climate change will affect sei whale habitat and prey abundance by altering water temperatures and ocean currents. Although specific potential impacts related to climate change are unknown, it is possible that the sei whale will be more resilient than other whale species because of its relatively wide variety of prey species and habitats (NMFS, 2011h).

3.4.1.9 Sperm whale

Sperm whale

The sperm whale (*Physeter macrocephalus*) is a toothed whale that has a disproportionately large head and a narrow, under-slung jaw. Sperm whales are generally dark gray, with white lips and white areas on the belly and flanks. Males grow to be much larger than females, up to 18 m (60 ft) in length and 70 tons in weight, compared with 11.5 m (38 ft) and 17 tons for females. Their diet consists of mostly medium to large squid, but they also feed on sharks, skates, and fish. Sperm whales are known to "steal" fish from hooks on deep-water long-line commercial fisheries off the coast of Southeast Alaska (ADF&G, 2012h). Sperm whales use acoustic signals to communicate, navigate, locate prey, and sense their environment (Southall et al., 2007; cited in NMFS, 2010b). They are highly gregarious, and are typically observed in loose family groups of about 30 individuals (MarineBio, 2012c). These groups are frequently made up of either sexually inactive males or mature females and their juveniles; older mature males are usually solitary, except during the breeding season (MarineBio, 2012c).

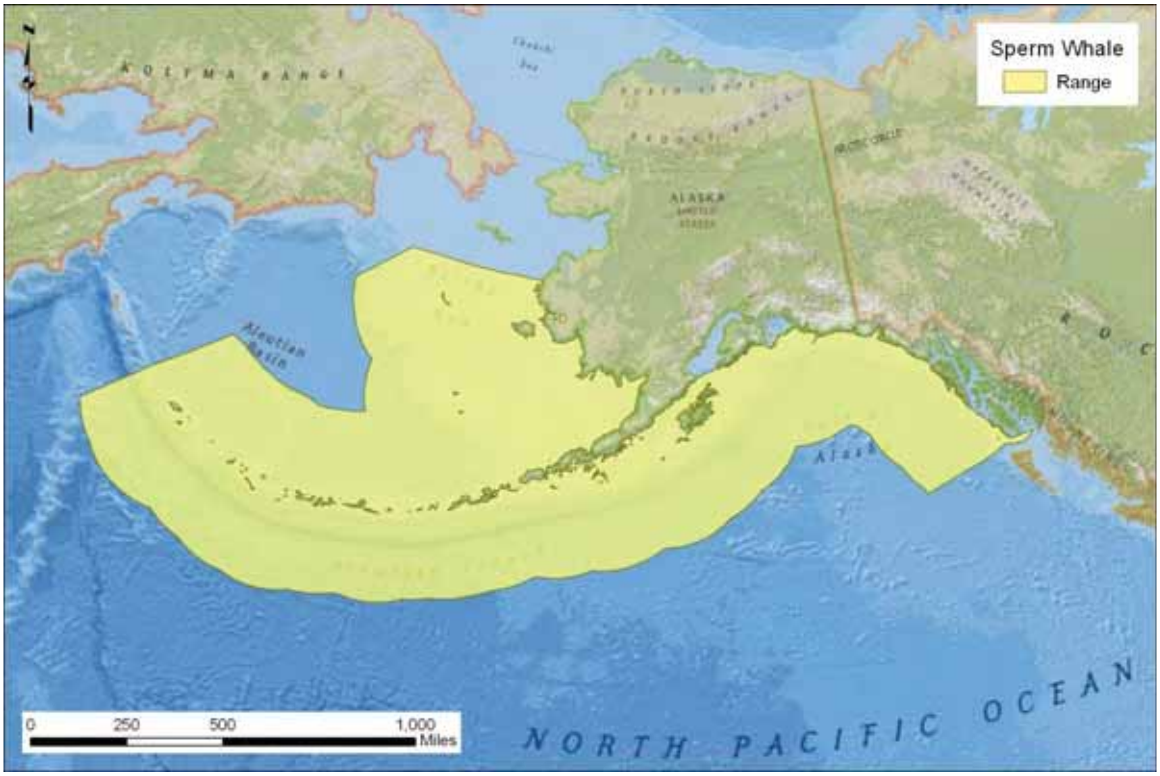
The sperm whale was originally listed under the Endangered Species Conservation Act (35 FR 8491, 1970), and remained listed after the passage of the ESA in 1973. Thus, the sperm whale is also designated as depleted under the MMPA. The International Union for Conservation of Nature (IUCN) lists sperm whales as vulnerable (Lowry et al., 2007).

3.4.1.9.1 Distribution and critical habitat

Sperm whales are widely distributed across the entire North Pacific and into the southern Bering Sea in summer, but the majority are thought to remain south of 40°N in the winter (Gosho et al., 1984; Miyashita and Kato, 1998; Rice, 1974, 1989; all cited in Carretta et al. 2009; Allen and Angliss, 2011).

Surveys conducted by the National Marine Mammal Laboratory (NMML) in the summer months between 2001 and 2006 (NMML unpublished data cited in Allen and Angliss, 2011) reported that sperm whales were the most frequently sighted large cetacean in the coastal waters around the central and western Aleutian Islands. Based on limited information, and lacking additional data concerning population structure, the sperm whales of the eastern North Pacific have been divided into three separate stocks, reflecting the waters in which they are found: Alaska (North Pacific), California/Oregon/Washington, and Hawaii (Allen and Angliss, 2011). Only the Alaska (North Pacific) stock falls within the scope of this BA.

Figure 3-16 presents the seasonal distribution of sperm whales in Alaska waters.



Data source: NOAA Fisheries (2013)

Figure 3-16. Sperm whale range in Alaska

Sperm whale movements seem to be largely dictated by gender and age. Females and younger whales remain in warmer waters year-round, with older males joining them during the breeding season. During the breeding season, young males journey north to feed in the GOA, Bering Sea, and throughout the Aleutian Islands. The northern limit for the sperm whale is 62°N in the eastern Bering Sea. In the North Pacific, there is little evidence of north-south migration among sperm whales; rather, there is an east-west migration among Alaska, Japan, and the Bonin Islands (ADF&G, 2012h).

The distribution of sperm whales in the North Pacific has been documented in whaling records and shipboard surveys and by various acoustic recordings. The northern limit of the distribution of adult male sperm in the North Pacific is estimated to extend from Cape Navarin, Russia, to the Pribilof Islands in the northeastern Bering Sea (Berzin and Rovnin, 1966; cited in NMFS, 2010b). Females and juveniles were generally thought to venture no further north than about 50 °N but data presented in Mizroch and Rice (Mizroch and Rice, 2006) showed catches of females above this latitude (Allen and Angliss, 2011). There also appear to be movements along the North American west coast into the GOA and Bering Sea/Aleutian Islands region (NMFS, 2010b).

There is no designated critical habitat for the sperm whale because the original listing under the ESA was prior to 1978.

3.4.1.9.2 Population status

Commercial whaling of this species ended in 1986 with the implementation of a moratorium by the IWC (IWC 2011). Although it is often assumed that the worldwide population of sperm whales has increased since the moratorium was implemented, insufficient data exist on population structure and abundance of ocean basins where sperm whales are present to accurately determine population trends (NMFS, 2010b). Historical and current estimates of sperm whale abundance in the North Pacific are considered to be unreliable. A preliminary analysis (Miyashita and Kato, 1998; cited in Allen and Angliss, 2011), which is considered to be biased toward overestimation, estimates the number of sperm whales in the western North Pacific to be slightly more than 100,000 individuals. The best estimate for the worldwide population of sperm whales is between 200,000 and 1,500,000 individuals (NMFS, 2010b). The number of sperm whales present within Alaska waters is unknown (Allen and Angliss, 2011).

3.4.1.9.3 Habitat requirements

Distribution

- Bering Sea
- Aleutian Islands
- GOA

Habitats

- Open water
- Sea ice (edges)

Vulnerabilities

- Few known, major threats
- Disturbance (noise)
- Exposure (contaminants, marine debris)
- Injury/death (ship strike, hunting)
- Reduced prey base

Adult male sperm whales are generally found in open, largely ice-free waters between 500 and 1,000 m deep but are occasionally found in water as shallow as 300 m (NMFS, 2010b). Female sperm whales are generally found in deep waters (at least 1,000 m [3,280 ft]) at low latitudes (less than 50° N, in the North Pacific Ocean) far from land. These depths and locations generally correspond to sea surface temperatures greater than 15 °C (Rice, 1989; cited in Taylor et al., 2008).

Immature males stay with female sperm whales in tropical and subtropical waters until they are between the ages of 4 and 21 years, at which time they form bachelor schools. Over time, these bachelors migrate from temperate waters toward the poles to feed in the summer (Rice, 1989; cited in Carretta et al., 2009). Older, larger males are generally found near the edge of pack ice at higher latitudes (Best, 1979; cited in Dufault et al., 1999); however, these males will occasionally return to the warm-water breeding area (Rice, 1989; cited in Carretta et al., 2009).

Diving is a key aspect of whale behavior that highlights the importance of the deep oceanic environment for sperm whales. During deep dives, sperm whales forage for squid and other deep sea-dwelling cephalopods and fish (NMFS, 2010b). These dives often exceed a depth of 400 m and durations of 30 minutes, although dives as deep as 2,000 m have been documented (Watkins et al., 2002; cited in US Navy, 2008). In general, males tend to spend more time below the sea surface, up to 83% of daylight hours and do not spend extensive periods of time at the surface (Jacquet et al., 2000; cited in US Navy, 2008). Females, on the other hand, spend less time below the sea surface and more time at the surface, where they have been observed to spend prolonged periods of time, on the order of 1 to 5 hours a day without foraging (Whitehead and Weilgart, 1991; Amano and Yoshioka, 2003; both cited in US Navy, 2008).

3.4.1.9.4 Current stressors and threats

As reported by NMFS (2010b), there are currently few threats to sperm whales. Various studies reviewed by NMFS evaluated fishery interactions, vessel interactions, disease, injury from marine debris, research, predation and natural mortality, direct harvest, competition for resources, and cable laying, and all were deemed to present a low or unknown but potentially low threat to the recovery of the species. The effects of anthropogenic noise, contaminants and pollutants, and loss of prey base due to climate and ecosystem change were unknown.

Potential effects of anthropogenic noise on sperm whales are relatively unstudied and fairly uncertain (NMFS, 2010b). Responses vary with noise characteristics, distance, and individual whale characteristics (e.g., sex, age, and previous experience with sound). Inasmuch as marine mammals use sound for communication, navigation, and prey location, anthropogenic noise has the potential to impair these capabilities.

3.4.1.10 Steller sea lion – western and eastern populations

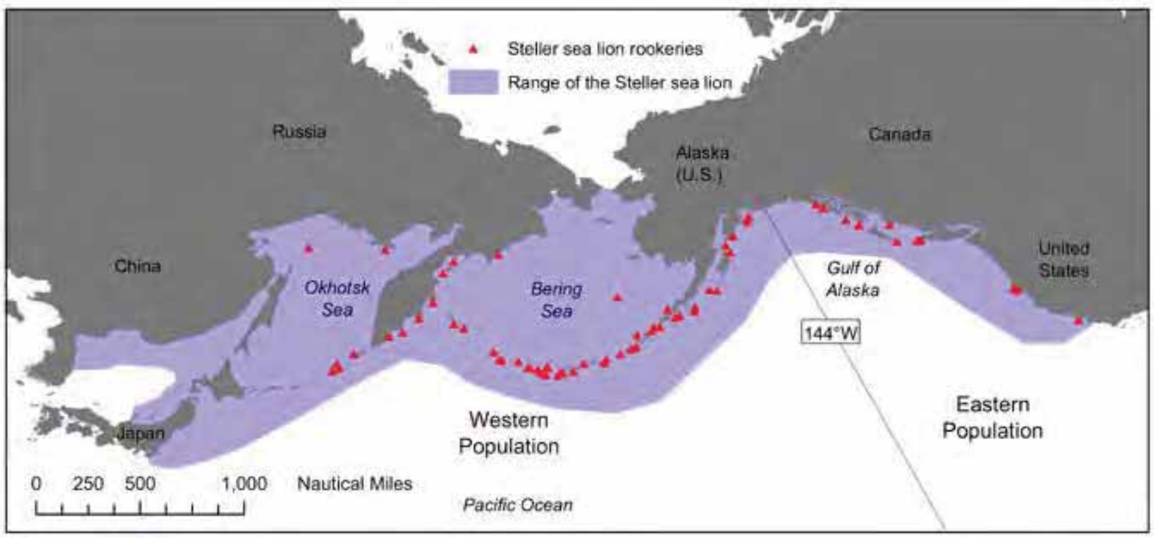
Steller sea lion

The Steller sea lion (*Eumetopias jubatus*), also known as the northern sea lion, is the largest member of the otariid (eared seal) family. Adult males are distinguished by a thick mane of coarse hair and their substantially larger size than females. Adult males measure from 3 to 3.4 m (from 10 to 11 ft) in length and can weigh up to 1,120 kg (2,500 lbs). Females are smaller (2.5 to 3.0 m [7.5 to 9.5 ft]) and lighter (350 kg [770 lbs]) than males. Steller sea lions are colonial breeders. Although sexually mature between 3 and 8 years old, adult males (bulls) are usually around 9 or 10 before they are big enough to establish and defend breeding territories at rookeries. Females (cows) breed annually upon maturity (aged 4 to 6 years), giving birth to a single pup in late May or early June. Most pups are weaned after a year, although some continue suckling for another year or more.

In 1990, NOAA Fisheries listed the Steller sea lion as threatened throughout all of its range under the ESA (55 FR 49204, 1990). A recovery plan was published in 1992 and subsequently revised in 2008 (NMFS, 2008c). In 1997, based on demographic and genetic dissimilarities, NMFS designated two DPSs of Steller sea lions under the ESA: a western population and an eastern population (62 FR 24345, 1997; 62 FR 30772, 1997). As a result of persistent population declines, the western DPS was reclassified at that time as endangered, while the increasing eastern DPS remained classified as threatened. In 2010, NMFS received two petitions to delist the eastern Steller sea lion DPS, and the 90-day finding indicated that such an action might be warranted (75 FR 77602, 2010). In 2012, the agency proposed delisting (NMFS, 2012a), which is undergoing public review and comment at the time of the publication of this BA.

3.4.1.10.1 Distribution and critical habitat

The division of the Steller sea lions into eastern and western populations was based on rookery locations, relative to a line at 144°W longitude from a point near Cape Suckling, Alaska, to just west of PWS (Figure 3-17). The eastern DPS includes animals born at rookeries east of this line, while the western DPS includes animals born to the west. However, animals from both populations, particularly juveniles, frequently cross this boundary.

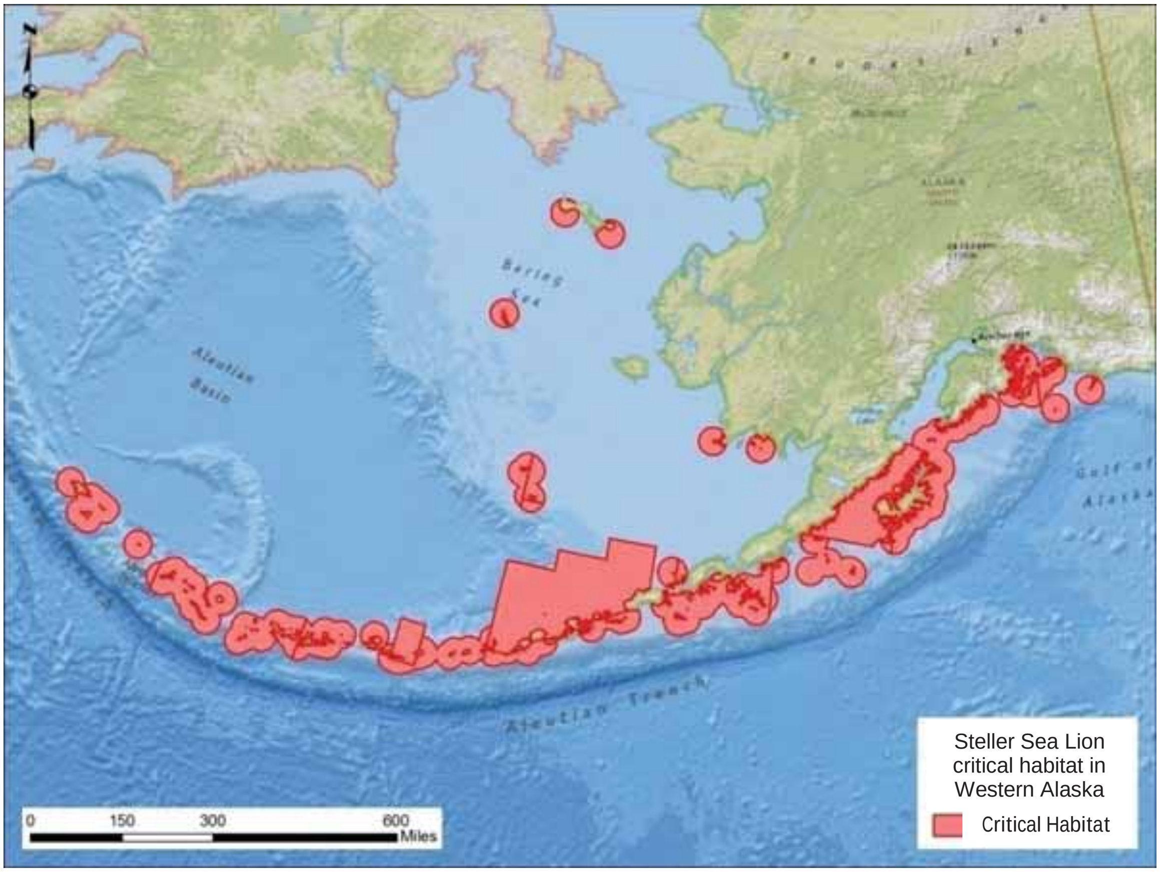


Source: NOAA Fisheries (2012)

Figure 3-17. Range of Steller sea lions, rookery locations, and boundary between western and eastern populations

The western Steller sea lion DPS follows the North Pacific Ocean rim from northern Japan, the Kuril Islands, and Okhotsk Sea, through the Bering Sea and Aleutian Islands, along Alaska's southern coast to 144°W. Prior to the decline of this DPS, the largest rookeries were in the GOA and Aleutian Islands. The Steller sea lion eastern DPS ranges from Baja California north along the west coast of the United States and Canada to 144°W in south central Alaska. Currently, the largest rookeries are in Southeast Alaska and British Columbia.

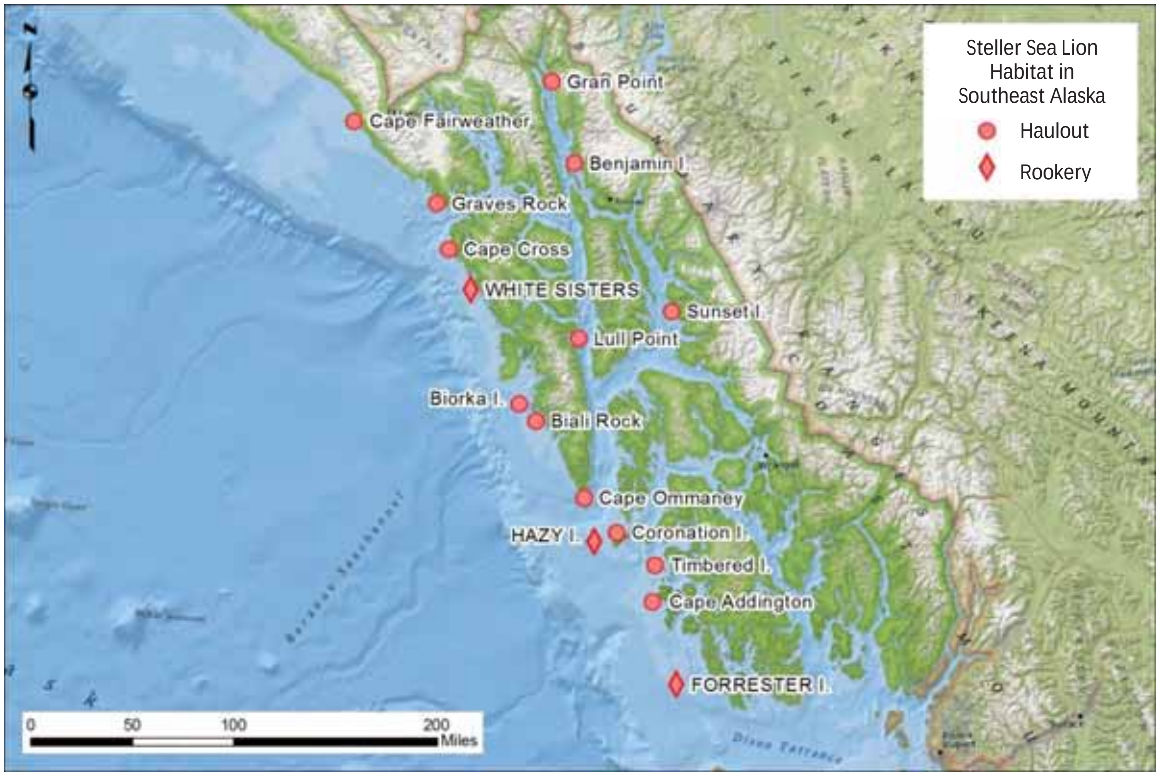
Critical habitat for the Steller sea lion in western Alaska encompasses a 37-km (23-mi) buffer around all major haulouts and rookeries, including associated terrestrial, air, and aquatic zones, and three large offshore foraging areas (Figure 3-18) (NMFS, 2008c; 58 FR 45269, 1993).



Data source: NMFS (58 FR 45269, 1993)

Figure 3-18. Designated critical habitat for the Steller sea lion in western Alaska

In Southeast Alaska, critical habitat for the Steller sea lion encompasses a terrestrial zone that extends 0.9 km (3,000 ft) landward from the baseline or base point of each major rookery and haulout area in Alaska. Critical habitat also includes an air zone that extends 0.9 km (3,000 ft) above the terrestrial critical habitat, measured vertically from sea level, and an aquatic zone that extends 0.9 km (3,000 ft) seaward in state- and federal government-managed waters from the baseline or base point of each major rookery and haulout area (Figure 3-19) (NMFS, 2008c; 58 FR 45269, 1993).



Data source: NMFS (58 FR 45269, 1993)

Figure 3-19. Designated critical habitat for the Steller sea lion in Southeast Alaska

Juvenile Steller sea lions have been observed at great distances from their natal rookeries, up to 1,785 km (1,100 mi) away, whereas adults are generally less than 500 km (310 mi) away from their natal rookeries, although adult males have been observed more than 1,000 km (620 mi) from their natal rookeries, particularly if they have established a territory (Raum-Suryan et al., 2002; cited in NMFS, 2008c). Occasionally other individuals, particularly breeding females, also move from their natal rookery. Genetic analyses of breeding females from both DPSs suggests that sea lions from the western DPS are crossing the 144°W longitude line, apparently for the purpose of pupping and, presumably, breeding. At the two most recently established rookeries in the east, Graves Rock and White Sisters, approximately 70 and 45%, respectively, of pups were from western DPS females (NMFS, unpublished data; Gelatt et al., 2006; both cited in NMFS, 2008c).

3.4.1.10.2 Population status

Worldwide population estimates include Steller sea lions found in Russian waters, eastern Canadian waters, and waters off the west coast of the continental United States. Given the best recent population estimates available for the western and eastern DPS, the worldwide population is at least 115,700 (Allen and Angliss, 2013; NMFS, 2012c). Of the this total population, approximately 47% is comprised of the eastern DPS (NMFS, 2012c). The majority of the population lies within the Alaska EEZ (200 nm [230 mi] from the coastline), inasmuch as it covers approximately half of the Steller sea lion distribution (Figure 3-17). Between 1960 and 1989, the Alaska population of Steller sea lions declined by 63% (55 FR 49204, 1990).

Numerous studies reviewed by NMFS (2008c) indicate that through the 1990s, the population of the western DPS continued to decline but then increased approximately 3% per year between 2000 and 2004. These were the first recorded increases in the population since the 1970s. However, the most recent data available (Allen and Angliss, 2013) suggest that the western DPS population would be more stable through 2011. The data also indicate significant differences in trends among subregions within the western DPS. Based on data from pup and non-pup surveys conducted between 2008 and 2011, the total population of the Steller sea lion western DPS in Alaska is estimated at 52,209 individuals (Allen and Angliss, 2013)

The eastern DPS population of the Steller sea lion was estimated at 63,488 individuals in 2009 (Pitcher et al., 2007, cited in NMFS, 2008c; NMFS, 2012c). This population has been increasing at a rate of approximately 4.3% per year since the late 1970s (NMFS, 2012c), more than doubling in size in Southeast Alaska, British Columbia, and Oregon (NMFS, 2008c).

3.4.1.10.3 Habitat requirements

Steller sea lion habitat includes a variety of both marine waters and shoreline rookeries and haulouts, and individuals display strong site fidelity to specific locations from year to year. Rookeries are also used as haulouts during non-breeding seasons. Birthing areas within the rookeries are typically gently sloping and protected from waves. Sea lion pups remain on land for 2 to 3 weeks after birth, after which time they are increasingly seen in intertidal and coastal areas. Shoreline sites are used for resting, breeding, and nursing (NMFS, 2008c).

Sites used by Steller sea lions are generally on exposed rock shorelines adjacent to fairly shallow and well-mixed waters with average current speeds and gradual bottom slopes (Ban, 2006; Call and Loughlin, 2005; both cited in NMFS, 2008c). Some rookeries and haulouts are also located on gravel and cobble beaches. Peak pupping and breeding occur during June and July at rookeries located on relatively remote islands, rocks, and reefs. Although most often found within the continental shelf region, Steller sea lions are also be found in pelagic waters (Kajimura and Loughlin, 1988; Merrick and Loughlin, 1997; both cited in NMFS, 2008c). Steller sea lions use the continental shelf and pelagic waters to access their food source, schooling fish (e.g., walleye, pollock, Atka mackerel, herring, capelin) (62 FR 24345, 1997).

3.4.1.10.4 Current stressors and threats

Some anthropogenic and natural threats (i.e., ocean regime shift, competition with fisheries, and predation by orcas) have been deemed to have a potentially high impact on the recovery of the Steller sea lion western DPS (NMFS, 2008c). The effects of toxic substances have been deemed to have a medium impact on recovery, and a variety of other anthropogenic and natural threats, including incidental take by fisheries, subsistence harvest, illegal shooting, entanglement in marine debris, disease and parasitism, and disturbance from vessel traffic and tourism, have been assessed as having a low impact. Although these threats and stressors would logically have the same potential for negative effects on the eastern DPS, there is no evidence of limiting factors on this population (NMFS, 2008c).

Distribution

- Bering Sea
- Aleutian Islands
- Kodiak Island
- PWS
- GOA
- Southeast Alaska

Habitats

- Shoreline
- Nearshore
- Open water

Vulnerabilities

- Exposure (contaminants)
- Competition for prey

Commercial fisheries directly compete with Steller sea lions for their prey, and the potential impacts of this competition are under debate. Many factors, including the effects of fisheries on sea lions at various spatial and temporal scales and the efficacy of regulations in mitigating effects, are highly uncertain. As with the threat posed by environmental variability, adult females and juveniles are deemed to be the most vulnerable, and there is no consensus on the appropriate rank for this threat (NMFS, 2008c).

Orca predation is widely recognized a being responsible for the natural mortality in sea lions, although there is substantial uncertainty regarding the level of predation and its population-level effects. Pups and juveniles are deemed to be the most vulnerable, and there is no consensus on the appropriate rank for this threat (NMFS, 2008c).

3.4.1.11 Polar bear

Polar bear

The polar bear (*Ursus maritimus*) is a carnivore and has a large body, stocky build, and white to yellow fur. Males are larger than females, ranging from 350 kg to more than 650 kg (770 to 1,500 lbs) (Stirling, 1998). They are classified as marine mammals because of their evolutionary adaptation to life on the sea ice, which serves as their primary habitat. Polar bears are closely related to grizzly bears, brown bears, and other subspecies of *Ursus arctos* and are believed to have diverged between 200,000 and 250,000 years ago (Stirling, 1998).

The polar bear was listed as threatened throughout its range in 2008 (73 FR 28212, 2008) based on the current and likely future loss of sea ice habitat due to climate change. Because polar bears are designated as threatened under the ESA, they are also, by default, considered depleted by the MMPA.

3.4.1.11.1 Distribution and critical habitat

Polar bears have a circumpolar range, and are found within the borders of Russia, Canada, the United States (Alaska), Greenland, and Norway (DeMaster and Stirling, 1981; Stirling, 1998; Stirling et al., 2007). Polar bears have been observed as far north as 88°N and as far south as St. Mathews Island and the Pribilof Islands of Alaska (DeMaster and Stirling, 1981). Populations within regions that are seasonally ice-free, such as Hudson Bay, occupy terrestrial habitats throughout the year (Regehr et al., 2010), but in Alaska, terrestrial habitat is used primarily by pregnant females for denning (Stirling, 1998).

Polar bear critical habitat was designated in 2011 (75 FR 76086, 2010). On 10 January 2013, however, the US District Court for the District of Alaska issued an order vacating and remanding the designation of critical habitat for polar bear (US District Court District of Alaska, 2013).

3.4.1.11.2 Population status

The global polar bear population was recently estimated to be between 20,000 and 25,000 individuals (Aars et al., 2006). As reported by USFWS (2010e, f), there are two distinct stocks of Alaska polar bears: the Southern Beaufort Sea (SBS) and the Chukchi-Bering Seas (CBS) stocks, which are distinguished by: "(a) variations in levels of heavy metal contaminants of organ tissues, (b) morphological characteristics, (c) physical oceanic features which segregate stocks, and (d) movement information collected from mark and recapture studies of adult female bears."

Obtaining accurate population estimates of polar bear stocks is difficult because of their low population densities, inaccessible habitat, and movement across international boundaries (USFWS, 2010e, f). The most current and valid population estimate for the SBS stock is 1,526 individuals (Regehr et al., 2006). As reported by USFWS (2010e), there is no current and reliable population estimate for the CBS stock; a low-confidence estimate of 2,000 individuals is the best available estimate. Both stocks are believed to be in decline (Regehr et al., 2010; USFWS, 2010f).

3.4.1.11.3 Habitat requirements

Moore and Huntington (2008) classify polar bears as an ice-obligated species. Polar bears exhibit two major adaptations for life on sea ice: large feet that act as snowshoes on thin ice and as oars when swimming and small papillae and depressions on their paws that increase friction and aid in walking on the ice (Stirling, 1998). Their preferred habitat is closely associated with seal abundance and is near the edge of the annual sea ice located over the more biologically productive continental shelf and in polynyas (Stirling et al., 1982; Kingsley et al., 1985; Stirling and Øritsland, 1995; all cited in Stirling et al., 2007; Regehr et al., 2010; 75 FR 76086, 2010).

Polar bears are an apex predator of the circumpolar arctic environment; they use the sea ice to hunt their primary prey, ringed seals (*Phoca hispida*), and, to a lesser degree, bearded seals (*Erignathus barbatus*) (DeMaster and Stirling, 1981; Stirling and Derocher, 1993; Stirling, 1998; Regehr et al., 2010). During the spring months, polar bears forage in the shorefast ice zone for ringed seal pups inside subnivean (i.e., under the snow) birthing lairs. Ringed seal pups are an important part of the polar bear's diet because at 6 weeks of age, the pups can be up to 75% fat (Stirling, 1998). Polar bears do not enter a state of torpor during the winter because the presence of sea ice allows them to continue hunting.

While winter lethargy is a survival strategy for other bears, it is a reproductive strategy for polar bears. Dens are excavated from drifted snow on both sea ice and land; sufficient topographic relief to cause early winter snow to form drifts is the key characteristic necessary for denning habitat. Typically, pregnant females enter dens in November, give birth in December, and emerge in March or April (Ramsay and Stirling, 1988). Polar bears are particularly vulnerable to disturbance while denning, and cubs will die if the family group leaves the den early (Blix and Lentfer, 1979; cited in Amstrup, 2003). Denning habitats in northern Alaska are diffuse and include barrier islands, river banks, coastal bluffs, and much of the North Slope coastal plain (Durner et al., 2004; Durner et al., 2006). The CBS population typically dens in Russian territory (Stishov, 1991a, b; Ovsyanikov, 2006).

3.4.1.11.4 Current stressors and threats

The greatest threat to the polar bear is sea ice habitat loss due to climate change. The presence of sea ice is essential to polar bears because it provides a means for them to both access prey and travel around the Arctic (Stirling and Derocher, 1993; Regehr et al., 2010). Since 1979, the warming of the Arctic region has led to an 8 to 9.5% decline per decade in the extent of the summer sea ice, raising concern about species with obligate relationships to sea ice, such as the polar bear (Regehr et al., 2010). Declines in body condition, reproduction, survival of all age classes with the exception of prime adults, and population size have all been associated with the earlier break up of sea ice (Regehr et al., 2010). Regehr et al. (2010) reported a decline in polar bear survival associated with longer annual ice-free periods and hypothesized that these ice-free periods cause increased nutritional stress and "cause polar bears to enter the winter in poorer nutritional health." Arctic warming could also increase the mortality rate of ringed seals, the primary prey of polar bears (Regehr et al., 2010). There is an increased potential for human interaction with polar bears, which could compound current and predicted ecological changes (Stirling and Derocher, 1993); these include an expansion of industrial and commercial activity in the Arctic, and polar bears spending more time on land.

Distribution
- Beaufort Sea
- Chukchi Sea
- Bering Sea
- North Slope
- Western Alaska

Habitats
- Terrestrial
- Shoreline
- Nearshore
- Sea ice

Vulnerabilities
- Disturbance (human interactions)
- Habitat loss (sea ice)
- Direct injury (poaching)
- Reduced prey base

3.4.1.12 Northern sea otter – Southwest Alaska DPS

The Northern sea otter (*Enhydra lutris kenyoni*) is one of three subspecies of sea otter (*E. lutris*) in the family Mustelidae. Because this large sea otter lacks blubber, its dense fur coat insulates it against the cold sea water; consequently, sea otters are very vulnerable to the effects of oil spills (USFWS, 2010b). Thermoregulation is aided by a high metabolism but requires Northern sea otters to consume large quantities of benthic invertebrate prey (USFWS, 2010b). Sea otters are a keystone species, depressing urchin populations, which in turn allows for productive kelp forests to flourish along shallow rocky reefs (Estes and Palmisano, 1974; Estes and Duggins, 1995). Thus, declines in sea otter populations can lead to wholesale shifts in ecosystems,

Northern sea otter

from productive and diverse kelp forests to unproductive barrens, as recently documented in Alaska's Aleutian archipelago (Estes et al., 1998; Estes et al., 2004).

USFWS recognizes three stocks of Northern sea otter in Alaska: southeast, south-central, and southwest. The southwest Alaska DPS is listed as threatened under the ESA (70 FR 46366, 2005) and thus depleted under the MMPA; it is the only stock discussed in detail in the BA.

3.4.1.12.1 Distribution and critical habitat

The Northern sea otter is the only subspecies that is found along Alaska's southern coastline (i.e., the Aleutian and Pribilof Islands and south-central and Southeast Alaska); their distribution extends to British Columbia and the northwest coast of Washington State.

The southwest Alaska DPS is distributed over more than 1,500 mi of shoreline that includes the Alaska Peninsula coast; the Aleutian to Attu Islands; Barren Islands, Kodiak archipelago; the Pribilof Islands; and Bristol Bay (Gorbics and Bodkin, 2001; USFWS, 2010b).

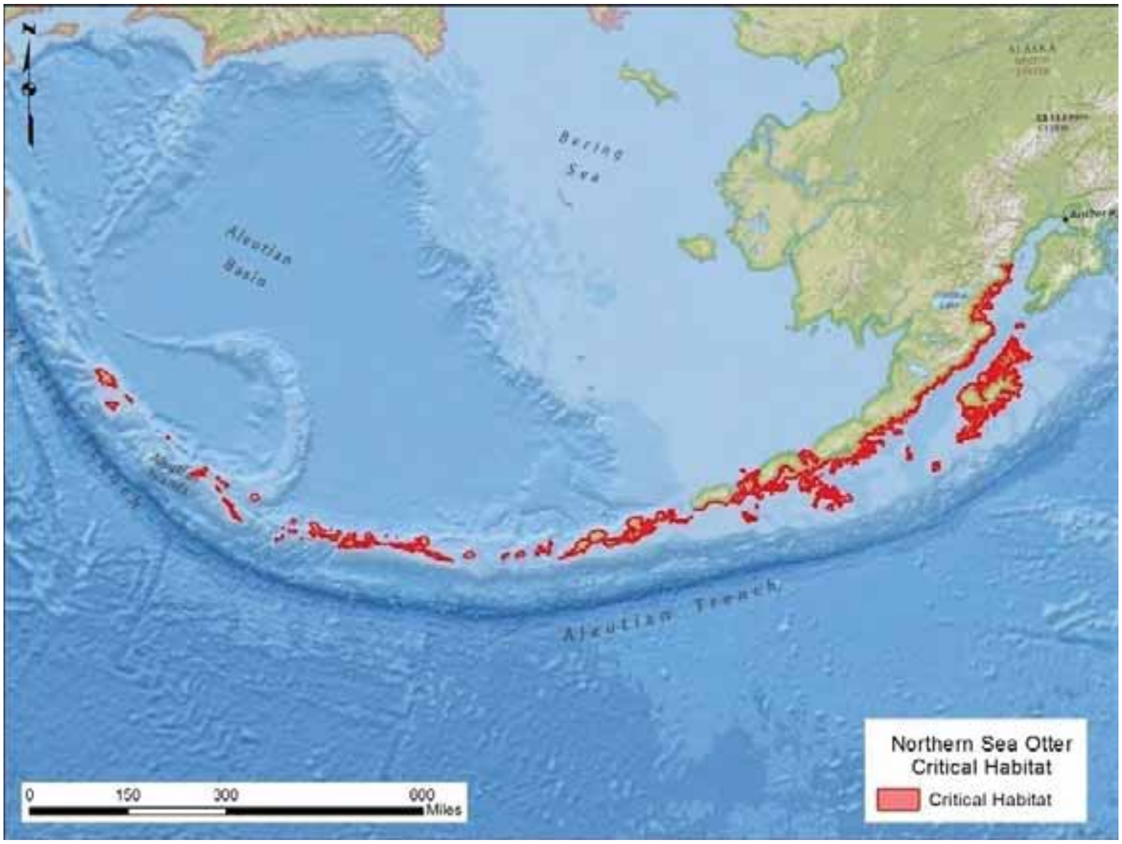
The northern range limit of the Northern sea otter appears to be related to the extent of the sea ice, likely because sea ice precludes access to foraging habitat. Accordingly, any seasonal and inter-annual variation in the extent of the sea ice can expand or contract available sea otter habitat (USFWS, 2010b). Sea otters have been documented traveling across the Alaska Peninsula in attempts to reach the ice-free Pacific from the ice-covered Bering Sea (NMFS unpublished data; Schneider and Faro, 1975; both cited in USFWS, 2010b). These efforts are generally unsuccessful, resulting in death by starvation or predation. Northern sea otter southern range limits are not well understood but appear to coincide with the southern limits of coastal upwelling, which are associated with canopy-forming kelp forests, and the 20 to 22°C sea surface isotherm (Kenyon, 1969; cited in USFWS, 2010b).

Critical habitat has been designated for the Northern sea otter southwest Alaska DPS (74 FR 51988, 2009). The PCEs of sea otter critical habitat include:

- Shallow, rocky areas where marine predators are less likely to forage (waters less than 2 m [6.6 ft] deep)
- Nearshore waters that provide protection from marine predators (waters within 100 m [328.1 ft] of the mean high tide line)
- Kelp forests that are present in waters less than 20 m (65.6 ft) deep, which provide protection from marine predators
- Sufficient prey resources within nearshore habitats (74 FR 51988, 2009).

Critical habitat for the Northern sea otter southwest Alaska DPS comprises nearshore marine waters that range from mean high tide to 20 m (65.6 ft) in depth or are within

100 m (328.1 ft) of the mean high tide line (or both) and extend from Bristol Bay around the Aleutian Islands and into Cook Inlet (74 FR 51988, 2009) (Figure 3-20).



Data source: USFWS (74 FR 51988, 2009)

Figure 3-20. Northern sea otter critical habitat

3.4.1.12.2 Population status

The sea otter was granted protection from commercial exploitation under the International Fur Seal Treaty of 1911, when the worldwide population was drastically depleted (fewer than 1,000 animals in 13 colonies) (USFWS, 2010b). Populations of sea otters have generally increased throughout the 20th century, with the exception of the Northern sea otter southwest Alaska DPS, which was listed as threatened under the ESA in August 2005 (70 FR 46366, 2005) as a result of a substantial population decline along the Aleutian archipelago (Estes et al., 1998; Estes et al., 2005). Doroff et al. (2003) estimated that from 1965 to 2000 the population within the Aleutian archipelago declined 70%; the population subsequently continued to decline and Estes et al. (2005) noted that sea otters were absent or nearly absent on some smaller islands in 2005.

Because the Northern sea otter southwest Alaska DPS inhabits a large, heterogeneous geographic range, five management units (MUs) have been defined to accurately assess the populations on a more relevant scale (USFWS, 2010b): 1) western Aleutian Islands; 2) eastern Aleutian Islands; 3) south Alaska Peninsula; 4) Bristol Bay; and 5) the Kodiak

Archipelago, Kamishak Bay, and the Alaska Peninsula. All populations except for the Kodiak-Kamishak-Alaska Peninsula MU population exhibited substantial declines from the mid-1980s to early 1990s, ranging from a 39% decline in the Bristol Bay MU to a 74% decline in the south Alaska Peninsula MU (2010b). The Northern sea otter southwest Alaska DPS is estimated to have a combined population of nearly 54,000 individuals and is believed to have experienced a 43 to 58% decline since the mid-1980s (USFWS, 2010b).

3.4.1.12.3 Habitat requirements

Sea otters are present in a variety of coastal marine habitats, from protected bays and estuaries to exposed coasts and offshore islands, although they tend to prefer complex coastlines which often have higher concentrations of sea otters (Riedman and Estes, 1990). Sea otters dive to the sea floor to forage, so their habitat is constrained by their diving depth of approximately 100 m (330 ft). As a result sea otters are most commonly found within a few kilometers of shore (Riedman and Estes, 1990), and higher densities are often found at locations with shallower water (Laidre et al., 2002). Sea otters can navigate across great distances and through deep water, and there are several well-documented reports of individuals traveling tens to hundreds of kilometers, during which they swam across waters deeper than their maximum foraging depth (Ralls et al., 1992; Monnet et al., 1990; Bodkin et al., 2000; all cited in USFWS, 2010b; Rathbun et al., 1990).

Sea otters, especially adult males, occupy and defend home ranges. Garshelis and Garshelis (1984; cited in USFWS, 2010b) estimated that in PWS, female home ranges were 1.0 to 4.8 km^2 (0.4 to 1.9 mi^2), and male home ranges were 4.6 to 11.0 km^2 (1.8 to 4.2 mi^2). These findings are in contrast with more recent work by Ballachey and Bodkin (2006; cited in USFWS, 2010b), who estimated much smaller home ranges for male sea otters than for females in PWS; they reported that the areas where individuals spent 90% of their time were approximately 9.6 km^2 and 23.8 km^2 (3.7 mi^2 and 9.2 mi^2) for males and females, respectively. The differences in these findings could be attributable to the definition of home range; while Ballachey and Bodkin (2006; cited in USFWS, 2010b) used kernel densities, Garshelis and Garshelis (1984; cited in USFWS, 2010b) used the minimum coastline distance between the most extreme locations, thereby defining the maximum possible home range for an individual. Additional telemetry tracking of juveniles in PWS and adults along the Alaska Peninsula and in the Kodiak archipelago documented movements of 50 km (31.1 mi) or less (USGS unpublished data,Monnet et al., 1988; both cited in USFWS, 2010b). In the Aleutian Islands, home ranges for females have been estimated to be 8 to 16 km (5 to 10 mi) of contiguous coastline; males in the Aleutian Islands have larger home ranges than do females (Lensink, 1962; Kenyon, 1969; both cited in USFWS, 2010b).

Because Northern sea otters rely, in part, on their high metabolic rates for thermoregulation, they must consume 20 to 33% of their body weight in prey every day (Costa, 1982; Kenyon, 1969; both cited in USFWS, 2010b). Sea otters primarily prey on sessile or slow-moving benthic invertebrates (e.g., mollusks, crustaceans, and echinoderms) but are considered generalists and will shift to other prey if their preferred prey is scarce (USFWS, 2010b). As reported by USFWS (2010b), clams are the primary prey species for sea otters in the soft-sediment habitats of Southeast Alaska, PWS, and Kodiak; whereas sea urchins and finfish are dominant in the diets of sea otters in the Aleutian, Commander, and Kuril Islands.

Sea otters spend a significant amount of time floating on the water surface feeding, bathing, socializing, and sleeping. Canopy-forming kelp, particularly species of *Macrocystis*, *Eularia*, and *Nereocystis*, can provide Northern sea otter with preferred resting habitat and cover from predators (Kenyon, 1969, cited in USFWS, 2010b; Riedman and Estes, 1990). Sea otters will periodically haul out above the high tide line to rest but remain close to the shore (Kenyon, 1969, cited in USFWS, 2010b; Riedman and Estes, 1990). Females can also place their pups on rocks while they dive to feed (USFWS, 2010b). Shallow water provides refuge from predators; Estes et al. (1998) reported a stable sea otter population inside a shallow lagoon on Adak Island in the Aleutian archipelago but a 90% population decline outside the lagoon, where sea otters were presumably preyed upon by orca.

3.4.1.12.4 Current stressors and threats

As determined by the USFWS (2010b) threat analysis, habitat loss, changes to prey base, fishery bycatch, disturbance, biotoxins, point-source contaminants, and non-point-source contaminants pose little threat to the recovery of the southwestern Alaska DPS of Northern sea otters, and oil spills (including exposure to oil and contaminated prey), subsistence harvest, infectious disease, and illegal take are a low to moderate threat. Predation alone is deemed to pose a moderate to significant threat to the recovery of the southwestern Alaska DPS of Northern sea otters (USFWS, 2010b).

Distribution
- Aleutian Islands
- Bristol Bay
- Alaska Peninsula
- Kodiak Island
- Pribilof Islands

Habitats
- Shoreline
- Nearshore

Vulnerabilities
- Predation
- Direct injury (poaching, subsistence harvest)

Predation by orcas is presumed to be the cause of the substantial population decreases in the two Aleutian Island MUs. As reported by USFWS (2010b), this presumption is based on several factors: increased observation of predation; sea otter population stability in areas inaccessible to orcas; behavioral responses that indicate otters actively avoid orcas; analyses that indicate that a small population of orcas could cause the observed decline (and observed predation rates could be solely responsible for the observed decline); the indiscriminate loss of sea otters, regardless of age class; the fact that few sea otter carcasses wash ashore; and the high rate of disappearance of radio-tagged sea otters. There is little potential to manage or estimate this threat to the sea otter population.

Subsistence harvest of the southwest Alaska DPS still occurs; from 1989 to 2008, the average annual take was 89 animals (USFWS, 2010b), the lowest take among the three Alaska stocks of sea otters. Poaching also remains a threat to the population.

3.4.1.13 Pacific walrus

Pacific walrus

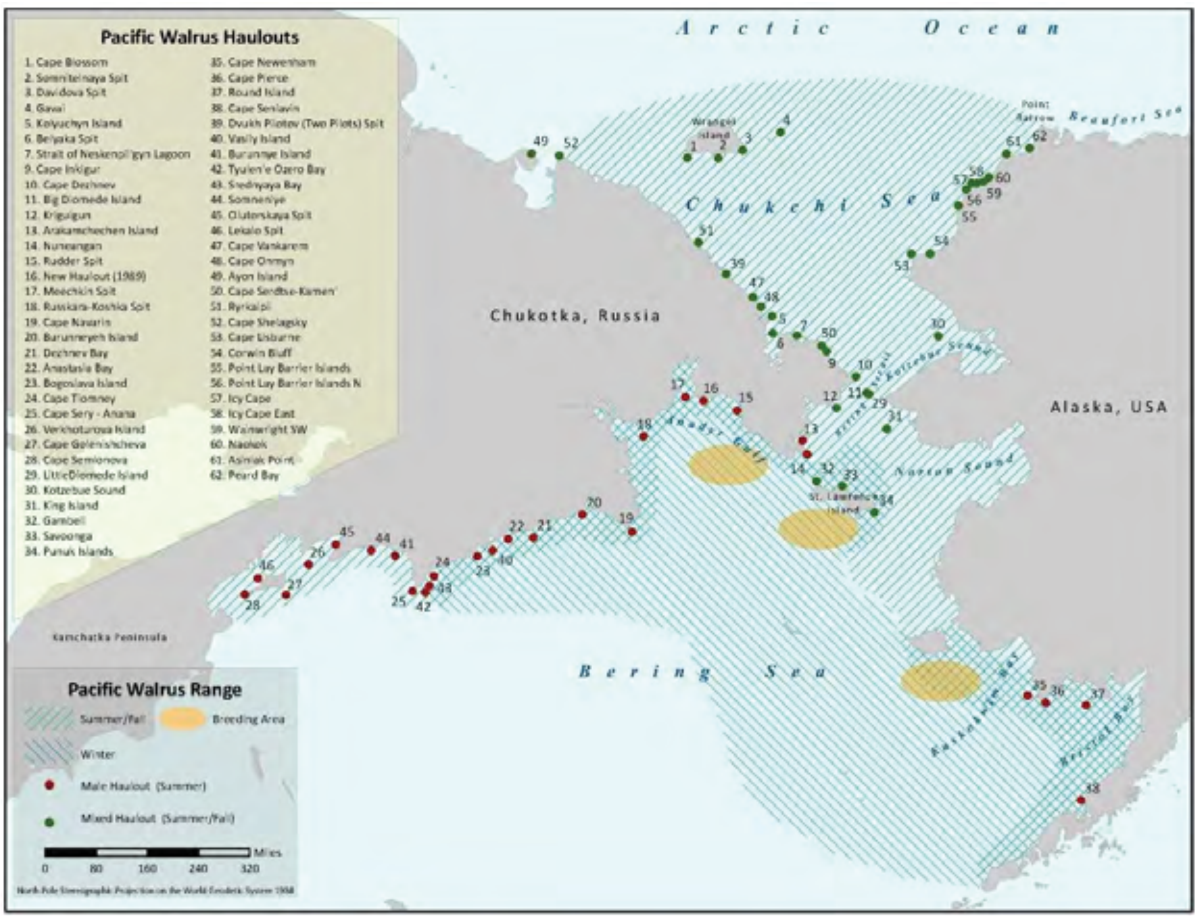
The Pacific walrus (*Odobenus rosmarus divergens*) is one of the largest pinnipeds and is moderately sexually dimorphic. The size of the average adult Pacific walrus (measured from nose to tail) is 3.2 m (10.5 ft) for males and 2.7 m (9 ft) for females; average adult weights are 1,210 kg (2,670 lbs) for males and 830 kg (1,830 lbs) for females (Fay, 1982; cited in USFWS, 1994). The walrus head has a pair of enlarged upper canine teeth that project downward as tusks, small eyes, no external ear pinnae, dorsally situated external nostrils, and a squarish snout that bears hundreds of stiff whiskers. Walruses are social and gregarious animals. They tend to travel and haul out to rest on ice or land in densely packed groups in close physical contact with each other. There are two recognized subspecies of walrus (Berta and Churchill, 2012): Atlantic walrus (*Odobenus rosmarus rosmarus*) and Pacific walrus (*O. r. divergens* [Illiger 1811]. Only the Pacific walrus falls within the scope of this BA.

In 2008, the USWFS received a petition to list the Pacific walrus as threatened or endangered under the ESA (74 FR 46548, 2009). The USFWS found that the listing was warranted but that development of a proposed rule was precluded at that time due to other priorities (76 FR 7634, 2011). The Pacific walrus is currently a candidate species for listing. However, under the terms of a negotiated settlement, the subspecies will either be removed from the list or a proposed rule will be developed by 2017. The IUCN classifies the species as data deficient, meaning there is "inadequate information to make a direct, or indirect, assessment of its risk of extinction based on its distribution and/or population status" (Lowry et al., 2008). Data deficient is not a category of threat. The Marine Mammal Commission considers the walrus to be a species of special concern (MMC, 2002).

3.4.1.13.1 Distribution and critical habitat

The Pacific walrus is geographically isolated and ecologically distinct from other walrus populations in the Arctic (USFWS, 1994). They are distributed across vast offshore areas of the shallow continental shelf in the waters of the northern Bering Sea and southern Chukchi Sea, principally relying on broken pack ice to access offshore feeding areas (Fay, 1982; cited in Lowry et al., 2008).

In winter, the entire population is often hauled out on the pack ice in the Bering Sea. During the breeding season in January, February, and March, the animals congregate in three areas: 1) in the Gulf of Anadyr, 2) southwest of St. Lawrence Island, and 3) south of Nunivak Island. As the pack ice retreats, most females and younger animals migrate northwards through the Bering Strait to summer feeding areas in the Chukchi Sea. In summer, they are widely distributed from northern Kamchatka and the Alaska Peninsula through the Bering Strait to the edge of the ice in the Chukchi Sea (USFWS, 1994; Garlich-Miller et al., 2011). Large concentrations of Pacific walruses are found between the Bering Strait and St. Lawrence Island, and the Alaska Peninsula and Norton Sound. In July, concentrations of mainly males are found on and near shoreline haulouts in the Bering Sea, Bristol Bay, and the northern Gulf of Anadyr (USFWS, 1994). Depending on ice conditions, shoreline haulouts may be used until November and December. As the ice thickens, walruses move to wintering areas along the ice edge throughout the Bering Sea. Figure 3-21 shows the seasonal range, haulout locations, and breeding areas of the Pacific walrus.



Source: Garlich-Miller et al. (2011)

Figure 3-21. Pacific walrus distribution, including seasonal range, haulout locations, and breeding areas

The State of Alaska created the Walrus Islands State Game Sanctuary (WISGS) in 1960 to protect one of the largest shoreline haulout sites for the Pacific walrus and other species. WISGS is a group of seven small, craggy islands and their adjacent waters in northern Bristol Bay, approximately 65 mi southwest of Dillingham, Alaska. One of these islands (Round Island), is one of four major haulouts in Alaska; the others are Capes Peirce (Togiak NWR), Newenham (Togiak NWR), and Seniavin (near Port Moller). Male walruses return to these haulouts every spring as the ice pack recedes, remaining in Bristol Bay during the summer (ADF&G, 2012h).

The Pacific walrus also uses shoreline sites within the Bering Sea and Chukchi Sea units of the Alaska Maritime National Wildlife Refuge (AMNWR), which is managed by the USFWS. NMFS has also established commercial fishing and commercial fishing vessel transit exclusion zones around some walrus haulouts in Bristol Bay.

Because the species has not yet been listed under the ESA, critical habitat has not been designated.

3.4.1.13.2 Population status

Commercial exploitation has greatly reduced the Pacific walrus population at least three times since the middle of the 19th century, but each time the species has been protected, the population has recovered (Fay et al., 1989; cited in USFWS, 1994). In the 1950s, the population was reduced to between approximately 50,000 to 100,000 animals (MMC, 2002). In 1985, the population was estimated to be approximately 230,000 animals (Gilbert, 1989); and in 1990, the estimated population was 201,000 animals (Gilbert et al., 1992; cited in Lowry et al., 2008). However, characteristics of walrus behavior and difficulties associated with conducting population surveys resulted in imprecise estimates (Gilbert, 1999; cited in Lowry et al., 2008). A recent survey (Speckman et al., 2011; USFWS, 2010d) estimated the Pacific walrus population to be 129,000 animals, but this estimate was noted as biased low. However, because of the inadequacy of survey methodologies, survey timing, and segments of the population surveyed, as well as incomplete coverage of areas where walruses could have been present, the current population size and trend is unknown (MMC, 2002; USFWS, 2010d).

3.4.1.13.3 Habitat requirements

Walrus habitat requirements include areas of shallow water that support a productive benthic community, the reliable presence of open water over these feeding areas, and suitable ice or land nearby to haul out (Garlich-Miller et al., 2011).

Walruses also use sea ice as a substrate for birthing and nursing (Tynan and DeMaster, 1997; Laidre et al., 2008; Moore, 2005; USFWS, 2010d) and require areas of thin or broken ice cover over suitably shallow depths (Finley and Renaud, 1980; Burns et al., 1981; both cited in Tynan and DeMaster, 1997). In winter, walruses use areas where the pack ice is thick enough to support their weight (Burns et al., 1981; cited in Tynan and DeMaster, 1997) but has areas that are broken or sufficiently thin so as to allow them to break the ice with their heads to maintain breathing holes (Stirling et al., 1981; cited in Tynan and DeMaster, 1997).

Walruses are usually found in waters less than 100 m (328 ft) deep. Typically, feeding areas are composed of sediment of soft mud and sand; compacted sediment apparently inhibits their preferred prey of clams and other benthic invertebrates (Richard, 1990; cited in USFWS, 1994). Walruses sometimes forage along rocky shorelines. Their use of shoreline haulouts is influenced by natural or human disturbance; isolated sites such as islands, points, spits, and headlands are occupied most frequently (Richard, 1990; cited in USFWS, 1994).

3.4.1.13.4 Current stressors and threats

Over the course of a 12-month analysis related to the ESA listing petition, USFWS concluded that the two main causes of Pacific walrus population loss in the foreseeable future will be the degradation of sea ice habitat due to a warming climate and hunting by humans. USFWS also determined that existing regulatory mechanisms will be inadequate to address these threats (76 FR 7634, 2011).

Distribution

- Chukchi Sea
- Bering Sea
- Bristol Bay

Habitats

- Shoreline
- Nearshore
- Open water
- Sea ice

Vulnerabilities

- Disturbance
- Habitat loss (ice)
- Injury/death (hunting)

The loss of sea ice habitat is likely to cause walruses to become increasingly concentrated in coastal habitats. This increasing dependence on coastal habitats is likely to lead to increased disturbances from anthropogenic sources (76 FR 7634, 2011). Other potential stressors associated with the increased use of coastal haulouts include the depletion of local prey species, decline in physical condition as walruses expend more energy traveling further from shore in search of food, and predation by polar bears. Any reduction in sea ice could also lead to an increase in commercial shipping activity in areas of the walruses' range that today are rarely visited by humans. Increases in commercial shipping will mean an increased risk of spills and discharge of pollutants, disturbances, ship strikes, and coastal development (Tynan and DeMaster, 1997; Moore, 2005).

The Pacific walrus is an important cultural and subsistence resource for coastal communities in Alaska and Russia (Kawerak, 2011). Over the past 50 years, the Pacific walrus population has sustained annual harvests estimated to range from 3,200 to 16,100 animals per year. Recent harvest levels have been reduced, but whether these reductions reflect changes in walrus abundance or hunting efforts is unknown (USFWS, 2010d). Cooperative agreements between the USFWS and the Eskimo Walrus Commission have been developed annually since 1997 to facilitate the participation of subsistence hunters in activities related to the conservation and management of walruses in Alaska.

Direct conflicts between the Pacific walrus and fisheries are uncommon (USFWS, 2010d); however, trawl fisheries can disturb benthic feeding areas important to the species (COSEWIC, 2006). Human disturbances at land-based haulout sites, low-level aircraft flyovers, and the nearshore passage of vessels can have serious effects on walruses in rookeries or haulouts, as the species is highly susceptible to disturbance and easily panicked into stampedes.

3.4.1.14 Ringed seal

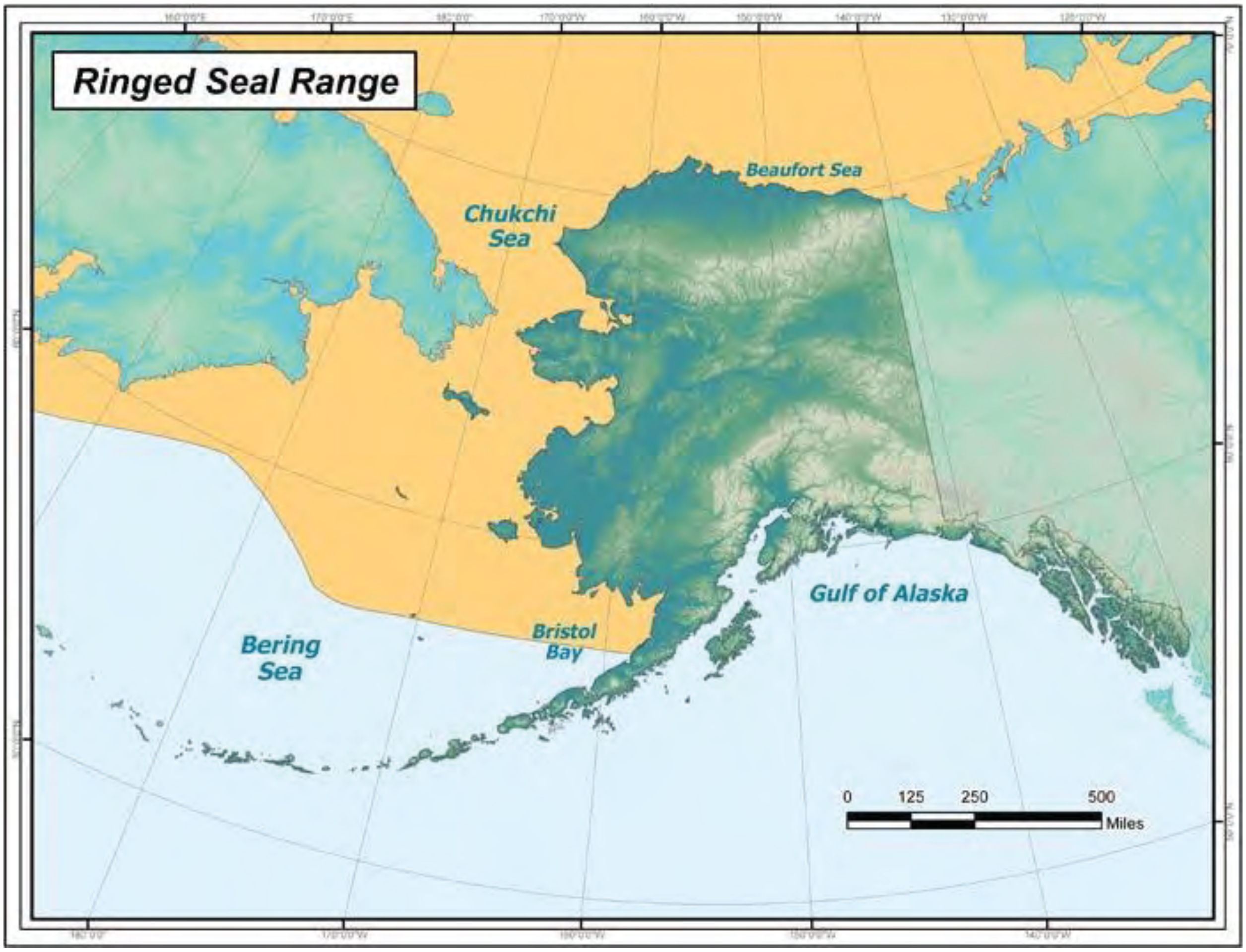
Ringed seal

The ringed seal (*Phoca hispida*) is one of the smallest true seals (Phocidae), a group of marine carnivores descended from terrestrial mammals. Adults range from 1.1 to 1.5 m (3.5 to 5 ft) in length and from 50 to 70 kg (110 to 150 lbs) in weight. Their coats, or pelages, have both light and dark phases. The light phase consists of a dark gray saddle with superimposed lighter rings, and the dark phase has a dark background with light rings over its body. Both phases create a "ringed" effect that gives the species its common name. Pups are born with white coats, which are shed within 1 to 2 months, and are nursed for up to 2 months on stable, shorefast ice. Ringed seals prefer large ice floes and are found on the interior icepack, where sea ice coverage is > 90% (Allen and Angliss, 2011). There are currently five recognized subspecies of ringed seal, of which only the Arctic subspecies (*Phoca h. hispida*) is discussed in this BA (Kelly et al., 2010b).

On 28 December 2012, NMFS issued a final determination to list three of the five subspecies of ringed seal as threatened with extinction throughout all or a significant part of their range (77 FR 76706, 2012). This included the Arctic (*P. h. hispida*), Okhotsk (*P. h. ochotensis*), and Baltic (*P. h. botnica*) subspecies of ringed seal. In the same ruling, NMFS listed the subspecies Ladoga (*P. h. ladogensis*) as endangered of extinction and proposed to determine critical habitat for the ringed seal in a future rulemaking. As previously stated, only the Arctic subspecies has a range within the scope of this BA.

3.4.1.14.1 Distribution and critical habitat

Ringed seals are a circumpolar species (Figure 3-22) and are the most common seals in the Arctic; they are found on firm ice along Japanese Pacific coasts, northern parts of the Baltic Sea, Canada, Alaska, and Siberia. The seasonal distribution and extent of sea ice is a major factor that affects ringed seal movement, foraging, and vulnerability to predation. During the open-water season from May to August, seals that breed on shorefast ice travel up to 1,000-km to forage in the highly productive areas at the edge of the pack ice (Kelly et al., 2010a). Critical habitat has not yet been designated (77 FR 76706, 2012).



Source: ADF&G (2012e)

Figure 3-22. Ringed seal distribution

3.4.1.14.2 Population status

The widespread distribution of the ringed seal Arctic subspecies across various habitats and political boundaries has made "estimation of a credible population size or trend impossible" (Kelly et al., 2010b). In 1970, the number of ringed seals observed on shorefast ice along the North Slope of Alaska was estimated to be at least 11,612 individuals (Burns and Harbo, 1972; cited in Kelly et al., 2010b). Based on more recent surveys conducted in the late 1990s (2005; 2004), the total ringed seal population in the Chukchi and Beaufort Seas is estimated to be at least 300,000 individuals. However, Frost et al.'s (2004) survey in the Beaufort Sea was limited to 40 km (15.6 mi) from shore (mostly shorefast ice habitat); thus the estimate is likely low. If seal populations on the pack ice had been taken into account, the estimated total could have been as much as 1.5 million (Frost, 1985; cited in Kelly et al., 2010b). The current population is unknown.

3.4.1.14.3 Habitat requirements

Throughout most its range, the ringed seal Arctic subspecies does not come ashore but uses sea ice for resting, pupping, and molting (Kelly et al., 2010a). Ringed seals give birth in late winter or early spring in subnivean lairs (snow caves) on sea ice and in the lee of ice hummocks. Ringed seals require a snow depth accumulation of at least 45 cm (17.7 in.) to build a lair (Kelly et al., 2010a). Except during the spring molt, ringed seals spend most of their time foraging in water (Kelly et al., 2010a). Ringed seals primarily eat fish (e.g., cod, smelt, herring) and some invertebrates (e.g., shrimp) (Kelly et al., 2010b). From August to November, along the coast of Alaska, in the Beaufort and Chukchi Seas, ringed seals spend 10% or less of their time on the ice. Time out of the water increases, but remains less than 20%, from December to March, and then increases to an average of 55% in May and June, when the seals bask on the ice while molting (Kelly et al., 2010a). Ringed seals use their stout claws to maintain breathing holes in the ice during fall, winter, and spring, when the ice cover is heavy.

3.4.1.14.4 Current stressors and threats

Distribution

- Chukchi Sea
- Beaufort Sea

Habitats

- Nearshore
- Open water
- Sea ice

Vulnerabilities

- Habitat loss (ice)
- Disturbance
- Exposure (contaminants, disease, parasites)
- Injury/death (poaching, subsistence harvest, predation, bycatch)

Threats to ringed seals include loss of habitat due global climate change; predation; pollution and contaminants; diseases and parasites; stressors related to oil and gas exploration, development, and production; subsistence and illegal harvesting; and bycatch (e.g., commercial trawls).

Climate change, including warming, ocean acidification, and changes in precipitation and weather patterns, is potentially the most serious threat to ringed seal populations because much of their habitat is dependent upon pack ice (Kelly et al., 2010b; NOAA Fisheries, 2013). The extent of multi-year sea ice has exhibited a 40% loss over the past 5 years (Kwok et al., 2009; cited in Kelly et al., 2010b). In its status review, the NMFS Biological Review Team determined that the greatest future risk to ringed seals will be increased juvenile hypothermia and predation as a result of the decreasing depth and duration of snow cover (Kelly et al., 2010b).

Female ringed seals generally build multiple birthing lairs to avoid predation by their main predator, polar bears. Snow cover is a major factor that affects not only the depth, number, and distribution of birthing lairs but the availability of suitable locations. Annually, polar bear predation accounts for the loss of 8 to 44% of ringed seal pups. Predation increases as lair density increases, triples when pups are exposed because of unseasonably warm conditions, and nearly quadruples when average snow depth decreases from 23 to 10 cm (9 to 3.9 in.) (Hammill and Smith, 1991; cited in Kelly et al., 2010b).

Reductions in sea ice cover are also likely to increase human-related activities, such as shipping and resource extraction, creating the potential for increased ringed seal mortality from accidents and pollution. Oil and gas exploration, development, and production activities have been conducted off the coast of Alaska since the 1970s, mostly in the Beaufort Sea. However, Moulton et al. (2005) concluded that the effects of offshore oil development on the local abundance and distribution of basking ringed seals at the Northstar development in the Beaufort Sea was relatively small compared with natural environmental factors, such as weather.

Disease and parasites also affect ringed seals. Parasitic worms (e.g., tapeworms, flukes, and nematodes) that infect the cardiovascular systems, lungs, and intestinal tracts of their hosts have been found in all populations of ringed seals throughout their ranges. In 1988 and 2002, phocine distemper virus (PDV) and canine distemper virus (CDV), both of the genus *Morbillivirus*, were responsible for several die-offs of European populations of harbor, harp, and gray seals, all closely related species. In 1992, 41% of the ringed seals in the Canadian Arctic tested positive for exposure to PDV and CDV. Terrestrial mammals, both scavengers and predators, also contribute to the spread of *Morbillivirus*. Since the summer of 2011, an outbreak of an unidentified disease, or "unusual mortality event," has caused illness and death in ringed seals and walruses in the Arctic and Bering Straits of Alaska. Reports of sick or dead animals have also come from Russia and Canada. The precise cause has not been identified, but preliminary tests have determined that the cause is not viral in nature (NMFS, 2011e).

Pollutants, including heavy metals and organochlorine compounds, have been found in all populations of ringed seals. (Helle et al., 1976; Olsson et al., 1986; Becker, 2000; Nyman et al., 2002; Quakenbush, 2007; Quakenbush and Sheffield, 2007; all cited in Kelly et al., 2010b). Other contaminants include perfluorinated compounds, which are used as antifouling agents in ship paint; metals; and pharmaceuticals. Ringed seals in the Arctic are also exposed to low levels of radioactive contamination. Heavy metals concentrations vary by age of an animal and region, with higher concentrations measured in European Arctic populations as compared with those of the United States or Canadian Arctic. Organochlorine contaminants are of particular concern because of their potential effects on health and reproduction, although measured levels of these contaminants in Alaska and western Canada Arctic ringed seal populations are well below those in seals found in the Baltic and Russian Arctic regions.

The average annual subsistence harvest of ringed seals by Alaska natives was 7,000 to 15,000 from 1962 to 1972 but decreased to 2,000 to 3,000 in 1979 (Frost, 1985; cited in Kelly et al., 2010b). As of August 2000, ADF&G Division subsistence harvest database estimated that the harvest of ringed seals by Alaska Natives to be 9,500 animals per year (Allen and Angliss, 2012).

3.4.1.15 Bearded seal

The bearded seal (*Erignathus barbatus*) is a member of the true seal family, Phocidae. The seal has a small head, large body, and small, square fore-flippers, as well as a short snout with long, thick white whiskers, which give the species its name. The bearded seal is the largest species of arctic seal, measuring 2.1 to 2.4 m (7 to 8 ft) in standard length and weighing 260 to 360 kg (575 to 800 lbs). Bearded seal coats are dark brown or gray with dark rings and spots, and some individuals have rust-colored heads (Cameron et al., 2010). Their diet consists of mostly benthic organisms, but they have been known to prey upon schooling pelagic fish(75 FR 77496, 2010).

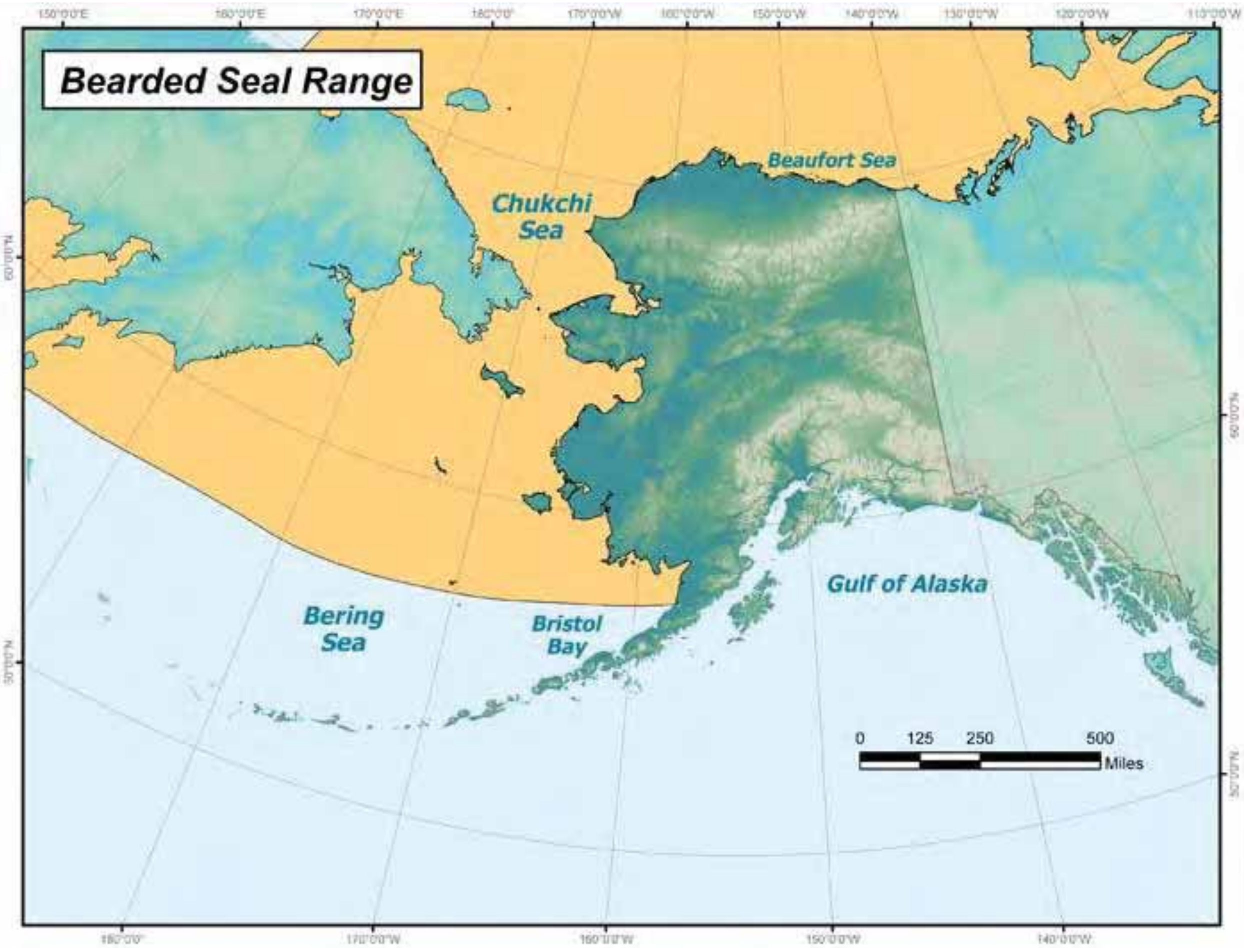
Bearded seal

There are two recognized subspecies of bearded seal: *E. b. barbatus,* which ranges across the Laptev Sea, Barents Sea, North Atlantic Ocean, and Hudson Bay, and *E. b. nauticus,* which ranges across the remaining portions of the Arctic Ocean and the Bering and Okhotsk Seas. The ranges of these two subspecies overlap generally along the northern Russian and Canadian coasts. Based on genetic and ecological data, *E. b. nauticus* is further divided into the Ohkotsk and Beringia DPSs (Cameron et al., 2010).

On 28 December 2012, NMFS issues a final determination to list the Beringia and Okhotsk DPSs of *E. b. nauticus* as threatened under the ESA (77 FR 76740, 2012). An earlier rule (75 FR 77496, 2010), determined that the listing *E. b. barbatus* was not warranted at that time. The IUCN has classified the bearded seal as a species of least concern because of its large population, broad distribution, variable feeding habits, and the fact that there is no evidence of a population decline (Kovacs and Lowry, 2008).

3.4.1.15.1 Distribution and critical habitat

Bearded seals generally inhabit shallow water (i.e., < 200 m [< 650 ft] deep) that is at least seasonally covered in ice. Their normal range extends from the Arctic Ocean (85°N) south to Sakhalin Island (45°N) in the Pacific and south to Hudson Bay (55°N) in the Atlantic. In winter, bearded seals are most commonly found in areas with broken pack ice (Burns, 1967; cited in Cameron et al., 2010) but also in areas with shorefast ice (Smith, 1980; cited in Cameron et al., 2010). The Alaska stock of bearded seals is distributed over the continental shelf of the Bering, Chukchi, and Beaufort Seas (Ognev, 1935; Johnson et al., 1966; Burns, 1981; all cited in Cameron et al., 2010) (Figure 3-23). NMFS will designate critical habitat for the Beringia DPS of bearded seal in a future rulemaking (77 FR 76740, 2012).



Source: ADF&G (2012a)

Figure 3-23. Bearded seal distribution

The region that includes the Bering and Chukchi Seas is the largest area of continuous habitat for bearded seals (Burns, 1981; Nelson et al., 1984; both cited in Cameron et al., 2010). These seas overlie a shallow intercontinental shelf that encompasses about half of the Bering Sea, spans the Bering Strait, and covers nearly all of the Chukchi Sea. Bearded seals can reach the sea bottom everywhere along the shallow shelf, so it provides them with favorable foraging habitat.

The seasonal movement and distribution of bearded seals are linked to seasonal changes in ice conditions; they migrate north in late spring and summer as the melting ice retreats and then move south in the fall, as sea ice re-forms in order to remain close to their preferred ice habitat (Johnson et al., 1966; Potelov, 1969; Burns, 1967, 1981; Burns and Frost, 1979; Fay, 1974; Heptner et al., 1976; Nelson, 1981; Simpkins et al., 2003; Frost et al., 2008; all cited in Cameron et al., 2010).

3.4.1.15.2 Population status

Early estimates of the Bering-Chukchi Seas population range from 250,000 to 300,000 animals (Popov, 1976; Burns, 1981; both cited in Cameron et al., 2010). Aerial surveys of territory from Shishmaref to Barrow, Alaska, conducted during the late spring to early summer (i.e., May and June) resulted in an average density of 0.07 seals / km^2 in 1999 and 0.14 seals / km^2 in 2000, with consistently high densities along the coast to the south of Kivalina, Alaska (Bengtson et al., 2005; Allen and Angliss, 2011). However, these densities cannot be used to develop an abundance estimate because no correction factor is available. There is no reliable population abundance estimate for the Alaska stock of bearded seals, and the population trend for the species is unknown (Allen and Angliss, 2011).

3.4.1.15.3 Habitat requirements

Bearded seals use a wide variety of ice types for pupping, molting, and resting and appear to be less particular about the type and quality of ice than are other ice seal species, although they do prefer low, "clean" floes with less dirt and fewer hummocks. Individuals rest near the edges of floes, within a few feet of and facing open water, their bodies lying perpendicular to the lead (Cameron et al., 2010). Bearded seals are less dependent on snow cover than are ringed seals and only occasionally construct snow lairs (Heptner et al., 1976; Smith, 1981; both cited in Cameron et al., 2010). Bearded seals also prefer ice habitat that is in constant motion, with natural gaps and openings in the ice, and generally avoid areas of thick shorefast ice, unbroken, drifting ice, and large areas of multi-year ice. Aerial surveys conducted in the vicinity of Saint Lawrence Island indicate that bearded seals select habitat with medium ice coverage (70 to 90% cover) and floes of varying sizes and avoid areas with heavy ice coverage (90 to 100% cover) and large floes. They appear to prefer the transitional habitat between small and large floes (Simpkins et al., 2003; cited in Cameron et al., 2010).

Because they are benthic feeders, bearded seals prefer shallow waters that allow them to reach foraging areas along the ocean floor, although adults have been recorded diving to depths greater than 300 m (1,000 ft) (Kovacs, 2002; Cameron and Boveng, 2007; both cited in Cameron et al., 2010).

3.4.1.15.4 Current stressors and threats

Current potential threats to the bearded seal include the destruction, modification, or curtailment of habitat or range due to global climate change, pollution, and / or contaminants; predation; diseases and parasites; stressors associated with oil and gas exploration; development and production; subsistence and illegal harvesting; and bycatch (e.g., commercial trawls).

Distribution

- Chukchi Sea
- Beaufort Sea
- Bering Sea

Habitats

- Nearshore
- Open water
- Sea ice

Vulnerabilities

- Habitat loss (ice)
- Exposure (contaminants, disease, parasites)
- Injury/death (poaching, subsistence harvest, predation, bycatch)

If suitable ice cover is absent from shallow feeding areas during times of peak whelping, nursing, or molting, bearded seals are forced to seek sea ice habitat over deeper waters, presumably with poor access to food, or coastal regions in the vicinity of onshore haulout sites, presumably with increased risks of disturbance, predation, and competition. Both scenarios require bearded seals to adapt to suboptimal conditions and exploit habitats to which they are not be well adapted, likely compromising their reproduction and survival rates.

Known predators of bearded seals include polar bears, orcas, brown bears, and man, although direct observations and data are limited (Cameron et al., 2010). Walruses have been known to eat bearded seals, and the Greenland shark is also a suspected predator.

Bearded seals have been harvested for subsistence by the native people of the Arctic coasts since the area was first occupied by humans. Estimates of the number of harvested animals vary considerably due to different survey methods, areas surveyed, and reporting. Based on the mean annual harvest reported from 1990 to 1998 and assuming that 25 to 50% of seals hunted are killed, Cameron et al. (2010) estimated that the total annual take by Alaska Natives (for the area along the coasts of the northern Bering, Chukchi, Eastern Siberian, and Beaufort Seas) would range from 8,485 to 10,182 bearded seals. Subsistence harvest levels are not closely monitored in Canada, but it is estimated that roughly 2,400 bearded seals are taken per year; and approximately 500 to 1,000 bearded seals are taken annually in Greenland.

The former Soviet Union historically had commercial harvests of bearded seals in the Sea of Okhotsk and the Bering, Chukchi, Barents, and White Seas. Harvest levels were at times high and grew from 9,000 in 1957 to 13,000 in 1964, and from 1964 to 1967, 8,000 to 10,000 individuals were harvested per year for the combined Bering and Okhotsk Seas (Reeves et al., 1992; cited in Kovacs and Lowry, 2008). Since then, the commercial harvest of bearded seals has ceased.

Relatively little is known about disease and the natural causes of mortality of bearded seals. Several bacterial diseases, including *Brucella abortushave*, are known to affect phocids. *Brucella* antibodies were found in 2% (1 out of 46) of the bearded seals tested

(Quakenbush et al., 2010a; cited in Cameron et al., 2010). *Morbillivirus* pathogens, such as phocid herpesvirus-1, phocid herpesvirus-2, PDV, and CDV, are also possible threats. Quakenbush et al. (2010a; cited in Cameron et al., 2010) found antibodies for only one of these viruses in bearded seals, and 29.5% (18 out of 61) of the bearded seals tested were positive for phocid herpesvirus-1.

3.4.2 Birds

This section presents information regarding six species of birds; source documents provide further detail. Protected species and the habitats that they use in Alaska are listed in Table 3-5.

Table 3-5. Distribution of bird species in Alaska by habitat type

Protected Species	Habitat							
	Terrestrial	Riverine/ Riparian	Lake/ Wetland/Bog	Shoreline	Tidal Marsh/ Delta	Nearshore[a]	Open Water	Sea Ice
Eskimo curlew	X	X		X			X	
Short-tailed albatross							X	
Spectacled eider				X	X	X	X	X[b]
Steller's eider					X	X	X	
Kittlitz's murrelet				X		X	X	
Yellow-billed loon		X	X			X	X	

[a] Nearshore = MLLW to 20 m deep or 100 m offshore, whichever is greater.
[b] Spectacled eider congregate in leads and polynyas in the ice during the winter.
MLLW – mean lower low water

3.4.2.1 Eskimo curlew

Eskimo curlew

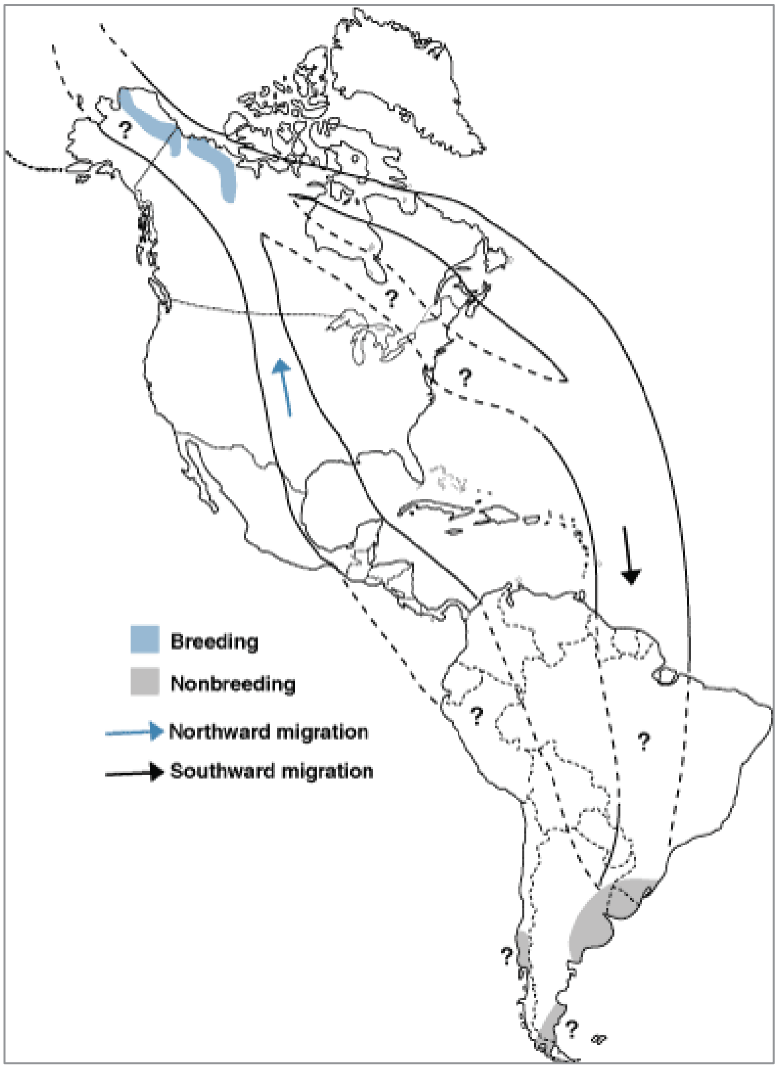
The Eskimo curlew (*Numenius borealis*) is a member of the sandpiper family, Scolopacidae. Eight curlew species are classified in this genus, three of which occur in the Western hemisphere (USFWS, 2011a). Eskimo curlews were not well studied before their decline, so very limited information exists on their biology.

The ESA lists the Eskimo curlew as endangered, the IUCN lists it as critically endangered (Birdlife International, 2009), and the Committee on the Status of

Endangered Wildlife in Canada listed it as endangered (COSEWIC, 2009). The last confirmed sighting occurred in 1962.

3.4.2.1.1 Distribution and critical habitat

Historically, the Eskimo curlew migrated annually (Figure 3-24) between breeding grounds in Arctic North America and wintering grounds in the Pampas of South America. Confirmed Eskimo curlew breeding grounds were located in the Arctic and Subarctic tundra of Canada's Northwest Territories but likely extended through adjacent similar habitats in Nunavut, Canada, and potentially as far as the northern foothills of Alaska's Brooks Range and Chukotka, Russia (Gill et al., 1998). Eskimo curlews moved into Labrador and eastern Canada to feed on berries after nesting. During fall migration, they crossed the western Atlantic to South America, where they wintered in the Pampas of Argentina, southern Brazil, Uruguay, and Chile. The spring Eskimo curlew migration brought them through North American prairies on their return to Arctic nesting grounds.



Source: Cornell Lab (2012)

Figure 3-24. Eskimo curlew breeding and non-breeding ranges and likely migration routes

There is no critical habitat listed for the Eskimo curlew. Critical habitat is not required for species listed under the ESA prior to 1978, and the Eskimo curlew was originally listed as endangered in 1967 under the Endangered Species Preservation Act (32 FR 4001, 1967).

3.4.2.1.2 Population status

Although the population of Eskimo curlews is believed to have numbered in the hundreds of thousands during the 1860s (Gill et al., 1998), a precipitous population decline from 1870 to 1890 led to their near extinction by 1900. The current population is estimated to comprise fewer than 50 individuals, and it is possible that they are now extinct (USFWS, 2011a; Elphick et al., 2010; Butchart et al., 2006). However, during its 5-year species review, USFWS did not deem it advisable to declare the species extinct because of potential sightings within the past decade, inadequate survey efforts throughout all potential habitat, and difficulty in distinguishing the Eskimo curlew from other whimbrels and curlews, which complicated the interpretation of sightings and lack of sightings (USFWS, 2011a).

The last confirmed sighting of an Eskimo curlew was in Texas in 1962, and an individual was harvested in Barbados in 1963. Numerous unconfirmed sightings have taken place since, the most recent in 2006 (COSEWIC, 2009). The rarity of potential sightings in recent decades indicates that if the species is indeed still extant, the population is very small.

3.4.2.1.3 Habitat requirements

Insects and berries, particularly crowberries (*Empetrum nigrum*), were the primary foods at the Eskimo curlew's breeding grounds. Gill et al. (1998) cited several sources, implying that Eskimo curlews could also have used vegetated and unvegetated intertidal habitats in western and northwestern Alaska. During the fall migration through eastern Canada, Eskimo curlews foraged for berries in heath-shrub upland habitats and invertebrates in intertidal habitats (Gill et al., 1998). Insects and other invertebrates are presumed to have been the main food source while wintering in the Pampas. During the spring migration, Eskimo curlews preferred burned and disturbed prairie habitats and agricultural fields, feeding on grasshopper egg cases and emerging nymphs (Gill et al., 1998). Local irruptions of the now extinct Rocky Mountain grasshopper are believed to have been an important food source for migrating Eskimo curlews (Gill et al., 1998).

3.4.2.1.4 Current stressors and threats

Eskimo curlew habitat within the Arctic breeding range is largely undisturbed; however, altered habitats necessary for other portions of the life cycle have likely impeded recovery of the population (2011a). The conversion of tall-grass prairie and eastern mixed-grass prairie into agricultural land during the late 1800s, combined with habitat alteration resulting from fire suppression, limits the amount of suitable habitat and key food sources during the spring migration. Conversion of South American wintering habitat to agricultural land also hindered recovery.

Distribution

- Likely extinct
- Arctic

Habitats

- Terrestrial (tundra)

Vulnerabilities

- Loss of habitat
- Disturbance

Market hunting is not a current threat to the species in North America, but sport and subsistence hunting of shorebirds still occurs in the Caribbean and Guyana (USFWS, 2011a).

It is not known whether Eskimo curlews are sensitive to disturbance. Efforts to view or study any extant birds could disturb individuals, potentially displacing them from preferred habitats or resulting in other physiological or reproductive consequences.

Due to the small size of any remaining population, investigator disturbance could result in population-level effects on the species (USFWS, 2011a).

3.4.2.2 Short-tailed albatross

Short-tailed albatross

The short-tailed albatross (*Phoebastria albatrus*) is the largest of the three North Pacific albatross species and has a body length of 84 to 94 cm (33 to 37 in.) and a wingspan of 213 to 229 cm (84 to 90 in.) (Harrison, 1985; cited in USFWS, 2008b). These pelagic birds are in the order Procellariiformes, or tube-nosed marine birds. Their bills are pink, with a bluish hooked tip, a black line around the base, and evident external nostrils (USFWS, 2008b). The bodies of adult short-tailed albatross are mostly white with dark brown wings and tails but their heads and napes turn yellow-gold after several years. Juveniles are dark brown or black but quickly develop pale legs and pink bills (Roberson, 1980; Tuck, 1978; both cited in USFWS, 2008b).

The short-tailed albatross was listed under the Endangered Species Conservation Act of 1969 prior to the passing of the ESA (35 FR 18319, 1970). At the time of listing, the species was accidentally not listed as endangered throughout its entire range. This error was resolved in 2000 to include the short-tailed albatross population in the United States (65 FR 46643, 2001).

3.4.2.2.1 Distribution and critical habitat

The pre-exploitation range of the short-tailed albatross spanned the North Pacific Ocean and Bering Sea (USFWS, 2008b). Since the 1940s, at-sea observations have indicated that short-tailed albatross are distributed throughout their historical foraging range in the temperate and subarctic North Pacific Ocean (Sanger, 1972; USFWS unpublished data; both cited in USFWS, 2008b), and sightings have occurred all along the west coast of North America and throughout the GOA, Aleutian Islands, and Bering Sea (McDermond and Morgan, 1993; Sherburne, 1993; USFWS unpublished data; all cited in USFWS, 2008b) to the Baja Peninsula, Mexico (Palmer, 1962; cited in USFWS, 2008b). They seldom occur north of St. Lawrence Island (approximately 63°N), and their southern limit likely corresponds with the northern edge of the North Equatorial Current (USFWS, 2008b).

All known successful North Pacific nesting areas for the short-tailed albatross are located exclusively in either Japan or Taiwan (USFWS, 2008b); thus, the birds are primarily present in Alaska waters only during the non-breeding season, from approximately May through November. Currently, the majority of breeding short-tailed albatross (80 to 85%) form a single colony on the southeast edge of the island of Torishima (an active volcano) in an area vulnerable to erosion and slides.

Figure 3-25 shows observations of short-tailed albatross overlapped with proposed the proposed dispersant preauthorization zone.

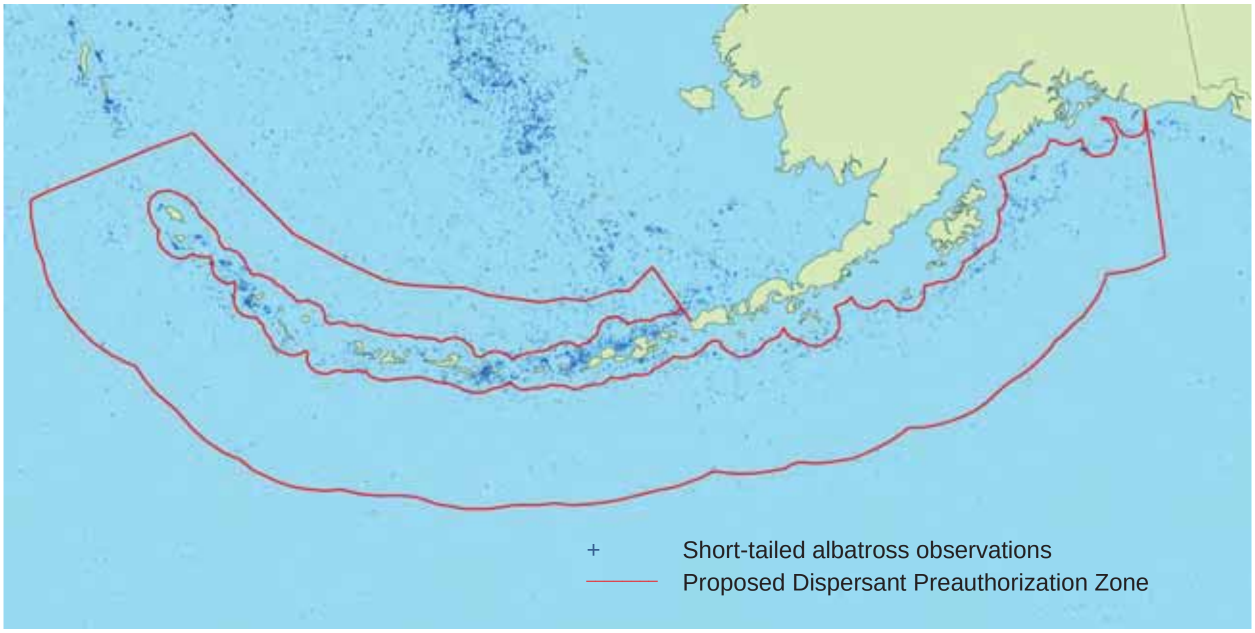


Figure 3-25. Distribution of short-tailed albatross compared with proposed dispersant preauthorization zone

From December through April, the short-tailed albatross remains concentrated near its breeding colonies, making foraging trips that can span hundreds of miles (Suryan, 2008; cited in USFWS, 2008b). In the spring, most birds begin to travel northward to the Aleutian Islands, Bering Sea, and GOA, although some portion of the population summers in the coastal waters of Japan and the Kuril Islands) (USFWS, 2008b). These temporal and spatial differences could be gender and age related; limited data suggest that females tend to spend more time offshore of Japan, the Kuril Islands, and the Kamchatka Peninsula, whereas males head northward sooner and spend more time in the Aleutian Islands and Bering Sea (Suryan et al., 2006; Suryan et al., 2007; both cited in USFWS, 2008b). In the summer, short-tailed albatross disperse widely throughout the temperate and subarctic North Pacific Ocean (Sanger, 1972; Suryan et al., 2007; both cited in USFWS, 2008b). Yearlings have been recorded migrating nearly twice as far per day as older albatross (Suryan et al., 2007; cited in USFWS, 2008b). Juvenile birds spend more time in the Bering Sea and GOA, which exposes them to fisheries activities (O'Connor, 2013; cited in USFWS, 2008b). In late September, large flocks of short-tailed albatross have been observed over Bering Sea canyons, the only known concentrations of the species besides their breeding colonies (Piatt et al., 2006; cited in USFWS, 2008b).

Critical habitat has not been designated for the short-tailed albatross. This designation was not made at the time of listing because threats to the species were not habitat related and specific areas that could meet the definition of critical habitat were lacking (65 FR 46643, 2001).

3.4.2.2.2 Population status

Over-exploitation of the Japanese breeding colonies, which primarily consisted of the slaughter of birds for their feathers, occurred in the early 20th century and continued until 1949, when there were no short-tailed albatross breeding at their known breeding sites, and the species was thought to be extinct (Austin, 1949; cited in USFWS, 2008b). The following year, 10 short-tailed albatross were observed on Torishima (Hasegawa, 2001; cited in USFWS, 2008b), and by 1954, there were 25 birds (Ono, 1955; cited in USFWS, 2008b). In 2007, an estimated 375 breeding pairs nested on Torishima (USFWS, 2008b), the result of an annual population growth of 6 to 8% (Hasegawa and DeGange, 1982; Cochrane and Starfield, 1999; both cited in USFWS, 2008b). The current worldwide estimate of the short-tailed albatross population is 3,100 individuals (Jacobs, 2012).

3.4.2.2.3 Habitat requirements

Short-tailed albatross do not breed in Alaska, so breeding habitat is not addressed in this BA. The birds are pelagic feeders, consuming squid (*Todarodes pacificus*), fish (including bonitos [*Sarda* sp.], flying fish [Exocoetidae], and sardines [Clupeidae]), flying fish eggs, shrimp, and other crustaceans (Hasegawa and DeGange, 1982; Tickell, 1975, 2000; all cited in USFWS, 2008b) during the winter months. They frequently scavenge on marine mammal carcasses and blubber from whaling vessels and offal from fisheries (USFWS, 2008b). Summer diets are not well documented but thought to be similar to winter diets. In the Bering Sea, their primary prey are squid (*Berryteuthis magister* and *Gonatopis borealis*) (Sinclair et al., 1999; cited in USFWS, 2008b), crustaceans, and fish. Short-tailed albatross forage extensively along the margins of the continental shelf (USFWS, 2008b), so the distribution of squid could be a factor for the short-tailed albatross's preference for the shelf break and slope regions of the western North Pacific Ocean and Bering Sea (Suryan et al., 2006; cited in USFWS, 2008b).

Short-tailed albatross adults and subadults feed in waters that are shallower than 1,000 m (3,280 ft) deep 70% of the time (Suryan et al., 2007; cited in USFWS, 2008b). The short-tailed albatross can be present in coastal areas but only in areas of upwelling; rather, it has been suggested that they rely most heavily on ocean upwelling areas along continental shelf-edge (even to the point of specialization), instead of a coastal or nearshore species (Piatt et al., 2006; cited in USFWS, 2008b). They are known to frequent the shelf breaks on the northern edge of the GOA, Aleutian Chain, and in the Bering Sea from the Alaska Peninsula to St. Matthew Island, which have been described as "greenbelts" of high chlorophyll concentrations and primary productivity (Springer et al., 1996; cited in USFWS, 2008b).

3.4.2.2.4 Current stressors and threats

Current known and potential threats to short-tailed albatross recovery include habitat loss or alteration due to catastrophic events, global climate change, ocean regime shifts, commercial fishing, contaminants and pollution, disease and parasites, predation, invasive species, and stochastic and genetic factors (USFWS, 2008b).

Distribution

- Aleutian Islands
- Bering Sea
- GOA

Habitats

- Open water

Vulnerabilities

- Habitat loss
- Exposure (contaminants, disease, parasites)
- Injury/death (bycatch, marine debris, predation)

A catastrophic event could result in habitat loss or alteration and the destruction of the albatross breeding grounds in Japan; volcanic eruption or monsoon rains are examples of two potentially devastating events. The primary nesting site for 80 to 85% of short-tailed albatross is on an active volcano on Torishima, on the actively eroding, fluvial plain of the caldera. The volcano is believed to be overdue for a major eruption, the last minor eruption having occurred in 2002. In the event of an eruption, lava flow, ash, and poisonous gas could fall upon the breeding colony. Monsoon rains have been known to create mudslides and wash ash over the breeding site, ruining nests and killing chicks (USFWS, 2008b).

As reported by Arctic Climate Impact Assessment (ACIA) (2005), global climate change has caused temperatures in the Arctic to rise at almost twice the rate of those in the rest of the world, with the potential for a myriad of effects on short-tailed albatross and their habitats. Warming Arctic waters could cause albatross prey to shift their distribution northward, resulting in the need for albatross to travel greater distances to reach their feeding grounds (USFWS, 2008b). Changes such as ocean regime shifts in atmospheric sea level pressure and upper ocean temperature structure are also occurring in the Pacific Ocean. These shifts result in changes in wind patterns, ocean circulation, salinity, and depth of the thermocline and thus alter phytoplankton and zooplankton productivity. At this time, it is unknown whether ocean regime shifts positively or negatively affect short-tailed albatross.

Bycatch associated with commercial fishing is a potential threat to short-tailed albatross, but current mortality rates do not appear to be accelerating a population decline. Since 1988, 12 instances of short-tailed albatross being taken by commercial fishers have been reported (Jacobs, 2012), but this number is assumed to be a substantial underestimate of the worldwide take (USFWS, 2008b).

Contaminants such as PCBs, pesticides, and toxic metals (e.g., mercury, lead) could alter albatross growth and development (Berger, 1972; cited in USFWS, 2008b). In addition, oil contamination could:

- Compromise thermoregulation through the fouling of feathers
- Cause direct toxicity through ingestion (e.g., during preening)

- Contaminate food resources
- Reduce prey availability (as a result of toxic effects on prey species)
- Cause embryotoxic effects

Plastic debris in the ocean is frequently consumed by most, if not all, species of albatross. In December 2004, bottle caps and disposable lighters were the plastic items most commonly found in the Midway albatross colony (USFWS, 2008b). Plastic can also be a direct source of toxic contaminants, cause internal injury upon ingestion, and suppress the bird's immune system (Auman et al., 1997; cited in USFWS, 2008b).

The fact that the population of the short-tailed albatross is already small makes these birds more susceptible to impacts from disease, parasites, or both. Neither of the populations on Torishima and Senkaku Islands are currently infected with known diseases, but there is potential for infection associated with avian influenza, West Nile virus, and funguses or bacteria (USFWS, 2008b).

Predation is one of the greatest potential threats to the short-tailed albatross. The breeding population could potentially be decimated by feral animals, crows, or rats (USFWS, 2008b). Only rats currently inhabit the island of Torishima (Atkinson, 1985; cited in USFWS, 2008b), although there is no documented predation on short-tailed albatross chicks or eggs by rats on the island. Sharks prey on other albatross species, and although it has not been documented, might also prey on short-tailed albatross.

Invasive vegetation could also have negative effects on the short-tailed albatross population. Shrubs, for example, could limit or destroy suitable nesting habitat. Invasive plants are not currently a problem on Torishima, but the potential for introduction continues as long as humans continue to visit the island (USFWS, 2008b).

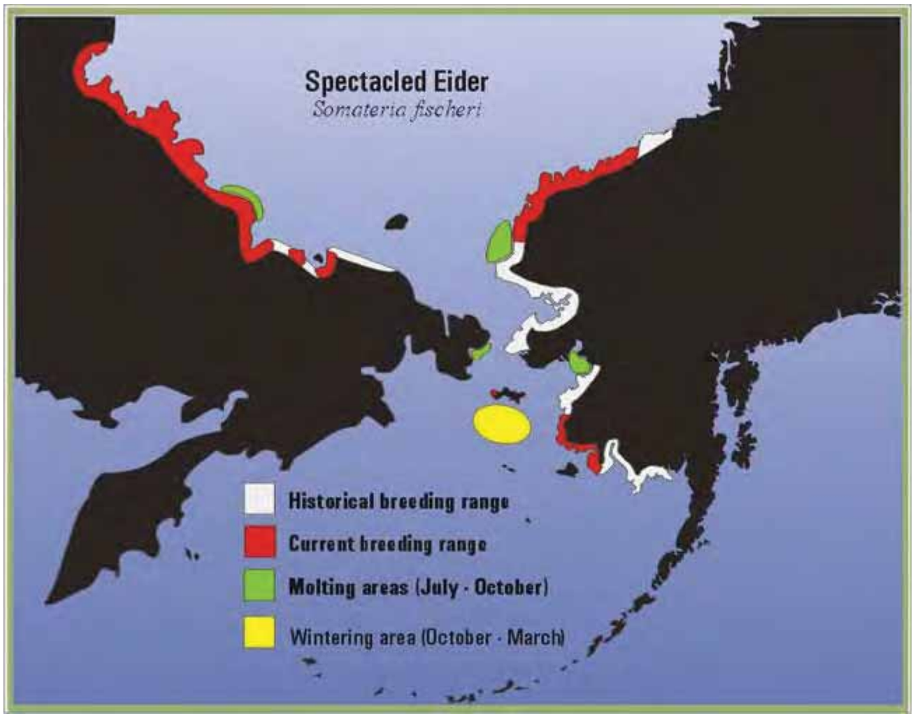
Stochastic events, both demographic and environmental, have great potential to harm the short-tailed albatross population (USFWS, 2008b). The effects of a genetic bottleneck, including inbreeding and genetic drift, are potential limitations to recovery.

3.4.2.3 Spectacled eider

The spectacled eider (*Somateria fischeri*) is a large-bodied sea duck and one of three eiders in the genus *Somateria,* which also includes the king eider and common eider. Three breeding populations of spectacled eider are recognized within the coastal Arctic and Subarctic regions: one in Russia and two in Alaska (Figure 3-26). Of the two Alaska breeding populations, one is on the North Slope and the other is on the Yukon-Kuskokwim Delta (Y-K Delta) of western Alaska (Petersen et al., 2000). The USFWS listed the spectacled eider as threatened under the ESA in 1993, primarily due

Spectacled eider

to the rapid decline in the Y-K Delta breeding population, as well as indications of possible decline on the North Slope.



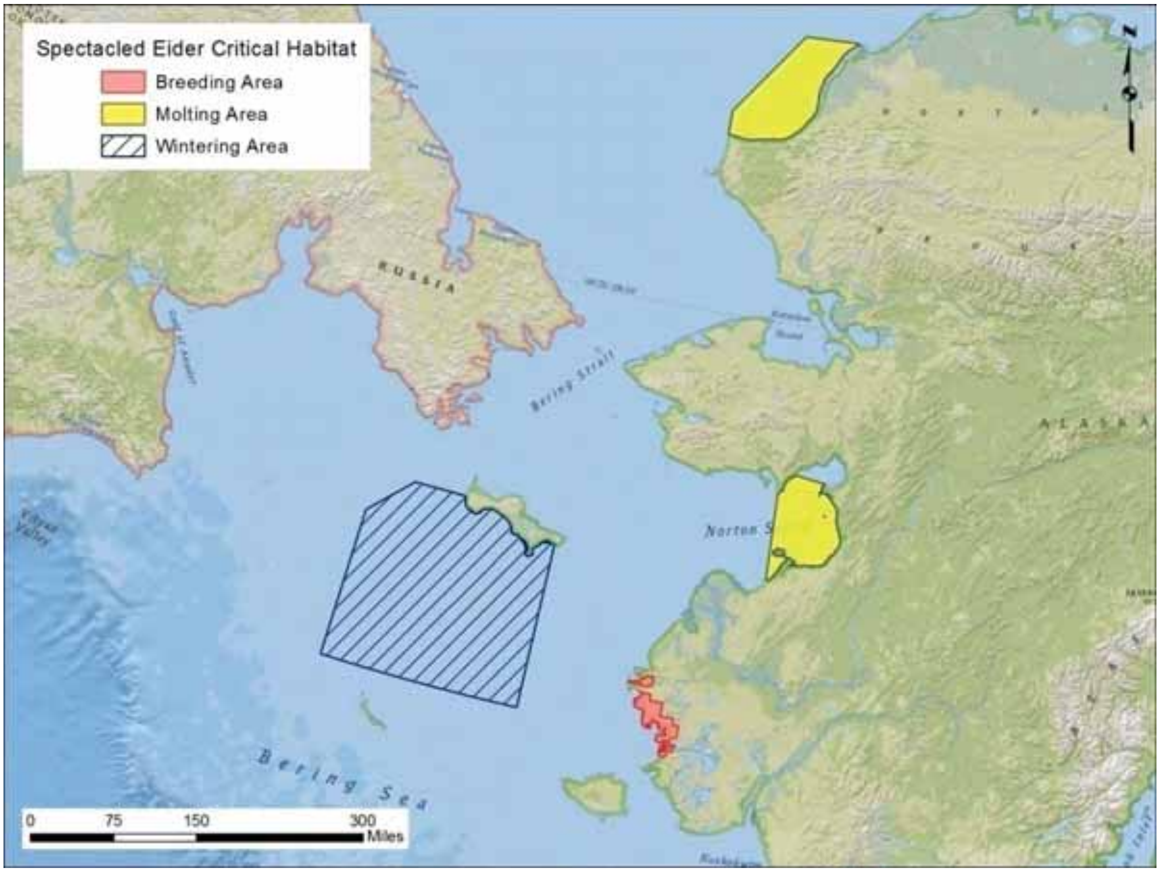
Source: USFWS (2011d)

Figure 3-26. Historical and current breeding ranges of the spectacled eider in Alaska and Russia

All three breeding populations in both Alaska and Russia were included in the ESA listing. The spectacled eider recovery plan was completed in 1996 (USFWS, 1996).

3.4.2.3.1 Distribution and critical habitat

The USFWS-designated critical habitat (Figure 3-27) for the spectacled eider includes five different areas (or units): two in the Y–K Delta, one in Norton Sound, one in Ledyard Bay, and one in the Bering Sea between St. and St. Matthew Islands. The total geographic area associated with these five units is approximately 10,098,827 ha (100,988.3 km^2; 38,991.6 mi^2) (66 FR 9146, 2001).



Data source: USFWS (66 FR 9146, 2001)

Figure 3-27. Spectacled eider critical habitat

The PCEs of spectacled eider critical habitat (66 FR 9146, 2001) vary by geographic area and season. The Y–K Delta units are important breeding areas; PCEs include vegetated intertidal habitat and all open water in the intertidal zone. PCEs for the Norton Sound and the Ledyard Bay, where eiders aggregate during molting, include all marine waters between 5 m (16.4 ft) and 25 m (82.0 ft) in depth, along with associated marine aquatic flora and fauna in the water column and the underlying marine benthic community. PCEs for critical habitat for over-wintering include all marine waters that are 75 m (246.1 ft) or less in depth, along with associated marine aquatic flora and fauna in the water column and the underlying marine benthic community.

Several studies (USFWS, 1996) indicate that in Alaska, the historical spectacled eider breeding/nesting distribution extended (discontinuously) from the Nushagak Peninsula of southwestern Alaska north to Barrow, Alaska, and from near the Canadian border in the east to Saint Lawrence Island in western Alaska. The spectacled eider currently breeds almost exclusively on the North Slope (Larned and Balogh, 1997; cited in USFWS, 1996) and in the Y-K Delta (Stehn et al., 1993; cited in USFWS, 1996) in late spring and summer.

The molting, wintering, and migration staging locations of spectacled eiders were not well understood until a 1995 study, during which transmitters were placed on individual birds and they were tracked using aerial telemetry (Petersen et al., 1999). This study identified two principal molting (late summer / fall) and migration (early spring) staging areas: eastern Norton Sound, north of the Y-K Delta; and Ledyard Bay on the North Slope. Currently, the only known wintering area for the spectacled eider is an area between St. Lawrence and St. Mathews Islands, where dense flocks consisting of all three breeding populations (i.e., North Slope, Y-K Delta and Russian) congregate between October and March in holes in the nearly continuous pack ice (Petersen et al., 1999).

3.4.2.3.2 Population status

In 1993, USFWS estimated that the number of spectacled eider nesting pairs in the Y-K Delta had declined from 47,740 in the early 1970s to 1,721 by 1992, a 96% drop (Stehn et al., 1993). Surveys from 1992 to 1995 (USFWS, 1996) indicated that the Y-K Delta breeding population might have stabilized, and as of the 2001 USFWS critical habitat designation (66 FR 9146, 2001), the Y-K Delta breeding population was estimated to be between 3,500 and 4,000 breeding pairs (66 FR 9146, 2001).

USFWS (Larned and Balogh, 1997) conducted aerial surveys on the North Slope in the early 1990s and estimated the yearly breeding population of spectacled eiders to be between 7,000 and 9,000 individuals. USFWS surveys documented an average decline of approximately 2.6% per year on the North Slope throughout the 1990s (66 FR 9146, 2001). Although this decline was not determined to be statistically significant, scientists suspect that the North Slope breeding population is in slow decline (USFWS, 2011d). As of 2001, the North Slope breeding population was estimated to be approximately 5,000 breeding pairs. The breeding area on the North Slope is much larger than that in the Y-K Delta, resulting in much lower nesting pair densities (USFWS, 1996; 66 FR 9146, 2001).

Estimates from late winter / early spring surveys indicate that 333,000 (Petersen et al., 1999) to nearly 375,000 (Petersen et al., 1999; 66 FR 9146, 2001) spectacled eiders from all three breeding populations winter in open water areas of the pack ice in the Bering Sea between St. Lawrence and St. Mathews Islands. Because this location is the only known wintering area for spectacled eiders, these numbers are thought to potentially represent the worldwide population of the species (Petersen et al., 1999; 66 FR 9146, 2001). USFWS did note that dense sea ice and high winds in the wintering habitat might account for the greatest variability regarding inter-annual breeding population changes in Alaska.

3.4.2.3.3 Habitat requirements

Studies of spectacled eider habitat requirements were reviewed in the critical habitat designation (66 FR 9146, 2001). The spectacled eider is a diving duck that spends most of its life in the marine environment, feeding on benthic mollusks and crustaceans (Dau, 1974). In the Y-K Delta, spectacled eiders breed within 15 km (9.3 mi) of the coast and nest adjacent to small water bodies located within the vegetated intertidal zone in areas dominated by low, wet sedge and grass marshes (66 FR 9146, 2001). On the North Slope, spectacled eiders breed within 80 km (43 mi) of the coast and nest on the shores of shallow lakes or small islands characterized by emergent vegetation (Larned and Balogh, 1997; Anderson et al., 1998; both cited in 66 FR 9146, 2001). Spectacled eiders typically incubate 3 to 6 eggs for 20 to 25 days in early summer (USFWS, 1996). In breeding areas, adults and young feed mostly on mollusks and aquatic insect larva and plants in shallow ponds and flooded tundra (Dau, 1974).

Spectacled eiders spend 8 to 10 months of the year (during non-breeding / non-rearing seasons) in marine environments (Petersen et al., 1999), but little is known about their feeding habits at sea. Mollusks, amphipods, and crabs have been found in spectacled eiders taken by subsistence hunters. USFWS (Petersen et al., 1999) studied the migration corridors, molting areas, migration staging areas, and wintering areas of spectacled eiders and found that the species spends the molting period and migration staging periods in shallow waters that are usually less than 36 m ([120 ft) deep. The Y-K Delta breeding population molts and stages in eastern Norton Sound, while the North Slope breeding population spends molting and staging periods in Ledyard Bay. The only identified wintering habitat consists of holes in the pack ice between St. Lawrence and St. Mathews Islands, where flocks congregate from October through March in waters as deep as 65 m (213 ft) (Petersen et al., 1999).

3.4.2.3.4 Current stressors and threats

Suspected stressors and threats to spectacled eiders recovery include the ingestion of spent lead shot in the Y-K Delta; changes in their marine food supply; the predation of eider eggs and young by owls, foxes, jaegers, and gulls; and subsistence hunting. Although subsistence hunting is not thought to have caused a decline in the spectacled eider population, it is thought to be potentially inhibiting recovery (66 FR 9146, 2001; USFWS, 1996). Since 1991, spectacled eiders have not been legally hunted for subsistence (ADF&G, 2012f). Lead poisoning from spent lead shot has been confirmed in the Y-K Delta breeding population but has not been confirmed in the North Slope breeding population. Commercial fishing was previously thought to be a potential stressor but has not been demonstrated to be affecting the survival of spectacled eiders (66 FR 9146, 2001).

Distribution

- Beaufort Sea
- Bering Sea
- Arctic coastal plain
- Y-K Delta

Habitats

- Open water
- Nearshore
- Wetland/lakes/tundra
- Leads/polynyas in ice (winter only)

Vulnerabilities

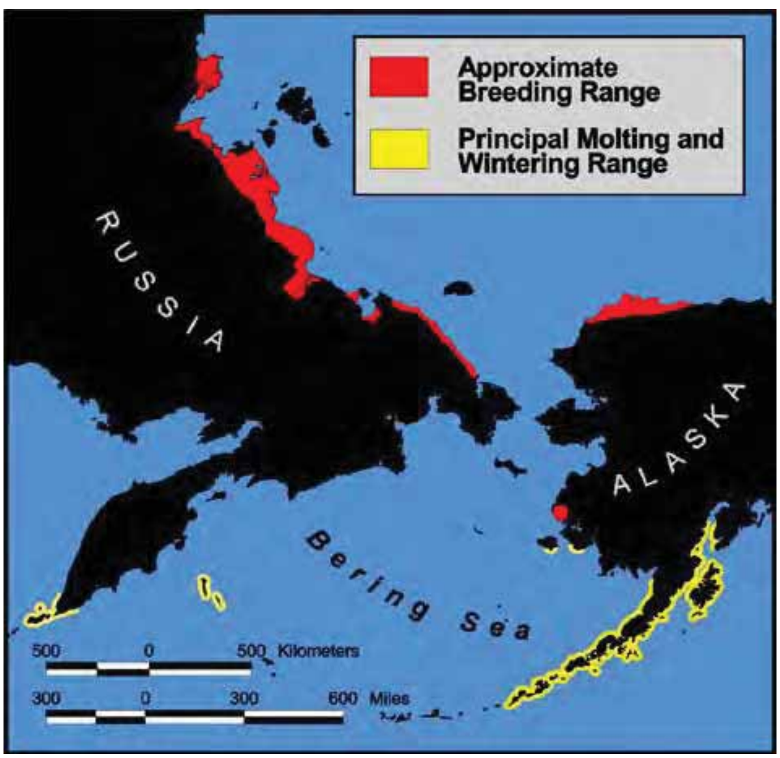
- Injury/death (hunting, predation, bycatch)
- Exposure (contaminants)
- Reduced prey base

3.4.2.4 Steller's eider

Steller's eider

The Steller's eider (*Polysticta stelleri*) is a sea duck and is the smallest of the four eider species. Both males and females are approximately 45 cm (17.7 in.) long and weigh about 800 g (1.8 lbs). Three breeding populations of Steller's eiders are recognized within the coastal Arctic region: two in Russia (Pacific and Atlantic) and one in Alaska (Figure 3-28). The Steller's eider was the first species petitioned for endangered status under the ESA in 1990, but it was determined that only the Alaska breeding population merited listing (66 FR 8850, 2001; USFWS, 2002), inasmuch as the Alaska breeding population had all but disappeared from its historical range within the Y-K Delta.

The Alaska breeding population of Steller's eiders was officially listed as threatened in 1997, and the recovery plan was completed in 2002 (USFWS, 2002).



Source: USFWS (2002).

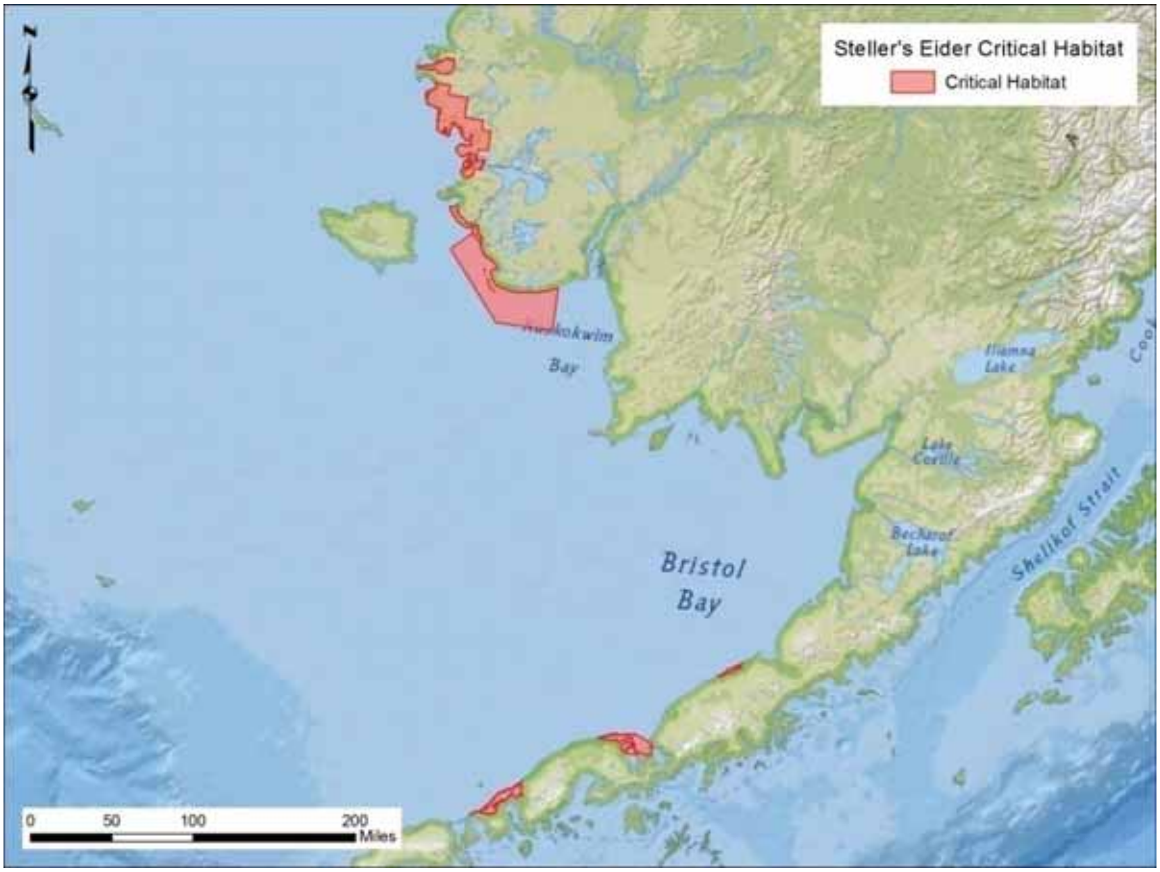
Figure 3-28. Breeding and molting/wintering ranges of the Steller's eider in Alaska and Russia

3.4.2.4.1 Distribution and critical habitat

The historical distribution of the Alaska breeding population of Steller's eiders is not clear. Based on anecdotal evidence and the journals of Alaska naturalists (e.g., Murie, 1924; cited in USFWS, 2002) from the early 20th century, biologists generally agree that the current range of the Alaska breeding population of Steller's eider is significantly contracted (66 FR 8850, 2001; USFWS, 2002). The Alaska breeding population currently exists in two regions of Alaska. The majority of the population is found on the Arctic coastal plain of northern Alaska, from approximately Point Lay east to Prudhoe Bay, usually within 80 km (50 mi) of the ocean, with breeding activity concentrated around Barrow, Alaska (USFWS, 2002). A small subpopulation also nests and winters in the Y-K Delta of western Alaska (66 FR 8850, 2001).

Studies have also confirmed that molting occurs primarily in four areas along the northern shores of the Alaska Peninsula: Izembek Lagoon, Nelson Lagoon, Port Heiden, and the Seal Islands (Gill et al., 1981; Petersen, 1981; Metzner, 1993; all cited in USFWS, 2002). The Alaska breeding population winters on coastal Kodiak Island and the Aleutian Islands, as far east as western Cook Inlet.

The USFWS-designated critical habitat for the Alaska breeding population of the Steller's eider includes "breeding habitat on the Y-K Delta and four units in the marine waters of southwest Alaska, including the Kuskokwim Shoals in northern Kuskokwim Bay, and Seal Islands, Nelson Lagoon, and Izembek Lagoon on the north side of the Alaska Peninsula"(66 FR 8850, 2001). Kuskokwim Shoals and Seal Islands are important habitat during both molting and spring staging; Nelson and Izembek Lagoons are used during molting and spring staging and often as wintering habitat. Collectively, critical habitat areas total approximately 7,333 km^2 (2,830 mi^2) and 1,363 km (852 mi) of shoreline (Figure 3-29).



Data source: USFWS (66 FR 9146, 2001)

Figure 3-29. Steller's eider critical habitat

The PCEs for breeding habitat within the Kuskokwim Delta include the vegetated intertidal zone and all open water within the zone. The PCEs for Kuskokwim Shoals, Seal Islands, Nelson Lagoon, and Izembek Lagoon are defined as the marine waters up to 9 m (30 ft) deep and the underlying substrate, the associated water column invertebrate fauna, the underlying marine benthic community, and eelgrass beds and associated flora and fauna, where present.

3.4.2.4.2 Population status

It is difficult to determine the trends with regard to the Steller's eider Alaska breeding population, but biologists agree that the species has disappeared from most of its historical breeding range within Alaska. Estimates of the northern Alaska breeding population on the Arctic coastal plain made based on aircraft aerial surveys vary widely. Between 1989 and 2000, USFWS estimates ranged from 175 to 2,500 breeding pairs (Mallek, 2002; cited in USFWS, 2002). Although aerial surveys are considered to be the best method for estimating the Steller's eider population, they likely underestimate the actual population size. However, biologists are confident that the number of breeding pairs ranges from the hundreds to the low thousands for the northern Alaska population. Because of their lack of specificity, aerial population estimates have not been used to determine a significant upward, stable, or downward trend in the northern Alaska breeding population since the time of ESA listing (USFWS, 2002).

In the 1920s, the Y-K Delta of western Alaska, was considered to be a common breeding site for the Steller's eider (Murie, 1924; cited in USFWS, 2002). However, in surveys conducted between 1975 and 1991, no nests were documented in the Y-K Delta (Kertel, 1991; cited in USFWS, 2002) and 1991 and 1993 (Flint and Herzog, 1999). Flint and Herzog (1999) reported only six nesting pairs between 1994 and 1998. Steller's eider nests have not been documented at any other locations in western Alaska (USFWS, 2002).

Although the Alaska breeding population is clearly limited in number and merits ESA listing, Steller's eiders are abundant in southwestern Alaska during the molting, wintering, and winter and spring migration staging periods (Petersen, 1981; Metzner, 1993; both cited in USFWS, 2002). Studies reviewed by USFWS (66 FR 8850, 2001) that had conducted counts of wintering Steller's eiders estimated the population at 138,000 birds in southwest Alaska. Biologists attribute the high numbers during these times to the intermixing of the Alaska breeding population with the more numerous (and indistinguishable) Russian (Pacific) population (66 FR 8850, 2001).

3.4.2.4.3 Habitat requirements

Quakenbush et al. (2004) studied Steller's eider breeding biology on the Arctic coastal plain near Barrow, Alaska, from June through September from 1991 to 1999. The study found that Steller's eiders nest on tundra next to small ponds, on the rims of low-centered polygonal ground, or in drained lake basins and that they incubate 1 to 8 eggs for about 24 days. These eiders nest either directly on the coast or up to approximately 80 km (50 mi) inland (USFWS, 2002). After hatching in late June, ducklings spend about 40 days in adjacent wetlands, feeding on aquatic insects and plants (Obritschkewitsch et al., 2001; cited in USFWS, 2002).

Steller's eiders molt in coastal marine waters, completely replacing their flight feathers and rendering them flightless for about 3 weeks. The molting period for the population lasts from about late July to late October (Petersen, 1981; cited in USFWS, 2002). During molting, Steller's eiders feed on mollusks and crustaceans in extensive shallows characterized by eelgrass beds, intertidal sand flats, and mudflats. Wintering usually occurs in coastal waters less than 10 m deep and within 400 m of the shore, unless the shallows extend farther offshore.

3.4.2.4.4 Current stressors and threats

Stressors and threats to Steller's eiders are poorly understood but are thought to include predation, hunting and other human disturbances (especially near Barrow, Alaska), the ingestion of spent lead shot, and trophic disturbances in the coastal environment that impact food sources. Exposure to oil and contaminants associated with fish processing plants in southwest Alaska, have also been cited as potential threats. USFWS has identified and prioritized specific tasks to be completed to aid in the recovery of the Alaska breeding population of Steller's eider (USFWS, 2007b).

Distribution

- Bering Sea
- Alaska Peninsula
- Aleutian Islands
- Kodiak Island
- Cook Inlet
- Arctic coastal plain
- Y-K Delta

Habitats

- Open water
- Nearshore
- Wetland/lakes/tundra

Vulnerabilities

- Disturbance
- Exposure (contaminants)
- Injury/death (hunting, predation, bycatch)
- Reduced prey base

3.4.2.5 Kittlitz's murrelet

Kittlitz's murrelet

The Kittlitz's murrelet (*Bracyramphus brevirostris*) belongs to the family Alcidae (USFWS, 2011c). *Brachyramphus* murrelets are unique in the Alcidae family in that they are not colonial but solitary nesters (USFWS, 2011c). The Kittlitz's murrelet has been nicknamed the "Glacier murrelet," because it nests in rugged mountains near glaciers or on previously glaciated sites (USFWS, 2006). The species closely resembles the marbled murrelet (*B. marmoratus*), and both species are distributed throughout the same regions of Alaska (USFWS, 2006), making it difficult to correctly identify the Kittlitz's murrelet. According to Pitocchelli et al. (1995; cited in USFWS, 2011c) and Kuletz et al. (2008), Kittlitz's murrelets are heavier and have larger heads, longer wings and tails, and smaller bills than do marbled murrelets (USFWS, 2011c).

In 2004, USFWS listed the species as a candidate for protection (69 FR 24876, 2004; USFWS, 2006, 2012b). However, in its 12-month finding on the petition to list the Kittlitz's murrelet, published on 3 October 2013, USFWS determined that listing the species is not currently warranted (78 FR 61764, 2013). This listing determination was published during finalization of the BA. Therefore, the species has been retained in the BA, but an effects determination has not been made because listing under the ESA is not imminent.

3.4.2.5.1 Distribution and critical habitat

The distribution of the Kittlitz's murrelet is restricted to Alaska, northeastern Siberia, and the Sea of Okhotsk, with the majority of birds found in Alaska (van Vliet, 1993; cited in Agler et al., 1998). During the breeding season, the range of the Kittlitz's murrelet along the Alaska coast is discontinuous. Population centers are known to exist on "the south side of the Alaska Peninsula, PWS, Lower Cook Inlet and Kenai Fjords, Icy Bay, Yakutat Bay and the Malaspina Forelands, and Glacier Bay" (USFWS, 2006). Nests have also been found on the Seward Peninsula and likely can be found as far north as the Cape Lisburne area (Day et al., 2011). Distribution in winter, the non-breeding season, is less well-known (Day et al., 2011). There have been sightings in southeastern and western Alaska, a few locations in south-coastal Alaska, and the mid-shelf regions of the northern GOA (USFWS, 2006). Leads and polynyas southwest of St. Lawrence Island, east of the Pribilof Islands, and southeast of St. Matthew Island could also be important wintering areas for the Kittlitz's murrelet (Kuletz and Lang, 2010; cited in USFWS, 2011c). They also winter in Russia and have been observed on the Kamchatka Peninsula and Kuril Islands and in the Sireniki polynya of southern Chukotka (Flint et al., 1984; cited in USFWS, 2011c). The annual movements of these birds in Russia, the Aleutian Islands, and northern Alaska are not well-known (USFWS, 2011c). Some individuals have been observed in typical wintering areas year-round, suggesting that they are residents (USFWS, 2011c). The Kittlitz's murrelet has not been listed under the ESA; therefore, no critical habitat has been designated.

3.4.2.5.2 Population status

Accurately estimating Alaska's population of Kittlitz's murrelet is difficult due to the species' large range and solitary nesting habits. However, by combining local population estimates across the Kittlitz's murrelet's range, USFWS estimates the population to be 33,583 birds (78 FR 61764, 2013). Estimates further suggest that although the species' abundance declined between 1989 and 2000, the population appears to have either stabilized or is in a slow (< 2% annually) decline (78 FR 61764, 2013).

3.4.2.5.3 Habitat Requirements

In the summer, Kittlitz's murrelets use the glacier tidewaters, outflow streams, and icebergs for feeding (USFWS, 2006); they prey on schooling fish, such as Pacific capelin (*Mallotus villosus*), Pacific sand lance (*Ammodytes hexapterus*), juvenile Pacific herring (*Clupea pallasi*), and juvenile walleye pollock (*Theragra chalcogramma*) (Day et al., 1999). These fish are thought to be preferred prey because of their high fat content (van Pelt et al., 1997; Litzow et al., 2004; both cited in USFWS, 2011c). Kittlitz's murrelets likely switch prey based on seasonal availability. They are considered to be primarily piscivorous but have also been observed to consume euphausiids (Hobson et al., 1994; cited in USFWS, 2011c).

Kittlitz's murrelets use camouflage and secretive behavior to avoid predation (USFWS, 2006); because they are solitary nesters, they cannot rely on a colony's numbers to lessen the risk of predation. A study in the Aleutian Islands concluded that Kittlitz's murrelets tend to nest in areas with a ground cover of orange crustose lichens, bare ground, small rocks, and grasses, in general selecting nesting sites with local microhabitat features that aid in camouflaging the eggs, nestlings, and adults (Kaler et al., 2009). The Kittlitz's murrelet nests in alpine terrain (van Pelt and Piatt, 2003) and requires sites that are near glaciers or were previously glaciated, which can be up to 73 km (45 mi) inland (USFWS, 2006). They are known to nest on stable, unvegetated scree slopes, or more rarely, on small crevices in cliff faces, especially when these sites are near the coast (Day et al., 1999). Such nesting sites are probably preferred because they are generally free of predators (Piatt et al., 1999; cited in USFWS, 2011c).

Until recently, as few as 17 Kittlitz's murrelet nests had been confirmed in northern Alaska. However, recent research has documented 234 Kittlitz's murrelet nests in Alaska, scattered among Agattu Island, Adak Island, Kodiak Island, and glaciated areas around Icy Bay (78 FR 61764, 2013). A greater understanding of nesting habitat preferences is, therefore, becoming available. Most nests were found on low-elevation (< 700 m) (Day et al., 2011) slopes of 15 to 30°, approximately 0.25 to 75 km (0.2 to 46.6 mi) from the coastline. Plant cover around the nests was minimal (ranging from 0 to 50%), and all nests were found in areas of barren land (i.e., bare rocks) or mixed dwarf shrub habitat (i.e., rocks mixed with spare, prostrate vegetation). Nest site suitability also depends on factors such as local climate, geomorphology, substrate, unobstructed view of the ocean, and elevation (Day, 1995; Kaler et al., 2009; Kaler et al., 2011; Lawonn et al., 2009; all cited in USFWS, 2011c).

A single Kittlitz's murrelet egg is laid by a breeding pair between mid-May and mid-July and is incubated by both parents (USFWS, 2011c). Incubation duration is approximately 30 days, and the parents feed the chick for 3 to 4 weeks before it fledges (USFWS, 2011c).

Habitat requirements in the winter are not well-known. It is thought that open ice leads and polynyas are important because they yield more abundant prey.

3.4.2.5.4 Current stressors and threats

The causes of the Kittlitz's murrelet population decline have not been determined conclusively (USFWS, 2006). Possible threats and stressors to the recovery of Kittlitz's murrelet include its slow reproductive rate, fisheries interactions, oil spills and pollution, other factors altering the type and abundance of prey, and human disturbances (USFWS, 2006, 2011c).

Distribution

- Alaska Peninsula
- Aleutian Islands
- Glacier Bay
- Kenai Peninsula
- Kodiak Island
- Point Lay
- PWS
- Seward Peninsula
- Yakutat Bay
- Southeast Alaska

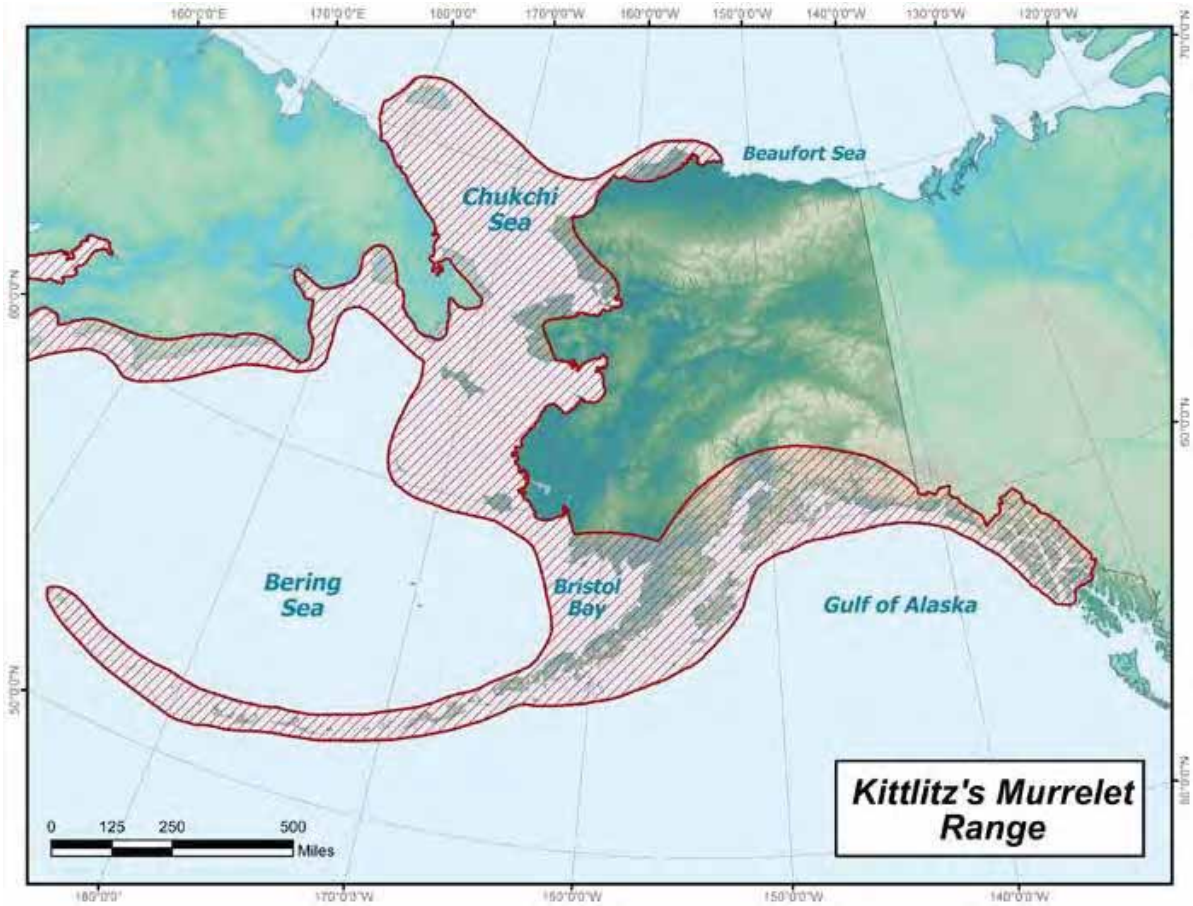
Habitats

- Terrestrial (near glaciers)
- Nearshore (near glaciers)
- Open water
- Sea ice (edges, polynyas, leads)

Vulnerabilities

- Disturbance
- Exposure (contaminants, disease)
- Habitat loss
- Injury/death (bycatch)
- Reduced prey base

The life history and behavior of the Kittlitz's murrelet do not provide an easy road to recovery. It is a relatively long-lived (approximately 15 years) species with a low rate of reproduction, laying a single egg per breeding season (USFWS, 2011c). Cliff nest locations are dangerous for chicks, such that if a chick falls from the nest, death is certain. If a parent dies, the chick is nearly guaranteed to die as well, either from starvation or heat loss. Furthermore, a recent study (USFWS, 2011c) reported that large numbers of Kittlitz's murrelet eggs were not viable: 6 out of 34 eggs in nests on Kodiak, 9 out of 66 eggs in nests at Agattu, and 1 out of 10 eggs in nests at Icy Bay did not hatch. No reason is known for these non-viable eggs. Figure 3-30 shows the range of the Kittlitz's murrelet in Alaska (Day et al., 1999; USFWS, 2006).



Source: ADF&G (2012b)

Figure 3-30. Kittlitz's murrelet range in Alaska

Kittlitz's murrelets are coastal divers and thus are often caught and drowned in gillnets, which has been documented in south coastal Alaska (e.g., PWS) (USFWS, 2006). In 1991, it was estimated that in PWS, 133 Kittlitz's murrelets were caught and killed in set nets (Wynne et al., 1992; cited in USFWS, 2011c).

Oil spills have also caused the mortality of Kittlitz's murrelets. After the Exxon Valdez spill, 72 carcasses were positively identified as Kittliz's murrelet (USFWS, 2006). Five hundred birds were estimated to have died as a result of the oil spill, a significant portion of the current world population (USFWS, 2006). With increasing vessel traffic in the Kittlitz's murrelet's habitat, there is greater risk of harm from oil spills. From 1995 to 2005, more than 271,700 gal. of petroleum (primarily diesel) were released in Alaska's waters as a result of spills, with 90% of these spills occurring within the Kittlitz's murrelet's range (ADEC unpublished data, cited in USFWS, 2011c).

A changing climate and ocean regime shifts are altering the habitat and prey of the Kittlitz's murrelet. However, because so little is known about the species, it is unclear how receding glaciers and prey shifts will affect their survival (USFWS, 2011c).

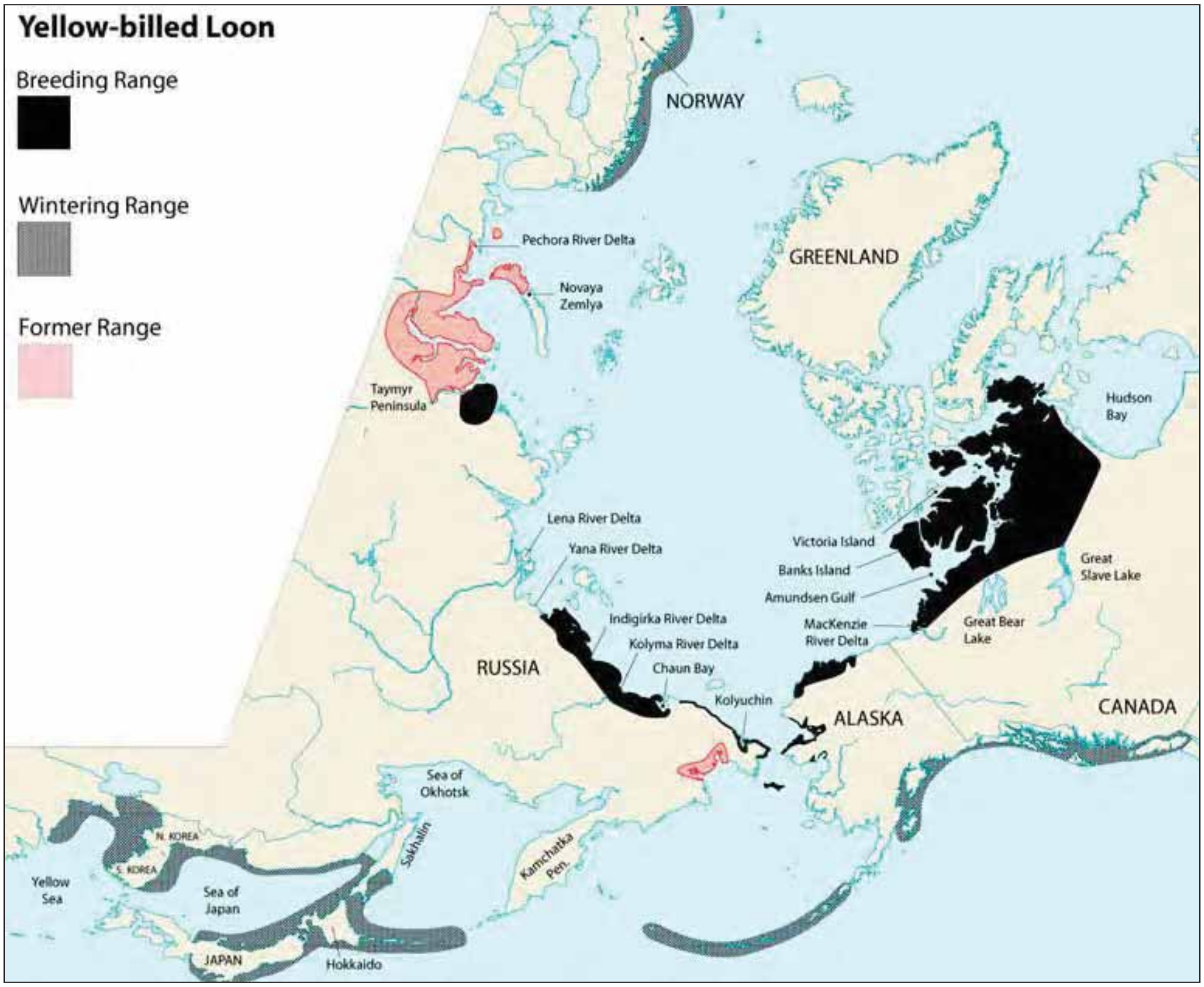
Disease is a potential threat, but no known diseases have been recorded for this species, other than one incident of a tapeworm in a bird from Kodiak (Hoberg, 1984; cited in USFWS, 2011c). Because of the small existing population, disease could be extremely detrimental if the population were to be infected.

Human disturbances associated with marine and air traffic, research, and recreation could alter the distribution and behavior of the Kittlitz's murrelet. For example, boats have been documented to disrupt Kittlitz's murrelets; in areas with a higher density of vessels, there were fewer murrelets (Kuletz, 1996; cited in USFWS, 2011c).

3.4.2.6 Yellow-billed loon

Yellow-billed loon

The yellow-billed loon (*Gavia adamsii*) is one of the largest of the five loon species. It is similar in appearance to the common loon (*G. immer*), differentiated by its larger yellow- or ivory-colored bill. Adults weigh 4 to 6 kg (~9 to 13 lbs) and are 77 to 92 mm (30 to 37 in.) in length. The yellow-billed loon was petitioned for listing under the ESA in 2004. In 2006, ADF&G wrote a conservation agreement document (ADF&G, 2006a), which was a cooperative effort between the ADF&G, the Alaska Department of Natural Resources, the North Slope Borough, the US Bureau of Land Management, USFWS, and the National Parks Service (NPS). The goal of the document was to protect the yellow-billed loon and its breeding (Figure 3-31), brood-rearing, and migration habitats in Alaska so that they would not become threatened or endangered.



Source: USFWS (74 FR 12932, 2009)

Figure 3-31. Historical and current breeding and wintering ranges of the yellow-billed loon in Alaska, Russia, and Norway

On 25 March 2009, USFWS published a "warranted but precluded" finding for the yellow-billed loon (74 FR 12932, 2009). This finding documented that listing the yellow-billed loon as threatened or endangered was warranted under the ESA but was precluded by other species of higher priority. USFWS published the species assessment and listing priority assignment form on 1 June 2010, confirming the yellow-billed loon's status as a "continuing candidate" for ESA listing as a result of other higher-priority listing actions (USFWS, 2010c). The yellow-billed loon continues to be a USFWS species of special concern and is currently listed as a BLM sensitive species.

3.4.2.6.1 Distribution and critical habitat

Yellow-billed loons breed and nest on the coastal tundra of Alaska, Canada, and Russia, from 62 to 74°N (2010c; North, 1994). In Alaska, breeding and nesting primarily occur in three locations: on the North Slope, on the Seward Peninsula in western Alaska, and on St. Lawrence Island in the Bering Sea (Figure 3-31). The highest densities of yellow-billed loons are found on the North Slope within the National Petroleum Reserve, between the Meade and Ikpikpuk Rivers (Earnst et al., 2006).

North (1994) reviewed several studies on the distribution of wintering yellow-billed loons. Their winter range includes coastal marine waters from Kodiak Island south through Southeast Alaska to Puget Sound, Washington, as well as the coastal waters of Norway and the Pacific coast of Asia (Figure 3-31). The yellow-billed loon is an occasional winter resident in the Aleutian Islands and of the Pacific coast from Washington to Baja, California (North, 1994). As a candidate species, the yellow-billed loon has no designated critical habitat.

3.4.2.6.2 Population status

The global breeding population of yellow-billed loons is not known, but based on estimates in Alaska, Canada, and Russia, it is estimated to be between roughly 16,000 and 32,000 individuals, as reported by USFWS (2010c). Based on aerial surveys conducted by USFWS and other researchers, the Alaska breeding population is estimated to be between 3,000 and 4,000 individuals (Earnst et al., 2006; Larned et al., 2010; USFWS, 2009b). Information on the Canadian and Russian yellow-billed loon breeding populations is limited, but the best available data suggest that their number is between 8,000 and 20,000 individuals in Canada and 5,000 and 8,000 individuals in Russia (as summarized in USFWS, 2010c).

Larned et al. (2010) reviewed population data for yellow-billed loons on the North Slope's Arctic coastal plain, and reported that the mean size of the Alaska breeding population from 1986 to 2010 was 2,465 individuals. Based on aerial surveys in 2005, Earnst et al. (2006) estimated the North Slope breeding population of yellow-billed loons to be approximately 2,200 individuals or 1,000 breeding pairs. In 2010, Larned et al. (2010) estimated this breeding population to be 2,618 individuals.

The estimated size of the breeding populations of western Alaska and St. Lawrence Island are more limited. USFWS estimates that currently, the western Alaska population of yellow-billed loons during breeding season is approximately 500 individuals (USFWS, 2010c). In 1999, USFWS estimated the western Alaska breeding population to be approximately 730 individuals (Platte, 1999; cited in USFWS, 2010c). In 2005, 2007, and 2009, the NPS conducted aerial surveys of lakes on the Seward Peninsula and Cape Kruenstern in western Alaska. NPS estimated the presence of 431 individuals based on the 2005 and 2007 surveys (Bollinger et al., 2008; cited in USFWS, 2010c) and 179 individuals based on the 2009 survey (Flamme et al., 2009; cited in USFWS, 2010c). Data on breeding on St. Lawrence Island is inconclusive. North (1994) noted that 50 individuals were thought to breed on St. Lawrence Island prior to 1994, but the USFWS species assessment (USFWS, 2010c) reported that although yellow-billed loons were documented on St. Lawrence Island in the 1950s, their presence since that time has not been confirmed.

Population trends for the Alaska breeding population of yellow-billed loons have been established on only the Arctic coastal plain, where the highest concentration of yellow-billed loons during the breeding season occurs. Data from Arctic coastal plain surveys conducted from 1986 to 2006 suggested that the population was stable (Mallek et al., 2007; cited in USFWS, 2010c). Similarly, studies reviewed by North (1994) in the early 1990s suggested that numbers appeared to be stable on the North Slope. Based on studies summarized by USFWS (2010c), sufficient data are lacking to determine population trends in the western Alaska breeding population.

3.4.2.6.3 Habitat requirements

Yellow-billed loons nest and rear their young adjacent to permanent freshwater lakes in low-lying areas of coastal and inland Arctic tundra. The presence of fish and associated fish habitat is an important characteristic of these breeding/rearing lakes (Earnst et al., 2006; North, 1994; North and Ryan, 1989, cited in USFWS, 2010c). Earnst et al. (2006) found that yellow-billed loons are significantly more likely to be present on lakes that are connected to streams; have undulating, vegetated shorelines; and are more than 2 m (6 ft) deep. Nests are typically located on islands or hummocks or along low shorelines, within 1 m (3 ft) of the water (Earnst et al., 2006; North and Ryan, 1989, cited in USFWS, 2010c). Yellow-billed loons lay 1 or 2 eggs in mid- to late June that they incubate for 27 or 28 days. Foraging studies summarized by North (1994) and USFWS (2010c) indicate that during the breeding season, yellow-billed loons forage for fish and aquatic invertebrates in lakes, rivers, and coastal areas. These studies also indicate that in Alaska, primary prey for young include fish, such as sticklebacks and least cisco.

The wintering habitat of yellow-billed loons is not well documented but is thought to include coastal, sheltered marine waters less than 30 m (98 ft) deep, as documented in Norway by Strann and Østnes (2007; cited in USFWS, 2010c). Yellow-billed loons gathering for spring migration in polynyas off the Beaufort Sea coast of Alaska and Canada (USFWS, 2010c).

3.4.2.6.4 Current stressors and threats

Yellow-billed loon populations are thought to be naturally limited by their low reproductive rate and breeding habitat requirements, as well as natural stressors intrinsic to the arctic and subarctic climates (USFWS, 2009b, 2010c). A low-productivity species such as the yellow-billed loon will have an inherently slower rate of recovery as populations decline (USFWS, 2010c). This slow rate of recovery could be compounded by anthropogenic factors, including loss of breeding habitat, reduction in prey populations, subsistence harvest, bycatch, and nest predation (USFWS, 2009b, 2010c). USFWS (2009b) reviewed all available data with regard to the potential impacts on the yellow-billed loon, including subsistence harvest, climate change, oil and gas development, contaminants, fishing bycatch, and marine pollution in their Asian wintering habitat.

Distribution

- Aleutian Islands
- Kodiak Island
- Seward Peninsula
- Southeast Alaska
- St. Lawrence Island
- Arctic coastal plain

Habitats

- Nearshore
- Sea ice (polynyas)
- Lakes

Vulnerabilities

- Exposure to contaminants
- Habitat loss
- Injury/death (hunting, predation, bycatch)
- Reduced prey base

3.4.3 Fish

Three species of ESA-listed salmonids (i.e., Chinook salmon, coho salmon, and steelhead trout) representing runs from the Columbia River and Puget Sound basin are evaluated in this BA because of their distribution as adults in Alaska waters. The Southeast Alaska Pacific herring DPS is also included in this BA because of this species' candidate status.

3.4.3.1 Chinook salmon

Chinook salmon (*Oncorhynchus tshawytscha),* also called king salmon, are the largest and least abundant species of Pacific salmon and are important to commercial, sport, and subsistence fisheries in Alaska (NMFS, 2005e). Chinook salmon are anadromous, requiring both freshwater and saltwater to complete their life cycle. Adults spend most of their lives in the ocean before migrating to freshwater streams to spawn and subsequently die.

Chinook salmon

NOAA Fisheries recognizes nine ESA-listed evolutionarily significant units (ESUs) (i.e., subpopulations isolated in space and / or time with regard to spawning) (defined by Waples, 1991; cited in Good et al., 2005) of Chinook salmon that spawn in Washington, Oregon, Idaho, and California. Six of these ESUs are addressed in this BA (Table 3-6), based on their documented distribution, or potential to be found, in Alaska coastal waters (Crane et al., 2000; NMFS, 2005e; Templin and Seeb, 2004; Wahle and Vreeland, 1978; Wahle et al., 1981). Because these ESU subpopulations spawn in Washington, Oregon, and Idaho streams, only the non-spawning adults and juveniles that are present in Alaska waters are addressed in this BA.

Two Snake River ESUs were listed in April 1992 (57 FR 14653, 1992), the Upper Willamette River ESU was listed in March 1999 (64 FR 14308, 1999), and the two Columbia River and single Puget Sound ESUs were listed in August 1999 (64 FR 41835, 1999). In 2005, NOAA published a scientific report entitled *Updated Status of Federally Listed ESUs of West Coast Salmon and Steelhead* (Good et al., 2005), which included Chinook salmon. The 5-year status review was conducted in 2010 (76 FR 50448, 2011) and concluded that all Chinook salmon ESUs should remain listed as when classified. Each ESU is treated as a separate species under the ESA (76 FR 50448, 2011). ESUs include both naturally-spawned and artificially-propagated (hatchery stock) fish. Chinook salmon that are not part of these five ESUs, such as salmon that spawn and rear in Alaska freshwater streams, are not addressed in this BA.

Table 3-6. Chinook ESUs addressed in this BA and their ESA status, freshwater distribution, and distribution in Alaska waters

ESU	ESA Status	Freshwater Distribution[a]	Sources Confirming Presence in Alaska Waters
Puget Sound	threatened	rivers and streams flowing into Puget Sound, including the Strait of Juan De Fuca from the Elwha River, eastward, including rivers and streams flowing into Hood Canal, and the Strait of Georgia in Washington	Crane et al. (2000); Templin and Seeb (2004)
Lower Columbia River	threatened	Lower Columbia River and its tributaries, from its mouth at the Pacific Ocean upstream to a transitional point between Washington and Oregon east of the Hood River and the White Salmon River; includes the Willamette River to Willamette Falls, Oregon, but does not include spring-run Chinook salmon in the Clackamas River	Crane et al. (2000); Templin and Seeb (2004); Wahle and Vreeland (1978)
Upper Columbia River (spring run)	endangered	all river reaches accessible to spring-run Chinook salmon in Columbia River tributaries upstream of Rock Island Dam and downstream of Chief Joseph Dam in Washington	Wahle et al. (1981)
Snake River (fall run)	threatened	main stem of the Snake River below Hells Canyon Dam, and the Tucannon River, Grande Ronde River, Imnaha River, Salmon River, and Clearwater River	Good et al. (2005); Crane et al. (2000); Templin and Seeb (2004)
Snake River (spring/summer run)	threatened	main stem of the Snake River and the Tucannon River, Grande Ronde River, Imnaha River, and Salmon River subbasins	Wahle et al. (1981)
Upper Willamette River	threatened	spring-run Chinook salmon in the Clackamas River and in the Willamette River, and its tributaries, above Willamette Falls, Oregon	Good et al.(2005); NMFS (64 FR 41835, 1999)

[a] NOAA Fisheries (2013)

BA – biological assessment
ESA – Endangered Species Act
ESU – evolutionarily significant unit
NMFS – National Marine Fisheries Service
NOAA – National Oceanic and Atmospheric Administration

3.4.3.1.1 Distribution

The current range of Chinook salmon in both freshwater and marine environments includes the Pacific rim of North America and Asia. Historically, their North American range extended from the Ventura River in southern California to Kotzebue Sound in Alaska (NMFS, 2005e). Gilbert (1913) categorized Chinook salmon into two types, stream-type and ocean-type, depending on the amount of time spent in freshwater versus estuarine / ocean water. Stream-type Chinook salmon have longer freshwater residencies, with juveniles spending 1 to 2 years in fresh water before moving downstream as smolts to the estuarine / marine environment. In contrast, ocean-type Chinook salmon have shorter freshwater residencies (i.e., a few days to a year) and spend an extended period of time in estuaries before moving to the marine environment. Ocean-type fish tend to migrate along the coast, while stream-type fish swim farther from the shore during migration (as reviewed in NOAA Fisheries, 2013).

3.4.3.1.2 Presence in Alaska waters

Adult Chinook salmon from all six of the ESUs addressed in this BA have been confirmed in the GOA, including Southeast Alaska troll fisheries and GOA ground fisheries (Crane et al., 2000; NMFS, 2005e; Templin and Seeb, 2004; Wahle and Vreeland, 1978; Wahle et al., 1981). The Lower Columbia River (LCR) and Upper Willamette River ESUs of Chinook salmon are also found in the Bering Sea (NMFS, 2009a). Good et al. (2005) reported that tagged hatchery fish from the Snake River fall-run ESU have been captured in coastal fisheries in Southeast Alaska waters. In the early 1960s, Wahle and Vreeland (1978) documented LCR marked hatchery Chinook salmon as far north as Pelican, Alaska, 90 km northwest of Sitka, Alaska. In the early 1970s, Wahle et al. (1981) documented spring-run Chinook salmon from various Columbia River hatcheries as far north as Pelican. The Wahle et al. (1981) study included marked fish from hatcheries representing three of the ESUs included in this BA: Lower Columbia River ESU, Upper Columbia River spring run ESU, and Snake River spring / summer run ESU. However, very few individuals from the Snake River hatcheries were recaptured. Note that for both of these mark and recapture studies (Wahle and Vreeland, 1978; Wahle et al., 1981), Pelican was the northern-most sampling location.

More recently, ADF&G used genetic methods to determine the relative contributions of Chinook stocks caught in Southeast Alaska troll fisheries (Crane et al., 2000; Templin and Seeb, 2004). In 1998, Crane et al. (2000) reported that stock from the Snake River fall run combined Upper Columbia summer / fall run (not a listed run) was one of the largest contributors to the Southeast Alaska trolling fishery. Chinook salmon from the Puget Sound and Washington coastal runs (which would include the LCR ESU) were also present, but in smaller numbers. It should be noted that these studies did not distinguish genetically between the Snake River fall run and the Upper Columbia summer / fall run (not an ESA-listed run).

Templin and Seeb (2004) assessed the origins of Southeast Alaska troll fishery stocks from 2000 to 2002 and found that certain Chinook salmon stocks that originate in

Washington and Oregon streams are "major contributors" to the fishery, depending on the season. Stocks from Washington and Oregon coastal waters (e.g., the LCR and Puget Sound ESUs) were present in significant numbers only during the summer, while stocks from the UCR summer/fall run (not a listed run) and the Snake River fall run ESUs were caught in every season except the spring (Templin and Seeb, 2004).

Although the last confirmed presence of Upper Columbia spring run and Snake River spring/summer run Chinook salmon in Alaska waters was in the 1970s (Wahle et al., 1981), it is possible that fish from these runs do still exist in Southeast Alaska.

3.4.3.1.3 Critical habitat designation

NOAA Fisheries has designated critical habitat for each of the six ESUs addressed in this BA (70 FR 52488, 2005); however, all of the designated watersheds are freshwater rivers and streams located outside Alaska.

3.4.3.1.4 Population status

Like all Pacific salmon species, Chinook salmon have experienced dramatic declines over the past several decades as a result of both human and natural factors (NOAA Fisheries, 2013). Due in part to protective measures, some Chinook salmon ESUs have been increasing in recent years, but most are either stable or remain in decline (NMFS, 2005e; NOAA Fisheries, 2013). The following subsections summarize the Chinook salmon population status by ESU, based on population data reviewed in NOAA's *Updated Status of Federally Listed ESUs of West Coast Salmon and Steelhead* (Good et al., 2005). This document is referenced on the NOAA's website (NOAA Fisheries, 2013) as the most up-to-date summary of the population status of the ESUs addressed in this BA.

Puget Sound ESU

A NOAA review of the Puget Sound ESU in 1998 indicated that this ESU was "likely to become endangered in the foreseeable future" (Good et al., 2005); it was subsequently listed as threatened in 1999. Population data reviewed in Good et al.(2005) indicated that as of 2001, half of the Puget Sound ESU populations were increasing, while the other half were decreasing. NOAA Fisheries reviewed and reaffirmed this ESU's threatened status in 2005 and again in 2011. Historically, the Puget Sound ESU run was 690,000 fish from 31 distinct populations, but this number had dropped to 240,000 fish from 22 populations by the early 1990s, with 9 of the populations having become extinct (Good et al., 2005).

Lower Columbia River ESU

A NOAA (Good et al., 2005) review of the LCR ESU in 1998 indicated that few self-sustaining native populations remained in the LCR and that this ESU was "likely to become endangered in the foreseeable future." The LCR ESU was listed as threatened in 1999. As of 2001, population data reviewed in Good et al. (2005) indicated that most populations of this ESU were in decline. NOAA Fisheries reviewed and reaffirmed its threatened status in 2005, and again in 2011. As of 2001, this ESU was largely sustained by hatchery stock (Good et al., 2005).

Upper Columbia River Spring Run ESU

NOAA's 1998 review of the UCR spring run ESU reported a "strong downward trend in annual returns" and that the ESU was "in danger of extinction" (Good et al., 2005). The UCR ESU was listed as endangered in 1999. NOAA Fisheries reviewed and reaffirmed its endangered status in 2005, and again in 2011. Analysis of 1996 to 2001 spawning returns for the three populations identified for this ESU (i.e., Wenatchee, Entiat, and Methow Rivers) indicated an average decline of 5% per year (Good et al., 2005).

Snake River Fall Run ESU

The Snake River fall run ESU was listed as threatened in 1992. NOAA Fisheries reviewed and reaffirmed its threatened status in 2005, and again in 2011. As of 2001, data reviewed in Good et al. (2005) indicated that the populations of both naturally spawned and hatchery stock fish were increasing for this ESU. The 2001 escapement count over Lower Granite Dam (downstream of Lewiston, Idaho) exceeded 8,700 fish, the highest on record since a count of 1,000 fish in 1975 (Good et al., 2005).

Snake River Spring/Summer Run ESU

The Snake River spring/summer run ESU was listed as threatened in 1992. As of 2001, data reviewed in Good et al. (2005) indicated that some populations of this ESU were increasing, while others were decreasing. NOAA Fisheries reviewed and reaffirmed this ESU's threatened status in 2005, and again in 2011. Between 1979 and 2000, escapement counts for naturally spawned and hatchery stock fish spring and summer runs at Lower Granite Dam fluctuated, but then spiked in 2001. Spring escapement for total fish neared 150,000 in 2001, with 17,000 (11%) of those fish being naturally spawned. Summer escapement in 2001 totaled close to 1,000 fish, approximately 700 (70%) of which were naturally spawned. Since 2001, spring/summer run escapement levels at Little Granite Dam have returned to previous levels.

Upper Willamette River ESU

The Upper Willamette River ESU was listed as threatened in 1999 (64 FR 41835, 1999) following a status review in 1998 (Myers et al., 1998; 64 FR 14308, 1999) that determined that Chinook salmon in this ESU were likely to become endangered in the foreseeable future. The ESU is dominated by hatchery production and only one out of eight populations (McKenzie River) has significant natural reproduction (Good et al., 2005). NOAA Fisheries reviewed and reaffirmed its threatened status in 2005, and again in 2011.

3.4.3.1.5 Habitat requirements

Chinook salmon from the six ESA-listed ESUs are potentially present within Alaska marine waters only as juveniles or adults because their spawning/egg and larval life stages occur exclusively in freshwater streams in Washington, Idaho, and Oregon. NMFS (2005e) and Healy (1991) reviewed several studies, which agreed on the following life history and habitat requirements:

- Chinook salmon generally remain in the ocean for 1 to 6 years, and tend to be found deeper in the water column than other Pacific salmon species, from 30 to 70 m (approximately 100 to 230 ft).
- Chinook salmon are commonly harvested by commercial troll fisheries at depths of 30 m (100 ft) or greater and are the most common bycatch species taken by mid-water and bottom-trawl fisheries.
- Adult Chinook salmon are primarily piscivorous, with squid, pelagic amphipods, copepods, and euphausiids making up smaller proportions of their diet.
- Chinook salmon have been found in ocean waters with temperatures ranging from 1 to 15°C.

3.4.3.1.6 Current stressors and threats

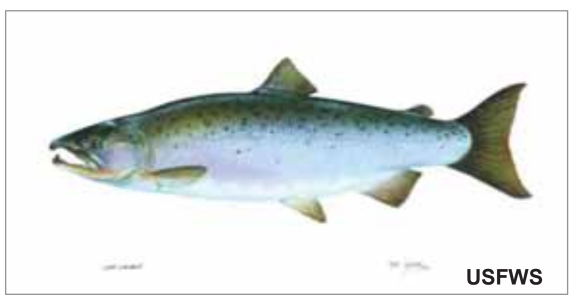
Distribution
- GOA
- Bering Sea

Habitats
- Nearshore
- Open water

Vulnerabilities
- Exposure to contaminants
- Reduced prey base

Most threats to Chinook salmon habitat occur within the freshwater spawning and rearing habitat and include logging, hydropower, agriculture, and urbanization, with greater habitat degradation occurring in the southern portion of their range. With regard to habitat threats to Chinook during its juvenile (marine) and adult life stages while present in Alaska waters, NMFS (2005e) noted that "the oceanic environment of Chinook salmon is considered largely unchanged by anthropogenic activities, although offshore petroleum production and local, transitory pollution events such as oil spills do pose some degree of risk." Studies do suggest that climate change could be affecting ocean productivity and, in turn, salmon abundance in the marine environment (Hare et al., 1999; Mueter et al., 2002; both cited in Good et al., 2005).

3.4.3.2 Coho salmon – Lower Columbia River ESU



Coho salmon

Coho salmon (*Oncorhynchus kisutch,* also called silver salmon) are one of five species of salmon in Alaska waters and are the fourth most abundant salmon species in Alaska after pink, chum, and sockeye salmon. Coho salmon are anadromous, requiring both fresh water and salt water to complete their life cycle. Adults spend most of their lives in the ocean before migrating to freshwater streams to spawn and subsequently die. NOAA Fisheries recognizes four ESA-listed ESUs (Good et al., 2005) of coho salmon that spawn in Washington, Oregon, and California. One of these ESUs, the LCR coho salmon, is addressed in this BA based on its documented distribution or potential to occur in coastal Alaska waters (Orsi et al., 2000; Morris et al., 2007). Because this ESU subpopulation spawns in Oregon and Washington only the non-spawning adults and juveniles that are found in Alaska waters are addressed here.

The LCR coho salmon ESU was listed as threatened in June 2005 (70 FR 37160). A 5-year status review was conducted in 2011 (76 FR 50448) and concluded that the ESU should remain listed as then classified. The LCR coho salmon ESU includes all naturally spawned populations of coho salmon in the Columbia River and its tributaries from the mouth of the Columbia River up to and including the Big White Salmon and Hood Rivers, and the Willamette River to Willamette Falls, Oregon. Twenty-five artificial propagation programs are considered to be part of the ESU (70 FR 37160).

3.4.3.2.1 Distribution

Coho salmon are present in most major rivers of the Pacific Rim from Monterey Bay, California, north to Point Hope, Alaska, throughout the Aleutian Islands, and from the Anadyr River in Russia, south to Korea and northern Hokkaido, Japan (Laufle et al., 1986). Coho salmon smolts from the west coast of North America typically leave fresh water in the spring (April to June). From September to November, they re-enter fresh water at age 3 or 4 to spawn. Spawning occurs from November to December and in some cases January (Sandercock, 1991).

During their ocean life stage, coho salmon generally do not migrate as far as the other species of Pacific salmon (Behnke, 2002; Biostream, 2007). Coho salmon that originate in the rivers of California, Oregon, and Washington tend to feed along the continental shelf associated with their region of origin (Sandercock, 1991). However, distribution patterns of northern and southern stocks of coho salmon at sea vary with latitude. Northern stocks are found farther offshore compared with a more coastal distribution of southern stocks (including the LCR coho salmon ESU) (Quinn and Myers, 2005). Migration pathways mapped during coded wire tag (CWT) studies show the consistent movement of coho salmon north along the continental shelf during their first year of ocean life and continued migration in a counter-clockwise direction around the rim of the Gulf of Alaska (Morris et al., 2007) aided by the Alaska current, which rotates in the same direction (Favorite, 1965).

3.4.3.2.2 Presence in Alaska waters

From 1995 to 2004, over 23 million Columbia River Basin coho salmon, including almost 14 million LCR coho salmon, were implanted with CWTs and released. The tags were read manually using a microscope, and tagging, coding, or reading errors are possible. Only those coho salmon that were adipose fin-clipped (hatchery-origin) were examined for CWTs during the NMFS surveys in Alaska (Morris et al., 2007). Of the CWT LCR-released coho salmon, 107 juvenile individuals were recaptured (7.7 per million fish), only 17 of which (1.2 per million fish) were recaptured in GOA waters (either in Southeast Alaska or central Alaska near Kodiak Island) over the 10-year period. The majority of the CWT LCR-released juveniles were recovered in the GOA from July through September, with few individuals recaptured from October to November (Morris et al., 2007).

3.4.3.2.3 Critical habitat designation

There is currently no critical habitat designated for the LCR coho salmon ESU and none has been proposed for designation (NMFS, 2012b).

3.4.3.2.4 Population status

The most recent review of the status of this ESU (NMFS, 2011a) indicates that there is a low abundance of natural-origin spawners (fewer than 500 individuals on average for each LCR population except for Clackamas River and Sandy River populations) and a high abundance of hatchery-origin spawners. Short- and long-term trends in productivity are below levels necessary for replacement (70 FR 37160, 2005), and although the ESU has made little progress toward meeting recovery criteria, there is no indication that the risk of extinction has increased significantly (NMFS, 2011a). Overall hatchery production of LCR coho salmon has decreased slightly since the last status review. The 2011 5-year status review concluded that the LCR coho salmon ESU should remain listed as threatened (NMFS, 2011a).

3.4.3.2.5 Habitat requirements

Coho salmon from the LCR ESU are only potentially present in Alaska marine waters as juveniles or adults because during their spawning/egg and larval life stages, they remain exclusively in freshwater streams in Washington and Oregon. Sandercock (1991) reviewed several studies, which agreed on the following life history and habitat requirements:

- Coho salmon remain in the ocean for 18 or more months, and the majority of individuals return to fresh water as 3-year-old fish.
- Juvenile coho salmon (i.e., smolts) feed on marine invertebrates when they first enter the ocean but subsequently become piscivorous.
- Adult coho salmon are primarily piscivorous, but squid, pelagic amphipods, isopods, crab larvae, euphausiids, and other invertebrates can make up a significant portion of their diet.
- Coho salmon have been found in ocean waters with temperatures ranging from 5 to 7 °C.

3.4.3.2.6 Current stressors and threats

Distribution
• GOA • Aleutian Islands • Bering Sea, north to Point Hope • Southeast Alaska
Habitats
• Nearshore • Open water
Vulnerabilities
• Exposure to contaminants • Reduced prey base

Approximately 40% of coho historical habitat is currently inaccessible, which restricts the number of areas that might support natural production, and further increases the ESU's vulnerability to environmental change and catastrophic events. The extreme loss of naturally spawning populations, the low abundance of extant populations, diminished diversity, and fragmentation and isolation of the remaining naturally produced fish create considerable risks to the ESU (70 FR 37160, 2005). The paucity of naturally produced spawners in this ESU is in contrast with the very large number of hatchery-produced adults. The number of hatchery coho salmon returning to the LCR in 2001 and 2002 exceeded 1,000,000 and 600,000 fish, respectively. The magnitude of hatchery production continues to pose significant genetic and ecological threats to the extant natural populations in the ESU. However, at present, these hatchery stocks collectively represent a significant portion of the ESU's remaining genetic resources. The 25 hatchery stocks considered to be part of the ESU, if appropriately managed, could prove essential to the restoration of more widespread naturally spawning populations (70 FR 37160, 2005).

3.4.3.3 Steelhead trout

Steelhead trout

Steelhead trout (*Oncorhynchus mykiss*) are the anadromous, ocean-going species of rainbow trout. Unlike other salmon in this genus, steelhead can spawn more than once. They are larger than river rainbow trout and can reach up to 120 cm (45 in.) in length and 25 kg (55 lbs) in weight.

NOAA Fisheries recognizes 15 ESA-listed DPSs of steelhead trout (NOAA Fisheries, 2013) that spawn in Washington, Oregon, Idaho, and California. Five of these DPSs are addressed in this BA (Table 3-7) based on their documented distribution or potential presence in coastal Alaska waters (Burgner et al., 1992; McKinnell et al., 1997; Sheppard, 1972). These five steelhead DPSs were ESA-listed in the late 1990s; and in 2005, NOAA published a document entitled *Updated Status of Federally Listed ESUs of West Coast Salmon and Steelhead* (Good et al., 2005). A 5-year status review was conducted in 2010 and concluded that all steelhead trout DPSs should remain listed as or be upgraded from endangered to threatened status (76 FR 50448, 2011). Steelhead that are not part of these five DPSs are not addressed in this BA.

Table 3-7. Steelhead DPSs addressed in this BA and their freshwater distributions

DPS	ESA Status	Freshwater Distribution of DPS[a]	Sources Confirming Presence in Alaska Waters
Lower Columbia River	threatened	streams and tributaries to the Columbia River between the Cowlitz and Wind Rivers in Washington (inclusive) and the Willamette and Hood Rivers in Oregon (inclusive)	McKinnell et al. (1997)
Middle Columbia River	threatened	from above the Wind River in Washington and the Hood River in Oregon (exclusive) upstream to and including the Yakima River in Washington, excluding the Snake River basin	McKinnell et al. (1997)
Upper Columbia River	endangered	streams in the Columbia River basin upstream from the Yakima River in Washington to the United States-Canada border	McKinnell et al. (1997)
Snake River Basin	threatened	streams in the Snake River basin of southeast Washington, northeast Oregon, and Idaho	McKinnell et al. (1997)
Upper Willamette River	threatened	in the Willamette River in Oregon and its tributaries upstream from Willamette Falls to the Calapooia River (inclusive)	none

[a] NOAA Fisheries (2013)
BA – biological assessment
DPS – distinct population segment
ESA – Endangered Species Act
NOAA – National Oceanic and Atmospheric Administration

Each DPS is treated as a separate species under the ESA. The DPSs include only anadromous fish, both naturally-spawned and artificially-propagated (hatchery stock) but do not include con-specific populations of resident rainbow trout that could mitigate short-term extinction risks for some steelhead (Good et al., 2005; 70 FR 67130, 2005).

3.4.3.3.1 Distribution

The current range of steelhead in both freshwater and marine environments includes the entire Pacific Coast of North America and the western Pacific to the south of the Kamchatka Peninsula in Russia. They have also been introduced in several other countries (NOAA Fisheries, 2013). Scientists recognize two basic reproductive types of steelhead trout (Burgner et al., 1992; Good et al., 2005): the stream-maturing type and the ocean-maturing type. The classification is based on an individual's state of sexual maturity when it enters freshwater and the duration of its spawning migration. Good et al. (2005) noted that "the stream-maturing type (summer-run steelhead in the Pacific Northwest (PNW) and northern California) enters fresh water in a sexually immature state between May and October and requires several months to mature and spawn. The ocean-maturing type (winter-run steelhead in the PNW and northern California) enters fresh water having well-developed gonads sometime between November and April and spawns shortly thereafter."

3.4.3.3.2 Presence in Alaska waters

Few studies have attempted to document steelhead from Washington and Oregon stocks in Alaska marine waters, primarily because they are not fished commercially. Sheppard (1972; cited in Pauley et al., 1986) reported that steelhead tagged at the Skamania Hatchery in Washington were recovered 72 km (45 mi) south of Adak Island in the Aleutian Islands 3 years later. Burgner et al. (1992; cited in McKinnell et al., 1997) reported that in their first few years of life, North American steelhead aggregated in the western GOA and off the coast of the eastern Aleutian Islands.

McKinnell et al. (1997) conducted a more detailed study to assess the distribution of North American hatchery steelhead stock in the GOA and Aleutian Islands; the study used CWT mark and recapture data collected by the NMFS Auke Bay Laboratories in Juneau, Alaska, and the Pacific Biological Station in Nanaimo, British Columbia, from 1981 through 1994. These data showed that tagged steelhead from hatcheries in the upper, middle, and lower Columbia River, the Snake River basin, and coastal Washington were recaptured in the northern and southern GOA and the Aleutian Islands. McKinnell et al. (1997) found that the total number of tagged steelhead recovered from the Columbia and Snake River basins was very low (i.e., fewer than 100 fish per year). These studies indicate that although steelhead from the DPS reviewed in this BA are indeed present in Alaska waters, they do not comprise a large percentage of the steelhead found there.

3.4.3.3.3 Critical habitat designation

USFWS has designated critical habitat for each of the five DPS, but all of the designated watersheds are freshwater rivers and streams located outside of Alaska (NOAA Fisheries, 2013). The following subsections describe the distribution of each of the five DPSs addressed in this BA, as listed on the NOAA Fisheries website (NOAA Fisheries, 2013).

3.4.3.3.4 Population status

Like many of the Pacific salmon stocks, steelhead trout stocks have experienced substantial declines from their historical numbers over the past several decades. The population of the species is now at a fraction of its historical abundance (NOAA Fisheries, 2013). The following subsections summarize the status of the steelhead population by DPS.

Lower Columbia River DPS

The LCR DPS was listed as threatened in 1998. NOAA Fisheries reviewed and reaffirmed its threatened status in 2005, and again in 2011 (NMFS, 2011a). Only 2 of the 26 LCR steelhead populations are considered "viable," whereas 17 are in the very high or high risk categories. Populations whose habitats are above impassable dams or in highly urbanized watersheds performed the most poorly. While all of the populations showed an increase in abundance during the early 2000s and typically peaked in 2004, three recent status evaluations concluded that the DPS is currently at high risk of extinction (Ford et al., 2010).

Middle Columbia River DPS

The Middle Columbia River (MCR) DPS was listed as threatened in 1999. NOAA Fisheries reviewed its status in 2005 and 2011, both times reaffirming the threatened status (NMFS, 2011b). Four major population groups have been identified for this DPS: Yakima River basin, Umatilla/Walla Walla drainages, John Day River drainage, and Eastern Cascades group. Some of these component populations have shown improvement in their viability ratings; however, several concerns or key uncertainties remain (2005). The populations within this DPS have been highly variable with regard to natural-origin spawning estimates relative to minimum abundance thresholds. For example, recently, the number of fish returning to the Yakima and Umatilla/Walla Walla drainages have been higher, while those to the John Day River drainage have decreased (Ford et al., 2010).

Upper Columbia River DPS

The UCR DPS was listed as endangered in 1997. Its status was upgraded to threatened in 2006 but was returned to endangered in 2007 as a result of a US District Court decision. The status was again upgraded to threatened in 2009 per US District Court order. NOAA Fisheries reviewed this DPS's status in 2011 and concluded that it should remain listed as threatened (NMFS, 2011d). Four major population groups have been identified for the UCR DPS based on each population's use of a major tributary (i.e., the Wenatchee River, Entiat River, Methow River, and Okanogan River) for spawning and rearing. Recent estimates of both spawner abundance and annual returns are higher for all four populations relative to estimates from the 2005 review (Ford et al., 2010). Hatchery-origin returns are extremely high across this DPS; modest improvements in natural returns have been documented in recent years, apparently as a result of good natural survival in the ocean and tributaries. However, the most recent review concluded that all four populations of this DPS remain at high risk of extinction (63 FR 11798, 1998).

Snake River Basin DPS

The Snake River Basin DPS was listed as threatened in 1997. This status was reaffirmed by NOAA Fisheries during both the 2005 and 2011 reviews (NMFS, 2011c). This DPS includes five major population groups: Lower Snake River, Grande Ronde River, Imnaha River, Clearwater River, and Salmon River. Only two of these five populations have a full dataset with which to determine population-level abundance, so other types of abundance indices are used for the remaining populations. Since the last review period 5 years ago, a decrease in total abundance has occurred in the two groups that have population-level datasets, but the trend in returns has been slightly positive over the longer term. At Lower Granite Dam, both wild and hatchery-origin returns have increased, although the rate was higher for the hatchery fish. Overall, a majority of the 23 extant populations within this DPS have high-risk viability ratings, and only one is considered highly viable (Ford et al., 2010).

Upper Willamette River DPS

The Upper Willamette River DPS was listed as threatened in 1999, a status that NOAA Fisheries reviewed and reaffirmed in both 2005 and 2011 (NMFS, 2011d). All steelhead in this DPS pass through Willamette Falls, where data indicate that after a decade of very low abundance, numbers increased in 2001 and peaked in 2002. However, since 2002, the population has returned to relatively low abundance levels, similar to those seen in the 1990s (Ford et al., 2010).

3.4.3.3.5 Habitat requirements

Steelhead from the five ESA-listed DPSs have the potential to be present within Alaska marine waters only as juveniles or adults because during their spawning/egg and larval life stages, they remain exclusively in freshwater streams in Washington, Idaho, California, and Oregon. ADF&G (2012g), NOAA (2011), and Pauley et al. (1986) reported following life history and habitat requirements:

- Steelhead typically remain in the ocean for 2 to 3 years prior to returning to their natal streams to spawn (Shapovalov and Taft, 1954; cited in Pauley et al., 1986).
- Although 20 to 30% of steelhead typically return to spawn a second time, the percentage of second returns ranges from 10 to 50%.

- Steelhead generally live 8 to 9 years (Sumner, 1945; cited in Pauley et al., 1986) but can live as many as 11 years (NOAA, 2011).
- In the ocean, steelhead feed primarily on mollusks, crustaceans, and other small fish.
- Steelhead have been found in ocean waters that have temperatures ranging from 5 to 15°C.

3.4.3.3.6 Current stressors and threats

Threats to steelhead trout habitat are the same as those to all Pacific salmon and occur primarily within the freshwater spawning and rearing habitat. Identified threats include logging, hydropower, agriculture, and urbanization, with greater habitat degradation occurring in the southern part of their range (NOAA, 2011). Unlike other Pacific salmon, steelhead are not commercially fished, and the numbers of steelhead caught as bycatch are not commonly recorded.

Distribution

- GOA
- Aleutian Islands

Habitats

- Nearshore
- Open water

Vulnerabilities

- Exposure to contaminants
- Reduced prey base

3.4.3.4 Pacific herring—Southeast Alaska DPS

Pacific herring (*Clupea pallasi*) is one of approximately 330 species of the family Clupeidae, which includes herrings, shads, sardines, and menhadens (Moyle and Cech, 1988). Clupeids are easily recognized by their keeled bellies and silvery, deciduous scales (Moyle and Cech, 1988). Herring are small, mobile planktivores that provide a link between lower trophic levels (e.g., phytoplankton and zooplankton, small crustaceans, larval fish) and higher trophic levels (e.g., marine mammals, birds, large fish) (Bakun, 2006; Hart, 1973; Hourston and Haegele, 1980). In Alaska, Pacific herring grow to an average size of 25 cm (9.8 in.) in length (Mecklenburg et al., 2002).

Pacific Herring

Pacific herring are sexually mature at 3 to 4 years of age and spawn every year after reaching maturity (ADF&G, 2012c). Spawning occurs in the spring in shallow, vegetated areas in intertidal and subtidal zones. When herring migrate inshore they cease feeding and do not eat for 1 to 2 weeks (NOAA, 2012a). Males and females release their milt and eggs into the water column where they mix and fertilize. The eggs are adhesive and attach to vegetation or the bottom substrate. On average, a single female can produce 20,000 eggs annually; however. the mortality of the eggs is high (ADF&G,

2007). After feeding for several months in shallow water, larvae metamorphose into juveniles that spend their first summer in nearshore bays and inlets. These schools disappear from nearshore habitats in the fall and move to deep water for the next 2 to 3 years (NOAA Fisheries, 2013).

Pacific herring swim and feed in large schools that potentially stay together for years. They feed seasonally on phytoplankton and zooplankton, building up fat stores for periods of inactivity. They generally feed in surface waters at night in areas of upwelling. Young herring feed mainly on crustaceans but will eat decapod and mollusk larvae. Adults consume mostly larger planktonic crustaceans and small fish (ADF&G, 2012c). They can live up to 20 years of age but more typically survive until age 9.

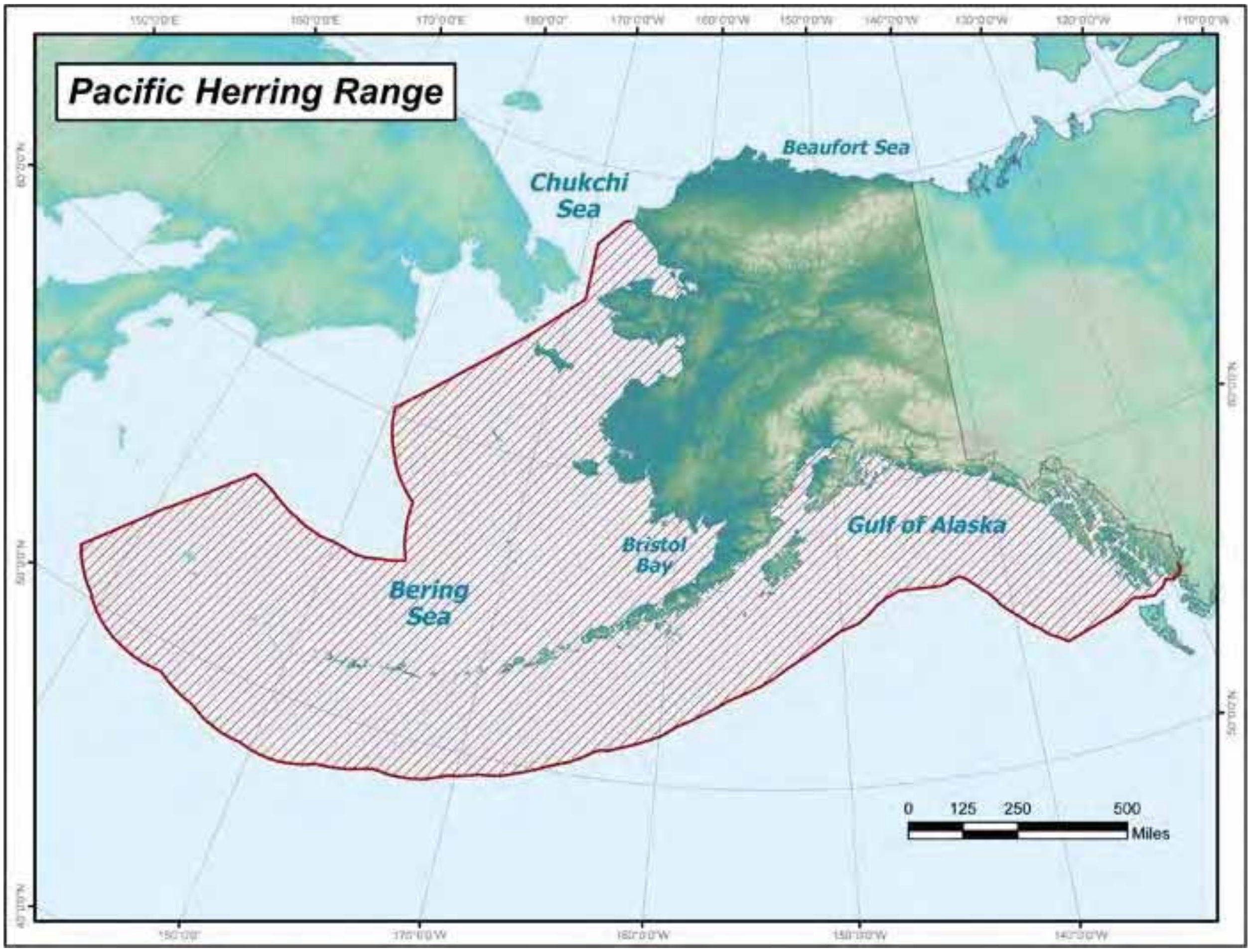
In 2007, NMFS received a petition from an environmental group to list the Lynn Canal population of Pacific herring under ESA (NOAA, 2008a). After a status review, NOAA determined that the petition was not warranted because the Lynn Canal population did not constitute a subspecies or DPS, so the action of listing under the ESA was not taken. However, the agency determined that the Lynn Canal population was part of a larger Southeast Alaska DPS, which is distributed from the Dixon Entrance to Southeast Alaska waters (where this stock is generally distinguished from the British Columbia stock) to Cape Fairweather and Icy Point in the north (where use of more northern habitats by the stock is limited by physical and ecological barriers). The status review further concluded that the DPS to which the Lynn Canal Pacific herring belong should be considered a candidate species for listing under the ESA (NOAA 2008b).

3.4.3.4.1 Distribution

Pacific herring are distributed around the Pacific Rim from Baja California to the Arctic in the eastern Pacific (Eschmeyer et al., 1983) and are concentrated in the coastal waters of British Columbia, the Bering Sea, and the Yellow Sea (Hourston and Haegele, 1980; Mitchell, 2006). Spawning times for Pacific herring are influenced by latitude, occurring later in the spawning season with increasing latitude. Spawning begins as early as October for stocks near Baja California and can occur in as late as August for Alaska stocks during the same spawning season (Haegele and Schweigert, 1985). Migratory herring populations have seasonal oceanic feeding grounds and inshore spawning grounds, while resident populations feed and spawn year-round in coastal bays and inlets (Mitchell, 2006).

3.4.3.4.2 Distribution and presence in Alaska waters

Pacific herring are seasonally abundant off all Alaska coasts, from Southeast Alaska north to the Chukchi and Beaufort Seas (Mitchell, 2006; Mecklenburg et al., 2002) (Figure 3-32).



Source: ADF&G (2012d)

Figure 3-32. Distribution of Pacific Herring in Alaska

The Southeast Alaska DPS is restricted to the coast region of Alaska from Cape Fairweather (near Glacier Bay) to the Dixon Entrance of Southeast Alaska inside waters. The Southeast Alaska stock is distinguished from the British Columbia stock, based on genetic differences, as well as differences in recruitment and average weight-at-age, parasitism, spawn timing and location. The northern boundary is defined by physical and ecological features that create migratory barriers, as well as large stretches of exposed ocean beaches that lack herring spawning and rearing habitats (NOAA, 2008b).

3.4.3.4.3 Critical habitat designation

The Pacific herring Southeast Alaska ESU is a candidate for listing under the ESA; thus, no critical habitat has been proposed or designated.

3.4.3.4.4 Population status

The population of adult Pacific herring is highly variable. Survival during early life stages is an important influence on the adult population size; high recruitment of a year class will typically influence population size and age structure until senescence. Pacific herring are particularly vulnerable to physical variability during early life stages, resulting in high inter-annual variability and reproductive success (Bakun, 2006).

Herring population trends are very dynamic and subject to fairly substantial changes on both large and small geographic scales. The primary causes of these fluctuations in abundance are environmental changes that affect herring growth and recruitment. In Southeast Alaska the ADFG is responsible for managing the herring fishery on a long-term, sustained-yield basis. As listed on the NOAA Fisheries web site NOAA Fisheries (2013), ADFG currently monitors nine spawning aggregates of the Southeast Alaska DPS including:

- Sitka
- Hoonah Sound
- Seymour Canal
- Hobart-Houghton
- Tenakee Inlet
- Ernest Sound
- West Behm Canal
- Craig
- Lynn Canal

3.4.3.4.5 Habitat requirements

Pacific herring are found in coastal areas of the Pacific Ocean from the surface to depths of 400 m (1,300 ft) (NOAA Fisheries, 2013). Pacific herring are relatively adaptable and are life-stage dependent on a variety of habitats in Southeast Alaska. The nearshore habitats most commonly used have organic, semi-protected, and partially mobile substrate (NMFS, 2007). Herring spawn on beaches in Southeast Alaska, and these are distributed non-continuously along Southeast Alaska waters. Observation of areas and beaches in Southeast Alaska that are used repeatedly for herring spawning are one method by which ADFG defines spawning aggregates for management purposes. Eelgrass meadows, kelp communities, sand-gravel beaches, and bedrock outcrops are all within a habitat continuum used by Southeast Alaska Pacific herring (NMFS, 2007). Unstable, open ocean beaches are inadequate as spawning and rearing habitat (NMFS, 2007).

Spawning areas (i.e., inlets, sounds, bays, and estuaries) are typically protected from ocean surf, reflecting a likely ecological adaptation to minimize egg loss (Haegele and Schweigert, 1985). Herring typically spawn along the same shoreline every year. Herring apparently do not favor specific vegetation types (Haegele and Schweigert, 1985).

3.4.3.4.6 Current stressors and threats

Known and anticipated threats to Southeast Alaska Pacific herring include habitat destruction and modification, overharvest, disease, predation, inadequate regulations, and other unspecified natural or human factors, including (NOAA Fisheries, 2013; NMFS, 2007):

- Loss or degradation of herring spawning grounds, juvenile feeding habitat, and rearing/foraging habitat due to activities such dredging, construction, log storage, and oil spills
- Reductions in the amount of phytoplankton and zooplankton prey available to Pacific herring due to ecosystems changes from climate change
- Increases in populations of animals that compete with or prey upon herring, such as humpback whales or Steller sea lions
- Mortality or reduced recruitment due to continued harvest of adults and roe

Distribution

- GOA
- Aleutian Islands
- Bering Sea
- Southeast Alaska

Habitats

- Nearshore
- Open water
-

Vulnerabilities

- Reduced prey base
- Spawning habitat loss
- Commercial harvest
- Predation

Other factors responsible for adult herring mortality include starvation, disease, and contaminants; these in turn are influenced by ocean conditions, climate change, and intricate ecological relationships.

3.4.4 Accidental or uncommon species

Additional threatened and endangered species have been documented in Alaska, although without regular sufficient observation to be considered common. Accidental species are those recorded only once or twice and so far from their usual ranges that further observations are considered unlikely (e.g., egret or white pelican). Casual species, which have been recorded no more than a few times but are likely to be seen again at irregular intervals over a period of years, include loggerhead and olive ridley turtles (*Caretta caretta* and *Lepidochelys olivacea*, respectively) (Hodge and Wing, 2000, cited in McAlpine et al., 2004; Wing and Hodge, 2001). Green turtles (*Chelonia mydas)* are among the rare species that occur, or probably occur regularly within the region but in very small numbers (Hodge and Wing, 2000, cited in McAlpine et al., 2004; Wing and Hodge, 2001). Uncommon species are those that are found regularly but use very little of the suitable habitat, are regularly present in the region but in relatively small numbers, or are not observed regularly even in appropriate habitat. The leatherback turtle (*Dermochelys coriacea*) is considered an uncommon species (Hodge and Wing, 2000, cited in McAlpine et al., 2004; Wing and Hodge, 2001).

Section 3.4.4.1 Leatherback turtle

Leatherback turtle

Leatherback turtles (*Dermochelys coriacea*) are the largest living reptile in the world; on average, they weigh 900 kg (2,000 lbs) and are 2 m (6.5 ft) long (NOAA Fisheries, 2013). The turtles are black with pinkish-white coloration on their ventral side and have been named "leatherbacks" because they lack the hard, bony shells featured by other sea turtles. Instead, they have a 4-cm (1.5-in.)-thick carapace made of leathery, oil-saturated connective tissue covering dermal bones (NOAA Fisheries, 2013).

The leatherback turtle is listed as endangered under the ESA (35 FR 8491, 1970). A recovery plan for the Pacific population in US waters was produced in 1998 (NMFS and USFWS, 1998b).

3.4.4.1.1 Distribution and critical habitat

Leatherback turtles are a primarily pelagic species and have the most extensive range of any living reptile, reportedly being present in all of the world's oceans (NMFS and USFWS, 1998b). Physiologic and anatomical adaptations allow leatherback turtles to inhabit cold water (Frair et al., 1972; Greer et al., 1973), extending their range to the GOA (Hodge and Wing, 2000, cited in McAlpine et al., 2004) and waters off of British Columbia (McAlpine et al., 2004). Leatherback turtles are the most common turtle in Alaska waters; at least 19 individuals were recorded between 1960 and 1998 from Southeast Alaska to the Alaska Peninsula (Hodge and Wing, 2000, cited in McAlpine et al., 2004).

Nesting grounds are typically located on sandy tropical or sub-tropical beaches, with the largest nesting assemblages being on the coasts of northern South America and West Africa (NOAA Fisheries, 2013). Although the US Caribbean, primarily Puerto Rico, and the US Virgin Islands represent the largest nesting assemblages within the United States, they are minor from a global perspective (76 FR 25660, 2011).

The distribution of juvenile leatherback turtles is less well understood; Eckert (2002) reported that leatherback turtles with carapace lengths of 100 cm (39.4 in.) or less were generally observed in waters 26°C or warmer, indicating that subadult leatherback turtles likely remain in tropical waters.

Leatherback turtle migration routes are not fully understood. Recent telemetry work (Eckert, 2006; James et al., 2005; James et al., 2007; Benson et al., 2011) indicates that leatherback turtles undertake transoceanic migrations between nesting and foraging grounds and that a leatherback turtle can swim more than 10,000 km (6,213 mi) in the course of 1 year (Eckert, 2006; Eckert et al., 2006). A telemetry study observing 126 deployed leatherback turtles noted migrations as far north as Washington state and southern British Columbia, with no turtles observed in Alaska waters (Benson et al., 2011). Foraging habitat was largely concentrated along the coast of California, and nesting occurred primarily in Southeast Asia, Soloman Islands, eastern Australia, Papua New Guinea, and New Zealand. Numerous published studies reviewed by NMFS and USFWS (2007b) on telemetry work indicate that, in general, the Atlantic, Indian, and western Pacific populations exhibit a wide dispersal pattern from nesting grounds to multiple foraging areas, while the eastern Pacific population appears to be limited to foraging grounds in the southeastern Pacific.

Critical habitat for the leatherback turtle was designated in 1979 to include the coastal waters adjacent to Sandy Point, St. Croix, US Virgin Islands. A proposed rule to revise leatherback turtle critical habitat to include areas off the western coast of the United States, encompassing eight specific areas in waters adjacent to California, Oregon, and Washington, was published on January 5, 2010 (75 FR 319, 2010). An additional petition to include waters adjacent to Puerto Rico was made in November 2010, and NMFS published a 90-day finding and 12-month determination (76 FR 25660, 2011) to revise leatherback turtle critical habitat. An additional 41,914 sq mi of leatherback turtle critical habitat off the coasts of California, Oregon, and Washington were designated on January 20, 2012 (77 FR 4170, 2012). No critical habitat occurs in Alaska waters.

The PCE of critical habitat essential for the conservation of leatherback turtles is the presence of prey species, primarily the jellyfish scyphomedusae of the order Semaeostomeae (i.e., Chrysaora, Aurelia, Phacellophora, and Cyanea), of sufficient condition, distribution, diversity, abundance, and density to support the individual and population growth, reproduction, and development of leatherbacks.

3.4.4.1.2 Population status

Leatherback turtles frequently nest on different beaches, making population estimates or trends difficult to monitor (NOAA Fisheries, 2013). At the time of the 5-year review for leatherback turtles (NMFS and USFWS, 2007b), Atlantic Ocean populations were seen as stable or increasing for all but the Western Caribbean and West Africa. Pacific Ocean populations have dropped dramatically, with the likely extirpation of the species from key nesting beaches in the eastern Pacific. Indian Ocean populations have experienced similar population declines, although long-term datasets for this region are rare. Spotila et al. (1996) estimated the worldwide population of nesting females to be 34,500, substantially fewer than the 115,000 estimated in 1980 (Pritchard, 1982). Although it has been acknowledged that some Atlantic populations are increasing, the overall trend for the species is a dramatic population decline; and modeling efforts suggest that even small increases in mortality over background mortality rates are unsustainable (Spotila et al., 1996; Spotila et al., 2000).

NMFS and USFWS (2007b) recommended investigating whether the DPS policy applies to leatherback turtles. This status review is planned to coincide with the evaluation of critical habitat revisions (76 FR 25660, 2011), and has not yet taken place. Leatherback turtles are currently listed as endangered under the ESA (35 FR 18319, 1970).

3.4.4.1.3 Habitat requirements

Although commonly considered pelagic animals, leatherback turtles forage in coastal waters on cnidarians and tunicates. Convergence zones and upwelling areas along continental margins and in archipelagic waters, where concentrations of prey occur, are exploited by leatherback turtles (2007b). Multiple telemetry and tagging studies have documented leatherback turtles traveling long distances to arrive in coastal waters coincident with seasonal peak aggregations of jellyfish (Benson et al., 2007; Bowlby, 1994).

Females nest on sandy beaches in tropical and subtropical areas, selecting sloped beaches that minimize the crawl to dry sand. Preferred beaches are near deep water with relatively rough seas (USFWS, 2001).

3.4.4.1.4 Current stressors and threats

The greatest threats to leatherback turtle populations are long-term harvest and incidental capture in fishing gear (i.e., bycatch) (2007b). A variety of fishing gear results in incidental capture, including gill nets, trawls, traps and pots, longlines, and dredges. Both adult leatherback turtles and their eggs are harvested on nesting beaches, and both adults and juveniles are harvested on feeding grounds.

Distribution
- GOA
- Southeast Alaska

Habitats
- Open water

Vulnerabilities
- Injury/death (harvest, bycatch)

3.4.4.2 Loggerhead turtle

Loggerhead turtles (*Caretta caretta*) are hard shelled, weigh an average of 113 kg (250 lbs), and measure about 1 m (3 ft) in length as adults (NOAA Fisheries, 2013). They have a red-brown shell and pale green or tan skin. Their common name comes from their relatively large heads, which support powerful jaws for crushing sturdy prey species (NOAA Fisheries, 2013).

Loggerhead turtle

The loggerhead turtle was listed as threatened throughout its range in 1978 (43 FR 32800, 1978). Nine loggerhead turtle DPSs are recognized by USFWS and NMFS (76 FR 58868, 2011); the two loggerhead turtles observed in Alaska were from the North Pacific Ocean DPS, which is designated an endangered species under the ESA. Because this is the only DPS whose range extends into Alaska waters, all further discussion will focus on the North Pacific Ocean DPS of loggerhead turtles.

3.4.4.2.1 Distribution and critical habitat

Hodge and Wing (2000, cited in McAlpine et al., 2004) documented two cases of loggerhead turtles in the GOA. Throughout their life cycle, North Pacific Ocean loggerhead turtles generally do not interbreed with loggerhead turtles from the South Pacific. Those from the North Pacific Ocean DPS can be found foraging as far south as Baja California Sur, Mexico. Although loggerheads can be found throughout tropical and temperate Pacific waters, nesting areas in the North Pacific are limited to Japan (Hatase et al., 2002; Kamezaki et al., 2003, cited in76 FR 58868, 2011) and potentially to areas surrounding the South China Sea (Chan et al., 2007; cited in 76 FR 58868, 2011). Important juvenile foraging areas are the Kuroshio Extension Bifurcation Region, Japan (Polovina et al., 2006), and off the Baja California Sur coast, Mexico (Pitman, 1990). No critical habitat was designated in the endangered species ruling (76 FR 58868, 2011); however, in July 2013, critical habitat was proposed for loggerhead turtles outside of Alaska.(78 FR 43006, 2013)

3.4.4.2.2 Population status

Complete population data do not exist for the North Pacific Ocean DPS of loggerhead turtles; available data consist of counts of nests and nesting females at nesting beaches. Kamezaki et al. (2003; cited in 76 FR 58868, 2011) reviewed available data from Japanese nesting beaches and concluded that there had been a 50 to 90% decrease in the size of the North Pacific Ocean DPS loggerhead nesting population since the 1950s. Although recent surveys referenced by NMFS and USFWS (76 FR 58868, 2011) indicate that nesting numbers have increased gradually over recent years, NMFS and USFWS also concluded that there was a substantial decline in the loggerhead turtle North Pacific Ocean DPS nesting population over the last half of the 20th century and that current populations are a fraction of historical populations. The loggerhead turtle North Pacific Ocean DPS is listed as endangered under the ESA (76 FR 58868, 2011).

3.4.4.2.3 Habitat requirements

Loggerhead turtles typically nest on wide, sandy beaches that have a flat, sandy approach from the water and are backed by low dunes (Miller et al., 2003; cited in Conant et al., 2009); mitochondrial DNA data indicate strong female natal homing with nesting populations independent of demographic units (Bowen and Karl, 2007). Eggs require high-humidity sand with temperatures conducive to development (Miller, 1997; Miller et al., 2003; both cited in Conant et al., 2009). Post-hatchling loggerheads are found in areas of local downwellings, where accumulations of floating material are commonly available for foraging (Witherington, 2002) or where there are eddies and meanders that concentrate prey. Juvenile loggerheads have also been found in the transition zone chlorophyll front, where surface prey is concentrated (Polovina et al., 2001; Kobayashi et al., 2008). Juvenile loggerheads appear to enter the oceanic zone and follow predominant currents for several years before returning to the neritic zone (McClellan and Read, 2007; Bolten, 2003). The species is primarily carnivorous and consumes a wide variety of prey items (Bjorndal, 1997).

3.4.4.2.4 Current stressors and threats

Distribution
• GOA
Habitats
• Open water
Vulnerabilities
• Injury/death (bycatch)
• Habitat loss (breeding range)

The greatest threats to loggerhead turtle populations are incidental capture in fishing gear (i.e., bycatch) and loss of habitat from coastal development and the coastal armoring on Japanese nesting beaches (Conant et al., 2009). A variety of fishing gear results in incidental capture (primarily longlines and gill nets, but also trawls, traps and pots, and dredges). Threats to loggerhead turtles from loss of nesting habitat will likely be compounded by the anticipated sea level rise associated with climate change.

3.4.4.3 Green turtle

On average, green turtles (*Chelonia mydas*) weigh 135 to 160 kg (300 to 350 lbs) and are 1 m (3 ft) in length (NOAA Fisheries, 2013). They are similar in length to but heavier than the loggerhead turtle. Green turtles are the largest hard-shelled turtle. Despite their name, the green turtle's shell can be several colors (shades of black, grey, green, brown, and yellow are all on record), and their undersides are more pale (NOAA Fisheries, 2013).

Green turtle

Green turtles are listed as threatened globally, and two populations are listed as endangered under the ESA (43 FR 32800, 1978), specifically the breeding populations off Florida and on the Pacific coast of Mexico. A recovery plan for the East Pacific green turtle was produced in 1998 (NMFS and USFWS, 1998a).

3.4.4.3.1 Distribution and critical habitat

The green turtle is found in tropical and subtropical waters and to a lesser extent in temperate waters and is believed to inhabit the coastal waters of more than 140 countries (Groombridge and Luxmoore, 1989). They forage along open coastlines and in protected bays and lagoons and currently nest in more than 80 countries, including the United States (Hawaii and Florida) (Hirth, 1997; NMFS and USFWS, 2007a). In Southeast Alaska, 15 green turtles has been sighted between 1960 and 1998 (Hodge and Wing, 2000, cited in McAlpine et al., 2004). In 1998, critical habitat for the green turtle was designated in coastal waters around Culebra Island, Puerto Rico (63 FR 46693, 1998). No critical habitat for the green turtle has been designated in Alaska.

3.4.4.3.2 Population status

Each year, an estimated 108,000 to 150,000 females nest at 46 evaluated sites (NMFS and USFWS, 2007a). Although some nesting sites were excluded from the NMFS and USFWS (2007a) evaluation, these nesting sites were believed to be minor and to not have a substantial effect on the estimate.

NMFS and USFWS (2007a) analyzed population trends for 23 nesting sites that had datasets, allowing for a comparison of recent and historical abundance data. At these sites, 10 nesting populations were increasing, 9 were stable, and 4 were decreasing. Nesting populations in the Pacific, Western Atlantic, and Central Atlantic were generally doing well, while nesting populations in Southeast Asia, Eastern Indian Ocean, and Mediterranean were doing relatively poorly. However, the authors cautioned that trend data were available for only about half of all nesting sites and that trends were not assessed over a full generation (NMFS and USFWS, 2007a). Thus, impacts on juvenile recruitment within the previous four decades are not reflected in these trend analyses.

3.4.4.3.3 Habitat requirements

Adult green turtles forage primarily on marine algae and seagrass, though some populations include invertebrates as a large component of their diet (Bjorndal, 1997). Coastal foraging areas are dynamic, with conditions varying seasonally and annually (Carballo et al., 2002). Ocean habitats are used by juveniles and migrating adults, although little is known about how oceanography affects survival or migration.

Green turtles require nesting beaches that have intact dune structures, native vegetation, and normal temperatures (Ackerman, 1997). Vegetation removal and coastal construction can affect thermal regimes, altering hatchling gender ratios and perhaps generating lethal incubation temperatures.

3.4.4.3.4 Current stressors and threats

Distribution

- GOA

Habitats

- Open water

Vulnerabilities

- Injury/death (harvest, bycatch)
- Habitat loss (breeding range)
- Exposure (disease)

Threats to green turtle populations include habitat modification, harvest of adults and eggs, incidental capture in fishing gear (i.e., bycatch), and disease (NMFS and USFWS, 2007a). Both marine and terrestrial habitat modification resulting from human expansion into coastal areas is a serious concern due to potential synergies with other existing threats. Habitat modification will likely be compounded by predicted rising sea levels and increased temperatures associated with climate change. The harvest of adults and eggs continues to be a concern, and directed hunts of both nesting females and foraging turtles continue to be a problem in many areas throughout the world. Incidental capture in fishing gear, primarily gillnets but also longlines and trawls, has a major impact on green turtle populations. Fibropapillomatosis, a disease characterized by large numbers of internal and / or external tumors, has been reported in all sea turtle species, but its frequency is much higher in green turtles.

3.4.4.4 Olive ridley turtle

The olive ridley turtle (*Lepidochelys olivacea*) is hard shelled and smaller than the green and loggerhead turtles. On average, olive ridley turtles weigh 45 kg (100 lbs) and measure 55 to 80 cm (22 to 31 in.) in length (NOAA Fisheries, 2013). The shells and skin are olive in color, hence their name. Vast numbers of females come ashore to nest at the same time, an event called an arribada, one of the most extraordinary nesting habits in the world (NOAA Fisheries, 2013).

Olive ridley turtle

The global population of olive ridley turtles is listed as threatened under the ESA, and the Pacific Mexico nesting population is listed as endangered (43 FR 32800, 1978). A recovery plan was written for the Pacific population in US waters in 1998 (NMFS and USFWS, 1998c).

3.4.4.4.1 Distribution and critical habitat

The olive ridley turtle has a circumtropical distribution in the Pacific Ocean. Although they are not known to move between ocean basins, they do move between oceanic and neritic zones within a given region (Plotkin et al., 1995; Shanker et al., 2003). Olive ridley turtles in the eastern Pacific are generally found from Peru to northern California but have been documented as far north as Alaska three times between 1960 and 2007(Hodge and Wing, 2000) (Hodge and Wing, 2000, cited in McAlpine et al., 2004). No migration corridors between foraging and nesting habitats appear to exist. Rather, olive ridley turtles are nomadic migrants, foraging across large oceanic areas (Plotkin et al., 1994, 1995).

Arribadas occur on certain eastern Pacific beaches in Mexico, Nicaragua, and Costa Rica, and on one beach in Panama. Five Mexican nesting beaches historically were the site of large arribadas, but only one continues to support a large arribada today, with more than one million nests (2007c). Solitary nesting occurs throughout the olive ridley turtle's range and has been documented in approximately 40 countries. There is no designated critical habitat for the olive ridley turtle.

3.4.4.4.2 Population status

Although olive ridley turtle is the most abundant turtle in the world (Pritchard, 1997; cited in NMFS and USFWS, 2007c), Abreu-Grobois and Plotkin (2008), summarizing previous and current population estimates at a number of index sites worldwide, estimated a 31 to 36% reduction in the global population. Arribada beaches in Mexico have seen steep declines in the number of nesting females since the first half of the 20th century; a conservative estimate shows a drop from 10 million adults prior to 1950 to just over 1 million in 1969 (Cliffton et al., 1982; cited in NMFS and USFWS, 2007c). The Mexican nesting populations appear to be stable or increasing but have not returned to their earlier numbers (NMFS and USFWS, 2007c).

3.4.4.4.3 Habitat requirements

Distribution
- GOA

Habitats
- Open water

Vulnerabilities
- Injury/death (harvest, bycatch)
- Habitat loss (breeding range)

Olive ridley turtles in the eastern Pacific are believed to spend most of their non-breeding lives in the oceanic zone, moving to the neritic zone only during the breeding season (Plotkin et al., 1994, 1995).

Both juvenile and adult olive ridley turtles forage on jellyfish, salps, and tunicates in ocean habitats (Kopitsky et al., 2005). Both arribada and solitary nesters rely on coastal sandy beaches for nesting; however, although arribada nesters display a high level of site fidelity to nesting beaches, solitary nesting olive ridley turtles use multiple beaches within a single season (Kalb, 1999; cited in NMFS and USFWS, 2007c).

3.4.4.4.4 Current stressors and threats

The greatest threats to olive ridley turtle populations are the continued harvest of both adults and eggs, incidental capture in fishing gear, and loss of habitat (NMFS and USFWS, 2007c). Olive ridley turtle adults and their eggs have been overharvested worldwide, at both arribada and solitary nesting beaches. A nationwide ban on harvesting females and eggs in Mexico has reduced the threat to eastern Pacific olive ridley turtles, but illegal harvesting of both eggs and adults is still believed to be widespread. Fishing gear also causes turtle mortality, primarily by capture in trawls, longlines, purse seines, and gillnets.

3.4.4.5 Aleutian shield fern

Aleutian shield fern

The Aleutian shield fern (*Polystichum aleuticum*) is endemic to Mt. Reed on Adak Island, in the center of the Aleutian Island chain of Alaska (approximately 51°N, 176°W), making it one of the rarest and most restricted ferns in North America. A member of the wood fern family Dryopteridaceae (USDA, 2011), it is a dwarf fern and measures approximately 10 to 15 cm (3.9 to 5.9 in.) in height (Talbot and Talbot, 2002). Within Alaska, the *Polystichum* genus also includes sword ferns and several species of hollyferns.

In 1988, the Aleutian shield fern was listed as endangered, and 4 years later a recovery plan was developed. USFWS initiated its 5-year review in 2005 (USFWS, 2007a). A management plan was completed it in 2007 (Byrd and Williams, 2007).

3.4.4.5.1 Distribution and critical habitat

The known Aleutian shield fern distribution is restricted to a northeast ridge of Mt. Reed on Adak Island in the center of the Aleutian Island chain in Alaska (approximately 51°N, 176°W), from approximately 340 to 560 m (1,115 to 1,837 ft) in elevation. The species was first collected on Atka Island, 80.5 km (50 mi) east of Adak Island, in 1932. In 1975, a small population was discovered on the rocky slopes of Mt. Reed on Adak Island. The estimated population at the time of its listing in 1988 was seven plants. In 1992, the population was estimated at 112 plants, all located on Adak Island (Anderson, 1992). Extensive efforts since 1975 have not able to relocate the fern on Atka. Surveys have also been conducted on 11 other Aleutian Islands but have not documented any additional Aleutian shield fern populations (Byrd and Williams, 2007). No critical habitat has been established for the Aleutian shield fern (USFWS, 2011d).

3.4.4.5.2 Population status

The Aleutian shield fern was listed as endangered in 1988, and a recovery plan was developed in 1992. The 5-year review concluded that the fern should remain classified as endangered (USFWS, 2007a). At the time of the writing of the 2007 management plan, the population was estimated to be 142 clumps of plants in four subpopulations on the rocky slopes of Mt. Reed on Adak Island (Byrd and Williams, 2007). Mt. Reed is located within the AMNWR. A greenhouse conservation effort was also established in 1992 to preserve the Aleutian shield fern, but due to several factors, including the slow growth of the species, the effort was abandoned after a few years (Byrd and Williams, 2007).

3.4.4.5.3 Habitat requirements

The current known Aleutian shield fern habitat on Mt. Reed consists of rock grottos and moist crevices at the bases of steep rock outcrops on east- to northeast-facing slopes, between approximately 340 and 560 m (1,115 and 1,837 ft) in elevation. Most of the plants grow in clumps along rock walls and on shallow soil mats that cap rocks. The fern is associated with dwarf willow-moss, dwarf willow-sedge-moss, and sedge anemone/arnica moss communities (Talbot and Talbot, 2002; Byrd and Williams, 2007). The climate on Adak Island is cool and moist, with mild temperatures and fog that often blankets Mt. Reed during the summer months.

3.4.4.5.4 Current stressors and threats

Distribution
- Adak Island

Habitats
- Terrestrial

Vulnerabilities
- Disturbance

The factors that contribute to the rarity of the Aleutian shield fern are not understood but are thought to be primarily related to natural processes, including the inefficiency of the fern in natural reproduction and distribution (Anderson, 1992; Byrd and Williams, 2007). Potential stressors and threats to the fern include human foot traffic, introduced ungulates (i.e., caribou), and earthquakes and other natural events that can cause slumping of the fragile soil mats on the rock faces on which the ferns grow (Byrd and Williams, 2007). In 1958 and 1959, 23 caribou were introduced to Adak Island to provide hunting opportunities (Anderson, 1992). As of 2007, their population had increased to around 2,700 animals, which are commonly seen on the lower slopes of Mt. Reed. Although no sign of caribou grazing or trampling have been noted within the vicinity of the Aleutian shield fern population, the increased caribou numbers suggest that they might at some point expand their range and pose a greater threat to the fern population (Byrd and Williams, 2007).

The military installation on Adak Island closed in 1997, and the human population currently numbers around only 300 residents in the town of Adak, down from almost 6,000 at the peak of the military presence. Therefore, human traffic is currently less of a threat to the fern than it was prior to 1997.

These human and natural threats are of increasing concern for such a spatially restricted and isolated species as the Aleutian shield fern. A single event has the potential to destroy a large percentage of the known population. The fern is currently protected under existing AMNWR regulations. Additional efforts to protect the fern include yearly visits by botanists to Mt. Reed to document any changes to the site, as well as discussions of fencing off the site of the fern population, and caribou management efforts by the ADF&G.

4 Effects on Protected Species and Critical Habitats

This section evaluates the likelihood that an individual species listed under the ESA would encounter a response action and identifies the effects associated with that encounter. The likelihood of an encounter is based on the incidence, location, and timing of historical spills relative to the distribution (spatial and temporal) of ESA-listed species and critical habitats. The sufficiency of decision processes and response practices that would be implemented under the Unified Plan to protect vulnerable species and habitats are also evaluated.

The underlying assumption of this evaluation is that in the event of a spill, implementing an appropriate response action would provide greater protection for ESA-listed species and habitats than not responding to the spill. Decisions made during an emergency spill response are focused on protecting and reducing risks to human and environmental resources, including ESA-listed species and critical habitats from exposure to a spilled material. During an emergency spill response, the Services identify known locations of sensitive species and habitats and then gather additional information to provide recommendations to the FOSC in order to avoid or minimize impacts on species and habitats from both the spill and the response activities. These recommendations are incorporated into the site-specific IAP agreed to and implemented by the Unified Command. Elements of the responses described in the IAP that are designed to protect listed species and critical habitats include:

- Initiating an emergency consultation at the onset of an emergency response, if the response activities used are not covered under this consultation
- Performing reconnaissance to verify the locations of protected species and habitats upon the advice of the Services
- Monitoring the location and behavior of spilled material relative to those species and habitats
- Establishing zones to protect sensitive resources and contain spilled material
- Implementing other BMPs identified by the Services or other natural resource agencies
- Conducting and overseeing the response action with awareness and care

Programmatic elements that are designed to protect resources include:

- Planning and coordinating on various scales (community to statewide levels) to identify stakeholder concerns, sensitive resources, and initial countermeasures that will expedite responses
- Involving federal and state natural resource trustees in plan development
- Staging response equipment in specific areas of Alaska that could be vulnerable to spills to minimize spill response times

- Conducting extensive training in spill response with agency and support personnel, communities, industry personnel, any holders of a spill response plan to increase response capabilities
- Performing collaborative risk evaluations to examine responses and likely outcomes under various scenarios prior to an emergency
- Involving the public in the review of response plans, revisions, and updates

Effects associated with response actions are discussed for each species by category of effect (see Section 4.1) as follows:

- Physical or behavioral disturbance (e.g., physical disruption, behavioral response)
- Exposure to contaminants (e.g., exposure to dispersants, dispersed oil, or airborne particulates or residues from an *in situ* burn)
- Exclusion from resources (e.g., lack of access to breeding, foraging, or refuge areas)
- Habitat degradation or loss (e.g., change in air, sediment, or water quality or areal extent of a specific habitat)
- Direct injury (e.g., ship or vehicle strikes, hypothermia from exposure to dispersants or dispersed oil)

The resulting impacts are further described in terms of their anticipated duration (temporary or long-term) and magnitude (low or high). For the purpose of this BA, the terms used to describe duration and magnitude are defined as follows:

- Duration
  - Temporary – Impacts would last only for the duration of the response action or for a single season beyond the cessation of the response action.
  - Long-term – Impacts would extend from the time of the response action to several years beyond the cessation of the response action.
- Magnitude
  - Low – A change in a resource (e.g., food, refuge, breeding habitat, migratory corridor) condition that does not significantly alter the survival, growth, or reproduction of the protected individual
  - High – A change in a resource (e.g., food, refuge, breeding habitat, migratory corridor) condition that clearly alters the survival, growth, or reproduction of the protected individual

It is important to note that response activities will likely have a range of potential effects in terms of both duration and magnitude, depending on various factors such as the individual animal's life stage, specific sensitivities or vulnerabilities, the type of oil or fuel product, and the nature and scale of the response interaction.

4.1 DESCRIPTION OF EFFECTS CATEGORIES

The five effects categories used to evaluate impacts to ESA-listed species and critical habitats in this BA are described in detail in the following subsections and include common examples of each effect.

4.1.1 Physical or behavioral disturbance

Physical or behavioral disturbance is defined as any alteration of an animal's normal behavior caused by the presence of response workers and/or equipment. An animal's reaction to the presence of workers and equipment is often flight, mimicking a response to predators. Behaviors are typically dictated by season and life stage and include feeding, breeding, rearing, nesting, calving, molting, resting, or migrating. Animal behavior has evolved to optimize survival, and a key component of survival is minimizing energy expenditure. Because disturbance is likely to increase energy expenditure as an animal flees from an area of optimal habitat, the result potentially decreases fitness and overall survival of that individual and its young, if present. In general, disturbance would be expected to be temporary. Examples of the effects of physical or behavioral disturbance include whales swimming away from an area of concentrated forage as a reaction to vessels and associated noise; birds abandoning their nests as a reaction to the presence of spill response workers, thus exposing their eggs or young to predators and the elements; boat noise disrupting beluga whales' ability to use acoustic signals to communicate, navigate, and locate prey; or any animal leaving an area of refuge as a reaction to a spill response activity. Any injury indirectly resulting from a behavioral reaction (e.g., chick mortality when a parent is flushed from a nest) is evaluated in this category rather than in the direct injury category, which includes only injuries directly resulting from response activities (e.g., ship or vehicle strikes).

Note that if an action prevents an animal from accessing optimal habitat (e.g., a nesting or forage location) due to avoidance rather than a flight response, this effect is included in the exclusion effects category. For example, if an airplane or boat causes walruses to flee a haulout area, this is a physical/behavioral disturbance effect. However, if increased boat or air traffic near a haulout causes walruses to avoid the haulout altogether, this is an exclusion from resources effect.

4.1.2 Exposure to contaminants

For the purposes of this BA, exposure to contaminants is examined with regard to response actions that include the application of dispersants or *in-situ* burning. Both of these response actions must be approved by the ARRT prior to implementation (EPA et al., 2010), except areas that may become subject to pre-authorization. Exposure to airborne or particulate residues from in-situ burning is discussed for sensitive species. A more extensive evaluation of the effects from use of two chemical dispersants, Corexit® 9500 and Corexit®9527, as well as the effects of dispersed oil are discussed as part of the exposure assessment.

The dispersant formulations Corexit® 9500 and Corexit®9527 are the chemical agents that are available for use (i.e., currently stockpiled) in Alaska, although Corexit® 9527 is no longer manufactured and availability is restricted to existing stocks.

Dispersants are used only in an oiled aquatic environment (Alaska Clean Seas, 2010) (i.e., the baseline condition). Thus, it is assumed that the identified species or their prey will most likely be exposed to dispersants in conjunction with oil (i.e., dispersed oil) rather than concentrated or diluted dispersants alone. Exposure to dispersants without oil would only occur under the condition of overspray or a missed target trajectory during spray, which is anticipated to be an unlikely occurrence (Butler et al., 1988). The inadvertent and direct spraying of wildlife with dispersant chemicals is also possible but unlikely assuming that all appropriate measures have been taken to avoid such an exposure (e.g., spraying when wildlife are not present, monitoring for the presence of wildlife, establishing buffer zones, and/or deterring wildlife from approaching an area where a response action is being carried out) (Nuka Research, 2006; Alaska Clean Seas, 2010).

In order to assess the risks associated with exposure to dispersants and dispersed oil, it was first necessary to research the known or potential adverse impacts of the approved chemical dispersants, alone or in a mixture with oil, both directly on species listed under the ESA (or similar surrogates) and indirectly on their prey. These impacts then needed to be weighed against the baseline condition. In order to properly assess the exposure and effects of dispersants and dispersed oil, it was then necessary to determine the fate, transport, and toxicity of these chemical mixtures. Once the data had been compiled, it was analyzed. The synthesis of available data regarding the known impacts on ESA-listed or candidate species and their prey, toxicity in laboratory testing, and fate and transport testing was weighed with species-specific information (i.e., life history, seasonal use of Alaska waters, feeding strategies, and habitat associations) to reach a determination of direct and/or indirect adverse effects on individual ESA-listed or candidate species. Appendix B details the properties of dispersants and dispersed oil as discovered during the research phase as well as the results of the evaluation, and both are summarized below.

Chemical dispersants remove crude oil from the ocean surface by redistributing oil as dispersed droplets into the water column to a depth of approximately 10 m (NRC, 2005); this depth is defined by the pycnocline, which is a salinity-driven water density barrier to deeper mixing of surface waters (NRC, 2005; NOAA, 2012b). The dispersion process has been documented to occur under Arctic conditions (e.g., under and around sea ice or within ice leads and in cold water temperatures) (Potter et al., 2012; Sørstrøm et al., 2010; Brandvik et al., 2010; MMS, 2010).

During the dispersion of oil, the concentration of oil at the ocean surface decreases rapidly as a result of the dilution of chemically dispersed droplets (Mackay and McAuliffe, 1988); dispersants dilute at a similar rate (Gallaway et al., 2012; NOAA, 2012b).Chemical dispersants also increase the efficiency of biodegradation in natural marine bacterial communities (Hazen et al., 2010; Lu et al., 2011; Baelum et al., 2012) even under Arctic conditions (Lee et al., 2011a; McFarlin et al., 2012a). The rates of biodegradation of component chemicals of dispersants vary substantially (West et al., 2007; Dow, 1993, 1987; Dow AgroSciences, 2012; OECD, 1997; EPA, 2009; TOXNET, 2011; EPA, 2005, 2010; Scientific, 2010; Howard et al., 1991; Staples and Davis, 2002; Rozkov et al., 1998; Baelum et al., 2012). The rate at which degradation decreases the concentration of dispersed oil in the water column is much lower than the rate at which dilution occurs (Mackay and McAuliffe, 1988; NOAA, 2012b; Gallaway et al., 2012; TOXNET, 2011; Baelum et al., 2012); however, dilution does not result in the destruction of dispersant or oil components, only their redistribution into the environment.

The use of chemical dispersants is expected to mitigate many impacts on the majority of ESA-listed or candidate species, particularly those that are active at the ocean surface (e.g., pinnipeds, birds) because the oiling of sensitive habitat and direct exposure to concentrated surface oiling will assumedly be reduced after the use of dispersants (NRC, 2005; Lessard and Demarco, 2000; Fingas, 2008a). However, listed pelagic species, such as herring or salmonids, would likely be more exposed to oil under dispersed conditions, more so than if oil were not dispersed. Impacts on these species are highly dependent on their life stage at the point of exposure: individuals at early life stages (e.g., eggs, embryo, larvae) are likely to be more sensitive to dispersed oil than those during late juvenile or adult life stages (Rand, 1995). Listed pelagic species (at various life stages) may represent a major prey item for other ESA-listed or candidate species, so toxic impacts on the listed pelagic species, particularly during sensitive life stages, could result in indirect effects (i.e., impacted prey base). Although spawning habitats for certain species (e.g., salmonids, herring) have been identified in GRS for many areas (ARRT, 2013) and could therefore be excluded from chemical dispersant use, indirect impacts would be likely under a worst-case scenario (i.e., oiled spawning habitat inadvertently sprayed with chemical dispersants) (Appendix B).

The acute toxicity (i.e., lethality) of oil is greater than that of dispersants or dispersed oil, based on the dissolved concentrations of each (Appendix B). Although chemical dispersants can greatly increase the concentrations of dissolved components of oil, such as PAHs (Milinkovitch et al., 2011; Ramachandran et al., 2004; Wolfe et al., 1998; Wolfe et al., 2001; Yamada et al., 2003), exposures to such components have decreased in a few cases (Chase et al., 2013). OPAHs in solutions with surfactants partition into the water column but remain sorbed to the surfactants (Volkering et al., 1995; Liu et al., 1995; Kim and Weber, 2003; Guha et al., 1998). The desorption of dissolved-phase PAHs from surfactants results in the repartitioning of PAHs to the non-bioavailable solid phase (Kim and Weber, 2003). Therefore, laboratory tests show that dispersants may not greatly impact the bioavailability of PAHs in all cases. Conversely, many have reported that dispersed oil is more toxic than oil alone (Milinkovitch et al., 2011; Ramachandran et al., 2004; Couillard et al., 2005; Faksness et al., 2011), possibly because of increased exposures to toxic components of oil such as PAHs in solution. Because these two potential and contrary outcomes exist, there is uncertainty in the toxicity of chemically dispersed oil. There is also uncertainty regarding the relative toxicity of dispersed oil due to photo-enhanced toxicity (Barron, 2006; Barron et al., 2008). Photo-enhanced toxicity results from the interaction between ultraviolet (UV) radiation and certain contaminants when ingested by certain species, particularly those that have translucent bodies (e.g., plankton and embryonic or larval fish and invertebrates) (Barron et al., 2008). In Alaska, this is a particularly important environmental factor due to extreme seasonal periods of light (e.g., "midnight sun" phenomenon) and dark. For example, during spring and summer, UV exposure in the Alaska marine environment is greatly extended, potentially contributing to a relatively higher potential for photo-enhanced toxicity of PAHs (Barron et al., 2008). This is a point of uncertainty for the analysis presented in Appendix B, because not all of the toxicity data used to determine the relative toxicity of oil, dispersants, and dispersed oil (see Attachment B-1 for a complete list of the studies) was conducted under natural lighting conditions; toxicological experimentation involving chemicals that can undergo photolysis (e.g., PAHs) tend to exclude environmental UV during testing in order to prevent degradation of the chemical being measured, which sometimes results in greatly underestimated toxicity of PAHs in the field (Rand, 1995).

Pacific herring and Pacific walrus are the species most likely to be impacted from a toxicological standpoint (i.e., excluding considerations of disturbance or exclusion from habitat for example) by the use of chemical dispersants, even if all appropriate measures (e.g., avoiding known spawning habitat) are taken to ensure the safety of fish and wildlife during a response action (Appendix B). If such measures fail to ensure the safety of ESA-listed or candidate species or their prey, then any species could be adversely impacted if they were to be present in Alaska in areas where such a response occurs.

4.1.3 Exclusion from resources

Exclusion from resources is the prevention, either directly or indirectly, of an animal's ability to access optimal habitat (e.g., breeding, forage, refuge), either by physically preventing the animal from using a habitat or by causing an animal to avoid a habitat, either temporarily or long-term. It is assumed that spill response activities would cause exclusion only in very specific circumstances because in most cases, an animal could fly, swim, or otherwise move to an adjacent unaffected area that would provide quality habitat. Animals are more vulnerable to exclusion during the breeding / rearing season or in areas where large numbers of a species are congregated in a single location (e.g., walrus haulouts or bird wintering areas on leads in the sea ice). Specific examples of exclusion include *in situ* burning that temporarily excludes a bird from a nesting or foraging area or repeated airplane or boat traffic that causes walruses to avoid a certain haulout area.

If an action causes an animal that is present in an optimal habitat to flee from that habitat, the action is considered to be a physical disturbance.

4.1.4 Habitat degradation or loss

Habitat degradation or loss is when physical or chemical perturbations result in alterations in the amount or quality of a habitat. Examples include:

- Degradation of water quality from increased concentrations of petroleum compounds (e.g., PAHs) in the water column as a result of the use of dispersants
- Reduction in prey as a result of the mortality of the benthic and epibenthic invertebrate community following use of hot water for flushing and flooding on a shoreline
- Reduction in pelagic prey (e.g., plankton, invertebrates, and larval fish) as a result of contact with dispersed oil
- Degradation of habitat through the removal of contaminated vegetation or soil from Arctic tundra nesting habitat
- Degradation of habitat through the loss of vegetation and surface soil microbes and invertebrates as a result of *in situ* burning in terrestrial environments
- Reduction in prey as a result of benthic communities being smothered by burnt residues following *in situ* burning in aquatic environments

As with all of the effects categories, the magnitude of the impact depends on the duration, location, and spatial scale of the response action. Any change in water quality due to the use of dispersants would be considered temporary relative to the baseline condition because dispersants are readily biodegradable (West et al., 2007; Dow, 1993, 1987; Dow AgroSciences, 2012; OECD, 1997; EPA, 2009; TOXNET, 2011; EPA, 2005, 2010; Scientific, 2010; Howard et al., 1991; Staples and Davis, 2002; Rozkov et al., 1998; Baelum et al., 2012) and increase the rate of oil degradation (Hua, 2006; Lindstrom et al., 1999; Lindstrom and Braddock, 2002; Hazen et al., 2010, cited in Lee et al., 2011a; McFarlin et al., 2012b; Otitoloju, 2010; MacNaughton et al., 2003; Prince et al., 2003; Zahed et al., 2010; Zahed et al., 2011; Prince et al., 2013; Baelum et al., 2012). Impacts to benthic communities in shoreline and nearshore areas would likely have a longer-term effect (Peterson et al., 2003), but these impacts could be reduced after a dispersant application relative to oiling alone (Cross and Thomson, 1987; Humphrey et al., 1987). As an example, long-term effects in sediment and nearshore areas were observed after the *Exxon Valdez* oil spill, whereas the observed water column effects were short-lived (Peterson et al., 2003). Long-term leaching of oil from shoreline sediment results in chronic exposures of wildlife to hydrocarbons (Peterson et al., 2003), whereas dispersed oil does not persist so long in the environment, resulting in reduced exposure durations (Cross and Martin, 1987; Cross and Thomson, 1987; Mageau et al., 1987; Humphrey et al., 1987); however, sublethal or acute impacts may still result in long-term impacts in sensitive species (e.g., bivalves) (Cross and Thomson, 1987). These impacts are discussed in more detail in Appendix B.

Any loss or degradation of tundra habitat (e.g., destruction of permafrost) would also likely represent a longer-term impact if it were to occur on a large scale (e.g., acres) because this habitat recovers at a very slow rate (i.e., from several seasons to years) (Osterkamp et al., 2009).

4.1.5 Direct injury

Direct injury includes physical injury, extreme physiological stress, and/or the mortality of an individual organism as a result of interaction with spill response activities or workers. The onsite implementation of response activities as well as mobilization and demobilization could increase the risk of direct injury as a result of ship or vehicle strikes. *In situ* burning is also commonly identified as having the potential to cause direct injury via heat stress and/or smoke inhalation if, for example, a whale were to surface directly within or downwind of an area being burned (ADEC et al., 2008).

Indirect mortality that results from disturbance is discussed under the physical or behavioral disturbance category. For example, an action that causes an adult bird to abandon a nest resulting in the mortality of its chicks (from predation or exposure), or juvenile walruses that are crushed during a stampede as a reaction to a low-flying aircraft over a haulout area, are evaluated as a disturbance rather than direct injury.

4.2 Evaluation of Individual-Level Effects by Species

4.2.1 Beluga whale – Cook Inlet distinct population segment

Spill response activities that occur in or near Cook Inlet can affect the small population of Cook Inlet beluga whales. Belugas use a diverse range of habitats in the inlet, varying by season, including river channels and deltas, shallow nearshore habitat, and mid-inlet waters (Section 3.2.1.3). In spring and summer, beluga whales are more frequently found in shallow coastal areas, which they prefer for feeding, calving, and predator evasion. In late autumn through early spring beluga whales tend to use deeper, mid-inlet waters (NMFS, 2008a), as their prey availability and distribution changes.

Between January 1995 and August 2012, there were 30 spills > 100 gal. in the marine waters of Cook Inlet. Of those, 19 (~ 1 per year) consisted of petroleum products (primarily diesel or other refined products). All petroleum product spills were below 600 gallons except one spill of 6,000 gal. (see Appendix D for spill data). There were four incidents of crude oil spills in Cook Inlet; all were < 500 gal. Spills occurred year round, most occurring in the mid inlet or near Homer. Figure 4-1 shows the spill locations, seasons, and types of material spilled in Cook Inlet during the 17 years between 1995 and 2012). Mechanical containment, recovery, and cleanup were the primary response actions, when noted; there are no records of dispersant use in response to spills in Cook Inlet during this period.

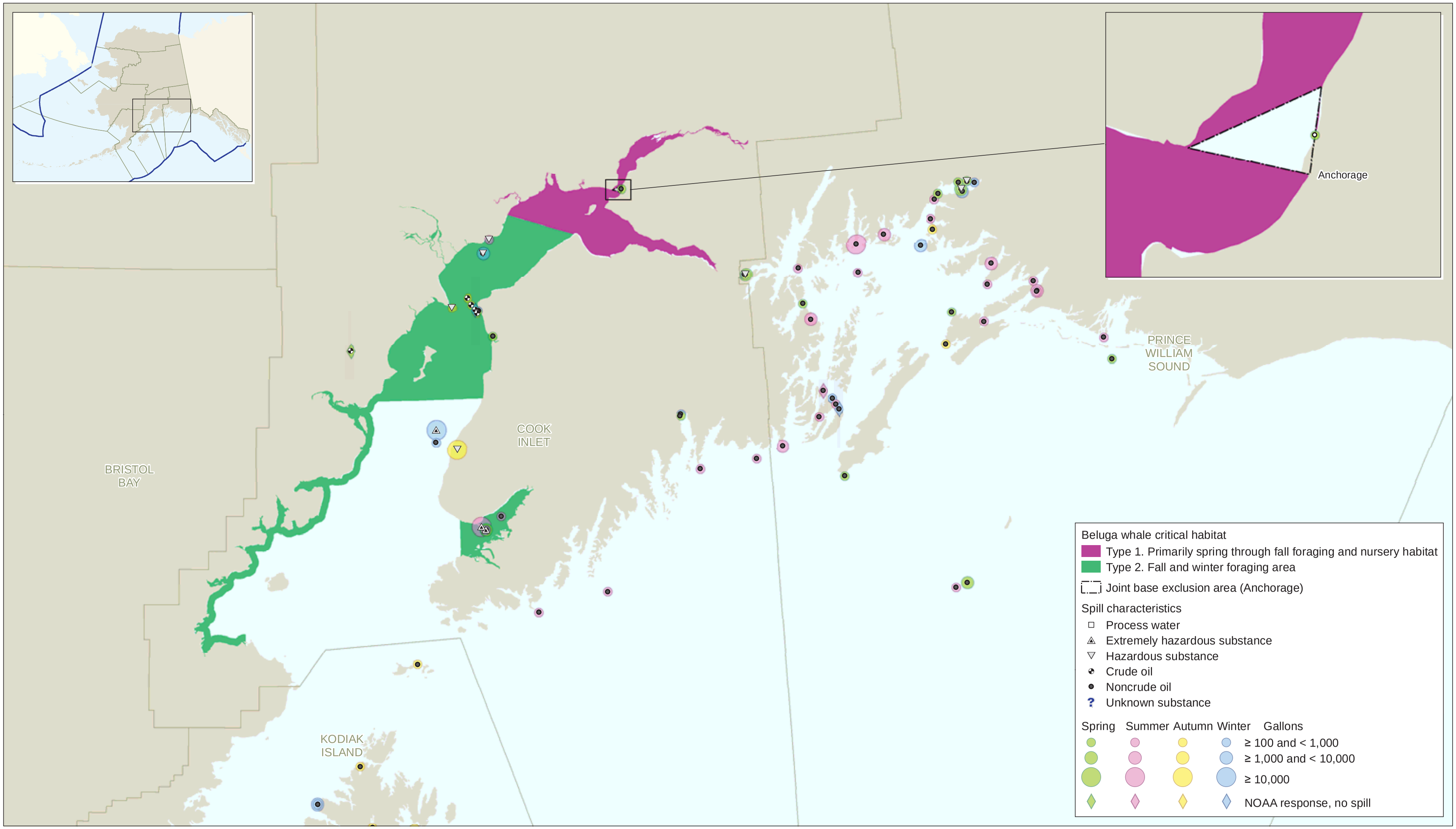


Figure 4-1. Characteristics of spills that occurred between January 1995 and August 2012 and beluga whale critical habitat areas

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Over 130 GRS have been approved for Cook Inlet (ARRT, 2013); each GRS defines specific locations for staging response actions and boom placement, areas appropriate for collection and recovery of oil products, and resources to be protected. There is also specific guidance about when and where dispersants can be used in the inlet. Activities designed to avoid or minimize wildlife impacts would be implemented as part of the spill response in consultation with the Services; these actions would be documented in the IAP.

The following subsections describe how spill response activities could affect the beluga whale and are organized according to the five effect categories detailed in Section 4.1.

Response activities that do not occur in beluga whale habitat and thus will not adversely affect beluga whales include the creation of berms, dams, barriers, pits, and trenches; culvert blocking; and vegetation cutting and removal.

4.2.1.1 Physical or behavioral disturbance

Avoidance and minimization measures (e.g., observing whales, establishing buffer zones, reducing vessel speeds in the vicinity of whales, altering routes) will help ensure that response actions do not cause physical or behavioral disturbance to beluga whales. However, if the use of these measures is precluded, individual beluga whales could be disturbed by the increased presence of response workers, boats, equipment and materials, aircraft, and associated noise.

Beluga whales can potentially be affected by booming, skimming or vacuuming, the placement of sorbents, removal of beach sediment, application of dispersants, *in situ* burning, spill tracking and monitoring, mobilization and demobilization, and marine transport of solid wastes. All of these spill response activities involve aircraft, vessels, equipment, and personnel, all of which introduce noise to the beluga whales' environment. Within their critical habitat, unrestricted passage within or between critical habitat areas is a PCE which may be affected by response operations.

Beluga whales use acoustic signals to communicate, navigate, locate prey, and sense their environment. Noise can disrupt these essential whale behaviors, resulting in highly variable impacts on individuals, groups of animals, or populations. Anthropogenic noise can directly mask communication between beluga whales (NMFS, 2009b). Beluga whales have been reported to change their call types, rates, and frequencies when a boat approaches, possibly to make their calls more detectable (Lesage et al., 1993; cited in Richardson et al., 1995). Richardson et al. (1995) stated that noise can also reduce the availability of prey or increase vulnerability to other hazards, such as fishing gear or predators, both of which constitute indirect effects on beluga whales. Coastal marine areas such as those in Cook Inlet, however, are subject to anthropogenic noise pollution under the baseline condition (Southall et al., 2007), and the noise produced by spill response teams will contribute to this noise, although for a limited duration.

Individuals can apparently habituate to vessel noise and activity over time. Richardson et al. (1995) reported that beluga whales can tolerate frequent passages made by larger vessels traveling in consistent directions, but they often flee from fast and erratically moving small boats. Even when beluga whales are heavily hunted, they still return annually to their traditional estuarine summering grounds, only showing short-term, localized displacement when harassed (Finley et al., 1982; cited in Richardson et al., 1995). NMFS (2009b) however, states that the effects of harassment could result in habitat abandonment, further exemplifying that beluga whale reactions to disturbance are variable. If a summer feeding area were to be abandoned, it would be considered a high-magnitude, long-term direct effect because of the implications for winter survival.

The effects of response actions on beluga whales will vary due to a number of factors including, but not limited to, the location, timing, duration, areal extent, and intensity of the activity, as well as the ability of the individual whale to move away from the activity. Based on the history of spills that have occurred to date (e.g., the largest spill, which consisted of a maximum volume of 6,000 gal. of a relatively non-persistent material, was allowed to disperse naturally), disturbance will likely be a low-magnitude, temporary effect.

4.2.1.2 Exposure to contaminants

The restricted distribution of Cook Inlet beluga whales increases their risk for exposure to dispersants or *in situ* burning in the event that those response actions are selected in Cook Inlet. Should dispersants or *in situ* burning be selected as a response to a future spill, exposure to dispersed oil or smoke could occur. Although these responses have not been used in Cook Inlet to date and exposure is unlikely given the decision criteria for implementation (e.g., significant restrictions on timing relative to tides, distance to shore, location of sensitive resources, known presence and movements of beluga whales within Cook Inlet, proximity of Cook Inlet waters to available response equipment) (Norman, 2011; Hobbs et al., 2011; NMFS, 2008a; Alyeska Pipeline Service, 2008), exposure remains a possibility.

If dispersants were applied during a spill response, chronic effects of dispersant exposure on beluga whales would not be expected due to the rapid rate at which current formulations dilute and biodegrade in the environment (Appendix B). The acute toxic effects related to dispersed oil exposures (in the water column) would likely be less than those caused by oil alone, particularly for beluga whales, which spend much of their time near the ocean surface; this is due to the severity of impacts related to the aspiration of liquid or inhalation of volatile components of oil as opposed to those related to dermal exposure or ingestion (Section 5.1.1 of Appendix B).

The uptake and effect of PAHs on cetaceans is a point of uncertainty requiring further study. It is possible that the application of chemical dispersants would temporarily increase the exposure of beluga whales to PAHs through the water column and through their diet. The likely impact of such a temporary increase in exposure is unclear (Section 6.3.4 of Appendix B).

Beluga whales could be indirectly affected if their primary prey (i.e., salmonids, eulachon, several species of cod, sole) or the food of their prey (i.e., small fish and invertebrates, plankton) is exposed to dispersed oil. The exposure of several prey species to dispersed oil could cause an acute toxicological response, which could affect them during early life stages and potentially reduce the localized abundance of the food of beluga whale prey species (e.g., planktonic invertebrates). Embryonic or larval fish may be severely impacted by the application of dispersants and exposure to dispersed oil (Sections 3.1.2.1, 4.2, 4.3, and 5.3.4 of Appendix B); however, larger juveniles and adults will not likely be exposed to sufficient amounts of dispersed oil or dispersants to cause mortality (Sections 4.2, 4.3, and 5.3.1 to 5.3.3 of Appendix B).

Exposure to *in situ* burning is unlikely for all whale species. Decision criteria associated with *in situ* burning as a response action restrict its use in the vicinity of a protected species or critical habitat, and beluga whales are expected to avoid the types of activities associated with *in situ* burning, deterred by noise and presence of ships. However, NMFS (2003) stated that if a whale is within ~0.25 mi (0.4 km) of an *in situ* burn, the risk of soot and emissions exposure by surfacing cetaceans is increased. Inhalation of soot particles upon surfacing could cause irritation to membrane tissues (i.e., lung tissue), and significant exposure could impair lung function, although these effects have not been documented in whales.

Although not documented, *in situ* burning could potentially affect invertebrates and larval fish (i.e., whale prey) that might be present at the sea surface through heat stress (significantly increased temperatures do not extend far into the water column). During a simulated *in situ* burning, Evans et al. (1988; cited in NMFS, 2003) determined that significant heating occurred at the surface and to a depth of 5 in. (~13 cm), while temperature changes were minimal beyond the 5-in.-depth mark. Planktonic organisms would be replaced as the water mass associated with the burn mixes with unaffected waters or through recruitment as seasonal reproduction or spawning occurs, depending on the timing of the burn. The area of the burn would have to be extremely large relative to the total area of Cook Inlet to reduce recruitment to adult prey populations of beluga whales.

Discharge of treated water could expose beluga whales to contaminants if effluent limits are not met. The expectation is that treated effluents would meet state water quality standards and conditions, including those for petroleum compounds, prior to discharge, thus mitigating this risk.

Waters free of toxins or other agents in amounts harmful to beluga whales and abundant prey species are both PCEs of the beluga whale critical habitat. Therefore, chemical dispersant application and *in situ* burning response actions may result in adverse affects to these PCEs if residual chemicals are present at concentrations that are harmful to beluga whale and their prey.

4.2.1.3 Exclusion from resources

Beluga whales could be excluded from a resource if they avoid it due to the increased presence of response workers, boats, response equipment and materials, aircraft, and associated noise. Depending on the duration of response activities, beluga whales could be excluded from their environment temporarily or could abandon the habitat entirely.

Noise disturbance and human activity could directly prevent beluga whales from using their preferred resources. Native hunters near Kotzebue Sound reported that beluga whales abandoned areas where fishing vessels were common (NMFS unpublished data, cited in NMFS, 2008a). Beluga whales in Cook Inlet have exhibited some habituation to in-water activities and might not be disturbed by some sounds, depending on the timing and acoustic frequency (Norman, 2011). However, based on the responses of other whales (Norman, 2011), if human activity is more significant or of longer duration, then the likelihood that beluga whales will avoid the cleanup area and possibly be excluded from essential resources will be increased.

The degree to which habitat exclusion would affect beluga whales depends on many factors. Due to their mobility and use of open water habitat, it is expected that the majority of spill response activities will have a minor and temporary effect on the ability of beluga whales to access important resources. However, a longer-duration response effort could lead to prolonged exclusion from resources and adversely affect the Cook Inlet beluga whale population. Unrestricted passage within or between critical habitat areas is a PCE and, therefore, exclusion may impact their critical habitat.

4.2.1.4 Habitat degradation and loss

Response activities could adversely affect beluga whale habitat, including critical habitat. Essential characteristics of beluga whale critical habitat include abundant primary prey, access to shallow-water feeding and refuge areas, absence of toxins, and absences of noise sufficient to cause habitat abandonment. Potential effects from response activities include, but are not limited to, short-term degradation of water quality and/or air quality from the use of dispersants or *in situ* burning, short-term changes in the food web that supports their prey base from use of dispersants, and anthropogenic noise from the use of vessels and aircraft.

Intertidal and subtidal waters of Cook Inlet are PCEs and may be affected by response operations in these areas. Water quality could be directly degraded by dispersants and dispersed oil, but degradation would be short-term inasmuch as these chemicals are not expected to persist (Appendix B). Changes in the seasonal prey base (e.g., small fish and their planktonic prey) of beluga whale's primary prey (i.e., salmonids, eulachon, cod, and sole) could occur in the vicinity and down current of the area where dispersants are applied. Although such impacts are expected to be temporary and localized, inasmuch as larval fish and plankton could recolonize an affected area within weeks or months (Abbriano et al., 2011), any change in the food web potentially reduces habitat quality. As a result of policy and guidance, the use of dispersants in nearshore habitats or near concentrations of wildlife is avoided. Dispersants were not used in Cook Inlet during the 17 years between 1995 and 2012, and future dispersant use in the area would require concurrence by the incident-specific RRT and consultation with the Services prior to implementation.

The noise level in the water is also a PCE in the critical habitat designation for Cook Inlet beluga whales and, therefore, if noise levels exceed thresholds, this may be considered an adverse modification. Noise represents a temporary degradation of habitat quality, and effects would be considered significant if the noise caused beluga whales to abandon a feeding or shallow-water refuge area. Noise impacts (including behavioral disturbance) could be mitigated by BMPs, such as the use of overflight altitude limits, use of buffer zones, and reductions in vessel speeds.

4.2.1.5 Direct injury

The primary sources of direct injury from spill response activities are ship strikes and entanglement in response equipment. Exposure to heat from *in situ* burning is a potential, although unlikely, source of direct injury.

Ship strikes are a serious risk for the beluga whale population, especially because beluga whales can habituate to vessel traffic. The presence of vessels and deployed equipment will increase substantially during most spill response activities. The Cook Inlet beluga whale conservation plan (NMFS, 2008a) ranks the threat of strikes by large ships as "low impact," and the threat of strikes by small ships as "moderate impact" to population recovery. Beluga whales are also at risk of entanglement in ropes and other equipment (e.g., anchor lines, booms, sorbent materials) associated response activities. Incidents of beluga whale entanglement in fishing nets have been documented (NMFS, 2008a); entanglement in response equipment is possible.

Ship strikes and entanglement in equipment can have long-term, high-magnitude effects on beluga whales were these interactions to occur. Overall, response action protocols are designed to prevent these types of injuries through observation, tracking, and avoidance of the location and activities of protected species in the vicinity of an emergency response.

In the unlikely event that a whale were to surface in an area of an *in situ* burn, it could be exposed to extreme heat. Whales below the surface would not likely be affected due to the rapid attenuation of temperature with depth (Evans et al., 1988).

4.2.1.6 Determination of effects

Beluga whales in Cook Inlet are present year-round in a geographically restricted area that has the greatest level of anthropogenic activity in Alaska. Marine shipping, oil and gas exploration and production, and human development are expected to intensify in this area, increasing the likelihood of a spill and a resultant response action, even with the commensurate increase in safety regulations and standards of practice.

In the event that protective measures, including field-implemented BMPs, are unsuccessful in preventing interactions between individual beluga whales and spill response activities, response actions could result in high-magnitude adverse effects on individual beluga whales, including:

- Physical injury via entanglement with equipment or ship strike
- Impaired breathing or lung damage from smoke inhalation following *in situ* burning

Response actions could also have lower-magnitude effects, including:

- Behavioral disturbance due to small vessel and aircraft noise or activities associated with *in situ* burning or dispersant application
- Alteration of the food web through the use of dispersants (e.g., temporary changes in abundance and composition of prey due to dispersed oil toxicity)
- Tissue irritation (i.e., skin, eye, nose, mucous membrane) caused by exposure to or the ingestion of dispersed oil, dispersants, or smoke from *in situ* burning
- Short-term habitat degradation due to changes in water quality (from burnt residues or use of dispersants), noise levels, or prey base

Emergency response actions in Alaska are, as a matter of policy, based first on mechanical response actions. Non-mechanical responses are considered only if mechanical containment, removal, and/or cleanup are expected to be ineffective, incomplete, or dangerous for responders. *In situ* burning and dispersant application are only implemented if feasible (i.e., a number of field conditions must be met for the effective use of these responses), and the use of *in situ* burning or dispersants will cause less harm than would the spill in their absence. The use of these non-mechanical response methods is avoided near concentrations of wildlife or in nearshore habitats and requires concurrence from the incident-specific RRT and consultation with the Services prior to any decision regarding implementation.

The IAP and subsequent response actions are designed to protect sensitive resources; site-specific strategies have been created for the most important sites used by beluga whales in the Cook Inlet with the input of the Services and other natural resource trustees. Furthermore, during a response, all response activities are developed and implemented in consultation with Services to avoid or minimize impacts to ESA-listed species and critical habitats. If necessary, the harassment of beluga whales can be permitted by NOAA Fisheries if it is deemed critical to the prevention of exposure to oil or hazardous substances. Deterrence activities have the highest likelihood of impact on beluga whales because, by default, they constitute an adverse impact under ESA.

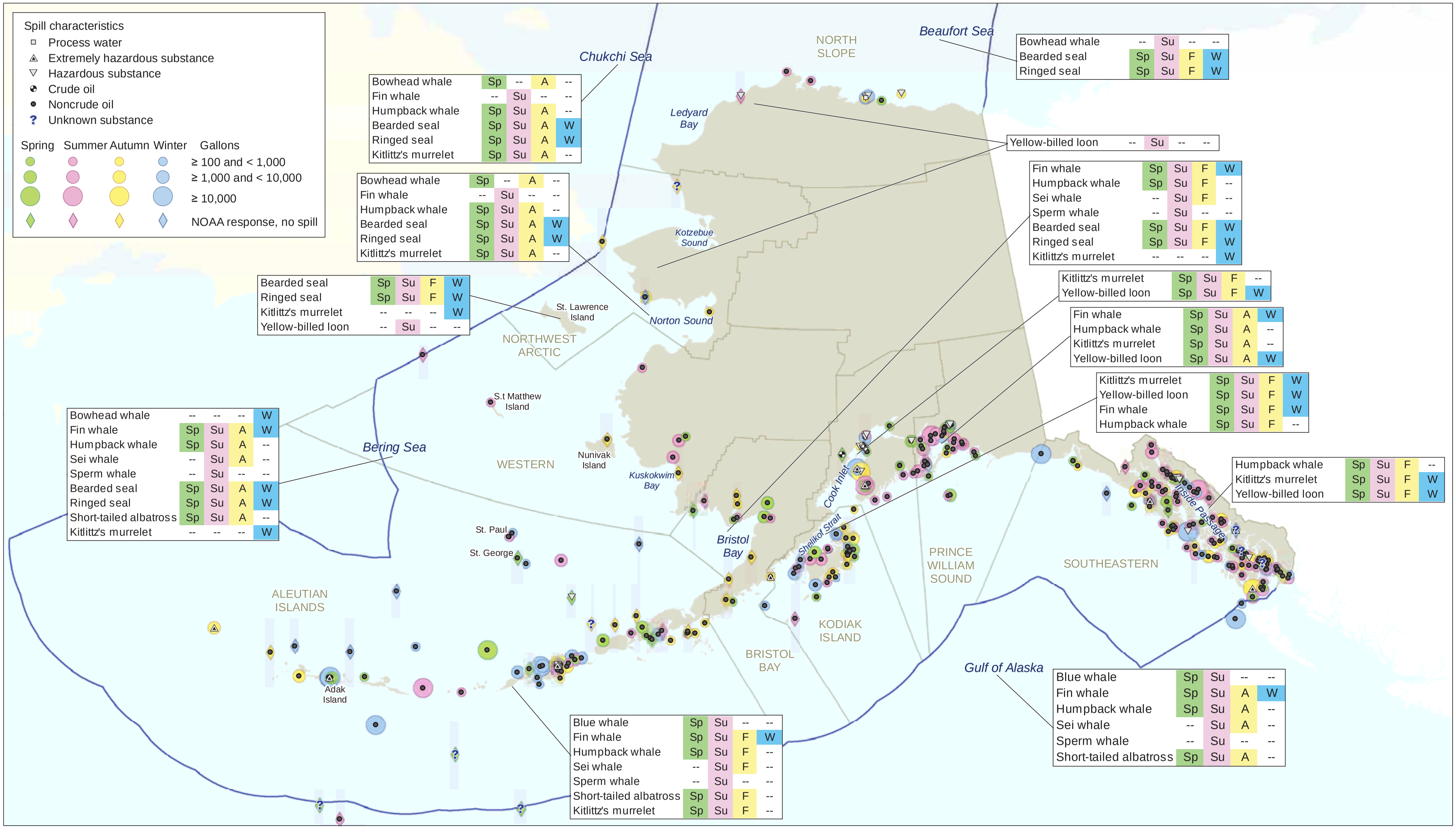
Although the protection of sensitive species and habitats is one of the highest priorities of a response action, the possibility remains that a beluga whale or its critical habitat could be adversely affected by response activities during implementation of the Unified Plan, particularly in Cook Inlet. Their year-round presence in an area of high anthropological activity increases the likelihood of potential exposure to and injury from response activities, which has significant ramifications for a sensitive species and thus cannot be discounted.

4.2.2 Blue whale

Once widely distributed in the North Pacific prior to whaling, only 15 sightings of blue whales occurred in the GOA and off the coast of British Columbia between 1997 and 2009 (Calambokidis et al., 2009). Three of these sightings were of blue whales feeding in Southeast Alaska (185 km offshore between Yakutat and PWS) and off the Aleutian Islands. Blue whales are found in the deep water over the continental shelf and in upwelling regions when their primary prey, phytoplankton and krill, tend to be abundant (US Navy, 2011; Reeves et al., 1998). Therefore, spill response actions that occur over deep, open water and coastal areas in Alaska (mainly the Aleutian Islands and GOA) could affect blue whales during their non-breeding season (May to October).

Since 1995, there have been approximately 20 spills greater than 100 gal. in the deep[29] marine waters of the GOA and southern Bering Sea in habitats most likely used by blue whales. Almost all involved refined petroleum products (primarily diesel fuel). Most spills were less than 1,000 gal.; 4 spills were between 1,000 and 10,000 gal.; 2 were greater than 10,000 gal (the maximum spill volume was 320,000 gal.) (see Appendix D for all spill data). No crude oil spills were recorded for this period. Spills occurred year-round; however, about half were in winter, when blue whales are not present. Figure 4-2 identifies the spill locations, seasons, and types of material spilled in Alaska during the 17 years between 1995 and 2012. Mechanical containment, recovery, and cleanup were the primary historical response actions, when noted; dispersants were approved for use in two events (for the M/V *Selendang Ayu* spill, north of the Aleutian Island chain, and the M/V *Cougar Ace* spill, south of the Aleutian Island chain), although dispersants were not physically applied in either instance. Dispersants were only approved for use and applied during the M/V *Kuroshima* spill in 1997.

[29] No depth information was available for historical spill records. A distance of 5 mi. from land was used as a surrogate for identifying deep water habitats.



WindWard environmental LLC

0 50 100 150 200 Miles

0 100 200 300 Kilometers

N

Data sources: USFWS, NOAA, ESRI, Canada Centre for Cadastral Management, and Alaska State Geo-Spatial Data Clearinghouse

Exclusive economic zone (200 nautical miles from TS)

Subarea contingency planning region

Figure 4-2. Characteristics of spills that occurred between January 1995 and August 2012 by season and habitat of other wildlife

Prepared by mkey, 1/23/2014; W:\Projects\06-60-01 US Coast Guard\Data\GIS\Biological_Assessment\Maps_and_Analysis\5352_Spills and presence of other wildlife_LSM_20131114.mxd

The following subsections describe how spill response activities could affect the blue whale and are organized according to the five effect categories detailed in Section 4.1.

Response activities that do not occur in blue whale habitat and thus will not affect blue whales include the deflection or containment berms, dams, or other barriers, pits, and trenches; and cleanup activities such as flushing and flooding, soil or sediment removal, or vegetation cutting and removal.

4.2.2.1 Physical or behavioral disturbance

Avoidance and minimization measures (e.g., observing whales, establishing buffer zones, reducing vessel speeds in the vicinity of whales, altering routes) will help ensure that response actions do not cause physical or behavioral disturbance to blue whales. However, if the use of these measures is precluded, individual blue whales could be disturbed by the increased presence of response workers, boats, equipment and materials, and aircraft, as well as any associated noise.

Anthropogenic noise is considered to be a threat of unknown severity to the blue whale population. The presence of people and operation of vessels and equipment necessary during response activities will introduce a source of noise to the whales' environment and has the potential to cause temporary, low-magnitude physical disturbance to and behavioral changes in the whales. Response activities that involve use of vessels and on-water equipment include wildlife protection (i.e., hazing); booming and skimming; the placement of sorbents and dispersants; *in situ* burning; activities associated with the tracking and monitoring of spills; and mobilization and demobilization. In the open ocean habitat used by blue whales, response actions such as the placement of sorbents are likely to be limited.

Blue whales use acoustic signals to communicate, navigate, locate prey, and sense their environment. Noise, particularly low-frequency noise, can disrupt these essential whale behaviors, resulting in highly variable impacts on individuals or groups of animals. However, NMFS (Reeves et al., 1998) noted that smaller vessels, such those used for whale watching, have no known impact on blue whales, indicating that the smaller vessels used in spill response activities might have little physical and behavioral impact on the whales with respect to noise.

In addition to noise, the presence of vessels, aircraft, equipment, and people during response activities can generate other types of physical disturbance. Spill response-induced disturbance can contribute to ongoing environmental stresses experienced by the species. In particular, any behavior–altering stress response represents an energy expenditure that could contribute to the mortality of young, old, sick, or injured whales. However, healthy individual whales are likely capable of tolerating the additional stress associated with spill response activities.

The magnitude of the disturbance by mechanical and non-mechanical response activities will vary based on a number of factors, including, but not limited to, the activity's duration, size, and intensity, and the ability of the whale to move away from the activity.

4.2.2.2 Exposure to contaminants

The seasonal nature of the blue whale's presence in Alaska waters reduces the likelihood of exposure to dispersants or *in situ* burning. Historically, spills occurring during the season when blue whale are present have generally been in coastal areas rather in open ocean (Appendix D). Although the whales can be found in Alaska coastal waters during non-breeding periods (spring through fall), they tend to gather in offshore, open water habitats over deep waters.

Potential impacts on blue whales from exposure to dispersants or dispersed oil are discussed in Appendix B, Section 5.1.2.

Direct toxicity to whales from exposure to dispersants or dispersed oil has not been documented; however, the potential exists for baleen whales, such as blue whale, to ingest dispersants or dispersed oil as a result of the volume of water that they take in and then filter through baleen plates as they graze on prey. Little is known about the acute or chronic sublethal effects of dispersed oil on whales. Albers (1990) reported that gastrointestinal tract hemorrhaging occurred in European otter (*Lutra lutra*) following exposure to oil, although . Dispersed oil is composed of oil in a diluted form, so it is speculated that dispersed oil might cause effects similar to those of non-dispersed oil but of a lower magnitude due to the potentially lower ingested doses. Dispersants and dispersed oil could also foul the baleen as they are being expelled by the whale during feeding, temporarily reducing feeding capabilities. This is likely to occur only when blue whales feed near the surface, within 10 m depth of the ocean surface.

Inhalation or aspiration of oil fumes, which are related to severe acute impacts in mammals (Section 3.1.2.3 of Appendix B), are expected to decrease as a result of chemical dispersion.

Exposure to dispersed oil in the water column may also result in dermal contact and contact with sensitive organ tissue such as the eyes of blue whale resulting in temporary irritation of said tissues. Irritation of tissues is not expected to cause significant impacts in cetaceans. Furthermore, the enhancement of dispersion of oil into the water column may reduce dermal exposures of blue whale to concentrated oil at the ocean surface when periodically surfacing to breathe.

Planktonic prey species of the blue whale are often present in the shallow ocean, where acute toxicity may occur in sensitive species (Sections 4.2 and 4.3 of Appendix B). This may result in a localized and short-term alteration of the blue whale prey base, although significant impacts (i.e., reduced prey abundance over a large spatiotemporal scale) resulting in greatly diminished feeding is not expected.

The uptake and effect of PAHs on cetaceans is a point of uncertainty requiring further study. It is possible that the application of chemical dispersants would temporarily increase the exposure of blue whales to PAHs through the water column and through their diet. The likely impact of such a temporary increase in exposure is unclear (Section 6.3.4 of Appendix B).

Exposure to *in situ* burning is unlikely for all whale species. Decision criteria associated with *in situ* burning as a response action restrict its use in the vicinity of a protected species or critical habitat, and blue whales are expected to avoid the types of activities associated with *in situ* burning, deterred by noise and presence of ships. However, NMFS (2003) stated that if a whale is within ~0.25 mi (0.4 km) of an *in situ* burn, the risk of soot and emissions exposure by surfacing cetaceans is increased. The inhalation of soot particles upon surfacing could cause irritation to membrane tissues (i.e., lung tissue), and significant exposure could impair lung function, although these effects have not been documented in whales.

Organisms in the uppermost portion of the water column would be those most affected by thermal exposure during an *in situ* burn (Evans et al., 1988; cited in NMFS, 2003), although the effects of burning on prey species are expected to be short-term and localized. A localized and short-term reduction in the prey base of blue whale, impacted by *in situ* burning, is not expected to indirectly affect blue whales.

The discharge of treated wastewater (e.g., oil/water separation) could expose whales to unacceptable levels of contaminants only if effluent limits or conditions are not being met. However, the expectation is that treated effluent will meet state water quality standards and conditions, including those for petroleum hydrocarbons, prior to discharge, thus eliminating this risk.

4.2.2.3 Exclusion from resources

Whales could be excluded from a resource if they avoid it due to the increased presence of response workers, vessels, response equipment and materials, and aircraft, as well as any associated noise. However, exclusion from a resource would likely be temporary and of low magnitude, occurring only during the response event. For example, whales might avoid a feeding area during booming, skimming, or other recovery activities or as a result of supporting vessel or aircraft traffic.

The degree to which habitat exclusion would affect blue whales depends on many factors, including the age or life stage of the whale, the season, and the size and location of the spill response. Because blue whales are mobile and occupy a vast open-water habitat, it is expected that any exclusion from resources due to the avoidance of spill response actions will be temporary in duration and low in magnitude.

4.2.2.4 Habitat degradation and loss

Blue whales feed in both deep coastal and pelagic environments in Alaska, particularly in the GOA (Reeves et al., 1998). Response activities that occur at the sea's surface could affect blue whale habitat due to temporarily increased noise from the surface deployment of equipment (e.g., booms and skimmers), vessel or air traffic, and other activities. Although noise is evaluated as a disturbance, it also represents a temporary degradation of the acoustic environment.

Non-mechanical response actions, such as dispersant application and *in situ* burning, could cause the short-term degradation of water and / or air quality in coastal or open-water blue whale habitat, particularly in areas where whales surface. Longer-term changes are not expected, as indicated above and discussed in Appendix B.

Habitat degradation caused by spill response actions is assessed to be low magnitude for blue whale because of the large range of this species, their seasonal distribution, and their infrequent presence in Alaska waters.

4.2.2.5 Direct injury

The primary means of direct injury to whales from spill response activities are boat or equipment strikes or entanglement in response equipment. *In situ* burning is a potential, although unlikely, source of direct injury.

Ship strikes were considered to be a threat to the recovery of the blue whale in the blue whale recovery plan prepared by Reeves et al. (1998). However, no blue whales were reported to have been struck by a vessel in a research article by Neilson et al. (2012), which summarized 108 whale-vessel collisions specific to Alaska waters between 1978 and 2011. If the presence of vessels and deployed equipment increases in blue whale habitat during some spill response incidents, the risk of direct injury to blue whales could increase.

In the unlikely event that a whale were to surface in an area of an *in situ* burn, it could be exposed to extreme heat. Whales below the surface would not likely be affected due to the rapid attenuation of temperature with depth (Evans et al., 1988).

4.2.2.6 Determination of effects

Individual blue whales could be exposed to emergency response actions that occur in open ocean environments in the GOA and around the Aleutian Islands (including the southern Bering Sea) during the spring, summer, and fall months. The likelihood that blue whales will encounter an emergency response action is low due to the infrequency of spill response in open ocean environments (i.e., once or twice per year) and the rarity of blue whales in Alaska waters (only a few have been documented over the past 20 years). In the event that the blue whale population increases, the encounter rate will remain low because of the areal extent of their range in Alaska. If whales are observed in the vicinity of an emergency response, the harassment of blue whales can be permitted by NOAA Fisheries if it is deemed to be critical to prevent their exposure to oil or hazardous substances. Deterrence activities have the highest likelihood of impact on the whales because by definition, they constitute an adverse impact under ESA. However, all other emergency response protocols require the observation and avoidance of whales in the vicinity of any response activities.

In the unlikely event that an interaction between an individual blue whale and a spill response were to occur, the following high-magnitude effects could result from specific response actions:

- Physical injury from ship strikes or entanglement with equipment
- Impaired breathing or lung damage from smoke inhalation following *in situ* burning

Response actions could also have a lesser effect. These low-magnitude direct or indirect effects could include:

- Behavioral disturbance due to small vessel or aircraft noise or activities associated with *in situ* burning or the application of dispersants
- Tissue irritation (i.e. skin, eye, nose, mucous membrane) from exposure to dispersants, dispersed oil, or smoke from *in situ* burning
- Alteration of the food web through the use of dispersants (e.g., temporary changes in abundance and composition of prey due to dispersed oil toxicity)
- Short-term reduction in feeding efficiency caused by the fouling of baleen by dilute, dispersed oil or burn residues
- Habitat degradation from attendant noise or alteration of the food web

Emergency response actions in Alaska are, as a matter of policy, based first on mechanical response actions. Non-mechanical responses are considered only if mechanical containment, removal, and/or cleanup are ineffective or incomplete. *In situ* burning and dispersant application are only implemented if feasible (i.e., a number of field conditions must be met for the effective use of these responses) and use of *in situ* burning or dispersants will cause less harm than would the spill in their absence. The use of these non-mechanical response methods is avoided near concentrations of wildlife and requires concurrence from the incident-specific RRT and consultation with the Services prior to any decision regarding implementation.

No GRS have been developed for open water areas; rather incident-specific response strategies that reflect the sea state, weather, and oceanographic conditions at the time are developed during the response. The IAP and subsequent response actions are intended to protect sensitive resources. Protective measures for endangered species are implemented as part of the spill response in consultation with the Services; these actions are documented in the IAP. Emergency consultation with the Services, supported by reconnaissance and observation of whales in the vicinity of a response action are the primary components of response action that will be used in developing incident-specific protections for whales.

Furthermore, all response activities are developed and implemented as part of an emergency consultation with the Services during the response to avoid or minimize impacts to ESA species and critical habitats.

Given that the protection of sensitive species is one of the highest priorities of a response action and given the extensive home range and seasonal presence of blue whales in Alaska, it is unlikely that a blue whale would be adversely affected by response activities during the implementation of the Unified Plan.

4.2.3 Bowhead whale

Spill response activities that occur in the Bering, Chukchi, or Beaufort Seas can affect bowhead whales. Bowhead whales use the seas of northern Alaska seasonally but can be found in Arctic waters year-round. These whales are not restricted to ice-free regions because they are able to create breathing holes by using their heads to break through relatively thin ice (i.e., < 18 cm thick) (George et al., 1989; cited in NMFS, 2002) and by seeking out polynyas. While migrating, bowhead whales prefer water that is < 50 m deep and can venture as close as 457 m from shore (NMFS, 2002), although juveniles tend to stay in shallower water (< 20 m).

Between 1995 and 2012, there were 15 spills greater than 100 gal. in the northern Bering, Beaufort, or Chukchi Seas (< 1 per year). Most spills were of petroleum products (primarily diesel or other refined products) but several were drilling muds. Spill volumes of any material were generally small: 10 were less than 1,000 gal.; 5 were between 1,000 and 10,000 gal. (maximum volume spilled was 6,300 gal. of drilling mud). No crude oils spills were recorded for this period (see Appendix D for all spill data). Spills occurred primarily during the summer and early fall (i.e., ice-free periods); almost all occurred in the nearshore or shallow coastal areas of these regions. Figure 4-2 identifies the spill locations, seasons, and types of material spilled in the Bering, Beaufort, and Chukchi Seas during the 17 years between 1995 and 2012. Mechanical containment, recovery, and/or cleanup were the primary historical response actions, when noted; there are no records of dispersants being used on historical spills during this period.

The following subsections describe how spill response activities could affect the bowhead whale and are organized according to the five effect categories detailed in Section 4.1.

Response activities that do not occur in bowhead whale habitat and thus will not adversely affect bowhead whales include the creation of berms, dams, barriers, pits, and trenches; culvert blocking; vegetation cutting and removal; and upland *in situ* burning.

4.2.3.1 Physical or behavioral disturbance

Avoidance and minimization measures (e.g., observing whales, establishing buffer zones, minimizing vessel speeds in the vicinity of whales, altering routes) identified during planning will help ensure that response actions do not disturb bowhead whales physically or behaviorally during implementation. However, if the use of these measures is precluded, individual bowhead whales could be disturbed by the increased presence of response workers, boats, equipment and materials, and aircraft, as well as any associated noise.

Spill response efforts that involve aircraft, vessels, equipment, and / or personnel and introduce noise into the bowhead whale's environment include booming, skimming or vacuuming, the application of sorbents, removal of sediment, the application of dispersants, *in situ* burning, spill tracking and monitoring, mobilization and demobilization, and marine transport of solid wastes. Bowhead whales use low-frequency acoustic signals to communicate, navigate under ice, and locate open-water polynyas (Ellison et al., 1987; cited in NMFS, 2002). Anthropogenic noise can disrupt these essential whale behaviors, resulting in highly variable impacts on individuals or groups of animals, in part by masking communication between individuals (NMFS, 2006b).

Bowhead whales often turn abruptly or quickly dive if flown over by fixed-wing aircraft or helicopters (Richardson et al., 1995). Bowheads are the most responsive to aircraft noise when resting in shallow water; they are less responsive while feeding, socializing, or mating (Richardson et al., 1995; Richardson and Malme, 1993). Flyovers are not known to permanently displace bowhead whales, inasmuch as whales have been observed at their feeding grounds the day after repeated flyovers took place at the same location (Richardson et al., 1995; Koski et al., 1988). It appears that some bowhead whales do become habituated to distant drilling and vessel noise, but other individuals determinedly avoid some types of anthropogenic noise because they have come to associate the noise with hunting (NMFS, 2006b). Outboard motors have a greater effect on bowhead whales than do non-motorized boats, primarily because outboards are used during subsistence hunts (Richardson et al., 1995). Bowhead whales are more tolerant of vessels that move slowly or that move in directions other than toward the whales (Richardson and Finley, 1989; Wartzok et al., 1989; both cited in Richardson et al., 1995). When fleeing from a vessel, bowhead whales can be displaced by as much as 1 km (Richardson et al., 1995). No data are available to determine whether some whales are more vulnerable to disturbance than others based on gender, age, or reproductive status (NMFS, 2006b).

Bowhead whale exposure to spill response activities will vary due to a number of factors including, but not limited to, the location, timing, duration, areal extent, and intensity of the activities, as well as the ability of the whale to avoid the activity. The effects of visual and auditory disturbance on bowhead whales will likely be temporary and of low magnitude.

4.2.3.2 Exposure to contaminants

The exposure of bowhead whales to dispersants or *in situ* burning would depend on the timing of a spill, characteristics of the oil, and the ice conditions at the time of the spill. Dispersants would not be applied under solid ice because water currents or ice movement is insufficient to mix the dispersants with the oil. Depending on ice movement, dispersants can be used in areas with broken ice (Potter et al., 2012). Testing has shown that effective dispersion can be achieved in areas with ice by using vessel propeller wash to mix oil and dispersants (Sørstrøm et al., 2010). *In situ* burning can be conducted on solid ice, broken ice, or open water (Potter et al., 2012).

Bowhead whales remain in Arctic waters throughout the year, often in areas that have ongoing oil exploration and drilling activities and marine traffic. Because of their mobility, bowhead whales are less likely to be exposed to dispersants than species that are more spatially restricted (e.g., Cook Inlet beluga whales), particularly under ice-free conditions. Conversely, oiling of polynyas or areas near sea ice, which bowhead whale require in order to breathe may result in concentrated exposures to oil; dispersion in these areas may reduce potentially severe impacts of oil vapor inhalation or aspiration (Section 3.1.2.3 of Appendix B).

Dispersants distribute oil and other chemicals both laterally and vertically in the water column. Whales in the immediate vicinity of recently applied (< 24 hours) dispersants will be exposed to dispersants and dispersed oil. Potential impacts to bowhead whales related to exposure to oil, dispersed oil, and dispersants are discussed in Section 5.1.3 of Appendix B. For example, dispersed oil could foul bowhead whale baleen during feeding, thereby reducing feeding capabilities. Baleen fouling could result in short-term reductions in feeding efficiency, with 95% of residual oil in baleen being removed after 24 hours (BOEMRE, 2011). Repeated fouling may result in significant impacts on bowhead whales in particular, inasmuch as they feed in shallow waters where dispersed oil may be most concentrated (i.e., within 10 m below the ocean surface).

Baleen whales feed on large quantities of relatively small water column-inhabiting species (i.e., plankton, small fish, and invertebrates) that would be vulnerable to the acute, short-term exposure effects of dispersed oil or *in situ* burnings near the water surface. Although the bulk of a bowhead whale's feeding does not take place immediately at the sea's surface, the surface does serve as a productive habitat for many fish and invertebrate species during a variety of life stages (NMFS, 2005a, b, c, d, e), species that are then preyed upon by bowhead whales deeper in the water column. The species that reside in the water column move with the flow of water and would thus remain in contact with the most concentrated portion of dispersant or dispersed oil for a longer period of time than would free-swimming organisms. Localized reduction in zooplankton populations due to exposure to dispersants is expected to be short-term and localized resulting in a low-magnitude impact to bowhead whale.

The uptake and effect of PAHs on cetaceans is a point of uncertainty requiring further study. It is possible that the application of chemical dispersants would temporarily increase the exposure of bowhead whales to PAHs through the water column and through their diet. The likely impact of such a temporary increase in exposure is unclear (Section 6.3.4 of Appendix B).

Exposure to dispersed oil in the water column may also result in dermal contact and contact with sensitive organ tissue such as the eyes of bowhead whale resulting in temporary irritation of said tissues. Irritation of tissues is not expected to cause significant impacts in cetaceans. Furthermore, the enhancement of dispersion of oil into the water column may reduce dermal exposures of bowhead whale to concentrated oil at the ocean surface when surfacing to breathe.

Exposure to *in situ* burning is unlikely for all whale species. Decision criteria associated with *in situ* burning as a response action restrict its use in the vicinity of a protected species or critical habitat, and whales would avoid the types of activities associated with *in situ* burning, deterred by noise and the presence of ships. However, NMFS (2003) stated that if a whale is within ~0.25 mi (0.4 km) of an *in situ* burn, the risk of soot and emissions exposure by surfacing cetaceans is increased. The inhalation of soot particles upon surfacing could cause irritation to membrane tissues (i.e., lung tissue), and significant exposure could impair lung function, although these effects have not been documented in whales. Bowhead whales sometimes feed near the sea floor, where they could be exposed to *in situ* burn residues associated with sediment. Subadult bowhead whales might be more at risk from the effects of impacted air and *in situ* burns because they spend more time in shallow coastal water than do adult whales.

Organisms that reside near the surface would be most affected by thermal exposure during *in situ* burning. Evans et al. (1988; cited in NMFS, 2003) reported that temperature changes were minimal below 5 in. (~13 cm) from the water's surface during a simulated burn; significant heating did occur within the upper 5 in. Exposure to heat from *in situ* burning is unlikely for all whale species, although they could be exposed to smoke while surfacing to breathe. Bowhead whales feed primarily in the water column, but some feeding does occur near the sea floor where burnt residues could settle. However, residues created from burning are unlikely to affect bowhead whales because these residues would likely settle over a wide area due to current transport. It is possible that buoyant residues could be ingested during feeding, but exposure to large volumes of residue is not expected due to the mobility and large foraging range of bowhead whales.

4.2.3.3 Exclusion from resources

Certain response activities (e.g., booming, skimming or vacuuming, deployment of sorbents, removal of sediment, application of dispersants, *in situ* burning, spill tracking and monitoring, mobilization and demobilization, and transport of solid wastes) have the potential to prevent bowhead whales from accessing important resources, such as feeding grounds or polynyas. Bowhead whales could be temporarily excluded from a resource if they avoid it due to the increased presence of response workers, vessels, equipment and materials, aircraft, and associated noise. For example, whales could avoid a feeding area due to vessel or aircraft traffic. Depending on the duration of response activities, bowhead whales could be excluded from their feeding grounds or polynyas. To date, the largest petroleum product spill recorded in bowhead whale habitat involved 3,000 gal. of a relatively non-persistent material (diesel); there is no record of the response action taken for this spill, but response to a spill of this size would likely of short duration.

The degree to which habitat exclusion would affect bowhead whales depends on many factors. Because of their mobility and the vastness of their open-water habitat, it is expected that spill response activities would not affect the ability of bowhead whales to access important resources. Spill response planning will consider the presence of these species and will be adjusted to mitigate impacts to the maximum extent practicable.

4.2.3.4 Habitat degradation and loss

Response activities have the potential to degrade bowhead whale habitat. Response activities that occur at the sea's surface could adversely affect bowhead whales when they are at or near the surface (e.g., traveling, breathing, and feeding). These response actions include booming, skimming or vacuuming, the application of sorbents or dispersants, *in situ* burning, activities associated with tracking and monitoring spills, mobilization and demobilization, and the transport of solid wastes. Impacts include, but are not limited to, water quality and air quality impacts, changes or reductions in prey due to impacts on other species within the food web, and anthropogenic noise.

Bowhead whales spend a significant amount of time below the water surface feeding on zooplankton and sometimes feed near the sea floor (NMFS, 2006b). Bowhead habitat could be directly affected by the degradation in water quality because of *in situ* burn residues or dispersed oil in the water column. The removal of contaminated sediment from shoreline beaches could temporarily degrade the bowhead whale's habitat by increasing sedimentation (via erosion) in subtidal bottom habitats or turbidity in the water column.

During winter and migration periods, bowhead whales congregate in open water polynyas and leads in ice-covered areas in order to breathe (NMFS, 2006b). If a response effort were necessary in the vicinity of a highly used polynya or lead, a group of bowhead whales might have nowhere else to surface and be forced to search for another open area in the ice, potentially resulting in mortality. Depending on the available habitat and the size of the response effort, response activities in a polynya or lead could have a high-magnitude, long-term effect on individual bowhead whales. However, response activities in any other setting would likely have low-magnitude, temporary effects on bowhead whale habitat.

Although the effects of noise as a disturbance event have been discussed previously, noise also represents a temporary degradation of habitat quality.

4.2.3.5 Direct injury

The primary causes of direct injury during spill response activities include ship strikes or entanglement in response equipment. Exposure to heat from *in situ* burning is a possible, although unlikely, source of direct injury.

Ship strikes are a serious risk for bowhead whales, especially because bowheads can habituate to vessel traffic. The presence of vessels and deployed equipment will increase substantially during some spill response activities, which in turn will increase the risk of direct injury to bowhead whales. Bowheads are also at risk of being entangled in ropes and other equipment (e.g., anchor lines and booms) associated with response activities. Entanglement of bowhead whales in fishing gear and anchor lines has been reported (Shelden and Rugh, 1995; Angliss and Lodge, 2002; Angliss and Outlaw, 2005; all cited in MMS, 2006). These whales could also be entangled in response equipment but this event is unlikely given the equipment tending and whale monitoring that occurs during a response action.

In the unlikely event that a whale were to surface in an area of an *in situ* burn, direct injury (of variable duration and magnitude) could result from heat stress. Whales below the surface would not likely be affected due to the rapid attenuation of temperature with depth (Evans et al., 1988).

4.2.3.6 Determination of effects

Bowhead whales are present in Arctic waters throughout the year, including the Beaufort, Chukchi, and northern Bering Seas. Bowhead whales are generally found in remote areas, including under sea ice, where spill response actions may be limited. In addition, few historical spills have been recorded in the regions where bowhead whales are present. Ship strikes in these areas are possible but unlikely; this assumption is based on the remoteness of the areas in which they are found and the relatively low level of vessel traffic in remote and often ice-covered areas. Also, bowhead whales are able to travel great distances at depth to avoid human activities, if necessary. These factors reduce the likelihood of behavioral disturbances, equipment entanglement, exclusion from resources, and exposure to chemicals as a result of spill response action. The wide range of the bowhead whale mitigates the possibility that temporary and localized changes in the prey species presence and abundance will adversely impact even individual bowhead whales.

In the event that an individual bowhead whale were to encounter spill response activities, these actions could result in the following high-magnitude effects on individual bowhead whales:

- Physical injury from ship strikes or entanglement with equipment
- Impaired breathing or lung damage from smoke inhalation following *in situ* burning

Response actions could also have lower-magnitude effects, including:

- Behavioral disturbance due to the noise of aircraft or small vessels or activities associated with *in situ* burning or dispersant application
- Tissue irritation (i.e., skin, eye, nose, mucous membrane) caused by exposure to dispersants, dispersed oil, or smoke from *in situ* burning
- Alteration of the food web through the use of dispersants (e.g., changes in abundance and composition of prey due to dispersed oil toxicity)

- Short-term habitat degradation due to changes in water quality, air quality, noise, or prey abundance and composition
- Short-term reduction in feeding efficiency caused by the fouling of baleen by dilute, dispersed oil or burn residues

Emergency response actions in Alaska are, as a matter of policy, based first on mechanical response actions. Non-mechanical responses are considered only if mechanical containment, removal, and/or cleanup are ineffective or incomplete. *In situ* burning and dispersant application are only implemented if feasible (i.e., a number of field conditions must be met for the effective use of these responses) and the use of *in situ* burning or dispersants will cause less harm would the spill in their absence. The use of these non-mechanical response methods is avoided near concentrations of wildlife and requires concurrence from the incident-specific RRT and consultation with the Services prior to any decision regarding implementation.

The IAP and subsequent response actions have been designed to protect sensitive resources; site-specific strategies for coastal areas of bowhead habitat have been created with input from the Services and other natural resource trustees. There are 103 GRS that have been approved for the Western Alaska and Northwest Arctic SCPs, which encompass the northern Bering Sea and part of the Chukchi Sea (ARRT, 2013); over 80 candidate sites have been identified for the development of GRS in the North Slope SCP (ARRT, 2013), which incorporates the remainder of Chukchi Sea and the Beaufort Sea. Each GRS defines specific locations for staging response actions, boom placement, areas appropriate for the collection and recovery of oil products, and resources to be protected.

Furthermore, all response activities are developed and implemented as part of an emergency consultation with the Services during the response to avoid or minimize impacts to ESA species and critical habitats. If necessary, the harassment of bowhead whales can be permitted by NOAA Fisheries, if it is deemed critical to preventing their exposure to oil or hazardous substances. Deterrence activities have the highest likelihood of impact on whales because, by default, these activities constitute an adverse impact under ESA.

The protection of sensitive species and habitats is one of the highest priorities of a response action. However, given the year-round presence of bowhead whales in Arctic waters and the potential effects of increased anthropogenic noise and response activity in bowhead habitat, particularly activity that could exclude bowhead whales from polynyas, it is possible that bowhead whales could be adversely affected by response activities during the implementation of the Unified Plan.

4.2.4 Fin whale

Spill response actions that could affect fin whales include those that could occur in coastal areas and areas of deep open water off Alaska, except the Arctic Ocean. The highest densities of fin whales occur between May and October in the southern Bering

Sea and northern GOA, although some individuals appear to be year-round residents. Spill response activities have the potential to adversely affect individual or small groups[30] of fin whales.

During the 17 years between 1995 and 2012, there were about 110 spills greater than 100 gal. in Alaska's marine waters (coastal and offshore)[31] (Appendix D). Almost all of the spills were in shallow coastal waters; and the spills occurred year-round, about 75% occurred during seasons when fin whales would likely be present. The material most typically spilled was diesel; spill sizes ranged from 100 gal. to over 300,000 gal., although most were < 1,000 gal. (see Appendix D for all spill data). Figure 4-2 identifies the spill locations, seasons, and type of material spilled in Alaska between 1995 and 2012. When identified, mechanical containment, recovery, and cleanup were the primary response actions, when noted. There are only two records of dispersant approval for use on spills in the Aleutian Islands during this period (Appendix D), although dispersants were not applied in either instance.

Response activities that do not occur in fin whale habitat and thus will not adversely affect fin whales include the following: the deployment of deflection or containment berms, dams, or other barriers; the use of pits and trenches; and cleanup activities such as flushing or flooding, soil or sediment removal, cleaning and grooming, or vegetation cutting and removal.

The following subsections detail how spill response activities could affect the fin whale and are organized according to the five effect categories detailed in Section 4.1.

4.2.4.1 Physical or behavioral disturbance

Avoidance and minimization measures (e.g., observing whales, establishing buffer zones, minimizing vessel speeds in the vicinity of whales, altering routes) will help ensure that response actions do not disturb fin whales or change fin whale behavior. However, if use of these measures is precluded, fin whales could be disturbed by the increased presence of vessels, equipment and materials, aircraft, and associated noise. Actions associated with these potential disturbances include booming and skimming; the application of sorbents, dispersants; *in situ* burning; activities associated with the tracking and monitoring of spills; mobilization and demobilization; and marine transport of solid wastes.

According to the 2010 final *Recovery Plan for the Fin Whale* (NMFS, 2010a), anthropogenic noise is considered to be a threat of unknown severity to the fin whale population. The presence of people and operation of vessels and equipment necessary to implement response actions will introduce a source of noise to the whale's environment. Fin whales, like many marine mammals, use acoustic signals to communicate, navigate,

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[30] Fin whales may aggregate in small groups of 2 to 7 individuals, or in some instances pods as large as 20 individuals (NMFS, 2010a).

[31] Spills in the nearshore environment were excluded from this count. A distance from land <0.5 mi. was used as a surrogate for nearshore.

locate prey, and sense their environment (NMFS, 2010a; US Navy, 2008, 2011). Noise, particularly low-frequency noise, can disrupt these essential whale behaviors and have variable impacts on individuals, groups, or populations. For example, the low-frequency sounds used by fin whales for communication and (possibly) courtship (Watkins, 1981; cited in NMFS, 2010a) could be masked or interrupted by ship noise. Richardson et al. (1995) stated that noise can also reduce the availability of prey or increase vulnerability to other hazards, such as fishing gear or predators. An individual's response to noise can vary widely. Some whales become more sensitive to noise exposure over time, during which the adverse physical and behavioral responses, such as stress, become exacerbated. Alternatively, other whales are known to habituate to chronic noise exposure, which can actually cause the animal to be drawn to the source of the noise (Southall et al., 2007; cited in NMFS, 2011g). Other factors that could affect how an individual responds to noise include sound characteristics (e.g., frequency); geographic location of source of the sound; ability of the whale to move away from the sound source; and the whale's hearing sensitivity, age, sex, reproductive status, health, and social behavior (NMFS, 2010a). It is unknown whether short-term behavioral responses to noise can have long-term effects on individual fin whales.

In addition to noise, response activities could generate other types of disturbance as a result of the presence of vessels, aircraft, and equipment. NMFS (2010a) suggested that there was evidence that wild animals respond to human activities in the same manner as they respond to predators, including abandoning areas when people are present (Bartholomew, 1949; Allen, 1991; both cited in NMFS, 2010a). This response can also result in reduced reproductive success (Giese, 1996; Mullner et al., 2004; both cited in NMFS, 2010a), or the mortality of physiologically compromised individuals (Daan et al., 1996; cited in NMFS, 2010a). Although healthy individual whales are capable of tolerating various stressors, any behavior–altering stress response represents an energy expenditure that could contribute to the mortality of young, old, sick, or injured fin whales.

Fin whale exposure to mechanical and non-mechanical response activities will vary based on a number of factors, including, but not limited to, the location, timing, duration, areal extent, and intensity of response activities, as well as the ability of the whale to move away from the activity. If any physical and / or behavioral disturbance of individual whales results from these actions, it is likely to be short-lived and of low magnitude, given the species' ability to avoid and / or move away from areas of disturbance.

4.2.4.2 Exposure to contaminants

The potential impacts associated with exposure are limited to the use of dispersants and *in situ* burning; no other response actions are expected to pose an exposure threat to fin whales. Direct toxicity to whales from exposure to dispersants or *in situ* burning is not likely because of the mobility of the whales and the limited conditions under which these response actions are applied. The toxicological impacts of dispersants and dispersed oil on fin whales are discussed in detail in Section 5.1.4 of Appendix B.

The impacts of the chemical dispersion of oil to fin whale are expected to be similar to that of other baleen whales (Section 4.2.2.2), in that dispersion may increase chemical exposures (i.e., direct contact and ingestion) in the shallow water column and through the prey base as well as temporarily alter the prey base of fin whales (Section 5.1.4 of Appendix B).

Fin whales rely on large quantities of relatively small species (i.e., plankton, small fish, and invertebrates), which inhabit the most highly productive layer near the ocean's surface. Although the fin whale feeds from throughout the water column, the ocean's surface serves as important habitat for many important species during various stages of life; this includes fish and invertebrates that are preyed upon by fin whales (NMFS, 2005a, b, c, d, e). The organisms in the uppermost part of the water column would be the most affected by thermal exposure during *in situ* burning. Evans et al. (1988; cited in NMFS, 2003) reported that significant heating did occur within the upper 5 in. (~13 cm), which is where these organisms concentrate. Reduction in the abundance of organisms at the sea surface due to the use of dispersants or *in situ* burning could affect whale diet; but given the large area of suitable feeding habitat available to whales, this indirect effect on fin whales is unlikely. The areal extent and duration of any spill would have to be very significant in order to have an adverse effect on the fin whale's prey base, given the size of the species' range.

Whales are expected to avoid areas where spill responders are present and actively treating oil, but the fouling of baleen could also result if a fin whale were to feed in an area where dispersants had been applied. Dilute dispersed oil would be filtered through the baleen, and oil residues could reduce feeding efficiency for short periods of time (i.e., less than 24 hours) (BOEMRE, 2011). Continued feeding in areas unaffected by a spill or spill response activities would likely flush dispersants and dispersed oil from baleen plates; however, repeated fouling could result in a more significant effect if whales were unable to feed for prolonged periods of time (BOEMRE, 2011).

Exposure to *in situ* burning is unlikely for all whale species. Decision criteria associated with *in situ* burning as a response action restrict its use in the vicinity of a protected species or critical habitat and, whales are expected to avoid the types of activities associated with *in situ* burning. However, NMFS (2003) stated that if a whale is within ~0.25 mi (0.4 km) of an *in situ* burn, the risk of soot and emissions exposure to surfacing cetaceans is increased. Inhalation of soot particles upon surfacing could cause irritation to membrane tissues (i.e., lung tissue), and significant exposure could impair lung function, although these effects have not been documented in whales.

4.2.4.3 Exclusion from resources

Certain mechanical and non-mechanical response activities have the potential to exclude fin whales from important resources, primarily by triggering avoidance behaviors. These activities include booming and skimming; the application of sorbents and / or dispersants; and *in situ* burning; activities associated with tracking and monitoring spills; mobilization and demobilization; and the shipment of solid wastes. Physical restrictions would not be relevant because whales can swim or dive to circumvent barriers. Long-term exclusion from a resource is unlikely due to the likely short duration of response actions and the large area over which suitable and accessible whale habitat exists in Alaska's marine waters.

The degree to which habitat or resource exclusion would adversely affect fin whales depends on many factors. Because of their mobility and the vastness of their open water habitat, it is expected that the effects of spill response activities on the ability of fin whales to access important resources would be relatively low, with only temporary or low-magnitude effects, if any.

4.2.4.4 Habitat degradation and loss

Actions that have the potential to directly or indirectly impact fin whale habitat include booming and skimming; the application of sorbents and / or dispersants; and *in situ* burning; activities associated with tracking and monitoring spills; mobilization and demobilization; and the marine transport of solid waste.

Diving is a key aspect of whale behavior that highlights the importance of the deep ocean environment for fin whales. Based on the research conducted by Goldbogen et al. (2006), fin whales spend approximately 44% of their time at depths < 50 m, 23% at depths of 50 to 225 m, and 33% at depths of > 225 m. For the purpose of this BA, the entire water column from 0 m to > 225 m deep, in coastal and open, deep water areas is considered to be potential fin whale habitat, and the degradation of any portion of this water column could have temporary detrimental effects on the fin whale.

Response activities that occur at the sea's surface could adversely affect the whale's ability to access habitat and resources at or near the surface. These activities include booming and skimming; the application of sorbents and / or dispersants; *in situ* burning; tracking and monitoring spills; mobilization and demobilization; and the marine transport of solid waste. Potential impacts include, but are not limited to, the degradation of water quality and air quality; changes in the prey base due to impacts on other species within the food web (e.g., plankton and larval fish); and anthropogenic noise. Although, the effects of noise as a disturbance have been discussed, noise also represents a temporary degradation of habitat quality.

Habitat degradation in the deeper water column could result from impaired water quality as burnt residues sink through the water column to the sea bottom. Dispersants are limited in their vertical transport to approximately 10 m in depth because of changes in water density.

Response actions are not expected to cause a loss in fin whale habitat because of the short-term duration of the actions and the dynamic nature of the ocean environment. Temporary habitat degradation could result in low-magnitude effects on localized whale habitat (e.g., temporary and localized prey base reduction or water quality impairment). Unlike many other species, fin whales are extremely mobile and have access to large expanses of suitable habitat; therefore, it is highly unlikely that temporary habitat degradation from response activities would have a long-term or high-magnitude effect on this species.

4.2.4.5 Direct injury

The primary sources of direct injury from spill response activities are ship strikes and entanglement in response equipment. Activities that require the use of vessels or in-water equipment could contribute to the risk of ship strike or entanglement. Exposure to heat from *in situ* burning is another, although unlikely, direct injury.

According to the *Recovery Plan for Fin Whales* (NMFS, 2010a), ship strikes are considered to be one of the greatest threats to the recovery of the fin whale population. Although vessel traffic could increase temporarily in response to a spill, many precautions and protection measures would be incorporated into the BMPs for each response action so that the risk of a direct strike would likely be very rare. However, despite the rarity of such an event, a ship strike does have the potential to cause an injury that could range from temporary to long-term with low- to high-magnitude consequences.

Whale entanglement in spill response equipment and materials (e.g., booms) was not specifically documented in the scientific journals and technical documents reviewed while preparing this BA. However, it is worth noting the potential for this type of injury to occur. Entanglement of fin whales and other whale species with fishing equipment has been reported (Hill and Demaster 1999, cited in US Navy, 2008; Rice, 1989); entanglement with response equipment could happen but is unlikely due to the equipment tending and wildlife observation that is part of a response action. It is anticipated that protective measures designed to detect an animal's presence and avoid entanglement would prevent injury from occurring.

In the unlikely event that a whale were to surface in an area of an *in situ* burn, it could be exposed to extreme heat. Whales below the surface are also unlikely to be affected due to the rapid attenuation of temperature with depth (Evans et al., 1988).

4.2.4.6 Determination of effects

Fin whales would be most vulnerable to spill response activities in the off-shore and coastal areas of Alaska (Figure 3-11) throughout the year, especially between the months of May and October, when fin whale populations peak in the northern GOA and southern Bering Sea. Spills in these waters during this time of the year tend of involve relatively non-persistent materials (e.g., diesel), and most spills involve less than 1,000 gal. The observation, detection, and avoidance of marine mammals during a spill response would be a major component of an IAP.

In the unlikely event that an interaction between a fin whale and response actions were to occur, these actions could result in the following high-magnitude effects on individual whales:

- Physical injury via entanglement or ship strikes
- Impaired breathing or lung damage from smoke inhalation during *in situ* burning

Response actions could also have lower-magnitude effects, including:

- Behavioral disturbance due to the noise of aircraft or small vessels or activities associated with *in situ* burning or dispersant application
- Tissue irritation (i.e., skin, eye, nose, mucus membrane) caused by exposure to dispersed oil, dispersants, or smoke from *in situ* burning
- Alteration of the food web through the use of dispersants (e.g., changes in abundance and composition of prey due to dispersed oil toxicity)
- Short-term habitat degradation due to changes in water quality, air quality, or noise or in prey abundance and composition
- Short-term reduction in feeding efficiency caused by the fouling of baleen by dilute, dispersed oil or burn residues.

Emergency response actions in Alaska are, as a matter of policy, based first on mechanical response actions. Non-mechanical responses are considered only if mechanical containment, removal, and/or cleanup are ineffective or incomplete. *In situ* burning and dispersant application are only implemented if feasible (i.e., a number of field conditions must be met for the effective use of these responses) and the use of *in situ* burning or dispersants will cause less harm than would the spill in their absence. The use of these non-mechanical response methods is avoided near concentrations of wildlife and requires the concurrence of the incident-specific RRT and consultation with the Services prior to any decision regarding their implementation.

The IAP and subsequent response actions have been designed to protect sensitive resources; site-specific strategies have been created for most important sites in the coastal areas of Alaska with input from the Services and other natural resource trustees. There are approximately 500 GRS approved for coastal regions in Alaska (about 60 more are being developed) (ARRT, 2013) where fin whales may be present. Each GRS defines specific locations for the staging of response actions and boom placement, areas appropriate for the collection and recovery of oil products, and resources to be protected.

Furthermore, all response activities are developed and implemented as part of an emergency consultation with the Services during the response to avoid or minimize impacts to ESA species and critical habitats. If necessary, the harassment of whales can be permitted by NOAA Fisheries, if it is deemed critical to preventing their exposure to oil or hazardous substances. Deterrence activities have the highest likelihood of impact on whales, because by default, these activities constitute an adverse impact under ESA. However, all other actions seek to avoid whales.

Given that the protection of sensitive species and habitats is one of the highest priorities of a response action and given the fin whale's extensive home range and preference for deeper waters, it is highly unlikely that fin whales would be adversely affected by response activities during the implementation of the Unified Plan.

4.2.5 Western North Pacific gray whale

The majority of the population of gray whales in Alaska waters consists of individuals from the delisted ENP stock. Although exchange between the critically endangered WNP stock and the ENP stock has been documented (Weller et al., 2012), the proportion of WNP whales migrating from the WNP feeding grounds to the ENP population is likely to be small. Nevertheless, due to the severe depletion of the WNP stock, the ramifications of potential threats to those individuals are greater.

In Alaska waters, densities of ENP gray whales are typically highest in Southeast Alaska, in the northern and western Bering Sea and in Northeast Alaska in the southern Chukchi between Point Barrow and Point Lay. It is possible that some small number of individuals from the WNP stock could also be present in these areas. Gray whales will be most vulnerable to spill response activities that occur during the months of April through October, when they are present in Alaska waters to forage. Spill response activities have the potential to affect individuals or groups of whales, due to their tendency to aggregate for long periods of time in areas of concentrated food (NMFS, 2011g).

The following subsections describe how spill response activities could affect the gray whale and are organized according to the five effect categories detailed in Section 4.1. Response activities that do not occur in gray whale habitat and thus would not adversely affect gray whales include terrestrial or shoreline cleanup responses; these include the construction of berms, dams, or other barriers; the creation of pits and / or trenches; cleanup activities such as flushing or flooding; soil or sediment removal and / or cleaning; and vegetation cutting and removal.

4.2.5.1 Physical or behavioral disturbance

Avoidance and minimization measures (e.g., observing whales, establishing buffer zones, reducing vessel speeds in the vicinity of whales, altering routes) will help ensure that response actions do not cause physical or behavioral disturbance to gray whales. However, if the use of these measures is precluded, individual gray whales could be disturbed by the increased presence of response workers, boats, equipment and materials, and aircraft, as well as associated noise.

Like other marine mammals that use acoustic signals to communicate, navigate, locate prey, and sense their environment (NMFS, 1991, 2011g; US Navy, 2008, 2011), gray whales are vulnerable to being disturbed by anthropogenic noise (Moore and Clarke, 2002). Noise can disrupt essential whale behaviors such as resting, feeding, nursing, and migrating and result in a variety of impacts on individuals, groups, or populations of whales. Moore and Clarke (2002) reported changes in gray whale call timing and structure, swimming direction and surface behaviors during playback experiments using variations of artificially-increased noise levels. Noise can increase a whale's vulnerability to other hazards, such as fishing gear or predators, by masking auditory cues (Richardson et al., 1995). Some whales become more sensitive to noise over time, causing adverse physical and behavioral responses to become exacerbated; alternatively, whales are known to habituate to chronic noise exposure, which can actually cause the animals to be drawn to the source of the noise (NMFS, 1991). Other factors that affect how an individual reacts to noise include sound characteristics (e.g., frequency); the geographic location of sound source and the ability of the whale to move away from the sound source; and a whale's hearing sensitivity, age, sex, reproductive status, health, and social behavior (NMFS, 2010b). It is unknown if short-term behavioral responses to noise can have long-term effects on individual whales.

Gray whale exposure to mechanical and non-mechanical response activities will vary based on a number of factors, including, but not limited to, the location, timing, duration, areal extent, and intensity of the response activities and the whale's ability to move away from the activity. If physical and behavioral disturbances to individual whales result from response activities, these disturbances are likely to be short-lived and of low magnitude in nature, given the species' ability to avoid and/or move away from areas of disturbance.

4.2.5.2 Exposure to contaminants

The potential impacts associated with exposure are limited to the use of dispersants and *in situ* burning; no other response actions are expected to pose a chemical exposure threat to gray whales. Direct toxicity caused by the exposure of gray whales to chemical dispersants or *in situ* burn residues is not likely due to the limited conditions under which these response actions are applied, the seasonal presence of the WNP gray whale population, and the mobility of these whales. During a spill response action, gray whale feeding and other activities in the action area are unlikely, because whales will likely avoid the response area where humans are present and underwater noise is being produced. Smoke from burning oil could also be inhaled upon surfacing and could injure lungs or impair breathing. In addition, the use of BMPs associated with *in situ* burning or the application of chemical dispersants as well as the implementation of the Unified Plan decision framework for selecting spill response actions will very likely limit the exposure of gray whales to contaminants related to these actions. The following impacts are possible, if these protective measures fail to limit such these exposures of gray whales to dispersants, dispersed oil, or burn residues or smoke from *in situ* burns. The toxicological effects of dispersants on gray whales are discussed in detail in Section 5.1.5 of Appendix B.

The direct impacts of dispersants on whales are not well understood, but they may be similar to reported impacts on humans and laboratory mammals (Nalco, 2005, 2010; CDC and ATSDR, 2010). The direct exposure of a gray whale to dispersants could result in tissue irritation of skin, eyes, or mucous membranes (CDC and ATSDR, 2010), and the aspiration of fumes immediately after an application could result in respiratory, liver, or kidney damage (Nalco, 2010). Such exposures are possible while gray whale are surfacing and diving within the upper 10 m of the water column (NRC, 2005).

Unlike other baleen whales, gray whales are predominately bottom feeders, relying on small benthic organisms in sediment as a primary food source (Nerini, 1984). Burnt residues from *in situ* burning settle in bottom sediment (ADEC et al., 2008), where gray whales forage by rolling in and filtering sediment through their baleen (Nerini, 1984) and could thus be exposed to these materials. Such exposures to residues may result in baleen fouling but are unlikely to result in toxicity (NOAA OR&R, 2013).

Exposures of gray whale to dispersed oil in sediment are unlikely in areas over 10 m deep due to physical limits on vertical mixing of dispersed oil (NRC, 2005), however it is possible that they would be exposed in waters less than 10 m deep. Gray whales typically feed in sediments between 50 and 60 m deep (Nerini, 1984; ADF&G, 2008), so exposures at 10 m are less likely while feeding. Exposure to dispersed oil in the water column is possible in gray whale when periodically feeding off the bottom; ingestion of dispersed oil may cause similar impacts as crude oil. Impacts related to dermal contact or ingestion of dispersed oil (e.g., irritation of tissues, gastrointestinal hemorrhaging) may be less severe than inhalation or aspiration of oil (e.g., tissue damage to lungs, kidneys) when surfacing to breathe in an untreated spill (Section 3.1.2.3 of Appendix B).

Although unlikely, the fouling of baleen could also result if a gray whale were to feed in an area where dispersants had been applied. Dilute dispersed oil would be filtered through the baleen, and oil residues could reduce feeding efficiency for short periods of time (i.e., less than 24 hours) (BOEMRE, 2011). Continued feeding in areas unaffected by a spill or spill response activities would likely flush dispersants and dispersed oil from baleen plates; however, repeated fouling could result in a more significant effect if whales were unable to feed for prolonged periods of time (BOEMRE, 2011).

Benthic invertebrate prey species may be adversely impacted by the application of chemical dispersants, particularly pelagic species that would otherwise not be exposed to oil during a spill (NRC, 2005). An in-depth discussion of potential impacts to these species is presented in Sections 4.2 and 4.3 of Appendix B. However, the areal extent and duration of the spill would have to be significant to have an adverse effect on their prey base, given the size of the gray whale's range. Even after significant dispersed oil exposures, benthic communities may not suffer from acute mortality and may recover within a matter of years (Cross and Thomson, 1987; Mageau et al., 1987), though certain sensitive species may be impacted for longer periods (Cross and Thomson, 1987). Although hydrocarbons in benthic invertebrate tissues may be immediately increased after chemical dispersion, some benthic invertebrates can quickly depurate such chemicals (Humphrey et al., 1987), and cetaceans such as the gray whale are able to rapidly metabolize hydrocarbons (including PAHs) (Douben, 2003). The impact of temporarily increased exposures to PAHs as a result of chemical dispersion on gray whales or their prey is a point of uncertainty (Section 6.3 of Appendix B).

Exposure to *in situ* burning is unlikely for all whale species. Decision criteria associated with *in situ* burning as a response action restrict its use in the vicinity of a protected species or critical habitat, and whales are expected to avoid the types of activities associated with *in situ* burning, deterred by noise and presence of vessels. However, NMFS (2003) stated that if a whale is within ~0.25 mi (0.4 km) of an *in situ* burn, the risk of soot and emissions exposure by surfacing cetaceans is increased. Inhalation of soot particles upon surfacing and could cause irritation to membrane tissues (i.e., lung tissue), and significant exposure could impair lung function, although these effects have not been documented in whales.

The discharge of treated wastewater (e.g., oil / water separation) could expose whales to unacceptable levels of contaminants only if effluent limits or conditions are not being met. However, the expectation is that treated effluent will meet state water quality standards and conditions, including those for petroleum hydrocarbons, prior to discharge, thus eliminating this risk.

4.2.5.3 Exclusion from resources

Gray whales could be temporarily excluded from a resource due to the presence of response workers, vessels, response equipment and materials, and aircraft, as well as the associated noise. For example, gray whales could temporarily avoid a feeding area during booming, skimming, application of sorbents or vessel or aircraft traffic. Long-term exclusion from a resource is unlikely due to the relatively short duration of response actions and the vastness of the area in which suitable and accessible whale habitat exists in Alaska's marine waters.

The degree to which habitat exclusion adversely affects gray whales depends on many factors. Due to their mobility and the availability of coastal habitat, it is expected that the effects of spill response activities on the ability of gray whales to access important resources will be relatively low, with only temporary effects, if any.

4.2.5.4 Habitat degradation and loss

Actions that have the potential to directly or indirectly impact gray whale habitat include booming and skimming; the application of sorbents and / or dispersants; *in situ* burning; activities associated with tracking and monitoring spills; mobilization and demobilization; and the marine transport of solid waste.

Diving is a key aspect of whale behavior; due to the gray whales reliance on coastal sediments as a primary food source, their diving behavior differs from other whale species that feed at greater depths of the deep ocean environment. Gray whale dive times during foraging are five to eight minutes to depths of 50 to 60 km (164 to 196 ft)

(US Navy, 2011). When migrating, gray whales tend to remain near surface to travel longer distances (500 m or 1,640 ft) before resurfacing to breathe, spending up to 10 minutes submerged (US Navy, 2011).

Gray whales primarily feed in bottom sediments and occasionally from the water column, they are not reliant on surface waters for food resources, so response activities that occur at the sea surface are unlikely to adversely affect their ability to access resources at or near the surface. These activities include booming and skimming; the application of sorbents and / or dispersants; *in situ* burning; tracking and monitoring of spills; mobilization and demobilization; discharge of wastewater (i.e., during decanting of collected oil and water), and the marine transport of solid and liquid waste (e.g., oiled sorbents and free oil). If these activities take place in coastal areas, access to gray whale foraging grounds could be temporarily limited. Other potential impacts include, but are not limited to, the degradation of water quality and / or air quality, changes in prey base due to impacts on other species within the food web (e.g., planktonic benthic larva), and anthropogenic noise. Although the effects of noise as a disturbance have been discussed previously, noise also represents a temporary degradation of habitat quality.

Habitat degradation in the deeper water column could result from *in situ* burning because burnt residues that sink and pass through the water column could adversely affect water quality and prey populations at depth. As bottom feeders, gray whales would be exposed to burnt residues that become associated with sediment in their coastal forage areas.

Response actions are not expected to cause a loss in gray whale habitat due to the short-term duration of the actions and the dynamic nature of the ocean environment. Temporary habitat degradation could result in low-magnitude effects on localized whale habitat (e.g., temporary localized prey base reduction or water quality impairment). Like many other whale species, gray whales are mobile and have access to large expanses of suitable habitat; therefore, it is unlikely that temporary habitat degradation from response activities will have long-term effects on this species.

4.2.5.5 Direct injury

The primary sources of direct injury to gray whales from spill response activities would be ship strikes or entanglement in response equipment. Exposure to heat from *in situ* burning is a potential, though unlikely, source of direct injury.

Like other migratory whales, gray whales are victim to ship strikes; the number of serious injury and mortality attributed to ship strikes is an estimated 2.2 gray whales per year (Carretta et al., 2013). The presence of boats, vessels, and / or deployed equipment would likely increase substantially during spill response actions, which in turn would increase the risk of direct injury to gray whales. Evidence suggests that whales are less aware of nearby vessels when engaged in feeding or other energetic activities and are thus more vulnerable to strikes. In addition, calves and juveniles are more susceptible to ship strikes because they are smaller (i.e., more difficult to see), spend more time at the surface than do adults, and are often closer to the shore (Herman et al., 1980; Mobley et al., 1999). Although vessel traffic would increase temporarily in response to a spill, many precautions and protection measures would be incorporated into the BMPs of each response action so that the risk of a direct strike is expected to be extremely small. Despite the rarity of such an event, a ship strike does have the potential to cause an injury that could have temporary to long-term and low- to high-magnitude effects on gray whales.

Whale entanglement in spill response equipment and materials (e.g., booms) has not been specifically documented in the scientific journals or technical documents that were reviewed during the preparation of this BA. However, it is important to note the potential for this type of injury to occur. Entanglement of gray whales and other whale species with fishing equipment has been reported; entanglement in fishing gear is a frequent human-related cause of injury and death among gray whales (Carretta et al., 2013). Although possible, it is anticipated that entanglement in equipment during a response action would be a rare occurrence due to the associated procedures designed to prevent such an injury (e.g., frequent monitoring of booms and other equipment). In the rare event that a whale were to become entangled in response equipment, an injury of varying magnitude could occur.

In the highly unlikely event that a gray whale were to surface in the immediate vicinity of an *in situ* burn, direct injury could result from heat stress. Heat stress injury would only occur in gray whales if an individual were to surface within an *in situ* burn where response crew where active and potentially managing fire booms. Whales below the surface are unlikely to be affected due to the rapid attenuation of temperature at depth (Evans et al., 1988).

4.2.5.6 Determination of effects

WNP gray whales are highly unlikely to be present in Alaska waters because the area is outside of their primary home range and the WNP population is severely depleted. However, any WNP gray whales that were to be present would be most vulnerable to spill response activities that occur in the coastal areas of Alaska during spring and summer, when the abundance of ENP gray whale is greatest. Bristol bay and St. Lawrence Island in the Bering Sea, the southern Chukchi Sea, and the GOA near Kodiak Island and Sitka are areas in which gray whales are known to aggregate during the spring and summer (Allen and Angliss, 2013; Calambokidis et al., 2002; Moore et al., 2003; Moore et al., 2007).

Some of these areas also have a higher frequency of historical spills. From 1995 to 2012, there were a small number of spills (8 to 50) of mostly non-crude oil in Bristol Bay, around Kodiak Island, and Western Alaska, totaling 60,200 gallons. In Southeast Alaska, 193 spills total about 148,700 gal. of mostly non-crude oil. Historically, more spills have occurred in July and August than in early spring and winter. Total spill volumes during July and August in these areas from 1995 to 2012 were relatively low, totaling approximately 7,200 gal., and occurred primarily in Western Alaska. In Southeast Alaska, only 60 spills totaled about 51,500 gal. over the 17-year time period (Appendix D).

The detection, observation and avoidance of marine mammals during a spill response would be a major component of an IAP.

In the unlikely event that individual WNP gray whales were to encounter response activities, the following high-magnitude effects could result from specific response actions:

- Physical injury via entanglement in equipment or ship strike
- Impaired breathing or lung damage from smoke inhalation during *in situ* burning
- Degradation of sediment in foraging habitat from accumulation of burnt residues and dispersed oil.

Response actions could also have lower-magnitude effects, including:

- Behavioral disturbance due to the noise of aircraft or small vessels or activities associated with *in situ* burning or dispersant application
- Tissue irritation (i.e., skin, eye, nose, mucus membrane) caused by exposure to dispersed oil, dispersants, or smoke from *in situ* burning
- Alteration of the food web through the use of dispersants (e.g., changes in abundance and composition of prey due to dispersed oil toxicity)
- Short-term habitat degradation due to changes in water quality (from use of dispersants, burnt residues) or noise levels
- Short-term reduction in feeding efficiency caused by the fouling of baleen by dilute, dispersed oil or burn residues

Emergency response actions in Alaska are as a matter of policy, based first on mechanical response actions. Non-mechanical responses are considered only if mechanical containment, removal, and/or cleanup are ineffective or incomplete. *In situ* burning and dispersant application are only implemented if feasible (i.e., a number of field conditions must be met for the effective use of these responses) and if the use of *in situ* burning or dispersants will cause less harm than would the spill in their absence. The use of these non-mechanical response methods is avoided near concentrations of wildlife or in nearshore habitats. In addition, their use requires concurrence from the incident-specific RRT and consultation with the Services prior to any decision regarding their implementation.

The IAP and subsequent response actions will be designed to protect sensitive resources; site-specific strategies have been created for the most important sites used by gray whales, with input from the Services and other natural resource trustees. Approximately 500 GRS have been approved for coastal regions in Alaska (about 60 more are being developed) in regions where gray whales may be present (ARRT, 2013).

Each GRS defines specific locations for response action staging and boom placement; areas appropriate for the collection and recovery of oil products; and the resources to be protected.

Furthermore, all response activities are developed and implemented as part of an emergency consultation in conjunction with the Services during the response in order to avoid or minimize impacts to ESA species and critical habitats. If necessary, the deterrence of whales can be permitted by NOAA Fisheries if it is deemed critical to preventing the exposure of whales to oil or hazardous substances. Deterrence activities have the highest likelihood of impact on whales because, by default, they constitute an adverse impact under ESA. All other response actions seek to avoid interactions with whales.

The protection of sensitive species and habitats is one of the highest priorities of a response action. Although WNP gray whales are critically endangered, given the extremely low likelihood that they would be present outside of their primary home range during response activities, it is highly unlikely that they would be adversely affected by the implementation of the Unified Plan.

4.2.6 Humpback whale

Spill response actions that could affect the North Pacific humpback whale include actions that would occur in areas of deep, open water or the relatively shallow coastal areas or nearshore of Alaska. Higher densities of humpback whales are typically found in Southeast Alaska, in the northern GOA, and around the eastern Aleutian Islands. Humpback whales will be most vulnerable to spill response activities that occur during the months of April through January, although some whales may be present year round in Southeast Alaska. Spill response activities have the potential to affect individuals or groups of whales, due to their tendency to aggregate for long periods of time in areas of concentrated food (NMFS, 2011g).

There have been approximately 400 spills in Alaska waters (Appendix D); almost all have been of refined petroleum products (typically diesel). The greatest number and volume of historical spills have occurred in Southeast Alaska and in the vicinity of the Aleutian Islands (Figure 4-2), which, along with Kodiak Island, represent three areas where humpback whales are known to aggregate. Although the vast majority of the spill volumes have been <1,000 gal., there have been about a dozen spills >10,000 (with two >100,000 in the Aleutian Islands). In addition, most spills have occurred in the more shallow coastal areas (within 5 mi of land) during the spring, summer, or fall, which coincide with the humpback whale's potential use of these areas.

The following subsections describe how spill response activities could affect the humpback whale and are organized according to the five effect categories detailed in Section 4.1. Response activities that do not occur in humpback whale habitat and thus would not adversely affect humpback whales include the deployment or construction of deflection or containment berms, dams, or other barriers; the creation of pits and/or trenches; cleanup activities such as flushing or flooding; soil or sediment removal and / or cleaning; and vegetation cutting and removal.

4.2.6.1 Physical or behavioral disturbance

Avoidance and minimization measures (e.g., observing whales, establishing buffer zones, reducing vessel speeds in the vicinity of whales, altering routes) will help ensure that response actions do not cause physical or behavioral disturbance to humpback whales. However, if use of these measures is precluded, individual humpback could be disturbed by the increased presence of response workers, boats, equipment and materials, aircraft, and associated noise.

According to the *Final Recovery Plan for the Humpback Whale* (NMFS, 1991), humpback whales are vulnerable to being disturbed by anthropogenic noise. Implementation of response actions will introduce a source of noise to the whale's environment. Humpback whales, like many marine mammals, use acoustic signals to communicate, navigate, locate prey, and sense their environment (NMFS, 1991, 2011g; US Navy, 2008, 2011). Noise can disrupt essential whale behaviors such as resting, feeding, nursing, and migrating and result in a variety of impacts on individuals, groups, or populations of whales. For example, NMFS (1991) reported numerous studies in which humpback whales reacted to vessels attempting to move away, changing their breathing and diving patterns, and occasional displaying possibly aggressive behavior. Noise can also reduce the availability of prey due to avoidance or increase a whale's vulnerability to other hazards, such as fishing gear or predators, by masking auditory cues (Richardson et al., 1995). Individual responses to noise can vary widely. Some whales become more sensitive to noise over time, causing adverse physical and behavioral responses to become exacerbated; alternatively, whales are known to habituate to chronic noise exposure, which can actually cause the animals to be drawn to the source of the noise (NMFS, 1991). Other factors that affect how an individual reacts to noise include sound characteristics (e.g., frequency); the geographic location of sound source and the ability of the whale to move away from the sound source; and a whale's hearing sensitivity, age, sex, reproductive status, health, and social behavior (NMFS, 2010b). It is unknown at this time whether short-term behavioral responses to noise can have long-term effects on individual whales.

In addition to noise, vessels, aircraft, equipment, and people could generate other types of disturbances during response actions. NMFS noted that wild animals can respond to human disturbances in the same manner as they respond to predators, including abandoning locations where they are disturbed (Bartholomew, 1949; Allen, 1991; both cited in NMFS, 2010a). This type of disturbance can also cause reduced reproductive success, and mortality of physiologically compromised individuals (Daan et al., 1996; Giese, 1996; Mullner et al., 2004; all cited in NMFS, 2010a). Spill response-induced disturbance could contribute to ongoing environmental stressors experienced by the species. Although healthy whales are capable of tolerating additional stress, any behavior-altering stress response represents an energy expenditure that could contribute to the mortality of young, old, sick, or injured humpback whales.

Humpback whale exposure to mechanical and non-mechanical response activities will vary based on a number of factors, including, but not limited to, the location, timing, duration, areal extent, and intensity of the response activities and the whale's ability to move away from the activity. If physical and behavioral disturbances to individual whales result from response activities, these disturbances are likely to be short-lived and of low magnitude in nature, given the species' ability to avoid and / or move away from areas of disturbance.

4.2.6.2 Exposure to contaminants

The potential impacts associated with exposure are limited to the use of dispersants and *in situ* burning; no other response actions are expected to pose an exposure threat to humpback whales. Direct toxicity to whales from exposure to dispersants or *in situ* burning is not likely due to the limited conditions under which these response actions are applied, the seasonal nature of the North Pacific humpback population, and the mobility of these whales. Additional toxicological considerations for the humpback whale are discussed in Section 5.1.6 of Appendix B.

The exposure of humpback whales to waterborne chemicals and airborne particulates is expected to be similar to that of other baleen whales. However, humpback whale feeding behaviors are somewhat specialized in comparison with those of other cetaceans, which could increase their exposure to dispersants or dispersed oil relative to that of other whales. Humpback whales periodically use bubble nets to corral prey within an area so they can be foraged upon more efficiently. This behavior normally occurs in shallow waters through breaching and forcing air bubbles into a ring that disorients some prey species and traps others. The use of surface waters for bubble net feeding could increase the humpback whale's exposure, especially when breaching, to chemicals applied at the surface. The dispersion (and thus dilution) of oil in an area where humpback whales are feeding will reduce the concentration at the surface and will potentially be protective of humpback whales in this instance.[32] During a spill response action, humpback whale feeding and other activities are unlikely because of the whale's avoidance of human activity noise in the response area.

Like other baleen whales, humpback whales rely on plankton and small, free-swimming organisms that could be directly affected by exposure to dispersants and dispersed oil. However, given the size of the humpback whale's range, the areal extent and duration of a given spill would have to be extensive to have a lasting and / or large-scale adverse effect on the prey base of humpback whales.

[32] For example, the potential for inhalation or aspiration of crude oil vapors and for dermal contact with a concentrated oil slick will be reduced, thereby reducing impacts related with these types of exposures (Section 3.1.2.3 of Appendix B).

Dispersants distribute oil and other chemicals both laterally and vertically in the water column. Whales in the immediate vicinity of recently applied (< 24 hrs) dispersants would likely be exposed to dispersants and / or dispersed oil. The potential exists for baleen whales to ingest dispersants or dispersed oil due to the volume of water filtered through their baleen plates. The fouling of baleen could also result if a humpback whale were to feed in an area where dispersants had been applied. Dilute dispersed oil would be filtered through the baleen, and oil residues could reduce feeding efficiency for short periods of time (i.e., less than 24 hours) (BOEMRE, 2011). Continued feeding in areas unaffected by a spill or spill response activities would likely flush dispersants and dispersed oil from baleen plates; however, repeated fouling could result in a more significant effect if whales were unable to feed for prolonged periods of time (BOEMRE, 2011).

The uptake and effect of PAHs on cetaceans is a point of uncertainty requiring further study. It is possible that the application of chemical dispersants would temporarily increase the exposure of humpback whales to PAHs through the water column and through their diet. The likely impact of such a temporary increase in exposure is unclear (Section 6.3.4 of Appendix B).

Exposure to *in situ* burning is unlikely for all whale species. Decision criteria associated with *in situ* burning as a response action restrict its use in the vicinity of a protected species or critical habitat, and whales are expected avoid the types of activities associated with *in situ* burning. However, NMFS (2003) stated that if a whale is within ~0.25 mi (0.4 km) of an *in situ* burn, the risk of soot and emissions exposure to surfacing cetaceans is increased. The inhalation of soot particles upon surfacing might cause irritation to membrane tissues (i.e., lung tissue), and significant exposure could impair lung function, although these effects have not been documented in whales. Burnt residues are unlikely to affect humpback whales because they do not feed on bottom sediment, where these materials settle.

4.2.6.3 Exclusion from resources

Humpback whales could be temporarily excluded from a resource due to the presence of response workers, vessels, response equipment and materials, and aircraft, as well as the associated noise. For example, whales could temporarily avoid a feeding area during booming, skimming, the application of sorbents, or vessel or aircraft traffic. Long-term exclusion from a resource is unlikely due to the likely short duration of response actions and the vastness of the area in which suitable and accessible whale habitat exists in Alaska's marine waters.

The degree to which habitat exclusion adversely affects humpback whales depends on many factors. Due to their mobility and the availability of open-water habitat, it is expected that the effects of spill response activities on the ability of humpback whales to access important resources will be relatively low-magnitude and temporary.

4.2.6.4 Habitat degradation and loss

Actions that have the potential to directly or indirectly impact humpback whale habitat include booming and skimming; the application of sorbents and / or dispersants; *in situ* burning; activities associated with tracking and monitoring spills; mobilization and demobilization; and the marine transport of solid waste.

Diving is a key aspect of whale behavior that highlights the importance of the deep ocean environment for humpback whales. North Pacific humpback whale dive times are typically less than 5 minutes but occasionally last up to 10 minutes (US Navy, 2011). Most of their prey base is located within 300 m (~1,000 ft) of the surface, so that the whales spend most of their dive time between 92 and 120 m (300 to 400 ft) (NMFS, 2011g), although they have been known to dive as deep as 500 m (1,600 ft) (US Navy, 2011). For the purpose of this BA, the entire water column from 0 to 300 m deep, in coastal and open, deep-water areas, is considered potential humpback whale habitat; degradation to any portion of this water column could have temporary detrimental effects on the humpback whale.

Response activities that occur at the sea surface could adversely affect the whale's ability to access habitat and / or resources at or near the surface. These activities include booming and skimming; the application of sorbents and / or dispersants; *in situ* burning; tracking and monitoring of spills; mobilization and demobilization; discharge of wastewater, and the marine transport of solid waste. Potential impacts include, but are not limited to, the degradation of water quality and / or air quality, changes in prey base due to impacts on other species within the food web (e.g., plankton and larval fish), and anthropogenic noise. Although the effects of noise as a disturbance have been discussed previously, noise also represents a temporary degradation of habitat quality.

Habitat degradation in the deeper water column could result from *in situ* burning because burnt residues that sink and pass through the water column could adversely affect water quality and prey populations at depth.

Response actions are not expected to cause a loss in humpback whale habitat due to the short-term duration of the actions and the dynamic nature of the ocean environment. Temporary habitat degradation could result in low-magnitude effects on localized whale habitat (e.g., temporary localized prey base reduction or water quality impairment). Like many other whale species, humpback whales are mobile and have access to large expanses of suitable habitat; therefore, it is unlikely that temporary habitat degradation from response activities will have long-term or high-magnitude effects on this species.

4.2.6.5 Direct injury

The primary means of direct injury from spill response activities are ship strikes or entanglement in response equipment. Exposure to heat from *in situ* burning is another potential, although unlikely, injury.

According to the *Final Recovery Plan for Humpback Whales* (NMFS, 1991), ship strikes are considered one of the greatest threats to the recovery of the humpback whale population. The presence of boats, vessels, and / or deployed equipment would likely increase substantially during spill response actions, which in turn would increase the risk of direct injury to humpback whales. Evidence suggests that humpbacks are less aware of nearby vessels when engaged in feeding or other energetic activities and are thus more vulnerable to strikes. In addition, calves and juveniles are more susceptible to ship strikes because they are smaller (i.e., more difficult to see), spend more time at the surface than do adults, and are often closer to the shore (Herman et al., 1980; Mobley et al., 1999). Although vessel traffic could increase temporarily in response to a spill, many precautions and protection measures would be incorporated into the BMPs of each response action so that the risk of a direct strike is expected to be extremely small. Despite the rarity of such an event, a ship strike does have the potential to cause an injury that could have temporary to long-term and low- to high-magnitude effects on humpback whales.

Whale entanglement in spill response equipment and materials (e.g., booms) has not been specifically documented in the scientific journals or technical documents that were reviewed during the preparation of this BA. However, it is important to note the potential for this type of injury to occur. Entanglement of humpback whales and other whale species with fishing equipment have been reported; entanglement in fishing gear is the most frequent human-related cause of injury and death among humpback whales (NMFS, 1991). Although possible, it is anticipated that entanglement in equipment during a response action would be a rare occurrence due to the associated procedures designed to prevent such an injury. In the rare event that a whale were to become entangled in response equipment, an injury of varying magnitude could occur.

In the unlikely event that a humpback whale were to surface in an area of an *in situ* burn, direct injury (of variable duration and magnitude) could result from heat stress. Whales below the surface are also unlikely to be affected due to the rapid attenuation of temperature with depth (Evans et al., 1988).

4.2.6.6 Determination of effects

Humpback whales would be most vulnerable to spill response activities that occur in the coastal areas of Alaska (Figure 3-13) during spring and summer, when North Pacific humpback whale populations peak in Alaska waters. Kodiak Island, the Shumagin Islands, north of Unalaska Island, and Southeast Alaska are areas where it is known that humpback whales seasonally aggregate (Zerbini et al., 2006). These areas also have a higher frequency of historical spills. Most documented spills were relatively small; approximately 40 spills (of any material) were between 1,000 and 10,000 gal., and 13 were greater than 10,000 gal. for the period 1995 to 2012 (Appendix D). Most of these spills were of relatively non-persistent diesel fuel; two response actions involved the use of dispersants. Spill response activities could also potentially affect local year-round residents in the Southeast Alaska.

The detection, observation and avoidance of marine mammals during a spill response would be a major component of an IAP. In the event that individual humpback whales were to encounter response activities, the following high-magnitude effects could result from specific response actions:

- Physical injury via entanglement in equipment or ship strike
- Impaired breathing or lung damage from smoke inhalation during *in situ* burning
- Lung damage from the aspiration of dispersants or dispersed oil

Response actions could also have lower-magnitude effects, including:

- Behavioral disturbance due to the noise of aircraft or small vessels or activities associated with *in situ* burning or dispersant application
- Tissue irritation (i.e., skin, eye, nose, mucus membrane) caused by exposure to dispersed oil, dispersants, or smoke from *in situ* burning
- Alteration of the food web through the use of dispersants (e.g., changes in abundance and composition of prey due to dispersed oil toxicity)
- Short-term habitat degradation due to changes in water quality (from use of dispersants, burnt residues) or noise levels
- Short-term reduction in feeding efficiency caused by the fouling of baleen by dilute, dispersed oil or burn residues

Emergency response actions in Alaska are, as a matter of policy, based first on mechanical response actions. Non-mechanical responses are considered only if mechanical containment, removal, and/or cleanup are ineffective or incomplete. *In situ* burning and dispersant application are only implemented if feasible (i.e., a number of field conditions must be met for the effective use of these responses) and if the use of *in situ* burning or dispersants will cause less harm than would the spill in their absence. The use of these non-mechanical response methods is avoided near concentrations of wildlife or in nearshore habitats. In addition, their use requires concurrence from the incident-specific RRT and consultation with the Services prior to any decision regarding their implementation.

The IAP and subsequent response actions will be designed to protect sensitive resources; site-specific strategies have been created for the most important sites used by humpback whales, with input from the Services and other natural resource trustees. Approximately 500 GRS have been approved for coastal regions in Alaska (about 60 more are being developed) in regions where humpback whales may be present (ARRT, 2013). Each GRS defines specific locations for response action staging and boom placement; areas appropriate for the collection and recovery of oil products; and the resources to be protected.

Furthermore, all response activities are developed and implemented as part of an emergency consultation in conjunction with the Services during the response in order to avoid or minimize impacts to ESA species and critical habitats. If necessary, the deterrence of whales can be permitted by NOAA Fisheries if it is deemed critical to preventing the exposure whales to oil or hazardous substances. Deterrence activities have the highest likelihood of impact on whales because, by default, they constitute an adverse impact under ESA. All other response actions seek to avoid interactions with whales.

The protection of sensitive species and habitats is one of the highest priorities of a response action. However, given the potential effects of increased anthropogenic noise during response activities and exposure to dispersed oil, along with possible direct injury from vessel strikes or entanglement, it is likely that response activities during the implementation of the Unified Plan could adversely affect the humpback whale.

4.2.7 North Pacific right whale

Spill response actions that could affect North Pacific right whales include those that will occur in areas of deep, open water. Spill response activities have the potential to affect North Pacific right whales during the spring, summer, and fall, the seasons when they are most likely to be present in Alaska waters, particularly in mid-summer, when their numbers peak. These whales are most commonly found in areas north of the Aleutian Islands and on the southwest side of Kodiak Island, which are designated as critical habitat (Figure 3-14).

The historical spills in the deep ocean environment have been limited in the vicinity of the Aleutian and Kodiak Islands. During the 17 years between 1995 and 2012, there were approximately 10 spills that involved more than 100 gal. in deep water.[33] Half of these spills occurred during the seasons when the North Pacific right whales could have been present; all involved refined petroleum products (primarily diesel). (see Appendix D for all spill data). Most spill volumes were smaller; however, two spills exceeded 100,000 gal. Only one spill of about 1,000 gal. of diesel was reported in the North Pacific right whale's designated critical habitat north of the Aleutian Islands in June within this 17-year period (Appendix D). No crude oil spills were recorded for this period. Figure 4-3 identifies the spill locations, seasons, and types of material spilled in North Pacific right whale critical habitat between 1995 and 2012. Mechanical containment, recovery, and cleanup were the primary response actions, when noted.

33 Depth information is typically not available for spill locations. A distance of 5 mi. (or greater) from land was used as a surrogate metric to screen for deeper locations.

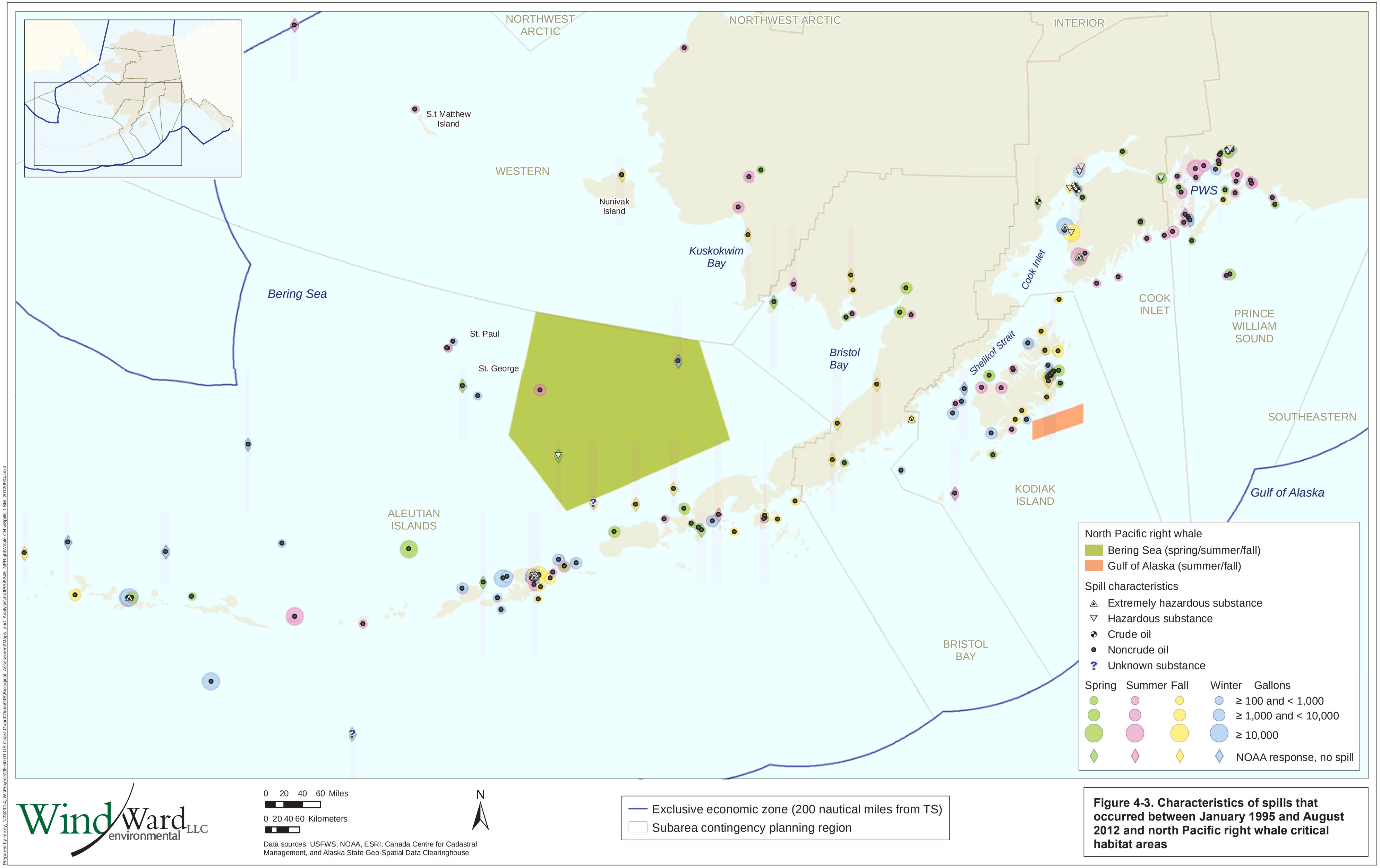

Figure 4-3. Characteristics of spills that occurred between January 1995 and August 2012 and north Pacific right whale critical habitat areas

The following subsections describe how spill response activities could affect the North Pacific right whale and are organized according to the five effect categories detailed in Section 4.1.

Response activities that do not occur in North Pacific right whale habitat and thus will not adversely affect North Pacific right whales include the following: deflection or containment berms, dams, or other barriers, pits, and trenches; and cleanup activities such as flushing or flooding, soil or sediment removal, cleaning, or vegetation cutting and removal.

4.2.7.1 Physical or behavioral disturbance

Avoidance and minimization measures (e.g., observing whales, establishing buffer zones, reducing vessel speeds in the vicinity of whales, altering routes) will help ensure that response actions do not cause physical or behavioral disturbance to North Pacific right whales. However, if use of these measures is precluded, individual whales could be disturbed by the increased presence of response workers, boats, equipment and materials, and aircraft, as well as associated noise. Actions associated with these potential disturbances include booming and skimming; the application of sorbents and/or dispersants; *in situ* burning; activities associated with tracking and monitoring spills; mobilization and demobilization; and the marine transport of solid waste.

Anthropogenic noise is considered to be a threat of unknown severity to the North Pacific right whale population (NMFS, 2006c). The presence of people and operation of vessels and equipment necessary to implement response actions will introduce a source of noise to the whales' environment. North Pacific right whales, like many marine mammals, use acoustic signals to communicate, navigate, locate prey, and sense their environment (NMFS, 2006c; US Navy, 2011; Richardson et al., 1995). NMFS (2006c) noted, "in right whales, the level of sensitivity to noise disturbance and vessel activity appears related to the behavior and activity in which they are engaged at the time" (Watkins, 1986; Perry et al., 1999; both cited in NMFS, 2006c). In particular, feeding or courting right whales are relatively unresponsive to loud sounds and therefore might be slow to react to approaching vessels or even be oblivious to them. In other species, noise can disrupt these essential whale behaviors, resulting in highly variable effects on individuals or groups of animals. Richardson et al. (1995) stated that noise can also reduce the availability of prey or increase a whale's vulnerability to other hazards, such as fishing gear or predators, by masking associated sounds. Individual responses to noise can vary widely. Some whales can become more sensitive to noise exposure over time, causing adverse physical and behavioral responses, such as stress, to increase; alternatively, whales are also known to habituate to chronic noise exposure, which can actually cause the animal to be drawn to the source of the noise (Geraci and St. Aubin, 1980; cited in NMFS, 2006c). It is unknown if short-term behavioral responses to noise would have long-term effects on individual whales.

In addition to noise, the presence of people, vessels, aircraft, and equipment during response activities could generate other types of disturbance. NMFS (2010a) noted that wild animals respond to human disturbances in the same manner as they respond to predators, which may include abandoning sites (Bartholomew, 1949; Allen, 1991; both cited in NMFS, 2010a). This stressor may also result in reduced reproductive success (Giese, 1996; Mullner et al., 2004; both cited in NMFS, 2010a), or the mortality of compromised individuals due to physiological stress (Daan et al., 1996; cited in NMFS, 2010a). Spill response-induced disturbances could contribute to ongoing environmental stressors experienced by whales. Although healthy individuals are capable of tolerating additional stress, behavior–altering stress response represents an energy expenditure that could contribute to the mortality of young, old, sick, or injured North Pacific right whales.

North Pacific right whale exposure to mechanical and non-mechanical response activities will vary based on a number of factors, including, but not limited to, the duration, size, and intensity of response activities and the ability of the whale to move away from the activity. If physical and behavioral disturbances to individual whales result from response activities, they are likely to be short-lived and low magnitude in nature given the species' ability to avoid or move away from areas of disturbance.

4.2.7.2 Exposure to contaminants

The potential impacts associated with exposure are limited to the use of dispersants and *in situ* burning; no other response actions are expected to pose an exposure threat to North Pacific right whales. Direct toxicity to whales from exposure to dispersants or *in situ* burning is not likely due to the limited conditions under which these response actions are applied, the seasonality of the small North Pacific right whale population, and the transient nature of the whales. Specific considerations of dispersant or dispersed oil toxicity for North Pacific right whale are discussed in Section 5.1.7 of Appendix B.

The impacts of the chemical dispersion of oil to North Pacific right whale are expected to be similar to that of other baleen whales (see Section 4.2.2.2), in that dispersion may increase chemical exposures (i.e., direct contact and ingestion) in the shallow water column and through the prey base as well as temporarily alter the prey base of North Pacific right whales (Section 5.1.7 of Appendix B).

North Pacific right whales' prey could be impacted by dispersant use or *in situ* burning, depending on the location, size, and duration of the spill. Baleen whales rely on large quantities of relatively small species (i.e., plankton, small water-column fish and invertebrates). Many of these species (or their larvae) live near the ocean's surface in what is thought to be the most highly productive portion of the water. Because of where they live, these species would have the greatest exposure to newly applied dispersants, and some would be most affected by thermal exposure during *in situ* burning. Evans et al. (1988; cited by NMFS, 2003) reported that significant heating occurred within the upper 5 in. (~13 cm), where these organisms concentrate. Any reduction in the abundance of organisms at the sea's surface from the use of dispersants or *in situ* burning is unlikely to affect the whale diet given the vastness of the area of suitable habitat available for whales to feed. The areal extent and duration of a given spill would have to be extensive to have a lasting and / or large-scale adverse effect on the species' prey base, given the size of the North Pacific right whale's range.

The fouling of baleen could also result if a North Pacific right whale were to feed in an area where dispersants had been applied. Dilute dispersed oil would be filtered through the baleen, and oil residues could reduce feeding efficiency for short periods of time (i.e., less than 24 hours) (BOEMRE, 2011). Continued feeding in areas unaffected by a spill or spill response activities would likely flush dispersants and dispersed oil from baleen plates; however, repeated fouling could result in a more significant effect if whales were unable to feed for prolonged periods of time (BOEMRE, 2011).

The uptake and effect of PAHs on cetaceans is a point of uncertainty requiring further study. It is possible that the application of chemical dispersants would temporarily increase the exposure of North Pacific right whales to PAHs through the water column and through their diet. The likely impact of such a temporary increase in exposure is unclear (Section 6.3.4 of Appendix B).

Exposure to *in situ* burning is unlikely for all whale species. Decision criteria associated with *in situ* burning as a response action restrict its use in the vicinity of a protected species or critical habitat, and whales are expected to avoid the types of activities associated with *in situ* burning, deterred by noise and the presence of vessels. However, NMFS (2003) stated that if a whale is within ~0.25 mi (0.4 km) of an *in situ* burn, the risk of soot and emissions exposure to surfacing cetaceans is increased. The inhalation of soot particles upon surfacing and might cause irritation to membrane tissues (i.e., lung tissue), and significant exposure could impair lung function, although these effects have not been documented in whales.

4.2.7.3 Exclusion from resources

Certain mechanical and non-mechanical response activities have the potential to indirectly prevent North Pacific right whales from accessing or cause them to avoid important resources, such as feeding areas. All of the response actions that could potentially occur in North Pacific right whale habitat have the potential to cause whales to avoid resource areas; these actions include booming and skimming; the application of sorbents and / or dispersants; *in situ* burning; activities associated with tracking and monitoring spills; mobilization and demobilization; and the marine transport of solid waste. For example, whales could be temporarily excluded from a feeding area because of avoidance behavior. Long-term exclusion from a resource is unlikely due to the short duration of response actions and the size of the area of suitable and accessible North Pacific right whale habitat in Alaska's marine waters.

The degree to which exclusion adversely affects North Pacific right whales depends on many factors. Because of their mobility and the vastness of their open water habitat, it is expected that the effects of spill response activities on the ability of North Pacific right whales to access important resources would be relatively low, with only temporary or low-magnitude effects, if any. The exception to this would be if North Pacific right whales were to avoid important resources within their designated critical habitat. However, it is unknown what level of impact a temporary exclusion from critical habitat resources would have on affected whales. Given the particularly sensitive status of the North Pacific right whale population, temporary exclusion from important resources could result in a range of low-to-high-magnitude consequences.

4.2.7.4 Habitat degradation and loss

Mechanical and non-mechanical response activities have the potential to temporarily degrade North Pacific right whale habitat. Response activities that occur at the sea surface could adversely affect the whale's use of habitat and resources at or near the surface. Potential impacts include, but are not limited to, the degradation of water quality and air quality; changes in prey base due to impacts on other species within the food web (e.g., zooplankton), and anthropogenic noise. Although the effects of noise as a disturbance have been discussed previously, noise also represents a temporary degradation of habitat quality.

Diving is a key aspect of whale behavior and highlights the importance of the deep ocean environment for North Pacific right whales. Information on right whale diving behavior is limited. North Atlantic right whales are known to dive for 5 minutes to more than 15 minutes at a time, the average depth being strongly related to the depth of copepod prey abundance, or roughly between 80 to 175 m (260 to 600 ft) (US Navy, 2011).

Due to the limited amount of data regarding their habitat, the top 175 m of the water column in coastal and open, deep-water areas, is considered to be potential North Pacific right whale habitat. The degradation of any portion of this water column could have detrimental effects on the right whale; although any contribution from a response action would be short-term.

North Pacific right whales are especially vulnerable to habitat degradation or loss, particularly within their critical habitat area. The sole PCE for critical habitat for this species is the aggregation of copepods within these areas. Therefore if response operations degraded habitat such that there was a reduction in copepod populations, this may be considered an adverse modification. Habitat degradation in the deeper water column could result from *in situ* burning, which creates residues that sink through the water column and could adversely affect water quality and prey populations at depth.

Response actions are not expected to cause a loss in North Pacific right whale habitat due to the short-term duration of the actions and the dynamic nature of the ocean environment. Temporary habitat degradation could have low-magnitude effects on localized whale habitat (e.g., temporary and localized prey base reduction or water quality impairment); however, because the North Pacific right whale population is so depleted, even temporary habitat degradation could result in a range of low-to-high-magnitude consequences.

4.2.7.5 Direct injury

The primary sources of direct injury from spill response activities are ship strikes or entanglement in response equipment. Activities associated with potential means of injury include booming and skimming; the application of sorbents and / or dispersants; *in situ* burning; and activities associated with the tracking and monitoring of spills; mobilization and demobilization; and solid waste handling and disposal. Exposure to heat from *in situ* burning is a potential, although unlikely, source of direct injury.

According to the NMFS (2006c), the risk to North Pacific right whales from ship strikes is unknown. Ship strikes are the most common known direct cause of mortality in the large, slow-moving North Atlantic right whale (NMFS, 2006c), which elevates the risk associated with vessel interaction with the North Pacific right whale population. Some larger spills may require the deployment of a number of vessels which could increase the risk of vessel strikes for this whale. Although vessel traffic could increase temporarily in response to a spill, many precautions and protection measures would be incorporated into the BMPs of each response action, so that the risk of a direct strike is highly unlikely.

Entanglement of various whale species with fishing equipment has been reported (NMFS, 2006c, 2011g; US Navy, 2011) and the potential exists for entanglement in spill response equipment. It is anticipated that this would be a rare occurrence due to the precautions and protection procedures associated with response actions to prevent such an injury.

In the unlikely event that a North Pacific right whale were to surface directly in an area where *in situ* burning was being conducted, direct injury (of unknown duration and magnitude) could result from heat stress. Whales below the surface are unlikely to be affected because of the rapid attenuation of temperature with depth(Evans et al., 1988).

4.2.7.6 Determination of Effects

North Pacific right whales would be most vulnerable to spill response activities that occur in offshore and coastal areas of the northern GOA and Bering Sea (Figure 3-14), especially within their designated critical habitat, during all seasons except winter.

The area designated as critical right whale habitat has been the site of very few historical spills;[34] two of these spills had no release of materials, and one involved approximately 1,000 gal. of diesel fuel, which is a relatively small release. In no case was a persistent chemical released or was the material chemically treated. If the historical record is any indication of the potential for future incidents, spills will most likely be of

[34] The precise locations of spills within Northern Pacific right whale critical habitat are uncertain because of the imprecision of spill reporting (i.e., lack of specific coordinates).

a non-persistent nature and will not require chemical treatment. This expectation is further supported by the fact that the North Pacific right whale critical habitat is in the deep ocean, far from most anthropogenic activity, and outside current shipping lanes.

Response actions could have a range of effects on individual North Pacific right whales. In the event that a right whale were to encounter response activities, these actions could result in the following high-magnitude effects on individual whales:

- Physical injury via entanglement or ship strikes
- Impaired breathing or lung damage from smoke inhalation during *in situ* burning

Response actions could also have lower-magnitude effects, including:

- Behavioral disturbance due to the noise of aircraft or small vessels or activities associated with *in situ* burning or dispersant application
- Alteration of the food web through the use of dispersants (e.g., changes in abundance and composition of prey due to dispersed oil toxicity)
- Tissue irritation (i.e., skin, eye, nose, mucus membrane) caused by exposure to dispersants and dispersed oil or smoke
- Short-term habitat degradation due to changes in water quality, air quality, noise, or abundance and composition of prey
- Short-term reduction in feeding efficiency caused by the fouling of baleen by dilute, dispersed oil or burn residues

Emergency response actions in Alaska are, as a matter of policy, based first on mechanical response actions. Non-mechanical responses are considered only if mechanical containment, removal, and/or cleanup are ineffective or incomplete. *In situ* burning and dispersant application are only implemented if feasible (i.e., a number of field conditions must be met for the effective use of these responses) and the use of *in situ* burning or dispersants will cause less harm than would the spill in their absence. The use of these non-mechanical response methods is avoided near concentrations of wildlife and requires concurrence from the incident-specific RRT and consultation with the Services prior to any decision regarding implementation.

The IAP and subsequent response actions are designed to protect sensitive resources; site-specific strategies have been created for the most important sites used by whales with input from the Services and other natural resource trustees. Of the species with designated critical habitat, no specific GRS are applicable to the North Pacific right whale because these whales congregate in open water, as opposed to in the nearshore environment. Instead, incident-specific response strategies that reflect the sea state, weather, and oceanographic conditions at the time are developed. The IAP and subsequent response actions are designed to protect sensitive resources.

Furthermore, all response activities are developed and implemented as part of an emergency consultation with the Services during the response to avoid or minimize impacts to ESA-listed species and critical habitats. Reconnaissance and observation of whales in the vicinity of a response action is a primary component of a response action that will support further development of protections for whales. If necessary, deterrence of whales can be permitted by NOAA Fisheries if it is deemed critical to preventing their exposure to oil or hazardous substances. Deterrence activities have the highest likelihood of impact on the whales because, by default, they constitute an adverse impact under ESA.

Given that the protection of sensitive species and habitats is one of the highest priorities of a response action, the North Pacific right whale's preference for open ocean habitat, where oil spills are infrequent, it is highly unlikely that this species would be adversely affected by response activities during implementation of the Unified Plan.

4.2.8 Sei whale

Spill response actions that could affect sei whales are limited to those actions that would occur in deep, open water in the Bering Sea and the area around Kodiak Island (two areas with concentrations of sei whales) and during the summer months. Spill response activities have the potential to adversely affect individuals or small groups[35] of sei whales.

Spills in the deep ocean environment are limited in frequency in the Bering Sea and northern GOA (specifically around Kodiak Island). During the 17 years between 1995 and 2012, there were approximately 10 spills greater than 100 gal. in deep water.[36] Two of these spills occurred in summer when sei whales could have been present; both spills were <500 gal. and were of diesel (see Appendix D for spill data). No crude oil spills were recorded for this period. Figure 4-2 identifies the spill locations, seasons, and types of material spilled in sei whale habitat between 1995 and 2012. Mechanical containment, recovery, and cleanup were the primary response actions, when identified; there are no records of dispersant use on these spills during the seasons that sei whales would have been present.

Response actions that do not occur in sei whale habitat (Section 4.2.7) are not expected to cause physical or behavioral disturbances to the whales. The following subsections describe spill response activities that could affect the sei whale and are organized according to the five effect categories detailed in Section 4.1.

4.2.8.1 Physical or behavioral disturbance

Avoidance and minimization measures (e.g., observing whales, establishing buffer zones, reducing vessel speeds in the vicinity of whales, altering routes) will help ensure that response actions do not cause physical or behavioral disturbance to sei whales.

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[35] These whales are typically observed alone or in small groups of 3 to 5 individuals but have been known to aggregate in groups as large as 30 to 50 individuals (NMFS, 2011h).

[36] Depth information is typically not available for spill locations. A distance of 5 statute miles (or greater) from land was used as a surrogate metric to screen for deeper locations.

However, if the use of these measures is precluded, individual whales could be disturbed by the increased presence of response workers, boats, equipment and materials, and aircraft, as well as associated noise. Actions associated with these potential disturbances include booming and skimming; the application of sorbents and/or dispersants; *in situ* burning; activities associated with tracking and monitoring spills; mobilization and demobilization; and the marine transport of solid waste.

According to the *Final Recovery Plan for the Sei Whale* (NMFS, 2011h), anthropogenic noise is considered to be a threat of unknown severity to the sei whale population. The presence of people and operation of vessels and equipment necessary to implement response actions will introduce a source of noise to the whales' environment. Sei whales, like many marine mammals, use acoustic signals to communicate, navigate, locate prey, and sense their environment (NMFS, 2011h; US Navy, 2008). Noise, particularly low-frequency noise, can disrupt these essential whale behaviors, resulting in highly variable impacts on individuals, groups of animals, or populations. For example, excessive noise requires whales to alter their vocalization; this alteration could be short-lived or prolonged (Tyack, 2008). Richardson et al. (1995) reported that noise can also reduce the availability of prey or increase vulnerability to other hazards, such as fishing gear or predators. Individual responses to noise can vary widely. Some whales become more sensitive to noise exposure over time, causing adverse physical and behavioral responses, such as stress, to be exacerbated; alternatively, whales are also known to habituate to chronic noise exposure, which can actually cause the animal to be drawn to the source of the noise (Southall et al., 2007; cited in NMFS, 2011h). Other factors that could affect how an individual responds to noise include sound characteristics (e.g., frequency); geographic location of sound source and ability of the whale to move away from the sound; and the whale's hearing sensitivity, age, sex, reproductive status, health, and social behavior (NMFS, 2011h).

In addition to noise, the presence of people, vessels, aircraft, and/or equipment as part of response activities could generate other types of disturbance. NMFS (2011h) reported that wild animals respond to human disturbances in the same manner they respond to predators, including abandoning sites (Bartholomew, 1949; Allen, 1991; both cited in NMFS, 2011h). This stressor could also result in reduced reproductive success (Giese, 1996; Mullner et al., 2004; both cited in NMFS, 2011h) or the mortality of physiologically compromised individuals (Daan et al., 1996; cited in NMFS, 2011h). Spill response-induced disturbance could contribute to ongoing environmental stressors experienced by the species. Although healthy individuals might be capable of tolerating additional stress, any behavior–altering stress response represents an energy expenditure that could contribute to the mortality of young, old, sick, or injured sei whales.

Sei whale exposure to mechanical and non-mechanical response activities would vary based on a number of factors, including, but not limited to, the duration, size, and intensity of response activities and the ability of the whale to move away from the activity. If physical and behavioral disturbances to individual whales result from these response actions, they are likely to be short-lived and low magnitude in nature given the species' ability to avoid and / or move away from areas of disturbance.

4.2.8.2 Exposure to contaminants

The potential impacts associated with exposure are limited to the use of dispersants and *in situ* burning; no other response actions are expected to pose an exposure threat to sei whales. The seasonal (i.e., summer) presence of sei whales in deep Alaska waters makes their exposure to dispersants or *in situ* burning unlikely, but there would be some potential for adverse effects were an interaction between a whale and a response to occur. Specific considerations of toxicity in the sei whale resulting from dispersant application are discussed in Section 5.1.8 of Appendix B.

Sei whale prey could be impacted by dispersant use or *in situ* burning, depending on the location, size, and duration of the spill. Baleen whales rely on large quantities of relatively small species (i.e., plankton, small fish, and invertebrates) that live in the most highly productive upper water column. Sei whales feed at the ocean surface when skim feeding (NOAA Fisheries, 2013); this puts sei whales at particular risk with regard to the ingestion of oil, which could be reduced through the use of dispersants (Appendix B). However, Sei whales also feed between 0 and 300 m in depth (MarineBio, 2012b) and do so opportunistically (NOAA Fisheries, 2013); therefore, their potential for exposure during feeding is uncertain. Sensitive prey species that reside near the sea surface are likely to be injured through the application of dispersants or the use of *in situ* burning. Any reduction in the abundance of organisms near the sea's surface could affect sei whale diets; however, this effect is unlikely given the large area over which this whale feeds. The areal extent and duration of the spill would have to be significant to have an adverse effect on the species' prey base given the size of the sei whale range.

The fouling of baleen could also result if a sei whale were to feed in an area where dispersants had been applied. Dilute dispersed oil would be filtered through the baleen, and oil residues could reduce feeding efficiency for short periods of time (i.e., less than 24 hours) (BOEMRE, 2011). Continued feeding in areas unaffected by a spill or spill response activities would likely flush dispersants and dispersed oil from baleen plates; however, repeated fouling could result in a more significant effect if whales were unable to feed for prolonged periods of time (BOEMRE, 2011).

The uptake and effect of PAHs on cetaceans is a point of uncertainty requiring further study. It is possible that the application of chemical dispersants would temporarily increase the exposure of sei whales to PAHs through the water column and through their diet. The likely impact of such a temporary increase in exposure is unclear (Section 6.3.4 of Appendix B).

Exposure to *in situ* burning is unlikely for all whale species. Decision criteria associated with *in situ* burning as a response action restricts its use in the vicinity of a protected species or critical habitat, and whales are expected to avoid the types of activities associated with *in situ* burning, deterred by noise and the presence of vessels. However, NMFS (2003) stated that if a whale is within ~0.25 mi (0.4 km) of an *in situ* burn, the risk of soot and emission's exposure to surfacing cetaceans is increased. The inhalation of soot particles upon surfacing cause irritation to membrane tissues (i.e., lung tissue), and significant exposure could impair lung function, although these effects have not been documented in whales.

4.2.8.3 Exclusion from resources

Mechanical and non-mechanical response activities have the potential to indirectly exclude sei whales from important resources, such as prey and/or refuge areas. All of the response actions have the potential to cause whales to avoid resource areas, including booming and skimming; the application of sorbents and/or dispersants; *in situ* burning; activities associated with tracking and monitoring spills; mobilization and demobilization; and the marine transport of solid waste. Long-term exclusion from a resource is unlikely due to the short duration of the response actions and the large area over which suitable and accessible sei whale habitat is available.

The degree to which a temporary loss of access to resources could adversely affect sei whales depends on many factors. Due to their mobility and the vastness of their open-water habitat, it is expected that spill response activities would have a relatively low effect on the ability of sei whales to access important resources, with only temporary or low-magnitude effects, if any.

4.2.8.4 Habitat degradation and loss

Mechanical and non-mechanical response activities could temporarily degrade sei whale habitat. Diving is a key aspect of whale behavior that highlights the importance of the deep ocean environment and the surface environment for sei whales. Sei whales are capable of diving for 5 to 20 minutes at a time to feed on plankton (e.g., copepods, krill), small schooling fish, and cephalopods (e.g., squid) by means of both gulping and skimming (NMFS, 2011h). Because sei whales are known to dive as deep as 300 m while foraging, the entire water column between 0 and 300 m (~1,000 ft) deep is considered to be important habitat for the species. Degradation to this part of the water column could have detrimental effects on sei whales.

Habitat degradation in the deeper water column could result from *in situ* burning from residues that sink through the water column; these residues could cause adverse effects on water quality and prey populations at depth.

Response activities that occur at the sea surface could adversely affect whale habitat use and resources when sei whales are at or near the surface. Potential impacts include, but are not limited to, the degradation of water quality and/or air quality, changes in prey base due to impacts on other species within the food web (e.g., plankton, larval fish), and anthropogenic noise. In addition to being a disturbance event, as discussed previously, increased anthropogenic noise also represents a temporary degradation of habitat quality. Temporary habitat degradation could result in low-magnitude effects on localized whale habitat (e.g., temporary and localized prey base reduction or water quality impairment). Sei whales are extremely mobile and have access to large expanses of suitable habitat; therefore, it is very unlikely that any temporary habitat degradation resulting from response activities would have long-term or high-magnitude effects on this species.

4.2.8.5 Direct injury

The primary sources of direct injury from spill response activities are ship strikes or entanglement in response equipment. Exposure to heat from *in situ* burning is another potential, though unlikely, injury. Activities associated with potential means of injury include booming and skimming; the application of sorbents and / or dispersants; *in situ* burning; and activities associated with the tracking and monitoring of spills; mobilization and demobilization; and solid waste handling and disposal.

The *Final Recovery Plan for the Sei Whale* (NMFS, 2011h) reported that the number of recorded ship strikes for sei whales is disproportionately low compared with those for other whale species (Jensen and Silber, 2004; cited in NMFS, 2011h). This could be attributed to the sei whale's broad distribution in deep open waters and relatively low population densities in shipping lanes that have heavy vessel traffic. As a result of this low number, NMFS (2011h) reported that the risk of direct injury from ship strikes is unknown but potentially low. However, this risk could increase during spill response activities that require a substantially increased presence of vessels and equipment. As a result of this potential increase, many precautions and protection measures would be incorporated into the BMPs of each response action so that the risk of a direct strike would be very small.

Although whale entanglement in spill response equipment and materials (e.g., booms) was not documented in the scientific journals and technical documents that were reviewed while preparing this BA, there is potential for this type of injury to occur. Various whale species are known to become entangled with fishing equipment while trying to eat caught fish (Rice, 1989; Hill and DeMaster, 1999; both cited in US Navy, 2008). The *Final Recovery Plan for the Sei Whale* (NMFS, 2011h) reported that sei whales have an unknown but potentially low risk of entanglement in fishing gear because of their sparse distribution offshore. It is anticipated that any entanglement with response action equipment would be a rare occurrence due to the precautions and protection measures implemented to prevent such an injury.

In the unlikely event that a sei whale were to surface in an area of an *in situ* burn, direct injury (of variable duration and magnitude) could result from heat stress. Whales below the surface are also unlikely to be affected due to the rapid attenuation of temperature with depth (Evans et al., 1988).

4.2.8.6 Determination of effects

Sei whales would be most vulnerable to spill response activities that occur offshore in the Bering Sea and near Kodiak Island during summer months when sei whales are more likely to be present.

The areas associated with sei whale distribution in Alaska have had very few historical spills during the season in which the whales would have been present. Spills were typically small (< 500 gal.) and consisted of relatively non-persistent petroleum (i.e., diesel fuel). There is no record of the use of non-mechanical responses for these spills. If the historical record is any indication of the potential for future incidents, spills will most likely be of a non-persistent nature and will not require chemical treatment. This expectation is further supported by the fact that the sei whale habitat critical habitat is in the deep ocean, far from most anthropogenic activity.

Response actions could have a range of effects on individual sei whales. In the event that a sei whale were to encounter a response action, these activities could result in the following high-magnitude effects on individual sei whales:

- Physical injury via entanglement or ship strikes
- Impaired breathing or lung damage from smoke inhalation during *in situ* burning

Response actions could also have lower-magnitude effects, including:

- Behavioral disturbance due to the noise of aircraft or small vessels or activities associated with *in situ* burning or dispersant application
- Alteration of the food web through use of dispersants (i.e., changes in abundance and composition of prey due to dispersed oil toxicity)
- Tissue irritation (i.e., skin, eye, nose, mucous membrane) caused by exposure to dispersants and dispersed oil or smoke
- Short-term habitat degradation—water quality, air quality, noise, or change in abundance or composition of prey
- Short-term reduction in feeding efficiency caused by the fouling of baleen by dilute, dispersed oil or burn residues

Emergency response actions in Alaska are, as a matter of policy, based first on mechanical response actions. Non-mechanical responses are considered only if mechanical containment, removal, and/or cleanup are ineffective or incomplete. *In situ* burning and dispersant application are only implemented if feasible (i.e., a number of field conditions must be met for the effective use of these responses) and the use of *in situ* burning or dispersants will cause less harm than would the spill in their absence. The use of these non-mechanical response methods is avoided near concentrations of wildlife and requires concurrence from the incident-specific RRT and consultation with the Services prior to any decision regarding their implementation.

The IAP and subsequent response actions are designed to protect sensitive resources; site-specific strategies have been created for most important sites used by sei whales with input from the Services and other natural resource trustees. Furthermore, all response activities are developed and implemented as part of an emergency consultation with Services during the response to avoid or minimize impacts to ESA species and critical habitats. If necessary, the deterrence of whales can be permitted by NOAA Fisheries if it is deemed critical to preventing their exposure to oil or hazardous substances. Deterrence activities have the highest likelihood of impact on the whales because, by default, they constitute an adverse impact under ESA.

Given that the protection of sensitive species and habitats is one of the highest priorities of a response action, the extensive open-ocean habitat, where oils spills are infrequent, and seasonal presence of sei whales in Alaska, it is highly unlikely that they would be adversely by response activities during implementation of the Unified Plan.

4.2.9 Sperm whale

Spill response actions that could affect sperm whales are limited to those actions that occur in deep,[37] open water, particularly in the southern Bering Sea, in the northern GOA, and throughout the Aleutian Islands during the summer months. However, these populations are largely composed of males; females and juveniles typically range only as far north as the 50 or 51 N (e.g., Vancouver Island) (Berzin and Rovnin, 1966; cited in NMFS, 2010b).

Spills in the deep ocean environment are limited in frequency in Alaska waters where sperm whales are likely to be present during summer months. During the 17 years between 1995 and 2012, there were approximately 10 spills that involved more than 100 gal. during the summer. Two of these spills occurred during summer when sperm whales could have been present; both were < 500 gal. and were of diesel (see Appendix D for all spill data). No crude oil spills were recorded for this period. Figure 4-2 identifies the spill locations, seasons, and types of material spilled in Alaska between 1995 and 2012. Mechanical containment, recovery, and/or cleanup were the primary response actions, when noted. There are no records of dispersant use on spills in these areas during the summer for this period.

The following subsections describe how spill response activities could affect the sperm whale and are organized according to the five effect categories detailed in Section 4.1.

Response activities that do not occur in sperm whale habitat and thus will not adversely affect sperm whales include deflection or containment berms, dams, or other barriers, pits, and trenches occurring on land or in shallow water; and cleanup activities such as flushing or flooding, soil or sediment removal, cleaning and grooming, or vegetation cutting and removal.

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[37] Depth information is typically not available for spill locations. A distance of 5 miles (or greater) from land was used as a surrogate metric to screen for deeper locations.

4.2.9.1 Physical or behavioral disturbance

Avoidance and minimization measures (e.g., observing whales, establishing buffer zones, reducing vessel speeds in the vicinity of whales, altering routes) will help ensure that response actions do not cause physical or behavioral disturbance to sperm whales. However, if the use of these measures is precluded, individual whales could be disturbed by the increased presence of response workers, boats, equipment and materials, and aircraft, as well as their associated noise. Actions associated with these potential disturbances include booming and skimming; the application of sorbents and/or dispersants; *in situ* burning; and activities associated with the tracking and monitoring spills; mobilization and demobilization; and marine transport of solid waste.

Anthropogenic noise is considered to be one of the greatest threats to the recovery of the sperm whale population (NMFS, 2010b). The presence of people and operation of vessels and equipment necessary to implement response actions will introduce a source of noise to the whale's environment. Sperm whales, like many marine mammals, use acoustic signals to communicate, navigate, locate prey, and sense their environment (NMFS, 2010b; US Navy, 2008; Southall et al., 2007, cited in NMFS 2010b). Noise can disrupt these essential whale behaviors, resulting in highly variable effects on individuals, groups, or populations of whales. For example, excessive noise requires whales to alter their vocalization. This alteration could be short-lived or prolonged (Tyack, 2008). Richardson et al. (1995) reported that noise can also reduce the availability of prey or increase vulnerability to other hazards, such as fishing gear or predators. Individual response to noise can vary widely. Some whales become more sensitive to noise exposure over time, causing their adverse physical and behavioral responses, such as stress, to be exacerbated; alternatively, whales are also known to habituate to chronic noise exposure, which can actually cause the animal to be drawn to the source of the noise (Southall et al., 2007; cited in NMFS, 2010b).

In addition to noise, people, response activity vessels, aircraft, and equipment could generate other types of disturbances. The 2010 sperm whale recovery plan (NMFS, 2010b) reported that sperm whales respond to human disturbances in the same manner as they respond to predators, including abandoning sites (Bartholomew, 1949; Allen, 1991; both cited in NMFS, 2010b). This stressor can also result in reduced reproductive success (Giese, 1996; Mullner et al., 2004; both cited in NMFS, 2010b) or the mortality of physiologically compromised individuals (Daan et al., 1996; cited in NMFS, 2010b). Spill response-induced disturbances could contribute to ongoing environmental stressors experienced by the species. Although healthy whales are capable of tolerating additional stress, any behavior-altering stress response represents an energy expenditure that could contribute to the mortality of young, old, sick, or injured sperm whales.

Sperm whale exposure to mechanical and non-mechanical response activities vary based on a number of factors, including, but not limited to, the duration, size, and intensity of response activities and the ability of the whale to move away from the activity. If physical and behavioral disturbances to individual whales result from the response activities, they are likely to be short-lived and low magnitude in nature, given the species' ability to avoid and move away from areas of disturbance.

4.2.9.2 Exposure to contaminants

The potential impacts associated with exposure are limited to the use of dispersants and *in situ* burning; no other response actions are expected to pose a chemical exposure threat to sperm whales. As a species that spends little time at the surface, sperm whale exposures to dispersants or dispersed oil are likely negligible. The sperm whale is a toothed whale, as opposed to a baleen whale, and forages in deep waters. It is unlikely that sperm whales will ingest dispersants or a mixture of oil and dispersants while swimming or feeding at depth, although they could be exposed when surfacing to breathe. The possible results of such an exposure are expected to be similar to other whales (see Section 4.2.2.2), with the exception of baleen fouling. Chemical dispersion may increase chemical exposures (i.e., direct contact and ingestion) in the shallow water column and through the prey base as well as temporarily alter the prey base of sperm whales (Section 5.1.9 of Appendix B).

Sperm whales could incidentally ingest burnt oil residues while feeding on benthic organisms (e.g., octopus), but this exposure would likely be low due to the low density of their benthic prey and the wide dispersal of residues as they settle to the bottom. The species could also come into contact with buoyant residues when surfacing to breathe, but such an exposure would not likely be prolonged.

The transient nature of the sperm whale makes exposure to dispersants or *in situ* burning unlikely, given that their presence during a spill response action will be limited by their seasonal distribution (summer) and low densities in any one area. Some individuals, particularly older males, are more limited in mobility due to their use of the edges of winter pack ice. This is not expected to increase their risk of exposure, because of the depths at which they feed and the lower probability of a spill and subsequent response in ice conditions.

In the unlikely event that a sperm whale were to be exposed to dispersants, dispersed oil, or *in situ* burning, the effects would be similar as those on other whales. The duration of the exposure would likely be temporary. The magnitude of effects, if any, from exposure to dispersants is unknown; effects from exposure to dispersed oil are uncertain, but likely less than those from exposure to undispersed oil due to dilution and biodegradation. The inhalation of soot particles upon surfacing could cause irritation to membrane tissues (i.e., lung tissue), and significant exposure could impair lung function, although these effects have not been documented in whales. Female and subadult whales could be at greater risk from the effects of degraded air and *in situ* burning because they spend more time at the surface than do adult males; however, females are not commonly present in Alaska waters.

Sperm whales could be affected by indirect effects on its prey species (i.e., loss of zooplankton or larval organisms could affect the overall marine food web, including whale prey). However, large-scale losses of fish or invertebrate larvae such that the whale's prey base would be significantly reduced are not anticipated from either dispersant use or *in situ* burning because of the short exposure durations of those species (e.g., larval invertebrates or fish) to these chemicals (Appendix B) or response actions. The magnitude and duration of the spill would have to be very significant to have an adverse effect on the sperm whale's prey base, given the size of the species' range.

4.2.9.3 Exclusion from resources

Certain mechanical and non-mechanical response activities have the potential to directly or indirectly exclude sperm whales from important resources, such as feeding areas. Although unlikely, all of the response actions that occur in sperm whale habitat have the potential to exclude whales from resources.

Whales could be temporarily excluded from a resource if they were to avoid it due to the increased presence of people, vessels, response equipment and materials, and/or aircraft, as well as their associated noise. Long-term exclusion from a resource is unlikely due to the large area of suitable and accessible whale habitat.

The degree to which habitat exclusion adversely affects sperm whales depends on many factors. Due to their mobility, the vastness of their open-water habitat, and the fact that they feed at depth, it is expected that the effects of spill response activities on the ability of sperm whales to access important resources would be relatively low, with only temporary and low-magnitude effects, if any.

4.2.9.4 Habitat degradation and loss

Actions that have the potential to directly or indirectly impact sperm whale habitat include booming and skimming; the application of sorbents and/or dispersants; *in situ* burning; and activities associated with the tracking and monitoring of spills; mobilization and demobilization; discharge of treated wastewater; and solid waste handling and disposal.

Because sperm whales are deep divers, the entire water column is considered to be important habitat, and the degradation of any portion of the water column could have temporary detrimental effects on sperm whales. Diving is a key aspect of whale behavior that highlights the importance of the deep ocean environment for sperm whales. During deep dives, whales forage for squid and other deep sea-dwelling cephalopods and fish (NMFS, 2010b). These dives often exceed depths of 400 m for durations of 30 minutes, but dives as deep as 2,000 m have been documented (Watkins et al., 2002; cited in US Navy, 2008). In general, males tend to spend more time below the sea surface (up to 83% of daylight hours) and do not spend extensive periods of time at the surface (Jacquet et al., 2000; cited in US Navy, 2008). Alternatively, females and juveniles spend less time underwater and more time at the surface. Females are commonly observed at the surface for prolonged periods of time, between 1 to 5 hours per day, without foraging (Whitehead and Weilgart, 1991; Amano and Yoshioka, 2003; both cited in US Navy, 2008), although females are less common in Alaska waters.

Response activities that occur at the sea surface could adversely affect the sperm whale's use of habitat and resources when they are at or near the surface. Potential impacts include, but are not limited to, the degradation of water quality and air quality; changes in prey base due to impacts on other species within the food web (e.g., larval fish); and anthropogenic noise. Although the effects of noise have been discussed previously as a disturbance effect, noise also represents a temporary degradation of habitat quality. Dispersant effects on prey at depth are unlikely because salinity and density gradients tend to limit vertical mixing. The exposure of prey to dispersants during early life stages is possible; however, the impacts of exposure to dispersed oil may be less severe than those for oil alone (Appendix B), depending on the depth at which the plankton live.

Response actions are not expected to cause a loss in sperm whale habitat due to the short-term duration of the actions and the dynamic nature of the ocean environment. Temporary habitat degradation could result in low-magnitude effects on whale habitat (e.g., temporary and localized prey base reduction of sensitive species, water quality impairments). Sperm whales are extremely mobile and have access to large expanses of suitable habitat; therefore, it is very unlikely that temporary habitat degradation from response activities would have long-term or high-magnitude effects on this species.

4.2.9.5 Direct injury

The primary means of direct injury from spill response activities are ship strikes and entanglement in response equipment. Activities associated with potential means of injury include booming and skimming; the application of sorbents and / or dispersants; and *in situ* burning; and activities associated with the tracking and monitoring of spills; mobilization and demobilization; and marine transport of solid waste. Exposure to heat from *in situ* burning is a potential, though unlikely, source of direct injury.

The *Recovery Plan for the Sperm Whale* (NMFS, 2010b) reported that ship strikes are one of the main threats to the recovery of the sperm whale population. The presence of vessels and deployed equipment would likely increase substantially during spill response actions, which in turn would increase the risk of direct injury to sperm whales. However, it is important to note that many precautions and protection measures would be incorporated into the BMPs of each response action so that the risk of a direct strike is expected to be very rare.

Although whale entanglement in spill response equipment and materials (e.g., booms) was not documented in the scientific journals and technical documents that were reviewed while preparing this BA, there is potential for this type of injury to occur. Sperm whales have been known to have interactions with fishing equipment in the GOA by attempting to eat caught fish and subsequently becoming entangled (Rice, 1989; Hill and DeMaster, 1999; both cited in US Navy, 2008). It is anticipated that any entanglement with response action equipment would be a rare occurrence because of the precautions and protection measures implemented to prevent such an injury.

In the unlikely event that a sperm whale were to surface in an area of an *in situ* burn, direct injury (of variable duration and magnitude) could result from heat stress. Whales below the surface are unlikely to be affected due to the rapid attenuation of temperature with depth (Evans et al., 1988).

4.2.9.6 Determination of effects

Response actions could have a range of potential effects on individual sperm whales. In the event that a sperm whale were to encounter a response action, these activities could result in the following high-magnitude effects on individual sperm whales:

- Physical injury via entanglement or ship strikes
- Impaired breathing or lung damage from smoke inhalation during *in situ* burning

Response actions could also have lower-magnitude effects, including:

- Behavioral disturbance due to the noise of aircraft or small vessels or activities associated with *in situ* burning or dispersant application
- Tissue irritation (i.e., skin, eye, nose, mucous membrane) caused by exposure to dispersed oil, dispersants, or smoke from *in situ* burning
- Localized alteration of the food web through the use of dispersants (e.g., changes in abundance and composition of prey due to dispersed oil toxicity)
- Short-term habitat degradation due to changes in water quality (from burnt residues or use of dispersants), noise levels, or prey base

Emergency response actions in Alaska are, as a matter of policy, based first on mechanical response actions. Non-mechanical responses are considered only if mechanical containment, removal, and/or cleanup are ineffective or incomplete. *In situ* burning and dispersant application are only implemented if feasible (i.e., a number of field conditions that must be met for the effective use of these responses) and the use of *in situ* burning or dispersants will cause less harm than would the spill in their absence. Use of these non-mechanical response methods is avoided near concentrations of wildlife and requires concurrence from the incident-specific RRT and consultation with the Services prior to any decision regarding their implementation.

The IAP and subsequent response actions are designed to protect sensitive resources; site-specific strategies have been created for most important sites used by sperm whales with input from the Services and other natural resource trustees. Furthermore, all response activities are developed and implemented as part of an emergency consultation with the Services during the response to avoid or minimize impacts to ESA species and critical habitats. If necessary, the harassment of whales can be permitted by NOAA Fisheries, if it is deemed to be critical to preventing their exposure to oil or hazardous substances. Deterrence activities have the highest likelihood of impact on the whales because, by default, they constitute an adverse impact under ESA.

Given that the protection of sensitive species and habitats is one of the highest priorities of a response action, the low population density of sperm whales in Alaska, their preference deep ocean habitat, and the infrequency of spills in open ocean, it is highly unlikely that sperm whales would be adversely affected by response activities during implementation of the Unified Plan.

4.2.10 Steller sea lion – western and eastern populations

Steller sea lion habitat occurs throughout Alaska waters, except for the Beaufort and Chukchi Seas. Spill response actions that could affect the Steller sea lion are limited to those actions that would occur in the vicinity of haulouts, rookeries or adjacent nearshore and shallow coastal waters where sea lions feed (see Figures 3-18 and 3-19).

During the 17 years between 1995 and 2012, there were approximately 400 spills that involved more than 100 gal. in Alaska's marine waters. Almost all spills were in nearshore and shallow coastal waters; the material spilled was usually diesel. About 1% of those spills were of crude oil. Spill sizes ranged from 100 to over 300,000 gal. (see Appendix D for spill data). Although the spills occurred year-round; for each region, they were more frequent during ice-free periods. Figure 4-4 identifies the spill locations, seasons, and types of material spilled in Alaska between 1995 and 2012. Mechanical containment, recovery, and / or cleanup were the primary historical response actions, when noted.

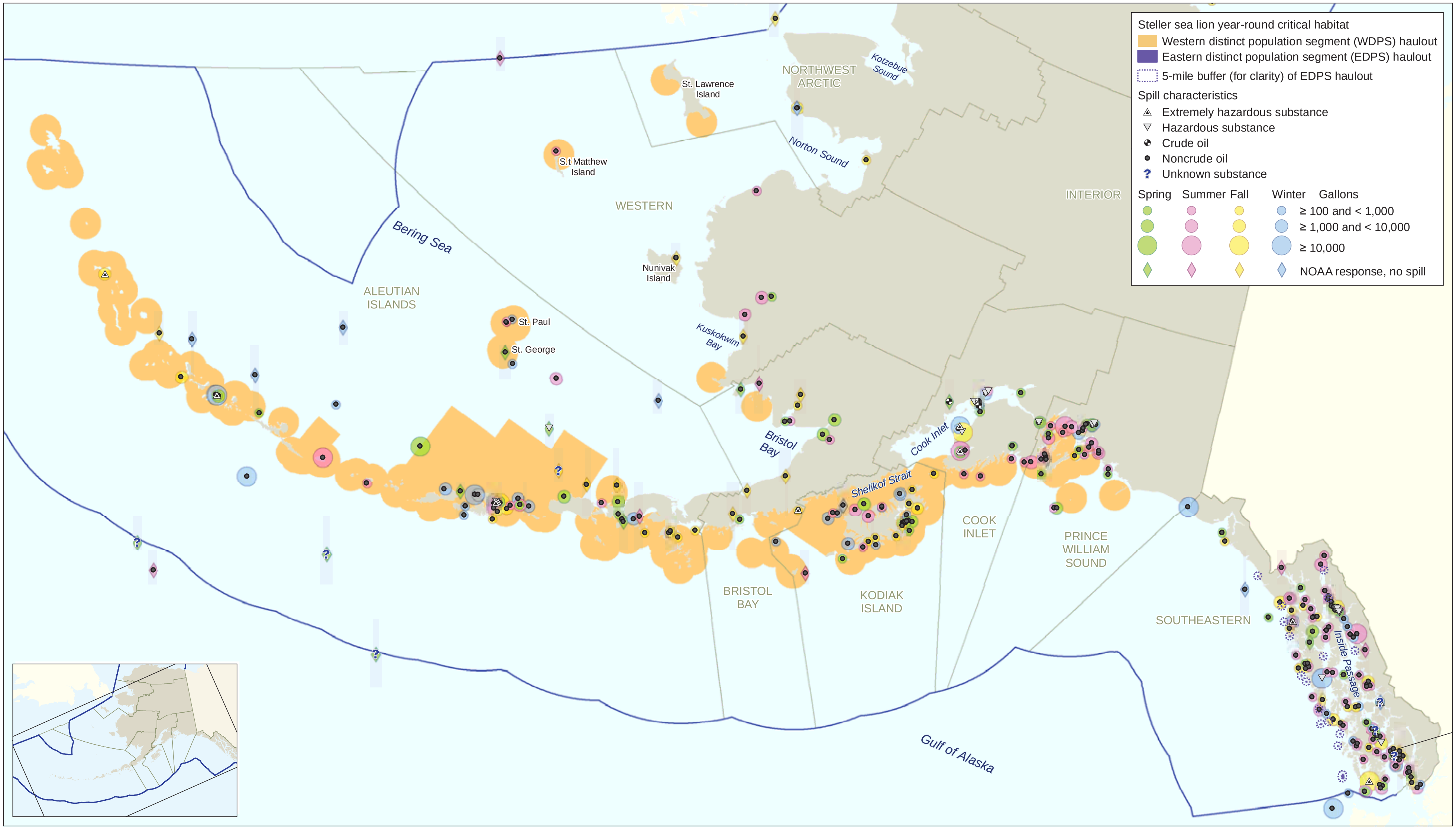

Figure 4-4. Characteristics of spills that occurred between January 1995 and August 2012 and steller sea lion critical habitat areas

Approximately 760 GRS have been approved for coastal regions in Alaska (ARRT, 2013). Each GRS defines specific locations for the staging of response actions, boom placement, areas appropriate for collection and recovery of oil products, and resources to be protected. Additional activities designed to avoid or minimize wildlife effects are implemented as part of the spill response in consultation with the Services, and these actions would be documented in the IAP.

The following subsections describe how spill response activities could affect the Steller sea lion and are organized according to the five effect categories detailed in Section 4.1.

Response activities that would not occur in Steller sea lion habitat and thus would not adversely affect the species include culvert blocking and upland *in situ* burning.

4.2.10.1 Physical or behavioral disturbance

Throughout their distribution in Alaska, Steller sea lions could be disturbed by several aspects of spill response actions. Steller sea lions are strong swimmers and would likely be able to avoid response activities that take place in the water. However, response actions could result in the abandonment of pups and/or juveniles, putting them at risk of predation and starvation.

The majority of response actions discussed in this document could occur in Steller sea lion habitat; those actions that involve noise and/or the presence of people could disturb the sea lion's behavior. These might include booming; the deployment of berms, dams, or barriers; the creation of pits and/or trenches; skimming or vacuuming; the use of sorbents; flushing; the removal of soil or sediment; vegetation cutting and removal; the use of dispersants; *in situ* burning; spill tracking and monitoring, mobilization and demobilization, water treatment, and solid waste handling and disposal. Vessels that approach suddenly could cause Steller sea lions to startle and stampede into the water, but vessels that approach slowly would allow sea lions to become accustomed to their presence, possibly resulting in a minimal response (NMFS, 2008c). Aircraft disturbances would cause variable reactions from Steller sea lions, and some or all could be frightened and retreat into the water (Calkins, 1979; cited in Richardson et al., 1995). Rookeries or haulouts could be permanently abandoned if they are subjected to repeated disturbance (Kenyon, 1962; cited in NMFS, 2008c). Human foot traffic on a haulout or rookery often has the greatest startling effect on sea lions, resulting in stampedes (NMFS, 2008c). Although not documented, stampedes can result in the trampling or abandonment of pups (Calkins and Pitcher, 1982; Lewis, 1987; Kucey, 2005; all cited in NMFS, 2008c), which would have long-term, high-magnitude effects. In addition, pup health and survival rates could be negatively affected if repeated disturbances were to result in the abandonment or reduced use of the rookery by lactating females (NMFS, 2008c).

Steller sea lions communicate under water using clicks, growls, snorts, and bleats (Poulter, 1968; cited in Richardson et al., 1995). Anthropogenic noise could mask and/or reduce the effectiveness of sea lion communication. However, NMFS (2008c) ranked disturbance by vessel traffic as a low threat to the recovery of the Steller sea lion population.

Disturbance effects on Steller sea lions can vary greatly; effects would be greatest if haulouts and rookeries were to be abandoned due to frequent disturbance.

4.2.10.2 Exposure to contaminants

The potential effects associated with exposure are limited to those caused by the use of dispersants and by *in situ* burning. Steller sea lions feed on fish, epibenthic crustaceans, and cephalopods and could ingest or otherwise be exposed to dispersants or dispersed oil while feeding in shallow waters, although dispersants are typically not approved for use in shallow, nearshore habitats. Steller sea lions are less likely to be exposed when foraging in deeper waters because they would be feeding below the depths at which dispersed oil mixes in the water column (NRC, 2005). While hauling out of the water, sea lions could also come into contact with burnt residues that have washed ashore. The exposure of Steller sea lions to oil at the ocean surface could be reduced if oil were dispersed or burnt; Steller sea lions are active at the ocean surface when diving or hauling out onto shore at which time they may be exposed to concentrated dispersed oil and oil vapors. The dispersion of oil at the ocean surface could reduce the inhalation or aspiration of oil vapors (NRC, 2013) and dermal contact (Neff, 1988; CDC and ATSDR, 2010; Lessard and Demarco, 2000). Additional discussion of the toxicity of oil, dispersant, and dispersed oil to Steller sea lion is provided in Section 5.1.10 of Appendix B.

Steller sea lions could be exposed to smoke and other emissions from *in situ* burning while swimming at the surface or hauled out. Because pinnipeds spend much of their time exposed to the open air, they are at greater risk for smoke inhalation than are cetacean species. However, it is anticipated that the production of noise and the presence of ships and people during *in situ* burning would likely deter Steller sea lions from approaching burning operations. In addition, *in situ* burning is typically not approved for implementation near concentrations of wildlife.

Although direct toxicity to Steller sea lions is not expected from exposure to dispersants, prey populations could be affected by dispersant use or *in situ* burning, depending on the location, size, and / or duration of the spill. Plankton, small fish, and invertebrates that reside in the upper water column could be injured through the application of dispersants or during *in situ* burning. The upper water column provides important habitat for many important species (during various life stages), including fish and invertebrates, which are both preyed upon by Steller sea lions (NMFS, 2005a, b, c, d, e). Planktonic and larval organisms that reside in the upper water column move with the flow of water and so remain in contact with the most concentrated portion of dispersants and dispersed oil. In addition, these species are most affected by thermal exposure during *in situ* burning. Evans et al. (1988; cited in NMFS, 2003) reported that significant heating occurred within the upper 5 in. (~13 cm) of the water column. However, such impacts would be expected to be temporary and highly localized.

Effects on Steller sea lion prey from burnt residues would likely be low because these residues would disperse widely on ocean currents.

The uptake and effect of PAHs on pinnipeds is a point of uncertainty requiring further study. It is possible that the application of chemical dispersants would temporarily increase the exposure of Steller sea lions to PAHs through the water column and through their diet. The likely impact of such a temporary increase in exposure is unclear (Section 6.3.4 of Appendix B).

The discharge of treated wastewater (e.g., from oil / water separation) in nearshore habitats could expose sea lions to contaminants if effluent limits were not met. However, the level of exposure would need to be severe for any effects on populations or individuals to be observed; thus, the effects would likely be of low magnitude and short term. In addition, treated effluent would meet state water quality standards and conditions prior to discharge, thus mitigating any potential risk.

Given the risks associated with unmitigated oiling of shorelines (e.g., haul-outs or rookeries) and the amount of time Steller sea lions spend at the ocean surface, chemical dispersant application is likely to reduce the likelihood of acute adverse impacts associated with the baseline condition (Section 5.1.10 of Appendix B), such as inhalation, aspiration, or significant dermal exposures to crude oil.

4.2.10.3 Exclusion from resources

If avoidance and minimization measures cannot be implemented or they are not effective, Steller sea lions could be excluded from resources (i.e., feeding areas, rookeries, and haulouts) as a result of avoidance behavior.

On-water response equipment and vessels are unlikely to prevent Steller sea lions from accessing haulouts, rookeries, or preferred feeding areas because Steller sea lions could potentially swim around or under these obstacles. However, if a response activity takes place directly adjacent to a Steller sea lion resource, they might avoid the area because of the noise being generated by nearby response activities even if they are not physically excluded from the resource. Steller sea lions use haulouts for resting and rookeries for resting, breeding, and rearing. Haulout and rookery locations are selected because of their proximity to feeding areas. The farther a Steller sea lion must travel to feed and the deeper it must dive to find food, the more energy it must expend. This, in turn, causes physiological stress and depletes energy reserves. If a disturbance such as noise or vessel traffic were to cause Steller sea lions to avoid a preferred haulout, they would need to find a new haulout, possibly at a less favorable location.

Depending on the amount of material spilled and the time required for response efforts, effects on Steller sea lions from resource exclusion could vary from low magnitude and temporary to high magnitude and long term. If a haulout or rookery were to be abandoned as a result of response actions, the effects would be high magnitude and long term.

4.2.10.4 Habitat degradation and loss

Spill response activities taking place in sea lion habitat (e.g., dispersants; *in situ* burning; discharge of wastewater; removal of soil or sediment; vegetation cutting and removal; flushing and flooding; and creation of berms, dams, barriers, pits, and trenches) could directly degrade that habitat, with effects of variable magnitude and duration.

Use of dispersants (and resulting dispersed oil) will temporarily reduce water quality; *in situ* burning could reduce both air and water quality in the short-term.

Any modification of nearshore or shoreline habitats through construction of structures or removal of substrates or vegetation could change the functional value of those habitats for sea lions. Although habitats would likely be restored, there could be a period of reduced value or function for this species.

The effects of noise as a disturbance event have been discussed previously; however, noise also represents a temporary degradation of habitat quality.

4.2.10.5 Direct injury

Steller sea lions could be directly affected by ship strikes. Vessels, aircraft, or equipment used in spill response activities in Steller sea lion habitat could potentially cause injury or mortality. However, the Steller sea lions' aquatic mobility renders it unlikely to be struck and injured during response activities. In addition, on-water BMPs that include the detection and observation of wildlife in the vicinity of an emergency response would make an interaction unlikely.

In situ burning could also cause heat or smoke injury to Steller sea lions. Steller sea lions are also prone to becoming entangled in marine debris (NMFS, 2008c) and could be injured as a result of entanglement during a response action(e.g., anchor lines). If a ship strike entanglement were to occur and result in the injuring or killing of a Steller sea lion, the effect would be of high magnitude and long term in duration. The detection, observation, and avoidance of wildlife during a response would mitigate this effect.

4.2.10.6 Determination of effects

Steller sea lions would be most vulnerable to spill response activities that occur in the nearshore and shallow coastal areas of Alaska, particularly at the locations of shoreline rookeries and haulout areas (see Figure 3-19). Most historical marine spills have occurred in nearshore and shallow coastal areas, although they involved less-persistent materials (i.e., fuels and other refined petroleum products). If the historical record is any indication of the potential for future incidents, spills will most likely be of a non-persistent nature and will not require chemical treatment. This expectation is further supported by the fact that the Steller sea lion critical habitat is far from most anthropogenic activity.

Response actions could have a range of potential impacts on individual Steller sea lions. In the event that a sea lion were to encounter a response action, these activities could result in the following high-magnitude effects on individual sea lions:

- Physical injury via entanglement or ship strikes
- Impaired breathing or lung damage from smoke inhalation during *in situ* burning

Response actions could also have lower-magnitude effects, including:

- Behavioral disturbance from the noise of aircraft or small vessels or activities associated with *in situ* burning or dispersant application
- Alteration of the food web through the use of dispersants (i.e., changes in abundance and composition of prey due to dispersed oil toxicity)
- Tissue irritation (i.e., skin, eye, nose, mucous membrane) caused by exposure to dispersed oil, dispersants, or smoke from *in situ* burning
- Short-term habitat degradation due to changes in water quality (from burnt residues or use of dispersants), noise levels, or prey base

Emergency response actions in Alaska are, as a matter of policy, based first on mechanical response actions. Non-mechanical responses are considered only if mechanical containment, removal, and/or cleanup are ineffective or incomplete. *In situ* burning and dispersant application are implemented only if feasible (i.e., a number of field conditions must be met for the effective use of these responses) and if the use of *in situ* burning or dispersants will cause less harm than would the spill in their absence. Use of these non-mechanical response methods is avoided near concentrations of wildlife. In addition, their use requires concurrence from the incident-specific RRT and consultation with the Services prior to any decision regarding their implementation.

The IAP and subsequent response actions are designed to protect sensitive resources; site-specific strategies have been created for most important sites used by Steller sea lions with input from the Services and other natural resource trustees. Furthermore, all response activities are developed and implemented as part of an emergency consultation with the Services during the response in order to avoid or minimize impacts to ESA species and critical habitats. If necessary, the harassment of sea lions can be permitted by NOAA Fisheries if it is deemed to be critical to preventing their exposure to oil or hazardous substances. Deterrence activities have the highest likelihood of impact on sea lions because, by default, they constitute an adverse impact under ESA.

Although the protection of sensitive species and habitats is one of the highest priorities of a response action, there remains the possibility that Steller sea lions could be adversely affected by some response activities during implementation of the Unified plan. Injury, mortality, and/or abandonment of pups during a stampede, exposure to contaminants, or disturbance of critical habitat are of low likelihood, but have significant ramifications for a sensitive species and thus cannot be discounted.

4.2.11 Polar bear

The effects of spill response activities would vary by the season, location, and habitat(s) within which the response action is carried out. Polar bears could potentially be affected by spill response activities that occur in marine habitats (i.e., shoreline, coastal, open water, and areas of sea ice) or terrestrial habitats (i.e., barrier islands and riverine and riparian areas) have the potential to affect individual polar bears at any life stage throughout the year.

During the 17 years between 1995 and 2012, there were 15 spills greater than 100 gal. in the northern Bering, Chukchi, and Beaufort Seas. Almost all of these spills were in nearshore and shallow coastal waters; materials spilled included diesel and other fuels, drilling muds, and antifreeze. Spill sizes ranged from 100 gal. to over 6,300 gal. (see Appendix D for spill data; land-based spills are not included). Although the spills occurred year-round, they were more frequent during ice-free periods. Figure 4-5 identifies the spill locations, seasons, and types of material spilled in Alaska between 1995 and 2012 near areas formerly designated as critical habitat for polar bear. Mechanical containment, recovery, and cleanup were the primary response actions, when noted.

A recent BO (USFWS, 2012a) concerning oil and gas activities in and around the Beaufort and Chukchi Seas assessed the likelihood of adverse effects on polar bears as a result of these activities and concluded that upland activities such as vehicle traffic and changes to habitat (e.g., facility construction) could adversely affect polar bears but would not jeopardize the species or the function of its critical habitat. Polar bears might be found in areas near small oil spills or easily contained spills but their exposure would be minimal (USFWS, 2012a). It was further noted that oil spill response was likely to displace polar bears from an action area prior to individual bears coming into contact with spilled oil (USFWS, 2012a). A sufficiently large oil spill, considered to be a catastrophic and unlikely circumstance, could result in adverse impacts on individual polar bear (USFWS, 2012a). An analysis of spills on the North Slope indicate that pipeline spill frequency and severity increases with the age of the extraction infrastructure (Nuka Research, 2010). Spill frequency may also increase because the extraction of crude oil is ongoing along the entire northern Alaska coast (NETL, 2009), which was formerly designated as critical habitat for polar bear, and this area may also be subject to significant oil and gas exploration in the future (MMS, 2006).

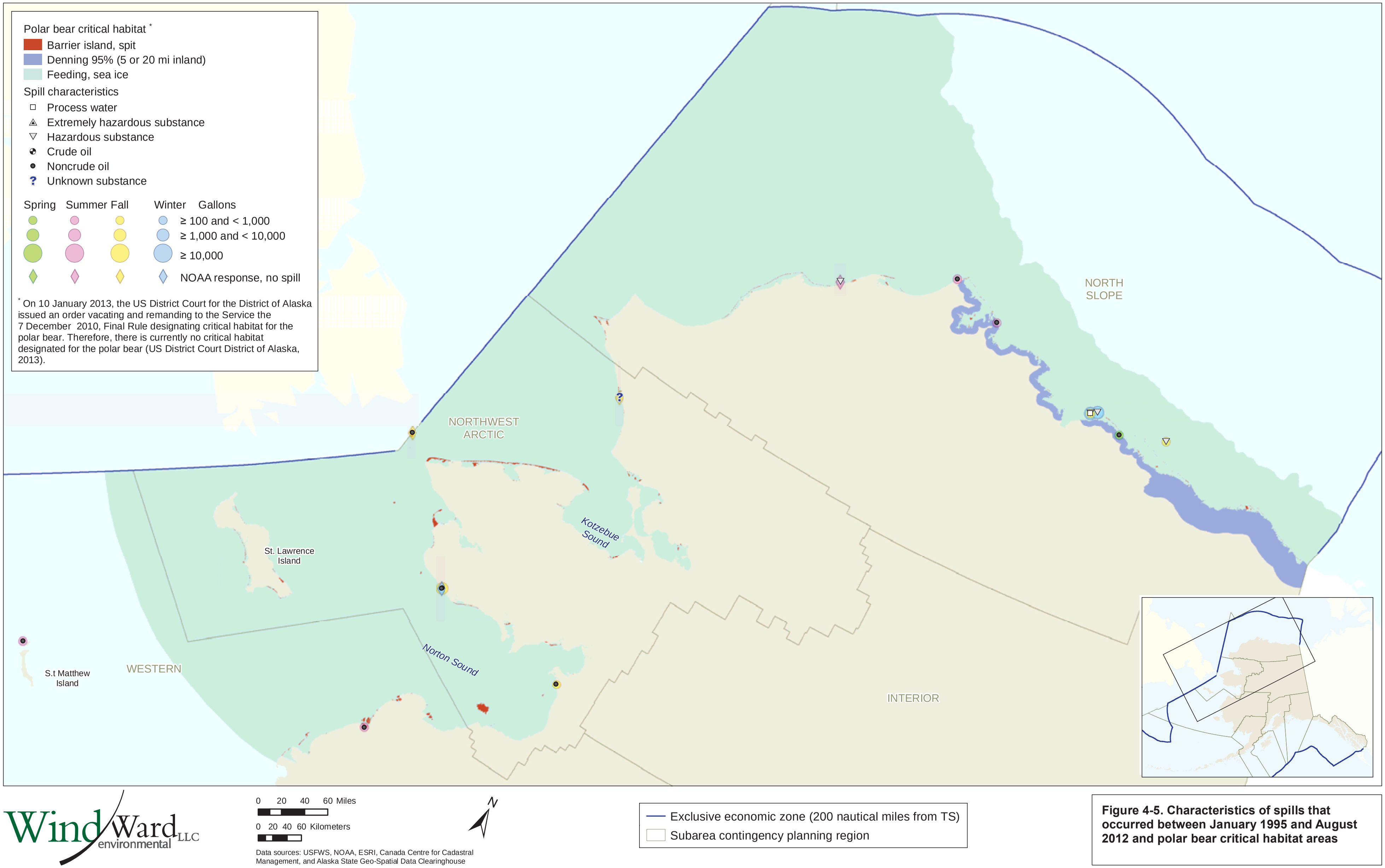

Figure 4-5. Characteristics of spills that occurred between January 1995 and August 2012 and polar bear critical habitat areas

The following subsections describe how spill response activities could affect the polar bear and are organized according to the five effect categories detailed in Section 4.1.

4.2.11.1 Physical or behavioral disturbance

Female polar bears that are about to give birth often shift from the marine to the terrestrial environment in the fall in order to search for denning sites, although in a study of the SBS subpopulation, nearly half of the known dens were located on the multi-year pack ice (Amstrup and Gardner, 1994). More recent denning studies (Fischbach et al., 2007) have reported a trend toward more terrestrial denning (~60% land based). The November-to-April time period is when any physical disturbance in close proximity to a den site, including any noise associated with human activity, could lead to den abandonment, which would result in cub mortality.

Because all response activities introduce a level of physical disturbance to the environment (e.g., noise caused by human activity, including the use of heavy equipment, vehicles, and aircraft), land- or ice-based response activities conducted during the November-to-April timeframe have the potential to result in den abandonment and cub mortality, and thus are considered to be high-magnitude effects of long-term duration. Actions associated with these potential disturbances include the application of sorbents; construction of berms; *in situ* burning; and activities associated with the tracking and monitoring of spills, mobilization and demobilization, and solid waste handling and disposal.

Any activity associated with a spill response conducted during the non-denning period could cause temporary physical disturbances of low magnitude as polar bears alter their behavior and either attempt to move away from the source of the disturbance or are drawn to it in search of food. If polar bears are forced to swim around man-made in-water obstructions or away from human-caused disturbances, they expend energy that could otherwise be used to obtain prey. These effects are compounded if physical disturbance also displaces their marine mammal prey (i.e., seals). Actions associated with these potential disturbances include booming and skimming; the application of sorbents and / or dispersants; *in situ* burning; and activities associated with the tracking and monitoring of spills; mobilization and demobilization; and marine transport of solid wastes.

4.2.11.2 Exposure to contaminants

Polar bears have large home ranges but spend most of their time in the shear zone (i.e., the highly productive zone at the interface of moving pack ice and shore-fast ice), where dispersants are less likely to be used because of the impracticability of dispersing oils trapped under sea ice. If dispersants were to be used near sea ice (e.g., to reduce the amount of oil that could become trapped under sea ice), polar bears could be exposed to dispersants and dispersed oil.

Direct toxicity to polar bears is not expected from exposure to dispersants because polar bears spend the majority of their time out of the water. Dispersants or dispersed oil could be ingested by polar bears during grooming or the consumption of contaminated prey (e.g., seals exposed to dispersed oil); however, dermal exposures to oil are expected to be greatly reduced through the use of dispersants (Lessard and Demarco, 2000; Neff, 1988; CDC and ATSDR, 2010). The potential for polar bears to consume toxic substances exists within the context of spill response. Polar bears are naturally curious and instinctively investigate any and all potential food sources they encounter. Any spilled material or petroleum product, as well as dispersant materials or chemicals used in spill response, has the potential to be ingested by polar bears that are seeking food;[38] however, bears selectively avoid oil when possible (Geraci and St. Aubin, 1988), suggesting that the likelihood of a polar bear selectively ingesting oil is very low. Additional considerations of toxicity to polar bears or their prey are discussed in Section 5.1.11 of Appendix B. For example, the ingestion of significant quantities of oil resulted in vomiting, gastrointestinal distress, serious liver and kidney damage, hematological damage, and mortality (St. Aubin, 1988). These impacts are likely to diminish as a result of chemical dispersant application, which could be expected to decrease oil concentrations to which polar bear are exposed as well as the extent of fur fouling (Section 5.1.11 of Appendix B).

Polar bears could be exposed to smoke or other emissions from *in situ* burns; however, little is known of the potential effects of this exposure, and there is an expectation that bears would avoid smoke plumes.

The uptake and effect of PAHs on polar bears is a point of uncertainty requiring further study. It is possible that the application of chemical dispersants would temporarily increase the exposure of many species to PAHs through the water column and through their diet. Because PAHs are actively metabolized by fish and mammal species and do not biomagnify up the food chain, it is less likely that polar bears will be impacted by PAHs like species that do not as readily depurate PAHs (e.g., invertebrates) or those that consume invertebrates. The likely impact of PAH exposures to polar bears is unclear (Section 6.3.4 of Appendix B).

The discharge of treated wastewater from oil / water separation or similar processes could degrade water quality if effluent limits were not met, resulting in an acute exposure of polar bears to contaminants. The level of exposure would need to be extensive for any effects to be observable in populations or individuals, likely making the effects low magnitude and short term. However, treated effluents would be required to meet state water quality standards and conditions prior to discharge, thus mitigating this risk.

[38] A polar bear death was attributed to the consumption of improperly stored ethylene glycol (i.e., antifreeze) (Amstrup et al., 1989).

4.2.11.3 Exclusion from resources

Polar bears have evolved to be able to withstand prolonged periods with little or no food. Seasonal changes in the presence of sea ice and its thickness and location necessitate this ability, which enables them to forego sustenance until conditions permit them to hunt seals from a platform of sea ice. Polar bears in a period of fasting would be particularly vulnerable to exclusion from resources. If spill response activities were to cause a bear to avoid a particular resource, nutritional stress could worsen, potentially resulting in mortality. In addition, any physical disturbance of the polar bear's main prey species, ringed seals and, to a lesser extent, bearded seals, would cause similar effects by displacing the seals from areas where they would normally be hunted. These potential impacts could affect adult and sub-adult male and female polar bears, as well as female polar bears with cubs. The latter group would be particularly vulnerable during the period immediately following den emergence, when the nursing cubs are completely dependent on the mother polar bear and her milk. Actions associated with these instances of potential avoidance or loss of access to a resource include booming and skimming (open water only); the application of sorbents and / or dispersants; *in situ* burning; and activities associated with the tracking and monitoring of spills; mobilization and demobilization; and solid waste handling and disposal. The effects of these actions are assessed as temporary but of high magnitude because they could potentially deter polar bears, preventing them from accessing core habitat areas, including federally designated critical habitat (i.e., sea ice, barrier island, and coastal areas) and prey.

4.2.11.4 Habitat degradation and loss

Currently, the primary factor threatening polar bears at the population level is habitat loss. The polar bear was listed as a threatened species under the ESA due to receding sea ice and potential habitat loss (73 FR 28212, 2008). Changes in global climate are altering the timing and extent of Arctic pack ice, resulting in the diminished area and extent of sea ice, fragmentation of existing sea ice, increased areas of open water, retraction of sea ice from the productive continental shelf, and declining quality of shore-fast ice. Accelerated coastal erosion associated with climate changes is also threatening polar bear denning habitat. Terrestrial denning polar bears den along the coast in areas where snow accumulates due to local topography. These areas can include bluffs and river banks near the coast that are vulnerable to coastal erosion (Wendler et al., 2010). Spill response activities would not contribute to changes in the timing and extent of sea ice, but could limit their accessibility by polar bears.

Actions that disturb ground cover and vegetation (e.g., construction of berms, trenches, or pits; mobilization of equipment; waste handling) could lead to terrestrial habitat degradation. These effects would be temporary in duration and low in magnitude because impacted habitats would be restored or allowed to recover over time, and polar bear habitat adjacent to and beyond the perimeter of the response operation would be available and of similar quality.

The potential effects of response actions could extend beyond the duration of the activity if the ground surface were to become destabilized and erosion were to increase. Actions that cause permafrost to thaw could contribute to thermal and hydraulic coastal erosion. These actions include the use of heavy equipment, the removal of soil or sediment, and vegetation cutting and removal. The effects of these actions on habitat degradation and loss are assessed as potentially long-term because each action has the potential to increase the rate and extent of thermal and hydraulic coastal erosion. These effects are also assessed as high magnitude because under a worst-case scenario, these actions could reduce habitat function for polar bears, including barrier island and coastal denning habitat. However, the IAP would incorporate BMPs to limit response impacts to tundra or terrestrial habitats. In addition, soil would be stabilized at the termination of a response action. It is also likely that habitat restoration would be required of the party responsible for the spill as part of the overall natural resources damage settlement.

Other actions, including the application of dispersants and *in situ* burning, could temporarily degrade sea ice and open-water habitat. The use of dispersants could reduce water quality over the short term, and *in situ* burning could result in short-term effects on air and water quality. If dispersed oil contamination of the benthic zone were to occur as a result of chemical dispersion, the duration of exposure to dispersed oil would be brief (minutes to hours) and the area impacted would likely be small and thus would not greatly affect the overall benthic community (Mageau et al., 1987; Cross and Thomson, 1987). Furthermore, the pooling of oil in broken ice, polynyas, or breathing holes in the ice (i.e., those created by ringed or bearded seals) could result in the greater exposure of polar bears to contaminants (both liquid oil and volatile components of oil) than if the oil were dispersed into the water column. This is based on the fact that dispersion reduces the volume of oil at the surface that could foul polar bear fur (NRC, 2005), potentially reducing the oiling of fur by reducing the stickiness of the oil (CDC and ATSDR, 2010; Lessard and Demarco, 2000) and reducing the volatilization of oil by dissolving volatile components into the water column (NRC, 2013). Regardless, of these potential mitigating actions of chemical dispersants, impacts related to the use of dispersants (or *in situ* burning) could occur in polar bears. Non-mechanical countermeasures are thus assessed as having the potential to cause short-term, low-magnitude effects on polar bear habitat.

Actions common to all responses could potentially cause habitat degradation; these responses include spill tracking and monitoring, mobilization and demobilization, water treatment, and solid waste handling and disposal. These actions are temporary in duration and of low magnitude. In the cases of spill tracking and monitoring and mobilization and demobilization, the wakes of passing boats could increase coastal erosion and the erosion of coastal bluffs, which provide core denning habitat for pregnant polar bears; however, BMPs such as reduced vessels speeds would prevent this impact. Wastes generated by spill response actions could be consumed by or otherwise contaminate polar bears; however, spill response wastes are managed as part of the overall response. These actions would potentially cause short-term, low-magnitude habitat effects, but these effects are unlikely.

4.2.11.5 Direct injury

Swimming polar bears could be harmed or killed by spill response vessels if a direct collision were to occur. Vehicles and equipment used for land-based or sea ice spill response actions could also collide with and injure or kill polar bears, although the ability to detect and avoid bears on land would make such a collision unlikely.

The potential risk associated with these activities is temporary, lasting as long as response actions are ongoing, but of high magnitude because of the possibility that polar bears could be injured or killed as a result of a collision with a vessel or vehicle. Polar bears could also be harmed if they were to become entangled in any in-water equipment; such encounters with swimming polar bears could lead to their drowning. However, detection and observation of wildlife during a spill response would avoid this impact.

In situ burning could cause heat or smoke injury. It is highly unlikely that a polar bear would surface in an area with burning oil, and polar bears avoid diving into oiled waters (Geraci and St. Aubin, 1988). However, the inhalation of smoke could cause damage to polar bear respiratory system tissues (ADEC et al., 2008).

Wastewater discharge and solid waste handling and disposal could potentially produce temporary, low-magnitude effects. Polar bears could be injured or killed if they were to consume any toxic waste generated by spill response actions that was accidently left in the environment or spilled again during transport. However, wastes produced by spill response actions are carefully managed to prevent the re-contamination of the environment.

Hazing polar bears in order to discourage them from approaching spilled materials in water or on land carries inherent risks of direct injury. In 2011, a polar bear was accidently killed by security personnel during an attempted hazing (Cockerham, 2011). Although such incidents are rare, the possibility exists that polar bears could be inadvertently harmed or killed during spill response-related hazing.

4.2.11.6 Determination of effects

Polar bears are vulnerable to the effects of spill response activities. They have low reproductive potential, are prone to den abandonment, and are highly specialized predators that are dependent on the presence of sea ice and prey.

Response actions could have a range of effects on individual polar bears. In the event that a polar bear were to encounter a response action, these activities could result in the following high-magnitude effects on individual polar bears:

- Abandonment of maternal dens as a result of the operation of vehicles and equipment associated with upland response activities
- Physical injury from ship strikes or entanglement with in-water equipment

Response actions could also have lower-magnitude effects, including:

- Behavioral disturbance of bears or their prey from the noise of aircraft or small vessels or activities associated with *in situ* burning or dispersant application
- Tissue irritation (i.e., skin, eye, nose, mucous membrane) caused by exposure to dispersed oil, dispersants, or smoke from *in situ* burning
- Ingestion of non-food wastes
- Short-term habitat degradation due to changes in water quality (from use of dispersants, burnt residues) or noise levels

The IAP and subsequent response actions are designed to protect sensitive resources; site-specific strategies have been created for the most important sites used by bears in the Arctic with input from the Services and other natural resource trustees. There are 81 candidate sites in the North Slope SCP that have been identified for development of GRS; over 100 have been developed for coastal areas of the Northwest Arctic and Western Alaska SCP (ARRT, 2013). Each GRS defines specific locations for the staging of response actions and boom placement; areas appropriate for the collection and recovery of oil products; and resources to be protected. Additional activities designed to avoid or minimize wildlife impacts are implemented as part of the spill response in consultation with the Services; these actions would be documented in the IAP. If necessary, the deterrence of bears can be permitted by the USFWS if it is deemed critical to preventing their exposure to oil or hazardous substances. Deterrence activities have the highest likelihood of impact on polar bears because, by default, they constitute an adverse impact under ESA.

Although the protection of sensitive species and habitats is one of the highest priorities of a response action, there remains the possibility that polar bears could be adversely affected by some response activities during implementation of the Unified Plan. Injury and/or mortality resulting from encounters with security personnel or equipment, exposure to contaminants via ingestion, or habitat disturbances that result in behavioral changes or abandonment of maternal dens are unlikely but cannot be discounted.

4.2.12 Northern sea otter – Southwest Alaska distinct population segment

The Southwest Alaska DPS of the northern sea otter could be affected by spill response activities in shallow, nearshore habitats in the GOA, including areas designated as critical habitat for sea otters (i.e., coastal Aleutian Islands, the Alaska Peninsula, Kodiak

Island, and part of Lower Cook Inlet). Most of the response actions discussed in this document could affect sea otters in some regard, although sea otters are an adaptable species—their curiosity often allows them to habituate to human activity—and they are adaptable to noise disturbance. In that regard, they are also difficult to deter, should the need arise to protect them from imminent exposure to spilled material.

During the 17 years between 1995 and 2012, there were approximately 100 spills greater than 100 gal. in Gulf of Alaska shallow[39] coastal areas. Almost all spills involved diesel or other fuels; a smaller number of spills involved ammonia or other chemicals. No crude oil spills occurred during this same period. Spill sizes ranged from 100 gal. to over 134,400 gal.; the vast majority were <1,000 gal. (see Appendix D for spill data). Although these spills occurred year-round, they were more frequent during the summer and winter. Figure 4-6 identifies the spill locations, seasons, and types of material spilled in northern sea otter critical habitat between 1995 and 2012.

[39] No depth data are available for spill records. A distance of ≤ 0.5 statute mile from shore was used as a surrogate for shallow, nearshore water

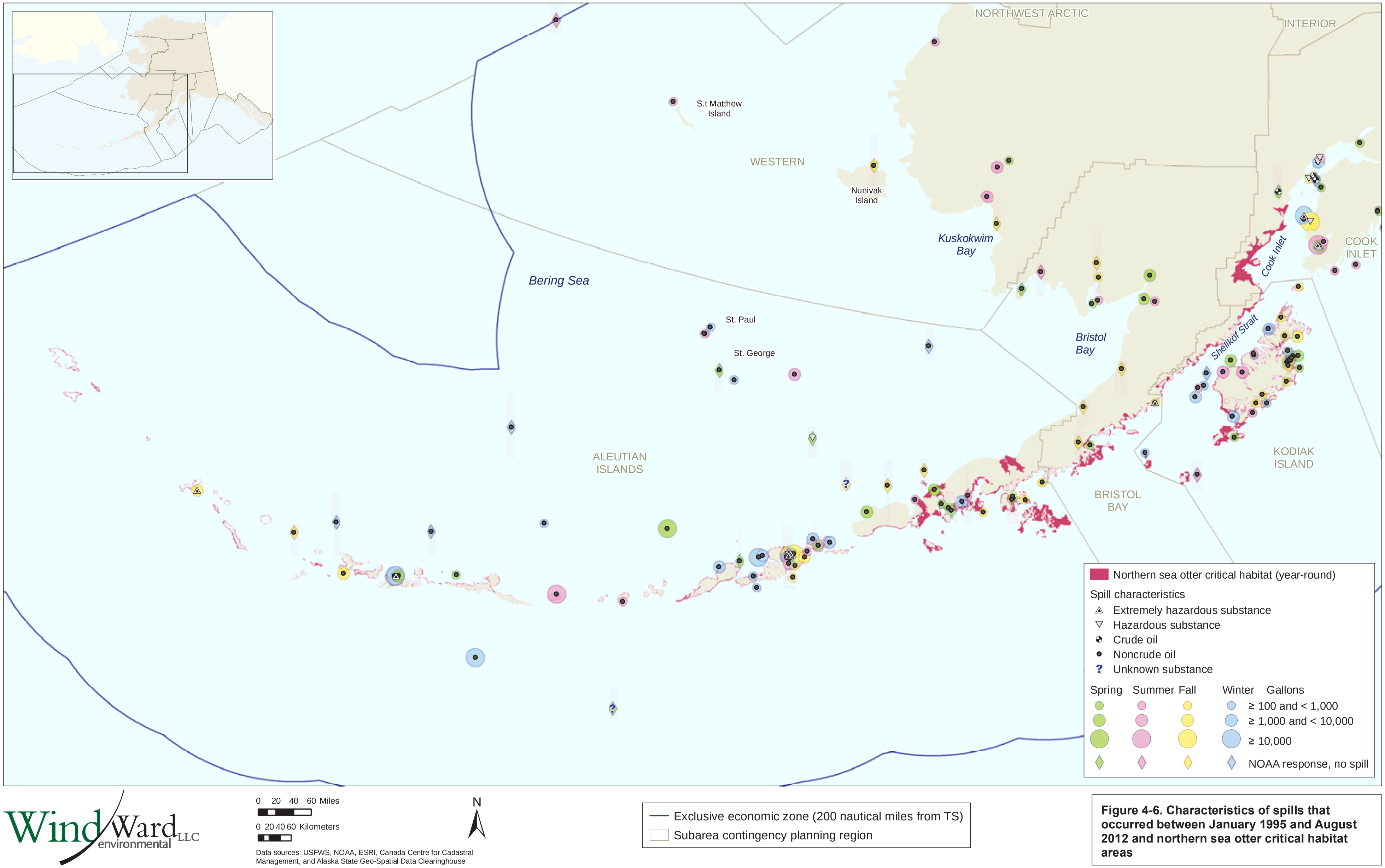

Figure 4-6. Characteristics of spills that occurred between January 1995 and August 2012 and northern sea otter critical habitat areas

The following subsections describe how spill response activities could affect the northern sea otter and are organized according to the five effect categories detailed in Section 4.1. Response activities that do not occur in sea otter habitat and thus will not adversely affect sea otters include culvert blocking and upland *in situ* burning.

4.2.12.1 Physical or behavioral disturbance

Sea otters are strong swimmers, are curious, and habituate easily to sounds such as auditory deterrents (EPA et al., 2010). Angliss and Allen (2009) reported that there was no evidence that disturbances such as oil and gas development and transport have a direct impact on the Southwest Alaska sea otter stock. In the draft recovery plan for the Southwest Alaska DPS of the northern sea otter, USFWS (2010b) ranked physical or behavioral disturbance as being of low importance for the recovery of the population because sea otters in the eastern portion of the Southwest DPS, where the highest concentration of boat traffic exists, are thriving.

Response actions that are conducted in or near sea otter habitat (Section 3.4.1.11) could potentially disturb sea otters, though these disturbances would be of low impact and short term (i.e., only for the length of time of the response effort). Aspects of these response actions that could physically or behaviorally disturb sea otters include noise produced by vessels or aircraft; the presence of people or equipment; and the use of in-water equipment, booms, or sorbent materials. Noise is unlikely to disturb to sea otters in any significant way inasmuch as they are known to habituate to noise. Physical objects are also unlikely to disturb sea otters because they are fast and agile swimmers, capable of avoidance. Therefore, the disturbance effects of response actions on sea otters would be temporary and of low magnitude.

4.2.12.2 Exposure to contaminants

The northern sea otter's range is limited to coastal areas of the GOA. Northern sea otters inhabit shallow, nearshore waters but periodically come ashore (Kenyon, 1969, cited in USFWS, 2010b; Riedman and Estes, 1990). Because sea otters spend much of their time swimming and feeding at the surface, they are at greater risk than other marine mammals for exposure to spilled crude oil.

Northern sea otters may be exposed to smoke and other emissions from *in situ* burning while swimming at the surface or using shoreline habitats. Because sea otters spend the majority of their time exposed to the open air (except when diving for prey), they are at a higher risk for smoke inhalation than most other species discussed in the BA. However, dispersants and *in situ* burning are not recommended for use near concentrations of wildlife or in nearshore areas; decision to do so would include a wildlife protection plan, which could involve the use of deterrents or capture/release. Specific considerations of the toxicity of dispersants, oil, and dispersed oil to the Northern sea otter are discussed in Section 5.1.12 of Appendix B.

Potential physical impacts related to chemical dispersant and dispersed oil application include dermal exposures leading to impacted thermoregulation and hypothermia (often resulting in death). Hypothermia-related deaths were observed during the EVOS event, suggesting that hypothermia is an impact related to the baseline condition. Assuming that the mass of oil present at the ocean surface was responsible for a large number of Northern sea otter mortalities during EVOS, the use of chemical dispersants to remove oil mass from the ocean surface could reduce such impacts. Therefore, the use of chemical dispersants may serve to avoid or minimize the thermoregulatory effects that would otherwise be caused by concentrated (un-dispersed) oil under baseline conditions. Prey population may be affected by dispersant use or *in situ* burning, depending on the location, size, and duration of any spill. Plankton, small fish, and invertebrates could be most affected by the application of dispersants or *in situ* burns.[40] The sea surface provides an important habitat for the beginning life stages of many significant invertebrate prey species (NMFS, 2005a, b, c, d, e). The species that reside in the upper water column move with the flow of water and so would remain in contact with the most concentrated portion of dispersant and dispersed oil. In addition, the organisms in the uppermost part of the water column would be the most affected by thermal exposure during *in situ* burning. Evans et al. (1988; cited in NMFS, 2003) reported that significant heating occurred within the upper 5 in. (~13 cm) of the water column.

The uptake and effect of PAHs on pinnipeds is a point of uncertainty requiring further study. It is possible that the application of chemical dispersants would temporarily increase the exposure of sea otters to PAHs through the water column and through their diet. The likely impact of such a temporary increase in exposure is unclear (Section 6.3.4 of Appendix B).

The discharge of treated water could acutely expose northern sea otters to contaminants if discharge limits were not met. The level of exposure would need to be significant for any effects to be observed on populations or individuals, likely making these effects of low magnitude and short term. Treated effluent would be required to meet state water quality standards and conditions prior to discharge, thus mitigating this risk.

4.2.12.3 Exclusion from resources

Sea otters are capable of swimming around or under in-water equipment, such that it would not be likely that they could be physically excluded from a resource (e.g., food, shelter) during a response action. However, if the presence of people or equipment causes them to avoid an area, this could constitute exclusion. Avoidance is unlikely because otters are known to habituate to noise and the presence of humans. If otters

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[40] Northern sea otter prey (clams, urchins, finfish) do not appear to be more or less sensitive in general than other taxa discussed in Sections 4.2 and 4.3 of Appendix B. Bivalve larvae have been shown to be sensitive to chemical dispersants and dispersed oil (Sections 3.3 and 3.4 of Appendix B), so alteration of the Northern sea otter prey base as a result of chemical dispersant application cannot be discounted.

were to be excluded from a resource, the effects would be of low magnitude and temporary.

4.2.12.4 Habitat degradation and loss

Sea otter habitat could be degraded by spill response actions that disturb intertidal or benthic habitats (e.g., sediment flushing, berming on beaches, anchoring of booms or other equipment) or remove aquatic vegetation (specifically kelp). Because sea otters use nearshore, shallow water (< 100 m deep), cleanup actions that occur on land or in deep offshore waters will not directly affect sea otter habitat. Kelp within the sea otter's critical habitat is a PCE and therefore removal may be considered an adverse modification.

The benthic food source for sea otters would likely be directly affected by shoreline cleanup activities if beach substrates were to be removed or used to divert or contain spilled material. Although disturbed beach habitats would be restored, there would likely be a lag (one or more seasons) in function in terms of benthic prey productivity. The use of anchors to stabilize vessels and equipment could disturb subtidal benthic communities (Lissner et al., 1991); however, the anchor footprint is typically small and would be unlikely to affect benthic productivity to an extent that would affect sea otters. In addition, USFWS (2010b) stated that changes in prey base were of low importance for the recovery of the Southwest Alaska sea otter DPS.

The use of dispersants would temporarily reduce water quality; *in situ* burning might reduce both air and water quality in the near term. Toxicity from dispersants could cause temporary changes in the seasonal prey base (i.e., benthic invertebrates and their planktonic prey), reducing habitat quality. However, such impacts would likely be temporary and highly localized, inasmuch as benthos can return to a condition similar to that present before an exposure to dispersed oil within 2 years (Cross and Thomson, 1987; Mageau et al., 1987). Residues from burning could have longer-lasting effects on the benthic communities upon which otters feed if residues were sufficient to smother large areas of the sea bottom. The use of dispersants is intended to reduce the amount of oil that reaches sensitive shorelines and nearshore habitats (Fingas, 2008b), thus reducing the effect from long-term, chronic exposure of benthic organisms to hydrocarbons (Peterson et al., 2003). Both of the impacts described above relate directly to the PCE for sufficient prey resources within nearshore habitats.

4.2.12.5 Direct injury

Vessels, aircraft, or equipment involved in spill response activities that occur in shallow water (< 100 m deep) could potentially strike sea otters, causing injury or mortality, which would cause a high-magnitude, long-term effect. Although sea otters are excellent swimmers, the FWS necropsy program has reported the mortality of sea otters from vessel strikes.

In situ burning could cause heat or smoke injury. Exposure to dispersed oil could result in hypothermia if the insulating properties of the otter's fur were to become degraded.

This is not necessarily more severe than the baseline condition, under which surface oil is left in place; such oiling is known to cause severe impacts on sea otters, who spend much time on the ocean surface (St. Aubin, 1988). The use of dispersants is, in part, intended to be protective of sensitive, surface-dwelling species (Fingas, 2008b). Without capture and treatment, hypothermia would likely result in mortality.

4.2.12.6 Determination of effects

Northern sea otters inhabit the shallow, nearshore habitats of the GOA (including the Aleutian Islands). This habitat is likely to be the site of a spill because of the many anthropogenic activities (e.g., fish, fuel transport) that occur within close proximity of the shore.

In the event that protective measures, including field-implemented BMPs, were to be unsuccessful in preventing interactions between sea otters and spill response activities, these activities could have a range of effects on individual sea otters. The following high-magnitude effects could result from specific response actions:

- Physical injury via entanglement with equipment or ship strike
- Impaired breathing or lung damage from smoke inhalation following *in situ* burning
- Hypothermia from the fouling of fur by dispersants or dispersed oil[41]

Response actions could also have lower-magnitude effects, including:

- Alteration of food web through the use of dispersants (i.e., changes in abundance and composition of prey due to dispersed oil toxicity)
- Tissue irritation (i.e., skin, eye, nose, mucous membrane) caused by exposure to dispersed oil, dispersants, or smoke from *in situ* burning
- Short-term habitat degradation due to changes in water quality (from use of dispersants, burnt residues) or air quality (from smoke)

The IAP and subsequent response actions are designed to protect sensitive resources; site-specific strategies have been created for the most important sites used by otters with input from the Services and other natural resource trustees. Approximately 500 GRS have been approved for coastal regions where sea otters could be present (ARRT, 2013). Each GRS defines specific locations for the staging of response actions, boom placement, areas appropriate for collection and recovery of oil products, and resources to be protected.

[41] This impact on Northern sea otter has been documented during untreated crude oil exposures as well, suggesting that hypothermia is an impact also resulting from the baseline condition. It is not clear whether this impact is enhanced by the dispersion of oil into the water column, although it has been suggested that fouling of fur is reduced by chemical dispersion (Lessard and Demarco, 2000; CDC and ATSDR, 2010). By reducing the volume of oil at the ocean surface, this impact may also be made less likely through chemical dispersion.

Despite the protective measures specified in the GRS, sea otters could be harmed, or their critical habitat affected by the sources detailed above during spill response activities. Thus, the implementation of the Unified Plan is likely to adversely affect the northern sea otter or its critical habitat.

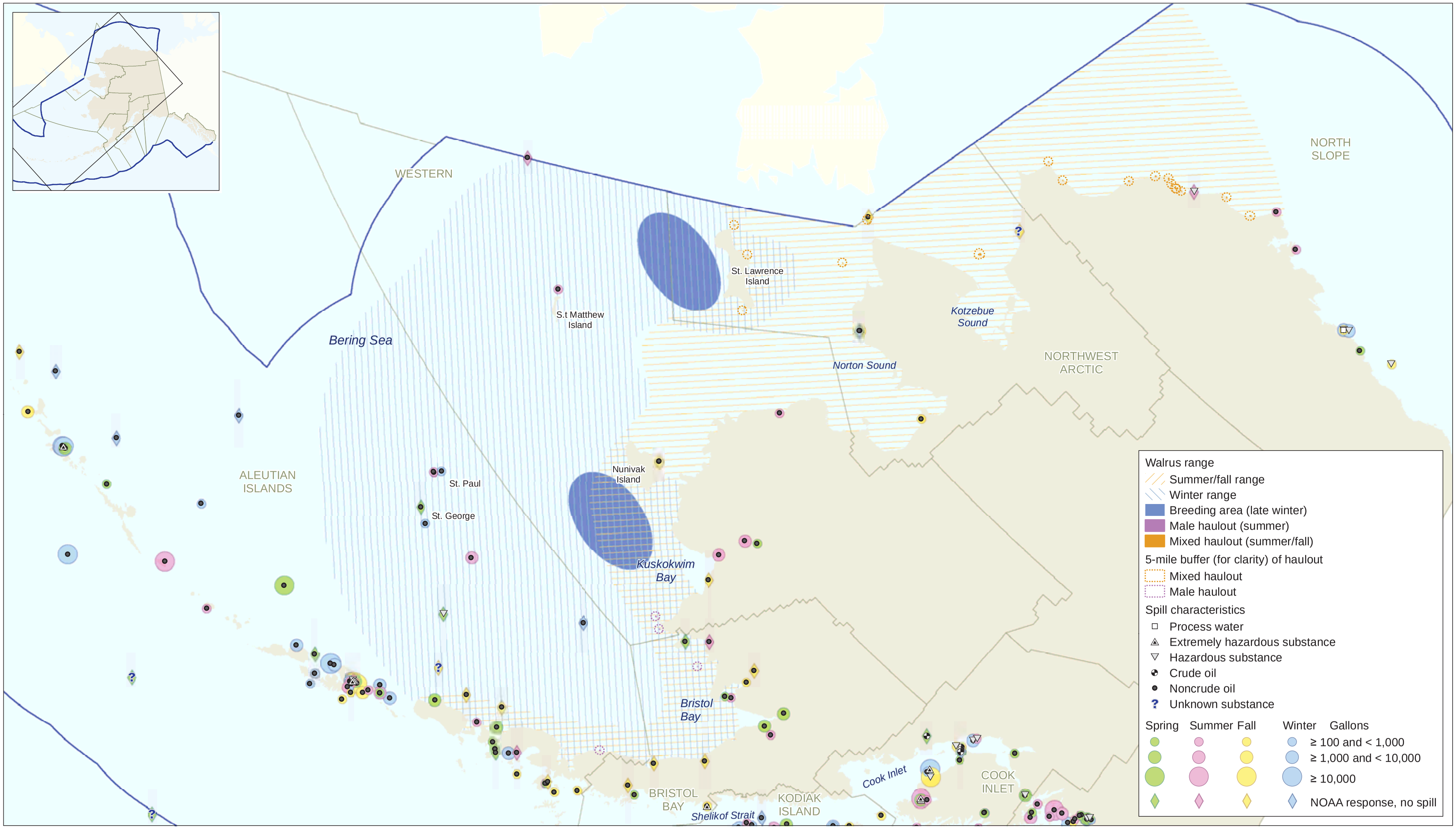
Response activities are developed and implemented as part of an emergency consultation with the Services during the response to avoid or minimize impacts to ESA-listed species and critical habitats. Additional consultation and concurrence of the incident-specific RRT is required for non-mechanical response actions that may pose a greater risk to wildlife. If necessary, the deterrence or capture/release of otters can be permitted by the USFWS if it is deemed critical to preventing their exposure to oil or hazardous substances. Sea otter are not easily deterred; if capture and release is conducted, these activities have the highest likelihood of effect on the otters and constitute a take under ESA.

Although the protection of sensitive species and habitats is one of the highest priorities of a response action, there remains the possibility that Northen sea otters could be adversely affected by some response activities during implementation of the Unified Plan. Entanglement, hypothermia caused by fouling of fur, sublethal effects of contaminant exposure, or disturbances to critical habitat are effects of low likelihood, but have significant ramifications for a sensitive species and thus cannot be discounted

4.2.13 Pacific walrus

Walruses use a diverse range of habitats including nearshore or shallow water, which vary seasonally and temporally; and the effects of any potential spill response actions will vary accordingly. Most of the response actions discussed in this document could potentially have some effect on walruses.

During the 17 years between 1995 and 2012, there were approximately 100 spills greater than 100 gal. in areas of the Arctic and Bering Seas where walruses could have been present. Almost all spills involved diesel or other fuels; a smaller number of spills involved ammonia, antifreeze, corrosion inhibitors, or drilling muds. Most spills were small; approximately 20 spills with volumes of between 1,000 gal. and 10,000 gal. spilled. Four spills of refined petroleum products were >100,000 gal. (see Appendix D for spill data). Although spills occurred year-round, they were more frequent during the summer and winter. Mechanical containment, recovery, and cleanup were the primary response actions, when noted. Dispersants were approved for use in response to two spills; however, they were never applied. Figure 4-7 identifies the spill locations, seasons, and types of material spilled in walrus habitat between 1995 and 2012.



Wind Ward environmental LLC

Data sources: USFWS, NOAA, ESRI, Canada Centre for Cadastral Management, and Alaska State Geo-Spatial Data Clearinghouse

Figure 4-7. Characteristics of spills that occurred between January 1995 and August 2012 and walrus range

The following subsections describe how spill response activities could affect the walruses, and are organized according to the five effect categories detailed in Section 4.1. Response activities that do not occur in walrus habitat and thus will not adversely affect walruses include culvert blocking and upland *in situ* burning.

4.2.13.1 Physical or behavioral disturbance

The majority of response actions discussed in this document could occur in walrus habitat, and walruses may be affected if avoidance and minimization procedures are ineffective or cannot be implemented. All of these spill response efforts involve noise and the presence of people, although the magnitude and duration these disturbances could vary greatly. Walruses are strong swimmers and could avoid response activities taking place in the water or on ice. Any onshore activities could also disturb walruses by preventing them from coming ashore or displacing them from coastal haulouts. If large groups of walruses were to be disturbed while onshore and stampede to the water, smaller animals could be trampled.

The presence of people and response activities near walrus concentrations would undoubtedly cause them to leave the area; their departure from the cleanup area could be a temporary, low-magnitude disturbance, depending on the length and intensity of the cleanup efforts. However, if startled while hauled out on land, walruses will often stampede, which frequently results in injuries and mortality, especially among juveniles (USFWS, 1994, 2008a). Prolonged or repeated disturbances (Wilson and Evans, 2009) could also cause the abandonment of a walrus haulout, which would have a long-term, high-magnitude effect. If walruses were to be present in the vicinity of a response action, a wildlife protection plan would be developed in consultation with the USFWS in order to minimize the effects on walruses.

4.2.13.2 Exposure to contaminants

Pacific walrus feed primarily on bivalves, gastropods, and polychaetes and may be exposed to dispersed oil or burnt oil residues that sink to the bottom of the shallow waters in which they forage. When foraging in deeper waters, away from their haulouts, walruses are less likely to be exposed to such substances because residues and dispersed oil are expected to be widely distributed over greater depth and area as a result of the greater water mass and currents. Chemical dispersant application and *in situ* burning are not intended to be used in nearshore habitats or near concentrations of wildlife (e.g., haul-outs), therefore, the likelihood of chemical exposure within the action area is unlikely.

Specific considerations of the toxicity of dispersants or dispersed oil to Pacific walrus are discussed in Section 5.1.13 of Appendix B. Similar to other species, exposures to dispersed oil in the water column may result in skin and tissue irritation (e.g., eyes), although these impacts are likely to be short-term and may be reduced relative to the baseline condition (Lessard and Demarco, 2000).

Pacific walruses could also be exposed to smoke and other emissions from *in situ* burning while swimming at the surface or hauled out. Because pinnipeds spend much of their time exposed to the open air, they are at higher risk than cetacean species for smoke inhalation. However, it is anticipated that the production of noise and the presence of vessels and humans during *in situ* burning would likely cause Pacific walruses to move away from burning operations and deter their approach.

Pelagic larvae of walrus prey, which reside in the uppermost portion of the water column, are the most susceptible to thermal stress during *in situ* burning. Evans et al. (1988; cited in NMFS, 2003) reported that significant heating occurred within the upper 5 in. (~13 cm) of the water column. *In situ* burning could have a localized effect on plankton survival, but it is highly unlikely that this would affect the abundance of prey due to the transport and mixing of unaffected water by ocean currents and recruitment following seasonal (spring) plankton blooms.

Dispersant use could indirectly affect walruses through their interactions with prey. Plankton, small fish, and invertebrates in the water column might be most affected by the application of dispersants. Although the bulk of the Pacific walrus diet does not come from the water column, this habitat is important for the beginning life stages of many significant invertebrate prey species (NMFS, 2005a, b, c, d, e) and provides much of the nutrients that fall to the sea floor. The same oceanographic processes that help replace plankton populations following *in situ* burning would also be relevant following the use of dispersants. Pacific walrus prey are particularly sensitive to dispersants and dispersed oil at early life stages, and significant mortality of prey could result from the use of dispersants near Pacific walrus habitat (Clark et al., 2001; NRC, 2005).

The uptake and effect of PAHs on pinnipeds is a point of uncertainty requiring further study. It is possible that the application of chemical dispersants would temporarily increase the exposure of walrus to PAHs through the water column and through their diet. The likely impact of such a temporary increase in exposure is unclear (Section 6.3.4 of Appendix B).

The discharge of treated wastewater during cleanup operations could potentially degrade water quality if effluent limits were not met, thereby causing the acute exposure of Pacific walruses to contaminants. The expectation is that treated effluents would meet state water quality standards and conditions prior to discharge, thus avoiding or minimizing this risk.

4.2.13.3 Exclusion from resources

Pacific walruses could be directly or indirectly affected by response actions through exclusion from feeding grounds, ice habitats, migration paths, and/or coastal haulouts.

Physical barriers and objects involved in response activities (e.g., booms, vessels, aircraft, and sorbent materials) on the water could block walruses from their preferred haulouts or feeding areas. Walruses are capable of swimming around or under these obstacles, but most would likely avoid the area entirely because of noise and the presence of humans. Walruses would not necessarily need to be physically excluded from a resource; visual and noise disturbances associated with nearby response efforts might be sufficient to deter walruses from accessing resources. If walruses are excluded from a particular haulout location for an extended period of time, they may abandon it all together (Wilson and Evans, 2009), which would constitute a long-term, high-magnitude effect. Known important haulout areas are shown in Figure 3-22 (Section 3.2.12). Haulouts are critical for walruses because walruses cannot remain in the water indefinitely; they require haulout locations to rest. In addition, one of the major factors in haulout area selection is proximity to feeding areas. Walrus foraging trips can last as long as several days and range up to 100 km (60 mi) in distance (76 FR 7634, 2011), but the farther a walrus travels to feed and the deeper it dives to find food, the more energy it expends. This could cause physiological stress and deplete energy reserves, a high-magnitude effect that can be temporary or long-term. Also, if female walruses need to travel greater distances to access food resources, there is an increased risk of calf separation and mortality (76 FR 7634, 2011). Female walruses that must swim long distances between forage locations and haulout areas may be forced to leave their calves (Cooper et al., 2006; cited in Garlich-Miller et al., 2011), which could result in the calf starving, drowning, or becoming prey (76 FR 7634, 2011), which would be a direct, high-magnitude, long-term effect.

4.2.13.4 Habitat degradation and loss

If avoidance and minimization measures (e.g., sediment flushing, shoreline berming, and anchoring of booms or other equipment) could not be used in a spill response situation, walrus habitat could be degraded. Walruses use a diverse range of habitats: shorelines, offshore areas, shoals, sea ice, and open water. Spill response activities that take place in the vicinity of the pacific walrus have the potential to directly degrade their habitat, with variable magnitude and duration of effects. The use of anchors to secure vessels and equipment could disrupt benthic communities, but the footprint of an anchor would typically be small and highly unlikely to affect long-term benthic productivity. The use of dispersants would temporarily reduce water quality, and *in situ* burning could diminish both air and water quality in the short-term. In the unlikely event that residues from *in situ* burning were to smother large areas of the ocean bottom (residues are more likely to be dispersed over a wide area, precluding this effect), these residues could have longer-term effects on the benthic communities that serve as prey to walruses.

Toxicity from dispersants could cause temporary changes in the seasonal prey base (i.e., benthic invertebrates and their planktonic prey) and thus diminish habitat quality.

Any response activities that were to take place at walrus haulouts could degrade habitat as a result of sediment or vegetation removal, flushing and flooding, or the construction of berms, dams, pits, and trenches in shoreline areas. The effects of noise as a disturbance have been discussed previously; however, noise also represents a temporary degradation of habitat quality.

The effects of walrus habitat degradation that could result from response activities would be of low magnitude and temporary in duration.

4.2.13.5 Direct injury

Walruses can be injured by ship strikes or entanglement in response equipment. However, a strike injury is unlikely; USFWS (76 FR 7634, 2011) stated that walruses tend to dive or swim out of range when a vessel approaches. But if a walrus were to be struck, the impact would likely be of high magnitude and long-term duration.

In situ burning could cause heat or smoke injury; respiratory tissues could become damaged after exposure to smoke. Heat injury is much less likely, inasmuch as walruses would likely avoid areas where oil was burning, and response crew were present.

4.2.13.6 Determination of Effects

Pacific walruses would be vulnerable to the effects of response actions conducted in the vicinity of haulouts and / or rookeries in the Chukchi and Bering Seas. Historically, almost all spills have occurred in the nearshore environments used by Pacific walruses. These spills have been relatively frequent (~4 per year) and some have been large, although almost all have involved diesel, which tends to dissipate rapidly through natural dispersal, mixing, and volatilization.

In the event that protective measures, including field-implemented BMPs, were unsuccessful in preventing interactions between individual walrus and spill response activities, these activities could have a range of effects on individual walruses. These activities could result in the following high-magnitude effects on individual walruses:

- Physical injury via entanglement with equipment or ship strike
- Juvenile mortality from stampeding following disturbance
- Impaired breathing or lung damage from smoke inhalation following *in situ* burning

Response actions could also have lower-magnitude effects, including:

- Alteration of food web through the use of dispersants (i.e., changes in abundance and composition of prey due to dispersed oil toxicity)
- Tissue irritation (i.e., skin, eye, nose, mucus membrane) caused by exposure to dispersed oil, dispersants, or smoke from *in situ* burning
- Short-term habitat degradation due to changes in water quality (from use of dispersants, burnt residues) or air quality (from smoke)

The IAP and subsequent response actions are designed to protect sensitive resources; site-specific strategies have been created for most important sites used by walruses with input from the Services and other natural resource trustees. There are approximately 180 GRS approved for coastal regions where walruses could be present (ARRT, 2013). Each GRS defines specific locations for the staging of response actions, boom placement, areas appropriate for the collection and recovery of oil products, and resources to be protected.

Furthermore, all response activities are developed and implemented as part of an emergency consultation with Services during the response to avoid or minimize impacts to ESA species and critical habitats. Additional consultation and concurrence of the incident-specific RRT is required for non-mechanical response actions that may pose a greater risk to wildlife. If necessary, the deterrence of walruses can be permitted by the USFWS if it is deemed critical to preventing their exposure to oil or hazardous substances. These activities have the highest likelihood of impact on the Pacific walrus and constitute an adverse impact take under ESA.

Although the protection of sensitive species and habitats, particularly of the nearshore environment, is one of the highest priorities of a response action, there remains a possibility that the Pacific walrus could be adversely affected by response activities during the implementation of the Unified Plan. Stampedes triggered by response activities or other disturbances to haulouts or rookeries due to response activities, along with potential sublethal effects of exposure to dispersants or dispersed oil, are of low likelihood but have significant ramifications for a sensitive species and thus cannot be discounted.

4.2.14 Ringed seal

Ringed seals are present year-round in the Bering, Chukchi, and Beaufort Seas (Section 3.2.13). They are an ice-dependent species, but their regional movements are not well documented. Ringed seals are not known to use coastal haulouts, limiting their haulout locations to ice. They use shore-fast ice, broken pack ice, and ice floes for resting, molting, birthing pups, nursing, and refuge from predators. Some ringed seals breed on shore-fast ice and others use pack ice. Those that breed on shore-fast ice spend the open-water season (May through August) traveling hundreds to thousands of kilometers on foraging trips. The movements of ringed seals that breed on pack ice are not well known. Response actions that occur in the ringed seal's open-water or sea ice habitat could have negative impacts on the species.

Historically, there have been approximately 15 spills in the central and northern portions of the Bering Sea and the Arctic Ocean where ringed seals could have been present. About half of the spills were during ice-free periods. Of those spills that occurred when ice (and therefore seals) could have been present, all but one were in the nearshore area. Materials spilled during these incidents included diesel and other refined petroleum products, drilling muds, antifreeze, and process water. Spill sizes ranged from 100 to 6,300 gal. with five spills ranging between 1,000 and 10,000 gal. (Appendix D).

As previously discussed, measures designed to avoid or minimize wildlife impacts would be implemented as part of a spill response. The following subsections describe how spill response activities could affect the ringed seal if avoidance and minimization measures could not be implemented or were ineffective in protecting or deterring the animals. The subsections are organized according the five effect categories detailed in Section 4.1.

Response activities that do not occur in ringed seal habitat and thus will not adversely affect ringed seals include the creation of berms, dams, barriers, pits, and / or trenches; culvert blocking; upland *in situ* burning; and vegetation cutting and removal.

4.2.14.1 Physical or behavioral disturbance

If avoidance and minimization procedures were to be ineffective or could not be implemented, ringed seals could be disturbed by several aspects of spill response actions throughout their distribution in Alaska. A spill or spill response is not likely to occur in ringed seal habitat because activities that could cause a spill are very restricted in areas of ice. However, if a spill response action were necessary within the ringed seal's range, they could potentially be disturbed by the presence of humans and / or noise from aircraft, vessels, and / or equipment. The presence of vessels could disturb the ringed seal's normal behavior (Jansen et al., 2010; cited in Kelly et al., 2010b) and cause them to abandon their preferred breeding habitats in high-traffic areas (Smiley and Milne, 1979; Mansfield, 1983; both cited in Kelly et al., 2010b). If anthropogenic noise in the area were to inhibit seal communication, they would likely move to another area. Richardson et al. (1995) reported that ringed seals exhibited temporary escape reactions when vessels came within 0.25 to 0.5 km. Low-flying aircraft could cause ringed seals to dive from their ice haulouts, but this disturbance would typically be brief and have a minor effect (Kelly et al., 2010b). An indirect effect of the presence of aircraft would result if seal pups were sufficiently disturbed to dive and spend more time in the water than under natural circumstances; such a situation would greatly increases the pups' energy expenditure. Seal pups lose heat faster than do adults, making them more susceptible to the effects of frequent disturbance (Kelly et al., 2010b). The risk of pup abandonment would be greater with more frequent disturbance (Smiley and Milne, 1979; cited in Kelly et al., 2010b); however, pups are weaned within 1 month of birth, limiting but not eliminating the likelihood of this effect.

The effects of activities that disturb ringed seals can vary greatly, but disturbance effects resulting from response activities would typically be of low magnitude and temporary in duration.

4.2.14.2 Exposure to contaminants

Ringed seals use shore-fast ice, broken pack ice, and ice floes; they inhabit areas near cracks or holes dug in the ice to facilitate escape, hunting, and breathing while swimming under the ice. Because of the impracticability of dispersing oil trapped under sea ice, ringed seals are unlikely to be exposed to dispersants or dispersed oil in the event of an oil spill. Dispersants could be used near the edge of sea ice or in broken ice to reduce the amount of oil that might be trapped under sea ice, in which case ringed seals could be exposed to dispersants and dispersed oil. Because ringed seals dive and feed on benthic and pelagic species of invertebrates and fish, they are likely to be exposed to surface oil; the reduction in surface oil is expected to result in diminished transfer of oil to ringed seals (i.e., through inhalation or dermal exposure) (Section 3.1.2.3 of Appendix B). Ringed seals are most vulnerable at their breathing holes, which would not likely be a site of dispersant application. The exposure of ringed seals during *in situ* burning would be unlikely, although they could be exposed to smoke while swimming at the surface or hauled out. Additional discussion of the toxicity of oil, dispersants, or dispersed oil to ringed seal is provided in Section 5.1.14 of Appendix B. Effects on ringed seals caused by exposures to dispersants and dispersed oil are likely similar to those in other large pinnipeds (Section 4.2.10.2).

The uptake and effect of PAHs on pinnipeds is a point of uncertainty requiring further study. It is possible that the application of chemical dispersants would temporarily increase the exposure of ringed seals to PAHs through the water column and through their diet. The likely impact of such a temporary increase in exposure is unclear (Section 6.3.4 of Appendix B).

Organisms nearest the sea surface would be most affected by thermal exposure during *in situ* burning. Evans et al. (1988; cited in NMFS, 2003) reported that significant heating did not occur below the upper 5 in. (~13 cm) of the water column during an *in situ* burn. The discharge of treated water could degrade water quality if effluent limits were not met, acutely exposing ringed seals to contaminants. It is expected that any discharges would meet state water quality criteria and conditions, which would mitigate this risk.

4.2.14.3 Exclusion from resources

Ringed seals could be directly or indirectly affected were a response action that to exclude them from their resources (i.e., feeding areas and sea ice haulouts).

Any vessels or physical barriers deployed during a response action (e.g., booms, sorbent material) on the water could block ringed seals from haulouts, lairs, or preferred feeding areas; however, this is unlikely to occur because ringed seals could swim around or under such obstacles. Ringed seals are unlikely to be physically excluded from a resource, but they would likely avoid an area in the vicinity of response activities (Section 4.2.13.1). Ringed seals use sea ice haulouts to construct subnivean lairs, which they use for resting, and nursing, and / or protection from predators. Lairs are especially important for ringed seal pups, which use them to dry off and warm up after emerging from the water (75 FR 77476, 2010). Haulout and lair locations are selected because of their proximity to feeding areas. The farther a seal must travel to feed and the deeper it must dive to find food, the greater amount of energy it expends. This, in turn, causes physiological stress and depletes energy reserves. If noise or vessel traffic were to exclude ringed seals from a preferred sea ice haulout, they would need to find a new haulout area and dig new lairs, possibly at a less favorable location. The effect from the exclusion from resources would depend on the level and duration of the response action.

4.2.14.4 Habitat degradation and loss

Any spill response action within the seal's range would have the potential to directly degrade seal habitat, with effects of variable magnitude and duration. The use of dispersants would temporarily reduce water quality; *in situ* burning could diminish both air quality and water quality in the short term. Residues from *in situ* burning could have longer-term effects on the benthic communities that provide food to seals if residues were sufficient to smother large areas of benthic habitat; however, any burnt residues would be likely to disperse. Dispersants could reduce habitat quality through the reduction of prey. However, such impacts would be temporary and highly localized because fish and plankton would likely recolonize or be replaced in an affected area within a short timeframe.[42] The effects of noise as a disturbance event have been discussed previously; however, noise also represents a temporary degradation of habitat quality. Response activity effects on ringed seal habitat would be of low magnitude and temporary.

4.2.14.5 Direct injury

Spill response activities that involve vessels or in-water equipment could potentially result in ship strikes, resulting in ringed seal injury or mortality. However, the ringed seal's mobility makes it unlikely that they would be struck during response activities.

Although highly unlikely, *in situ* burning could cause heat or smoke injury, although heat injury is unlikely given that ringed seals would likely avoid areas of open flame. If a ship strike or *in situ* burning were to injure or kill a ringed seal, the effect would be high magnitude and long-term in duration.

4.2.14.6 Determination of effects

Ringed seals are found in the Bering, Chukchi, and Beaufort Seas but only where sea ice is present. Ringed seals are typically solitary animals. They might be temporarily

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[42] This statement is based on multiple assumptions. First, plankton are borne on ocean currents, and those currents can quickly transport unexposed plankton into previously exposed areas. Second, many planktonic species are short-lived and reproduce very rapidly relative to large species; thus, the localized population of these species will increase quickly. Planktonic fish larvae would not recover as rapidly, but they would be replaced after the following spawn. Third, pelagic planktonic communities have been shown to recover quickly (i.e., weeks to months) in a warm environment (Abbriano et al., 2011). A cold-water pelagic planktonic community may respond somewhat slower (Cross and Martin, 1987; Cross and Thomson, 1987). A benthic community in a cold-water environment has shown to mostly return to baseline conditions within a matter of 2 years (Cross and Thomson, 1987; Mageau et al., 1987; Humphrey et al., 1987). Fourth, dispersed oil would likely be diluted to concentrations below toxic levels within a matter of hours to days (Appendix B), so continued exposure within an affected area should not occur once the spill and dispersion has ceased.

disturbed by the presence of vessels or aircraft, as well as transport or heavy machinery used on ice. This type of disturbance could cause avoidance behavior, resulting in a temporary exclusion from resources (e.g., haulouts, breathing holes). However, these effects would not be of high magnitude because ringed seals are highly mobile and can temporarily access new resources and then return to a habitat once response actions have ended. Ringed seal habitat is not likely to be affected by spill response actions, in part, because spills in the Arctic Ocean and central and northern Bering Sea are rare, particularly in winter.

In the event that protective measures, including field-implemented BMPs, are unsuccessful in preventing interactions between individual seals and spill response activities these activities could have a range of effects on individual ringed seals. The following high-magnitude effects to individual seals could result from specific actions:

- Physical injury via entanglement with equipment or ship strikes
- Impaired breathing or lung damage from smoke inhalation following *in situ* burning

Response actions could also have lower magnitude effects, including:

- Alteration of food web through the use of dispersants (i.e., changes in abundance and composition of prey due to dispersed oil toxicity)
- Tissue irritation (i.e., skin, eye, nose, mucus membrane) caused by exposure to dispersed oil, dispersants, or smoke from *in situ* burning
- Short-term habitat degradation due to changes in water quality (from use of dispersants, burnt residues) or air quality (from smoke)

The IAP and subsequent response actions are designed to protect sensitive resources. Furthermore, all response activities are developed and implemented as part of an emergency consultation with the Services during the response to avoid or minimize impacts to ESA species and critical habitats. Additional consultation and concurrence of the incident-specific RRT is required for non-mechanical response actions that may pose a greater risk to wildlife. The deterrence of seals can be permitted by NOAA Fisheries if it is deemed critical to preventing their exposure to oil or hazardous substances. These activities have the highest likelihood of impact on the seals and constitute an adverse impact take under ESA.

Although the protection of sensitive species and habitats is one of the highest priorities of a response action, the possibility remains that a ringed seal could be adversely affected by response activities during the implementation of the Unified Plan. Exclusion from haulouts on sea ice or subnivean lairs caused by disturbance from response activities or exposure to smoke, dispersants, or dispersed oil are effects of low likelihood but that have significant ramifications for a sensitive species and thus cannot be discounted.

4.2.15 Bearded seal

Bearded seals, an ice-dependent species, have a distribution similar to that of the ringed seal (Section 3.2.14). In winter, sea ice might extend as far south as the southern Bering Sea; in summer, the ice retreats north into the Arctic Ocean. Bearded seals use broken pack ice, ice edges, and ice floes, typically over water < 200 m deep, for resting, molting, birthing, and nursing, as well as refuge from predators. Bearded seals may also use coastal haulouts. Due to the large ranges of bearded seals and their use of drifting pack ice, the effects of spill response activities will vary by season, location, and habitat(s), depending on the type and duration of the spill response actions.

Historically, there have been approximately 15 spills in the central and northern portions of the Bering Sea and the Arctic Ocean since 1995 where ice seals could have been present. About half the spills occurred during ice-free periods; of those that occurred when ice (and therefore seals) might have been present, all but one were in the nearshore area. The materials involved in these incidents included diesel and other refined petroleum products, drilling muds, antifreeze, and / or process water. Spill sizes ranged from 100 to 6,300 gal., with five spills between 1,000 and 10,000 gal. (Appendix D).

As previously discussed, measures designed to avoid or minimize wildlife impacts would be implemented as part of a spill response. The following subsections describe how spill response activities could affect the bearded seal if avoidance and minimization measures could not be implemented or were ineffective in protecting or deterring the animals. The subsections are organized according to the five effect categories detailed in Section 4.1.

Response activities that do not occur in bearded seal habitat and thus will not adversely affect bearded seals include creation of berms, dams, barriers, pits, and trenches; culvert blocking; upland *in situ* burning; and vegetation cutting and removal.

4.2.15.1 Physical or behavioral disturbance

Bearded seals could be disturbed by several aspects of spill response actions throughout their distribution in Alaska. Response actions could result in the abandonment of pups, putting them at risk of predation and starvation if avoidance and minimization procedures were to be ineffective or could not be implemented. Adult bearded seals are highly mobile and would likely be able to avoid response activities taking place in the water.

The likelihood that a spill or spill response would occur in bearded seal habitat is low because spill response options are very restricted in ice. Spill response actions would likely involve the presence of people and noise from aircraft, vessels, equipment, and personnel, all of which can disturb seals. Cameron et al. (2010) reported that the presence of vessels could disturb bearded seals and cause them to abandon their preferred breeding habitats. This could be especially problematic if noise were to occur during the spring breeding season, when bearded seals are particularly vocal

(Richardson et al., 1995). If noise were inhibit communication among bearded seals, they would likely move to an area not affected by anthropogenic noise. In addition, Richardson et al. (1995) reported that aircraft can cause bearded seals to dive from their sea ice haulouts, and helicopters might be more disruptive than fixed-wing aircraft. Disturbance caused by response efforts could interfere with nursing, resulting in the reduced weight of seal pups (St. Aubin, 1988); however, bearded seal pups are weaned within a few weeks of birth, limiting the likelihood of this impact.

The effects of the disturbance of bearded seals would be highly variable. For example, a flyover by a fixed-wing aircraft might cause a bearded seal to dive; but the frequent passage of a vessel past a favored sea ice haulout might cause a bearded seal to avoid the resource. However, any disturbance from response activities would typically be of low magnitude and temporary in duration.

4.2.15.2 Exposure to contaminants

Bearded seals live near cracks or holes made in the ice to facilitate escape, hunting, and breathing while swimming. Because of the impracticability of dispersing oils trapped under sea ice, bearded seals are unlikely to be exposed to dispersants or dispersed oil in the event of an oil spill. Near the edge of sea ice, dispersants could be used to reduce the amount of oil that could be trapped under the sea ice. In this case, bearded seals might be exposed to dispersants and dispersed oil, but the risk of direct exposure would be relatively low. Bearded seals are most vulnerable at their breathing holes, which are not likely to be sites for dispersant application. Because bearded seals dive and feed primarily on benthic invertebrates and fish, they are likely to be exposed to oil at the ocean surface and could be somewhat exposed in the water column. For bearded seals, exposures associated with surface oil could result in more severe impacts relative to those associated with dispersed oil because of the greater severity of acute responses caused by inhalation and aspiration of oil vapor (e.g., lung, kidney, and liver tissue damage) (Section 3.1.2.3 of Appendix B); evaporation of oil can be diminished through the use of chemical dispersants by dispersing highly volatile components of oil into the water column. Additional considerations of the toxicity of dispersants, oil, and dispersed oil to bearded seals are discussed in Section 5.1.15 of Appendix B. Effects on bearded seals caused by exposures to dispersants and dispersed oil are likely similar to those in other large pinnipeds (see Section 4.2.10.2).

The uptake and effect of PAHs on pinnipeds is a point of uncertainty requiring further study. It is possible that the application of chemical dispersants would temporarily increase the exposure of bearded seal to PAHs through the water column and through their diet. The likely impact of such a temporary increase in exposure is unclear (Section 6.3.4 of Appendix B). Exposure to *in situ* burns is unlikely for all seal species, although they could be exposed to smoke while swimming at the surface or hauled out.

The discharge of treated water could expose bearded seals to contaminants if effluent limits were not met. It is expected that discharges would meet the state's water quality criteria and conditions, which would mitigate this risk.

4.2.15.3 Exclusion from resources

If avoidance and minimization measures cannot be implemented or are not effective, bearded seals could be directly or indirectly affected by being excluded from resources (i.e., feeding grounds and sea ice haulouts).

Any vessels or physical barriers used during response activities (e.g., booms, sorbent material) would not likely exclude bearded seals from resources because the seals could swim around or under them. However, although bearded seals might not be physically excluded from a resource, they might avoid a resource because of nearby activities (Section 4.2.14.1). Sea ice haulout areas are important habitat for bearded seals during pupping and nursing and likely reduce the predation rate on pups (Cameron et al., 2010). In addition, because bearded seals cannot remain in the water for extended periods of time, haulout areas are necessary for resting. Haulout locations are selected based on their proximity to feeding areas. A lactating female bearded seal spends more than 90% of her time in the water foraging for herself and her pup (Holsvik, 1998; Krafft et al., 2000; both cited in Cameron et al., 2010), and the farther a seal must travel to feed and deeper it must dive to find food, the more energy it expends. This extra expenditure of energy can deplete energy reserves and cause physiological stress. If a disturbance such as noise or vessel traffic were to exclude bearded seals from a preferred sea ice haulout, the seals would need to find a new haulout area, potentially at a less favorable location. Effects on bearded seals from exclusion from resources would be of low magnitude and temporary in duration.

4.2.15.4 Habitat degradation and loss

Bearded seal habitat could be degraded by spill response actions with effects of variable magnitude and duration. Bearded seals use several types of ice habitat but are not known to use coastal areas. Any spill response activities that were to take place in any part of their range could potentially directly degrade bearded seal habitat. The use of dispersants would temporarily reduce water quality; *in situ* burning could reduce both air quality and water quality in the short term. Residues from *in situ* burning might have longer-term effects on benthic prey communities if residues were sufficient to smother large areas of the ocean bottom; however, residues tend to disperse and are not expected to contribute to smothering. Dispersants could reduce habitat quality by altering the prey base (i.e., benthic organisms and their planktonic prey). However, such effects would be expected to be temporary and highly localized because benthos and plankton would likely be replaced by adjacent communities or be recolonized within a short timeframe.[43] The effects of noise as a disturbance have been previously

[43] This statement is based on multiple assumptions. First, plankton are borne on ocean currents, and those currents will carry unexposed plankton into the previously exposed region very quickly. Second, many planktonic species are short-lived and reproduce very rapidly relative to large species; thus the localized population of these species will increase quickly. Planktonic fish larvae would not recover as rapidly, but they would be replaced after the following spawn. Third, pelagic planktonic communities have been shown to recover quickly in a warm environment, in the range of weeks to months (Abbriano

discussed; however, noise would also represent a temporary degradation of habitat quality.

Response activity effects on bearded seal habitat would be of low magnitude and temporary in duration.

4.2.15.5 Direct injury

During and offshore response action, the presence of vessels and / or deployed equipment would increase substantially, which in turn could increase the risk of direct injury to bearded seals. Vessels or equipment could strike bearded seals, causing injury or mortality; however, because bearded seals are mobile, they are unlikely to be struck and injured during these activities. Cameron et al. (2010) reported how early visual and acoustic warnings to bearded seals reduced the risk of ship strikes, making them an insignificant threat.

In situ burning could cause heat or smoke injury; and although highly unlikely, dermal contact with dispersants or dispersed oil could cause tissue damage. If injury to or the death of a bearded seal were to result from a ship strike or *in situ* burning, the effect would be of high magnitude and long-term in duration.

4.2.15.6 Determination of effects

Bearded seals are found in the Bering, Chukchi, and Beaufort Seas but only where sea ice is present. These seals are typically solitary, except for females and their pups. They could be temporarily disturbed by the presence of vessels or aircraft, as well as transport and / or heavy machinery on the ice. This type of disturbance could cause avoidance behavior, resulting in temporary exclusion from resources (e.g., haulouts, breathing holes). However, such effects are not expected to be of high magnitude because bearded seals are highly mobile and can find new resources to use temporarily until they can return to their former habitat once response actions have ended.

In the event that protective measures, including field-implemented BMPs, are unsuccessful in preventing interactions between seals and spill response activities, the following actions could impact an individual. Potential high-magnitude impacts to individual seals from specific actions include:

- Physical injury via entanglement with equipment or ship strikes
- Impaired breathing or lung damage from smoke inhalation following *in situ* burning

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et al., 2011). A cold-water pelagic planktonic community may respond somewhat slower (Cross and Martin, 1987; Cross and Thomson, 1987). A benthic community in a cold-water environment has shown to mostly return to baseline conditions within a matter of two years (Cross and Thomson, 1987; Mageau et al., 1987; Humphrey et al., 1987). Fourth, dispersed oil would likely be diluted to concentrations below toxic levels within a matter of hours to days (Appendix B), so continued exposure within one area should not occur after the spill has ceased and dispersion has ended.

Response actions could also have lower magnitude effects, including:

- Alteration of food web through use of dispersants (i.e., changes in abundance and composition of prey due to dispersed oil toxicity)
- Tissue irritation (i.e., skin, eye, nose, mucus membrane) caused by exposure to dispersed oil, dispersants, or smoke from *in situ* burning
- Short-term habitat degradation due to changes in water quality (from use of dispersants, burnt residues) or air quality (from smoke)

The IAP and subsequent response actions are designed to protect sensitive resources. Furthermore, all response activities are developed and implemented as part of an emergency consultation with the Services during the response to avoid or minimize impacts to ESA species and critical habitats. Additional consultation and concurrence of the incident-specific RRT is required for non-mechanical response actions that may pose a greater risk to wildlife. If necessary, the deterrence of seals can be permitted by NOAA Fisheries if it is deemed critical to preventing their exposure to oil or hazardous substances. These activities have the highest likelihood of impact on seals and constitute an adverse impact take under ESA.

Although the protection of sensitive species and habitats is one of the highest priorities of a response action, the possibility remains that a bearded seal could be adversely affected by some response activities during the implementation of the Unified Plan. Exclusion from haulouts and/or subnivean lairs due to disturbance from response activities or sublethal effects of exposure to smoke, dispersants, or dispersed oil are effects of low likelihood but that have significant ramifications for a sensitive species and thus cannot be discounted.

4.2.16 Eskimo curlew

The current population status (e.g., distribution, abundance, seasonal presence) of Eskimo curlews in Alaska is not well understood because confirmed sightings have not been made, and the species may no longer exist in the wild (USFWS, 2011a; Elphick et al., 2010; Butchart et al., 2006). Eskimo curlews could historically have been found in the foothills of the Brooks Range in northern Alaska (Gill et al., 1998), spatially isolated from areas of oil and gas exploration and extraction (i.e., where a spill and subsequent response might occur). Based on this limited understanding, this rare and isolated species is unlikely to come into contact with either marine or terrestrial spill response activities or to be found in the action area.

Given the lack of understanding regarding the presence or abundance of Eskimo curlews in Alaska and the very low probability of encountering this species during a spill response action, the implementation of the Unified Plan may affect this species, but is not likely to adversely affect individual Eskimo curlews.

4.2.17 Short-tailed albatross

The short-tailed albatross is primarily present in Alaska only during the non-breeding season, from approximately May through November (USFWS, 2008b). However, a satellite tracking study begun in 2006 has documented the year-round presence of short-tailed albatross in Alaska (O'Connor, 2013). During the breeding season, juvenile and male birds have been tracked migrating along the Bering Sea continental shelf late into the fall, and in the southeast Bering Sea, Aleutian Island, GOA, and Southeast Alaska in the winter. These birds are found primarily at sea along the continental shelf margins (200 to 1,000 m deep) of the GOA and the Aleutian Islands, and in the Bering Sea (USFWS, 2008b).

Historically, few spills have occurred in the open ocean, deep-water habitats of the GOA, and the Bering Sea. There were 20 spills > 100 gal. during the 17 years between 1995 and 2012. Spill sizes ranged up to 211,000 gal.; five spills were between 1,000 and 10,000 gal.; and three spills were > 10,000 gal. All were of refined petroleum products (primarily diesel). Approximately seven spills occurred between 1995 and 2012 during seasons when the short-tailed albatross could have been present (Appendix D).

As previously discussed, measures designed to avoid or minimize wildlife impacts would be implemented as part of a spill response. If avoidance and / or minimization measures could not be implemented, response activities could potentially adversely affect short-tailed albatross. Any effects caused by these response actions would likely range from low to high magnitude and from temporary to long-term, depending on the type of interaction. The following subsections describe how spill response activities could affect the short-tailed albatross and are organized according to the five effect categories detailed in Section 4.1.

Response activities that do not occur in short-tailed albatross habitat and are therefore not evaluated for this species in this BA include: the use of deflection or containment berms, dams, or other barriers, pits, and trenches; culvert blocking; and removal and cleanup activities such as flushing and flooding, soil or sediment removal, or vegetation cutting and removal.

4.2.17.1 Physical or behavioral disturbance

Avoidance and minimization measures would be implemented during a response action to ensure that response activities would not cause a physical disturbance to short-tailed albatross behavior. In the event that these measures were unsuccessful, a response action that were to occur in the marine open-water environment (i.e., short-tailed albatross habitat) could potentially cause a temporary, low-magnitude physical disturbance, such as cause an albatross to alter its foraging behavior. Such a disturbance would be primarily due to the increased presence of people, boats, and / or noise associated with both mechanical and non-mechanical response activities. It should be noted that the short-tailed albatross recovery plan (USFWS, 2008b) reported that researchers conducting studies in short-tailed albatross breeding habitat in Japan caused “some level” of disturbance, but the document did not consider human disturbance to be a “significant” threat to short-tailed albatross.

No response activities that would cause a high-magnitude physical or behavioral disturbance to short-tailed albatross have been identified.

4.2.17.2 Exposure to contaminants

Any exposure to dispersants and dispersed oil in marine habitats could potentially have temporary effects on both the albatross and its habitat resources (e.g., prey). Considerations of the toxicity of oil, dispersants, and dispersed oil to short-tailed albatross and its prey are discussed in Section 5.2.1 of Appendix B. Similar to other species described above, exposures of short-tailed albatross to chemical dispersants could result in irritation of skin and other tissues or membranes (CDC and ATSDR, 2010). Ingestion, aspiration, and inhalation of components of oil are likely to be diminished by the application of chemical dispersants, which effectively reduce the mass of oil at the ocean surface, where short-tailed albatross are most active.

Short-tailed albatross feed primarily on squid and fish (USFWS, 2008b) from the sea surface, which is the area most likely to be affected by a spill response using dispersants. Large prey items (e.g., adult squid or fish) are less likely than planktonic species to be exposed to acutely toxic levels of dispersed oil for sufficiently long as to cause mortality (Sections 3.3 and 3.4 of Appendix B) so the preferred prey of short-tailed albatross are unlikely to be significantly impacted by the use of chemical dispersants. As larvae or subadults, sensitive, pelagic, marine invertebrates and fish may be impacted by the use of chemical dispersants due to the relatively reduced freedom of motion in the water column of such species at early life stages. Acute mortality in the majority of these species is unlikely (Section 4.2 of Appendix B), but sublethal impacts are possible (Lee et al., 2011b; Singer et al., 1998; Wu et al., 2012).

The uptake and effect of PAHs on birds is a point of uncertainty requiring further study. It is possible that the application of chemical dispersants would temporarily increase the exposure of short-tailed albatross to PAHs through the water column and through their diet. The likely impact of such a temporary increase in exposure is unclear (Section 6.3.3 of Appendix B).

In situ burning would potentially expose albatross to airborne particulates (if the birds were in the immediate vicinity of the response action). The effects of the inhalation of soot are unknown in marine birds but could be deleterious if breathing were impaired. It is highly unlikely that an albatross would remain in an area where *in situ* burning was taking place, so short-tailed albatross are unlikely to be exposed for long periods of time. The ingestion of or contact with *in situ* burn residues are likely to result in similar toxic impacts (i.e., mutagenicity) as exposure to unburned, weathered oil (Sheppard et al., 1983). *In situ* burning both decreases the volume of oil at the ocean surface and redistributes the remaining residue into the water column (ADEC et al., 2008), both of which will reduce the likelihood of exposure of short-tailed albatross to such residues (or unburned oil).

Dispersant application and *in situ* burning are not conducted near concentrations of wildlife. If endangered species were present, the USFWS would provide guidance regarding wildlife management and protection during a response.

In the unlikely scenario that a short-tailed albatross were to land on an oil spill where dispersants had been recently applied, the bird's plumage could be damaged by the applied dispersants, perhaps more so than by oil alone (Duerr et al., 2011), which could lead to hypothermia. Landing in an oil spill where dispersants had been recently applied could also result in the inhalation or aspiration of fumes from volatile components of chemical dispersants (CDC and ATSDR, 2010; Nalco, 2005, 2010). However, such an impact is unlikely, because short-tailed albatross are expected to avoid areas of actively responding crew or vessels.

4.2.17.3 Exclusion from resources

Short-tailed albatross do not breed or nest in Alaska and are limited to the marine environment. Exclusion from open ocean during a response to a spill is expected to be temporary (i.e., restricted to the duration of the response action) because the birds are relatively mobile and it is assumed that they will be able to seek alternative habitat resources in the event of a spill. At the completion of the spill response, albatross could return to the area from which they were disturbed and seek out prey resources as available. However, it is possible that a response action could occur across a large area (e.g., during a very large spill); during such a response, albatross might avoid these areas and thereby lose access to a greater amount of resources for the duration of the response action.

4.2.17.4 Habitat degradation and loss

Avoidance and minimization measures would likely ensure that spill response activities would not degrade short-tailed albatross habitat in Alaska waters. However, the use of dispersants and skimming has the potential to cause temporary, low-magnitude habitat degradation. Short-tailed albatross seasonally forage in Alaska open waters (along the edge of the continental shelf), but they have neither designated critical habitat nor nesting, breeding, or molting habitat in Alaska.

Dispersants could degrade habitat quality by causing temporary changes in the seasonal prey base (i.e., impacts on early life stages of pelagic fish and invertebrates or their planktonic prey). However, such impacts are expected to be temporary and highly localized, inasmuch as fish and invertebrates might be replaced or recolonized within a short timeframe (Abbriano et al., 2011); prey would be available from adjacent, unaffected open-water habitats (to recolonize an impacted area); and the majority of species are unlikely to be exposed to lethal concentrations of dispersed oil (Appendix B).

Although any skimming conducted in marine habitats would likely entrain plankton, the limited reduction in plankton abundance is not expected to significantly impact the prey base for short-tailed albatross.

4.2.17.5 Direct injury

Ship strikes from vessels associated with any of the marine response activities could potentially cause direct injury to short-tailed albatross. Injuries could have a range of effects, from temporary and low magnitude (e.g., bruising, physiological stress) to death.

It is also feasible that a short-tailed albatross could become entangled in response equipment. Entanglement could result in drowning or strangulation, if response crew were unable to prevent or remedy entanglement. This impact is unlikely due to the mobility of the short-tailed albatross, the large area over which the species forages, the small number of responses that occur in open ocean environments in which albatross are found, and the low likelihood that an albatross would approach actively responding crew and equipment (USFWS, 2008b).

In situ burning could also cause heat or smoke injury, which could potentially result in high-magnitude effects; however, *in situ* burning is not conducted near large concentrations of wildlife. If albatross were present, the decision to burn oil would be made in consultation with the Services, and the IAP would include wildlife protection measures identified by the Services (including deterrence). It is unlikely that albatross would be directly injured by heat because they would likely avoid areas of burning oil and response activity.

4.2.17.6 Determination of effects

Short-tailed albatross are present in Alaska only during their non-breeding season and are found in the offshore, open-water marine environment. Historically, spill response actions in this habitat have been very limited. In addition, albatross are highly mobile and could avoid an area where a response action was being conducted.

In the event that protective measures, including field-implemented BMPs, are unsuccessful in preventing interactions between albatross and spill response activities, the following actions could impact an individual. Potential high-magnitude impacts to individual short-tailed albatross from specific actions include:

- Physical injury via entanglement with equipment or ship strikes
- Impaired breathing or lung damage from the aspiration of dispersants or dispersed oil or smoke inhalation following *in situ* burning
- Hypothermia from the degradation of the insulating properties of feathers following exposure to dispersants during or immediately after the application of chemical dispersants

Response actions could also have lower-magnitude effects, including:

- Alteration of food web through the use of dispersants (i.e., changes in abundance and composition of prey due to dispersed oil toxicity)
- Tissue irritation (i.e. skin, eye, nose, mucus membrane) caused by exposure to dispersed oil, dispersants, or smoke from *in situ* burning
- Short-term habitat degradation due to changes in water or air quality (from burnt residues or use of dispersants)

The IAP and subsequent response actions are designed to protect sensitive resources. Furthermore, all response activities are developed and implemented as part of an emergency consultation with the Services during the response to avoid or minimize impacts to ESA species and critical habitats. Additional consultation and concurrence of the incident-specific RRT is required for non-mechanical response actions that may pose a greater risk to wildlife. If necessary, the deterrence of albatross can be permitted by the USFWS if it is deemed critical to preventing their exposure to oil or hazardous substances. These activities have the highest likelihood of impact on the albatross and constitute an adverse impact under ESA.

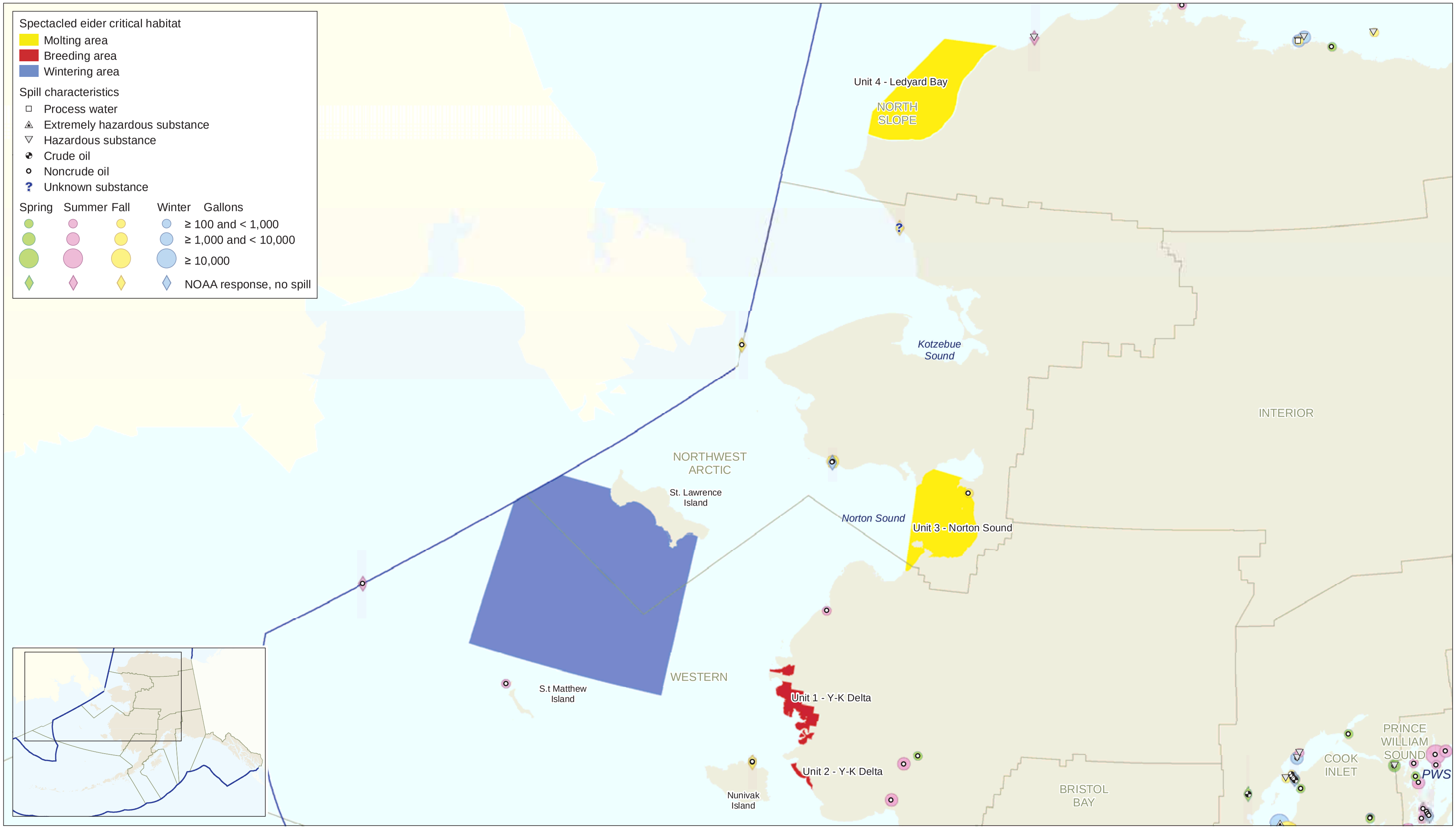
Given that the short-tailed albatross is highly mobile, is found along the continental shelf where spills are less likely to occur, has no critical habitat in Alaska, and it neither breeds, nests, nor undergoes molting in Alaska waters, there is a low likelihood that a response action would occur in short-tailed albatross habitat and that long-term degradation of said habitat would occur as a result of a response action. Thus, it is not likely that the implementation of the Unified Plan will adversely affect this species.

4.2.18 Spectacled eider

Due to the migratory nature of spectacled eiders, any effects from response actions would vary by season and the habitat affected by the spill response activities. Response activities in critical marine habitats could potentially impact spectacled eiders during their non-breeding (i.e., molting, staging, and wintering) season from late summer through winter to late spring. In contrast, spill response activities in upland habitats would impact spectacled eiders from late spring through the summer, when they breed, nest, and rear their young on the North Slope tundra and in the vegetated shoreline areas of the Y-K Delta. The eider's ability to avoid spill response activities in the species' only known wintering locations in the Bering Sea would be very limited because they congregate in polynyas in the sea ice. However, spill response during winter conditions is unlikely because of the limited access for vessels or aircraft (i.e., ice and weather conditions may preclude response), so that over-wintering birds would not likely be exposed to (or protected by) response activities in the event of a spill.

Historically, there have been very few spills in the habitats used by spectacled eiders (represented primarily by the spill history in the North Slope, Northwest Arctic, Western Alaska SCP regions, where spectacled eider critical habitat is located). On the North Slope, there have been seven marine spills, ranging in size from 100 to 6,300 gal. (two were over 1,000 gal.) (Appendix D). No spills occurred in critical molting habitat (Figure 4-8) on the North Slope. These spills occurred year-round and involved a wide range of materials (i.e., diesel, drilling muds, antifreeze, and/or produced water). An assessment of the risk of spills on the North Slope (Nuka Research, 2010) concluded that spills could increase in frequency and severity as infrastructure in the area becomes older. Direct development in spectacled eider critical habitat is not planned (NETL, 2009).

A recent BO (USFWS, 2012a) concerning oil and gas activities in and around the Beaufort and Chukchi Seas assessed the likelihood of adverse effects on the spectacled eider as a result of these activities and concluded that activities in the upland, such as vehicle traffic or the construction of permanent facilities could adversely impact spectacled eider but would not jeopardize the species or the function of its critical habitat. It was assumed that spectacled eider could be present in areas near small oil spills or easily contained spills but that their exposure would be minimal. It was further noted that an oil spill response would likely displace individuals away from spill sites before they could come into contact with oil (USFWS, 2012a), thereby limiting direct exposures to spilled oil or response activities. Large spills into their habitat, although unlikely, could have individual-level impacts (i.e., reduced survival, growth, or reproduction) (potentially leading to population-level impacts) (USFWS, 2012a).



Windward environmental LLC

0 20 40 60 Miles

0 20 40 60 Kilometers

Data sources: USFWS, NOAA, ESRI, Canada Centre for Cadastral Management, and Alaska State Geo-Spatial Data Clearinghouse

N

Exclusive economic zone (200 nautical miles from TS)

Subarea contingency planning region

Figure 4-8. Characteristics of spills that occurred between January 1995 and August 2012 and spectacled eider critical habitat areas

There have been two marine spills in the Northwest Arctic SCP, one of which (a 900-gal. diesel spill) occurred during the fall in Norton Sound, which is the location of critical molting/spring-staging habitat for the spectacled eider. The other spill (1,000 gal. of diesel) occurred during the summer in the Port of Nome (Appendix D).

In the Western Alaska SCP region, there were approximately six spills in marine waters during the 17 years between 1995 and 2012. These spills ranged in size from 100 to 3,000 gal. and involved refined petroleum products. All of these spills occurred during the spring or summer, and almost all were in nearshore areas. No spills occurred in spectacled eider critical habitat (Appendix D).

Historical upland spills that could have affected tundra habitat in the North Slope SCP region were typically (90%) associated with the oil and gas industry (e.g., pipelines) (ADEC, 2007a). Although frequent (~ 8,000 spills), most (87%) of the upland spills in the North Slope region were less than 100 gal. in size (ADEC, 2007a), and most were spilled to ice, snow, gravel, or containment structures. The oil and gas industry is required to have their own spill response plan that supports the Unified Plan, as well as operational procedures designed to detect and control structural and mechanical failures, which are the leading cause of spills on the North Slope.

In the Northwest Arctic SCP region, there were approximately 300 spills > 100 gal. in the upland environment, and over half of these spills were associated with the mining industry (ADEC, 2007a). In the Western SCP region, there were approximately 170 spills > 100 gal. in the upland; most of these spills were associated with oil storage facilities (ADEC, 2007a).

The distribution of historical upland spills relative to spectacled eider nesting areas is unknown; breeding pairs in proximity to villages and towns[44] would be more likely to encounter a spill response, because industrial facilities are subject to greater regulation and are required to implement spill control plans, which should reduce the likelihood of a release to habitats used by eider.

As previously discussed, activities designed to avoid or minimize wildlife impacts would be implemented as part of a spill response. If avoidance and minimization measures could not be implemented, response activities could potentially adversely affect spectacled eiders. The following subsections describe how spill response activities could affect the spectacled eider and are organized according to the five effect categories detailed in Section 4.1.

Because spectacled eiders are found in marine and non-marine habitats, any of the response actions conducted under the Unified Plan could potentially be implemented in their habitats, and thus all of the response actions were evaluated for this species. Response actions that could occur only in breeding habitats include the construction of

[44] Unregulated entities (e.g., vessels < 400 gross tons, vehicles, small-capacity storage tanks) have historically been responsible for the greatest number of spills in Alaska (ADEC, 2007b).

berms, dams, barriers, pits, and trenches; culvert blocking; and removal of soil. The remaining response actions could be implemented in both marine and non-marine aquatic habitats and could affect eiders during either the breeding or non-breeding seasons: booming, skimming or vacuuming, the use of sorbents and dispersants, *in situ* burning, spill tracking and monitoring, mobilization and demobilization, and the transport of solid wastes.

4.2.18.1 Physical or behavioral disturbance

Avoidance and minimization measures would likely ensure that spill response activities would not cause a physical disturbance of spectacled eider behavior. In the event that these measures are unsuccessful, any of the response actions could potentially cause physical disturbance to spectacled eiders, primarily due to the increased presence of people, vehicles, vessels, and / or heavy equipment, as well as the noise associated with both mechanical and non-mechanical response activities. This disturbance could cause spectacled eiders to be subject to increased predation if they were to flee from an area of refuge or could cause the birds to alter their breeding and rearing behaviors and possible abandon their young or nests. *In situ* burning could also cause behavioral changes, including nest or young abandonment if it were conducted during the breeding season.

The duration and magnitude of any of these physical and behavioral disturbances would depend on whether nests or young were present in the spill response area, the behavioral response of the nesting and rearing adult, and the duration of the spill response. The spectacled eider recovery plan (USFWS, 1996) identified human disturbance as a potential obstacle to the species' recovery, but the plan did not quantify the degree to which human disturbance would impact birds. Response activities that would occur during the nesting and rearing season would be expected to cause only a direct, temporary, low-magnitude effect on adult birds. However, any disturbance to adult birds could potentially have indirect, longer-term, and higher-magnitude effects on young birds (e.g., mortality) if adult birds were to abandon their nests or young, even temporarily, which could expose young birds to predators and / or cold stress. Spill response actions applicable to upland environments could occur in nesting and rearing habitat (i.e., tundra), and therefore have the potential for long-term, high-magnitude effects, primarily on young nesting birds. Although an IAP would include measures to detect and avoid nesting birds, the possibility of habitat or behavioral disturbances caused by implementation of the Unified Plan cannot be discounted.

If response actions were to occur in marine habitats during the non-breeding season, the effects would likely be temporary and of low magnitude, limited primarily to increased energy expenditure and physiological stress as the adult and sub-adult birds moved to lesser-quality habitat to avoid spill response activities. Actions that would occur in marine habitats have the potential for temporary, low-magnitude effects include the following: booming, skimming or vacuuming, use of sorbents, flushing and flooding, spill tracking and monitoring, mobilization and demobilization, and transport of solid wastes.

4.2.18.2 Exposure to contaminants

In the marine environment, spectacled eiders feed in shallow, ocean bottom habitats along the shoreline, in nearshore areas, and in open-water areas along winter ice. The risk of exposure for the spectacled eider would therefore be high if a spill were to impact nearshore, shallow-water environments. The eider uses inland and freshwater habitats during the summer breeding season. Thus, exposure to dispersants would be limited to non-breeding seasons, because no dispersants are currently approved for use in freshwater environments. Furthermore, exposures within the action area may be limited during other seasons when eider are present in nearshore or shoreline areas, because dispersants are not intended for use in such areas. In the unlikely event of an eider becoming substantially fouled by chemically-dispersed oil, significant embryotoxicity could result; as just noted, exposures to dispersed oil during the breeding season are unlikely. Additional considerations of the toxicity of oil, dispersant, and dispersed oil to spectacled eiders are discussed in Section 5.2.2 of Appendix B.

Similar to other species described above, spectacled eider, if exposed directly to dispersants or dispersed oil, may exhibit symptoms of dermal exposure such as tissue or membrane irritation (CDC and ATSDR, 2010). Such exposures may be mitigated somewhat during certain seasons by chemical dispersion, assuming that the response action occurs outside of eider habitat (e.g., nearshore or shoreline habitats); the removal of oil from the ocean surface would assumedly reduce exposures to eider, which are active at the ocean surface. Dispersed oil plumes that are forced by currents into such habitat would likely already have been diluted substantially, so that concentrations of oil in the water column were relatively low (Section 2.1 of Appendix B).

It is suggested that in a worst-case scenario spectacled eider might be exposed to volatile components of dispersants, if individuals were to land in a very recently sprayed area. Such an area would assumedly also contain oil, which is comprised of between 20 and 50% volatile components (Mackay and McAuliffe, 1988; Suchanek, 1993), many of which are known to be toxic (Geraci and St. Aubin, 1980; Park and Holliday, 1999). Dispersants are expected to reduce the extent of volatilization of such components by increasing their solubility (NRC, 2013). Therefore, the application of dispersants may result in a decreased exposure to volatile components associated with oil, although inhalation of dispersants could feasibly occur in isolated, unlikely (i.e., accidental) cases (e.g., application of dispersants directly to wildlife, significant overspray into clean seawater).

The uptake and effect of PAHs on birds is a point of uncertainty requiring further study. It is possible that the application of chemical dispersants would temporarily increase the exposure of spectacled eider to PAHs through the water column and through their diet. The likely impact of such a temporary increase in exposure is unclear (Section 6.3.3 of Appendix B).

In situ burning could also expose eiders to airborne particulates (if the birds were in the immediate vicinity of a response action). The effects on marine birds of the inhalation of soot are unknown; however, the effects could be deleterious if breathing were to be impaired.

Although *in situ* burning and the application of dispersants could adversely affect birds, these non-mechanical response actions are not recommended for use near concentrations of wildlife or in nearshore environments as directed by the Unified Plan and supporting guidance documents (EPA et al., 2010; Alaska Clean Seas, 2010; Nuka Research, 2006), reducing the likelihood of such actions being taken in areas where eiders congregate. The IAP would include protocols to detect and avoid eiders. Any decision to use dispersants or *in situ* burning would be made in consultation with the USFWS. Even though the decision framework for using non-chemical response actions is intended to protect sensitive wildlife, the possibility of a chemical exposure occurring in response to an implementation of the Unified Plan cannot be discounted.

4.2.18.3 Exclusion from resources

The previously described avoidance and minimization measures would likely ensure that spill response activities would not exclude spectacled eiders from resources. If any of these avoidance and minimization measures could not be implemented, certain mechanical and non-mechanical response activities could directly exclude spectacled eiders from their breeding and non-breeding habitat, including forage, refuge, and nesting areas. It is assumed that adult birds would be relatively mobile, and would not be directly excluded from resources as a result of many of the response activities, because they could seek habitat resources in a nearby location. Molting birds will likely be more limited in their ability to relocate. In addition, birds that are actively nesting or rearing young would have difficulty seeking resources elsewhere because of their inability to leave the established nesting and rearing area for long periods of time.

Only three response actions—removal of vegetation, removal of soil or sediment, and *in situ* burning—were identified as potentially causing temporary, high-magnitude effects when implemented during the breeding season over a large area. These actions could cause spectacled eiders to avoid breeding habitat areas. However, it is highly unlikely that vegetation and/or soil would be removed from a large (e.g., several acres) area, and if it were to occur, the presence of heavy equipment and response workers could cause eiders to avoid the area. *In situ* burning could also cause the eiders to avoid an area of important habitat.

The following actions would not likely cause eiders to avoid an area of important habitat during any season because these actions would be either relatively unobtrusive and/or would occur only in non-breeding habitats: booming; flushing and flooding; spill tracking and monitoring; mobilization and demobilization; solid waste handling; mechanical construction of berms, dams, and barriers; skimming or vacuuming; culvert blocking; and the use of sorbents. In addition, if response activities such as booming, skimming, vacuuming, or the use of sorbents were to occur in the species' wintering area, it is unlikely that these activities would fully exclude the eiders from their habitat.

4.2.18.4 Habitat degradation and loss

Avoidance and minimization measures would likely ensure that spill response activities would not degrade spectacled eider habitat. However, if these measures were unsuccessful and response activities were to occur within their habitat, the following response activities would potentially have temporary but high-magnitude effects on the birds if the actions were applied over a large (e.g., several acres) area: removal of soil or sediment, vegetation removal, and *in situ* burning.

Breeding, nesting, and rearing activities are dependent on high-quality nesting sites located near wetlands and ponds on the tundra or within vegetated shoreline areas (specifically, in the Y-K Delta). The removal of soil, sediment, or vegetation through mechanical measures or via *in situ* burning could directly impact local habitats by reducing available nesting sites and displacing benthic forage species (e.g., mollusks and aquatic insect larvae). Soil and vegetation removal also has the potential to directly contribute to shoreline destabilization and the additional loss of habitat and forage. Such habitat degradation could persist for decades in the tundra environment at higher latitudes. However, although the degradation would be long term, breeding pairs would likely be impacted only temporarily (i.e., during a single breeding season). It is also assumed that these response activities would have greater consequence in the Y-K Delta breeding habitat, where spectacled eider nesting is known to be more concentrated than that on the North Slope.

The following response activities have been identified as having the potential to cause temporary, low-magnitude habitat degradation: the use of heavy equipment (for berming or trenching) and flushing. The use of heavy equipment in tundra nesting areas during the construction of berms, dams, barriers, pits, and / or trenches could degrade breeding habitat. Any flushing or flooding of marine shorelines could cause the physical displacement of benthic organisms, reducing forage availability until those communities were able to recover (one or more growing seasons). Flushing could also cause thermal stress to forage species if warm or hot water were used.

Dispersants applied in non-breeding habitat could degrade habitat quality by causing dispersed oil toxicity in sensitive benthic invertebrates (the spectacled eider prey base) (Clark et al., 2001; NRC, 2005). *In situ* burning residues that accumulate in marine or freshwater benthic habitats could also smother benthic invertebrates, impacting the prey base, if sufficient area were impacted. However, such effects would be temporary, of low magnitude, and highly localized because residues would likely be dispersed over a wide area (i.e., unlikely to smother). In addition, not all species would be adversely impacted by dispersed oil (Appendix B), and most benthic invertebrate communities would likely recover within a matter of months or years (e.g., < 2 years), though the recovery of more-sensitive species could take longer (e.g., > 2 years) (Cross and Thomson, 1987; Mageau et al., 1987).

Although skimming and vacuuming in marine and freshwater habitats would likely entrain plankton, the limited reduction in plankton abundance is not expected to significantly impact the prey base for eiders.

PCEs for the spectacled eider vary by area. The Y–K Delta units are important breeding areas; PCEs include vegetated intertidal habitat and all open water habitat in the intertidal zone. PCEs for the Norton Sound and the Ledyard Bay, where spectacled eiders aggregate during molting, include all marine waters between 5 m (16.4 ft) and 25 m (82.0 ft) in depth, along with associated marine aquatic flora and fauna in the water column and the underlying marine benthic community. PCEs for critical habitat for over-wintering include all marine waters that are 75 m (246.1 ft) or less in depth, along with associated marine aquatic flora and fauna in the water column and the underlying marine benthic community. Response operations that degrade these types of areas within critical habitat boundaries may be considered an adverse modification.

4.2.18.5 Direct injury

Direct strikes of birds by vehicles or vessels associated with any of the response activities have the potential to cause direct injury. In addition, although a significant effort would be made to identify the presence and location of all ESA-listed species, response activities in upland tundra habitats, if applied during the breeding season, could destroy undiscovered nests. The effect of any injury could range from low magnitude and temporary (e.g., bruising and physiological stress) to high magnitude and long term (i.e., mortality).

It is feasible that eider species could become entangled in response equipment (e.g., booms, floating or submerged anchor lines). Entanglement could result in drowning or strangulation, if response crew were unable to prevent or remedy entanglement through active monitoring of response equipment or wildlife avoidance measures.

A bird's ability to use the aquatic environment as habitat is dependent upon its ability to trap air in its feathers to create an insulating layer. Contact with chemical dispersants or dispersed oil could cause a loss of insulation and hypothermia. The effect of dispersed oil on the functional structure of plumage is slightly greater than that of oil alone (Duerr et al., 2011; Jenssen and Ekker, 1991a).

In situ burning could also cause heat or smoke injury, resulting in high-magnitude effects. However, the effects related to heat exposure would be unlikely, because eiders would likely avoid areas with burning oil and active response crews.

4.2.18.6 Determination of effects

Spectacled eiders would be most vulnerable to spill response activities that occurred during the summer, when they breed, nest, and rear young on the North Slope tundra or the vegetated shoreline areas of the Y-K Delta, or during the winter in the Bering Sea.

During other seasons, the birds would be more likely to avoid most spill response activities.

Historically, spill response actions have been very limited in spectacled eider aquatic habitat; between 1995 and 2012, one diesel spill occurred in their molting / staging habitat. The number of upland spills that have occurred in areas where spectacled eider breed is unknown, although numerous spills have occurred in coastal marine regions where they may breed.

In the unlikely event that protective measures, including field-implemented BMPs, are unsuccessful in preventing interactions between eider and spill response activities, the activities could have a range of effects on individual eiders. The following high-magnitude effects on individual birds could result from specific actions:

- Physical injury via entanglement with in-water equipment or ship strikes
- Impaired breathing or lung damage from the aspiration of dispersants or dispersed oil or smoke inhalation following *in situ* burning
- Hypothermia from the degradation of the insulating properties of feathers following exposure to dispersants during or immediately after the application of chemical dispersants
- Nest destruction from heavy equipment or vehicles in upland nesting habitats

Response actions could also have lower magnitude effects, including:

- Alteration of food web through the use of dispersants (i.e., dispersed oil toxicity)
- Tissue irritation from exposure to dispersants, dispersed oil, and / or smoke
- Short-term habitat degradation due to changes in water quality (from use of dispersants, burnt residues) or air quality (from smoke) or from the removal of soil or vegetation in nesting areas

The IAP and subsequent response actions are designed to protect sensitive resources. Furthermore, all response activities are developed and implemented as part of an emergency consultation with Services during the response to avoid or minimize impacts to ESA species and critical habitats. Additional consultation and concurrence of the incident-specific RRT is required for non-mechanical response actions that could pose a greater risk to wildlife. If necessary, the deterrence of eiders can be permitted by the USFWS if it is deemed critical to preventing their exposure to oil or hazardous substances. These activities have the highest likelihood of effect on a spectacled eider and constitute an adverse impact take under ESA.

Although the protection of sensitive species and habitats is one of the highest priorities of a response action, there remains the possibility that the spectacled eider could be adversely affected by implementation of the Unified Plan. The likelihood of response activities impacting spectacled eider is high because they are present in Alaska year-round and are spatially restricted to very specific areas, particularly during molting season when they are less mobile and therefore unable to avoid a spill response action. Spill responses that occur in critical habitat are likely to impact both the critical habitat PCEs and the species itself, and thus their potential effects cannot be discounted.

4.2.19 Steller's eider

Due to the migratory nature of Steller's eiders, the effects of response activities would vary by season and the habitat affected by the spill response. Response activities in marine habitats could potentially affect Steller's eiders during their non-breeding (i.e., molting, staging, and wintering) season, from late summer through winter to late spring. Molting occurs in specific coastal locations along the Alaska Peninsula while the birds winter in coastal marine areas in the Aleutian Islands, Kodiak Island, and western Cook Inlet (they do not congregate in the Bering Sea polynyas, as do spectacled eiders). Spill response activities in upland habitats could affect Steller's eiders during the summer, when they breed, nest, and rear their young on the North Slope tundra and the Y-K Delta (although very few nests have been found on the Y-K Delta in recent years [USFWS, 2002]). The Steller's eider recovery plan (USFWS, 2002) reported that on the North Slope, Steller's eider breeding is concentrated around the village of Barrow, which has a population of approximately 5,000 people.

Historically, a number of spills (primarily refined petroleum products) have occurred in the aquatic habitats used by Steller's eiders (represented by the spill history for the North Slope, Western Alaska, Aleutian Islands, and Kodiak Island SCP regions, where Steller's eider are present during different times of the year). Collectively, there have been at least 130 spills, ranging from 100 to over 320,000 gal. in the coastal waters[45] of these four SCPs (Appendix D). However, few marine spills have occurred in the North Slope or Western Alaska SCPs. In addition, no spills have occurred in critical habitat for Steller's eider (Figure 4-9).

A recent BO (USFWS, 2012a) concerning oil and gas activities in and around the Beaufort and Chukchi Seas assessed the likelihood of adverse affects on Steller's eider related to these activities and concluded that activities in the upland, such as vehicle traffic or the construction of permanent facilities, could adversely impact Steller's eider but would not jeopardize the species or the function of its critical habitat. The report (USFWS, 2012a) estimated that < 1 Steller's eider would be killed over a period of 14 years as a result of activity in northern coastal Alaska. It was assumed that Steller's eider might be present in areas near small oil spills or easily contained spills but that exposures would be minimal. It was further noted that oil spill response would likely displace individuals away from spill sites before they could come into contact with oil (USFWS, 2012a).

Large spills into Steller's eider habitat, although unlikely, would have individual-level impacts (i.e., reduced survival, growth, or reproduction) (potentially leading to population-level impacts) (USFWS, 2012a).

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[45] In this case, coastal waters are defined as those within 5 mi of land.

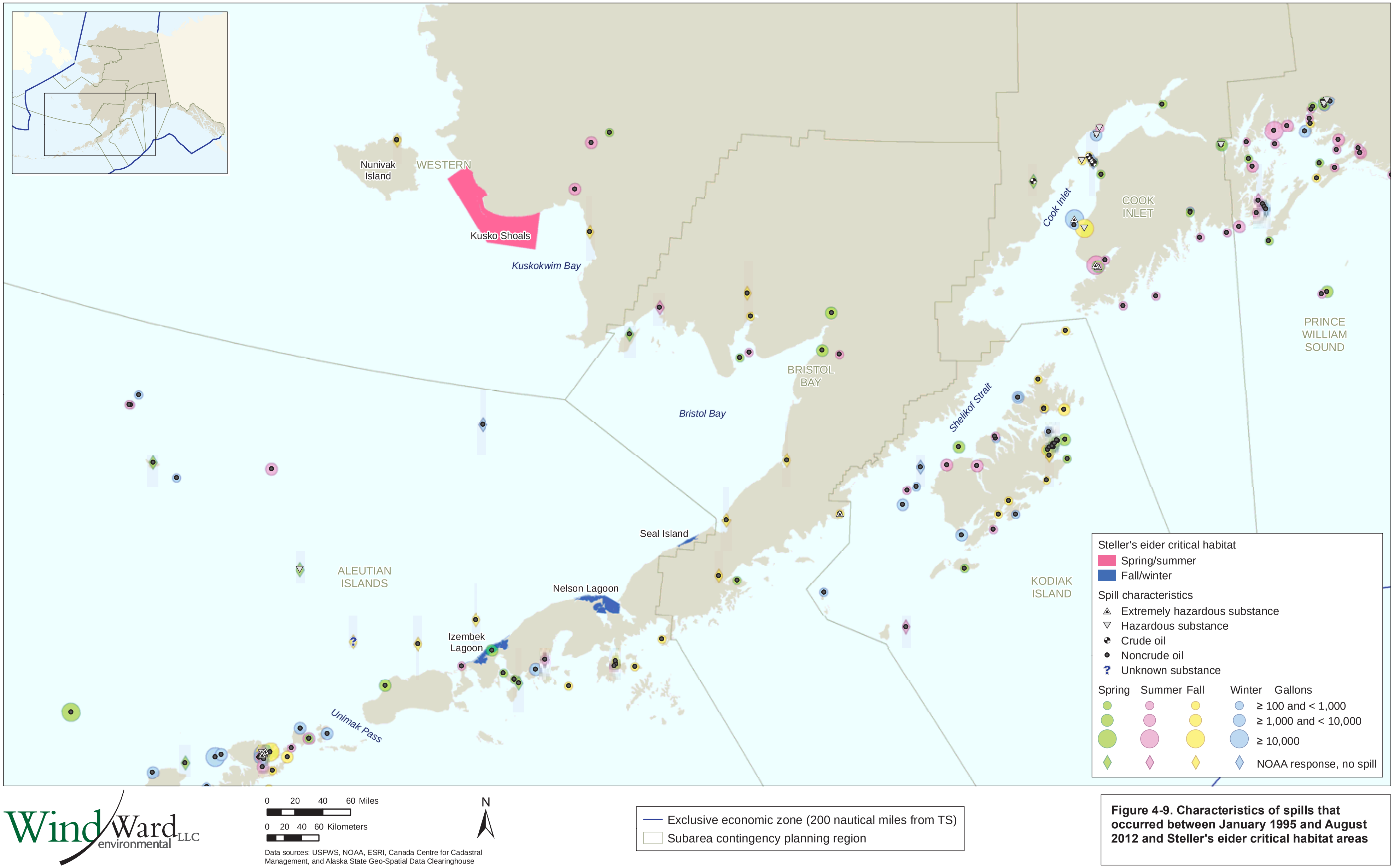

Figure 4-9. Characteristics of spills that occurred between January 1995 and August 2012 and Steller's eider critical habitat areas

Historical upland spills that could have affected Steller's eider nesting habitat in the North Slope SCP region were typically (90%) associated with the oil and gas industry (e.g., pipelines) (ADEC, 2007a). Although frequent (~ 8,000 spills), most (87%) of the upland spills in the North Slope SCP region were less than 100 gal. in size (ADEC, 2007a), and most involved spills to ice, snow, gravel or containment structures.

In the Western SCP region, where there is a small subpopulation that breeds in the Y-K Delta, there were about 170 spills > 100 gal. in the upland area; most were associated with oil storage facilities (ADEC, 2007a) in communities or areas of industrial activity.

The distribution of upland spills relative to Steller's eider nesting areas is unknown; however, breeding pairs in proximity to Barrow, AK could potentially be subjected to more emergency response actions because of the greater density of both people and Steller's eiders in the area.

As previously discussed, measures designed to avoid or minimize wildlife impacts would be implemented as part of a spill response action. If avoidance and minimization measures could not be implemented or were ineffective, response activities could potentially adversely affect Steller's eiders. The following subsections describe how spill response activities could affect Steller's eiders and are organized according to the five effect categories detailed in Section 4.1.

Because Steller's eiders are found in marine and upland habitats, any response action could potentially be implemented in their habitats, and thus all of the response actions were evaluated for this species. The following activities occur in upland habitats and thus could only affect eiders during the breeding season: construction of berms, dams, barriers, pits, and trenches; culvert blocking; removal of soil; removal of vegetation; solid waste handling. The response actions that could affect eiders during their non-breeding season include booming, skimming or vacuuming, use of sorbents, sediment flushing or flooding, use of dispersants, *in situ* burning, spill tracking and monitoring, mobilization and demobilization, and transport of solid wastes.

4.2.19.1 Physical or behavioral disturbance

The previously described avoidance and minimization measures would likely ensure that spill response activities would not cause a physical disturbance to Steller's eider behavior. In the event that these measures were unsuccessful, any of the response actions could potentially cause a physical disturbance to Steller's eiders, primarily due to the increased presence of people, vehicles, boats, and/or heavy equipment, as well as the noise associated with both mechanical and non-mechanical response activities. This disturbance could cause Steller's eiders to be subject to increased predation if they were to flee from an area of refuge or could cause the birds to alter their breeding and rearing behaviors and possibly abandon their young or nests. Non-mechanical responses that alter the immediate environment (i.e., *in situ* burning) could also cause behavioral changes, including the abandonment of young or nests during the breeding season.

The duration and magnitude of the effects that might result from any of these physical and behavioral disturbances would depend on whether nests or young were present in the spill response area, the behavioral response of the nesting and rearing adult, and the duration of the spill response action. One task identified in the Steller's eider recovery plan (USFWS, 2002) was to evaluate the Steller's eiders' response to human disturbance, particularly near Barrow, AK, inasmuch as USFWS biologists believe that human disturbance (cumulatively with other factors) could be contributing to the decline of the Steller's eider population. Any response activities that would occur during the nesting and rearing season (particularly in the vicinity of Barrow, AK) would be expected to have a temporary, low-magnitude effect on adult birds. However, this disturbance could potentially have indirect, long-term, high-magnitude effects on young birds (e.g., mortality) were adult birds to abandon their nests or young, even temporarily, exposing the young to predators and/or cold stress. Spill response actions in upland environments could potentially disturb breeding adults in nesting habitat and therefore have the potential for long-term, high-magnitude effects, primarily on young.

If a disturbance were to occur in marine habitats during the non-breeding season, the effects would likely be temporary and of low magnitude, limited to increased energy expenditure and physiological stress if the adult and sub-adult birds were to fly or move to lesser-quality habitat to avoid spill response activities. The following actions have the potential for temporary, low-magnitude disturbance in marine habitats: booming, skimming or vacuuming, use of sorbents, flushing or flooding, use of dispersants, *in situ* burning, spill tracking and monitoring, mobilization and demobilization, and solid waste handling.

4.2.19.2 Exposure to contaminants

In marine environments, Steller's eiders feed in shallow, ocean bottom habitats along shorelines and in nearshore areas. The risk of exposure for the Steller's eider could be high if a spill were to occur in nearshore, shallow water environments. However, the use of dispersants in nearshore habitats is not recommended under the Unified Plan; the decision to use dispersants would require the concurrence of the incident-specific RRT and consultation with the Services. The application of dispersants could result in the dispersion of a surface oil slick before it could significantly affect the nearshore environment (NRC, 2005; Fingas, 2008b), potentially providing a benefit to Steller's eider, which are present in these areas during much of the year (Section 3.2.4.3). Steller's eider also use inland and freshwater habitats during the summer breeding season. Thus, potential exposure to dispersants would be limited to non-breeding seasons because no dispersants are currently approved for use in freshwater environments. Other specific considerations of the toxicity of oil, dispersant, and dispersed oil to Steller's eider are discussed in Section 5.2.3 of Appendix B. It is possible, for Steller's eiders to come into contact with dispersants or dispersed oil immediately after application of chemical dispersants, resulting in dermal contact (discussed in Section 4.2.17.5 below), inhalation, or aspiration of oil components and chemical dispersants.

Prolonged exposure to the volatile components of dispersants could possibly result in acute or chronic impacts on wildlife (CDC and ATSDR, 2010), similar to those noted in Section 4.2.18.2.

The use of dispersants in marine habitats could potentially have an adverse effect on prey resources due to acute exposure to dispersants and dispersed oil resulting in lethality or sublethal impacts (e.g., reduced reproductive capabilities or abnormal growth). Although acutely toxic impacts on the majority of benthic species are not expected (Mageau et al., 1987; Cross and Thomson, 1987), planktonic larvae of benthic organisms could be affected (Cross and Martin, 1987), thereby reducing recruitment. Planktonic communities have been observed to recover quickly after exposure to dispersed oil (Abbriano et al., 2011); however, fish and longer-lived benthic invertebrates (e.g., bivalves) may be slower to recover from dispersed oil exposures (Cross and Thomson, 1987).

The uptake and effect of PAHs on birds is a point of uncertainty requiring further study. It is possible that the application of chemical dispersants would temporarily increase the exposure of Steller's eider to PAHs through the water column and through their diet. The likely impact of such a temporary increase in exposure is unclear (Section 6.3.3 of Appendix B).

In situ burning could also expose eiders to airborne particulates (if the birds were in the immediate vicinity of this response action). The effects of the inhalation of soot on marine birds are unknown but might cause lung damage if birds were unable to avoid a smoke plume. However, under the Unified Plan, *in situ* burning would be avoided near concentrations of wildlife. In addition, the Services would be consulted prior to the decision to use this countermeasure, and their recommendations for wildlife protection would be incorporated into the IAP. Still, the possibility of exposures of Steller's eiders to smoke (as well as chemical dispersants and dispersed oil) cannot be entirely discounted.

4.2.19.3 Exclusion from resources

The previously described avoidance and minimization measures would likely ensure that spill response activities would not exclude Steller's eiders from resources. If any of the avoidance and minimization measures could not be implemented or were ineffective, certain mechanical and non-mechanical response activities would have the potential to directly exclude Steller's eiders from their breeding and non-breeding habitat, including forage, refuge, and nesting areas. It is assumed that adult birds, even when molting, would be relatively mobile and would not be directly excluded from resources as a result of many of the response activities because they could seek habitat resources in a nearby location. However, birds that were actively nesting or rearing young would have difficulty seeking resources elsewhere due to their inability to leave the established nesting and rearing area for long periods of time.

None of the response actions would have the potential to cause high-magnitude effects as a result of exclusion from resources because any exclusion would be temporary, occurring only during the response, and temporary exclusion from resources would be unlikely to cause substantial adverse effects.

Only three response actions—removal of vegetation, removal of soil or sediment, and *in situ* burning—would have the potential to cause temporary, low-magnitude effects when applied during the breeding season over a large area, inasmuch as these actions could cause eiders to avoid breeding habitat areas. Although it is highly unlikely that vegetation and/or soil would be removed from a large area (e.g., several acres), if it were to occur, the presence of heavy equipment and people would likely cause eiders to avoid the area. *In situ* burning could degrade local air and water quality conditions, also causing eiders to avoid an area of important habitat.

4.2.19.4 Habitat degradation and loss

Any avoidance and minimization measures would likely ensure that spill response activities would not degrade Steller's eider habitat. However, if these measures were unsuccessful and response activities were to occur within the species' habitat, the following activities would have the potential to have temporary, high-magnitude effects on eiders if the actions were applied over a large area (e.g., several acres): removal of soil, removal of vegetation, and *in situ* burning.

The success of breeding, nesting, and rearing activities are dependent on high-quality nesting habitat near wetlands and ponds on the tundra. Any removal of soil or vegetation through mechanical measures or *in situ* burning could directly affect habitat quality by reducing available nesting sites. Soil and vegetation removal could also directly contribute to shoreline destabilization and the additional loss of habitat and forage (however, site stabilization and restoration would be conducted following a response action). The recovery of tundra habitat following a disturbance could take decades in the Arctic environment. However, although the degradation itself would be long term, breeding pairs would likely be impacted only temporarily (e.g., during a single breeding season).

The following response activities have been identified as having the potential to cause temporary, low-magnitude habitat degradation: the use of heavy equipment (for berming or trenching) and sediment flushing. The use of heavy equipment in tundra nesting areas (e.g., ponds, wetlands, and vegetated shoreline) during the construction of berms, dams, barriers, pits, and trenches could degrade breeding habitat. Any flushing or flooding of marine beach sediment in shorelines could cause the physical displacement of benthic organisms, reducing forage availability until those communities have recovered (which would take one or more growing seasons). Flushing could also cause thermal stress to forage species if warm or hot water were used.

Dispersants applied in non-breeding habitat could degrade water quality, causing temporary changes in the benthic invertebrate community and reducing habitat quality. *In situ* burning residues that accumulate in marine or freshwater benthic habitats could also smother benthic invertebrates, impacting the prey base, if sufficient area were impacted.

Although skimming and vacuuming in marine and freshwater habitats would likely entrain plankton, the limited reduction in plankton abundance would not likely have a significant effect on the Steller's eider's prey base.

4.2.19.5 Direct injury

Any direct strike of individuals by vehicles or vessels associated with response activities could potentially cause direct injury to Steller's eiders. In addition, although a significant effort would be made to identify the presence and location of all ESA-listed species, the use of heavy equipment and / or vehicles in the tundra during the breeding season could potentially destroy undiscovered nests. Direct injury could range from low-magnitude, temporary effects (e.g., bruising and physiological stress) to long-term, high-magnitude effects (i.e., mortality).

A bird's ability to use the aquatic environment is dependent upon its ability to trap air in its feathers to create an insulating layer. Dermal exposure to dispersants or dispersed oil (as well as oil alone) could cause a loss of insulation and hypothermia (Duerr et al., 2011; Jenssen and Ekker, 1991a, b). *In situ* burning could also cause heat or smoke injury, resulting in high-magnitude effects, although heat injury is incredibly unlikely; heat injury would occur if an eider swam or flew directly into an *in situ* burn.

4.2. 19.6 Determination of effects

Steller's eiders would be most vulnerable to spill response activities during summer, when they are breeding, nesting, and rearing young on the North Slope tundra (particularly in the vicinity of Barrow) or potentially on the Y-K Delta. During other seasons, the birds would be more widely dispersed and more likely to be able to avoid most spill response activities.

Historically, spill response actions have occurred throughout the Steller's eider's aquatic habitat (particularly molting and wintering habitat), although no spills have occurred in critical habitat. The number of upland spills that have occurred in areas where eider are nesting is unknown.

In the event that protective measures, including field-implemented BMPs, are unsuccessful in preventing interactions between eider and spill response activities, the following actions could affect an individual. Potential high-magnitude effects to individual birds from specific actions include:

- Physical injury via entanglement with in-water equipment or ship strike

- Impaired breathing or lung damage from the aspiration of dispersants or dispersed oil or smoke inhalation following *in situ* burning
- Hypothermia from the degradation of the insulating properties of feathers following exposure to dispersants during or immediately after the application of chemical dispersants
- Nest destruction from heavy equipment or vehicles in upland nesting habitats

These and other response actions can also have lower magnitude effects, including:

- Alteration of food web through the use of dispersants (i.e., changes in abundance and composition of prey due to dispersed oil toxicity)
- Tissue irritation (i.e. skin, eye, nose, mucus membrane) caused by exposure to dispersed oil, dispersants, or smoke from *in situ* burning
- Short-term habitat degradation due to changes in water quality (from use of dispersants, burnt residues) or air quality (from smoke) or from the removal of soil or vegetation in nesting areas

The IAP and subsequent response actions are designed to protect sensitive resources. Furthermore, all response activities are developed and implemented as part of an emergency consultation with Services during the response to avoid or minimize impacts to ESA species and critical habitats. As a matter of policy, the use of dispersants and *in situ* burning is not recommended in areas with wildlife concentrations and in nearshore areas. Additional consultation and concurrence of the incident-specific RRT is required for non-mechanical response actions that could pose a greater risk to wildlife. If necessary, the deterrence of eiders can be permitted by the USFWS if it is deemed critical to preventing their exposure to oil or hazardous substances.[46] These activities have the highest likelihood of impact on the spectacled eider and constitute an adverse effect under ESA.

Given that Steller's eider are present in Alaska year-round, they are spatially restricted to specific areas (i.e., critical habitat, particularly during molting season when they are less mobile and therefore unable to avoid a spill response action), and spill responses that occur in critical habitat is therefore likely to impact both the critical habitat PCEs and the species itself, it is likely that implementation of the Unified Plan would adversely affect this species.

4.2.20 Kittlitz's murrelet

Due to the migratory nature of Kittlitz's murrelets, any effects from response activities would vary by season and the habitat affected by the spill response. Response activities in coastal marine habitats could potentially impact Kittlitz's murrelets during their

[46] Wildlife deterrence is permitted under Section 6(c) of the ESA through a Cooperative Agreement with the State of Alaska.

non-breeding season, from late summer through winter and late spring, as well as during their breeding season (summer months), when they feed in shoreline areas. Although their winter range is not well known, Kittlitz's murrelets have been sighted in Southeast and western Alaska and in the northern GOA (USFWS, 2006; Agler et al., 1998). It is also thought that open ice leads and polynyas are important winter habitat for murrelets. Response activities in upland environments are unlikely to impact Kittlitz's murrelets during their nesting season because their nests tend to be in remote, barren areas.

In the breeding season (i.e., summer months), the murrelet nests up to 75 km (~46 mi) inland in rugged, unvegetated terrain near glaciers or tidewater streams, where it feeds. During this time, the species is usually concentrated in the vicinity of the Alaska Peninsula, PWS, lower Cook Inlet, Kenai Fjords, Icy Bay, Yakutat Bay, the Malaspina Forelands, Glacier Bay (USFWS, 2006; Piatt et al., 1999), and Kodiak Island (Lawonn et al., 2009). Nests have also been found on the Seward Peninsula, Cape Lisburne, and within the Wulik River watershed (Day et al., 2011). Due to the rarity of the Kittlitz's murrelet, and the specificity of its habitat during the breeding season (USFWS, 2006), it is assumed that the minimization and avoidance measures would be particularly suited to ensuring the bird's safety from spill response activities during the breeding season. At other times of the year, the effectiveness of these measures would be less certain. The USFWS (2009a) reported that between 500 and 1,000 Kittlitz's murrelets died (and were recovered) during the Exxon Valdez oil spill in PWS (which occurred in March 1989), although the actual cause of death (i.e., the spill, spill response, or other cause) was unknown.

Historically, over the 17 years between 1995 and 2012, approximately 400 spills occurred in coastal habitats that have been used by Kittlitz's murrelet. These spills have ranged in size from 100 to over 320,000 gal.; over 90% of the spills involved refined petroleum products (typically diesel) (Appendix D). The spills occurred year-round but were more prevalent in different seasons by region.

Activities designed to avoid or minimize wildlife impacts would be implemented as part of a spill response. If avoidance and minimization measures could not be implemented, response activities could potentially adversely affect Kittlitz's murrelets. The following subsections describe how spill response activities could affect the Kittlitz's murrelet and are organized according to the five effect categories detailed in Section 4.1.

Although Kittlitz's murrelets are found in marine and upland habitats, only those responses that could occur in aquatic habitats are evaluated for this species because of the remoteness of their upland nesting habitat. It is unlikely that an upland spill would impact upland the Kittlitz's murrelet's nesting habitat because of the remoteness of that habitat. The following activities occur in upland habitats and are unlikely to affect murrelets when nesting: construction of berms, dams, barriers, pits, and trenches; culvert blocking; removal of soil; removal of vegetation; and upland *in situ* burning.

4.2.20.1 Physical or behavioral disturbance

The previously discussed avoidance and minimization measures would likely ensure that spill response activities would not cause a physical disturbance to Kittlitz's murrelet behavior. In the event that these measures were unsuccessful, any of the response actions could potentially cause physical disturbance to Kittlitz's murrelets, primarily due to increased presence of response workers, vehicles, vessels, and / or heavy equipment, as well as the noise associated with both mechanical and non-mechanical response activities. Because murrelets are found in coastal areas where commercial fishing and tour boats are common (e.g., PWS and Southeast Alaska), USFWS (2006, 2009a) has identified disturbance by commercial and recreational boats as a potential factor that could cause Kittlitz's murrelet mortality. If murrelets were to flee from an area of refuge due to disturbance, they could experience increased predation or could alter their breeding and rearing behaviors, abandoning their young or nests. In addition, Speckman et al. (2004; cited in USFWS, 2009a) reported that boat disturbance could reduce food delivery to marbled murrelet chicks, which are behaviorally similar to Kittlitz's murrelets, decreasing survival. Non-mechanical responses (e.g., the use of dispersants and *in situ* burning) could also elicit a behavioral change, as the birds attempt to avoid such actions.

The duration and magnitude of any of these physical and behavioral disturbance effects would depend on the response of the nesting or rearing adults and the duration of the spill response. Response activities during the nesting and rearing season would be expected to cause only temporary, low-magnitude direct effects to adult birds. However, this disturbance of adult birds could have the potential to have long-term, high-magnitude effects on young birds (i.e., mortality) if adult birds were to abandon their nests or young, exposing young to predators and / or cold stress. USFWS (2011c) identified disturbances that cause nest and young abandonment as having potentially high-magnitude effects for Kittlitz's murrelets; because their nests are located on cliffs, chicks can die by falling or being exposed to cold stress if adults are absent from nests, even temporarily.

If disturbance were to occur in marine habitats during the non-breeding season, effects would likely be of low magnitude, limited to increased energy expenditure and physiological stress if the adult and sub-adult birds were to fly or move to lesser-quality habitat to avoid spill response activities (Agness et al., 2008).

4.2.20.2 Exposure to contaminants

The exposure of this species to dispersants or dispersed oil could possibly result in the aspiration or inhalation of volatile components of dispersants, resulting in impaired respiratory function or tissue damage (CDC and ATSDR, 2010). Inhalation exposures to oil alone may represent a greater threat than untreated oil, which has led some to suggest using dispersion as a method to reduce the threat to human responders of inhalation exposure (NRC, 2013). However, the possible impact to Kittlitz's murrelet of exposure to dispersants alone cannot be entirely discounted.

Because Kittlitz's murrelets are primarily piscivorous, the use of dispersants in marine habitats could potentially be acutely toxic to their prey base (particularly in sensitive species or early life stages such as embryos or larvae) (Lee et al., 2011b; Clark et al., 2001) affecting fish abundance either temporarily or long-term, which in turn could cause physiological stress or even death if the reduction in prey were widespread. Given the rapid dilution of dispersants following application, it is unlikely that prey species would be exposed to dispersants above potentially lethal concentrations[47] for more than a matter of hours (NOAA, 2012b; Gallaway et al., 2012). Additional discussion of the likely direct and indirect impacts of oil, dispersants, and dispersed oil on Kittlitz's murrelets is provided in Section 5.2.4 of Appendix B. In the unlikely event that a Kittlitz's murrelet were exposed to oil, dispersants, or dispersed oil, impacts could be similar to those noted for other bird species as noted above (Section 4.2.18.2), including irritation of sensitive tissues and hypothermia.

The uptake and effect of PAHs on birds is a point of uncertainty requiring further study. It is possible that the application of chemical dispersants would temporarily increase the exposure of Kittlitz's murrelet to PAHs through the water column and through their diet. The likely impact of such a temporary increase in exposure is unclear (Section 6.3.3 of Appendix B).

In situ burning could potentially expose murrelets to airborne particulates (if the birds were in the immediate vicinity of this response action). The effects of the inhalation of soot on marine birds are unknown but could result in lung damage. However, *in situ* burning is avoided near concentrations of wildlife, and its use requires consultation with the Services.

4.2.20.3 Exclusion from resources

The previously discussed avoidance and minimization measures would likely ensure that spill response activities would not exclude Kittlitz's murrelets from their resources. If any of the avoidance and minimization measures could not be implemented, certain mechanical and non-mechanical response activities would have the potential to directly exclude Kittlitz's murrelets from their forage, and refuge areas. However, the presence of people and equipment could deter the birds from using preferred feeding or refuge areas, at least on a temporary basis. Kittlitz's murrelets are not spatially restricted to critical habitat, and they are highly mobile. Thus, it is assumed that adult murrelets would not be completely excluded from necessary resources (e.g., forage habitat) as a result of response activities because they would be able to seek out forage habitat in nearby locations. As stated above, disturbance may result in abandonment of nests, however the impact would not likely persist longer than the response action; Kittlitz's

[47] Potentially lethal concentrations are in reference to the HC5 values calculated and presented in Appendix B. The HC5 is based on median lethal concentrations (LC50 values).

murrelet would not be excluded from the resource for longer than the duration of the response action. Exclusion from protected bays during seasonal molting could result in significant impacts, because murrelets are flightless during that period; it is feasible that they would be less likely to avoid harsher sea conditions or to effectively forage when molting.

In situ burning could degrade local air and water quality conditions, also causing murrelets to avoid an area of important habitat. In addition, because Kittlitz's murrelet nests are located on cliffs, chicks would be likely to die from falling or cold stress if adults were delayed or deterred from returning to their nests, even temporarily (USFWS, 2011c).

4.2.20.4 Habitat degradation and loss

Avoidance and minimization measures will likely ensure that spill response activities would not degrade Kittlitz's murrelet habitat. However, the following response activities have the potential to cause temporary, low-magnitude habitat degradation: flushing, use of dispersants, and use of hand or mechanical equipment to remove *in situ* burning residues (if such actions occur in nesting areas). Any flushing or flooding of marine shorelines could cause the physical displacement of benthic organisms or aquatic vegetation, reducing forage availability until those communities have recovered (one or more growing seasons). Flushing could also cause thermal stress to forage species if warm or hot water were used.

Dispersants applied in non-breeding (i.e., marine) habitat could degrade water quality, causing temporary changes in the forage fish community (i.e., reduction in sensitive species or life stages) and reducing habitat quality (e.g., increasing concentration of oil in the water column).

Although skimming and vacuuming in marine and freshwater habitats would likely entrain plankton, the limited reduction in plankton abundance is not expected to significantly affect the prey base for Kittlitz's murrelets.

4.2.20.5 Direct injury

If vessels were used as part of a response action, Kittlitz's murrelets could be at risk from physical injury from a ship strike. The effects of direct injury could range from temporary and low magnitude (e.g., bruising and physiological stress) to long-term and high magnitude (i.e., mortality). Direct exposure to dispersants or dispersed oil could cause a loss of insulation and hypothermia (Duerr et al., 2011), potentially leading to death; the bird's survival would be dependent on rescue and rehabilitation. *In situ* burning could cause heat or smoke injury, resulting in high-magnitude effects. Heat injury is highly unlikely, because such an effect would require that Kittlitz's murrelets to swim or fly directly into oiled areas that are being burned and where response crews were actively working to contain and burn oil.

4.2.20.6 Determination of effects

On 3 October 2013, USFWS published a determination that the listing of the Kittlitz's murrelet as an endangered or threatened species is not currently warranted (78 FR 61764, 2013). This listing was published during finalization of the BA. Therefore, discussion of the Kittlitz's murrelet has been retained in the BA, but no effects determination has been made because listing under ESA is not imminent.

4.2.21 Yellow-billed loon

Yellow-billed loons could potentially be impacted by spill response activities throughout their entire range (coastal areas of Beaufort and Chukchi Seas, northern GOA and Southeast Alaska). Due to the migratory behavior or yellow-billed loons, the effects of response activities would vary by season and the habitat affected by the spill response event. Response activities in marine habitats could potentially affect yellow-billed loons during their non-breeding (i.e., molting, staging, wintering) season, which occurs from late summer through winter to late spring. The birds winter in nearshore[48] marine areas from Kodiak Island south through Southeast Alaska (Strann and Østnes, 2007; cited in USFWS, 2010c); yellow-billed loons are irregular winter residents in the Aleutian Islands (North, 1994). In contrast, response activities in upland habitats could impact yellow-billed loons during late spring and summer, when they are breeding, nesting, and rearing young adjacent to permanent, freshwater, fish-bearing lakes on the North Slope tundra, Seward Peninsula, and potentially St. Lawrence Island (although their presence there has not been confirmed since the 1950s) (USFWS, 2010c).

Historically, there have been over 130 marine spills from late summer to late spring in the nearshore areas of Kodiak Island to Southeast Alaska (the non-breeding range of the yellow-billed loon); these spills have ranged in size from 100 to 34,000 gal. and involved mostly diesel or other refined petroleum products (Appendix D). Approximately 10 additional spills have occurred in the nearshore areas of the Aleutian Islands in winter, when the yellow-billed loon is known to be an occasional visitor. There is also evidence that loons stage in polynyas in the Beaufort Sea in the spring (see Section 3.4.2.5.3); there has only been one small spill in this area, in the spring. Loon breeding and nesting habitat is located primarily in the National Petroleum Reserve. Thus, potential exists for the release of both crude and refined petroleum products or other chemicals within the loon's summer nesting habitat; the occurrence, frequency, and / or magnitude of such releases is unknown.

As previously discussed, activities designed to avoid or minimize wildlife impacts would be implemented as part of a spill response. If avoidance and minimization measures could not be implemented, response activities could potentially adversely affect yellow-billed loons. The following subsections describe how spill response

[48] Historical spill records do not include depth; a distance from land of ≤ 0.5 statute miles was used as a surrogate for identifying nearshore habitats.

activities could affect the yellow-billed loons and are organized according to the five effect categories detailed in Section 4.1.

Because yellow-billed loons are found in marine and freshwater habitats, any of the response actions could potentially be implemented in their habitats, and thus all of the actions were evaluated for this species. The following activities occur in upland habitats and thus could impact loons only during the breeding season: construction of berms, dams, barriers, pits, and trenches; culvert blocking; removal of soil or freshwater sediment; removal of vegetation; and upland *in situ* burning. Other response actions could impact loons during other seasons: booming, skimming or vacuuming, use of sorbents, sediment flushing, use of dispersants, *in situ* burning, spill tracking and monitoring, mobilization and demobilization, and transport of solid wastes.

A recent BO (USFWS, 2012a) noted that insufficient data regarding the presence of yellow-billed loons near oil and gas activities in the vicinity of the Beaufort and Chukchi Seas were available to make an informed conclusion about the potential impacts of such activities on the species. According to USFWS (2012a) oil industry activities, which would include oil and gas exploratory drilling and surveying, as well as associated oil spills and potential response actions, in potential habitat of yellow-billed loon would not have a significant impact on the species. Still, the possibility of a spill or response action occurring in terrestrial yellow-billed loon habitat cannot be discounted.

4.2.21.1 Physical and behavioral disturbance

Avoidance and minimization measures implemented under the Unified Plan guidance would likely ensure that spill response activities would not cause a physical disturbance to yellow-billed loon behavior. In the event that these measures were unsuccessful, any of the response actions could potentially cause physical disturbance to yellow-billed loons, primarily due to the increased presence of people, vehicles, vessels, and heavy equipment, as well as any noise associated with both mechanical and non-mechanical response activities. This disturbance could subject loons to increased predation if they were to flee from an area of refuge or cause them to alter their breeding and rearing behaviors, possibly abandoning their young or nests (Earnst, 2004).

The duration and magnitude of any of these physical and behavioral disturbance effects would depend on whether nests or young were present in the spill response area, the behavioral response of the nesting and / or rearing adults, and the duration of the spill response. Although not documented in any formal studies, biologists recognize yellow-billed loons as being particularly timid and prone to human disturbance, especially in their nesting habitat (Earnst, 2004; North, 1994). Response activities during the nesting and rearing season would likely cause only a temporary, low-magnitude disturbance of adult birds. However, any disturbance of adult birds could potentially have significant effects on young birds (e.g., mortality) if adult birds were to abandoned their nests and / or young, even temporarily, exposing them to predators and / or cold stress.

If the disturbance were to occur in marine habitats during the non-breeding season, the effects would likely be temporary and low magnitude, limited to increased energy expenditure and physiological stress if the adult and sub-adult birds were to fly or move to potentially lesser-quality habitat to avoid spill response activities.

4.2.21.2 Exposure to contaminants

A specific concern for birds is the inhalation or aspiration of dispersant fumes or dispersed oil fumes. As described in previous sections (for example, see Section 4.2.17.2), such impacts are unlikely to occur, although the possibility of such impacts occurring is not entirely discountable. A discussion of the likely direct impacts of oil, dispersants, and dispersed oil on yellow-billed loons is provided in Section 5.2.5 of Appendix B. Impacts to yellow-billed loons resulting from exposures to oil, dispersed oil, and dispersants are expected to be similar to other bird species as described above (see Section 4.2.18.2).

Because loons are primarily piscivorous, the use of dispersants in marine habitats has the potential to be acutely toxic to particularly sensitive prey species, and may lead to temporary impacts on local fish communities. A more in-depth analysis of the potential and likely indirect impacts of dispersants on prey species is provided in Section 4 of Appendix B.[49] Dispersants are not currently intended for use in freshwater habitats, so this countermeasure would not impact breeding loons. Therefore, it is not likely that embryotoxicity as a result of dispersed oil exposure (Finch et al., 2011; Finch et al., 2012; Wooten et al., 2012) will occur in yellow-billed loons.

The uptake and effect of PAHs on birds is a point of uncertainty requiring further study. It is possible that the application of chemical dispersants would temporarily increase the exposure of yellow-billed loon to PAHs through the water column and through their diet. The likely impact of such a temporary increase in exposure is unclear (Section 6.3.3 of Appendix B).

In situ burning would potentially expose loons to airborne particulates (if the birds were in the immediate vicinity of this response action). The effects of the inhalation of soot on marine birds are unknown; however, lung damage could result if birds were unable to avoid a smoke plume.

Under the Unified Plan, the use of dispersants and *in situ* burning would be avoided near concentrations of wildlife or in nearshore areas. In addition, the Services would be consulted prior to the decision to use this countermeasure, and their recommendations for wildlife protection would be incorporated into the IAP. It is possible (under a worst-case scenario) that the impacts noted above will occur regardless of the decision framework and available BMPs (e.g., location-specific GRSs), which are intended to prevent or mitigate said impacts.

[49] Section 4 of Appendix B provides an analysis of the likelihood of impacts to planktonic and juvenile fish and invertebrate species which likely compose a major portion of the yellow-billed loon diet.

4.2.21.3 Exclusion from resources

The previously described avoidance and minimization measures would likely ensure that spill response activities would not exclude yellow-billed loons from resources. If any of the avoidance and minimization measures could not be implemented, certain mechanical and non-mechanical response activities would have the potential to directly exclude yellow-billed loons from their breeding and non-breeding habitat, including forage, refuge, and nesting areas. It is assumed that adult birds, even when molting, would be relatively mobile and would not be directly excluded from resources as a result of many of the response activities, inasmuch as they could seek habitat resources in a nearby location. However, birds that are actively nesting or rearing young would have difficulty seeking resources elsewhere due to their inability to leave the established nesting and rearing area for long periods of time.

Only three response actions—removal of vegetation, removal of soil, and *in situ* burning in upland environments—were identified as having the potential to cause temporary, low-magnitude consequences when applied during the breeding season over a large area because these actions could cause loons to avoid nesting areas. Although it is highly unlikely that vegetation and/or soil would be removed from a large area (e.g., several acres), if it were to occur, the presence of heavy equipment and people would likely cause loons to avoid an action area. *In situ* burning could degrade air quality and water quality, also causing loons to avoid important habitat.

Although culvert blocking could temporarily prohibit fish passage, it is unlikely that this would cause a detectable reduction in forage fish for loons.

4.2.21.4 Habitat degradation and loss

Avoidance and minimization measures would likely ensure that spill response activities would not degrade yellow-billed loon habitat. However, if these measures were unsuccessful and response activities were to occur within their habitat, the following activities would have the potential to cause high-magnitude impacts if the actions were applied over a large area (e.g., several acres): removal of soil or sediment (or disturbance of soil for the construction of earthen containment structures), vegetation removal, and upland *in situ* burning.

Yellow-billed loon breeding, nesting, and rearing activities are dependent on high-quality nesting sites located adjacent to permanent, freshwater, fish-bearing lakes on the tundra. Any removal of soil, sediment, or vegetation through mechanical measures or via *in situ* burning could directly affect habitat quality by reducing available nesting sites and displacing benthic species (e.g., mollusks and aquatic insect larvae), in turn altering the prey base for this piscivorous species if sufficient benthic habitat were impacted. Soil and vegetation removal would also have the potential to directly contribute to shoreline destabilization and additional loss of habitat and forage; however, disturbed habitats would be stabilized and restored following a response action. However, although the degradation would be long-term, breeding pairs would likely be impacted only temporarily (e.g., during a single breeding season).

The following response activities have been identified as having the potential to cause temporary, low-magnitude habitat degradation: use of heavy equipment (for berming or trenching), and flushing. The use of heavy equipment in tundra nesting areas (i.e., ponds, wetlands, and vegetated shorelines) during the construction of berms, dams, barriers, pits, and trenches could also degrade breeding habitat. Any flushing and flooding of shoreline sediment could cause the physical displacement of benthic organisms or vegetation, reducing forage availability until those communities had recovered (one or more growing seasons). Flushing and flooding could also cause thermal stress to forage species if warm or hot water were used.

Dispersants applied in non-breeding habitat could degrade water quality, causing temporary changes in the benthic invertebrate and fish communities and reducing habitat quality. Overall, the prey community in shallow waters is not expected to be greatly impacted by the application of dispersants (Appendix B). *In situ* burning residues that accumulate in marine or freshwater benthic habitats could also smother benthic invertebrates, physically impacting the prey base, if sufficient area were impacted.

Although skimming and vacuuming in marine and freshwater habitats is likely to entrain plankton, the limited reduction in plankton abundance is not expected to significantly impact the prey base for loons.

4.2.21.5 Direct injury

If avoidance and minimization measures were unsuccessful, the direct strike of individual loons by vessels associated with any of the response activities has the potential to cause direct injury. In addition, although a significant effort would be made to identify the presence and location of all ESA-listed species, any of the response activities in freshwater habitats have the potential to destroy undiscovered nests during the breeding/nesting season. Any direct injury could result in effects that range from temporary and low-magnitude (e.g., bruising and physiological stress) to long-term and high magnitude (i.e., mortality).

Direct exposure to dispersants could also cause long-term effects of high magnitude. A bird's ability to use the aquatic environment as habitat is dependent on its ability to trap air in its feathers to create an insulating layer. External exposure to dispersants or dispersed oil (as well as oil alone) could cause a loss of insulation and hypothermia; the bird's survival would be dependent on rescue and rehabilitation. These impacts are discussed in more detail in Appendix B. *In situ* burning could also cause heat or smoke injury, resulting in high-magnitude effects. Heat injury would only occur if yellow-billed loons swam or flew directly toward an area where oil was being actively burned and where response crew were also active; either action by the yellow-billed loon are unlikely, because loons are wary of human activity (Earnst, 2004; North, 1994).

4.2.21.6 Determination of effects

Yellow-billed loons would be most vulnerable to spill response activities during the late spring and summer, when they are breeding, nesting, and rearing young in freshwater lakes of the North Slope, Seward Peninsula, and (potentially) St. Lawrence Island. During other seasons, the birds would be more likely to be able to avoid most spill response activities.

In the unlikely event that protective measures, including field-implemented BMPs, were unsuccessful in preventing interactions between a loon and spill response activities, the following actions could impact an individual. Potential high-magnitude impacts to individual birds from specific actions include:

- Physical injury via entanglement with in-water equipment or ship strike
- Nest destruction from heavy equipment or vehicles in nesting habitats
- Impaired breathing or lung damage caused by smoke inhalation following *in situ* burning
- Hypothermia from the degradation of the insulating capabilities of feathers following exposure to dispersants or newly dispersed oil during or immediately after dispersant application

Response actions could also have lower magnitude effects, including:

- Alteration of food web through use of dispersants (i.e., changes in abundance and composition of prey due to dispersed oil toxicity)
- Tissue irritation (i.e. skin, eye, nose, mucus membrane) caused by exposure to dispersed oil, dispersants, or smoke from *in situ* burning
- Short-term habitat degradation due to changes in water quality (from use of dispersants, burnt residues) or air quality (from smoke); removal of sediment or vegetation in fish-bearing tundra ponds or lakes

The IAP and subsequent response actions are designed to protect sensitive resources. Furthermore, all response activities are developed and implemented as part of an emergency consultation with the Services during the response to avoid or minimize impacts to ESA species and critical habitats. As a matter of policy, the use of dispersants and *in situ* burning is avoided in areas with wildlife concentrations and in nearshore areas. Additional consultation and concurrence of the incident-specific RRT would be required for non-mechanical response actions that might pose a greater risk to wildlife. If necessary, the deterrence of loons can be permitted by the USFWS if it is deemed critical to preventing their exposure to oil or hazardous substances. These activities have the highest likelihood of impact on a loon and constitute an adverse impact take under ESA.

Given that yellow-billed loon are present in Alaska during most, if not all, of the year, they are distributed throughout coastal habitats in Northwestern Alaska and the North

Slope, where spills are frequent and future oil exploration and extraction activities have the potential to occur (i.e., within the National Petroleum Reserve), and upland nesting and marine forage habitats may be directly impacted by spills and subsequent responses, it is likely that the implementation of the Unified Plan would adversely affect this species.

4.2.22 Chinook and coho salmon

Chinook and coho salmon inhabit ocean waters in Alaska in the GOA and southern Bering Sea for part of their lifecycle. ESA-listed Chinook and coho salmon could potentially be impacted by spill response activities in all of the coastal waters of Alaska, except the Arctic Ocean (64 FR 41835, 1999; Crane et al., 2000; NMFS, 2005e; Templin and Seeb, 2004; Wahle and Vreeland, 1978; Wahle et al., 1981), where they are presumed to be present year-round, although in unknown numbers.

Six ESA-listed Chinook stocks and one coho stock (i.e., the LCR ESU) from the PNW have been documented in mixed-stock trawl fisheries in Alaska waters. However, two of the ESA-listed Chinook stocks (i.e., Upper Columbia River spring run and Snake River spring/summer run Chinook salmon) have not been documented in Alaska waters since the 1970s (Wahle et al., 1981). The Puget Sound Chinook salmon and Snake River fall run Chinook salmon stocks have only been documented in Southeast Alaska waters as far north as Pelican (Crane et al., 2000; Templin and Seeb, 2004). The final two Chinook stocks (i.e., Upper Willamette River and Lower Columbia River) are found in Southeast Alaska, GOA, Aleutian Islands, and Bering Sea waters (NMFS, 2009a). Salmon from the LCR coho stock have been captured in Southeast Alaska and near Kodiak Island, according to CWT studies (see Section 3.4.3). At sea, individual Chinook salmon belonging to the ESA-listed stocks are indistinguishable from non-ESA-listed fish; the two groups can only be differentiated through genetic analysis or tags or marks that indicate origin.

Theoretically, juvenile fish would be more vulnerable to the effects of response actions because they sometimes swim closer to shore areas that are more likely to be targeted by spill responders. They also feed lower on the food chain and so would be more immediately affected by the consumption of hydrocarbon-contaminated prey; and they are still growing and developing physiologically, which makes them more vulnerable than adults to toxicity of dispersants or the residues of *in situ* burning. However, salmonids are among the least sensitive of the aquatic species tested (Appendix B), even at early life stages (i.e., juveniles).[50]

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[50] Attachment B-1 provides sublethal dispersed oil toxicity data, including various data for rainbow trout, a salmonid. Tests were conducted either with juveniles, but the reported endpoints are indicative of exposure only rather than an individual-level effect (i.e., reduced survival, growth, or reproduction). It is not clear whether sublethal, individual-level effects on juvenile salmonids (e.g., reduced growth, reproduction) would occur as a result of exposure to dispersed oil. Similarly, dispersants alone have not yet been shown to cause sublethal impacts in juvenile salmonids, and Corexit® 9500 has been shown to not be an endocrine disrupting compound (EPA and NIH, 2010).

During the 17 years between 1995 and 2012, approximately 400 spills > 100 gal. occurred in Alaska waters that could have been inhabited by ESA-listed salmon stocks. These spills occurred year-round and ranged in size from 100 to over 320,000 gal. (~ 20 spills have been > 10,000 gal.). The most commonly spilled material was diesel or other refined petroleum products. (Appendix D).

The following subsections describe how spill response activities could affect the ESA-listed salmon and are organized according to the five effect categories detailed in Section 4.1.Response activities that do not occur in ESA-listed salmon ocean habitat and thus will not affect these stocks include the following: deflection or containment berms, dams, or other barriers, pits and trenches; and cleanup activities such as flushing and flooding, soil or sediment removal, mechanical cleaning of sand, or vegetation cutting and removal.

4.2.22.1 Disturbance

Adult salmon occur most frequently in open water where they feed on fish and invertebrates from the water column. Salmon have high metabolic rates that allow for rapid growth if food is available; large size increases survival and reproductive potential (i.e., fecundity and egg size in females and competitive ability in males) (Quinn, 2005). Any disturbance that interrupts feeding or the abundance of prey has the potential to decrease survival and reproductive potential. If a response action were to disturb salmon, the effect would likely be low magnitude due to the ability of salmon to swim away from disturbances at the water's surface. Salmon ocean habitat is filled with natural sounds that represent an unknown level of background noise that varies from location to location. It is unlikely that response activities (either mechanical or non-mechanical) at the surface would produce sounds loud enough to cause a disturbance effect over ambient noise levels. Furthermore, response activities, whether mechanical or non-mechanical in nature, would be temporary actions and thus unlikely to adversely affect salmon.

4.2.22.2 Exposure to contaminants

ESA-listed salmon stocks from Washington State are present in Alaska waters as juveniles and adults and thus would likely be less sensitive to exposure to dispersants or dispersed oil than during more vulnerable life stages (i.e., egg, alevin, fry, and smolt). As juveniles and adults, they forage over wide areas and are not present at any one location for long periods of time, which would likely reduce the likelihood of exposure to spill response activities. The distribution of dispersants and dispersed oil in the water column would likely be limited by density and salinity gradients to the upper 10 m of the water column. Salmonids feeding within this depth range could be exposed to dispersants or dispersed oil following a response action.

An in-depth review of the available literature on oil, dispersant, and dispersed oil toxicity to fish is provided in Appendix B (Sections 3.1.1.1, 3.1.2.1, and 5.3 of

Appendix B)[51]. The toxicity of dispersants to fish has mostly been tested on larval fish under laboratory exposure conditions using temperate water species, over 48 to 96 hours. In addition, dispersants are typically present in a mixture with oil (i.e., dispersed oil), and the magnitude of dispersed oil toxicity depends on exposure conditions. In some studies, it has been shown that the more toxic constituent chemicals in oil (e.g., PAHs) are more soluble in the presence of dispersants and thus induce a greater toxic response than oil alone under laboratory conditions (Couillard et al., 2005; Ramachandran et al., 2004; Lee et al., 2011b);[52] in other studies, the toxicity of dispersed oil was similar to or less than that of non-dispersed oil (NRC, 2005). An acute toxic response to dispersants or dispersed oil would be unlikely in the endangered ESUs of salmon, based on their ability to metabolize PAHs and other hydrocarbons (Douben, 2003), their likely brief duration of exposure to dissolved oil constituent chemicals (e.g., PAHs), and the rapid dilution of dispersed oil concentrations in the water column (Section 2 of Appendix B). Although PAHs are quickly metabolized, toxic impacts are generally caused by products of metabolism (Payne et al., 2003), and sublethal impacts are generally those most often noted (Logan, 2007). The likelihood of such impacts occurring as a result of an acute exposure after chemical dispersion is a point of uncertainty discussed in Section 6.3.2 of Appendix B.

The study of the effects of chemicals on the olfactory senses of fish has generally focused on metals (copper in particular) and pesticides (e.g., atrazine, carbaryl, diazinon, and simazine) (Tierney et al., 2010). The potential for PAHs to induce olfactory impairment does not appear to have been studied; however, Brannon et al. (1986) reported that Chinook salmon exposed to Prudhoe Bay crude oil at concentrations similar to those in actual spills returned to the hatchery at the same frequency and time as did control fish that were not exposed to crude oil. This suggests that the crude oil did not cause olfactory impairment in the salmon or, if it did, that the combination of the exposure concentration and exposure time did not preclude the olfactory neurons from recovering.

Prey might be adversely affected by exposure to dispersants and dispersed oil; however, reduced prey abundance would be expected to be localized. Because juvenile and adult salmonids forage over large areas, a localized and temporary reduction in prey abundance (Section 3.1.2.4 of Appendix B) would not be expected to have a significant impact on Chinook or coho salmon from protected stocks.

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[51] Additional data for fish can be found in Sections 3.2, 3.3, and 4 of Appendix B, although these sections are not specific to fish.

[52] The toxic response noted by Couillard et al. (2005), Lee et al. (2011b), and Ramachandran et al. (2004) is the induction of detoxification enzymes as evidenced by the activity of ethoxyresorufin-O-deethylase. This indicates that the fish were exposed to some contaminant and that their bodies were metabolizing that contaminant; it does not necessarily imply that individual-level impacts (i.e., reduced survival, growth, or reproduction) occur at low-level exposures of dispersed oil (Lee et al., 2011b). Furthermore, activity of the enzyme may be influenced by other environmental factors such as the exposure temperature (Lyons et al., 2011).

Salmon would not likely be directly affected by *in situ* burning because the transfer of heat through the water column is retarded by water's high specific heat. Salmon feeding in the water column would not likely come into contact with burned oil residues. Nor would they be expected to selectively consume residues from either the water column or the sea floor, inasmuch as residues do not resemble their prey species. Smoke produced during burning would not affect fish.

4.2.22.3 Exclusion from resources

Spill response actions would not likely exclude ESA-listed salmon stocks from resources, but they could temporarily displace salmon from localized feeding areas or migration corridors. Although this event is unlikely to occur, and if it were to occur, it would not have a deleterious effect because of the vast range used by post-smolt juvenile and adult salmon.

4.2.22.4 Habitat degradation and loss

Ocean habitat degradation could temporarily occur as a result of spill response actions. The mechanism for habitat degradation would be the short-term distribution of dispersant and dispersed oil in the water column or the deposition of burned residues on the sediment substrate. Dispersed oil would likely degrade rapidly (Appendix B), but burned residues could be more persistent. Burnt residues would likely disperse widely via ocean currents and would not likely affect benthic habitats or prey. Temporary, low-magnitude feeding and migration habitat degradation could result from *in situ* burning or the application of dispersants (Section 4.2.20.3). No critical habitat would be affected because none has been designated for ESA-listed salmon stocks in Alaska waters.

4.2.22.5 Direct injury

The direct injury effects category is only marginally applicable to salmon because they are highly mobile and would be able to avoid direct injury from vessels, in-water containment, response equipment, and *in situ* burning.

4.2.22.6 Determination of effects

Salmon from PNW ESA-listed stocks could be present year-round in unknown numbers in Alaska waters off Southeast Alaska, in the GOA, and offshore of the Aleutian Islands. Chinook stocks could also be present in the Bering Sea. This mobility would allow them to avoid the direct effects of spill response activities. Indirect effects would be possible if non-mechanical countermeasures (e.g., oil dispersants and *in situ* burning) were to contaminate or destroy the ocean environment, prey species, or habitats that prey species use to reproduce or develop.

No high-magnitude or long-term effects from spill response activities have been identified for salmonids. In the event that protective measures, including BMPs, were unsuccessful in preventing interactions between individual salmonids and spill response activities, these activities could have a range of effects on individual salmonids. The following low-magnitude, temporary effects on individual fish could result from specific response actions:

- Physical displacement or disturbance from in-water activities or equipment
- Short-term habitat degradation due to changes in water quality (from use of dispersants, burnt residues)
- Alteration of the food web through the use of dispersants (i.e., changes in abundance and composition of prey due to dispersed oil toxicity)

The IAP and subsequent response actions are designed to protect sensitive resources, including ESA-listed salmon stocks. Furthermore, all response activities are developed and implemented as part of an emergency consultation with the Services during the response to avoid or minimize impacts to ESA species. Additional consultation and concurrence of the incident-specific RRT is required for non-mechanical response actions that might pose a greater risk to natural resources.

Although the protection of sensitive species and habitats is one of the highest priorities of a response action, there remains a possibility that ESA-listed Chinook or coho salmon could be adversely affected by some response activities during the implementation of the Unified Plan. Physical displacement of salmonids caused by nearshore activities, habitat degradation or food web alteration, or sublethal effects of exposure to dispersants or dispersed oil in the nearshore are effects of low likelihood but that have significant ramifications for a sensitive species and thus cannot be discounted.

4.2.23 Steelhead trout

Anadromous rainbow trout, known as steelhead, inhabit the ocean during a portion of their lifecycle. Some steelhead from five ESA-listed PNW stocks could potentially be impacted by spill response activities off the coast of Southeast Alaska, in the GOA, or offshore of the Aleutian Islands; steelhead might be present year-round in these areas in unknown numbers.

In some aspects, steelhead are more oceanic than salmon, often migrating directly offshore and into the GOA rather than through the coastal corridor to the north (Pearcy and Masuda, 1982; Hartt and Dell, 1986; Pearcy et al., 1990). The waters surrounding the Aleutian Islands and the GOA are two important foraging areas for steelhead. They are discouraged from ranging farther north by cold water temperatures. At sea, individuals from the ESA-listed stocks are indistinguishable from other steelhead trout and can only be differentiated through genetic analysis or by tags or marks that indicate their origin.

Theoretically, juveniles would be more vulnerable to the effects of response actions because, in some cases, they swim closer to shore in areas that are more likely to be targeted by spill responders; they feed lower on the food chain, and so would be more immediately impacted by the consumption of hydrocarbon-contaminated prey; and they are still growing and developing physiologically, making them more vulnerable to acute toxicity of dispersants or the residues of *in situ* burning. However, salmonids such as rainbow or steelhead trout are among the least sensitive to exposures to dispersed oil (Appendix B). Fish also do not accumulate PAHs through brief dietary exposures, which is likely due to their ability to metabolize these chemicals (Wolfe et al., 2001; Douben, 2003).

During the 17 years between 1995 and 2012, approximately 400 spills > 100 gal. occurred in Alaska waters that may have been inhabited by ESA-listed steelhead. These spills occurred year-round and ranged in size from 100 to more than 320,000 gal. (~ 20 spills have been > 10,000 gal). The most commonly spilled material was diesel or other refined petroleum products (Appendix D).

The following subsections describe how spill response activities could affect steelhead trout and are organized according to the five effect categories detailed in Section 4.1.

Response activities that do not occur in steelhead trout ocean habitat and thus will not adversely affect steelhead trout include the following: deflection or containment berms, dams, or other barriers, pits, and trenches; and cleanup activities such as flushing and flooding, soil or sediment removal, mechanical cleaning of sand, or vegetation cutting and removal.

4.2.23.1 Disturbance

As large, ocean-going fish, steelhead are equipped to avoid disturbance through their ability to swim under, around, or away from areas of human activity, including mechanical and non-mechanical countermeasures. However, the process of avoiding disturbance requires time and energy that would ordinarily be used to find and capture small fish and crustacean prey. Fecundity and overall reproductive fitness could be decreased if steelhead were to be repeatedly disturbed. The amount of time spent at sea and the quantity and quality of forage obtained determines adult body size and mass, with implications for survival and fecundity. If a disturbance effect were to result from response activities, either mechanical or non-mechanical in nature, it would be expected to be temporary and of low magnitude because of the ability of steelhead trout to swim away from disturbances at the water's surface.

The habitat of steelhead trout during the ocean life phase of their development is filled with natural sounds that represent an unknown level of background noise, which varies from location to location. It is unlikely that response activities (either mechanical or non-mechanical) at the surface would produce sounds loud enough to cause a disturbance effect over ambient noise levels.

4.2.23.2 Exposure to contaminants

Potential exposure effects on steelhead trout would be similar to those on Chinook and coho salmon. See Section 4.2.20.2 for additional discussion of potential exposure effects on salmonids or Section 5.3.3 of Appendix B for a discussion specific to steelhead trout stocks.

4.2.23.3 Exclusion from resources

Steelhead could be displaced from feeding areas without being completely excluded from resources because areas beyond the perimeter of spill response activities would also contain prey species (Section 4.2.21.1). Any displacement of individual steelhead trout could result in lost feeding opportunities, depending on the duration of response actions.

4.2.23.4 Habitat degradation and loss

Ocean habitat degradation could occur as a result of spill response actions. The mechanism for habitat degradation would be the distribution of dispersant and dispersed oil in the water column or deposition of burned residues on the sediment substrate. Dispersed oil would likely degrade rapidly (Appendix B); burned residues could be more persistent but would be widely dispersed and would not likely adversely affect benthic habitat or prey on a large scale. Temporary, low-magnitude habitat loss could result if steelhead trout were displaced from feeding or migration habitat by *in situ* burning or by the application of dispersants (Section 4.2.21.3). No critical habitat has been designated for ESA-listed steelhead trout stocks in Alaska waters. Spill response activities could cause the degradation or loss of steelhead ocean habitat, but the effects would be temporary and of low magnitude.

4.2.23.5 Direct injury

The direct injury effects category is only marginally applicable to steelhead trout because these fish are highly mobile and would be able to avoid direct injury from vessels, in-water containment, response equipment, and *in situ* burning. Direct injury could occur at a very low frequency during boom deployment or maintenance but any effect would be of low magnitude and temporary.

4.2.23.6 Determination of effects

Steelhead trout from PNW ESA-listed stocks could be present year-round in unknown numbers in Alaska waters off Southeast Alaska, in the GOA, and offshore of the Aleutian Islands. Their swimming ability and overall mobility would allow them to avoid the direct effects of spill response activities.

No high-magnitude or long-term effects from spill response activities have been identified for steelhead trout. In the event that protective measures, including BMPs, are unsuccessful in preventing interactions between individual steelhead trout and spill response activities, the following low-magnitude, and temporary effects on individual fish could result from specific response actions:

- Physical displacement or disturbance from in-water activities or equipment

- Short-term habitat degradation due to changes in water quality (from use of dispersants, burnt residues)
- Alteration of the food web through the use of dispersants (e.g., changes in abundance and composition of prey due to dispersed oil toxicity)

The IAP and subsequent response actions are designed to protect sensitive resources, including ESA-listed steelhead stocks. Furthermore, all response activities are developed and implemented as part of an emergency consultation with the Services during the response to avoid or minimize impacts to ESA species. Additional consultation and concurrence of the incident-specific RRT is required for non-mechanical response actions that might pose a greater risk to natural resources.

Given that steelhead trout are only present in Alaska waters during part of their life cycles, during which they are not spawning, and their studied habitat use suggests low likelihood of exposure to response activities, it is unlikely that a trout would be adversely affected by response activities during the implementation of the Unified Plan.

4.2.24 Pacific Herring

Pacific herring are schooling fish that inhabit nearshore and coastal waters of Alaska, except for the Beaufort Sea (Haegele and Schweigert, 1985). They require shallow, vegetated intertidal and subtidal areas for spawning (Hourston and Haegele, 1980). Pacific Herring are present as juveniles in nearshore environments in the spring and summer of their first year, moving into deeper offshore waters in the fall, occupying similar habitat as adults (Hourston and Haegele, 1980). Herring exhibit diel migration, staying near the bottom during the day but coming to the surface at night to feed (Hourston and Haegele, 1980). They are a highly productive, relatively long-lived fish (up to 19 years) that many other species depend on for food (NOAA Fisheries, 2013).

During the 17 years between 1995 and 2012, approximately 400 spills > 100 gal. occurred in Alaska waters that may have been inhabited by herring. These spills occurred year-round and ranged in size from 100 to over 320,000 gal. (about 20 spills were >10,000 gal.). The most commonly spilled material was diesel or other refined petroleum products (Appendix D).

The following subsections describe how spill response activities could affect the Pacific herring and are organized according to the five effect categories detailed in Section 4.1. Response activities that do not occur in herring habitat and thus would not adversely affect herring are those associated with upland responses: upland deflection or containment berms, dams, or other barriers, pits, trenches and upland *in situ* burning. Response activities that could occur on beaches used as spawning are included in the evaluation.

4.2.24.1 Physical and behavioral disturbance

Herring are highly mobile and have the ability to swim under, around, or away from areas of human activity, including mechanical and non-mechanical countermeasures. During daylight hours, they are likely to occupy deeper water only coming to the surface at night (Hourston and Haegele, 1980). If disturbed when at or near the surface, they would be forced to expend time and energy that would otherwise be used to feed in order to avoid the disturbance. If response activities, either mechanical or non-mechanical in nature, were to result in disturbances, it would be of low magnitude due to the ability of herring to swim away from disturbances at the water's surface.

4.2.24.2 Exposure to contaminants

Herring stocks are present as eggs, larvae, juveniles, and adults in Alaska waters; eggs, larvae and juveniles in the nearshore environment would be the most sensitive to exposure from contaminants, including dispersants and dispersed oil (Lee et al., 2011b; Greer et al., 2012; McIntosh et al., 2010; Carls et al., 1999; Carls et al., 2000). However, dispersant use in nearshore areas is not recommended under the Unified Plan and would require concurrence from the incident-specific RRT and consultation with the Services, making the use of dispersants in nearshore environments highly unlikely if spawning habitat has been identified for a specific GRS where dispersants might be applied. Schools of older juveniles and adults forage over wide areas and would likely not be present at any one location for long periods of time, which would reduce the likelihood of exposure to spill response activities that might be a source of contaminants in the water column. Furthermore, juvenile and adult herring are often found at depths between 100 and 200 m (Hourston and Haegele, 1980), well below the depth to which oil will disperse into the water column (NRC, 2005). Herring spawning grounds are identified in GRS (ARRT, 2013), such that they can be avoided during an implementation of the Unified Plan. Conversely, larvae could be present over a much broader area. Impacts to herring larvae are, therefore, likely to occur as a result of the application of chemical dispersants (Section 5.3.4 of Appendix B).

Herring would not likely be directly impacted by *in situ* burning because the transfer of heat through the water column is retarded by water's high specific heat. Herring feeding near the sea surface would not likely come into contact with burned oil residues. Nor would they be expected to selectively consume residues from the water column because residues do not resemble their prey species. Smoke produced during burning would not affect fish.

4.2.24.3 Exclusion from resources

Herring could be displaced from feeding areas without being completely excluded from resources because areas beyond the perimeter of spill response activities would also contain prey species (Section 4.2.22.1). The displacement of individual herring could result in lost feeding opportunities, but the magnitude of effect would depend on the duration of response actions.

4.2.24.4 Habitat degradation and loss

Coastal habitat degradation could occur as a result of spill response actions. The following response activities have the potential to cause temporary, low-magnitude habitat degradation: sediment flushing and flooding, and the distribution of dispersants and dispersed oil, or release of burnt residues from *in situ* burning.

Nearshore habitat would not likely be affected by these response actions because they would be avoided in nearshore areas and their use would require additional decision-making processes. For example, available GRS specifically identify areas where herring are known to spawn (ARRT, 2013). Such considerations are unlikely to be made for herring larvae, which could be present over a much broader area, feeding on plankton in the shallow water column (Hourston and Haegele, 1980).

Dispersed oil in the ocean environment would likely degrade rapidly (Appendix B); burned residues might be more persistent but would be widely dispersed and would be unlikely to adversely affect pelagic habitat or prey.

Flushing and flooding of coastal shorelines could cause the physical displacement of benthic prey organisms or aquatic vegetation, reducing forage availability until those communities have recovered. Flushing could also cause thermal stress to herring embryos or larvae if warm or hot water were to be used.

No critical habitat has been designated for herring stocks in Alaska waters because they are currently a candidate species. Spill response activities could cause the degradation or loss of herring coastal habitat, but the effects would be temporary and of low magnitude. Nearshore habitat degradation would not be anticipated because the use of dispersants and *in situ* burning would be avoided in nearshore areas.

4.2.24.5 Direct injury

The direct injury effects category is only marginally applicable to juvenile and adult herring because these fish are highly mobile and would be able to avoid direct injury from vessels, response equipment, and *in situ* burning. However, eggs could be damaged or destroyed if shallow subtidal or intertidal bottom substrates or vegetation were to be disturbed from a response action during the spring along a shoreline where herring were spawning. Egg mortality, although naturally high, would represent a high-magnitude, long-term effect for those individuals.

4.2.24.6 Determination of effects

Herring could be present year-round in all Alaska waters, except the Beaufort Sea. Older juveniles and adults would be less vulnerable to the impacts of a response action because of their overall mobility and use of deeper, coastal waters. These herring would not likely be disturbed, excluded from resources, or injured by vessels or equipment involved in a response action. However, herring could be exposed to dispersants and *in situ* burning in coastal waters during these life stages, which could also contribute to local degradation of water column habitat.

In the event that protective measures, including BMPs, were unsuccessful in preventing interactions between herring and spill response activities, the following high-magnitude, long-term effects on individual fish could result from specific response actions:

- Physical disruption of spawning habitat, when eggs are present
- Acute mortality of herring larvae or embryos caused by exposure to dispersants and dispersed oil

Response actions could also have low-magnitude, short-term effects, including:

- Habitat degradation due to changes in water quality (from use of dispersants, burnt residues)
- Alteration of the food web through the use of dispersants (i.e., changes in abundance and composition of prey due to dispersed oil toxicity)

The IAP and subsequent response actions have been designed to protect sensitive resources, including herring stocks. Furthermore, all response activities are developed and implemented as part of an emergency consultation with the Services during the response to avoid or minimize impacts to ESA species. Additional consultation and concurrence of the incident-specific RRT is required for non-mechanical response actions that might pose a greater risk to natural resources.

Although the protection of sensitive species and habitats is one of the highest priorities of a response action, particularly nearshore and shoreline habitats, the possibility remains that Pacific herring could be adversely affected by response activities during the implementation of the Unified Plan. Physical disturbances to spawning habitat, including mortality of larval or embryonic individuals, or habitat degradation or alteration of the food web caused by dispersant use, dispersed oil, or burnt residues are effects of low likelihood but that have ramifications for a sensitive species and thus cannot be discounted.

5 Cumulative Effects

Cumulative effects are defined in 50 CFR 402.02 as effects that are likely to occur as a result of future state or private activities, not involving federal activities, that are reasonably certain to occur within the action area of the federal action subject to consultation. The purpose of this section is to discuss the implications of project or program activities in the State of Alaska that are reasonably certain to occur in the foreseeable future, but that do not share a federal nexus (via federal permitting, approval, or funding). Effects associated with federal actions that are unrelated to the proposed action contribute to the environmental baseline and current status of the species evaluated in this BA. Past and present impacts of non-federal actions are part of the environmental baseline discussed in Section 3 of this BA. Non-federal actions that are reasonably likely to continue into the foreseeable future include:

- Subsistence harvest of protected species[53]
- State management of commercial fisheries
- Sport fishing
- Commercial or private marine or air traffic
- Commercial or residential development
- Permitted wastewater or stormwater discharges

The State of Alaska has assumed the administration and implementation of the majority of Clean Water Act (CWA) requirements pertaining to the National Pollutant Discharge Elimination System (NPDES); thus, most discharges into Alaska waters will be permitted by ADEC.[54] The issue of the additional effects of climate change, although not the result of an individual non-federal action, was discussed in Section 3. The cumulative effects of non-federal actions on ESA-listed species, including both lethal and nonlethal effects, are considered in this section.

Alaska waters and uplands may be affected by future activities under city, borough, state, Tribal, or other private control. Such activities are expected to result in increased population growth in urban areas, commercial development, industrial activities, natural resource extraction (e.g., oil extraction and state-managed commercial fishing), and recreational activities (e.g., recreational boating or fishing). These effects are evaluated according the categories used to evaluate the effects on individual species and habitats in Section 4.

[53] The Federal Subsistence Management Program is administered by both federal and state agencies (50 CFR 100).

[54] EPA retained CWA 301(h) permits for publically owned treatment works (POTW), vessel discharges covered by EPA vessel general permits, permits for discharges to federal waters (typically oil and gas, and seafood processors), and general permits for pesticide wastewater discharges.

5.1 Physical or behavioral disturbance

Most anthropogenic activities that occur on-water or in sensitive habitats (nearshore habitats, estuaries, haulouts, rookeries, riparian corridors, etc.) have the potential to disturb species that rely on those habitats for food, refuge, breeding or rearing of young. The majority of the species evaluated in this BA use marine habitats during all or a portion of their life history.

Commercial and sport fisheries take place in habitats that are used by marine mammals and sea birds; the location and timing of those activities are regulated by the state within state waters (up to 3 miles offshore in most cases). However, the frequency and duration of any disturbances of ESA-listed species by commercial or recreational fisheries is unlikely to change in the near future as these fisheries are managed for sustainable harvest, and thus an increase in harvest levels is not expected.

Hunting and subsistence harvest will introduce a level of disturbance because of the presence of and attendant noise from people, vessels or vehicles, but are more likely to contribute to direct injury, which is addressed under Section 5.1.5. Commercial or private vessels or aircraft that traverse areas where ESA species are present can also cause disturbance. Population centers or popular recreation areas are likely to experience increased marine or air traffic and therefore the potential for disturbance as Alaska's population grows or areas become more accessible due to changes in climate conditions.

In general, population growth in Alaska is likely to increase human encroachment on critical habitats and ESA-listed species. With the exception of the western Aleutian Islands, the population in Alaska has grown since 1950s. Decadal growth rates have ranged from 13% (2000 to 2010) to 37% (1980 to 1990)[55] and the overall population is projected to continue to grow[56] for the next several decades. Most of the population is located in Anchorage or the Matanuska-Susitna Borough at the north end of Cook Inlet.

Alaska's NPDES program has jurisdiction over domestic discharges, log storage and transfer facilities, seafood processors, hatcheries, federal facilities, stormwater, mining discharges and various other miscellaneous discharges that occur in state waters. Typical activities that may take place in the environment include construction or maintenance of outfalls and compliance monitoring. These activities could introduce a disturbance through the presence of equipment and people, but are very infrequent.

5.2 Exposure

Commercial or recreational fishing, boating, tours or other on-water activities may contribute contaminants to the water column through leaks and spills of fuel or waste products or to the air from combustion of fuels. Hunting or subsistence harvest could use vessels or vehicles that could make a similar contribution. ESA-listed species could

[55] http://www.censusscope.org/us/s2/chart_popl.html
[56] http://laborstats.alaska.gov/pop/popproj.htm

be exposed to these discharges or emissions, as they are now. Smaller (< 400 gross tons) vessels that are not required to have oil spill contingency plans are a frequent source of small spills in Alaska; these spills often occur during fuel transfer (ADEC, 2007b). The state tracks the frequency of spills and implements outreach programs to address sources of spills; an outreach program is in place to educate fishing vessel and marina operators about ways to reduce the impact of fuel loss. It is expected that this program will reduce the number and size of spills associated with fishing vessels and marinas and thus, the potential exposure of ESA-listed species.

Alaska's NPDES program meets the requirements of the CWA and will not alter the quality of the discharges that were permitted under the previous federal program, and as such, should continue to offer a level of protection to ESA-listed species and prey resources that are present in the marine environment. However, neither the federal or state programs regulate all manufactured chemicals that could be a component of a permitted discharge (e.g., personal care products). The number of permitted discharges is likely to increase with the continued population growth and expansion of industry and commerce in the state. It is unclear if exposure to low level contaminants (either regulated or unregulated) would cause an adverse effect on an ESA-listed species or the resources that it uses.

5.3 Exclusion from resources

Exclusion of a species from a resource constitutes a take[57] for protected species. For all protected marine mammals, the Marine Mammal Protection Act requires that activities do not result in a take (there are a few exceptions, such as stock assessments and research) (16 U.S.C. §1372). The Migratory Bird Treaty Act provides similar protections for birds (16 U.S.C. §703). The state of Alaska endangered species program lists several species: short-tailed albatross, Eskimo curlew, blue whale, humpback whale and North Pacific right whale. Conservation and protection of these, and other federally listed species are addressed under the state's Wildlife Action Plan (ADF&G, 2006b[Appendix 5.2]).

Few activities evaluated as a potential contributor to cumulative effects on ESA-species or critical habitats would be likely to prevent access of protected species from resources (e.g., feeding, refuge, nesting, or migration areas). However, animals could be excluded from a resource if they avoid an area where there are hunters, fishers, or people engaged in recreational or work-related activities. In one case, NOAA Fisheries established no-entry zones around sea lion rookeries as a protective measure to prevent interactions between commercial fishers and Steller sea lion in order to preclude disturbance to the species from commercial fishing (58 CFR 45269, 1993).

[57] 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" (ESA Section 3). Take may also include significant habitat modification that results in injury or death by impairing essential behaviors (e.g., feeding, breeding, or finding refuge).

5.4 Habitat degradation or loss

Fishing (commercial or recreational), hunting (recreational or subsistence), marine or air traffic, and other commercial or industrial activities that are permitted by the state or occur privately could affect the amount or quality of habitat. Stressors include noise pollution, water and air quality degradation, and loss (primarily to conversion to another use) or degradation of fish or wildlife habitat. The magnitude of effects is expected to be dependent on the local human population density and local land uses; effects are expected to increase in regions where population densities or commercial or industrial activities are increasing.

5.5 Direct injury

Direct injury to an ESA-listed species could occur from a variety of activities. Marine vessel traffic from commercial or recreational fishing, boating or other on-water activities increases the risk of ship strikes of marine mammals and birds. In the case of commercial fishing, gear entanglement is also a risk. Risks of ship strike could be greater than current conditions if vessel traffic increases following growth of resident or visitor populations in Alaska or increased shipping because access is greater due to decline in sea ice.

Native Alaskans (and permanent residents of Native villages) are permitted to conduct subsistence harvest of protected species, but this type of harvest is not expected to pose a greater threat than that of existing conditions. Protected species currently subject to subsistence harvest in Alaska include:

- Bowhead whale
- Beluga whale
- Humpback whale
- Sei whale
- Steller sea lion
- Polar bear
- Pacific walrus
- Northern sea otter
- Ringed seal
- Bearded seal
- Chinook salmon
- Steelhead trout

Illegal hunting of protected species within Alaska is thought to occur as well, although the frequency is undocumented, and uncertain. Individual animals from populations that inhabit Alaska territory also may utilize territory in other nations (e.g., Canada and Russia) where, under various conditions, hunting is allowed.

IWC provides harvest quotas for bowhead whale, and it is anticipated that the quota for 2013 through 2017, the next period being evaluated by NOAA Fisheries, will be similar to the quota currently in place: < 1% of the existing stock (76 FR 58781, 2011). Whale harvest is permitted for scientific purposes, typically with limited[58] take of fin (1 or 2 individuals per year), sperm (1 to 3 individuals annually), and sei whales (approximately 100 per year). By far, Japan has harvested the most whales of any country since 1986 under scientific permitting, but North Korea, Iceland, and Norway have also participated in this program in other oceans or for other species.

5.6 Determination of effects

Reasonably foreseeable activities that do not fall under federal jurisdiction could have an adverse impact on ESA-listed species or habitats. Adverse effects might include behavioral disturbance, exposure to contaminants, exclusion from resources, habitat degradation or loss and injury. However, several of the activities are unlikely to represent a change from current conditions. These activities include:

- Commercial or recreational fishing
- Recreational hunting or subsistence harvest

Other activities could be subject to change as they are affected by the number and density of people either residing in or visiting Alaska. The activities that could increase the frequency of impacts (whether or not there is a change in magnitude is unclear) to ESA-listed species or critical habitats include:

- Commercial or private marine or air traffic
- Commercial or residential development
- Wastewater (non-POTW) or stormwater state-permitted discharges

[58] Annual take based on the years 2008, 2009, and 2010 from IWC data

6 Determination of Effects

This section presents the summary of the determination of adverse effects on ESA-listed species or critical habitat from implementation of the Unified Plan during an emergency response. The evaluation and rationale were presented in detail, in Section 4. Questions evaluated in the determination include:

1. Where and when are the animals present in Alaska?
2. What is the frequency, volume, type, and timing of historical spills that have occurred in a species' Alaska range?
3. What is the likelihood of an interaction between an animal and a response action based on the temporal and spatial overlap of species ranges and historical response actions?
4. What is the type and duration of a stressor introduced by the response action?
5. How vulnerable is the species to the stressor potentially introduced by a response action?
6. What decisions are made or processes are implemented to mitigate the effects of an emergency action?

Historical spill location, frequency and timing were used to represent the likelihood of a future response in various regions and habitats in Alaska. The seasonal distribution, habitat requirements, and behavior of an ESA-listed species were used to determine the likelihood that an individual animal could encounter or be affected by a response action. The vulnerabilities of a species and the duration and magnitude of the potential stressors introduced by a response action, accounting for mitigative procedures and BMPs that would be implemented during an emergency response were used to determine the likely impacts to an ESA-listed species.

Table 6-1 presents the final effects determination that a particular response action is either likely to adversely affect (LAA) an individual animal or that it may affect, but is not likely to adversely affect (NLAA) an individual of an ESA-listed species. If an interaction between an ESA-listed species and a response action is extremely unlikely, a conclusion of "may affect, but NLAA" may be made, even if an adverse effect might result if the interaction were to occur. Effects on critical habitats are based on the likelihood of a spill response occurring in that habitat and what the likely outcome would be. Table 6-1 presents the final effects determination that a particular response action is either LAA or NLAA a critical habitat.

Table 6-1. Summary of determination of effects

Protected Species or DPS	Status	Critical Habitat?	Determination	Rationale
Marine mammals				
Beluga whale (*Delphinapterus leucas)* – Cook Inlet DPS	E	yes	LAA	• Species is present year round in a geographically restricted area in Cook Inlet that has the greatest level of anthropogenic activity in Alaska. • Increased level of anthropogenic noise may temporarily impact the ability to communicate and disrupt essential behaviors. • Potential ship strikes from fast-moving vessels could result in injury. • Frequent petroleum product spills occurred in Cook Inlet between January 1995 and August 2012. • Exposure to dispersants and dispersed oil could result in sublethal effects (see Appendix B).
			LAA (CH)	• Response operations may restrict passage within or between critical habitat areas. • Exposure to dispersants and dispersed oil could result in a reduction in some prey species (see Appendix B). • Noise levels from response activities could cause behavioral disturbance.
Blue whale (*Balaenoptera musculus)*	E	no	may affect, NLAA	• Extensive home range, preference for open water (i.e., offshore) habitat, and seasonal presence in Alaska minimize potential for exposure to oil spill response activities. • Vessel noise during response activities is not likely to have adverse physical or behavioral impact.
Bowhead whale (*Balaena mysticetus)*	E	no	LAA	• Year-round presence in Arctic waters in areas with ongoing anthropogenic activity increases likelihood of exposure to response activities. • Exclusion from polynyas and leads, particularly during winter and migration periods, caused by response activities could result in physical harm. • Increased level of anthropogenic noise may temporarily impact the ability to communicate and disrupt essential behaviors. • Potential ship strikes from fast-moving vessels or entanglement could result in injury. • Exposure to dispersants and dispersed oil could result in sublethal effects (see Appendix B).
Fin whale (*Balaenoptera physalus)*	E	no	may affect, NLAA	• Extensive home range and preference for deep water minimizes the potential for exposure to oil spill response activities. • As a deep-ocean species, fin whales spend more than half of their time at depths from 50 m to greater than 225 m, thereby minimizing their exposure to response activities.

Protected Species or DPS	Status	Critical Habitat?	Determination	Rationale
Gray whale (*Eschrichtius robustus*) – WNP stock	E	no	may affect, NLAA	• Low likelihood of presence during response activities because the area is outside the primary home range for this stock of gray whale. • Low likelihood of seasonal presence of a small number of WNP gray whales in Alaska.
Humpback whale (*Megaptera novaeangliae)*	E	no	LAA	• Increased level of anthropogenic noise may temporarily impact the ability to communicate and disrupt essential behaviors. • Potential ship strikes from fast-moving vessels or entanglement could result in injury. • Dispersed oil may foul baleen plates, temporarily reducing filtration efficiency and impacting the ability to feed. • Ingestion of or dermal contact with dispersed oil may result in sublethal effects (see Appendix B).
North Pacific right whale (*Eubalaena japonica)*	E	yes	may affect, NLAA	• Low likelihood of seasonal presence in Alaska minimizes the potential for exposure to oil spill response actions. • Oil spills in the open ocean where right whales may be present are infrequent (6 in 17 years), making an encounter with oil spill response actions unlikely.
			may affect, NLAA (CH)	• Historical oil spills in critical habitat have been infrequent, with only 1 small (1,000 gal.) spill in 17 years.
Sei whale (*Balaenoptera borealis)*	E	no	may affect, NLAA	• Extensive open-ocean habitat, high mobility, and seasonal presence in Alaska minimize the potential for exposure to oil spill response activities. • Spills in the open ocean where sei whales are present are infrequent and of small volume (2 spills of ≤ 350 gal. in 17 years), making an encounter with oil spill response actions extremely unlikely.
Sperm whale (*Physeter macrocephalus)*	E	no	may affect, NLAA	• Low population density in Alaska and feeding habits (i.e., deep diving) reduce the potential for exposure to surface response activities. • Spills in the open ocean, where sperm whales are present are infrequent and of small volume (2 spills of ≤ 350 gal. in 17 years), making an encounter with oil spill response actions extremely unlikely.

Protected Species or DPS	Status	Critical Habitat?	Determination	Rationale
Steller sea lion (*Eumetopias jubatus)* – western population	E	yes	LAA	• Present throughout Alaska waters increases likelihood of exposure to response activities. • A stampede would likely result in injury, mortality, and abandonment of pups, and injury to animals of other life stages. • Potential sublethal effects may occur from inhaling particulates from *in situ* burn and exposure to dispersants or dispersed oil (see Appendix B). • Dermal exposure to dispersants and dispersed oil could result in sublethal effects (see Appendix B), although exposures and effects are expected to be short-term.
			LAA (CH)	• Potential exists for disturbances to resting, breeding, rearing, and feeding individuals due to mechanical removal of oil with heavy equipment; such disturbances may include abandonment of haulouts or rookeries.
Steller sea lion (*E. jubatus)* – eastern population	T[a]	yes	LAA	• Present throughout Alaska waters increases likelihood of exposure to response activities. • A stampede would likely result in injury, mortality, and abandonment of pups, and injury to animals of other life stages. • Potential sublethal effects may occur from inhaling particulates from *in situ* burn and exposure to dispersants or dispersed oil (see Appendix B). • Dermal exposure to dispersants and dispersed oil could result in sublethal effects (see Appendix B), although exposures and effects are expected to be short-term.
			LAA (CH)	• Potential exists for disturbances to resting, breeding, rearing, and feeding individuals due to mechanical removal of oil with heavy equipment; such disturbances may include abandonment of haulouts or rookeries.
Polar bear (*Ursus maritimus*)	T	no[b]	LAA	• Injury and/or mortality may result from encounters with security personnel (i.e., bear guards) stationed during a response action. • Ingestion of petroleum hydrocarbons may occur during grooming or consumption of contaminated prey (e.g., seals exposed to dispersed oil). • Disturbances near den sites could cause a female to abandon the den, resulting in cub mortality from hypothermia or predation. • Man-made in-water obstructions or other disturbances that force bears to alter swimming courses may result in stress and increased energy output, reducing their overall fitness, particularly if the disturbance also displaces their marine mammal prey (i.e., seals).

Protected Species or DPS	Status	Critical Habitat?	Determination	Rationale
Northern sea otter (*Enhydra lutris kenyoni*) – southwest Alaska DPS	T	yes	LAA	• Encountering dispersed oil would likely result in fouling of fur causing a reduction in the ability of otters to thermoregulate, resulting in hypothermia; ingestion of dispersed oil while cleaning pelage could result in sublethal effects. • Sublethal effects to eyes, mucus membranes, or lungs may occur from exposure to dispersants or dispersed oil.
			LAA (CH)	• Removal of kelp in critical habitat that provides protection from marine predators and other essential functions may occur.
Pacific walrus (*Odobenus rosmarus,* ssp. *divergens*)	C[c]	no	LAA	• Year-round presence in the Bering and Chukchi Seas increases likelihood of encounters with response activities. • A stampede caused by response activities would likely result in injury, mortality and abandonment of pups, and injury to animals of other life stages. • Disturbance of animals at haulouts or rookeries may occur due to response activities. • Potential sublethal effects may occur through inhaling particulates from *in situ* burn and exposure to dispersants or dispersed oil (see Appendix B). • Potential for alteration of prey (e.g., bivalves) based on use of dispersants.
Ringed seal (*Phoca hispida spp. hispida)*	T	no	LAA	• Year-round presence in the Chukchi and Beaufort Seas increases likelihood of encounters with response activities. • Disturbances resulting in exclusion from haulouts and subnivean lairs used for resting, nursing pups, and protection from predators could result in harm if animals are forced to locate resources and refuge elsewhere. • Potential sublethal effects may occur through inhaling particulates from *in situ* burn and exposure to dispersants or dispersed oil (see Appendix B).
Bearded seal (*Erignathus barbatus ssp. nauticus)*	T	no	LAA	• Year-round presence in the Bering, Chukchi, and Beaufort Seas increases likelihood of encounters with response activities. • Disturbances resulting in exclusion from haulouts and subnivean lairs used for resting, nursing pups, and protection from predators could result in harm if animals are forced to locate resources and refuge elsewhere. • Potential sublethal effects may occur through inhaling particulates from *in situ* burn and exposure to dispersants or dispersed oil (see Appendix B).
Birds				
Eskimo curlew (*Numenius borealis*)	E	no	may affect, NLAA	• Current population status is unknown and this species is considered potentially extinct in Alaska.
Short-tailed albatross (*Phoebastria albatrus*)	E	no	may affect, NLAA	• Year round presence in Alaska • This highly mobile species does not breed, nest, or undergo molting in Alaska. • Species congregates in open ocean and at the edge of the continental shelf, where fewer oil spills are expected to occur.

Protected Species or DPS	Status	Critical Habitat?	Determination	Rationale
Spectacled eider (*Somateria fischeri*)	T	yes	LAA	• Disturbance by terrestrial response activities during the breeding season could result in nest abandonment, destruction of nests, and disruption of other essential behaviors, such as feeding and sheltering. • Response activities may result in exclusion of molting (i.e., flightless) eiders from feeding and sheltering habitat. • Exposure to dispersants or dispersed oil may reduce the thermoregulatory ability of eider feathers resulting in hypothermia • Exposure to particulates generated by *in situ* burning could result in adverse effects on molting eiders that are unable to avoid the response actions.
			LAA (CH)	• Removal of upland soil and vegetation in critical habitat and nesting areas would likely reduce the available nesting sites and feeding areas during molting periods. • Flushing of marine shorelines could result in displacement of and/or thermal stress to benthic organisms, reducing the eider prey base until those communities could recover. • Exposure of sensitive prey species and life stages (e.g., larval bivalves) during certain seasons (e.g., May through July) and in certain areas (e.g., Norton Sound or near Barrow, AK) may result in indirect impacts to eiders that selectively eat such species.
Steller's eider (*Polysticta stelleri*) – Alaska breeding population	T	yes	LAA	• Disturbance by terrestrial response activities during the breeding season could result in nest abandonment, destruction of nests, and disruption of other essential behaviors, such as feeding and sheltering. • Response activities may result in exclusion of molting (i.e., flightless) eiders from feeding and sheltering habitat. • Exposure to dispersants or dispersed oil may reduce the thermoregulatory ability of eider feathers resulting in hypothermia • Exposure to particulates generated by *in situ* burning could result in adverse effects on molting eiders that are unable to avoid the response actions.
			LAA (CH)	• Removal of upland soil and vegetation in critical habitat and nesting areas would likely reduce the available nesting sites and feeding areas during molting periods. • Flushing of marine shorelines could result in displacement of and/or thermal stress to benthic organisms, reducing the eider prey base until those communities could recover. • Exposure of sensitive prey species and life stages (e.g., larval bivalves) during certain seasons (e.g., May through July) and in certain areas (e.g., Norton Sound or near Barrow, AK) may result in indirect impacts to eiders that selectively eat such species.

Protected Species or DPS	Status	Critical Habitat?	Determination	Rationale
Yellow-billed loon (*Gavia adamsii*)	C[c]	no	LAA	• Exposure to response activities may occur in nesting areas within the National Petroleum Reserve. • Disturbance from response activities during the breeding season could result in nest abandonment, destruction of undiscovered nests, and disruption of other essential behaviors, such as feeding and sheltering. • Historically, spills have occurred frequently in the summer range in Southeast Alaska and the Aleutian Islands. • Exposure to dispersants or dispersed oil may foul feathers and reduce the thermoregulatory ability of loons.
Fish				
Chinook salmon (*Oncorhynchus tshawytscha*) – PNW protected stocks	T/E	no	LAA	• Nearshore response activities, such as vegetation removal, beach cleaning, and booming, could cause physical displacement of salmonids. • Habitat degradation and alteration of the food web could result from to changes in water quality caused by dispersant use, dispersed oil, or burnt residues from *in situ* burning. • Sublethal effects in salmon could occur from exposure to dispersants or dispersed oil if these materials were discharged in the vicinity of the nearshore (see Appendix B).
Coho salmon (*Oncorhynchus kisutch*) – Lower Columbia River ESU	T			
Steelhead trout (*Oncorhynchus mykiss)* – PNW protected stocks	T	no	may affect, NLAA	• No spawning occurs in Alaska, the species is present in Aleutian Islands and GOA during part of its life cycle. • Habitat use studies conducted in Alaska suggest low likelihood of exposure.
Pacific herring *(Clupea pallasi*)	C	no	LAA	• Presence at a sensitive life stage (juvenile) in nearshore and coastal waters of Alaska increases susceptibility to response activities in those areas. • Physical disturbance to spawning habitat (e.g., flushing and flooding or shoreline with hot/warm water) could occur when eggs are present. • Acute mortality of larval or embryonic individuals could be caused by exposure to hot/warm water used for cleaning and dispersed oil (see Appendix B). • Habitat degradation and alteration of the food web could result from to changes in water quality caused by dispersant use, dispersed oil, or burnt residues from *in situ* burning. • Exposure to dispersants and dispersed oil could result in acute mortality, particularly in embryonic and larval herring.

Protected Species or DPS	Status	Critical Habitat?	Determination	Rationale
Reptiles and Plants				
Leatherback sea turtle (*Dermochelys coriacea*)	E	no[d]	No effect	• Reptiles are rare in Alaska waters.
Loggerhead sea turtle (*Caretta caretta*)	E			
Green sea turtle (*Chelonia mydas*)	T			
Olive Ridley turtle (*Lepidochelys olivacea*)	T			
Aleutian shield fern (*Polystichum aleuticum*)	E	no	No effect	• Aleutian shield fern is present in an isolated location where oil spill response action would not take place.

a NMFS (2012a) issued a proposal to delist the eastern population of the Steller's sea lion; the proposal is undergoing public review and comment at the time of the publication of this BA.

b On 10 January 2013, the US District Court for the District of Alaska issued an order vacating the rule designating critical habitat for the polar bear. Therefore, at this time, there is no critical habitat designated for the polar bear (US District Court District of Alaska, 2013).

c The Pacific walrus and yellow-billed loon have been designated as candidate species. A 12 July 2011 court settlement agreement established that USFWS would either submit a proposed rule to list the species as a candidate species, or issue a not-warranted finding. The dates of submittal established in the settlement agreement are October 2014 for the yellow-billed loon and October 2017 for the Pacific walrus (US District Court for the District of Columbia, 2011).

d Critical habitat has been designated for leatherback sea turtles (77 FR 4170, 2012) and proposed for loggerhead turtles (78 FR 43006, 2013) outside of Alaska.

C – candidate
CH – critical habitat
DPS – distinct population segment
E – endangered
ESU – evolutionarily significant unit
GOA – Gulf of Alaska
LAA – likely to adversely affect
NLAA – not likely to adversely affect
NMFS – National Marine Fisheries Services
PNW – Pacific Northwest
T – threatened
WNP – Western North Pacific

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Appendix A. The Alaska Unified Plan Organization, Incident Command System, and Draft ARRT Dispersant Authorization Plan

Components:

- The Alaska Unified Plan Organization
- Incident Command System
- Draft ARRT Dispersant Authorization Plan

The Alaska Unified Plan Organization

The Alaska Unified Plan Organization

Title: Alaska Federal/State Preparedness Plan for Response to Oil & Hazardous Substance Discharges/Releases

Version: Change 3 (January 2010)

Letter of Promulgation dataed January 27, 2010

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Incident Command System

1 Introduction

The oil and hazardous substance response Incident Command System (ICS) described in this section is designed to organize and manage responses to incidents involving a number of interested parties in a variety of activities. This system is based on the National Incident Management System (NIMS) and is adapted for the particular aspects of responding to an oil and hazardous substance release. The ICS is organized around the following five major functions:

- Command
- Planning
- Operations
- Logistics
- Finance/administration

The basic structure remains the same for all incidents, so the ICS can expand and contract to match the size, type, and complexity of the response. Staffing is dynamic, based on need. Using common sense and ICS principles, the system can be modified to fit any incident. (See Attachment A-1.)

2 The Federal and State Role in Incident Response

The Unified Command directs all aspects of incident response and uses a designated Incident Commander (IC) or On-Scene Coordinators (OSCs) to carry out containment, control, and cleanup operations.

Because of the complex nature of oil and hazardous substance responses, the National Contingency Plan (NCP) and the Unified Plan have designated OSCs to act as ultimate authority for their respective level of governmental authority. OSCs represent all agencies from their respective federal, state and local governmental levels as on-scene coordinators in the Unified Command. They also are responsible for coordinating their respective organization's activities with the activities of other response organizations.

2.1 Federal On-Scene Coordinator

The Federal On-Scene Coordinator (FOSC) is the designated authority delegated by the President under the NCP to direct and coordinate the federal response to incidents under the authority of federal laws and regulations. Within Unified Command, the FOSC has ultimate authority for incidents under federal jurisdiction. Federal responsibilities are divided into a coastal zone and an inland zone, as defined by an interagency agreement between the US Environmental Protection Agency (EPA) and the United States Coast Guard (USCG). In the coastal zone, the commanding officers of the USCG sectors or Captains of the Port are designated FOSCs for oil discharges and hazardous substance releases. For oil discharges and hazardous substance releases in the inland zone, the EPA designates the FOSC. For releases of hazardous substances where the release is from any facility or vessel under the jurisdiction, custody, or control of the Department of Defense (DOD) or Department of Energy (DOE), the department with jurisdiction designates the FOSC.2.2 State On-Scene Coordinator

The State On-Scene Coordinator (SOSC) is responsible for directing and coordinating the State's response to oil and hazardous substance discharges. The SOSC has ultimate authority for incidents not involving federal jurisdiction. In Alaska, SOSCs are designated by the Commissioner of the Alaska Department of Environmental Conservation (ADEC). SOSCs have been pre-designated for the following response areas covering the entire state and state waters: Northern Alaska; Central Alaska; and Southeast Alaska. In the event of a major spill incident, the Commissioner may designate the Director, Spill Prevention and Response Division, or another individual to serve as the SOSC.

2.3 LOCAL ON-SCENE COORDINATOR

The Local On-Scene Coordinators (LOSCs) are designated by local governments with jurisdiction to direct and coordinate local responses to incidents. LOSCs are normally part of the Unified Command as long as there is an immediate threat to public safety and / or the incident occurs within their local jurisdiction.

For as long as there is an immediate threat to public safety, the LOSC will serve as the ultimate command authority and will direct the response, unless the LOSC requests a higher authority to assume that responsibility. Once the immediate threats to public safety are abated, either the SOSC or FOSC becomes the ultimate command authority for the cleanup operation, depending on jurisdiction and agency response.

2.4 RESPONSIBLE PARTY'S ON-SCENE COORDINATOR

The Responsible Party's On-Scene Coordinator (RPOSC) will be designated by the responsible party to direct and coordinate their resources in response to incidents for which they are responsible. Facility or vessel response or contingency plans designate the RPOSC. If the facility or vessel does not have a response or contingency plan, the RPOSC is the person in charge of the responsible party's response.

The Responsible Party (RP) is the person(s) responsible for a discharge of a hazardous substance to the water or land of the State. Federal laws require RPs to respond to their spills and oblige the RP to direct their own containment, control and cleanup efforts. Even though the RP is required to respond to a spill, the FOSC and SOSC oversee the RP's containment, control, and cleanup efforts and have the authority to take over or supplement the response activities if either the FOSC or SOSC determines that the response is inadequate. Additionally, the Oil Pollution Act of 1990 (OPA 90) authorizes the USCG and EPA to direct the activities of the RP without "federalizing" (taking federal control of) the spill cleanup.

RPs may use contracted resources, which may include Oil Spill Response Organizations (OSROs), Incident Management Teams (IMTs), and Non-Tank Vessel Cleanup Contractors (NTVCCs), to assist the RP or to act on their behalf during the incident response. These entities may fill ICS positions, or work in the field to facilitate cleanup efforts.

Please refer to Attachment A-1 to see an example of the Unified Command structure.

3 Unified Command

In the State of Alaska, the Unified Command for oil and hazardous substance discharge response consists solely of the OSCs for the federal, state and local governments, plus the OSC for the RP. Other government agencies are represented by the respective OSC for the federal, state and local government. The Unified Command is implemented whenever there is an incident involving more than one agency with jurisdiction. The Unified Command will also be implemented if there is only one agency with jurisdiction and the RP is responding adequately. All agencies that have jurisdictional responsibilities and the responsible party will contribute to the process of:

- Determining overall incident objectives and priorities
- Selecting strategies
- Ensuring joint planning for tactical activities
- Ensuring integrated tactical operations are conducted
- Maximizing use of all assigned resources
- Resolving conflicts
- Ensuring the public and stakeholders are informed

The Unified Command respects all governmental agencies' and private jurisdictional authorities. Most of the time, the Unified Command will be able to agree upon a single incident action plan. In cases where there are disputes or differences, the OSC having ultimate authority described above will settle the dispute

4 Incorporation of Federal and State Agencies into a Single Government Response

Although the USCG, EPA, and ADEC are the lead federal and state agencies, with broad responsibilities during an oil or hazardous substance discharge, other federal and state agencies have major roles in spill response, which are defined by federal and state statutes. The federal OSC will incorporate all federal agencies that have a regulatory role in oil and hazardous substance discharge into a single federal response with a single FOSC in charge. Even though the FOSC is from the USCG or EPA, he/she is responsible for representing all federal concerns regarding the response action.

The State of Alaska will incorporate all state agencies that have a regulatory or mandated role in oil or hazardous substance discharge into a single state response with a single SOSC in charge. Even though the SOSC is from the ADEC, he / she is responsible for representing all of the state's concerns. ADEC is Alaska's designated lead agency for oil spill response.

In the federal and state response, every effort will be made to incorporate personnel from the participating agencies in specific ICS functional roles within the Planning, Finance / Administration, Operations and Logistics Sections and / or the Command Staff. All participants assigned to the response, while representing their respective agency, will work under the direction of the FOSC or SOSC. Any disputes between agency personnel which cannot be resolved at the response staff level should be referred to their agency representative for resolution at the command level.

The FOSC is the final arbitrator within the federal response organization. All disputes should be resolved within the response structure so the federal government can speak with a single consistent voice - the FOSC's. As per the NCP, disputes that cannot be resolved within the response structure will be elevated to the Alaska Regional Response Team (ARRT) for resolution, if within their jurisdiction. Disputes that cannot be resolved by the ARRT shall be elevated to the National Response Team (NRT).

The SOSC is the final arbitrator within the state's spill response organization. All disputes should be resolved within the response structure so the state can speak with a single, timely, consistent voice - the SOSC's. Disputes that cannot be resolved within the spill response structure will be elevated by the Agency Representative or SOSC to the Disaster Policy Cabinet for resolution at the commissioner level.

There are numerous functionally based elements that work within the ICS (See Attachment A-1), but for the purposes of the BA, the focus is on the elements that have functions related to natural resources. These elements are the Planning Section and Environmental Unit and the Operations Section and the Wildlife Recovery and Protection Branch.

4.1 ENVIRONMENTAL UNIT

The Environmental Unit (EU) is a unit within the Planning Section of the ICS. The EU is typically staffed by experienced professionals from federal and state environmental and wildlife agencies, most of which are designated as federal and state natural resource trustees. EU's that are established in Alaska typically have members from ADEC, National Marine Fisheries Service (NMFS), US Fish and Wildlife Service (USFWS), and Alaska Department of Fish and Game (ADFG). The following are a number of the EU responsibilities during an oil spill.

- Provide expertise on living marine resources and their habitats and information on associated clean up and mitigation methods.

- Develop strategies to minimize environmental impact of the spill that is based on consensus of stakeholders.
- Develop a list of resources at risk, such as sensitive shorelines, spawning areas, Critical Habitat, and the presence of Threatened and Endangered Species.
- Develop environmental monitoring strategies that will help decision-makers understand the impact of response countermeasures that have been implemented.
- Identify sensitive areas and recommend response priorities.
- Provide input on wildlife protection strategies.
- Identify the need for and obtain permits, consultations and other authorizations
- Assemble and coordinate environmental stakeholders to reach consensus on protection priorities and cleanup strategies and endpoints.
- Assemble and coordinate trustees and stakeholders for Natural Resource Damage Assessment.
- Monitor the environmental consequences of cleanup actions
- Develop shoreline cleanup and assessment plans
- Identify the need for, and prepare any special advisories or orders
- Identify the need for, and obtain permits, consultations, and other authorizations
- Evaluate the opportunities to use various response technologies
- Advise the Unified Command of the impact of potential response tactics on resources at risk and suggest options and alternatives to mitigate such impact

The Environmental Unit Leader (EUL) must ensure that all necessary environmental permits and / or consultations are acquired and adhered to. By working closely with federal and state representatives, the EUL can determine what permits and procedures are in place or pre-approved for use in emergency situations. (Attachment A-1 highlights the location of the EU within the ICS structure)

Utilizing expertise from technical specialists (representatives from NMFS, USFWS, and ADFG), stakeholders, and local experts, the EU analyzes the impacts from the oil spill. After the analysis is complete, the team listed above determines primary strategies to protect sensitive resources. The EU team will also identify appropriate spill response countermeasures such as dispersant use, *in-situ* burn use and other applied technologies. The EU team then evaluates the impact of the strategies on wildlife and the ecosystem. After evaluating the impact of the response strategies, the EU advises the Unified Command through the Planning Section Chief on which response options are the most effective and the least harmful to wildlife and the ecosystem.

4.2 WILDLIFE RESCUE AND REHABILITATION BRANCH

Wildlife rescue and rehabilitation resides in the Operations Section of ICS. The mission of the wildlife rescue branch is to coordinate wildlife rescue and rehabilitation efforts in concert with federal agencies, the responsible party, and nongovernmental organizations, in accordance with established rescue protocols. The EUL must work closely with this group and with local, state and federal fish and wildlife specialists who have the responsibility to establish protocols for keeping un-oiled wildlife away from an oil spill and for dealing with oiled wildlife. (Attachment A-1 highlights the location of the Wildlife Branch within the ICS structure)

4.3 ALASKA REGIONAL RESPONSE TEAM

The ARRT is a standing body established by the NCP. The ARRT is responsible for recommending changes to the regional response organization as needed, revising the Regional Contingency Plan (i.e., the Unified Plan) as needed, evaluating the preparedness of participating agencies and the effectiveness of Area Contingency Plans (in Alaska Area Contingency Plans are referred to as Subarea Contingency Plans) for a federal response to discharges and releases, and providing technical assistance for preparedness to the general response community. The ARRT also serves as a channel for FOSC access to the combined resources of the agencies represented on the ARRT and as an avenue to the NRT and national level resources should they become necessary. The ARRT is composed of state and federal agencies. The ADEC provides the state's representative. The alternate state representative is provided by the Alaska Department of Military and Veterans Affairs / Division of Homeland Security and Emergency Management. The ARRT provides a regional mechanism for the development and coordination of preparedness activities prior to a pollution response.

The ARRT can coordinate assistance and advice to the FOSC, when requested, by providing additional federal and state resources and expediting approvals for federal and state permits. The ARRT is chaired by the agency providing the FOSC (USCG or EPA).

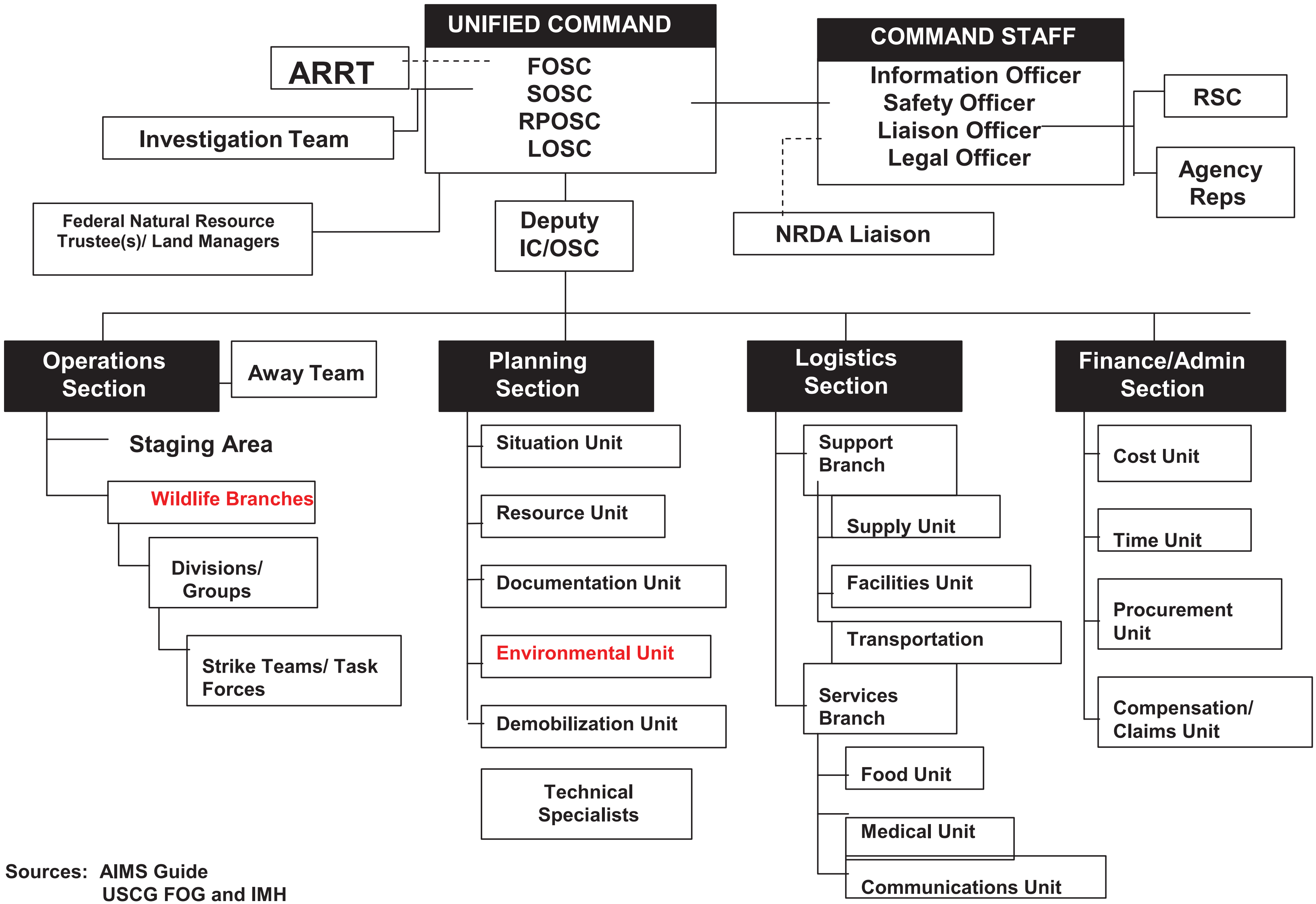
Due to the relatively sparse staffing of federal agencies within Alaska, ARRT members may also be called upon to staff positions on the IMT. While assigned to ICS sections within the Unified ICS, ARRT members or their representatives are immediately available to work with other agencies that have similar concerns and responsibilities. This enhances the timeliness and thoroughness of decisions. A formal "convening" of the ARRT during a spill event will only be necessary for dispute resolution or major policy issues affecting multiple agencies. During any response requiring state input to the ARRT, the SOSC has been delegated the authority to serve as the state’s representative to the ARRT. The SOSC, as the state representative, will consult with other state agencies that have management authorities / responsibilities for resources that might be affected by ARRT decisions. Appropriate ARRT members will convene as necessary to make decisions on *in situ* burning, use of chemical countermeasures, and nationwide permits (404 permits). (Attachment A-1 highlights where the ARRT works with the ICS structure)

4.4 Natural Resource Trustees

For incidents with significant effects or the potential for significant effects on federal trust resources (e.g., critical habitat for threatened and endangered species), the federal trustees(s) will have the option of each providing input directly to the Unified Command to help ensure that information on these resources is available to, and used appropriately, in decision making. This representative(s) would provide guidance on response and protection strategies commensurate with the special status of the affected or threatened lands or resources. (Attachment A-1 highlights where the Natural Resource Trustees work with the ICS structure.)

Attachment A-1. Oil and Hazardous Substance Response Incident Command System Structure

OIL AND HAZARDOUS SUBSTANCE RESPONSE INCIDENT COMMAND SYSTEM (ICS) STRUCTURE



Sources: AIMS Guide
USCG FOG and IMH

Draft ARRT Dispersant Authorization Plan

ANNEX F

APPENDIX I: ALASKA REGIONAL RESPONSE TEAM OIL DISPERSANT AUTHORIZATION PLAN

This document is also available on the Alaska Regional Response Team website at:

http://alaskarrt.org/

or at the Alaska Department of Environmental Conservation website at:

http://dec.alaska.gov/spar/perp/plans/uc/Annex%20F%20(Jan%2010).pdf

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Oil Dispersant Authorization Plan

Revision 1

Photo of dispersant application during the T/V Exxon Valdez Oil Spill to be inserted here

[Month/Year of plan approval to be inserted here]

Table of Contents

1.0 BACKGROUND AND OVERVIEW[1]

1.1 Introduction

The purpose of the Alaska Regional Response Team (ARRT) Oil Dispersant Authorization Plan is to outline the process to be used following an oil discharge in Alaska when dispersant use is being considered in a Preauthorization Area or in an Undesignated Area. In addition, this plan streamlines and facilitates the dispersant use authorization process, establishes a Preauthorization Area for Alaska, and provides a framework to identify areas where dispersant use should be avoided. Moreover, this plan will result in an Alaska-based regulated dispersant response capability.

The previous statewide guidelines and guidelines specific to Cook Inlet were approved by the ARRT in April 1986. Specific guidelines for Prince William Sound were approved by the ARRT on March 6, 1989. This plan, which was approved by the ARRT on ________, supersedes all previous statewide and area-specific dispersant guidelines/plans[2]. In effect for all marine waters in Alaska[3], this plan is subject to periodic review and update by the ARRT.

1.2 Background

The capability to respond to an oil discharge in Alaska can be hampered by great distances, underdeveloped transportation networks, limited labor force, finite mechanical spill cleanup technology, severe weather, and other conditions. The use of dispersants may provide a response tool in addition to mechanical recovery and *in-situ* burning. See Figure 1 for a conceptual marine spill response decision chart.

Dispersants are chemical agents consisting of surfactants, solvents, and other compounds specifically designed to enhance dispersion of oil into water by generating larger numbers of small droplets of oil that are entrained into the water column by wave or tidal action. These small submerged oil droplets are then subject to natural processes, such as dissolution, volatilization from the water surface, biodegradation, and sedimentation resulting from interactions with suspended particulate material. Oil spill dispersants do not actually reduce the total amount of oil in the environment. Rather, they may change the inherent characteristics of the dispersed oil, thereby changing the oil's transport, fate, and potential effects.

As noted by the National Academy of Sciences[4] review of ongoing research on the use of dispersants as an oil spill response technique and the impact of dispersed oil on marine and coastal ecosystems, there are many uncertainties regarding the efficacy [effectiveness] and toxicity of dispersant use. Decisions to use dispersants involve trade-offs between decreasing the

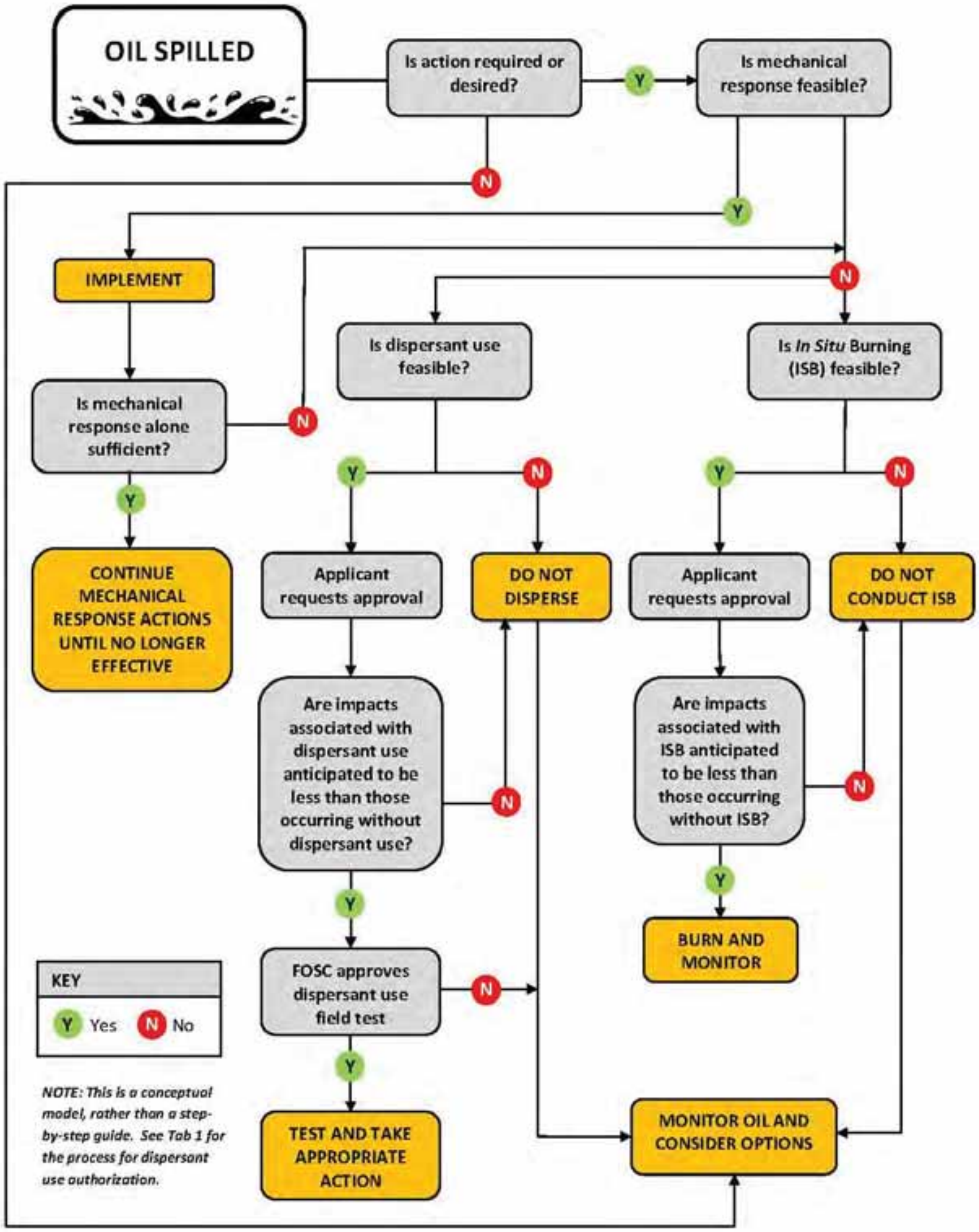
[1] Prior to the Alaska Regional Response Team approving this plan, Endangered Species Act Section 7 consultation with the U.S. Fish and Wildlife Service and National Marine Fisheries Service will be completed.

[2] This plan no longer includes Preauthorization Areas inside Prince William Sound or Cook Inlet.

[3] For the purposes of this document, "marine waters in Alaska" is defined to include all waters seaward of the mean low water line along the coast of Alaska outward to the 200 mile Exclusive Economic Zone.

[4] Oil Spill Dispersants Efficacy and Effects. 2005. National Academy of Sciences, available at: http://dels.nas.edu/resources/static-assets/materials-based-on-reports/special-products/oil_spill_dispersants_key_findings_final.pdf

Figure 1. Conceptual Marine Spill Response Decision-Making



potential risk to water surface and shoreline habitats while increasing the potential risk to organisms in the water column. This trade-off reflects the complex interplay of many variables, including, but not limited to, the type of oil spilled; the volume of the spill; sea state and weather; water depth; water temperature; water salinity; degree of turbulence; presence, relative abundance, and life stages of potentially-affected wildlife and marine organisms; and the use of those resources. Prior to authorizing dispersant use in marine waters in Alaska, the Federal On-Scene Coordinator (FOSC) needs to consider factors including, but not limited to, valuable commercial, subsistence, and recreational fisheries, as well as large and important populations of birds and marine mammals, including threatened and endangered species.

Key questions to consider during the dispersant use decision-making process include:

- Will the selected dispersant work effectively on the oil discharged and in the given circumstances?
- Can the dispersant be effectively applied to the oil?
- What are the environmental trade-offs of dispersant use and do they support the use of the dispersant in a given circumstance?

As stated in a May 2012 Government Accountability Office report, "Every oil spill is different, and the conditions—such as weather, oil type and volume, currents, and location—surrounding any unanticipated release of oil into the ocean are highly variable. Given this variability, no one study can account for all the potential permutations."[5]

1.3 Dispersant Use Authorizations

This document constitutes a dispersant use preauthorization plan and a case-by-case dispersant use authorization process in accordance with the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) - Subpart J (Section 300.910). This plan is included in Annex F of *The Alaska Federal/State Preparedness Plan for Response to Oil and Hazardous Substance Discharges/Releases (Unified Plan).*

Subpart J Section 300.910 of the NCP addresses the concurrence and consultation requirements for dispersant use authorizations. Specifically, it addresses dispersant use decision-making in the following circumstances:

- In accordance with the NCP - Subpart J (Section 300.910(a)), the [Federal] On-Scene Coordinator (OSC) may authorize the use of certain products without obtaining spill-specific concurrences under specified circumstances described in the preauthorization plan where the U.S. Environmental Protection Agency (EPA) Regional Response Team (RRT) representative, the state with jurisdiction over the waters of the area to which a preauthorization plan applies, and the U.S. Department of the Interior (DOI) and U.S. Department of Commerce (DOC) natural resource trustees approve the preauthorization plan in advance[6].

[5] Oil Dispersants: Additional Research Needed, Particularly on Subsurface and Arctic Applications. 2012. U.S. Government Accountability Office. A Report to Congressional Requestors. GAO-12-585.

[6] In Alaska, the natural resource trustee authorities are vested in the DOI and DOC ARRT representatives; state authorities for oil spill response are vested in the Alaska Department of Environmental Conservation ARRT representative.

- In accordance with the NCP - Subpart J (Section 300.910(b)), for spill situations that are not addressed by the preauthorization plan, the [Federal] OSC, with concurrence of the EPA representative to the RRT and, as appropriate, the concurrence of the RRT representative from the state with jurisdiction over the navigable waters threatened by the release or discharge, and in consultation with the DOI and DOC natural resource trustees, when practicable, may authorize the use of dispersants on oil discharges provided that the products are listed on the NCP Product Schedule[7].

- In accordance with the NCP – Subpart J (Section 300.910(d), the [Federal] OSC may authorize the use of any dispersant without obtaining the concurrence of the EPA representative to the RRT and, as appropriate, the RRT representative from the state with jurisdiction over the navigable waters threatened by the release or discharge, when, in the judgment of the [Federal] OSC, the use of the product is necessary to prevent or substantially reduce a hazard to human life. In that case, the [Federal] OSC is to inform (as soon as possible) the EPA RRT representative and, as appropriate, the RRT representative from the affected state and, when practicable, the DOI and DOC natural resource trustees[8] of the use of a product, including products not on the NCP Product Schedule. Once the threat to human life has subsided, the continued use of dispersant must follow the approval process described in Section 300.910(a) or (b).

1.4 Dispersant Areas

Preauthorization Area

The Preauthorization Area for Alaska is shown on Figure 2 and is described as follows: commencing at Cape Suckling in position 59-59.35N 143-53.49W, thence proceeding south to the outermost extent of the Exclusive Economic Zone (EEZ) at position 56-18.00N 144-00.00W, thence proceeding westerly along the outermost extent of the EEZ until it intersects with the outermost extent of the maritime boundary line (MBL) at position 51-21.49N 167-40.44W, thence proceeding northeast along the outermost extent of the MBL to position 54-54.00N 171-58.50W, thence proceeding easterly remaining 100 nautical miles offshore to position 55-45.00N 167-00.00W, thence proceeding southeasterly to Cape Sarichef at position 54-35.90N 164-55.65W, thence proceeding northwesterly to the outermost extent of the Contiguous Zone at position 54-52.43N 165-26.00W, thence proceeding westerly along the outermost extent of the Contiguous Zone following along the entire Aleutian Islands chain rounding Attu Island counter clockwise and entering the North Pacific Ocean, thence proceeding easterly along the outermost extent of the Contiguous Zone along the southern coast of the Aleutian Islands and south of the Shumagin Islands into the Gulf of Alaska and along the eastern coast of the Kodiak Archipelago, thence proceeding south of the Kenai Peninsula and Prince William Sound until reaching position 59-29.00N 144-03.00W, and thence proceeding north connecting to Cape Suckling at position 59-59.35N 143-53.49W. It should be noted, the Preauthorization Area excludes any avoidance areas identified in certain Subarea Contingency Plans (SCPs), as noted below in this section.

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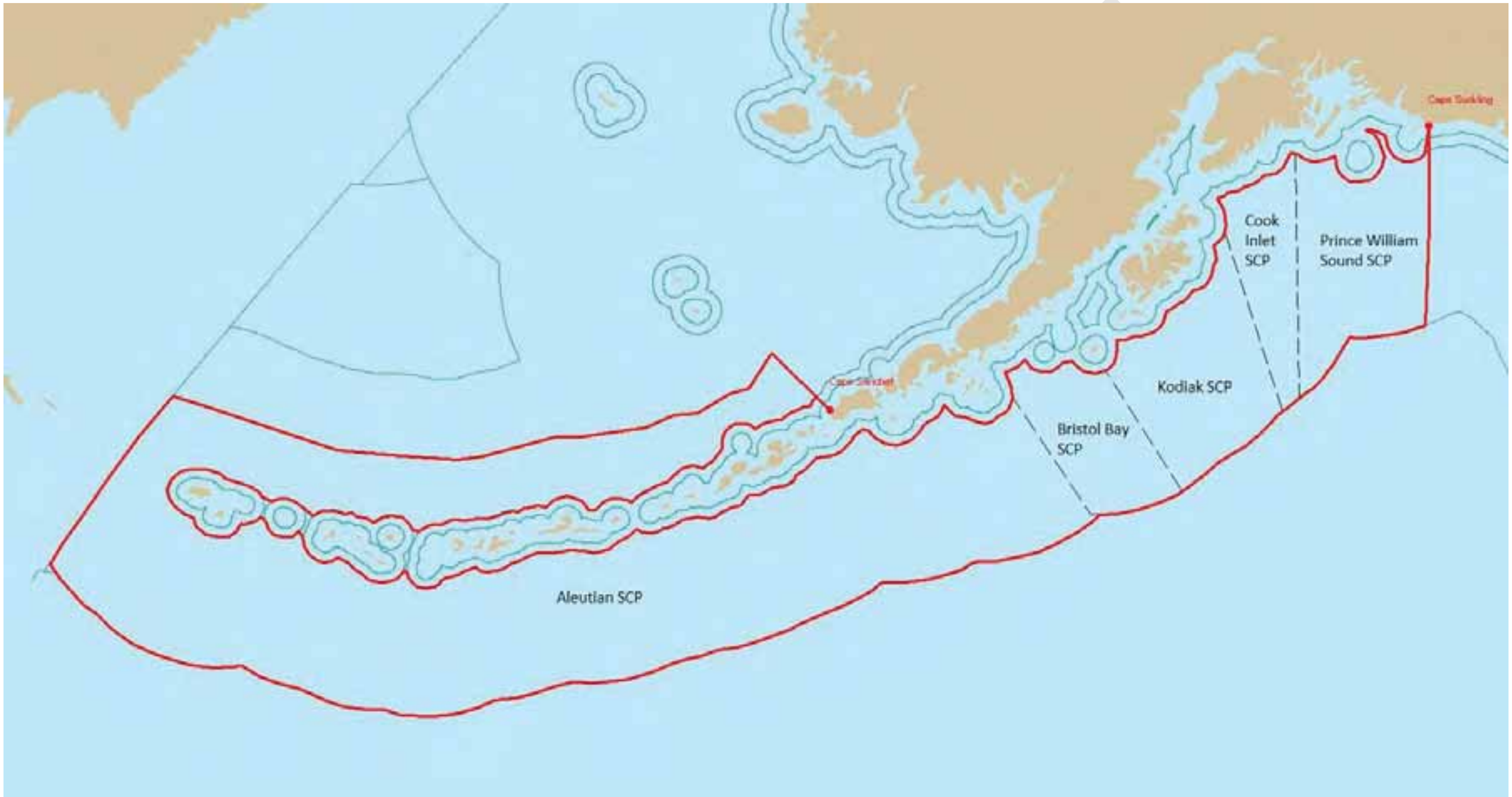
[7] In Alaska, the natural resource trustee authorities are vested in the DOI and DOC ARRT representatives; state authorities for oil spill response are vested in the State On-Scene Coordinator.

[8] In Alaska, the natural resource trustee authorities are vested in the DOI and DOC ARRT representatives

Figure 2. Preauthorization Area



Note: The boundaries of the Preauthorization Area and of the subarea contingency plans (SCPs) that overlap the Preauthorization Area are shown in this figure. As described below in Section 1.4, Federal On-Scene Coordinators shall use this figure in conjunction with Section I (Dispersant Use Avoidance Areas) of the appropriate SCPs identified in this figure. Section I of the SCPs identifies areas within the Preauthorization Area that have been reclassified as an avoidance area where requests for dispersant use shall be considered using the Process for Case-by-Case Dispersant Use Authorization in Tab 1, Part 1B.

This Preauthorization Area ensures the USCG can require certain vessel and facility response plan holders in Alaska to maintain a minimum dispersant use capability in accordance with a USCG August 31, 2009 rulemaking, 33 CFR Parts 154 and 155 "Vessel and Facility Response Plans for Oil: 2003 Removal Equipment Requirements and Alternative Technology Revisions; Final Rule (Final Rule)." This includes tank vessels that carry crude oil and stop at one or more U.S. ports at some point during their transit.

The boundaries of the Preauthorization Area were based on the location of common shipping routes followed by crude oil vessels regulated under the Final Rule. The 24 nautical mile boundary, which corresponds to the U.S. contiguous zone (a feature commonly depicted on nautical charts), excludes nearshore sensitive areas from the Preauthorization Area.

This Preauthorization Area overlaps offshore areas included in several SCPs; i.e., the Prince William Sound, Cook Inlet, Kodiak Island, Bristol Bay, and Aleutian Islands SCPs as shown on Figure 1. Following approval of this plan by the ARRT, the appropriate USCG FOSC, EPA FOSC, and Alaska Department of Environmental Conservation (ADEC) State On-Scene Coordinator (SOSC) shall engage federal and state natural resource trustees, federally-recognized tribes, and stakeholders in a process to identify locations where dispersant use should be avoided within the Preauthorization Area where the Preauthorization Area overlaps their respective SCP. Any identified locations shall be included in Section I (Dispersant Use Avoidance Areas) of each SCP and posted online (see http://alaskarrt.org/Documents.aspx?f=175). This process shall be completed within 24 months following ARRT approval of this plan. Any avoidance area identified in an SCP shall no longer be considered part of the Preauthorization Area for dispersant use. Rather the avoidance area shall be automatically reclassified as an Undesignated Area where requests for dispersant use shall follow the process for Case-by-Case Dispersant Use Authorization in Tab 1, Part 1B. Any preauthorization area within an SCP, for which this process is not completed within 24 months following ARRT approval of this plan, will be removed as a pre-authorized area until such time the process is completed.

Undesignated Areas

Undesignated Areas include all marine waters in Alaska outside of the Preauthorization Area. These Undesignated Areas overlap offshore areas included in several SCPs as noted above. Following approval of this plan by the ARRT, the appropriate USCG FOSC, EPA FOSC, and ADEC SOSC shall engage federal and state natural resource trustees, federally-recognized tribes, and stakeholders in a process to identify locations where dispersant use should be avoided within the Undesignated Areas where the Undesignated Areas overlap their respective SCP. Any identified locations shall be included in Section I (Dispersant Use Avoidance Areas) of each SCP and posted online (see http://alaskarrt.org/Documents.aspx?f=175).

2.0 DISPERSANT USE POLICIES, CRITERIA, AND CONDITIONS/STIPULATIONS

2.1 Policies

The following policies shall be followed whenever dispersant use is considered and/or authorized:

- The primary method for cleaning up oil will be mechanical removal.
- The use of dispersants may provide an alternative response tool when conditions prevent using mechanical recovery and/or *in-situ* burning.
- Dispersant delivery in a mechanical recovery area will not displace or interfere with mechanical or other response operations.
- All requests for dispersant use will follow the appropriate process in Tab 1.
- Prolonged applications of dispersants that exceed 96 hours, or the use of dispersants subsea (i.e., below the water surface), are not preauthorized.
- All input related to dispersant use authorizations will be provided to the FOSC within the timeframe requested by the FOSC. The FOSC will provide sufficient time for that input.
- The preauthorization of dispersant use (inside the Preauthorization Area) only applies to crude oil. Requests for dispersant use for any other type of oil (e.g., diesel fuel, jet fuel, intermediate fuel oils, bunker oils) will be considered using the Process for Case-by-Case Dispersant Use Authorization in Tab 1, Part 1B.
- The evaluation of trade-offs will consider the criteria identified below in Section 2.2. The basis for these decisions will be documented.
- One or more dispersant application field tests to determine the effectiveness of oil dispersion under existing site-specific environmental conditions will be conducted. The resulting information will be analyzed to determine whether full-scale dispersant application(s) will begin. A dispersant application field test is defined as one aircraft sortie or one vessel-based application swath.
- Any atypical use of dispersants[9] or any use of dispersant subsea (i.e., below the surface) in a Preauthorization Area or in an Undesignated Area will only be considered using the Process for Case-by-Case Dispersant Use Authorization in Tab 1, Part 1B.
- All dispersant applications (including field tests) will include effectiveness monitoring as outlined in the Special Monitoring of Applied Response Technologies (SMART) Tier 1, Tier 2, and Tier 3 protocols (see Tab 3, Part 1). In the event SMART Tier 2 and Tier 3 monitoring is not operationally feasible in the Preauthorization Area, the request for dispersant use or continued use will be considered via the Process for Case-by-Case Dispersant Use Authorization in Tab 1, Part 1B.
    - Monitoring for effectiveness of dispersant use and any other factors (or "key indicators") established by the FOSC in consultation with the EPA, DOI, and DOC

[9] Atypical use of dispersants is defined to include: (1) full scale dispersant application ongoing for, or expected to exceed or exceeding 96 hours following the dispersant application field test, and/or (2) the use of dispersants subsea; i.e., below the water surface.

ARRT representatives and, when appropriate, the State On-Scene Coordinator (SOSC), will be conducted by a qualified third party (who is acceptable to the Unified Command and the EPA, DOI, and DOC ARRT representatives and, when appropriate, the SOSC) or by the USCG Strike Team/SMART Team. All SMART Tier 1, 2, and 3 monitoring will be performed in accordance with procedures in the most current SMART protocols (see Tab 3, Part 1).

- For every dispersant application, the FOSC will ensure that all required monitoring is conducted. The resulting information will be analyzed and used on a daily basis to determine whether dispersant application(s) will continue, be postponed, or cease and whether any modification(s) need to be made.
- Environmental monitoring atypical use of dispersants will be guided by the NRT "Environmental Monitoring for Atypical Dispersant Operations" (see Tab 4, Part 2).
- All monitoring that includes sampling will be conducted in accordance with a Quality Assurance Project Plan that addresses sample collection methodology, handling, chain of custody, and decontamination procedures (see Tab 4, Part 2, Section 4).

2.2 Criteria

The following criteria will be considered in dispersant use decision-making within marine waters in Alaska:

- Bathymetry - it is generally recognized that adequate mixing and dilution of dispersants should occur if applied in waters deeper than 10 fathoms (or 60 feet) depth provided there is sufficient energy for mixing. The 10 fathom contour is a standard depth contour line included on National Oceanic and Atmospheric Administration marine charts.
- Distance from shore - an adequate buffer needs to be established to reduce the chances of applying dispersants to sensitive shorelines/nearshore areas and to ensure that drifting dispersant and/or dispersed oil mixtures do not adversely affect intertidal and benthic biota.
- Wind and currents - areas where there is generally little movement of water would not provide sufficient mixing energy for effective dispersant use. With higher wind speeds (beginning at 12-14 meters per second (26.8 to 31.3 miles per hour)), the benefits of dispersant application start to diminish compared to natural dispersion.
- Salinity - most dispersants are made for use in saltwater and are not effective in fresh water or waters with a salinity of less than 15 parts per thousand.
- Temperature - dispersant effectiveness will be affected by ambient water temperatures, with more complete dispersion in warmer waters.
- Response equipment - the availability and time to mobilize response equipment may affect whether dispersants can be used.
- Shoreline types - certain shoreline types (e.g., gravel, mixed sand and gravel, coarse-grained sand beaches, and marshes) may trap oil for long periods. The amount of wave energy (e.g., protected inlets vs. high-energy exposed beaches) will also affect oil retention and persistence.

- Sensitive habitats - certain habitats where biota breed, rear young, feed, or congregate (e.g., eelgrass beds, kelp beds, saltwater marshes, and designated critical habitats for threatened or endangered species) may be adversely affected by oil and/or dispersed oil.
- Sensitive species including threatened or endangered species – these species may be adversely affected by oil and/or dispersed oil.
- Other areas designated for special use or protection - these areas (e.g., national and state parks, national wildlife refuges, and wildness areas) may be adversely affected by oil and/or dispersed oil.
- Historic properties - these resources (e.g. archeological and historic resources) may be adversely affected by oil and/or dispersed oil.
- Human use activities - these activities (e.g., subsistence, fishing, and boating activities) may be adversely affected by oil and/or dispersed oil.
- Public and private facilities – these facilities (e.g., fish hatcheries, aquaculture and mariculture facilities, public water intakes, and docks) may be adversely affected by oil and/or dispersed oil).

2.3 Conditions/Stipulations

The following conditions and stipulations shall be included in any dispersant application field test and in any subsequent authorization of full-scale dispersant application(s):

- All dispersant application field tests will be conducted on a representative portion of the oil slick.
- All dispersant applications will be conducted in accordance with the conditions and procedures identified in Tab 1. Dispersant application effectiveness and potential trade-offs associated with its use will be evaluated on a daily basis, informing the FOSC's decision to continue, postpone, modify, or cease dispersant application based on that day's monitoring information.
- Dispersant applications will only be carried out in daylight conditions.
- Dispersants will only be applied in areas where the water depth is ≥ 10 fathoms (60 feet) and at sufficient distances from shore to ensure that sensitive near-shore and benthic habitats are not affected by dispersants and/or dispersed oil.
- Dispersants applications will maintain a minimum 500 meters (1,640 feet) horizontal separation from swarming fish[10], rafting flocks of birds, marine mammals in the water, and/or marine mammal haul-outs.
- To avoid disturbances at walrus haul-outs, any dispersant-related aircraft will comply with any Federal Aviation Administration Temporary Flight Restriction(s) and Notice to Airmen and/or aviation restrictions issued by the U.S. Fish and Wildlife Service (FWS). In addition, any dispersant-related vessel(s) will comply with any USCG Notice to Mariners and/or FWS restrictions for walrus haul-outs.

[10] Swarming fish include schools of fish that are active and visible at the surface of the water.

- Any monitoring required by FWS and/or National Marine Fisheries Service for Endangered Species Act Section 7 compliance will be conducted.
- DOI and/or DOC will provide a specialist in aerial surveying of marine mammals and pelagic birds to accompany a Tier 1 monitoring team to help ensure compliance with the above requirements. If DOI and/or DOC cannot provide the appropriate specialist(s), a third party acceptable to the DOI and/or DOC will be identified to accompany the monitoring team.
- Any atypical use of dispersants will be guided by the NRT "Environmental Monitoring for Atypical Dispersant Operations" (see Tab 4, Part 2).
- Other incident-specific conditions/stipulations: ________________________________
  ____
  ____
  ____

TAB 1. PROCESS FOR DISPERSANT USE AUTHORIZATION

Part 1A: Process for Dispersant Use in the Preauthorization Areas

The following information outlines the procedure that shall be followed when the Federal On-Scene Coordinator (FOSC) has made a decision to authorize the use dispersants on a crude oil discharge within the dispersant Preauthorization Area[1]:

1. The FOSC directs the Responsible Party (RP) to mobilize resources for dispersant use, while the RP and the Environmental Unit (EU) of the Incident Command immediately begin to complete the checklists contained in Parts 2-3. This checklist information will be used to inform the decision to authorize dispersant use and establish the parameters of the incident-specific use, as appropriate. If there is no RP identified, the FOSC, serving as the "Requestor," may direct mobilization of resources for dispersant use as noted above.
2. The FOSC immediately notifies the following entities of the decision to authorize the use dispersants:
   - U.S. Environmental Protection Agency (EPA) Alaska Regional Response Team (ARRT) representative
   - U.S. Department of the Interior (DOI) ARRT representative
   - U.S. Department of the Commerce (DOC) ARRT representative
   - State On-Scene Coordinator (SOSC)
   - Representative for each appropriate federally-recognized tribe
   - Representative for each appropriate stakeholder group (e.g., local government(s), Native corporation(s), regional citizens' advisory council(s))
3. The FOSC directs appropriate entities (i.e., previously-agreed upon third party (or parties) and/or USCG Strike Team/Special Monitoring of Applied Response Technologies [SMART] Team) to mobilize Tier 1, 2, and 3 monitoring capabilities.
4. The FOSC initiates, as appropriate, Endangered Species Act (ESA) Section 7 consultation(s) with U.S. Fish and Wildlife Service and/or National Marine Fisheries Service (NMFS) representatives in accordance with the ESA Memorandum of Agreement (see Annex K of the *Unified Plan*).
5. The FOSC initiates, as appropriate, Essential Fish Habitat consultation with a NMFS representative.
6. The National Oceanic and Atmospheric Administration (NOAA) Scientific Support Coordinator (SSC) and EU, in coordination with the Operations Section, provide any necessary supporting information (e.g., ADIOS model runs, currents, water temperature, salinity, and fish and wildlife observations) required in Parts 2-3. The completed Parts 2-3 are submitted by the EU Leader to the FOSC. The FOSC completes Questions 1-17 in Part 4. The completed Parts 2-4 are provided to other members of the Unified Command (UC) and representatives identified in Step 2 above.

[1] These steps assume that the FOSC will be working within a Unified Command structure and that all input related to dispersant use authorization(s) will be provided to the FOSC within the timeframe required by the FOSC.

Tab 1, Part 1A: Process for Dispersant Use in Preauthorization Areas, Cont.

7. An individual representing the FOSC holds a teleconference (at a time determined by the FOSC) with individuals identified in Step 2 above, appropriate members of the EU, and the UC for the purpose of informing the FOSC's decision to use dispersants.
8. The FOSC completes Questions 18-20 in Part 4, documents any changes to Parts 2-4, and completes Part 5 prior to proceeding with a dispersant application field test (following Steps 9-15 below, as appropriate) or postponing or cancelling the field test.
9. The Dispersant Field Task Force (DFTF)[2] advises the FOSC that dispersant application and monitoring personnel, equipment, and supplies are staged and ready to deploy for a dispersant application field test.
10. The DFTF, under the supervision of the FOSC, conducts a dispersant application field test and all required monitoring.
11. The NOAA SSC, using the results of the SMART Tier 1, 2, and 3 monitoring, determines whether the dispersant is effectively dispersing the oil, documents the basis for that determination, and provides the information to the EU.
12. The EU provides to the FOSC, other members of the UC, and individuals identified in Step 2 above, a recommendation on whether full-scale dispersant application(s) should commence with any modification(s) and/or any additional monitoring requirements.
13. An individual representing the FOSC holds a teleconference (at a time determined by the FOSC) with individuals identified in Step 2 above, appropriate members of the EU, and the UC for the purpose of informing the FOSC's decision to authorize any full-scale dispersant application(s) or to postpone or cancel authorization of dispersant application(s). [The frequency of teleconferences following any first full-scale dispersant application will be determined on an incident-specific basis by the FOSC, the EPA, DOI, and DOC ARRT representatives and, when appropriate, the SOSC. Those teleconferences will inform the FOSC's decision to continue, postpone, modify, or cease authorization of full-scale dispersant application(s).]
14. The FOSC determines whether to authorize full-scale dispersant application(s) with any modification(s) and/or any additional monitoring requirements will begin, be postponed, or cancelled; documents any revisions to Parts 2-5; and provides the information to the rest of the UC and individuals identified in Step 2 above. For any atypical use of dispersants[3], any additional dispersant use will be considered via the Process for Case-by-Case Dispersant Use Authorization in Tab 1, Part 1B.
15. After the response for this incident has been completed, the FOSC will complete a Dispersant Use After-Action Report (as required in Tab 3) for submittal to all signatories in Part 5, all members of the UC, ARRT, and National Response Team, , and other individuals identified in Step 2 above The report will also be posted on the ARRT public website.

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[2] The DFTF includes all dispersant application and dispersant monitoring teams.

[3] Atypical use of dispersants is defined to include: (1) full scale dispersant application ongoing for, or expected to exceed or exceeding 96 hours following the dispersant application field test, and/or (2) the use of dispersants subsea; i.e., below the water surface.

Tab 1, Part 1B: Process for Case-by-Case Dispersant Use Authorization

The following information outlines the procedure that shall be followed when the application of dispersants into marine waters in Alaska is being proposed as a response option for discharges of any oil in Undesignated Areas and/or discharges of oil, other than crude oil, in a Preauthorization Area[1].

1. The Responsible Party (RP), serving as the Requestor, notifies the Federal On-Scene Coordinator (FOSC) of their intention to prepare and submit a Dispersant Use Request (see Part 2). Depending on the timing and need to move quickly, the FOSC may direct the RP to begin mobilizing equipment, materials, and personnel in preparation to implement the dispersant use plan to be proposed. [If there is no RP identified, the FOSC may serve as the Requestor.]
2. The FOSC immediately notifies the following entities of the RP's intent to submit a Dispersant Use Request:
   - U.S. Environmental Protection Agency (EPA) Alaska Regional Response Team (ARRT) representative
   - U.S. Department of the Interior (DOI) ARRT representative
   - U.S. Department of Commerce (DOC) ARRT representative
   - State On-Scene Coordinator (SOSC)
   - Representative for each appropriate federally-recognized tribe
   - Representative for each appropriate stakeholder group (e.g., local government(s), Native corporation(s), regional citizens' advisory council(s))
3. Depending on the timing and need to move quickly, the FOSC directs appropriate entities (i.e., previously-agreed upon third party (or parties) and/or USCG Strike Team/Special Monitoring of Applied Response Technologies [SMART] Team) to mobilize Tier 1, 2, and 3 monitoring capabilities.
4. The FOSC initiates, as appropriate, Endangered Species Act (ESA) Section 7 consultation(s) with U.S. Fish and Wildlife Service and/or National Marine Fisheries Service (NMFS) representatives in accordance with the ESA Memorandum of Agreement (see Annex K of the *Unified Plan*).
5. The FOSC initiates, as appropriate, Essential Fish Habitat consultation with a NMFS representative.
6. The National Oceanic and Atmospheric Administration (NOAA) Scientific Support Coordinator (SSC) and Environmental Unit (EU), in coordination with the Operations Section, provide any necessary supporting information (e.g., ADIOS model runs, currents, water temperature, salinity, and fish and wildlife observations) required in Parts 2-3. The completed Parts 2-3 are submitted by the EU Leader to the FOSC. The FOSC completes Questions 1-17 in Part 4.
7. An individual representing the FOSC holds a teleconference (see procedure listed below) with individuals identified in Step 2 above, the Unified Command (UC), and appropriate members of the EU for the purpose of the EPA, DOI, and DOC ARRT representatives and, when appropriate, the SOSC, to take action on the Dispersant Use Request.

[1] These steps assume that the FOSC will be working within a Unified Command structure and that all input related to dispersant use authorization(s) will be provided to the FOSC within the timeframe requested by the FOSC.

Tab 1, Part 1B: Process for Case-by-Case Dispersant Use Authorization, Cont.

Teleconference Procedure for Dispersant Application Field Test

Individual representing the FOSC:

- Confirms when the FOSC requires input from all parties identified in Step 2 above.
- Provides to all parties identified in Step 2 above, information on the teleconference time and call-in number, and copies of Parts 2-4.
- Chairs the teleconference and: (1) conducts roll call, recording name, title, and affiliation of teleconference participants; (2) requests (from the Requestor) a brief summary/overview of the plan for the proposed dispersant application field test (field test); (3) directs questions to the appropriate UC or EU representative(s); (4) requests input from the EPA, DOI, and DOC ARRT representatives and, when appropriate, the SOSC; (5) requests input from federally-recognized tribes and stakeholders; (6) facilitates development of a consensus recommendation (if possible) by the EPA, DOI, and DOC ARRT representatives and, when appropriate, the SOSC, on the proposed field test, including any special considerations, constraints, permit requirements, and/or special authorizations; (7) queries the EPA, DOI, and DOC ARRT representatives and, when appropriate, the SOSC, for their summary input on the proposed field test; and (9) verbally summarizes input received.
- Prepares and provides as soon as possible to the EPA, DOI, and DOC ARRT representatives and, when appropriate, the SOSC, a draft written summary of the teleconference results along with the names, titles, and affiliations of teleconference participants. Incorporates as soon as possible any corrections to the summary provided by the EPA, DOI, and DOC ARRT representatives and, when appropriate, the SOSC, and immediately provides the final summary to the UC with a copy to each teleconference participant.

8. The FOSC completes Questions 18-20 in Part 4 and documents any changes to Parts 2-4; the FOSC, the EPA, DOI and DOC ARRT representatives and, when appropriate, the SOSC, complete Part 5, prior to proceeding with a dispersant application field test (following Steps 9-15 below, as appropriate) or postponing or cancelling the field test as determined in the above procedure.
9. The Dispersant Field Task Force (DFTF)[2] advises the FOSC that dispersant application and monitoring personnel, equipment, and supplies are staged and ready to deploy for a dispersant application field test.
10. The DFTFs, under the supervision of the FOSC, conducts a dispersant application field test and all required monitoring.
11. The NOAA SSC, using the results of the SMART Tier 1, 2, and 3 monitoring, determines whether the dispersant is effectively dispersing the oil, documents the basis for that determination, and provides the information to the EU.
12. The EU provides to the UC and individuals identified in Step 2 above, a recommendation on whether full-scale dispersant application(s) should commence with any modification(s) and/or any additional monitoring requirements.

[2] The DFTF includes all dispersant application and dispersant monitoring teams.

Tab 1, Part 1B: Process for Case-by-Case Dispersant Use Authorization, Cont.

13. An individual representing the FOSC holds a teleconference (see procedure listed below) with individuals identified in Step 2 above, the UC, and appropriate members of the EU for the purpose of the EPA, DOI, and DOC ARRT representatives and, when appropriate, the SOSC, to take action on a request for full-scale dispersant application(s). [The frequency of teleconferences following any first full-scale dispersant application will be determined on an incident-specific basis by the FOSC, the EPA, DOI, DOC ARRT representatives and, when appropriate, the SOSC. Those teleconferences will reconsider the decision to continue, postpone, or cease full-scale dispersant application(s). For any atypical use of dispersants[3] , a teleconference will be held to reconsider the decision to continue dispersant application(s).

Teleconference Procedure for Full-Scale Dispersant Application

Individual representing the FOSC:

- Confirms when the FOSC requires input from all parties identified in Step 2 above.
- Provides to all parties identified in Step 2 above, information on the teleconference time and call-in number and any revisions to Parts 2-4 made following any dispersant application field test(s) and/or the EU's recommendation regarding whether full-scale dispersant application(s) should commence with any modification(s) and/or any additional monitoring requirements.
- Chairs the teleconference and: (1) conducts roll call, recording name, title, and affiliation of teleconference participants; (2) requests (from the Requestor) a brief summary/overview of the plan for the proposed full-scale dispersant application (full-scale application); (3) directs questions to the appropriate UC or EU representative(s); (4) requests input from the EPA, DOI, and DOC ARRT representatives and, when appropriate, the SOSC; (5) requests input from appropriate federally-recognized tribes and stakeholders; (6) facilitates development of a consensus recommendation (if possible) by the EPA, DOI, and DOC ARRT representatives and, when appropriate, the SOSC, on the proposed full scale application, including any special considerations, constraints, permit requirements, and/or special authorizations; (7) queries the EPA, DOI, and DOC ARRT representatives and, when appropriate, the SOSC, for their summary input on the proposed full-scale application; and (9) verbally summarizes input received.
- Prepares and provides as soon as possible to the EPA, DOI, and DOC ARRT representatives and, when appropriate, the SOSC, a draft written summary of the teleconference results along with the names, titles, and affiliations of teleconference participants. Incorporates as soon as possible any corrections to the summary provided by the EPA, DOI, and DOC ARRT representatives and, when appropriate, the SOSC, and immediately provides the final summary to the UC with a copy to each teleconference participant.

[3] Atypical use of dispersants is defined to include: (1) full scale dispersant application ongoing for, or expected to exceed or exceeding 96 hours following the dispersant application field test, and/or (2) the use of dispersants subsea; i.e., below the water surface.

Tab 1, Part 1B: Process for Case-by-Case Dispersant Use Authorization, Cont.

14. The FOSC documents any changes to Parts 2-4. In addition, the FOSC, the EPA, DOI and DOC ARRT representatives and, when appropriate, the SOSC complete Part 5 prior to commencing, postponing, or cancelling full-scale dispersant application(s) as determined through the above procedure. Any revisions to Parts 2-5 will be provided to the rest of the UC and individuals identified in Step 2 above.
15. After the response for this incident has been completed, the FOSC will complete a Dispersant Use After-Action Report (as required in Tab 3) for submittal to all signatories in Part 5, all members of the UC, ARRT, , and National Response Team, and other individuals identified in Step 2 above. The report will also be posted on the ARRT public website.

Tab 1, Part 2: Dispersant Use Request

INCIDENT NAME		Date Prepared:	
		Time Prepared:	
INCIDENT LOCATION		REQUESTOR INFORMATION	
Latitude:		Name:	
Longitude:		Affiliation:	
Description:		Address:	
		Phone:	
		Cell Phone:	
Incident Date:		Fax:	
Incident Time:		Email:	

Areas dispersants to be applied in: ☐ Preauthorization Area ☐ Undesignated Area

BASIC DATA

Type of incident (check one):
- ☐ Grounding
- ☐ Transfer operations
- ☐ Explosion
- ☐ Collision
- ☐ Allision
- ☐ Blowout
- ☐ Other ____________________

Oil discharged: API:
- ☐ North Slope Crude ____________
- ☐ Cook Inlet Crude ____________
- ☐ Residuals ____________
- ☐ Diesel #2 ____________
- ☐ JP4 ____________
- ☐ Other: ____________

Estimated volume of oil discharged/discharge rate:
__________ gallons; __________ gallons per ______

Potential oil discharge volume estimate:
__________ gallons

Oil discharge status (check one):
- ☐ Continuous
- ☐ Intermittent
- ☐ One time only, now stopped

Current estimate of water surface covered by oil as of:
Date/Time: __________ Area: __________ sq. mi.

Did source burn?	☐ Yes	☐ No
Is source still burning?	☐ Yes	☐ No
Is oil easily emulsified?	☐ Yes	☐ No

RESPONSE CONSIDERATIONS

Why is mechanical recovery ineffective and/or inadequate?
Is the mechanical recovery insufficient? If so, why?
____
____
____
____

Will *in-situ* burning (ISB) also be used?	☐ Yes	☐ No
Will mechanical recovery also be used?	☐ Yes	☐ No
Will dispersant use impede mechanical recovery?	☐ Yes	☐ No

If yes, explain how this will be resolved:
____
____
____

ADIOS MODEL

Has ADIOS been run by a qualified person? ☐ Yes ☐ No
Identify individual and affiliation: ____________________
If yes, please fill out the following ADIOS input parameters:
Wind speed __________ Water temp. __________
ADIOS output parameters to be specified:
- Percentage evaporation
- Viscosity change
- Water percentage or emulsification over a 5-day period

Tab 1, Part 2: Dispersant Use Request, Cont.

WEATHER AND SEA CONDITIONS

Check boxes and enter wind values in the following table:

	Present Condition	12-hour Forecast	24-hour Forecast
Clear			
Partly cloudy			
Overcast			
Rain			
Snow			
Fog			
Wind speed (knots/mph)			
Wind direction (from)			

Visibility (miles): ______________________

Tidal state at ______________ o'clock (check one):

☐ Slack tide ☐ Incoming (flood) ☐ Outgoing (ebb)

✓ **Attachment 1:** Graph with tidal information for 3 tidal cycles.

Dominant current (net drift):

Speed (knots): __________ Direction (to): __________

Sea state: present condition (check one)

☐ Calm ☐ Choppy ☐ Swell

Sea state: 24-hour forecast (check one)

☐ Calm ☐ Choppy ☐ Swell

Waves (height estimate), present condition: __________ feet

Waves (height estimate), 24-hr forecast: __________ feet

Depth of water at slick: ______________________ feet

Water temperature: ________________ degrees C and F

Water salinity: ______________________ parts/thousand

If ice is present, describe: ______________________

____

____

Next sunrise: __________ Next sunset: __________

WILDLIFE INFORMATION

Have fish swarms, birds, and/or marine mammals been observed near the oil slick?

☐ Yes ☐ No If yes, please answer the following:

Type observed (e.g., birds, sea otters, seals, whales, fish)	Estimated Number

*(Include in the chart being submitted as **Attachment 2** the proximity of the above observed fish and wildlife)*

DISPERSANT USE PLAN

Proposed date and time for application of dispersants:

Date: ______________ Time: ______________

Distance to nearest staging area (airport/facility):

______________ mi

What is the dispersant proposed for use?

☐ ______________________________________

Material Safety Data Sheet (MSDS) attached? ☐ Yes ☐ No

What is the proposed dispersant to oil ratio? ______:______

How much total dispersant per acre is proposed?

____________________ gallons

What is the estimated percentage of spill slick area to be treated? ________________ percent

Who will apply the dispersants?

Individual/Affiliation: ______________________

Application Method	Estimated Dispersant Capacity Per Sortie	Estimated Number of Sorties
☐ Boat	__________	__________
☐ C-130	__________	__________
☐ CASA	__________	__________
☐ Helicopter	__________	__________
☐ Other:	__________	__________

Distance from source: __________ miles

Distance from nearest shoreline: __________ miles

✓ **Attachment 2:** Provide a chart with a distance scale. Chart must include: 1) estimated spill trajectory and landfalls with time; 2) location and distance of proposed dispersant application relative to zone boundaries, proposed dispersant application field test location, and other response activities including ISB; 3) dispersant tactic summary and how it will augment the mechanical response, if used; and 4) fish and wildlife locations relative to the oil slick.

DISPERSANT USE HEALTH AND SAFETY PLAN

Does the site-specific health and safety plan cover the dispersant use plan? ☐ Yes ☐ No

✓ **Attachment 3**: Relevant portion of health and safety plan, including MSDS.

Tab 1, Part 2: Dispersant Use Request, Cont.

DISPERSANT SYSTEM APPLICATION

Application system design:

- Designed specifically for this purpose? ☐ Yes ☐ No
- Used previously for this purpose? ☐ Yes ☐ No
- Tested to be effective and safe? ☐ Yes ☐ No
- Meet manufacturer's recommendations? ☐ Yes ☐ No

Application personnel are trained and/or experienced in the use of dispersants and this application system? ☐ Yes ☐ No

Aerial application system:

- A qualified Dispersant Controller will be in a separate aircraft over the spray area(s)? ☐ Yes ☐ No
- Dispersant Controller will be able to direct operations and avoidance of fish and wildlife? ☐ Yes ☐ No

Boat application system:

- A qualified Dispersant Controller will oversee operations? ☐ Yes ☐ No
- System components meet relevant ASTM standards? ☐ Yes ☐ No

✓ **Attachment 4**: Description of dispersant application system and application team personnel name(s), title(s), affiliation(s), and qualifications.

COMMUNICATIONS PLAN

Describe the communications plan to be used for communications between and among the Unified Command, Dispersant Controller, SMART Team, and dispersant applications platform(s):

DISPERSANT MONITORING

Indicate the SMART monitoring to be used:

- Tier 1: ☐ Yes ☐ No
- Tier 2: ☐ Yes ☐ No
- Tier 3: ☐ Yes ☐ No

Describe other monitoring to be used:

Describe monitoring platform(s) that will be used:

Identify name, title, affiliation, and qualification of each monitoring team member:

SIGNATURES

Requestor:

____

Requester's Printed Name and Signature

Requester contact cell phone: ________________________

Date and time submitted to FOSC and, when appropriate, the SOSC:

________________________ ______________

Date Time

Received by:

________________________ ______________

FOSC Printed Name and Signature Date/Time

________________________ ______________

SOSC Printed Name and Signature Date/Time

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Tab 1, Part 3: Incident-Specific Resources at Risk

A. Information Considered

- ☐ Sensitive Areas information in the subarea contingency plan(s) (SCPs) for this incident, including any locations where dispersant use should be avoided
- ☐ Relevant Geographic Response Strategies in appropriate SCPs for this incident
- ☐ Incident-specific on-scene observations (e.g., by responders, local agency representatives, and local residents); identify name/affiliation: ___________________________________
- ☐ Others: ____

B. Biological Species (may not be a complete list of species present)

	Present/Absent/ or Unknown	Other Relevant Information	Used for Subsistence?
Endangered/Threatened/Candidate Species:			
Migratory birds (specify)			
Sea otters (southwest Distinct Population Segment)			
Polar bears			
Seals (specify)			
Toothed whales (specify)			
Baleen whales (specify)			
Sea Lions			
Other Species:			
Seabirds			
Diving birds (unlisted populations)			
Waterfowl (unlisted populations)			
Shorebirds			
Raptors (unlisted populations)			
Sea Otters (unlisted populations)			
Walruses			
Fur seals			
Other seals (unlisted populations)			
Toothed whales (unlisted populations)			
Baleen whales (unlisted populations)			
Ungulates			
Bears (brown and/or black)			
Furbearers			
Fish:			
Pelagic and larval			
Bottomfish			
Intertidal mollusks			
Crustacea			
Plankton (including larval species)			

Tab 1, Part 3: Incident-Specific Resources at Risk, Cont.

C. Habitat Types

	Present/Absent/Unknown	Other Relevant Information
Salt/brackish-water marshes		
Eelgrass beds/kelp beds		
Tidal mudflats		
Sheltered rocky shores/shallow reefs		
Gravel beaches		
Mixed sand and gravel beaches		
Coarse-grained sand beaches		
Peat shorelines		
Inundated low-lying tundra		
Ice (seasonal, multi-year)		
Marine mammal haul-outs/rookeries		
Migratory bird nesting colonies		
Fish spawning grounds		
Others:		

D. Special Designations

	Present/Absent/Unknown	Other Relevant Information
ESA designated critical habitats		
Essential Fish Habitat		
Legislatively-designated areas		
Native allotments		
Others:		

E. Historic Properties

	Present/Absent/Unknown	Other Relevant Information
Historic Resources		
Archaeological Resources		
Others:		

F. Other Considerations

	Present/Absent/Unknown	Other Relevant Information
Commercial harvest areas		
Subsistence harvest areas		
Recreational use areas		
Mariculture facilities		
Commercial facilities/activities		
Public infrastructure		
Others:		

Tab 1, Part 4: FOSC Dispersant Authorization Checklist*

	YES	NO	CONSIDERATIONS
1.	☐	☐	***Dispersant Use Request Received:*** The Requestor has submitted a completed Dispersant Use Request (Part 2).
			Notifications: The following entities have been notified of the potential dispersant use for this incident:
2a.	☐	☐	a) State On-Scene Coordinator (SOSC)
2b.	☐	☐	b) U.S. Environmental Protection Agency (EPA) Alaska Regional Response Team (ARRT) representative
2c.	☐	☐	c) U.S. Department of the Interior (DOI) ARRT representative
2d.	☐	☐	d) U.S. Department of Commerce (DOC) ARRT representative
2e.	☐	☐	e) Appropriate federally-recognized tribes (identify representative(s)): ________________________
2f.	☐	☐	f) Appropriate stakeholders (e.g., local governments, Native corporations, regional citizens' advisory councils) (identify representative(s)): ____
2g.	☐	☐	g) Agreed-upon monitoring team(s) and/or USCG Strike Team/Special Monitoring of Applied Response Technologies (SMART) Team.
3.	☐	☐	***Endangered Species Act (ESA) Consultations:*** The U.S. Fish and Wildlife Service (FWS) and/or National Marine Fisheries Service (NMFS) ESA contact(s) have been notified and, if appropriate, ESA Section 7 consultation(s) have begun in accordance with the ESA Memorandum of Agreement.
4.	☐	☐	***Essential Fish Habitat (EFH) Consultations:*** NMFS EFH contact has been notified and, if appropriate, EFH consultations have begun.
5.	☐	☐	***Dispersability:*** Available technical and scientific information, including results from the ADIOS model, suggests that the discharged oil is dispersible. The analysis delineates the conditions and timeframe in which the oil is no longer dispersable. Identify source(s) relied upon: ______________________________
6.	☐	☐	***NCP Listed Dispersant:*** The dispersant to be used is listed on the current NCP Product Schedule, is considered appropriate for the existing environmental and physical conditions, and its use is consistent with the recommended application information provided in the NCP Product Schedule Technical Notebook. Identify source(s) relied upon: ____
			Response Considerations:
7a.	☐	☐	a) Has mechanical response been deemed to be ineffective and/or inadequate? If yes, specify reason(s) (e.g., availability, effectiveness, timeliness, sea state, spatial coverage, weather conditions): ____
7b.	☐	☐	b) Is dispersant application being used to supplement mechanical recovery?
7c.	☐	☐	c) Is *in-situ* burning being considered in conjunction with mechanical recovery and dispersant use?
7d.	☐	☐	d) Is a map illustrating timing, tactics, and proximity of each response option to each other attached?
			Dispersant Availability and Timeliness: Sufficient dispersant application and monitoring equipment has been confirmed to be available:
8a.	☐	☐	a) to meet the conditions of use in the Dispersant Use Plan (see Part 2), and
8b.	☐	☐	b) to be deployable within the conditions and time frame the oil will be dispersible.
9.	☐	☐	***Weather and Sea Conditions:*** Predicted weather and sea conditions are conducive to dispersant application by the chosen system or platform. (Generally, for aerial application, wind ≤ 25 kts (28.77 mph), visibility ≥ 3 nm (3.45 miles), and ceiling ≥1,000 ft. Generally for boat application, a sea state that will allow the vessel to be used to conduct an effective and safe spray operation.) Identify any updated conditions: ____
10.	☐	☐	***Personal Protective Equipment (PPE):*** PPE for all personnel involved in, or affected by, dispersant application conforms to the site-specific health and safety plan and has been confirmed to be available.
			General Adequacy of Dispersant Spray System and Personnel Competency: Note: The general criteria for evaluating the suitability for use of any dispersant system is the ability of the Requestor to demonstrate to the satisfaction of the FOSC, the following: Has the application system been:
11a.	☐	☐	a) Specifically designed for its intended purpose, <u>or</u>
11b.	☐	☐	b) If not specifically designed for dispersant use, used previously and deemed to be effective and appropriate, and will be used again in a similar manner, <u>or</u>

Tab 1, Part 4: FOSC Dispersant Authorization Checklist, Cont.

	YES	NO	CONSIDERATIONS
11c.	☐	☐	c) If not specifically designed and not previously used for dispersant application, deemed to be effective and appropriate by some other specific means; if so, identify specific means: _________
11d.	☐	☐	d) Is the design and operation of the application system such that it can reasonably be expected to apply the chemical dispersant in a manner consistent with the dispersant manufacturer's recommendation, especially with regards to dosage rates, and concentrations?
11e.	☐	☐	e) Will the dispersant application be supervised by personnel that have experience, knowledge, specific training, and/or recognized competence with chemical dispersants and the type of system to be used?
			Aerial Application Operational and Technical Issues: In the case of aerial application of dispersants:
12a.	☐	☐	a) Is there a Dispersant Controller who will be over the spray area(s) in a separate aircraft from the dispersant aircraft while dispersants are being applied?
12b.	☐	☐	b) Is the Dispersant Controller qualified and able to direct the dispersant aircraft to maintain a 500 meter (1,640 feet) horizontal separation between the dispersant application and swarming fish, rafting flocks of birds, marine mammals in the water, and marine mammal haul-outs?
12c.	☐	☐	c) Is the aircraft spray system capable of producing dispersant droplet sizes that provide for optimal dispersant effectiveness (generally 250-500 µm), by following manufacturer and ASTM guidance?
			Boat Application Operational Technical Issues: If the system involves spray arms or booms that extend over the edge of a boat and has fan type nozzles that spray a fixed pattern of dispersant, has the Requestor confirmed that the dispersant application will comply with all of the following ASTM standards?
13a.	☐	☐	a) **ASTM F 1413-92** *Standard Guide for Oil Spill Dispersant Application Equipment: Boom and Nozzle Systems*
13b.	☐	☐	b) **ASTM F 1460-93** *Standard Practice for Calibrating Oil Spill Dispersant Application Equipment: Boom and Nozzle Systems*
13c.	☐	☐	c) **ASTM F 1737-96** *Standard Guide for Use of Oil Spill Dispersant Application Equipment during Spill Response: Boom and Nozzle Systems*
			Monitoring Protocols/Deployment:
14a.	☐	☐	a) Have the agreed-upon monitoring team(s) and/ or USCG Strike Team SMART Team been activated?
14b.	☐	☐	b) Are they prepared to fly over the response area to conduct Tier 1 visual monitoring during every dispersant application?
14c.	☐	☐	c) Are they prepared to implement the Tier 2 and Tier 3 water column monitoring component of the SMART monitoring protocols for every dispersant application?
14d.	☐	☐	d) Are wildlife observers prepared to accompany Tier 1 monitors to watch for swarming fish, rafting flocks of birds, marine mammals in the water, and marine mammal haul-outs?
14e.	☐	☐	e) Are there additional monitoring requirements? If so, identify: ________________________ and indicate if appropriate entities are prepared to implement any additional requirement?
15.	☐	☐	***Communications:*** Has a communications plan been developed that will allow communications between and among the Unified Command, Dispersant Controller, all monitoring team(s), and dispersant applications platform(s)?
16.	☐	☐	***Natural Resource Trustee Input:*** Has the FOSC received input from natural resource trustees on incident-specific resources at risk (see Part 3)?
			Conditions/Stipulations: Will the following application conditions and stipulations be included in any dispersant application?
17a.	☐	☐	a) All dispersant application field tests will be conducted on a representative portion of the slick.
17b.	☐	☐	b) Dispersant application will be in accordance with the approved dispersant application plan.
17c.	☐	☐	c) Dispersants will only be applied in areas where the water depth is ≥ 10 fathoms (60 feet).
17d.	☐	☐	d) Dispersant applications will maintain a minimum 500 meters (1,640 feet) horizontal separation from swarming fish, rafting flocks of birds, marine mammals in the water, and marine mammal haul-outs.

Tab 1, Part 4: FOSC Dispersant Authorization Checklist, Cont.

	YES	NO	CONSIDERATIONS
17e.	☐	☐	e) Federal Aviation Administration Temporary Flight Restrictions and Notice to Airmen and/or FWS flight and vessel restrictions to avoid disturbing walrus on haul-outs will be followed.
17f.	☐	☐	f) Dispersant applications will only be carried out in daylight conditions.
17g.	☐	☐	g) DOI and/or DOC (or a third party observer acceptable to DOI and/or DOC) will provide a specialist in aerial surveying of marine mammals and/or pelagic birds to accompany the SMART observer.
17h.	☐	☐	h) Monitoring protocols required by EPA, State, and/or DOI and DOC natural resource trustees (e.g., ESA compliance) will occur.
17i.	☐	☐	i) Prolonged dispersant application will be guided by the NRT "Environmental Monitoring for Atypical Dispersant Operations."
17j.	☐	☐	j) SMART Tier 1, 2, and 3 monitoring will occur during any dispersant application.
18.	☐	☐	***SOSC, EPA, DOI, and DOC Input:*** Has the FOSC received input from the EPA, DOI, and DOC ARRT representatives and, when appropriate, the SOSC on the dispersant request?
19.	☐	☐	***Federally-Recognized Tribe Input:*** Has the FOSC received input from appropriate federally-recognized tribes?
20.	☐	☐	***Stakeholder Input:*** Has the FOSC received input from appropriate stakeholders on the dispersant request?

* If "no" is checked for any of the above questions, the FOSC will document in Tab 1, Part 4, reasons for making that determination and what, if anything, may be done to change the response to "yes."

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Tab 1, Part 5: Dispersant Use Authorization Document[1]

Incident: ____

U.S. Department of the Interior Consultation by DOI ARRT Representative (for case-by case authorization only):

- o ______Does not support the use of dispersants (reasons attached)
- o ______Agrees with dispersant use in the selected areas under attached conditions
- o ______Agrees with dispersant use as requested in the application form

Signature	Printed Name	Time/Date

U.S. Department of Commerce Consultation by DOC ARRT Representative (for case-by-case authorization only):

- o ______Does not support the use of dispersants (reasons attached)
- o ______Agrees with dispersant use in the selected areas under attached conditions
- o ______Agrees with dispersant use as requested in the application form

Signature	Printed Name	Time/Date

U.S. Environmental Protection Agency Concurrence by EPA ARRT Representative (for case-by-case authorization only):

- o ______No dispersants may be applied (reasons attached)
- o ______Dispersants may be used in the selected areas under attached conditions
- o ______Dispersants may be applied as requested in the application form

Signature	Printed Name	Time/Date

State of Alaska Concurrence by State On-Scene Coordinator (for case-by-case authorization only):

- o ______No dispersants may be applied (reasons attached)
- o ______Dispersants may be used in the selected areas under attached conditions
- o ______Dispersants may be applied as requested in the application form

Signature	Printed Name	Time/Date

Federal On-Scene Coordinator Decision

- o ______No dispersants may be applied (reasons attached)
- o ______Dispersant use is postponed (reasons attached)
- o ______Dispersants may be used in the selected areas under attached conditions
- o ______Dispersants may be applied as requested in the application form (reasons attached for the basis of determining that dispersant use would minimize overall environmental impacts)

Signature	Printed Name	Time/Date

[1] This document shall be completed, as appropriate, for both a dispersant application field test and any subsequent request for full-scale application. Where signatures cannot be immediately obtained in person or via email or fax, verbal input will suffice until signatures can be obtained.

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TAB 2. DISPERSANT USE AFTER-ACTION REPORT

A draft dispersant use after-action report shall be prepared within 30 days of completion of the dispersant operation(s) or a timeframe agreed upon by the ARRT. The draft shall be to all signatories in Tab 1, Part 5, for a two-week review and comment period or a timeframe agreed upon by the ARRT. The final report, which shall address all comments received by the signatories, shall be submitted to all signatories in addition to UC, ARRT, and National Response Team members and all individuals identified in Step 2 of Tab 1, Part 1A and/or Part 1B.

The Dispersant Application After-Action Report shall focus on the following elements of the dispersant application and shall include the elements identified in the Report Outline below:

- An overview of the incident (prepared by the FOSC)
- A description of how the dispersant application(s) were conducted (prepared by the Requestor)
- A description of how Tier 1 monitoring was conducted and the results (prepared by the Tier 1 Monitoring Team)
- A description of how Tier 2 and Tier 3 monitoring was conducted and the results (prepared by the Tier 2 and 3 Monitoring Team)
- Description of how other dispersant monitoring was conducted and the results, if applicable (prepared by the individuals/team conducting the monitoring)
- Description of any adverse environmental effects associated with the dispersant application, such as impacts to fish and/or wildlife (e.g. disturbance, unintentional over-spray)
- Other elements requested by the FOSC or the ARRT

Report Outline
I. Incident Overview A. Background information 1. Cause or potential cause of spill, if known 2. Type and amount of oil spilled 3. Location of spill 4. Movement of oil slick, including any trajectories 5. Weathering and behavior of oil 6. Other pertinent information B. Response actions taken/effectiveness (e.g., mechanical recovery, protective booming, *in-situ* burning, dispersant use) C. Summary of decision-making process resulting in the authorization of a request for the use of dispersants, including the evaluation of whether the selected dispersant would work effectively on the oil discharged, if the dispersant could be effectively applied to the oil, and trade-offs associated with the potential impacts of dispersants, dispersed oil, and non-dispersed oil on the environmental and human-use areas, including when compared to other response options.

TAB 2. DISPERSANT USE AFTER-ACTION REPORT, Cont.

Report Outline, Cont.
II. Description and the Dispersant Application A. Description of dispersant application (including all dispersant application field test(s)) 1. Type and amount of dispersant applied 2. Type(s) of aircraft and/or vessel(s) used and dispersant system(s) used 3. Personnel directly involved in dispersant application (e.g., Dispersant Controller) and summary of their qualifications and experience 4. Location (shown on a map of appropriate scale), date, time, ratio of dispersant to oil, and total amount of dispersant applied for each dispersant application 5. Weather conditions at time(s) of each application, including sea state, water temperature, water salinity 6. Staging area, distance to region of application, and specifics regarding logistics (including time) involved in supporting the dispersant application 7. Communications used 8. Interaction between UC and field units carrying out guidance received 9. Spotter aerial observations 10. Description of any adverse environmental effects associated with the dispersant application, such as impacts to fish and wildlife (e.g., disturbance, unintentional over-spray) 11. Health and Safety Plan requirements (including Personal Protective Equipment) B. Lessons learned 1. What worked well 2. What needed improvement 3. Recommendations III. Description and Results of Tier 1 (Visual) Monitoring A. How the monitoring was carried out (e.g., method, vehicle, monitors, etc.) 1. Specifics regarding equipment and suitability of vessel(s) used 2. Description of observations regarding the dispersal of oil 3. Communications used and any associated problems 4. Operational support from the staging area, etc. 5. Interaction between the Incident Management Team (IMT) and the field units carrying out guidance received from the IMT B. Results of Tier 1 monitoring, including a copy of the National Oceanic and Atmospheric Administration (NOAA) Scientific Support Coordinator's (SSC) documentation on monitoring results and the Environmental Unit's (EU) recommendation to the FOSC C. Lessons learned 1. What worked well 2. What needed improvement 3. Recommendations IV. Description and Evaluation of Tier 2 and Tier 3 (Water Column) Monitoring A. How the monitoring was carried out (e.g. method, vehicle, monitors, etc.) 1. Specifics regarding equipment and suitability of the vessel(s) used

TAB 2. DISPERSANT USE AFTER-ACTION REPORT, Cont.

Report Outline, Cont.

2. Description of observations regarding the dispersal of oil
3. Communications used and any associated problems
4. Operational support from the staging area, etc.
5. Interaction between the IMT and the field units carrying out guidance received from the IMT

B. Results of Tier 2 and Tier 3 monitoring, including a copy of the NOAA SSC's documentation on monitoring results and the EU's recommendation to the FOSC

C. Lessons learned
1. What worked well
2. What needed improvement
3. Recommendations

V. Description and Evaluation of Additional Monitoring, if conducted

A. How the monitoring was carried out (e.g. method, vehicle, monitors, etc.)
1. Specifics regarding equipment and suitability of the aircraft/vessel(s) used
2. Description of observations
3. Communications used and any associated problems
4. Operational support from the staging area, etc.
5. Interaction between the IMT and the field units carrying out guidance received from the IMT

B. Results of monitoring

C. Lessons learned
1. What worked well
2. What needed improvement
3. Recommendations

VI. Additional Elements (as requested by the FOSC or ARRT)

Appendix [*This will include completed copies of Tab 1, Parts 2, 3, 4, and 5*]

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TAB 3. MONITORING PROTOCOLS

Part 1: Special Monitoring of Applied Response Technologies (SMART)

SPECIAL MONITORING of APPLIED RESPONSE TECHNOLOGIES

Developed by:

U.S. Coast Guard
National Oceanic and Atmospheric Administration
U.S. Environmental Protection Agency
Centers for Disease Control and Prevention
Minerals Management Service

Smoke rising from the *New Carissa*, February 1999. Photo by USCG

v. 8/2006

SMART is a living document

SMART is a living document. We expect that changing technologies, accumulated experience, and operational improvements will bring about changes to the SMART program and to the document. We would welcome any comment or suggestion you may have to improve the SMART program.

Please send your comments to:

SMART Mail
NOAA OR&R
7600 Sand Point Way N.E.
Seattle, WA 98115
USA

Fax: (206) 526-6329

Or email to:
smart.mail@noaa.gov

SMART approval status

As of January, 2001 EPA Regions II, III, and VI adopted SMART. It was reviewed and approved by the National Response Team (NRT).

Acknowledgments

Gracious thanks are extended to the members of the SMART workgroup for their tireless efforts to generate this document, to the many reviewers who provided insightful comments, and to the NOAA OR&R Technical Information Group for assistance in editorial and graphic design.

SMART is a Guidance Document Only

Purpose and Use of this Guidance:

This manual and any internal procedures adopted for its implementation are intended solely as guidance. They do not constitute rulemaking by any agency and may not be relied upon to create right or benefit, substantive or procedural, enforceable by law or in equity, by any person. Any agency or person may take action at variance with this manual or its internal implementing procedures. Mention of trade names or commercial products does not constitute endorsement or recommendation for their use by the USCG, NOAA, EPA, CDC, or the Government of the United States of America.

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v. 8/2006

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INTRODUCTION

The need for protocols to monitor response technologies during oil spills has been recognized since the early 1980s. Technological advances in dispersant applications and in situ burning (referred to as *applied response technologies*) have resulted in their increased acceptance in most regions in the U.S. Many regions have set up pre-approval zones for dispersant and in-situ burn operations, and established pre-approval conditions, including the requirement for monitoring protocols. This reaffirms the need for having national protocols to standardize monitoring, especially when the Federal Government assumes full responsibility for the response under the National Oil and Hazardous Substances Pollution Contingency Plan (Title 40 CFR Part 300). Protocols are also needed to serve as guidelines for assisting or overseeing industry's monitoring efforts during spills.

In November 1997, a workgroup consisting of Federal oil spill scientists and responders from the U.S. Coast Guard, the National Oceanic and Atmospheric Administration, the U.S. Environmental Protection Agency, and the Centers for Disease Control and Prevention, convened in Mobile, Alabama to draft guidelines for generating this protocol. The workgroup built upon currently available programs and procedures, mainly the Special Response Operations Monitoring Program (SROMP), developed in 1994, and lessons learned during spill responses and drills. The result of this collaboration is the Special Monitoring of Applied Response Technologies (SMART) program.

SMART establishes a monitoring system for rapid collection and reporting of real-time, scientifically based information, in order to assist the Unified Command with decision-making during in situ burning or dispersant operations. SMART recommends monitoring methods, equipment, personnel training, and command and control procedures that strike a balance between the operational demand for rapid response and the Unified Command's need for feedback from the field in order to make informed decisions.

SMART is not limited to oil spills. It can be adapted to hazardous substance responses where particulate air emissions should be monitored, and to hydrocarbon-based chemical spills into fresh or marine water.

General Information on SMART Modules

A. General Considerations and Assumptions

Several considerations guided the workgroup in developing the SMART guidelines:

1. SMART is designed for use at oil spills both inland and in coastal zones, as described in the National Oil and Hazardous Substances Pollution Contingency Plan.

2. SMART does not directly address the health and safety of spill responders or monitoring personnel, since this is covered by the general site safety plan for the incident (as required by 29 CFR 1910.120).

3. SMART does not provide complete training on monitoring for a specific technology. Rather, the program assumes that monitoring personnel are fully trained and qualified to use the equipment and techniques mentioned and to follow the SMART guidelines.

4. SMART attempts to balance feasible and operationally efficient monitoring with solid scientific principles.

5. In general, SMART guidelines are based on the roles and capabilities of available federal, state, and local teams, and NOAA's Scientific Support Coordinators (SSC). The SSC most

often fills the role of Technical Specialist, mentioned throughout the document. Users may adopt and modify the modules to address specific needs.

6. SMART uses the best available technology that is operationally practical. The SMART modules represent a living document and will be revised and improved based on lessons learned from the field, advances in technology, and developments in techniques.

7. SMART **should not** be construed as a regulatory requirement. It is an option available for the Unified Command to assist in decision-making. While every effort should be made to implement SMART or parts of it in a timely manner, **in situ burning or dispersant application should not be delayed** to allow the deployment of the SMART teams.

8. SMART is not intended to supplant private efforts in monitoring response technologies, but is written for adoption and adaptation by any private or public agency. Furthermore, users may choose to tailor the modules to specific regional needs. While currently addressing monitoring for in-situ burning and dispersant operations, SMART will be expanded to include monitoring guidelines for other response technologies.

9. It is important that the Unified Command agree on the monitoring objectives and goals early on in an incident. This decision, like all others, should be documented.

Organization

The SMART document is arranged in modules. Each module is self-sustaining and addresses monitoring of a single response technology. The modules are divided into three sections:

Section 1: Background Information provides a brief overview of the response technology being used, defines the primary purpose for monitoring, and discusses monitoring assumptions.

Section 2: Monitoring Procedures provide general guidelines on what, where, when, and how to monitor; information on organization; information flow; team members; and reporting of data.

Section 3: Attachments provide detailed information to support and expand sections 1 and 2.

MONITORING DISPERSANT OPERATIONS

1. BACKGROUND

1.1 Mission Statement

To provide a monitoring protocol for rapid collection of real-time, scientifically based information, to assist the Unified Command with decision-making during dispersant applications.

1.2 Overview of Dispersants

Chemical dispersants combine with oil and break a surface slick into small droplets that are mixed into the water column by wind, waves, and currents. The key components of a chemical dispersant are one or more surface-active agents, or surfactants. The surfactants reduce the oil-water interfacial tension, thus requiring only a small amount of mixing energy to increase the surface area and break the slick into droplets.

Several actions must occur for a surface oil slick to be chemically dispersed:

- The surfactant must be applied to the oil in an appropriate ratio;
- The surfactant must mix with the oil or move to the oil/water interface;
- The molecules must orient properly to reduce interfacial tension;
- Energy (such as waves) must be applied to form oil droplets; and
- The droplets must not recoalesce significantly.

Dispersants can be applied by air from airplanes and helicopters, by land using pumping/spray systems, or by boat. They are usually applied in small droplets and in lower volumes than the oil being treated.

1.3 Monitoring Dispersant Application

When dispersants are used during spill response, the Unified Command needs to know whether the operation is effective in dispersing the oil. The SMART dispersant monitoring module is designed to provide the Unified Command with real-time feedback on the efficacy of dispersant application. Data collected in Tier III of the SMART dispersant protocol may be useful for evaluating the dilution and transport of the dispersed oil. **SMART does not monitor the fate, effects, or impacts of dispersed oil.**

Dispersant operations and the need to monitor them vary greatly. Therefore, SMART recommends three levels (or tiers) of monitoring.

1. Tier I employs the simplest operation, visual monitoring, which may be coupled with Infra Red Thermal Imaging or other remote detection methods.

2. Tier II combines visual monitoring with on-water teams conducting real-time water column monitoring at a single depth, with water-sample collection for later analysis. **While fluorometry remains the most technologically advantageous detection method, other approaches may be considered. The performance-based guidelines provided in attachment 1 define SMART Dispersant Module criteria for instrument selection and validation.**

3. Tier III expands on-water monitoring to meet the information needs of the Unified Command. It may include monitoring at multiple depths, the use of a portable water laboratory, and/or additional water sampling. Tier III monitoring might for example include the redeployment of the monitoring team to a sensitive resource (such as near a coral reef system) as either a protection strategy or to monitor for evidence of exposure. In addition, Tier III might include the use of the monitoring

package for activities unrelated to actual dispersant operations such as monitoring of natural dispersion or to support surface washing activities where water column concerns have been identified. Any Tier III operation will be conducted with additional scientific input from the Unified Command to determine both feasibility and help direct field activities. The Scientific Support Coordinator or other Technical Specialists would assist the SMART Monitoring Team in achieving such alternative monitoring goals.

MONITORING PROCEDURES

Tier I: Visual Observations

Tier I recommends visual observation by a trained observer. A trained observer, using visual aids, can provide a general, qualitative assessment of dispersant effectiveness. Use of guides such as the NOAA *Dispersant Application Observer Job Aid* is recommended for consistency. Observations should be photographed and videotaped to help communicate them to the Unified Command, and to better document the data for future use.

When available, visual monitoring may be enhanced by advanced sensing instruments such as infrared thermal imaging. These and other devices can provide a higher degree of sensitivity in determining dispersant effectiveness.

Visual monitoring is relatively simple and readily done. However, visual observations do not always provide confirmation that the oil is dispersed. Tier II provides a near real-time method using water column monitoring via a direct reading instrument and water sampling.

Tier II: On-Water Monitoring for Efficacy

Sometimes dispersant operations effectiveness is difficult to determine by visual observation alone. To confirm the visual observations, a monitoring team may be deployed to the dispersant application area to confirm the visual observations by using real-time monitoring and water sampling. SMART defines it as Tier II monitoring.

Tier II prescribes single depth monitoring at 1-meter but rough field conditions may force continuous flow monitoring at increased depths of up to 2 meters. Water sampling may be conducted in concert with in-situ monitoring rather than collecting samples from the flow-through hose. Such a change may reduce direct comparisons between field instrument and laboratory verifications, but the data is still expected to meet mission requirements.

A water-column monitoring team composed of at least one trained technician and a support person is deployed on a suitable platform. Under ideal circumstances, the team collects data in three primary target locations: (1) background water (no oil); (2) oiled surface slicks prior to dispersant application, and (3) post-application, after the oil has been treated with dispersants. Data are collected in real-time by both a built-in data-logging device and by the technician who monitors the readings from the instrument's digital readout and records them in a sampling log. The sampling log not only provides a backup to the data logger, but allows the results to be communicated, near real-time, to the appropriate technical specialist in the Unified Command. Data logged by the instrument are used for documentation and scientific evaluation.

The field team should record the time, instrument readings, and any relevant observations at selected time intervals. Global Positioning System (GPS) instruments are used to ascertain the exact position of each reading.

If feasible, water samples should be collected in bottles to validate and quantify monitoring results. Samples should be collected at the outlet port or discharge side of the monitoring instrument to ensure the integrity of the readings. Exact time and position is noted for each sample taken to correlate the instrument reading. The number of water samples taken reflects the monitoring effort. Generally, five samples collected for each data run is considered adequate in addition to background samples. The water samples are stored in a cooler and sent to a laboratory for future analysis.

□□□ Tier □□□Additional Monitoring

Tiers I and II provide feedback to the Unified Command on the effectiveness of dispersant application. If dispersants are effective and additional information on the movement of the dispersed oil plume is desired, SMART Tier III procedures can address this need.

Tier III follows Tier II procedures, but collects information on the transport and dispersion of the oil in the water column. It helps to verify that the dispersed oil is diluting toward background levels. Tier III is simply an expanded monitoring role that is intended to meet the needs of the Unified Command.

Tier III monitoring may be conducted as follows:

1. Multiple depths with one instrument: This monitoring technique provides a cross-section of relative concentrations of dispersed oil at different depths, measuring the dilution of dispersed oil down to background levels. When transecting the dispersant-treated slick (as outlined for Tier II) the team stops the vessel at location(s) where elevated readings are detected at 1 meter and, while holding position, the team monitors and collects samples at multiple increments down to a maximum depth of 10 meters. Readings are taken at each water depth, and the data recorded both automatically in the instrument data logger and manually by the monitors. Manual readings should be taken at discreet time intervals of 2 minutes, 5 minutes, etc. as specified by the Monitoring Group Supervisor or as indicated in a written sampling plan developed by the Dispersant Technical Specialist.

2. Transect at two different depths: This technique also looks at changes in concentration trends, but uses two monitoring instruments at different depths as the monitoring vessel transects the dispersed oil slick while making continuous observations. It is done as follows:

   Monitoring is conducted at two different depths, 1 and 5 meters, or any two water depths agreed upon by the Incident Commander or the Unified Command. Two sampling setups and two separate monitoring instruments are used on a single vessel. The vessel transects the dispersant-treated slick as outlined in Tier II, except that now data are collected simultaneously for two water depths. While the data logger in each instrument automatically records the data separately, the monitoring team manually records the data from both instrument simultaneously at discrete time intervals of 2 minutes, 5 minutes, etc, as specified by the Monitoring Group Supervisor or the sampling plan developed by the Dispersant Technical Specialist. Comparison of the readings at the two water depths may provide information on the dilution trend of the dispersed oil.

3. Water parameters: In addition to instrument data, the Unified Command may request that water physical and chemical parameters be measured. This can be done by using a portable lab connected in-line with the instrument to measure water temperature, conductivity, dissolved oxygen content, pH, and turbidity. These data can help explain the behavior of the dispersed oil. The turbidity data may provide additional information on increased concentrations of dispersed oil if turbidity is elevated. The other physical and chemical parameters measure the characteristics of the water column that could possibly affect the rate of dispersion.

4. As in Tier II, water samples are collected, but in greater numbers to help validate instrument readings.

Calibration and documentation used for Tier II are valid for Tier III as well, including the use of a check standard to verify instrument response. Because of the increased complexity of Tier III, a dispersant technical specialist (e.g., member of the scientific support team) should be on location to assist the monitoring efforts.

A critical point to keep in mind is that in the hectic and rapidly changing conditions of spill response, flexibility and adaptability are essential for success. The sampling plan is dictated by many factors such as the availability of equipment and personnel, on-scene conditions, and the window of opportunity for dispersant application. The need for flexibility in sampling design, effort, and rapid deployment (possibly using a vessel of opportunity), may dictate the nature and extent of the monitoring. To assist the monitoring efforts, it is important that the unified command agrees on the goals and objectives of monitoring and chooses the Tier or combination thereof to meet the needs of the response.

Mobilizing Monitoring Resources

Dispersant application has a narrow window of opportunity. Time is of the essence and timely notification is critical. It is imperative that the monitoring teams and technical advisors are notified of possible dispersant application and SMART monitoring deployment as soon as they are considered, even if there is uncertainty about carrying out this response option. Prompt notification increases the likelihood of timely and orderly monitoring.

The characteristics of the spill and the use of dispersants determine the extent of the monitoring effort and, consequently, the number of teams needed for monitoring. For small-scale dispersant applications, a single visual monitoring team may suffice. For large dispersant applications several visual and water-column monitoring teams may be needed.

Using and Interpreting Monitoring Results

Providing the Unified Command with objective information on dispersant efficacy is the goal of Tier I and II dispersant monitoring. When visual observations and on-site water column monitoring confirm that the dispersant operation is not effective, the Unified Command may consider evaluating further use. If, on the other hand, visual observations and/or water column monitoring suggest that the dispersant operation is effective, dispersant use may be continued.

When using fluorometry, the readings will not stay steady at a constant level but will vary widely, reflecting the patchiness and inconsistency of the dispersed oil plume. Persons reviewing the data should look for trends and patterns providing good indications of increased hydrocarbon concentrations above background. As a general guideline only, a fluorometer signal increase in the dispersed oil plume of five times or greater over the difference between the readings at the untreated oil slick and background (no oil) is a strong positive indication. This should not be used as an action level for turning on or off dispersant operations. The final recommendation for turning a dispersant operation on or off is best left to the judgment of the Technical Specialist charged with interpreting the data. The Unified Command, in consultation with the Technical Specialist, should agree early on as to the trend or pattern that they would consider indicative or non-indicative of a successful dispersant operation. This decision should be documented.

SMART as Part of the ICS Organization

SMART activities are directed by the Operations Section Chief in the Incident Command System (ICS). A "group" should be formed in the Operations Section to direct the monitoring effort. The head of this group is the Monitoring Group Supervisor. Under each group there are teams: Visual

Monitoring Teams and Water Column Monitoring Teams. At a minimum, each monitoring team consists of two trained members: a monitor and an assistant monitor. An additional team member could be used to assist with sampling and recording. The monitor serves as the team leader. The teams report to the Monitoring Group Supervisor, who directs and coordinates team operations, under the control of the Operations Section Chief.

Dispersant monitoring operations are very detailed. They are linked with the dispersant application, but from an ICS management perspective, they should be separated. Resources for monitoring should be dedicated and not perform other operational functions.

Information Flow and Data Handling

Communication of monitoring results should flow from the field (Monitoring Group Supervisor) to those persons in the Unified Command who can interpret the results and use the data. Typically this falls under the responsibility of a Technical Specialist on dispersants in the Planning Section of the command structure. For the U.S. Coast Guard, the technical specialist is the Scientific Support Coordinator. Note that the operational control of the monitoring groups remains with the Operations Section Chief, but the reporting of information is to the Technical Specialist in the Planning Section.

The observation and monitoring data will flow from the Monitoring Teams to the Monitoring Group Supervisor. The Group Supervisor forwards the data to the Technical Specialist. The Technical Specialist or his/her representative reviews the data and, most importantly, formulates recommendations based on the data. The Technical Specialist communicates these recommendations to the Unified Command.

Quality assurance and control should be applied to the data at all levels. The Technical Specialist in the Planning section is the custodian of the data during the operation. The data belongs to the Unified Command. The Unified Command should ensure that the data are properly stored, archived, and accessible for the benefit of future monitoring operations.

□□ATTA□□M□□TS

The following attachments are designed to assist response personnel in implementing the SMART protocol. A short description of each attachment is provided below. Attachments may be modified as required to meet the stated objectives. **□hese attach□ents are sti□□a□id re□ated to the use of the □urner □esi□n □U□□instru□ent pac□a□e□□hou□d □onitorin□tea□s choose to chan□e to a□ternati□e instru□ent pac□a□es□i□e protoco□s □ou□d □e re□uired to insure proper trainin□□ docu□entation□and □□□□□**

□u□□er	**□it□e**	**□escription**
3.1	Roles and Responsibilities	Detailed roles and responsibilities for responders filling monitoring positions
3.2	Command, Control, and Data Flow	An ICS structure for controlling monitoring units and transferring monitoring results
3.3	Dispersant Observation General Guidelines	General guidelines for Tier I monitoring
3.4	Dispersant Observation Training Outline	Outline of what should be covered for Tier I observation training
3.5	Dispersant Observation Checklist	Equipment and procedure checklist for Tier I monitoring
3.6	Dispersant Observation Pre-Flight List	A checklist for getting air resources coordinated and ready for Tier I monitoring
3.7	Dispersant Observation Reporting Form	A form for recording Tier I observations
3.8	Dispersant Monitoring Training Outline	A training outline for water column monitoring done in Tiers II and III
3.9	Dispersant Monitoring Job Aid Checklist	A list of the tasks to accomplish before, during, and after the monitoring operations
3.10	Dispersant Monitoring Performance Guidelines	A list of performance guidelines for monitoring dispersants
3.11	Dispersant Monitoring Field Guidelines	Field procedures for using Tier II and III monitoring protocols
3.12	Dispersant Monitoring Water Sampling	Procedures for collecting water samples for Tiers II and III
3.13	Dispersant Monitoring Recorder Sheet	A form for recording fluorometer readings for Tiers II and III

Roles and Responsibilities

Visual Monitoring Team

The Visual Monitoring Team is ideally composed of two persons: a Monitor and an Assistant Monitor.

The Monitor:
- Functions as the team leader
- Qualitatively measures dispersant effectiveness from visual observation
- Communicates results to the Monitoring Group Supervisor.

The Assistant Monitor:
- Provides photo and visual documentation of dispersant effectiveness
- Assists the Monitor as directed.

Water-Column Monitoring Team

The Water-Column Monitoring Team is composed of a minimum of two persons: a Monitor and Assistant Monitor. They shall perform their duties in accordance with the Tier II and Tier III monitoring procedures.

The Monitor:
- Functions as the team leader
- Operates water-column monitoring equipment
- Collects water samples for lab analysis
- Communicates results to the Monitoring Group Supervisor.

The Assistant Monitor:
- Provides photo and visual documentation of dispersant effectiveness
- Assists Monitor as directed
- Completes all logs, forms, and labels for recording water column measurements, water quality measurements, interferences, and environmental parameters.

Monitoring Group Supervisor

The Monitoring Group Supervisor:
- Directs Visual Monitoring and Water Column Monitoring teams to accomplish their responsibilities
- Follows directions provided by the Operations Section in the ICS
- Communicates monitoring results to the Technical Specialist in the Planning Section
- The Monitoring Group Supervisor may not be needed for a Tier I deployment. In these cases, the Visual Monitoring Team monitor may perform the duties of the Monitoring Group Supervisor.

Dispersant Monitoring Technical Specialist Federal:

The Technical Specialist or his/her representative:
- Establishes communication with the Monitoring Group Supervisor
- Advises the Group Supervisor on team placement and data collection procedures
- Receives the data from the Group Supervisor
- Ensures QA/QC of the data, and analyzes the data in the context of other available information and incident-specific conditions
- Formulates recommendations and forwards them to the Unified Command
- Makes the recommendations and data available to other entities in the ICS
- Archives the data for later use, prepares report as needed.

Command, Control, and Data Flow

In general, dispersant monitoring operations take place as an integral part of the Incident Command System (see Figures 1 and 2).

Dispersant monitoring operations are tactically deployed by the Operations Section Chief or deputy, in cooperation with the Technical Specialist (SSC) in the Planning Section regarding the specifics of the monitoring operations, especially if they affect the data collected. The Monitoring Group Supervisor provides specific on-scene directions to the monitoring teams during field deployment and operations.

The observation and monitoring data flow from the Monitoring Teams to the Monitoring Group Supervisor. After initial QA/QC the Group Supervisor passes the data to the Technical Specialist to review, apply QA/QC if needed, and, most importantly, formulate recommendations based on the data. The Technical Specialist forwards these recommendations to the Unified Command.

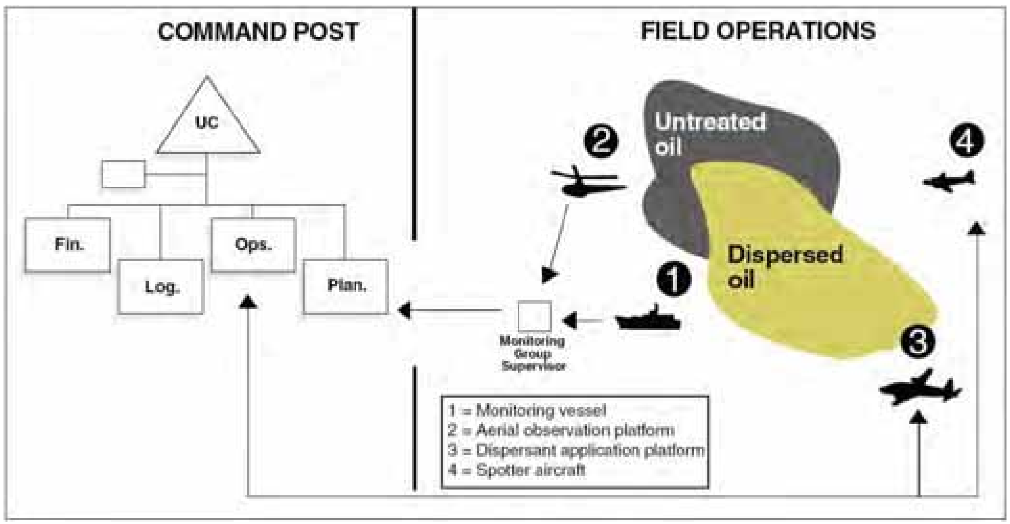

Figure 1. Command, control, and data flow during dispersant monitoring operations.

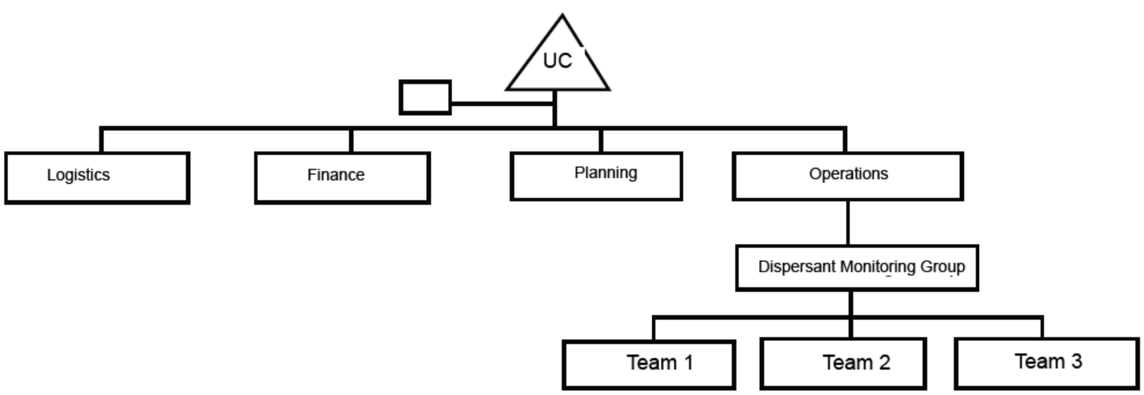

Figure 2. The Dispersant Monitoring Group in the ICS structure.

3.3 Dispersant Observation General Guidelines

3.3.1 Goal

The goal of Tier I monitoring is to identify oil, visually assess efficacy of dispersants applied to oil, and report the observations to the Unified Command with recommendations. The recommendations may be to continue, to modify, or to evaluate further monitoring or use because dispersants were not observed to be effective.

3.3.2 Guidelines and Pointers

<u>3.3.2.1 Reporting Observations</u>

- The observer does not make operational decisions, e.g., how much dispersant to apply, or when and where to apply it. These decisions are made at the Operations Section level, and the observer makes observations based on those decisions.

- Different observers at the same site may reach different conclusions about how much of the slick has been dispersed. For that reason, a comprehensive standard reporting criteria and use of a common set of guidelines is imperative. Use of the NOAA *Dispersant Application Observer Job Aid* is highly encouraged.

<u>3.3.2.2 Oil on the Water</u>

- Oil surface slicks and plumes can appear different for many reasons including oil or product characteristics, time of day (different sun angles), weather, sea state, rate at which oil disperses. The use of the NOAA *Open Water Oil Identification Job Aid for Aerial Observation* is highly recommended.

- Low-contrast conditions (e.g., overcast, twilight, and haze) make observations difficult.

- For best viewing, the sun should be behind the observer and with the aircraft at an altitude of about 200 - 300 feet flying at a 30-degree angle to the slick.

<u>3.3.2.3 Dispersant Applications</u>

- During dispersant application, it may be impossible to determine the actual area of thickest oil concentrations, resulting in variable oil/dispersant application rates. This could lead to variations in the effectiveness of application. The observer should report these conditions.

- Initial applications may have a herding effect on the oil. This would cause the slick to appear to be shrinking when, in fact, it is the dispersant "pushing" the oil together. Due to this effect, in some cases, the oil slick may even disappear from the sea surface for a short time.

- After dispersant application, there may be color changes in the emulsified slick due to reduction in water content and viscosity, and changes in the shape of the slick, due to the de-emulsification action of the dispersant.

- Many trials have indicated that dispersants apparently modify the spreading rates of oils, and within a few hours treated slicks cover much larger areas than control slicks.

- In some situations, especially where there may be insufficient mixing energy, oil may resurface.

<u>3.3.2.4 Effective/Ineffective Applications</u>

- Dispersed oil plume formation may not be instantaneous after dispersant application. In some cases, such as when the oil is emulsified, it can take several hours. A dispersed oil plume may not form at all.
- The appearance of the dispersed plume can range from brown to white (cloudy) to no visible underwater plume (this is why Tier II may be necessary).
- Sometimes other things such as suspended solids may resemble dispersed oil.
- The visibility of the dispersed plume will vary according to water clarity. In some cases, remaining surface oil and sheen may mask oil dispersing under the slick and thus interfere with observations of the dispersed oil plume.
- Dispersed oil plumes are often highly irregular in shape and non-uniform in concentration. This may lead to errors in estimating dispersant efficiency.
- If a visible cloud in the water column is observed, the dispersant is working. If a visible cloud in the water column is not observed, it is difficult to determine whether the dispersant is working.
- If there are differences in the appearance between the treated slick and an untreated slick, the dispersant may be working.
- Boat wakes through oil may appear as a successful dispersion of oil; however, this may be just the vessel wake breaking a path through the oil (physically parting the oil), not dispersing it.

Dispersant Observation Training Outline

Below is a suggested outline for dispersant observation training.

Topics and subtopics	**Duration**
Observation Platforms	30 min.
• Helo or fixed-wing, separate from application platform • Safety considerations: daylight; safe flying conditions • Logistical considerations: personnel; equipment; communication • Planning an over-flight	
Oil on Water	1 hour
• Physical properties • Different types of oil • Chemistry, crude vs. refined product • Appearance and behavior • Effects of wind, waves, and weather	
How dispersants work	45 min.
• Method of action • Compatible/incompatible products • Appropriate environmental conditions (wave energy, temperature, salinity, etc.) • Oil weathering • Oil slick thickness • Beaching, sinking, etc.	
Dispersant application systems	45 min.
• Platform: boat, helo, plan • Encounter rate • Importance of droplet size • Dispersant-to-oil ratio (dosage)	
Effective application	45 min.
• Hitting the target • Dispersal into water column • Color changes • Herding effect	
Ineffective application	30 min.
• Missing the target • Oil remaining on surface • Coalescence and resurfacing	
Wildlife concerns	30 min.
• Identifying marine mammals and turtles • Rafting birds	
Documenting observations	30 min.
• Estimating surface coverage • Photographs: sun reflection effects, use of polarizing filter, videotaping • Written notes and sketches	
Reporting observations	30 min.
• Calibrating eyeballs • Recommended format • Information to include • Who to report to • Coordination with water-column monitoring	

Dispersant Observation Checklist

Below is a dispersant observation checklist. Check √ the items/tasks accomplished.

Check √	**Item**
	Observation Aids
	Base maps / charts of the area
	Clipboard and notebook
	Pens / pencils
	Checklists and reporting forms
	Handheld GPS with extra set of batteries
	Observation job aids (*Oil on Water & Dispersant Observation*)
	Still camera
	Extra film
	Video camera
	Binoculars
	Safety Equipment
	Personal flotation device
	Emergency locator beacon
	Survival equipment
	NOMEX coveralls (if available)
	Coldwater flotation suit (if water temperature requires)
	Intercom
	Direct communications back to the Incident Command Post
	Safety Brief
	Preflight safety brief with pilot
	Safety features of aircraft (fire extinguishers, communications devices, emergency locator beacon, flotation release, raft, first aid kit, etc.)
	Emergency exit procedures
	Purpose of mission
	Area orientation / copy of previous over-flight
	Route / flight plan
	Duration of flight
	Preferred altitude
	Landing sites
	Number of people on mission
	Estimated weight of people and gear
	Gear deployment (if needed, i.e., dye marker, current drogue)
	Frequency to communicate back to command post

[illegible] Dispersant Observation Preflight List

Spill Information				
Incident Name:				
Source Name:				
Date / Time Spill Occurred				
Location of Spill: Latitude			Longitude	
Type of Oil Spilled:			Amount of Oil Spilled:	
Weather On Scene				
Wind Speed and Direction				
Visibility:			Ceiling:	
Precipitation:			Sea State:	

Aircraft Assignments

Title	**Name**	**Call Sign**	[illegible]	[illegible]
Spotter (s)				
Sprayer (s)				
Observer (s)				
Monitor (s)				
Supervisor				

Safety Check

Check all safety equipment. Pilot conducts safety brief

Entry/Exit Points

	Airport	**Tactical Call Sign**
Entry:		
Exit:		

Communications (complete only as needed; primary/secondary)

Observer to Spotter (air to air)	VHF	UHF	Other
Observer to Monitor (air to vessel)	VHF	UHF	Other
Observer to Supervisor (air to ground)	VHF	UHF	Other
Supervisor to Monitor (ground to vessel)	VHF	UHF	Other
Monitor to Monitor (vessel to vessel)	VHF	UHF	Other

Dispersant Observation Reporting Form

Names of observers/Agency: ______________________________

Phone/pager: ______________ Platform: ________________

Date of application: ________ Location: Lat.: _______ Long.: _______

Distance from shore: ____________

Time dispersant application started: _______ Completed: __________

Air temperature: _____ Wind direction ______ Wind speed: _______

Water temperature: ____ Water depth: _____ Sea state: ________

Visibility: ________________

Altitude (observation and application platforms): _________________

Type of application method (aerial/vessel): ____________________

Type of oil: _________________________

Oil properties: specific gravity _____ viscosity _____ pour point _______

Name of dispersant: ___________________________________

Surface area of slick: ___________________________________

Operational constraints imposed by agencies: ______________________

Percent slick treated: ____ Estimated efficacy: __________________

Visual appearance of application: _____________________________

Submerged cloud observed?__________________________________

Recoalescence (reappearance of oil): ____________________________

Efficacy of application in achieving goal (reduce shoreline impact, etc.): ________

____

Presence of wildlife (any observed effects, e.g., fish kill): ______________

Photographic documentation: ________________________________

Lessons learned: ______________________________________

____

□□ □luorometry Monitoring Training Outline

□□□ Genera□

Training for Tier II and III monitoring consists of an initial training for personnel involved in monitoring operations, Group Supervisor training, and refresher training sessions every six months. Emphasis is placed on field exercise and practice.

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Monitor Level Training includes monitoring concepts, instrument operation, workprocedures, and a field exercise.

□opic	**□uration**
Brief overview of dispersant monitoring. Review of SMART: What is it, why do it, what is it good for.	1 hour
Monitoring strategy: who, where, when. Reporting	1 hour
Basic instrument operation (hands-on): how the fluorometer works, how to operate: brief description of mechanism, setup and calibration, reading the data, what the data mean, troubleshooting; using Global Positioning Systems; downloading data; taking water samples	3 hours
Field exercise: Set up instruments within available boat platforms, measure background water readings at various locations. Using fluoroscein dye or other specified fluorescent source monitor for levels above background. Practice recording, reporting, and downloading data.	3-4 hours

□□□ Group □uper□isor □rainin□

Group Supervisor training may include:
- Independent training with the monitoring teams; or
- An additional structured day of training as suggested below

□opic	**□uration**
Review of ICS and role of monitoring group in it, roles of Monitoring Group Supervisor, what the data mean, QA/QC of data, command and control of teams, communication, and reporting the data.	1 hour
Field exercise. Practice deploying instruments in the field with emphasis on reporting, QA/QC of data, communication between teams and the Group Supervisor, and communication with the Technical Specialist.	3-6 hours
Back to the base, practice downloading the data.	30 min.
Lessons learned.	30 min.

[1] This training is designed for fluorometers. Other instruments could provide valid results, and may be suitable for SMART operations.

[illegible] Refresher Training

Topic	**Duration**
Review of SMART: What is it, why do it, what is its purpose.	15 min.
Monitoring and reporting: Who, where, and when; level of concern; what the data mean; communication; and reporting the data	30-45 min.
Basic instrument operation (hands-on): how the fluorometer works and how to operate it; brief description of the mechanism, setup, calibration, reading data, and troubleshooting; using GPS.	2 hours
Downloading data	30 min.
Field exercise: Outside the classroom, set up instrument on a platform, and measure background readings. Using fluorescence or other common input sources, monitor fluorescence levels. Practice recording, reporting, and downloading data.	1-3 hours
Lessons learned	30–45 min.

[illegible] Dispersant Monitoring Job Aid Checklist

This checklist is designed to assist SMART dispersant monitoring by listing some of the tasks to accomplish before, during, and after the monitoring operations.

Check √	Step	To
	Preparations	
	Activate personnel	• Contact and mobilize the monitoring teams and Technical Specialist (SSC where applicable)
	Check equipment	• Check equipment (use checklists provided) • Verify that the fluorometer is operational • Include safety equipment
	Obtain deployment platforms	Coordinate with incident Operations and Planning Section regarding deployment platforms (air, sea, land)
	Amend site safety plan	Amend the general site safety plan for monitoring operations.
	Monitoring Operations	
	Coordinate plan	• Coordinate with the Operations Section Chief • Coordinate with Technical Specialist
	Conduct briefing	• Monitoring: what, where, who, how • Safety and emergency procedures
	Deploy to location	Coordinate with Operations Section.
	Setup instrumentation	• Unpack and set up the fluorometer per user manual • Record fluorometer response using the check standards
	Evaluate monitoring site	• Verify that the site is safe • Coordinate with spotter aircraft (if available)
	Conduct monitoring (See attachment 11 for details)	• Background, no oil present • Background, not treated with dispersants • Treated area
	Conduct data logging (see attachment 12)	• Date and time • Location (from GPS) • Verify that the instrument data logger is recording the data • Manually record fluorometer readings every five minutes • Record relevant observations
	Conduct water sampling (see attachment)	• Collect water samples post-fluorometer in certified, clean, amber bottles for lab analysis
	Conduct photo and video documentation	• Document relevant images (e.g., monitoring procedures, slick appearance, evidence of dispersed oil)
	Conduct quality assurance and control	• Instrument response acceptable? • Check standards current? • Control sampling done at oil-free and at untreated locations? • Water samples in bottles taken for lab analysis? • Date and time corrected and verified? • Any interfering factors?

	Report (by Teams)	Report to Group Supervisor: • General observation (e.g., dispersed oil visually apparent) • Background readings • Untreated oil readings • Treated oil readings
	Report (by Group Supervisor)	Report to Technical Specialist: • General observation • Background readings • Untreated oil readings • Treated oil readings
	Report by Technical Specialist (SSC)	Report to Unified Command: • Dispersant effectiveness • Recommendation to continue or re-evaluate use of dispersant.
	Post Monitoring	
	Conduct debrief	• What went right, what can be done better • Problems and possible solutions • Capture comments and suggestions
	Preserve data	• Send water samples to the lab • Download logged data from fluorometer to computer • Collect and review Recorder data logs • Correlate water samples to fluorometer readings • Generate report
	Prepare for next spill	Clean, recharge, restock equipment

Dispersant Monitoring Performance Guidelines

SMART does not require nor endorse a specific instrument or brand for dispersant monitoring. Rather, SMART specifies performance criteria, and instruments meeting them may be used for monitoring.

1) Instrument package must be field rugged and portable. Instrument package must be able to operate from a vessel or small boat under a variety of field conditions, including air temperatures between 5 and 35°C, water temperatures between 5 and 30°C, seas to 5 feet, humidity up to 100%, drenching rain, and even drenching sea spray. The criteria for field deployment should be limited by the safety of the field monitoring team and not instrument package limitations.
2) Instrument package must be able to operate continuously in real-time or near-real time mode by analyzing seawater either in-situ (instrument package is actually deployed in the sea) or ex-situ (seawater is continuously pumped from a desired depth).
3) Monitoring depth must be controllable to between 1 meter and 3 meters. Discrete water sampling for post-incident laboratory validation is required at the same depths as actual instrument monitoring. Note, actual analysis of water samples collected may or may not be required by the FOSC.
4) Instrument must be able to detect dispersed crude oil in seawater. To allow a wide range of instruments to be considered, no specific detection method is specified. If fluorometry is used, the excitation and emission wavelengths monitored should be selected to enhance detection of crude oil rather than simply hydrocarbons, in order to reduce matrix effects (for the Turner AU-10, long wavelength kits developed for oil detection are preferred over the short wavelength kits developed by the manufacture for other applications).
5) Instrument must be able to provide a digital readout of measured values. Given that different oils that have undergone partial degradation due to oil weathering will not provide consistent or accurate concentration data, measured values reported as "raw" units are preferred for field operations over concentration estimations that might be misleading as to the true dispersed oil and water concentrations.
6) In additional to a digital readout (as defined above), the instrument must be able to digitally log field data for post-incident analysis. Data logging must be in real-time, but downloading of achieved data is not required until after the monitoring activity, i.e., downloading the raw data to a computer once the boat has returned from the field operation is acceptable.
7) For instrument validation prior to operational use, the instrument must have a minimum detection limit (MDL) of 1 ppm of dispersed fresh crude oil in artificial seawater and provide a linear detection to at least 100 ppm with an error of less than 30% compared to a known standard. The preferred calibration oil is Alaskan North Slope Crude or South Louisiana Crude (the oils specified by the EPA's Dispersant Effectiveness). Similar dispersible crude oils may be used if availability is a limitation (diesel fuel is not a suitable substitute). Some method of instrument calibration or validation is required on-scene prior to any operational monitoring for Quality Assurance/Quality Control (QA/QC). In the past, the use of a fluorescent dye at a concentration that would provide an equivalent value of 18 ppm for fresh ANS Crude was used for both calibration and field validation.

3.11 Dispersant Monitoring Field Guidelines

3.11.1 Overview

Dispersant monitoring with fluorometers employs a continuous flow fluorometer at adjustable water depths. Using a portable outrigger, the sampling hose is deployed off the side of the boat and rigged so that the motion of the boat's propeller or the wake of the sampling boat does not disrupt the sampling line. The fluorometer is calibrated with a check standard immediately prior to use in accordance with the operator's manual. In addition, water samples are collected for confirmation by conventional laboratory analysis.

3.11.2 Tier III Monitoring Operations

3.11.2.1 Monitoring Procedures

Monitoring the water column for dispersant efficacy includes three parts:

1. Water sampling for background reading, away from the oil slick;
2. Sampling for naturally dispersed oil, under the oil slick but before dispersants are applied; and
3. Monitoring for dispersed oil under the slick area treated with dispersants.

3.11.2.2 Background sampling, no oil

En route to the sampling area and close to it, the sampling boat performs a monitoring run where there is no surface slick. This sampling run at 1-meter depth (or deeper depending on sea state conditions) will establish background levels before further sampling.

3.11.2.3 Background sampling, naturally dispersed oil

When reaching the sampling area, the sampling boat makes the sampling transects at 1-meter depths across the surface oil slick(s) to determine the level of natural dispersion before monitoring the chemical dispersion of the oil slick(s).

3.11.2.4 Monitoring of dispersed oil

After establishing background levels outside the treated area, the sampling boat intercepts the dispersed subsurface plume. The sampling boat may have to temporarily suspend continuous sampling after collecting baseline values in order to move fast enough to intercept the plume. The sampling boat moves across the path of the dispersed oil plume to a point where the center of the dispersed plume can be predicted based on the size of the treatment area and the locations of new coordinates. The sampling boat may have to be directed by an aerial asset to ensure correct positioning over the dispersed slick.

When conducting the monitoring, the transects consist of one or more "legs," each leg being as close as possible to a constant course and speed. The recommended speed is 1-2 knots. The monitoring team records the vessel position at the beginning and end of each leg.

The instrument data may be reviewed in real time to assess the relative enhanced dispersion of the water-soluble fraction of the oil. Figure 1 shows an example of how the continuous flow data may be presented.

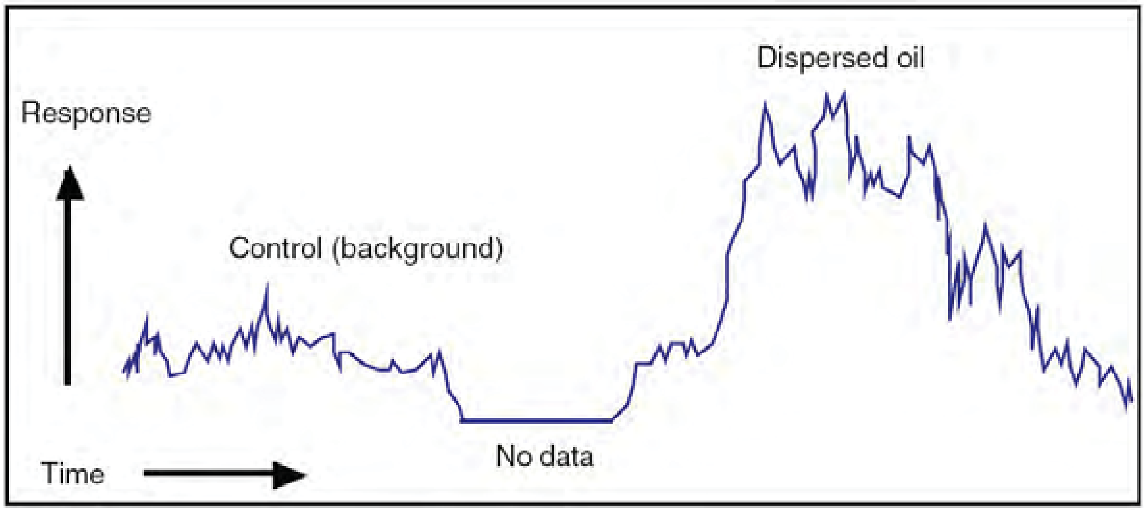

Figure 1. Example of a graphical presentation of fluorometer data.

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The observation aircraft identifies the target slick or target zone for the sampling vessel by a four-corner box (Figure 2). Each corner of the box is a specific latitude/longitude, and the target zone is plotted on a chart or map for easy reference. The sampling vessel positions near the slick and configures the fluorometer sampling array. The pre-application sampling transect crosses the narrow width of the box. After completing the sampling transect, the sampling vessel waits at a safe distance during dispersant application. Data logging may continue during this period. Fifteen to twenty minutes after dispersants have been applied, the observation aircraft generates a second box by providing the latitude and longitude coordinates of the four corners corresponding to any observed dispersed oil plume. The post-application transect is identical to the pre-application transect. If no plume is observed, the sampling vessel samples the same transect used for pre-application.

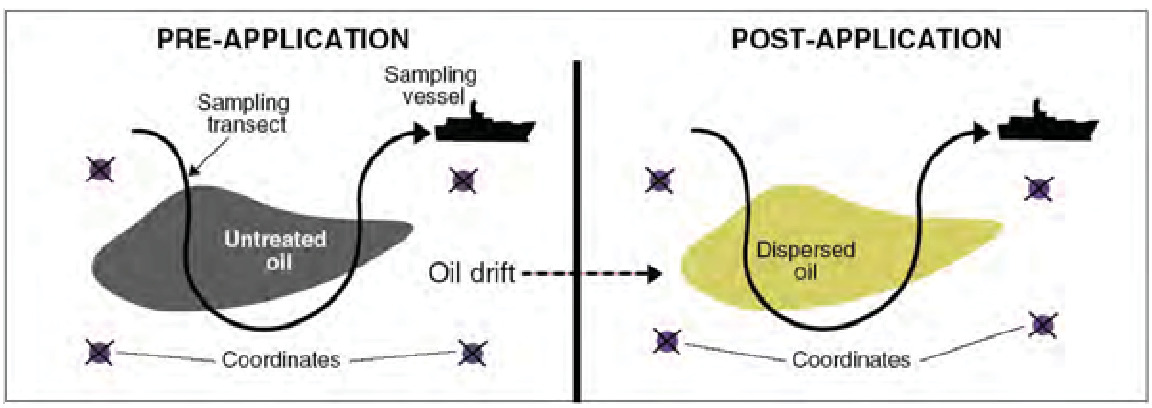

Figure 2. The box coordinates Method.

□□□□ □ier □□□ onitorin□ □perations

If monitoring indicates that dispersant application is effective, the Unified Command may request that additional monitoring be done to collect information on the transport and dilution trends of the dispersed oil. Tier III may be conducted to address this information need. Tier III is highly flexible. Any Tier III operation will be conducted with additional scientific input from the Unified Command to determine both feasibility and help direct field activities. The Scientific Support Coordinator or other Technical Specialists would assist the SMART Monitoring Team in achieving such alternative monitoring goals.

3.11.4.1 Multiple Depths with One Instrument

This monitoring technique provides a cross section of relative concentrations of dispersed oil at different depths. To conduct this operation, the team stops the vessel while transecting the dispersant-treated slick at a location where the fluorometry monitoring at the one-meter depth indicated elevated readings. While holding steady at this location, the team lowers the fluorometer sampling hose at several increments down to approximately ten meters (Figure 7). Monitoring is done for several minutes (2-3 minutes) for each water depth, and the readings recorded both automatically by the instrument's data logger and manually by the monitoring team, in the data logging form. This monitoring mode, like Tier II, requires one vessel and one fluorometer with a team to operate it.

3.11.4.2 Simultaneous Monitoring at Two Different Depths.

If two fluorometers and monitoring setups are available, the transect outlined for Tier II may be expanded to provide fluorometry data for two different water depths (one and five meters are commonly used). Two sampling set-ups (outriggers, hoses, etc.) and two separate fluorometers (same model) are used, all on a single vessel, with enough monitoring personnel to operate both instruments. The team transects the dispersant-treated slick as outlined in Tier II, but simultaneously collect data for two water depths (Figure 7).

While the data logger in each instrument is automatically recording the data separately, the monitoring teams manually record the data from both instruments at the same time. Comparison of the readings at the two water depths may provide information on the dilution trend of the dispersed oil.

If requested by the Unified Command, water chemical and physical parameters may be collected by using a portable water quality lab in-line with the fluorometer to measure water temperature, conductivity, dissolved oxygen content, pH, and turbidity. These data can help explain the behavior of the dispersed oil.

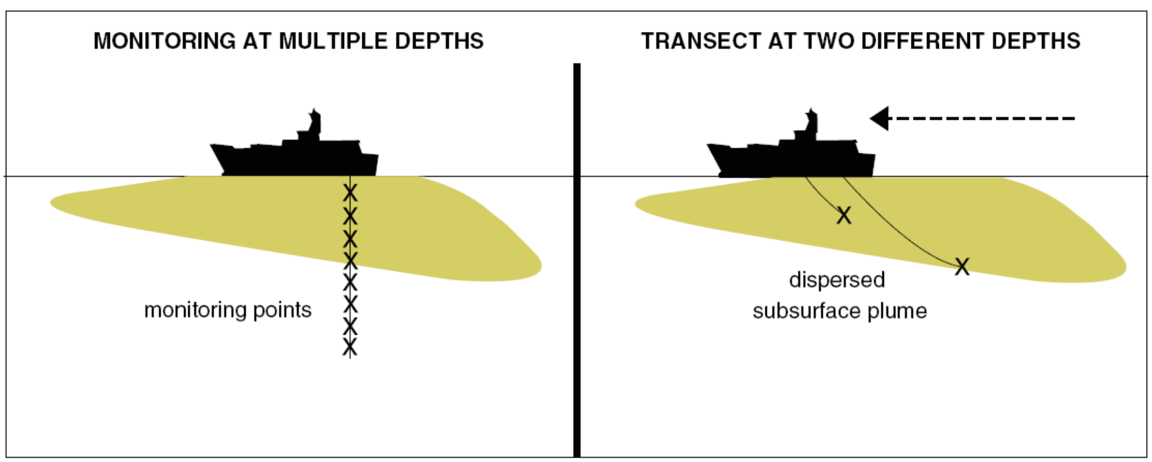

Figure 3: Monitoring options for Tier III.

3.12 Dispersant Monitoring Water Sampling

3.12.1 Purpose

Collection of water samples during Tier II and III monitoring should assist in correlating instrument readings in the field to actual dispersed oil concentrations in the water column. The samples provide validation of the field monitoring. The following guidelines were drafted for flow-through fluorometers. The procedures must be modified for alternative instruments. Such modifications might include discrete water sampling in concert with monitoring. The guidelines provided below are general, and should serve as an initial starting point for water sample collection. The number of samples collected may vary, depending on the operation and the need for verification.

3.12.2 Guidelines

3.12.2.1 Equipment

1. Certified pre-cleaned amber 500-ml bottles with Teflon™-lined caps.
   - For Tier II, a minimum of six bottles is required.
   - For Tier III, a minimum of thirteen bottles is required.

2. Labels for bottles documenting time and location of collection.

3. Observation notes corresponding fluorometer readings to water sample collection, and any other observations.

3.12.2.2 Procedure

1. Open valve for water sample collection and allow water to run for ten seconds before opening and filling the bottle.

2. Fill the bottle to the top and allow no headspace in bottles after sealing.

3. Label bottle with exact time of initial filling from the fluorometer clock as well as sampling depth, transect, and the distance of water hose from the outflow port of the fluorometer to the actual collection point of the water sample (to account for residence time of water in the hose)

4. Store filled bottles in a cooler with ice while on the monitoring vessel. Keep refrigerated (do not freeze) after returning to shore and send to the laboratory as soon as possible.

5. Measure and record the length of the hose between the fluorometer outlet and the bottle end, hose diameter, and flow rate (by filling a bucket). This will assist in accurately linking water sample results to fluorometer readings.

3.12.2.3 Number of Samples

1. Collect one water sample per monitoring depth during the background (no oil) transect. The fluorometer readings prior to collection should be relatively constant.

2. Collect two samples per monitoring depth during the pre-dispersant monitoring (under untreated oil slick). Try to collect water samples correlating with representative fluorometer values obtained.

3. Collect approximately three samples per monitoring depth during the post-dispersant transects. These samples should represent the range of high, middle, and low values obtained from the fluorometer screen.

4. Label the bottles and store them in a cooler with ice. Do not freeze. Enter water sample number, time, and correlated fluorometer reading in the Recorder Log for future data processing

Dispersant Monitoring Recorder Form

Date:_________________ Fluorometer #:______________
Project: ________________________ Platform: __________________________
Monitoring Start/End Time: __________
Team members: ____
On-scene weather (log all possible entries) Wind direction from: _____ Wind speed: _______
Sea state: ___________ Cloud cover: ____________ Visibility: _____________
Air temp. :__________ Sea temp.: _____________

Comments should include: Presence or lack of surface oil or dispersed oil plume, whether conducting background run, transect in relation to slick, instrument or gear problem, or any other noteworthy event. Positions should always be recorded when a sample is taken. Otherwise, a log entry every five minutes is sufficient.

Time	Water depth	Fluorometer reading	GPS reading	Sample taken	Comments / observations
			lat:_______________ long:		
			lat:_______________ long:		
			lat:_______________ long:		
			lat:_______________ long:		
			lat:_______________ long:		
			lat:_______________ long:		
			lat:_______________ long:		
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			lat:_______________ long:		

MONITORING IN SITU BURNING OPERATIONS

1. BACKGROUND

1.1 Mission Statement

To provide a monitoring protocol for rapid collection of real-time, scientifically based information to assist the Unified Command with decision-making during in situ burning operations.

1.2 Overview of In situ Burning

In situ burning of oil may offer a logistically simple, rapid, and relatively safe means for reducing the net environmental impact of an oil spill. Because a large portion of the oil is converted to gaseous combustion products, in situ burning can substantially reduce the need for collection, storage, transport, and disposal of recovered material. In situ burning, however, has several disadvantages: burning can take place only when the oil is not significantly emulsified, when wind and sea conditions are calm, and when dedicated equipment is available. In addition, in situ burning emits a plume of black smoke, composed primarily (80-85%) of carbon dioxide and water; the remainder of the plume is gases and particulates, mostly black carbon particulates, known as soot. These soot particulates give the smoke its dark color. Downwind of the fire, the gases dissipate to acceptable levels relatively quickly. The main public health concern is the particulates in the smoke plume.

With the acceptance of in situ burning as a spill response option, concerns have been raised regarding the possible effects of the particulates in the smoke plume on the general public downwind. SMART is designed to address these concerns and better aid the Unified Command in decisions related to initiating, continuing, or terminating in situ burning.

2. MONITORING PROCEDURES

2.1 General Considerations

In general, SMART is conducted when there is a concern that the general public may be exposed to smoke from the burning oil. It follows that monitoring should be conducted when the predicted trajectory of the smoke plume indicates that the smoke may reach population centers, and the concentrations of smoke particulates at ground level may exceed safe levels. Monitoring is not required, however, when impacts are not anticipated.

Execution of in situ burning has a narrow window of opportunity. It is imperative that the monitoring teams are alerted of possible in situ burning and SMART operations as soon as burning is being considered, even if implementation is not certain. This increases the likelihood of timely and orderly SMART operations.

2.2 Sampling and Reporting

Monitoring operations deploy one or more monitoring teams. SMART recommends at least three monitoring teams for large-scale burning operations. Each team uses a real-time particulate monitor capable of detecting the small particulates emitted by the burn (ten microns in diameter or smaller), a global positioning system, and other equipment required for collecting and documenting the data. Each monitoring instrument provides an instantaneous particulate concentration as well as the time-weighted average over the duration of the data collection. The readings are displayed on the instrument's screen and stored in its data logger. In addition, particulate concentrations are logged manually every few minutes by the monitoring team in the recorder data log.

The monitoring teams are deployed at designated areas of concern to determine ambient concentrations of particulates before the burn starts. During the burn, sampling continues and readings are recorded both in the data logger of the instrument and manually in the recorder data log. After the burn has ended and the smoke plume has dissipated, the teams remain in place for some time (15-30 minutes) and again sample for and record ambient particulate concentrations.

During the course of the sampling, it is expected that the instantaneous readings will vary widely. However, the calculated time-weighted average readings are less variable, since they represent the average of the readings collected over the sampling duration, and hence are a better indicator of particulate concentration trend. When the time-weighted average readings approach or exceed the Level of Concern (LOC), the team leader conveys this information to the In-Situ Burn Monitoring Group Supervisor (ISB-MGS) who passes it on to the Technical Specialist in the Planning Section (Scientific Support Coordinator, where applicable), which reviews and interprets the data and passes them, with appropriate recommendations, to the Unified Command.

Monitoring Locations

Monitoring locations are dictated by the potential for smoke exposure to human and environmentally sensitive areas. Taking into account the prevailing winds and atmospheric conditions, the location and magnitude of the burn, modeling output (if available), the location of population centers, and input from state and local health officials, the monitoring teams are deployed where the potential exposure to the smoke may be most substantial (sensitive locations). Precise monitoring locations should be flexible and determined on a case-by-case basis. In general, one team is deployed at the upwind edge of a sensitive location. A second team is deployed at the downwind end of this location. Both teams remain at their designated locations, moving only to improve sampling capabilities. A third team is more mobile and is deployed at the discretion of the ISB-MGS.

It should be emphasized that, while visual monitoring is conducted continuously as long as the burn takes place, air sampling using SMART is not needed if there is no potential for human exposure to the smoke.

Level of Concern

The Level of Concern for SMART operations follows the National Response Team (NRT) guidelines. As of March 1999, the NRT recommends a conservative upper limit of 150 micrograms of PM-10 per cubic meter of air, averaged over one hour. Furthermore, the NRT emphasizes that this LOC does not constitute a fine line between safe and unsafe conditions, but should instead be used as an action level: If it is exceeded substantially, human exposure to particulates may be elevated to a degree that justifies precautionary actions. However, if particulate levels remain generally below the recommended limit with few or no transitory excursions above it, there is no reason to believe that the population is being exposed to particulate concentrations above the EPA's National Ambient Air Quality Standard (NAAQS).

It is important to keep in mind that real-time particulate monitoring is one factor among several, including smoke modeling and trajectory analysis, visual observations, and behavior of the smoke plume. The Unified Command must determine early on in the response what conditions, in addition to the LOC, justify termination of a burn or other action to protect public health. The Unified Command should work closely with local Public Health organizations in determining burn termination thresholds.

When addressing particulate monitoring for in situ burning, the NRT emphasizes that concentration trend, rather than individual readings, should be used to decide whether to continue or terminate the burn. For SMART operations, the time-weighted average (TWA) generated by the particulate monitors should be used to ascertain the trend. The NRT recommends that burning not take place if the air quality in the region already exceeds the NAAQS and if burning the oil will add to the particulate exposure concentration. SMART can be used to take background readings to indicate whether the region is within the NAAQS, before the burn operation takes place. The monitoring teams should report ambient readings to the Unified Command, especially if these readings approach or exceed the NAAQS.

SMART as Part of the ICS Organization

SMART activities are directed by the Operations Section Chief in the Incident Command System (ICS). It is recommended that a "group" be formed in the Operations Section that directs the monitoring effort. The head of this group is the Monitoring Group Supervisor. Under each group there are monitoring teams. At a minimum, each monitoring team consists of two trained members: a monitor and assistant monitor. An additional team member could be used to assist with sampling and recording. The monitor serves as the team leader. The teams report to the Monitoring Group Supervisor who directs and coordinates team operations, under the control of the Operations Section Chief.

Information Flow and Data Handling

Communication of monitoring results should flow from the field (Monitoring Group Supervisor) to those persons in the Unified Command who can interpret the results and use the data. Typically, this falls under the responsibility of a Technical Specialist on in-situ burning in the Planning Section of the command structure.

The observation and monitoring data will flow from the Monitoring Teams to the Monitoring Group Supervisor. The Group Supervisor forwards the data to the Technical Specialist. The Technical Specialist or his/her representative reviews the data and, most importantly, formulates recommendations based on the data. The Technical Specialist communicates these recommendations to the Unified Command.

Quality assurance and control should be applied to the data at all levels. The Technical Specialist is the custodian of the data during the operation, but ultimately the data belongs to the Unified Command. The Unified Command should ensure that the data are properly archived, presentable, and accessible for the benefit of future monitoring operations.

□□ ATTA□□M□□TS

The following attachments are designed to assist response personnel in implementing the SMART protocol. A short description of each attachment is provided below.

Number	Title	Description
3.1	Roles and Responsibilities	Provides detailed roles and responsibilities for responders filling monitoring positions
3.2	Command, Control, and Data Flow	A suggested ICS structure for controlling monitoring units and transferring monitoring results
3.3	ISB Monitoring Training Outline	General training guidelines for ISB monitoring
3.4	ISB Monitoring Job Aid Checklist	A checklist to assist in assembling and deploying SMART ISB monitoring teams
3.5	ISB Monitoring Equipment List	A list of equipment needed to perform SMART operations
3.6	ISB Monitoring Instrumentation Requirements	Abbreviated performance requirements for particulate monitors
3.7	ISB Monitoring Recorder Sheet	A template for manual recording of burn data
3.8	ISB Monitoring Possible Locations	An example of monitoring locations for offshore ISB operations
3.9	ISB Monitoring Data Sample: Graph	An example of real ISB data

Roles and Responsibilities

Team Leader

The Team Leader
- Selects specific team location
- Conducts monitoring
- Ensures health and safety of team
- Ensures monitoring QA/QC
- Establishes communication with the group supervisor
- Conveys to him/her monitoring data as needed

Monitoring Group Supervisor

The Group Supervisor
- Oversees the deployment of the teams in the group
- Ensures safe operation of the teams
- Ensures QA/QC of monitoring and data
- Establishes communication with the field teams and the command post
- Conveys to the command post particulate level trends as needed
- Addresses monitoring technical and operational problems, if encountered

In-Situ Burn Technical Specialist

The Technical Specialist or his/her representative
- Establishes communication with the Monitoring Group Supervisor
- Receives the data from the Group Supervisor
- Ensures QA/QC of the data
- Analyzes the data in the context of other available information and incident-specific conditions, formulates recommendations to the Unified Command
- Forwards the recommendations to the Unified Command
- Makes the recommendations and data available to other entities in the ICS, as needed
- Archives the data for later use

Role and function	**Training**	**Number**
Monitoring Team Leader Leads the monitoring team	SMART Monitor Training	3
Monitor Assistant Assists with data collection.	SMART Monitor Training	3
Group Supervisor Coordinates and directs teams; field QA/QC of data; links with UC.	SMART Monitor training. Group Supervisor training	1 per group
Technical Specialist Overall QA/QC of data; reads and interprets data; provides recommendations to the Unified Command	SMART Monitor training. Scientific aspects of ISB	1 per response

Command, Control, and Data Flow

In general, in situ burn monitoring operations take place as an integral part of the Incident Command System (Figures 1 and 2).

ISB monitoring operations are directed by the Operations Section Chief or deputy. The Operations Section Chief provides the Monitoring Group Supervisor with tactical directions and support regarding deployment, resources, communications, and general mission as adapted to the specific incident. The Operations Section consults with the ISB monitoring Technical Specialist about the specifics of the monitoring operations, especially if they affect the data collected. The Monitoring Group Supervisor provides specific direction to the monitoring teams during field deployment and operations.

The observation and monitoring data flow from the Monitoring Teams to the Monitoring Group Supervisor. After initial QA/QC the Group Supervisor passes the data to the Technical Specialist. The Technical Specialist or his/her representative reviews the data, applies QA/QC if needed, and, most importantly, formulates recommendations based on the data. The Technical Specialist forwards these recommendations to the Unified Command.

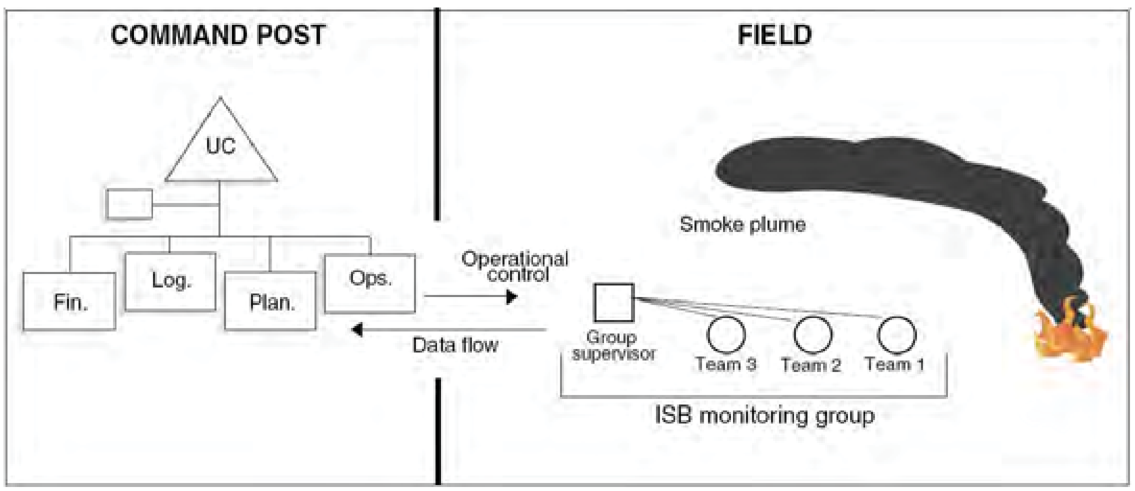

Figure 1. Command, control, and data flow during in-situ burning monitoring operations.

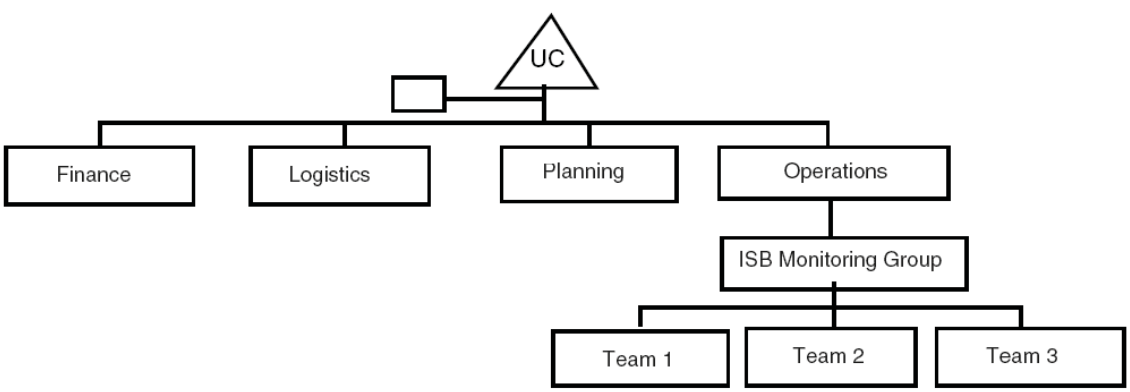

Figure 2. ISB Monitoring Group in the ICS organization.

ISB Monitoring Training Outline

General

Training for in-situ burning monitoring operations consists of an initial Monitor Level Training for all, Group Supervisor Training for supervisors, and refresher training sessions every six months for all.

Monitor Level Training

The Monitor Level Training includes monitoring concepts, instrument operation, work procedures, and a field exercise.

Topic	Duration
• Brief review of in-situ burning. • Review of SMART: What is it, why do it, what is it good for.	1 hour
• Monitoring strategy: Who, where, when. • Open water, inland. • Reporting: What and to whom • LOC: What is the LOC, how to report it. • Instantaneous reading vs. TWA, use of recorder data sheet	1 hour
• Basic instrument operation (hands-on): How the particulate monitoring instrument works, and how to operate it: brief description of mechanism, setup, and calibration, reading the data, what do the data mean; trouble shooting. • Using GPS • Downloading data	2 hours
Field exercise: Set up the instruments outdoors and measure background readings. Using a smoke source monitor for particulate levels, practice recording the data and reporting it. When done, practice downloading the data.	4 hours

Group Supervisor Training

Group Supervisor training may include two options:
• Independent training at each unit; or
• An additional structured day of training as suggested below

Topic	Duration
• Review of ICS and the role of the Monitoring Group in it • Roles of Monitoring Group Supervisor • What the data mean • QA/QC of data • Command and control of teams • Communication with the Technical Specialist	1 hour
Field exercise: Practice deploying instruments in the field with emphasis on reporting, QA/QC of data, communication between teams and the group supervisor, and group supervisor to the Technical Specialist.	3-6 hours
Back to the base, practice downloading the data	30 min.
Lessons learned	30 min.

□□□□ Refresher Training

Topic	Duration
Review of SMART: What is it, why do it, what is it good for.	15 min.
• Monitoring and reporting: Who, where, and when • Level of concern • What do the data mean • Reporting the data • Work with the Technical Specialist (SSC).	30-45 min.
• Basic instrument operation (hands-on): How the monitoring instrument works, how to operate it; brief description of mechanism, setup, and calibration; • Reading the data, trouble-shooting. • Using GPS.	2 hours
Downloading data	30 min.
• Field exercise: Outside the classroom, set up the instrument and measure background readings. Using a smoke source, monitor particulate levels. • Practice recording the data and reporting it. • Back to the base, download data.	1-2 hours

ISB Monitoring Job Aid Checklist

This checklist is designed to assist SMART in situ burning monitoring by listing some of the tasks to accomplish before, during, and after the monitoring operations.

Check √	Item	To Do
	Preparations	
	Activate personnel	Notify monitoring personnel and the Technical Specialist (SSC where applicable)
	Conduct equipment check	• Check equipment using equipment checkup list. • Verify that the monitoring instruments are operational and fully charged • Include safety equipment
	Coordinate logistics	Coordinate logistics (e.g., deployment platform) with ICS Operations
	Amend Site Safety Plan	Amend site safety plan to include monitoring operations
	Monitoring Operations	
	Monitoring Group setup	• Coordinate with Operations Section Chief • Coordinate with Technical Specialist
	Conduct Briefing	• Monitoring: what, where, who, how • Safety and emergency procedures
	Deploy to location	Coordinate with Operations Section Chief
	Select site	• Safe • Consistent with monitoring plan • As little interference as possible • Communication with Group Supervisor and UC possible
	Set up instrumentation	Unpack monitoring instruments and set up, verify calibration, if applicable
	Mark position	• Use GPS to mark position in recorder sheet • Re-enter position if changing location
	Collect background data	Start monitoring. If possible, record background data before the burn begins
	Collect burn data	• Continue monitoring as long as burn is on • Monitor for background readings for 15-30 minutes after the smoke clears
	Record data	Enter: • Instantaneous and TWA readings every 3-5 minutes, or other fixed intervals • Initial position from GPS, new position if moving • Initial wind speed and direction, air temperature, relative humidity, re-enter if conditions change
	Conduct quality assurance and control	• Verify that instrument is logging the data • Record data, location, relative humidity, temp, wind, interferences in the recorder data sheet • Note and record interference from other sources of particulates such as industry, vehicles, vessels

	Report by team	Report to Group Supervisor: • Initial background readings • TWA readings (every 15 min.) • TWA readings when exceeding 150 µg/m^3, (every 5 min.) • Interferences • Safety problems • QA/QC and monitoring problems
	Report by Group Supervisor	Report to the Technical Specialist (SSC): • Initial background readings • TWA, when exceeding 150 µg/m^3 • Data QA/QC and monitoring problems
	Report by Technical Specialist (SSC)	Report to the Unified Command: • TWA consistently exceeding 150 µg/m^3 • Recommend go/no-go
	Post Monitoring	
	Debrief and lessons learned	• What went right, what went wrong • Problems and possible solutions • Capture comments and suggestions
	Preserve data	• Download logged data from monitoring instrument to a computer • Collect and review Recorder data logs • Generate report
	Prepare for next burn	Clean, recharge, restock equipment

□□□ □S□ Monitoring □□uipment □ist

□□or each tea□ □un□ess other□ise noted□

□hec□ √	□te□	□t□	□e□ar□s
	Particulate monitoring instrument, accessories and manuals	1 or more	
	Computer and cables	1/group	Should include downloading software
	Printer	1/group	
	Recorder data sheets	10	
	Write-in-the-rain notebooks, pens	3	
	Job aid check list	1	
	GPS	1	
	Extra batteries for GPS	1 set	
	Radio	1	
	Cell phone	1	
	Binoculars	1	
	Stop watch	1	
	Camera	1	digital camera or camcorder optional
	Film	3	
	Thermometer	1	
	Humidity meter	1	
	Anemometer	1	

Particulate Monitor Performance Requirements

SMART does not require nor endorse a specific brand of particulate monitoring instrument. Rather, SMART specifies performance criteria, and instruments meeting them may be used for ISB monitoring.

Performance Criteria

- Rugged and portable: The monitor should be suitable for field work, withstand shock, and be easily transportable in a vehicle, small boat or helicopter. Maximum size of the packaged instrument should not exceed that of a carry-on piece of luggage
- Operating temperature: 15-120 ºF
- Suitability: The instrument should be suitable for the media measured, i.e., smoke particulates
- Operating duration: Eight hours or more
- Readout: The instrument should provide real-time, continuous readings, as well as time-weighted average readings in ug/m3
- Data logging: The instrument should provide data logging for 8 hours or more
- Reliability: The instrument should be based on tried-and-true technology and operate as specified
- Sensitivity: A minimum sensitivity of 1 µg/m^3
- Concentration range: At least 1-40000 µg/m^3
- Data download: The instrument should be compatible with readily available computer technology, and provide software for downloading data

ISB Monitoring Possible Locations

Monitoring locations are dictated by the potential for smoke exposure to human populations. In general, the monitoring teams deploy where the potential for human exposure to smoke is most probable. Precise monitoring locations should be flexible and determined on a case-by-case basis. In the figure below, one team is deployed at the upwind edge of a sensitive location (e.g., a town). A second team deploys at the downwind end of this location. Both teams stay at the sensitive location, moving only to improve sampling capabilities. A third team is more mobile, and deploys at the discretion of the Group Supervisor.

It should be emphasized that, while visual observation is conducted continuously as long as the burn takes place, air sampling using SMART is not required if there is no potential for human exposure to the smoke.

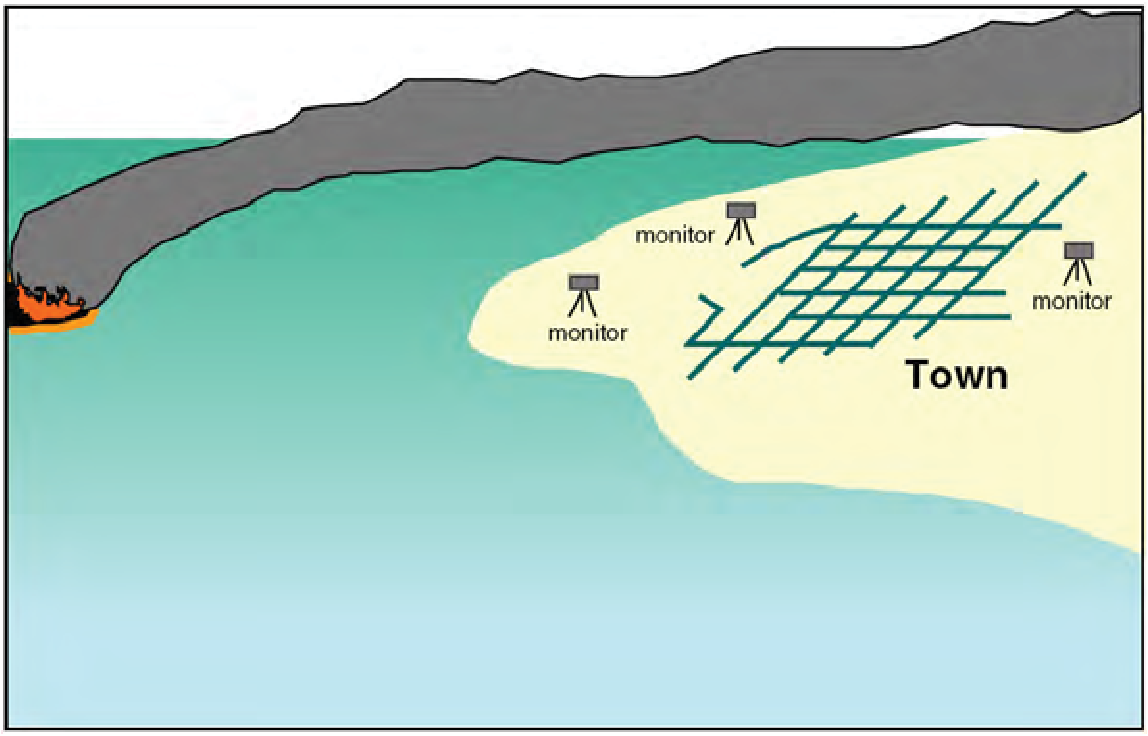

Figure 1. Possible locations of monitors (not to scale).

□□□ □S□ Monitoring Recorder S□eet

Date: __________ General Location: ________________________________

Genera□infor□ation	□ eather infor□ation
Recorder name	Temperature
Operator name	Wind direction
Vehicle/vessel #	Wind speed
Monitoring Instrument #	Relative humidity
Burn #	Cloud cover
Calibration factors:	

Comments should include: location of the smoke plume relative to the instrument, interfering particulate sources, any malfunction of the instrument

Time	G□S reading	□articulates concentration	□omments □ o□servations
	lat:_______________ long:	Inst: ________ TWA:	
	lat:_______________ long:	Inst: ________ TWA:	
	lat:_______________ long:	Inst: ________ TWA:	
	lat:_______________ long:	Inst: ________ TWA:	
	lat:_______________ long:	Inst: ________ TWA:	
	lat:_______________ long:	Inst: ________ TWA:	
	lat:_______________ long:	Inst: ________ TWA:	
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	lat:_______________ long:	Inst: ________ TWA:	
	lat:_______________ long:	Inst: ________ TWA:	
	lat:_______________ long:	Inst: ________ TWA:	

S Monitoring Data Sample Grap

The graph below represents field monitoring data from a test burn smoke plume near Mobile, Alabama, on September 25, 1997, after the data were downloaded from the instrument. The graph (Figure 1) portrays the differences between the transient instantaneous readings (Conc.) and the time weighted average readings (TWA). Note that while instantaneous readings varied widely, the TWA remained relatively constant throughout the burn. The TWA provides an indication of the concentration trends, which is a more stable and reliable indicator of exposure to particulates.

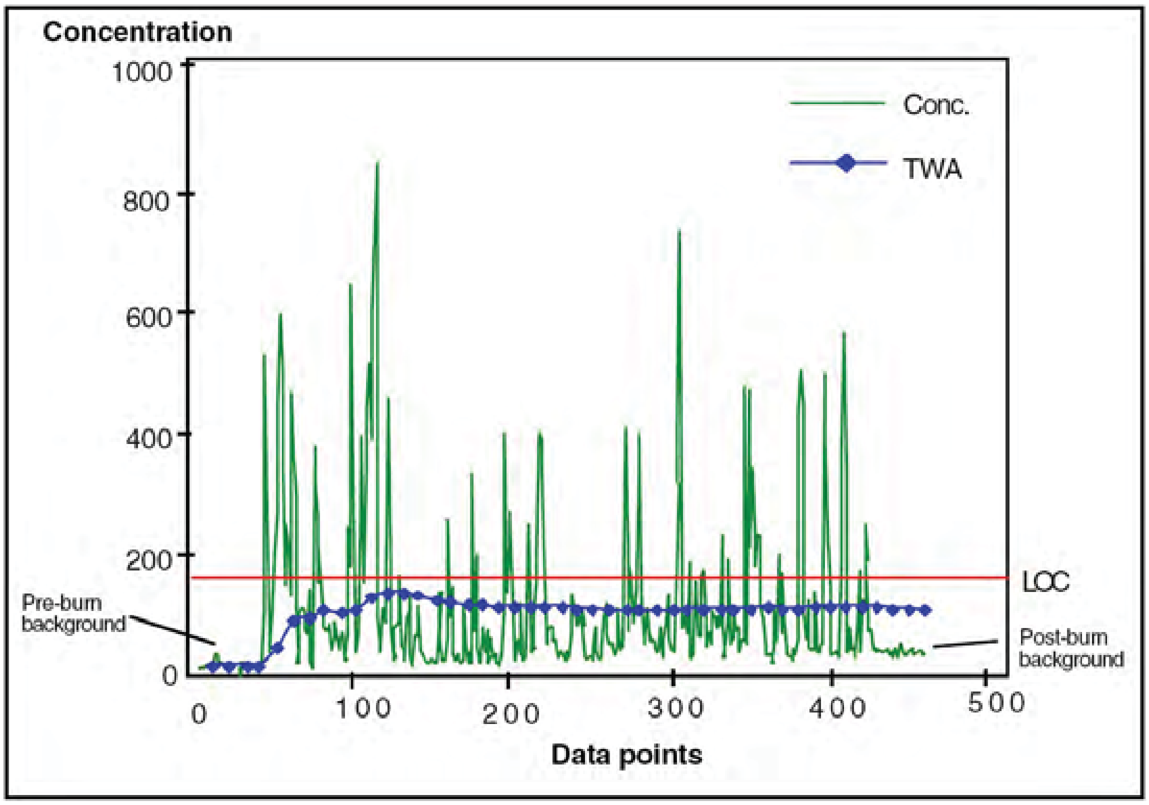

Figure 1. Graph of instantaneous and TWA particulate concentrations

SMART R□SO□R□□S

Comments and suggestions on the SMART program and document
Fax: (206) 526-6329; Email: smart.mail@noaa.gov

SMART Web Sites
http://response.restoration.noaa.gov/smart

In-situ Burning Page
http://response.restoration.noaa.gov/ISB

Dispersant Guided Tour
http://response.restoration.noaa.gov/dispersantstour

Dispersant Application Observer Job Aid
http://response.restoration.noaa.gov/dispersants_jobaid

US Coast Guard
http://www.uscg.mil/

USCG National Strike Force
http://www.uscg.mil/hq/nsfweb

NOAA OR&R
http://response.restoration.noaa.gov

EPA ERT
http://www.ert.org

CDC
http://www.cdc.gov/

MMS Oil Spill Response Research Program
http://www.mms.gov/taroilspills/

OHMSETT Facility
http://www.ohmsett.com/

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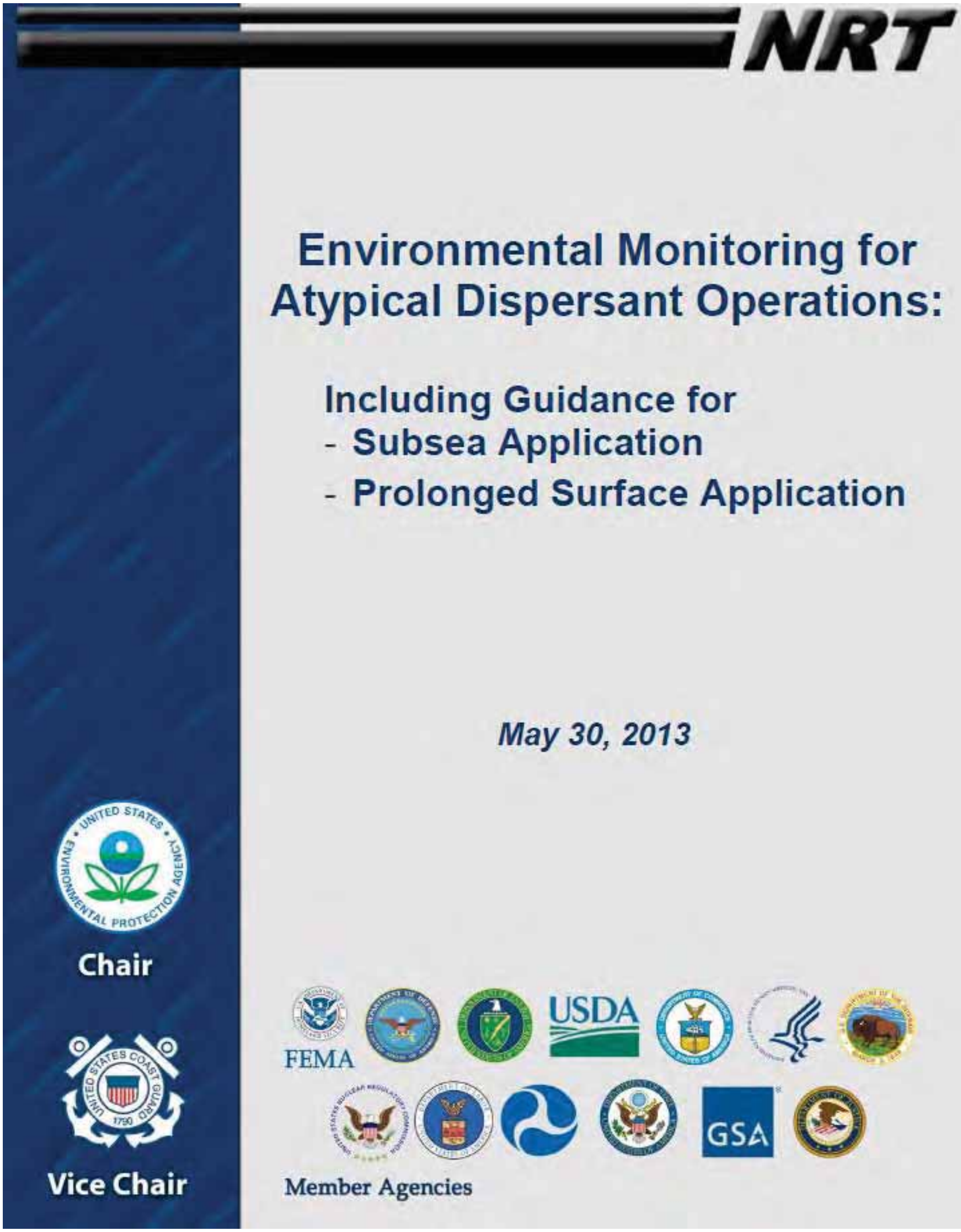
Part [illegible]: Environmental Monitoring for Atypical Dispersant Operations



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PREFACE

During the *Deepwater Horizon* event in the Gulf of Mexico, dispersant was applied using novel techniques and in amounts never seen in U.S. waters. For the first time, dispersant was injected at the source of the release at depths of nearly a mile, and in quantities approximating three quarters of a million gallons. In addition, aircraft and vessels deployed dispersant to the surface at volumes topping 1,000,000 gallons over the course of the response, quantities unsurpassed in North America. Such atypical uses of dispersant during a response were neither envisioned nor incorporated into existing Regional Response Team (RRT) dispersant use plans, nor were they addressed in the existing Special Monitoring of Applied Response Technologies (SMART) monitoring program.

Therefore, the National Response Team (NRT) developed the *Environmental Monitoring for Atypical Dispersant Operations: Including Guidance for Subsea Application and Prolonged Surface Application* (approved May 30, 2013) to assist On-Scene Coordinators (OSCs) and RRTs in making incident-specific decisions regarding atypical dispersant use, including expedited decision making.

The *Environmental Monitoring for Atypical Dispersant Operations* is a living document envisioned to continue addressing monitoring challenges as they become necessary; and, as resources allow, other atypical dispersant applications. In its current version, this document contains the following:

- ***Subsea Application Guidance –*** generally applies to the subsurface ocean environment, focusing particularly on operations in waters below 300 meters and below the average pycnocline.

- ***Prolonged Surface Application Guidance –*** supplements and complements the existing protocols as outlined in the SMART monitoring program where the duration of the application of dispersants on discharged oil extends beyond 96 hours from the time of the first application.

The *Environmental Monitoring for Atypical Dispersant Operations* may be adopted and/or modified to address specific needs. The RRTs may also use this guidance to inform their planning and response activities in an ocean environment, consistent with national policy. This guidance does not negate existing pre-authorization plans developed in accordance with 40 CFR 300.910(a) of the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). The NRT urges RRTs to actively engage with members of federal, state, local, tribal, and industry groups in using the guidance. The NRT's Science and Technology Committee expects that changing technologies, accumulated experience, and operational improvements will bring about revisions to the document.

Comments should be submitted to the attention of the NRT Science and Technology Committee Chair at NRTSandTCommittee@sra.com.

ACKNOWLEDGMENTS

The National Response Team (NRT) acknowledges and thanks the NRT member agencies, and state and federal agencies participating on the Regional Response Teams (RRTs), for their contributions in preparing this document.

Core contributing participation includes the following:

- U.S. Environmental Protection Agency
  - Office of Emergency Management
  - Office of Research and Development
- U.S. Coast Guard
  - Office of Marine Environmental Response Policy
  - Gulf Strike Team
- National Oceanic and Atmospheric Administration
  - Office of Response and Restoration
- U.S. Department of the Interior
  - Office of Environmental Policy and Compliance
  - Bureau of Ocean Energy Management
  - Bureau of Safety and Environmental Enforcement
- SRA International, Inc. (Contractor)
  - Energy, Environment, and Organizational Performance

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1.1 Introduction

The *Environmental Monitoring for Atypical Dispersant Operations* provides a resource for the Regional Response Team (RRT), in accordance with 40 CFR 300.910 of the National Oil and Hazardous Substances Pollution Contingency Plan (NCP), when considering the atypical use of dispersants before and during an oil discharge. This document, developed by National Response Team (NRT) member agency representatives, is intended for use when responding to oil discharges and for RRT development of Regional Contingency Plans and expedited decision making addressing dispersant use of this nature.

The data generated by the measures below are meant for use as an operational response decision-making tool and not as a part of the long-term Natural Resources Damage Assessment (NRDA) data gathering efforts that may apply to the dispersant operation or other parts of the response. However, all of the data collected as a function of the guidance may be made available to NRDA personnel as soon as practicable.

While this document does not recommend specific cut-off points for dispersant applications (e.g., based on quantity of oil, amount of dispersant applied, duration of application), it does recommend “key indicators” the On-Scene Coordinator (OSC), and other decision makers should consider during dispersant monitoring and application activities. These key indicators should be revisited repeatedly throughout the incident to help determine whether and when dispersants should be applied or continue to be applied. Actions taken based on key indicator data should also consider the resource tradeoffs associated with dispersant use.

This document is intended solely as guidance, does not constitute rulemaking or limit future rulemaking in any way by any agency and may not be relied upon to create any right or benefit, substantive or procedural, enforceable by law or in equity, by any person. Any agency or person may take action at variance with this guidance. Mention of trade names or commercial products does not constitute endorsement or recommendations for their use by the U.S. Environmental Protection Agency (EPA), U.S. Coast Guard (USCG), U.S. Department of Commerce (DOC) including the National Oceanic and Atmospheric Administration (NOAA), U.S. Department of the Interior (DOI) including the Bureau of Ocean Energy Management (BOEM) and the Bureau of Safety and Environmental Enforcement (BSEE), or the Government of the United States of America.

1.2 Guidance Objectives

The monitoring guidance does not impose regulatory requirements on oil development and production companies or impose Oil Spill Response Plan (OSRP) requirements. It is intended for use as a planning tool by each RRT, to be tailored to regional-specific concerns, needs, and environmental considerations. RRTs should use the guidance when modifying or reviewing existing Regional Contingency Plans to address lessons learned from the *Deepwater Horizon* event.

The guidance provides recommendations to RRTs for making incident-specific decisions concerning atypical dispersant applications. Authorization of the use of dispersants is governed by 40 CFR 300.910 of the NCP. The guidance recommends sampling and monitoring protocols that should be in place when atypical dispersant use for applicable situations is authorized.

1.3 General Scope and Assumptions

1) The guidance does not directly address the health and safety of spill responders or monitoring personnel, which is covered by the general site safety plan for the incident (as required by 29 CFR 1910.120). Field personnel should be trained under the Occupational Safety and Health Administration (OSHA) Hazardous Waste Operations and Emergency Response (HAZWOPER) requirements, as appropriate.

2) It is important that the Unified Command (UC) agree on the sampling and monitoring objectives, goals, and associated procedures and plans early on in an incident. However, the UC may modify these objectives and goals based on incident-specific circumstances. Authorization of use for all dispersant applications must be done in accordance with 40 CFR 300.910 of the NCP. Decisions to apply dispersants, like all other decisions, should be documented.

3) The OSC, with the concurrence of EPA and, as appropriate, the states, and in consultation with DOC and DOI natural resource trustees, retains the authority to direct the collection of data and/or to grant temporary deviation from one or more of the sampling or monitoring recommendations if deemed necessary due to incident-specific circumstances, field observations, and/or input from key stakeholders and technical specialists.

4) The OSC should establish a Dispersant Environmental Monitoring Unit (DEMU), comprised of government, academia (as practical) and the Responsible Party's (RP's) technical specialists, as appropriate, to coordinate and oversee the implementation of sampling and monitoring activities. The DEMU should be established as a part of Environmental Unit (EU) unless otherwise directed by the OSC, and in consultation with the OSC's Scientific Support Coordinator (SSC).

5) This document is not designed to be a monitoring plan specific to an individual oil discharge event. It is designed to provide general guidance for the development of a sampling and monitoring plan tailored to the actual discharge, taking into account the needs of a particular region. As such, prior to any atypical dispersant application, the RP should develop a detailed sampling and monitoring plan in coordination with the DEMU.

6) The guidance does not provide training on monitoring for a specific technology. Rather, the guidance assumes that monitoring personnel are fully trained and qualified to use the equipment and techniques mentioned and to follow those guidelines.

7) While the guidance should inform such policies, it is not intended to preempt or replace any RRT agreements currently in place that address dispersant operations discussed below.

8) The guidance attempts to balance feasible, operationally efficient, and scientifically sound monitoring activities with the understanding that atypical dispersant applications necessitate specific considerations beyond those addressed by Special Monitoring of Applied Response Technologies (SMART).

9) The NRT intends to revise and improve the guidance based on lessons learned from the field, advances in technology, and developments in techniques as appropriate, but recommends using the best available technologies and practices.

10) Relevant definitions can be found in 40 CFR 300.5 of the NCP. To the extent that other terms are defined herein, it is solely for clarity of this guidance.

11) The RP or appropriate technical specialist should consult with the manufacturer to identify any dispersant-specific marker compounds for monitoring purposes and confirm its suitability for use. Information on dispersant-specific markers should be used to advise the OSC and incorporated into all monitoring plans.

12) The guidance encourages a joint effort between governmental and RP personnel when the RP has been identified and is acting as a coordinating member of the UC established for the response. All monitoring data collected should be directed to the DEMU. Data management should be overseen by the Federal Government with full transparency and data sharing within the UC and with the RP.

13) The guidance is not intended to provide action levels or specific ecological levels of concern. These levels should be developed during case-by-case discussions between the UC and key stakeholders. However, action levels and levels of concern should be compatible with the ecological risk screening tools recommended in the guidance in order for these tools to be most useful.

14) The guidance provides a framework for the collection, analyses, and dissemination of pertinent data to key stakeholders so resource-tradeoff decision making can be supported.

15) Sections 3.0 *Communications and Reporting*, 4.0 *Quality Assurance Project Plan*, 5.0 *Airborne Volatile Organic Compounds*, 6.0 *Ecological Toxicity Assessment*, and 7.0 *Action Levels* apply to all atypical dispersant applications addressed in this guidance.

1.4 Dispersant Environmental Monitoring Unit (DEMU)

1) The DEMU, under the direction of the OSC, coordinates and oversees the implementation of the sampling and monitoring activities set forth in this guidance and, as appropriate, any additional sampling and monitoring activities required by circumstances of the particular response.

2) The DEMU is established within the EU under the Planning Section of the UC (see Figure 1), unless otherwise directed by the OSC. The DEMU is co-led by EPA and NOAA.

3) The SSC directly coordinates with the DEMU to ensure an unfiltered data flow to the OSC and government decision-makers, including the EPA representative and the federal Natural Resources Trustees.

4) As required, the DEMU will establish and operate task forces, in coordination with the Dispersants Group in the Operations Section, in order to facilitate sample collection, analysis and reporting.

5) The RP, when identified, has primary responsibility for sampling and monitoring activities during a response to a spill incident under the direction of the OSC, including financial and logistical support for the DEMU and any subordinate task force activities.

Dispersant Environmental Monitoring Unit (DEMU)

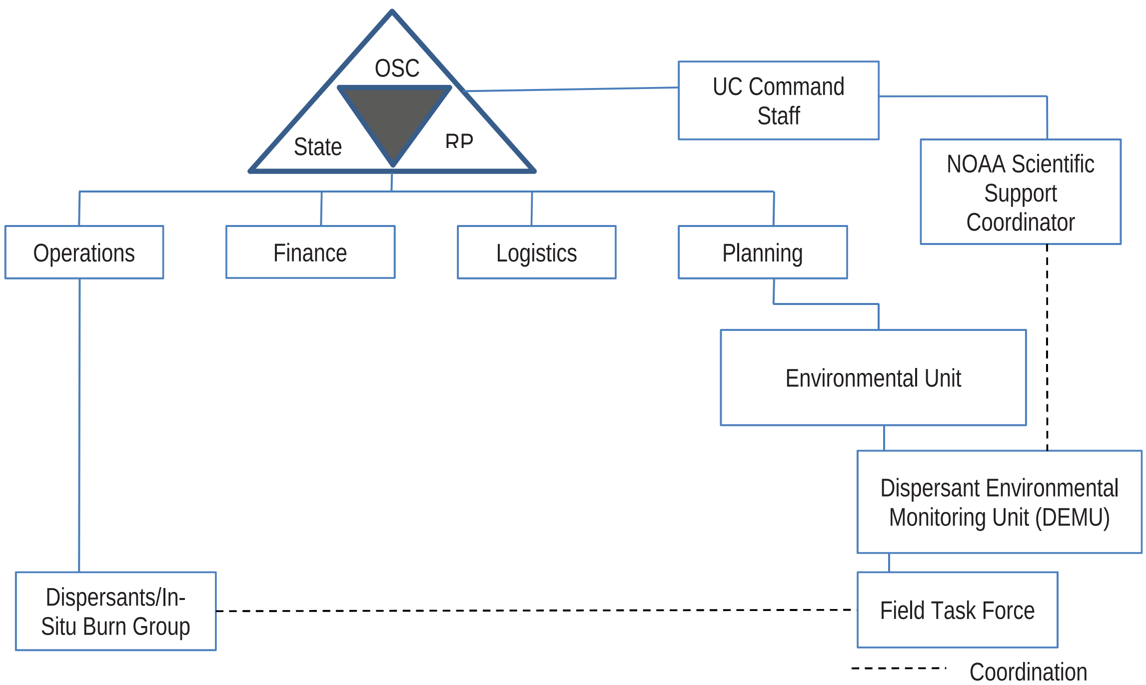

Figure 1: Dispersant Environmental Monitoring Unit (DEMU) Organization and Coordination

2. MONITORING GUIDANCE

2.1 Subsea Application Guidance

2.1.1 Background and Overview

<u>Introduction</u>

The *Subsea Application Guidance* was developed by NRT member agency representatives for RRT use in responding to and planning for oil discharges. This guidance is designed to assist

OSCs and state and federal agencies participating in the authorization, continued observation, and monitoring of subsea applications on oil discharges.

<u>Subsea Application Guidance General Scope and Assumptions</u>

1) The *Subsea Application Guidance* is intended for use on oil discharges originating from oil exploration, production and/or transmission facilities (e.g., in cases where there is a loss of well control).

2) These recommendations generally apply to dispersant use in response to subsea discharges at depths greater than 300 meters and below the average pycnocline.

3) The DEMU, in accordance with incident-specific objectives, should coordinate the development and implementation of a sampling and monitoring plan prior to the deployment of any subsea dispersants.

Pre-Incident Subsea Monitoring Recommendations

RRTs and Area Committees should know what resources (e.g., recreational, economic, biological, ecological) are potentially at risk in areas where subsea dispersant use may be considered. To better inform the resource tradeoffs in the decision making process of the response, RRTs and Area Committees should also consider the risks to resources that may be affected if subsea dispersants are not used. Among the sources of information that may be used to identify resources at risk are the following:

- National Environmental Policy Act (NEPA) Environmental Impact Statement(s);
- Exploration Plans;
- Development and Production Plans or Development Operations Coordination Documents;
- Population and community level ecology data;
- Relevant models (e.g., circulation, ecological, trajectory);
- Subject matter experts; and/or
- Any other relevant documents in which biological resources are identified.

Subsea Application Monitoring Recommendations

The sampling and monitoring plan for subsea dispersant applications should include the following:

- Site Characterization;
- Source Oil Sampling;
- Water Sampling and Monitoring; and
- Sediment Sampling and Monitoring.

<u>Site Characterization</u>

1) Best estimate of the oil discharge flow rate, periodically reevaluated as conditions dictate, including a description of the method, associated uncertainties, and materials;

2) Best estimate of the discharge flow rate of any associated volatile petroleum hydrocarbons, periodically reevaluated as conditions dictate, including a description of the method, associated uncertainties, and materials;

3) Identity of and rationale for the dispersant to be used, including the recommended dispersant-to-oil ratio for the intended application;

4) Description of the methods and equipment to be used for dispersant injection and application, including a plan for observation (not limited to visual);

5) Actual injection rate of the dispersant in gallons/minute; and

6) Estimated total length of time of dispersant injection.

<u>Source Oil Sampling</u>

For an incident-specific authorization, it is important for the OSC to have specific chemical data on the source oil, and samples collected for fingerprinting profile analysis before directing subsea dispersant application. Additional samples may be collected and stored for future analysis. The DEMU should coordinate sampling of the source oil, including associated volatile petroleum hydrocarbons (e.g., methane) and production fluids (e.g., drilling fluids), as soon as possible. Sample collection should be as follows:

1) Collect representative source oil samples at the source of the oil discharge, securing the samples in three or more Seewald Samplers or equivalent isobaric gas-tight samplers.[1]

2) Conduct chemical analyses, consistent with gas chromatography-mass spectrometry (GC-MS) analysis (see Water Sampling and Monitoring below, item 5.c.i). Document the methods and analyses used to fingerprint the source oil so as to distinguish between the oil associated with subsea discharge and other potential sources of oil (e.g., seeps, pipelines) to the maximum extent practicable.

3) If methane is present in the discharge, use an *in situ* methane detection method that provides sufficient sensitivity to detect changes in the environment in which the device is operating. Given that the biodegradation of methane may contribute to oxygen depression, understanding methane concentrations can inform the key indicator factors for dissolved oxygen. The sensitivity of the device(s)/method(s) to low concentrations of methane should be used as a factor in determining device selection, relative to other available devices and/or methods.

[1] Refer to http://www.whoi.edu/oceanus/viewArticle.do?id=89768&sectionid=1000

4) Include in the analysis an estimated rise rate through the water column for non-dispersed oil to the surface as a function of droplet size, density (or specific gravity) along the thermal gradient of the water column, and kinematic viscosity.

Water Sampling and Monitoring

Understanding the fate and concentrations of chemically and physically dispersed oil in the water column is critical. To accomplish this, a combination of hydrodynamic modeling, real-time data, and discrete water sample analysis is vital to ensure decision makers have the information necessary to authorize the continuation or modification of subsea dispersant operations. As with all dispersant operations, data retrieved and analyzed from water column measurements is intended to help decision makers and key stakeholders consider dispersant operations as a part of the broader oil discharge mitigation effort and weigh the risks associated with continuing the operation against those injuries the operation is intended to minimize. The DEMU should coordinate the reporting of water column measurements described below.

1) *Oceanographic Data.* Identify and implement a plume model with a validated methodology to predict the location and behavior of the subsurface oil plume, which is critical to properly monitor oil fate, dispersant effectiveness, and water column concentrations. Provide a subsea current analysis that characterizes the subsurface circulation, bathymetry, and oceanographic conditions, critical to model accurately. Note that subsea plume behavior forecasting and sample collection targeting may be improved by the installation of Acoustic Doppler Current Profilers (ADCPs) on the ocean floor with the capability of real-time telemetry.

2) *Microbial Oxidation.*
    a. *Dissolved oxygen* is an indicator of potential injury in the subsea ecological system. An increase in organic carbon loading enhances microbial activity, thereby increasing respiration and depleting oxygen. The monitoring plan should be particularly sensitive to signs of hypoxia. The DEMU should coordinate the analyses of *in situ* dissolved oxygen (DO) using industry standard sensing devices calibrated using Winkler titrations. In addition, water samples should regularly measure *ex situ* DO using Winkler titrations to verify measurements from industry standard sensing devices, particularly at depths where evidence of oxygen depression is indicated or predicted as a function of the dispersant operation.
        - **□e□□ndicator:**
            - Approaching hypoxia (e.g., 2 milligrams per liter or as appropriate for the region).
    b. *Carbon dioxide* is another potential indicator of microbiological activity in the subsea environment and may help distinguish between microbial activity associated with hydrocarbon consumption and naturally occurring dissolved oxygen drawdown. The DEMU may require, if practicable, the use of a properly calibrated *in situ* carbon dioxide sensor (e.g., Contros HydroC™ carbon dioxide sensor or equivalent instrument) to quantify carbon dioxide formation from biodegradation.
        - **□e□□ndicator:**
            - Confirmatory data.

3) *Oil Droplet Size Distribution* is an indicator of dispersant effectiveness and can be used to inform plume modeling. The DEMU should coordinate the deployment of a droplet size analyzer, such as, but not limited to, a Laser In-Situ Scattering and Transmissometry (LISST). It should be capable of reaching the depth of the sea floor from the vessel(s) for continuous sampling of surface water during transits, to provide droplet size counts information, which potentially distinguishes between dispersed and non-dispersed oil. A particle size distribution analysis focused on droplet size ranging from at least 2.5 to 100 µm should be conducted, with measurements for droplet size distribution between 2.5 and 2,000 µm, if practicable, for trajectory analysis. A baseline analysis should be conducted to determine droplet size distribution prior to dispersant application.
    - **Key Indicator:**
        - Observations of relative significant changes in the droplet size range indicating dispersant effectiveness.

4) *Continuous Water Column Data* is useful for providing a continuous data stream and background information for other data obtained. In addition, fluorometric data should be used to help track and model the dispersed plume. The DEMU should ensure that a sufficient number of vessels are equipped with the Conductivity, Temperature, Depth recorder (CTD) rosette package with one or more properly calibrated fluorometer(s), targeted to the type of oil discharged and capable of operating at depth (including to the sea floor) in which the dispersed oil plume may travel. A 2-way communication cable spooled to the ship should be used to ensure that profile data can be viewed as the rosette package is deployed to appropriate depths.
    - **Key Indicator:**
        - Observations of relative significant changes in the fluorometric output indicating the possible presence of a dispersed plume.
        - Identification of the pycnocline and the thermocline.

5) *Discrete Water Sampling.* The DEMU, should coordinate the development of Standard Operating Procedures (SOPs) for collecting water samples throughout the range of the water column, including background or reference samples that address the spatial distribution of dispersed oil using applicable analytical methods. Oceanographic monitoring should be conducted while collecting water samples (see item 1 above), if practicable and as appropriate.
    a. Take discrete water samples at depths specified in the sampling and monitoring plan. The CTD rosette package (see item 4 above) should be capable of collecting discrete samples in the water column using a sufficient number of Go-Flo sampling bottles, or equivalent, with a volumetric capacity to provide water samples for all analyses, and using the live feed data stream. If practicable, vessels should have onboard GC with flame ionization detector (FID) capability to determine total petroleum hydrocarbons (TPHs).
    b. Conduct an oil analysis to determine the effects of the dispersed oil plume on aquatic life (e.g., toxicity) through standard testing methodologies. The analysis should be designed and implemented to determine whether the dispersed oil will persist in the

water column and the likelihood the dispersed oil will come in contact with the benthos community.

c. Water sample analysis should include:
   i. GC-MS analysis of aliphatic hydrocarbons, monocyclic (e.g., benzene, toluene, ethylbenzene, and xylene up to C_3-benzenes), polycyclic, and other aromatic hydrocarbons (PAHs) including alkylated homologs (e.g., 2-, 3-, and 4-ring PAHs (C_0-C_4-naphthalenes, C_0-C_3-fluorenes, C_0-C_3-dibenzothiophenes, C_0-C_4-phenanthrenes-anthracenes, C_0-C_4-naphthobenzothiophenes, C_0-C_2-pyrenes-fluoranthenes, C_0-C_4-chrysenes, and the pyrogenic PAHs)), and hopane and sterane biomarker compounds, TPH, and volatile organic compounds;
   ii. Dispersant constituents;
   iii. Ultraviolet (UV)/visible fluorescence for fluorescence intensity ratio (FIR). The RP should conduct spectrofluorometric analyses on discrete water samples using the two fixed emission wavelength spectrofluorometers (e.g., 340 and 445 nm) targeted to the source oil or a scanning spectrofluorometer on board ship to determine the FIR; and
   iv. Turbidity.

- **□e□□ndicators:**
  - Comparison of water sample data to ecological toxicity (ecotoxicity) benchmarks for aquatic organisms in order to assess potential toxicity risks.
  - Comparison to available Species Sensitivity Distribution (SSD) curves (see Section 6.0 *Ecological Toxicity Assessment*).
  - The FIR ranges that indicate effective chemical dispersion of the oil.

<u>Sediment Sampling and Monitoring (i.e., physical, chemical, and biological)</u>

Under certain circumstances sediment sampling and monitoring may be necessary for operational response decision making. Sediment sampling can be a means of gathering additional information on subsea dispersant effectiveness and oil transport by means of sedimentation. If the OSC, with the concurrence of EPA and, as appropriate, the states, and in consultation with DOC and DOI, determines sediment sampling and monitoring is warranted, the DEMU should coordinate the development of SOPs for collecting sediment samples, including reference areas (i.e., located in the same geographic area with similar characteristics but not impacted by the discharge). These SOPs should address the spatial distribution of dispersed oil using applicable analytical methods. In addition, observations on benthic fauna should be collected and analyzed (i.e., comparing the species composition and percentage impacted by dispersed oil or subsea dispersant to reference area analyses). The sampling and monitoring plan should include appropriate sediment sampling for quantitative analysis including, but not limited to, oil when applicable.

1) Sediment sampling and monitoring should include analysis of sediment from reference areas to serve as benchmark information. This information should be collected prior to any exposure to oil or direct application of dispersant.
    a. The analysis of reference data should include, but is not limited to, water and sediment in the immediate vicinity of the discharge, in the direction of likely transport (i.e., a direction that may periodically shift due to changes in the subsea currents), and in any direction toward the shoreline(s).

        - **Key Indicators:**
            - Observation of relative differences between samples for reference areas and potentially impacted areas.

2.2 Prolonged Surface Application Guidance

2.2.1 Background and Overview

Introduction

The *Prolonged Surface Application Guidance* is designed to supplement the existing monitoring protocols outlined in SMART where the duration of the application of dispersants on discharged oil extends beyond what was originally envisioned by SMART, the need for which was demonstrated during the *Deepwater Horizon* event. This guidance is designed to assist the OSC and those state and federal agencies participating in the authorization and monitoring of dispersant applications on oil discharges on the surface of the water.

Prolonged Surface Application Guidance General Scope and Assumptions

1) The *Prolonged Surface Application Guidance* is intended to supplement and not replace SMART protocols. This guidance assumes SMART monitoring activities through Tier 3 have already been deployed by the UC.

2) This guidance defines prolonged dispersant operations as **any operation expected to exceed 96 hours[2] or that has already exceeded 96 hours from the time of the first application of any dispersant.**

3) Monitoring should be implemented within 96 hours of an oil discharge where prolonged surface application of dispersants is anticipated, or earlier at the direction of the OSC.

4) Surface application of dispersants should be inclusive of dispersant applied via aircraft or vessel to the sea surface and either impacting or potentially impacting the upper 10 meters of the water column. In the event the SSC believes oceanographic circumstances justify monitoring to a greater depth, this definition may be expanded to include the water column from the surface to the mix layer.

[2] Timeframe based on 96 hours being a common exposure duration used in toxicological studies of dispersants.

[illegible] Prolonged Surface Application Monitoring Recommendations

SMART Protocols

This guidance assumes that SMART protocols will be used for initial confirmation of dispersant effectiveness and deployed at the earliest time practicable for the response conditions. Additional guidance offered in this document focuses on issues not currently considered by the existing SMART program and should be considered as a supplement to and not a replacement for the existing SMART program.

Assessment of the Potential Dispersibility of Oil

In a prolonged dispersant operation, despite the possibility of a continuous source of fresh oil, it is likely that some portion of floating oil will eventually weather[3] to the point where dispersants no longer have the desired effect. By delineating an outer boundary, mission planners can better target aerial sorties and, by defining visual characteristics of non-dispersible oil, can improve the on-site pilot/spotter target determination. Having a better understanding of the oil characteristics under environmental conditions and providing trained spotters better visual cues will result in more appropriate targets selected, less chemical dispersant applied to poor quality targets, and greater stakeholder confidence that the dispersant used will be applied in the most effective manner.

Weathering of oil will not be entirely homogeneous throughout the impact area due to variations in temperature, wind speed, sea state, etc. However, it may be possible to define the outer limit of dispersibility by field testing, and to correlate it to appearance and/or modeling. SMART protocols were designed to evaluate the chemical effectiveness of a specific dispersant sortie on a specific target under existing environmental conditions. It was never intended to provide insight into oil at various stages of weathering that might result from a long, continuous release that might require a prolonged response.

The DEMU should examine the extent to which the oil in question remains susceptible to the selected dispersant under the actual field conditions. The DEMU can then provide site-specific guidance based on visual characteristics (i.e., predominately changes in color), geographic, or other cues. This examination can be informed by additional data generated from laboratory weathered and tested oil coupled with oil fate modeling.[4] Recommended modeling and field approaches are as follows:

1) *The Modeling Approach.*
    a. The oil in question should be weathered in the laboratory and tested as to its dispersibility using the same test employed by the DEMU field task force.
    b. As oil viscosity is an indicator of its dispersibility, measurement of increases in viscosity under artificial weathering conditions and comparison of these data to findings in the field can help calibrate predictive fate models.

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[3] Oil "weathering" describes the process of changes in the oil chemical and physical condition as a result of evaporation, photo-oxidation, water entrainment, and other factors.
[4] One such model is the NOAA *ADIOS-2*.

2) *The Field Approach.*
   a. Verify oil dispersibility based on weathering as a function of distance from the source and/or appearance.
   b. Using a boat equipped with dispersant spray arms and dispersant of the same type used for surface application, apply dispersant to previously untreated oil. Application rates, dispersant to oil ratios, and mixing times should resemble field operations as closely as possible.
   c. If time and logistics allow, try increasing the sampling mixing time for more viscous oils and emulsions.
   d. Shipboard equipment should include a field effectiveness test (such as SINTEF-FET and the Australian Nat-DET plan), a particle analyzer (such as a LISST), and a handheld thermal imaging camera to measure temperature differentials between effective and less effective dispersant/oil interactions.
   e. Samples of the treated and untreated oil should be obtained for both laboratory and shipboard analysis.
   f. Shipboard analysis and monitoring should include measurements of viscosity and effectiveness, as well as full photo documentation of oil before and after treatment.

3) *Reporting and Documentation.*
   a. The results of the field tests should be reported to the DEMU as soon as possible, or at least daily.
   b. *Spotters Guide.* Compile the results of field tests and laboratory analysis into a spotter's guide for use by both the DEMU and the SMART Spotters. The guide may include:
      i. Photographs of oil where dispersants are known to be effective and/or oil that is considered too weathered to be dispersed;
      ii. Geographic boundaries beyond which the oil is too weathered to be dispersed;
      iii. Model outputs; and
      iv. Other useful information.

<u>Water Column Loading and Assessment</u>
In the event of prolonged application of dispersant on the surface of the water in response to an oil discharge, personnel should be concerned about increasing concentrations of chemically dispersed oil in the water column. The UC should be prepared to implement SMART Tier 3 protocols. Further, the DEMU should deploy a field task force specifically and exclusively responsible to monitor and quantify water column loading over the timeframe of the approved dispersant operation. The field task force should use the same type of equipment and methods as those used by tactical SMART teams implementing SMART Tier 3 sampling protocols, including any additional methods and/or equipment (e.g., particle size analyzers) instructed by the UC. The protocols should compare water column data gathered as part of the application mission, taken at the highest probable concentration of chemically dispersed oil (immediate post application of the dispersant), with data collected 24 hours later. The data comparison should also include data gathered from samples collected in designated reference areas away from the dispersant operation.

1) *Sample Area.*
    a. Dispersed oil sampling should be conducted in the predicted plume of the oil that was dispersed 24 hours earlier. The DEMU should utilize trajectory and oceanographic models and, if appropriate, oil surrogates such as drogues and drifters, to guide the field task force to the most likely location of the plume.
    b. In order to not potentially contaminate the samples collected 24 hours following dispersant application with freshly dispersed oil, avoid water column loading sampling in areas where dispersant needs to be applied because of the presence of surface oil.

2) *Reference Areas.*
    a. Identify several suitable reference areas that are not impacted by the dispersant operation; it is not necessary that the reference areas be outside the oil-impacted area, provided chemical dispersants have not been used in the general vicinity.
    b. Sampling methods and equipment used in the reference areas should be the same as those employed in the study area.

3) *Sample Collection.*
    a. All sampling should be conducted in the manner prescribed by the SMART Tier 3 monitoring protocol and/or any supplemental protocols, including specifically the collection of discrete water samples at several depths up to 10 meters for laboratory for analysis.
    b. Carefully track both the location of the sampling and the time, and adjust as necessary to account for expanded monitoring depths.

4) *Water Column Loading Data Analysis.*
    a. Fluorometric and particle size data should be provided daily for analysis, processing, and dissemination to the UC and key decision makers. The UC may also want to consider collecting UV/visible fluorescence data to determine the FIR as an additional measure of dispersant effectiveness.
        i. Data should be charted to display a minimum of three data plots, including for immediate post application, for 24-hours post application, and for reference areas to confirm dispersant effectiveness.
    b. Discrete water samples should be analyzed within 24 hours, on-board ship if possible, using a GC with FID or MS detectors, to determine TPH and resolvable constituents. Because of the heterogeneous nature of oil in the water column, it is recommended that multiple samples be composited for analysis.

COMMUNICATIONS AND REPORTING

Effective communications and timely reporting of sampling and monitoring data is critical to inform decisions regarding the continued relative benefit of using a dispersant. Timely reporting is also crucial for effective communications with the general public. Sampling data and monitoring results addressed in the sampling and monitoring plan, including any additional or modified data requests approved by the UC, should be reported to the DEMU. The DEMU technical specialists should review and interpret the data and formulate recommendations for use in operational decision-making. The DEMU should report to the OSC those analyses relative to established action levels that would trigger modifications in the operation, including any "shut down" criteria. The OSC should communicate this information to the RRTs and the NRT as appropriate, through the RRT.

The DEMU should coordinate the design and implementation of a communication plan that addresses the UC established incident-specific goals and objectives. In response to a release and prior to the application of any dispersant, the DEMU should submit this communication plan to the OSC for review and approval, and should begin implementation upon notice from the OSC.

The communication plan should include a protocol addressing sample tracking, data management, data format, and mutually accessible digital data storage determined by the UC. A mutually accessible digital data storage protocol should be established. All data collected and/or analyzed by the RP or the government (with the exception of data and/or analysis strictly associated with NRDA or legal investigations) will be available to both the RP and the government.

The communication plan should also address data reporting, both for field data provided to the DEMU, and for analyses supported by that data provided to the OSC and key decision makers. Key indicator data for "shut down" criteria should be reported daily to the RRT with jurisdiction, and any agreed upon specific key indicators and/or benchmark data, as requested by the RRT with jurisdiction. These key indicators/benchmark data may be reported to the NRT, as appropriate, through the RRT.

All relevant sampling and monitoring results from field analytical teams and onshore laboratories, including collection methods and sampling locations, should be reported daily to the DEMU for review and evaluation. However, the UC may approve alternative reporting periods for specific sampling and monitoring activities based on its priorities, the time restrictions required for various analyses, and the time sensitivity of the measurement or data relative to future operational decisions. If practicable, real-time monitoring information and visual observations (e.g., trained aerial spotters) should be reported. Anomalies observed in the field, in the analysis, or resources at risk as well as key indicator data approaching defined action levels should be reported to the DEMU as soon as possible.

DEMU data reports should characterize the site, dispersant effectiveness, oil behavior, and any other relevant information specific to the incident. The reports guide operational decision-making and help communicate recommendations to pertinent stakeholders. Data analyses should be informed by, for example:

1) Droplet size distribution and FIR, which account for other key factors namely percent oil, percent water, and percent dispersant. The droplet size distribution analysis should include a discussion and analysis on the number mean diameter (NMD) and/or the volume mean diameter (VMD).

2) The actual amount of dispersant applied for the previous 24-hour period, in hourly intervals.

3) Variations in the planned subsea dispersant application plus or minus 10 percent of the previous daily average.

4) Water column loading and measurement reports.

5) Dispersing potential assessment reports and recommendations.

6) Updated subsea transport estimate of oil, dispersant, and dispersed oil plumes using the most current trajectory modeling as available.

QUALITY ASSURANCE PROJECT PLAN

The sampling and monitoring plans should include a Quality Assurance Project Plan (QAPP)[5] to address sample collection methodology, handling, chain of custody, and decontamination procedures to ensure the highest quality data will be collected and maintained. Discrete samples should be tested at a laboratory approved by the OSC, with the concurrence of EPA and, as appropriate the states, and in consultation with DOC and DOI. Triplicate samples should be collected and tested. All samples should be archived for potential future analysis. Where technically practicable, all samples should be at least 1 liter.

The QAPP should include the following components and criteria:

1) An introduction that identifies project objectives and the project staff.

2) A site description and background.
    a. The site description should include bathymetry, subsea currents (including temporal variations), and other relevant geological features.
    b. The site description should include relevant oil seeps or other potential sources of contamination (e.g., recent oil discharges), and relevant oil and/or natural gas infrastructure (e.g., oil platforms, subsea pipelines).

3) A description of the sampling and monitoring recommendations.
    a. A brief overview of sampling activities, data quality objectives, and health and safety implementation strategies (frequently, this references another specific document, but should be included in the QAPP).
    b. The actual sampling and/or monitoring approach, to ensure data repeatability and consistent procedures. The approach should describe sampling, monitoring, and field quality control (QC) procedures; spoil or waste disposal procedures resulting from this effort; and specimen/data handling issues.
    c. Management procedures to document how the samples will be procured, handled, and delivered. Address the expeditious and timely transport of samples to laboratories

[5] The QAPP should be consistent with EPA's QA/R-4 and 5 (http://www.epa.gov/quality/qa_docs.html).

where necessary, in order to minimize delays due to weather or other operational delays.

d. Instructions to address sample preservation (including acidification issues), containers, and hold times.

4) The analytical approach to determine what laboratory tests will be run, any special instructions, how the data will be verified, and how the data will be reported.

5) Quality assurance (QA) to address chain of custody procedures, field records including logs, and qualitative data handling, including photographs.

6) If multiple atypical dispersant applications are implemented, the DEMU is responsible for ensuring the effective coordination of all recommendations. The results from the monitoring plan should be provided daily to the OSC.

AIRBORNE VOLATILE ORGANIC COMPOUNDS

Volatile organic compounds (VOCs) should be measured in the vicinity of fresh oil. While this document does not specifically address worker safety, the data collected in this effort should be reported to the DEMU and the natural resource trustees to assess overall exposure to birds, marine mammals, and reptiles, all of whom breathe at the air–water interface. VOC data collected on a regular basis should be shared with the OSC and the natural resource trustees for the purposes of gauging potential environmental impacts to trustee resources.

1) The DEMU should address the need to monitor within the vicinity of the surfacing oil plume, including individual constituents of the VOCs.

2) The DEMU should coordinate the development of a diagram identifying the time and location of all VOC samples taken, and its reporting as instructed by the UC. The diagram should also identify any potential sources that may contribute to VOCs (e.g., vessel exhaust, oil collected on containment vessels).

3) The DEMU should coordinate the recording of the meteorological conditions (particularly wind speed) with all VOC measurements.

4) The DEMU should coordinate the collection and analyses of corresponding representative water samples and report the individual VOC constituents.

ECOLOGICAL TOXICITY ASSESSMENT

The DEMU, in consultation with the UC, should develop an ecological toxicity (ecotoxicity) assessment plan that incorporates ecotoxicity benchmarks derived by using a Species Sensitivity Distribution (SSD). SSDs are a probability distribution of the sensitivity of a group of species to a toxicant.

1) The toxicity plan should use the best available technology at the time of the response.

2) Monitoring for ecotoxicity should occur concurrently with dispersed oil sampling for fluorometry, particle size, and water quality (e.g., DO). Ecotoxicity may be assessed by comparing TPH concentrations in water samples collected at appropriate depths to TPH-based ecotoxicity benchmarks (EBs). The ecotoxicity assessment should also be performed in areas where no dispersant has been applied to allow determination and comparison of ecotoxicity from physically dispersed and chemically dispersed oil.

3) EBs should be derived using the SSD approach and made available to the UC. SSDs should be developed for representative oils (e.g., crude oils) using existing acute toxicity values for mortality or immobility (e.g., 48-hr and 96-hr lethal concentration, 50 percent (LC_{50})) where sufficient species diversity is available (e.g., toxicity data for 10 or more species). The EBs should be computed from the fifth percentile of the SSD as the HC_5 (hazard concentration, 5 percent). EBs may be developed for specific oils or for oil types (e.g., crude, middle distillate, heavy oil). Chronic toxicity benchmarks may be derived by applying a safety factor to the acute toxicity EBs. The development of the actual safety factors should be the responsibility of the approving authorities (including the federal natural resource trustees) with input from appropriate technical specialists.

4) Water samples collected for comparison of aqueous TPH concentrations to EBs should be analyzed within 24 hours of collection and reported within 48 hours of analysis to the UC, via the DEMU.

5) The UC may also consider additional ecotoxicity testing methods, in consultation with subject matter experts, to monitor whole water samples with considerations for:
   a. Site conditions (e.g., location of the discharge, weather conditions at the discharge, field water temperature);
   b. Operational relevance;
   c. Field ecological receptors at risk;
   d. Test organism availability; and
   e. Availability of testing equipment and/or laboratories.

   All sample collection and testing should be conducted using standardized sampling and test protocols. If standardized protocols cannot be followed due to existing conditions or alternate tests/methods are available, the test methods proposed for use should first be specifically approved through the OSC, with the concurrence of EPA and, as appropriate, the states, and in consultation with DOC and DOI.

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1) The RRT in the incident specific authorization plan may establish action thresholds relative to the key indicators from monitoring operations. The OSC may propose new or alternative

action thresholds to the RRT. These thresholds and the actions they elicit should consider dispersant, oil, and dispersant mixed with oil toxicity data available on the NCP Product Schedule and SSDs for the chemical dispersant in use and other appropriate references, including region-specific toxicity data that may have been required by the RRT as part of a preauthorization process. These action thresholds should consider as much as practicable, region-specific biological data and input from the Scientific Support Coordinator, local resource managers, and other subject matter experts.

2) The actions prescribed, along with modifications in the operation, may include “shut down” criteria. These criteria should relate to specific key indicators and/or UC defined benchmarks in conditions such as, but not limited to, dramatic changes in dissolved oxygen, total petroleum hydrocarbon levels remaining in the water column after a defined period of time, persistent water column toxicity, and species of particular sensitivity (e.g., endangered species, whales, and rafting birds) moving into the area. **Any “shut down” criteria developed should consider the resource tradeoffs associated with dispersant use.**

A□□□□D□□ A□A□RO□□MS

□□□Ps – Acoustic Doppler Current Profilers
□□□□ – Bureau of Ocean Energy Management
□□□□ – Bureau of Safety and Environmental Enforcement
□□□ – Code of Federal Regulations
□□□ – Conductivity, Temperature, and Depth Recorder
□□□ U – Dispersant Environmental Monitoring Unit
□□ – Dissolved Oxygen
□□□ – (U.S.) Department of Commerce
□□□– (U.S.) Department of the Interior
□□s – Ecotoxicity Benchmarks
□U – Environmental Unit
□P□ – (U.S.) Environmental Protection Agency
□□□ – Flame Ionization Detector
□□□ – Fluorescence Intensity Ratio
G□□□ □– Gas Chromatography-Mass Spectrometry
□□□□ □P□□ – Hazardous Waste Operations and Emergency Response
□□ – Hazard Concentration
□□ – Lethal Concentration
□□□□□ – Laser In-Situ Scattering and Transmissometry
□□P – National Oil and Hazardous Substances Pollution Contingency Plan
□□P□ – National Environmental Policy Act
□□ □ – Number Mean Diameter
□□□□ – National Oceanic and Atmospheric Administration
□□□□ – Natural Resources Damage Assessment
□□□ – National Response Team
□□□ – On-Scene Coordinator
□□□□ – Occupational Safety and Health Administration
□□□P – Oil Spill Response Plan
P□□ – Polycyclic Aromatic Hydrocarbons
□□ – Quality Assurance
□□PP – Quality Assurance Project Plan
□□ – Quality Control
□P – Responsible Party
□□□ – Regional Response Team
□□ □□□ – Special Monitoring of Applied Response Technologies
□□P – Standard Operating Procedure
□□□ – Scientific Support Coordinator
□□□ – Species Sensitivity Distribution
□P□ – Total Petroleum Hydrocarbons
U□ – Unified Command
U□□G – United States Coast Guard
U□ – Ultraviolet
□□ □ – Volume Mean Diameter
□□□ – Volatile Organic Compounds

Appendix B. Dispersant and Dispersed Oil Aquatic Exposure and Toxicity Evaluation

U.S. DEPARTMENT OF
HOMELAND SECURITY

United States Coast Guard

DISPERSANT AND DISPERSED OIL AQUATIC EXPOSURE AND TOXICITY EVALUATION

FINAL

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Acronyms

ANS	Alaska North Slope
ARRT	Alaska Regional Response Team
BA	biological assessment
BO	biological opinion
BMP	best management practice
CAS	Chemical Abstracts Service
CDC	Centers for Disease Control and Prevention
DHOS	Deepwater Horizon oil spill
DOSS	dioctyl sulfosuccinate sodium
DPnB	1-(2-butoxy-1-methylethoxy)-2-propanol
DPS	distinct population segment
EC50	concentration that has an effect on 50% of an exposed sample
EPA	United States Environmental Protection Agency
EROD	ethoxyresorufin-O-deethylase
ESA	Endangered Species Act
ESU	evolutionarily significant unit
EVOS	*Exxon-Valdez* oil spill
GNOME	General NOAA Operational Modeling Environment
GOA	Gulf of Alaska
HC	hazardous concentration (for a given proportion or percentile of a species sensitivity distribution)
HPAH	high-molecular-weight polycyclic aromatic hydrocarbon
IQR	interquartile range
LC50	concentration that is lethal to 50% of an exposed sample
LPAH	low- molecular-weight polycyclic aromatic hydrocarbon
NOAA	National Oceanic and Atmospheric Administration
NOEC	no-observed-effect concentration
NPRW	North Pacific right whale
OECD	Organisation for Economic Cooperation and Development
PAH	polycyclic aromatic hydrocarbon
ppb	parts per billion

ppm	parts per million
PWS	Prince William Sound
SSD	species sensitivity distribution
TPH	total petroleum hydrocarbons
USCG	United States Coast Guard
Y-K Delta	Yukon-Kuskokwim Delta

1 Introduction

1.1 PURPOSE AND THE BASELINE CONDITION

This document is a Appendix B to the *Biological Assessment of the Alaska Federal/State Preparedness Plan for Response to Oil & Hazardous Substance Discharges/Releases (Unified Plan),* hereafter referred to as the BA. The purpose of this appendix is to describe the known or potential adverse impacts of chemical dispersants, alone or in a mixture with oil, both directly on species listed under the Endangered Species Act (ESA) (or similar surrogates) and indirectly on their prey. These impacts must be weighed against the baseline condition: that petroleum has been spilled, and that a response can be taken in accordance with the Unified Plan. Such a response may involve the application of chemical dispersants under certain circumstances, which are elaborated upon in the BA.

In order for adverse impacts related to chemical dispersants to be considered relevant to this BA, dispersants must be shown to meet one or more of the following qualifications:

- Be inherently more toxic than oil (i.e., causing toxicity when alone in solution).
- Increase the exposure concentration and/or duration of exposure to oil of ESA-listed or candidate species or their prey to oil or its component chemicals (e.g., polycyclic aromatic hydrocarbons [PAHs]).
- Increase the toxicity of petroleum or its component chemicals to ESA-listed or candidate species or their prey (Milinkovitch et al., 2011a; Ramachandran et al., 2004; Wolfe et al., 1998; Wolfe et al., 2001; Yamada et al., 2003).

If the application of dispersants to an oil spill can be shown to mitigate the known impacts of a non-dispersed oil spill (i.e., the baseline condition), then the impacts of dispersants as a potential response tool can be considered negligible (or even beneficial by comparison) (Fingas, 2008; NRC, 2005).

The synthesis of available data regarding the known impacts on ESA-listed or candidate species and their prey, toxicity in laboratory testing, and fate and transport testing is weighed with species-specific information (i.e., life history, seasonal use of Alaska waters, feeding strategies, and habitat associations) in the final determination of direct and/or indirect adverse effects on individual ESA-listed or candidate species. This synthesis is presented in Section 5 and summarized in Section 7.

1.2 SPECIES CONSIDERED

1.2.1 ESA-listed or candidate species

Table 1. Protected species status, habitats, and distribution

Protected Species	Status	Habitat Type in Potentially Affected Area	Critical Habitat?	Geographic Location
Marine Mammals				
Beluga whale (*Delphinapterus leucas)* – Cook Inlet DPS	E	nearshore, open water (including polynyas)	yes	Cook Inlet
Blue whale (*Balaenoptera musculus)*	E	open water	no	Aleutian Islands, Bering Sea, GOA
Bowhead whale (*Balaena mysticetus)*	E	open water, ice edge	no	Bering Sea, Beaufort Sea, Chukchi Sea
Fin whale (*Balaenoptera physalus)*	E	open water	no	Bering Sea, Beaufort Sea, Chukchi Sea, GOA, Aleutian Islands
Gray whale (*Eschrichtius robustus*) – Western North Pacific stock	E	nearshore, open water	no	Okhotsk Sea, Sakhalin Island, Russia, South China Sea (Potentially: Bering and Chukchi Seas, Aleutian Islands, GOA)
Humpback whale (*Megaptera novaeangliae)*	E	open water, nearshore	no	Bering Sea, Aleutian Islands, Kodiak Island, PWS, GOA including Inside Passage, Chukchi Sea, western Beaufort Sea
North Pacific right whale (*Eubalaena japonica)*	E	open water	yes	Bering Sea, Aleutian Islands, GOA
Sei whale (*Balaenoptera borealis)*	E	open water	no	Bering Sea, Aleutian Islands, GOA
Sperm whale (*Physeter macrocephalus)*	E	open water, ice edge	no	Bering Sea, Aleutian Islands, GOA
Steller sea lion (*Eumetopias jubatus)* – *western population*	E	shoreline, nearshore, open water	yes	Bering Sea, PWS, Kodiak Island, Aleutian Islands, GOA
Steller sea lion (*E. jubatus*) – *eastern population*[a]	T	shoreline, nearshore, open water	yes	GOA, southeast Alaska
Polar bear (*Ursus maritimus*)	T	terrestrial, shoreline, nearshore, ice	no[b]	Bering Sea, Beaufort Sea, Chukchi Sea, North Slope, western Alaska
Northern sea otter (*Enhydra lutris kenyoni*) – southwest Alaska DPS	T	shoreline, nearshore	yes	Aleutian Islands, Bristol Bay, Alaska Peninsula, Kodiak Island, Pribilof Islands
Pacific walrus (*Odobenus rosmarus,* ssp. *divergens*)	C[d]	shoreline, nearshore, open water, ice	no	Chukchi Sea, Bering Sea, Bristol Bay

Protected Species	Status	Habitat Type in Potentially Affected Area	Critical Habitat?	Geographic Location
Ringed seal (*Phoca hispida)*	T	nearshore, open water, ice	no	Chukchi Sea, Beaufort Sea
Bearded seal (*Erignathus barbatus)*	T	nearshore, open water, ice	no	Chukchi Sea, Beaufort Sea, Bering Sea
Birds				
Eskimo curlew (*Numenius borealis*)	E	terrestrial (tundra)	no	Arctic, although likely extinct
Short-tailed albatross (*Phoebastria albatrus*)	E	open water	no	Aleutian Islands, Bering Sea, GOA
Spectacled eider (*Somateria fischeri*)	T	shoreline, tidal marsh/delta, nearshore, open water, ice	yes	Beaufort Sea, Bering Sea, Arctic coastal plain, Y-K Delta
Steller's eider (*Polysticta stelleri*) – Alaska breeding population	T	tidal marsh/delta, nearshore, open water	yes	Bering Sea, Alaska Peninsula, Aleutian Islands, Kodiak Island, Cook Inlet, Arctic coastal plain, Y-K Delta
Kittlitz's murrelet (*Brachyramphus brevirostris*)	NL[c]	shoreline, nearshore, open water	no	Alaska Peninsula, Aleutian Island, Glacier Bay, Kenai Peninsula, Kodiak Island, Point Lay, PWS, Seward Peninsula, Yakutat Bay
Yellow-billed loon (*Gavia adamsii*)	C[d]	riverine/riparian, lake/wetland/bog, nearshore, open water	no	Aleutian Islands, Kodiak Island, Seward Peninsula, southeast Alaska, St. Lawrence Island, Arctic coastal plain
Fish				
Chinook salmon (*Oncorhynchus tshawytscha*) – Lower Columbia River ESU	T	open water, nearshore	no	GOA
Chinook salmon (*O. tshawytscha*) – Upper Columbia River, spring run ESU	E	open water, nearshore	no	GOA
Chinook salmon (*O. tshawytscha*) – Puget Sound ESU	T	open water, nearshore	no	GOA
Chinook salmon (*O. tshawytscha*) – Snake River, fall run ESU	T	open water, nearshore	no	GOA
Chinook salmon (*O. tshawytscha*) – Snake River, spring/summer run ESU	T	open water, nearshore	no	GOA, Bering Sea
Chinook salmon (*O. tshawytscha*) – Upper Willamette River ESU	T	open water, nearshore	no	GOA, Bering Sea
Coho salmon (*Oncorhynchus kisutch*) – Lower Columbia River ESU	T	open water, nearshore	no	GOA, Aleutian Islands, Bering Sea (north to Point Hope), Southeast Alaska
Steelhead trout (*Oncorhynchus mykiss*) – Lower Columbia River DPS	T	open water, nearshore	no	GOA, Aleutian Islands

Protected Species	Status	Habitat Type in Potentially Affected Area	Critical Habitat?	Geographic Location
Steelhead trout (*O. mykiss*) – Middle Columbia River DPS	T	open water, nearshore	no	GOA, Aleutian Islands
Steelhead trout (*O. mykiss*) – Snake River basin DPS	T	open water, nearshore	no	GOA, Aleutian Islands
Steelhead trout (*O. mykiss*) – Upper Columbia River DPS	T	open water, nearshore	no	GOA, Aleutian Islands
Pacific herring (*Clupea pallasi*) -- Southeast Alaska DPS	C	open water, nearshore	no	GOA, Aleutian Islands, Bering Sea, Southeast Alaska
Reptiles				
Leatherback sea turtle (*Dermochelys coriacea*)	E	open water	no[e]	GOA
Loggerhead turtle (*Caretta caretta*)	E	open water	no[e]	GOA
Green turtle (*Chelonia mydas*)	T	open water	no	GOA
Olive Ridley turtle (*Lepidochelys olivacea*)	T	open water	no	GOA
Plants				
Aleutian shield fern (*Polystichum aleuticum*)	E	terrestrial	no	Adak Island

[a] The eastern population of Steller sea lion is currently proposed for delisting (NMFS, 2012).

[b] On 10 January 2013, the US District Court for the District of Alaska issued an order vacating the rule designating critical habitat for the polar bear (US District Court District of Alaska, 2013). Therefore, at this time, there is no critical habitat designated for the polar bear.

[c] The Kittlitz's murrelet was designated as a candidate species during the preparation of the BA. On 3 October 2013, USFWS issued a determination finding that listing the Kittlitz's murrelet is not currently warranted (78 FR 61764, 2013). This listing determination was published during finalization of the BA. Therefore, the Kittlitz's murrelet has been included in the BA but an effects determination has not been made because listing under ESA is not imminent.

[d] The Pacific walrus and yellow-billed loon have been designated as candidate species. A 12 July 2011 court settlement agreement established that USFWS would either submit a proposed rule to list the species, or issue a not-warranted finding. The dates of submittal established in the settlement agreement are October 2014 for the yellow-billed loon and October 2017 for the Pacific walrus (US District Court for the District of Columbia, 2011).

[e] Critical habitat has been designated for leatherback sea turtles (77 FR 4170, 2012) and proposed for loggerhead turtles (78 FR 43006, 2013) outside of Alaska.

BA – biological assessment
C – candidate
DPS – distinct population segment
E – endangered
ESA – Endangered Species Act
ESU – evolutionarily significant unit
GOA – Gulf of Alaska
NL – not listed
T – threatened
USFWS – US Fish and Wildlife Service

Chemical dispersants are not intended for terrestrial application. Therefore, terrestrial species protected by the ESA (i.e., Aleutian shield fern [*Polystichum aleuticum*] and Eskimo curlew [*Numenius borealis*]) are not described in this appendix. It is assumed that the probability of exposure of these species to dispersants or dispersed oil is very small. This is particularly true of Aleutian shield fern, which is found in only one area, removed from the marine environment. Eskimo curlew, if still in existence,[1] could conceivably come into contact with oil spill responders in the terrestrial environment. This scenario is outside the scope of this discussion, because upland oil spill responses will not consider the use of chemical dispersants as a response tool (Section 1.3).

ESA-listed or candidate species for which multiple distinct population segments (DPS) or evolutionarily significant units (ESUs) are recognized by ESA will be considered as a single species in this appendix. It is not expected that impacts will differ greatly between either, nor is sufficient information available to determine whether one DPS or ESU is more susceptible to exposure than another. DPS and ESU information is important for identifying stock information (e.g., population size) and information about spawning locations and timing, none of which directly relate to chemical exposures that occur in Alaska. For example, ESA-listed species of salmon that are found in Alaska do not spawn in Alaska waters.

1.2.2 Non-ESA-listed or candidate species

Those ecological receptors at greatest risk of exposure to dispersants and dispersed oil include plankton, embryonic or larval forms of fish, and embryonic, larval, and adult forms of invertebrates that reside in the upper water column (Rico-Martinez et al., 2013; Ortmann et al., 2012). This risk is due to the relative immobility of these species relative to ocean currents; they are carried with currents and are not expected to be able to move away from the area of a spill response. Many larger species of fish and invertebrates (e.g., squid, octopus, herring) gain mobility as they mature, and others (e.g., crab, bivalves, echinoderms, worms) settle to the ocean floor. These species generally represent the prey of the ESA-listed or candidate mammals, birds, fish, and some reptiles evaluated in this BA. Data specific to protected species are assessed in Section 3.2. Impacts on non-ESA-listed or candidate species can be considered indirect impacts on ESA-listed species, if the non-listed or candidate species are prey items of listed species.

1.3 Description of Dispersants and Conceptual Model

Chemical dispersants are mixtures of surfactants and hydrocarbon-based solvents that alter the spatial distribution, physical transport, and chemical and biological fate of spilled oil in aquatic environments. The intended purpose of dispersant application is to reduce the concentration of oil at the surface of the ocean by breaking the oil slick into emulsified droplets that can be suspended and distributed (and subsequently diluted and biologically degraded) throughout the water column. The process of the chemical dispersion of oil is portrayed in Figure 1. Dispersant application is also a useful tool for reducing oil in shoreline habitats, when applied appropriately and in a timely manner (i.e., prior to migration of the slick into shallow waters, where oil

[1] Eskimo curlew have not been sighted for decades (since 1969) and are suspected to be extinct in the wild (USFWS, 2011a).

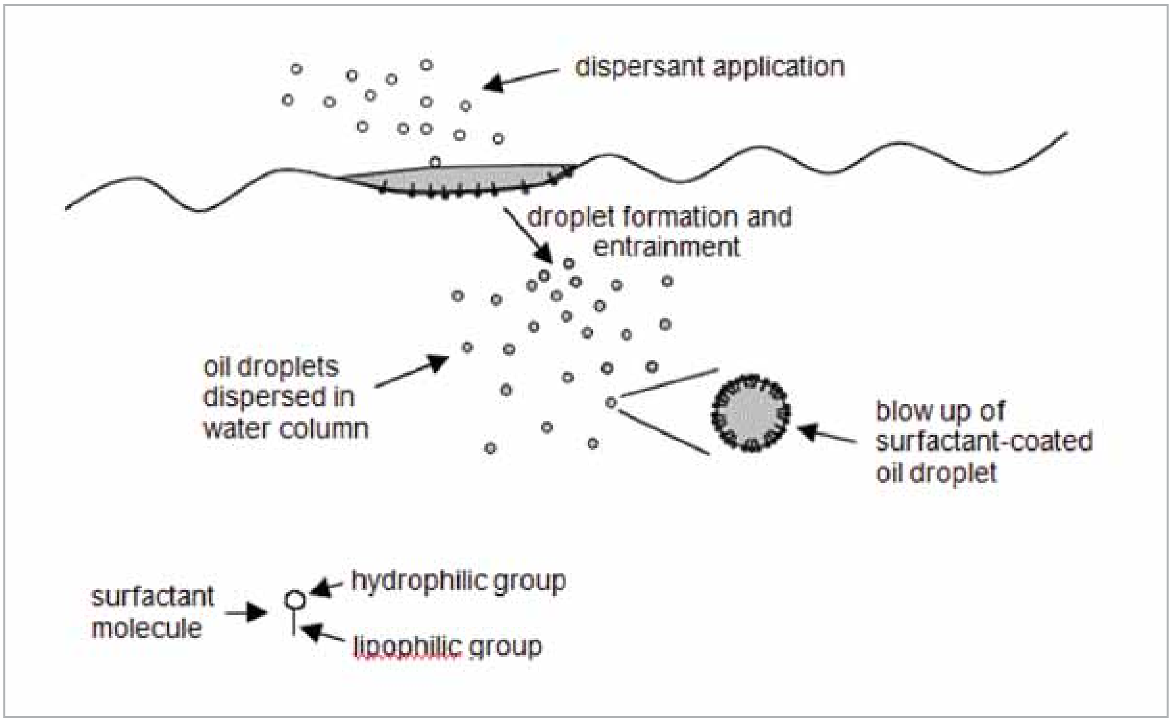
cannot be greatly diluted, and prior to significant weathering of the oil), and is expected to substantially reduce the known long-term impacts of shoreline oiling (Peterson et al., 2003; Cross and Thomson, 1987).

When released into the aquatic environment, crude oil tends to form a thin layer, < 1 mm thick on average (Lee et al., 2011a) and typically ~0.1 mm (NRC, 2005), that spreads over the surface of the water; after oil is spilled, a number of physical, chemical, and biological factors affect its dispersion and ultimate fate (NRC, 2005). Physical factors such as surface tension (a measure of attraction between the molecules of a liquid), density, and viscosity (a measure of resistance to flow) cause the oil molecules to generally stay together, if there are no other forces at work (NRC, 2005). A chemical dispersant can cause an oil slick to either spread rapidly and then disperse, or to spread slowly through "herding" (NRC, 2005), after which additional dispersant applications may be required to remove the oil slick from the ocean's surface.

In the event of a subsurface release, spreading is different; the presence of natural gas in crude oil makes it buoyant, driving it quickly to the surface as a uniform plume (NRC, 2005). The resulting surface slick may be similar to a surface release, particularly when the subsurface release is shallow (NRC, 2005). In the event of deep releases, such as the Deepwater Horizon oil spill (DHOS), density stratification and ambient currents can cause denser oil components to split from gaseous components (i.e., natural gas and methane), resulting in a much slower and less uniform ascent to the surface (NRC, 2005). The resultant surface slick is expected to be thinner and spread over a larger area (NRC, 2005). Thinner slicks are less affected by chemical dispersion (NRC, 2005), making the spill less likely to be contained and mechanically recovered. The application of chemical dispersant at the wellhead during DHOS may have been in response to such expectations. The application of chemical dispersants at the wellhead during DHOS represented an unprecedented use of this chemical countermeasure; such a response has never been conducted in Alaska, nor is it approved for use in Alaska. For that reason, deepwater response actions are not being assessed as part of this consultation.

Wind, waves, and other physical forces (such as the movement of sea ice) can either enhance dispersion or mix the oil and water, forming an emulsion that remains relatively cohesive and does not disperse easily (NRC, 2005; MMS, 2010; Brandvik et al., 2010). Over time, chemical processes (e.g., volatilization and oxidation) can change the makeup and density of oil, which affects, in turn, its fate in the environment (Mackay and McAuliffe, 1988). Biodegradation occurs over time, as fractions of the oil become bioavailable (i.e., dissolve in the water column) (Prince et al., 2013); however, oil thickness, cohesiveness, viscosity, and other factors affect bacterial access to oil molecules (Prince et al., 2003).

The concepts laid out in this section are further expanded in Section 2, and are incorporated in the conclusions regarding the likelihood of impacts on certain species in Sections 4 and 5.



Source: NRC (2005)

Figure 1. Mechanism of chemical dispersion

2 Fate and Transport of Dispersants and Dispersed Oil

This section expands upon the conceptual model (Section 1.3) of how dispersed oil behaves in an aquatic environment, and discusses the factors that affect the toxicity of dispersed oil under field conditions. Oil is assumed to be fresh or slightly weathered crude petroleum, the most likely material for which dispersants would be used (Alaska Clean Seas, 2010; Nuka Research, 2006; NOAA, 2012b; ARRT, 2013). Diesel fuel is the most common type of petroleum spilled in Alaska waters (See Appendix D to the BA), but it is very rarely, if ever, treated with chemical dispersants (Appendix D). The rapid rate at which refined fuels (such as diesel) naturally attenuate (i.e., volatilize, disperse, and degrade) makes dispersant application impractical for such spills.

Factors affecting oil dispersion and dilution are discussed in Section 2.1, dispersants and dispersed oil degradation is discussed in Section 2.2, and transport is discussed Section 2.3.

2.1 Dispersion and Dilution

Dispersion is a natural process that distributes petroleum at the ocean's surface into the water column over time, resulting in many small droplets that may or may not resurface and coalesce with the oil slick (NRC, 2005). This process can be very slow under natural conditions, but the addition of chemical dispersants greatly increases the rate of dispersion (NRC, 2005).

The application of dispersants in a typical spill response involves the release of a large tank of undiluted dispersant chemical (commonly referred to as a sortie) from deployed vehicles (e.g., airplanes, boats, or helicopters) onto the surface of a spill on open water (Nuka Research, 2006). The volume released depends largely on the vehicles' carrying capacities for liquid dispersants (Nuka Research, 2006); however, the rate of application (i.e., volume per unit area) is expected to be as consistent as possible over a large area (Nuka Research, 2006), resulting in a more or less uniform input of dispersant chemicals. Ideally, the dispersant droplets come into contact with the oil and mix rapidly, resulting in nearly instantaneous dispersion into the water column. Although dispersant is applied as evenly as possible, because oil slicks tend to be unevenly distributed across the ocean's surface (NRC, 2005), the true dispersant-to-oil ratio (DOR) is expected to vary spatially. The required volume of chemical dispersant is assumed to be that which is needed to coat the surface of an oil slick with minimal volume allowed for overspray (Scelfo and Tjeerdema, 1991) and to achieve a recommended DOR, typically between 1:10 and 1:50 (Rico-Martinez et al., 2013), and more specifically, 1:20 in Alaska (Alaska Clean Seas, 2010).

The goal of dispersant application is to break the surface tension of the water-oil interface such that droplets of oil form that are small enough to remain suspended in the water column (Brandvik et al., 2010). Dispersant chemical formulations are designed to bind to non-polar substrates and crude oil specifically, so the individual chemicals in dispersants tend to move through the water column with plumes of dispersed oil (Kujawinski et al., 2011).[2] Once broken into droplets, the oil mixes into the water column, effectively lowering the surface concentration of oil and thus the exposure of aquatic organisms at the ocean's surface. Note that pelagic species (e.g., fish) may be more exposed to oil after chemical dispersion, because typical concentrations of oil in the water column are very low prior to dispersion, even just below the slick (Mackay and McAuliffe, 1988). Also, the exposure of species to toxic components of oil (i.e., PAHs) is likely to increase immediately after dispersant application (Yamada et al., 2003; Ramachandran et al., 2004; Milinkovitch et al., 2011a), and may result in increased toxicity (Barron, 2003; Barron et al., 2008). PAHs are likely to decrease rapidly in concentration as a result of natural processes (e.g., wave action, wind-driven currents and advection, photo-oxidation, and biodegradation), though toxicity may still occur (French-McCay, 2010). These possible impacts are discussed at length in Section 3.

The rate of oil and chemical dispersant mixing is primarily determined by the energy of the environment into which the dispersant is applied, although some additional factors contribute to effective dispersion (e.g., spill size, dispersant droplet size, penetration of spill upon impact, thickness of spill, extent of weathering, and the formation of less dispersible emulsions) (NRC, 2005). A calm sea will mix more slowly than churning waters, where waves stir the oil and dispersant together. Wind also produces turbulent mixing, facilitating dispersion (NRC, 2005). Both wave action and wind energy act on any oil, regardless of the presence of dispersants, and cause the natural dispersion of oil droplets. In the Arctic, sea ice can dampen the effect of wind and waves, requiring the deliberate addition of turbulence (e.g., propeller wash from a response vessel) (Sørstrøm et al., 2010). However, the movement of the ice itself has been shown to sufficiently mix oil and dispersant, such that chemical dispersion is highly effective even in the presence of broken ice (Sørstrøm et al., 2010; Potter et al., 2012). It is also important to note that the effectiveness of dispersion at Arctic temperatures is not dissimilar to its effectiveness in warmer waters (Potter et al., 2012; Sørstrøm et al., 2010; Brandvik et al., 2010; MMS, 2010). Still, under certain circumstances, it is possible that dispersion will be less effective in areas covered by sea ice due to decreases in surface water salinity (Brandvik et al., 2010; Chandrasekar et al., 2006) or sheltering from sea energy (Sørstrøm et al., 2010).

The environment in which dispersants are applied is often much different than the system in which a controlled toxicology study is conducted. In an artificial test system with well-defined boundaries, oil is constrained even when dispersed, limiting dilution. In a large water body, such as an ocean or embayment, dispersed oil is less

[2] Therefore, free dispersant in the water column is unlikely in the presence of oil; overspray into unoiled water is an exception and would result in partitioning to water.

constrained. Typically, field applications are more effective in reducing surface oiling than are applications in laboratory tests, as shown by Nedwed and Coolbaugh (2008).

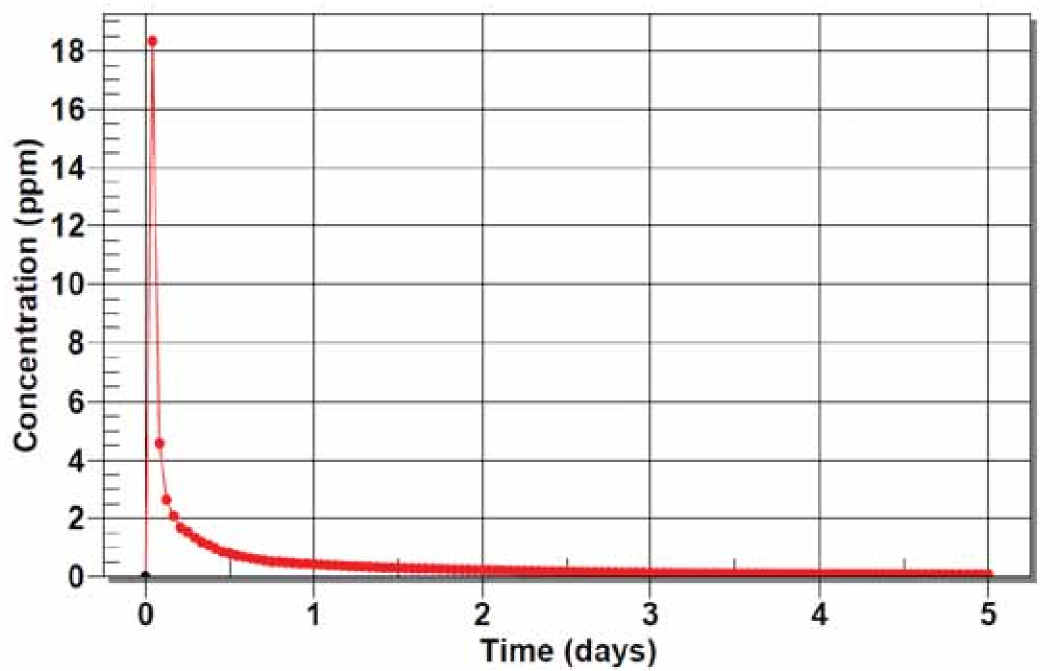
Gallaway et al. (2012) modeled the expected concentration of dispersant released to the environment assuming an application rate of 5 gal. of Corexit® 9500 per acre, a 10-km^2 area, and a total volume of 5,000 gal. of dispersant. The receiving waters were modeled as having a local initial value of approximately 18 parts per million (ppm) of Corexit® 9500, which was diluted rapidly over time (Figure 2). Within approximately one hour, the concentration of dispersant was diluted to below the 5th percentile of the species sensitivity distribution (SSD), the Hazardous Concentration-5 (HC5), calculated for this BA (i.e., 5.53 ppm Corexit® 9500) (Section 3.2; Table 3). The implication of this model is that the concentration of a dispersant is diluted rapidly after application to below protective concentrations (specific to dispersants alone); overspray is unlikely to result in significant acute toxicity to planktonic, embryonic, or larval species of fish or invertebrates, because the duration of exposure to toxic concentrations is very short, much shorter than in controlled toxicity experiments. The rate of dispersant dilution indicated by the Gallaway et al. (2012) model is similar to that reported by Nedwed (2012), who indicated that concentrations of dispersant decreased to < 1 ppm within a matter of hours (and to the parts per billion [ppb] range within 24 hours). Similar modeling conducted by the National Oceanic and Atmospheric Administration (NOAA) using the General NOAA Operational Modeling Environment (GNOME) provides similar results (NOAA, 2012b): dispersion is rapid, and dilution drives concentrations of dispersants to < 1 ppm within 24 hours.[3]

McAuliffe et al. (1980, 1981) and Mackay and McAuliffe (1988) showed that dispersed oil, although highly concentrated in the water column below an oil slick immediately after dispersion, decreased to below what the authors considered to be protective levels[4] within a matter of hours. Furthermore, the time-averaged concentration of dispersed oil was low (i.e., 0.46 ppm C_1-C_{10} hydrocarbons), even over short time periods immediately following the application of dispersant (i.e., between 10 and 30 minutes after application) (Mackay and McAuliffe, 1988). Although Mackay and McAuliffe (1988) measured only the light fraction of oil as it dispersed, it can be assumed that heavier fractions of oil (i.e., C_{11} and larger molecules) will disperse and dilute at the same rate (i.e., be transported within the same droplets of oil). That is not to say that dissolution and biodegradation of hydrocarbons into the water column

[3] GNOME model inputs used to derive dispersant concentration dilution models assumed idealized conditions for dispersion, such as 100% effectiveness (NOAA, 2012b).

[4] A direct comparison to the protective concentrations presented in Table 5 is not appropriate, because Mackay and McAuliffe (1988) reported the concentration of hydrocarbons as a light fraction, C_1-C_{10} hydrocarbons, rather than total petroleum hydrocarbons (TPH), a broader fraction of the possible hydrocarbons found in dispersed oil. The concentrations presented in Tables 4 and 5 are based on TPH, the broader fraction.

from oil droplets will be equivalent, as heavier organic molecules tend to be inherently less soluble and less biodegradable than lighter fractions even in the presence of chemical dispersants (Yamada et al., 2003).



Source: Gallaway et al. (2012)

Note: Concentration (ppm) refers to Corexit® 9500. The rapid decrease in Corexit® 9500 concentration is driven by dilution. Degradation occurs concurrently, but at a much slower rate.

Figure 2. Model of Corexit® 9500 concentration as a function of time after 5,000-gal. application over 10 km^2

In all cases, concentrations of dispersant or dispersed oil are shown to be diluted below their respective HC5s in less than the 48- to 96-hour exposure durations used in toxicity tests (Section 3). For this reason, it is expected that the chemical dispersion of oil will result in mitigated acute toxicity, even in relatively sensitive species, due to the reduction in exposure duration and concentration driven primarily by dilution. Mackay and McAuliffe (1988) stated the same conclusion. Furthermore, it is expected, based on previously published models of oil and dispersant dilution and the HC5s calculated in Section 3, that limited acute toxicity will occur in pelagic species, such as ESA-listed or candidate fish or prey species of ESA-listed wildlife. These findings are restated in Sections 4 and 5.

2.2 Degradation of Dispersants and Dispersed Oil

The purpose of this section is to describe the effect on the concentration of oil resulting from the biological and abiotic degradation of oil components or chemical dispersant components. Unlike dilution (Section 2.1), degradation results in the complete destruction of oil or chemical dispersants. Dilution is a rapid process that occurs immediately after chemical dispersion, but the rate and extent to which components of chemical dispersants and oil will degrade are dependent on various environmental factors, as well as the chemical itself.

Biological degradation, as discussed in Section 2.2.1, is strictly limited to microbial degradation, so the section does not relate to metabolism in larger organisms. Metabolism of oil components (e.g., PAHs) is discussed in Section 3.1.2; such metabolism has been linked to various toxic impacts (Shemer and Linden, 2007; Albers and Loughlin, 2003; Payne et al., 2003).

2.2.1 Biodegradation

Dispersants, once released into the environment, undergo physical and chemical processes much like spilled oil or other degradable substances. Neff (1988) indicated that as the volatile components of dispersants evaporate, physical processes initially control the rate of elimination of dispersants from a marine system.[5] After initial evaporation, biological processes determine the rate of removal from the environment.[6]

In a spiked laboratory exposure, Corexit® mixtures were reported to have a 107-minute half-life (i.e., time required for 50% degradation of chemical) in solution (George-Ares and Clark, 2000), indicating rapid removal from water under certain conditions. Mulkins-Phillips and Stewart (1974) also noted that dispersants are biodegradable, but that degradation occurred only after a microbial lag period in growth; this lag period is likely due to observed shifts in natural microbial communities in response to oil spills (Hazen et al., 2010; Lu et al., 2011; Baelum et al., 2012). A study by Okpokwasili and Odokuma (1990) observed that Corexit® 9527 biodegraded 90% or more within 16 days, and the half-life of the chemical mixture was approximately 2 to 3 days. Baelum et al. (2012) measured total Corexit® 9500 and the glycol and dioctyl sulfosuccinate sodium (DOSS) components individually in the presence of oil; the authors report rapid biodegradation of Corexit and DOSS within 5 to 20 days, but glycol components that were largely unaffected after 20 days. Mudge et al. (2011) specifically observed 1-(2-butoxy-1-methylethoxy)-2-propanol (DPnB), for which a half-life of approximately 30 days was determined.

Studies by Staples and Davis (2002), Kim and Weber (2005), the US Environmental Protection Agency (EPA) (2005, 2009, 2010), the Organisation for Economic Cooperation and Development (OECD) (1997), and West et al. (2007) indicate that the component chemicals of Corexit® 9500 and Corexit® 9527 are marginally or readily biodegradable (as well as abiotically degradable; see Section 2.2.2). Table 2 provides a

[5] Refer to Table 2, which indicates that current Corexit® formulations contain only one potentially volatile component, petroleum distillates.

[6] Dilution is also a major factor in determining the concentration of dispersed oil in the water column, although such redistribution of oil does not, in itself, result in removal from the environment.

summary of biodegradation information for Corexit® component chemicals. The rates are given as either the half-life or percent degradation. Percent degradation is accompanied by the duration of the microbial exposure. The percent loss over time is used in determining biodegradability, such that a > 60% loss of a chemical within 28 days characterizes that chemical as readily biodegradable.

Table 2. Biodegradation information for Corexit® component chemicals

CAS No.	Chemical Name (Common Name)	Biodegradability	Half-Life (Days)	Concentration Loss (%, Duration)	Source(s)
57-55-6	1,2-propanediol (propylene glycol)	readily biodegradable	13.6	81%, 28 days	West et al. (2007); Dow AgroSciences (2012)
111-76-2	2-butoxyethanol[a]	readily biodegradable	nr	> 60%, 28 days	OECD (1997)
577-11-7	butanedioic acid, 2-sulfo-, 1,4-bis(2-ethylhexyl) ester, sodium salt (1:1) (DOSS)	readily biodegradable[b]	nr	66.4%, 28 days	EPA (2009)
		readily biodegradable	nr	91 to 97.7%, 3 to 17 days	TOXNET (2011)
1338-43-8	sorbitan, mono-(9Z)-9-octadecenoate (Span™ 80)	readily biodegradable	nr	58 to 62%, 14 to 28 days	EPA (2005, 2010)
9005-65-6	sorbitan, mono-(9Z)-9-octadecenoate, poly(oxy-1,2-ethanediyl) derivs. (Polysorbate 80)	not readily biodegradable	nr	52%, 28 days	Fisher Scientific (2010)
9005-70-3	sorbitan, tri-(9Z)-9-octadecenoate, poly(oxy-1,2-ethanediyl) derivs (Polysorbate 85)	readily biodegradable	nr	60 to 83%, 28 days[c]	EPA (2005)
29911-28-2	1-(2-butoxy-1-methylethoxy)-2-propanol (glycol ether DPnB)	readily biodegradable	10.3 – 28	> 60%, 28 days	Howard et al. (1991); Dow (1993, 1987); Staples and Davis (2002)
64742-47-8	petroleum distillates, hydro-treated, light[a]	readily biodegradable	nr	> 97%, 4.7 days	Rozkov et al. (1998)

[a] Potentially volatile component

[b] EPA states that DOSS did not biodegrade readily; however, the rate at which biodegradation occurred was greater than 60%, above the typical criterion for ready biodegradability. Therefore, it has been changed in the table to reflect the more widely accepted criterion.

[c] Value is expected based on the degradation of chemicals with similar chemical structures.

CAS – Chemical Abstracts Service
DOSS – dioctyl sulfosuccinate sodium
DPnB – dipropylene glycol n-butyl ether
EPA – US Environmental Protection Agency
nr – not reported
OECD – Organisation for Economic Cooperation and Development

Kujawinski et al. (2011) reported only minimal evident biodegradation of DOSS, a component of Corexit® formulations, in samples collected up to 64 days after dispersant application had ceased at the Deepwater Horizon wellhead.[7] It is important to note that dilution of the chemical over time resulted in barely detectable concentrations of DOSS (0.07 ppb); initial concentrations were assumed to be ~7 ppb, 3 orders of magnitude greater than was measured after 64 days. Baelum et al. (2012) reported that that DOSS, in particular, was substantially degraded during a 20-day experiment, but found that glycol components were less biodegradable during that time period.

The biodegradation of dispersed oil is well studied, although results vary among studies (NRC, 2005; Fingas, 2008; Bruheim et al., 1999). In general, biodegradation testing results indicate that oil dispersion increases the rate of oil elimination from the water column under a variety of conditions (Hua, 2006; Lindstrom et al., 1999; Lindstrom and Braddock, 2002; Hazen et al., 2010, as cited in Lee et al., 2011a; McFarlin et al., 2012b; Otitoloju, 2010; MacNaughton et al., 2003; Prince et al., 2003; Zahed et al., 2010; Zahed et al., 2011; Prince et al., 2013; Baelum et al., 2012). Zahed et al. (2011) reported Corexit® 9500-dispersed oil half-lives of 28, 32, 38, and 58 days at oil concentrations of 100, 500, 1,000, and 2,000 ppm, respectively; concentrations of dispersed oil have rarely exceeded 100 ppm during testing, and have not been shown to exceed 500 ppm (McAuliffe et al., 1980, 1981; Mackay and McAuliffe, 1988). These half-lives were all less than those of untreated oil: 31, 40, 50, and 75 days at the same respective oil concentrations. Baelum et al. (2012) reported that non-dispersed oil degraded only 20% within 20 days, whereas dispersed oil degraded by 60%, an increase of 40% caused by the addition of Corexit® 9500. Prince et al. (2013) reported half-lives for oil and Corexit® 9500-dispersed oil of 13.8 days and 11 days, respectively, corroborating previous results (2011; Baelum et al., 2012). It is important to note that the test conditions applied by Prince et al. (2013) and Baelum et al. (2012) (i.e., water temperatures of 8 and 5°C, respectively) were more relevant to Alaskan waters than those applied by 2011) (i.e., water temperature of 27.5°C). McFarlin et al. (2012b) reported that biodegradation increased in response to dispersant application when observing an Arctic microbial community exposed at -1 and 2°C (in two tests). Biodegradation in the Arctic has been shown to progress rapidly (Lee et al., 2011a), but there have been concerns over temperature limitations on microbial activity (Venosa and Holder, 2007). Rapid degradation under Arctic conditions may occur due to the presence of cold-adapted communities of symbiotic bacteria (Lee et al., 2011a; McFarlin et al., 2012a), and such adaptations are not adequately addressed when using one community at various temperatures, as was done by Venosa and Holder (2007).

[7] Kujawinski et al. (2011) did not observe degradation directly, but assumed that minimal degradation had occurred based on the small discrepancies from modeled concentrations (which assumed minimal degradation). In addition, the study was conducted on an atypical spill and response action; impacts related to deepwater applications of chemical dispersants are not being assessed under this consultation.

Increased biodegradation in the presence of dispersant chemicals is significant, but often incomplete. Biodegradation processes are limited largely to the lighter components of oil, and the addition of dispersants appears to facilitate the mineralization of oil only somewhat (McFarlin et al., 2012b). Studies investigating individual components of oil over time found that heavy components within degraded oil made up a larger proportion of the whole volume (Lindstrom and Braddock, 2002; Lindstrom et al., 1999). This has been shown to be true in field observations as well (Hazen et al., 2010; Atlas and Hazen, 2011). Heavier organic components of oil become enriched over time for both oil and dispersed oil (Lindstrom et al., 1999), so this phenomenon does not constitute a negative long-term impact on the degradation of oil relative to baseline conditions. Reductions in the biodegradation of some hydrocarbons due to the addition of chemical dispersant may be linked to selective inhibition of hydrocarbon-degrading bacteria in the marine environment (Hamdan and Fulmer, 2011). The results of such tests are not relevant to field conditions, considering the rapid community-level shifts that occur under natural conditions when oil and dispersant are introduced to a diverse microbial community (Hazen et al., 2010; Lu et al., 2011).

2.2.2 Abiotic degradation

Lyman et al. (1990) indicate that components of Corexit® 9500 are not expected to be susceptible to photolysis, although hydrolytic degradation may occur in the absence of microbial action. The half-lives indicated for individual components range from 77 days for Tween 85® to 7.7 years for Span® 80 (TOXNET, 2011). Rates of hydrolytic degradation vary greatly based on pH. For example, DOSS has a half-life of 240 days at pH 8, but a half-life of 6.7 years at pH 7, in the absence of microbial degradation (TOXNET, 2011). Because these chemicals have much shorter half-lives for biodegradation than under abiotic conditions, (George-Ares and Clark, 2000; Baelum et al., 2012), it is not expected that abiotic degradation pathways play a major role in initial degradation of Corexit® dispersants in the field.

Similarly, it is expected that abiotic degradation is limited relative to biodegradation (and physical effects) in decreasing the dispersed oil in an aquatic system over an extended period of time. However, physical weathering is known to have a marked impact on the initial concentration of oil, primarily since evaporation from the ocean's surface can result in the loss of approximately 20–50% of an oil spill within 24 hours (Mackay and McAuliffe, 1988; Suchanek, 1993). Similarly, many components of oil (e.g., PAHs) are susceptible to photolysis (Shemer and Linden, 2007).

2.3 TRANSPORT OF DISPERSANTS AND DISPERSED OIL

Horizontal transport of dispersants and dispersed oil is largely driven by ocean currents. Both oil and dispersed oil will assumedly be carried in the direction of major currents. It has been noted that the spread of oil across the ocean's surface can rapidly increase after dispersant application (preceding dispersion into the water column)

(NRC, 2005), and that dispersants sprayed at the edge of a slick can cause oil to be herded, whereby the slick area decreases somewhat (Fingas, 2008).

The long-distance transport of dispersants was studied by Kujawinski et al. (2011), who observed a component of Corexit® dispersant formulations, DOSS, after application in deep water (900 to 1,400 m) during the DHOS event. The compound was found within plumes of dispersed oil and gas from the point of application up to 315 km away at a detectable concentration (0.07 ppb) up to 64 days later.[8] The transport of dispersant components within oil plumes is expected due to the known partitioning characteristics of the surfactant components of Corexit® formulations, as well as the creation of surfactant micelles (Figure 1) (TOXNET, 2011; Nalco, 2005, 2010). It has been noted that, at very dilute concentrations of dispersant, surfactants may slowly partition to the water column and be lost from the dispersion process (Fingas, 2008).[9] Although such transport was observed after DHOS, that instance may not be an entirely relevant case study, because the application of chemical dispersants at the wellhead in deepwater represented an atypical response action, one that is not being assessed as part of this consultation.

Vertical transport of dispersants and dispersed oil is limited by density gradients within the water column that are controlled by temperature and salinity. Temperature gradients are referred to as thermoclines, and the salinity gradient is referred to as the pycnocline; each represents a density barrier against sea water mixing. Typically, the pycnocline is between 5 and 10 m below the ocean's surface (NOAA, 2012b), and thermoclines exist even deeper (i.e., 100 m or more). The presence of density barriers does not hinder the rapid dilution of dispersants and dispersed oil, because in addition to being transported vertically to approximately 10 m, they also are transported horizontally through advection caused by ocean currents (NRC, 2005; NOAA, 2012b).

The buoyancy of dispersed oil droplets is driven by their size (i.e., diameter), such that smaller droplets disperse deeper and rise to the surface more slowly (NRC, 2005). Also, the presence of suspended sediment can regulate droplet buoyancy through the creation of oil-mineral aggregates that tend to sink (Fingas, 2008). In the event that stable emulsions do not form, which can be common (Fingas, 2008), dispersed oil tends to remain in the water column for between 4 and 24 hours before resurfacing.

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[8] The application of dispersants at depth will not occur in Alaskan waters because oil exploration and drilling occurs in waters less than 300 m deep. Some components of Corexit® were not detected after DHOS in any samples collected by EPA (data available through Socrata, 2012). Similar monitoring by the United States Coast Guard (USCG) (2010) resulted in no exceedances of established dispersant chemical component benchmarks. However, USCG did observe detectable concentrations of dispersant constituent chemicals in 60 of 4,850 samples (2010). Discrepancies among the results of Kujawinski et al. (2011), EPA (data available through Socrata, 2012), and USCG (2010) may be due to differences in sampling depth, location, and target analytes.

[9] Note that this occurs specifically under conditions of dilute concentrations (Fingas, 2008); this process is unlikely to contribute sufficient chemicals to illicit toxic effects in marine biota.

Based on the dilution modeling conducted by Nedwed (2012), Gallaway et al. (2012), and Mackay and McAuliffe (1988) (Section 2.1, Figure 2), 4 to 24 hours is sufficient to greatly dilute the concentrations of dispersant and dispersed oil. Lewis et al. (1995) also showed that subsequent sprayings can increase the effectiveness of dispersion when oil resurfaces quickly, resulting in a rapid removal of oil from the ocean's surface.

3 Effects

3.1 SUMMARY OF KNOWN EFFECTS OF OIL, DISPERSANTS, AND DISPERSED OIL

3.1.1 Effects of chemical dispersants

The purpose of this section is to discuss the mechanisms of toxicity or physical impacts of dispersants alone (i.e., without oil). The toxicity of dispersants is typically less than that of oil (Fingas, 2008; NRC, 2005), so impacts of dispersants alone on aquatic species are not expected to be greater than those of oil on its own; however, the combination of oil and dispersants can be either more toxic (NRC, 2005; Fingas, 2008) or less toxic than oil alone.[10]

Dispersants are not intended to be applied to wildlife at all, neither directly nor indirectly; therefore, concentrated exposure to dispersants alone is not expected as a result of their application. Exposures to very diluted concentrations may occur as a result of leaching to the water column from micelles over time (Fingas, 2008) or, to a limited extent, as a result of overspray during application (Butler et al., 1988; Scelfo and Tjeerdema, 1991). The effects caused by dispersed oil are discussed in Sections 3.1.2 and 3.2.5. Although dispersants are shown to have inherently toxic characteristics in this section, later discussions (Sections 3.1.2 and 3.2.5) provide evidence that dispersants may mitigate the acute (i.e., lethal) toxicity of oil alone to certain species (e.g., larval fish and invertebrates), or have little to no effect on species that pass through the upper 10 m of the ocean, but generally reside much deeper (e.g., cetaceans, pinnipeds, fish, and marine reptiles).

3.1.1.1 Fish

The toxicity of dispersants to sensitive species and life stages of fish are discussed at length in Section 3.2, and so will only be noted briefly here. Abnormal development and narcosis are the most often cited modes of toxicity (NRC, 2005). At very low doses, dispersants have been shown to be embryotoxic to fish exposed at early life stages (Lonning and Falk-Petersen, 1978; Falk-Petersen et al., 1983). This is only relevant to Pacific herring (*Clupea pallasii*), which spawn in Alaska nearshore waters. While the direct application of dispersants is not intended for nearshore waters, dispersion in open water that, over time, results in diluted dispersant concentrations in nearshore waters could have a marked impact on Pacific herring, a species highly sensitive to dispersed oil. However, given the toxicity of oil alone and the potential impacts caused by oiling of nearshore areas and intertidal shorelines, it may still be

[10] The analysis presented in Sections 3.3 and 3.4 of this appendix show that the lethality of chemically dispersed oil is less than that of oil. Figures 8 and 9 clearly show the differences between oil and chemically dispersed oil, particularly oil dispersed by Corexit® 9500.

beneficial (relative to baseline oiling) to apply dispersants, if done at a distance from known spawning habitat. This is further explained in Section 3.2 and Section 4.

ESA-listed Chinook (*Oncorhynchus tshawytscha*) and coho salmon (*Oncorhynchus kisutch*) and steelhead trout (*Oncorhynchus mykiss*) are present only as juveniles and adults in Alaska waters, and therefore are not as susceptible as Pacific herring to the toxic effects of dispersants. This is further discussed in Section 4.

3.1.1.2 Birds

Chemical dispersants are known to impact bird species in various ways. Dispersants have been shown to substantially alter the structure and function of common murre (*Uria aalge*) feathers; the impact of dispersants alone on feather structure has been shown to be greater than that of dispersed oil or oil alone (Duerr et al., 2009; 2011). Such alterations in feather structure have been observed in lesser scaup (*Aythya affinis*) that were exposed to oils and / or dispersants (Stephenson, 1997), and these alterations are known to lead to a loss of thermoregulatory ability (Jenssen and Ekker, 1991a, b). Lost thermoregulation in experiments has been largely associated with oil, rather than dispersants (Lambert et al., 1982). Lambert et al. (1982) observed that birds became wetted and lost buoyancy when exposed to dispersants, although this did not immediately impact their metabolic rate. This suggests that, although oil drives the loss of thermoregulation, dispersants may contribute to lost thermoregulation by allowing greater wetting of feathers, facilitated in part by the alteration in function (Duerr et al., 2011). Diminished thermoregulation is particularly important to birds in Alaska, where temperatures are often low enough to induce hypothermia, and where birds have adapted specialized feathers for trapping heat. For example, Jenssen and Ekker (1991a, b) showed that common eider (*Somateria mollissima*) were more affected by alterations to their feathers (made incrementally worse by the addition of dispersants to oil) than were mallards. Furthermore, molting birds, which already have functionally compromised plumage, are more susceptible to the impacts of oil or dispersants (Stephenson, 1997), and are less able to avoid oil. This is an important consideration for any dispersant application, particularly near critical molting habitat for Steller's (*Polysticta stelleri*) and spectacled eiders (*Somateria fischeri*) (Petersen et al., 1999). The ecology of ESA-listed species is discussed at length in Section 3 of the BA. Other ESA-listed bird species, including short-tailed albatross (*Phoebastria albatrus*), yellow-billed loon (*Gavia adamsii*), and Kittlitz's murrelet (*Brachyramphus brevirostris*), could be similarly impacted at the individual level (e.g., reduced survival) if directly coated with chemical dispersants. Since dispersants are not intended for direct application to birds, the probability of such an undesirable incident occurring is remote (Butler et al., 1988). If dispersants were applied to a slick that later came into contact with birds, negative impacts on bird plumage could increase relative to the baseline condition (Duerr et al., 2009, 2011; Jenssen and Ekker, 1991a, b). However, the volume of oil at the ocean's surface is expected to diminish once dispersant has been applied (Lewis et al., 1995; Section 2), thereby reducing the area in which birds could be impacted by dispersed oil. Furthermore, it has been claimed (CDC and ATSDR, 2010; Lessard and Demarco, 2000) that the application of dispersants to oil (and the subsequent formation of oil droplets) may reduce the likelihood of birds becoming oiled, at least by dispersed oil droplets.

In one study, ingestion of concentrated Corexit® 9527 was shown to have acute but non-lasting neurological impacts on birds that persisted for a few hours (Rocke et al., 1984). All birds returned to normal within 24 hours, and none died from such exposure. This effect was not observed in either crude oil only or dispersed oil treatments (Rocke et al., 1984). Behavioral impacts resulting from temporary intoxication may result in decreased fitness or the death of some individuals (e.g., if birds could not escape predation). It is not likely that highly concentrated doses of dispersants will be directly ingested by birds immediately following application, given the rapid rate of dilution expected to occur (Section 2). Birds are also expected to disperse due to noise caused by response workers, equipment, and airplanes, or be dispersed (i.e., hazed using noise), such that they would not be present in an area at a time when dispersants were most concentrated in the water column.

The inhalation of fumes from dispersants poses little risk to birds and other animals, unless they are directly exposed to undiluted dispersants. Such exposure is unlikely considering the best management practices (BMPs) or response actions (e.g., avoidance of wildlife, monitoring for bird presence, and hazing in an area to intentionally disperse wildlife) that could be implemented prior to chemical dispersion.

Of the chemicals in Corexit® 9527 and Corexit® 9500, both petroleum distillates and 2-butoxyethanol are volatile, although the manufacturer notes inhalation as a potential route of exposure. Inhalation (or aspiration) of sprayed droplets during application is perhaps the more likely pathway of exposure for the non-volatile components of chemical dispersants than volatilization from the ocean surface. Nalco (2005, 2010) and the Centers for Disease Control and Prevention (CDC) (CDC and ATSDR, 2010) report that prolonged inhalation of Corexit® chemicals may cause chemical pneumonia, respiratory irritation, and eye irritation. Corexit® 9527 specifically contains 2-butoxyethanol, which, after prolonged exposure, can cause damage to the blood (i.e., hemolysis), liver, and kidneys, central nervous system depression, nausea, vomiting, anesthesia, and narcotic effects (Nalco, 2010; CDC and ATSDR, 2010). Oil alone is also known to contain approximately 20 to 50% volatile chemicals (by volume) (Mackay and McAuliffe, 1988; Suchanek, 1993), which may cause similar impacts in birds through inhalation. The inhalation or aspiration of chemical dispersants is a possible outcome of a worst-case scenario in which the chemical is sprayed in the immediate vicinity of ESA-listed or candidate species; in the main text of the BA, this is noted as a possible impact on all air-breathing ESA-listed or candidate species (i.e., excluding fish species).

Various studies have observed the embryotoxicity of Corexit® 9500 to birds by directly applying the chemical to mallard (*Anas platyrhyncos*) eggs (Wooten et al., 2012). Direct exposure of mallard eggs to Corexit® 9500 resulted in significantly reduced hatch success at an application of 20 µl (of pure dispersant), and significantly reduced the developmental stage (mortality occurred at 40 µl of pure dispersant). As mentioned above, the direct application of dispersants to adult birds (i.e., nesting parents) is neither intended nor likely (Butler et al., 1988), nor is application of dispersants to terrestrial habitats where birds nest (Wooten et al., 2012). There are currently no studies available that investigate the embryotoxicity of Corexit® 9527 alone.

3.1.1.3 Mammals

Dispersants have no visible impact on sea otter fur structure (Duerr et al., 2009; 2011), but the effects of oil on thermoregulation have been shown (Geraci and St. Aubin, 1980; St. Aubin, 1988; Geraci, 1990). This is particularly significant to marine mammals that do not have subcutaneous blubber to regulate their body temperature (Geraci and St. Aubin, 1980). The sea otter is the most relevant marine mammal in this BA that utilizes dense fur to trap air against the skin (Williams et al., 1988). It is not clear if dispersants will physically affect mammals.

Data on the toxicity of dispersants to mammals are very limited. The inhalation of fumes from dispersants poses a possible route of exposure, and could lead to various localized or systemic impacts including chemical pneumonia; inflammation of organ tissues (e.g., eyes and respiratory tract); increased difficulty breathing (not directly related to inflammation) (Roberts et al., 2011); injury to kidneys, liver, and blood cells (i.e., hemolysis); nausea; vomiting; narcosis; defatting and drying of skin; dermatitis (Nalco, 2005, 2010; CDC and ATSDR, 2010); and acute neurological impacts (e.g., altered neurotransmitter signaling) potentially leading to chronic depression, lack of motor coordination, and short-term memory loss (Sriram et al., 2011). It is unclear how neurological impacts could affect ESA-listed mammals at the individual level (e.g., reduced survival), but behavioral impacts could assumedly result in a diminished ability to forage or avoid predation. It is not clear whether ecologically relevant concentrations of chemical dispersants will result in such impacts on marine mammals, particularly after dispersants mix into the water column. Direct application to mammals is not the intended or suggested use of chemical dispersants, and BMPs or response actions (e.g., avoidance of wildlife, monitoring for mammal presence, and hazing in an area to intentionally disperse wildlife) should mitigate animal exposures to concentrated dispersant chemicals.

3.1.1.4 Invertebrates

The toxicity of dispersants to invertebrates (which may compose part of the diet of ESA-listed species) is discussed at length in Section 3.2. Abnormal development and narcosis are the most often cited modes of toxicity (NRC, 2005), although numerous sublethal impacts on invertebrates may also occur. Dispersants have been shown to be toxic to invertebrates at early life stages at very low doses (Lonning and Falk-Petersen, 1978; Falk-Petersen et al., 1983), but dispersants have also been shown to be less toxic than oil alone (Attachment B-1; Fingas, 2008; NRC, 2005). Therefore, dispersants alone do not pose a greater threat than that of the baseline condition for a spill cleanup.

3.1.1.5 Marine reptiles

At present, there are no known studies investigating the impacts of dispersants alone on marine reptiles, such as sea turtles. There is extensive research on the effects of oil alone, and at least one study investigating dispersed oil. Dispersants are not intended for direct application to sea turtles, so direct toxicity due to dispersants alone is unlikely. Various other factors limiting the likelihood of exposure of marine reptiles to oil response actions in Alaska are discussed in Sections 2 and 3 of the BA. Nesting does not occur in Alaska (Section 3 of the BA), so ESA-listed marine reptiles in sensitive life stages would not be exposed to dispersants (or dispersed oil) as a result of an oil spill response in Alaska. Furthermore, the presence of marine reptiles in Alaska is "accidental or uncommon" (Section 3.4.4 of the BA), which limits the likelihood of an individual coming into contact with dispersants, spilled oil, or dispersed oil in Alaska waters.

3.1.2 Known effects of oil and dispersed oil

Dispersants are known to have a variety of effects on aquatic species (Sections 3.1.1.1 to 3.1.1.5). However, the toxicities of various dispersants (e.g. Corexit® 9500 and Corexit® 9527) are known to be less than that of crude oil alone (Fingas, 2008; NRC, 2005); conversely, some have shown dispersed oil to be more toxic than either oil or dispersants alone (Attachment B-1; Fingas, 2008; NRC, 2005). Therefore, the impacts of dispersed oil are caused primarily by the toxicity of oil, and may be enhanced by its interaction with dispersants. The enhanced toxicity of dispersed oil (over oil alone) is frequently attributed to the increased bioavailability of the toxic components of oil, principally PAHs (Wolfe et al., 1998; Wolfe et al., 2001; Yamada et al., 2003; Ramachandran et al., 2004; Milinkovitch et al., 2011a). Dispersants have been shown to increase the acute toxicity (e.g., lethality) of oil in only about half of the comparable studies (Attachment B-1, Section 3.4.1); the other half of these studies showed that chemical dispersants actually decrease the lethality of oil in a mixture. These studies are discussed in Sections 3.2 through 3.4, which present , SSDs developed to show how oil and dispersed oil compare across the available studies of acute toxicity (Figures 8 and 9). When considering the available, relevant, and comparable acute toxicity data in Attachment B-1 (including studies in which oil toxicity was enhanced by chemical dispersants), it appears that the acute lethality of oil is generally decreased by chemical dispersants.

The sublethal impacts of dispersed oil are generally enhanced relative to those of oil alone (Attachment B-1), suggesting that an immediate response to dispersed oil exposure is generally less likely than a delayed response (e.g., decreased fitness leading to death). Due to diminishing concentrations of dissolved and dispersed components of oil in the water column over time (Section 2), long-term impacts are unlikely within an area. Observed impacts (i.e., toxicity endpoints) of chronic exposure to PAHs include genotoxicity, immunotoxicity, histopathological impacts (e.g., hepatic lesions), behavioral impacts, and reproductive impacts (Payne et al., 2003; Albers and Loughlin, 2003; Malcolm and Shore, 2003; Besten et al., 2003; Meador, 2003; Barron, 2012; Godschalk et al., 2000; Lemiere et al., 2005; Carls et al., 1999; Jonsson et al., 2010). The likelihood of such impacts affecting listed species as a result of short-term exposure is a point of uncertainty, although the rapid reduction in exposure concentrations and biodegradation of dispersed oil within a relatively short time period (Section 2) may limit the likelihood.[11] Changes in enzyme activity, blood plasma chemistry, and increased PAH metabolites in bile have been observed in various species after exposure to dispersed oil, suggesting that exposure increases, but not necessarily that impacts at the individual level (i.e., reduced growth, reproduction, or survival) occurs (Lee and Anderson, 2005; Cohen et al., 2001; Ramachandran et al., 2004; Baklien et al., 1986).

3.1.2.1 Fish

The exposure of fish to oil (and its component chemicals) appears to occur predominately across the gill surface or through ingestion of contaminated food (Baussant et al., 2001; Cohen et al., 2001; Milinkovitch et al., 2011b). If exposed continuously to PAHs dissolved in the water column, oil may require as many as seven days to reach a maximum concentration in fish (Logan, 2007). The more soluble components of oil (e.g., low-molecular-weight PAHs [LPAHs]) are internalized across the gills more efficiently than the larger molecules, resulting in a greater exposure to LPAHs than to high-molecular-weight PAHs (HPAHs) over short time periods (Baussant et al., 2001; Cohen et al., 2001; Wolfe et al., 2001). HPAHs may be quickly and efficiently metabolized and depurated from some fish (e.g., turbot) (Baussant et al., 2001), whereas they are concentrated in invertebrates (e.g., *Mytilus edulis*) (Baussant et al., 2001). Due to the rapid depuration of the LPAHs, Wolfe et al. (2001) did not find a significant increase in the accumulation of an LPAH (i.e., naphthalene) or its metabolites after 12 hours of depuration in larval topsmelt.

HPAHs, which fish can also internalize across the gills, are metabolized and excreted from the fish body at a slower rate than LPAHs (Logan, 2007; Payne et al., 2003); their solubility also increases after dispersant application, resulting in greater exposure for fish to HPAHs than after exposure to untreated crude oil (Couillard et al., 2005; Cohen et al., 2001). HPAH accumulation is more strongly correlated with enzymatic

[11] Impacts of chronic PAH exposure have historically been reported for species found in areas impacted by spilled but untreated oil (e.g., sea otters in PWS after EVOS) or in areas with significant anthropogenic inputs of contaminants (e.g., beluga St. Lawrence waterway), including but not limited to PAHs. Therefore, such impacts cannot be directly related to dispersants or PAHs alone.

responses indicative of metabolism in fish (and subsequent exposure to toxic PAH metabolites) (Couillard et al., 2005). The correlation between HPAH exposure and metabolic activity further indicates that these chemicals are efficiently metabolized to forms that can be removed from the body, limiting trophic transfer.[12]

Similarly, the accumulation of oil and its components in invertebrates, which is enhanced by the addition of chemical dispersants (Wolfe et al., 1998; Jensen et al., 2011), can influence uptake in fish species through ingestion. Ingestion of contaminated food appears to be more important in the exposure of fish to HPAHs, because lipids in prey items, specifically invertebrates, accumulate organic, lipophilic compounds such as HPAHs (Logan, 2007). However, the apparent exposure of fish to HPAHs when fed dispersed oil-contaminated prey was not significantly different from the exposure of fish fed crude oil-contaminated prey (Cohen et al., 2001). Wolfe et al. (2001) reported a similar result for the accumulation of naphthalene and its metabolites in larval topsmelt exposed to both contaminated food and exposure solution.

Reported individual-level impacts (i.e., impacted growth, survival, or reproduction) on fish include abnormal growth, reduced growth (Claireaux et al., 2013; Couillard et al., 2005), reduced hatch (Greer et al., 2012; Anderson et al., 2009), and mortality (Van Scoy et al., 2012). An additional impact of note is the onset of blue sac disease, which was observed in Atlantic herring (*Clupea harengus*) by Greer et al. (2012). Reduced hatch and diseases in early-life-stage individuals pose a significant threat at the individual and population levels for fish species known to spawn in Alaska (e.g., Pacific herring). However, Greer et al. (2012) showed that dispersion reduced the acute toxicity of oil to Atlantic herring embryos 5, 30, and 60 minutes post-dispersion, even though blue sac disease had been induced.[13] This disease has been observed in fish exposed to either oil alone or dispersed oil (Greer et al., 2012; Colavecchia et al., 2006). Reduced acute toxicity in Chinook salmon was observed by both Lin et al. (2009) and Van Scoy et al. (2010). Therefore, the impact of chemical dispersion on oil toxicity to fish is uncertain, although likely to be enhanced in embryonic and larval life stages in planktonic fish species (e.g., Pacific herring).

In addition to causing internal impacts, dispersed oil affects transfer across the gills of fish (Singer et al., 1996), particularly by affecting Na^+/K^+-ATPase pumps (Duarte et al., 2010), which are necessary for regulating ionic and osmotic gradients in fish tissues. Duarte et al. (2010) showed that the flux of ions across fish gills significantly

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[12] HPAHs are known to be broken down into much more toxic metabolites prior to egestion, and metabolites have been linked to various sublethal impacts on fish (Logan, 2007; Payne et al., 2003). Although PAHs are actively metabolized and excreted, it is not implied here that sublethal impacts will not result.

[13] Solution collected 15 minutes post-dispersion from the wave tanks where dispersion was conducted was more toxic than oil alone (Greer et al., 2012); it is unclear why this duration resulted in a conflicting result.

increased (both influx and efflux), and that the net flux significantly decreased, such that more sodium was lost from the gill surface, when fish were exposed to dispersed oil, relative to the control, dispersant-only, or oil-only treatments. Such a disruption could lead to increased stress in fish. However, the effect does not directly relate to an impact at the individual level (i.e., reduced survival, growth, or reproduction).

Although bioaccumulation of PAHs has been shown to occur in fish over short time periods, efficient metabolic processes limit the bioconcentration of PAHs in fish tissues over time (Logan, 2007; Payne et al., 2003) and the transfer of parent PAHs from fish to higher trophic levels (i.e., birds and mammals) (Payne et al., 2003; Albers and Loughlin, 2003). The transfer or bioconcentration of PAH metabolites in higher trophic levels has not been extensively studied; it is possible that metabolites stored in fish lipids could be transferred to higher trophic levels, resulting in PAH-related toxicity in those species.

3.1.2.2 Birds

The impacts of oil on birds are well documented. For example, Holmes et al. (1979) showed that mallards that ingested large quantities of oiled food succumbed to stress-related exhaustion more frequently than those that did not ingest oiled food. Eastin and Rattner (1982) observed that oil ingestion resulted in altered blood chemistry and lost osmoregulation (i.e., retaining of salt after seawater ingestion), and cited reduced growth as also possible after oil exposure through ingestion. The same authors noted that such impacts appeared to be mitigated when exposed to Corexit® 9527-dispersed oil. Rocke et al. (1984) observed immunological impacts on waterfowl exposed to ingested crude and dispersed oil.

Oiling causes hypothermia in birds by altering the function of feathers that regulate body heat (O'Hara and Morandin, 2010; Jenssen, 1994; Stephenson, 1997; Jenssen and Ekker, 1991a, b). Duerr et al. (2009; 2011) showed that dispersed oil had a greater impact on common murre feathers than did oil alone, likely leading to a loss of thermoregulatory ability, hypothermia, and death. This result has been corroborated in mallard and common eider (Jenssen and Ekker, 1991a, b); conversely, Lambert et al. (1982) showed that mallards exposed to dispersed oil experienced changes in basal metabolic rate not significantly different from those caused by oil, and that dispersants alone did not increase their metabolic rate relative to the control; the key difference between Lambert et al. (1982) and Jenssen and Ekker (1991a, b) is that the latter exposed birds on water, whereas the former exposed birds on water briefly, then moved them to dry land. Lambert et al. (1982) speculated that prolonged exposure to cold water and dispersed oil would have different results than exposure to only dispersed oil, which Jenssen and Ekker (1991a, b) later definitively showed. The CDC (CDC and ATSDR, 2010) and Lessard and Demarco (2000) noted that dispersants could make oil droplets "less likely to stick to birds and other animals," so oiling may be mitigated somewhat by chemical dispersion. However, it is likely that dispersed oil has greater physically impacts than oil alone at equivalent concentrations (Jenssen and

Ekker, 1991a, b). Section 2 discusses how the dilution of dispersed oil and its subsequent removal results in a marked decrease in the concentration of oil at the ocean's surface.

The toxicity of oil to birds has been reported in the literature, and various impacts have been observed. For example, Esler et al. (2010) reported that harlequin ducks (*Histrionicus histrionicus*) in areas oiled by the *Exxon Valdez* oil spill (EVOS) had elevated levels of ethoxyresorufin-O-deethylase (EROD) compared to birds that frequented nearby, un-oiled areas, indicating exposure to oil-related hydrocarbons some time after shoreline oiling had occurred. Exposure to oil during the EVOS event resulted in mass bird mortalities related to the ingestion of hydrocarbons (in addition to the loss of thermoregulatory ability) (Peterson et al., 2003). Stubblefield et al. (1995a, b) indicated that impacts on adult mallards related to oil ingestion were not significantly different from impacts on control birds, but that significant impacts on egg production, shell thickness, and hatch success resulted from exposure to oil; hatch success was reduced when oil was directly applied to the mallard egg. Eastin and Rattner (1982) observed that ingestion of oil was related to alterations in blood chemistry, potentially leading to immunological impacts and reduced osmoregulation; the authors suggested that mallards could probably ingest low levels of oil for months without exhibiting effects. Barron (2012) cites additional sublethal impacts on birds exposed to petroleum products, which include hemolytic anemia, the presence of Heinz bodies in red blood cells,[14] cachexia,[15] and diminished resistance to bacterial infection.[16] Reduced immune response was also noted in oiled, rehabilitated, and released American coots (*Fulica americana*) (Newman et al., 2000). It is not clear if the chemical dispersion of oil would increase such impacts on birds, but it is expected that any measure reducing the direct oiling of birds would diminish the likelihood of such impacts; therefore, chemical dispersion, which is expected to reduce such oiling (CDC and ATSDR, 2010; Section 2), is expected to reduce the likelihood of sublethal impacts related to oiling.

Modeling conducted by French-McCay (2004) estimated that waterfowl and other surface-dwelling birds that came into contact with oil spills in open ocean environments (i.e., where dispersants would be applied) had a 99% probability of

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[14] Heinz bodies are inclusions within red blood cells that have been linked to various blood disorders, including hemolytic anemia. Heinz bodies are caused by heritable mutations or oxidative stress; oxidative stress is generally caused by reactive oxygen species or "oxygen radicals." PAHs are known to react in the body to create oxygen radicals (Altenburger et al., 2003).

[15] Cachexia is also referred to as "wasting syndrome," and is characterized by weight loss, fatigue, muscle atrophy, and weakness that cannot be corrected nutritionally. Cachexia has been observed in cases of advanced cancers, infectious diseases such as AIDS or tuberculosis, and exposure to contaminants such as mercury.

[16] Barron (2012) also notes that studies with mallards exposed to Bunker C and dispersed Bunker C (through ingestion) did not show significantly reduced antibody production or resistance to viral infection.

mortality. French-McCay (2004) also noted that species of loon (i.e., yellow-billed loon), which do not behaviorally avoid oil, are more susceptible to oiling than those species of birds that do avoid oiled areas. It is clear that oiling alone poses a significant threat to ESA-protected birds.

Dispersed oil may be more toxic to and have greater physical impacts on bird species than oil alone. Butler et al. (1988), Finch et al. (2012), and Peakall et al. (1987) showed that dispersed oil is more toxic to developing birds exposed *in ovo*[17] than oil alone. However, the application of chemical dispersants is expected to reduce the exposure of birds to oil; this assumption is discussed further in Section 4, and is corroborated by modeling reported by French-McCay (2010). Also, it has been observed that the application of dispersants can, under certain circumstances, reduce embryotoxicity from oil in birds (Albers and Gay, 1982; Albers, 1979; both as cited in Wooten et al., 2012). In these ecologically relevant tests, which observed the toxicity of dispersed oil applied to eggs via contact with an oiled nesting parent, it was shown that dispersants more often increased the toxicity of oil to the developing embryo (Albers and Gay, 1982, as cited in Wooten et al., 2012; Peakall et al., 1985, as cited in Peakall et al., 1987).

Corexit® formulations may contribute volatile petroleum distillates or 2-butoxyethanol (Table 2; TOXNET, 2011) to the environment, possibly resulting in increased inhalation exposure relative to oil alone. However, approximately 20 to 50% of crude oil is composed of volatile chemicals that are lost on the first day after an oil spill (Mackay and McAuliffe, 1988; Suchanek, 1993), a greater volume of volatile chemicals than is added by the application of dispersants. More importantly, dispersants decrease the amount of chemical that is released through evaporation (NRC, 2013), so chemical dispersant application may mitigate impacts on ESA-protected species of birds (as well as other animals, including human responders) caused by inhalation of multiple chemicals, relative to the baseline condition. The dispersion of volatile chemicals into the water column represents a trade-off in toxicity between protecting species that breathe air (e.g., birds) and protecting those that do not surface to breathe (e.g., fish). This is also an important consideration for human safety during a response action (NRC, 2013).

Chemical dispersants have been shown to decrease the amount of oiling of shorelines, thereby reducing the chronic input of hydrocarbons to filter-feeders such as bivalves, and reducing the long-term (i.e., > 2 years) uptake of hydrocarbons in those species from oiled sediment (Humphrey et al., 1987). Since both shoreline and bird oiling are known to have severe impacts, chemical dispersant application may, under certain circumstances, have an immediate benefit to ESA-listed species. It is not clear whether short-term benefits (e.g., reduced oiling of birds or forage habitat) outweigh potential

[17] Butler et al. (1988) and (Peakall et al., 1987) exposed eggs indirectly, applying the oil to the parent's breast. Finch et al. (2012) exposed eggs directly, brushing the oil onto the egg.

long-term impacts (e.g., altered prey base, increased PAH contamination in prey, and sublethal effects of PAH toxicity).

3.1.2.3 Mammals

Geraci and St. Aubin (1988) and Williams et al. (1988) showed that sea otter are susceptible to lost thermoregulation after contact with crude oil. This impact can result in either hypothermia and death (Geraci and St. Aubin, 1988), or sublethal effects on behavior (Davis et al., 1988). The effect is likely to depend on the season in which the exposure occurs, as colder ambient temperatures result in more severe effects once thermoregulation is compromised. Geraci and St. Aubin (1988) also note that oil alone can impact buoyancy, which can result in drowning.

Results from Duerr et al. (2011) suggest that dispersants do not increase the impacts of oil on thermoregulation, since ecologically relevant concentrations of dispersed oil (12 to 320 ppm) do not alter the functional structure[18] of otter fur. This was corroborated by Williams et al. (1988), who found the increase in metabolic activity in oiled otters to be similar to that of otters exposed to dispersed oil. The application of dispersants is expected to decrease the exposure of mammals to oil that are sensitive to its physical impacts (e.g., sea otter); this is discussed further in Section 4. Note that the CDC (CDC and ATSDR, 2010), as well as Lessard and Demarco (2000), claim that dispersants may reduce the likelihood of oil droplets sticking to animals, so the physical impacts on sea otter of oiling may be reduced by the application of dispersants.

It is important to note that most of the marine mammals assessed in this BA, particularly those that develop subcutaneous blubber, are not expected to be impacted by physical effects of oiling. Primary examples include cetaceans and pinnipeds, which regulate their body heat with blubber. According to modeling conducted by French-McCay (2004), the probability of surface oiling in the open ocean leading to death is 0.1% for cetaceans, 1% for pinnipeds, and 75% for furbearing marine mammals (e.g., sea otter). Clearly, sea otter is the ESA-listed species assessed in this BA most susceptible to the physical impacts of oiling.

Toxicity and altered behaviors in mammals relating to oil has been documented extensively. Geraci and St. Aubin (1988) provided a review of the known impacts of oil alone on marine mammals, including sea otter, polar bear, pinniped, and cetacean species. Examples of known impacts of oil alone on pinnipeds and otters include irritation of the eyes, skin, and other sensitive tissues or mucous membranes; reduced body weights in pups; altered maternal care for pups (potentially due to olfactory disturbance); altered swimming behaviors; loss of thermoregulatory ability; gastrointestinal distress after direct ingestion; organ lesions when vapors are inhaled; and reduced resilience to stress (Geraci and St. Aubin, 1988). Duffy et al. (1994)

[18] Weisel et al. (2005) provides a discussion of the functionality of otter fur in relation to maintaining body heat.

observed that otters abandoned latrine sites that had been oiled, even after two years had elapsed since the oiling.

Cetaceans are likely to be affected in similar ways, such that oiling may lead to localized irritation of tissues, and gastrointestinal problems relating to the ingestion of oil. Fouled baleen is another possible effect, assumedly resulting in decreased feeding efficiency. Feeding at the surface is uncommon among whales, although some species may skim feed or surface in oil, resulting in some ingestion of oil alone. Skim feeding has been observed in North Pacific right whales and sei whales, which are assessed more specifically in Sections 5.1.7 and 5.1.8, respectively.

Taylor et al. (2001) and Duffy et al. (1994) observed altered blood chemistry in otters exposed to oil alone, but it is unclear the extent to which such impacts relate to effects at the individual level (i.e., reduced survival, growth, or reproduction). Toxic impacts relating to ingestion are fairly minimal, unless very large volumes of oil are ingested; Geraci and St. Aubin (1988) indicated that given the small volumes of oil found in pinniped stomachs after oiling events and the infrequency of grooming, this is unlikely for pinnipeds. Cetaceans do not groom either, but sea otters groom frequently; among the marine mammals, sea otters are the most likely to ingest large quantities of oil from their coats. The low toxicity of ingested oil is corroborated by other studies (Rogers et al., 2002; Stubblefield et al., 1995a), although tissue damage was noted at relatively high rates of ingestion (in mouse and ferret tests). Sea otters have been shown to suffer from immunological impacts resulting from modifications to gene expression after exposure to PAHs from crude oil (Bowen et al., 2007).

Dispersed oil sometimes has greater toxicity than oil alone, assumedly due to the higher bioavailability of toxic components such as PAHs (Wolfe et al., 2001; Wolfe et al., 1998; Ramachandran et al., 2004; Yamada et al., 2003; Milinkovitch et al., 2011a). PAHs are known carcinogens that cause oxidative stress and DNA damage (Lemiere et al., 2005), as well as narcosis (DiToro et al., 2000), topical lesions, developmental deformities, decreased growth, and ultimately mortality (Albers and Loughlin, 2003; Logan, 2007). They are also known to become more toxic when released into the environment than when studied under controlled laboratory conditions (due to photo-enhanced toxicity) (Barron, 2006; Barron et al., 2008; Barron and Ka'aihue, 2001) particularly after dispersant application (Barron, 2003; Ramachandran et al., 2004; Milinkovitch et al., 2011a). PAHs are bioaccumulated in the tissues of many species that may then be ingested by mammals; for example, bivalves and other invertebrates accumulate PAHs (Wolfe et al., 1998; Logan, 2007; Meador, 2003).

It is unclear whether mammals exposed to increased PAHs in a dispersed oil plume will develop any symptoms or be directly impacted at the individual level (i.e., reduced survival, growth, or reproduction).

Trophic transfer of parent PAHs (i.e., non-metabolized PAHs) from invertebrates to marine mammals is not thought to be significant (Albers and Loughlin, 2003), because metabolisms at higher trophic levels (i.e., above invertebrates) limit such accumulation (or biomagnification) (Wolfe et al., 2001; Albers and Loughlin, 2003). Fish may accumulate PAHs in their tissues, but they also are able to readily metabolize these chemicals (Logan, 2007), somewhat limiting the trophic transfer of parent PAHs to predominantly piscivorous mammals (Albers and Loughlin, 2003). Wolfe et al. (2001) found that Corexit® 9527 significantly increased the uptake of naphthalene from the water column by larval topsmelt (*Atherinops affinis*), but dispersants also resulted in significantly increased depuration; the result after 12 hours was a slightly decreased final tissue concentration of naphthalene. Using a simplified food chain, Wolfe et al. (2001) found that the dietary uptake of naphthalene was different between oil and dispersed oil. For this reason, piscivorous mammals are less likely to accumulate (or biomagnify) high concentrations of parent LPAHs as a direct result of dispersant application.

HPAHs are also metabolized by fish, though the rate of excretion is slower than for LPAHs (Payne et al., 2003; Wolfe et al., 2001). Therefore, HPAHs are more likely to be transferred from fish tissue to mammals through the latter's diet than are LPAHs (Payne et al., 2003; Wolfe et al., 2001). Toxicity caused by PAHs is generally associated with highly toxic metabolites (Albers and Loughlin, 2003), so the transfer of metabolites rather than parent PAHs may result in some toxicity.

Although historical data of PAH toxicity in marine mammals is available (Albers and Loughlin, 2003), it is not clear whether deceased marine mammals found with high concentrations of PAHs in tissues were chronically exposed to PAHs, nor is it clear to what concentrations they were exposed, what the source of the PAHs was, or whether they were exposed to various other chemicals at the same time (as a mixture) (Albers and Loughlin, 2003).

One component in each of the Corexit® dispersants is potentially volatile (i.e., petroleum distillates in Corexit® 9500 and 2-butoxyethanol in Corexit® 9527) (Table 2) and may become volatile soon after application. Exposure of mammals to toxic volatile chemicals through inhalation of dispersed oil is expected to be less than exposure through inhalation of oil alone, because volatile components in oil are effectively dispersed into the water column (Section 1.2.2; NRC, 2013). Volatilization may be reduced through increased dispersion and dilution of volatile chemicals into the water column (NRC, 2013); this represents another trade-off in toxicity between protecting species that breathe air (e.g., mammals and birds) and protecting those that do not surface to breathe (e.g., fish).

3.1.2.4 Invertebrates

Invertebrates are known to bioaccumulate hydrocarbons and PAHs (Boehm et al., 2004; Meador, 2003), which can lead to narcosis (Logan, 2007). Early-life-stage exposures to oil (including PAHs) can lead to developmental impacts, reduced growth, and death (Lee, 2013; Lonning and Falk-Petersen, 1978; Falk-Petersen et al., 1983; Albers and Loughlin, 2003). Exposure to oil can also lead to localized lesions on organ tissues (Brown, 1992), although it is unclear whether lesions in invertebrate species would have an impact at the population level that would, in turn, indirectly impact ESA-listed species by significantly reducing their prey base (i.e., invertebrates). Various other effects have been noted, including reduced respiration and movement (related to physical smothering), cytotoxicity and cytogenotoxicity, and altered feeding and excretion (Suchanek, 1993). These sublethal impacts may lead to mortality, but it is unclear whether, in an oil dispersion situation, PAH concentrations would be high enough, or exposures to PAHs sufficiently long, to cause such impacts on a broad scale (i.e., in a large enough area to reduce the prey base of ESA-listed or candidate species).

Measured toxicities of dispersed oil and dispersants alone to invertebrates are discussed at length in Section 3.2; sensitivities are modeled in Section 3.3. It has been commonly noted that dispersants are less toxic than oil alone, but that dispersed oil is more toxic than oil alone (Fingas, 2008; NRC, 2005);[19] therefore, the addition of dispersants is typically considered a direct threat to pelagic invertebrates and fish, and an indirect threat to mammals, birds, and reptiles. An example of such impacts on a planktonic community is presented by Jung et al. (2012), who observed greater impacts in a mesocosm study after dispersants had been applied to oil (relative to oil alone). Similarly, Scholten and Kuiper (1987) observed impacts on planktonic communities relating to the bioavailable fraction of oil; they warned against the use of dispersants, which enhance the dissolved (and therefore bioavailable) fraction of hydrocarbons in the water column. Many invertebrates, particularly during larval life stages, are found in shallow water, where they are exposed to high concentrations of oil and dispersed oil during a spill event. Acute mortality in the vicinity of the dispersed spill may occur in many sensitive species (French-McCay, 2010; Scholten and Kuiper, 1987; Stige et al., 2011), but widespread mortality will result from the uncontrolled spread of an oil spill (i.e., associated with baseline condition) (Abbriano et al., 2011).

Historical applications of dispersants have shown that planktonic species are increasingly exposed to oil after dispersant application (Lee, 2013), that such exposures may result in decreased growth and reproductive capabilities (Lee, 2013), and that these species may be at greater risk under natural conditions due to photo-enhanced toxicity (Barron et al., 2008). These are points of uncertainty that have not been incorporated into the analysis provided in Section 3.3. Uncertainties are described in further detail in Sections 6.2 and 6.3.1.

[19] This position is brought into question in Sections 3.3 and 3.4 when considering the available, relevant, and comparable acute toxicity data (Attachment B-1). See Figures 8 and 9 for a clear comparison of the SSDs for dispersants, oil, and dispersed oil. The analysis presented in Sections 3.3 and 3.4 does not incorporate potential adverse impacts due to sublethal effects or photo-enhanced toxicity.

Ultimately, indirect impacts on prey species must be weighed against direct benefits to ESA-listed birds, marine reptiles, and mammals (i.e., reduced oiling of feathers and fur or other dermal contact and reduced ingestion, inhalation, and aspiration of crude oil). In the context of the survival of an ESA-listed or candidate species, the localized (i.e., in the area directly under a dispersed oil spill) mortality of quickly reproducing planktonic prey may be relatively unimportant compared to the possible mortality or impaired reproduction in a relatively slowly reproducing, geographically limited, and/or sparsely populated species of bird, marine reptile, or marine mammal.

It is possible that the addition of oil and dispersant to a natural system may cause a planktonic or benthic community to become dominated by species that are already present (i.e., to tolerant species) (Ortmann et al., 2012; Atlas and Hazen, 2011; Parsons et al., 1984), but such a shift may not result in an overall reduction in biomass (Varela et al., 2006) or a sustained impact (Abbriano et al., 2011), even in low-productivity environments (Cross and Martin, 1987). For that reason, it is not necessarily true that acutely lethal responses in sensitive species will result in significant reductions in the prey bases of listed or candidate species. This is particularly relevant for non-specific planktivores like baleen whales. It is less relevant for species that consume specific invertebrates that only exist as plankton during embryonic or larval life stages; examples of such species include bivalves, crab, some finfish, and many others.

Infaunal invertebrates in subtidal habitats exposed to a dispersed oil slick were found to be adversely affected relative to those in a similar shoreline that was exposed to a non-dispersed slick; but conditions returned to baseline within 2 years, and little difference was noted between the two shorelines thereafter (Cross and Thomson, 1987; Mageau et al., 1987; Humphrey et al., 1987). Behavioral responses (e.g., migrating out of sediment burrows to the sediment surface) and limited mortality were observed, but mass mortality of infaunal invertebrates did not occur during either the oil-only scenario or the dispersed oil scenario (Cross and Thomson, 1987; Mageau et al., 1987). Although hydrocarbon uptake did increase notably, particularly in filter-feeding species (e.g., bivalves), bivalve species metabolized or depurated the hydrocarbons within 1 year (Humphrey et al., 1987). It was noted that the immediate effects on infauna were not likely to have a long-term impact on populations (except in sensitive species) (Mageau et al., 1987), whereas untreated crude oil that reached the shoreline posed a long-term, chronic source of contamination for these species (Humphrey et al., 1987). Long-term (i.e., > 2 years) impacts were obvious in an echinoderm and a bivalve on the dispersed shoreline (Cross and Thomson, 1987). Peterson et al. (2003) observed long-term impacts on benthic invertebrates along oiled shorelines after EVOS, suggesting that removing oil from the ocean surface before it heavily oils shorelines may serve to protect these productive communities (Fingas, 2008).

Sublethal responses (e.g., reduced superoxide generation and phagocytic activity, as well as impairment of "several aspects of immune competence,"[20] indicating reduced immunosuppression) measured in invertebrate communities resulting from chronic exposures to oil (and PAHs in particular) are often temporary within a population, such that a community may return to pre-spill conditions within a matter of months or years (Edwards and White, 1999; Dyrynda et al., 2000). It is unclear whether temporary fluctuations in invertebrate populations will have a marked adverse impact on predator individuals (Section 6.4).

3.1.2.5 Marine reptiles

The impacts of oil on marine reptiles have been studied to a lesser extent than the impacts on other groups. Oil is known to cause mortality in sea turtles, as evidenced by strandings of dead individuals after DHOS (Barron, 2012) and other major oil spills. As with other species, this is likely related to PAHs in oil, which have been shown to significantly impact developing turtles (Albers and Loughlin, 2003; Van Meter et al., 2006). Other noted impacts include effects on respiration, skin, blood chemistry, and salt gland functioning (Albers and Loughlin, 2003). Turtles are especially susceptible to oil spills that foul nesting areas (ITOPF, 2011), which suggests that the baseline condition under consideration by this BA would pose a great risk to sea turtles if it were to occur in nesting areas. However, nesting does not occur in Alaska; rather the presence of marine reptiles in Alaska is considered "accidental or uncommon" (Section 3.4.4 of the BA).

Since PAHs are the primary cause of toxicity in marine reptiles, it may seem logical that an increase in PAHs resulting from the application of dispersants would result in greater toxicity. However, as discussed in Section 2, many factors in a field application of dispersants to an oil slick may mitigate such impacts, namely rapid dilution of an oil slick into the water column and removal of oil from the ocean's surface.

Another aspect of dispersion that is not described at length in the BA, but that is important to the assessment of sea turtles, is that dispersants are known to reduce the formation of buoyant tarballs (Shigenaka, 2003). It is speculated that the major route of oil exposure for adult sea turtles ingestion, particularly the ingestion of tarballs (Shigenaka, 2003); this is based on the facts that oil has been found in turtle stomachs following field exposure, turtles apparently do not avoid oiled waters (Shigenaka, 2003), and tarballs are known hazards for turtles (Shigenaka, 2003). It is therefore suggested that dispersant use would reduce the concentration of oil at the surface, and sea turtles' contact with it, or reduce the prevalence of tarballs that might be ingested incidentally by sea turtles. This conclusion was also reached by Shigenaka (2003), who noted that, prior to dispersant application, on-scene coordinators must take into account area contingencies (e.g., presence of eelgrass beds, depth of water column, presence of nesting habitat, etc.) in order to ensure the protectiveness of dispersion. It

[20] Quote taken from Edwards and White (1999)

is not suggested that oil dispersion will entirely mitigate the mortality of sea turtles, since observations during the DHOS event suggest the opposite (Barron, 2012).

It is also important to note that the only available study observing the impacts of dispersed oil on sea turtle embryos resulted in no adverse impacts (Van Meter et al., 2006); it was found that the percolation of oil through sediment in simulated nests resulted in a very low transfer of PAHs to the interior of the nest and eggs. It is still possible that the emergence of juveniles would result in exposure to those PAHs, but the bioavailability of PAHs in sediment would be significantly less than the bioavailability of dissolved PAHs initially in the water column (Albers and Loughlin, 2003). Exposure of adults to increased PAHs is not likely to result in acute toxicity, due to the rapid dilution and degradation of oil and its components after a dispersant application (Section 2). Also, reptiles are able to efficiently metabolize and excrete ingested hydrocarbons (Albers and Loughlin, 2003), which should limit the bioaccumulation of PAHs after a dispersant application.

Exposure of reptiles to toxic volatile chemicals through inhalation of dispersed oil is expected to be less than through inhalation of oil alone (NRC, 2013), even though at least one component of dispersants is volatile (i.e., petroleum distillates, 2-butoxyethanol) (Table 2). This is achieved through the dispersion of volatile chemicals into the water column, another trade-off in toxicity between protecting species that breathe air (e.g., reptiles) and protecting those that do not surface to breathe (e.g., fish).

The relatively low abundance of sea turtles in Alaska (Section 3.4.4 of the BA) and the potential reduction in the routes of exposure (i.e., ingestion of tarballs while foraging; inhalation or aspiration, ingestion, and oiling when surfacing to breathe) suggest that the application of dispersants may have a negligible or beneficial effect on marine turtles relative to the baseline condition.

3.2 Analysis of Oil, Dispersants, and Dispersed Oil Toxicities

The purpose of this section is to describe in detail the method for developing SSDs and HC5s for dispersants, crude oil, and dispersed oil as they relate to prey species of ESA-listed or candidate species. In some cases, data that are directly (i.e., species-level data) or closely (i.e., genus-level data) related to ESA-listed or candidate species are available. For example, Chinook salmon, coho salmon, steelhead (or rainbow trout [*Oncorhynchus mykiss*]), and Pacific herring toxicity data are all available, as are data from possible surrogates such as sockeye salmon (*Oncorhynchus nerka*) and Atlantic herring. Regardless, the majority of the data represent species that can be considered planktonic prey or early life stages of prey species (i.e., fish and invertebrate embryo, larvae, or juveniles).

3.2.1 Overview of toxicity data

The majority of the toxicological studies were conducted with established test species (e.g., mysids, daphnids, and inland silverside [*Menidia beryllina*]), which are sensitive to chemical perturbation, and are relatively short-lived (compared to cetaceans, for example). The majority of individuals were exposed at an early life stage, the goal being to observe the response in each species at its most sensitive stage of development. Such studies are conducted to determine the relative toxicity of a chemical (or a mixture) compared to other chemicals, or to address the relative sensitivity of many species or groups of species (i.e., genera) to a single chemical. Of the species tested, rainbow trout (which is not evolutionarily distinct from steelhead trout), Chinook salmon, coho salmon, and Pacific herring were the only protected or candidate species included in the calculations of HC5s; among these, only Chinook salmon had directly comparable oil and dispersed oil toxicity data.[21] All other test species are considered surrogates for the prey of endangered species, and are important when considering food web interactions that result from the chemical dispersion of oil. Potential food web interactions are discussed for endangered species identified in this BA, as applicable.

The criteria used for the development of SSDs are discussed below. The SSDs were created using reported acute aquatic toxicity data from the literature (Attachment B-1) to assess the relative toxicity of Corexit® 9500 and Corexit® 9527 to a number of model species. The HC5s reported are the concentrations of dispersants or dispersed oil below which no expected acutely toxic effects will occur in 95% of aquatic species. There are exceptions to this method of threshold derivation, which are discussed below. Emphasis was placed on Arctic, Alaska, or cold-water species, although these species were not disproportionately weighted in the determination of the HC5s. All species were treated equally in the calculations. Limiting the dataset to only the most relevant species would have resulted in too few tests to create meaningful SSDs for Corexit® 9500 and dispersed oils.

3.2.2 Toxicity data acceptability criteria for developing SSDs

Acute aquatic toxicity values were compiled from the literature available for dispersants and dispersed oil, as summarized in Attachment B-1. SSDs for each mixture were developed using the median lethal concentrations (i.e., concentration that is lethal to 50% of an exposed population) (LC50) for exposure durations of between 48 and 96 hours for all species, with continuous (i.e., static, static renewal, or

[21] Median lethal concentrations were directly comparable, in that the endpoints and exposure durations were the same, the species was the same, and the exposure scenario was the same. Furthermore, the oil types were the same: Prudhoe Bay Crude Oil (PBCO). Dispersed oil is less toxic than oil alone to Chinook salmon (Van Scoy et al., 2010; Lin et al., 2009; Moles et al., 1979 as cited in Barron et al., 2013).

flow-through) and spiked exposures.[22] Only 96-hour exposures were included for larval or juvenile fish, but 48-hour exposures were included for embryonic or embryolarval fish; only 4 data were included for 3 species (i.e., Atlantic menhaden [*Brevoortia tyrannus*], spot croaker [*Leiostomus xanthurus*], and red drum [*Sciaenops ocellatus*]).

Continuous exposures are the most common in the dataset (Attachment B-1), but spiked exposures are typically considered the most applicable to the use of a chemical dispersant in the field (Clark et al., 2001), assuming the dispersant is applied to a surface slick rather than a subsurface release (e.g., wellhead blowout). Spiked exposures result in non-specific durations of exposure, but are perhaps the most relevant to a real-world spill. Spiked exposures should result in realistic LC50 values for surface applications. Dispersant application to subsurface releases, such as occurred during the DHOS, are atypical, but not impossible. This type of application may be mimicked during toxicity testing by a continuous exposure scenario. For this reason, toxicity data using either exposure type is considered valid for the calculation of HC5s. The inclusion of such data does not greatly affect the calculation of protective HC5 values, because the lower SSDs (i.e., the most sensitive tests) are generally composed of constant exposures; spiked exposures often result in much higher LC50 values. The HC5s calculated in this appendix are similar to those reported elsewhere for oil or dispersants (Barron et al., 2013). Dispersed oil SSDs have not been previously developed, so no such comparison can be made for dispersed oil.

Aquatic plant and algae bioassays were included if they satisfied the other criteria for inclusion (i.e., mortality endpoint reported as LC50, 48- to 96-hour exposure). Plants were not obviously more or less sensitive to dispersants, so their inclusion in the HC5 calculations did not bias the distribution.[23] Lastly, both freshwater and saltwater species were used, particularly because of the availability of rainbow trout data. The inclusion of both types of species did not ultimately affect the HC5 values.[24]

[22] Continuous exposures imply that the toxicant is cycled through the test chamber at a constant concentration, or added at appropriate intervals to ensure that significant degradation does not occur during the toxicity test. Spiked exposures imply that the toxicant is added once during the test and allowed to diminish over time (e.g., to degrade or evaporate).

[23] Exclusion of the plant species would not have resulted in the selection of a different best-fit model. Neither plant species was at the lower end of the distribution, and therefore did not affect the selection of the HC5.

[24] HC5s were calculated using both freshwater and saltwater species, and then omitting freshwater species. The calculated HC5 did not change, because the freshwater species tended to be less sensitive to dispersants or dispersed oil. The lower end of the SSD was composed of sensitive saltwater species.

3.2.3 Summary of acute lethality data for dispersants

3.2.3.1 Corexit® 9527

Acute toxicity data for 48- and 96-hour exposures to Corexit® 9527 were compiled from 48 tests on 34 species within 31 different genera. Specifically, for invertebrates and aquatic plants, toxicity tests that lasted only 48 hours were included, because these species tend to have shorter periods of development than fish. Only 96-hour toxicity test data were included for fish species, with the exception of embryo-larval tests using Atlantic menhaden, red drum, and spot croaker (Fucik et al., 1995; Slade, 1982). Spiked tests had non-specific exposure durations, but they are expected to be ecologically relevant (Clark et al., 2001). Of the tests conducted, 2 used plants, 28 used invertebrates, and 18 used fish species. The observed LC50s for all species were between 2.4 and 840 ppm or mg dispersant / L water. Only bounded data were included in the calculation of HC5s; unbounded values (e.g., LC50 > 1,000 ppm) were omitted. Tests were carried out under various temperatures, each assumedly appropriate to the test species; therefore, not all tests are entirely applicable to waters in Alaska. As applicable, Arctic and sub-Arctic Alaska species are identified and discussed below.

Invertebrate species had more varied LC50s than did fish or plants, likely due to the greater number of tests and test conditions conducted for invertebrates. Green hydra (*Hydra viridissima*) and grass shrimp (*Palaemonetes pugio*) were the least sensitive invertebrate species and least sensitive species, overall. Various crustaceans (*Allorchestes compressa, Pseudocalanus minutes, Penaeus setiferus*) and Pacific oyster (*Crassostrea gigas*) were the most sensitive invertebrates and most sensitive species, overall.

The majority of fish were less sensitive than invertebrates, and as sensitive as plant species. The range of LC50s for rainbow trout, the only tested species that can be considered endangered (i.e., Steelhead trout), was between 96 and 260 ppm Corexit® 9527 (Doe and Wells, 1978; Wells and Doe, 1976).

Two aquatic plant species were tested: a brown alga (*Phyllospora comosa)* and turtle grass (*Thalassia testudinum*). The 48-hour LC50 for the brown alga was 30 ppm (Burridge and Shir, 1995), and the 96-hour LC50 for turtle grass was 200 ppm (Baca and Getter, 1984).

3.2.3.2 Corexit® 9500

Acute toxicity data for spiked and 48- to 96-hour exposures to Corexit® 9500 were compiled from 48 tests with 26 species and 24 genera. Of the tests conducted, 26 used invertebrates and 22 used fish. The observed range of 48- to 96-hour LC50s was between 3.5 and 1,038 ppm, the highest values being for spiked exposures.

Invertebrates that were less sensitive to Corexit® 9527 included the green hydra and Eastern oyster (*Crassostrea virginica*). Sensitive species included the amphipod

(*A. compressa*), copepods (*Eurytemora affinis* and *Tigriopus japonicus*), and red abalone (*Haliotis rufescens*).

Fish were generally less sensitive to Corexit® 9500 than to Corexit® 9527. Of the fish tested, rainbow trout and red drum were the least sensitive; rainbow trout had a 96-hour LC50 of 354 ppm, and red drum had a spiked LC50 of 744 ppm. Other relatively insensitive species included the sheepshead minnow (*Cyprinodon variegatus*) and gulf killifish (*Fundulus grandis*). In addition some tests, but not all, indicated inland silverside to be relatively insensitive.

3.2.3.3 Corexit® toxicity to cold-water species

Most laboratory toxicity tests use temperate or warm-water species, warm exposure conditions (e.g., 20–25°C), and variable exposure scenarios or test types. There is a paucity of data representing those conditions more likely to be encountered by species of concern in Alaska waters. Recent tests by McFarlin et al. (2011) were conducted under conditions that would be observed during an oil spill response in Alaska. These tests incorporated cold-water temperatures, spiked exposures, and Arctic test species.

A second study was conducted by Ordzie and Garofalo (1981) with Corexit® 9527. Reported 6-hour LC50s were between 200 ppm at 20°C and 2,500 ppm at 2°C. This toxicity test was conducted using temperatures similar to those of Alaska waters and an appropriate exposure duration, but using a test species (a scallop [*Argopecten irradians*]), not present in Alaska. These values were excluded from the SSD due to the short exposure duration. However, it is important to note that this exposure duration (in addition to the exposure temperature) is ecologically relevant (Gallaway et al., 2012).

The following studies used species that may be present in Alaska, or tested species under conditions approximating the application of dispersant under Arctic field conditions:

- Clark et al. (2001) reported an LC50 of 13.9 ppm Corexit® 9527 for larval Pacific oyster using a spiked exposure system. The Pacific oyster is found in Alaska, although it is a non-native species primarily valued for aquaculture.
- Clark et al. (2001) determined a spiked LC50 of > 1,055 ppm Corexit® 9500 for turbot (*Scophthalmus maximus*), a fish present in the North Atlantic. This value is unbounded, and was therefore not included in SSD.
- Nalco (2005, 2010) determined 96-hour LC50s of 75 ppm Corexit® 9500 and 50 ppm Corexit® 9527 for turbot.
- Rhoton et al. (2001) reported an LC50 of 355 ppm Corexit® 9500 for larval tanner crab (*Chionoecetes bairdi*), an Alaska species, in a spiked exposure system.
- Duval et al. (1982; cited in NRC, 2005) reported a 96-hour continuous exposure LC50 of > 1,000 ppm Corexit® 9527 for the isopod *Gnorimosphaeroma oregonensis*,

which can be found in intertidal areas of Alaska. This value is unbounded, and therefore was not included in SSD.

- Hartwick et al. (1982; cited in NRC, 2005) reported a 96-hour LC50 of 100 ppm Corexit® 9527 for littleneck clam (*Protothaca stamiea*), an important aquaculture species that is present throughout nearshore and intertidal areas of the Gulf of Alaska (including the Aleutian Islands).
- Foy (1982; cited in NRC, 2005) reported 96-hour LC50s for four Arctic amphipod species—*Anonyx laticoxae, Anonyx nugax*, *Boeckosimus edwardsi*, and *Onisimus litoralis*—as well as an unidentified species within the genus *Boeckosimus*; all were exposed continuously to Corexit® 9527. The LC50s were as follows: > 140 ppm for *A. laticoxae*; 97 to 111 ppm for *A. nugax*; > 80 ppm for *B. edwardsi*; > 175 ppm for *Boeckosimus* sp.; and 80 to 160 ppm for *O. litoralis.* The same study reported 96-hour LC50s of < 40 and > 80 ppm Corexit® 9527 for fourhorn sculpin (*Myoxocephalus quadricornis*) and a copepod (*Gammarus oceanicus)*, respectively. Unbounded values were not included in the SSD.
- Rainbow trout 96-hour LC50 toxicity values were reported by Wells and Doe (1976; cited in NRC, 2005) and by Doe and Wells (1978; cited in NRC, 2005) as being between 96 and 293 ppm Corexit® 9527.
- George-Ares and Clark (2000) reported a 96-hour LC50 of 354 ppm Corexit® 9500 for rainbow trout.

Not all studies listed herein report the temperatures at which exposures were conducted. It can be assumed that all studies were conducted under conditions appropriate to the test species, such that temperatures were not outside the species' tolerable limits.[25] Exposures of Alaska species using temperatures higher than those typically observed in Alaska would likely result in an overestimate of toxicity, based on the findings of Ordsie and Garofalo (1981; cited in NRC, 2005), rather than an underestimate.

3.2.3.4 Sublethal or chronic toxicity of dispersants

Although sublethal and chronic toxicity data were not included in the calculation of HC5s, some data have been compiled; it is presented here for comparison to acutely toxic concentrations, as well as to identify known sublethal impacts. In a small number of studies, exposure to chemical dispersants has been shown to cause sublethal or chronic[26] toxic responses. Singer et al. (1991) reported a concentration at which 50% of

[25] This assumption is based on the use of a negative control treatment in each study that indicated the health or condition of the test species under the given test conditions.

[26] Chronic responses are those following exposure of a duration that includes a notable portion of a species' entire life cycle or early life stages. The duration is characteristically longer than acute exposures, and endpoints often include sublethal effects that are slow to manifest and continual (e.g., abnormal growth).

the number of exposed organisms were affected (EC50) of 13.6 ppm Corexit® 9527, based on abnormal growth in red abalone after a 48-hour exposure to spiked concentrations. Nalco (2010) reported a 72-hour reduced biomass EC50 of 9.4 ppm Corexit® 9527 for the diatom *Skeletonema costatum* when it was continuously exposed. The bioluminescent marine bacterium *Vibrio fischeri* was observed to have a reduced bioluminescence EC50 of 104 ppm Corexit® 9500 (NRC, 2005) after a 15-minute exposure; reduced bioluminescence is an indication of lowered metabolic activity. The 15-minute *V. fischeri* bioassay is considered a chronic test because of the bacterium's very short life span. Mitchell and Holdway (2000) reported chronic, 7-day no-observed-effect concentration (NOEC) values of 13 and < 15 ppm for green hydra exposed (static, daily renewal) to Corexit® 9527 and Corexit® 9500, respectively. Other studies found that dispersants inhibited reproduction (Singer et al., 1991), growth, development (Singer et al., 1991; Wells et al., 1982), and other endpoints (Gulec et al., 1997; Norwegian Institute for Water Research, 1994; Burridge and Shir, 1995; all cited in NRC, 2005) in various species (e.g., giant kelp [*Macrocsytis pyrifera*], amphipods, diatoms, mysids, and red abalone) when these species were exposed over a relatively long period of time.

Very short-lived species are also briefly discussed in this appendix. The 48-hour time-to-molt EC50 for *Artemia* sp. (42 ppm) and the 72-hour biomass production EC50 for *S. costatum* (9.4 ppm) are within the range of LC50s for Corexit® 9527 (i.e., from 2.4 to 840 ppm). Similarly, the *V. fischeri* chronic 15-minute bioluminescence EC50 (104 ppm) and the 72-hour biomass production EC50 for *S. costatum* are within the range of acute LC50s for Corexit® 9500 (i.e., from 3.5 to 744 ppm).

3.2.4 Summary of acute lethality data for crude oil

A number of studies were compiled to characterize the toxicity of oil alone in an aquatic system. Oil toxicity data represent exposure durations between 48 and 96 hours with established test species. The same assumptions and limitations that applied to the dispersant toxicity data (Section 3.2.3) apply to this dataset. However, the interpretation of this dataset is less straightforward, because additional variables exist when dealing with oil, which is a complex mixture. In order for a definitive statement to be made regarding the change in toxicity due to the application of dispersants, it is important to establish the toxicity of crude oil relative to that of dispersants and dispersed oil.

Lacking a singular source or composition, oil is expected to elicit variable acute responses in ecological receptors. More specifically, different types of oil have different fractions of toxic components, such as PAHs (Ramachandran et al., 2004). In addition, degrees of weathering are included in the dataset; a single oil type can be either fresh or weathered, depending on the time the oil has spent exposed to natural conditions (e.g., ultraviolet radiation, wind and water, biodegradation, and evaporation). Weathered oil tends to have fewer bioavailable components due to the volatilization and biodegradation of its lighter (and typically more acutely toxic) constituents (NRC, 2005; 2003b as cited in NRC, 2005; 2003a). This was a particular point of study by Barron et al. (2013), who developed SSDs and reported HC5 values for different oil types; HC5 values ranged from 0.285 to 3.53 ppm TPH, depending on the type of oil.

Unlike the toxicity datasets for dispersants or dispersed oil, the majority (56%) of species tested with oil alone were cold-water species. A total of 134 tests were conducted; 73 tests were conducted on invertebrates, and 61 tests were conducted on fish. A total of 59 species were tested, of which 34 were invertebrates and 25 were fish. A total of 45 genera were tested, of which 27 were invertebrates and 18 were fish. Approximately half of all the species tested (as well as within the groups of species or genera) are found in cold-water environments. Not all tests with cold-water species were conducted under cold-water conditions, but it is assumed that the exposure conditions were appropriate (i.e., tolerable range of temperatures) for the species.[27]

Two warm-water invertebrates (*Palaemon serenus* and *A. compressa*) and one warm-water fish (Australian bass [*Macquaria novemaculeata*]) were found to have 96-hour LC50 values between 258,000 and 465,000 ppm TPH; these three LC50 values are more than three orders of magnitude greater than the fourth-least sensitive species (*T. japonicus*), and more than four orders of magnitude greater than the fifth-least sensitive genera (*Platichthys*). The four highest LC50 values (i.e., *P. serenus, A. compressa, M. novemaculeata,* and *T. japonicus*) were confirmed as outliers using the Interquartile Range (IQR) method.[28] When developing the SSD, two distributions were fit using the entire dataset, excluding the upper three data points.[29] The removal of the three highest data points resulted in the selection of a distribution that fit the entire dataset better, both visually and statistically (based on the Anderson-Darling statistic). Therefore, the statistical distribution was fit to the empirical SSD with the three highest LC50 values omitted to minimize (i.e., improve) the best-fit statistic and more realistically predict values at the lower end. It is un clear, based on the studies available (Gulec and Holdway, 2000; Gulec et al., 1997), why the LC50 values are so much higher than those of other similar exposures.

After removing the three highest LC50 values, the least sensitive invertebrates were the copepod *T. japonicus* and a polychaete worm, *Platynereis dumerilli*. Insensitive fish included flounder (*Platichthys* sp.) and topsmelt. Sensitive invertebrates included pale octopus (*Octopus pallidus*), black chiton (*Katharina tunicate*), Alaska shrimp (*Crangon*

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[27] This assumption is validated by the use of a negative control during toxicity testing. The control indicated the condition of the test species under the given exposure conditions.

[28] Outliers are defined according to the range between the 25th and 75th percentiles of the dataset (or the IQR), such that values that are greater than 1.5 or 3 times the IQR plus the 75th percentile value are considered outliers. The method also applies to low outliers that are less than 1.5 or 3 times the IQR below the 25th percentile.

[29] Removal of the 4th highest data point resulted in no change in the best-fit distribution selected or the calculated HC5.

alaskensis), and green hydra. The range of LC50 values at the genus level was between 0.39 and 124.3 ppm (excluding the values between 258,000 and 465,000 ppm). These values (e.g., 0.39 to 124.3 ppm) are somewhat similar to those reported for dispersed oils (Section 3.3), although the SSDs and HC5s calculated in this appendix (Sections 3.3 and 3.4, Tables 3 through 5, and Figures 8 and 9) suggest that oil is more acutely toxic than dispersed oil. This finding is consistent with much of the literature, although contrary to what has been suggested in past literature reviews (Fingas, 2008; NRC, 2005) and many toxicity studies (Attachment B-1).

3.2.4.1 Sublethal or chronic toxicity of crude oil

Smit et al. (2009) synthesized chronic exposure data and developed an SSD of chronic or sublethal endpoints (i.e., DNA damage; oxidative stress; and reduced survival, growth, and reproduction, or "whole-organism" responses). The data compiled by Smit et al. (2009) will be briefly discussed here.

The most sensitive species to DNA damage were blue mussel (*M. edulis*) and green sea urchin (*Strongylocentrotus droebachiensis*), with chronic 210-day LOECs of 2.8 and 4 ppb TPH, respectively. Iceland scallop (*Chlamys islandicus*) was the most sensitive to oxidative stress, with a chronic 30-day LOEC of 2.3 ppb TPH. Blue mussel was the most sensitive to whole-organism responses, with a 33-day chronic reproductive NOEC of 30 ppb TPH.

Sheepshead minnow was the least sensitive to DNA damage, with a 21-day chronic LOEC of 100 ppb TPH; blue mussel and Atlantic cod (*Gadus morhua*) were the least sensitive to oxidative stress, with a chronic 30-day LOEC of 63.4 ppb TPH and sublethal 3-day LOEC of 69.4 ppb TPH. Longnose killifish (*Fundulus similis*) was the least sensitive to whole-body responses, with a chronic 8-day NOEC of 9,900 ppb TPH.

HC5 values for different groups of endpoints were between 1.4 and 70.5 ppb TPH; 70.5 ppb TPH, the HC5 for whole-body responses, was identified as the maximum allowable threshold for chronic exposures of aquatic life (based on various fish and invertebrates). This chronic threshold is approximately 15% of the HC5 calculated for oil alone based on acute toxicity (Section 3.3).

3.2.5 Summary of acute lethality data for dispersed oil

A number of studies were compiled to characterize the toxicity of dispersed oil in an aquatic system. Dispersed oil data represent exposure durations between 48 and 96 hours with established test species. The same assumptions and limitations applied to dispersant toxicity data (Section 3.2.3) apply to this dataset. However, the interpretation of this dataset is less straightforward due to the complex nature of oil (Section 3.2.4), as well as the varied interaction of dispersant chemicals with different types of oil (Fingas, 2008).

3.2.5.1 Corexit® 9527-dispersed oil

Acute values used in the calculation of SSDs for dispersed oil were based on the minimum calculated spiked or 48- to 96-hour LC50 of exposure. This dataset is the smallest of those presented in this appendix, particularly as regards the number of species represented (n = 12), those that can be considered cold-water species (n = 2), and those that are ESA listed (n = 0). Corexit® 9527-dispersed oil data were available for 29 tests with 13 different species, each from a different genus. Of the tests performed, 8 were conducted with fish (5 different species), and 21 were conducted with invertebrates (8 different species). LC50s ranged from 0.74 to 75 ppm Corexit® 9527-dispersed oil, analyzed as TPH.

LC50s from tests spiked with Corexit® 9527-dispersed oil (n = 11) ranged from 1.8 to 111 ppm. Pacific oyster, a cold-water species, had a spiked LC50 between 1.92 and 2.28 ppm dispersed oil (depending on the oil type). Data from 7 static renewal tests were available, with LC50s ranging from 0.74 to 28.5 ppm.[30] Constant exposure 48- to 96-hour LC50s ranged from 0.11 to 75 ppm; excluding the maximum value for this exposure type (75 ppm), all other values were ≤ 1.09 ppm.

3.2.5.2 Corexit® 9500-dispersed oil

Corexit® 9500-dispersed oil data were available for 51 tests with 18 different species, each from a different genus. Of these, 28 tests were conducted with fish (9 different species) and 23 with invertebrates (9 different species). The range of LC50s was from 0.186 to 155.9 ppm as TPH. The species geometric mean LC50s used to develop the SSD were between 1.37 and 76.0 ppm.

LC50s from 27 spiked tests conducted with Corexit® 9500-dispersed oil ranged from 2.84 to 72.6 ppm. Clark et al. (2001) reported LC50s between 0.81 and 3.99 ppm dispersed oil for spiked exposures of Pacific oyster; a single LC50 of 48.6 ppm dispersed oil was reported for turbot under the same exposure conditions.

LC50s from 24 tests using constant exposure (i.e., continuous, static, and static renewal) to Corexit® 9500-dispersed oil were in the range of 0.19 to 155.9 ppm, the highest value being for Chinook salmon, an ESA-listed species.

Five cold-water species or genera are represented in the dataset, three fish (sculpin [*Myoxocephalus* sp.], Arctic cod [*Boreogadus saida*], and Chinook salmon) and two invertebrates (Pacific oyster and *Calanus glacialis*). Cold-water species were the most insensitive to Corexit® 9500-dispersed oil, with the exception of Pacific oyster, which was relatively sensitive. McFarlin et al. (2011) reported LC50 values for three of the

[30] Static renewal is similar to a static exposure, in that the chemical is premixed with the exposure solution prior to testing. In a renewal test, the solution is periodically replaced with fresh solution; the result is an exposure scenario similar to a continuous exposure, such that the chemical remains relatively constant over the exposure period. It is not held constant throughout (i.e., continuous), nor is it allowed to degrade or partition without replacement (i.e., static, without renewal).

four relatively insensitive cold-water species (sculpin, *C. glacialis,* and Arctic cod), indicating that different methodologies may result in decreased toxicity. All three species were exposed to a spiked dispersed oil scenario in very cold water (2°C), whereas others (e.g., Pacific oyster) were exposed in warmer water (Clark et al., 2001; as cited in NRC, 2005).

The geometric mean 96-hour LC50 value for Chinook salmon exposed to Corexit® 9500-dispersed oil under constant conditions was approximately 76.0 ppm TPH. This is the only ESA-listed species for which toxicity data is available.

3.2.5.3 Sublethal or chronic toxicity of dispersed oil

The chronic and sublethal effects of dispersed oil have not been studied extensively. A study by Lee et al. (2011b) reported hatchability of Atlantic herring embryos exposed to Corexit® 9500-dispersed oil over a period of 2.4 to 336 hours. The chronic LC50s were time dependent and ranged from < 0.25 to 18 ppm for 336- to 2.4-hour exposures, respectively. In the same study, chronic 336-hour LC50s for Corexit® 9500-dispersed oil were between 1.75 and 1.94 ppm for Pacific herring, and between 2.03 and 4.33 ppm for Atlantic herring. Although these values are not represented in the SSDs for Corexit® 9500-dispersed oil, they have important implications for Pacific herring, which is a candidate for listing under ESA. Even under the short, ecologically-relevant exposure durations associated with the dispersion of surface spills, the concentration of dispersed oil caused embryotoxicity to Pacific herring. Pacific herring typically spawn in kelp beds in shallow areas, where severe oiling may occur under baseline conditions; concentrations of crude oil as low as 1.22 ppm TPH are sufficient to cause mortality in Pacific herring (Rice et al., 1979; cited in Barron et al., 2013), so this species may be adversely impacted under any condition that allows oil (dispersed or not) to enter spawning habitat. The application of dispersants is not intended for nearshore areas, but dilute dispersed oil may wash into such areas; thus, longer-term exposures within this range of LC50 values are possible, and Pacific herring could be adversely impacted by dispersants.

Ramachandran et al. (2004) reported 48-hour EC50s between 1.00E-7 and 6.60E-6 ppm (volume / volume) of Corexit® 9500-dispersed oil for rainbow trout. The endpoint was measured by the EROD enzyme activity bioassay, which can indicate general toxicant exposure at very low concentrations; EROD activity does not result from any sort of effect at the individual level (e.g., reduced growth, reproduction, or survival), although it implies that sublethal impacts caused by PAH metabolites may occur (Lee and Anderson, 2005). Concentrations required to cause acute, individual-level effects (i.e., reduced survival, growth, or reproduction) in salmon (using Chinook salmon as a representative) (Van Scoy et al., 2010; Lin et al., 2009) are more than eight orders of magnitude greater than those reported by Ramachandran et al. (2004).

3.3 SSDs and Calculation of HC5s for Dispersants, Oil, and Dispersed Oil

In order to assess the potential risk to plankton, invertebrates, and fish associated with dispersant application, SSDs were developed for simplified scenarios of exposure to Corexit® 9500 and Corexit® 9527, crude oil (including all oil types, weathered or fresh), and oil dispersed by the Corexit® products. This approach has been recently applied to similar datasets for crude oil, dispersants alone (Barron et al., 2013; Smit et al., 2009; de Hoop et al., 2011), and dispersed oil (Gardiner et al., 2012). The SSDs were developed using toxicological data from the literature, and HC5s were calculated from the lower (i.e., more sensitive) ends of the distributions for each mixture. The HC5 was chosen to represent a concentration that was protective of 95% of aquatic species (Barron et al., 2013).

LC50s for each species[31] were ranked according to increasing acute 48- to 96-hour LC50s (Table 2) for dispersants, and plotted on a logarithmic scale (Figure 3). Additional criteria for data acceptability were applied (Section 3.2.1.1). Similar data for dispersed oil are provided in Table 3 and Figure 4. The geometric mean of each species was used when multiple valid tests were available for a single species, and the geometric mean of a genus was used when data existed for multiple species within the same genus. If a single test was replicated for a single species in a single study, only the lowest LC50 (i.e., the most protective value) was included.

The distribution of empirical data was described using @Risk® software (Palisade Decision Tools, Version 6.1.1) as a Microsoft Excel® add-in. Distributions can take a number of theoretical forms (e.g., normal, logarithmic, etc.), so the best-fitting distribution (i.e., the distribution most like the empirical data from the literature) was used based on the Anderson-Darling statistic. This statistic is specifically useful for describing the ends of a distribution. It was also assumed that predicted LC50 values could not be less than 0 ppm. For crude oil, Corexit® 9500, and Corexit® 9527, a Pearson 6 distribution best described the empirical data. A log-logistic distribution best fit to Corexit® 9500-dispersed oil toxicity data, and a lognormal distribution best fit to Corexit® 9527-dispersed oil toxicity data.

The Latin Hypercube method was used to simulate 5,000 iterations of hypothetical data points from the selected distributions, which were then plotted and compared to the empirical datasets (Figures 3 through 9). The data simulated by @Risk® for each distribution was ranked from low to high, and the 250th value of 5,000 (i.e., the 5th percentile) was selected as the HC5.

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[31] The dataset of LC50 values was limited to exposure durations between 48 and 96 hours for invertebrates and 96 hours for fish; only juvenile or other early life stages of fish were acceptable, although adult life stages of small, short-lived invertebrates (e.g., kelp forest mysid [*Holmesimysis costata*]) were also deemed acceptable. All exposure types (e.g., static, flow-through, etc.) were included in the calculation of HC5.

Table 3. Summary of LC50 geometric mean values, best-fit distributions, and calculated HC5s for Corexit® 9500 and Corexit® 9527

Dispersant	Genus	Cold Water?	Genus Geomean LC50 (ppm)	Rank	Distribution selected in @Risk®	HC5 (ppm)
Corexit 9500	*Allorchestes*	no	3.5	1	Pearson 6	5.53
	Eurytemora	no	5.2	2		
	Tigriopus	no	10	3		
	Haliotis	no	12.8	4		
	Macquaria	no	19.8	5		
	Artemia	no	20.8	6		
	Litopenaeus	no	31.1	7		
	Acartia	yes	34	8		
	Chionoecetes	yes	44.6	9		
	Penaeus	no	48	10		
	Atherinosoma	no	50	11		
	Americamysis	no	50.4	12		
	Menidia	no	51.1	13		
	Scophthalamus	yes	74.7	14		
	Palaemon	no	83.1	15		
	Lates	no	143	16		
	Sarotherodon	no	150	17		
	Fundulus	no	155.4	18		
	Holmesimysis	no	158	19		
	Hydra	no	160	20		
	Crassostrea	yes	167	21		
	Cyprinodon	no	262.8	22		
	Oncorhynchus	yes	354	23		
	Sciaenops	no	744	24		

Dispersant	Genus	Cold Water?	Genus Geomean LC50 (ppm)	Rank	Distribution selected in @Risk®	HC5 (ppm)
Corexit 9527	*Allorchestes*	no	3	1	Pearson 6	7.18
	Pseudocalanus	yes	5	2		
	Crassostrea	yes	6.6	3		
	Macquaria	no	14.3	4		
	Holmesimysis	no	20.6	5		
	Acartia	yes	23	6		
	Americamysis	no	23.7	7		
	Litopenaeus	no	24.1	8		
	Phyllospora	no	30	9		
	Menidia	no	35.4	10		
	Atherinops	no	38.9	11		
	Leiostomus	no	40.9	12		
	Brevoortia	no	42.4	13		
	Artemia	no	46.0	14		
	Palaemon	no	49.4	15		
	Scophthalamus	yes	50	16		
	Sciaenops	no	52.6	17		
	Cyprinodon	no	74	18		
	Daphnia	yes	75	19		
	Callinectes	no	77.9	20		
	Onisimus	yes	80	21		
	Fundulus	no	89.5	22		
	Anonyx	yes	97	23		
	Platichthys	yes	100	24		
	Protothaca	yes	100	25		
	Oncorhynchus	yes	158.0	26		
	Corophium	no	159	27		
	Thalassia	no	200	28		
	Pimephales	no	201	29		
	Hydra	no	230	30		
	Palaemonetes	no	840	31		

HC5 – hazardous concentration, 5th percentile
LC50 – concentration that is lethal to 50% of an exposed population
ppm – parts per million

Table 4. Summary of LC50 geometric mean values, best-fit distribution, and calculated HC5s for crude oil alone

Genus	Cold Water?	Genus Geomean LC50 (ppm TPH)	Rank	Distribution selected in @Risk®	HC5 (ppm TPH)
Octopus	no	0.39	1	Pearson 6	0.46
Katharina	yes	0.44	2		
Crangon	yes	0.56	3		
Hydra	no	0.7	4		
Sciaenops	no	0.85	5		
Holmesimysis	no	1.11	6		
Pagurus	yes	1.14	7		
Boreogadus	yes	1.2	8		
Clupea	yes	1.22	9		
Cryptochiton	yes	1.24	10		
Melanotaenia	no	1.28	11		
Pandalus	yes	1.29	12		
Eualus	yes	1.32	13		
Capitella	yes	1.44	14		
Salvelinus	yes	1.49	15		
Oncorhynchus	yes	1.68	16		
Theragra	yes	1.73	17		
Aulorhynchus	yes	1.85	18		
Myoxocephalus	yes	1.89	19		
Farfantepenaeus	no	1.9	20		
Chlamys	yes	1.90	21		
Americamysis	no	1.91	22		
Thymallus	yes	2.04	23		
Paralithodes	yes	2.22	24		
Eleginus	yes	2.28	25		
Xenacanthomysis	yes	2.31	26		
Calanus	yes	2.4	27		
Cottus	yes	3	28		
Menidia	no	4.02	29		
Palaemonetes	no	4.60	30		
Neanthes	yes	4.82	31		
Spiochaetopterus	no	4.92	32		
Notoacmea	yes	5.32	33		
Leander	no	6	34		

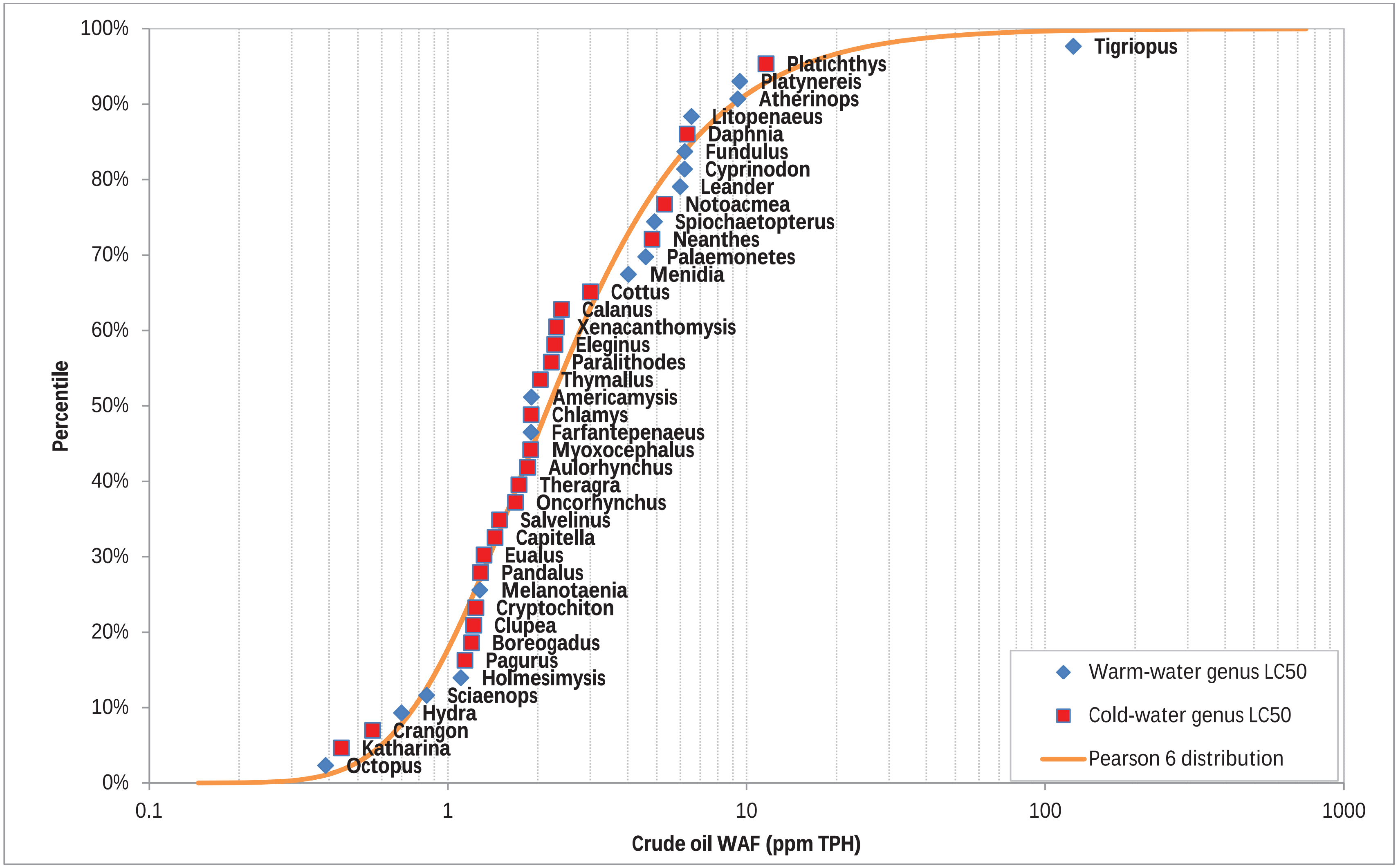
Genus	Cold Water?	Genus Geomean LC50 (ppm TPH)	Rank	Distribution selected in @Risk®	HC5 (ppm TPH)
Cyprinodon	no	6.21	35		
Fundulus	no	6.22	36		
Daphnia	yes	6.32	37		
Litopenaeus	no	6.54	38		
Atherinops	no	9.35	39		
Platynereis	no	9.5	40		
Platichthys	yes	11.62	41		
Tigriopus	no	124.3	42		
Palaemon	no	258,000	43		
Allorchestes	no	311,000	44		
Macquaria	no	465,000	45		

HC5 – hazardous concentration, 5th percentile
LC50 – concentration that is lethal to 50% of an exposed population
ppm – parts per million
TPH – total petroleum hydrocarbons

Table 5. Summary of LC50 geometric mean values, best-fit distributions, and calculated HC5s for Corexit® 9500- and Corexit® 9527-dispersed oil

Dispersant	Species	Cold Water?	Species Geomean LC50 (ppm TPH)	Rank	Distribution selected in @Risk®	HC5 (ppm TPH)
Corexit 9500	*Melanotaenia fluviatilis*	no	1.37	1	log-logistic	1.71
	Crassostrea gigas	yes	1.8	2		
	Palaemon serenus	no	3.6	3		
	Americamysis bahia	no	3.7	4		
	Sciaenops ocellatus	no	4.23	5		
	Menidia beryllina	no	6.2	6		
	Hydra viridissima	no	7.2	7		
	Holmesimysis costata	no	7.4	8		
	Litopenaeus setiferus	no	7.5	9		
	Tigriopus japonicus	no	10.7	10		
	Atherinops affinis	no	11.1	11		
	Macquaria novemaculeata	no	14.1	12		
	Allorchestes compressa	no	14.8	13		
	Myoxocephalus sp.	yes	17	14		
	Cyprinodon variegatus	no	18.6	15		
	Calanus glacialis	yes	20.5	16		
	Boreogadus saida	yes	45	17		
	Oncorhynchus tshawytscha	yes	76.0	18		
Corexit 9527	*Melanotaenia fluviatilis*	no	0.74	1	lognormal	0.69
	Crassostrea gigas	yes	1.03	2		
	Octopus pallidus	no	1.8	3		
	Holmesimysis costata	no	2.35	4		
	Menidia beryllina	no	2.55	5		
	Americamysis bahia	no	3.65	6		
	Palaemon serenus	no	8.1	7		
	Hydra viridissima	no	9	8		
	Daphnia magna	yes	15.28	9		
	Allorchestes compressa	no	16.2	10		
	Macquaria novemaculeata	no	28.5	11		
	Atherinops affinis	no	28.6	12		
	Platichthys flesus	no	75	13		

HC5 – hazardous concentration, 5th percentile
LC50 – concentration that is lethal to 50% of an exposed population
ppm – parts per million
TPH – total petroleum hydrocarbons



Note: The three highest LC50 values were removed, and the distribution was fit to the remaining points.

Figure 3. SSDs for crude oil water-accommodated fraction with the selected distribution fit to empirical toxicity data

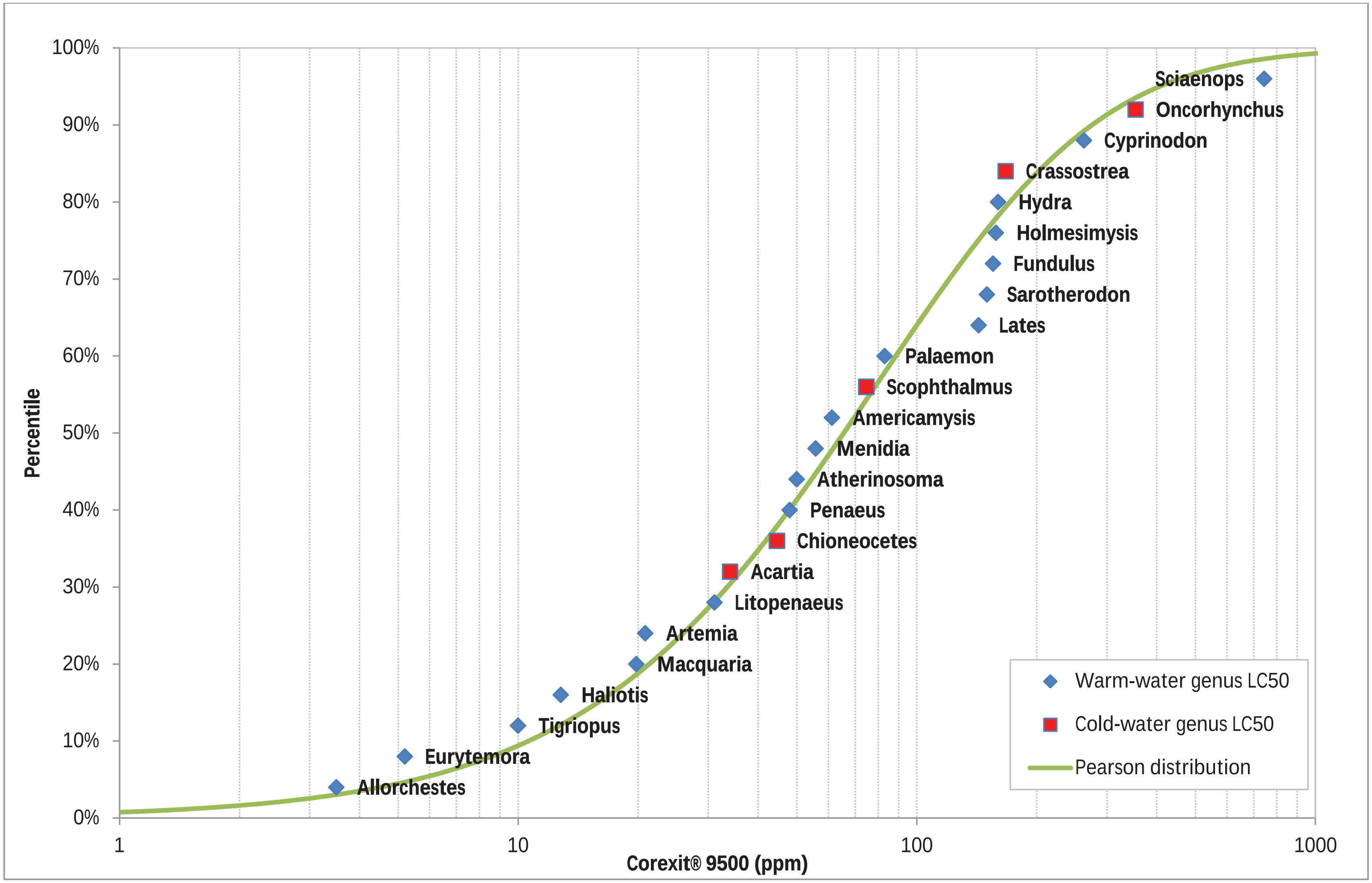


Figure 4. **SSDs for Corexit® 9500 with the selected distribution fit to empirical toxicity data**

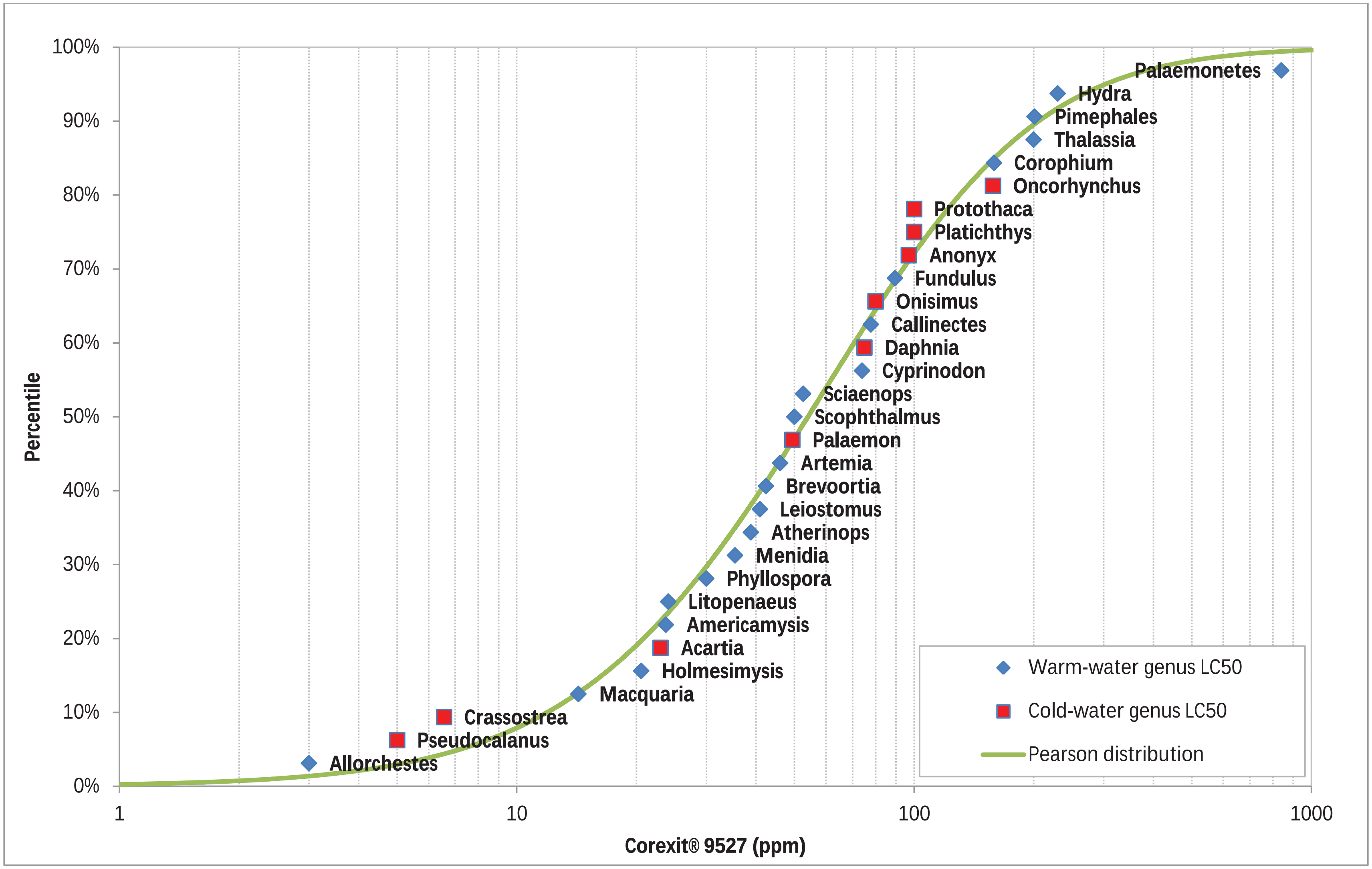


Figure 5. SSDs for Corexit® 9527 with the selected distribution fit to empirical toxicity data

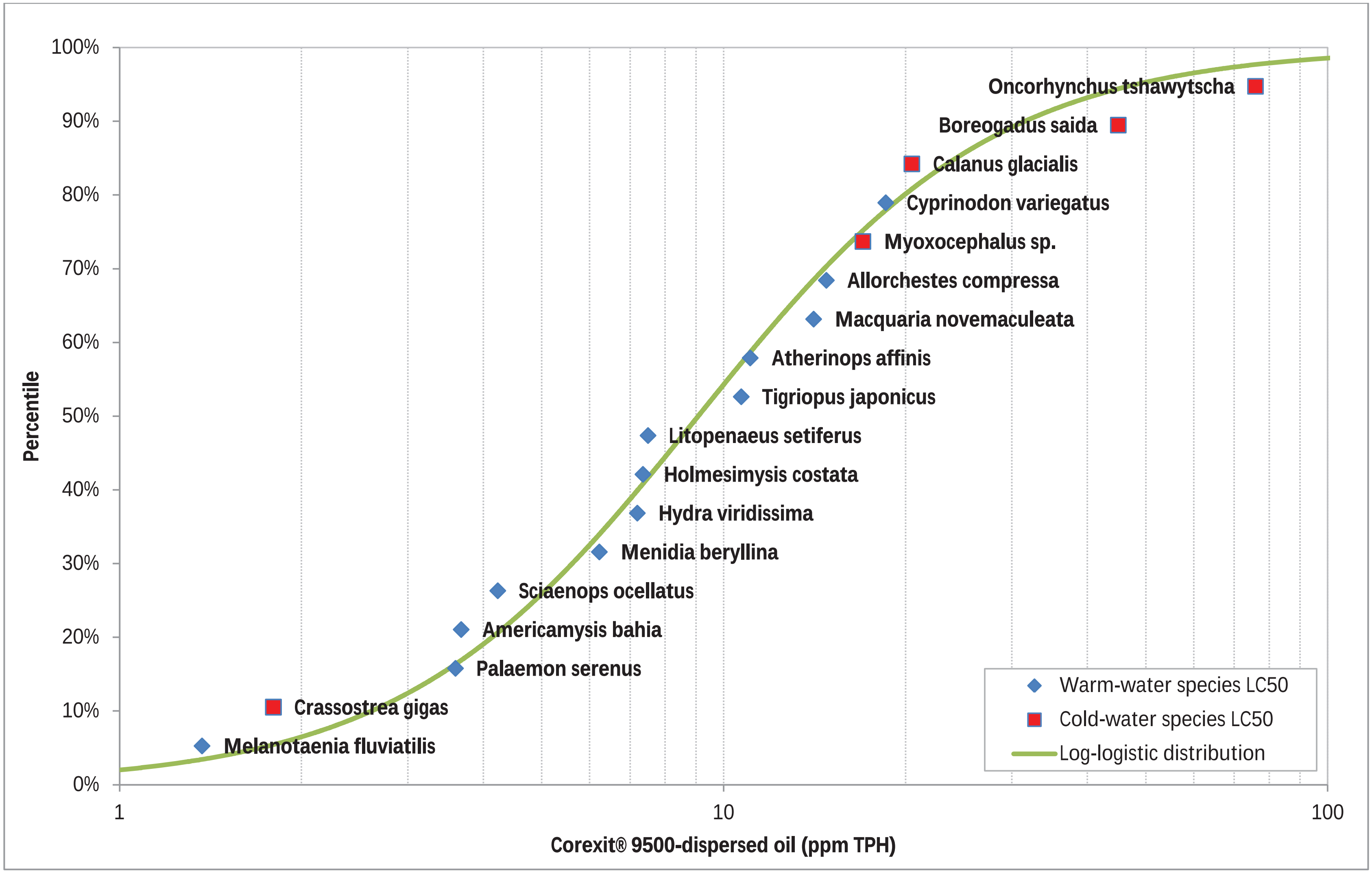


Figure 6. SSDs for Corexit® 9500-dispersed oil with the selected distribution fit to empirical toxicity data

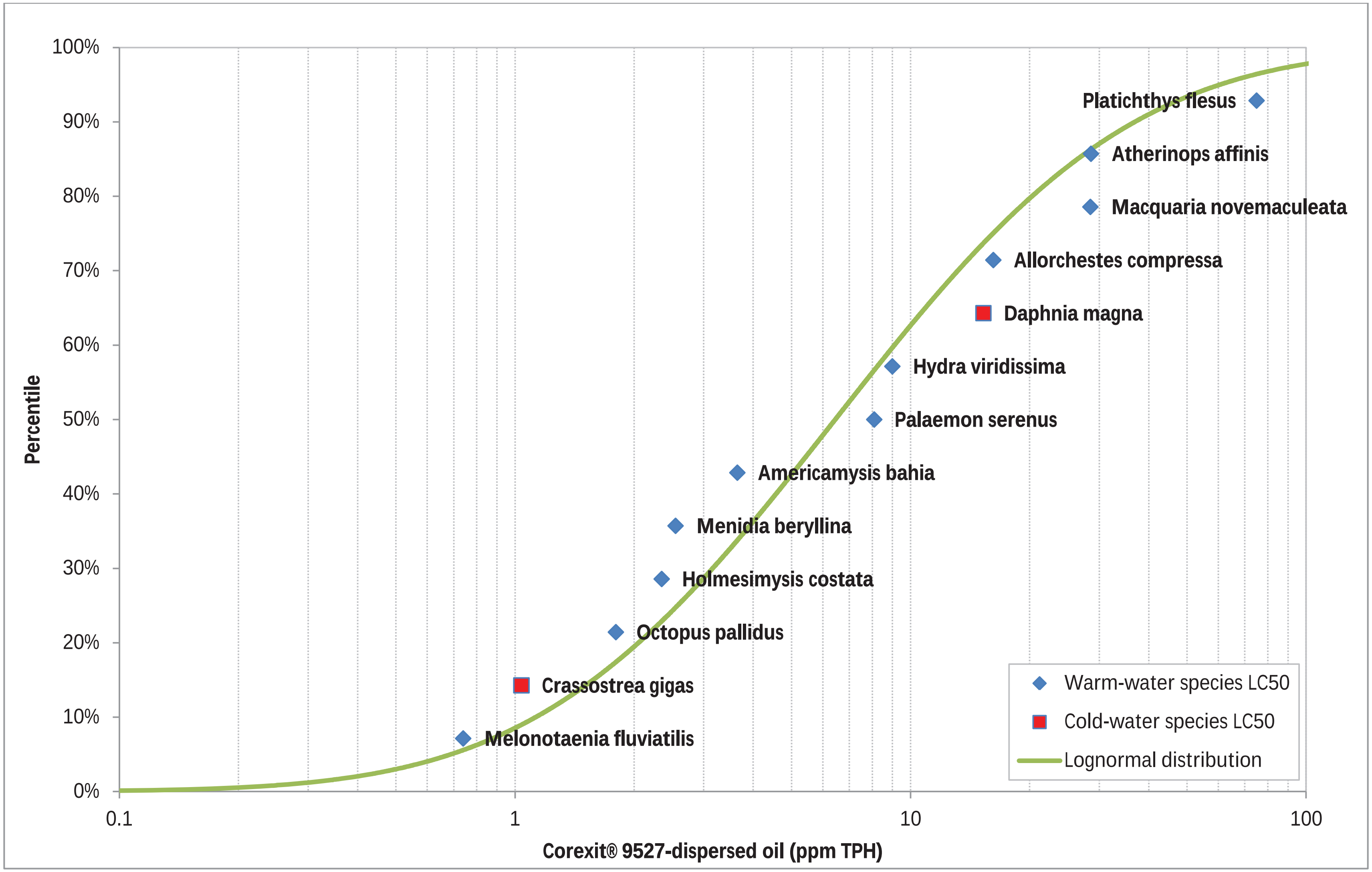


Figure 7. SSDs for Corexit® 9527-dispersed oil with the selected distribution fit to empirical toxicity data

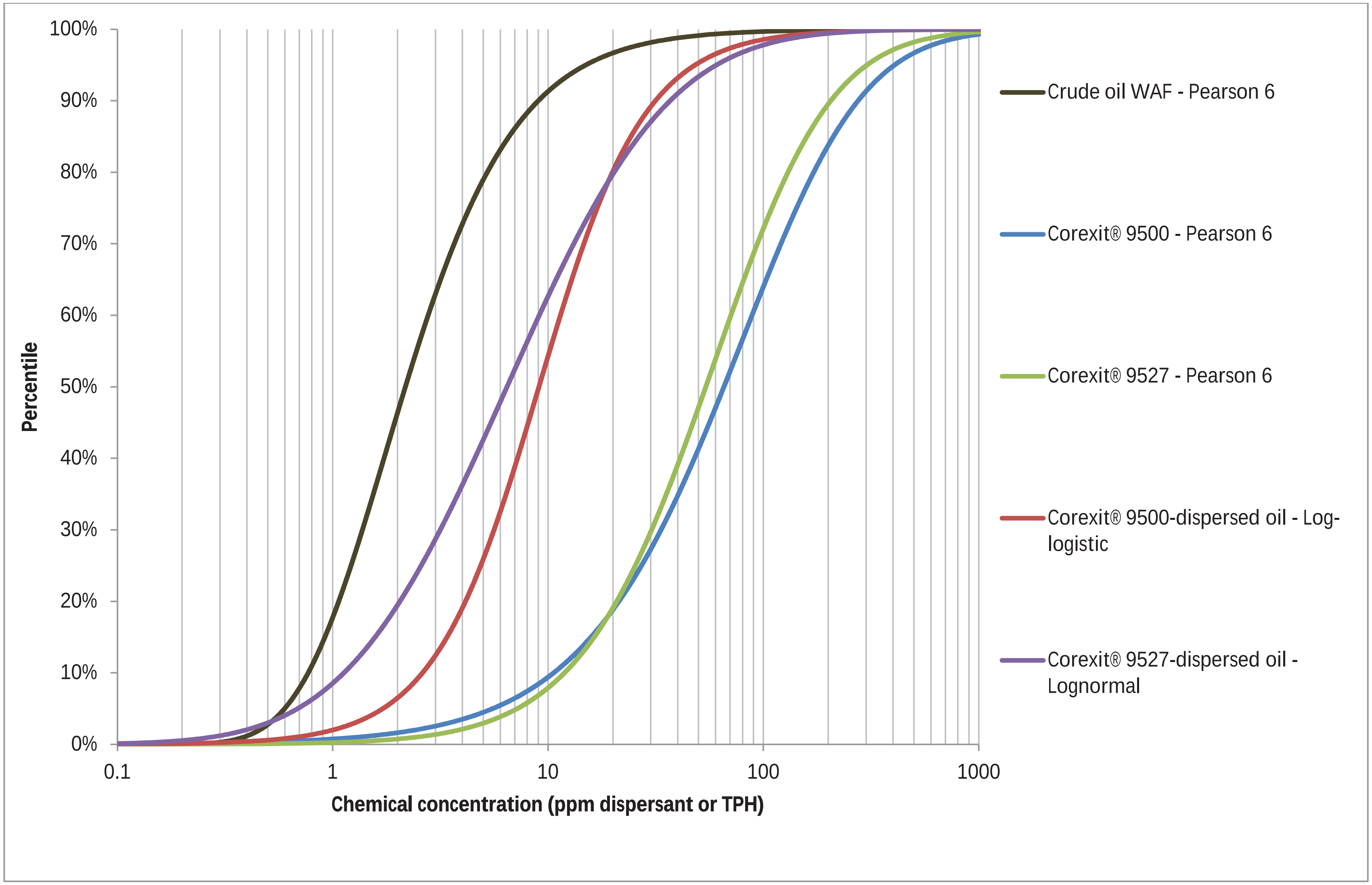


Figure 8. Comparison of selected distributions for multiple toxicity datasets

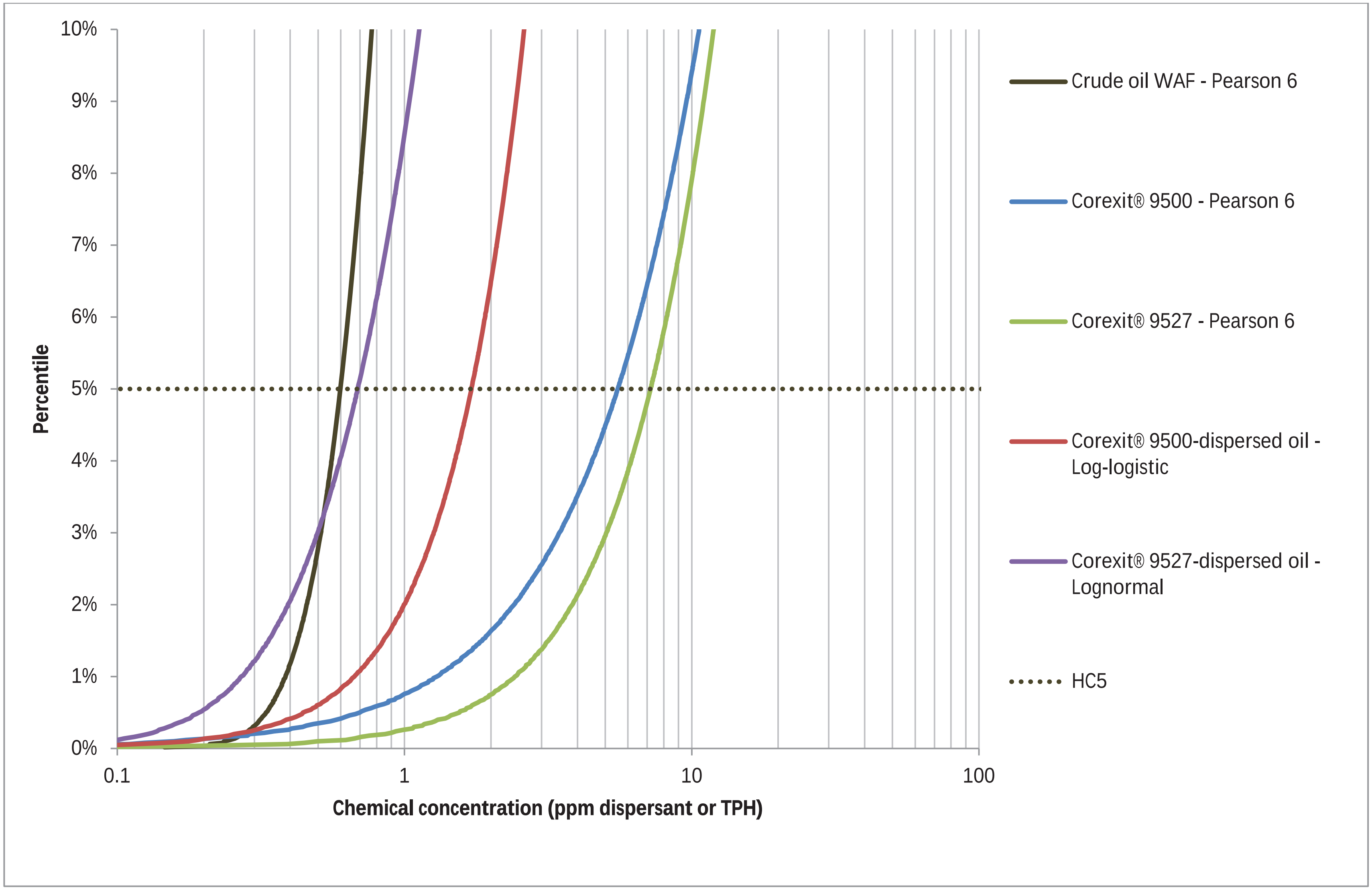


Figure 9. Comparison of selected distributions for multiple toxicity datasets, lower end with HC5 shown

The resulting HC5s for Corexit® 9500 and Corexit® 9527 were 5.53 and 7.18 ppm, respectively, indicating that the Corexit® 9527 appears to be less acutely toxic at the lower end (related to the HC5) of the SSDs than Corexit® 9500 (Figure 9). This finding runs contrary to what has been reported previously (NRC, 2005). However, Figure 8 shows that Corexit® 9527 is more acutely toxic at higher concentrations than Corexit® 9500, in accordance with the accepted view of the two dispersant formulations (NRC, 2005). The fact that the two SSDs appear to overlap can be explained by the similarities in the chemical composition of each formulation.

The crude oil HC5 was calculated as 0.46 ppm TPH. This value is similar to (i.e., within 20%) HC5 values reported by de Hoop et al. (2011), but low compared to those reported by Barron et al. (2013), except for No. 2 fuel oil (0.285 ppm TPH), which Barron et al. (2013) reported as lower. The HC5 calculated by Barron et al. (2013) for Bunker C was similar that calculated here for crude oil (i.e., 0.561 ppm TPH), but about 22% more. The HC5 reported by Gardiner et al. (2012) for Alaska North Slope (ANS) crude oil was similar to that reported here (within 5% for non-Arctic species), but lower than the HC5 for Arctic species (i.e., 0.80 ppm TPH). Variability in calculated HC5 values for crude oil can be explained by variability in oil types used (Barron et al., 2013) and species included Gardiner et al. (2012). Although de Hoop et al. (2011) report lower HC5 values for polar species than for temperate species, the differences were slight; Gardiner et al. (2012) reported a larger difference between cold- and warm-water species, but used fewer species to develop the SSDs than did de Hoop et al. (2011). It is not clear whether cold- or warm-water species are more sensitive to oil.

The Corexit® 9500-dispersed oil HC5 was 1.71 ppm TPH, and the Corexit® 9527-dispersed oil HC5 was 0.69 ppm TPH. The HC5s for Corexit® 9500-dispersed oil reported by Gardiner et al. (2012) were higher than that calculated here by factors of 1.52 and 4.91 for non-Arctic and Arctic species, respectively.

3.4 RELATIVE ACUTE TOXICITY OF OIL VERSUS DISPERSED OIL

The purpose of this section is to place the discussion of dispersed oil toxicity in the context appropriate for this BA. The toxicity of dispersed oil relative to the toxicity of oil alone is the primary concern that must be considered in order to provide a determination of effect for ESA-listed species. This is due to the fact that the exposure to and toxicity of oil, alone, represents the baseline condition against which dispersed oil toxicity and exposure must be compared. Neither the toxicity of dispersants compared to natural seawater nor the toxicity of oil alone compared to natural seawater are considered appropriate discussions for the BA.

Although many laboratory studies have shown that oil is more acutely toxic than or similarly toxic to dispersed oil (Section 3.3; Attachment B-1), dispersed oil is generally thought to be more toxic than oil alone (Singer et al., 1998; McFarlin et al., 2011; Ramachandran et al., 2004), because dispersants increase the solubility of the toxic components of oil (e.g., PAHs) (Wolfe et al, 1998, 2001; Ramachandran et al., 2004). Bioavailability is assumed to increase via the spatial redistribution of oil into the water column, the spread of the oil-water interface on the ocean's surface as droplets form, and the increased solubility of hydrophobic constituent components drawn into solution by surface active components and solvents in dispersants. The formation of oil droplets is facilitated by the surface active chemicals (i.e., surfactants) in dispersants (e.g., DOSS, Tween®80, Tween®85, and Span® 80) (Figure 1).

Although some studies have shown PAH concentrations in tissue and water to increase in the presence of dispersants (Yamada et al., 2003; Milinkovitch et al., 2011a; Ramachandran et al., 2004; Couillard et al., 2005; Faksness et al., 2011), others have shown that retention or net uptake of oil (as TPH) in tissue decreases (relative to oil alone) when the oil is dispersed (Wolfe et al., 2001; Mageau et al., 1987; Lin et al., 2009; Chase et al., 2013). Wolfe et al. (1998) showed a non-significant increase in uptake of an LPAH, and Milinkovitch et al. (2012) showed a lack of effects related to the increased uptake.

Other possible mitigating factors of acute toxicity include temperature (i.e., lower exposure at lower temperatures) (Lyons et al., 2011) and salinity (i.e., exposure decreases as salinity increases) (Ramachandran et al., 2006). Lin et al. (2009) note that dispersed oil droplets may be unavailable due to the creation of bulky, stable micelles (see "surfactant-coated oil droplet" in Figure 1) that encapsulate oil and render PAHs and other oil components non-bioavailable. This effect has been verified by others in biodegradation experiments with surfactants and PAHs (Volkering et al., 1995; Liu et al., 1995; Kim and Weber, 2003; Guha et al., 1998); PAHs have also been shown to partition to non-aqueous phases upon microbial degradation of non-ionic surfactants, again resulting in non-bioavailable forms of PAHs (Kim and Weber, 2003).

3.4.1 Relative acute lethal toxicity

The purpose of this section is to discuss all available acute toxicity data (Attachment B-1), without the limitations placed on data for inclusion in the SSDs. The available literature shows that chemical dispersants either increase or decrease the acute toxicity (i.e., lethality) of oil under laboratory conditions (Attachment B-1). Increased toxicity is generally associated with increased solubility of toxic PAHs or other hydrocarbons; decreased toxicity is often explained by variable oil chemical compositions, variable rates of oil and dispersant degradation, and the relatively low toxicity of dispersants alone (Pollino and Holdway, 2002). Fucik et al. (1995) speculated that the creation of oil droplets increased the rate of volatilization of the lighter toxic components of oil (NRC, 2005), but it has since been shown that volatilization is reduced after chemical dispersion due to the increased solubility of lighter volatile components (NRC, 2013).

A number of studies reported reduced toxicity associated with the application of chemical dispersants to oil; several studies that reported unbounded LC50 values for oil or dispersed oil are discussed here (though they were not included in the calculations of HC5 values).[32] Based on the entire dataset for comparable 46- to 96-hour acutely lethal LC50 values, approximately 54% of comparable studies had decreased toxicity when oil was dispersed, and approximately 46% had increased toxicity. Thus, contrary to popular opinion, it is slightly more likely that toxicity will decrease once dispersants have been applied.

The addition of Corexit® 9527 in spiked exposures increased toxicity in 75% of tests (n = 4), and the addition of Corexit® 9500 in spiked exposures decreased toxicity in 80% of tests (n=21)[33]. In static renewal exposures with Corexit® 9500, 64% of tests (n = 11) showed increased toxicity, and in static renewal exposures with Corexit® 9527, 75% of tests (n = 8) showed increased toxicity. Static tests without renewal have not been conducted extensively. Only one test for Corexit® 9500 and two for Corexit® 9527 have occurred with comparable LC50s for dispersed oil and oil, alone; all three tests resulted in decreased toxicity in dispersed oil treatments. In continuous exposures (i.e., flow through), 80% of tests with Corexit® 9500-dispersed oil showed increased toxicity, but 60% of tests with Corexit® 9527-dispersed oil showed decreased toxicity.

Based on the most applicable laboratory test results (using spiked or static exposure scenarios) for Corexit® 9500-dispersed oil and oil-only exposures, the use of chemical dispersants may decrease the acute lethality of oil. This is evidenced by the relative toxicity observed in 18 of 21 studies (Attachment B-1). Among the studies that reported comparable LC50 values for dispersed oil and oil alone, 60% of the tests conducted with Corexit® 9500-dispsersed oil (n = 38) showed reduced toxicity (Attachment B-1), indicating that, regardless of exposure conditions, toxicity may decrease more often than it increases with the use of dispersants.

The reported LC50s for ESA-listed fish (e.g., Chinook salmon) and larger invertebrate species (e.g., tanner crab, scallop) indicate that these species are less sensitive to dispersed oil than smaller species at early life stages (Figures 3 through 7, Tables 3 through 5, Attachment B-1). Ordzie and Garofalo (1981) showed that exposures under

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[32] Only the lowest LC50 values reported in studies for each endpoint were used for this discussion. Note that some unbounded values are included in this section as well. If an unbounded LC50 indicates a range that excludes the other LC50 to which the first is compared, then it can be said to be more or less toxic, depending on the circumstance. For example, Singer et al. (1998)Singer et al. (1998)Singer et al. (1998) reported a 96-hour LC50 for a spiked exposure of kelp forest mysid as > 25.45 ppm oil and equal to 10.54 ppm for Corexit 9527-dispersed oil; because the range of possible LC50 values greater than 25.45 ppm excludes the value 10.54 ppm, the latter value can be said to be more toxic. Note that SSDs and calculated HC5s exclude unbounded values that are not appropriate for that specific type of analysis.

[33] The majority of these studies were conducted by McFarlin et al. (2011). Where unbounded LC50s were reported for "water-accommodated fractions" of oil, "breaking water-water-accommodated fractions" were used. These tests used oil that had been vigorously mixed into exposure water prior to exposures. Excluding this study (which was methodologically different than the others), the percentage of tests indicating decreased toxicity after Corexit® 9500 application is 66.67% (n = 9).

Arctic conditions (i.e., 2°C) may result in lower toxicity (in scallop) at relevant dispersed oil concentrations in the water column (i.e., up to 28 ppm dispersed oil immediately after application), particularly during short exposures (i.e., 6 hours) within the initial period of dilution (Mackay and McAuliffe, 1988; Nedwed, 2012; Gallaway et al., 2012).[34]

3.4.2 Relative sublethal toxicity

The data available for sublethal toxicity are very limited. Three tests with Corexit® 9500-dispersed oils (i.e., Terra Nova, Mesa, and Scotian light crude oils) were available for a single species (rainbow trout) (Ramachandran et al., 2004). Dispersants increased the exposure in all three of these tests, as indicated by the induction of cytochrome P4501A and measured using the EROD enzyme activity bioassay (Ramachandran et al., 2004). After the oil was treated with Corexit® 9500, EC50s decreased by factors of 5.91 to 1,116. It should be noted that these tests were conducted under laboratory conditions with closed systems and a static-renewal exposure scenario, both of which may overestimate the exposure of test species to dispersed oil under expected field conditions.[35] Also, EROD activity is a biomarker of exposure and does not necessarily indicate an adverse effect.

Four tests comparing Corexit® 9527-dispersed oil and oil alone were available. A study by Singer et al. (1998) tested Corexit® 9527 and red abalone larval shell abnormalities, as well as initial narcosis in topsmelt and kelp forest mysid. In the abnormal growth assay, EC50s for dispersed oil (17.81 to 32.70 ppm) were less (i.e., more toxic) than concentrations for oil alone (33.58 to 46.99 ppm, measured as total [C_7-C_{30}] hydrocarbons); however, toxicity decreased in the initial narcosis bioassays. A second study (Mitchell and Holdway, 2000) showed changes in the modeled population growth rate of green hydra. Over a period of 168 hours, the toxicity of the oil increased after dispersant had been added. The mortality endpoint for green hydra measured during the same study indicated that oil alone was more acutely toxic than dispersed oil.

3.5 Uncertainties Associated with the Application of HC5s

The data presented in Sections 3.2 and 3.3 and Attachment B-1 often do not consider ecologically-relevant exposure durations. This is a major shortcoming of the current analysis and those presented elsewhere (Barron et al., 2013; Smit et al., 2009; de Hoop

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34 This statement is based on the reported 6-hour LC50 values for *Argopecten irradians* (a scallop) of 1,800 and 2,500 ppm Corexit 9527-dispersed oil at 10°C and 2°C, respectively. The species was not impacted by oil alone, but was impacted by dispersants alone, suggesting that in this case, dispersants were driving toxicity.

35 This statement assumes that exposed species are mobile rather than held within a plume. The former assumption is relevant for the test species, rainbow trout in question, but the latter condition is relevant for many planktonic species. In that case, exposures can be expected to increase, as observed by Ramachandran et al. (2004).

et al., 2011); however, the inclusion of less relevant data was necessary to develop meaningful SSDs from the available data. The use of spiked exposures is perhaps most relevant (for surface application), as discussed in Section 3.2.1.1; these tests were specifically investigated by Gardiner et al. (2012), who noted that dispersed oil was approximately 5 to 10 times less toxic than oil alone, and that Arctic species were less sensitive than non-Arctic species. Although analysis was limited by the number of available studies with Arctic species (n = 5), the results generally corroborated the findings presented in Section 3.3, specifically the comparison of crude oil and Corexit® 9500-dispersed oil.

Exposure durations in a real spill event are expected to vary by individual, species, and population or community. The dilution of oil and dispersant over time was discussed by Nedwed (2012) and Gallaway et al. (2012) and modeled by Mackay and McAuliffe (1988). Nedwed (2012) indicated that the rate of dilution of dispersed oil results in a concentration of dispersed oil < 10 ppm within minutes of application, approximately 1 ppm within hours, and in the parts per billion range (i.e., < 1 ppm) within one day. Previous measurements of immediate dispersed oil concentrations after dispersant application have been as high as 50 to 150 ppm (Belore et al., 2009), although usually lower (between 10 and 30 ppm) (Mackay and McAuliffe, 1988; McAuliffe et al., 1980; McAuliffe et al., 1981). However on average, over short time periods (i.e., 10 to 30 minutes after dispersant application), concentrations have been shown to be in only the parts per billion range (Mackay and McAuliffe, 1988),[36] suggesting that while instantaneous spikes in concentration may occur, dilution is rapid. Mackay and McAuliffe (1988) state, "the measured field exposures to C_1-C_{10} dissolved hydrocarbons from untreated and chemically dispersed crude oils are thus much lower (by a factor of 150 to 1 million) than those observed to kill a wide range of organisms in laboratory bioassays." When considering whether the increased concentration of dissolved hydrocarbons in the water column could cause "irreversible damage" to species that would otherwise not be exposed at depth to dispersed oil, Mackay and McAuliffe (1988) state that, "it appears that in many cases there is an adequate safety margin."

Other important uncertainties regarding the HC5s include the variety of exposure scenarios used in their development. Exposure temperatures, salinities, oil conditions (i.e., weathered or fresh), oil types, and species life stages all potentially contribute to variability in observed toxicity. For example, tests using different species exposed at different temperatures or salinities could result in different rates of ingestion, respiration, and depuration; an indirect example is provided by Venosa and Holder (2007), who observed that microbial activity in a single consortium slowed at colder temperatures. Fresh oils characteristically contain higher concentrations of small,

[36] MacKay and McAuliffe (1988) report these time-averaged concentrations as TPH (C_1-C_{10}), the lightest fraction of hydrocarbons and the most volatile. Other, less volatile fractions of hydrocarbons (e.g., C_7-C_{30}) may be expected to be concentrated under a dispersed oil plume also.

volatile, and more bioavailable hydrocarbons than weathered oil (Bobra et al., 1989; Rhoton, 1999; Singer et al., 2001; Rhoton et al., 2001); in this analysis, HC5s were calculated using results from either fresh or weathered oils. Similarly, different oil types or sources (e.g., ANS, Cook Inlet, and Prudhoe Bay) have different chemical compositions, and may illicit varying toxicity (Barron et al., 2013). Species life stage is known to affect toxicity testing, such that earlier life stages (particularly embryonic or larval life stages) tend to be much more susceptible to chemical intoxication. Attachment B-1 includes data from various literature reviews that did not explicitly state the life stage of the tested species, so the HC5 calculations may have inadvertently included mature life stage LC50s.

4 Synthesis of Fate and Transport, Exposure, and Toxicity Data

The purpose of this section is to synthesize the information provided in Sections 2 and 3, as well as information in Section 3 of the BA. The likely exposures of groups of species and their relative sensitivities to dispersants and dispersed oil are discussed to assess the likelihood of physical or toxicological impacts. Oil toxicity is discussed only in relation to the baseline condition. Species-specific discussions are provided in Section 5.

4.1 Likelihood of Physical Effects

Based on the available dispersant application guidelines for response actions in Alaska (Alaska Clean Seas, 2010; Nuka Research, 2006 [STAR]) and the life histories and behaviors of the wildlife addressed by this BA (Section 3 of the BA), it is unlikely that the bird and mammal species protected under the ESA would be directly exposed to undiluted dispersants as a result of a spill response action. This will limit potential physical impacts on birds and furbearing mammals (e.g., sea otter and polar bear), such as reduced thermoregulation of feathers or fur (Section 3.1) caused by dispersants alone.

Pinnipeds will not likely be impacted due to their use of nearshore and intertidal habitat (i.e., near haulouts, where dispersant application is unlikely to be permitted), and the subcutaneous blubber that maintains their body heat (Section 3 of the BA). If exposure to dispersants alone were to occur for any species, it is likely that the concentration would be very dilute, based on the rate of dilution after application (Gallaway et al., 2012). Species will more likely be exposed to dispersed oil. Cetaceans are likely to be exposed to dilute dispersed oil, but physical impacts are unlikely based on the function of subcutaneous blubber in these species.

If birds are exposed to dispersed oil, the physical impacts may be greater than those of oil alone (Duerr et al., 2011). However, at least three factors may reduce the overall impact of oil on these species under field conditions: reduced spill area (NRC, 2005), reduced spill volume and concentration (NRC, 2005), and reduced extent of oiling (CDC and ATSDR, 2010; Lessard and Demarco, 2000). Birds and furbearing mammals that use feathers or fur for thermoregulation or buoyancy on water tend to spend much of their time resting (among other activities) at the ocean's surface (Section 3 of the BA). If the area of the oil slick is reduced at the surface, then the likelihood of a slick coming into contact with such ESA-protected species should be reduced relative to the baseline condition. Modeling by French-McCay (2004) highlighted the importance, particularly for birds and furbearing mammals, of reducing oil at the ocean's surface. The same study indicated that cetaceans and pinnipeds are not at risk of such physical effects. Additionally, reducing the volume and concentration of oil at the surface should mitigate the extent of oiling of these species (NRC, 2005). Although it is not clear whether this will entirely protect these species from becoming oiled, complete dispersion and removal of an oil slick from the surface should reduce oiling to negligible levels. The CDC and ATSDR (2010) and Lessard and Demarco (2000) found that dispersed oil is less likely to "stick to birds and other animals," so it is possible that reduced oiling of birds and mammals (in combination with a reduction in surface slick area and oil concentration) will ultimately reduce the likelihood of lost thermoregulatory or swimming ability. This is a potential diminishment of physical impacts relative to the baseline condition.

Physical impacts caused by dispersants or dispersed oil are not expected in other ESA-listed groups, such as fish or reptiles; French-McCay (2004) modeled the likelihood of mortality in marine reptiles within an oiled area, and found the likelihood of such mortality to be very low (i.e., 1% probability). Fish and reptile species do not regulate their body heat as do birds and mammals, and assumedly do not suffer physically from oiling in a similar way.

4.2 Likelihood of Acute Toxicity

As stated, dispersants are intended exclusively for use on an oil slick at the ocean's surface, and would not be applied directly to water where oil was not present. It has been noted that dispersants will slowly leach from dispersed oil droplets over time (Fingas, 2008), but at a concentration expected to be low relative to acute LC50 values observed in the lab (Attachment B-1, Table 3, Figures 3 and 4). Some overspray is expected during application, but spraying of areas with wildlife is not expected or suggested; certain BMPs or wildlife deterrence measures (if permitted) are intended to preclude wildlife from areas where dispersants are being sprayed. Furthermore, spotter aircraft are used during aerial applications to ensure that overspray is minimized (Brown et al., 2011).

HC5s are provided for Corexit® 9500 and Corexit® 9527 (Table 3) in order to show the relative acute toxicity of dispersants, crude oil, and dispersed oil (i.e., dispersed oil is more acutely toxic than dispersants alone, but less acutely toxic than oil alone) (Tables 3 through 5, Figures 8 and 9). Approximately half of the comparable data suggest that oil is more toxic than dispersed oil, particularly according to the most relevant laboratory testing scenarios (Section 3..2).

The rapid dilution of dispersant after application is expected to result in a very short duration of exposure to concentrated dispersant, even for the most sensitive and vulnerable of aquatic species (e.g., sea surface microlayer, larval fish and invertebrates, and plankton).[37] Dispersant chemicals, when applied during a response action, mix rapidly into an oil spill (ExxonMobil, 2008), are transported and diluted with the motion of waves and currents (NRC, 2005; Nedwed, 2012; Gallaway et al., 2012), and

[37] Shallow-dwelling pelagic and neustonic species are most often represented in the SSDs (Section 3; Attachment B-1). They are also the most likely to be impacted by dispersants applied at the surface of the ocean (as well as by any oil that would be dispersed).

are biodegraded over time (Section 2). Dilution alone is expected to greatly reduce the concentration of dispersants within a matter of hours (Gallaway et al., 2012). Durations of dispersant exposure above the dispersed oil HC5 (Table 5) at a given location may be a matter of minutes or hours (Mackay and McAuliffe, 1988), although repeated dispersant applications may occur over the course of days (Fingas, 2008), potentially resulting in multiple short pulses of dispersed oil into the water column. As the HC5s for dispersed oil (and dispersants alone) are based on constant 48- to 96-hour toxicity tests, a typical response action is not expected to cause acute toxicity to sensitive aquatic life, let alone larger ESA-listed or candidate species. Repeated dispersions may result in mortality of sensitive species, but are unlikely to result in concentrations high enough to cause acute mortality at higher trophic levels (i.e., ESA-listed or candidate species).

Many of the ESA-listed birds and mammals are wide ranging, occur in specific areas only seasonally, forage throughout the water column (some to great depths), and avoid areas of human activity. These activities are discussed at length in Section 3 of the BA. The observance of BMPs is required during any spill response, and these practices are intended to ensure that wildlife are not impacted by the response action. Together, these limiting factors are expected to reduce the likelihood of exposure to dispersed oil and any possibility of acute toxicity resulting from the application of chemical dispersants.

Indirect oil embryotoxicity in birds (i.e., transfer from oiled parent to nest), which can increase after exposure to dispersants (Wooten et al., 2012), is not likely, because the direct exposure of nesting birds or birds on the water to chemical dispersants is unlikely (Butler et al., 1988). This conclusion has also been reached by previous studies (Peakall et al., 1987; French-McCay, 2004; NRC, 2005). BMPs or other response actions (e.g., hazing) could be used (if permitted by a regulating agency) to disperse birds from an area where dispersants were to be applied.

Exposure of marine reptiles to dispersed oil has been specifically studied at least once (Rowe, 2009), and findings suggest that dispersed oil is unlikely to be toxic to turtles *in ovo*. Previously reported toxicity to marine reptiles (Yender and Mearns, 2003; cited in Rowe, 2009) is likely overestimated, as the percolation of oil and dispersed oil through sediment (i.e., where sea turtle eggs are deposited) results in a very low transfer of toxic oil components to eggs under realistic conditions. Species-specific considerations are stated in Section 5.

4.3 Likelihood of Chronic or Sublethal Toxicity

Chronic, large-scale exposures of ESA-listed or candidate species to chemical dispersants alone are not expected to occur in the natural environment, largely due to the rapid rate of dilution and biodegradation after a dispersant application. This is specifically true of larger, less sensitive individuals. However, Pacific herring, a candidate species for listing under ESA, is known to spawn in Alaska and is present during all life stages (Section 3 of the BA). Although dispersants alone are not likely to be sufficiently concentrated in the water column to cause acute toxicity (due to partitioning to oil and sediment, Section 2), over time, the increased surface area of droplets containing dispersants and oil may allow dispersants to leach into the water column in dilute concentrations (Fingas, 2008); also, overspray is possible, but is not expected to be substantial (Butler et al., 1988), and the use of spotter aircraft to guide aerial dispersant applications minimizes overspray (Brown et al., 2011). Leaching and oversprayed dispersants may result in sublethal toxicity in sensitive species (e.g., early-life-stage Pacific herring, Section 5.3.4). It is not clear what concentration of dispersants is likely to leach from dispersed oil droplets into the water column, but it is likely to be dilute (Section 2.1). Chronic, sublethal toxicity in fish is likely to manifest as abnormal development (Lonning and Falk-Petersen, 1978; Falk-Petersen et al., 1983), possibly leading to altered fitness and death.[38] Delayed development has also been observed at high concentrations of Corexit® 9527 (100 ppm) (Lonning and Falk-Petersen, 1978; Falk-Petersen et al., 1983), but this is not an ecologically-relevant concentration, nor is it clearly linked to adverse impacts on survival, growth, or reproduction.

Short-term, sublethal effects on sensitive species and life stages are possible from exposure to dispersed oil at ecologically-relevant concentrations. One study with Atlantic herring embryos (Lee et al., 2011b) reported that concentrations of Corexit® 9500-dispersed oil of 11.08 and 18.00 ppm (ANS and Arabian light crude oils, respectively) were sufficient to cause reduced hatching in half of the exposed embryos after only 2.4 hours. A similar effect was noted for concentrations of 2.21 and 3.07 ppm (using the same dispersant and oil types) after an 8-hour exposure (Lee et al., 2011b); a range of 0.49 to 1.94 ppm was reported as the 24-hour EC50, and a range of < 0.25 to < 0.37 ppm was reported as the 14-day EC50 (Lee et al., 2011b). Even if the concentration of dispersed oil in the water column decreases below the calculated HC5 within a matter of minutes to hours (Mackay and McAuliffe, 1988), it may still be possible for a significant adverse effect to occur in planktonic species at sensitive embryonic life stages. This may have implications for the decision to use dispersants in areas where fish are spawning, particularly for ESA candidate species and concentrations of prey of protected species.

No SSDs were created for sublethal or chronic effects due to the variety of measured endpoints and exposure durations reported in the literature, as well as the paucity of data and species assessed in chronic or sublethal tests (that reported meaningful toxicity values). Without SSDs, HC5s were not calculable for chronic or sublethal endpoints.

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[38] Death in this case is distinct from mortality resulting from exposure to chemicals; the former is indirectly caused by chemical exposure but directly results from reduced fitness (e.g., reduced growth and survival in response to normal environmental factors, such as temperature or dissolved oxygen changes).

5 Summary of Species-Specific Impacts

The purpose of this section is to make a definitive statement about the likelihood of adverse impacts on each species at the individual level (i.e., reduced survival, growth, or reproduction) caused by the use of chemical dispersants. These conclusions are applied to the larger discussion in the BA, and represent just one of many potential adverse impacts on ESA-listed or candidate species that could be caused by an implementation of the Unified Plan.

As noted in Section 1, terrestrial species are not included in this assessment, so Eskimo curlew and the Aleutian shield fern are omitted. Dispersants are intended for use in open water, marine environments; neither of these species utilizes such habitats, so exposures to dispersants or dispersed oil is considered highly unlikely (i.e., discountable) under expected circumstances.

5.1 MAMMALS

5.1.1 Beluga whale, Cook Inlet DPS

Beluga whale are unlikely to be impacted by the physical effects of dispersants (Section 3.1). They rely on subcutaneous blubber to regulate their body heat, instead of fur, which could be compromised by oiling, dispersants, or dispersed oil.

This species is very large and will not likely be exposed to concentrations of dispersants or dispersed oil in quantities large enough to cause acutely toxic effects (e.g., mortality); such effects are unlikely even in lower trophic levels (Section 4). Dispersed oil rapidly dilutes and degrades over time, so chronic exposure to dispersants or dispersed oil in the water column is unlikely (Section 2). Accumulation of PAHs in tissue over time as a result of chemical dispersion is unlikely due to the ability of mammals to metabolize and excrete PAHs, as well as the expected acute nature of a PAH exposure after a chemical dispersion event (Sections 2.1 and 2.2).

Acute exposures to PAHs, which may become more bioavailable in the shallow water column after chemical dispersion, have been linked to various effects on wildlife in PWS after EVOS, although toxicity is noted as secondary to the physical impacts of fouling (e.g., hypothermia) (Albers and Loughlin 2003). Larger marine mammals with subcutaneous blubber (e.g., cetaceans), which would not suffer from hypothermia caused by fouling, were observed to experience sublethal impacts (e.g., lesions) after EVOS (Albers and Loughlin 2003). It is unclear whether the application of chemical dispersants would increase the exposure of whales to PAHs, resulting in a greater prevalence of lesions. It is also unclear whether lesions caused by increased exposure to PAHs would lead to significant effects resulting in the impairment of essential behavioral patterns (e.g., breeding, feeding, and sheltering). The impact of PAHs on whale species as a result of acute exposure after chemical dispersion is a point of uncertainty (Section 6.3.4).

Beluga spend much of their time in fairly shallow water, so they may be more exposed to dispersed oil than other cetaceans. However, they also may be more exposed to oil alone, in the event that dispersant is not applied, because they remain at the surface, where oil becomes concentrated. Dispersion would assumedly remove much of the oil from the ocean's surface, effectively reducing the exposure of beluga. And, as noted in Section 3.1, exposure to oil alone when surfacing to breathe is more likely to cause severe impacts on cetacean species than exposure to dispersed oil in the water column.

The prey base of beluga whale is largely composed of juvenile or adult fish species, often anadromous fish. Anadromous fish are unlikely to be impacted by dispersants or dispersed oil during spawning or rearing (i.e., not present in marine waters during those activities), but they may be exposed to sufficient levels of dispersed oil as juveniles to elicit sublethal effects (Section 3.2.3.4). Beluga also prey upon marine fish, which may be impacted to a greater extent if spawning occurs in shallow waters (i.e., less than 10 m deep) (Section 1.3). As stated in Sections 3.1.1 and 3.1.2, embryonic fish are much more likely to suffer from the acutely toxic impacts of dispersant application. Such impacts may be greater than those caused by oil alone if spawning occurs between 1 and 10 m deep, since embryos at such depths would not be exposed to oil, but would be exposed to dispersed oil.

Based on the rationale provided above, Cook Inlet beluga whale are anticipated to be exposed to dispersed oil in the event of a chemical dispersant application, potentially resulting in adverse impacts. Exposures to dispersed oil and increased uptake of PAHs from the water column may result in sublethal responses (e.g., lesions and irritation of sensitive tissues). The likelihood and duration of exposure of beluga whale to dispersed oil may be facilitated by their localized, year-round distribution within Cook Inlet, and the importance of their critical habitat (e.g., shallow waters used for feeding, calving, and predator evasion), which may be degraded by dispersed oil (NMFS, 2008a). Furthermore, the likelihood of exposure is greater due to the frequency of oil or other petroleum products spills in Cook Inlet (Appendix D).

5.1.2 Blue whale

Blue whale are unlikely to be impacted by the physical effects of dispersants (Section 3.1). They rely on subcutaneous blubber to regulate their body heat, instead of fur, which could be compromised by oiling, dispersants, or dispersed oil.

This species is extremely large and will not likely be exposed to dispersants or dispersed oil in quantities significant enough to cause acute toxic effects (e.g., mortality); such effects are unlikely even at lower trophic levels (Section 4). Dispersed oil rapidly dilutes and degrades over time, so chronic exposure to dispersants or dispersed oil is unlikely (Section 2).

It is possible (although unlikely) that dispersed oil will be ingested by blue whale, which feed through their baleen on planktonic species. However, the ingestion of even large quantities of crude oil by much smaller species has been found to cause minimal effects (Section 3.1), and cetaceans are likely able to efficiently metabolize hydrocarbons (Albers and Loughlin, 2003). It is highly unlikely that blue whale will ingest large quantities of dispersed oil due to the depth at which they are found (Wade and Friedrichsen, 1979; as cited in Reeves et al., 1998). Given that embryonic and larval life stages of blue whale prey may be found in shallow water during a chemical dispersant application, it is possible that these prey species may be impacted (Section 3.2).

The trophic transfer of PAHs to invertebrates in dispersed-oil exposures does occur, but fish metabolize PAHs fairly efficiently (Wolfe et al., 2001; Logan, 2007). The magnification of PAHs in blue whale through their diet is unlikely (Albers and Loughlin, 2003), because the higher trophic levels, including cetaceans, metabolize PAHs efficiently. Accumulation of PAHs in tissue over time as a result of chemical dispersion is unlikely due to the ability of mammals to metabolize and excrete PAHs, as well as the expected acute nature of a PAH exposure after a chemical dispersion event (i.e., rapid dilution and increased rate of degradation) (Sections 2.1 and 2.2).

Acute exposures to PAHs, which may become more bioavailable in the shallow water column after chemical dispersion, have been linked to various effects on wildlife in PWS after EVOS, although toxicity is noted as secondary to the physical impacts of fouling (e.g., hypothermia) (Albers and Loughlin 2003). Larger marine mammals with subcutaneous blubber (e.g., cetaceans), which would not suffer from hypothermia caused by fouling, were observed to experience sublethal impacts (e.g., lesions) after EVOS (Albers and Loughlin 2003). It is unclear whether the application of chemical dispersants would increase the exposure of whales to PAHs, resulting in a greater prevalence of lesions. It is also unclear whether lesions caused by increased exposure to PAHs would lead to significant effects resulting in the impairment of essential behavioral patterns (e.g., breeding, feeding, and sheltering). The impact of PAHs on whale species as a result of acute exposure after chemical dispersion is a point of uncertainty (Section 6.3.4).

Blue whales periodically surface to breathe, which requires that they potentially come into contact with oil at the ocean's surface. Because dispersants remove oil from the ocean's surface and, through dilution, reduce the concentration of oil, it can be expected that the exposure of blue whale to oil will be mitigated by dispersants. Exposure will increase as the species moves from deep waters through the upper 10 m (before reaching the surface), but this is expected to result in minimal impacts (Section 3.1). It is not expected that exposures will last, as blue whales surface briefly and then return to deeper water to feed.

For these reasons, blue whale are not anticipated to be negatively impacted by the application of dispersants if BMPs are implemented during the response action. For example, dispersant applications should not occur in areas where blue whales are known to be present.

In the unlikely event that BMPs fail, and the implementation of the Unified Plan fails to protect marine mammals, blue whales may be adversely impacted by the application of dispersants. Potential impacts on blue whales in a worst-case scenario are provided in the main text of the BA.

5.1.3 Bowhead whale

Bowhead whale are unlikely to be impacted by the physical effects of dispersants (Section 3.1). They rely on subcutaneous blubber to regulate their body heat, instead of fur, which could be compromised by oiling, dispersants, or dispersed oil.
It is possible that dispersed oil will be ingested by bowhead whale, which feed through their baleen on planktonic species, particularly in shallow waters. The amount of hydrocarbons accumulated will be limited by the use of dispersants to break up oil and facilitate metabolic breakdown and the ability of cetaceans to efficiently metabolize ingested hydrocarbons (Albers and Loughlin, 2003). Therefore, substantial bioaccumulation or magnification of oil components from direct ingestion of dispersed oil are not likely to occur over time (Sections 2.1 and 2.2). Oiling of bowhead whale habitat, such as broken sea ice, breathing holes, or polynyas, could result in pools and concentrations of oil, severely impacting bowhead whale. Dispersion in these areas, particularly where bowhead whale surface to breathe, could mitigate such impacts by reducing the amount of surface oil (Section 3.1). However, ingestion of dispersed oil during feeding may increase, leading to fouled baleen and sublethal impacts (e.g., vomiting and tissue irritation). Such effects may reduce the feeding efficiency of bowhead whale (BOEMRE, 2011). Bowhead whale will likely be most susceptible to such impacts during summer, when feeding increases (BOEMRE, 2011).

During migration from April to June, calves are born (Koski et al., 1993; cited in NMFS, 2002). Calves tend to reside in the upper 20 m of the water column (Koski and Miller, 2009), which puts them at particular risk of exposure to both dispersed oil and oil alone. As noted in Section 3.1, the acute impacts of dispersed oil on cetaceans are less than those of oil alone, due to the altered route of exposure (i.e., ingestion of dispersed oil as opposed to inhalation or aspiration of surface oil).

The trophic transfer to invertebrates of PAHs in dispersed-oil exposures has been shown, but fish metabolize PAHs fairly efficiently (Wolfe et al., 2001). The magnification of PAHs in bowhead whale through their diet is unlikely (Albers and Loughlin, 2003), because higher trophic levels, including cetaceans, metabolize PAHs efficiently. Accumulation of PAHs in tissue over time as a result of chemical dispersion is unlikely due to the ability of mammals to metabolize and excrete PAHs, as well as the acute nature of a PAH exposure after a chemical dispersion event (i.e., rapid dilution and increased rate of degradation) (Sections 2.1 and 2.2).

Acute exposures to PAHs, which may become more bioavailable in the shallow water column after chemical dispersion, have been linked to various effects on wildlife in PWS after EVOS, although toxicity is noted as secondary to the physical impacts of fouling (e.g., hypothermia) (Albers and Loughlin 2003). Larger marine mammals with subcutaneous blubber (e.g., cetaceans), which would not suffer from hypothermia caused by fouling, were observed to experience sublethal impacts (e.g., lesions) after EVOS (Albers and Loughlin 2003). It is unclear whether the application of chemical dispersants would increase the exposure of whales to PAHs, resulting in a greater prevalence of lesions. It is also unclear whether lesions caused by increased exposure to PAHs would lead to significant effects resulting in the impairment of essential behavioral patterns (e.g., breeding, feeding, and sheltering). The impact of PAHs on whale species as a result of acute exposure after chemical dispersion is a point of uncertainty (Section 6.3.4).

For the reasons noted, chemical dispersion may affect bowhead whales by causing increased baleen fouling and reduced feeding efficiency. However, the incremental benefit of removing oil from the surface (i.e., reducing inhalation or aspiration) outweighs the potential for exposure in the water column (i.e., increasing ingestion and potentially fouled baleen). This conclusion assumes that dispersants are not directly applied to areas where bowhead whale are known to be congregated.

In the unlikely event that BMPs fail, and the implementation of the Unified Plan fails to protect marine mammals, bowhead whales may be adversely impacted by the application of dispersants. Potential impacts on bowhead whales in a worst-case scenario are provided in the main text of the BA.

5.1.4 Fin whale

Fin whale are unlikely to be impacted by the physical effects of dispersants (Section 3.1). They rely on subcutaneous blubber to regulate their body heat, instead of fur, which could be compromised by oiling, dispersants, or dispersed oil.

This species is extremely large and will not likely be exposed to dispersants or dispersed oil in quantities large enough to cause acute toxic effects (e.g., mortality); such effects are unlikely even at lower trophic levels (Section 4). Dispersed oil rapidly dilutes and degrades over time, so chronic exposure to dispersants or dispersed oil is unlikely (Section 2).

It is possible (although unlikely) that dispersed oil will be ingested by fin whale, which feed through their baleen on planktonic species. The ingestion of crude oil, even in large quantities, in much smaller species has been found to cause minimal impacts (Section 3.1), and cetaceans are likely able to efficiently metabolize hydrocarbons (Albers and Loughlin, 2003). It is highly unlikely that fin whale will ingest large quantities of dispersed oil due to the depths at which they are often found (i.e., between 50 and 600 m) (US Navy, 2011; Croll et al., 2001; Goldbogen et al., 2006; Panigada et al., 2003). Assuming that fin whale feed at depths > 10 m, it is likely that their prey are also found primarily at depths > 10 m; therefore, the prey population of fin whale is unlikely to be exposed to high concentrations of dispersed oil, if any at all (Section 2). However, the larval life stages of these species may be found in shallower waters, so impacts may occur in very sensitive species (Section 3.2). Within the overall community, acute toxicity is expected to decrease as a result of chemical dispersion relative to oil alone (Section 3.3).

The trophic transfer to invertebrates of PAHs in dispersed-oil exposures has been shown, but fish metabolize PAHs fairly efficiently (Wolfe et al., 2001). The accumulation and / or magnification of PAHs in fin whale through their diet is unlikely (Albers and Loughlin, 2003), because higher trophic levels, including cetaceans, metabolize PAHs efficiently. Also, rapid dilution, biodegradation, and transportation of an oil plume are expected to result in acute, temporary exposures in the water column (Section 2).

Acute exposures to PAHs, which may become more bioavailable in the shallow water column after chemical dispersion, have been linked to various effects on wildlife in PWS after EVOS, although toxicity is noted as secondary to the physical impacts of fouling (e.g., hypothermia) (Albers and Loughlin 2003). Larger marine mammals with subcutaneous blubber (e.g., cetaceans), which would not suffer from hypothermia caused by fouling, were observed to experience sublethal impacts (e.g., lesions) after EVOS (Albers and Loughlin 2003). It is unclear whether the application of chemical dispersants would increase the exposure of whales to PAHs, resulting in a greater prevalence of lesions. It is also unclear whether lesions caused by increased exposure to PAHs would lead to significant effects resulting in the impairment of essential behavioral patterns (e.g., breeding, feeding, and sheltering). The impact of PAHs on whale species as a result of acute exposure after chemical dispersion is a point of uncertainty (Section 6.3.4).

Fin whale surface periodically to breathe, requiring that they potentially come into contact with oil at the ocean's surface. Because dispersants remove oil from the ocean's surface and, through dilution, reduce the concentration of oil, the exposure of fin whale to oil will be mitigated through dispersion. Exposure will increase as they move from deep water through the upper 10 m (before reaching the surface), but this is expected to result in minimal or minimized impacts (Section 3.1); fin whale surface briefly, then return to deeper water to feed. Fin whale spend approximately 44% of their time in water less than 50 m deep (Goldbogen et al., 2006), a depth that will be mostly unaffected by dispersed oil.

For these reasons, fin whale are not anticipated to be negatively impacted by the application of dispersants if all BMPs are implemented during the response action. For example, dispersant applications should not occur in areas where fin whale are known to be present.

In the unlikely event that BMPs fail, and the implementation of the Unified Plan fails to protect marine mammals, fin whale may be adversely impacted by the application of dispersants. Potential impacts on fin whales in a worst-case scenario are provided in the main text of the BA.

5.1.5 Gray whale, Western North Pacific DPS

Gray whale are unlikely to be impacted by the physical effects of dispersants (Section 3.1). They rely on subcutaneous blubber to regulate their body heat, instead of fur, which could be compromised by oiling, dispersants, or dispersed oil.

This species is very large and will not likely be exposed to concentrations of dispersants or dispersed oil in quantities large enough to cause acute toxic effects (e.g., mortality); such effects are unlikely even at lower trophic levels (Section 4). Dispersed oil rapidly dilutes and degrades over time, so chronic exposure to dispersants or dispersed oil is unlikely (Section 2).

It is possible that dispersed oil will be ingested by gray whale, which feed through their baleen on benthic species suctioned from sediment (Nerini, 1984). The ingestion of crude oil, even in large quantities, in much smaller species has been found to cause minimal impacts (Section 3.1), and cetaceans are likely able to efficiently metabolize hydrocarbons (Albers and Loughlin, 2003). It is highly unlikely that gray whale will ingest large quantities of dispersed oil due to where they feed, typically 50 to 60 m deep along the continental shelf (Nerini, 1984; ADF&G, 2008). Benthic prey species that live at these depths will not be exposed to dispersed oil in large concentrations, so indirect effects on gray whale are unlikely.

Acute exposures to PAHs, which may become more bioavailable in the shallow water column after chemical dispersion, have been linked to various effects on wildlife in PWS after EVOS, although toxicity is noted as secondary to the physical impacts of fouling (e.g., hypothermia) (Albers and Loughlin 2003). Larger marine mammals with subcutaneous blubber (e.g., cetaceans), which would not suffer from hypothermia caused by fouling, were observed to experience sublethal impacts (e.g., lesions) after EVOS (Albers and Loughlin 2003). It is unclear whether the application of chemical dispersants would increase the exposure of whales to PAHs, resulting in a greater prevalence of lesions. It is also unclear whether lesions caused by increased exposure to PAHs would lead to significant effects resulting in the impairment of essential behavioral patterns (e.g., breeding, feeding, and sheltering). The impact of PAHs on whale species as a result of acute exposure after chemical dispersion is a point of uncertainty (Section 6.3.4).

Gray whale surface periodically to breathe, requiring that they potentially come into contact with oil at the ocean's surface. Because dispersants remove oil from the ocean's surface and, through dilution, reduce the concentration of oil, the exposure of gray whale to oil will be mitigated through dispersion.

For these reasons, gray whale are not anticipated to be negatively impacted by the application of dispersants if all BMPs are implemented during the response action. For example, dispersant applications should not occur in areas where gray whales are known to be present.

In the unlikely event that BMPs fail, and the implementation of the Unified Plan fails to protect marine mammals, gray whale may be adversely impacted by the application of dispersants. Potential impacts on gray whales in a worst-case scenario are provided in the main text of the BA.

5.1.6 Humpback whale

Humpback whale are unlikely to be impacted by the physical effects of dispersants (Section 3.1). They rely on subcutaneous blubber to regulate their body heat, instead of fur, which could be compromised by oiling, dispersants, or dispersed oil.

This species is very large and will not likely be exposed to concentrations of dispersants or dispersed oil in quantities large enough to cause acute toxic effects (e.g., mortality); such effects are unlikely even at lower trophic levels (Section 4). Dispersed oil rapidly dilutes and degrades over time, so chronic exposure to dispersants or dispersed oil is unlikely (Section 2).

It is possible that dispersed oil will be ingested by humpback whale, which feed through their baleen on various species, small fish in particular, which are captured by various methods (Ingebrigtsen, 1929; Jurasz and Jurasz, 1979; Watkins and Schevill, 1979; Hain et al., 1982; Weinrich, 1983; Baker, 1985; Baker and Herman, 1985; Hays et al., 1985; Winn and Reichley, 1985; D'Vincent et al., 1985; as cited in NMFS, 1991). The ingestion of crude oil, even in large quantities, has been found to cause minimal impacts in much smaller species than humpback whales (Section 3.1), and cetaceans are likely able to efficiently metabolize hydrocarbons (Albers and Loughlin, 2003). It is unlikely that humpback whale will ingest large quantities of dispersed oil due to the depths at which they feed, typically between 92 and 120 m deep (NMFS, 2011a), and as deep as 500 m (US Navy, 2011).

Humpback whales can also be found in the nearshore environment, where exposures to chemical dispersants should not be substantially different. Dispersant applications are not intended for nearshore habitats, although tides and currents may move a dispersed spill into the nearshore environment. If an oil spill has been appropriately dispersed (i.e., all BMPs have been implemented by the On-Scene Coordinator and dispersion has been effective), dilution and biodegradation are likely to occur to some extent prior to a plume reaching the nearshore environment.

Acute exposures to PAHs, which may become more bioavailable in the shallow water column after chemical dispersion, have been linked to various effects on wildlife in PWS after EVOS, although toxicity is noted as secondary to the physical impacts of fouling (e.g., hypothermia) (Albers and Loughlin 2003). Larger marine mammals with subcutaneous blubber (e.g., cetaceans), which would not suffer from hypothermia caused by fouling, were observed to experience sublethal impacts (e.g., lesions) after EVOS (Albers and Loughlin 2003). It is unclear whether the application of chemical dispersants would increase the exposure of whales to PAHs, resulting in a greater prevalence of lesions. It is also unclear whether lesions caused by increased exposure to PAHs would lead to significant effects resulting in the impairment of essential behavioral patterns (e.g., breeding, feeding, and sheltering). The impact of PAHs on whale species as a result of acute exposure after chemical dispersion is a point of uncertainty (Section 6.3.4).

For these reasons, humpback whale are not anticipated to be negatively impacted by the application of dispersants if all BMPs are implemented during the response action. For example, dispersant applications should not occur in areas where humpback whale are known to be present.

In the unlikely event that BMPs fail, and the implementation of the Unified Plan fails to protect marine mammals, humpback whale may be adversely impacted by the application of dispersants. Potential impacts on humpback whales in a worst-case scenario are provided in the main text of the BA.

5.1.7 North Pacific right whale, eastern stock

North Pacific right whale (NPRW) are unlikely to be impacted by the physical effects of dispersants (Section 3.1). They rely on subcutaneous blubber to regulate their body heat, instead of fur, which could be compromised by oiling, dispersants, or dispersed oil.

This species is very large and will not likely be exposed to concentrations of dispersants or dispersed oil in quantities large enough to cause acute toxic effects (e.g., mortality); such effects are unlikely even at lower trophic levels (Section 4). Dispersed oil rapidly dilutes and degrades over time, so chronic exposure to dispersants or dispersed oil is unlikely (Section 2).

Acute exposures to PAHs, which may become more bioavailable in the shallow water column after chemical dispersion, have been linked to various effects on wildlife in PWS after EVOS, although toxicity is noted as secondary to the physical impacts of fouling (e.g., hypothermia) (Albers and Loughlin 2003). Larger marine mammals with subcutaneous blubber (e.g., cetaceans), which would not suffer from hypothermia caused by fouling, were observed to experience sublethal impacts (e.g., lesions) after EVOS (Albers and Loughlin 2003). It is unclear whether the application of chemical dispersants would increase the exposure of whales to PAHs, resulting in a greater prevalence of lesions. It is also unclear whether lesions caused by increased exposure to PAHs would lead to significant effects resulting in the impairment of essential behavioral patterns (e.g., breeding, feeding, and sheltering). The impact of PAHs on whale species as a result of acute exposure after chemical dispersion is a point of uncertainty (Section 6.3.4).

It is possible that dispersed oil will be ingested by NPRW, which feed through their baleen on various species, particularly copepods. The ingestion of crude oil, even at large quantities, has been found to cause minimal impacts in much smaller species than NPRW (Section 3.1), and cetaceans are likely able to efficiently metabolize hydrocarbons (Albers and Loughlin, 2003). It is unlikely that NPRW will ingest large quantities of dispersed oil due to the depths at which they feed, between 80 and 175 m (as assumed from NPRW behavior) (US Navy, 2011).

In NPRW critical habitat (Section 3.4.1.6.1 of the BA), NPRW prey species are known to be very dense, and dense aggregations of copepods are directly related to NPRW movements (Shelden et al., 2005). Although NPRW are thought to feed deeper (i.e., > 10 m) in the water column (US Navy, 2011), dispersant application could impact the sensitive prey species of NPRW. However, based on the information presented in Section 3.3, dispersion will reduce toxicity in aquatic species, particularly at the ocean's surface. Those prey species that NPRW feed upon at depth should be unaffected by oil or dispersed oil due to environmental restrains on vertical mixing (Section 2). Furthermore, toxicity data indicates that Arctic copepod species (e.g., *C. glacialis*) are less sensitive to dispersed oil toxicity than other species (Figure 6), and approximately 20 times more sensitive to oil alone than dispersed oil (McFarlin et al., 2011). Based on these two indications of toxicity, a significant portion of the planktonic community (as well as specific dietary components for NPRW [i.e., copepods]) will not be significantly affected by dispersant application, making indirect impacts on NPRW unlikely.

NPRW surface periodically, approximately every 5 to 15 minutes, to breathe (US Navy, 2011), requiring that they potentially come into contact with oil at the ocean's surface. Because dispersants remove oil from the ocean's surface and, through dilution, reduce the concentration of oil, the exposure of NPRW to oil will be mitigated through dispersion. As noted in Section 3.1.2.3, oil at the ocean's surface is likely to cause more severe impacts than dispersed oil due to the altered route of exposure (i.e., inhalation and aspiration at the surface when breathing, as opposed to ingestion and dermal contact in the water column).[39]

For these reasons, NPRW are not anticipated to be negatively impacted by the application of dispersants if all BMPs are implemented during the response action. For example, dispersant applications should not occur in areas where NPRW are known to be present, particularly not in critical habitat for this species, where a larger portion of the population could be exposed.

[39] This statement is based on the assumption that acute lung, kidney, and liver tissue damage are more likely to result in observable impacts than exterior irritation, inflammation, or lesions or gastrointestinal irritation. Lung functionality in particular has been deemed important for cetaceans, which rely on their ability to dive and remain underwater for long periods of time.

In the unlikely event that BMPs fail, and the implementation of the Unified Plan fails to protect marine mammals, NPRW may be adversely impacted by the application of dispersants. Potential impacts on NPRW in a worst-case scenario are provided in the main text of the BA.

5.1.8 Sei whale

Sei whale are unlikely to be impacted by the physical effects of dispersants (Section 3.1). They rely on subcutaneous blubber to regulate their body heat, instead of fur, which could be compromised by oiling, dispersants, or dispersed oil.

This species is very large and will not likely be exposed to concentrations of dispersants or dispersed oil in quantities large enough to cause acute toxic effects (e.g., mortality); such effects are unlikely even at lower trophic levels (Section 4). Dispersed oil rapidly dilutes and degrades over time, so chronic exposure to dispersants or dispersed oil is unlikely (Section 2).

It is possible that dispersed oil will be ingested by sei whale, which feed through their baleen on planktonic species, fish, and large invertebrates (e.g., squid) (Nemoto and Kawamura, 1977; Kawamura, 1982; both cited in NMFS, 2011b). Sei whale feed throughout the water column, periodically skimming the surface (NOAA Fisheries, 2013). Surface skimming and feeding in the shallow water column put sei whale at particular risk of ingesting oil at the ocean's surface. Although oil ingestion is not likely to be the most toxic route of exposure for mammals (Section 3.1), excessive feeding at the ocean's surface could result in the ingestion of very large quantities of oil. Diving among sei whale is limited, with dives typically lasting 5 to 10 minutes and rarely being deeper than 300 m (MarineBio, 2012). It is possible that sei whale surface more frequently to breathe than do other deeply diving whales (e.g., blue whale), so inhalation and aspiration of oil fumes is also a potential route of exposure, more so than for other ESA-listed cetaceans, particularly when oil is left at the surface (i.e., not dispersed). The application of dispersants greatly reduces the concentration of oil at the surface, as well as the volatilization of the oil spill (Section 2), so chemical dispersion should reduce the exposure of sei whale to oil, specifically limiting the more harmful routes of exposure (Section 3.1).

Acute exposures to PAHs, which may become more bioavailable in the shallow water column after chemical dispersion, have been linked to various effects on wildlife in PWS after EVOS, although toxicity is noted as secondary to the physical impacts of fouling (e.g., hypothermia) (Albers and Loughlin 2003). Larger marine mammals with subcutaneous blubber (e.g., cetaceans), which would not suffer from hypothermia caused by fouling, were observed to experience sublethal impacts (e.g., lesions) after EVOS (Albers and Loughlin 2003). It is unclear whether the application of chemical dispersants would increase the exposure of whales to PAHs, resulting in a greater prevalence of lesions. It is also unclear whether lesions caused by increased exposure to PAHs would lead to significant effects resulting in the impairment of essential behavioral patterns (e.g., breeding, feeding, and sheltering). The impact of PAHs on whale species as a result of acute exposure after chemical dispersion is a point of uncertainty (Section 6.3.4).

Indirect impacts on sei whale due to dispersant application are not expected, because dispersants decrease toxicity in the overall planktonic community relative to oil alone (Sections 3.3 and 3.4, Figures 8 and 9). Sei whale are known to be opportunistic feeders (Flinn et al., 2002; Tamura et al., 2009; as cited in NMFS, 2011b) and often feed on large species (e.g., adult squid and mackerel) (Nemoto and Kawamura, 1977; Kawamura, 1982; both cited in NMFS, 2011b), so the prey species of sei whale are likely to be insensitive, large-bodied fish and invertebrates in later life stages, which are known to be less sensitive than small species in early life stages (Attachment B-1).

For these reasons, sei whale are not anticipated to be negatively impacted by the application of dispersants if all BMPs are implemented during the response action. Rather, dispersion would likely result in a net benefit for sei whale relative to the baseline condition.

In the unlikely event that BMPs fail, and the implementation of the Unified Plan fails to protect marine mammals, sei whale may be adversely impacted by the application of dispersants. Potential impacts on sei whales in a worst-case scenario are provided in the main text of the BA.

5.1.9 Sperm whale

Sperm whale are unlikely to be impacted by the physical effects of dispersants (Section 3.1). They rely on subcutaneous blubber to regulate their body heat, instead of fur, which could be compromised by oiling, dispersants, or dispersed oil.

This species is extremely large and will not likely be exposed to concentrations of dispersants or dispersed oil in quantities large enough to cause acute toxic effects (e.g., mortality); such effects are unlikely even at lower trophic levels (Section 4). Dispersed oil rapidly dilutes and degrades over time, so chronic exposure to dispersants or dispersed oil is unlikely (Section 2).

Acute exposures to PAHs, which may become more bioavailable in the shallow water column after chemical dispersion, have been linked to various effects on wildlife in PWS after EVOS, although toxicity is noted as secondary to the physical impacts of fouling (e.g., hypothermia) (Albers and Loughlin 2003). Larger marine mammals with subcutaneous blubber (e.g., cetaceans), which would not suffer from hypothermia caused by fouling, were observed to experience sublethal impacts (e.g., lesions) after EVOS (Albers and Loughlin 2003). It is unclear whether the application of chemical dispersants would increase the exposure of whales to PAHs, resulting in a greater prevalence of lesions. It is also unclear whether lesions caused by increased exposure to PAHs would lead to significant effects resulting in the impairment of essential behavioral patterns (e.g., breeding, feeding, and sheltering). The impact of PAHs on whale species as a result of acute exposure after chemical dispersion is a point of uncertainty (Section 6.3.4).

Sperm whale generally prey on large and deep-dwelling species of cephalopod and fish (NMFS, 2010), species highly unlikely to be impacted by dispersed oil or baseline oiling. As larvae, these species may be found in the shallow ocean as plankton. As shown in Sections 3.3 and 3.4 and Figures 8 and 9, the toxicity of dispersed oil is expected to be less than that of oil alone. This is particularly true for large fish species (e.g., *Oncorhynchus* sp. and Arctic cod) and cephalopods (e.g., pale octopus) (Attachment B-1). For these reasons, it is unlikely that the application of dispersants will have a significant adverse impact on sperm whale prey; rather, dispersants may have a positive net impact due to decreased toxicity. Thus, an indirect impact on sperm whale is unlikely.

Because sperm whale tend to dive very deeply to seek prey, as much as 30 minutes at a time and often > 400 m (and up to 2,000 m) (Watkins et al., 2002; cited in US Navy, 2008), it is not expected that sperm whale will be exposed to oil or dispersed oil for extended periods of time. However, surfacing to breathe poses a potential point of exposure. Oiling where sperm whale surface could result in severe impacts (Section 3.1), so the application of dispersants to reduce the volume, concentration, and areal extent of surface oiling would reduce impacts on surfacing sperm whale. The resulting increase in dispersed oil in the shallow water column should not cause as severe of impacts (Section 3.1), and dispersed oil is expected to be less toxic than oil alone (Section 3.1).

For these reasons, sperm whale are not anticipated to be negatively impacted by the application of dispersants if all BMPs are implemented during the response action.

In the unlikely event that BMPs fail, and the implementation of the Unified Plan fails to protect marine mammals, sperm whales may be adversely impacted by the application of dispersants. Potential impacts on sperm whales in a worst-case scenario are provided in the main text of the BA.

5.1.10 Steller sea lion, eastern and western populations

Steller sea lion are unlikely to be impacted by the physical effects of dispersants (Section 3.1). They rely on subcutaneous blubber to regulate their body heat, instead of fur, which could be compromised by oiling, dispersants, or dispersed oil.

This species is large and will not likely be exposed to concentrations of dispersants or dispersed oil in quantities large enough to cause acute toxic effects (e.g., mortality); such effects are unlikely even at lower trophic levels (Section 4). Dispersed oil rapidly dilutes and degrades over time, so chronic exposure to dispersants or dispersed oil is unlikely (Section 2). Sublethal impacts related to dispersed oil are certainly possible, but it is unlikely that dispersed oil will have greater impacts than oil alone, particularly on Steller sea lion, which frequently dive through the ocean's surface and use shoreline haulouts. The application of dispersants is expected to result in diminished oiling of shorelines (Fingas, 2008) and haulouts, as well as a reduced volume, concentration, and areal extent of oil at the ocean surface (NRC, 2005), where Steller sea lions could be exposed. Allowing haulouts or rookeries to be oiled (i.e., No Action alternative) may result in the chronic exposure of this species, as the oil degrades slowly on the shoreline over many years (Peterson et al., 2003).

Dispersants are expected to reduce the volatilization of oil by dissolving its lighter components (Section 2). Thus, the risk of inhalation or aspiration exposure for Steller sea lions at the ocean's surface or on haulouts may be diminished by dispersant application. Inhalation and aspiration of oil may have severe impacts in mammals (Section 3.1).

Ingestion of oil in the shallow water column (as deep as 10 m) may be increased by dispersion, but ingestion results in less severe impacts on mammals than does inhalation (Section 3.1). Mammals are known to effectively metabolize and excrete PAHs when ingested (Albers and Loughlin, 2003), so ingested hydrocarbons are unlikely to accumulate or magnify in Steller sea lions over time as a result of chemical dispersion; exposures to chemical dispersants are expected to be acute and temporary (Section 2). Acute exposures to PAHs have been linked to various effects on wildlife in PWS after EVOS, although toxicity is noted as secondary to the physical impacts caused by fouling (e.g., hypothermia) (Albers and Loughlin, 2003). Larger marine mammals with subcutaneous blubber (i.e., those that would not suffer from hypothermia) experienced sublethal impacts (e.g., lesions) after EVOS, although it was not determined whether observed impacts corresponded to impacts on survival, growth, or reproduction (Albers and Loughlin, 2003).

Steller sea lions generally feed on schooling fish (62 FR 24345, 1997), which could, as larvae, be exposed to dispersants and dispersed oil. The application of dispersants has a severe impact on sensitive species, particularly herring (Lee et al., 2011b), but dispersed oil is less toxic to these species than oil alone (Lee et al., 2011b; Sections 3.3 and 3.4; Figures 8 and 9). Impacts on herring are discussed in Section 5.3.4. Allowing important spawning habitat for sea lion prey species (e.g., walleye [*Sander vitreus*], pollock species, Atka mackerel [*Pleurogrammus monopterygius*], herring species, and capelin [*Mallotus villosus*]) to be oiled will likely result in greater toxicity than if dispersants are applied (Sections 3.3 and 3.4, Figures 8 and 9), and long-term impacts on kelp beds or other intertidal shorelines will be reduced (Peterson et al., 2003). Appropriately planned and executed dispersant applications (i.e., all BMPs properly implemented) will have a net positive benefit on Steller sea lion prey species relative to baseline conditions.

For these reasons, the application of dispersants is not expected to have significant adverse effects on Steller sea lion relative to the baseline condition. All BMPs should be implemented to avoid applying dispersants directly where sea lion are present, or where sensitive prey species are spawning.

In the unlikely event that BMPs fail, and the implementation of the Unified Plan fails to protect marine mammals, Steller sea lions may be adversely impacted by the application of dispersants. Potential impacts on Steller sea lions in a worst-case scenario are provided in the main text of the BA.

5.1.11 Polar bear

Polar bears selectively avoid oil on water when given the choice (St. Aubin, 1988), so it is unlikely that polar bears will approach and dive through oiled waters. It is not clear whether the dispersion of oil into the water column will result in behavioral changes in polar bears, or whether polar bears will dive into waters where oil has been dispersed. It is possible that slight oiling will occur on polar bears that dive into waters where dispersed oil exists. This may result in increased physical impacts.

Polar bears are furbearing mammals that may be significantly impacted by the physical effects of oiling or dispersant exposure (Section 3.1). Polar bears that dive through heavily oiled surface waters will themselves become heavily oiled, resulting in a decreased ability to maintain their body temperature. Hypothermia and death could result (St. Aubin, 1988). Thermal regulation is also important to keep polar bears cool during the summer (St. Aubin, 1988), so oiling could result in heat exhaustion or other heat-related maladies. The application of chemical dispersants in areas with heavily oiled surface water would result in a decreased concentration, volume, and areal extent of surface oil, likely reducing the potential for polar bears to be oiled. Although severe oiling is unlikely (and behaviorally avoided) (St. Aubin, 1988), slight oiling may have less extensive sublethal impacts on polar bears. Impacts would be less extensive due to the lower concentration or volume of oil, as well as the decrease in the stickiness of the oil (CDC and ATSDR, 2010; Lessard and Demarco, 2000).

Polar bears groom their fur, so oiling results in the ingestion of large volumes of oil (St. Aubin, 1988). Ingestion of oil in bears caused vomiting, gastrointestinal distress, serious liver and kidney damage, blood cell damage, and death (St. Aubin, 1988). It is not clear whether such effects would occur in polar bears if oil were chemically dispersed, but it is expected that the lower concentrations ingested would result in less exposure and reduced toxic effects (Section 3.1). It can be assumed that polar bears would avoid oil associated with the baseline condition.

Ringed and bearded seals are the primary prey of polar bears in Alaska; neither species is expected to be more adversely impacted by dispersed of oil than by the baseline condition. Rather, oiling of these species is more likely under the baseline condition, as they frequently dive through small holes in sea ice where oil could accumulate. Dispersing any oil under the ice would likely decrease the oiling of ice seals, and thereby reduce the potential transfer of oil from seal pelts to polar bears.

It is unlikely that hydrocarbons would bioaccumulate in seal tissues as a result of acute exposure, because seals are able to metabolize PAHs (Albers and Loughlin, 2003). Similarly, polar bears have efficient mechanisms for metabolizing and excreting hydrocarbons, so the transfer of parent PAHs from seals to polar bears as a result of chemical dispersant application in the arctic is unlikely, as is the accumulation of PAHs in polar bears resulting from the consumption of seal tissue. The impacts of PAH exposures on polar bears, and whether such exposures would result in reduced survival, growth, or reproduction, are points of uncertainty, discussed in Section 6.3.4. Acute exposures to PAHs have been linked to various effects on wildlife in PWS after EVOS, although toxicity is noted as secondary to the physical impacts caused by fouling (e.g., hypothermia) (Albers and Loughlin, 2003), which may be reduced by chemical dispersion (Lessard and Demarco, 2000; CDC and ATSDR, 2010).

Based on the improbability of polar bears becoming significantly oiled by dispersed oil or under baseline conditions, it is not expected that polar bears will be adversely impacted due to the dispersion of oil. It is possible that minimal oiling will occur as a result of eliminating concentrated oil at the ocean's surface and the associated sensory cues for avoidance (i.e., smell and clearly visible sheen), but it is not expected that exposures to dilute, dispersed oil or dispersants will significantly impact polar bears at the individual level (i.e., reduced survival, growth, or reproduction). Similarly, indirect effects on polar bear prey are unlikely, as discussed in Sections 5.1.14 and 5.1.15, for ringed and bearded seal, respectively.

In the unlikely event that BMPs fail, and the implementation of the Unified Plan fails to protect marine mammals, polar bears may be adversely impacted by the application of dispersants. Potential impacts on polar bears in a worst-case scenario are provided in the main text of the BA.

5.1.12 Northern sea otter, southwest Alaska DPS

Sea otters are furbearing mammals that may be significantly impacted by the physical effects of oiling or dispersant exposure (Section 3.1). Otters that dive through heavily oiled surface waters will themselves become heavily oiled, resulting in a decreased ability to maintain their body temperature. Hypothermia and death could result (Geraci and St. Aubin, 1988). The application of chemical dispersants in areas that are heavily oiled at the ocean's surface would result in a decreased concentration, volume, and areal extent of surface oil, which would likely reduce the potential for oiling of sea otters.

Sea otters rely on critical nearshore habitat and shallow areas, where oiling could cause significant ecological damage and long-term effects (Peterson et al., 2003). The application of chemical dispersants is intended to reduce the oiling of shorelines (Fingas, 2008), thereby protecting sea otter habitat. The application of dispersants is not intended for nearshore application, so direct and concentrated exposures of sea otters to dispersants and dispersed oil are fairly unlikely (Section 2).

Sea otters groom their fur, which, if oiled, may result in ingestion of significant quantities of oil. The elimination of oil from the ocean's surface is expected to reduce oiling of sea otters, and therefore the ingestion of oil through grooming.

Inhalation and aspiration of oil is a potential route of exposure for sea otters, particularly because they spend much of their time at the water's surface (Kenyon, 1969; as cited in USFWS, 2010a; Riedman and Estes, 1990) or hauled out on the shoreline (Kenyon, 1969; as cited in USFWS, 2010a; Riedman and Estes, 1990). Chemical dispersion has been shown to reduce the evaporation of volatile oil components (NRC, 2013), which should in turn reduce the inhalation or aspiration of vapors by sea otters.

Clams, sea urchins, and finfish are the primary dietary components of sea otter (USFWS, 2010a), but they will shift their diet when certain species become scarce (USFWS, 2010a). Because sea otter are generalist feeders, it is unlikely that small changes in their prey base will cause significant impacts at the individual or population levels. The toxicity of oil alone is greater than that of dispersed oil (Sections 3.3 and 3.4, Figures 8 and 9), so chemical dispersion may reduce toxicity to the overall community, and indirect impacts on the food web are therefore not expected.[40] Chronic exposure of benthic species should be less under dispersed oil conditions than under baseline conditions (Humphrey et al., 1987).

Although PAHs and other hydrocarbons are known to accumulate in benthic invertebrates (Wolfe et al., 1998), such chemicals are unlikely to be biomagnified at higher trophic levels (Wolfe et al., 2001; Logan, 2007) due to more efficient PAH metabolisms in mammals (Albers and Loughlin, 2003). The impact of dietary PAHs in mammals is a point of uncertainty, discussed in Section 6.3.4. Acute exposures to PAHs have been linked to various effects on wildlife in PWS after EVOS, although toxicity is noted as secondary to the physical impacts caused by fouling (e.g., hypothermia) (Albers and Loughlin, 2003), which may be reduced by chemical dispersion (Lessard and Demarco, 2000; CDC and ATSDR, 2010). It is unclear whether such exposures would result in reduced survival, growth, or reproduction.

For these reasons, it is expected that sea otters will not be adversely impacted, either directly or indirectly, by the application of chemical dispersants relative to baseline oiling, particularly in the event that oil slick reaches nearshore, critical habitat.

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[40] The relative sensitivities of species that might be consumed by Northern sea otter (i.e., large epibenthic invertebrates, bivalves, and finfish) vary substantially, essentially bracketing the SSDs presented in Section 3.3 (Figure 7). Sensitive larval bivalves (e.g., *Crassostrea* sp.) may be more impacted by chemical dispersion of oil than larval or juvenile finfish. Adult bivalves may be less impacted over the long term in areas where oil is dispersed than in areas where oil is not treated. For example, increased rates of depuration of hydrocarbons in impacted benthos communities have been previously observed (Humphrey et al., 1987; Wolfe et al., 1998).

In the unlikely event that BMPs fail, and the implementation of the Unified Plan fails to protect marine mammals, Northern sea otters may be adversely impacted by the application of dispersants. Potential impacts on Northern sea otters in a worst-case scenario are provided in the main text of the BA.

5.1.13 Pacific walrus

Walruses are unlikely to be impacted by the physical effects of dispersants (Section 3.1). They rely on subcutaneous blubber to regulate their body heat, instead of fur, which could be compromised by oiling, dispersants, or dispersed oil.

This species is large and will not likely be exposed to concentrations of dispersants or dispersed oil in quantities great enough to cause acute toxic effects (e.g., mortality); such effects are unlikely even at lower trophic levels (Section 4). Dispersed oil rapidly dilutes and degrades over time, so chronic exposure to dispersants or dispersed oil is unlikely as well (Section 2). Sublethal impacts related to dispersed oil are certainly possible, but it is unlikely that dispersed oil will have a greater impact than oil alone, particularly on walruses, which frequently dive through the surface of water and use shoreline haulouts. Rather, oil alone is expected to cause greater toxicity (Section 3.1) due to its build up at the ocean's surface under baseline conditions (NRC, 2005).

The application of dispersants is expected to result in diminished oiling of shorelines (Fingas, 2008) and haulouts, as well as a reduced volume, concentration, and areal extent of oil at the ocean surface (NRC, 2005), where walruses could be exposed. Allowing haulouts or rookeries to be oiled (i.e., No Action alternative) may result in the chronic exposure of this species, as the oil degrades slowly on the shoreline over many years (Peterson et al., 2003).

Haulouts on sea ice are expected to be impacted differently by oil than shorelines, since ice does not trap and slowly release oil over time to the same extent as sediment. Still, baseline conditions in areas covered by sea ice are expected to cause substantial oiling of walruses that dive into water to forage, and the increased concentration of volatile oil at the surface (associated with baseline conditions) is expected to result in increased inhalation and aspiration of oil. This is particularly true at points where oil may concentrate, such as spatially constrained polynyas or breathing holes in the ice. Dispersants are expected to reduce the volatilization of oil by dissolving its lighter components (Section 2). Thus, the risk of inhalation or aspiration for hauled-out or surfacing walruses may diminish after dispersant application (NRC, 2013). Inhalation and aspiration of oil may have severe impacts on mammals (Section 3.1).

Ingestion of oil in the shallow water column (as deep as 10 m) may increase due to dispersion, but it has been shown that ingestion has less severe impacts on mammals than does inhalation (Section 3.1). Ingestion of PAHs is not expected to be a major source of parent PAH body burdens in marine mammals, because mammals are known to effectively metabolize and excrete PAHs (Albers and Loughlin, 2003). Ingested hydrocarbons are unlikely to accumulate or magnify in walruses over time as a result of chemical dispersion; exposures to PAHs after dispersion is expected to be acute rather than chronic (Section 2).

Acute exposures to PAHs have been linked to various effects on wildlife in PWS after EVOS, although toxicity is noted as secondary to the physical impacts caused by fouling (e.g., hypothermia) (Albers and Loughlin, 2003). Larger marine mammals with subcutaneous blubber (i.e., those that would not suffer from hypothermia) experienced sublethal impacts (e.g., lesions) after EVOS, although it was not determined whether those impacts corresponded to reductions in survival, growth, or reproduction (Albers and Loughlin, 2003).

Walruses are unique among the ESA-listed pinnipeds, in that they forage on benthic invertebrates (e.g., bivalves) exclusively (Richard, 1990; as cited in USFWS, 1994). These species are known to accumulate hydrocarbons and PAHs (Wolfe et al., 1998), although they do not readily transfer PAHs to higher trophic levels, which can efficiently metabolize those chemicals (Albers and Loughlin, 2003; Wolfe et al., 2001). The application of dispersants increases PAHs in the water column, which may increase the uptake of such chemicals in walrus prey species. It is not likely that this will provide a major route of exposure to toxic chemicals, but it could contribute to toxicity in sensitive prey species (e.g., Pacific oyster). Invertebrate larvae have been shown to be particularly sensitive to dispersants and dispersed oil (Attachment B-1). However, impacts on benthic communities are anticipated to be short-term and of a low magnitude (Mageau et al., 1987; Cross and Martin, 1987; Cross and Thomson, 1987); mass mortality has not occurred in field observations with dispersed oil. Still, long-term reproduction in bivalves may be inhibited by oil dispersion (Cross and Thomson, 1987), which may impact foraging by walruses. The potential for reduced populations of sensitive bivalves suggests that indirect impacts at the local scale are possible, as are indirect impacts at the individual walrus level.

The impact of dietary PAHs in mammals is a point of uncertainty, discussed in Section 6.3.4. Walrus are perhaps at a higher risk than other species, but it is not clear if sublethal impacts caused by PAHs will manifest as an effect on growth, survival, or reproduction, given that exposures to PAHs through the diet as a result of chemical dispersant application will likely attenuate within a year (Humphrey et al., 1987).

Based on the rationale provided in this section, it is not expected that Pacific walruses will be directly affected by dispersed oil or dispersants, however, indirect effects are possible, due to the selective diet of walrus on species that are particularly sensitive to dispersants and dispersed oil.

In the unlikely event that BMPs fail, and the implementation of the Unified Plan fails to protect marine mammals, Pacific walruses may be directly impacted by the application of dispersants. Potential direct impacts on Pacific walruses in a worst-case scenario are provided in the main text of the BA.

5.1.14 Ringed seal

Ringed seals are unlikely to be impacted by the physical effects of dispersants or dispersed oil (Section 3.1), because they use subcutaneous blubber to regulate body heat. Although slight surface oiling of seal fur may occur after oil is dispersed into the water column, the oil is expected to be dilute (Section 2) and less likely to stick to fur (CDC and ATSDR, 2010; Lessard and Demarco, 2000) than oil alone.

Ringed seals live near sea ice and maintain holes through which they can breathe or haul out to rest, pup, or molt (Kelly et al., 2010). Oil under ice could pool in breathing holes and affect seals that surface to breathe, or coat seals as they move in and out of the holes. Heavy coating of seal fur may result in localized irritation (Section 3.1). Surfacing in untreated oil poses a greater threat to ringed seal, as oil could be inhaled (volatile components) or aspirated (vapors and liquid oils) (Section 3.1), leading to various systemic impacts or death. The removal of oil from the ocean's surface by chemical dispersion should reduce the likelihood of such impacts.

Ringed seals primarily feed on fish and large epibenthic invertebrates under sea ice. These species are unlikely to be exposed to oil under baseline conditions as adults, but may be exposed to toxic levels at early life stages. As shown in Sections 3.3 and 3.4 and Figures 8 and 9, dispersants reduce the toxicity of crude oil to early life stages of aquatic species in general, although some sensitive species are more sensitive to dispersed oil. It is not expected that the application of dispersants will significantly impact adult benthic invertebrates or finfish (Section 4), nor will dispersants increase toxicity to sensitive life stages of benthic invertebrates or finfish relative to baseline conditions. Therefore, indirect impacts on ringed seals are unlikely.

Ingestion of dispersed oil is possible among ringed seals as they feed in the shallow water column, but they are not expected to ingest large volumes of oil in this way, since oil concentrations decrease rapidly over time and throughout the water column after chemical dispersion (Section 2). Ingestion of oil in the shallow water column (as deep as 10 m) may increase due to dispersion, but ingestion results in less severe impacts on mammals than does inhalation (Section 3.1). Ingestion of PAHs is not expected to be a major source of PAH body burdens in marine mammals, because mammals are known to effectively metabolize and excrete PAHs (Albers and Loughlin, 2003); ingested hydrocarbons are unlikely to magnify in ringed seals as a result of chemical dispersant applications. Body burdens are expected to return to background levels after depuration, metabolism, and excretion, particularly after a short-term exposure (Albers and Loughlin, 2003).

Based on the rationale presented in this section, ringed seals are not anticipated to be significantly impacted, either directly or indirectly, by chemical dispersion. Rather, under most circumstances, the removal of oil from the ocean's surface will benefit ringed seals, eliminating the most impactful routes of exposure and reducing toxicity to the planktonic base of the food web (i.e., early life stages of prey species).

In the unlikely event that BMPs fail, and the implementation of the Unified Plan fails to protect marine mammals, ringed seals may be adversely impacted by the application of dispersants. Potential impacts on ringed seals in a worst-case scenario are provided in the main text of the BA.

5.1.15 Bearded seal

Bearded seals are unlikely to be impacted by the physical effects of dispersants or dispersed oil (Section 3.1), because they use subcutaneous blubber to regulate body heat. Although slight surface oiling of seal fur may occur after oil is dispersed into the water column, the oil is expected to be dilute (Section 2) and less likely to stick to fur (CDC and ATSDR, 2010; Lessard and Demarco, 2000) than oil alone.

Bearded seals live near sea ice and maintain holes through which they can breathe or haul out to rest, pup, or molt (Cameron et al., 2010). Oil under ice could pool in breathing holes and affect seals that surface to breathe, or coat seals as they move in and out of the holes. Heavy coating of seal fur may result in localized irritation (Section 3.1). Surfacing in untreated oil poses a greater threat to bearded seal, as oil could be inhaled (volatile components) or aspirated (vapors and liquid oils) (Section 3.1), leading to various systemic impacts or death. The removal of oil from the ocean's surface by chemical dispersion should reduce the likelihood of such impacts.

Bearded seals primarily feed on large epibenthic invertebrates, bivalves, and benthic fish under sea ice (Cameron et al., 2010). These species are unlikely to be exposed to oil under baseline conditions as adults, but may be exposed to toxic levels at early life stages. As shown in Sections 3.3 and 3.4 and Figures 8 and 9, dispersants reduce the toxicity of crude oil to early life stages of aquatic species in general, although some species (e.g., bivalves) are more sensitive to dispersed oil than to oil alone (Attachment B-1). It is not expected that the application of dispersants will significantly impact adult benthic invertebrates (Section 4), nor will dispersants increase toxicity to sensitive life stages of benthic invertebrates relative to baseline conditions. Therefore, indirect impacts on bearded seals are unlikely.

Ingestion of dispersed oil is possible among bearded seals as they feed in the shallow water column, but they are not expected to ingest large volumes of oil in this way, since oil concentrations decrease rapidly over time and throughout the water column after chemical dispersion (Section 2). Ingestion of oil in the shallow water column (as deep as 10 m) may increase due to dispersion, but ingestion results in less severe impacts on mammals than does inhalation (Section 3.1). Ingestion of PAHs is not expected to be a major source of PAH body burdens in marine mammals, because mammals are known to effectively metabolize and excrete PAHs (Albers and Loughlin, 2003). Ingested hydrocarbons are unlikely to accumulate or magnify in bearded seals as a result of chemical dispersion; exposures to PAHs are likely to be acute rather than chronic due to dilution (Section 2.1) and biodegradation of oil and PAHs after chemical dispersion (Section 2.2). Acute exposures to PAHs have been linked to various effects on wildlife in PWS after EVOS, although toxicity is noted as secondary to the physical impacts caused by fouling (e.g., hypothermia) (Albers and Loughlin, 2003). It is not clear whether such exposures caused by the chemical dispersion of oil would result in reduced survival, growth, or reproduction.

Based on the rationale presented in this section, bearded seals are not anticipated to be significantly impacted, either directly or indirectly, by chemical dispersion. Rather, under most circumstances, the removal of oil from the ocean's surface will benefit bearded seals, eliminating the most impactful routes of exposure and reducing toxicity to the planktonic base of the food web (i.e., early life stages of prey species).

In the unlikely event that BMPs fail, and the implementation of the Unified Plan fails to protect marine mammals, bearded seals may be adversely impacted by the application of dispersants. Potential impacts on bearded seals in a worst-case scenario are provided in the main text of the BA.

5.2 BIRDS

As discussed in Section 3.1, bird species are at particular risk of exposure to baseline oiling, and are especially susceptible to the physical impacts of oiling.

5.2.1 Short-tailed albatross

Dispersants, if applied inappropriately, could result in severe impacts on the short-tailed albatross (Duerr et al., 2011). BMPs dictate monitoring for bird presence and avoiding the application of dispersants directly to birds on water or in flight; Butler et al. (1988) indicate that such BMPs are unlikely to be ignored. If BMPs are implemented and dispersants are not applied directly to short-tailed albatross, the impacts of surface oiling (Section 3.1) would assumedly be reduced. The reduced concentration, volume, and areal extent of an oil slick would limit the likelihood of exposure of birds found over open water.

Although embryotoxicity has been observed in response to dispersants and dispersed oil (Finch et al., 2012; Wooten et al., 2012; Albers, 1979 and Albers and Gay, 1982, both cited in Wooten et al., 2012), it is not clear whether short-tailed albatross oiled in Alaska waters transfer oil to their nestlings in Japan or Taiwan (USFWS, 2008). Since oiling is expected to lessen after dispersion (Section 2, Section 3.1; CDC and ATSDR, 2010; Lessard and Demarco, 2000), it is unlikely that dispersed oil would be transferred from Alaska waters to nestlings in Asia.

Short-tailed albatross feed mostly at the surface, diving from either the air or an on-water position for shallow fish (e.g., bonito [*Sarda* sp.], flying fish [*Exocoetidae* sp.], and sardines [*Clupeidae* sp.]) and invertebrates (i.e., squid, shrimp) (Hasegawa and DeGange, 1982; Tickell, 1975, 2000; all cited in USFWS, 2008). Since the prey of the short-tailed albatross reside in the shallow ocean, they are susceptible to exposure to oil and dispersed oil. Based on the analyses presented in Sections 3.3 and 3.4, dispersants can reduce the toxicity of oil to these species relative to baseline conditions

(Figures 8 and 9). Thus, it is unlikely that dispersants will have adverse indirect effects on the short-tailed albatross.

While PAHs are known to increase in concentration in dispersed oil plumes relative to baseline conditions (Ramachandran et al., 2004), acute toxicity is generally not increased (Sections 3.3 and 3.4, Figures 8 and 9). Furthermore, the uptake and trophic transfer of PAHs to fish is limited by their efficient metabolisms (Wolfe et al., 2001; Logan, 2007; Payne et al., 2003). Long-term uptake is likely limited by the acute nature of dispersed oil plume exposure, given natural transport mechanisms, rapid dilution, and increased rates of biodegradation (Section 2). Alterations to the bioavailability of PAHs caused by oil dispersion will not likely increase the body burden of PAHs in short-tailed albatross, since exposures to increased PAHs will be acute rather than chronic; chronic exposures tend to result in increased body burdens over time (Albers and Loughlin, 2003). Acute exposures to PAHs have been linked to various effects on wildlife in PWS after EVOS, although toxicity is noted as secondary to the physical impacts caused by fouling (e.g., hypothermia) (Albers and Loughlin, 2003), which may be reduced by chemical dispersion (CDC and ATSDR, 2010; Lessard and Demarco, 2000). It is unclear whether PAH exposures in bird species would result in reduced survival, growth, or reproduction (Section 6.3.3).

Ingestion, aspiration, and inhalation of oil by short-tailed albatross during flight, feeding, and preening are all likely to be much greater under baseline conditions (Sections 2 and 3.1). The removal of oil from the ocean's surface will effectively reduce the volume, concentration, and areal extent (i.e., likelihood of encounter) of oil to which this species will be exposed.

Based on the rationale presented in this section, short-tailed albatross is not anticipated to be significantly impacted, either directly or indirectly, by chemical dispersion. Rather, under most circumstances, the removal of oil from the ocean's surface will benefit short-tailed albatross by eliminating the most impactful routes of exposure and reducing toxicity to the planktonic base of the food web (i.e., early life stages of prey species), as well as adult prey species of fish and invertebrates.

In the unlikely event that BMPs fail, and the implementation of the Unified Plan fails to protect marine birds, short-tailed albatrosses may be adversely impacted by the application of dispersants. Potential impacts on short-tailed albatrosses in a worst-case scenario are provided in the main text of the BA.

5.2.2 Spectacled eider

Dispersants, if applied inappropriately, could result in severe impacts on the spectacled eider (Duerr et al., 2011; Jenssen and Ekker, 1991a, b). BMPs dictate monitoring for bird presence and avoiding the application of dispersants directly to birds on water or in flight; Butler et al. (1988) indicate that such BMPs are unlikely to be ignored. If BMPs are implemented and dispersants are not applied directly to spectacled eider, the impact of surface oiling (Section 3.1) would assumedly be reduced. The reduced concentration, volume, and areal extent of an oil slick would limit the likelihood of exposure of birds found over open water. This is particularly important for spectacled eider, which congregate in very limited areas (i.e., wintering habitat), many of which are listed as critical habitat (66 FR 9146, 2001).

Critical habitat for spectacled eider includes vegetated intertidal habitat on the Yukon-Kuskokwim (Y-K) Delta, shallow (between 5 and 15 m) marine waters in Norton Sound, and relatively deep waters (as deep as 75 m) between St. Matthew and St. Lawrence Islands in the Bering Sea. Although physical impacts would likely be most pronounced in wintering habitat (i.e., Bering Sea) due to low temperatures and the cooling effect of water (Section 3.1), baseline oiling effects on habitat would likely be greatest in the molting and breeding areas, where shorelines might trap oil and slowly release it over time (Peterson et al., 2003). The application of dispersants to an oil spill on the open ocean before it reaches these critical habitats would likely reduce the extent of oiling (Sections 2 and 3.1) and the long-term impacts on the benthic community (Section 3.1).

Embryotoxicity in birds has been observed in response to dispersants and dispersed oil (Finch et al., 2012; Wooten et al., 2012; Albers, 1979 and Albers and Gay, 1982, both cited in Wooten et al., 2012). Since oiling is expected to lessen after dispersion (Section 2, Section 3.1; CDC and ATSDR, 2010; Lessard and Demarco, 2000), it is less likely that oil would be transferred from nesting eiders to nestlings. This assumes that dispersants are applied at a distance from eider populations and critical habitat, in accordance with BMPs (Alaska Clean Seas, 2010).

Spectacled eider mostly feed on benthic invertebrates (Petersen et al., 1999) in shallow waters during much of the year, although they move to deeper waters in winter. As their prey base is generally within the upper 15 m of the water column, some exposure of prey to dispersed oil may occur, and early life stages of prey may be exposed to both oil and dispersed oil. The application of chemical dispersant is expected to decrease the toxicity to the overall planktonic community (including sensitive life stages of prey), so such an application is not expected to have adverse impacts on eider prey overall. Certain sensitive prey species (e.g., bivalve larvae) may be at greater risk of chemical toxicity (Figures 3 through 7), so indirect impacts may occur at times when eider diets are primarily composed of bivalve tissues (May through July) (USFWS, 1996). Invertebrate larvae have been shown to be particularly sensitive to dispersants and dispersed oil (Attachment B-1). However, impacts on benthic communities are anticipated to be short-term and of low magnitude (Mageau et al., 1987; Cross and Martin, 1987; Cross and Thomson, 1987); mass mortality has not occurred in field observations with dispersed oil. Still, long-term reproduction in bivalves may be inhibited by oil dispersion (Cross and Thomson, 1987), which may impact foraging by eiders. The potential for reduced populations of sensitive bivalves suggests that indirect impacts at the local scale are possible, as are indirect impacts at the individual eider level.

While PAHs are known to increase in bioavailability in dispersed oil plumes relative to baseline conditions (Section 2), toxicity is generally not increased (Sections 3.3 and 3.4, Figures 8 and 9). Furthermore, the uptake and trophic transfer of PAHs to fish is limited by their efficient metabolisms (Wolfe et al., 2001; Logan, 2007). Alterations to the bioavailability of PAHs caused by dispersed oil will not likely increase the body burden of PAHs in spectacled eider over time (Albers and Loughlin, 2003). The exposure of spectacled eider to PAHs after chemical dispersion is likely to be acute rather than chronic (due to dilution and degradation of oil components after chemical dispersion) (Sections 2.1 and 2.2), so body burdens are likely to decrease over time as dissolved PAH concentrations in the environment, which were increased as a result of chemical dispersion, are metabolized and excreted by spectacled eider. The uptake of PAHs in diet is also expected to decrease over time, as PAHs and other oil components are depurated and degraded in prey tissues (e.g., bivalves) (Humphrey et al., 1987). It should be noted that chemical dispersant application is not intended for shallow, nearshore habitats where eider are likely to be feeding on invertebrates, so exposures to dispersed oil are likely to occur after dilution and biodegradation have already begun to decrease the concentration of oil components in the water column. It is not clear whether sublethal impacts resulting from short-term PAH exposures (enhanced by chemical dispersion) would result in reduced survival, growth, or reproduction in bird species (Section 6.3.3).

Ingestion, aspiration, and inhalation of oil by spectacled eider during flight, feeding, and preening are all likely to be much greater under baseline conditions (Sections 2 and 3.1). The removal of oil from the ocean's surface will effectively reduce the volume, concentration, and areal extent (i.e., likelihood of encounter) of oil to which this species will be exposed.

Based on the rationale presented in this section, spectacled eider may be significantly impacted, either directly or indirectly, by chemical dispersion. Although, the removal of oil from the ocean surface will benefit spectacled eider by eliminating the most impactful routes of exposure to oil, their prey, which is at times limited to more sensitive species, could be impacted by chemical dispersion of oil close to nearshore habitats (although dispersion is not intended for use within nearshore habitats).

5.2.3 Steller's eider

Dispersants, if applied inappropriately, could result in severe impacts on the Steller's eider (Duerr et al., 2011; Jenssen and Ekker, 1991a, b). BMPs dictate monitoring for bird presence and avoiding applying dispersants directly to birds on water or in flight; Butler et al. (1988) indicate that such BMPs are unlikely to be ignored. If BMPs are implemented and dispersants are not directly applied to Steller's eider, the impact of surface oiling (Section 3.1) would assumedly be reduced. The reduced concentration, volume, and areal extent of an oil slick would limit the likelihood of exposure of birds found over open water. This is particularly important for Steller's eider, which congregate in very limited areas (i.e., critical breeding habitat) (66 FR 9146, 2001). Also, Steller's eider molt on water and are flightless for approximately three weeks during the late summer (between July and October) (Petersen, 1981; as cited in USFWS, 2002), during which time oiling could result in significant impacts (Section 3.1); this is based on the assumption that post-molt plumage is more sensitive to oil than fully developed plumage. Dispersant application would reduce the amount (i.e., concentration, volume, and areal extent) of oil that enters Steller's eider critical habitat (Section 3.4.2.3.1 of the BA) and the time that the oil remains on the surface (Section 2).

Critical habitat for Steller's eider includes vegetated intertidal areas on the Y-K Delta, open marine waters up to 9 m deep, and associated eelgrass beds and the benthic invertebrate communities in that area; additional habitat can be found along the Aleutian Islands. Impacts are most likely to occur in the southern critical habitat along the Aleutian Islands, due to the prevalence of spills in that area (Appendix D to the BA). However, baseline oiling effects on habitat are likely to be greatest in the breeding and nesting areas on the Y-K Delta and near Barrow, Alaska (USFWS, 2002); oil on the shorelines and forage habitat of these areas could result in significant oiling of nesting birds and nestlings, as well as chronic exposures of the benthic community to oil trapped in sediment along the intertidal shoreline (Peterson et al., 2003; Cross and Thomson, 1987). The application of dispersants to an oil spill on the open ocean before it reaches these critical habitats would likely reduce the extent of oiling (Sections 2 and 3.1) and the long-term impacts to the benthic community (Peterson et al., 2003; Cross and Thomson, 1987). The application of dispersants in shallow, nearshore habitats is not an approved use, so dispersed oil that moves into Steller's eider critical habitat will already have begun to dilute and biodegrade (Sections 2.1 and 2.2).

Embryotoxicity in birds has been observed in response to dispersants and dispersed oil (Finch et al., 2012; Wooten et al., 2012; Albers, 1979 and Albers and Gay, 1982, both cited in Wooten et al., 2012). Since oiling is expected to lessen after dispersion (Section B2, Section B3.1; CDC and ATSDR, 2010; Lessard and Demarco, 2000), it is less likely that oil would be transferred from nesting eiders to nestlings. This assumes that dispersants are applied at a distance from eider populations and critical habitat in accordance with BMPs (Alaska Clean Seas, 2010).

Steller's eider mostly feed on benthic invertebrates (Petersen, 1981; as cited in USFWS, 2002) in shallow waters during much of the year. Their prey base generally resides in shallow waters, based on where they congregate (Section 3.4.2.3.1 of the BA), indicating that some exposure to dispersed oil may occur. Early life stages of prey may be exposed to both oil and dispersed oil. The application of chemical dispersant is expected to decrease the toxicity to the overall planktonic community (including sensitive life stages of prey), so such an application is not expected to have adverse impacts to Steller's eider prey overall. However, larvae of certain invertebrate species have been shown to be particularly sensitive to dispersants and dispersed oil

(Attachment B-1, Figures 3 through 7). Impacts on benthic communities tend to be short-term and of low magnitude (Mageau et al., 1987; Cross and Martin, 1987; Cross and Thomson, 1987), and mass mortality has not occurred in field observations with dispersed oil. Still, long-term reproduction in bivalves may be inhibited by oil dispersion (Cross and Thomson, 1987), which may impact foraging by eiders. The potential for reduced populations of sensitive bivalves suggests that indirect impacts at the local scale are possible, as are indirect impacts at the individual eider level.

While PAHs are known to increase in concentration in dispersed oil plumes relative to baseline conditions (Section 2), toxicity is generally not increased (Sections 3.3 and 3.4, Figures 8 and 9). Furthermore, uptake and trophic transfer of PAHs to fish is limited by their efficient metabolisms (Wolfe et al., 2001). Alterations to the bioavailability of PAHs caused by oil dispersion will not likely increase the body burden of PAHs in Steller's eider over time (Albers and Loughlin, 2003). The exposure of Steller's eider to PAHs after chemical dispersion is likely to be acute rather than chronic (due to dilution and degradation of oil components after chemical dispersion) (Sections 2.1 and 2.2), so body burdens are likely to decrease over time as dissolved PAH concentrations in the environment, which were increased as a result of chemical dispersion, are metabolized and excreted by Steller's eider. The uptake of PAHs in diet is also expected to decrease over time, as PAHs and other oil components are depurated and degraded in prey tissues (e.g., bivalves) (Humphrey et al., 1987).

Acute exposures to PAHs have been linked to various effects on wildlife in PWS after EVOS, although toxicity is noted as secondary to the physical impacts caused by fouling (e.g., hypothermia) (Albers and Loughlin, 2003), which may be reduced by the application of chemical dispersant (Lessard and Demarco, 2000; CDC and ATSDR, 2010). It is not clear whether sublethal impacts resulting from short-term PAH exposures (enhanced by chemical dispersion) would result in reduced survival, growth, or reproduction in bird species (Section 6.3.3).

Ingestion, aspiration, and inhalation of oil by Steller's eider during flight, feeding, and preening are all likely to be much greater under baseline conditions (Sections 2 and 3.1). The removal of oil from the ocean's surface will effectively reduce the volume, concentration, and areal extent (i.e., likelihood of encounter) of oil to which this species will be exposed.

Based on the rationale presented in this section, Steller's eider may be significantly impacted, either directly or indirectly, by chemical dispersion. Although, the removal of oil from the ocean's surface will benefit Steller's eider by eliminating the most impactful routes of exposure to oil, their prey, which is at times limited to more sensitive species, could be impacted by chemical dispersion of oil close to nearshore habitats (although dispersion is not intended for use within nearshore habitats).

5.2.4 Kittlitz's murrelet

Dispersants, if applied inappropriately, could result in severe impacts on the Kittlitz's murrelet (Duerr et al., 2011; Jenssen and Ekker, 1991a, b). BMPs dictate monitoring for bird presence and avoiding the application of dispersants directly to birds on water or in flight; Butler et al. (1988) indicate that such BMPs are unlikely to be ignored. It is expected that the reduced concentration, volume, and areal extent of an oil slick resulting from dispersant application in open water would limit the likelihood of exposure of birds found in the nearshore environment, or in polynyas and glacial meltwaters (Sections 2 and 3.1; Day et al., 1999; Day et al., 2011).

Embryotoxicity in birds has been observed in response to dispersants and dispersed oil (Finch et al., 2012; Wooten et al., 2012; Albers, 1979 and Albers and Gay, 1982, both cited in Wooten et al., 2012). Since oiling is expected to lessen after dispersion (Sections 2 and 3.1; CDC and ATSDR, 2010; Lessard and Demarco, 2000), it is less likely that oil would be transferred from nesting murrelets to nestlings. This assumes that dispersants are applied at a distance from Kittlitz's murrelet populations in accordance with BMPs (Alaska Clean Seas, 2010). Nesting habitat is typically removed from areas where such applications might occur, in coarse, rocky, and uneven ground or skree (USFWS, 2006); these features are associated with glaciated (or formerly glaciated) habitats on alpine terrain (van Pelt and Piatt, 2003). To a lesser extent, Kittlitz's murrelet nest in crevasses of cliffs, potentially near the coast (Day et al., 1999); dispersants and dispersed oil are unlikely to encounter these hidden nesting areas.

Kittlitz's murrelet mostly feed by diving after schooling fish (e.g., capelin, sand lance [*Ammodytidae* sp.], herring, and juvenile walleye) (Day et al., 1999), but may switch seasonally to feed on what is available (Hobson et al., 1994; as cited in USFWS, 2011b; Day et al., 1999; Day and Nigro, 2000; Day et al., 2011). Kittlitz's murrelet is predominately piscivorous, but they will also feed on crustaceans such as euphausiids (Hobson et al., 1994; as cited in USFWS, 2011b) (Hobson et al., 1994; as cited in USFWS, 2011b; Day et al., 1999; Day and Nigro, 2000; Day et al., 2011). Exposure of murrelet prey species to both oil and dispersed oil may occur due to the shallow depths at which murrelet feed (i.e., nearshore and shallow offshore) (Day et al., 1999; Day and Nigro, 2000; Day et al., 2011). The application of chemical dispersant is expected to decrease toxicity to the overall planktonic community (including sensitive life stages of prey) (Sections 3.3 and 3.4, Figures 8 and 9), and dispersants are expected to protect nearshore habitats and shorelines (Fingas, 2008) that support Kittlitz's murrelet and its prey (Day et al., 1999; Day and Nigro, 2000; Day et al., 2011). One notable exception may be spawning species that could potentially be impacted by oil or dispersed oil (Section 5.3.4); it is possible that oil is less toxic to embryonic or larval herring species than dispersed oil, although the long-term impacts of shoreline and vegetation oiling (Peterson et al., 2003) may be more lasting (Humphrey et al., 1987).

While PAHs are known to increase in concentration in dispersed oil plumes relative to baseline conditions (Section 2), toxicity is generally not increased (Sections 3.3 and 3.4, Figures 8 and 9). Furthermore, the uptake and trophic transfer of PAHs to fish is limited by their efficient metabolisms (Wolfe et al., 2001; Logan, 2007). Alterations to the bioavailability of PAHs caused by oil dispersion will not likely increase the body burden of PAHs in Kittlitz's murrelet over time (Albers and Loughlin, 2003). The exposure of Kittlitz's murrelet to PAHs after chemical dispersion is likely to be acute rather than chronic (due to dilution and degradation of oil components after chemical dispersion) (Sections 2.1 and 2.2), so body burdens are likely to decrease over time as dissolved PAH concentrations in the environment, which were increased as a result of chemical dispersion, are metabolized and excreted by Kittlitz's murrelet. The uptake of PAHs in diet is also expected to decrease over time, as PAHs and other oil components are depurated and degraded in prey tissues (e.g., fish) (Wolfe et al., 2001; Wolfe et al., 1998; Logan, 2007).

Acute exposures to PAHs have been linked to various effects on wildlife in PWS after EVOS, although toxicity is noted as secondary to the physical impacts caused by fouling (e.g., hypothermia) (Albers and Loughlin, 2003), which may be reduced by the application of chemical dispersant (Lessard and Demarco, 2000; CDC and ATSDR, 2010). It is not clear whether sublethal impacts resulting from short-term PAH exposures (enhanced by chemical dispersion) would result in reduced survival, growth, or reproduction in bird species (Section 6.3.3).

Ingestion, aspiration, and inhalation of oil by Kittlitz's murrelet during flight, feeding, and preening are all likely to be much greater under baseline conditions (Sections 2 and 3.1). The removal of oil from the ocean's surface will effectively reduce the volume, concentration, and areal extent (i.e., likelihood of encounter) of oil to which this species will be exposed (Sections 2 and 3).

Based on the rationale presented in this section, Kittlitz's murrelet is not anticipated to be significantly impacted, either directly or indirectly, by chemical dispersion. Rather, under most circumstances, the removal of oil from the ocean's surface will benefit Kittlitz's murrelet by eliminating the most impactful routes of exposure to oil and reducing toxicity to the planktonic base of the food web (i.e., early life stages of prey species, winter forage) (Day et al., 1999; Day and Nigro, 2000; Day et al., 2011).

In the unlikely event that BMPs fail, and the implementation of the Unified Plan fails to protect marine birds, Kittlitz's murrelets may be adversely impacted by the application of dispersants. Potential impacts on Kittlitz's murrelets in a worst-case scenario are provided in the main text of the BA.

5.2.5 Yellow-billed loon

Dispersants, if applied inappropriately, could result in severe impacts on yellow-billed loons (Duerr et al., 2011; Jenssen and Ekker, 1991a, b). BMPs dictate monitoring for bird presence and avoiding the application of dispersants directly to birds on water or in flight; Butler et al. (1988) indicate that such BMPs are unlikely to be ignored. This is particularly true due to the fact that yellow-billed loon tend to be found in the uplands near permanent freshwater lakes (Earnst et al., 2006).

Exposures of yellow-billed loon to dispersants or dispersed oil are very unlikely during warm seasons, when they inhabit upland areas, but this species winters in coastal areas of the Aleutian Islands, Gulf of Alaska (GOA), Prince William Sound (PWS), Cook Inlet, Southeast Alaska (74 FR 12932, 2009), and particularly in Southeast Alaska south of Kodiak Island (North, 1994).[41] Although many spills have occurred in these areas since 1995 (Appendix D to the BA, Section 3.1.1 of the BA), the majority occurred during summer months. Crude oil was rarely spilled in these areas, although two crude oil spills have occurred in Cook Inlet during winter (Section 3.1.1). Oil spilled in loon habitat that is allowed to reach the coastal nearshore environment, particularly protected embayments less than 30 m deep (Strann and Østnes, 2007; as cited in USFWS, 2010b), could result in exposure and serious physical impacts. The reduced concentration, volume, and areal extent of an oil slick resulting from dispersant application in open water would limit the likelihood of exposure of birds found in the nearshore environment (Sections 2 and 3.1).

Yellow-billed loon migrate north in spring to breeding and nesting areas, particularly on the North Slope; on the way, loon stop periodically in groups in melting polynyas (2010b). Oiling in polynyas may be concentrated and cause serious harm to yellow-billed loon. It is expected that dispersion will reduce the exposure of this species to oil in polynyas (CDC and ATSDR, 2010; Lessard and Demarco, 2000), since the oil is removed quickly and effectively from the surface (Section 2.1).

Embryotoxicity in birds has been observed in response to dispersants and dispersed oil (Finch et al., 2012; Wooten et al., 2012; Albers, 1979 and Albers and Gay, 1982, both cited in Wooten et al., 2012). Since oiling is expected to lessen after dispersion (Section 2, Section 3.1;CDC and ATSDR, 2010; Lessard and Demarco, 2000), it is less likely that oil would be transferred from nesting loons to nestlings. Nesting generally occurs in the uplands, away from oiling, so direct application of dispersants to nests is unlikely.

Yellow-billed loon mostly feed by diving after small fish (e.g., stickleback [*Gasterosteidae* sp.] and least cisco [*Coregonus sardinella*]) and invertebrates (Earnst et al., 2006; North and Ryan, 1989; North, 1994; USFWS, 2010b). Exposure of loon prey to both oil and dispersed oil may occur due to the shallow depths at which loon feed (i.e., shallow coastal nearshore) (Strann and Østnes, 2007; as cited in USFWS, 2010b). The application of chemical dispersant is expected to decrease toxicity to the overall planktonic community (including sensitive life stages of prey) (Sections 3.3 and 3.4, Figures 8 and 9), and to protect nearshore habitats and shorelines (Fingas, 2008) that support yellow-billed loon and its prey. One notable exception may be spawning

[41] Southeast Alaska has been the site of frequent releases of diesel fuel (Appendix D), although diesel fuel is not a substance that is likely to be dispersed due to its volatility.

species that could potentially be impacted by oil or dispersed oil (Section 5.3.4); it is possible that oil is less toxic to embryonic or larval herring species than dispersed oil (Section 5.3.4), although the long-term impacts of shoreline and vegetation oiling (Peterson et al., 2003) may be more lasting (Humphrey et al., 1987; Section 2).

While PAHs are known to increase in concentration in dispersed oil plumes relative to baseline conditions (Section 2), toxicity is generally not increased (Sections 3.3 and 3.4, Figures 8 and 9). Furthermore, the uptake and trophic transfer of PAHs to fish is limited by their efficient metabolisms (Wolfe et al., 2001). Alterations to the bioavailability of PAHs caused by oil dispersion will not likely increase the body burden of PAHs in yellow-billed loon over time (Albers and Loughlin, 2003). The exposure of yellow-billed loon to PAHs after chemical dispersion is likely to be acute rather than chronic (due to dilution and degradation of oil components after chemical dispersion) (Sections 2.1 and 2.2), so body burdens are likely to decrease over time as dissolved PAH concentrations in the environment, which were increased as a result of chemical dispersion, are metabolized and excreted. The uptake of PAHs in diet is also expected to decrease over time, as PAHs and other oil components are depurated and degraded in prey tissues (e.g., fish, bivalves, and other macroinvertebrates) (Wolfe et al., 2001; Wolfe et al., 1998; Logan, 2007; Humphrey et al., 1987).

Acute exposures to PAHs have been linked to various effects on wildlife in PWS after EVOS, although toxicity is noted as secondary to the physical impacts caused by fouling (e.g., hypothermia) (Albers and Loughlin, 2003), which may be reduced by the application of chemical dispersant (Lessard and Demarco, 2000; CDC and ATSDR, 2010). It is not clear whether sublethal impacts resulting from short-term PAH exposures (enhanced by chemical dispersion) would result in reduced survival, growth, or reproduction in bird species (Section 6.3.3).

Ingestion, aspiration, and inhalation of oil by yellow-billed loon during flight, feeding, and preening are all likely to be much greater under baseline conditions (Sections 2 and 3.1). The removal of oil from the ocean's surface will effectively reduce the volume, concentration, and areal extent (i.e., likelihood of encounter) of oil to which this species will be exposed.

Based on the rationale presented in this section, yellow-billed loon are not anticipated to be significantly impacted, either directly or indirectly, by chemical dispersion. Rather, under most circumstances, the removal of oil from the ocean's surface will benefit yellow-billed loon by eliminating the most impactful routes of exposure to oil and reducing toxicity of oil to the planktonic base of the food web (i.e., early life stages of prey species, winter forage) (Strann and Østnes, 2007; as cited in USFWS, 2010b).

In the unlikely event that BMPs fail, and the implementation of the Unified Plan fails to protect marine birds, yellow-billed loons may be adversely impacted by the application of dispersants. Potential impacts on yellow-billed loons in a worst-case scenario are provided in the main text of the BA.

5.3 FISH

5.3.1 Chinook salmon, all ESUs

Non-spawning adult and juvenile Chinook salmon may be found in Alaska, offshore or in coastal areas, living relatively deep in the water column (i.e., 30 to 70 m) (NMFS, 2005; Healey, 1991). It is unlikely that this species will be exposed to oil under baseline conditions. It is possible that dispersed oil will reach depths at which Chinook salmon are present, but it will be dilute, particularly at or beyond 10 m deep (Section 2).

Since Chinook salmon are among the most insensitive species to have been tested in exposures to oil and dispersed oil (Figures 4 through 6; Attachment B-1), it is likely that this species is particularly resilient, even as juveniles, relative to the entire aquatic community. Sensitive life stages of this salmonid are not found in Alaska, and thus cannot be exposed to dispersants or dispersed oil.

The larvae of salmon prey may be found in the upper water column during certain times of the year, and may be exposed to both concentrated oil and dispersed oil. Based on the assessment in Sections 3.2 through 3.4, it is likely that the toxicity of oil to Chinook salmon and its prey will decrease after dispersant application.

Fish species are able to efficiently metabolize and excrete PAHs (Payne et al., 2003; Wolfe et al., 2001; Logan, 2007), so the markedly increased dissolved PAHs in the water column resulting from chemical dispersion (Ramachandran et al., 2004) do not biomagnify in fish tissues and transfer to higher trophic levels (i.e., piscivorous salmonids) (Payne et al., 2003; Wolfe et al., 2001; Logan, 2007). The toxicity of PAHs to early-life-stage fish species is addressed indirectly in Sections 3.2.4 through 3.2.5.3 (given that PAHs are a component of the oil and dispersed oil used in toxicity tests), and uncertainties involved with the analysis of PAH toxicity in fish are provided in Sections 6.2 (general analytical uncertainties) and 6.3.2 (specific to fish). For example, it is unclear whether sublethal impacts caused by increased PAH exposures after chemical dispersion would lead to decreased survival, growth, or reproduction in juvenile and adult salmon species.

Due to the relatively low expected exposure of Chinook salmon, their insensitivity to dispersed oil as adults and juveniles, and the low likelihood that their prey population will be impacted (relative to the baseline condition), Chinook salmon are not anticipated to be negatively impacted by the application of dispersants in Alaska waters.

In the unlikely event that BMPs fail, and the implementation of the Unified Plan fails to protect species of salmon, Chinook salmon may be adversely impacted by the application of dispersants. Potential impacts on Chinook salmon in a worst-case scenario are provided in the main text of the BA.

5.3.2 Coho salmon, Lower Columbia River ESU

Non-spawning adult and juvenile coho salmon may be found in Alaska, offshore or in coastal areas (Morris et al., 2007; Favorite, 1965), living relatively deep in the water column. It is unlikely that this species will be exposed to oil under baseline conditions. It is possible that dispersed oil will reach depths at which coho salmon are present, but it will be dilute, particularly at or beyond 10 m (Section 2).

Coho salmon appear to be highly sensitive to oil alone, although it is unknown whether they are sensitive to dispersants alone or dispersed oil (Attachment B-1). Based on the genus geometric mean LC50 values for *Oncorhynchus* sp., this group is relatively insensitive to dispersed oil and dispersants, Corexit® 9500 in particular (Figure 4). It is therefore likely that coho salmon are less sensitive to dispersed oil than to oil alone, based on the general trend in the whole community (Sections 3.3 and 3.4, Figures 8 and 9) and the relative sensitivity of Chinook salmon (Sections 3.2 and 5.3.1).

The larvae of salmon prey may be found in the upper water column during certain times of the year, and may be exposed to both concentrated oil and dispersed oil. Based on the assessment in Sections 3.2 through 3.4, it is likely that the toxicity of oil to coho salmon and its prey will decrease after dispersant application.

Fish species are able to efficiently metabolize and excrete PAHs (Douben, 2003; Wolfe et al., 2001), so the markedly increased dissolved PAHs in the water column resulting from chemical dispersion (Ramachandran et al., 2004) do not biomagnify in fish tissues and transfer to higher trophic levels (i.e., piscivorous salmonids) (Payne et al., 2003; Wolfe et al., 2001; Logan, 2007). The toxicity of PAHs to early-life-stages of various fish species is addressed indirectly in Sections 3.2.4 through 3.2.5.3 (given that PAHs are a component of the oil and dispersed oil used in toxicity tests), and uncertainties involved with the analysis of PAH toxicity in fish are provided in Sections 6.2 (general analytical uncertainties) and 6.3.2 (specific to fish). For example, it is unclear whether sublethal impacts caused by increased PAH exposures after chemical dispersion would lead to decreased survival, growth, or reproduction in juvenile and adult salmon species.

Due to the relatively low expected exposure of coho salmon, their insensitivity to dispersed oil as adults and juveniles, and the low likelihood that their prey population will be impacted (relative to the baseline condition), coho salmon are not anticipated to be negatively impacted by the application of dispersants in Alaska waters.

In the unlikely event that BMPs fail, and the implementation of the Unified Plan fails to protect species of salmon, coho salmon may be adversely impacted by the application of dispersants. Potential impacts on coho salmon in a worst-case scenario are provided in the main text of the BA.

5.3.3 Steelhead trout, all DPS

Non-spawning adult and juvenile steelhead trout may be found in Alaska, offshore or in coastal areas (Sheppard, 1972; as cited in Laufle et al., 1986; Burgner et al., 1992; as cited in McKinnell et al., 1997); they live relatively deep in the water column, where they feed on benthic species (ADF&G, 2012; NOAA, 2011). It is unlikely that this species will be exposed to oil under baseline conditions. It is possible that dispersed oil will reach depths at which steelhead trout are present, but it will be very dilute, particularly at or beyond 10 m deep (Section 2.1).

Rainbow trout (which are not a genetically different species from steelhead trout) appear to be highly insensitive to dispersants alone, although it is unknown whether they are sensitive to oil alone or dispersed oil (Attachment B-1). Based on the genus geometric mean LC50 values for *Oncorhynchus* sp., this group is relatively insensitive to dispersed oil (Attachment B-1), but moderately sensitive to oil alone. It is likely that steelhead trout are less sensitive to dispersed oil than to oil alone, based on the general trend in the whole community (Sections 3.3 and 3.4, Figures 8 and 9) and the relative sensitivities of related salmonids (Sections 3.2 and 5.3.1).

The larvae of salmon prey may be found in the upper water column during certain times of the year, and may be exposed to both concentrated oil and dispersed oil. Based on the assessment in Sections 3.2 through 3.4, it is likely that the toxicity of oil to steelhead trout and its prey will decrease after dispersant application.

Fish species are able to efficiently metabolize and excrete PAHs (Douben, 2003; Wolfe et al., 2001), so the markedly increased dissolved PAHs in the water column resulting from chemical dispersion (Ramachandran et al., 2004) do not biomagnify in fish tissues and transfer to higher trophic levels (i.e., piscivorous salmonids) (Payne et al., 2003; Wolfe et al., 2001; Logan, 2007). The toxicity of PAHs to early-life-stage fish species is addressed indirectly in Sections 3.2.4 through 3.2.5.3 (given that PAHs are a component of the oil and dispersed oil used in toxicity tests), and uncertainties involved with the analysis of PAH toxicity in fish are provided in Sections 6.2 (general analytical uncertainties) and 6.3.2 (specific to fish). For example, it is unclear whether sublethal impacts caused by increased PAH exposures after chemical dispersion would lead to decreased survival, growth, or reproduction in juvenile and adult salmon species.

Due to the relatively low expected exposure of steelhead trout, their insensitivity to dispersed oil as adults and juveniles, and the low likelihood that their prey population will be impacted (relative to the baseline condition), steelhead trout are not anticipated to be negatively impacted by the application of dispersants in Alaska waters.

In the unlikely event that BMPs fail, and the implementation of the Unified Plan fails to protect species of salmonids, steelhead trout may be adversely impacted by the application of dispersants. Potential impacts on steelhead trout in a worst-case scenario are provided in the main text of the BA.

5.3.4 Pacific herring

Pacific herring are found throughout Alaska waters seasonally (Mecklenburg et al., 2002), and are important prey for many larger species of fish, birds, and marine mammals. They live throughout the water column a depth of 400 m (NOAA Fisheries, 2013), and therefore may be exposed to dispersed oil when in the upper 10 m (Section 2). In Southeast Alaska, spawning generally occurs in nearshore environments with organic, semi-protected, and partially mobile substrate (NMFS, 2007), such as eelgrass or kelp. These areas are also highly susceptible to oiling (Peterson et al., 2003), (consistent with baseline conditions) so chemical dispersants may practicably be used to protect such habitats (Fingas, 2008).

Toxicity testing indicates that Pacific herring is particularly sensitive to oil alone (Rice et al., 1979; cited in Barron et al., 2013). Lee et al. (2011b) showed that although oil was slightly more toxic to Pacific herring than dispersed oil, both were highly toxic at low, ecologically relevant (Section 2) concentrations and at short exposure durations (i.e., 6 hours). This indicates that the application of chemical dispersants may cause significant mortality in embryonic herring (Section 3.2), even if dilution occurs fairly rapidly (Section 2.1).

Furthermore, the potential for localized mortality in small, sensitive zooplankton exists and may be enhanced after chemical dispersion (Sections 6.2, 6.3.1, and 6.4). At early life stages, larval Pacific herring are relatively immobile and graze on zooplankton in the upper water column. A reduction in the prey base of a larval species of fish, one that cannot move to an area not impacted by chemical dispersion (e.g., Pacific herring), could result in reduced growth and fitness. It is possible, therefore, that chemical dispersion will result in indirect adverse impacts on Pacific herring. The enhancement of toxicity to sensitive, shallow-dwelling invertebrates is a point of uncertainty discussed at more length in Sections 6.2, 6.3.1, and 6.4.

Based on the toxicity evaluation presented in Sections 3.2 through 3.4, Pacific herring are at particular risk for significant, direct, individual-level impacts (i.e., reduced survival, growth, or reproduction) resulting from the application of dispersants. The risk of acute toxicity to Pacific herring assumes that oil has not been dispersed to non-toxic concentrations prior to moving into the nearshore environment, and that dispersants will not be sprayed in the nearshore environment, where herring are known to spawn and rear (NOAA, 2012a). Although it is possible that dispersants could mitigate toxicity to herring (at early life stages) by limiting the concentration, volume, and areal extent of surface oiling (Section 2), the potential for significant toxicity remains with the oiling of shorelines, submerged aquatic vegetation (i.e., spawning substrate), and intertidal sediments (Fingas, 2008). In addition, toxicity may be increased by the redistribution of oil into the water column under foreseeable circumstances.

5.4 MARINE REPTILES

All marine reptiles are considered "accidental or uncommon" in Alaska, and as such will be treated in a similar manner in this section. The assumption is that sea turtles are very rarely found in Alaska waters, which precludes them from exposure to chemical dispersants. This section is therefore intended to describe a worst-case scenario, in which turtles would be found to be present in or near the area of a spill response when dispersants were applied or soon thereafter.

The potential for oiling of marine reptiles to occur in Alaska is remote due to their uncommon (or accidental) presence so far north. The likelihood of dispersants or dispersed oil coming into contact with these species in Alaska is equally remote.

Marine turtles feed on a variety of species, from plants and algae (Bjorndal, 1997) to tunicates, cnidarians, and other pelagic invertebrates (Bjorndal, 1997; NMFS and USFWS, 2007; Kopitsky et al., 2005) or shallow-water invertebrates (Witherington, 2002). The early life stages of these prey species and the mature forms of algae and shallow-dwelling invertebrates may be found in the upper water column during certain times of the day or year, and may be exposed to both concentrated and dispersed oil. Based on the assessment in Sections 3.2 through 3.4, it is likely that the toxicity of oil to marine turtle prey will decrease after dispersant application.

All marine reptiles must surface to breathe, so exposure to both oil and dispersed oil is possible. Little is known about the toxicity of oil and dispersed oil to marine reptiles, although it can be assumed that systemic impacts related to inhalation, aspiration, ingestion, and dermal contact are similar to those of other groups (Section 3.1). As mentioned in Section 3.1.1.2[42], it is expected that dispersion will remove a large amount of oil (i.e., volume, concentration, and areal extent) from the surface (Section 2), where marine reptiles surface to breathe. The redistribution of oil through chemical dispersion will likely result in mitigated acute impacts on marine reptiles, changing the route of exposure from predominately inhalation, aspiration, and dermal contact at the surface to ingestion and dermal contact with dilute oil in the water column.

Although dissolved PAHs in the water column are expected to increase after chemical dispersion (Ramachandran et al., 2004), it is unlikely that sea turtles will accumulate sufficient PAHs to cause acute impacts. Long-term impacts will assumedly be mitigated by the rapid decrease in ambient concentrations over time (Section 2). Therefore, chronic exposures to increased PAHs are unlikely. Marine reptiles have efficient mechanisms for metabolizing and excreting PAHs (Albers and Loughlin, 2003), which should prevent the accumulation of PAHs in their tissues over time.

[42] The discussion of marine reptiles is in Section 3.1.1.5, but the discussion of decreased risk of inhalation is in the analogous section for birds, Section 3.1.1.2.

Exposure to PAHs through the food web is possible, as PAHs bioaccumulate in invertebrates (Wolfe et al., 1998), which are prey items of several marine reptiles. However, prolonged uptake (e.g., chronic inputs) of LPAHs from invertebrates to reptiles as a result of chemical dispersion is unlikely, due to the rapid depuration of those chemicals in invertebrates (and fish) (Wolfe et al., 2001; Wolfe et al., 1998), as well as the relatively short time (~1 year) required to return to baseline tissue concentrations in other benthic species (Humphrey et al., 1987). Conversely, HPAHs may remain in invertebrate tissues for longer periods of time. Impacts related to PAH exposure are a point of uncertainty, in that individual-level impacts (i.e., reduced survival, growth, or reproduction) are not clearly defined for marine reptiles (Section 6.3.5).

Based on the rationale provided above, the application of chemical dispersants in accordance with associated BMPs will not adversely impact marine reptiles in Alaska. Specific BMPs relevant to marine reptiles include monitoring for their presence, and not applying dispersants when and where turtles are present. It should be noted again that marine reptiles are uncommon in Alaska waters, so the likelihood of encountering such species during any response action is low.

6 Uncertainty Analysis

There are various points of uncertainty that have been stated throughout this appendix that will be summarized in this section.

6.1 Sea Conditions, Spill Conditions, and Expected Spill Responses

No two spills are expected to be alike, considering the complex nature of the environment into which oil is spilled, the expansive area of the State of Alaska, and the various potential sources of oil (e.g., oil tanker, oil platform, marine fueling station, etc.). Therefore, it is impossible to accurately predict the response actions that will be applied and the efficacy of those actions. For example, the use of dispersants would not be effective under many conditions, nor would it be practical under all conditions (Nedwed, 2012).

Assuming that conditions are such that dispersants are approved for use on a given spill, it is impossible to know in advance the effectiveness of the dispersant due to changing sea conditions (e.g., wind and wave energy, tides), the presence of sea ice, salinity differences, and various other conditions. Furthermore, it is impossible to know in advance whether BMPs will be entirely successful in mitigating damages to listed or candidate fish and wildlife species.

6.2 Calculation of the HC5

The HC5s derived for use in this BA are representative of only Corexit® 9500 or Corexit® 9527, the only two dispersants currently available for use (i.e., stockpiled) in Alaska. However, Corexit® 9527 is no longer being manufactured, so the model created here will become obsolete once those stockpiles are exhausted. It is assumed that Corexit® 9500 will be used once Corexit® 9527 ceases to be available for emergency responses. Few toxicity data are available to evaluate other dispersant formulations that could be approved for use by the Alaska Regional Response Team (ARRT) in the future.

The majority of studies used to derive the HC5s were based on continuous exposure scenarios. As discussed, the resulting LC50s were generally lower than those derived from spiked exposures. Because a geometric mean LC50 was used to represent a given species or genera, spiked data were, in some cases, combined with continuous exposure data. Although spiked exposures are expected to provide a more realistic simulation of dispersants in the field (i.e., surface application), the HC5s derived are more representative of continuous exposures. For these reasons, the HC5s may overestimate toxicity as it relates to a field application, and can thus be seen as protective (over a short time period).

Although only early-life-stage fish species were used in developing the SSDs, there were various invertebrates included in the SSDs for which the life stage was uncertain.

Because life stage is important in driving the sensitivity of invertebrates (as well as most species in general), the sensitivity of certain taxa may be slightly overestimated.

The toxicity data largely represent either temperate or warm-water species (as opposed to Arctic species), which may not react in the same way as species in Alaska. Tests of Corexit® 9500-dispersed oil using arctic species have shown that they are somewhat less sensitive than non-Arctic species (Figure 6). However, this result was likely affected by a difference in exposure regimes: Toxicity tests using Arctic species mostly applied spiked exposures, whereas toxicity tests using temperate species used primarily continuous exposures (i.e., static, flow through, or renewal) (Attachment B-1). Because spiked exposures tend to result in increased LC50 values, regardless of species, the apparent insensitivity of Arctic species shown in Figure 6 may be an artifact of the exposure method.

It is assumed that the distributions of toxicity values are representative of all water column species in a given aquatic habitat, even though the true number of species is limited (i.e., the water column does not contain every species at a given location). The species used for each model are considered surrogates for all fish, aquatic plants, and invertebrates that may be affected in a field application of dispersants.

Most importantly, the analysis presented above, which uses acute laboratory data, does not incorporate two very important sources of uncertainty. Although sublethal and chronic impacts are discussed in a cursory way in Section 3.2, such impacts are not incorporated into the determination of the HC5s. PAHs are thought to be the most toxic component of oil, and chemical dispersants generally increase the exposure of planktonic species to PAHs by making PAHs more bioavailable (Ramachandran et al., 2004; Yamada et al., 2003; Milinkovitch et al., 2011a; Lee, 2013). Sublethal effects may occur at much lower exposure concentrations than the HC5s (Smit et al., 2009), and such effects may have lasting impacts on plankton.

Also of great importance is the fact that traditional laboratory testing of aquatic toxicity is conducted in chambers without UV light in order to control for photodegradation of PAHs or other similarly degraded toxicants. But PAHs are known to be up to 1,000 times more toxic when exposed to UV light (Barron and Ka'aihue, 2001). In the shallow ocean, solar irradiance is ubiquitous; furthermore, there can be extreme light conditions in the State of Alaska, depending on the time of year (i.e., midnight sun or polar day phenomena). For these reasons, it can be assumed that an ecologically relevant exposure to PAHs, made more bioavailable by the application of dispersants (Ramachandran et al., 2004), will occur in conjunction with photo-enhanced toxicity, particularly in species of invertebrates and larval fish that are translucent (Barron et al., 2008).

6.3 PAH TOXICITY

6.3.1 Invertebrates

The analysis of the toxicity of oil and dispersed oil (including PAHs as a component of both) presented in Section 3.3 clearly shows that dispersed oil is less toxic than oil alone. Although several authors have shown the opposite to be true (Attachment B-1; Section 3.4.1), the magnitude of differences in toxicity observed across all studies demonstrates that in general, dispersed oil is less toxic to aquatic species than oil alone (Section 3.3); the magnitude of differences across studies is presented visually in Figures 8 and 9. In addition, toxicity is shown to decrease in general after dispersant application (Section 3.3), even though PAHs have been shown to increase in solution as well as in tissues of various species (i.e., taken up from the water column) (Ramachandran et al., 2004). Therefore, the analysis addresses the acute toxicity of PAHs in solution, in a laboratory study, after chemical dispersant application.

There are various potential reasons for uncertainty in drawing conclusions about the likelihood of impacts of dispersed oil on planktonic species when using acute toxicity data. Based on the uncertainties identified in Section 6.2, it is possible that dispersed oil will have an impact on plankton, more so than the analysis presented in Section 3.3 (based on acute toxicity) would suggest.

6.3.2 Fish

A major point of uncertainty in the analyses provided in this appendix has to do with the use of surrogate fish species in the estimation of impacts on fish. For example, the fish included in the SSD presented in Section 3.3 include many taxa that are not found in Alaska waters and that are not protected under ESA.

Oil, particularly the toxic component PAHs in oil (Barron, 2012; Milinkovitch et al., 2011a; Roy et al., 1999; Brannon et al., 2006; Carls et al., 1999, 2000; Meador, 2003; Payne et al., 2003), has various sublethal impacts on fish species (Stige et al., 2011; ITOPF, 2011). Metabolites of PAHs are often more toxic than their parent compounds, so adverse impacts on fish are most likely to occur after accumulation and metabolism of parent compounds, but before excretion (Payne et al., 2003). Payne et al. (2003) provide a concise review of the historically reported sublethal impacts of PAHs on fish (e.g., Chinook salmon, rainbow trout, and herring), including genotoxicity, immunotoxicity, histopathological impacts (e.g., hepatic lesions), behavioral impacts, and reproductive impacts. Such impacts may result in reduced fitness, leading to the death of individuals. A clear example of this impact is provided by Claireaux et al. (2013), who showed that European sea bass (*Dicentrarchus labrax*) exposed to oil and dispersed oil were more susceptible to normal environmental perturbations than those that were not exposed to oil or dispersed oil. To test this, both chemically exposed and control fish were placed in a chamber that became hypoxic for a time and, subsequently, very warm for a time; the fish were then transferred to the field for monitoring of growth and survival. Those fish exposed (after exposure to oil or dispersed oil) to low dissolved oxygen and high temperatures had a significantly higher rate of mortality or a significantly lower rate of growth than the control fish, suggesting that their fitness was compromised by chemical exposure (Claireaux et al., 2013).

Another important consideration for fish, particularly unpigmented, early-life-stage fish that reside in the upper water column (e.g., Pacific herring), is the possibility of photo-enhanced toxicity; this is discussed in Section 6.1. Similarly to invertebrates, the potential for acute mortality in prey fish species or larval life stages of ESA-listed Pacific herring under natural lighting conditions may be underestimated by the analyses presented in Section 3.3.

Although dermal exposures of fish may increase after chemical dispersion, it is not clear how dermal exposures to dispersed oil will impact the survival, growth, or reproduction of fish. It is possible that topical lesions may occur based on studies with PAHs (Logan, 2007), however a clear link between topical lesions and reduced growth, survival, and / or reproduction in fish species has not been established.

6.3.3 Birds

Although contact of bird species with oil may be greatly diminished by the application of chemical dispersants, the increase of PAHs in the water column may impact various species of birds, particularly those that feed on invertebrates. Invertebrates are known to accumulate more PAHs in their lipids due to less efficient PAH metabolisms, so birds that feed on invertebrates are likely to be exposed to greater concentrations of dietary PAHs after chemical dispersion than if the chemicals had not been applied. Spectacled and Steller's eiders are known to selectively consume bivalves, which have been shown to accumulate significant amounts of oil after chemical dispersion (Michel and Henry Jr, 1997; Lemiere et al., 2005). Short-tailed albatross selectively consume squid, which may also accumulate PAHs; little or no data is available for accumulation in squid, but squid are invertebrates, and invertebrates tend to have less efficient PAH metabolisms (Meador, 2003). In lieu of direct exposure data for bird species, data from rats exposed to oil-contaminated mussel tissue were used. The rats experienced increased genetic liver damage (Lemiere et al., 2005), even though they assumedly have efficient PAH metabolisms (Albers and Loughlin, 2003), so such impacts may also be observable in birds that selectively consume invertebrates. Although fish accumulate PAHs to a lesser degree than do invertebrates, the trophic transfer of PAH metabolites stored in fish tissues to piscivorous birds (e.g., Kittlitz's murrelet, yellow-billed loon, short-tailed albatross) may also occur, resulting in PAH-related toxicity in those birds. HPAHs are more likely to be transferred in this way, as fish metabolize and depurate HPAHs at a slower rate than LPAHs (Payne et al., 2003; Wolfe et al., 2001).

Direct impacts on birds caused by exposure to dispersants or dispersed oil are generally extrapolated from non-ESA listed species, and may have been extrapolated from studies with non-bird species (e.g., Norway rats). For these reasons, conclusions made about potential direct impacts of dispersants alone or dispersed oil are uncertain.

6.3.4 Mammals

Toxicity caused by PAHs is generally associated with highly toxic metabolites (Albers and Loughlin, 2003), so the transfer of metabolites (rather than parent PAHs) through diet may result in some toxicity (Albers and Loughlin, 2003). Similarly, metabolism of parent molecules (taken up through direct contact) to toxic metabolites is generally expected to be a source of sublethal toxicity in mammals (Albers and Loughlin, 2003), although perhaps less relevant for more mutagenic HPAHs that concentrate in tissues of prey species. It is difficult to predict the level of toxicity in mammals due to PAH uptake, because previous studies have not directly investigated impacts on listed species related to PAHs alone (Albers and Loughlin, 2003); furthermore, it is not clear whether deceased marine mammals found with high concentrations of PAHs in tissues were chronically exposed to PAHs, nor is it clear to what concentrations they were exposed, what the source of the PAHs was, or whether they were exposed to various chemicals in addition to petrogenic PAHs (Albers and Loughlin, 2003). More importantly, it is not clear whether PAH uptake resulting from a chemical dispersant application will cause individual-level impacts (e.g., reduced survival, growth, or reproduction) in ESA-listed mammals. Given the expected difference in chemical exposures between mammals chronically exposed in contaminated waterways (e.g., beluga in St. Lawrence estuary) (Albers and Loughlin, 2003) and those exposed in a rapidly diluting and degrading oil plumes (Section 2), it is reasonable to assume that toxic responses will differ in the latter circumstance. In other words, the exposures of mammals to dispersed oil plumes is expected to be acute rather than chronic, and noted impacts in the literature tend to reflect chronic rather than acute exposures. Conversely, acute exposures noted in marine mammals exposed during and after EVOS resulted in high levels of PAH uptake; mortalities in Northern sea otter were attributed to hypothermia (a physical effect of oiling) rather than toxicity (a secondary effect) (Albers and Loughlin, 2003), and brain lesions noted in harbor seals[43] exposed to the same oil spill were not causally linked to PAH exposures (Albers and Loughlin, 2003). Therefore, there is a lack of directly relatable toxicity data for ESA-listed species regarding PAH exposures for relevant durations to accurately predict the likelihood of PAH impacts, particularly at the individual level (e.g., reduced survival, growth, or reproduction).

Given that PAH metabolites are known to impact mammalian species (Albers and Loughlin, 2003; Lemiere et al., 2005), and that dispersants increase the bioavailability

[43] Harbor seals were alive at the time of sampling (Albers and Loughlin, 2003).

of these chemicals to various species (including prey), the use of chemical dispersants may cause sublethal impacts in some mammals. It is expected that chemical dispersants will cause the uptake of PAHs in some mammal diets to increase; this is particularly true of those that selectively consume longer-lived invertebrates (e.g., Pacific walrus, northern sea otter, some baleen whales, and bearded seal), which accumulate higher concentrations of PAHs.[44] However, it is uncertain whether the increase in PAHs in invertebrate tissues will be over a large enough area and for a sufficiently long duration to cause reduced survival, growth, or reproduction in marine mammals that consume contaminated invertebrates. For example, bivalves on shorelines impacted by dispersed oil depurated or metabolized hydrocarbons over the period of year (Mageau et al., 1987), returning to the pre-spill condition (i.e., lower tissue concentration) after about 1 year; bivalves on shorelines impacted by untreated oil continued to take up hydrocarbons for a longer period of time (Humphrey et al., 1987). Chemical dispersion has been shown to increase the rate of depuration of LPAHs in both larval topsmelt (Wolfe et al., 2001) and a rotifer (Wolfe et al., 1998), suggesting that internalization of PAHs and the subsequent transfer to higher trophic levels of LPAHs can be mitigated by chemical dispersion.

Mammals that selectively feed on fish (e.g., Steller sea lion, some baleen and most toothed whales, and ringed seal) or other mammals (e.g., polar bear) are likely to accumulate PAHs through their diet, but they may accumulate lower concentrations due to the more efficient metabolic activity in fish and mammals.

Direct impacts on mammals caused by exposure to dispersants or dispersed oil are generally extrapolated from non-ESA listed species (e.g., Norway rats). For these reasons, conclusions made about potential impacts of dispersants alone or dispersed oil are uncertain.

Dermal exposures to dispersed oil may result in topical lesions in fish species (Logan, 2007) and possibly mammals as well; however, it is unclear how such lesions could result in reduced growth, reproduction, or survival. Dermal exposures are likely to be reduced by chemical dispersion, as fouling is expected to decrease (CDC and ATSDR, 2010; Lessard and Demarco, 2000).

6.3.5 Reptiles

As with birds and mammals, the likelihood of sublethal impacts on marine reptiles caused by the increased dissolution of PAHs into the water column and concomitant increase in PAH concentrations in prey tissues is uncertain. Reptile species tend to be little studied toxicologically, so it is exceedingly difficult to extrapolate impacts from previous studies. However, as reptiles are very rare in Alaska waters, it is unlikely that

[44] Note that sea otter, baleen whales, and bearded seal will also feed on finfish species if available, assuming that it is energetically favorable to forage on those fish species.

any adverse impact on marine reptiles will occur as a result of chemical dispersant application.

It is possible that dermal exposures will occur in marine reptiles, but dermal exposures are likely to be reduced by chemical dispersion (CDC and ATSDR, 2010; Lessard and Demarco, 2000).

6.4 Indirect Impacts of Dispersed Oil Toxicity

Given the discussion in Section 6.3, it is uncertain whether planktonic species will be significantly impacted by dispersed oil relative to oil alone due to the increased solubility and uptake of PAHs in the upper water column. Planktonic species that are immobile (aside from moving with ocean currents) have the greatest potential to be impacted (Barron and Ka'aihue, 2001). However, it is unclear whether the mortality of plankton in the vicinity of a treated oil spill will result in significant, indirect impacts on wildlife. For example, cetaceans are known to feed over large areas and may not be impacted by a localized mortality of sensitive plankton. Although many sensitive species may be killed during an oil spill or after chemical dispersion, the biomass contained within a planktonic community may remain much the same over time (Varela et al., 2006); therefore, the resource for non-selectively feeding species such as baleen whales may not be reduced.

In terms of duration, it is likely that the planktonic community within a given area will be replaced with new members as the ocean mixes and currents recharge a degraded area with previously unexposed planktonic individuals. Planktonic species impacted in the Gulf of Mexico during DHOS recuperated to pre-spill conditions within a matter of weeks to months (Abbriano et al., 2011). It was suggested that the rate of recruitment into impacted areas was due to various potential factors, including rapid reproduction, the ability of some species to selectively avoid oil droplets in water, and the circulation and mixing of the ocean; dispersion and degradation were also cited as potential reasons for this rapid recovery (Abbriano et al., 2011). Impacts on the prey base (i.e., available food rather than specific individuals or taxa) are therefore unlikely to persist.

6.5 Toxicity of Dispersant Components and Degradates/Metabolites

The analyses of dispersant toxicity presented in Sections 3.1 through 4.3 do not include a specific discussion of the individual component chemicals within dispersant mixtures. It is unclear, based on the analyses presented in this appendix, what the toxicities of these individual components are. However, the conceptual model for the application of chemical dispersants assessed in this appendix does not include individual components, applied singly or in mixtures, other than the original formulation (i.e., Corexit® 9500 or Corexit® 9527). Therefore, it is not deemed necessary to assess individual dispersant components. Similarly, individual components of oil are not directly assessed, though some emphasis is placed on PAHs as a group of chemicals found in oil.

There is a general paucity of data regarding the toxicity and fate and transport of the degradates or metabolites (created primarily via biodegradation) of chemical dispersant component chemicals (Table 2). It is not clear whether such resultant products will be more or less toxic than or equally toxic to parent chemicals in chemical dispersants. The assessment of chemical toxicity of chemical dispersants alone does not directly address this uncertainty, rather discussing the toxicity of the parent components as a mixture.

7 Conclusion

Based on the analyses of toxicity, fate, and transport, as well as the likelihood of exposure of ESA-protected or candidate species, many species will not be adversely impacted by chemical dispersion at the individual level (i.e., reduced survival, reproduction, or growth) relative to baseline oiling. This conclusion assumes that the Unified Plan (which is specifically structured to provide for the protection of sensitive wildlife) will be implemented in accordance with all appropriate BMPs. For ESA-listed birds, mammals, and reptiles, this conclusion contains a degree of uncertainty, as discussed in Sections 6.3.3, 6.3.4, and 6.3.5, respectively. However, several species have been specifically identified as being at direct or indirect risk for adverse impacts related to oil exposures enhanced by chemical dispersion. Steller's and spectacled eiders, Pacific walrus, and Pacific herring may all be impacted by the application of chemical dispersants, even if most BMPs are observed. Only Pacific herring is expected to be directly impacted, whereas Steller's and spectacled eiders and Pacific walrus are expected to be indirectly impacted; this conclusion is primarily based on the reliance of eiders and walrus on bivalves as prey, and the fact that bivalves are known to be highly sensitive to dispersants and dispersed oil (Section 3.3; Attachment B-1). Similarly, Pacific herring are known to be highly sensitive to dispersants and dispersed oil, and they are found in Alaskan waters during all times of the year and in the nearshore coastal areas during early life stages (when herring are most sensitive).

In the unlikely event that BMPs are not implemented, or that such practices fail to be protective of sensitive species (i.e., a worst-case scenario), chemical dispersants may impact any species other than Aleutian shield fern and Eskimo curlew, which are terrestrial species that would not be exposed to chemical dispersants, and sea turtles, which are extremely rare in Alaskan waters. For example, the inadvertent spraying of chemical dispersants on or very near individual birds (any species) or Northern sea otter may result in the loss of thermoregulation, leading to hypothermia and death. If spraying were to occur near individual marine mammals, dermal exposures could result in sublethal impacts, such as irritation of skin, eyes, and mucous membranes. Similarly, inhalation and aspiration of recently sprayed dispersants by marine birds and mammals could result in irritated lung tissue and impaired breathing (as well as affected diving and foraging behavior).

Chemical dispersion will likely increase the bioavailability of dissolved PAHs in the water column over a short period of time (i.e., prior to dilution and biodegradation [Section 2]), possibly resulting in sublethal impacts on all species (excepting Aleutian shield fern, Eskimo curlew, and marine reptiles). It is unclear whether sublethal impacts (e.g., lesions) will result in significant effects on ESA-listed or candidate species (Section 6.3). It is also possible that increased exposure to dissolved PAHs among shallow-dwelling planktonic species (i.e., invertebrates and fish) will result in alterations to the food web, potentially causing indirect impacts on ESA-listed or candidate species (as well as direct impacts on early life stage Pacific herring, should the dispersed oil reach the coastal areas). Although the analysis provided in this appendix supports the conclusion that chemical dispersion will reduce the overall toxicity of oil in the water column (Figures 8 and 9), it is possible that the analysis underestimates the risk to the aquatic community (e.g., early life stages of invertebrate and fish species) from PAH exposures, which may become more toxic under natural conditions (Barron and Ka'aihue 2001; Barron et al. 2008).

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Attachment B-1. Toxicity Data

Table of Contents

Acronyms

ALC	Arabian light crude oil
AMC	Arabian medium crude oil
ANS	Alaska North Slope crude oil
BSC	Bass Strait crude oil
BSD	blue sac disease
CIC	Cook Inlet crude oil
DOR	dispersant-to-oil ratio
EC50	concentration that causes a non-lethal effect in 50% of an exposed population
EPA	US Environmental Protection Agency
EROD	ethoxyresorufin-O-deethylase
KCO	Kuwait crude oil
LC50	concentration that is lethal to 50% of an exposed population
MESA	medium South American fuel oil
MFO	medium fuel oil
NPL	National Priorities List
NRC	National Research Council
PBCO	Prudhoe Bay crude oil
ppm	parts per million
SLC	Sweet Louisiana Crude oil
SSD	species sensitivity distribution
TTV	threshold toxicity value
VCO	Venezuelan medium crude oil
WQC	water quality criteria

Introduction

This attachment presents the currently available toxicity data from published literature on chemical dispersants (Tables 1 and 2), crude oil (Table 3), and chemically dispersed oil (Tables 4 and 5). These data (with some exceptions identified in the tables) were used to create chemical-specific species sensitivity distributions (SSDs) for current-use chemical dispersants (i.e., Corexit® EC9527A and Corexit® EC9500A, hereafter referred to as Corexit® 9527 and Corexit® 9500, respectively), crude oil alone, and crude oil dispersed by those chemicals. From the SSDs, hazardous concentrations (HC5) were calculated, and these values were compared. The raw data and the calculations of SSDs and HC5 values are discussed at length in Appendix B.

Table 1. Available median lethal toxicity values (LC50) for current-use and NPL-listed chemical dispersants

Dispersant Chemical	Latin Name	Life Stage	Duration (h)	Range of LC50s (ppm)	Source(s)
BP 1100-X	*Penaeus monodon*	post-larval	24	4,351 – 7,207	Bussarawit (1994)
BP 1100-X	*Penaeus monodon*	post-larval	48	2,818 – 4,598	Bussarawit (1994)
BP 1100-X	*Penaeus monodon*	post-larval	96	1,253 – 2,044	Bussarawit (1994)
Corexit 9500	*Allorchestes compressa*	adult	96	3.5	Gulec et al. (1997)
Corexit 9500	*Americamysis bahia*	neonate	48	42	Hemmer et al. (2010)
Corexit 9500	*Americamysis bahia*	neonate	48	5.4	Hemmer et al. (2011)
Corexit 9500	*Americamysis bahia*	nr	48	32.2	Inchcape (1995)
Corexit 9500	*Americamysis bahia*	nr	96	31.4 – 35.9	George-Ares and Clark (2000); Fuller and Bonner (2001); Clark et al. (2001); Rhoton et al. (2001)
Corexit 9500	*Americamysis bahia*	non-embryo	48 – I96	20.9	Edwards et al. (2003) as cited in Barron et al. (2013)
Corexit 9500	Americamysis bahia	non-embryo	48 – I96	32	Fuller et al. (2004)
Corexit 9500	*Americamysis bahia*	adult	nr	37.20	Wetzel and Van Fleet (2001)
Corexit 9500	*Americamysis bahia*	nr	SD	500 – 1,305	Coelho and Aurand (1997); Fuller and Bonner (2001); Clark et al. (2001); Rhoton et al. (2001)
Corexit 9500	*Americamysis bahia*	nr	SD	>789	Coelho and Aurand (1997); Fuller and Bonner (2001); Clark et al. (2001); Rhoton et al. (2001)
Corexit 9500	*Americamysis bahia*	adult	SD	1,038	Wetzel and Van Fleet (2001)
Corexit 9500	*Artemia salina*	nr	48	21	George-Ares and Clark (2000)
Corexit 9500	*Atherinosoma microstoma*	juvenile	96	50	Marine and Freshwater Resources Institute (1998)
Corexit 9500	*Brachydanio rerio*[a]	nr	24	>400	George-Ares and Clark (2000)
Corexit 9500	*Chionoecetes bairdi*	larvae	96	5.6	Rhoton et al. (2001)
Corexit 9500	*Chionoecetes bairdi*	larvae	SD	355	Rhoton et al. (2001)
Corexit 9500	*Crassostrea virginica*	non-embryo	48 – I96	167	Liu (2003) as cited in Barron et al. (2013)
Corexit 9500	*Cyprinodon variegatus*	larvae	96	170 – 193	Fuller and Bonner (2001)
Corexit 9500	*Cyprinodon variegatus*	non-embryo	48 – I96	180	Fuller et al. (2004)
Corexit 9500	*Cyprinodon variegatus*	larvae	SD	593 – 750	Fuller and Bonner (2001)
Corexit 9500	*Eurytemora affinis*	adult	96	5.2	Wright and Coehlo (1996)

Table 1. Available median lethal toxicity values (LC50) for current-use and NPL-listed chemical dispersants, cont.

Dispersant Chemical	Latin Name	Life Stage	Duration (h)	Range of LC50s (ppm)	Source(s)
Corexit 9500	*Fundulus grandis*	non-embryo	48 – l96	172.6	Liu (2003) as cited in Barron et al. (2013)
Corexit 9500	*Fundulus heteroclitus*	nr	96	25.2	Nalco (2005)
Corexit 9500	*Fundulus heteroclitus*	nr	96	140	George-Ares and Clark (2000)
Corexit 9500	*Haliotis rufescens*	embryo	SD	12.8 – 19.7	Singer et al. (1996)
Corexit 9500	*Holmesimysis costata*	juvenile	SD	158 – 245	Singer et al. (1996)
Corexit 9500	*Hydra viridissima*	non-budding	96	160	Mitchell and Holdway (2000)
Corexit 9500	*Lates calcarifer*	juvenile	96	143	Marine and Freshwater Resources Institute (1998)
Corexit 9500	*Litopenaeus setiferus*	non-embryo	48 – l96	31.1	Liu (2003) as cited in Barron et al. (2013)
Corexit 9500	*Macquaria novemaculeata*	larvae	96	19.8	Gulec and Holdway (2000)
Corexit 9500	*Menidia beryllina*	larvae	96	130	Hemmer et al. (2010)
Corexit 9500	*Menidia beryllina*	larvae	96	7.6	Hemmer et al. (2011)
Corexit 9500	*Menidia beryllina*	larvae	96	25.2 – 85.4	Inchcape (1995); (Fuller and Bonner, 2001); Rhoton et al. (2001)
Corexit 9500	*Menidia beryllina*	nr	96	140	Nalco (2005)
Corexit 9500	*Menidia beryllina*	non-embryo	48 – l96	79.3	Edwards et al. (2003) as cited in Barron et al. (2013)
Corexit 9500	*Menidia beryllina*	non-embryo	48 – l96	79	Fuller et al. (2004)
Corexit 9500	*Menidia beryllina*	juvenile	nr	85.1	Wetzel and Van Fleet (2001)
Corexit 9500	*Menidia beryllina*	larvae	SD	40.7 – 116.6	Fuller and Bonner (2001); Rhoton et al. (2001)
Corexit 9500	*Menidia beryllina*	larvae	SD	205	Fuller and Bonner (2001);; Rhoton et al. (2001)
Corexit 9500	*Menidia beryllina*	juvenile	SD	21.6	Wetzel and Van Fleet (2001)
Corexit 9500	*Oncorhynchus mykiss*[a]	nr	96	354	George-Ares and Clark (2000)
Corexit 9500	*Palaemon serenus*	nr	96	83.1	Gulec and Holdway (2000)
Corexit 9500	*Palaemonetes varians*	nr	6	8,103	Beaupoil and Nedelec (1994)
Corexit 9500	*Penaeus monodon*	larvae	96	48	Marine and Freshwater Resources Institute (1998)
Corexit 9500	*Polinices conicus*	nr	24	42.3	Gulec et al. (1997)
Corexit 9500	*Sarotherodon mozambicus*	nr	96	150	George-Ares and Clark (2000)
Corexit 9500	Sciaenops ocellatus	juvenile	SD	744	Wetzel and Van Fleet (2001)
Corexit 9500	*Scophthalamus maximus*	nr	96	75	Nalco (2005)

Table 1. Available median lethal toxicity values (LC50) for current-use and NPL-listed chemical dispersants, cont.

Dispersant Chemical	Latin Name	Life Stage	Duration (h)	Range of LC50s (ppm)	Source(s)
Corexit 9500	*Scophthalmus maximus*	yolk-sac larvae	48	74.7	George-Ares and Clark (2000); Clark et al. (2001)
Corexit 9500	*Scophthalmus maximus*	yolk-sac larvae	SD	>1,055	George-Ares and Clark (2000); Clark et al. (2001)
Corexit 9500	*Skeletonema costatum*	nr	72	20	Norwegian Institute for Water Research (1994)
Corexit 9500	*Tigriopus japonicus*	larvae	96	10	Lee et al. (2013)
Corexit 9527	*Allorchestes compressa*	nr	96	3	Gulec et al. (1997)
Corexit 9527	*Americamysis bahia*	nr	96	19 – 34	Bricino et al. (1992);George-Ares et al. (1999);Exxon Biomedical (1993a); Pace and Clark (1993)
Corexit 9527	*Americamysis bahia*	nr	96	29.2	Bricino et al. (1992); George-Ares et al. (1999);Exxon Biomedical (1993a); Pace and Clark (1993)
Corexit 9527	*Americamysis bahia*	nr	48	24.1 – 29.2	Inchcape (1995); Clark et al. (2001)
Corexit 9527	*Americamysis bahia*	nr	SD	>1,014	Pace et al. (1995); Clark et al. (2001)
Corexit 9527	*Anonyx laticoxae*	nr	96	>140	Foy (1982)
Corexit 9527	*Anonyx nugax*	nr	96	97 – 111	Foy (1982)
Corexit 9527	*Argopecten irradians*	nr	6	200	Ordzie and Garofalo (1981)
Corexit 9527	*Argopecten irradians*	nr	6	1,800	Ordzie and Garofalo (1981)
Corexit 9527	*Argopecten irradians*	nr	6	2,500	Ordzie and Garofalo (1981)
Corexit 9527	*Artemia salina*	nr	48	53 – 84	Bricino et al. (1992)
Corexit 9527	*Artemia* sp.	larvae	48	52 – 104	Wells et al. (1982)
Corexit 9527	*Artemia* sp.	larvae	48	42 – 72	Wells et al. (1982)
Corexit 9527	*Atherinops affinis*	larvae	96	25.5 – 40.6	Singer et al. (1990); Singer et al. (1991)
Corexit 9527	*Atherinops affinis*	larvae	SD	59.2 – 104	Singer et al. (1991)
Corexit 9527	*Boeckosimus edwardsi*	nr	96	>80	Foy (1982)
Corexit 9527	*Boeckosimus sp.*	nr	96	>175	Foy (1982)
Corexit 9527	*Brevoortia tyrannus*	embryo-larval	48	42.4	Fucik et al. (1995)
Corexit 9527	*Callinectes sapidus*	larvae	96	77.9 – 81.2	Fucik et al. (1995)
Corexit 9527	*Chlamydomonas reinhardti*	nr	4	575	Norland et al. (1978)

Table 1. Available median lethal toxicity values (LC50) for current-use and NPL-listed chemical dispersants, cont.

Dispersant Chemical	Latin Name	Life Stage	Duration (h)	Range of LC50s (ppm)	Source(s)
Corexit 9527	*Corophium volutator*	non-embryo	48 – l96	159	Scarlett et al. (2005)
Corexit 9527	*Crassostrea gigas*	embryos	48	3.1	George-Ares and Clark (2000); Clark et al. (2001)
Corexit 9527	*Crassostrea gigas*	embryos	SD	13.9	George-Ares and Clark (2000); Clark et al. (2001)
Corexit 9527	*Cyprinodon variegatus*	nr	96	74 – 152	Bricino et al. (1992)
Corexit 9527	*Daphnia magna*[a]	larvae	48	75	Bobra et al. (1989)
Corexit 9527	*Fundulus heteroclitus*	nr	96	81	Nalco (2010)
Corexit 9527	*Fundulus heteroclitus*	nr	96	99 – 124	Bricino et al. (1992)
Corexit 9527	*Gammarus oceanicus*	juvenile	96	>80	Foy (1982)
Corexit 9527	*Gnorimosphaeroma oregonensis*	nr	96	>1,000	Duval et al. (1982)
Corexit 9527	*Haliotis rufescens*	embryos	48	1.6 – 2.2	Singer et al. (1990); Singer et al. (1991)
Corexit 9527	*Haliotis rufescens*	embryos	SD	13.6 – 18.1	Singer et al. (1991)
Corexit 9527	*Holmesimysis costata*	nr	96	15.3	Coelho and Aurand (1997)
Corexit 9527	*Holmesimysis costata*	nr	96	2.4 – 10.1	Pace and Clark (1993); Exxon Biomedical (1993b, c); Clark et al. (2001)
Corexit 9527	*Holmesimysis costata*	juvenile	96	4.3 – 7.3	Singer et al. (1990); Singer et al. (1991)
Corexit 9527	*Holmesimysis costata*	nr	SD	195	George-Ares and Clark (2000); Clark et al. (2001)
Corexit 9527	*Holmesimysis costata*	juvenile	SD	120 – 163	Singer et al. (1991)
Corexit 9527	*Hydra viridissima*[a]	non-budding	96	230	Mitchell and Holdway (2000)
Corexit 9527	*Leiostomus xanthurus*	embryo-larval	48	27.4	Fucik et al. (1995)
Corexit 9527	*Leiostomus xanthurus*	embryos	48	61.2 – 62.3	Slade (1982)
Corexit 9527	*Macquaria novemaculeata*	larvae	96	14.3	Gulec and Holdway (2000)
Corexit 9527	*Macrobrachium rosenbergii*	embryo-larval	288	80.4	Law (1995)
Corexit 9527	*Macrocystis pyrifera*	zoospores	SD	86.6 – 102	Singer et al. (1991)
Corexit 9527	*Menidia beryllina*	larvae	96	14.6 – 57	Bricino et al. (1992); Fucik et al. (1995); Pace and Clark (1993); Inchcape (1995); Exxon Biomedical (1993d); Clark et al. (2001)
Corexit 9527	*Menidia beryllina*	larvae	96	52.3	Bricino et al. (1992); Fucik et al. (1995); Pace and Clark (1993); Inchcape (1995); Exxon Biomedical (1993d); Clark et al. (2001)
Corexit 9527	*Menidia beryllina*	larvae	96	>100	Fucik et al. (1995)

Table 1. Available median lethal toxicity values (LC50) for current-use and NPL-listed chemical dispersants, cont.

Dispersant Chemical	Latin Name	Life Stage	Duration (h)	Range of LC50s (ppm)	Source(s)
Corexit 9527	*Menidia beryllina*	nr	96	14.57	Nalco (2010)
Corexit 9527	*Menidia beryllina*	embryos	SD	58.3	George-Ares and Clark (2000);Clark et al. (2001)
Corexit 9527	*Myoxocephalus quadricornis*	nr	96	<40	Foy (1982)
Corexit 9527	*Oncorhynchus mykiss*[a]	juvenile	96	260	Doe and Wells (1978)
Corexit 9527	*Oncorhynchus mykiss*[a]	nr	96	96 – 293	Wells and Doe (1976)
Corexit 9527	*Onisimus litoralis*	nr	96	80 – 160	Foy (1982)
Corexit 9527	*Oryzias latipes*	nr	24	130 – 150	George-Ares and Clark (2000)
Corexit 9527	*Oryzias latipes*	nr	24	400	George-Ares and Clark (2000)
Corexit 9527	*Palaemon serenus*	nr	96	49.4	Gulec and Holdway (2000)
Corexit 9527	*Palaemonetes pugio*	nr	96	640	NRC (1989)
Corexit 9527	*Palaemonetes pugio*	nr	96	840	NRC (1989)
Corexit 9527	*Penaeus monodon*	post-larval	24	355 – 623	Bussarawit (1994)
Corexit 9527	*Penaeus monodon*	post-larval	48	120 – 213	Bussarawit (1994)
Corexit 9527	*Penaeus monodon*	post-larval	96	32 – 55	Bussarawit (1994)
Corexit 9527	*Penaeus monodon*	nr	96	35 – 45	Fucik et al. (1995)
Corexit 9527	*Penaeus setiferus*	post-larval	96	11.9	Fucik et al. (1995)
Corexit 9527	*Penaeus vannemai*	nr	96	35 – 45	Fucik et al. (1995)
Corexit 9527	*Phyllospora comosa*	nr	48	30	Burridge and Shir (1995)
Corexit 9527	*Pimephales promelas*	nr	96	201	Nalco (2010)
Corexit 9527	*Platichthys flesus*	350-g juvenile	96	100	Baklien et al. (1986)
Corexit 9527	*Protothaca stamiea*	nr	96	100	Hartwick et al. (1982)
Corexit 9527	*Pseudocalanus minutus*	adult	48	8.5 – 35.5	Wells et al. (1982)
Corexit 9527	*Pseudocalanus minutus*	nr	48	8 – 12	Wells et al. (1982)
Corexit 9527	*Pseudocalanus minutus*	adult	96	5 – 24.8	Wells et al. (1982)
Corexit 9527	*Pseudocalanus minutus*	nr	96	5 – 25	Wells et al. (1982)
Corexit 9527	*Sciaenops ocellatus*	embryo-larval	48	52.6	Fucik et al. (1995)
Corexit 9527	*Scophthalamus maximus*	nr	96	50	Nalco (2010)
Corexit 9527	*Scophthalamus maximus*	nr	72	9.4	Nalco (2010)

Table 1. Available median lethal toxicity values (LC50) for current-use and NPL-listed chemical dispersants, cont.

Dispersant Chemical	Latin Name	Life Stage	Duration (h)	Range of LC50s (ppm)	Source(s)
Corexit 9527	*Thalassia testudinum*	nr	96	200	Baca and Getter (1984)

[a] Freshwater species.

LC50 – concentration that is lethal to 50% of an exposed population

nr – not reported

NPL – National Priorities List

NRC – National Research Council

ppm – parts per million

SD – spiked concentration, declining exposure

Table 2. Available sublethal toxicity values for current-use chemical dispersants

Dispersant Chemical	Latin Name	Life Stage	Duration (h)	Endpoint	Range of LC50s (ppm)	Source(s)
Corexit 9500	*Haliotis rufescens*	embryos	48	NOEC	0.7	Aquatic Testing Laboratories (1994) as cited in NRC (2005)
Corexit 9500	*Haliotis rufescens*	nr	SD	NOEC	5.7 – 9.7	Singer et al. (1996)
Corexit 9500	*Holmesimysis costata*	nr	SD	NOEC	41.4 – 142	Singer et al. (1996)
Corexit 9500	*Hydra viridissima*	nr	168	NOEC	13	Mitchell and Holdway (2000)
Corexit 9500	*Phyllospora comosa*	zygotes	48	EC50, not specified	0.7	Burridge and Shir (1995)
Corexit 9500	*Skeletonema costatum*	nr	72	EC50, not specified	20	Norwegian Institute for Water Research (1994)
Corexit 9500	*Vibrio fischeri*	na	0.25	reduced bioluminescence	104 – 242	Fuller and Bonner (2001)
Corexit 9527	*Artemia* sp.	larvae	48	time to molt	42 – 72	Wells et al. (1982)
Corexit 9527	*Haliotis rufescens*	embryos	48	abnormal growth	1.6 – 2.2	Singer et al. (1990); Singer et al. (1991)
Corexit 9527	*Haliotis rufescens*	embryos	SD	abnormal growth	13.6 – 18.1	Singer et al. (1991)
Corexit 9527	*Hydra viridissima*	nr	168	NOEC	< 15	Mitchell and Holdway (2000)
Corexit 9527	*Macrobrachium rosenbergii*	embryo-larval	288	hatching	80.4	Law (1995)
Corexit 9527	*Macrocystis pyrifera*	zoospores	48	NOEC	1.3 – 2.1	Singer et al. (1990); Singer et al. (1991)
Corexit 9527	*Macrocystis pyrifera*	zoospores	SD	IC50, not specified	86.6 – 102	Singer et al. (1991)
Corexit 9527	*Macrocystis pyrifera*	zoospores	SD	NOEC	12.2 – 16.4	Singer et al. (1991)
Corexit 9527	*Polinices conicus*	nr	24	EC50, not specified	33.8	Gulec et al. (1997)
Corexit 9527	*Skeletonema costatum*	nr	72	biomass production	9.4	Nalco (2010)
Corexit 9527	*Vibrio fischeri*	na	0.25	reduced bioluminescence	4.9 – 12.8	George-Ares et al. (1999); Exxon Biomedical (1993a)[a]

Sources: NRC (2005) and George-Ares and Clark (2000)

Note: sublethal toxicity values were not used in further calculations.
EC50 – concentration that causes a non-lethal effect in 50% of an exposed population
IC50 – concentration required for 50% inhibition of a normal process (equivalent to an EC50)
NOEC – no-observed-effect concentration
nr – not reported
NRC – National Research Council
ppm – parts per million
SD – spiked concentration, declining exposure

Table 3. Available median lethal toxicity values (LC50) for crude oil

Oil Type	Weathered (Y/N)	Latin Name	Type of Exposure	Life Stage	Duration (h)	Oil LC50 (ppm TPH)	Source
ALC	Y	*Menidia beryllina*	static (75% renewal), sealed	early-life stage	96	4.9	Fuller and Bonner (2001) as cited in NRC (2005)
ALC	Y	*Menidia beryllina*	spiked	larval	96	32.3	Fuller and Bonner (2001) as cited in NRC (2005)
AMC	N	*Americamysis bahia*	static (75% renewal), sealed	larval	96	0.56	Fuller and Bonner (2001) as cited in NRC (2005)
AMC	N	*Americamysis bahia*	spiked	larval	96	26.1	Fuller and Bonner (2001) as cited in NRC (2005)
AMC	Y	*Cyprinodon variegatus*	static (75% renewal), sealed	larval	96	3.9	Fuller and Bonner (2001) as cited in NRC (2005)
AMC	Y	*Cyprinodon variegatus*	spiked	larval	96	6.1	Fuller and Bonner (2001) as cited in NRC (2005)
ANS	N	*Americamysis bahia*	flow-through	larval	96	2.61	Rhoton et al. (2001) as cited in NRC (2005)
ANS	N	*Americamysis bahia*	spiked	larval	96	8.21	Rhoton et al. (2001) as cited in NRC (2005)
ANS	N	*Boreogadus saida*	spiked	<1 year	96	1.2	McFarlin et al. (2011)
ANS	N	*Calanus glacialis*	spiked	nr	96	2.4	McFarlin et al. (2011)
ANS	N	*Fundulus grandis*	static	non-embryo	96	7.8	Liu (2003) as cited in Barron et al. (2013)
ANS	N	*Litopenaeus setiferus*	static	non-embryo	96	6.59	Liu et al. (2006)
ANS	Y	*Menidia beryllina*	flow-through	larval	96	0.79	Rhoton et al. (2001) as cited in NRC (2005)
ANS	N	*Menidia beryllina*	flow-through	larval	96	15.59	Rhoton et al. (2001) as cited in NRC (2005)
ANS	N	*Menidia beryllina*	spiked	larval	96	26.36	Rhoton et al. (2001) as cited in NRC (2005)
ANS	N	*Myoxocephalus sp.*	spiked	larvae	96	1.6	McFarlin et al. (2011)
BSC	N	*Allorchestes compressa*	static (60% renewal)	nr	96	311,000	Gulec et al. (1997)
BSC	N	*Hydra viridissima*[a]	static	nr	96	0.7	Mitchell and Holdway (2000)
BSC	N	*Macquaria novemaculeata*	static (50% renewal)	larval	96	465000	Gulec and Holdway (2000)
BSC	N	*Melonotaenia fluviatilis*[a]	static, daily renewal	embryo	96	1.28	Pollino and Holdway (2002)
BSC	N	*Octopus pallidus*	semi-static	hatchling	48	0.39	Long and Holdway (2002)
BSC	N	*Palaemon serenus*	static (50% renewal)	nr	96	258,000	Gulec and Holdway (2000)
Bunker C	N	*Americamysis almyra*	nr	nr	48 – 96[b]	0.9	Malins 1977 as cited in Barron et al. (2013)
Bunker C	nr	*Capitella capitata*	nr	nr	48 – 96[b]	0.9	Malins 1977 as cited in Barron et al. (2013)
Bunker C	nr	*Cyprinodon variegatus*	nr	nr	96	3.1	Malins 1977 as cited in Barron et al. (2013)
Bunker C	nr	*Farfantepenaeus aztecus*	nr	nr	48 – 96[b]	1.9	Malins 1977 as cited in Barron et al. (2013)
Bunker C	nr	*Fundulus similis*	nr	nr	96	1.69	Malins 1977 as cited in Barron et al. (2013)
Bunker C	nr	*Menidia beryllina*	nr	nr	96	1.9	Malins 1977 as cited in Barron et al. (2013)
Bunker C	nr	*Neanthes arenaceodentata*	nr	nr	48 – 96[b]	3.6	Malins 1977 as cited in Barron et al. (2013)
Bunker C	nr	*Pagurus longicarpus*	nr	nr	48 – 96[b]	0.42	Malins 1977 as cited in Barron et al. (2013)
Bunker C	nr	*Palaemonetes pugio*	nr	nr	48 – 96[b]	2.6	Malins 1977 as cited in Barron et al. (2013)
Bunker C	nr	*Spiochaetopterus costarum*	nr	nr	48 – 96[b]	4.92	Malins 1977 as cited in Barron et al. (2013)
CIC	nr	*Aulorhynchus flavidus*	nr	nr	96	1.34	Malins 1977 as cited in Barron et al. (2013)
CIC	nr	*Aulorhynchus flavidus*	nr	nr	96	2.55	Rice et al 1979 as cited in Barron et al. (2013)
CIC	nr	*Chlamys hastata*	nr	nr	48 – 96[b]	2	Moles 1998 as cited in Barron et al. (2013)
CIC	nr	*Chlamys hastata*	nr	nr	48 – 96[b]	3.94	Rice et al 1979 as cited in Barron et al. (2013)

Table 3. Available median lethal toxicity values (LC50) for crude oil, cont.

Oil Type	Weathered (Y/N)	Latin Name	Type of Exposure	Life Stage	Duration (h)	Oil LC50 (ppm TPH)	Source
CIC	nr	*Clupea pallasii*	nr	nr	96	1.22	Rice et al 1979 as cited in Barron et al. (2013)
CIC	nr	*Crangon alaskensis*	nr	nr	48 – 96 [b]	0.87	Rice et al 1979 as cited in Barron et al. (2013)
CIC	nr	*Eleginus gracilis*	nr	nr	48 – 96 [b]	2.28	Malins 1977 as cited in Barron et al. (2013)
CIC	nr	*Eualus fabricii*	nr	nr	48 – 96 [b]	1.46	Malins 1977 as cited in Barron et al. (2013)
CIC	nr	*Eualus suckleyi*	nr	nr	48 – 96 [b]	3.94	Rice et al 1979 as cited in Barron et al. (2013)
CIC	nr	*Myoxocephalus polyacanthocephalus*	nr	nr	96	3.82	Rice et al 1979 as cited in Barron et al. (2013)
CIC	nr	*Notoacmea scutum*	nr	nr	48 – 96 [b]	3.65	Malins 1977 as cited in Barron et al. (2013)
CIC	nr	*Notoacmea scutum*	nr	nr	48 – 96 [b]	8.18	Rice et al 1979 as cited in Barron et al. (2013)
CIC	nr	*Oncorhynchus gorbuscha*	nr	nr	96	1.2	Moles 1998 as cited in Barron et al. (2013)
CIC	nr	*Oncorhynchus gorbuscha*	nr	nr	96	1.47	Malins 1977 as cited in Barron et al. (2013)
CIC	nr	*Oncorhynchus gorbuscha*	nr	nr	96	1.5	Rice et al 1979 as cited in Barron et al. (2013)
CIC	nr	*Pagurus hirsutiusculus*	nr	nr	48 – 96 [b]	3.1	Malins 1977 as cited in Barron et al. (2013)
CIC	nr	*Pandalus borealis*	nr	nr	48 – 96 [b]	4.94	Rice et al 1979 as cited in Barron et al. (2013)
CIC	nr	*Pandalus danae*	nr	nr	48 – 96 [b]	0.81	Malins 1977 as cited in Barron et al. (2013)
CIC	nr	*Pandalus goniurus*	nr	nr	48 – 96 [b]	1.85	Malins 1977 as cited in Barron et al. (2013)
CIC	nr	*Pandalus hypsinotus*	nr	nr	48 – 96 [b]	1.4	Moles 1998 as cited in Barron et al. (2013)
CIC	nr	*Paralithodes camtschaticus*	nr	nr	48 – 96 [b]	1.5	Moles 1998as cited in Barron et al. (2013)
CIC	nr	*Paralithodes camtschaticus*	nr	nr	48 – 96 [b]	3.69	Rice et al 1979 as cited in Barron et al. (2013)
CIC	nr	*Platichthys stellatus*	nr	nr	96	1.8	Moles 1998 as cited in Barron et al. (2013)
CIC	nr	*Salvelinus malma*	nr	nr	96	1.54	Malins 1977 as cited in Barron et al. (2013)
CIC	nr	*Salvelinus malma*	nr	nr	96	1.55	Rice et al 1979 as cited in Barron et al. (2013)
CIC	nr	*Theragra chalcogramma*	nr	nr	48 – 96 [b]	1.73	Rice et al 1979 as cited in Barron et al. (2013)
Ecofisk	N	*Platichthys flesus*	constant	350-g juvenile	96	75	Baklien et al. (1986)
Iranian heavy crude	N	*Tigriopus japonicus*	static	juvenile	96	124.3	Lee et al. (2013)
KFO	N	*Americamysis bahia*	constant	nr	96	0.63	Clark et al. (2001)
KFO	N	*Americamysis bahia*	static daily renewal, sealed	nr	96	0.78	Pace et al. (1995) as cited in NRC (2005)
KFO	N	*Holmesimysis costata*	constant	nr	96	0.1	Clark et al. (2001)
KFO	Y	*Menidia beryllina*	constant	nr	96	0.14	Clark et al. (2001)
KFO	N	*Menidia beryllina*	constant	nr	96	0.97	Clark et al. (2001)
No. 2 fuel oil	nr	*Americamysis almyra*	nr	nr	48 – 96 [b]	0.9	Malins 1977 as cited in Barron et al. (2013)
No. 2 fuel oil	N	*Americamysis bahia*	static daily renewal	eggs	48	16.12	EPA (1995)
No. 2 fuel oil	nr	*Capitella capitata*	nr	nr	48 – 96 [b]	2.3	Malins 1977 as cited in Barron et al. (2013)
No. 2 fuel oil	nr	*Chlamys rubida*	nr	nr	48 – 96 [b]	0.8	Malins 1977 as cited in Barron et al. (2013)
No. 2 fuel oil	nr	*Crangon alaskensis*	nr	nr	48 – 96 [b]	0.36	Rice et al 1979 as cited in Barron et al. (2013)
No. 2 fuel oil	nr	*Cryptochiton stelleri*	nr	nr	48 – 96 [b]	1.24	Malins 1977 as cited in Barron et al. (2013)
No. 2 fuel oil	nr	*Cyprinodon variegatus*	nr	nr	96	6.3	Malins 1977 as cited in Barron et al. (2013)

Table 3. Available median lethal toxicity values (LC50) for crude oil, cont.

Oil Type	Weathered (Y/N)	Latin Name	Type of Exposure	Life Stage	Duration (h)	Oil LC50 (ppm TPH)	Source
No. 2 fuel oil	nr	*Eualus fabricii*	nr	nr	48 – 96 [b]	0.53	Malins 1977 as cited in Barron et al. (2013)
No. 2 fuel oil	nr	*Eualus suckleyi*	nr	nr	48 – 96 [b]	0.59	Rice et al 1979 as cited in Barron et al. (2013)
No. 2 fuel oil	nr	*Fundulus similis*	nr	nr	96	3.9	Malins 1977 as cited in Barron et al. (2013)
No. 2 fuel oil	nr	*Katharina tunicata*	nr	nr	48 – 96 [b]	0.44	Malins 1977 as cited in Barron et al. (2013)
No. 2 fuel oil	nr	*Menidia beryllina*	nr	nr	96	3.9	Malins 1977 as cited in Barron et al. (2013)
No. 2 fuel oil	N	*Menidia beryllina*	nr	nr	96	10.72	EPA (1995)
No. 2 fuel oil	nr	*Myoxocephalus polyacanthocephalus*	nr	nr	96	1.31	Rice et al 1979 as cited in Barron et al. (2013)
No. 2 fuel oil	nr	*Neanthes arenaceodentata*	nr	nr	48 – 96 [b]	2.6	Malins 1977 as cited in Barron et al. (2013)
No. 2 fuel oil	nr	*Notoacmea scutum*	nr	nr	48 – 96 [b]	5.04	Malins 1977 as cited in Barron et al. (2013)
No. 2 fuel oil	nr	*Oncorhynchus gorbuscha*	nr	nr	96	0.54	Rice et al 1979 as cited in Barron et al. (2013)
No. 2 fuel oil	nr	*Oncorhynchus gorbuscha*	nr	nr	96	0.81	Malins 1977 as cited in Barron et al. (2013)
No. 2 fuel oil	nr	*Palaemonetes pugio*	nr	nr	48 – 96 [b]	3.5	Malins 1977 as cited in Barron et al. (2013)
No. 2 fuel oil	nr	*Pandalus borealis*	nr	nr	48 – 96 [b]	0.21	Malins 1977 as cited in Barron et al. (2013)
No. 2 fuel oil	nr	*Pandalus danae*	nr	nr	48 – 96 [b]	0.8	Malins 1977 as cited in Barron et al. (2013)
No. 2 fuel oil	nr	*Pandalus goniurus*	nr	nr	48 – 96 [b]	1.69	Malins 1977 as cited in Barron et al. (2013)
No. 2 fuel oil	nr	*Paralithodes camtschaticus*	nr	nr	48 – 96 [b]	0.81	Rice et al 1979 as cited in Barron et al. (2013)
No. 2 fuel oil	nr	*Paralithodes camtschaticus*	nr	nr	48 – 96 [b]	5.1	Malins 1977 as cited in Barron et al. (2013)
No. 2 fuel oil	nr	*Salvelinus malma*	nr	nr	96	0.15	Rice et al 1979 as cited in Barron et al. (2013)
No. 2 fuel oil	nr	*Salvelinus malma*	nr	nr	96	2.29	Malins 1977 as cited in Barron et al. (2013)
No. 2 fuel oil	nr	*Xenacanthomysis pseudomacropsis*	nr	nr	48 – 96 [b]	2.31	Rice et al 1979 as cited in Barron et al. (2013)
Norman Wells Crude	Y	*Daphnia magna*	static	larval	48	4	Bobra et al. (1989)
Norman Wells Crude	N	*Daphnia magna*	static	larval	48	10	Bobra et al. (1989)
PBCO	N	*Atherinops affinis*	spiked	early-life stage	96	9.35	Singer et al. (2001) as cited in NRC (2005)
PBCO	nr	*Chlamys rubida*	nr	nr	48 – 96 [b]	2.07	Malins 1977 as cited in Barron et al. (2013)
PBCO	nr	*Cottus cognatus*	nr	nr	48 – 96 [b]	3	Moles et al. 1979 as cited in Barron et al. (2013)
PBCO	nr	*Eualus fabricii*	nr	nr	48 – 96 [b]	1.94	Malins 1977 as cited in Barron et al. (2013)
PBCO	Y	*Holmesimysis costata*	spiked	nr	96	0.951	Singer et al. (2001) as cited in NRC (2005)
PBCO	N	*Holmesimysis costata*	spiked	early-life stage	96	14.23	Singer et al. (2001) as cited in NRC (2005)
PBCO	N	*Menidia beryllina*	spiked	larval	96	11.83	Singer et al. (2001) as cited in NRC (2005)
PBCO	N	*Menidia beryllina*	flow-through	larval	96	14.81	Rhoton et al. (2001) as cited in NRC (2005)
PBCO	nr	*Oncorhynchus gorbuscha*	nr	nr	96	1.41	Malins 1977 as cited in Barron et al. (2013)
PBCO	nr	*Oncorhynchus gorbuscha*	nr	nr	96	3.73	Moles et al. 1979 as cited in Barron et al. (2013)
PBCO	nr	*Oncorhynchus kisutch*	nr	nr	96	1.45	Moles et al. 1979 as cited in Barron et al. (2013)
PBCO	nr	*Oncorhynchus nerka*	nr	nr	96	1.05	Moles et al. 1979 as cited in Barron et al. (2013)
PBCO	nr	*Oncorhynchus tshawytscha*	nr	nr	96	1.47	Moles et al. 1979 as cited in Barron et al. (2013)
PBCO	nr	*Pandalus borealis*	nr	nr	48 – 96 [b]	2.11	Malins 1977 as cited in Barron et al. (2013)

Table 3. Available median lethal toxicity values (LC50) for crude oil, cont.

Oil Type	Weathered (Y/N)	Latin Name	Type of Exposure	Life Stage	Duration (h)	Oil LC50 (ppm TPH)	Source
PBCO	nr	*Pandalus goniurus*	nr	nr	48 – 96 [b]	1.26	Malins 1977 as cited in Barron et al. (2013)
PBCO	nr	*Pandalus hypsinotus*	nr	nr	48 – 96 [b]	1.96	Malins 1977 as cited in Barron et al. (2013)
PBCO	nr	*Paralithodes camtschaticus*	nr	nr	48 – 96 [b]	2.35	Malins 1977 as cited in Barron et al. (2013)
PBCO	nr	*Salvelinus alpinus*	nr	nr	96	2.17	Moles et al 1979 as cited in Barron et al. (2013)
PBCO	nr	*Salvelinus malma*	nr	nr	96	1.1	Malins 1977 as cited in Barron et al. (2013)
PBCO	nr	*Salvelinus malma*	nr	nr	96	1.25	Moles et al 1979 as cited in Barron et al. (2013)
PBCO	nr	*Thymallus arcticus*	nr	nr	48 – 96 [b]	2.04	Moles et al 1979 as cited in Barron et al. (2013)
PBCO	N	*Oncorhynchus tshawytscha*	constant	juvenile	96	6.2	Van Scoy et al. (2010)
PBCO	N	*Oncorhynchus tshawytscha*	constant	juvenile	96	7.46	Lin et al. (2009)
SLC	nr	*Americamysis almyra*	nr	nr	48 – 96 [b]	8.7	Malins 1977 as cited in Barron et al. (2013)
SLC	N	*Americamysis bahia*	nr	nr	48	2.7	Hemmer et al. (2011)
SLC	nr	*Capitella capitata*	nr	nr	48 – 96 [b]	12	Malins 1977 as cited in Barron et al. (2013)
SLC	nr	*Cyprinodon variegatus*	nr	nr	96	19.8	Malins 1977 as cited in Barron et al. (2013)
SLC	N	*Fundulus grandis*	static	non-embryo	96	8.3	Liu et al 2003 as cited in Barron et al. (2013)
SLC	nr	*Fundulus similis*	nr	nr	96	16.8	Malins 1977 as cited in Barron et al. (2013)
SLC	nr	*Leander tenuicornis*	nr	nr	48 – 96 [b]	6	Malins 1977 as cited in Barron et al. (2013)
SLC	N	*Litopenaeus setiferus*	static	non-embryo	96	6.5	Liu et al 2003 as cited in Barron et al. (2013)
SLC	N	*Menidia beryllina*	nr	nr	96	3.5	Hemmer et al. (2011)
SLC	nr	*Menidia beryllina*	nr	nr	96	5.5	Malins 1977 as cited in Barron et al. (2013)
SLC	nr	*Neanthes arenaceodentata*	nr	nr	48 – 96 [b]	12	Malins 1977 as cited in Barron et al. (2013)
SLC	nr	*Palaemonetes pugio*	nr	nr	48 – 96 [b]	10.7	Malins 1977 as cited in Barron et al. (2013)
SLC	nr	*Platynereis dumerilii*	nr	nr	48 – 96 [b]	9.5	Malins 1977 as cited in Barron et al. (2013)
VCO	N	*Americamysis bahia*	static (90% renewal), sealed	larval	96	0.15	Wetzel and Van Fleet (2001)
VCO	N	*Americamysis bahia*	spiked	larval	96	0.59	Wetzel and Van Fleet (2001)
VCO	N	*Menidia beryllina*	spiked	larval	96	0.63	Wetzel and Van Fleet (2001)
VCO	N	*Sciaenops ocellatus*	spiked	larval	96	0.85	Wetzel and Van Fleet (2001)

Primary sources: NRC (2005), George-Ares and Clark (2000), and Barron et al. (2013) (supplemental material)

[a] Freshwater species.
[b] Exact durations were not reported by Barron et al. (2013), but the acceptability criterion for invertebrate species tests was reported as between 48 and 96 hours.

ALC – Arabian light crude oil
AMC – Arabian medium fuel oil
ANS – Alaska North Slope crude oil
BSC – Bass Strait crude oil
CIC – Cook Inlet crude oil
EPA – US Environmental Protection Agency
KFO – Kuwait fuel oil
LC50 – concentration that is lethal to 50% of an exposed population
nr – not reported
PBCO – Prudhoe Bay crude oil
ppm – parts per million
SLC – Sweet Louisiana Crude oil
TPH – total petroleum hydrocarbons
VCO – Venezuelan medium crude oil

Table 4. Available median lethal toxicity values (LC50) for oil and oil dispersed by current-use and NPL-listed chemical dispersants

Dispersant Chemical	Oil Type	Weathered (Y/N)	DOR	Latin Name	Type of Exposure	Life Stage	Duration (h)	Oil-only LC50 (ppm TPH)	Dispersed Oil LC50 (ppm TPH)	Relative Toxicity[a]	Source
Corexit 9500	BSC	N	1:10	*Allorchestes compressa*	static (60% renewal)	nr	96	311,000	14.8	more toxic	Gulec et al. (1997)
Corexit 9500	AMC	N	1:10	*Americamysis bahia*	static (75% renewal), sealed	larval	96	0.56 – 0.67	0.64 – 0.65	less toxic	Fuller and Bonner (2001) as cited in NRC (2005)
Corexit 9500	AMC	N	1:10	*Americamysis bahia*	spiked	larval	96	26.1 – 83.1	56.5 – 60.8	less toxic	Fuller and Bonner (2001) as cited in NRC (2005)
Corexit 9500	ANS	N	1:10	*Americamysis bahia*	continuous	larval	96	2.61	1.4	more toxic	Rhoton et al. (2001) as cited in NRC (2005)
Corexit 9500	ANS	N	1:10	*Americamysis bahia*	spiked	larval	96	8.21	5.08	more toxic	Rhoton et al. (2001) as cited in NRC (2005)
Corexit 9500	Forties	N	1:10	*Americamysis bahia*	constant	nr	96	--	0.42	na	Clark et al. (2001)
Corexit 9500	Forties	N	1:10	*Americamysis bahia*	spiked	nr	96	--	15.3	na	Clark et al. (2001)
Corexit 9500	No. 2 fuel oil	N	1:10	*Americamysis bahia*	static daily renewal	eggs	48	16.12	3.4	more toxic	EPA (1995)
Corexit 9500	PBCO	N	1:10	*Americamysis bahia*	spiked	larval	96	>6.86	15.9	na	Wetzel and Van Fleet (2001)
Corexit 9500	VCO	N	1:10	*Americamysis bahia*	spiked	larval	96	0.59 – 0.89	10.2 – 18.1	less toxic	Wetzel and Van Fleet (2001)
Corexit 9500	VCO	N	1:10	*Americamysis bahia*	static (90% renewal), sealed	larval	96	0.15 – 0.4	0.5 – 0.53	less toxic	Wetzel and Van Fleet (2001)
Corexit 9500	VCO	Y	1:10	*Americamysis bahia*	spiked	larval	96	> 0.63 – > 0.83	72.6 – 120.8	na	Wetzel and Van Fleet (2001)
Corexit 9500	PBCO	N	1:10	*Atherinops affinis*	spiked	early-life stage	96	9.35 – 12.13	7.27 – 17.7	more toxic	Singer et al. (2001) as cited in NRC (2005)
Corexit 9500	PBCO	Y	1:10	*Atherinops affinis*	spiked	nr	96	> 1.45 – > 1.60	16.86 – 18.06	na	Singer et al. (2001) as cited in NRC (2005)
Corexit 9500	ANS	N	1:20	*Boreogadus saida*	spiked	< 1 year	96	1.2	45	less toxic	
Corexit 9500	ANS	N	1:20	*Boreogadus saida*	spiked	< 1 year	96	2	46	less toxic	McFarlin et al. (2011)
Corexit 9500	ANS	N	1:20	*Boreogadus saida*	spiked	< 1 year	96	1.5	80	less toxic	McFarlin et al. (2011)
Corexit 9500	ANS	N	1:20	*Boreogadus saida*	spiked	< 1 year	96	--	50	na	McFarlin et al. (2011)
Corexit 9500	ANS	N	1:20	*Calanus glacialis*	spiked	nr	96	4	14	less toxic	McFarlin et al. (2011)
Corexit 9500	ANS	N	1:20	*Calanus glacialis*	spiked	nr	96	2.4	15	less toxic	McFarlin et al. (2011)
Corexit 9500	ANS	N	1:20	*Calanus glacialis*	spiked	nr	96	5	16	less toxic	McFarlin et al. (2011)
Corexit 9500	ANS	N	1:20	*Calanus glacialis*	spiked	nr	96	3.3	18	less toxic	McFarlin et al. (2011)
Corexit 9500	ANS	N	1:20	*Calanus glacialis*	spiked	nr	96	> 1.0	30	na	McFarlin et al. (2011)
Corexit 9500	ANS	N	1:20	*Calanus glacialis*	spiked	nr	96	> 5.5	30	na	McFarlin et al. (2011)
Corexit 9500	ANS	N	1:20	*Calanus glacialis*	spiked	nr	96	4	37	less toxic	McFarlin et al. (2011)
Corexit 9500	ANS	N	1:20	*Calanus glacialis*	spiked	nr	96	> 1.0	50	na	McFarlin et al. (2011)
Corexit 9500	ANS	N	1:20	*Calanus glacialis*	spiked	nr	96	> 0.8	75	na	McFarlin et al. (2011)
Corexit 9500	ANS	N	1:20	*Calanus glacialis*	spiked	nr	96	> 0.9	75	na	McFarlin et al. (2011)
Corexit 9500	ANS	N	1:20	*Calanus glacialis*	spiked	nr	96	> 0.8	79	na	McFarlin et al. (2011)
Corexit 9500	ALC	N	1:25	*Clupea harengus*	static daily renewal	embryos	336	--	4.33	na	Lee et al. (2011)
Corexit 9500	ANS	N	1:25	*Clupea harengus*	static daily renewal	embryos	336	--	2.03	na	Lee et al. (2011)
Corexit 9500	ANS	N	1:25	*Clupea pallasi*	static daily renewal	embryos	336	--	1.94	na	Lee et al. (2011)
Corexit 9500	MESA	N	1:25	*Clupea pallasi*	static daily renewal	embryos	336	--	1.75	na	Lee et al. (2011)

Table 4. Available median lethal toxicity values (LC50) for oil and oil dispersed by current-use and NPL-listed chemical dispersants, cont.

Dispersant Chemical	Oil Type	Weathered (Y/N)	DOR	Latin Name	Type of Exposure	Life Stage	Duration (h)	Oil-only LC50 (ppm TPH)	Dispersed Oil LC50 (ppm TPH)	Relative Toxicity[a]	Source
Corexit 9500	Forties	N	1:10	*Crassostrea gigas*	constant	larval	48	--	0.81	na	Clark et al. (2001)
Corexit 9500	Forties	N	1:10	*Crassostrea gigas*	spiked	larval	48	--	3.99	na	Clark et al. (2001)
Corexit 9500	AMC	Y	1:10	*Cyprinodon variegatus*	spiked	larval	96	> 5.7 – 6.1	31.9 – 39.5	na	Fuller and Bonner (2001) as cited in NRC (2005)
Corexit 9500	AMC	Y	1:10	*Cyprinodon variegatus*	static (75% renewal), sealed	larval	96	3.9 – 4.2	>9.7 – 10.8	na	Fuller and Bonner (2001) as cited in NRC (2005)
Corexit 9500	PBCO	Y	1:10	*Holmesimysis costata*	spiked	nr	96	0.951 – 1.03	5.72 – 33.27	less toxic	Singer et al. (2001) as cited in NRC (2005)
Corexit 9500	BSC	N	1:29	*Hydra viridissima*[b]	static	larval	96	0.7	7.2	less toxic	Mitchell and Holdway (2000)
Corexit 9500	ANS	N	1:20	*Litopenaeus setiferus*	static	non-embryo	96	6.59	7.5	less toxic	Liu et al. (2006)
Corexit 9500	BSC	N	1:10	*Macquaria novemaculeata*	static (50% renewal)	larval	96	465000	14.1	more toxic	Gulec and Holdway (2000)
Corexit 9500	BSC	N	1:50	*Melonotaenia fluviatilis*[b]	static, daily renewal	embryo	24	4.48	2.26	more toxic	Pollino and Holdway (2002)
Corexit 9500	BSC	N	1:50	*Melonotaenia fluviatilis*[b]	static, daily renewal	embryo	48	3.38	1.94	more toxic	Pollino and Holdway (2002)
Corexit 9500	BSC	N	1:50	*Melonotaenia fluviatilis*[b]	static, daily renewal	embryo	72	2.1	1.67	more toxic	Pollino and Holdway (2002)
Corexit 9500	BSC	N	1:50	*Melonotaenia fluviatilis*[b]	static, daily renewal	embryo	96	1.28	1.37	less toxic	Pollino and Holdway (2002)
Corexit 9500	ALC	Y	1:10	*Menidia beryllina*	spiked	larval	96	> 14.5 – 32.3	24.9 – 36.9	na	Fuller and Bonner (2001) as cited in NRC (2005)
Corexit 9500	ALC	Y	1:10	*Menidia beryllina*	static (75% renewal), sealed	early-life stage	96	4.9 – 5.5	1.5 – 2.5	more toxic	Fuller and Bonner (2001) as cited in NRC (2005)
Corexit 9500	ANS	Y	1:10	*Menidia beryllina*	continuous	larval	96	0.79	0.65	more toxic	Rhoton et al. (2001) as cited in NRC (2005)
Corexit 9500	ANS	N	1:10	*Menidia beryllina*	continuous	larval	96	15.59	12.42	more toxic	Rhoton et al. (2001) as cited in NRC (2005)
Corexit 9500	ANS	N	1:10	*Menidia beryllina*	spiked	larval	96	26.36	12.22	more toxic	Rhoton et al. (2001) as cited in NRC (2005)
Corexit 9500	ANS	Y	1:10	*Menidia beryllina*	spiked	larval	96	> 1.13	18.89	na	Rhoton et al. (2001) as cited in NRC (2005)
Corexit 9500	Forties	N	1:10	*Menidia beryllina*	constant	nr	96	--	0.49	na	Clark et al. (2001)
Corexit 9500	Forties	N	1:10	*Menidia beryllina*	spiked	early-life stage	96	--	9.05	na	Clark et al. (2001)
Corexit 9500	PBCO	N	1:10	*Menidia beryllina*	continuous	larval	96	14.81	4.57	more toxic	Rhoton et al. (2001) as cited in NRC (2005)
Corexit 9500	PBCO	N	1:10	*Menidia beryllina*	spiked	larval	96	> 19.86	12.29	more toxic	Rhoton et al. (2001) as cited in NRC (2005)
Corexit 9500	PBCO	Y	1:10	*Menidia beryllina*	spiked	larval	96	--	20.28	na	Singer et al. (2001) as cited in NRC (2005)
Corexit 9500	PBCO	N	1:10	*Menidia beryllina*	spiked	larval	96	11.83	32.47	less toxic	Singer et al. (2001) as cited in NRC (2005)
Corexit 9500	PBCO	N	1:10	*Menidia beryllina*	spiked	larval	96	> 6.86	18.1	na	Wetzel and Van Fleet (2001)
Corexit 9500	VCO	N	1:10	*Menidia beryllina*	spiked	larval	96	0.63	2.84	less toxic	Wetzel and Van Fleet (2001)
Corexit 9500	VCO	Y	1:10	*Menidia beryllina*	spiked	larval	96	> 1.06	30.8	na	Wetzel and Van Fleet (2001)
Corexit 9500	VCO	N	1:10	*Menidia beryllina*	static (90% renewal), sealed	larval	96	<0.11	0.68	less toxic	Wetzel and Van Fleet (2001)
Corexit 9500	ANS	N	1:20	*Myoxocephalus* sp.	spiked	larvae	96	> 1.4	18	na	McFarlin et al. (2011)
Corexit 9500	ANS	N	1:20	*Myoxocephalus* sp.	spiked	larvae	96	1.6	17	less toxic	McFarlin et al. (2011)
Corexit 9500	ANS	N	1:20	*Myoxocephalus* sp.	spiked	larvae	96	3	29	less toxic	McFarlin et al. (2011)

Table 4. Available median lethal toxicity values (LC50) for oil and oil dispersed by current-use and NPL-listed chemical dispersants, cont.

Dispersant Chemical	Oil Type	Weathered (Y/N)	DOR	Latin Name	Type of Exposure	Life Stage	Duration (h)	Oil-only LC50 (ppm TPH)	Dispersed Oil LC50 (ppm TPH)	Relative Toxicity[a]	Source
Corexit 9500	ANS	N	1:20	*Myoxocephalus* sp.	spiked	larvae	96	3.3	46	less toxic	McFarlin et al. (2011)
Corexit 9500	PCBO	N	1:10	*Oncorhynchus tshawytscha*	constant	juvenile	96	6.2 – 9.9	37 – 60.5	less toxic	Van Scoy et al. (2010)
Corexit 9500	PCBO	N	1:10	*Oncorhynchus tshawytscha*	constant	juvenile	96	7.46	155.93	less toxic	Lin et al. (2009)
Corexit 9500	BSC	N	1:10	*Palaemon serenus*	static (50% renewal)	nr	96	258000	3.6	more toxic	Gulec and Holdway (2000)
Corexit 9500	VCO	N	1:10	*Sciaenops ocellatus*	spiked	larval	96	0.85	4.23	less toxic	Wetzel and Van Fleet (2001)
Corexit 9500	Forties	N	1:10	*Scophthalamus maximus*	constant	nr	48	0.35	0.44	less toxic	Clark et al. (2001)
Corexit 9500	Forties	N	1:10	*Scophthalamus maximus*	spiked	nr	48	> 1.33	48.6	na	Clark et al. (2001)
Corexit 9500	Iranian heavy crude	N	1:10	*Tigriopus japonicus*	static	juvenile	96	124.3	10.7	more toxic	Lee et al. (2013)
Corexit 9527	BSC	N	1:10	*Allorchestes compressa*	static (60% renewal)	nr	96	311000	16.2	more toxic	(Gulec et al., 1997) as cited in NRC (2005)
Corexit 9527	KCO	Y	1:10	*Americamysis bahia*	constant	nr	96	--	0.11	na	Clark et al. (2001)
Corexit 9527	KCO	N	1:10	*Americamysis bahia*	constant	nr	96	0.63	0.65	less toxic	Clark et al. (2001)
Corexit 9527	KCO	N	1:10	*Americamysis bahia*	spiked	nr	96	> 2.93	17.2	na	Clark et al. (2001)
Corexit 9527	KCO	Y	1:10	*Americamysis bahia*	spiked	nr	96	> 0.17	111	na	Clark et al. (2001)
Corexit 9527	KCO	N	1:10	*Americamysis bahia*	spiked	nr	96	> 2.9	17.7	na	Pace et al. (1995) as cited in NRC (2005)
Corexit 9527	KCO	N	1:10	*Americamysis bahia*	static daily renewal, sealed	nr	96	0.78	0.98	less toxic	Pace et al. (1995) as cited in NRC (2005)
Corexit 9527	PBCO	N	1:10	*Atherinops affinis*	spiked	early-life stage	96	16.34 – 40.2	28.6 – 74.73	less toxic	Singer et al. (1998) as cited in NRC (2005)
Corexit 9527	ANS	Y	1:25	*Clupea pallasi*	static	larval	24	0.045	0.199	less toxic	Barron et al. (2004) as cited in NRC (2005)
Corexit 9527	KCO	N	1:10	*Crassostrea gigas*	constant	larval	48	--	0.5	na	Clark et al. (2001)
Corexit 9527	KCO	N	1:10	*Crassostrea gigas*	spiked	larval	48	--	1.92	na	Clark et al. (2001)
Corexit 9527	MFO	N	1:10	*Crassostrea gigas*	constant	larval	48	> 1.14	0.53	more toxic	Clark et al. (2001)
Corexit 9527	MFO	N	1:10	*Crassostrea gigas*	spiked	larval	48	> 1.83	2.28	na	Clark et al. (2001)
Corexit 9527	Norman Wells crude	N	1:20	*Daphnia magna*	static	larval	48	10	14	less toxic	Bobra et al. (1989)
Corexit 9527	Norman Wells crude	Y	1:20	*Daphnia magna*	static	larval	48	4	15	less toxic	Bobra et al. (1989)
Corexit 9527	Norman Wells crude	Y	1:20	*Daphnia magna*	static	larval	48	> 0.2	17	na	Bobra et al. (1989)
Corexit 9527	KCO	N	1:10	*Holmesimysis costata*	constant	nr	96	0.1	0.17	less toxic	Clark et al. (2001)
Corexit 9527	KCO	N	1:10	*Holmesimysis costata*	spiked	nr	96	> 2.76	1.8	more toxic	Clark et al. (2001)
Corexit 9527	PBCO	N	1:10	*Holmesimysis costata*	spiked	juvenile	96	> 25.45 – > 34.68	10.54 – 10.83	more toxic	Singer et al. (1998) as cited in NRC (2005)
Corexit 9527	PBCO	N	1:10	*Holmesimysis costata*	spiked	early-life stage	96	14.23 – > 17.5	9.46 – 14.4	more toxic	Singer et al. (2001) as cited in NRC (2005)
Corexit 9527	BSC	N	1:29	*Hydra viridissima*[b]	static	nr	96	0.7	9	less toxic	Mitchell and Holdway (2000)
Corexit 9527	BSC	N	1:10	*Macquaria novemaculeata*	static (50% renewal)	larval	96	465000	28.5	more toxic	Gulec and Holdway (2000)

Table 4. Available median lethal toxicity values (LC50) for oil and oil dispersed by current-use and NPL-listed chemical dispersants, cont.

Dispersant Chemical	Oil Type	Weathered (Y/N)	DOR	Latin Name	Type of Exposure	Life Stage	Duration (h)	Oil-only LC50 (ppm TPH)	Dispersed Oil LC50 (ppm TPH)	Relative Toxicity[a]	Source
Corexit 9527	BSC	N	1:50	*Melonotaenia fluviatilis*[b]	static, daily renewal	embryo	48	3.38	2.92	more toxic	Pollino and Holdway (2002)
Corexit 9527	BSC	N	1:50	*Melonotaenia fluviatilis*[b]	static, daily renewal	embryo	72	2.1	1.25	more toxic	Pollino and Holdway (2002)
Corexit 9527	BSC	N	1:50	*Melonotaenia fluviatilis*[b]	static, daily renewal	embryo	96	1.28	0.74	more toxic	Pollino and Holdway (2002)
Corexit 9527	KCO	N	1:10	*Menidia beryllina*	constant	nr	96	0.97	0.55	more toxic	Clark et al. (2001)
Corexit 9527	KCO	Y	1:10	*Menidia beryllina*	constant	nr	96	0.14	1.09	less toxic	Clark et al. (2001)
Corexit 9527	KCO	N	1:10	*Menidia beryllina*	spiked	nr	96	> 1.32	6.45	na	Clark et al. (2001)
Corexit 9527	KCO	Y	1:10	*Menidia beryllina*	spiked	nr	96	> 0.66	10.9	na	Clark et al. (2001)
Corexit 9527	BSC	N	1:50	*Octopus pallidus*	semi-static	hatchling	24	0.51	3.11	less toxic	Long and Holdway (2002)
Corexit 9527	BSC	N	1:50	*Octopus pallidus*	semi-static	hatchling	48	0.39	1.8	less toxic	Long and Holdway (2002)
Corexit 9527	BSC	N	1:10	*Palaemon serenus*	static (50% renewal)	nr	96	258000	8.1	more toxic	Gulec and Holdway (2000)
Corexit 9527	Ecofisk	N	1:1	*Platichthys flesus*	constant	350-g juvenile	96	75	--	more toxic	Baklien et al. (1986)
Corexit 9527	KCO	N	1:10	*Scophthalamus maximus*	constant	nr	48	--	2	na	Clark et al. (2001)
Corexit 9527	KCO	N	1:10	*Scophthalamus maximus*	spiked	nr	48	--	16.5	na	Clark et al. (2001)
Norchem OSD-570	Diesel oil	N	1:10	*Balanus amphitrite*	static	larval	24	--	505	na	Wu et al. (1997)
Norchem OSD-570	Diesel oil	N	1:10	*Balanus amphitrite*	static	larval	48	--	71	na	Wu et al. (1997)
nr	Middle East crude oil	N	nr	*Paleamon elegans*	static	nr	24	83.5	1.1	more toxic	Unsal (1991) as cited in NRC (2005)
Omniclean	No. 2 fuel oil	N	1:1 to 1:10	*Cyprinodon variegatus*	static	larval	96	94	80 – 165	more toxic	Adams et al. (1999) as cited in NRC (2005)
Vecom B-1425	Diesel oil	N	1:10	*Balanus amphitrite*	static	larval	24	--	514	na	Wu et al. (1997)
Vecom B-1425	Diesel oil	N	1:10	*Balanus amphitrite*	static	larval	48	--	48	na	Wu et al. (1997)

Primary sources: NRC (2005) and George-Ares and Clark (2000)

[a] Relative toxicity indicates whether the mixture of dispersant and crude oil is more or less toxic than crude oil alone. The determination is based on the lowest available, comparable LC50 values for both crude oil and dispersed oil reported in the study. Comparable data are bounded LC50 values or unbounded LC50 ranges that exclude the other bounded LC50 value or unbounded range.

[b] Freshwater species.

AMC – Arabian medium crude
ANS – Alaska North Slope crude oil
BSC – Bass Strait crude oil
DOR – dispersant-to-oil ratio
KCO – Kuwait crude oil
LC50 – lethal concentration for 50 % of the organisms tested
MESA – medium South American crude oil
MFO – medium fuel oil
NPL – National Priorities List
na – not applicable
nr – not reported
NRC – National Research Council
PBCO – Prudhoe Bay crude oil
VCO – Venezuelan medium crude oil

Table 5. Available sublethal toxicity values for oil and oil dispersed by current-use and NPL-listed chemical dispersants

Dispersant Chemical	Oil Type	Weathered (Y/N)	DOR	Latin Name	Type of Exposure	Life Stage	Duration (h)	Endpoint	Oil EC50 (ppm TPH)	Dispersed Oil EC50 (ppm TPH)	Source(s)
Corexit 9500	ANS	N	nr	*Oncorhynchus mykiss*	static daily renewal	embryo	528	BSD Index	> 0.362	> 0.606	Wu et al. (2012)
Corexit 9500	Federated	N	nr	*Oncorhynchus mykiss*	static daily renewal	embryo	528	BSD Index	> 0.508	> 0.589	Wu et al. (2012)
Corexit 9500	MESA	N	nr	*Oncorhynchus mykiss*	static daily renewal	embryo	528	BSD Index	> 0.895	> 0.506	Wu et al. (2012)
Corexit 9500	Scotian light	N	nr	*Oncorhynchus mykiss*	static daily renewal	embryo	528	BSD Index	> 1.744	> 5.369	Wu et al. (2012)
Corexit 9500	ANS	N	nr	*Oncorhynchus mykiss*	static daily renewal	nr	528	chronic mortality	> 0.362	0.764	Wu et al. (2012)
Corexit 9500	Federated	N	nr	*Oncorhynchus mykiss*	static daily renewal	nr	528	chronic mortality	> 0.508	0.714	Wu et al. (2012)
Corexit 9500	MESA	N	nr	*Oncorhynchus mykiss*	static daily renewal	nr	528	chronic mortality	0.880	0.614	Wu et al. (2012)
Corexit 9500	Scotian light	N	nr	*Oncorhynchus mykiss*	static daily renewal	nr	528	chronic mortality	> 1.744	3.281	Wu et al. (2012)
Corexit 9500	ANS	N	nr	*Oncorhynchus mykiss*	static daily renewal	embryo	528	EROD activity (CYP1A induction)	> 0.362	0.500	Wu et al. (2012)
Corexit 9500	Federated	N	nr	*Oncorhynchus mykiss*	static daily renewal	embryo	528	EROD activity (CYP1A induction)	0.293	> 0.589	Wu et al. (2012)
Corexit 9500	MESA	N	nr	*Oncorhynchus mykiss*	static daily renewal	embryo	528	EROD activity (CYP1A induction)	0.735	0.517	Wu et al. (2012)
Corexit 9500	Mesa sour crude	Y	1:20	*Oncorhynchus mykiss*	static daily renewal	juvenile	48	EROD activity (CYP1A induction)	1.06E-05	1.00E-07	Ramachandran et al. (2004)
Corexit 9500	Scotian light	N	1:50	*Oncorhynchus mykiss*	static daily renewal	juvenile	48	EROD activity (CYP1A induction)	3.90E-05	6.60E-06	Ramachandran et al. (2004)
Corexit 9500	Scotian light	N	nr	*Oncorhynchus mykiss*	static daily renewal	embryo	528	EROD activity (CYP1A induction)	> 1.744	2.415	Wu et al. (2012)
Corexit 9500	Terra Nova	N	1:20	*Oncorhynchus mykiss*	static daily renewal	juvenile	48	EROD activity (CYP1A induction)	3.35E-04	3.00E-07	Ramachandran et al. (2004)
Corexit 9500	ANS	N	nr	*Oncorhynchus mykiss*	static daily renewal	embryo	528	percentage normal	0.133	0.226	Wu et al. (2012)
Corexit 9500	Federated	N	nr	*Oncorhynchus mykiss*	static daily renewal	embryo	528	percentage normal	0.072	0.053	Wu et al. (2012)
Corexit 9500	MESA	N	nr	*Oncorhynchus mykiss*	static daily renewal	embryo	528	percentage normal	0.657	0.157	Wu et al. (2012)
Corexit 9500	Scotian light	N	nr	*Oncorhynchus mykiss*	static daily renewal	embryo	528	percentage normal	1.440	1.168	Wu et al. (2012)
Corexit 9500	BSC	N	1:29	*Hydra viridissima*	static renewal	adult	168	population growth rate	> 0.6	4	Mitchell and Holdway (2000)
Corexit 9500	ANS	N	nr	*Oncorhynchus mykiss*	static daily renewal	embryo	528	ratio of yolk weight to fish weight	> 0.362	> 1.015	Wu et al. (2012)
Corexit 9500	Federated	N	nr	*Oncorhynchus mykiss*	static daily renewal	embryo	528	ratio of yolk weight to fish weight	> 0.508	> 1.218	Wu et al. (2012)
Corexit 9500	MESA	N	nr	*Oncorhynchus mykiss*	static daily renewal	embryo	528	ratio of yolk weight to fish weight	0.823	0.777	Wu et al. (2012)
Corexit 9500	Scotian light	N	nr	*Oncorhynchus mykiss*	static daily renewal	embryo	528	ratio of yolk weight to fish weight	> 1.744	> 3.996	Wu et al. (2012)
Corexit 9500	ANS	N	1:25	*Clupea harengus*	static	embryos	2.4	reduced hatch	nr	11.08	Lee et al. (2011)
Corexit 9500	ANS	N	1:25	*Clupea harengus*	static	embryos	8	reduced hatch	nr	3.07	Lee et al. (2011)
Corexit 9500	ANS	N	1:25	*Clupea harengus*	static	embryos	24	reduced hatch	nr	0.49	Lee et al. (2011)
Corexit 9500	ANS	N	1:25	*Clupea harengus*	static	embryos	336	reduced hatch	nr	<0.25	Lee et al. (2011)
Corexit 9500	Arabian light	N	1:25	*Clupea harengus*	static	embryos	2.4	reduced hatch	nr	18	Lee et al. (2011)
Corexit 9500	Arabian light	N	1:25	*Clupea harengus*	static	embryos	8	reduced hatch	nr	2.21	Lee et al. (2011)
Corexit 9500	Arabian light	N	1:25	*Clupea harengus*	static	embryos	24	reduced hatch	nr	1.94	Lee et al. (2011)
Corexit 9500	Arabian light	N	1:25	*Clupea harengus*	static	embryos	336	reduced hatch	nr	<0.37	Lee et al. (2011)
Corexit 9500	ANS	N	nr	*Oncorhynchus mykiss*	static daily renewal	embryo	528	severity index	> 0.362	0.663	Wu et al. (2012)
Corexit 9500	Federated	N	nr	*Oncorhynchus mykiss*	static daily renewal	embryo	528	severity index	0.506	0.619	Wu et al. (2012)
Corexit 9500	MESA	N	nr	*Oncorhynchus mykiss*	static daily renewal	embryo	528	severity index	0.826	0.560	Wu et al. (2012)
Corexit 9500	Scotian light	N	nr	*Oncorhynchus mykiss*	static daily renewal	embryo	528	severity index	> 1.744	2.577	Wu et al. (2012)

Dispersant Chemical	Oil Type	Weathered (Y/N)	DOR	Latin Name	Type of Exposure	Life Stage	Duration (h)	Endpoint	Oil EC50 (ppm TPH)	Dispersed Oil EC50 (ppm TPH)	Source(s)
Corexit 9527	PBCO	N	1:10	*Haliotis refescens*	spike-flow through	adult	48	abnormal larval growth	> 33.58 to > 46.99	17.81 to 32.7	Singer et al. (1998)
Corexit 9527	PBCO	N	1:10	*Atherinops affinis*	spike-flow through	adult	96	initial narcosis	16.34 to 40.2	> 62.22 to > 140.97	Singer et al. (1998)
Corexit 9527	PBCO	N	1:10	*Holmesimysis costata*	spiked-flow through	adult	96	initial narcosis	11.1 to 15.9	111.07 to 48.03	Singer et al. (1998)
Corexit 9527	BSC	N	1:29	*Hydra viridissima*	static renewal	adult	168	population growth rate	> 0.6	0.6	Mitchell and Holdway (2000)
Norchem OSD-570	Diesel oil	N	1:10	*Balanus amphitrite*	static	larvae	24	phototaxis inhibition	nr	400	Wu et al. (1997)
Norchem OSD-570	Diesel oil	N	1:10	*Balanus amphitrite*	static	larvae	48	phototaxis inhibition	nr	80	Wu et al. (1997)
Omniclean	No. 2 fuel oil	N	1:1 – 1:10	*Cyprinodon variegatus*	static	< 24h fry	168	early life stage biomass production	nr	25	Singer et al. (1998)
Vecom B-1425	Diesel oil	N	1:10	*Balanus amphitrite*	static	larvae	24	phototaxis inhibition	nr	400	Wu et al. (1997)
Vecom B-1426	Diesel oil	N	1:10	*Balanus amphitrite*	static	larvae	48	phototaxis inhibition	nr	60	Wu et al. (1997)

Primary sources: NRC (2005) and George-Ares and Clark (2000)

ANS – Alaska North Slope crude oil
BSC – Bass Strait crude oil
BSD – blue sac disease
DOR – dispersant to oil ratio
EC50 – concentration that causes a non-lethal effect in 50% of an exposed population
EROD – ethoxyresorufin-O-deethylase
MESA – medium South American crude oil
NPL – National Priorities List
nr – not reported
NRC – National Research Council
PBCO – Prudhoe Bay crude oil
ppm – parts per million
TPH – total petroleum hydrocarbons

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APPENDIX C. BEST MANAGEMENT PRACTICES

Best Management Practices

Best management practices (BMPs) provided by Alaska supporting documents (Alaska Clean Seas) and the Geographic Response Strategies (GRSs) for minimizing the impact of oil spill response actions:

1) General Protections

a) Consult the GRS of the area of concern for site-appropriate cleanup actions, materials, deployment methods and locations, and valued resources (e.g., wildlife populations, important habitat).

b) Use existing roads, docks, airstrips, or other constructed features (e.g., gravel pad) to access site and mobilize equipment, unless otherwise indicated in the GRS.

c) Constantly monitor the trajectory of the spill and weather forecast.

d) Properly deploy, maintain, reconfigure, and redeploy oil containment and retrieval equipment to ensure wildlife safety (from entrapment), proper functioning and efficiency, and minimal harm to the local ecosystem.

e) Be aware of / watch for wildlife, including birds, marine mammals (e.g., sea otters, seals, or whales) and terrestrial mammals (e.g., foxes or bears) that may be encountered while performing field-based response activities.

f) Keep away from relevant populations of sensitive or dangerous wildlife. For specific distances, consult the GRS for each location. Do not approach, disturb, scare, deter, haze, touch, harass, handle, throw objects at, or capture any wildlife.

g) As a preliminary measure, hazing, capture and hold, and relocation of wildlife / shellfish may be necessary to ensure safety of receptor populations; however, these activities must be conducted by trained personnel, under the authority of a state permit.

h) Follow all incident-specific wildlife-related protocols included in the Incident Action Plan.

i) Use the STAR manual when beaches are in danger of oiling and containment is unlikely.

   i) If beaches will be cleaned, allow all oil to come ashore before action.

   ii) Only use approved methods of shoreline cleanup actions appropriate to the shoreline type, sediment type, tidal zone, and level of protection from wave energy and erosion.

j) Dispersants should be applied, as determined by the FOSC and with the concurrence of the incident-specific regional response team, at the prescribed application rate, under inclement weather conditions, and to oils with the appropriate physico-chemical properties.

   i) Dispersant use in nearshore habitats should be avoided.

   ii) Dispersant use near concentrations of wildlife should be avoided.

k) *In situ* burning should be utilized away from sensitive receptors (wildlife and human populations) to minimize smoke inhalation.

   i) Only burn oil when there is minimal chance of causing additional damage to the tundra or when smoke will not affect wildlife or human populations in the area.

l) Take measures to minimize compaction of tundra and shoreline sediments, especially when oiled

2) Response-specific Protections

a) Deflection, Diversion or Exclusion Booming

   i) Properly anchor booms to achieve desired positioning.

   ii) Use additional booms to prevent boom entrainment.

   iii) Avoid the use of live booming due to the difficulty of the procedure.

   iv) Continually monitor and readjust booms to meet changing conditions.

b) Shoreside Recovery

   i) Maintain proper storage equipment and area for recovered oil.

   ii) Monitor equipment and adjust based on changing conditions.

   iii) Constantly monitor equipment efficiency.

   iv) Use proper equipment to minimize waste and wastewater production (e.g., decant equipment).

c) Marine Recovery

   i) Use oleophillic and decanting systems where appropriate to minimize waste and wastewater production.

   ii) Monitor and reposition collection devices.

   iii) Constantly monitor equipment efficiency.

   iv) Be wary of large, submerged rocks when transporting recovery equipment.

d) Free-oil Recovery

   i) Use the proper boom configuration or combinations of configurations to best concentrate and capture oil.

   ii) Use the proper equipment based on water depth.

   iii) Develop plan for the transport of oil from collection equipment to transport vessels.

   iv) Use decant systems when feasible to minimize waste.

e) Follow GRS instructions and use associated maps for deployment of recovery methods (a-d) at specific locations.

f) Passive Recovery and Debris Removal

   i) Use appropriate absorbent material to minimize oiling of shorelines .

      (1) Snare booms for persistent oils (e.g., crude oil, Bunker C fuel) and sorbent booms for non-persistent oil (e.g., hydraulic oil, diesel fuel).

   ii) Properly anchor equipment.

   iii) Use natural sorbent materials in mammal haul-outs (i.e. sphagnum or peat mosses).

   iv) Monitor the effectiveness of sorbent materials and replace periodically, if necessary, to maximize sorbent capabilities during the action

g) Cold Water Deluge on Shorelines

   i) Regulate deluge pressure to minimize beach erosion and destruction of benthic organisms.

h) Underflow Dam, Marine Spill

   i) Use a culvert with a capacity greater than the stream flow rate.

   ii) Construct the dam with plastic sheeting or sandbags when local substrate is too porous to contain oil.

   iii) Use as little local substrate as possible.

   iv) Once the area is no longer threatened by oil, remove the dam to allow fish passage.

   v) Constantly monitor dam integrity and replace eroded sediments when necessary.

   vi) Adjust pipe valves, pumps, or numbers of siphons to compensate for changing stream flow conditions.

Appendix D. Historical Spill Data

U.S. DEPARTMENT OF
HOMELAND SECURITY

United States Coast Guard

HISTORICAL SPILL DATABASE
FINAL

Prepared for:

United States Coast Guard
Seventeenth Coast Guard District
709 W. 9th Street
Juneau, AK 99803

and

United States Environmental Protection Agency
Region 10 Alaska Operations Office
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23 January 2014

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Acronyms

ADEC	Alaska Department of Environmental Conservation
BA	biological assessment
LOE	line of evidence
LPG	liquefied petroleum gas
MISLE	Marine Information for Safety and Law Enforcement
NOAA	National Oceanic and Atmospheric Administration
PCB	polychlorinated biphenyl
USCG	US Coast Guard

1 Introduction

In order to provide a historical context for the biological assessment (BA), a database of all reported releases of oil and other hazardous substances in Alaska was developed. Evidence of spills is provided in the text of the BA (Section 4) to support certain assumptions about the historical threat of oil spills and subsequent spill response actions to protected species and their critical habitats. The database also provides information on the applicability of certain response actions to historical spills. Perhaps most importantly, the database provides spatial information using spill locations, and allows for the creation of maps.

The database does not, in itself, provide a reasonable basis for projections of future spill events (i.e., number of spills), locations, volumes, response actions, or materials spilled, so this database should not be used alone to draw such conclusions. The investigation of historical evidence provides only one line of evidence (LOE) for making statements about future events, and it is a line based on common sense as opposed to logic. Other LOEs to support the determination of effects made in the BA include discussion of the spill response decision framework, response actions and their appropriate usage, species and their life histories, and the likely effects (both physical and chemical) manifested by exposure to response actions. Taken together, the LOEs support a weight of evidence approach for making a determination of effects for protected species. The use of historical knowledge in the context of this BA provides a useful approximation, from a spatial standpoint (as indicated above), of areas at risk for oil spills. Areas at risk may be due to a number of factors, including swift and treacherous currents, submerged obstructions (e.g., shoals and rocks), heavy vessel traffic, or a higher density of fuel storage facilities. Regardless of the reason for historical spills in any given location, the dangers may still be present and, therefore, the risk of a spill occurring because of those reasons may remain.

Data were compiled from multiple sources and represent a range of contaminant types, spill locations, and affected media. In developing the database, many steps were taken to logically structure and qualify the data, such that it would be comparable between data sources (i.e., multiple reporting agencies) as well as within data sources. These steps are discussed in Section 2 and the resulting database is provided in Appendix D-3.

Summaries of the historical spill data are provided in tables and figures in Section 3. The tables and figures, which include only data for spills in marine waters, represent the database as summarized in different ways.

2 Database Development

2.1 DATA ACQUISITION

Data were acquired from multiple agencies (Table 2-1) in multiple iterations, as well as from published literature. Multiple sources were used for completeness, because there may be instances when the jurisdiction of two reporting agencies overlap; one agency may report an incident when the other does not. Not all data were included in the database, and not all agencies reported data in a similar manner. If data were excluded or limited, the reasoning is provided in Section 2.2.

Table 2-1. Sources of historical oil and hazardous waste spill data

Database	Reporting Agency	Dates Included in Source	Used in Database?	Dates Included in Database
Statewide Oil and Hazardous Substance Spills database	ADEC	1970 to 2012	yes	January 1995 to July 2012
IncidentNews database	NOAA	1942 to 2012	yes	January 1995 to August 2012
National Response Center On-Line Reporting Tool	USCG	1995 to 2005	no	na
MISLE database	USCG	2008 to 2012	no	na

ADEC – Alaska Department of Environmental Conservation
MISLE – Marine Information for Safety and Law Enforcement
na – not applicable
NOAA – National Oceanic and Atmospheric Association
USCG – United States Coast Guard

Additional documents were reviewed as part of a search of relevant literature (ADEC, 2007a, b). From those documents, it was evident that the databases provided by the National Oceanic and Atmospheric Administration (NOAA) and Alaska Department of Environmental Conservation (ADEC) (Table 2-1) were more comprehensive and up-to-date than those presented in the literature.

2.2 DATA ORGANIZATION AND QUALIFICATION

The compilation of data required many steps to create a comparable and functional dataset. Those steps are discussed here.

While compiling data from multiple agencies, it was apparent that that reporting had been initiated by each agency on a different date and that reporting did not become rigorous or consistent until about 1995. The paucity of data from earlier years indicates a lack of reporting rather than a lack of spills.

Data were made available through two US Coast Guard (USCG) databases, but the ranges of dates were limited to 4 and 10 years (Table 2-1). Spill descriptions were also limited relative to other more comprehensive databases. Lastly, the number of spills reported by USCG was lower than that reported by ADEC for the same time period. The reason for the discrepancy is not known, but it was decided that the most complete record should be used for the purpose of this BA.

In many cases, a single spill event was reported by multiple agencies, or multiple times by a single agency. Redundant and overlapping data were deleted for approximately 7,000 records out of approximately 47,000 total spills of any type to any receiving environment (i.e., marine water, freshwater, upland, or containment). In some cases this proved difficult, because of a lack of clear spill descriptions. For example, some spills were reported by different agencies as being in two locations, having different spilled material volumes, or occurring on different dates or at different times. In many cases, common sense judgments allowed for selection of more appropriate data and deletion of less appropriate data. The limitation of the database presented in this appendix is that the information compiled is only as good as the information reported in the source databases.

Spatial data were available for much of the spill data included in the source databases. However, some data had either incorrectly reported or no reported coordinates. Incorrect values were apparent once the reported coordinates were mapped and examined. Spatial analysis was initially conducted by plotting each set of coordinates using ArcGIS (version 10.1) software, then noting whether each point had a unique location that corresponded with its respective nominal location (e.g., Alaska subregion or city) and primary media impacted. Narrative descriptions of spills or online news reports were used as necessary to derive nominal locations and infer spatial coordinates. Many reported coordinates were locations inland, or default coordinates relating to the region of the spill or the closest municipality. These coordinates were adjusted to better reflect spill narratives. Many of the coordinates reported by ADEC were inexact or incorrect, so for those spill incidents also included in the NOAA database, the coordinates reported by NOAA were used.

The use of inconsistent units of measurement (i.e., pounds or gallons) by different reporting agencies was reconciled in the database by applying appropriate conversion factors. Those factors are summarized in Table 2-2. Materials assumed to be solid or gaseous wastes were not included in the final database; tables and graphs presented in Section 3 represent liquid spills only. Spilled materials are included in Table 2-2 for completeness, but conversion factors are generally not given for those materials not requiring conversion for the final product.

Table 2-2. Conversion factors for reported spilled materials

Oil or Hazardous Material	Conversion Factor	Unit	Notes/Assumptions
Acid, other	8.5	lbs/gal	assume diluted
Ammonia (anhydrous)	5.2	lbs/gal	none
Arsenic	none	none	assume solid
Asphalt	none	none	assume solid
Bases	none	none	physical state unknown
Calcium chloride	none	none	solid
Calcium hypochlorite	none	none	solid
Caustic alkali liquids (caustic soda)	none	none	always reported as gal.
Chlorine	5.1	lbs/gal	assume gaseous upon release
Compressed gases	none	none	assume gaseous upon release
Diesel	7.2	lbs/gal	none
Drilling muds	none	none	reported as gal.
Emulsion breaker	none	none	chemical unknown
Engine lube oil	7.3	lbs/gal	none
Ethylene glycol (antifreeze)	9.3	lbs/gal	none
Freon™ (dichlorodifluoromethane, all types)	2.9	lbs/gal	none
Gasoline	6.1	lbs/gal	none
Glycol, other	9.3	lbs/gal	used value for mono-, chemical uncertain
Grease	none	none	chemical unknown
Hydrogen sulfide	none	none	assume gaseous upon release
Insecticide	none	none	chemical unknown
Lead	none	none	assume solid
Methyl alcohol (methanol)	6.6	lbs/gal	none
Natural gas	3.5	lbs/gal	assume gaseous upon release
Nitric acid (>40% solution)	11.4	lbs/gal	assume 60% solution
Oil (sheen)	8	lbs/gal	none
Other	none	none	chemical unknown
PCB	8	lbs/gal	none
Phosphoric acid, dimethyl 4-(methylthio)	14.1	lbs/gal	none
Phosphorus	none	none	solid
Propane (LPG)	4.2	lbs/gal	none
Sodium azide	none	none	solid
Sodium cyanide	none	none	solid

Oil or Hazardous Material	Conversion Factor	Unit	Notes/Assumptions
Sulfur (dioxide)	12	lbs/gal	assume gaseous upon release
Sulfur	none	none	solid
Sulfuric acid	15.4	lbs/gal	assume pure/100%
Transformer oil	7.5	lbs/gal	none
Unknown	none	none	chemical unknown
Urea	none	none	solid
Used oil (all types)	7.3	lbs/gal	none
Zinc	none	none	conversion unclear
Zinc concentrate	none	none	conversion unclear

LPG – liquefied petroleum gas
PCB – polychlorinated biphenyl

In many instances, gaps in descriptive parameters (i.e., nominal location, media affected, and type of material spilled) were filled by inferring information from other parameters. For example, if spatial coordinates were provided but no nominal location, the Alaska subregion could easily be inferred. Affected media was assigned based on information in other fields or descriptions in the databases.

After data had been compiled, descriptive parameters were also developed in order to facilitate data presentation. These parameters were not provided explicitly in source databases, but rather were extrapolated from given dates or spill substances. These added parameters include seasonality, month, and substance persistence (i.e., persistent or non-persistent). Season and month are important for assessing the possible historical impacts of oil spills on migratory species. Substance persistence is a binary parameter that indicates how long a spilled material is expected to last in the environment. Spilled oils are characterized as persistent or non-persistent based on their specific gravities, as well as the portion of their mass that is distillable at given temperatures (40 CFR 112, 2012). Heavier crude oil contains a larger volume of components that distill at higher temperatures (i.e., 370°C and hotter), whereas the components of lighter, non-persistent oils distill at lower temperatures (i.e., between 340 and 370°C). Persistent oils also have characteristically higher specific gravities. The type and persistence of spilled material may affect which response actions are conducted, as may the properties of spilled material; chemical dispersants and *in situ* burning have specific conditions (e.g., oil thickness and degree of weathering or emulsification) under which they can be used or performed (NRC, 2005).

3 Summary of Historical Data

This section provides a summary of the historical spill data from 1995 to 2012. Summaries are provided, in part, in Section 3 of the BA. Table 3-1 provides a summary of spill records presented in an ADEC published report that summarized spill data for the 10-year period from 1995 to 2005 (ADEC, 2007a). Additional figures and tables supporting the information provided in the BA are presented in the following:

- Table 3-2 provides the number of spills, by subregion; Table 3-2 compiles the total volumes spilled of any material in each region over the past 17 years.
- Tables 3-4 and 3-5 provide the number and total volume of materials spilled, respectively, by month, to illustrate the seasonality of accidents in Alaska. Figure 3-1 shows the number of spills per month; Figure 3-2 shows the total volume spilled, by month.
- Tables 3-6 and 3-7 compile the number of spills and volume by year, respectively; Figures 3-3 and 3-4 are graphs of the data in those tables.
- Tables 3-8 and 3-9 show historical spill data broken out by month and region; Figures 3-5 and 3-6 show these same data in graph form.
- Historical spills are compiled by month for each year in the database; the number of spills is provided in Table 3-10 and the volume in Table 3-11. Figures 3-7 and 3-8 display these data as stacked bar graphs.

Table 3-1. Summary of spills to waters of the state, by subarea contingency planning area, for the period of 1995 to 2005

Subarea	Total No. of Spills	No. of Spills > 1,000 gal.	Total Volume in Gallons (Largest Single Spill)	Average Spill Size (gal.)	Main Type of Materials Spilled	Facilities Associated with Spills
Aleutian Islands	683	10	469,439 (335,732)	687	**fuel oil, diese**l, bunker fuel, aviation fuel, gasoline, Freon®	vessels, canneries, petroleum storage, airport
Bristol Bay	296	11	59,708 (10,000)	202	**diesel**, gasoline, used oil, aviation fuel	power plants, petroleum storage, vessels, canneries, heating oil tanks for public facilities or homes
Cook Inlet	5,819	16	622,231 (120,000)	107	**jet fuel**, diesel, process water, ammonia	oil exploration and production, chemical manufacturing, pipeline, gas stations, airports, railroad, military facilities, vessels
Interior Alaska	4,179	87	782,403 (462,000)	187	**sodium dichromate**, crude oil, diesel, process water, aviation fuel, ethylene glycol	hatchery, pipeline, airports, mining, vehicles, petroleum storage, military facilities
Kodiak Island	590	6	25,796 (7,000)	44	**diesel**, hydraulic oil, aviation fuel, gasoline	vessels, petroleum storage, logging operations, military facilities
North Slope	4,481	133	1,916,958 (994,400)	448	**process water**, crude oil, diesel, drilling mud, ethylene glycol, methanol	oil exploration and production, pipeline, vehicles, public facilities, power plants, airfield, petroleum storage
Northwest Arctic	1,483	48	1,105,220 (200,000)	745	**magnesium oxide slurry**, zinc concentrate, gasoline, diesel, process water, propylene glycol	mining, petroleum storage, power plants, public facilities, homes
Prince William Sound	813	18	146,436 (35,000)	180	**diesel**, crude oil, oily ballast water, process water, fuel oil	vessels, pipeline, refinery, crude oil terminal, petroleum storage, power plants, homes, vehicles, military facilities
Southeast Alaska	3,889	25	400,517 (125,000)	103	**acid**, diesel, process water, hydraulic oil	vessels, petroleum storage, homes, mining, log processing, power plants, pipeline, airport
Western Alaska	776	16	88,597 (9,000)	114	**gasoline**, diesel, used oil, aviation fuel, hydraulic oil	petroleum storage, vessels, homes, power plants, gas stations, mining

Source: ADEC. Summary of Oil and Hazardous Substance Spills by Subarea (July 1, 1995, to June 30, 2005). Alaska Department of Environmental Conservation. Juneau, Alaska (ADEC, 2007a).

ADEC – Alaska Department of Environmental Conservation

Bold indicates material accounting for largest spill.

Table 3-2. Number of marine spills > 100 gal. by Alaska subregion, January 1995 to August 2012

Alaska Subregion	No. of Spills by Material[a]						Total by Alaska Subregion
	Crude Oil	Extremely Hazardous Substance	Hazardous Substance	Non-Crude Oil	Process Water	Unknown	
Aleutian		6	1	74			**81**
Bristol Bay				7			**7**
Cook Inlet	4	2	3	19			**28**
Kodiak Island				46			**46**
North Slope			3	3	1		**7**
Northwest Arctic				2			**2**
Prince William Sound			3	40			**43**
Southeast Alaska		2	7	170		3	**182**
Western Alaska				6			**6**
Total by material	**4**	**10**	**17**	**367**	**1**	**3**	**402**

[a] Blank cells indicate times for which no spill data was available. It can be assumed that blank cells correspond to zero spill events.

Table 3-3. Volume of marine spills by Alaska subregion, January 1995 to August 2012

Alaska Subregion	Volume of Spilled Material (gal.)[a]						Total by Alaska Subregion (gal.)
	Crude Oil	Extremely Hazardous Substance	Hazardous Substance	Non-Crude Oil	Process Water	Unknown	
Aleutian		129,091	150	1,035,373			**1,164,614**
Bristol Bay				7,190			**7,190**
Cook Inlet	1,224	9,352	5,505	9,625			**22,706**
Kodiak Island				48,068			**48,068**
North Slope			8,595	500	730		**9,825**
Northwest Arctic				1,897			**1,897**
Prince William Sound			4,300	70,670			**74,970**
Southeast Alaska		16,480	6,300	124,593		1,352	**148,725**
Western Alaska				5,010			**5,010**
Total by material	**1,224**	**154,923**	**21,850**	**1,302,926**	**730**	**1,352**	**1,483,005**

[a] Blank cells indicate times for which no spill data was available. It can be assumed that blank cells correspond to zero spill volumes.

Table 3-4. Number of marine spills by month, January 1995 to August 2012

Month	No. of Spills by Material[a]						Total by Month
	Crude Oil	Extremely Hazardous Substance	Hazardous Substance	Non-Crude Oil	Process Water	Unknown	
January			1	39			**40**
February	1	1	3	36			**41**
March	1	1		21		2	**25**
April			2	27			**29**
May		2	2	24			**28**
June			2	31			**33**
July		1		49			**50**
August		1	2	58			**61**
September		2	2	42			**46**
October	2	2	1	25			**30**
November	1		2	26	1	1	**31**
December	1	2		26			**29**
Total by material	**6**	**12**	**17**	**404**	**1**	**3**	**443**

a Blank cells indicate dates for which no spill data was available. It can be assumed that blank cells correspond to zero spill events.

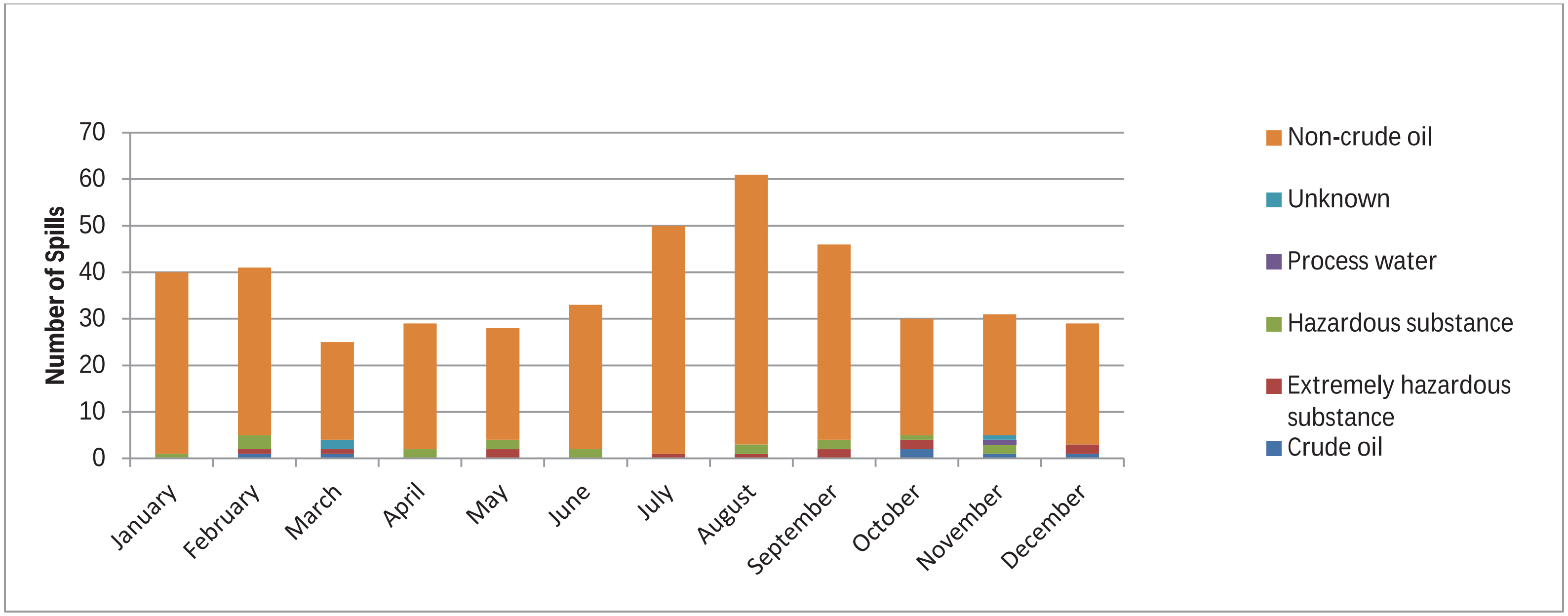

Figure 3-1. Number of marine spills by month, January 1995 to August 2012

Table 3-5. Volume of marine spills by month, January 1995 to August 2012

Month	Volume of Spilled Material (gal.)[a]						Total by Month (gal.)
	Crude Oil	Extremely Hazardous Substance	Hazardous Substance	Non-Crude Oil	Process Water	Unknown	
January			1,705	251,898			**253,603**
February	420	34,530	8,550	246,090			**289,590**
March	0	1,082		151,518		852	**153,452**
April			1,300	21,078			**22,378**
May		7,515	200	25,941			**33,656**
June			1,000	20,525			**21,525**
July		43,000		93,624			**136,624**
August		0	2,200	63,205			**65,405**
September		8,240	37,100	16,530			**61,870**
October	604	36,050	3,000	12,010			**51,664**
November	200		795	62,465	730	500	**64,690**
December	0	92,736		558,042			**650,778**
Total by material	**1,224**	**223,153**	**55,850**	**1,522,926**	**730**	**1,352**	**1,805,235**

[a] Blank cells indicate dates for which no spill data was available. It can be assumed that blank cells correspond to zero spill volumes. Values reported as zero indicate instances when a potential spill event occurred, but no material was released into the environment.

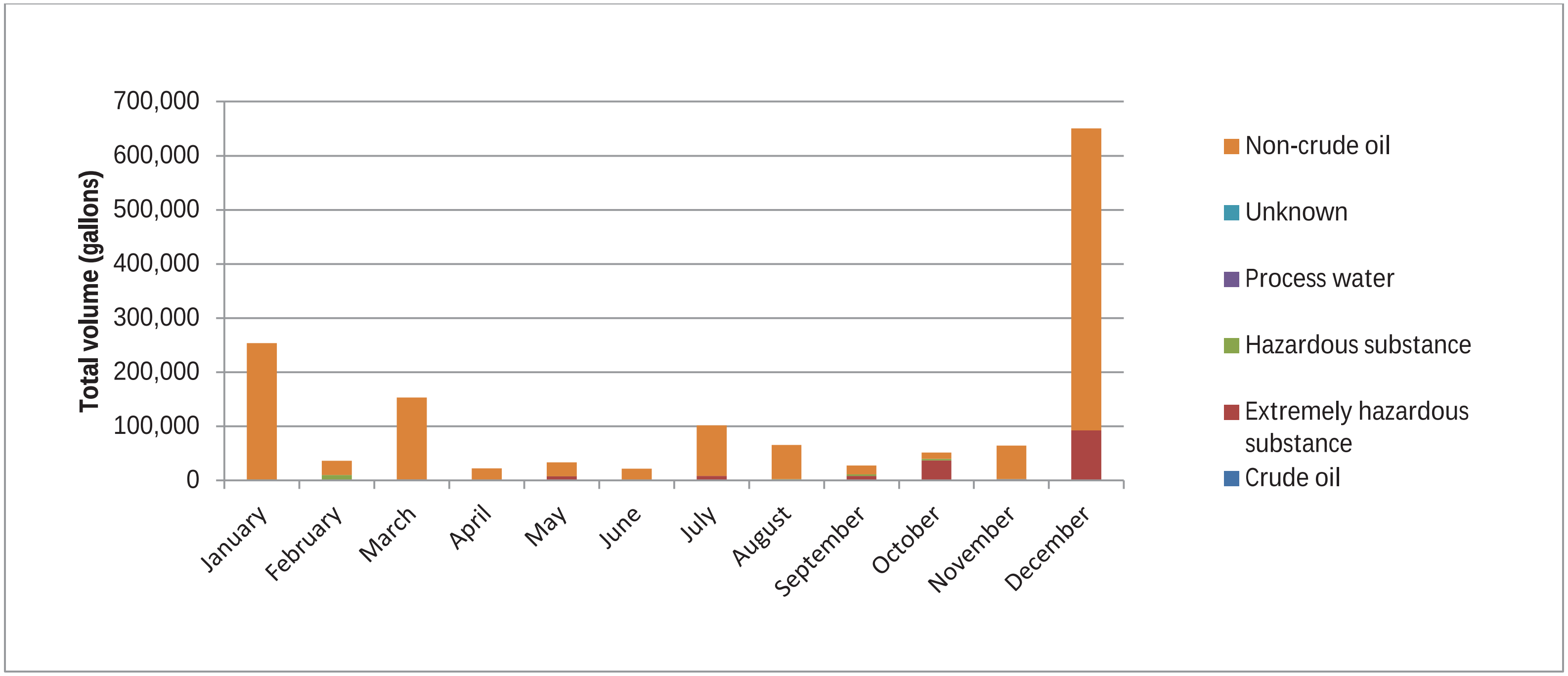

Figure 3-2. Volume of marine spills by month, January 1995 to August 2012

Table 3-6. Number of marine spills by year, 1995 to 2012

Year	No. of Spills by Material[a]						Total by Year
	Crude Oil	Extremely Hazardous Substance	Hazardous Substance	Non-Crude Oil	Process Water	Unknown	
1995	1			25			**26**
1996		2	1	28		1	**32**
1997		2	2	31			**35**
1998		1	1	35			**37**
1999	2	1		27			**30**
2000		1	4	26			**31**
2001	1			18		1	**20**
2002		1	2	17		1	**21**
2003				13			**13**
2004	1	1		21			**23**
2005			2	9			**11**
2006				23			**23**
2007		1		29	1		**31**
2008			1	22			**23**
2009	1	2	1	27			**31**
2010			2	12			**14**
2011			1	29			**30**
2012				12			**12**
Total by material	**6**	**12**	**17**	**404**	**1**	**3**	**443**

[a] Blank cells indicate dates for which no spill data was available. It can be assumed that blank cells correspond to zero spill events.

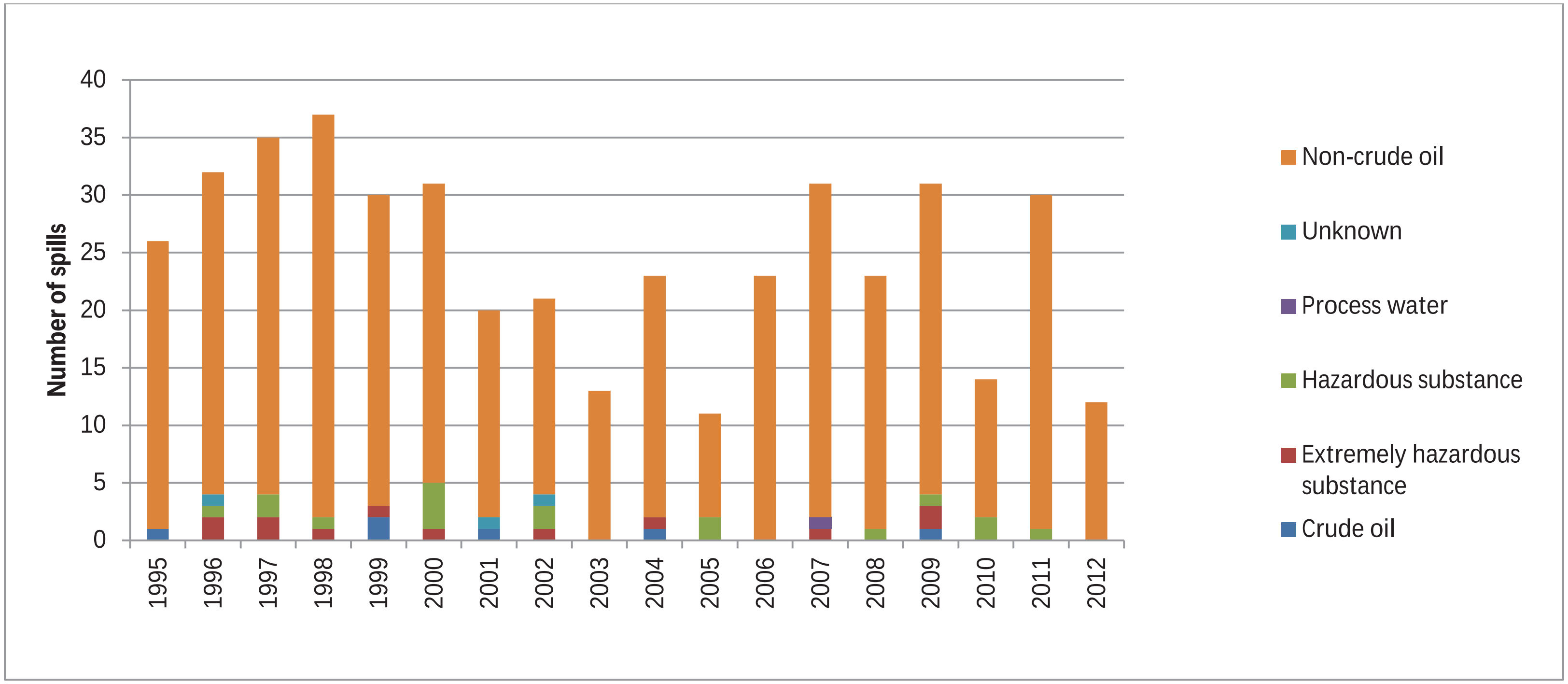

Figure 3-3. Number of marine spills by year, 1995 to 2012

Table 3-7. Volume of marine spills by year, January 1995 to August 2012

Year	Volume of Spilled Material (gal.)[a]						Total by Year (gal.)
	Crude Oil	Extremely Hazardous Substance	Hazardous Substance	Non-Crude Oil	Process Water	Unknown	
1995				75,545			**75,545**
1996		28,325	3,000	221,735		742	**253,802**
1997		15,450	695	63,849			**79,994**
1998		8,270	100	14,655			**23,025**
1999	924	515		31,095			**32,534**
2000		7,000	3,400	13,271			**23,671**
2001	200			47,145		110	**47,455**
2002		1,030	2,600	16,195		500	**20,325**
2003				5,017			**5,017**
2004	100	1,082		351,420			**352,602**
2005			6,600	5,108			**11,708**
2006				6,150			**6,150**
2007		92,736		27,443	730		**120,909**
2008			2,100	150,636			**152,736**
2009		515	1,705	26,685			**28,905**
2010			650	209,506			**210,156**
2011			1,000	14,601			**15,601**
2012				22,870			**22,870**
Total by material	**1,224**	**154,923**	**21,850**	**1,302,926**	**730**	**1,352**	**1,483,005**

[a] Blank cells indicate dates for which no spill data was available. It can be assumed that blank cells correspond to zero spill volumes. Values reported as zero indicate instances when a potential spill event occurred, but no material was released into the environment.

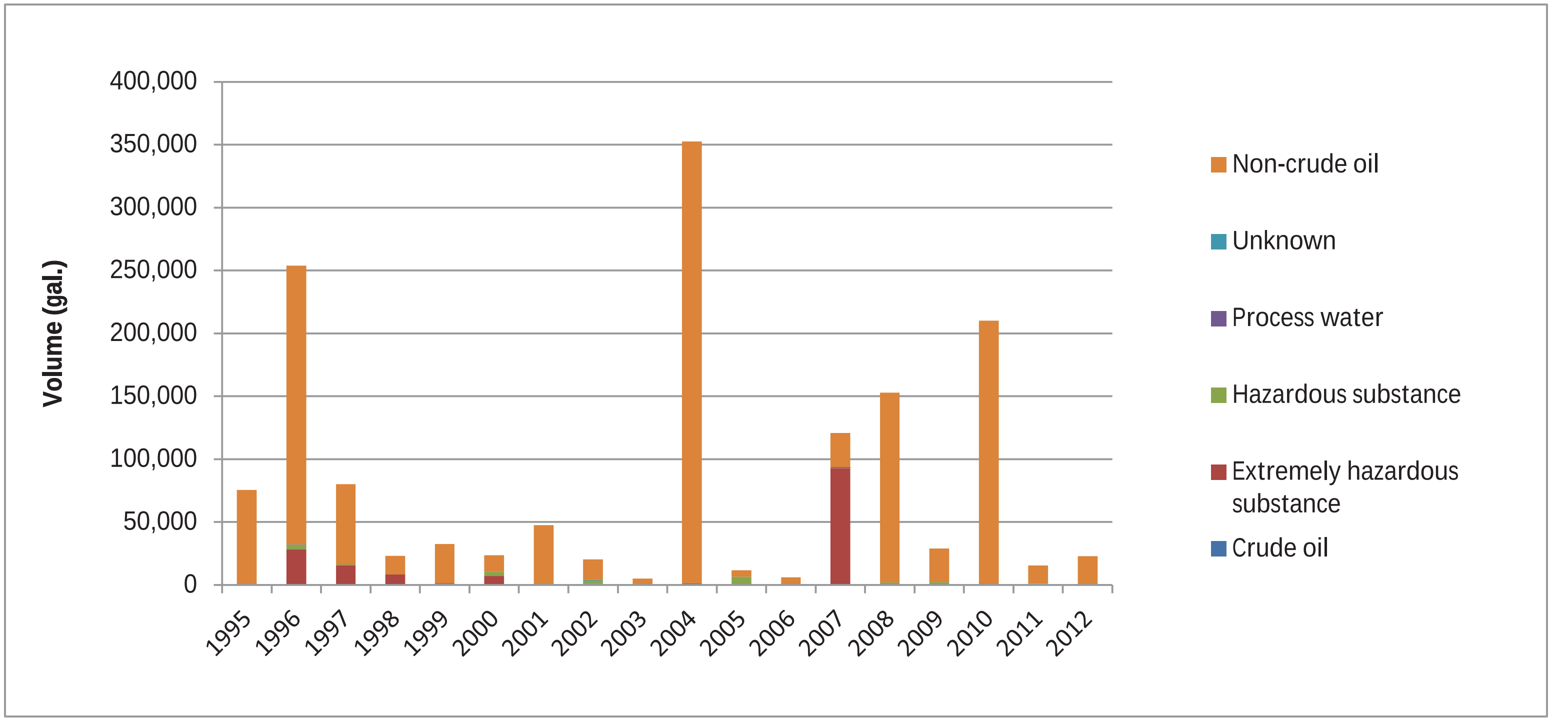

Figure 3-4. Volume of marine spills by year, 1995 to 2012

Table 3-8. Number of marine spills by month and Alaska subregion, January 1995 to August 2012

Month by Alaska Subregion	No. of Spills by Material[a]						Total by Month
	Crude Oil	Extremely Hazardous Substance	Hazardous Substance	Non-Crude Oil	Process Water	Unknown	
Aleutian[b]		**6**	**1**	**88**			**95**
January				7			**7**
February			1	17			**18**
March				6			**6**
April				5			**5**
May		2		3			**5**
June				6			**6**
July				7			**7**
August				4			**4**
September		2		11			**13**
October		1		8			**9**
November				4			**4**
December		1		10			**11**
Bristol Bay[b]				**11**			**11**
April				1			**1**
May				3			**3**
June				1			**1**
July				1			**1**
August				2			**2**
October				3			**3**
Cook Inlet[b]	**6**	**2**	**3**	**19**			**30**
January			1	2			**3**
February	1			4			**5**
March	1	1		1			**3**
April				1			**1**
May				2			**2**
June				2			**2**
July		1		2			**3**
August			1	3			**4**
September			1	1			**1**
October	2						**2**
November	1			1			**3**
December	1						**1**
Kodiak Island[b]				**50**			**50**
January				10			**10**
February				5			**5**
March				4			**4**
April				4			**4**

Month by Alaska Subregion	No. of Spills by Material[a]						Total by Month
	Crude Oil	Extremely Hazardous Substance	Hazardous Substance	Non-Crude Oil	Process Water	Unknown	
May				3			**3**
June				2			**2**
July				3			**3**
August				6			**6**
September				6			**6**
October				2			**2**
November				2			**2**
December				3			**3**
North Slope[b]			**3**	**3**	**1**		**7**
February			2				**2**
March				1			**1**
June				1			**1**
July							
August				1			**1**
November			1		1		**2**
Northwest Arctic[b]				**4**			**4**
September				2			**2**
November				1			**1**
December				1			**1**
Prince William Sound[b]			**3**	**42**			**45**
January				2			**2**
February				1			**1**
March				1			**1**
April			2	4			**6**
May				5			**5**
June				4			**4**
July				7			**7**
August				10			**10**
September			1	3			**4**
November				1			**1**
December				4			**4**
Southeast Alaska[b]		**4**	**7**	**179**		**3**	**193**
January				18			**18**
February		1		9			**11**
March				8		2	**10**
April				12			**12**
May			2	7			**9**
June			2	14			**16**

Month by Alaska Subregion	No. of Spills by Material[a]						Total by Month
	Crude Oil	Extremely Hazardous Substance	Hazardous Substance	Non-Crude Oil	Process Water	Unknown	
July				27			**27**
August		1	1	31			**33**
September			1	16			**17**
October		1	1	12			**14**
November				17		1	**18**
December		1		8			**9**
Western Alaska[b]				**8**			**8**
May				1			**1**
June				1			**1**
July				2			**2**
August				1			**1**
September				3			**3**

[a] Blank cells indicate dates for which no spill data were available. A blank cell corresponds to zero spill events.
[b] Subregion total.

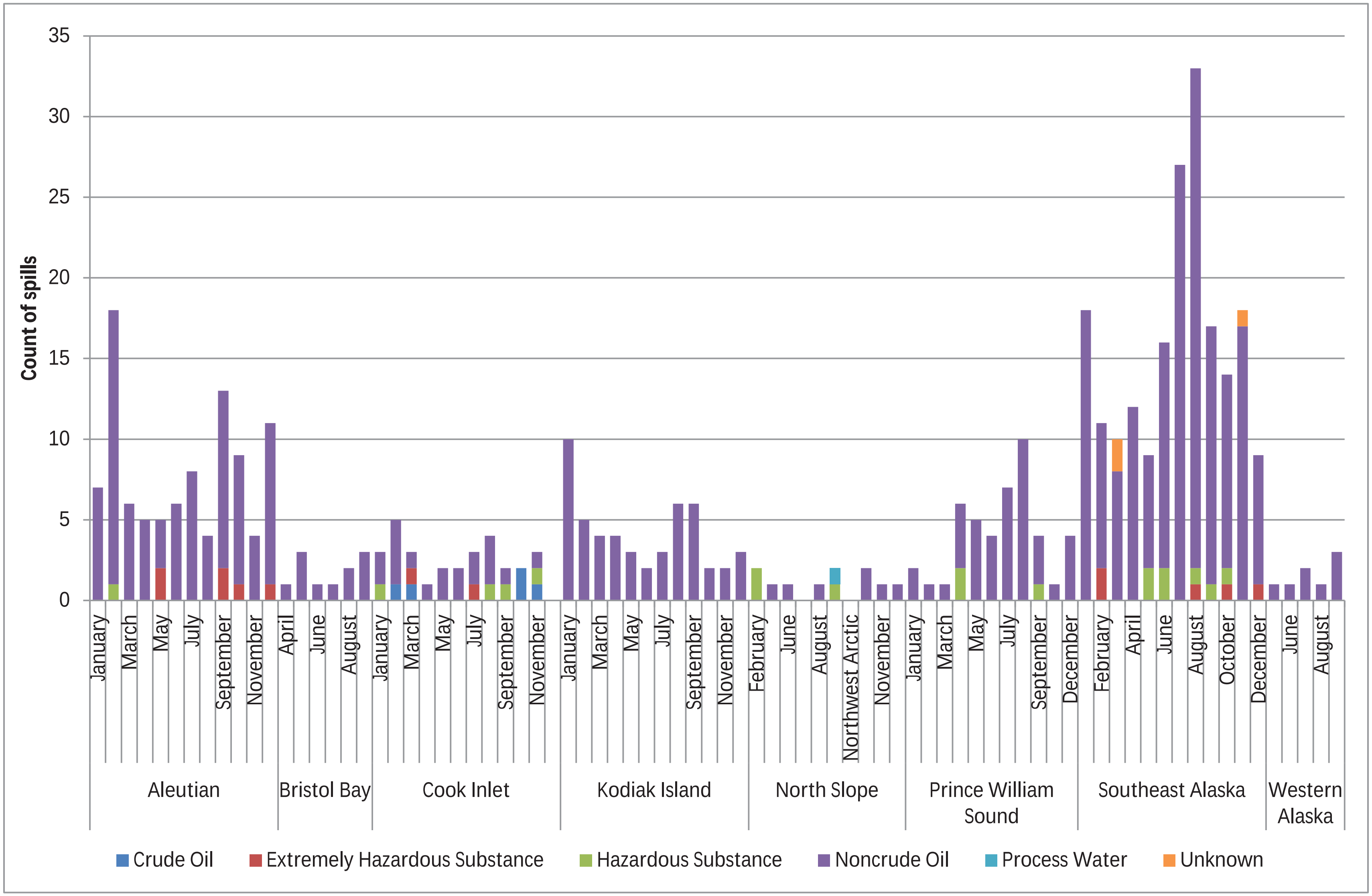

Figure 3-5. Number of marine spills by month and Alaska subregion, January 1995 to August 2012

Table 3-9. Volume of marine spills by month and Alaska subregion, January 1995 to August 2012

Month by Alaska Subregion	Volume of Spilled Material (gal)[a]						Total by Month (gal.)
	Crude Oil	Extremely Hazardous Substance	Hazardous Substance	Non-Crude Oil	Process Water	Unknown	
Aleutian[b]		**129,091**	**150**	**1,035,373**			**1,164,614**
January				204,126			**204,126**
February			150	14,030			**14,180**
March				148,300			**148,300**
April				1,350			**1,350**
May		7,515		11,500			**19,015**
June				1,950			**1,950**
July				45,500			**45,500**
August				1,430			**1,430**
September		8,240		4,005			**12,245**
October		20,600		4,100			**24,700**
November				51,300			**51,300**
December		92,736		547,782			**640,518**
Bristol Bay[b]				**7,190**			**7,190**
April				2,800			**2,800**
May				3,100			**3,100**
June				240			**240**
July				0			**0**
August				550			**550**
October				500			**500**
Cook Inlet[b]	**1,224**	**9,352**	**2,505**	**9,625**			**22,706**
January			1,705	6,200			**7,905**
February	420			1,025			**1,445**
March	0	1,081		275			**1,356**
April				200			**200**
May				325			**325**
June				200			**200**
July		8,270		400			**8,670**
August			200	800			**1,000**
September				100			**100**
October	604						**604**
November	200		600	100			**900**

Month by Alaska Subregion	Volume of Spilled Material (gal)[a]						Total by Month (gal.)
	Crude Oil	Extremely Hazardous Substance	Hazardous Substance	Non-Crude Oil	Process Water	Unknown	
December	0						**0**
Kodiak Island[b]				**48,068**			**48,068**
January				11,450			**11,450**
February				8,575			**8,575**
March				1,013			**1,013**
April				7,450			**7,450**
May				1,800			**1,800**
June				9,200			**9,200**
July				1,000			**1,000**
August				1,900			**1,900**
September				3,280			**3,280**
October				1,100			**1,100**
November				200			**200**
December				1,100			**1,100**
North Slope[b]			**8,595**	**500**	**730**		**9,825**
February			8,400				**8,400**
March				100			**100**
June				100			**100**
July							
August				300			**300**
November			195		730		**925**
Northwest Arctic[b]				**1,897**			**1,897**
September				1,000			**1,000**
November				897			**897**
December				0			**0**
Prince William Sound[b]			**4,300**	**70,670**			**74,970**
January				100			**100**
February				100			**100**
March				100			**100**
April			1,300	1,625			**2,925**
May				7,256			**7,256**
June				1,060			**1,060**
July				14,004			**14,004**
August				37,365			**37,365**

Month by Alaska Subregion	Volume of Spilled Material (gal)[a]						Total by Month (gal.)
	Crude Oil	Extremely Hazardous Substance	Hazardous Substance	Non-Crude Oil	Process Water	Unknown	
September			3,000	750			**3,750**
November				500			**500**
December				7,810			**7,810**
Southeast Alaska[b]		**16,480**	**6,300**	**124,593**		**1352**	**148,725**
January				30,022			**30,022**
February		1,030		2,360			**3,390**
March				1,730		852	**2,582**
April				7,653			**7,653**
May			200	1,460			**1,660**
June			1,000	7,665			**8,665**
July				29,620			**29,620**
August		0	2,000	19,860			**21,860**
September			100	7,095			**7,195**
October		15,450	3,000	6,310			**24,760**
November				9,468		500	**9,968**
December		0		1,350			**1,350**
Western Alaska[b]				**5,010**			**5,010**
May				500			**500**
June				110			**110**
July				3,100			**3,100**
August				1,000			**1,000**
September				300			**300**

a Blank cells indicate dates for which no spill data were available. It can be assumed that blank cells correspond to zero spill volumes. Values reported as zero indicate instances when a potential spill event occurred, but no material was released into the environment.

b Subregion total.

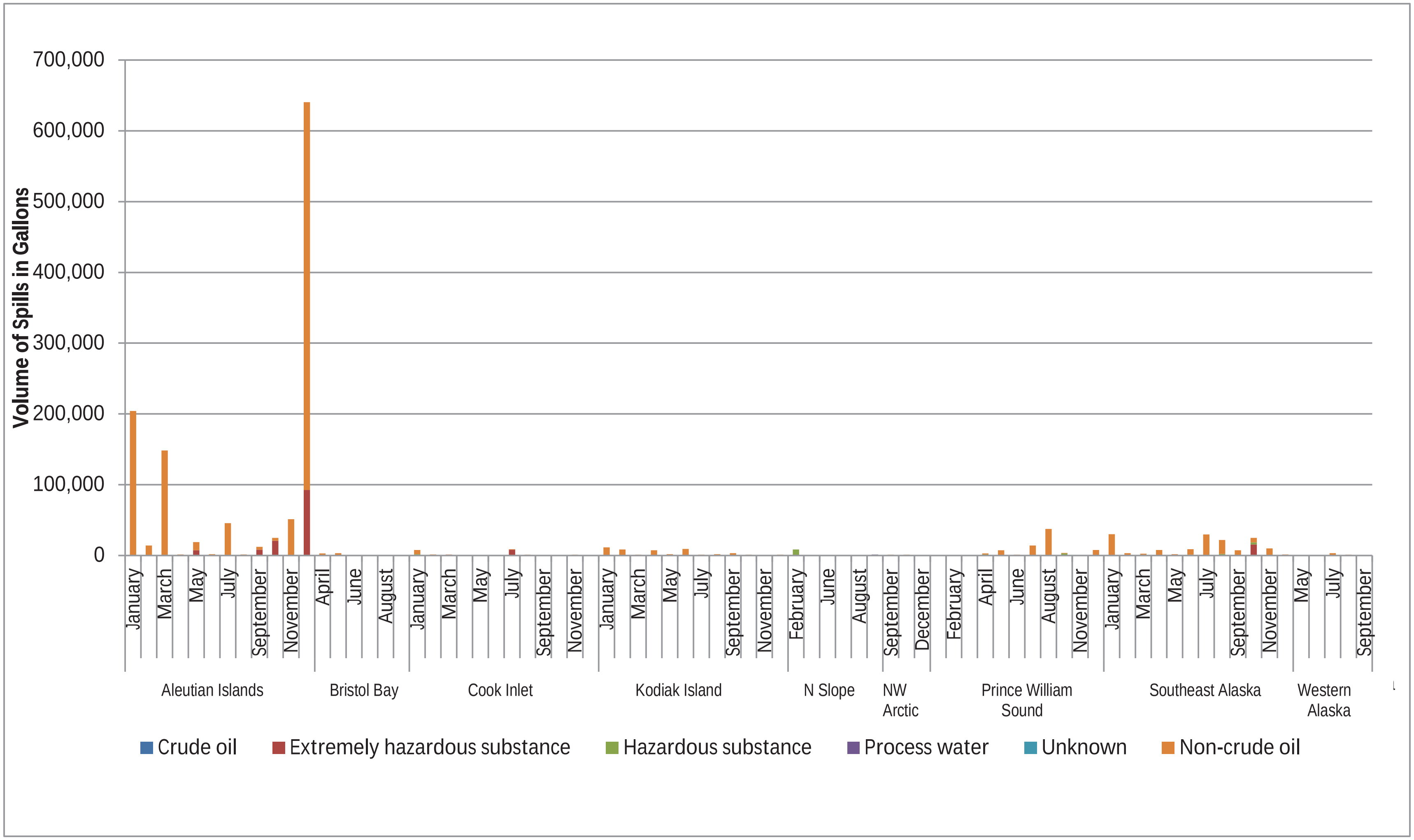

Figure 3-6. Volume of marine spills by month and Alaska subregion, January 1995 to August 2012

Table 3-10. Total number of marine spills by month and year, January 1995 to August 2012

Year	No. of Spills by Month[a]												Total by Year
	January	February	March	April	May	June	July	August	September	October	November	December	
1995	2	1		1		2	4	4	5	4	2	1	**26**
1996	3	1	1	4	2	3	4	4	2	4	2	2	**32**
1997	1	3		2	3	4	3	6	4	1	4	4	**35**
1998	1		4	3	3	3	6	4	6	3	3	1	**37**
1999	1	3		3	4	5	6	3	2	1	1	1	**30**
2000	2	2	2	2	5	1	2	8	1	1	3	2	**31**
2001	1		1	1	2	3	2	5	4		1		**20**
2002	2	2	1	1			4	3	1	2	3	2	**21**
2003	3				1		2	4	1	1	1		**13**
2004	2	2	2	2	1	1	2		4	2	2	3	**23**
2005	1	1		1			1	1	2	2	1	1	**11**
2006	2	5	1	3	1	1	1	3	1	2	1	2	**23**
2007	3	3	4		1	2	3	3	3	1	5	3	**31**
2008	3	5	3	1		2	3	2	1	2	1		**23**
2009	5	3	3	3	1	1		5	4	3	1	2	**31**
2010	3	1		1	2	1	1	2	1			2	**14**
2011	1	7	2	1	2	1	4	4	4	1		3	**30**
2012	4	2	1			3	2		na[b]	na[b]	na[b]	na[b]	**12**
Total by month	**40**	**41**	**25**	**29**	**28**	**33**	**50**	**61**	**46**	**30**	**31**	**29**	**443**

[a] Blank cells indicate months for which no spill data were available. It can be assumed that blank cells correspond to zero spill events in the given month.
[b] Outside the time period of this evaluation.
na – not applicable

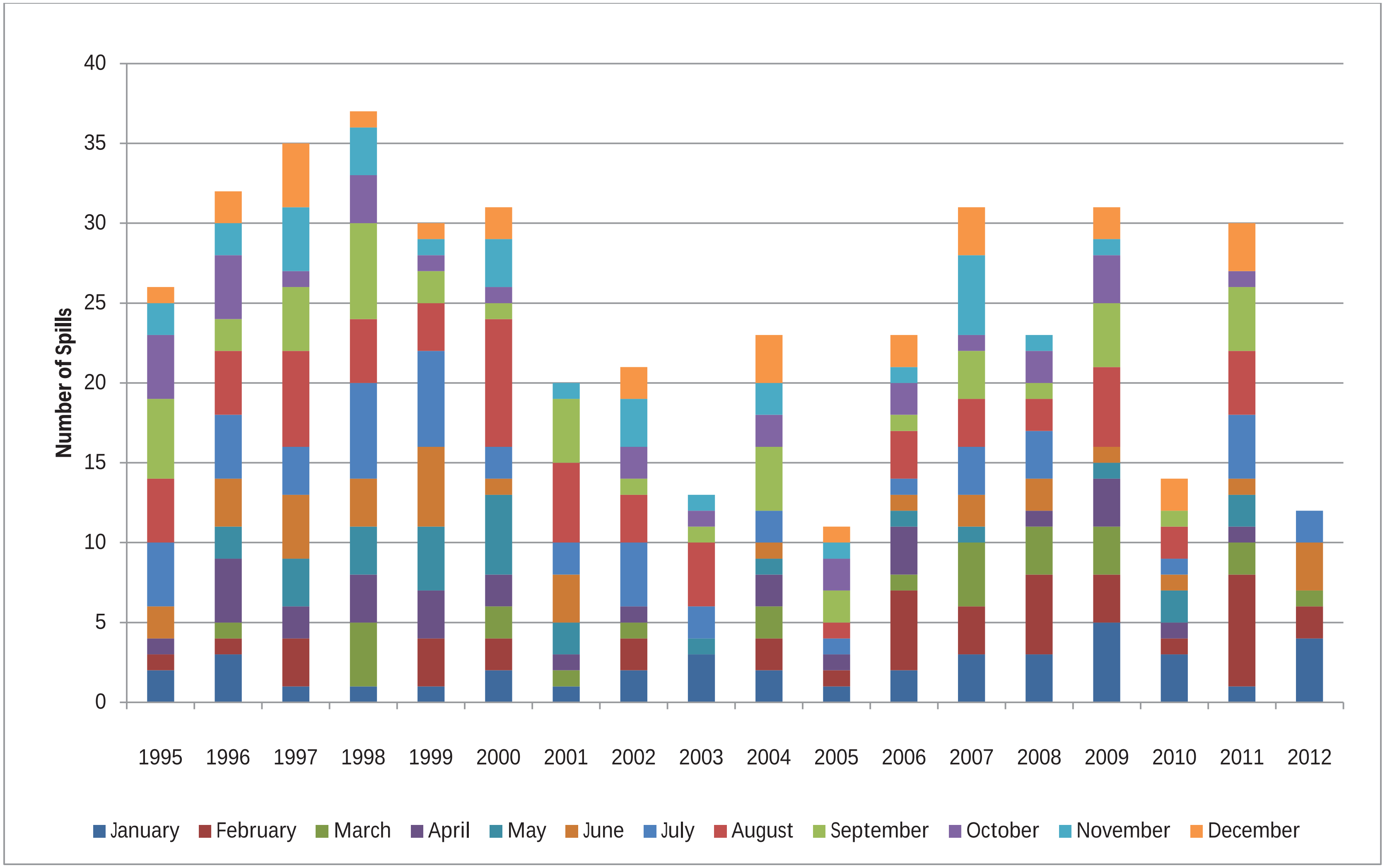

Figure 3-7. Total number of marine spills by month and year, January 1995 to August 2012

Table 3-11. Total volume of marine spills by month and year, January 1995 to August 2012

Year	Volume by Month (gal.)[a]												Total by Year (gal.)
	January	February	March	April	May	June	July	August	September	October	November	December	
1995	24,350	160		800		460	43,200	4,200	775	600	1,000	0	75,545
1996	1,675	300	742	700	600	850	2,350	800	7,825	25,260	900	211,800	253,802
1997	150	1,420		550	3,200	875	2,854	2,400	1,450	15,450	51,345	300	79,994
1998	170		1,260	5,800	500	975	9,790	1,750	1,100	700	780	200	23,025
1999	350	520		625	9,215	4,690	14,150	1,600	580	504	100	200	32,534
2000	400		113	7,158	7,900	100	550	3,300	3,000	300	400	450	23,671
2001	100		110	170	3,300	1,000	2,250	38,375	1,950		200		47,455
2002	770	1,130	100	200			6,500	6,125	1,400	1,650	1,200	1,250	20,325
2003	620				1,500		200	1,700	100	0	897		5,017
2004	208	330	1,832	3,000	0	300	5,200		3,350	1,300	1,200	335,882	352,602
2005	208	6,300		300			400	500	1,450	2,200	200	150	11,708
2006	350	1,575	0	350	100	450	900	1,100	225	750	100	250	6,150
2007	1200	3,900	3,520		6,000	400	4,150	1,265	770	0	6,268	93,436	120,909
2008	901	4,800	145,425	125		385	500	200	300	0	100		152,736
2009	10,505	5,700	100	600	125	240		1,130	1,495	2,450	0	6,560	28,905
2010	203,346	150		1,000	960	500	3,000	400	500			300	210,156
2011	0	7,535	100	1,000	256	1,000	3,050	560	1,600	500		0	15,601
2012	8,300	2,270	150			9,300	2,850		na[b]	na[b]	na[b]	na[b]	22,870
Total by month	**253,603**	**289,590**	**153,452**	**22,378**	**33,656**	**21,525**	**136,624**	**65,405**	**61,870**	**51,664**	**64,690**	**650,778**	**1,805,235**

[a] Volumes reported as zero are included when a potential spill was reported, but no material was released into the environment. Spaces have been left blank where no data were available for the appropriate month and year.

[b] Outside the time period of this evaluation.

na – not applicable

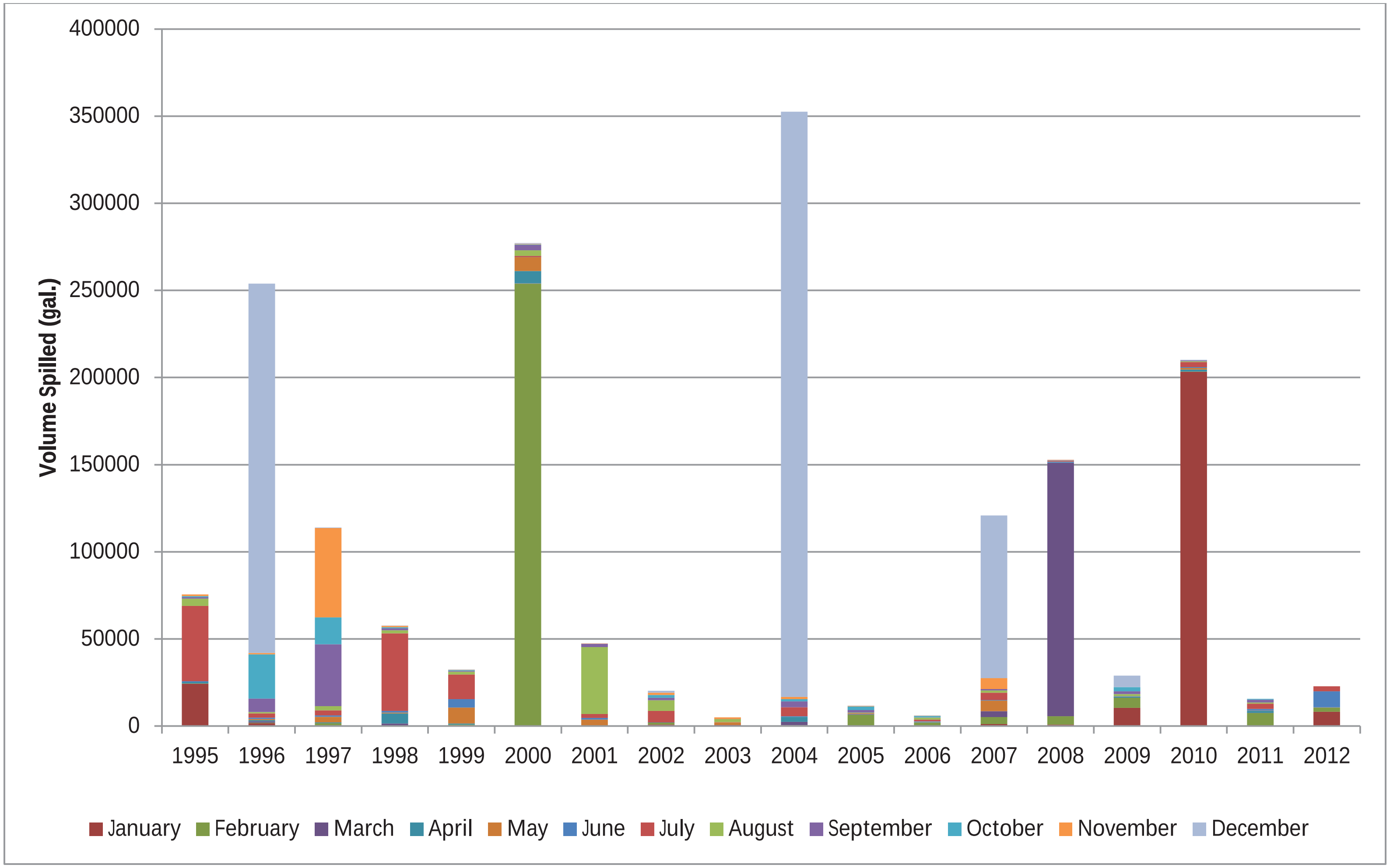

Figure 3-8. Total volume of marine spills by month and year, January 1995 to August 2012

4 References

40 CFR 112. 2012. Title 40: Protection of Environment, Part 112 - Oil Pollution Prevention. Appendix E to Part 112 - determination and evaluation of required response resources for facility response plans [online]. US Code of Federal Regulations. Updated 10/2/2012. Available from: http://ecfr.gpoaccess.gov/cgi/t/text/text-idx?c=ecfr&sid=43ee085649bddb0aa87099450c3bd3f9&rgn=div9&view=text&node=40:23.0.1.1.7.4.6.3.5&idno=40.

ADEC. 2007a. Summary of oil and hazardous substance spills by subarea (July 1, 1995-June 30, 2005). Alaska Department of Environmental Conservation, Juneau, AK.

ADEC. 2007b. Ten year statewide summary, oil and hazardous substance spill data (July 1, 1995-June 30, 2005). Alaska Department of Environmental Conservation, Juneau, AK.

NRC. 2005. Oil spill dispersants: efficacy and effects. Committee on Understanding Oil Spill Dispersants, Efficacy, and Effects, National Research Council. The National Academies Press, Washington, DC.

Attachment D-1. Historical Spill Database for 1995 to 2012 Compiled from NOAA and ADEC Sources

(included herein and provided electronically on CD)

ID	Substance Type	Persistent?	Substance Subtype	Quantity Released (gal)	SubArea	Spill No.	Spill Date	Month_	Year_	Season	Location
Used Oil (all types)9511990120134711Portland Canal	Non-crude oil		Used Oil (all typ	350	Southeast Alaska	95119901201	1/12/1995	January	1995	Winter	Portland Canal
Diesel707734715Dixon Entrance, southeast Alaska	Non-crude oil		Diesel	24000	Southeast Alaska	7077	1/16/1995	January	1995	Winter	Dixon Entrance, southeast Alaska
Diesel9511990540134753Tongass Narrows	Non-crude oil		Diesel	160	Southeast Alaska	95119905401	2/23/1995	February	1995	Winter	Tongass Narrows
Diesel9511991110134810Tongass Narrows	Non-crude oil		Diesel	800	Southeast Alaska	95119911101	4/21/1995	April	1995	Spring	Tongass Narrows
Diesel709934865Kupreanof Island, Alaska	Non-crude oil		Diesel	260	Southeast Alaska	7099	6/15/1995	June	1995	Spring	Kupreanof Island, Alaska
Other9511011740134873Lynn Canal South	Non-crude oil		Other	200	Southeast Alaska	95110117401	6/23/1995	June	1995	Spring	Lynn Canal South
Diesel9527991860134885Eek	Non-crude oil		Diesel	3000	Western Alaska	95279918601	7/5/1995	July	1995	Summer	Eek
Diesel9511991980134897Chatham Strait North	Non-crude oil		Diesel	200	Southeast Alaska	95119919801	7/17/1995	July	1995	Summer	Chatham Strait North
Diesel9525992030234902CENTRAL CHAIN	Non-crude oil		Diesel	15000	Aleutian	95259920302	7/22/1995	July	1995	Summer	CENTRAL CHAIN
Diesel710634904Sequam Island, Aleutian Island chain, Alasł	Non-crude oil		Diesel	25000	Aleutian	7106	7/24/1995	July	1995	Summer	Sequam Island, Aleutian Island chain, ,
Diesel9511992210234920Dixon Entrance	Non-crude oil		Diesel	2500	Southeast Alaska	95119922102	8/9/1995	August	1995	Summer	Dixon Entrance
Other9525992220134921AKUTAN	Non-crude oil		Other	1000	Aleutian	95259922201	8/10/1995	August	1995	Summer	AKUTAN
Diesel9524992230134922KODIAK UNKNOWN	Non-crude oil		Diesel	300	Kodiak Island	95249922301	8/11/1995	August	1995	Summer	KODIAK UNKNOWN
Diesel9511992340134933Wrangell Narrows	Non-crude oil		Diesel	400	Southeast Alaska	95119923401	8/22/1995	August	1995	Summer	Wrangell Narrows
Gasoline9511992470134946Tongass Narrows	Non-crude oil		Gasoline	150	Southeast Alaska	95119924701	9/4/1995	September	1995	Summer	Tongass Narrows
Hydraulic oil9525992480234947DUTCH HARBOR	Non-crude oil		Hydraulic oil	125	Aleutian	95259924802	9/5/1995	September	1995	Summer	DUTCH HARBOR
Other9523992500534949PASSAGE CANAL	Non-crude oil		Other	100	Prince William Sound	95239925005	9/7/1995	September	1995	Summer	PASSAGE CANAL
Diesel9511992510234950Chichagof Island NOS	Non-crude oil		Diesel	100	Southeast Alaska	95119925102	9/8/1995	September	1995	Summer	Chichagof Island NOS
Diesel9525992690134968EASTERN CHAIN	Non-crude oil		Diesel	300	Aleutian	95259926901	9/26/1995	September	1995	Summer	EASTERN CHAIN
Jet fuel9524992830134982KODIAK CITY	Non-crude oil		Jet fuel	100	Kodiak Island	95249928301	10/10/1995	October	1995	Fall	KODIAK CITY
Diesel9525992880134987EASTERN CHAIN	Non-crude oil		Diesel	150	Aleutian	95259928801	10/15/1995	October	1995	Fall	EASTERN CHAIN
Diesel9525992900134989CENTRAL CHAIN	Non-crude oil		Diesel	150	Aleutian	95259929001	10/17/1995	October	1995	Fall	CENTRAL CHAIN
Diesel9511992990234998Sumner Strait	Non-crude oil		Diesel	200	Southeast Alaska	95119929902	10/26/1995	October	1995	Fall	Sumner Strait
Gasoline9511993100135009Tongass Narrows	Non-crude oil		Gasoline	300	Southeast Alaska	95119931001	11/6/1995	November	1995	Fall	Tongass Narrows
Diesel9511993320135031Sumner Strait	Non-crude oil		Diesel	700	Southeast Alaska	95119933201	11/28/1995	November	1995	Fall	Sumner Strait
North Slope crude711635038Nikiski, Alaska	Crude oil	Yes	North Slope cru	0	Cook Inlet	7116	12/5/1995	December	1995	Fall	Nikiski, Alaska
Gasoline9611990050135069Clarence Strait North	Non-crude oil		Gasoline	575	Southeast Alaska	96119900501	1/5/1996	January	1996	Winter	Clarence Strait North
Diesel9624990250135089KODIAK UNKNOWN	Non-crude oil		Diesel	800	Kodiak Island	96249902501	1/25/1996	January	1996	Winter	KODIAK UNKNOWN
Diesel9624990310135095OUZINKIE CITY	Non-crude oil		Diesel	300	Kodiak Island	96249903101	1/31/1996	January	1996	Winter	OUZINKIE CITY
Bunker fuel9625990510135115SAINT PAUL IS.	Non-crude oil	Yes	Bunker fuel	300	Aleutian	96259905101	2/20/1996	February	1996	Winter	SAINT PAUL IS.
Unknown9611990680135132Wrangell area waters	Unknown		Unknown	742	Southeast Alaska	96119906801	3/8/1996	March	1996	Winter	Wrangell area waters
Diesel9624990950135159CHINIAK CDP	Non-crude oil		Diesel	100	Kodiak Island	96249909501	4/4/1996	April	1996	Spring	CHINIAK CDP
Diesel9611991010135165Dixon Entrance	Non-crude oil		Diesel	200	Southeast Alaska	96119910101	4/10/1996	April	1996	Spring	Dixon Entrance
Diesel9624991070135171KODIAK UNKNOWN	Non-crude oil		Diesel	250	Kodiak Island	96249910701	4/16/1996	April	1996	Spring	KODIAK UNKNOWN
Diesel9625991160235180EASTERN CHAIN	Non-crude oil		Diesel	150	Aleutian	96259911602	4/25/1996	April	1996	Spring	EASTERN CHAIN
Lead-based paint713935196Unalaska, Alaska	Hazardous sub:	Yes	Lead-based paint		Aleutian	7139	5/11/1996	May	1996	Spring	Unalaska, Alaska
Jet fuel9611991390135203Tongass Narrows	Non-crude oil		Jet fuel	400	Southeast Alaska	96119913901	5/18/1996	May	1996	Spring	Tongass Narrows
Diesel9623991510135215KENAI CITY	Non-crude oil		Diesel	200	Cook Inlet	96239915101	5/30/1996	May	1996	Spring	KENAI CITY
Diesel9625991570235221CENTRAL CHAIN	Non-crude oil		Diesel	350	Aleutian	96259915702	6/5/1996	June	1996	Spring	CENTRAL CHAIN
Diesel714235224Juneau, Alaska	Non-crude oil		Diesel	400	Southeast Alaska	7142	6/8/1996	June	1996	Spring	Juneau, Alaska
Diesel9625991820135246CENTRAL CHAIN	Non-crude oil		Diesel	100	Aleutian	96259918201	6/30/1996	June	1996	Spring	CENTRAL CHAIN
Other9611992020135266Chatham Strait North	Non-crude oil		Other	100	Southeast Alaska	96119920201	7/20/1996	July	1996	Summer	Chatham Strait North
Diesel9611992080135272Dixon Entrance	Non-crude oil		Diesel	2000	Southeast Alaska	96119920801	7/26/1996	July	1996	Summer	Dixon Entrance
Diesel9611992090135273Tongass Narrows	Non-crude oil		Diesel	150	Southeast Alaska	96119920901	7/27/1996	July	1996	Summer	Tongass Narrows
Diesel9611992120135276Tongass Narrows	Non-crude oil		Diesel	100	Southeast Alaska	96119921201	7/30/1996	July	1996	Summer	Tongass Narrows

ID	Substance Type	Persistent?	Substance Subtype	Quantity Released (gal)	SubArea	Spill No.	Spill Date	Month_	Year_	Season	Location
Diesel9622992150235279EVANS ISLAND	Non-crude oil		Diesel	250	Prince William Sound	96229921502	8/2/1996	August	1996	Summer	EVANS ISLAND
Diesel9623992200135284WHITTIER	Non-crude oil		Diesel	100	Prince William Sound	96239922001	8/7/1996	August	1996	Summer	WHITTIER
Used Oil (all types)9623992270135291HOMER CITY	Non-crude oil		Used Oil (all typ	100	Cook Inlet	96239922701	8/14/1996	August	1996	Summer	HOMER CITY
Diesel9611992300135294Sitka Sound	Non-crude oil		Diesel	350	Southeast Alaska	96119923001	8/17/1996	August	1996	Summer	Sitka Sound
Diesel9625992450135309KING COVE CITY	Non-crude oil		Diesel	100	Aleutian	96259924501	9/1/1996	September	1996	Summer	KING COVE CITY
Ammonia (anhydrous)9625992490135313EASTERN CHAIN	Extremely hazardous substar		Ammonia (anhy	7725	Aleutian	96259924901	9/5/1996	September	1996	Summer	EASTERN CHAIN
Diesel9611992780135342Gastineau Channel	Non-crude oil		Diesel	160	Southeast Alaska	96119927801	10/4/1996	October	1996	Fall	Gastineau Channel
Ammonia (anhydrous)9625992860135350EASTERN CHAIN	Extremely hazardous substar		Ammonia (anhy	20600	Aleutian	96259928601	10/12/1996	October	1996	Fall	EASTERN CHAIN
Optimer 7128 cation flocculant, or ethyl oxylated alcohol7156	Hazardous substance		Optimer 7128 c	3000	Southeast Alaska	7156	10/22/1996	October	1996	Fall	Ward Cove, Ketchikan, Alaska
Diesel9625992980235362EASTERN CHAIN	Non-crude oil		Diesel	1500	Aleutian	96259929802	10/24/1996	October	1996	Fall	EASTERN CHAIN
Used Oil (all types)9611993190135383Gastineau Channel	Non-crude oil		Used Oil (all typ	400	Southeast Alaska	96119931901	11/14/1996	November	1996	Fall	Gastineau Channel
Diesel9622993200135384HINCHINBROOK IS.	Non-crude oil		Diesel	500	Prince William Sound	96229932001	11/15/1996	November	1996	Fall	HINCHINBROOK IS.
Jet fuel9624993520135416KODIAK CITY	Non-crude oil		Jet fuel	800	Kodiak Island	96249935201	12/17/1996	December	1996	Fall	KODIAK CITY
Multiple: diesel & bunker C717435424Aleutian Island chain, /	Non-crude oil	Yes	Multiple: diesel	211000	Aleutian	7174	12/25/1996	December	1996	Fall	Aleutian Island chain, Alaska
Diesel9711990020135432Portland Canal	Non-crude oil		Diesel	150	Southeast Alaska	97119900201	1/2/1997	January	1997	Winter	Portland Canal
Diesel9711990420135472Portland Canal	Non-crude oil		Diesel	100	Southeast Alaska	97119904201	2/11/1997	February	1997	Winter	Portland Canal
Diesel719035480Akun Island, Aleutian Island Chain, Alaska	Non-crude oil		Diesel	1200	Aleutian	7190	2/19/1997	February	1997	Winter	Akun Island, Aleutian Island Chain, Ala
Other9711990560235486Tongass Narrows	Non-crude oil		Other	120	Southeast Alaska	97119905602	2/25/1997	February	1997	Winter	Tongass Narrows
Diesel9725990950135525AKUTAN CITY	Non-crude oil		Diesel	250	Aleutian	97259909501	4/5/1997	April	1997	Spring	AKUTAN CITY
Used Oil (all types)9723991130235543PASSAGE CANAL	Non-crude oil		Used Oil (all typ	300	Prince William Sound	97239911302	4/23/1997	April	1997	Spring	PASSAGE CANAL
Bunker fuel720135560George Inlet, Ketchikan, Alaska	Non-crude oil	Yes	Bunker fuel	100	Southeast Alaska	7201	5/10/1997	May	1997	Spring	George Inlet, Ketchikan, Alaska
Diesel9726991390135569BRISTOL BAY	Non-crude oil		Diesel	100	Bristol Bay	97269913901	5/19/1997	May	1997	Spring	BRISTOL BAY
Diesel9726991420235572LEVELOCK CDP	Non-crude oil		Diesel	3000	Bristol Bay	97269914202	5/22/1997	May	1997	Spring	LEVELOCK CDP
Diesel9725991520135582EASTERN CHAIN	Non-crude oil		Diesel	150	Aleutian	97259915201	6/1/1997	June	1997	Spring	EASTERN CHAIN
Other9711991590235589Gastineau Channel	Hazardous substance		Other	500	Southeast Alaska	97119915902	6/8/1997	June	1997	Spring	Gastineau Channel
Diesel9711991770135606Clarence Strait North	Non-crude oil		Diesel	125	Southeast Alaska	97119917701	6/25/1997	June	1997	Spring	Clarence Strait North
Diesel9711991800335610Revillagigedo Channel	Non-crude oil		Diesel	100	Southeast Alaska	97119918003	6/29/1997	June	1997	Spring	Revillagigedo Channel
Diesel9711991960435626Hobart Bay	Non-crude oil		Diesel	150	Southeast Alaska	97119919604	7/15/1997	July	1997	Summer	Hobart Bay
Diesel9722992020135632P.W.S. UNKNOWN	Non-crude oil		Diesel	2604	Prince William Sound	97229920201	7/21/1997	July	1997	Summer	P.W.S. UNKNOWN
Diesel9725992110135641ALEUTIAN E. UNKNOWN	Non-crude oil		Diesel	100	Aleutian	97259921101	7/30/1997	July	1997	Summer	ALEUTIAN E. UNKNOWN
Diesel9723992200135650SOUTH COOK INLET	Non-crude oil		Diesel	200	Cook Inlet	97239922001	8/8/1997	August	1997	Summer	SOUTH COOK INLET
Diesel9726992240135654KING SALMON CDP	Non-crude oil		Diesel	250	Bristol Bay	97269922401	8/12/1997	August	1997	Summer	KING SALMON CDP
Diesel9711992260235656Tongass Narrows	Non-crude oil		Diesel	250	Southeast Alaska	97119922602	8/14/1997	August	1997	Summer	Tongass Narrows
Asphalt emulsion722335661Haines, Alaska	Non-crude oil	Yes	Asphalt emulsio	1000	Southeast Alaska	7223	8/19/1997	August	1997	Summer	Haines, Alaska
Diesel9739992330135663BARROW CITY	Non-crude oil		Diesel	300	North Slope	97399923301	8/21/1997	August	1997	Summer	BARROW CITY
Diesel9724992420135672KODIAK CITY	Non-crude oil		Diesel	400	Kodiak Island	97249924201	8/30/1997	August	1997	Summer	KODIAK CITY
Diesel9725992510135681DUTCH HARBOR	Non-crude oil		Diesel	100	Aleutian	97259925101	9/8/1997	September	1997	Summer	DUTCH HARBOR
Diesel9711992680235698Cape Edgecumbe to Icy Bay	Non-crude oil		Diesel	150	Southeast Alaska	97119926802	9/25/1997	September	1997	Summer	Cape Edgecumbe to Icy Bay
Diesel9724992680135698KODIAK CITY	Non-crude oil		Diesel	400	Kodiak Island	97249926801	9/25/1997	September	1997	Summer	KODIAK CITY
Bilge Oil9725992680235698EASTERN CHAIN	Non-crude oil		Bilge Oil	800	Aleutian	97259926802	9/25/1997	September	1997	Summer	EASTERN CHAIN
Ammonia (anhydrous)9711992770135707Cordova Bay	Extremely hazardous substar		Ammonia (anhy	15450	Southeast Alaska	97119927701	10/4/1997	October	1997	Fall	Cordova Bay
Bilge Oil9711993080235738Tongass Narrows	Non-crude oil		Bilge Oil	150	Southeast Alaska	97119930802	11/4/1997	November	1997	Fall	Tongass Narrows
Ethylene Glycol (Antifreeze)9739993250135755BEAUFORT	Hazardous substance		Ethylene Glyco	195	North Slope	97399932501	11/21/1997	November	1997	Fall	BEAUFORT SEA
IFO-380501135760Unalaska Island, Alaska	Non-crude oil		IFO-380	12000	Aleutian	5011	11/26/1997	November	1997	Fall	Unalaska Island, Alaska
Bunker fuel9725993300135760EASTERN CHAIN	Non-crude oil	Yes	Bunker fuel	39000	Aleutian	97259933001	11/26/1997	November	1997	Fall	EASTERN CHAIN
Gasoline9724993370135767KODIAK CITY	Non-crude oil		Gasoline	100	Kodiak Island	97249933701	12/3/1997	December	1997	Fall	KODIAK CITY

ID	Substance Type	Persistent?	Substance Subtype	Quantity Released (gal)	SubArea	Spill No.	Spill Date	Month_	Year_	Season	Location
Gasoline9711993430135773Sitka Sound	Non-crude oil		Gasoline	100	Southeast Alaska	97119934301	12/9/1997	December	1997	Fall	Sitka Sound
Diesel9711993440135774Sitka Sound	Non-crude oil		Diesel	100	Southeast Alaska	97119934401	12/10/1997	December	1997	Fall	Sitka Sound
Ammonia725235788Wrangell, Alaska	Extremely hazardous substar		Ammonia	0	Southeast Alaska	7252	12/24/1997	December	1997	Fall	Wrangell, Alaska
Diesel9811990180135813Gastineau Channel	Non-crude oil		Diesel	170	Southeast Alaska	98119901801	1/18/1998	January	1998	Winter	Gastineau Channel
Diesel9824990660135861KODIAK CITY	Non-crude oil		Diesel	750	Kodiak Island	98249906601	3/7/1998	March	1998	Winter	KODIAK CITY
Used Oil (all types)9811990790135874Portland Canal	Non-crude oil		Used Oil (all typ	160	Southeast Alaska	98119907901	3/20/1998	March	1998	Winter	Portland Canal
Gasoline9811990820835877Portland Canal	Non-crude oil		Gasoline	250	Southeast Alaska	98119908208	3/23/1998	March	1998	Winter	Portland Canal
Diesel9822990830135878PORT OF VALDEZ	Non-crude oil		Diesel	100	Prince William Sound	98229908301	3/24/1998	March	1998	Winter	PORT OF VALDEZ
Diesel9811981060235901Tongass Narrows	Non-crude oil		Diesel	300	Southeast Alaska	98119810602	4/16/1998	April	1998	Spring	Tongass Narrows
Diesel9811991070135902Tenakee Inlet	Non-crude oil		Diesel	5000	Southeast Alaska	98119910701	4/17/1998	April	1998	Spring	Tenakee Inlet
Diesel9826991130135908CHIGNIK CITY	Non-crude oil		Diesel	500	Aleutian	98269911301	4/23/1998	April	1998	Spring	CHIGNIK CITY
Diesel9811981480235943Tongass Narrows	Non-crude oil		Diesel	200	Southeast Alaska	98119814802	5/28/1998	May	1998	Spring	Tongass Narrows
Diesel9822991480135943CULROSS IS.	Non-crude oil		Diesel	100	Prince William Sound	98229914801	5/28/1998	May	1998	Spring	CULROSS IS.
Diesel9811991500235945Glacier Bay	Non-crude oil		Diesel	200	Southeast Alaska	98119915002	5/30/1998	May	1998	Spring	Glacier Bay
Diesel9822991520235947CORDOVA	Non-crude oil		Diesel	175	Prince William Sound	98229915202	6/1/1998	June	1998	Spring	CORDOVA
Lube oil9811991620135957Lynn Canal South	Non-crude oil		Lube oil	100	Southeast Alaska	98119916201	6/11/1998	June	1998	Spring	Lynn Canal South
Diesel9811991750135970Stephens Passage South	Non-crude oil		Diesel	700	Southeast Alaska	98119917501	6/24/1998	June	1998	Spring	Stephens Passage South
Ammonia731235977Homer, Alaska	Extremely hazardous substar		Ammonia	8270	Cook Inlet	7312	7/1/1998	July	1998	Summer	Homer, Alaska
Other9827991890135984St. Matthew Island	Non-crude oil		Other	100	Western Alaska	98279918901	7/8/1998	July	1998	Summer	St. Matthew Island
Diesel9811991910235986Gastineau Channel	Non-crude oil		Diesel	200	Southeast Alaska	98119919102	7/10/1998	July	1998	Summer	Gastineau Channel
Hydraulic oil9811991970135992Tongass Narrows	Non-crude oil		Hydraulic oil	820	Southeast Alaska	98119919701	7/16/1998	July	1998	Summer	Tongass Narrows
Diesel9811991990135994Icy Strait	Non-crude oil		Diesel	300	Southeast Alaska	98119919901	7/18/1998	July	1998	Summer	Icy Strait
Gasoline9823992000135995HOMER CITY	Non-crude oil		Gasoline	100	Cook Inlet	98239920001	7/19/1998	July	1998	Summer	HOMER CITY
Diesel9811992150136010Sitka Sound	Non-crude oil		Diesel	200	Southeast Alaska	98119921501	8/3/1998	August	1998	Summer	Sitka Sound
Diesel9825992240136019CENTRAL CHAIN	Non-crude oil		Diesel	150	Aleutian	98259922401	8/12/1998	August	1998	Summer	CENTRAL CHAIN
Diesel9827992270136022Napakiak	Non-crude oil		Diesel	1000	Western Alaska	98279922701	8/15/1998	August	1998	Summer	Napakiak
Diesel9811992310336026Chatham Strait North	Non-crude oil		Diesel	400	Southeast Alaska	98119923103	8/19/1998	August	1998	Summer	Chatham Strait North
Diesel732436039Womens Bay, Kodiak, Alaska	Non-crude oil		Diesel	0	Kodiak Island	7324	9/1/1998	September	1998	Summer	Womens Bay, Kodiak, Alaska
Diesel732536039Womens Bay, Kodiak, Alaska	Non-crude oil		Diesel	800	Kodiak Island	7325	9/1/1998	September	1998	Summer	Womens Bay, Kodiak, Alaska
Unknown9811992650136060Lynn Canal South	Non-crude oil		Unknown	100	Southeast Alaska	98119926501	9/22/1998	September	1998	Summer	Lynn Canal South
Diesel733936062Alaska Peninsula	Non-crude oil		Diesel	0	Aleutian	7339	9/24/1998	September	1998	Summer	Alaska Peninsula
Other9811992670336062Gastineau Channel	Hazardous substance		Other	100	Southeast Alaska	98119926703	9/24/1998	September	1998	Summer	Gastineau Channel
Diesel9823992690136064CENTRAL COOK INLET	Non-crude oil		Diesel	100	Cook Inlet	98239926901	9/26/1998	September	1998	Summer	CENTRAL COOK INLET
Diesel9811992780136073Cross Sound	Non-crude oil		Diesel	100	Southeast Alaska	98119927801	10/5/1998	October	1998	Fall	Cross Sound
Diesel9811992850136080Glacier Bay	Non-crude oil		Diesel	200	Southeast Alaska	98119928501	10/12/1998	October	1998	Fall	Glacier Bay
Other9811993030236098Taiya Inlet	Non-crude oil		Other	400	Southeast Alaska	98119930302	10/30/1998	October	1998	Fall	Taiya Inlet
Diesel9811993130136108Gastineau Channel	Non-crude oil		Diesel	270	Southeast Alaska	98119931301	11/9/1998	November	1998	Fall	Gastineau Channel
Diesel9811983140136109Tongass Narrows	Non-crude oil		Diesel	370	Southeast Alaska	98119831401	11/10/1998	November	1998	Fall	Tongass Narrows
Diesel9811993160236111Sitka Sound	Non-crude oil		Diesel	140	Southeast Alaska	98119931602	11/12/1998	November	1998	Fall	Sitka Sound
Diesel9822993580136153VALDEZ	Non-crude oil		Diesel	200	Prince William Sound	98229935801	12/24/1998	December	1998	Fall	VALDEZ
Diesel9911990060136166Gastineau Channel	Non-crude oil		Diesel	350	Southeast Alaska	99119900601	1/6/1999	January	1999	Winter	Gastineau Channel
Crude9923990370136197CENTRAL COOK INLET	Crude oil	Yes	Crude	420	Cook Inlet	99239903701	2/6/1999	February	1999	Winter	CENTRAL COOK INLET
Multiple: diesel, lube oil & bunker C738736210Dutch Harbor,	Non-crude oil	Yes	Multiple: diesel,	0	Aleutian	7387	2/19/1999	February	1999	Winter	Dutch Harbor, Alaska
Diesel9925990510136211AKUTAN	Non-crude oil		Diesel	100	Aleutian	99259905101	2/20/1999	February	1999	Winter	AKUTAN
Diesel9911981040136264Tongass Narrows	Non-crude oil		Diesel	175	Southeast Alaska	99119810401	4/14/1999	April	1999	Spring	Tongass Narrows
Bilge Oil9925991110136271SAND POINT	Non-crude oil		Bilge Oil	150	Aleutian	99259911101	4/21/1999	April	1999	Spring	SAND POINT
Diesel9911981180136278Tongass Narrows	Non-crude oil		Diesel	300	Southeast Alaska	99119811801	4/28/1999	April	1999	Spring	Tongass Narrows
Ammonia (anhydrous)9925991260136286ADAK	Extremely hazardous substar		Ammonia (anhy	515	Aleutian	99259912601	5/6/1999	May	1999	Spring	ADAK
Diesel9925991280136288CENTRAL CHAIN	Non-crude oil		Diesel	8000	Aleutian	99259912801	5/8/1999	May	1999	Spring	CENTRAL CHAIN
Lube oil9925991300136290COLD BAY	Non-crude oil		Lube oil	500	Aleutian	99259913001	5/10/1999	May	1999	Spring	COLD BAY

ID	Substance Type	Persistent?	Substance Subtype	Quantity Released (gal)	SubArea	Spill No.	Spill Date	Month_	Year_	Season	Location
Diesel9911981370136297Craig / Klawock area waters	Non-crude oil		Diesel	200	Southeast Alaska	99119813701	5/17/1999	May	1999	Spring	Craig / Klawock area waters
Diesel9923991570136317EAST KENAI UNKNOWN	Non-crude oil		Diesel	100	Cook Inlet	99239915701	6/6/1999	June	1999	Spring	EAST KENAI UNKNOWN
Multiple: diesel & engine room slops740636323Dundas Bay,	Non-crude oil		Multiple: diesel	4200	Southeast Alaska	7406	6/12/1999	June	1999	Spring	Dundas Bay, Alaska
Diesel9911991630136323Glacier Bay	Non-crude oil		Diesel	100	Southeast Alaska	99119916301	6/12/1999	June	1999	Spring	Glacier Bay
Gasoline9927991660136326Nunam Iqua (Sheldon Point)	Non-crude oil		Gasoline	110	Western Alaska	99279916601	6/15/1999	June	1999	Spring	Nunam Iqua (Sheldon Point)
Diesel9911991670136327Sumner Strait	Non-crude oil		Diesel	180	Southeast Alaska	99119916701	6/16/1999	June	1999	Spring	Sumner Strait
Diesel741136342Sitka Sound	Non-crude oil		Diesel	800	Southeast Alaska	7411	7/1/1999	July	1999	Summer	Sitka Sound
Diesel9923991900536350HOMER CITY	Non-crude oil		Diesel	300	Cook Inlet	99239919005	7/9/1999	July	1999	Summer	HOMER CITY
Diesel9924991930136353KODIAK CITY	Non-crude oil		Diesel	250	Kodiak Island	99249919301	7/12/1999	July	1999	Summer	KODIAK CITY
Diesel9911991940136354Lynn Canal South	Non-crude oil		Diesel	800	Southeast Alaska	99119919401	7/13/1999	July	1999	Summer	Lynn Canal South
Multiple: diesel & lube oil742136368Tracey Arm, southeast A	Non-crude oil		Multiple: diesel	0	Southeast Alaska	7421	7/27/1999	July	1999	Summer	Tracey Arm, southeast Alaska
Diesel742236368Tracy Arm, AK	Non-crude oil		Diesel	12000	Southeast Alaska	7422	7/27/1999	July	1999	Summer	Tracy Arm, AK
Diesel9911992260136386<Null>	Non-crude oil		Diesel	600	Southeast Alaska	99119922601	8/14/1999	August	1999	Summer	<Null>
Other9922992390136399PRINCE WILLIAM SOUND	Non-crude oil		Other	200	Prince William Sound	99229923901	8/27/1999	August	1999	Summer	PRINCE WILLIAM SOUND
Diesel9911992430236403Annette Island	Non-crude oil		Diesel	800	Southeast Alaska	99119924302	8/31/1999	August	1999	Summer	Annette Island
Diesel9924992620136422OLD HARBOR CITY	Non-crude oil		Diesel	580	Kodiak Island	99249926201	9/19/1999	September	1999	Summer	OLD HARBOR CITY
Fuel oil743536433Just offshore, village of Mekoryuk, N side N	Non-crude oil		Fuel oil	0	Western Alaska	7435	9/30/1999	September	1999	Summer	Just offshore, village of Mekoryuk, N si
Middle Ground Shoal crude oil744336456right at the Forelan	Crude oil	Yes	Middle Ground	504	Cook Inlet	7443	10/23/1999	October	1999	Fall	right at the Forelands in Cook Inlet
Diesel9924993100136470OLD HARBOR CITY	Non-crude oil		Diesel	100	Kodiak Island	99249931001	11/6/1999	November	1999	Fall	OLD HARBOR CITY
Diesel9911993470236507Tongass Narrows	Non-crude oil		Diesel	200	Southeast Alaska	99119934702	12/13/1999	December	1999	Fall	Tongass Narrows
Gasoline23990190136544WEST CENTRAL KENAI	Non-crude oil		Gasoline	200	Cook Inlet	239901901	1/19/2000	January	2000	Winter	WEST CENTRAL KENAI
Gasoline11990250136550Portland Canal	Non-crude oil		Gasoline	200	Southeast Alaska	119902501	1/25/2000	January	2000	Winter	Portland Canal
Multiple: diesel, lube oil & hydraulic oil746736567Unimak Isla	Non-crude oil		Multiple: diesel,	0	Aleutian	7467	2/11/2000	February	2000	Winter	Unimak Island, Alaska
IFO-380747236582Icy Bay, Northern Gulf of Alaska	Non-crude oil		IFO-380	0	Southeast Alaska	7472	2/26/2000	February	2000	Winter	Icy Bay, Northern Gulf of Alaska
Propane (LPG)747636600Kodiak, AK	Non-crude oil		Propane (LPG)	0	Kodiak Island	7476	3/15/2000	March	2000	Winter	Kodiak, AK
Propane (LPG)24990750136600KODIAK UNKNOWN	Non-crude oil		Propane (LPG)	113	Kodiak Island	249907501	3/15/2000	March	2000	Winter	KODIAK UNKNOWN
Diesel11990980236623Tongass Narrows	Non-crude oil		Diesel	158	Southeast Alaska	119909802	4/7/2000	April	2000	Spring	Tongass Narrows
Diesel24991110136636SHELIKOF STRAIT	Non-crude oil		Diesel	7000	Kodiak Island	249911101	4/20/2000	April	2000	Spring	SHELIKOF STRAIT
Other11991330136658Gastineau Channel	Hazardous substance		Other	100	Southeast Alaska	119913301	5/12/2000	May	2000	Spring	Gastineau Channel
Diesel27991340136659Bethel	Non-crude oil		Diesel	500	Western Alaska	279913401	5/13/2000	May	2000	Spring	Bethel
Diesel24991460136671WOMENS BAY	Non-crude oil		Diesel	200	Kodiak Island	249914601	5/25/2000	May	2000	Spring	WOMENS BAY
Other11991480136673Gastineau Channel	Hazardous substance		Other	100	Southeast Alaska	119914801	5/27/2000	May	2000	Spring	Gastineau Channel
Ammonia (anhydrous)749536677Dutch Harbor, Unalaska Isla	Extremely hazardous substar		Ammonia (anhy	7000	Aleutian	7495	5/31/2000	May	2000	Spring	Dutch Harbor, Unalaska Island, Aleutia
Diesel25991730136698SAND POINT	Non-crude oil		Diesel	100	Aleutian	259917301	6/21/2000	June	2000	Spring	SAND POINT
Jet fuel11991870236712Tongass Narrows	Non-crude oil		Jet fuel	200	Southeast Alaska	119918702	7/5/2000	July	2000	Summer	Tongass Narrows
Diesel24992040136729SHELIKOF STRAIT	Non-crude oil		Diesel	350	Kodiak Island	249920401	7/22/2000	July	2000	Summer	SHELIKOF STRAIT
Diesel11992280136753Tongass Narrows	Non-crude oil		Diesel	800	Southeast Alaska	119922801	8/15/2000	August	2000	Summer	Tongass Narrows
Diesel11992280236753Craig / Klawock area waters	Non-crude oil		Diesel	200	Southeast Alaska	119922802	8/15/2000	August	2000	Summer	Craig / Klawock area waters
Diesel11992290136754Annette Island	Non-crude oil		Diesel	400	Southeast Alaska	119922901	8/16/2000	August	2000	Summer	Annette Island
Other23992310136756NORTH COOK INLET	Hazardous substance		Other	200	Cook Inlet	239923101	8/18/2000	August	2000	Summer	NORTH COOK INLET
Diesel11992320136757Wrangell area waters	Non-crude oil		Diesel	500	Southeast Alaska	119923201	8/19/2000	August	2000	Summer	Wrangell area waters
Diesel11992350236760Portland Canal	Non-crude oil		Diesel	100	Southeast Alaska	119923502	8/22/2000	August	2000	Summer	Portland Canal
Diesel11992360236761Cape Edgecumbe to Icy Bay	Non-crude oil		Diesel	100	Southeast Alaska	119923602	8/23/2000	August	2000	Summer	Cape Edgecumbe to Icy Bay
Diesel11992420136767Tongass Narrows	Non-crude oil		Diesel	1000	Southeast Alaska	119924201	8/29/2000	August	2000	Summer	Tongass Narrows
Other23992640136789WHITTIER	Hazardous substance		Other	3000	Prince William Sound	239926401	9/20/2000	September	2000	Summer	WHITTIER

ID	Substance Type	Persistent?	Substance Subtype	Quantity Released (gal)	SubArea	Spill No.	Spill Date	Month_	Year_	Season	Location
Diesel25992830236808DUTCH HARBOR	Non-crude oil		Diesel	300	Aleutian	259928302	10/9/2000	October	2000	Fall	DUTCH HARBOR
Heavy oil752036848Port Walter, AK	Non-crude oil	Yes	Heavy oil	0	Southeast Alaska	7520	11/18/2000	November	2000	Fall	Port Walter, AK
Diesel25993280136853SAND POINT	Non-crude oil		Diesel	300	Aleutian	259932801	11/23/2000	November	2000	Fall	SAND POINT
Diesel23993350136860KENAI CITY	Non-crude oil		Diesel	100	Cook Inlet	239933501	11/30/2000	November	2000	Fall	KENAI CITY
Diesel11993440136869Lisianski	Non-crude oil		Diesel	250	Southeast Alaska	119934401	12/9/2000	December	2000	Fall	Lisianski
Diesel25993540136879DUTCH HARBOR	Non-crude oil		Diesel	200	Aleutian	259935401	12/19/2000	December	2000	Fall	DUTCH HARBOR
Diesel122990300136921EVANS ISLAND	Non-crude oil		Diesel	100	Prince William Sound	1229903001	1/30/2001	January	2001	Winter	EVANS ISLAND
Unknown111990850236976Tongass Narrows	Unknown		Unknown	110	Southeast Alaska	1119908502	3/26/2001	March	2001	Winter	Tongass Narrows
Diesel111991200337011Clarence Strait North	Non-crude oil		Diesel	170	Southeast Alaska	1119912003	4/30/2001	April	2001	Spring	Clarence Strait North
Diesel122991290137020P.W.S. UNKNOWN	Non-crude oil		Diesel	300	Prince William Sound	1229912901	5/9/2001	May	2001	Spring	P.W.S. UNKNOWN
Diesel125991310137022COLD BAY	Non-crude oil		Diesel	3000	Aleutian	1259913101	5/11/2001	May	2001	Spring	COLD BAY
Diesel111991650237056Lynn Canal North	Non-crude oil		Diesel	200	Southeast Alaska	1119916502	6/14/2001	June	2001	Spring	Lynn Canal North
Diesel111991790137070Gastineau Channel	Non-crude oil		Diesel	500	Southeast Alaska	1119917901	6/28/2001	June	2001	Spring	Gastineau Channel
Diesel111991790337070Tongass Narrows	Non-crude oil		Diesel	300	Southeast Alaska	1119917903	6/28/2001	June	2001	Spring	Tongass Narrows
Diesel111992050137096Glacier Bay	Non-crude oil		Diesel	250	Southeast Alaska	1119920501	7/24/2001	July	2001	Summer	Glacier Bay
Diesel122992070137098PRINCE WILLIAM SOUND	Non-crude oil		Diesel	2000	Prince William Sound	1229920701	7/26/2001	July	2001	Summer	PRINCE WILLIAM SOUND
Diesel111992130237104Cordova Bay	Non-crude oil		Diesel	175	Southeast Alaska	1119921302	8/1/2001	August	2001	Summer	Cordova Bay
Diesel122992160137107P.W.S. UNKNOWN	Non-crude oil		Diesel	35000	Prince William Sound	1229921601	8/4/2001	August	2001	Summer	P.W.S. UNKNOWN
Diesel111992310137122Chatham Strait North	Non-crude oil		Diesel	400	Southeast Alaska	1119923101	8/19/2001	August	2001	Summer	Chatham Strait North
Diesel111992360137127Chatham Strait North	Non-crude oil		Diesel	2500	Southeast Alaska	1119923601	8/24/2001	August	2001	Summer	Chatham Strait North
Diesel111992390137130Annette Island	Non-crude oil		Diesel	300	Southeast Alaska	1119923901	8/27/2001	August	2001	Summer	Annette Island
Diesel111992440137135Sumner Strait	Non-crude oil		Diesel	650	Southeast Alaska	1119924401	9/1/2001	September	2001	Summer	Sumner Strait
Diesel111992560137147Gastineau Channel	Non-crude oil		Diesel	400	Southeast Alaska	1119925601	9/13/2001	September	2001	Summer	Gastineau Channel
Diesel125992600137151DUTCH HARBOR	Non-crude oil		Diesel	150	Aleutian	1259926001	9/17/2001	September	2001	Summer	DUTCH HARBOR
Diesel111992620137153Tongass Narrows	Non-crude oil		Diesel	750	Southeast Alaska	1119926201	9/19/2001	September	2001	Summer	Tongass Narrows
Crude123993310137222NORTH COOK INLET	Crude oil	Yes	Crude	200	Cook Inlet	1239933101	11/27/2001	November	2001	Fall	NORTH COOK INLET
Diesel225990070137263DUTCH HARBOR	Non-crude oil		Diesel	270	Aleutian	2259900701	1/7/2002	January	2002	Winter	DUTCH HARBOR
Diesel224990170137273AFOGNAK IS.	Non-crude oil		Diesel	500	Kodiak Island	2249901701	1/17/2002	January	2002	Winter	AFOGNAK IS.
Diesel211990490137305Tongass Narrows	Non-crude oil		Diesel	100	Southeast Alaska	2119904901	2/18/2002	February	2002	Winter	Tongass Narrows
Ammonia (anhydrous)211990590137315Tongass Narrows	Extremely hazardous substar		Ammonia (anhy	1030	Southeast Alaska	2119905901	2/28/2002	February	2002	Winter	Tongass Narrows
Diesel211990870237343Tongass Narrows	Non-crude oil		Diesel	100	Southeast Alaska	2119908702	3/28/2002	March	2002	Winter	Tongass Narrows
Ballast Water (containing oil)222991070137363VALDEZ MAI	Non-crude oil		Ballast Water ((	200	Prince William Sound	2229910701	4/17/2002	April	2002	Spring	VALDEZ MARINE TERMINAL-WATER
Diesel211992020137458Tongass Narrows	Non-crude oil		Diesel	200	Southeast Alaska	2119920201	7/21/2002	July	2002	Summer	Tongass Narrows
Diesel211992050137461Lynn Canal South	Non-crude oil		Diesel	100	Southeast Alaska	2119920501	7/24/2002	July	2002	Summer	Lynn Canal South
Diesel211992060137462Tongass Narrows	Non-crude oil		Diesel	200	Southeast Alaska	2119920601	7/25/2002	July	2002	Summer	Tongass Narrows
Diesel211992070137463Clarence Strait North	Non-crude oil		Diesel	6000	Southeast Alaska	2119920701	7/26/2002	July	2002	Summer	Clarence Strait North
Asphalt211992260137482Ketchikan Region NOS	Non-crude oil	Yes	Asphalt	4000	Southeast Alaska	2119922601	8/14/2002	August	2002	Summer	Ketchikan Region NOS
Other211992290137485Gastineau Channel	Hazardous substance		Other	2000	Southeast Alaska	2119922901	8/17/2002	August	2002	Summer	Gastineau Channel

ID	Substance Type	Persistent?	Substance Subtype	Quantity Released (gal)	SubArea	Spill No.	Spill Date	Month_	Year_	Season	Location
Diesel211992370237493Cordova Bay	Non-crude oil		Diesel	125	Southeast Alaska	2119923702	8/25/2002	August	2002	Summer	Cordova Bay
Diesel224992690137525AFOGNAK IS.	Non-crude oil		Diesel	1400	Kodiak Island	2249926901	9/26/2002	September	2002	Summer	AFOGNAK IS.
Diesel211992800137536Chichagof Island NOS	Non-crude oil		Diesel	250	Southeast Alaska	2119928001	10/7/2002	October	2002	Fall	Chichagof Island NOS
Diesel211992880137544Wrangell Narrows	Non-crude oil		Diesel	1400	Southeast Alaska	2119928801	10/15/2002	October	2002	Fall	Wrangell Narrows
Diesel224993140137570AFOGNAK IS.	Non-crude oil		Diesel	100	Kodiak Island	2249931401	11/10/2002	November	2002	Fall	AFOGNAK IS.
Unknown211993280137584Tongass Narrows	Unknown		Unknown	500	Southeast Alaska	2119932801	11/24/2002	November	2002	Fall	Tongass Narrows
Drilling Muds223993330137589NORTH COOK INLET	Hazardous substance		Drilling Muds	600	Cook Inlet	2239933301	11/29/2002	November	2002	Fall	NORTH COOK INLET
Diesel224993450137601KODIAK UNKNOWN	Non-crude oil		Diesel	200	Kodiak Island	2249934501	12/11/2002	December	2002	Fall	KODIAK UNKNOWN
Ballast Water (containing oil)222993460137602VALDEZ MAI	Non-crude oil		Ballast Water ((	1050	Prince William Sound	2229934601	12/12/2002	December	2002	Fall	VALDEZ MARINE TERMINAL-LAND
Diesel311990060237627Sitka Sound	Non-crude oil		Diesel	120	Southeast Alaska	3119900602	1/6/2003	January	2003	Winter	Sitka Sound
Diesel311990060537627Tongass Narrows	Non-crude oil		Diesel	100	Southeast Alaska	3119900605	1/6/2003	January	2003	Winter	Tongass Narrows
Diesel311990090137630Juneau / Douglas	Non-crude oil		Diesel	400	Southeast Alaska	3119900901	1/9/2003	January	2003	Winter	Juneau / Douglas
Diesel324991500137771KODIAK UNKNOWN	Non-crude oil		Diesel	1500	Kodiak Island	3249915001	5/30/2003	May	2003	Spring	KODIAK UNKNOWN
Diesel311991890237810Sitka Sound	Non-crude oil		Diesel	100	Southeast Alaska	3119918902	7/8/2003	July	2003	Summer	Sitka Sound
Diesel325991900137811SAINT PAUL IS.	Non-crude oil		Diesel	100	Aleutian	3259919001	7/9/2003	July	2003	Summer	SAINT PAUL IS.
Diesel108537840Kodiak Island, AK	Non-crude oil		Diesel	0	Kodiak Island	1085	8/7/2003	August	2003	Summer	Kodiak Island, AK
Diesel322992300137851P.W.S. UNKNOWN	Non-crude oil		Diesel	700	Prince William Sound	3229923001	8/18/2003	August	2003	Summer	P.W.S. UNKNOWN
Diesel109437853Tanglefoot Bay, AK	Non-crude oil		Diesel	1000	Kodiak Island	1094	8/20/2003	August	2003	Summer	Tanglefoot Bay, AK
Diesel109337860Pavlof Bay, AK	Non-crude oil		Diesel	0	Aleutian	1093	8/27/2003	August	2003	Summer	Pavlof Bay, AK
Diesel311992500137871Auke Bay / Fritz Cove	Non-crude oil		Diesel	100	Southeast Alaska	3119925001	9/7/2003	September	2003	Summer	Auke Bay / Fritz Cove
Diesel110737909North of Alaska Peninsula, Bering Sea, AK	Non-crude oil		Diesel	0	Aleutian	1107	10/15/2003	October	2003	Fall	North of Alaska Peninsula, Bering Sea,
Diesel338993120137933SHAKTOOLIK CITY	Non-crude oil		Diesel	897	Northwest Arctic	3389931201	11/8/2003	November	2003	Fall	SHAKTOOLIK CITY
Diesel411990090137995Stephens Passage South	Non-crude oil		Diesel	108	Southeast Alaska	4119900901	1/9/2004	January	2004	Winter	Stephens Passage South
Diesel425990290138015DUTCH HARBOR	Non-crude oil		Diesel	100	Aleutian	4259902901	1/29/2004	January	2004	Winter	DUTCH HARBOR
Diesel411990340138020Yakutat Bay	Non-crude oil		Diesel	180	Southeast Alaska	4119903401	2/3/2004	February	2004	Winter	Yakutat Bay
Diesel423990590138045HOMER CITY	Non-crude oil		Diesel	150	Cook Inlet	4239905901	2/28/2004	February	2004	Winter	HOMER CITY
Ammonia (anhydrous)423990700138056HOMER CITY	Extremely hazardous substar		Ammonia (anhy	1082	Cook Inlet	4239907001	3/10/2004	March	2004	Winter	HOMER CITY
Diesel411990720138058Chichagof Island NOS	Non-crude oil		Diesel	750	Southeast Alaska	4119907201	3/12/2004	March	2004	Winter	Chichagof Island NOS
Diesel411991060438092Tongass Narrows	Non-crude oil		Diesel	200	Southeast Alaska	4119910604	4/15/2004	April	2004	Spring	Tongass Narrows
Diesel426991080138094BRISTOL BAY UNKNOWN	Non-crude oil		Diesel	2800	Bristol Bay	4269910801	4/17/2004	April	2004	Spring	BRISTOL BAY UNKNOWN
Diesel117238118Peril Strait, AK	Non-crude oil		Diesel	0	Southeast Alaska	1172	5/11/2004	May	2004	Spring	Peril Strait, AK
Unknown117338119Bering Sea, AK	Non-crude oil		Unknown		Aleutian	1173	5/12/2004	May	2004	Spring	Bering Sea, AK
Unknown117338119Bering Sea, AK	Non-crude oil		Unknown		Aleutian	1173	5/12/2004	May	2004	Spring	Bering Sea, AK
Diesel411991610238147Hydaburg / Tlevak	Non-crude oil		Diesel	300	Southeast Alaska	4119916102	6/9/2004	June	2004	Spring	Hydaburg / Tlevak
Diesel120038199Baby Island, AK	Non-crude oil		Diesel	5000	Aleutian	1200	7/31/2004	July	2004	Summer	Baby Island, AK
Diesel425992130138199ALEUTIAN E. UNKNOWN	Non-crude oil		Diesel	200	Aleutian	4259921301	7/31/2004	July	2004	Summer	ALEUTIAN E. UNKNOWN
Diesel121338244SE Alaska, AK	Non-crude oil		Diesel	0	Southeast Alaska	1213	9/14/2004	September	2004	Summer	SE Alaska, AK
Multiple: diesel & gasoline122038251Auke Bay, AK	Non-crude oil		Multiple: diesel	1650	Southeast Alaska	1220	9/21/2004	September	2004	Summer	Auke Bay, AK
DieselNOAA ID 12238251Auke Bay / Fritz Cove	Non-crude oil		Diesel	1600	Southeast Alaska	NOAA ID 122	9/21/2004	September	2004	Summer	Auke Bay / Fritz Cove
Gasoline411992690138255Auke Bay / Fritz Cove	Non-crude oil		Gasoline	100	Southeast Alaska	4119926901	9/25/2004	September	2004	Summer	Auke Bay / Fritz Cove
Diesel411992830238269Cape Edgecumbe to Icy Bay	Non-crude oil		Diesel	1200	Southeast Alaska	4119928302	10/9/2004	October	2004	Fall	Cape Edgecumbe to Icy Bay
Crude423993020138288CENTRAL COOK INLET	Crude oil	Yes	Crude	100	Cook Inlet	4239930201	10/28/2004	October	2004	Fall	CENTRAL COOK INLET
Diesel411993230238309Ketchikan	Non-crude oil		Diesel	200	Southeast Alaska	4119932302	11/18/2004	November	2004	Fall	Ketchikan

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Lube oil411993330438319Saxman	Non-crude oil		Lube oil	1000	Southeast Alaska	4119933304	11/28/2004	November	2004	Fall	Saxman
Diesel425993430138329EASTERN CHAIN	Non-crude oil		Diesel	14680	Aleutian	4259934301	12/8/2004	December	2004	Fall	EASTERN CHAIN
IFO-380425993430138329EASTERN CHAIN	Non-crude oil		IFO-380	321052	Aleutian	4259934301	12/8/2004	December	2004	Fall	EASTERN CHAIN
Diesel411993620238348Chatham Strait North	Non-crude oil		Diesel	150	Southeast Alaska	4119936202	12/27/2004	December	2004	Fall	Chatham Strait North
Bunker fuel525990130138365ATTU	Non-crude oil	Yes	Bunker fuel	208	Aleutian	5259901301	1/13/2005	January	2005	Winter	ATTU
Drilling Muds539990590338411CHUKCHI SEA	Hazardous substance		Drilling Muds	6300	North Slope	5399905903	2/28/2005	February	2005	Winter	CHUKCHI SEA
Other522991150138467VALDEZ	Hazardous substance		Other	300	Prince William Sound	5229911501	4/25/2005	April	2005	Spring	VALDEZ
Diesel524992070138559KODIAK UNKNOWN	Non-crude oil		Diesel	400	Kodiak Island	5249920701	7/26/2005	July	2005	Summer	KODIAK UNKNOWN
Diesel523992380138590EAST KENAI UNKNOWN	Non-crude oil		Diesel	500	Cook Inlet	5239923801	8/26/2005	August	2005	Summer	EAST KENAI UNKNOWN
Diesel525992450138597CENTRAL CHAIN	Non-crude oil		Diesel	950	Aleutian	5259924501	9/2/2005	September	2005	Summer	CENTRAL CHAIN
Diesel511992530138605Icy Strait	Non-crude oil		Diesel	500	Southeast Alaska	5119925301	9/10/2005	September	2005	Summer	Icy Strait
Jet fuel524992740138626WOMENS BAY	Non-crude oil		Jet fuel	1000	Kodiak Island	5249927401	10/1/2005	October	2005	Fall	WOMENS BAY
Diesel511993040138656Ketchikan	Non-crude oil		Diesel	1200	Southeast Alaska	5119930401	10/31/2005	October	2005	Fall	Ketchikan
Diesel511993200238672Sitka	Non-crude oil		Diesel	200	Southeast Alaska	5119932002	11/16/2005	November	2005	Fall	Sitka
Hydraulic oil525993550138707WESTERN CHAIN	Non-crude oil		Hydraulic oil	150	Aleutian	5259935501	12/21/2005	December	2005	Fall	WESTERN CHAIN
Diesel624990130138730KODIAK UNKNOWN	Non-crude oil		Diesel	200	Kodiak Island	6249901301	1/13/2006	January	2006	Winter	KODIAK UNKNOWN
Diesel611990310138748Cape Edgecumbe to Icy Bay	Non-crude oil		Diesel	150	Southeast Alaska	6119903101	1/31/2006	January	2006	Winter	Cape Edgecumbe to Icy Bay
Other623990330138750NIKISKI	Non-crude oil		Other	125	Cook Inlet	6239903301	2/2/2006	February	2006	Winter	NIKISKI
Diesel624990370138754KODIAK CITY	Non-crude oil		Diesel	200	Kodiak Island	6249903701	2/6/2006	February	2006	Winter	KODIAK CITY
Jet fuel625990440138761WESTERN CHAIN	Non-crude oil		Jet fuel	100	Aleutian	6259904401	2/13/2006	February	2006	Winter	WESTERN CHAIN
Diesel625990440138761WESTERN CHAIN	Non-crude oil		Diesel	150	Aleutian	6259904401	2/13/2006	February	2006	Winter	WESTERN CHAIN
Diesel625990540138771CENTRAL CHAIN	Non-crude oil		Diesel	1000	Aleutian	6259905401	2/23/2006	February	2006	Winter	CENTRAL CHAIN
Multiple: diesel & lube oil607138807NW Unalaska Island, AK	Non-crude oil		Multiple: diesel	0	Aleutian	6071	3/31/2006	March	2006	Winter	NW Unalaska Island, AK
Diesel611990930438810Yakutat Bay	Non-crude oil		Diesel	150	Southeast Alaska	6119909304	4/3/2006	April	2006	Spring	Yakutat Bay
Kerosene611991000138817Gastineau Channel	Non-crude oil		Kerosene	100	Southeast Alaska	6119910001	4/10/2006	April	2006	Spring	Gastineau Channel
Diesel624991110138828KODIAK UNKNOWN	Non-crude oil		Diesel	100	Kodiak Island	6249911101	4/21/2006	April	2006	Spring	KODIAK UNKNOWN
Diesel624991380138855KODIAK CITY	Non-crude oil		Diesel	100	Kodiak Island	6249913801	5/18/2006	May	2006	Spring	KODIAK CITY
Diesel622991720138889Middleton Island	Non-crude oil		Diesel	450	Prince William Sound	6229917201	6/21/2006	June	2006	Spring	Middleton Island
Diesel610038910Sitka, AK	Non-crude oil		Diesel	900	Southeast Alaska	6100	7/12/2006	July	2006	Summer	Sitka, AK
Multiple: fuel oil & gasoline610338921North Pacific Ocean, A	Non-crude oil		Multiple: fuel oil & gasoline		Aleutian	6103	7/23/2006	July	2006	Summer	North Pacific Ocean, AK
Multiple: fuel oil & gasoline610338921North Pacific Ocean, A	Non-crude oil		Multiple: fuel oil & gasoline		Aleutian	6103	7/23/2006	July	2006	Summer	North Pacific Ocean, AK
Diesel611992160138933Clarence Strait North	Non-crude oil		Diesel	500	Southeast Alaska	6119921601	8/4/2006	August	2006	Summer	Clarence Strait North
Diesel622992250138942PRINCE WILLIAM SOUND	Non-crude oil		Diesel	300	Prince William Sound	6229922501	8/13/2006	August	2006	Summer	PRINCE WILLIAM SOUND
Diesel622992410138958PRINCE WILLIAM SOUND	Non-crude oil		Diesel	300	Prince William Sound	6229924101	8/29/2006	August	2006	Summer	PRINCE WILLIAM SOUND
Diesel611992700138987Duncan Canal	Non-crude oil		Diesel	225	Southeast Alaska	6119927001	9/27/2006	September	2006	Summer	Duncan Canal
Diesel626992830139000DILLINGHAM CITY	Non-crude oil		Diesel	500	Bristol Bay	6269928301	10/10/2006	October	2006	Fall	DILLINGHAM CITY
Diesel611993010139018Hollis	Non-crude oil		Diesel	250	Southeast Alaska	6119930101	10/28/2006	October	2006	Fall	Hollis
Diesel611993230139040Tongass Narrows	Non-crude oil		Diesel	100	Southeast Alaska	6119932301	11/19/2006	November	2006	Fall	Tongass Narrows

ID	Substance Type	Persistent?	Substance Subtype	Quantity Released (gal)	SubArea	Spill No.	Spill Date	Month_	Year_	Season	Location
Fuel Oil & Wheat614139055Adak, Bering Sea, AK	Non-crude oil		Fuel Oil & Whe	0	Aleutian	6141	12/4/2006	December	2006	Fall	Adak, Bering Sea, AK
Diesel611993400339057Juneau / Douglas	Non-crude oil		Diesel	250	Southeast Alaska	6119934003	12/6/2006	December	2006	Fall	Juneau / Douglas
Diesel724990080139090SHELIKOF STRAIT	Non-crude oil		Diesel	900	Kodiak Island	7249900801	1/8/2007	January	2007	Winter	SHELIKOF STRAIT
Diesel711990120139094Revillagigedo Channel	Non-crude oil		Diesel	200	Southeast Alaska	7119901201	1/12/2007	January	2007	Winter	Revillagigedo Channel
Diesel724990120139094KODIAK CITY	Non-crude oil		Diesel	100	Kodiak Island	7249901201	1/12/2007	January	2007	Winter	KODIAK CITY
Diesel711990380139120Wrangell Narrows	Non-crude oil		Diesel	100	Southeast Alaska	7119903801	2/7/2007	February	2007	Winter	Wrangell Narrows
Diesel725990410139123UNALASKA	Non-crude oil		Diesel	1000	Aleutian	7259904101	2/10/2007	February	2007	Winter	UNALASKA
Diesel724990510139133SHELIKOF STRAIT	Non-crude oil		Diesel	2800	Kodiak Island	7249905101	2/20/2007	February	2007	Winter	SHELIKOF STRAIT
Diesel711990680139150Gastineau Channel	Non-crude oil		Diesel	100	Southeast Alaska	7119906801	3/9/2007	March	2007	Winter	Gastineau Channel
Diesel711990720239154Thorne Bay	Non-crude oil		Diesel	120	Southeast Alaska	7119907202	3/13/2007	March	2007	Winter	Thorne Bay
Diesel725990770139159ADAK	Non-crude oil		Diesel	3000	Aleutian	7259907701	3/18/2007	March	2007	Winter	ADAK
Diesel725990830139165CENTRAL CHAIN	Non-crude oil		Diesel	300	Aleutian	7259908301	3/24/2007	March	2007	Winter	CENTRAL CHAIN
Diesel723991370139219WHITTIER	Non-crude oil		Diesel	6000	Prince William Sound	7239913701	5/17/2007	May	2007	Spring	WHITTIER
Diesel739991530639235WEST NORTH SLOPE	Non-crude oil		Diesel	100	North Slope	7399915306	6/2/2007	June	2007	Spring	WEST NORTH SLOPE
Diesel722991540139236P.W.S. UNKNOWN	Non-crude oil		Diesel	300	Prince William Sound	7229915401	6/3/2007	June	2007	Spring	P.W.S. UNKNOWN
Sheen767139269140 nm WNW St Matthew Island	Non-crude oil		Sheen		Western Alaska	7671	7/6/2007	July	2007	Summer	140 nm WNW St Matthew Island
Diesel722991970139279P.W.S. UNKNOWN	Non-crude oil		Diesel	650	Prince William Sound	7229919701	7/16/2007	July	2007	Summer	P.W.S. UNKNOWN
Diesel722992020139284PRINCE WILLIAM SOUND	Non-crude oil		Diesel	3500	Prince William Sound	7229920201	7/21/2007	July	2007	Summer	PRINCE WILLIAM SOUND
Diesel767839288Sunshine Cove, AK	Non-crude oil		Diesel	0	Southeast Alaska	7678	7/25/2007	July	2007	Summer	Sunshine Cove, AK
Diesel722992130139295ESTHER IS.	Non-crude oil		Diesel	355	Prince William Sound	7229921301	8/1/2007	August	2007	Summer	ESTHER IS.
Diesel711992200139302Frederick Sound	Non-crude oil		Diesel	110	Southeast Alaska	7119922001	8/8/2007	August	2007	Summer	Frederick Sound
Diesel711992300239312Revillagigedo Channel	Non-crude oil		Diesel	800	Southeast Alaska	7119923002	8/18/2007	August	2007	Summer	Revillagigedo Channel
Gasoline711992490239331Wrangell area waters	Non-crude oil		Gasoline	120	Southeast Alaska	7119924902	9/6/2007	September	2007	Summer	Wrangell area waters
Diesel722992540139336PRINCE WILLIAM SOUND	Non-crude oil		Diesel	400	Prince William Sound	7229925401	9/11/2007	September	2007	Summer	PRINCE WILLIAM SOUND
Gasoline722992540139336PRINCE WILLIAM SOUND	Non-crude oil		Gasoline	250	Prince William Sound	7229925401	9/11/2007	September	2007	Summer	PRINCE WILLIAM SOUND
Multiple: diesel & gasoline769839360Ugashik Bay, AK	Non-crude oil		Multiple: diesel	0	Bristol Bay	7698	10/5/2007	October	2007	Fall	Ugashik Bay, AK
Source water739993060439388WEST NORTH SLOPE	Process water		Source water	730	North Slope	7399930604	11/2/2007	November	2007	Fall	WEST NORTH SLOPE
Kerosene711993090139391Craig / Klawock area waters	Non-crude oil		Kerosene	1100	Southeast Alaska	7119930901	11/5/2007	November	2007	Fall	Craig / Klawock area waters
Propane (LPG)711993090139391Craig / Klawock area water	Non-crude oil		Propane (LPG)	4238	Southeast Alaska	7119930901	11/5/2007	November	2007	Fall	Craig / Klawock area waters
Bunker fuel711993250139407Tongass Narrows	Non-crude oil	Yes	Bunker fuel	200	Southeast Alaska	7119932501	11/21/2007	November	2007	Fall	Tongass Narrows
Multiple: diesel & hydraulic oil771739409George Inlet, SE Ala	Non-crude oil		Multiple: diesel	0	Southeast Alaska	7717	11/23/2007	November	2007	Fall	George Inlet, SE Alaska
Diesel725993370239419AKUTAN CITY	Non-crude oil		Diesel	300	Aleutian	7259933702	12/3/2007	December	2007	Fall	AKUTAN CITY
Diesel725993510139433DUTCH HARBOR	Non-crude oil		Diesel	400	Aleutian	7259935101	12/17/2007	December	2007	Fall	DUTCH HARBOR
Ammonia (anhydrous)725993560139438DUTCH HARBOR	Extremely hazardous substar		Ammonia (anhy	92736	Aleutian	7259935601	12/22/2007	December	2007	Fall	DUTCH HARBOR
Jet fuel824990050139452WOMENS BAY	Non-crude oil		Jet fuel	150	Kodiak Island	8249900501	1/5/2008	January	2008	Winter	WOMENS BAY
Diesel811990160139463Sumner Strait	Non-crude oil		Diesel	649	Southeast Alaska	8119901601	1/16/2008	January	2008	Winter	Sumner Strait
Diesel725990260239472CENTRAL CHAIN	Non-crude oil		Diesel	102	Aleutian	7259902602	1/25/2008	January	2008	Winter	CENTRAL CHAIN
Drilling Muds839990340139481WEST NORTH SLOPE	Hazardous substance		Drilling Muds	2100	North Slope	8399903401	2/3/2008	February	2008	Winter	WEST NORTH SLOPE
Diesel824990400139487KODIAK CITY	Non-crude oil		Diesel	950	Kodiak Island	8249904001	2/9/2008	February	2008	Winter	KODIAK CITY
Diesel811990420339489PELICAN CITY	Non-crude oil		Diesel	1500	Southeast Alaska	8119904203	2/11/2008	February	2008	Winter	PELICAN CITY
Hydraulic oil825990450139492S.E. BERING SEA	Non-crude oil		Hydraulic oil	150	Aleutian	8259904501	2/14/2008	February	2008	Winter	S.E. BERING SEA
Diesel811990480139495Craig / Klawock area waters	Non-crude oil		Diesel	100	Southeast Alaska	8119904801	2/17/2008	February	2008	Winter	Craig / Klawock area waters
Diesel824990630339510KODIAK CITY	Non-crude oil		Diesel	150	Kodiak Island	8249906303	3/3/2008	March	2008	Winter	KODIAK CITY
Diesel825990830139530EASTERN CHAIN	Non-crude oil		Diesel	145000	Aleutian	8259908301	3/23/2008	March	2008	Winter	EASTERN CHAIN
Jet fuel823990900139537COOK INLET	Non-crude oil		Jet fuel	275	Cook Inlet	8239909001	3/30/2008	March	2008	Winter	COOK INLET
Diesel822991150139562PORT OF VALDEZ	Non-crude oil		Diesel	125	Prince William Sound	8229911501	4/24/2008	April	2008	Spring	PORT OF VALDEZ

ID	Substance Type	Persistent?	Substance Subtype	Quantity Released (gal)	SubArea	Spill No.	Spill Date	Month_	Year_	Season	Location
Diesel825991570139604FALSE PASS	Non-crude oil		Diesel	250	Aleutian	8259915701	6/5/2008	June	2008	Spring	FALSE PASS
Bilge Oil822991720139619PRINCE WILLIAM SOUND	Non-crude oil		Bilge Oil	135	Prince William Sound	8229917201	6/20/2008	June	2008	Spring	PRINCE WILLIAM SOUND
Diesel811991850239632Tongass Narrows	Non-crude oil		Diesel	500	Southeast Alaska	8119918502	7/3/2008	July	2008	Summer	Tongass Narrows
Diesel785239636Glacier Bay, northern extremity	Non-crude oil		Diesel	0	Southeast Alaska	7852	7/7/2008	July	2008	Summer	Glacier Bay, northern extremity
Multiple: diesel, jet fuel & gasoline786239652Togiak, AK	Non-crude oil		Multiple: diesel,	0	Bristol Bay	7862	7/23/2008	July	2008	Summer	Togiak, AK
Diesel786939667Prince William Sd., Fleming Isl., Alaska	Non-crude oil		Diesel	0	Prince William Sound	7869	8/7/2008	August	2008	Summer	Prince William Sd., Fleming Isl., Alaska
Diesel811992310139678Kasaan Bay	Non-crude oil		Diesel	200	Southeast Alaska	8119923101	8/18/2008	August	2008	Summer	Kasaan Bay
Diesel789839718Mekoryuk village beach, Nunivak Isl., AK	Non-crude oil		Diesel	300	Western Alaska	7898	9/27/2008	September	2008	Summer	Mekoryuk village beach, Nunivak Isl., A
Multiple: gasoline & lube oil790339728Wood River, SW Alasl	Non-crude oil		Multiple: gasoli	0	Bristol Bay	7903	10/7/2008	October	2008	Fall	Wood River, SW Alaska
Diesel791139743100 mi w of Adak Is in Amchitka Pass	Non-crude oil		Diesel	0	Aleutian	7911	10/22/2008	October	2008	Fall	100 mi w of Adak Is in Amchitka Pass
Diesel811993160139763Tongass Narrows	Non-crude oil		Diesel	100	Southeast Alaska	8119931601	11/11/2008	November	2008	Fall	Tongass Narrows
Diesel794539817Aghiyuk Island, W. Gulf of Alaska	Non-crude oil		Diesel	500	Kodiak Island	7945	1/4/2009	January	2009	Winter	Aghiyuk Island, W. Gulf of Alaska
Diesel923990150139828NORTH COOK INLET	Non-crude oil		Diesel	6000	Cook Inlet	9239901501	1/15/2009	January	2009	Winter	NORTH COOK INLET
Other923990150139828NORTH COOK INLET	Hazardous substance		Other	1705	Cook Inlet	9239901501	1/15/2009	January	2009	Winter	NORTH COOK INLET
Diesel925990290139842AKUTAN	Non-crude oil		Diesel	300	Aleutian	9259902901	1/29/2009	January	2009	Winter	AKUTAN
Diesel911990300139843Chatham Strait South	Non-crude oil		Diesel	2000	Southeast Alaska	9119903001	1/30/2009	January	2009	Winter	Chatham Strait South
Diesel923990440139857SEWARD CITY	Non-crude oil		Diesel	150	Cook Inlet	9239904401	2/13/2009	February	2009	Winter	SEWARD CITY
Multiple: diesel, lube oil & hydraulic oil798339869Akutan Isl.,	Non-crude oil		Multiple: diesel,	2850	Aleutian	7983	2/25/2009	February	2009	Winter	Akutan Isl., Eastern Aleutians, Alaska
Diesel925990560139869AKUTAN CITY	Non-crude oil		Diesel	2700	Aleutian	9259905601	2/25/2009	February	2009	Winter	AKUTAN CITY
Multiple: diesel, lube oil & hydraulic oil798839877St. George	Non-crude oil		Multiple: diesel,	0	Aleutian	7988	3/5/2009	March	2009	Winter	St. George Isl, Pribilof Isls, Bering Sea,
Hydraulic oil939990800239893KUPARUK	Non-crude oil		Hydraulic oil	100	North Slope	9399908002	3/21/2009	March	2009	Winter	KUPARUK
Cook Inlet crude oil800039895Cook Inlet, Alaska	Crude oil	Yes	Cook Inlet crud	0	Cook Inlet	8000	3/23/2009	March	2009	Winter	Cook Inlet, Alaska
Diesel925991020139915CENTRAL CHAIN	Non-crude oil		Diesel	300	Aleutian	9259910201	4/12/2009	April	2009	Spring	CENTRAL CHAIN
Diesel911991070239920Clarence Strait North	Non-crude oil		Diesel	100	Southeast Alaska	9119910702	4/17/2009	April	2009	Spring	Clarence Strait North
Diesel923991170139930SEWARD CITY	Non-crude oil		Diesel	200	Cook Inlet	9239911701	4/27/2009	April	2009	Spring	SEWARD CITY
Gasoline923991470139960KENAI GAS FIELD	Non-crude oil		Gasoline	125	Cook Inlet	9239914701	5/27/2009	May	2009	Spring	KENAI GAS FIELD
Diesel926991560139969BRISTOL BAY UNKNOWN	Non-crude oil		Diesel	240	Bristol Bay	9269915601	6/5/2009	June	2009	Spring	BRISTOL BAY UNKNOWN
Black algae804640004Kuk River near Wainright, AK	Non-crude oil		Black algae		North Slope	8046	7/10/2009	July	2009	Summer	Kuk River near Wainright, AK
Diesel911992140140027Port Frederick	Non-crude oil		Diesel	200	Southeast Alaska	9119921401	8/2/2009	August	2009	Summer	Port Frederick
Diesel925992150140028SAINT PAUL IS.	Non-crude oil		Diesel	280	Aleutian	9259921501	8/3/2009	August	2009	Summer	SAINT PAUL IS.
Diesel911992160140029Tongass Narrows	Non-crude oil		Diesel	150	Southeast Alaska	9119921601	8/4/2009	August	2009	Summer	Tongass Narrows
Diesel911992200140033Chatham Strait North	Non-crude oil		Diesel	500	Southeast Alaska	9119922001	8/8/2009	August	2009	Summer	Chatham Strait North
Anhydrous ammonia & chlorine808640045Pelican, AK	Extremely hazardous substar		Anhydrous amr	0	Southeast Alaska	8086	8/20/2009	August	2009	Summer	Pelican, AK
Multiple: gasoline & jet fuel809740072Quinhagak, Alaska	Non-crude oil		Multiple: gasoli	0	Western Alaska	8097	9/16/2009	September	2009	Summer	Quinhagak, Alaska
Ammonia (anhydrous)926992670140080CHIGNIK CITY	Extremely hazardous substar		Ammonia (anhy	515	Aleutian	9269926701	9/24/2009	September	2009	Summer	CHIGNIK CITY
Diesel926992670140080CHIGNIK CITY	Non-crude oil		Diesel	800	Aleutian	9269926701	9/24/2009	September	2009	Summer	CHIGNIK CITY
Used Oil (all types)926992670140080CHIGNIK CITY	Non-crude oil		Used Oil (all typ	180	Aleutian	9269926701	9/24/2009	September	2009	Summer	CHIGNIK CITY
Diesel911992830140096Sitka Sound	Non-crude oil		Diesel	450	Southeast Alaska	9119928301	10/10/2009	October	2009	Fall	Sitka Sound
Diesel812740100Sand Point, Alaska	Non-crude oil		Diesel	0	Aleutian	8127	10/14/2009	October	2009	Fall	Sand Point, Alaska
Diesel925993030140116EASTERN CHAIN	Non-crude oil		Diesel	2000	Aleutian	9259930301	10/30/2009	October	2009	Fall	EASTERN CHAIN
Diesel814440122Unimak Isl., E. Aleutians, Alaska	Non-crude oil		Diesel	0	Aleutian	8144	11/5/2009	November	2009	Fall	Unimak Isl., E. Aleutians, Alaska
Diesel922993510140164VALDEZ	Non-crude oil		Diesel	150	Prince William Sound	9229935101	12/17/2009	December	2009	Fall	VALDEZ
Diesel922993570140170BLIGH IS.	Non-crude oil		Diesel	6410	Prince William Sound	9229935701	12/23/2009	December	2009	Fall	BLIGH IS.
Diesel817540189Adak Island, Aleutian Isls, Alaska	Non-crude oil		Diesel	134400	Aleutian	8175	1/11/2010	January	2010	Winter	Adak Island, Aleutian Isls, Alaska
Diesel1025990110140189WESTERN CHAIN	Non-crude oil		Diesel	68746	Aleutian	10259901101	1/11/2010	January	2010	Winter	WESTERN CHAIN
Diesel1011990220140200Holkham Bay Area	Non-crude oil		Diesel	200	Southeast Alaska	10119902201	1/22/2010	January	2010	Winter	Holkham Bay Area
Corrosion Inhibitor1025990370140215DUTCH HARBOR	Hazardous substance		Corrosion Inhib	150	Aleutian	10259903701	2/6/2010	February	2010	Winter	DUTCH HARBOR
Diesel1022991100140288Middleton Island	Non-crude oil		Diesel	1000	Prince William Sound	10229911001	4/20/2010	April	2010	Spring	Middleton Island
Diesel1022991390140317MONTAGUE ISLAND	Non-crude oil		Diesel	600	Prince William Sound	10229913901	5/19/2010	May	2010	Spring	MONTAGUE ISLAND
Diesel1011991400140318Sitka Sound	Non-crude oil		Diesel	360	Southeast Alaska	10119914001	5/20/2010	May	2010	Spring	Sitka Sound
Propylene glycol1011991530140331Juneau / Douglas	Hazardous substance		Propylene glyc	500	Southeast Alaska	10119915301	6/2/2010	June	2010	Spring	Juneau / Douglas

ID	Substance Type	Persistent?	Substance Subtype	Quantity Released (gal)	SubArea	Spill No.	Spill Date	Month_	Year_	Season	Location
DieselNOAA ID 82340385PRINCE WILLIAM SOUND	Non-crude oil		Diesel	3000	Prince William Sound	NOAA ID 823	7/26/2010	July	2010	Summer	PRINCE WILLIAM SOUND
Diesel1026992260140404NUSHAGAK	Non-crude oil		Diesel	300	Bristol Bay	10269922601	8/14/2010	August	2010	Summer	NUSHAGAK
Diesel1011992390140417Wrangell Narrows	Non-crude oil		Diesel	100	Southeast Alaska	10119923901	8/27/2010	August	2010	Summer	Wrangell Narrows
Diesel1011992630140441Sitka Sound	Non-crude oil		Diesel	500	Southeast Alaska	10119926301	9/20/2010	September	2010	Summer	Sitka Sound
Multiple: diesel, lube oil & IFO82754051570nm North of Adak	Non-crude oil		Multiple: diesel,	0	Aleutian	8275	12/3/2010	December	2010	Fall	70nm North of Adak Island, AK
Diesel1011993420140520Craig / Klawock area waters	Non-crude oil		Diesel	300	Southeast Alaska	10119934201	12/8/2010	December	2010	Fall	Craig / Klawock area waters
Diesel828340568Latouche Isl, Prince William Sound, Alaska	Non-crude oil		Diesel	0	Prince William Sound	8283	1/25/2011	January	2011	Winter	Latouche Isl, Prince William Sound, Ala
Diesel829040582Unalaska Isl., Aleutian Isl., Alaska	Non-crude oil		Diesel	800	Aleutian	8290	2/8/2011	February	2011	Winter	Unalaska Isl., Aleutian Isl., Alaska
Diesel1125990390140582EASTERN CHAIN	Non-crude oil		Diesel	790	Aleutian	11259903901	2/8/2011	February	2011	Winter	EASTERN CHAIN
Hydraulic oil1125990390140582EASTERN CHAIN	Non-crude oil		Hydraulic oil	120	Aleutian	11259903901	2/8/2011	February	2011	Winter	EASTERN CHAIN
Diesel1124990420140585SHELIKOF STRAIT	Non-crude oil		Diesel	4500	Kodiak Island	11249904201	2/11/2011	February	2011	Winter	SHELIKOF STRAIT
Hydraulic oil1124990420140585SHELIKOF STRAIT	Non-crude oil		Hydraulic oil	125	Kodiak Island	11249904201	2/11/2011	February	2011	Winter	SHELIKOF STRAIT
Diesel1123990460240589WHITTIER CITY	Non-crude oil		Diesel	100	Prince William Sound	11239904602	2/15/2011	February	2011	Winter	WHITTIER CITY
Diesel1125990460140589UNALASKA	Non-crude oil		Diesel	1100	Aleutian	11259904601	2/15/2011	February	2011	Winter	UNALASKA
Multiple: diesel, lube oil & hydraulic oil829540608King Cove,	Non-crude oil		Multiple: diesel,	0	Aleutian	8295	3/6/2011	March	2011	Winter	King Cove, Alaska Peninsula
Diesel1111990830140626Tongass Narrows	Non-crude oil		Diesel	100	Southeast Alaska	11119908301	3/24/2011	March	2011	Winter	Tongass Narrows
Ethylene Glycol (Antifreeze)1122991100140653VALDEZ MAI	Hazardous substance		Ethylene Glyco	1000	Prince William Sound	11229911001	4/20/2011	April	2011	Spring	VALDEZ MARINE TERMINAL-WATER
Multiple: diesel, lube oil, hydraulic oil, gasoline & waste oil832	Non-crude oil		Multiple: diesel,	0	Bristol Bay	8321	5/25/2011	May	2011	Spring	NW side of Hagemeister Island
Gasoline1122991500140693Gulf of Alaska	Non-crude oil		Gasoline	256	Prince William Sound	11229915001	5/30/2011	May	2011	Spring	Gulf of Alaska
Diesel1125991770140720S.E. BERING SEA	Non-crude oil		Diesel	1000	Aleutian	11259917701	6/26/2011	June	2011	Spring	S.E. BERING SEA
Diesel1122991840140727PRINCE WILLIAM SOUND	Non-crude oil		Diesel	250	Prince William Sound	11229918401	7/3/2011	July	2011	Summer	PRINCE WILLIAM SOUND
Diesel1122991870140730Gulf of Alaska	Non-crude oil		Diesel	2000	Prince William Sound	11229918701	7/6/2011	July	2011	Summer	Gulf of Alaska
Diesel1125991880240731DUTCH HARBOR	Non-crude oil		Diesel	100	Aleutian	11259918802	7/7/2011	July	2011	Summer	DUTCH HARBOR
Diesel1111991910140734Tongass Narrows	Non-crude oil		Diesel	700	Southeast Alaska	11119919101	7/10/2011	July	2011	Summer	Tongass Narrows
Diesel1122992180140761PRINCE WILLIAM SOUND	Non-crude oil		Diesel	160	Prince William Sound	11229921801	8/6/2011	August	2011	Summer	PRINCE WILLIAM SOUND
Diesel1111992290140772Chatham Strait North	Non-crude oil		Diesel	200	Southeast Alaska	11119922901	8/17/2011	August	2011	Summer	Chatham Strait North
Diesel1124992400140783KODIAK CITY	Non-crude oil		Diesel	100	Kodiak Island	11249924001	8/28/2011	August	2011	Summer	KODIAK CITY
Lube oil1124992400140783KODIAK CITY	Non-crude oil		Lube oil	100	Kodiak Island	11249924001	8/28/2011	August	2011	Summer	KODIAK CITY
Diesel1138992530140796NOME CITY	Non-crude oil		Diesel	1000	Northwest Arctic	11389925301	9/10/2011	September	2011	Summer	NOME CITY
Jet fuel836140807Diomede Islands, AK	Non-crude oil		Jet fuel	0	Northwest Arctic	8361	9/21/2011	September	2011	Summer	Diomede Islands, AK
Diesel1124992640140807AFOGNAK IS.	Non-crude oil		Diesel	100	Kodiak Island	11249926401	9/21/2011	September	2011	Summer	AFOGNAK IS.
Bunker fuel1125992710140814CENTRAL CHAIN	Non-crude oil	Yes	Bunker fuel	500	Aleutian	11259927101	9/28/2011	September	2011	Summer	CENTRAL CHAIN
Diesel1111992790140822Chatham Strait North	Non-crude oil		Diesel	500	Southeast Alaska	11119927901	10/6/2011	October	2011	Fall	Chatham Strait North
Multiple: diesel & bunker C837940882Aleutian Islands, Alask	Non-crude oil	Yes	Multiple: diesel	0	Aleutian	8379	12/5/2011	December	2011	Fall	Aleutian Islands, Alaska
Multiple: diesel & jet fuel838540895NE Gulf of Alaska	Non-crude oil		Multiple: diesel	0	Southeast Alaska	8385	12/18/2011	December	2011	Fall	NE Gulf of Alaska
Multiple: diesel & gasoline838940898Winter fuel delivery to N	Non-crude oil		Multiple: diesel	0	Northwest Arctic	8389	12/21/2011	December	2011	Fall	Winter fuel delivery to Nome, Alaska
Diesel1211990230140931Tongass Narrows	Non-crude oil		Diesel	100	Southeast Alaska	12119902301	1/23/2012	January	2012	Winter	Tongass Narrows
Diesel1211990230240931Tongass Narrows	Non-crude oil		Diesel	200	Southeast Alaska	12119902302	1/23/2012	January	2012	Winter	Tongass Narrows
Multiple: diesel, lube oil, hydraulic fluid & antifreeze83994093	Non-crude oil		Multiple: diesel,	0	Kodiak Island	8399	1/25/2012	January	2012	Winter	Shelikof Strait, Alaska
Diesel1224990250140933KODIAK UNKNOWN	Non-crude oil		Diesel	8000	Kodiak Island	12249902501	1/25/2012	January	2012	Winter	KODIAK UNKNOWN
Diesel1225990570140965EASTERN CHAIN	Non-crude oil		Diesel	1670	Aleutian	12259905701	2/26/2012	February	2012	Winter	EASTERN CHAIN
Diesel1223990600140968SOUTH COOK INLET	Non-crude oil		Diesel	600	Cook Inlet	12239906001	2/29/2012	February	2012	Winter	SOUTH COOK INLET
Diesel1211990630140971Juneau / Douglas	Non-crude oil		Diesel	150	Southeast Alaska	12119906301	3/3/2012	March	2012	Winter	Juneau / Douglas
Diesel1224991600141068CHINIAK CDP	Non-crude oil		Diesel	8000	Kodiak Island	12249916001	6/8/2012	June	2012	Spring	CHINIAK CDP
Diesel1223991660341074HOMER CITY	Non-crude oil		Diesel	100	Cook Inlet	12239916603	6/14/2012	June	2012	Spring	HOMER CITY
Diesel1224991700141078SHELIKOF STRAIT	Non-crude oil		Diesel	1200	Kodiak Island	12249917001	6/18/2012	June	2012	Spring	SHELIKOF STRAIT
Ammonia847441096Dutch Harbor, AK	Extremely hazardous substar		Ammonia		Aleutian	8474	7/6/2012	July	2012	Summer	Dutch Harbor, AK
Diesel848441117Cape Chacon, SE Alaska	Non-crude oil		Diesel	2450	Southeast Alaska	8484	7/27/2012	July	2012	Summer	Cape Chacon, SE Alaska
Diesel1211992110141119Clarence Strait South	Non-crude oil		Diesel	400	Southeast Alaska	12119921101	7/29/2012	July	2012	Summer	Clarence Strait South

ID	Spill Name	Facility Type	Facility Name	Address1	Address2	City	Region	Cause
Used Oil (all types)9511990120134711Portland Canal	F/V IDEAL	Vessel	KAKE CITY			Kake	Marine - Dixon Entrance	Sinking
Diesel707734715Dixon Entrance, southeast Alaska	F/V Alaskan Star							Other / Unknown
Diesel9511990540134753Tongass Narrows	SHOAL COVE, DRUMS	Other	SHOAL COVE, CARROLL INLET, KETCHIKAN			Ketchikan	Marine - Clarence Strait	External Factors
Diesel9511991110134810Tongass Narrows	F/V SHENANEGAN	Vessel	KETCHIKAN, 30 miles south Foggy Pt. on Rocks			Ketchikan	Marine - Clarence Strait	Other
Diesel709934865Kupreanof Island, Alaska	F/V Miss Doreen							Other / Unknown
Other9511011740134873Lynn Canal South	STAR PRINCESS	Vessel	Favorite Channel - Poundstone Rock	Favorite Channel - Poundstone Rock			Marine - Lynn Canal	Grounding
Diesel9527991860134885Eek	F/V MATTIE-O	Vessel	KUSKOKWIM BAY NEAR EEK ISLAND ON WATER.			Eek	Lower Kuskokwim	Rollover/Capsize
Diesel9511991980134897Chatham Strait North	F/V JOSEPH	Vessel	CHATHAM STRAIT, Point Agustus				Marine - Chatham Strait	Sinking
Diesel9525992030234902CENTRAL CHAIN	F/V NORTHERN WIND 7/22/95	Vessel	NAZAN BAY NEAR SEGUAM ISLAND AND ATKA ON WATER				Aleutian Chain	Grounding
Diesel710634904Sequam Island, Aleutian Island chain, Alask	M/V Northern Wind							Other / Unknown
Diesel9511992210234920Dixon Entrance	F/V ANNA-K	Vessel	DIXON ENTRANCE				Marine - Dixon Entrance	Unknown
Other9525992220134921AKUTAN	AKUTAN FISH OIL SPILL 8/10/95	Cannery	AKUTAN BAY ON WATER				Aleutian Chain	Human Error
Diesel9524992230134922KODIAK UNKNOWN	F/V SUMMER GAIL	Vessel	KODIAK TWO HEADED ISLAND ON SHORE			Kodiak	Kodiak	Grounding
Diesel9511992340134933Wrangell Narrows	NORQUEST FISHERIES	Other	PETERSBURG			Petersburg	Marine - Frederick Sound	Line Failure
Gasoline9511992470134946Tongass Narrows	SELEY BOAT YARD	Vessel	KETCHIKAN, Seley Boat Yard			Ketchikan	Marine - Clarence Strait	Seal Failure
Hydraulic oil9525992480234947DUTCH HARBOR	F/V NORTHERN VICTORY	Vessel	DUTCH HARBOR UDAGAK BAY				Aleutian Chain	Line Failure
Other9523992500534949PASSAGE CANAL	WHITTIER IMPOUND YARD 9/95	Other	WHITTIER IMPOUND YARD				Anch. Dist. Marine Waters	Corrosion
Diesel9511992510234950Chichagof Island NOS	F/V RELIEF	Vessel	CHATHAM STRAIT, Tenakee Harbor				Land - Baranof / Chichago	Hull Failure
Diesel9525992690134968EASTERN CHAIN		Vessel	DUTCH HARBOR SPIT DOCK				Aleutian Chain	Unknown
Jet fuel9524992830134982KODIAK CITY		Vessel	KODIAK OLD WOMANS BAY ON WATER			Kodiak	Kodiak	Human Error
Diesel9525992880134987EASTERN CHAIN	F/V OLYMPIC - DUTCH HARBOR	Vessel	DUTCH HARBOR DELTA WESTERN FUEL DOCK ON WATER				Aleutian Chain	Overfill
Diesel9525992900134989CENTRAL CHAIN	F/V OLYMPIC	Vessel	DUTCH HARBOR DELTA WESTERN FUEL DOCK ON WATER				Aleutian Chain	Overfill
Diesel9511992990234998Sumner Strait	LABOUCHERE BAY	Other	LABOUCHERE BAY CDP			Labouchere Ba	Marine - Sumner Strait	Human Error
Gasoline9511993100135009Tongass Narrows	TARA H	Vessel	KETCHIKAN, Bald Headed Island Cove, Pennock island			Ketchikan	Marine - Clarence Strait	Sinking
Diesel9511993320135031Sumner Strait	F/V ANTLER	Vessel	PRINCE OF WALES, RED BAY			Prince Of Wale	Marine - Sumner Strait	Sinking
North Slope crude711635038Nikiski, Alaska	Tesoro Tank Spill							Other / Unknown
Gasoline9611990050135069Clarence Strait North	F/V CAPE CHACON	Vessel	PRINCE OF WALES ISLAND, SINKING RATZ HARBOR			Prince Of Wale	Marine - Clarence Strait	Sinking
Diesel9624990250135089KODIAK UNKNOWN	TROXELL F/V SALLY J. KODIAK	Vessel	KODIAK UGANIK BAY ON WATER			Kodiak	Kodiak	Sinking
Diesel9624990310135095OUZINKIE CITY	F/V BLUE FOX KODIAK	Vessel	KODIAK OUZINKIE STRAIT, SPLIT ROCK ON WATER			Ouzinkie	Kodiak	Sinking
Bunker fuel9625990510135115SAINT PAUL IS.	ST. PAUL OILY BIRDS/MV CITRUS	Vessel	SAINT PAUL ISLAND ON WATER				Pribilof	Collision/Allision
Unknown9611990680135132Wrangell area waters	HARBOR DEPT	Unknown	WRANGELL HARBOR			Wrangell	Marine - Sumner Strait	Unknown
Diesel9624990950135159CHINIAK CDP	F/V DESIREE C. KODIAK	Vessel	KODIAK OFF CAPE CHINIAK ON WATER			Chiniak	Kodiak	Sinking
Diesel9611991010135165Dixon Entrance	F/V EVELYN MARY LOUISE	Vessel	DIXON ENTRANCE, METLAKATLA, ANNETTE ISLAND				Marine - Dixon Entrance	Sinking
Diesel9624991070135171KODIAK UNKNOWN	F/V DUTCHESS - KODIAK	Vessel	KODIAK SPRUCE ISLAND ON WATER			Kodiak	Kodiak	Rollover/Capsize
Diesel9625991160235180EASTERN CHAIN	F/V ELIZABETH F. KING COVE	Vessel	KING COVE HARBOR ON WATER				Aleutian Chain	Overfill
Lead-based paint713935196Unalaska, Alaska	Mystery Chemical Spill		Iluliuk River near Unalaska					Other / Unknown
Jet fuel9611991390135203Tongass Narrows	PETRO MARINE - AV GAS	Crude Oil Terminal	KETCHIKAN, PETRO MARINE DOCK			Ketchikan	Marine - Clarence Strait	Human Error
Diesel9623991510135215KENAI CITY	F/V CIP - NEW DAY	Vessel	KENAI NIKISKI COOK INLET PROCESSING BOAT YARD			Kenai	Central Kenai	Leak
Diesel9625991570235221CENTRAL CHAIN	F/V PROVIDER	Vessel	YUNASKA ISLAND IN ALEUTIANS ON WATER				Aleutian Chain	Grounding
Diesel714235224Juneau, Alaska	Mendenhall Wetlands							Other / Unknown
Diesel9625991820135246CENTRAL CHAIN	F/V LOWBOY	Vessel	KING COVE HARBOR ON LAND				Aleutian Chain	Leak
Other9611992020135266Chatham Strait North	FUNTER BAY MYSTERY	Unknown	CHATHAM STRAIT, FUNTER BAY				Marine - Chatham Strait	Unknown
Diesel9611992080135272Dixon Entrance	KINCOLITH DIESEL	Power Generation	DIXON ENTRANCE, BC SPILL				Marine - Dixon Entrance	Unknown
Diesel9611992090135273Tongass Narrows	M/V VARSITY	Vessel	KETCHIKAN, City Float			Ketchikan	Marine - Clarence Strait	Overfill
Diesel9611992120135276Tongass Narrows	M/V C-CHIEF	Vessel	KETCHIKAN, Bar Harbor			Ketchikan	Marine - Clarence Strait	Bilge Discharge

ID	Spill Name	Facility Type	Facility Name	Address1	Address2	City	Region	Cause
Diesel9622992150235279EVANS ISLAND	F/V MARTIE	Vessel	Prince William Sound EVANS ISLAND ON WATER			Evans Island	P.W.S.	Sinking
Diesel9623992200135284WHITTIER		Vessel	WHITTIER ALASKA RAILROAD YARD			Whittier	East Area	Tank Failure
Used Oil (all types)9623992270135291HOMER CITY	HOMER HARBOR WASTE OIL	Vessel	KENAI HOMER SMALL BOAT HARBOR ON WATE	1		Homer	Central Kenai	Unknown
Diesel9611992300135294Sitka Sound	F/V MERLE ELAINE	Vessel	SITKA, NEW THOMAS BASIN			Sitka	Marine - Outside Waters	Sinking
Diesel9625992450135309KING COVE CITY	F/V MELANIE	Vessel	KING COVE BOAT HARBOR			King Cove	Aleutian East	Human Error
Ammonia (anhydrous)9625992490135313EASTERN CHAIN	ARCTIC ENTERPRISE AMMONIA	Vessel	DUTCH HARBOR BEAVER INLET				Aleutian Chain	Unknown
Diesel9611992780135342Gastineau Channel	F/V FRANCIS IV	Vessel	GASTINEAU CHANNEL, HARRIS HARBOR, FLOAT 4, STALL 7			Juneau	Marine - Stephens Passag	Sinking
Ammonia (anhydrous)9625992860135350EASTERN CHAIN	M/V STORFJORD AMMONIA	Vessel	DUTCH HARBOR ON BOARD VESSEL				Aleutian Chain	Overfill
Optimer 7128 cation flocculant, or ethyl oxylated alcohol7156	Ketchikan Pulp Mill Chemical Release							Other / Unknown
Diesel9625992980235362EASTERN CHAIN	F/V REBECCA B. AGROUND	Vessel	TANGA ISLAND				Aleutian Chain	Grounding
Used Oil (all types)9611993190135383Gastineau Channel	JUNEAU HARBOR MASTERS SPII	Other	JUNEAU MARINE UNKNOWN, HARRIS HARBOR				Marine - Stephens Passag	Overfill
Diesel9622993200135384HINCHINBROOK IS.	F/V AUNT BRIDGATE	Vessel	Prince William Sound BEAR CAPE, HINCHINBROOK ENTRANCE ON WATER				P.W.S.	Sinking
Jet fuel9624993520135416KODIAK CITY	KODIAK COAST GUARD 800 GAL	Other	KODIAK OLD WOMANS BAY BY COAST GUARD FUEL FARM			Kodiak	Kodiak	External Factors
Multiple: diesel & bunker C717435424Aleutian Island chain, /	M/V Baneasa							Other / Unknown
Diesel9711990020135432Portland Canal	PT. GARDNER-DIESEL	Vessel	KAKE CITY,PT. GARDNER NEAR KAKE			Kake	Marine - Dixon Entrance	Overfill
Diesel9711990420135472Portland Canal	KAKE FUEL DOCK - 2" line	Gas Station	KAKE CITY,			Kake	Marine - Dixon Entrance	Corrosion
Diesel719035480Akun Island, Aleutian Island Chain, Alaska	F/V Lisa Jo							Other / Unknown
Other9711990560235486Tongass Narrows	BARGE KFP-1	Vessel	KETCHIKAN,			Ketchikan	Marine - Clarence Strait	Leak
Diesel9725990950135525AKUTAN CITY	F/V TRAIL BLAZER	Vessel	AKUTAN TRIDENT SEAFOOD DOCK	P.O. Box 9		Akutan	Aleutian East	Overfill
Used Oil (all types)9723991130235543PASSAGE CANAL	WHITTIER STORM DRAIN/DELON	Vehicle	WHITTIER STORM DRAIN TO DELONG DOCK ON WATER				Anch. Dist. Marine Waters	Leak
Bunker fuel720135560George Inlet, Ketchikan, Alaska	George Inlet Cannery							Other / Unknown
Diesel9726991390135569BRISTOL BAY	F/V REBECCA IRENE	Vessel	NUSHAGAK BAY				Bristol Bay Borough	Tank Failure
Diesel9726991420235572LEVELOCK CDP	F/V FOGGY CAPE - LEVELOCK	Vessel	LEVELOCK ON KVICHAK RIVER			Levelock	Alaska Peninsula	Sinking
Diesel9725991520135582EASTERN CHAIN	F/V BLUE NORTH	Vessel	DUTCH HARBOR OFFSHORE SYSTEMS DOCK ON WATER				Aleutian Chain	Overfill
Other9711991590235589Gastineau Channel	GALAXY SEWAGE DISCHARGE	Vessel	JUNEAU, FRANKLIN DOCK			Juneau	Marine - Stephens Passag	Bilge Discharge
Diesel9711991770135606Clarence Strait North	F/V LIZ THORNE BAY	Vessel					Marine - Clarence Strait	Other
Diesel9711991800335610Revillagigedo Channel	F/V SPARE PARTS II	Vessel	REVILLAGIGEDO CHANNEL, NORTH PENNOCK ISLAND				Marine - Clarence Strait	Grounding
Diesel9711991960435626Hobart Bay	S/V LOREN	Vessel	STEPHENS PASSAGE ENDICOTT ARM				Marine - Stephens Passag	Grounding
Diesel9722992020135632P.W.S. UNKNOWN	49ER BARGE FNT 255	Vessel	Prince William Sound BETWEEN KODIAK AND CORDOVA ON WATER				P.W.S.	Hull Failure
Diesel9725992110135641ALEUTIAN E. UNKNOWN	F/V SILENT LADY, SAND POINT	Vessel	SAND POINT TRIDENT SEAFOODS DOCK ON WATER				Aleutian East	Overfill
Diesel9723992200135650SOUTH COOK INLET	F/V BLUE FOX 8/97	Vessel	KENAI GORE POINT ON WATER				Cook Inlet	Sinking
Diesel9726992240135654KING SALMON CDP	M/V WHITE GOLD	Vessel	NAKNEK RIVER AT LAKE CAMP NEAR KING SALMON			King Salmon	Alaska Peninsula	Sinking
Diesel9711992260235656Tongass Narrows	P/C STEAMER	Vessel					Marine - Clarence Strait	Sinking
Asphalt emulsion722335661Haines, Alaska	Haines Dock Asphalt Spill							Other / Unknown
Diesel9739992330135663BARROW CITY		Vessel	BARROW CITY, CROWLEY MARITIME.			Barrow	North Slope	Leak
Diesel9724992420135672KODIAK CITY	F/V RENEGADE	Vessel	KODIAK DOG BAY HARBOR M-15 FLOAT ON WATER			Kodiak	Kodiak	Overfill
Diesel9725992510135681DUTCH HARBOR	F/V RONNY AGROUND	Vessel	SAND POINT FOX BAY				Aleutian Chain	Sinking
Diesel9711992680235698Cape Edgecumbe to Icy Bay	M/V LADY NINA	Vessel	SITKA			Situk	Marine - Outside Waters	Overfill
Diesel9724992680135698KODIAK CITY	F/V VICTORIA ANNE	Vessel	KODIAK UGAK BAY ON WATER			Kodiak	Kodiak	Sinking
Bilge Oil9725992680235698EASTERN CHAIN	F/V MARIA N.	Vessel	DUTCH HARBOR DELTA WESTERN FUEL DOCK				Aleutian Chain	Sabotage/Vandali
Ammonia (anhydrous)9711992770135707Cordova Bay	COASTAL TRADER	Vessel	GULF OF ALASKA AND INTO PORT CALDERA, 6 MILES SW O			Ketchikan	Marine - Waters west of P	Other
Bilge Oil9711993080235738Tongass Narrows	CITY FLOAT SLICK	Vessel					Marine - Clarence Strait	Unknown
Ethylene Glycol (Antifreeze)9739993250135755BEAUFORT		Vessel	BEAUFORT SEA, CROWLEY MARINE SERVICES, INC.				North Slope	Puncture
IFO-380501135760Unalaska Island, Alaska	M/V Kuroshima							Other / Unknown
Bunker fuel9725993300135760EASTERN CHAIN	M/V KUROSHIMA	Vessel	DUTCH HARBOR IN SUMMER BAY				Aleutian Chain	Grounding
Gasoline9724993370135767KODIAK CITY	F/V DUDEK 'KAZUB ONE'	Vessel	KODIAK HARBOR ACROSS FROM TOWN ON WATER			Kodiak	Kodiak	Grounding

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Gasoline9711993430135773Sitka Sound	ANB GASOLINE	Vessel	SITKA			Sitka	Marine - Outside Waters	Sinking
Diesel9711993440135774Sitka Sound	SITKA 32' TROLLER	Vessel	SITKA East Anchorage			Sitka	Marine - Outside Waters	Rollover/Capsize
Ammonia725235788Wrangell, Alaska	Barge Alaska							Other / Unknown
Diesel9811990180135813Gastineau Channel	F/V CAROL ANN	Vessel	GASTINEAU CHANNEL DUPONT DOCK				Marine - Stephens Passag	Rollover/Capsize
Diesel9824990660135861KODIAK CITY	KODIAK CG CUTTER STORIS	Vessel	KODIAK WOMANS BAY			Kodiak	Kodiak	Valve Failure
Used Oil (all types)9811990790135874Portland Canal	F/V/UNNAMED, KEKU STRAIT, KA	Vessel	KEKU STRAIT, KAKE			Kake	Marine - Dixon Entrance	Cargo Not Secure
Gasoline9811990820835877Portland Canal	KAKE CITY BOAT HARBOR, MYS	Other	KAKE CITY BOAT HARBOR, KAKE			Kake	Marine - Dixon Entrance	Sabotage/Vandali
Diesel9822990830135878PORT OF VALDEZ	F/V MATT GUNN	Vessel	VALDEZ SMALL BOAT HARBOR ON LAND AND ON WATER			Valdez	P.W.S.	Leak
Diesel9811981060235901Tongass Narrows	City pump station	Other					Marine - Clarence Strait	Leak
Diesel9811991070135902Tenakee Inlet	F/V SAMAQU	Vessel	TENAKEE INLET				Marine - Chatham Strait	Other
Diesel9826991130135908CHIGNIK CITY	CHIGNIK PRIDE FISHERIES	Cannery	CHIGNIK FISHERIES FACILITY ON WATER			Chignik	Alaska Peninsula	Overfill
Diesel9811981480235943Tongass Narrows	PETRO ALASKA	Vessel	TONGASS NARROWS				Marine - Clarence Strait	Line Failure
Diesel9822991480135943CULROSS IS.	F/V MERIT FIRE/SINKING	Vessel	PRINCE WILLIAM SOUND PORT NELLIE JUAN				P.W.S.	Sinking
Diesel9811991500235945Glacier Bay	M/V KINGFISHER	Vessel	GLACIER BAY				Marine - Glacier Bay	Sinking
Diesel9822991520235947CORDOVA	F/V DOVE	Vessel	COPPER RIVER FLATS NEAR CORDOVA ON WATER			Cordova	P.W.S.	Sinking
Lube oil9811991620135957Lynn Canal South	COMET BEACH BLACK OIL	Unknown	LYNN CANAL				Marine - Lynn Canal	Leak
Diesel9811991750135970Stephens Passage South	F/V SEA QUEST, GRAVES PT., ST	Vessel	STEPHENS PASSAGE				Marine - Stephens Passag	Grounding
Ammonia731235977Homer, Alaska	Icicle Seafoods							Other / Unknown
Other9827991890135984St. Matthew Island	MV/ MILOS REEFER ST. MATTHE	Vessel	ST MATTHEWS ISLAND NW SIDE				Lower Kuskokwim	Grounding
Diesel9811991910235986Gastineau Channel	GYPSY SAIL BOAT	Vessel	JUNEAU			Juneau	Marine - Stephens Passag	Other
Hydraulic oil9811991970135992Tongass Narrows	F/V PANDAD	Other					Marine - Clarence Strait	Leak
Diesel9811991990135994Icy Strait	AMIGO III SPILL	Vessel	POINT COVERDON, ICY STRAIT & LYNN CANNAL, NEAR JUN				Marine - Icy Strait	Grounding
Gasoline9823992000135995HOMER CITY	F/V K-BAY 7 SPILL	Vessel	HOMER SMALL BOAT HARBOR PETRO MARINE FUEL DOCK			Homer	Central Kenai	Collision/Allision
Diesel9811992150136010Sitka Sound	F/V CRISTA LEE, SITKA	Vessel	CRESENT BOAT HARBOR, SITKA			Sitka	Marine - Outside Waters	Sinking
Diesel9825992240136019CENTRAL CHAIN	F/V NOWITNA	Vessel	KING COVE HARBOR ON WATER				Aleutian Chain	Overfill
Diesel9827992270136022Napakiak	FAULKNER TUG OVERTURNED	Vessel	JOHNSON RIVER 1/2 MILE FROM CONFLUENCE WITH KUSKOKwim				Lower Kuskokwim	Rollover/Capsize
Diesel9811992310336026Chatham Strait North	F/V JACKIE R	Vessel	ANGOON UNKNOWN CUBE COVE			Angoon	Marine - Chatham Strait	Sinking
Diesel732436039Womens Bay, Kodiak, Alaska	M/V Cape Douglas							Other / Unknown
Diesel732536039Womens Bay, Kodiak, Alaska	MV Cape Douglas							Other / Unknown
Unknown9811992650136060Lynn Canal South	GASTINEAU CHANAL MYSTERY S	Unknown	LAWSON CREEK TO DOUGLAS BRIDGE, GASTINEAU CHANAL,			Dotsons Landi	Marine - Lynn Canal	Unknown
Diesel733936062Alaska Peninsula	Chignik Lake							Other / Unknown
Other9811992670336062Gastineau Channel	GASTINEAU CHANAL MYSTERY	Other	GASTINEAU CHANNAL IN GENERAL AREA OF THE DOUGLAS B			Douglas	Marine - Stephens Passag	Unknown
Diesel9823992690136064CENTRAL COOK INLET	F/V SPUTKIN	Vessel	KENAI COOK INLET BARON ISLAND				Cook Inlet	
Diesel9811992780136073Cross Sound	F/V MYRTLE	Vessel	ELFIN COVE CDP			Elfin Cove	Marine - Icy Strait	Sinking
Diesel9811992850136080Glacier Bay	BRANT CONTRACTORS, GLACEF	Unknown	GLACIER BAY National Park			Glacier Bay	Marine - Glacier Bay	Other
Other9811993030236098Taiya Inlet	WhitePass&YukonRROil/WaterSep	Railroad Operation	Port of Skagway	Skagway Waterfront except for SB harbor			Marine - Lynn Canal	Human Error
Diesel9811993130136108Gastineau Channel	LANDING CRAFT KRD	Vessel	DEER ISLAND, JUNEAU			Juneau	Marine - Stephens Passag	Sinking
Diesel9811983140136109Tongass Narrows	KRD	Vessel	DEER ISLAND NEAR KETCHIKAN			Ketchikan	Marine - Clarence Strait	Sinking
Diesel9811993160236111Sitka Sound	M/V MELAINE D	Vessel	MIRROR HARBOR, SITKA			Sitka	Marine - Outside Waters	Sinking
Diesel9822993580136153VALDEZ	F/V SEA VENTURE	Vessel	VALDEZ SERVS DOCK ON WATER			Valdez	P.W.S.	Overfill
Diesel9911990060136166Gastineau Channel	P/C BEE BOP FIRE	Vessel	JUNEAU			Juneau	Marine - Stephens Passag	Other
Crude9923990370136197CENTRAL COOK INLET	T/V CHESAPEAKE TRADER	Vessel	KENAI COOK INLET BETWEEN NIKISKI AND HOMER				Cook Inlet	Hull Failure
Multiple: diesel, lube oil & bunker C738736210Dutch Harbor,	M/V Hekifu							Other / Unknown
Diesel9925990510136211AKUTAN	F/V ALASKAN PACKER - AKUTAN	Vessel	AKUTAN HARBOR ON WATER			Akutan	Aleutian East Borough	Overfill
Diesel9911981040136264Tongass Narrows	LCM 8550	Vessel	TONGASS NARROWS				Marine - Clarence Strait	Human Error
Bilge Oil9925991110136271SAND POINT	F/V VIKING EXPLORER 4/21/99	Vessel	SAND POINT TRIDENT SEAFOODS DOCK ON W/	Trident Seafood Dock		Sand Point	Aleutian East Borough	Bilge Discharge
Diesel9911981180136278Tongass Narrows	TUG THUNDERBIRD	Vessel	KETCHIKAN SHIP YARD			Ketchikan	Marine - Clarence Strait	Hull Failure
Ammonia (anhydrous)9925991260136286ADAK	F/V YING FA, ADAK	Vessel	ADAK			Adak	Aleutian Central	Unknown
Diesel9925991280136288CENTRAL CHAIN	F/V CONTROLLER BAY	Vessel	UNAMAK ISLAND NORTH SIDE ON WATER				Aleutian Chain	Grounding
Lube oil9925991300136290COLD BAY	M/V RED FIN	Vessel	COLD BAY KELP POINT ON WATER			Cold Bay	Aleutian East Borough	Grounding

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Diesel9911981370136297Craig / Klawock area waters	F/V WINDWARD	Vessel	CAPE CHACON, HYDABURG, POW			Hydaburg	Marine - Waters west of P(	Sinking
Diesel9923991570136317EAST KENAI UNKNOWN	F/V CAPRICE	Vessel	KENAI BLYING SOUND 7 MILES SE OF OUTER ISLAND OUTS				East Kenai	Sinking
Multiple: diesel & engine room slops740636323Dundas Bay,	M/V Wilderness Adventurer							Other / Unknown
Diesel9911991630136323Glacier Bay	M/V WILDERNESS ADVENTURER	Vessel	DUNDUS BAY, GLACIER BAY NATIONAL PARK			Glacier Bay	Marine - Glacier Bay	Grounding
Gasoline9927991660136326Nunam Iqua (Sheldon Point)	YUTANA SPILL AT SHELDON POI	Vessel	SHELDON POINT TANK FARM			Nanum Iqua (S	Lower Yukon	Overfill
Diesel9911991670136327Sumner Strait	F/V REWARD	Vessel	SUMNER STRAIT, DOUGLAS BAY				Marine - Sumner Strait	Sinking
Diesel741136342Sitka Sound	F/V Su-Ce K							Other / Unknown
Diesel9923991900536350HOMER CITY	F/V IRISH - N. COUNTRY HALIBU	Vessel	KENAI KACHEMAK BAY 10 MILES FROM HOMER, 30 MILES F			Homer	Central Kenai	Seal Failure
Diesel9924991930136353KODIAK CITY	TUG POWHATAN AT LASH DOCK	Vessel	KODIAK LASH DOCK ON WATER			Kodiak	Kodiak	Overfill
Diesel9911991940136354Lynn Canal South	F/V WANDERER	Vessel	EAST SIDE KATAGUNI ISLAND, IN LYNN CANAL, 13 MILES				Marine - Lynn Canal	Grounding
Multiple: diesel & lube oil742136368Tracey Arm, southeast A	M/V Spirit of 98							Other / Unknown
Diesel742236368Tracy Arm, AK	MV Spirit of 98							Other / Unknown
Diesel9911992260136386<Null>	F/V CREST	Unknown	CHASINA PT., POW	<Null>		Prince Of Wal	Marine - Clarence Strait	Unknown
Other9922992390136399PRINCE WILLIAM SOUND	POTATO POINT BUNKER	Vessel	VALDEZ POTATO POINT, VALDEZ ARM ON WATER				P.W.S.	Overfill
Diesel9911992430236403Annette Island	F/V NICOLE MARIE	Vessel	KIRK POINT, ANNETTE ISLAND			Annette	Southeastern	Grounding
Diesel9924992620136422OLD HARBOR CITY	F/V ALEXANDRIA SEA	Vessel	KODIAK OLD HARBOR CITY ON WATER			Old Harbor	Kodiak	External Factors
Fuel oil743536433Just offshore, village of Mekoryuk, N side N	M/V River Ways 10							Other / Unknown
Middle Ground Shoal crude oil744336456right at the Forelan	Dillon Pipeline							Other / Unknown
Diesel9924993100136470OLD HARBOR CITY	F/V MITROPHENIA	Vessel	KODIAK CAPE KASIAK NEAR OLD HARBOR ON WATER			Old Harbor	Kodiak	Grounding
Diesel9911993470236507Tongass Narrows	MYSTERY SHEEN BAR HARBOR	Unknown	BAR HARBOR, KETCHIKAN	2933 Tongass Ave		Ketchikan	Marine - Clarence Strait	Unknown
Gasoline23990190136544WEST CENTRAL KENAI	NIKISKI TESORO	Vessel	KENAI NIKISKI TESORO DOCK T/B ENERGIZER				West Kenai	External Factors
Gasoline11990250136550Portland Canal	KAKE TRIBAL FUELS	Crude Oil Terminal	KAKE CITY			Kake	Marine - Dixon Entrance	Leak
Multiple: diesel, lube oil & hydraulic oil746736567Unimak Isla	F/V American Star							Other / Unknown
IFO-380747236582Icy Bay, Northern Gulf of Alaska	MV Pacsun							Other / Unknown
Propane (LPG)747636600Kodiak, AK	SEALAND Propane Tk							Other / Unknown
Propane (LPG)24990750136600KODIAK UNKNOWN	SEALAND KODIAK	Vessel	KODIAK UNKNOWN			Kodiak	Kodiak	Tank Failure
Diesel11990980236623Tongass Narrows	PETRO MARINE DOCK SPILL	Other	TONGASS NARROWS				Marine - Clarence Strait	Valve Failure
Diesel24991110136636SHELIKOF STRAIT	F/V DESTINY SINKING	Vessel	SHELIKOF STRAIT 57 45.6 N 154 17 W				Kodiak	Sinking
Other11991330136658Gastineau Channel	JUBILEE GRAY WATER	Vessel	JUNEAU			Juneau	Marine - Stephens Passag	Intentional Releas
Diesel27991340136659Bethel	STEAMBOAT SLOUGH	Vessel	BETHEL STEAMBOAT SLOUGH	Kuskokwim River		Bethel	Lower Kuskokwim	Unknown
Diesel24991460136671WOMENS BAY	CG CUTTER MORGANTHAL	Vessel	WOMANS BAY				Kodiak	Valve Failure
Other11991480136673Gastineau Channel	MV/ JUBILEE	Vessel	JUNEAU DOCK, JUNEAU			Juneau	Marine - Stephens Passag	Intentional Releas
Ammonia (anhydrous)749536677Dutch Harbor, Unalaska Isla	MV Arctic Wind							Other / Unknown
Diesel25991730136698SAND POINT	F/V SABRINA	Vessel	SAND POINT ROCK QUARRY, EAST SIDE ROAD TO AIRPORT			Sand Point	Aleutian East Borough	Other
Jet fuel11991870236712Tongass Narrows	PETRO MARINE FUEL MANIFOLD	Vessel	PETRO MARINE FUEL DOCK, KETCHIKAN	1100 Steadman Street		Ketchikan	Marine - Clarence Strait	Human Error
Diesel24992040136729SHELIKOF STRAIT	F/V CHANNEL SURFER	Vessel	SHELIKOF STRAIT 57.31N 155.25W				Kodiak	Sinking
Diesel11992280136753Tongass Narrows	TUG SEA BEAR	Vessel	CLEAVLAND PEN., MYERS CHUCK, KETCHIKAN AREA			Ketchikan	Marine - Clarence Strait	Grounding
Diesel11992280236753Craig / Klawock area waters	F/V ERIN LYNN	Vessel	HYDABURG CITY			Hydaburg	Marine - Waters west of P(	Grounding
Diesel11992290136754Annette Island	F/V MISS TRACY	Vessel	ANNETTE CDP			Annette	Southeastern	Sinking
Other23992310136756NORTH COOK INLET	GRANITE POINT TANK FARM	Crude Oil Terminal	NORTH COOK INLET GRANITE POINT TANK FARM ONSHORE				Cook Inlet	Other
Diesel11992320136757Wrangell area waters	F/V FRISCO	Vessel	WRANGELL			Wrangell	Marine - Sumner Strait	Sinking
Diesel11992350236760Portland Canal	F/V CASPER	Vessel	SMALL BOAT HARBOR, KAKE			Kake	Marine - Dixon Entrance	Sinking
Diesel11992360236761Cape Edgecumbe to Icy Bay	F/V TAMARA	Vessel	KALININ BAY, SALIBURY SOUND, JUNEAU				Marine - Outside Waters	Grounding
Diesel11992420136767Tongass Narrows	F/V OLIVUS	Vessel	BEHM CANAL, KETCHIKAN			Ketchikan	Marine - Clarence Strait	Sinking
Other23992640136789WHITTIER	CROWLEY AMMONIUM NITRATE	Vessel	WHITTIER	Delong Dock		Whittier	East Area	Other

ID	Spill Name	Facility Type	Facility Name	Address1	Address2	City	Region	Cause
Diesel25992830236808DUTCH HARBOR	F/V HUSKY	Vessel	DUTCH HARBOR ALYESKA DOCK	c/o Alaska Boat Com	P.O. Box 5	Dutch Harbor	Aleutian East	Overfill
Heavy oil752036848Port Walter, AK	Port Walter Spill							Other / Unknown
Diesel25993280136853SAND POINT	F/V BOWFIN	Vessel	3 MI WEST OF HIGH ISLAND NEAR SAND POINT			Sand Point	Aleutian East Borough	Other
Diesel23993350136860KENAI CITY	KENAI DIESEL	Vessel	KENAI 2000 COLUMBIA STREET INLET SALMON YARD			Kenai	Central Kenai	Other
Diesel11993440136869Lisianski	Whitestone Logging, Hoonah	Vessel	Whitestone Logging, Inc. P.O. Box 389, Hoonah, AK			Hoonah	Marine - Icy Strait	Sinking
Diesel25993540136879DUTCH HARBOR	NORTH PACIFIC FUEL, RESOFF I	Gas Station	DUTCH HARBOR RESOFF FACILITY NORTH PACIFIC FUEL			Dutch Harbor	Aleutian East	Leak
Diesel122990300136921EVANS ISLAND	F/V VETER	Vessel	EVANS POINT			Evans Island	P.W.S.	Grounding
Unknown111990850236976Tongass Narrows	Mystery Drums	Other	Bar Harbor, Ketchikan	Tongass Ave		Ketchikan	Marine - Clarence Strait	Other
Diesel111991200337011Clarence Strait North	F/V CHATHAM	Vessel	POW, COFFMAN COVE			Coffman Cove	Marine - Clarence Strait	Other
Diesel122991290137020P.W.S. UNKNOWN	DUNLOP TOWING - TUG MALOLO	Vessel	JOHNSTONE POINT, PRINCE WILLIAM SOUND				P.W.S.	Overfill
Diesel125991310137022COLD BAY	F/V KRISTEN	Vessel	COLD BAY			Cold Bay	Aleutian East Borough	Other
Diesel111991650237056Lynn Canal North	Petro Marine Skagway Plant	Other	skagway			Skagway	Marine - Lynn Canal	Support Structure
Diesel111991790137070Gastineau Channel	DONOHUES MARINA	Other	TEE HARBOR, JUNEAU,			Juneau	Marine - Stephens Passag	Other
Diesel111991790337070Tongass Narrows	Gateway Forest Products	Logging Operation	TONGASS HWY, KETCHIKAN			Ketchikan	Marine - Clarence Strait	Leak
Diesel111992050137096Glacier Bay	GBNP GENSET	Other	GLACIER BAY NATIONAL PARK FUEL FAMR			Gustavus	Marine - Glacier Bay	Overfill
Diesel122992070137098PRINCE WILLIAM SOUND	M/V VANGUARD SINKING	Vessel	PRINCE WILLIAM SOUND NORTH OF GLACIER ISLAND WEST				P.W.S.	Sinking
Diesel111992130237104Cordova Bay	F/V EDITH H. GRACIE	Vessel	POW, Craig			Craig	Marine - Waters west of P	Sinking
Diesel122992160137107P.W.S. UNKNOWN	F/V WINDY BAY	Vessel	OLSEN ROCK ON EAST SIDE OF OLSEN ISLAND 60.52.27N				P.W.S.	Human Error
Diesel111992310137122Chatham Strait North	F/V SEAGULL SINKING	Vessel	PT. MARSDEN, CHATHAM STRAITS 58;03.17 LAT, 134'49.				Marine - Chatham Strait	Sinking
Diesel111992360137127Chatham Strait North	F/V REVENGE II	Vessel	2 MILES WEST OF CAPE OMMANEY				Marine - Chatham Strait	Sinking
Diesel111992390137130Annette Island	F/V WESTERN II	Vessel	SNAIL ROCK, REVILLAGEGEDO CHANNEL N55-01.963, W 13			Annette	Southeastern	Grounding
Diesel111992440137135Sumner Strait	F/V JOCELYN	Vessel	P.O.W. WARREN CHANNEL				Marine - Sumner Strait	Sinking
Diesel111992560137147Gastineau Channel	F/V CHEROKEE MAID	Vessel	MOORING BUOY OF JUNEAU YACHT CLUB, NORWAY POINT, J				Marine - Stephens Passag	Sinking
Diesel125992600137151DUTCH HARBOR	PACIFIC STAR DIESEL	Vessel	DUTCH HARBOR CAPTAINS BAY	American Civil Const	P.O. Box 9	Dutch Harbor	Aleutian East	Overfill
Diesel111992620137153Tongass Narrows	Seley Dock Facility	Vessel					Marine - Clarence Strait	Bilge Discharge
Crude123993310137222NORTH COOK INLET	Unocal Dillon Platform	Oil Production	COOK INLET DILLON PLATFORM				Cook Inlet	Leak
Diesel225990070137263DUTCH HARBOR	OSI Dock Dutch Diesel	Vessel	DUTCH HARBOR OSI DOCK			Dutch Harbor	Aleutian East	Overfill
Diesel224990170137273AFOGNAK IS.	F/V Meridian sinking	Vessel	KODIAK AFOGNAK KAZAKOFF BAY				Kodiak	Sinking
Diesel211990490137305Tongass Narrows	F/V Westward Sinking/Bar Harbor	Vessel	BAR HARBOR			Ketchikan	Marine - Clarence Strait	Equipment Failur
Ammonia (anhydrous)211990590137315Tongass Narrows	Norquest Ammonia KTKN	Other					Marine - Clarence Strait	Other
Diesel211990870237343Tongass Narrows	Andres Oil Co., Ktkn	Harbor/Port					Marine - Clarence Strait	Other
Ballast Water (containing oil)222991070137363VALDEZ MAI	VMT - East Ballast Water Manifold	Crude Oil Terminal	VALDEZ MARINE TERMINAL-WATER BALLAST WATER EAST MA			Valdez	P.W.S.	Human Error
Diesel211992020137458Tongass Narrows	Pt Higgins Rd-Boom Truck	Vehicle	POINT HIGGINS, KETCHIKAN			Ketchikan	Marine - Clarence Strait	Rollover/Capsize
Diesel211992050137461Lynn Canal South	Riptide Sinking, Juneau	Vessel	LYNN CANAL				Marine - Lynn Canal	Human Error
Diesel211992060137462Tongass Narrows	Petro Marine Diesel Spill	Non-Crude Termina	PETRO MARINE DOCK, KETCHIKAN	1100 Steadman		Ketchikan	Marine - Clarence Strait	Leak
Diesel211992070137463Clarence Strait North	F/V Arctic Sun	Vessel	Ratz Harbor, Clarence Strait			Thorne Bay	Marine - Clarence Strait	Sinking
Asphalt211992260137482Ketchikan Region NOS	AML Barge Asphault Spill	Other	KETCHIKAN UNKNOWN			Ketchikan	Land - Ketchikan	Leak
Other211992290137485Gastineau Channel	Ryandam Brown Sludge Spill	Harbor/Port	Juneau Tour Ship Dock				Marine - Stephens Passag	Unknown

ID	Spill Name	Facility Type	Facility Name	Address1	Address2	City	Region	Cause
Diesel211992370237493Cordova Bay	Phoenix Logging Co.	Log Processing	KLAWOCK			Klawock	Marine - Waters west of P	Other
Diesel224992690137525AFOGNAK IS.	F/V Dakota Sinking	Vessel	ISHUT (Izhut) BAY				Kodiak	Sinking
Diesel211992800137536Chichagof Island NOS	Tenakee Hot Springs Lodge HHOT	Other	CHATHAM STRAIT, Tenakee Harbor				Land - Baranof / Chichago	Other
Diesel211992880137544Wrangell Narrows	F/V Foggy Cape, Petersburg	Vessel	Sockeye Island			Petersburg	Marine - Frederick Sound	Other
Diesel224993140137570AFOGNAK IS.	F/V Genei Maru #7 Grounding	Vessel	KODIAK AFOGNAK KAZAKOFF BAY				Kodiak	Grounding
Unknown211993280137584Tongass Narrows	Ktn. Dry Dock Unknown	Other	SHIP YARD, KETCHIKAN			Ketchikan	Marine - Clarence Strait	Other
Drilling Muds223993330137589NORTH COOK INLET	Osprey Platform Mud	Oil Production	Osprey Platform	Osprey Platform		Nikiski	Cook Inlet	Human Error
Diesel224993450137601KODIAK UNKNOWN	St Paul Harbor Diesel	Vessel	ST. PAUL HARBOR			Kodiak	Kodiak	Overfill
Ballast Water (containing oil)222993460137602VALDEZ MA	BWT East Manifold A Header Leak	Crude Oil Terminal	VALDEZ MARINE TERMINAL-LAND BALLAST WATER TREATMEN			Valdez	P.W.S.	Leak
Diesel311990060237627Sitka Sound	Gary Jarvil, M/V CJ, Sitka	Vessel	SITKA			Sitka	Marine - Outside Waters	Sinking
Diesel311990060537627Tongass Narrows	M/V Realm	Harbor/Port	BAR HARBOR			Ketchikan	Marine - Clarence Strait	Sinking
Diesel311990090137630Juneau / Douglas	Northland Services Facility	Other	3139 Channel Drive			Juneau	Land - Juneau	Human Error
Diesel324991500137771KODIAK UNKNOWN	F/V Rocona II sinking	Vessel	Off Spruce Cape				Kodiak	Sinking
Diesel311991890237810Sitka Sound	F/V Miss Everett	Vessel	Kruzof Island				Marine - Outside Waters	Sinking
Diesel325991900137811SAINT PAUL IS.	St Paul Diesel	Vessel	SAINT PAUL ISLAND			Saint Paul Isla	Pribilof	Overfill
Diesel108537840Kodiak Island, AK	F/V Chichagof Grounded							Grounding
Diesel322992300137851P.W.S. UNKNOWN	F/V Valiant Maid	Vessel	SPIKE ISLAND				P.W.S.	Grounding
Diesel109437853Tanglefoot Bay, AK	F/V Donna Ann Grounding							Grounding
Diesel109337860Pavlof Bay, AK	F/V Decade Overturned							Other / Unknown
Diesel311992500137871Auke Bay / Fritz Cove	Juneau Ferry Terminal Spill	Vessel	Alaska Marine Highway Ferry Terminal, Auke Bay			Juneau	Marine - Stephens Passag	Leak
Diesel110737909North of Alaska Peninsula, Bering Sea, AK	F/V Raven Adrift							Other / Unknown
Diesel338993120137933SHAKTOOLIK CITY	Shaktoolik School	School	Shaktoolik Schools	Pail Asicksik House		Shaktoolik	West Coast	External Factors
Diesel411990090137995Stephens Passage South	Point Arden Fuel Drums	Other	Point Arden, Stephens Passage				Marine - Stephens Passag	Intentional Releas
Diesel425990290138015DUTCH HARBOR	F/V Rebecca Irene Diesel	Vessel	DUTCH HARBOR CAPTAINS BAY				Aleutian Chain	Overfill
Diesel411990340138020Yakutat Bay	F/V Wild Coho	Vessel	YAKUTAT BOAT HARBOR			Yakutat	Marine - Outside Waters	Line Failure
Diesel423990590138045HOMER CITY	F/V Susitna Diesel	Vessel	HOMER HARBOR	Homer Harbor		Homer	Central Kenai	Human Error
Ammonia (anhydrous)423990700138056HOMER CITY	F/T Aurous Ammonia	Vessel	HOMER SMALL BOAT HARBOR			Homer	Central Kenai	Intentional Releas
Diesel411990720138058Chichagof Island NOS	Pelican Seafoods Overfill	Cannery	Pelican Seafood Plant			Pelican	Land - Baranof / Chichago	Overfill
Diesel411991060438092Tongass Narrows	SEA 76	Vessel	Petro Marine Dock, Ketchikan			Ketchikan	Marine - Clarence Strait	Puncture
Diesel426991080138094BRISTOL BAY UNKNOWN	F/V Dolphin Diesel	Vessel	Naknek River	Trident Facility		Naknek	Bristol Bay Borough	Grounding
Diesel117238118Peril Strait, AK	Ferry LaConte Grounding							Grounding
Unknown117338119Bering Sea, AK	Mystery Spill					Mystery Spill		
Unknown117338119Bering Sea, AK	Mystery Spill							Mystery Spill
Diesel411991610238147Hydaburg / Tlevak	M/V Captain Jack Grounding	Vessel	Kosciusko Island				Marine - Waters west of P	Grounding
Diesel120038199Baby Island, AK	P/V Clipper Odyssey							Grounding
Diesel425992130138199ALEUTIAN E. UNKNOWN	Clipper Odyssey Grounding	Vessel	UNALGA ISLAND BABY PASS				Aleutian East	Grounding
Diesel121338244SE Alaska, AK	F/V Royal Flush Grounding							Grounding
Multiple: diesel & gasoline122038251Auke Bay, AK	Auke Bay							Pipeline Leak
DieselNOAA ID 12238251Auke Bay / Fritz Cove	DeHarts Marina, Auke Bay	Other	Auke Bay, DeHarts Marina			Auke Bay	Marine - Stephens Passag	Intentional Releas
Gasoline411992690138255Auke Bay / Fritz Cove	CG Morale Boats	Vessel	AUKE BAY HARBOR			Auke Bay	Marine - Stephens Passag	Unknown
Diesel411992830238269Cape Edgecumbe to Icy Bay	M/V BLUE STAR	Vessel	NE Sugarloaf Island, N. of Cape Spencer				Marine - Outside Waters	Crack
Crude423993020138288CENTRAL COOK INLET	Cook Inlet Oil Stringers	Unknown	KENAI COOK INLET OFF NIKISKI			Nikiski	Cook Inlet	Unknown
Diesel411993230238309Ketchikan	Erma Bird HHOT Spill	Residence	Nichols Passage/Metlakatla				Land - Ketchikan	Support Structure

ID	Spill Name	Facility Type	Facility Name	Address1	Address2	City	Region	Cause
Lube oil411993330438319Saxman	SE Stevedoring Saxman	Maintenance Yard/S	SE Stevadoring maintance shop				Land - Ketchikan	Sabotage/Vandali
Diesel425993430138329EASTERN CHAIN	M/V Selendang Ayu	Vessel	Unalaska near Skan Bay				Aleutian Chain	Grounding
IFO-380425993430138329EASTERN CHAIN	M/V Selendang Ayu	Vessel	Unalaska near Skan Bay				Aleutian Chain	Grounding
Diesel411993620238348Chatham Strait North	F/V Tillie H capsizing	Vessel	CHATHAM STRAIT, Point Agustus				Marine - Chatham Strait	Sinking
Bunker fuel525990130138365ATTU	Attu Tarballs - Mystery Spill	Unknown	ATTU			Attu	Aleutian West	Unknown
Drilling Muds539990590338411CHUKCHI SEA	Spy Island Sea Floor Mud	Oil Exploration	Nikaitchuq #3 Ice Island				North Slope	Seal Failure
Other522991150138467VALDEZ	City of Valdez Sewage release	Water/Wastewater	Valdez Animal Shelter Parking lot			Valdez	P.W.S.	Equipment Failure
Diesel524992070138559KODIAK UNKNOWN	F/V Sylvia Star Sinking	Vessel	KODIAK UGANIK BAY ON WATER			Kodiak	Kodiak	Human Error
Diesel523992380138590EAST KENAI UNKNOWN	F/V Alliance Sinking	Vessel	Cape Resurrection				East Kenai	Sinking
Diesel525992450138597CENTRAL CHAIN	Delta Western Dutch Harbor Tank {	Other	DUTCH HARBOR DELTA WESTERN FUEL DOCK	1577 E. POINT		Dutch Harbor	Aleutian Chain	Overfill
Diesel511992530138605Icy Strait	F/V Perseverance Grounding	Vessel	Spasski Island, Icy Strait			Hoonah	Marine - Icy Strait	Human Error
Jet fuel524992740138626WOMENS BAY	USCGC Midgett, JP5 Spill	Vessel	WOMANS BAY KODIAK				Kodiak	Human Error
Diesel511993040138656Ketchikan	Hoadley Creek Unknown	Other	Hoadley Creek	Hoadley Creek Ketchikan		Ketchikan	Land - Ketchikan	Unknown
Diesel511993200238672Sitka	Sunset Drive, 104	Residence	Sunset Drive, 104	104 Sunset Drive		Sitka	Land - Baranof / Chichago	Puncture
Hydraulic oil525993550138707WESTERN CHAIN	F/V Bristol Leader Hydraulic OIl Sp	Vessel	Dutch Harbor Capins Bay				Aleutian Chain	Line Failure
Diesel624990130138730KODIAK UNKNOWN	F/V Horizon Ocean Bay	Vessel	Ocean Bay				Kodiak	Equipment Failure
Diesel611990310138748Cape Edgecumbe to Icy Bay	F/V HERMES II Sinking	Vessel	Near Cape Decision				Marine - Outside Waters	Hull Failure
Other623990330138750NIKISKI	T/V Seabulk Pride Grounding	Vessel	1/4 Mile North of KPL Dock				Central Kenai	Grounding
Diesel624990370138754KODIAK CITY	F/V Sea Warrior Diesel	Vessel	KODIAK ST PAUL HARBOR ON WATER ON WATI	St.. Paul Harbor		Kodiak	Kodiak	Human Error
Jet fuel625990440138761WESTERN CHAIN	Magone Marine Dutch Harbor Mud	Other	Magone Marine Service	990 Ballyhoo Road	P.O. Box 4	Dutch Harbor	Aleutian Chain	External Factors
Diesel625990440138761WESTERN CHAIN	Magone Marine Dutch Harbor Mud	Other	Magone Marine Service	990 Ballyhoo Road	P.O. Box 4	Dutch Harbor	Aleutian Chain	External Factors
Diesel625990540138771CENTRAL CHAIN	F/V Northern Dawn	Vessel	Volcano Bay				Aleutian Chain	Other
Multiple: diesel & lube oil607138807NW Unalaska Island, AK	F/V Blue North							Other / Unknown
Diesel611990930438810Yakutat Bay	Anthony Johnson Jr. spill, Yakutat	Vessel	YAKUTAT BOAT HARBOR			Yakutat	Marine - Outside Waters	Bilge Discharge
Kerosene611991000138817Gastineau Channel	Fuel Barge SCT 282, Juneau	Vessel	GASTINEAU CHANNEL, PETRO MARINE FUEL DOCK				Marine - Stephens Passag	Equipment Failure
Diesel624991110138828KODIAK UNKNOWN	Ocean Beauty Seafoods Diesel	Other	Ocean Beauty Seafoods			Alitak	Kodiak	Leak
Diesel624991380138855KODIAK CITY	International Seafoods Kodiak Boile	Cannery	International Seafoods of Alaska	517 Shelikof Street		Kodiak	Kodiak	Human Error
Diesel622991720138889Middleton Island	M/V Aleutian Founder Diesel Bilge	Vessel	24 Nautical Miles SW of Middleton Island				Gulf of Alaska	Tank Failure
Diesel610038910Sitka, AK	F/V Norqueen							Other / Unknown
Multiple: fuel oil & gasoline610338921North Pacific Ocean, A	M/V Cougar Ace							Unknown
Multiple: fuel oil & gasoline610338921North Pacific Ocean, A	M/V Cougar Ace							Unknown
Diesel611992160138933Clarence Strait North	F/V Carrie Sinking	Vessel	Narrow Point				Marine - Clarence Strait	Hull Failure
Diesel622992250138942PRINCE WILLIAM SOUND	F/V Northern Endurance Grounding	Vessel	East side of La Touche Island				P.W.S.	Grounding
Diesel622992410138958PRINCE WILLIAM SOUND	F/V Karen Marie - Diesel Spill to W	Vessel	off of Gravina Point in Orca Bay				P.W.S.	Collision/Allision
Diesel611992700138987Duncan Canal	FV Top Notch	Vessel	Nichols Bay				Marine - Sumner Strait	Grounding
Diesel626992830139000DILLINGHAM CITY	Raysson Barge Dillingham	Vessel	Bristol Allance Dock				Bristol Bay Borough	Human Error
Diesel611993010139018Hollis	Hollis Bay Unknown	School	HOLLIS School Library				Marine - Clarence Strait	Unknown
Diesel611993230139040Tongass Narrows	F/V Gloria T sinking	Vessel	Ward Cove	Gateway Forest Product dock		Ketchikan	Marine - Clarence Strait	Sinking

ID	Spill Name	Facility Type	Facility Name	Address1	Address2	City	Region	Cause
Fuel Oil & Wheat614139055Adak, Bering Sea, AK	M/V Sea Honesty							Other / Unknown
Diesel611993400339057Juneau / Douglas	s. Franklin St., 496 ORCA Ent. HOT	Other	S. Franklin St., 496; Orca Enterprises LLC	496 S. Franklin St.	495 S. Fra	Juneau	Land - Juneau	Line Failure
Diesel724990080139090SHELIKOF STRAIT	01/08/2007 F/V Hunter Sinking	Vessel	KODIAK SHELIKOF STRAIT ON WATER	1		Kodiak	Kodiak	Rollover/Capsize
Diesel711990120139094Revillagigedo Channel	Heitman Homeheating Oil Tank Re	Residence	Power House Road, 106	106 power house rd		Ketchikan	Marine - Clarence Strait	Rollover/Capsize
Diesel724990120139094KODIAK CITY	01/12/2007 Blackjack Partnership	Harbor/Port	KODIAK ST HERMAN HARBOR ON WATER			Kodiak	Kodiak	Equipment Failure
Diesel711990380139120Wrangell Narrows	Petersburg Harbor Mystery	Unknown	PETERSBURG BOAT HARBOR (SOUTH)			Petersburg	Marine - Frederick Sound	Unknown
Diesel725990410139123UNALASKA	F/V Illusion Sinking	Vessel	F/V Illusion	Makushin Bay		Unalaska Islan	Aleutian East	Leak
Diesel724990510139133SHELIKOF STRAIT	F/V Jade Alaska Sinking	Vessel	KODIAK SHELIKOF STRAIT ON WATER	1		Kodiak	Kodiak	Rollover/Capsize
Diesel711990680139150Gastineau Channel	F/V Alrita, sinking	Vessel	Aurora Harbor, Juneau	4048 Granite St.		Juneau	Marine - Stephens Passag	Sinking
Diesel711990720239154Thorne Bay	USCGC Elderberry overflow	Vessel	CLARENCE STRAIT				Land - Prince of Wales Isla	Overfill
Diesel725990770139159ADAK	F/V Exodus Explorer	Vessel	Kuluk Bay-Gannet Rocks	Adak, Alaska		Adak	Aleutian Central	Grounding
Diesel725990830139165CENTRAL CHAIN	Ocean Fury Bilge Spill	Vessel	Koniuji Island NW of Adak	Koniuji Island		Adak	Aleutian Chain	Grounding
Diesel723991370139219WHITTIER	M/V TRADITION sinking Whittier Al	Vessel	WHITTIER DELONG DOCK	Whittier Delong Dock		Whittier	East Area	Sinking
Diesel739991530639235WEST NORTH SLOPE	Cape Simpson 1st spill this day	Harbor/Port	Cape Simpson	Cape Simpson	Industrial I	Prudhoe Bay	North Slope	Unknown
Diesel722991540139236P.W.S. UNKNOWN	F/V Windward Diesel	Vessel	Near Goose Island	Near Goose Island		Tatitlek	P.W.S.	Human Error
Sheen767139269140 nm WNW St Matthew Island	Bering Sea sheen							Other / Unknown
Diesel722991970139279P.W.S. UNKNOWN	07/16/2007 F/V Miss Carol Sinking	Vessel	Cape Resurection	Blynd Sound		Seward	P.W.S.	Other
Diesel722992020139284PRINCE WILLIAM SOUND	F/V Nordic Viking grounding	Vessel	Olsen Bay in Port Gravina	Olsen Bay		Valdez	P.W.S.	Grounding
Diesel767839288Sunshine Cove, AK	M/V Pegasus							Other / Unknown
Diesel722992130139295ESTHER IS.	FV JOHNITA grounded-fire-sank Es	Harbor/Port	Ester Rock, N60ª-47.2 W148ª-08.6	8120 Lake Otis, Anch	(Above is	Whittier	P.W.S.	Grounding
Diesel711992200139302Frederick Sound	Temsco Drum Drop	Air Transportation	Temsco Drum Drop - 0.5 mile W of Pt Fredrick	Approx. .5 mile W of Pt Fredrick		Petersburg	Marine - Frederick Sound	Equipment Failure
Diesel711992300239312Revillagigedo Channel	F/V Aldebaran sinking	Vessel	Bold Island	marine env.		Annette	Marine - Clarence Strait	Human Error
Gasoline711992490239331Wrangell area waters	PM230 unleaded gas spill	Harbor/Port	Wrangell Oil Dock	oil dock wrangell		Wrangell	Marine - Sumner Strait	Unknown
Diesel722992540139336PRINCE WILLIAM SOUND	F/V Kapella Fire	Vessel	Black Point anchorage near Tatitlek Narrows			Tatitlek	P.W.S.	Sinking
Gasoline722992540139336PRINCE WILLIAM SOUND	F/V Kapella Fire	Vessel	Black Point anchorage near Tatitlek Narrows			Tatitlek	P.W.S.	Sinking
Multiple: diesel & gasoline769839360Ugashik Bay, AK	Barge OB6							Grounding
Source water739993060439388WEST NORTH SLOPE		Air Transportation	Oooguruk Development Project	West North Slope		Prudhoe Bay	North Slope	External Factors
Kerosene711993090139391Craig / Klawock area waters	Samson Tug&Barge Container	Vessel	Cape Decsion	kLAWOCK		Klawock	Marine - Waters west of P	Rollover/Capsize
Propane (LPG)711993090139391Craig / Klawock area water	Samson Tug&Barge Container	Vessel	Cape Decsion	kLAWOCK		Klawock	Marine - Waters west of P	Rollover/Capsize
Bunker fuel711993250139407Tongass Narrows	Ak Trams Bunker Oil Spill	Vessel	AML DOCK, KETCHIKAN	3295 Tongass Avenue		Ketchikan	Marine - Clarence Strait	Crack
Multiple: diesel & hydraulic oil771739409George Inlet, SE Ala	Evergreen Timber House Boat							Grounding
Diesel725993370239419AKUTAN CITY	Trident Akutan Diesel 12.3.07	Cannery	AKUTAN TRIDENT DOCK ON WATER	Akutan Trident Dock		Akutan	Aleutian East	Human Error
Diesel725993510139433DUTCH HARBOR	C/P BARANOF(D598508)Internal D	Other	Dutch Harbor, Iliuliuk Harbor, Coastal Transportat	Coastal Transportation Dock		Dutch Harbor	Aleutian East	Overfill
Ammonia (anhydrous)725993560139438DUTCH HARBOR	UNISEA INC Dutch Harbor NH3 Re	Cannery	DUTCH HARBOR UNISEA DOCK	UNISEA INC.	88 Salmor	Dutch Harbor	Aleutian East	Human Error
Jet fuel824990050139452WOMENS BAY	Piper PA-31 Plane Crash end of Ru	Air Transportation	In Water off of Runway 25 Kodiak Airport	Kodiak Airport		Kodiak	Kodiak	Cargo Not Secure
Diesel811990160139463Sumner Strait	F/V Dolphin Grounding, POW	Vessel	Sumner Strait - Pt Colpys (NE tip of POW Island)	Trident Seafoods, 53	Seattle, W	Coffman Cove	Marine - Sumner Strait	Human Error
Diesel725990260239472CENTRAL CHAIN	F/V Exito Adak Harbor	Vessel	ADAK Harbor	Adak Harbor Alaska		Adak	Aleutian Chain	Valve Failure
Drilling Muds839990340139481WEST NORTH SLOPE		Oil Production	Oooguruk Development Project	West North Slope		Prudhoe Bay	North Slope	Equipment Failure
Diesel824990400139487KODIAK CITY	F/V Velocity Capsize	Vessel	Mill Bay off Woodland Road	Mill Bay Kodiak Island		Kodiak	Kodiak	Rollover/Capsize
Diesel811990420339489PELICAN CITY	Pelican Utiltiy District Fuel Line	Power Generation	Pelican Power Plant	PO Box 86		Pelican	Marine - Icy Strait	Line Failure
Hydraulic oil825990450139492S.E. BERING SEA	Bearing Sea Trident Seafoods Hyd	Vessel	Bearing Sea SE of St George	Trident Seafoods		Saint George	Pribilof	Line Failure
Diesel811990480139495Craig / Klawock area waters	F/T Westward Aground POW	Vessel	Unknown Facility/Site Name			Klawock	Marine - Waters west of P	Grounding
Diesel824990630339510KODIAK CITY	F/V Erin Lynn Diesel Overfill	Vessel	KODIAK PETRO MARINE FUEL DOCK ON WATEF	Kodiak Petro Marine Fuel Dock		Kodiak	Kodiak	Overfill
Diesel825990830139530EASTERN CHAIN	F/V Alaska Ranger Sinking	Vessel	Alaska Ranger Sinking				Aleutian Chain	Sinking
Jet fuel823990900139537COOK INLET	K-Sea POL # 1 Jet Fuel 3.30.08	Vessel	Port of Anchorage POL # 1				Anch. Dist. Marine Waters	Human Error
Diesel822991150139562PORT OF VALDEZ	FV City of Seldovia capsize	Vessel	Mineral Creek off of Perkins Point	Marine waters		Valdez	P.W.S.	Rollover/Capsize

ID	Spill Name	Facility Type	Facility Name	Address1	Address2	City	Region	Cause
Diesel825991570139604FALSE PASS	F/V Andromeda Sinking False Pass	Vessel	FALSE PASS	P.O. Box 62		False Pass	Aleutian East Borough	Seal Failure
Bilge Oil822991720139619PRINCE WILLIAM SOUND	Mystery Sheen west of Storey Islan	Vessel	Storey Island - 1.84nm west				P.W.S.	Unknown
Diesel811991850239632Tongass Narrows	Promech Air Jet A release	Air Transportation	PROMECH DOCK, KETCHIKAN	Tongass Avenue 1515		Ketchikan	Marine - Clarence Strait	Corrosion
Diesel785239636Glacier Bay, northern extremity	Spirit of Glacier Bay							Grounding
Multiple: diesel, jet fuel & gasoline786239652Togiak, AK	Crowley Barge 180-1							Grounding
Diesel786939667Prince William Sd., Fleming Isl., Alaska	F/V Northern Mariner							Grounding
Diesel811992310139678Kasaan Bay	Saltery Provider Sinking	Vessel	Saltery Cove	Sportsmans COve lodge		Ketchikan	Marine - Clarence Strait	Rollover/Capsize
Diesel789839718Mekoryuk village beach, Nunivak Isl., AK	M/V Nunaniq							Grounding
Multiple: gasoline & lube oil790339728Wood River, SW Alasl	Tug Twilite							Grounding
Diesel791139743100 mi w of Adak Is in Amchitka Pass	F/V Katmai							Other / Unknown
Diesel811993160139763Tongass Narrows	F/V Zenith sinking	Vessel	Silver Lining Dock	1705 Tongass Ave		Ketchikan	Marine - Clarence Strait	Sinking
Diesel794539817Aghiyuk Island, W. Gulf of Alaska	F/V American Way							Grounding
Diesel923990150139828NORTH COOK INLET	M/V Monarch Sinking	Vessel	Granite Point Platform				Cook Inlet	Rollover/Capsize
Other923990150139828NORTH COOK INLET	M/V Monarch Sinking	Vessel	Granite Point Platform				Cook Inlet	Rollover/Capsize
Diesel925990290139842AKUTAN	Trident Seafood spill	Cannery	AKUTAN BAY AT TRIDENT SEAFOODS DOCK	1 Salmon Lane		Akutan	Aleutian Chain	Equipment Failure
Diesel911990300139843Chatham Strait South	M/V Lituya Grounding	Vessel	Metlakatla- Port Chester, Scrub Island				Marine - Chatham Strait	Grounding
Diesel923990440139857SEWARD CITY	P/C The Forty Niner sinking	Vessel	KENAI SEWARD CITY SMALL BOAT HARBOR ON	Seward Harbor		Seward	East Kenai	Sinking
Multiple: diesel, lube oil & hydraulic oil798339869Akutan Isl.,	FV Icy Mist							Grounding
Diesel925990560139869AKUTAN CITY	F/V ICY MIST grounding NW Akuta	Vessel	Akutan, NW corner of Akutan Island, N54-13.00W165-				Aleutian East	Grounding
Multiple: diesel, lube oil & hydraulic oil798839877St. George	FV Mar-Gun							Grounding
Hydraulic oil939990800239893KUPARUK	ENI Petroleum Hydraulic Oil	Oil Exploration	KUPARUK, SEA WATER TREATMENT PLANT	Sea Water Treatment Plant		Prudhoe Bay	North Slope	Equipment Failure
Cook Inlet crude oil800039895Cook Inlet, Alaska	Redoubt Volcano eruption							Other / Unknown
Diesel925991020139915CENTRAL CHAIN	F/V Heritage Adak Harbor	Harbor/Port	ADAK Harbor	Adak Harbor Alaska		Adak	Aleutian Chain	Unknown
Diesel911991070239920Clarence Strait North	F/V Sea-Fareer sinking	Vessel	COFFMAN COVE, POW			Coffman Cove	Marine - Clarence Strait	Rollover/Capsize
Diesel923991170139930SEWARD CITY	Shoreside Petroleum Diesel	Harbor/Port	KENAI SEWARD SMALL BOAT HARBOR ON WAT	Seward Harbor		Seward	East Kenai	Line Failure
Gasoline923991470139960KENAI GAS FIELD	Barge SCT 282	Vessel	1.5 miles WNW of East Forelands	1.5 miles WNW East Forelands		Nikiski	Central Kenai	Collision/Allision
Diesel926991560139969BRISTOL BAY UNKNOWN	F/V Two Boys sinking	Vessel	Nushagak Bay 5 mi W of Etolin Pt				Bristol Bay Borough	Sinking
Black algae804640004Kuk River near Wainright, AK	Mystery release							Other / Unknown
Diesel911992140140027Port Frederick	F/V Robetta J bilge discharge	Vessel	Hoonah Harbor	Hoonah Harbor	Box 317	Hoonah	Marine - Icy Strait	Leak
Diesel925992150140028SAINT PAUL IS.	F/V INTREPID (fuel tank overflow) :	Vessel	SAINT PAUL ISLAND CITY SOUTH DOCK	P.O. Box 901	Saint Paul	Saint Paul	Pribilof	Human Error
Diesel911992160140029Tongass Narrows	Bar harbor unknown	Harbor/Port	BAR HARBOR BOAT HARBOR, KETCHIKAN	Tongass Ave		Ketchikan	Marine - Clarence Strait	Unknown
Diesel911992200140033Chatham Strait North	F/V Patty J Grounding	Vessel	SQUARE COVE, CHATHAM STRAIT				Marine - Chatham Strait	Grounding
Anhydrous ammonia & chlorine808640045Pelican, AK	Pelican Seafood, Inc. - Ammonia							Other / Unknown
Multiple: gasoline & jet fuel809740072Quinhagak, Alaska	Crowley Barge 160-1							Grounding
Ammonia (anhydrous)926992670140080CHIGNIK CITY	F/V UNIMAK grounded NW David I	Vessel	Please pick selection...	NW David Island on	Rocky Sh(	Chignik	Alaska Peninsula	Human Error
Diesel926992670140080CHIGNIK CITY	F/V UNIMAK grounded NW David I	Vessel	Please pick selection...	NW David Island on	Rocky Sh(	Chignik	Alaska Peninsula	Human Error
Used Oil (all types)926992670140080CHIGNIK CITY	F/V UNIMAK grounded NW David I	Vessel	Please pick selection...	NW David Island on	Rocky Sh(	Chignik	Alaska Peninsula	Human Error
Diesel911992830140096Sitka Sound	FV Rascal Sinking	Vessel	St Lazaria Island				Marine - Outside Waters	Sinking
Diesel812740100Sand Point, Alaska	F/V Sea Dancer							Grounding
Diesel925993030140116EASTERN CHAIN	F/V Carley Renee Rollover and Sin	Vessel	F/V Carley Renee Sinking	Off Sedanka Island		Dutch Harbor	Aleutian Chain	Rollover/Capsize
Diesel814440122Unimak Isl., E. Aleutians, Alaska	F/V Lisa Marie							Other / Unknown
Diesel922993510140164VALDEZ	F/V Johnni J founder at slip	Vessel	Small Boat Harbor Slip I-24	Valdez Small Boat Harbor		Valdez	P.W.S.	Sinking
Diesel922993570140170BLIGH IS.	TUG PATHFINDER GROUNDING I	Vessel	Bligh Reef in Prince William Sound Alaska			Valdez	P.W.S.	Grounding
Diesel817540189Adak Island, Aleutian Isls, Alaska	Adak Petroleum tank release							Transfer
Diesel1025990110140189WESTERN CHAIN	Adak Petroleum Tank N7 Diesel Sp	Non-Crude Termina	Adak Petroleum Tank N-7 Diesel Fuel Release	Adak Petroleum		Adak	Aleutian Chain	Human Error
Diesel1011990220140200Holkham Bay Area	Alaska Adventurer Grounding	Vessel	Pt. Coke	n/a	n/a	Juneau	Marine - Stephens Passag	Grounding
Corrosion Inhibitor1025990370140215DUTCH HARBOR	UNISEA 150 gal Boiler Feed Water	Cannery	DUTCH HARBOR ILIULIUK HARBOR UNISEAFOC	88 Salmon Way		Dutch Harbor	Aleutian East	Seal Failure
Diesel1022991100140288Middleton Island	F/V Northern Belle sank	Vessel	50 nautical miles south south west of Middleton Is				Gulf of Alaska	Rollover/Capsize
Diesel1022991390140317MONTAGUE ISLAND	F/V Cape Spencer sank	Vessel	Cape Cleare - in marine waters of south end	Montague Island		Cordova	P.W.S.	Rollover/Capsize
Diesel1011991400140318Sitka Sound	F/V Ironwood	Vessel	Gagarin Island	P.O. Box 2362		Sitka	Marine - Outside Waters	Grounding
Propylene glycol1011991530140331Juneau / Douglas	Alaskan Brewery Propylene glycol :	Other	Shaune Drive, 5429	Shaune Drive, 5429		Juneau	Land - Juneau	Human Error

ID	Spill Name	Facility Type	Facility Name	Address1	Address2	City	Region	Cause
DieselNOAA ID 82340385PRINCE WILLIAM SOUND	F/V Cape Cross - Main Bay	Vessel	Main Bay - south shoal at mouth				P.W.S.	Human Error
Diesel1026992260140404NUSHAGAK	F/V Intrepid Sinking	Vessel	Nugashik Bay	Nushagak Bay		Ekwok	Bristol Bay Borough	Rollover/Capsize
Diesel1011992390140417Wrangell Narrows	FV Emily Jane Sinking	Vessel	WRANGELL NARROWS, NORTH END NEAR PETERSBURG			Wrangell	Marine - Frederick Sound	Sinking
Diesel1011992630140441Sitka Sound	F/V Zimovia Sinking	Vessel	SITKA SOUND, Kulichkof Rock	Sitka Sound, Kulichkof Rock		Sitka	Marine - Outside Waters	Human Error
Multiple: diesel, lube oil & IFO82754051570nm North of Adak	M/V Golden Seas							Other / Unknown
Diesel1011993420140520Craig / Klawock area waters	F/V Izzy B fire	Vessel	Port Santa Cruz	Sumez Island		Craig	Marine - Waters west of P	Explosion
Diesel828340568Latouche Isl, Prince William Sound, Alaska	F/V Ruffian							Other / Unknown
Diesel829040582Unalaska Isl., Aleutian Isl., Alaska	F/V Terrigail							Grounding
Diesel1125990390140582EASTERN CHAIN	F/V TERRIGALE Grounding Alimuc	Vessel	Unalaska Island Alimunda Bay			Unalaska	Aleutian Chain	Grounding
Hydraulic oil1125990390140582EASTERN CHAIN	F/V TERRIGALE Grounding Alimuc	Vessel	Unalaska Island Alimunda Bay			Unalaska	Aleutian Chain	Grounding
Diesel1124990420140585SHELIKOF STRAIT	F/V Midnite Sun Grounding	Vessel	F/V Midnite Sun	Chesapeake, Inc.	1035 W N	Anchorage	Kodiak	Human Error
Hydraulic oil1124990420140585SHELIKOF STRAIT	F/V Midnite Sun Grounding	Vessel	F/V Midnite Sun	Chesapeake, Inc.	1035 W N	Anchorage	Kodiak	Human Error
Diesel1123990460240589WHITTIER CITY	Whittier Harbor dredging Project	Harbor/Port	Whittier, Whittier Small Boat Harbor, AK	Small Boat Harbor		Whittier	East Kenai	Other
Diesel1125990460140589UNALASKA	F/V Aleutian Lady spill	Vessel	UNALASKA OSI POT DOCK ON WATER			Unalaska	Aleutian East	Overfill
Multiple: diesel, lube oil & hydraulic oil829540608King Cove,	F/V Capt Andrew							Grounding
Diesel1111990830140626Tongass Narrows	Ferry hhot release	Residence	Tongass Ave	Tongass Ave		Ketchikan	Marine - Clarence Strait	Line Failure
Ethylene Glycol (Antifreeze)1122991100140653VALDEZ MAI	VMT Berth 4 AFFF concentrate spil	Crude Oil Terminal	VALDEZ MARINE TERMINAL-WATER BERTH 4			Valdez	P.W.S.	Equipment Failure
Multiple: diesel, lube oil, hydraulic oil, gasoline & waste oil832	F/V Nor'Quest grdg-Bristol Bay, Alaska							Grounding
Gasoline1122991500140693Gulf of Alaska	F/V Gulkana capsize	Vessel	Grass Island - Copper River Delta			Cordova	Gulf of Alaska	Rollover/Capsize
Diesel1125991770140720S.E. BERING SEA	Tug Aries	Vessel	110 miles East of St Paul	110 miles east of st paul		Saint Paul	Pribilof	Sinking
Diesel1122991840140727PRINCE WILLIAM SOUND	F/V Ice Maiden sank	Vessel	Rocky Point, Valdez Arm	Valdez Arm		Valdez	P.W.S.	Rollover/Capsize
Diesel1122991870140730Gulf of Alaska	F/V Copasetic	Vessel	Off of Cape Puget, near Puget Bay			Seward	Gulf of Alaska	Sinking
Diesel1125991880240731DUTCH HARBOR	F/V Ocean ALaskan 100 gal Diesel	Vessel	DUTCH HARBOR CAPTAINS BAY			Dutch Harbor	Aleutian East	Overfill
Diesel1111991910140734Tongass Narrows	FV Legend grounding/fire	Vessel	Nichols Pass	Bostwich Point		Ketchikan	Marine - Clarence Strait	Human Error
Diesel1122992180140761PRINCE WILLIAM SOUND	F/V Arctic Lady grounding	Vessel	Narrows Light, Northeast end of Hawkins Island	Hawkins Island		Cordova	P.W.S.	Grounding
Diesel1111992290140772Chatham Strait North	FV Mabel Capsize	Vessel	Chatham Strait				Marine - Chatham Strait	Rollover/Capsize
Diesel1124992400140783KODIAK CITY	Saint Herman Harbor	Unknown	KODIAK ST HERMAN HARBOR ON WATER			Kodiak	Kodiak	Bilge Discharge
Lube oil1124992400140783KODIAK CITY	Saint Herman Harbor	Unknown	KODIAK ST HERMAN HARBOR ON WATER			Kodiak	Kodiak	Bilge Discharge
Diesel1138992530140796NOME CITY	Port of Nome LCM Kaktovik II Diese	Harbor/Port	Port of Nome				West Coast	Collision/Allision
Jet fuel836140807Diomede Islands, AK	Crowley Barge Adrift							Other / Unknown
Diesel1124992640140807AFOGNAK IS.	S/V Heide Marie	Vessel	Blue Fox Bay				Kodiak	Other
Bunker fuel1125992710140814CENTRAL CHAIN	F/S Nelson Star Dutch Harbor	Vessel	Dutch Harbor City Dock	klooserboer fish plant dock.		Dutch Harbor	Aleutian Chain	Leak
Diesel1111992790140822Chatham Strait North	FV Jager sinking	Vessel	CHATHAM STRAIT				Marine - Chatham Strait	Sinking
Multiple: diesel & bunker C837940882Aleutian Islands, Alask	M/V Morning Cedar							Other / Unknown
Multiple: diesel & jet fuel838540895NE Gulf of Alaska	Tug Nathan Stewart & Tanker Barge Adrift							Other / Unknown
Multiple: diesel & gasoline838940898Winter fuel delivery to N	Russian icebreaker Tanker Renda							Other / Unknown
Diesel1211990230140931Tongass Narrows	m/v Chrissara sinking	Vessel	Ward Cove	Gateway Forest Product dock		Ketchikan	Marine - Clarence Strait	Other
Diesel1211990230240931Tongass Narrows	Nordic Tug sinking	Vessel	WARD COVE	North Tongass Highway, 7363		Ketchikan	Marine - Clarence Strait	Hull Failure
Multiple: diesel, lube oil, hydraulic fluid & antifreeze83994093	FV Kimberly grounding							Grounding
Diesel1224990250140933KODIAK UNKNOWN	F/V Heritage	Vessel	KODIAK ALITAK BAY	Kodiak Alitak Bay		Kodiak	Kodiak	Rollover/Capsize
Diesel1225990570140965EASTERN CHAIN	F/V Neptune I Grounding Unimak Is	Vessel	Please pick selection...			U.S. Coast Gu	Aleutian Chain	Grounding
Diesel1223990600140968SOUTH COOK INLET	K-Sea Transportation barge day tar	Vessel	Kennedy Entrance to Cook Inlet				Cook Inlet	Equipment Failure
Diesel1211990630140971Juneau / Douglas	Glacier Highway 17095, HHOT	Residence	Glacier Highway, 17095	17095 Glacier Highway		Juneau	Land - Juneau	Tank Failure
Diesel1224991600141068CHINIAK CDP	M/V Monterrey Fuel Tank Release	Vessel	Puffin Island	Kodiak		Kodiak	Kodiak	Collision/Allision
Diesel1223991660341074HOMER CITY	M/V DANIEL D TAKAK Grounding	Vessel	KENAI HOMER KACHEMAK BAY	The Spit		Homer	Central Kenai	Hull Failure
Diesel1224991700141078SHELIKOF STRAIT	F/V Scandia Sinking	Vessel	Uyak Bay				Kodiak	Sinking
Ammonia847441096Dutch Harbor, AK	F/V Excellence ammonia release							Other / Unknown
Diesel848441117Cape Chacon, SE Alaska	FV Mary Kay							Sunken Vessel
Diesel1211992110141119Clarence Strait South	FV The View Point sinking	Vessel	Southeast end of POW	Cape Chacon, Southern tip of P		Hydaburg	Marine - Clarence Strait	Rollover/Capsize

ID	Cause Type	QC Note	Tag	Note	Lat_edited	Lon_edited	X_AlbersAK	Y_AlbersAK	Primary Media
Used Oil (all types)9511990120134711Portland Canal	Human Factors	Location was in Kake City, moved to Portland Canal.	moved loc		54.776636	-130.605986	1474887	791745	Marine
Diesel707734715Dixon Entrance, southeast Alaska				NOAA record	54.093300	-133.770000	0	0	Marine
Diesel9511990540134753Tongass Narrows	Other		not moved	default loc SE	55.342369	-131.656341	1390454	828374	Marine
Diesel9511991110134810Tongass Narrows	Other	Location was on land in Ketchikan; moved to Foggy Pt, more than 30 mi south of Tongass Narrows. Online search null.	moved loc		54.920652	-130.974933	1447128	798688	Marine
Diesel709934865Kupreanof Island, Alaska				NOAA record	57.000000	-133.317000	0	0	Marine
Other9511011740134873Lynn Canal South	Accident	NOAA 7101 same spill, coordinates nearby.	not moved	also NOAA	58.527688	-134.930563	1092167	1105575	Marine
Diesel9527991860134885Eek	Accident	Location not moved; Eek Island is a delta -- appears to be on land in generalized map layer.	not moved	Upriver	60.166667	-162.333333	-459696	1159810	Marine
Diesel9511991980134897Chatham Strait North	Human Factors		not moved	default loc SE	57.869254	-134.823990	1119049	1036812	Marine
Diesel9525992030234902CENTRAL CHAIN	Accident	Location moved to NOAA coordinates; see http://www.aleutiansriskassessment.com/documents/2011.7.5_Task5ReportRevX7-01Final.pdf.	moved loc		52.378300	-172.433000	-1244314	436694	Marine
Diesel710634904Sequam Island, Aleutian Island chain, Alask				NOAA record	52.378300	-172.433000	0	0	Marine
Diesel9511992210234920Dixon Entrance	Unknown	Moved to NOAA 7107 coordinates; see http://www.incidentnews.gov/incident/7107. Location now near Kanagunut Island within Dixon Entrance (78-mi difference).	moved loc	also NOAA	54.703300	-130.722000	1470678	781510	Marine
Other9525992220134921AKUTAN	Human Factors	Moved to larger dock in water in Akutan.	moved loc		54.129245	-165.783756	-767239	525491	Marine
Diesel9524992230134922KODIAK UNKNOWN	Accident	Location was in middle of island, moved to Twoheaded Island.	moved loc		56.908002	-153.597193	24487	766868	Marine
Diesel9511992340134933Wrangell Narrows	Structural/Mechani	Location was in middle of island, moved to Petersburg Harbor.	moved loc		56.811066	-132.964900	1260853	957345	Marine
Gasoline9511992470134946Tongass Narrows	Structural/Mechani	Southeast, no critical habitat; spill less than or equal to 300 gal., so not checked.	not moved	default loc SE	55.342369	-131.656341	1390454	828374	Marine
Hydraulic oil9525992480234947DUTCH HARBOR	Structural/Mechani	Moved location to Udagak Bay per facility name. Subarea edited from "Eastern Chain."	moved loc		53.733641	-166.313510	-809449	488536	Marine
Other9523992500534949PASSAGE CANAL	Structural/Mechani	Moved location to Whittier per facility name. Database listed subarea as Cook Inlet, but changed to Prince William Sound.	moved loc		60.777718	-148.682938	288299	1210821	Marine
Diesel9511992510234950Chichagof Island NOS	Structural/Mechanical		not moved	default loc SE	57.869254	-134.823990	1119049	1036812	Marine
Diesel9525992690134968EASTERN CHAIN	Unknown	Moved to harbor; see Figure 2-3, http://dec.alaska.gov/water/wnpspc/protection_restoration/DutchIliuliuk/documents/06DutchHarborImpairmentAnalysis.pdf.	moved loc		53.905021	-166.512310	-818797	509684	Marine
Jet fuel9524992830134982KODIAK CITY	Human Factors	Coordinates from database showed a location in the city, moved to Old Womens Bay.	moved loc		57.725498	-152.527688	87474	859032	Marine
Diesel9525992880134987EASTERN CHAIN	Human Factors	Moved location to harbor; see Figure 2-3, http://dec.alaska.gov/water/wnpspc/protection_restoration/DutchIliuliuk/documents/06DutchHarborImpairmentAnalysis.pdf.	moved loc		53.890682	-166.525390	-819941	508280	Marine
Diesel9525992900134989CENTRAL CHAIN	Human Factors	Moved location to harbor; see Figure 2-3, http://dec.alaska.gov/water/wnpspc/protection_restoration/DutchIliuliuk/documents/06DutchHarborImpairmentAnalysis.pdf.	moved loc		53.890682	-166.525390	-819941	508280	Marine
Diesel9511992990234998Sumner Strait	Human Factors		not moved		56.296338	-133.632250	1239470	890130	Marine
Gasoline9511993100135009Tongass Narrows	Human Factors	Southeast, no critical habitat; spill less than or equal to 300 gal., so not checked.	not moved	default loc SE	55.342369	-131.656341	1390454	828374	Marine
Diesel9511993320135031Sumner Strait	Human Factors	Location was in middle of island, moved to Red Bay.	moved loc		56.310951	-133.320163	1257350	897549	Marine
North Slope crude711635038Nikiski, Alaska				NOAA record	60.683300	-151.433000	0	0	
Gasoline9611990050135069Clarence Strait North	Human Factors	Location was in middle of island; moved to Ratz Harbor.	moved loc		55.882236	-132.593915	1315135	866195	Marine
Diesel9624990250135089KODIAK UNKNOWN	Human Factors	Location was in middle of island; moved to middle of Uganik Bay.	moved loc		57.851286	-153.542387	27093	872205	Marine
Diesel9624990310135095OUZINKIE CITY	Human Factors	Location was in city, moved to Narrow Strait, adjacent to city.	moved loc		57.911451	-152.503399	88449	879829	Marine
Bunker fuel9625990510135115SAINT PAUL IS.	Accident	Moved to NOAA 7131 coords, see http://www.incidentnews.gov/entry/509761 (several studies; http://www.gpo.gov/fdsys/pkg/FR-2005-08-15/html/05-16105.htm)	moved loc	also NOAA	57.245000	-170.170000	-964249	922382	Marine
Unknown9611990680135132Wrangell area waters	Unknown	Location was in middle of island, moved to harbor.	moved loc		56.467342	-132.384971	1306657	932168	Marine
Diesel9624990950135159CHINIAK CDP	Human Factors		not moved		57.626389	-152.150000	110216	848529	Marine
Diesel9611991010135165Dixon Entrance	Human Factors		not moved	default loc SE	54.530634	-132.653073	1359177	722226	Marine
Diesel9624991070135171KODIAK UNKNOWN	Accident	Location was in middle of island, moved to Spruce Cape.	moved loc		57.815025	-152.328623	99047	869308	Marine
Diesel9625991160235180EASTERN CHAIN	Human Factors	Moved location to King Cove per facility name.	moved loc		55.057773	-162.314661	-529897	593761	Marine
Lead-based paint713935196Unalaska, Alaska				NOAA record	55.833300	-166.500000	0	0	Marine
Jet fuel9611991390135203Tongass Narrows	Human Factors		not moved	default loc SE	55.342369	-131.656341	1390454	828374	Marine
Diesel9623991510135215KENAI CITY	Structural/Mechani	Location not moved; too little information to refine location.	not moved		60.550000	-151.266667	149370	1176878	Marine
Diesel9625991570235221CENTRAL CHAIN	Accident	Moved to Yunaska Island. No further info; see http://response.restoration.noaa.gov/sites/default/files/ResponseReports_96.pdf.	moved loc		52.545805	-170.675372	-1123693	423278	Marine
Diesel714235224Juneau, Alaska				NOAA record	58.333300	-134.417000	0	0	Marine
Diesel9625991820135246CENTRAL CHAIN	Structural/Mechani	Moved location to King Cove per facility name.	moved loc		55.057773	-162.314661	-529897	593761	Marine
Other9611992020135266Chatham Strait North	Unknown		not moved	default loc SE	57.869254	-134.823990	1119049	1036812	Marine
Diesel9611992080135272Dixon Entrance	Unknown		not moved	default loc SE	54.530634	-132.653073	1359177	722226	Marine
Diesel9611992090135273Tongass Narrows	Human Factors	Southeast, no critical habitat; spill less than or equal to 300 gal., so not checked.	not moved	default loc SE	55.342369	-131.656341	1390454	828374	Marine
Diesel9611992120135276Tongass Narrows	Human Factors	Southeast, no critical habitat; spill less than or equal to 300 gal., so not checked.	not moved	default loc SE	55.342369	-131.656341	1390454	828374	Marine

ID	Cause Type	QC Note	Tag	Note	Lat_edited	Lon_edited	X_AlbersAK	Y_AlbersAK	Primary Media
Diesel9622992150235279EVANS ISLAND	Human Factors		not moved	lat/long not marine	60.050000	-148.066667	328892	1132585	Marine
Diesel9623992200135284WHITTIER	Structural/Mechanic	Moved location offshore. Database had listed the subarea as Cook Inlet, but changed to reflect actual location in the Prince William Sound watershed.	moved loc		60.777974	-148.682915	288298	1210849	Marine
Used Oil (all types)9623992270135291HOMER CITY	Unknown	Location was in city, moved to harbor.	moved loc		59.600352	-151.410876	145633	1070439	Marine
Diesel9611992300135294Sitka Sound	Human Factors	Location was in Sitka, moved to sound.	moved loc		57.040863	-135.320375	1116535	939691	Marine
Diesel9625992450135309KING COVE CITY	Human Factors		moved loc		55.055556	-161.316667	-466597	586028	Marine
Ammonia (anhydrous)9625992490135313EASTERN CHAIN	Unknown	Moved location into Beaver Inlet (Little Kiska Island) per facility name.	moved loc		51.939758	177.668007	-1899189	625685	Marine
Diesel9611992780135342Gastineau Channel	Human Factors		moved loc		58.292021	-134.399378	1129374	1089233	Marine
Ammonia (anhydrous)9625992860135350EASTERN CHAIN	Human Factors	Moved location to harbor; see Figure 2-3, http://dec.alaska.gov/water/wnpspc/protection_restoration/DutchIliuliuk/documents/06DutchHarborImpairmentAnalysis.pdf	moved loc		53.889867	-166.511885	-819085	508024	Marine
Optimer 7128 cation flocculant, or ethyl oxylated alcohol7156				NOAA record	55.600000	-132.200000	0	0	Marine
Diesel9625992980235362EASTERN CHAIN	Accident	Moved to NOAA 7157 coordinates; see http://www.incidentnews.gov/incident/7157. 51 36.00' N, 177 57.00' W.	moved loc	also NOAA	51.600000	-177.950000	-1632826	474369	Marine
Used Oil (all types)9611993190135383Gastineau Channel	Human Factors		not moved		58.325754	-135.905518	1043828	1068207	Marine
Diesel9622993200135384HINCHINBROOK IS.	Human Factors	Location was in center of island; moved to water off Bear Cape.	moved loc		60.344009	-146.738571	398655	1172581	Marine
Jet fuel9624993520135416KODIAK CITY	Other		moved loc		57.725498	-152.527688	87474	859032	Marine
Multiple: diesel & bunker C717435424Aleutian Island chain, A				NOAA record	51.000000	-174.000000	0	0	Marine
Diesel9711990020135432Portland Canal	Human Factors	Southeast, no critical habitat; spill less than or equal to 300 gal., so not checked.	not moved	default loc SE	56.968540	-133.924975	1199881	956297	Marine
Diesel9711990420135472Portland Canal	Structural/Mechanical		not moved	default loc SE	56.968540	-133.924975	1199881	956297	Marine
Diesel719035480Akun Island, Aleutian Island Chain, Alaska				NOAA record	54.211700	-165.482000	0	0	Marine
Other9711990560235486Tongass Narrows	Structural/Mechanic	Southeast, no critical habitat; spill less than or equal to 300 gal., so not checked.	not moved	default loc SE	55.342369	-131.656341	1390454	828374	Marine
Diesel9725990950135525AKUTAN CITY	Human Factors	Moved location to larger dock in water in Akutan.	moved loc		54.129245	-165.783756	-767239	525491	Marine
Used Oil (all types)9723991130235543PASSAGE CANAL	Structural/Mechanic	Moved location to Whittier per facility name. Database listed subarea as Cook Inlet, but changed to Prince William Sound.	moved loc		60.777718	-148.682938	288299	1210821	Marine
Bunker fuel720135560George Inlet, Ketchikan, Alaska				NOAA record	55.375000	-131.472000	0	0	Marine
Diesel9726991390135569BRISTOL BAY	Structural/Mechanic	Moved location to Nushagak Bay per facility name.	moved loc		58.600833	-158.641333	-268722	965254	Marine
Diesel9726991420235572LEVELOCK CDP	Human Factors	Location not moved; on Kvichak River, no additional information found online.	not moved	Upriver	59.116667	-156.850000	-162618	1017009	Marine
Diesel9725991520135582EASTERN CHAIN	Human Factors		moved loc		53.842658	-166.589038	-825063	503827	Marine
Other9711991590235589Gastineau Channel	Human Factors	Location was in city, moved to dock area water.	moved loc		58.292228	-134.398069	1129440	1089277	Marine
Diesel9711991770135606Clarence Strait North	Other	Southeast, no critical habitat; spill less than or equal to 300 gal., so not checked.	not moved	lat/long not marine	55.659190	-132.524692	1327138	844000	Marine
Diesel9711991800335610Revillagigedo Channel	Accident		not moved		55.010777	-131.107740	1435725	805244	Marine
Diesel9711991960435626Hobart Bay	Accident		not moved	default loc SE	57.845689	-133.850293	1174947	1051111	Marine
Diesel9722992020135632P.W.S. UNKNOWN	Structural/Mechanic	Moved location to Cordova; see http://data.rtknet.org/erns/erns.php?reptype=f&database=erns&detail=3&datype=T&seqnos=396002.	moved loc		60.552287	-145.767125	448850	1201917	Marine
Diesel9725992110135641ALEUTIAN E. UNKNOWN	Human Factors	Location was on land, moved to Sand Point.	moved loc		55.332903	-160.505899	-412048	611382	Marine
Diesel9723992200135650SOUTH COOK INLET	Human Factors	Moved location to Gore Point per facility name.	moved loc		59.184408	-150.932843	174651	1025126	Marine
Diesel9726992240135654KING SALMON CDP	Human Factors	Location upriver, i.e., not marine.	not moved	Upriver	58.691667	-156.658333	-153589	969086	Marine
Diesel9711992260235656Tongass Narrows	Human Factors	Southeast, no critical habitat; spill less than or equal to 300 gal., so not checked.	not moved	default loc SE	55.342369	-131.656341	1390454	828374	Marine
Asphalt emulsion722335661Haines, Alaska				NOAA record	59.250000	-135.417000	0	0	Marine
Diesel9739992330135663BARROW CITY	Structural/Mechanic	Location in Barrow; too little information to refine location.	moved loc		71.297354	-156.815266	-103295	2368804	Marine
Diesel9724992420135672KODIAK CITY	Human Factors	Location was in Kodiak, moved to Dog Bay.	moved loc		57.776672	-152.419599	93758	864893	Marine
Diesel9725992510135681DUTCH HARBOR	Human Factors	Database listed subarea as Eastern Chain, but moved location per facility name; see map in http://www.hookandbullet.com/fishing-fox-bay-sand-point-ak/.	moved loc	GNIS loc doesn't m	55.634194	-159.712423	-359043	640198	Marine
Diesel9711992680235698Cape Edgecumbe to Icy Bay	Human Factors	Location was on land, moved offshore; too little information to refine further.	moved loc		59.391551	-139.570187	810513	1132655	Marine
Diesel9724992680135698KODIAK CITY	Human Factors	Location was in middle of island, moved to Ugak Bay.	moved loc		57.411086	-152.564294	86058	823882	Marine
Bilge Oil9725992680235698EASTERN CHAIN	Human Factors	Moved location to harbor; see Figure 2-3; http://dec.alaska.gov/water/wnpspc/protection_restoration/DutchIliuliuk/documents/06DutchHarborImpairmentAnalysis.pdf	moved loc		53.890682	-166.525390	-819941	508280	Marine
Ammonia (anhydrous)9711992770135707Cordova Bay	Other	Moved location into Cordova Bay.	moved loc		54.758147	-132.514809	1359625	749065	Marine
Bilge Oil9711993080235738Tongass Narrows	Unknown	Southeast, no critical habitat; spill less than or equal to 300 gal., so not checked.	not moved	default loc SE	55.342369	-131.656341	1390454	828374	Marine
Ethylene Glycol (Antifreeze)9739993250135755BEAUFORT	Structural/Mechanical		not moved		70.560481	-147.201134	257312	2299401	Marine
IFO-380501135760Unalaska Island, Alaska		Duplicate record.		NOAA record	53.916700	-166.417000	0	0	Marine
Bunker fuel9725993300135760EASTERN CHAIN	Accident	Moved to NOAA coordinates; see http://www.darrp.noaa.gov/northwest/kuro/pdf/kurofrp0.pdf (difference of 344 mi; unclear why ADEC so far off). Only case since 1995 in which dispersants have been authorized and used in AK.	moved loc	Initial vol was 1200	53.916700	-166.417000	-812392	509788	Marine
Gasoline9724993370135767KODIAK CITY	Accident	Location was in city, moved to Inner Harbor.	moved loc		57.783042	-152.409548	94338	865619	Marine

ID	Cause Type	QC Note	Tag	Note	Lat_edited	Lon_edited	X_AlbersAK	Y_AlbersAK	Primary Media
Gasoline9711993430135773Sitka Sound	Human Factors	Location was in city, moved offshore; too little information to refine further.	moved loc		57.045944	-135.334539	1115554	939998	Marine
Diesel9711993440135774Sitka Sound	Accident	Location was in city, moved offshore; too little information to refine further.	moved loc		57.045944	-135.334539	1115554	939998	Marine
Ammonia725235788Wrangell, Alaska				NOAA record	56.466700	-132.383000	0	0	Marine
Diesel9811990180135813Gastineau Channel	Accident		not moved		58.000000	-134.000000	1161371	1064934	Marine
Diesel9824990660135861KODIAK CITY	Structural/Mechanic	Location was in Kodiak city; moved to Womens Bay.	moved loc		57.725498	-152.527688	87474	859032	Marine
Used Oil (all types)9811990790135874Portland Canal	Human Factors	Southeast, no critical habitat; spill less than or equal to 300 gal., so not checked.	not moved	default loc SE	56.968540	-133.924975	1199881	956297	Marine
Gasoline9811990820835877Portland Canal	Human Factors		not moved	default loc SE	56.968540	-133.924975	1199881	956297	Marine
Diesel9822990830135878PORT OF VALDEZ	Structural/Mechanical		not moved		61.083333	-146.650000	394365	1255301	Marine
Diesel9811981060235901Tongass Narrows	Structural/Mechanical		not moved	default loc SE	55.342369	-131.656341	1390454	828374	Marine
Diesel9811991070135902Tenakee Inlet	Other		not moved		57.806183	-135.371035	1089930	1020952	Marine
Diesel9826991130135908CHIGNIK CITY	Human Factors		not moved	lat/long not marine	56.300000	-158.400000	-271778	707972	Marine
Diesel9811981480235943Tongass Narrows	Structural/Mechanic	Southeast, no critical habitat; spill less than or equal to 300 gal., so not checked.	not moved	default loc SE	55.361778	-131.710974	1386471	829273	Marine
Diesel9822991480135943CULROSS IS.	Human Factors	Location was in middle of island, moved to Port Nellie Juan, south of island.	moved loc		60.612392	-148.127497	319974	1194939	Marine
Diesel9811991500235945Glacier Bay	Human Factors		not moved	default loc SE	58.691242	-136.108171	1021552	1104411	Marine
Diesel9822991520235947CORDOVA	Human Factors	Location was in Cordova, moved to Copper River delta.	moved loc		60.283802	-145.163973	485530	1176379	Marine
Lube oil9811991620135957Lynn Canal South	Structural/Mechanical		not moved	default loc SE	58.699900	-135.097722	1077450	1121310	Marine
Diesel9811991750135970Stephens Passage South	Accident		not moved	default loc SE	57.845689	-133.850293	1174947	1051111	Marine
Ammonia731235977Homer, Alaska				NOAA record	59.617400	-151.455000	0	0	Marine
Other9827991890135984St. Matthew Island	Accident	Location was on land, moved northwest of St. Matthew Island.	moved loc		60.628248	-173.185892	-1031737	1332633	Marine
Diesel9811991910235986Gastineau Channel	Other		moved loc		58.292021	-134.399378	1129374	1089233	Marine
Hydraulic oil9811991970135992Tongass Narrows	Structural/Mechanical		not moved	default loc SE	55.342369	-131.656341	1390454	828374	Marine
Diesel9811991990135994Icy Strait	Accident		not moved		58.273949	-135.566870	1064451	1068011	Marine
Gasoline9823992000135995HOMER CITY	Accident	Location was in city, moved to harbor.	moved loc		59.600352	-151.410876	145633	1070439	Marine
Diesel9811992150136010Sitka Sound	Human Factors	Location was in town, moved to Crescent Harbor; see http://cityofsitka.com/government/departments/harbor/HarborMaps.html.	moved loc		57.048347	-135.327177	1115907	940379	Marine
Diesel9825992240136019CENTRAL CHAIN	Human Factors	Moved location to King Cove per facility name.	moved loc		55.057773	-162.314661	-529897	593761	Marine
Diesel9827992270136022Napakiak	Accident	Location moved to Johnson River; see http://dec.alaska.gov/spar/perp/docs/fy99q1.pdf.	moved loc	Upriver	60.662976	-162.109975	-440675	1213381	Marine
Diesel9811992310336026Chatham Strait North	Human Factors	Location was in middle of island, moved to Cube Cove.	moved loc		57.943297	-134.744048	1121218	1046087	Marine
Diesel732436039Womens Bay, Kodiak, Alaska		Duplicate record.		NOAA record	57.666700	-152.500000	0	0	Marine
Diesel732536039Womens Bay, Kodiak, Alaska				NOAA record	57.666700	-152.500000	0	0	Marine
Unknown9811992650136060Lynn Canal South	Unknown		not moved	lat/long not marine	58.488479	-134.778396	1101889	1103888	Marine
Diesel733936062Alaska Peninsula				NOAA record	56.333300	-158.750000	0	0	Marine
Other9811992670336062Gastineau Channel	Unknown		not moved		58.274850	-134.386094	1130675	1087623	Marine
Diesel9823992690136064CENTRAL COOK INLET		Moved location to Barren Islands near Homer. Often spelled Baron Island, but no Baron Island per facility name found. Contingency boundary map layer puts location in Kodiak Island subarea; subarea left unchanged.	moved loc		58.950639	-152.117004	107987	996490	Marine
Diesel9811992780136073Cross Sound	Human Factors	Southeast, no critical habitat; spill less than or equal to 300 gal., so not checked.	not moved	lat/long not marine	58.186246	-136.336824	1023641	1046467	Marine
Diesel9811992850136080Glacier Bay	Other		not moved	default loc SE	58.691242	-136.108171	1021552	1104411	Marine
Other9811993030236098Taiya Inlet	Human Factors		not moved		59.447100	-135.328400	1041475	1197842	Marine
Diesel9811993130136108Gastineau Channel	Human Factors	Location was in Juneau, moved to channel.	moved loc		58.292021	-134.399378	1129374	1089233	Marine
Diesel9811983140136109Tongass Narrows	Human Factors	No Deer Island near Ketchikan; too little information to refine location.	not moved	default loc SE	55.342369	-131.656341	1390454	828374	Marine
Diesel9811993160236111Sitka Sound	Human Factors	Location was in city; moved to Mirror Harbor per GNIS http://www.arcgis.com/home/webmap/viewer.html?services=43c0075ce9f44a638f899fddd9a09ea5.	moved loc		57.795034	-136.316616	1036284	1004616	Marine
Diesel9822993580136153VALDEZ	Human Factors	Location in enclosed harbor; appears to be on land in generalized map layer.	not moved	lat/long not marine	61.116667	-146.266667	414409	1261340	Marine
Diesel9911990060136166Gastineau Channel	Other	Location was in Juneau, moved to channel.	moved loc		58.292021	-134.399378	1129374	1089233	Marine
Crude9923990370136197CENTRAL COOK INLET	Structural/Mechanic	Location not moved; not far off and too little information to refine further.	moved loc		60.708413	-151.474298	137355	1194134	Marine
Multiple: diesel, lube oil & bunker C738736210Dutch Harbor,				NOAA record	53.833300	-166.500000	0	0	Marine
Diesel9925990510136211AKUTAN	Human Factors	Moved location to larger dock in water in Akutan.	moved loc		54.129245	-165.783756	-767239	525491	Marine
Diesel9911981040136264Tongass Narrows	Human Factors	Southeast, no critical habitat; spill less than or equal to 300 gal., so not checked.	not moved	default loc SE	55.361778	-131.710974	1386471	829273	Marine
Bilge Oil9925991110136271SAND POINT	Human Factors	Moved location to Sand Point per facility name.	moved loc		55.332903	-160.505899	-412048	611382	Marine
Diesel9911981180136278Tongass Narrows	Structural/Mechanic	Southeast, no critical habitat; spill less than or equal to 300 gal., so not checked.	not moved	default loc SE	55.342369	-131.656341	1390454	828374	Marine
Ammonia (anhydrous)9925991260136286ADAK	Unknown	Moved to NOAA 7400 coordinates, Kuluk Bay, location of Naval Station, per http://www.incidentnews.gov/incident/7400	moved loc	also NOAA	51.858275	-176.632718	-1537076	469775	Marine
Diesel9925991280136288CENTRAL CHAIN	Accident	Location moved to NOAA 7399 coordinates; see http://www.incidentnews.gov/incident/7399 (difference of 344 mi; unclear why ADEC so far off).	moved loc	also NOAA	54.803300	-164.602000	-679068	586539	Marine
Lube oil9925991300136290COLD BAY	Accident	Moved to NOAA 7401 coordinates; see http://www.incidentnews.gov/incident/7401.	moved loc	also NOAA	55.107200	-162.527000	-542652	600934	Marine

ID	Cause Type	QC Note	Tag	Note	Lat_edited	Lon_edited	X_AlbersAK	Y_AlbersAK	Primary Media
Diesel9911981370136297Craig / Klawock area waters	Human Factors	Location listed was identical to that for a spill from fishing vessel Erin Lynn at Hydaburg. Moved location to Cape Chacon area per facility name.	moved loc		54.684674	-132.010543	1393033	751774	Marine
Diesel9923991570136317EAST KENAI UNKNOWN	Human Factors	Location was in middle of island, moved to 7 mi southeast of Outside Island.	moved loc		59.267841	-150.256244	212615	1036415	Marine
Multiple: diesel & engine room slops740636323Dundas Bay,		Duplicate record; see ADEC 99119916301.		NOAA record	58.433300	-136.500000	0	0	Marine
Diesel9911991630136323Glacier Bay	Accident	Moved to NOAA coordinates in Dundas Bay; see http://www.incidentnews.gov/incident/7406.	moved loc		58.433300	-136.500000	1007215	1070616	Marine
Gasoline9927991660136326Nunam Iqua (Sheldon Point)	Human Factors	Location appears to be on land in generalized map layer.	not moved	lat/long not marine	62.533333	-164.866667	-555226	1441133	Marine
Diesel9911991670136327Sumner Strait	Human Factors	Southeast, no critical habitat; spill less than or equal to 300 gal., so not checked.	not moved	lat/long not marine	56.396415	-133.712800	1231366	899273	Marine
Diesel741136342Sitka Sound				NOAA record	56.983300	-134.583000	0	0	Marine
Diesel9923991900536350HOMER CITY	Structural/Mechani	Location was listed as in city, but moved 10 miles into bay.	moved loc		59.664174	-151.258559	153901	1077913	Marine
Diesel9924991930136353KODIAK CITY	Human Factors	Was in Kodiak city, moved to LASH Dock; see http://grin.nukaresearch.com/kodiak_island/kodiak/pdfs/kodiak_logistic_lashdock.pdf.	moved loc		57.730541	-152.524414	87656	859599	Marine
Diesel9911991940136354Lynn Canal South	Accident		not moved	default loc SE	58.699900	-135.097722	1077450	1121310	Marine
Multiple: diesel & lube oil742136368Tracey Arm, southeast A				NOAA record	57.550000	-133.183000	0	0	Marine
Diesel742236368Tracy Arm, AK				NOAA record	57.874300	-133.580000	0	0	Marine
Diesel9911992260136386<Null>	Unknown	Location was listed as on island; moved to off Chasina Pt. Database subarea was listed as Prince William Sound region of the Gulf of Alaska, but coordinates were consistent with location/city/facility, so moved to southeast Alaskan waters.	moved loc		55.301992	-132.028963	1369586	816382	Marine
Other9922992390136399PRINCE WILLIAM SOUND	Human Factors	Moved location to Potato Point per facility name.	moved loc		61.057046	-146.694076	392332	1252118	Marine
Diesel9911992430236403Annette Island	Accident	Location was listed as mid-island, but moved to Kirk Pt. Database listed subarea as Prince William Sound region of the Gulf of Alaska, but coordinates consistent with location/city/facility, sochanged to reflect location in southeast Alaskan waters.	moved loc		55.112079	-131.084647	1433301	816357	Marine
Diesel9924992620136422OLD HARBOR CITY	Other		not moved		57.204167	-153.300000	42205	800073	Marine
Fuel oil743536433Just offshore, village of Mekoryuk, N side N				NOAA record	60.383300	-166.183000	0	0	Marine
Middle Ground Shoal crude oil744336456right at the Forelanc				NOAA record	60.666700	-151.417000	0	0	
Diesel9924993100136470OLD HARBOR CITY	Accident	Location was at old harbor, moved to Cape Kasiak.	moved loc		57.064086	-153.495499	30537	784330	Marine
Diesel9911993470236507Tongass Narrows	Unknown		not moved	default loc SE	55.342369	-131.656341	1390454	828374	Marine
Gasoline23990190136544WEST CENTRAL KENAI	Other	Location was on land across inlet, moved to Tesoro dock; see http://s159443129.onlinehome.us/pdf/03_240e%20tesoro%20nikiski%20dock.pdf.	moved loc		60.677850	-151.402659	141383	1190869	Marine
Gasoline11990250136550Portland Canal	Structural/Mechanical		not moved	default loc SE	56.968540	-133.924975	1199881	956297	Marine
Multiple: diesel, lube oil & hydraulic oil746736567Unimak Isla				NOAA record	57.630000	-163.533000	0	0	Marine
IFO-380747236582Icy Bay, Northern Gulf of Alaska				NOAA record	59.933300	-141.433000	0	0	Marine
Propane (LPG)747636600Kodiak, AK		Duplicate record; see ADEC 00249907501.		NOAA record	57.789300	-152.392000	0	0	Marine
Propane (LPG)24990750136600KODIAK UNKNOWN	Structural/Mechani	Moved to NOAA 7478 coordinates, Kodiak Harbor; see http://www.incidentnews.gov/incident/7478.	moved loc	also NOAA	57.750000	-152.417000	93984	861919	Marine
Diesel11990980236623Tongass Narrows	Structural/Mechani	Location appears to be on land in generalized map layer.	not moved	default loc SE	55.361778	-131.710974	1386471	829273	Marine
Diesel24991110136636SHELIKOF STRAIT	Human Factors	Moved to NOAA 7490 coordinates; see http://www.incidentnews.gov/incident/7490.	moved loc	also NOAA	57.763300	-154.262000	-15551	862315	Marine
Other11991330136658Gastineau Channel	Human Factors		moved loc		58.292021	-134.399378	1129374	1089233	Marine
Diesel27991340136659Bethel	Unknown	Location upriver, not marine.	not moved	Upriver	60.791667	-161.750000	-419530	1225340	Marine
Diesel24991460136671WOMENS BAY	Structural/Mechani	Location was in gulf; moved to Womens Bay.	moved loc		57.725498	-152.527688	87474	859032	Marine
Other11991480136673Gastineau Channel	Human Factors		moved loc		58.292021	-134.399378	1129374	1089233	Marine
Ammonia (anhydrous)749536677Dutch Harbor, Unalaska Isla				NOAA record	53.916700	-166.500000	0	0	Marine
Diesel25991730136698SAND POINT	Other	Moved location per facility name, near Sand Point airport; quarry not found.	moved loc		55.312183	-160.535052	-414115	609267	Marine
Jet fuel11991870236712Tongass Narrows	Human Factors	Southeast, no critical habitat; spill less than or equal to 300 gal., so not checked.	not moved	default loc SE	55.342369	-131.656341	1390454	828374	Marine
Diesel24992040136729SHELIKOF STRAIT	Human Factors	Moved location to coordinates per facility name.	moved loc		57.310002	-155.250001	-75141	812373	Marine
Diesel11992280136753Tongass Narrows	Accident	Location was in Ketchikan; moved to Meyers Chuck.	moved loc		55.735640	-132.262030	1340051	857346	Marine
Diesel11992280236753Craig / Klawock area waters	Accident	Southeast, no critical habitat; spill less than or equal to 300 gal., so not checked.	not moved	lat/long not marine	55.208956	-132.817397	1325398	790565	Marine
Diesel11992290136754Annette Island	Human Factors	Location was listed as mid-island, but moved to near Metlakatle. Database listed subarea as Prince William Sound region of the Gulf of Alaska, but coordinates were consistent with location/city/facility, so changed to southeast Alaskan waters.	moved loc		55.132067	-131.601465	1401488	807424	Marine
Other23992310136756NORTH COOK INLET	Other	Moved location to Granite Point near tank visible in aerial photos.	moved loc		61.025147	-151.267918	147116	1229974	Marine
Diesel11992320136757Wrangell area waters	Human Factors	Location was in middle of island, moved to harbor.	moved loc		56.467342	-132.384971	1306657	932168	Marine
Diesel11992350236760Portland Canal	Human Factors	Southeast, no critical habitat; spill less than or equal to 300 gal., so not checked.	not moved	default loc SE	56.968540	-133.924975	1199881	956297	Marine
Diesel11992360236761Cape Edgecumbe to Icy Bay	Accident		not moved		56.987042	-134.365238	1173746	950402	Marine
Diesel11992420136767Tongass Narrows	Human Factors	Location was in Ketchikan; moved to narrows.	moved loc		55.324527	-131.625546	1392954	827144	Marine
Other23992640136789WHITTIER	Other	Moved location offshore. Database subarea said "Cook Inlet," changed to reflect location in the Prince William Sound watershed.	moved loc	edited subarea	60.777974	-148.682915	288298	1210849	Marine

ID	Cause Type	QC Note	Tag	Note	Lat_edited	Lon_edited	X_AlbersAK	Y_AlbersAK	Primary Media
Diesel25992830236808DUTCH HARBOR	Human Factors	Moved to harbor; see Figure 2-3, http://dec.alaska.gov/water/wnpspc/protection_restoration/DutchIliuliuk/documents/06DutchHarborImpairmentAnalysis.pdf.	moved loc		53.878734	-166.521519	-819940	506928	Marine
Heavy oil752036848Port Walter, AK				NOAA record	56.383400	-134.625000	0	0	Marine
Diesel25993280136853SAND POINT	Other	Moved near Sand Point; see http://www.mbendi.com/a_sndmsg/facility.asp?I=1932389.	moved loc		55.324663	-160.155131	-389983	608350	Marine
Diesel23993350136860KENAI CITY	Other	Location was not moved.	not moved		60.550000	-151.266667	149370	1176878	Marine
Diesel11993440136869Lisianski	Human Factors	Southeast, no critical habitat; spill less than or equal to 300 gal., so not checked.	not moved	lat/long not marine	58.111547	-135.419781	1077733	1052939	Marine
Diesel25993540136879DUTCH HARBOR	Structural/Mechani	Moved to harbor; see Figure 2-3, http://dec.alaska.gov/water/wnpspc/protection_restoration/DutchIliuliuk/documents/06DutchHarborImpairmentAnalysis.pdf	moved loc		53.908580	-166.508022	-818445	510019	Marine
Diesel122990300136921EVANS ISLAND	Accident	Location was in middle of island, moved to Evans Point.	moved loc		60.134780	-147.918158	336234	1142771	Marine
Unknown111990850236976Tongass Narrows	Other		not moved	default loc SE	55.853849	-132.462201	1323951	865812	Marine
Diesel111991200337011Clarence Strait North	Other	Southeast, no critical habitat; spill less than or equal to 300 gal., so not checked.	not moved	default loc SE	56.008165	-132.839065	1296193	874698	Marine
Diesel122991290137020P.W.S. UNKNOWN	Human Factors	Moved location to Johnstone Point per facility name.	moved loc		60.496937	-146.645462	401856	1190143	Marine
Diesel125991310137022COLD BAY	Other		not moved		55.325925	-162.783333	-555659	627204	Marine
Diesel111991650237056Lynn Canal North	Structural/Mechani	Company web page describes vessel fueling services, so location placed off central dock.	No coords	WGS84 (Google Ea	59.448699	-135.324765	0	0	Marine
Diesel111991790137070Gastineau Channel	Other		not moved	lat/long not marine	58.302914	-134.404008	1128761	1090318	Marine
Diesel111991790337070Tongass Narrows	Structural/Mechani	Location placed in Tongass Narrows offshore from large logging area visible on Google Earth, between Ward Cove and Point Higgins, north of Ketchikan.	No coords	WGS84 (Google Ea	55.434737	-131.801201	0	0	Marine
Diesel111992050137096Glacier Bay	Human Factors	Location was listed as in undeveloped area; moved location to park maintenace yard per personal knowledge of Windward staff.	moved loc		58.453203	-135.854623	1042848	1082722	Marine
Diesel122992070137098PRINCE WILLIAM SOUND	Human Factors	Moved location to northwest of Glacier Island per facility name.	moved loc		60.912167	-147.247728	364352	1232850	Marine
Diesel111992130237104Cordova Bay	Human Factors	Southeast, no critical habitat; spill less than or equal to 300 gal., so not checked.	not moved	lat/long not marine	55.482797	-133.123160	1297475	813511	Marine
Diesel122992160137107P.W.S. UNKNOWN	Human Factors	Location moved to NOAA 7574 coordinates; see GNIS map and http://www.incidentnews.gov/incident/7574.	moved loc	also NOAA	60.878300	-147.535000	349269	1227537	Marine
Diesel111992310137122Chatham Strait North	Human Factors		not moved	default loc SE	57.869254	-134.823990	1119049	1036812	Marine
Diesel111992360137127Chatham Strait North	Human Factors	Moved location to 2 mi west of Cape Ommaney.	moved loc		56.167570	-134.701746	1180396	856920	Marine
Diesel111992390137130Annette Island	Accident	Location was listed as mid-island, but moved to Snail Rock. Database listed subarea as Prince William Sound region of the Gulf of Alaska, but coordinates were consistent with location/city/facility, so changed to southeast Alaskan waters.	moved loc		55.033479	-131.048994	1438406	808894	Marine
Diesel111992440137135Sumner Strait	Human Factors	Location was on land, moved to Warren Channel.	moved loc		55.930893	-133.824488	1240325	847679	Marine
Diesel111992560137147Gastineau Channel	Human Factors		moved loc		58.315486	-134.452433	1125645	1090841	Marine
Diesel125992600137151DUTCH HARBOR	Human Factors	Location was listed as in subarea Eastern Chain; moved location to Captains Bay per facility name.	moved loc		53.842658	-166.589038	-825063	503827	Marine
Diesel111992620137153Tongass Narrows	Human Factors	Location in Ketchikan, appears on land on generalized map layer. Not enough information to refine location.	not moved	default loc SE	55.342369	-131.656341	1390454	828374	Marine
Crude123993310137222NORTH COOK INLET	Structural/Mechani	Moved to south MGS platform (http://www.dog.dnr.alaska.gov/oil/); see http://www.onepetro.org/mslib/servlet/onepetropreview?id=OTC-1194-MS.	moved loc		60.742136	-151.508543	135353	1197833	Marine
Diesel225990070137263DUTCH HARBOR	Human Factors	Moved location to Captain's Bay, Dutch Harbor; see http://www.offshoresystemsinc.com.	moved loc		53.842658	-166.589038	-825063	503827	Marine
Diesel224990170137273AFOGNAK IS.	Human Factors	Location placed in center of Kazakoff Bay.	No coords	WGS84 (Google Ea	58.147851	-152.584240	0	0	Marine
Diesel211990490137305Tongass Narrows	Structural/Mechani	Southeast, no critical habitat; spill less than or equal to 300 gal., so not checked.	not moved	default loc SE	55.342369	-131.656341	1390454	828374	Marine
Ammonia (anhydrous)211990590137315Tongass Narrows	Other	This is right in Ketchikan. See https://maps.google.com/maps?oe=utf-8&client=firefox-a&ie=UTF-8&q=trident+seafoods+ketchikan&fb=1&gl=us&hq=trident+seafoods&hnear=0x540c25088729e15b:0x7e90e56bcfc60674,Ketchikan,+Alaska&ei=NJxHUNebAaTrigK7soGQCw&ved=0CIwBELYD.	No coords	WGS84 (Google Ea	55.346820	-131.664634	0	0	Marine
Diesel211990870237343Tongass Narrows	Other		not moved	default loc SE	55.342369	-131.656341	1390454	828374	Marine
Ballast Water (containing oil)222991070137363VALDEZ MAI	Human Factors	Location not moved, coordinates match maps.	not moved		61.092983	-146.409605	407085	1257824	Marine
Diesel211992020137458Tongass Narrows	Accident	Location placed off South Point Higgins Road, just within Tongass Narrows.	No coords	WGS84 (Google Ea	55.444665	-131.822826	0	0	Marine
Diesel211992050137461Lynn Canal South	Human Factors		not moved	default loc SE	58.699900	-135.097722	1077450	1121310	Marine
Diesel211992060137462Tongass Narrows	Structural/Mechanical		not moved	default loc SE	55.342369	-131.656341	1390454	828374	Marine
Diesel211992070137463Clarence Strait North	Human Factors	Location moved to middle of Ratz Harbor, northwest of Thorne Bay. Searched in the geographic names map viewer; http://www.arcgis.com/home/webmap/viewer.html?services=43c0075ce9f44a638f899fddd9a09ea5.	No coords	WGS84 (Google Ea	55.884057	-132.599403	0	0	Marine
Asphalt211992260137482Ketchikan Region NOS	Structural/Mechani	Coordinates from database showed an inland location; moved from middle of island to near shore; too little information to refine further.	moved loc		55.328019	-131.619162	1393208	827645	Marine
Other211992290137485Gastineau Channel	Unknown	Awaiting lab results. Location placed off dock used by small cruise ships.	No coords	WGS84 (Google Ea	58.297424	-134.411146	0	0	Marine

ID	Cause Type	QC Note	Tag	Note	Lat_edited	Lon_edited	X_AlbersAK	Y_AlbersAK	Primary Media
Diesel211992370237493Cordova Bay	Other	Location placed off parcel that appears to be a log yard in Google maps.	No coords	WGS84 (Google Ea	55.541018	-133.107553	0	0	Marine
Diesel224992690137525AFOGNAK IS.	Human Factors	Location placed based on http://dec.alaska.gov/SPAR/perp/kppor/pdfs/kporriskmapslayers.pdf; Figure H-6.	No coords	WGS84 (Google Ea	58.136346	-152.190404	0	0	Marine
Diesel211992800137536Chichagof Island NOS	Other		not moved	default loc SE	57.869254	-134.823990	1119049	1036812	Marine
Diesel211992880137544Wrangell Narrows	Other	No "Sockeye Island" in official geographic names. Location placed at Sukoi Islets, locally known as Sockeye Islets, 3.8 mi from Petersburg; see ocsdata.ncd.noaa.gov/BookletChart/17377_BookletChart.pdf.	No coords	WGS84 (Google Ea	56.885271	-132.922289	0	0	Marine
Diesel224993140137570AFOGNAK IS.	Accident	Location was in middle of island, moved to Kazakof Bay.	moved loc		58.154558	-152.583459	83138	906878	Marine
Unknown211993280137584Tongass Narrows	Other		not moved	default loc SE	55.342369	-131.656341	1390454	828374	Marine
Drilling Muds223993330137589NORTH COOK INLET	Human Factors	See www.epa.gov/region10/pdf/permits/npdes/ak/ak0053309_fs.pdf. "The discharges for the Forest Oil Corporation Osprey Production Platform are located in the Cook Inlet, Alaska, at Latitude N 60ª41'46÷, Longitude W 151ª40'10÷." Also see http://homernews.co	No coords	WGS84 (Google Ea	60.696110	-151.669422	0	0	Marine
Diesel224993450137601KODIAK UNKNOWN	Human Factors	Location placed in middle of harbor.	No coords	WGS84 (Google Ea	57.760276	-152.440812	0	0	Marine
Ballast Water (containing oil)222993460137602VALDEZ MAI	Structural/Mechanical		not moved	lat/long not marine	61.080585	-146.400210	407745	1256504	Marine
Diesel311990060237627Sitka Sound	Human Factors	Location was in city, moved offshore; too little information to refine further.	moved loc		57.045944	-135.334539	1115554	939998	Marine
Diesel311990060537627Tongass Narrows	Human Factors		not moved	default loc SE	55.342369	-131.656341	1390454	828374	Marine
Diesel311990090137630Juneau / Douglas	Human Factors	Placed location offshore of address, which checked out in search of name.	No coords	WGS84 (Google Ea	58.328282	-134.475291	0	0	Marine
Diesel324991500137771KODIAK UNKNOWN	Human Factors	Location placed based on http://dec.alaska.gov/SPAR/perp/kppor/pdfs/kporriskmapslayers.pdf; Figure H-6.	No coords	WGS84 (Google Ea	57.826640	-152.186132	0	0	Marine
Diesel311991890237810Sitka Sound	Human Factors		not moved		57.250000	-135.900000	1076482	952577	Marine
Diesel325991900137811SAINT PAUL IS.	Human Factors	Location moved to St Paul Island per facility name.	moved loc		57.122222	-170.275000	-973710	910615	Marine
Diesel108537840Kodiak Island, AK				NOAA record	55.893300	-155.223000	0	0	Marine
Diesel322992300137851P.W.S. UNKNOWN	Accident	Moved to NOAA 1095 coordinates; see http://dec.alaska.gov/spar/perp/response/sum_fy04/030818201/030818201_sr_03.pdf.	moved loc	also NOAA	60.550000	-145.772000	448617	1201630	Marine
Diesel109437853Tanglefoot Bay, AK				NOAA record	57.573300	-154.490000	0	0	Marine
Diesel109337860Pavlof Bay, AK				NOAA record	55.300900	-161.805000	0	0	Marine
Diesel311992500137871Auke Bay / Fritz Cove	Structural/Mechanic	Southeast, no critical habitat; spill less than or equal to 300 gal., so not checked.	not moved	lat/long not marine	58.381500	-134.685700	1110481	1093977	Marine
Diesel110737909North of Alaska Peninsula, Bering Sea, AK				NOAA record	55.616700	-163.150000	0	0	Marine
Diesel338993120137933SHAKTOOLIK CITY	Other	Assumed pipe was full and there was no oil residue anywhere.	No coords	WGS84 (Google Ea	64.333589	-161.153878	0	0	Marine
Diesel411990090137995Stephens Passage South	Human Factors	Drums removed by USCG contractor (No development at Arden Point, so drums were possibly the result of illicit storage.)	No coords	WGS84 (Google Ea	58.158949	-134.177857	0	0	Marine
Diesel425990290138015DUTCH HARBOR	Human Factors	Database listed subarea as Eastern Chain; moved location to Captains Bay per facility name.	moved loc		53.842658	-166.589038	-825063	503827	Marine
Diesel411990340138020Yakutat Bay	Structural/Mechanical		not moved	default loc SE	59.557527	-139.762113	795951	1148461	Marine
Diesel423990590138045HOMER CITY	Human Factors	Location was in city, moved to harbor.	moved loc		59.600352	-151.410876	145633	1070439	Marine
Ammonia (anhydrous)423990700138056HOMER CITY	Human Factors	Coordinates from database showed an inland location; moved location into harbor.	moved loc		59.601283	-151.411962	145568	1070540	Marine
Diesel411990720138058Chichagof Island NOS	Human Factors		not moved		57.960300	-136.227890	979441	1008629	Marine
Diesel411991060438092Tongass Narrows	Structural/Mechanical		not moved	default loc SE	55.853849	-132.462201	1323951	865812	Marine
Diesel426991080138094BRISTOL BAY UNKNOWN	Accident	Facility identified by photo at http://www.tridentseafoods.com/company/plants_alaska.php#Naknek.	No coords	WGS84 (Google Ea	58.726797	-157.007301	0	0	Marine
Diesel117238118Peril Strait, AK				NOAA record	57.566700	-135.433000	0	0	Marine
Unknown117338119Bering Sea, AK		NOAA record	########	-170.250000		0	0 Marine	Gallons	
Unknown117338119Bering Sea, AK				NOAA record	50.800000	-170.250000	0	0	Marine
Diesel411991610238147Hydaburg / Tlevak	Accident	NOAA 1182 same spill, coordinates nearby.	not moved	also NOAA	55.886900	-133.716000	1248260	845034	Marine
Diesel120038199Baby Island, AK				NOAA record	53.750000	-166.500000	0	0	Marine
Diesel425992130138199ALEUTIAN E. UNKNOWN	Accident	http://dec.alaska.gov/spar/perp/response/sum_fy05/040731201/040731201_sr_03.pdf	No coords	WGS84 (Google Ea	54.000000	-166.059982	0	0	Marine
Diesel121338244SE Alaska, AK				NOAA record	54.803300	-130.933000	0	0	Marine
Multiple: diesel & gasoline122038251Auke Bay, AK				NOAA record	58.400000	-134.500000	0	0	Marine
DieselNOAA ID 12238251Auke Bay / Fritz Cove	Human Factors	NOAA db. Potential responsible party was tried and there was a hung jury. This person has not been re-tried yet. The AG has determined the responsible party (if convicted), and not the owner of the spilled product, will be responsible for reimbursing the State of Alaska.	No coords	WGS84 (Google Ea	58.385040	-134.647932	0	0	Marine
Gasoline411992690138255Auke Bay / Fritz Cove	Unknown	Southeast, no critical habitat; spill less than or equal to 300 gal., so not checked.	not moved	lat/long not marine	58.411155	-134.747101	1106103	1096127	Marine
Diesel411992830238269Cape Edgecumbe to Icy Bay	Structural/Mechanic	Location not moved; nearshore island generalized as cape on map layer; see http://dec.alaska.gov/spar/perp/response/sum_fy05/041007101/041007101_index.htm.	not moved	lat/long not marine	58.318000	-136.860000	990251	1052754	Marine
Crude423993020138288CENTRAL COOK INLET	Unknown	Moved location near Nikiski per facility name.	moved loc		60.708413	-151.474298	137355	1194134	Marine
Diesel411993230238309Ketchikan	Structural/Mechanic	Report was forwarded to EPA for action. Location placed near houses in center of town on waterfront.	No coords	WGS84 (Google Ea	55.130340	-131.579620	0	0	Marine

ID	Cause Type	QC Note	Tag	Note	Lat_edited	Lon_edited	X_AlbersAK	Y_AlbersAK	Primary Media
Lube oil411993330438319Saxman	Human Factors	Contaminated material still stockpiled and awaiting disposal. Placed location near tanks visible using Google Earth; see http://dec.alaska.gov/spar/perp/response/sum_fy05/041128101/041128101_index.htm.	No coords	WGS84 (Google Ea	55.315984	-131.597217	0	0	Marine
Diesel425993430138329EASTERN CHAIN	Accident	Duplicate location; different material. One of two cases where dispersants were authorized but not used	moved loc	dup incid, dif substa	53.756700	-167.346000	-875929	504151	Marine
IFO-380425993430138329EASTERN CHAIN	Accident	Moved to NOAA 1242 coordinates; see http://www.incidentnews.gov/incident/1242. One of two cases where dispersants were authorized but not used	moved loc	also NOAA	53.756700	-167.346000	-875929	504151	Marine
Diesel411993620238348Chatham Strait North	Human Factors		not moved	default loc SE	57.869254	-134.823990	1119049	1036812	Marine
Bunker fuel525990130138365ATTU	Unknown		not moved		53.438889	-173.291667	-1266979	565868	Marine
Drilling Muds539990590338411CHUKCHI SEA	Structural/Mechanic	See comments in facility file for more information.	No coords	WGS84 (Google Ea	70.573032	-149.934406	0	0	Marine
Other522991150138467VALDEZ	Structural/Mechanic	Spill ocurred during spring thaw with heavy runoff that flushed sewage into Port at Duck Flats. Location placed where a channel runs from Egan Ave (276 Egan) into Duck Flats.	No coords	WGS84 (Google Ea	61.128173	-146.342555	0	0	Marine
Diesel524992070138559KODIAK UNKNOWN	Human Factors	Location was in middle of island, moved to Uganik Bay.	moved loc		57.870880	-153.556665	26233	874388	Marine
Diesel523992380138590EAST KENAI UNKNOWN	Human Factors	Location placed off tip of Cape Resurrection.	No coords	WGS84 (Google Ea	59.842437	-149.278347	0	0	Marine
Diesel525992450138597CENTRAL CHAIN	Human Factors	Moved location to harbor; see Figure 2-3, http://dec.alaska.gov/water/wnpspc/protection_restoration/DutchIliuliuk/documents/06DutchHarborImpairmentAnalysis.pdf.	moved loc		53.890682	-166.525390	-819941	508280	Marine
Diesel511992530138605Icy Strait	Human Factors		not moved		58.131700	-135.270800	1085519	1057528	Marine
Jet fuel524992740138626WOMENS BAY	Human Factors	Coordinates from database showed location in gulf; moved to Womens Bay.	moved loc		57.725498	-152.527688	87474	859032	Marine
Diesel511993040138656Ketchikan	Unknown	ADEC has coordinated with USCG, City, and private entities to investigate and treat contaminated pads and products. City personnel contiue to check area periodically for necessary cleanup.	No coords	WGS84 (Google Ea	55.353634	-131.685498	0	0	Marine
Diesel511993200238672Sitka	Structural/Mechanic	There has never been any oil found between source and Sitka Sound. The spill occurred in the evening during heavy rains, which apparently washed all the oil into the Sound. Testing in September at tank did not indicate any remaining oil.	No coords	WGS84 (Google Ea	57.112763	-135.393130	0	0	Marine
Hydraulic oil525993550138707WESTERN CHAIN	Structural/Mechanic	No "Capin's Bay" found; placed location in Captain's Bay.	No coords	WGS84 (Google Ea	53.862767	-166.571646	0	0	Marine
Diesel624990130138730KODIAK UNKNOWN	Structural/Mechanic	Location placed in center of bay.	No coords	WGS84 (Google Ea	57.063124	-153.167682	0	0	Marine
Diesel611990310138748Cape Edgecumbe to Icy Bay	Structural/Mechanical		not moved		56.100000	-134.400000	1200510	855116	Marine
Other623990330138750NIKISKI	Accident	Moved to NOAA 6058 coordinates; see http://dec.alaska.gov/spar/perp/response/sum_fy06/060202201/060202201_index.htm.	moved loc	also NOAA	60.676700	-151.403000	141370	1190739	Marine
Diesel624990370138754KODIAK CITY	Human Factors	Location was in city, moved to harbor.	moved loc		57.777639	-152.430271	93123	864986	Marine
Jet fuel625990440138761WESTERN CHAIN	Other	Duplicate location; different material.	not moved	dup incid, dif substa	53.905200	-166.523900	-819542	509846	Marine
Diesel625990440138761WESTERN CHAIN	Other	Location appears to be on land in generalized map layer.	not moved	lat/long not marine	53.905200	-166.523900	-819542	509846	Marine
Diesel625990540138771CENTRAL CHAIN	Other	Location was generalized as in central chain; moved to Volcano Bay.	moved loc		55.187330	-161.953394	-505263	605262	Marine
Multiple: diesel & lube oil607138807NW Unalaska Island, AK				NOAA record	53.631300	-167.839000	0	0	Marine
Diesel611990930438810Yakutat Bay	Human Factors		not moved	default loc SE	59.557527	-139.762113	795951	1148461	Marine
Kerosene611991000138817Gastineau Channel	Structural/Mechanic	Southeast, no critical habitat; spill less than or equal to 300 gal., so not checked.	moved loc		58.315486	-134.452433	1125645	1090841	Marine
Diesel624991110138828KODIAK UNKNOWN	Structural/Mechanic	Location appears to be on land in generalized map layer.	not moved	lat/long not marine	56.505000	-154.143600	-8827	721840	Marine
Diesel624991380138855KODIAK CITY	Human Factors		not moved	lat/long not marine	57.788889	-152.411083	94231	866270	Marine
Diesel622991720138889Middleton Island	Structural/Mechanical		not moved		59.149720	-146.896550	404273	1038856	Marine
Diesel610038910Sitka, AK				NOAA record	56.411300	-135.042000	0	0	Marine
Multiple: fuel oil & gasoline610338921North Pacific Ocean, A		Spill volume not quantified; left 2-mile slick while drifting. One of two cases where dispersants were used		NOAA record	48.130000	-174.270000	0	0	Marine
Multiple: fuel oil & gasoline610338921North Pacific Ocean, A		Spill volume not quantified; left 2-mile slick while drifting. One of two cases where dispersants were authorized but not used		NOAA record	48.130000	-174.270000	0	0	Marine
Diesel611992160138933Clarence Strait North	Structural/Mechanic	Awaiting further response actions once additional information is available. See http://dec.alaska.gov/spar/perp/response/sum_fy07/060804101/060804101_index.htm, Division of Spill Prevention and Response, "The location of the sinking is approximately 38 nautical m."	No coords	WGS84 (Google Ea	55.785668	-132.474362	0	0	Marine
Diesel622992250138942PRINCE WILLIAM SOUND	Accident	Coordinates from http://dec.alaska.gov/spar/perp/response/sum_fy07/060813201/060804101_index.htm; not Latouche I, but its neighbor, Evans Island.	No coords	WGS84 (Google Ea	60.104665	-147.889978	0	0	Marine
Diesel622992410138958PRINCE WILLIAM SOUND	Accident		No coords	WGS84 (Google Ea	60.612420	-146.256205	0	0	Marine
Diesel611992700138987Duncan Canal	Accident		not moved		54.704900	-132.118200	1385734	751650	Marine
Diesel626992830139000DILLINGHAM CITY	Human Factors		No coords	WGS84 (Google Ea	59.035072	-158.481204	0	0	Marine
Diesel611993010139018Hollis	Unknown	Location was listed as on island; moved to Hollis Bay. Database subarea was lisetd as Prince William Sound region of the Gulf of Alaska, but coordinates were consistent with location/city/facility, so changed to southeast Alaskan waters.	moved loc		55.477459	-132.652258	1325926	822247	Marine
Diesel611993230139040Tongass Narrows	Human Factors	Southeast, no critical habitat; spill less than or equal to 300 gal., so not checked.	not moved	lat/long not marine	55.497000	-131.725000	1380673	843204	Marine

ID	Cause Type	QC Note	Tag	Note	Lat_edited	Lon_edited	X_AlbersAK	Y_AlbersAK	Primary Media
Fuel Oil & Wheat614139055Adak, Bering Sea, AK				NOAA record	54.778100	-174.958000	0	0	Marine
Diesel611993400339057Juneau / Douglas	Structural/Mechani	Southeast, no critical habitat; spill less than or equal to 300 gal., so not checked.	not moved	lat/long not marine	58.297100	-134.400300	1129157	1089760	Marine
Diesel724990080139090SHELIKOF STRAIT	Accident	Location was on land, moved to Shelikof Strait.	moved loc		57.347406	-155.074950	-64551	816364	Marine
Diesel711990120139094Revillagigedo Channel	Accident		not moved	lat/long not marine	55.327920	-131.526200	1398776	829589	Marine
Diesel724990120139094KODIAK CITY	Structural/Mechani	Moved location from city to adjacent harbor, near St Herman's Seminary, per Google Maps.	moved loc		57.788099	-152.399972	94892	866197	Marine
Diesel711990380139120Wrangell Narrows	Unknown		not moved		56.809600	-132.965500	1260869	957178	Marine
Diesel725990410139123UNALASKA	Structural/Mechanical		not moved		53.793300	-167.250200	-868920	506878	Marine
Diesel724990510139133SHELIKOF STRAIT	Accident		not moved		57.160000	-155.330000	-80284	795724	Marine
Diesel711990680139150Gastineau Channel	Human Factors	Southeast, no critical habitat; spill less than or equal to 300 gal., so not checked.	not moved	lat/long not marine	58.319330	-134.576000	1118610	1089164	Marine
Diesel711990720239154Thorne Bay	Human Factors		not moved		55.743206	-132.388842	1332242	855594	Marine
Diesel725990770139159ADAK	Accident	Original coordinates for city, location moved into bay; see http://dec.alaska.gov/spar/perp/response/sum_fy07/070318201/070318201_index.htm.	moved loc		51.873263	-176.570984	-1532494	469912	Marine
Diesel725990830139165CENTRAL CHAIN	Accident		not moved		52.200000	-175.133000	-1426975	472114	Marine
Diesel723991370139219WHITTIER	Human Factors	Location moved offshore. Database subarea "Cook Inlet" -- Edited because location was in the Prince William Sound watershed.	moved loc	edited subarea	60.777974	-148.682915	288298	1210849	Marine
Diesel739991530639235WEST NORTH SLOPE	Unknown		not moved	lat/long not marine	71.050000	-154.733334	-27212	2339819	Marine
Diesel722991540139236P.W.S. UNKNOWN	Human Factors	Location was in middle of Hinchinbrook Island, moved to water; see http://dec.alaska.gov/spar/perp/response/sum_fy07/070603201/070603201_index.htm.	moved loc		60.432431	-146.333995	419631	1184901	Marine
Sheen767139269140 nm WNW St Matthew Island				NOAA record	61.281700	-177.807000	0	0	Marine
Diesel722991970139279P.W.S. UNKNOWN	Other	Location not changed; location defined as Prince William Island, but actually in Kodiak Island subarea in open water, less than 5 miles from subarea boundary.	not moved		59.871700	-148.716830	294518	1109664	Marine
Diesel722992020139284PRINCE WILLIAM SOUND	Accident	NOAA 7679 same spill, coordinates nearby; see http://www.incidentnews.gov/incident/7679.	not moved	also NOAA	60.713333	-146.193833	423584	1216996	Marine
Diesel767839288Sunshine Cove, AK				NOAA record	58.603500	-134.926000	0	0	Marine
Diesel722992130139295ESTHER IS.	Accident	Moved location to coordinates per facility name.	moved loc		60.786667	-148.143336	317397	1214279	Marine
Diesel711992200139302Frederick Sound	Structural/Mechanical		not moved		56.797000	-132.839700	1268594	958238	Marine
Diesel711992300239312Revillagigedo Channel	Human Factors	Moved northwest of island, see http://dec.alaska.gov/spar/perp/response/sum_fy08/070817101/070817101_sr_01.pdf, http://www.incidentnews.gov/incident/7686.	moved loc	also NOAA	55.266712	-131.463762	1404781	824477	Marine
Gasoline711992490239331Wrangell area waters	Unknown	Location was in middle of island, moved to dock; see http://seaport.findthedata.org/l/5429/Wrangell-Oil-Wrangell-Dock	moved loc		56.464623	-132.381572	1306952	931948	Marine
Diesel722992540139336PRINCE WILLIAM SOUND	Human Factors	Location not moved, placed one-half mile from NOAA location, see http://www.incidentnews.gov/incident/7777.	not moved		60.910933	-146.746183	391327	1235566	Marine
Gasoline722992540139336PRINCE WILLIAM SOUND	Human Factors	Duplicate location, different material.	not moved	Also NOAA. dup in	60.910933	-146.746183	391327	1235566	Marine
Multiple: diesel & gasoline769839360Ugashik Bay, AK				NOAA record	57.573300	-157.595000	0	0	Marine
Source water739993060439388WEST NORTH SLOPE	Other		not moved		70.526920	-150.168750	145384	2286742	Marine
Kerosene711993090139391Craig / Klawock area waters	Accident	Loc was inland, moved to Cape Decision. Duplicate location, different material.	moved loc	dup incid, dif substa	55.998296	-134.125147	1220185	849284	Marine
Propane (LPG)711993090139391Craig / Klawock area water	Accident	Moved location to Cape Decision.	moved loc		55.988084	-134.116345	1221045	848358	Marine
Bunker fuel711993250139407Tongass Narrows	Structural/Mechani	SE, no crit hab, lte 300 gal, so not checked	not moved	default loc SE	55.342369	-131.656341	1390454	828374	Marine
Multiple: diesel & hydraulic oil771739409George Inlet, SE Ala				NOAA record	55.455000	-131.478000	0	0	Marine
Diesel725993370239419AKUTAN CITY	Human Factors	Moved to larger dock in water in Akutan.	moved loc		54.129245	-165.783756	-767239	525491	Marine
Diesel725993510139433DUTCH HARBOR	Human Factors		not moved	lat/long not marine	53.875167	-166.537333	-821037	506734	Marine
Ammonia (anhydrous)725993560139438DUTCH HARBOR	Human Factors	Moved location to harbor; see Figure 2-3, http://dec.alaska.gov/water/wnpspc/protection_restoration/DutchIliuliuk/documents/06DutchHarborImpairmentAnalysis.pdf	moved loc		53.875532	-166.543915	-821456	506855	Marine
Jet fuel824990050139452WOMENS BAY	Human Factors		not moved	lat/long not marine	57.750000	-152.494000	89413	861812	Marine
Diesel811990160139463Sumner Strait	Human Factors		not moved		56.339167	-133.199833	1263457	902827	Marine
Diesel725990260239472CENTRAL CHAIN	Structural/Mechani	Moved location to Adak Harbor.	moved loc		51.859079	-176.616501	-1535988	469483	Marine
Drilling Muds839990340139481WEST NORTH SLOPE	Structural/Mechanical		not moved		70.526920	-150.168750	145384	2286742	Marine
Diesel824990400139487KODIAK CITY	Accident	Location was on land, moved to bay.	moved loc		57.821580	-152.348865	97829	870010	Marine
Diesel811990420339489PELICAN CITY	Structural/Mechanical		not moved		57.960000	-136.233000	1036196	1023695	Marine
Hydraulic oil825990450139492S.E. BERING SEA	Structural/Mechanical		not moved		56.500000	-169.100000	-920326	826354	Marine
Diesel811990480139495Craig / Klawock area waters	Accident	NOAA 7777 same spill, coordinates nearby. Pt. Ildefonso; see http://dec.alaska.gov/spar/perp/response/sum_fy08/080217101/080217101_sr_09.pdf	not moved	also NOAA	55.575710	-133.270990	1285410	820484	Marine
Diesel824990630339510KODIAK CITY	Human Factors	Location was in town, moved to petroleum marine dock; see google map.	moved loc		57.787435	-152.401655	94794	866121	Marine
Diesel825990830139530EASTERN CHAIN	Human Factors	NOAA 7796 same spill, coordintes nearby. see http://dec.alaska.gov/spar/perp/response/sum_fy08/080323201/080307201_index.htm.	not moved	also NOAA	53.883333	-169.983333	-1042598	555982	Marine
Jet fuel823990900139537COOK INLET	Human Factors		not moved		61.240300	-149.886100	219955	1257827	Marine
Diesel822991150139562PORT OF VALDEZ	Accident		not moved		61.126750	-146.430683	405530	1261447	Marine

ID	Cause Type	QC Note	Tag	Note	Lat_edited	Lon_edited	X_AlbersAK	Y_AlbersAK	Primary Media
Diesel825991570139604FALSE PASS	Structural/Mechanical		not moved		55.120000	-163.290000	-590706	608857	Marine
Bilge Oil822991720139619PRINCE WILLIAM SOUND	Unknown		not moved		60.738333	-147.543333	350340	1211912	Marine
Diesel811991850239632Tongass Narrows	Structural/Mechanical		not moved	default loc SE	55.342369	-131.656341	1390454	828374	Marine
Diesel785239636Glacier Bay, northern extremity				NOAA record	59.056700	-137.035000	0	0	Marine
Multiple: diesel, jet fuel & gasoline786239652Togiak, AK				NOAA record	59.050000	-160.333000	0	0	Marine
Diesel786939667Prince William Sd., Fleming Isl., Alaska				NOAA record	60.176300	-148.003000	0	0	Marine
Diesel811992310139678Kasaan Bay	Accident	NOAA 7874 same spill, coordinates nearby; see http://www.incidentnews.gov/incident/7874.	not moved	also NOAA	55.402000	-132.330667	1347886	820752	Marine
Diesel789839718Mekoryuk village beach, Nunivak Isl., AK				NOAA record	60.388700	-166.185000	0	0	Marine
Multiple: gasoline & lube oil790339728Wood River, SW Alask				NOAA record	59.270000	-158.583000	0	0	Marine
Diesel791139743100 mi w of Adak Is in Amchitka Pass				NOAA record	51.933300	-179.550000	0	0	Marine
Diesel811993160139763Tongass Narrows	Human Factors	Southeast, no critical habitat; spill less than or equal to 300 gal., so not checked.	not moved	lat/long not marine	55.359000	-131.333000	1409174	836937	Marine
Diesel794539817Aghiyuk Island, W. Gulf of Alaska				NOAA record	56.225900	-156.769000	0	0	Marine
Diesel923990150139828NORTH COOK INLET	Accident	NOAA 7950 same spill, coordinates nearby; see http://www.incidentnews.gov/incident/7950.	not moved	also NOAA	60.958167	-151.335000	143806	1222342	Marine
Other923990150139828NORTH COOK INLET	Accident	Duplicate location, different material.	not moved	dup incid, dif substa	60.958167	-151.335000	143806	1222342	Marine
Diesel925990290139842AKUTAN	Structural/Mechanic	Moved to larger dock in water in Akutan.	moved loc		54.129245	-165.783756	-767239	525491	Marine
Diesel911990300139843Chatham Strait South	Accident	Moved to NOAA 7962 coordinates; see http://dec.alaska.gov/spar/perp/response/sum_fy09/090130101/090130101_index.htm.	moved loc	also NOAA	55.140700	-131.568000	1403184	809038	Marine
Diesel923990440139857SEWARD CITY	Human Factors	Location was in city, moved to harbor.	moved loc		60.117568	-149.435444	252637	1134125	Marine
Multiple: diesel, lube oil & hydraulic oil798339869Akutan Isl.,		Duplicate record; see ADEC 09259905601.		NOAA record	54.216700	-165.967000	0	0	Marine
Diesel925990560139869AKUTAN CITY	Accident	Location not moved; see http://www.incidentnews.gov/incident/7983.	not moved	lat/long not marine	54.216667	-165.966667	-777278	537182	Marine
Multiple: diesel, lube oil & hydraulic oil798839877St. George				NOAA record	56.600000	-169.600000	0	0	Marine
Hydraulic oil939990800239893KUPARUK	Structural/Mechanical		not moved	lat/long not marine	70.416667	-148.883333	195005	2278001	Marine
Cook Inlet crude oil800039895Cook Inlet, Alaska				NOAA record	60.500000	-152.700000	0	0	
Diesel925991020139915CENTRAL CHAIN	Unknown	Location was on land, moved to Adak Harbor; see http://www.nrc.uscg.mil/reports/rwservlet?standard_web+inc_seq=902486.	moved loc		51.862888	-176.583345	-1533683	469114	Marine
Diesel911991070239920Clarence Strait North	Accident	Southeast, no critical habitat; spill less than or equal to 300 gal., so not checked.	not moved	default loc SE	56.008165	-132.839065	1296193	874698	Marine
Diesel923991170139930SEWARD CITY	Structural/Mechanical		not moved	lat/long not marine	60.108333	-149.441667	252364	1133071	Marine
Gasoline923991470139960KENAI GAS FIELD	Accident	NOAA 8028 same spill, coordinates nearby. See http://dec.alaska.gov/spar/perp/response/sum_fy09/090527201/090527201_index.htm.	not moved	also NOAA	60.672667	-151.409000	141061	1190276	Marine
Diesel926991560139969BRISTOL BAY UNKNOWN	Human Factors		No coords	WGS84 (Google Ea	58.660727	-158.463740	0	0	Marine
Black algae804640004Kuk River near Wainright, AK				NOAA record	70.500000	-160.500000	0	0	Marine
Diesel911992140140027Port Frederick	Structural/Mechanic	Southeast, no critical habitat; spill less than or equal to 300 gal., so not checked.	not moved	lat/long not marine	58.100600	-135.446100	1076584	1051336	Marine
Diesel925992150140028SAINT PAUL IS.	Human Factors	Moved location south of Saint Paul Island per facility name.	moved loc		57.122542	-170.303131	-975350	911062	Marine
Diesel911992160140029Tongass Narrows	Unknown		not moved	default loc SE	55.342369	-131.656341	1390454	828374	Marine
Diesel911992200140033Chatham Strait North	Accident		not moved	default loc SE	57.869254	-134.823990	1119049	1036812	Marine
Anhydrous ammonia & chlorine808640045Pelican, AK				NOAA record	57.956700	-136.222000	0	0	Marine
Multiple: gasoline & jet fuel809740072Quinhagak, Alaska				NOAA record	59.750000	-161.917000	0	0	Marine
Ammonia (anhydrous)926992670140080CHIGNIK CITY	Human Factors	Duplicate location; different material.	not moved	dup incid, dif substa	57.047367	-156.527100	-152998	785259	Marine
Diesel926992670140080CHIGNIK CITY	Human Factors	Location within edge of generalized map layer; island very close, location not moved; too little information to refine further.	not moved	lat/long not marine	57.047367	-156.527100	-152998	785259	Marine
Used Oil (all types)926992670140080CHIGNIK CITY	Human Factors	Duplicate location, different material.	not moved	dup incid, dif substa	57.047367	-156.527100	-152998	785259	Marine
Diesel911992830140096Sitka Sound	Human Factors		not moved		56.983333	-135.720000	1095007	926863	Marine
Diesel812740100Sand Point, Alaska				NOAA record	55.365000	-160.521000	0	0	Marine
Diesel925993030140116EASTERN CHAIN	Accident	ADEC and NOAA coordinates identical. See http://incidentnews.gov/incident/8141.	not moved	also NOAA	53.900000	-166.100000	-792221	504134	Marine
Diesel814440122Unimak Isl., E. Aleutians, Alaska				NOAA record	55.283300	-164.133000	0	0	Marine
Diesel922993510140164VALDEZ	Human Factors	Location is in enclosed harbor; appears to be on land in generalized map layer.	not moved	lat/long not marine	61.126450	-146.340767	410330	1261966	Marine
Diesel922993570140170BLIGH IS.	Accident	NOAA 8166 same spill, coordinates nearby; see http://dec.alaska.gov/spar/perp/response/sum_fy10/091223201/091223201_index.htm.	not moved	also NOAA	60.839833	-146.882333	384861	1226865	Marine
Diesel817540189Adak Island, Aleutian Isls, Alaska		Duplicate record; see ADEC 10259901101.		NOAA record	51.863100	-176.639000	0	0	Marine
Diesel1025990110140189WESTERN CHAIN	Human Factors	Location not moved; see http://dec.alaska.gov/spar/perp/response/sum_fy10/100111201/100111201_index.htm.	not moved	lat/long not marine	51.850000	-176.668167	-1539696	469733	Marine
Diesel1011990220140200Holkham Bay Area	Accident		not moved		57.792348	-133.707775	1184790	1047959	Marine
Corrosion Inhibitor1025990370140215DUTCH HARBOR	Structural/Mechanical		not moved		53.890333	-166.551000	-821605	508558	Marine
Diesel1022991100140288Middleton Island	Accident	See http://www.docstoc.com/docs/115872752/FV_Northern_Belle; 59ª10'1.20"N, 146ª46'58.80"W last reported coordinates.	No coords	WGS84 (Google Ea	59.166998	-146.782978	0	0	Marine
Diesel1022991390140317MONTAGUE ISLAND	Accident		not moved		59.750000	-147.866667	343041	1100185	Marine
Diesel1011991400140318Sitka Sound	Accident		not moved		57.097300	-135.487100	1105097	942956	Marine
Propylene glycol1011991530140331Juneau / Douglas	Human Factors		not moved	lat/long not marine	58.357300	-134.489133	1122240	1094691	Marine

ID	Cause Type	QC Note	Tag	Note	Lat_edited	Lon_edited	X_AlbersAK	Y_AlbersAK	Primary Media
DieselNOAA ID 82340385PRINCE WILLIAM SOUND	Human Factors	NOAA coordinates, see http://incidentnews.gov/incident/8239, http://dec.alaska.gov/spar/perp/response/sum_fy11/100727201/100727201_index.htm.	No coords	WGS84 (Google Ea	60.530359	-148.063175	0	0	Marine
Diesel1026992260140404NUSHAGAK	Accident	Moved location to Nushagak Bay per Address 1; facility name misspelled.	moved loc		58.600833	-158.641333	-268722	965254	Marine
Diesel1011992390140417Wrangell Narrows	Human Factors	Location was in city, moved to Wrangell Narrows near Petersburg.	moved loc		56.773817	-132.969757	1261866	953303	Marine
Diesel1011992630140441Sitka Sound	Human Factors		not moved		56.995717	-135.444517	1110699	932767	Marine
Multiple: diesel, lube oil & IFO82754051570nm North of Adak				NOAA record	52.740300	-176.138000	0	0	Marine
Diesel1011993420140520Craig / Klawock area waters	Other		not moved		54.452520	-133.260620	1324449	701694	Marine
Diesel828340568Latouche Isl, Prince William Sound, Alaska				NOAA record	60.079300	-147.862000	0	0	Marine
Diesel829040582Unalaska Isl., Aleutian Isl., Alaska				NOAA record	53.433300	-167.383000	0	0	Marine
Diesel1125990390140582EASTERN CHAIN	Accident	Moved location to NOAA coordinates see http://incidentnews.gov/incident/8290.	moved loc		53.433300	-167.383000	-885515	469447	Marine
Hydraulic oil1125990390140582EASTERN CHAIN	Accident	Duplicate location, different material.	not moved	dup incid, dif substa	53.433300	-167.383000	-879334	448559	Marine
Diesel1124990420140585SHELIKOF STRAIT	Human Factors	Moved to NOAA 8291 coordinates; see http://dec.alaska.gov/spar/perp/response/sum_fy11/110211201/110211201_index.htm.	moved loc	also NOAA	58.272700	-153.094000	52997	919553	Marine
Hydraulic oil1124990420140585SHELIKOF STRAIT	Human Factors	Duplicate location, different material.	moved loc	dup incid, dif substa	58.272700	-153.094000	52997	919553	Marine
Diesel1123990460240589WHITTIER CITY	Other	Database listed subarea as Cook Inlet, but changed to reflect actual location in the Prince William Sound watershed.	not moved		60.778080	-148.691500	287833	1210824	Marine
Diesel1125990460140589UNALASKA	Human Factors	Location moved to Captain's Bay, Dutch Harbor; see http://www.offshoresystemsinc.com.	moved loc		53.842658	-166.589038	-825063	503827	Marine
Multiple: diesel, lube oil & hydraulic oil829540608King Cove,				NOAA record	55.025200	-162.224000	0	0	Marine
Diesel1111990830140626Tongass Narrows	Structural/Mechanical		not moved		55.345010	-131.658950	1390201	828597	Marine
Ethylene Glycol (Antifreeze)1122991100140653VALDEZ MAI	Structural/Mechanic	Location not moved, matches maps.	not moved		61.092983	-146.409605	407085	1257824	Marine
Multiple: diesel, lube oil, hydraulic oil, gasoline & waste oil832				NOAA record	58.745000	-160.881667	0	0	Marine
Gasoline1122991500140693Gulf of Alaska	Accident		not moved		60.172500	-145.111667	490048	1164426	Marine
Diesel1125991770140720S.E. BERING SEA	Human Factors	NOAA 8329 same spill, coordinates nearby; see http://www.incidentnews.gov/incident/8329.	not moved	also NOAA	56.800000	-167.383333	-810511	836688	Marine
Diesel1122991840140727PRINCE WILLIAM SOUND	Accident		not moved		60.963167	-146.754500	390244	1241325	Marine
Diesel1122991870140730Gulf of Alaska	Human Factors	NOAA 8331 same spill, coordinates nearby; see http://www.incidentnews.gov/incident/8331.	not moved	also NOAA	59.923333	-148.450000	308877	1116631	Marine
Diesel1125991880240731DUTCH HARBOR	Human Factors	Location appears to be on land in generalized map layer.	moved loc		53.842658	-166.589038	-825063	503827	Marine
Diesel1111991910140734Tongass Narrows	Human Factors	Location was listed as in middle of island, so moved to intersection of Nichols Passage and Tongass Narrows.	moved loc		55.296979	-131.576040	1396935	825289	Marine
Diesel1122992180140761PRINCE WILLIAM SOUND	Accident	Location appears to be on land in generalized map layer.	not moved		60.602350	-145.792683	446774	1207301	Marine
Diesel1111992290140772Chatham Strait North	Accident		not moved		57.717140	-134.816670	1124304	1020649	Marine
Diesel1124992400140783KODIAK CITY	Human Factors	Moved location from city to adjacent harbor, near St Herman's Seminary, per Google Maps.	moved loc		57.788099	-152.399972	94892	866197	Marine
Lube oil1124992400140783KODIAK CITY	Human Factors	Duplicate location, different material.	moved loc		57.788099	-152.399972	94892	866197	Marine
Diesel1138992530140796NOME CITY	Accident	Location placed in harbor entry.	No coords	WGS84 (Google Ea	64.498612	-165.431364	0	0	Marine
Jet fuel836140807Diomede Islands, AK				NOAA record	65.785278	-168.978333	0	0	Marine
Diesel1124992640140807AFOGNAK IS.	Other		not moved		58.454750	-152.687417	76375	940289	Marine
Bunker fuel1125992710140814CENTRAL CHAIN	Structural/Mechanical		moved loc		53.540000	-166.314800	-813498	467411	Marine
Diesel1111992790140822Chatham Strait North	Human Factors		not moved	default loc SE	57.869254	-134.823990	1119049	1036812	Marine
Multiple: diesel & bunker C837940882Aleutian Islands, Alask				NOAA record	52.346667	-178.610000	0	0	Marine
Multiple: diesel & jet fuel838540895NE Gulf of Alaska				NOAA record	58.460000	-138.365000	0	0	Marine
Multiple: diesel & gasoline838940898Winter fuel delivery to N				NOAA record	64.490678	-165.446006	0	0	Marine
Diesel1211990230140931Tongass Narrows	Other	Southeast, no critical habitat; spill less than or equal to 300 gal., so not checked.	not moved	lat/long not marine	55.399020	-131.725400	1384242	832889	Marine
Diesel1211990230240931Tongass Narrows	Structural/Mechanic	Southeast, no critical habitat; spill less than or equal to 300 gal., so not checked.	not moved	default loc SE	55.342369	-131.656341	1390454	828374	Marine
Multiple: diesel, lube oil, hydraulic fluid & antifreeze83994093				NOAA record	57.550000	-155.000000	0	0	Marine
Diesel1224990250140933KODIAK UNKNOWN	Accident		not moved		56.850000	-154.200000	-12178	760340	Marine
Diesel1225990570140965EASTERN CHAIN	Accident		not moved		53.462500	-168.359167	-948434	486098	Marine
Diesel1223990600140968SOUTH COOK INLET	Structural/Mechanical		not moved		60.038333	-151.874667	117988	1118466	Marine
Diesel1211990630140971Juneau / Douglas	Structural/Mechanical		not moved	lat/long not marine	58.398217	-134.751383	1106277	1094670	Marine
Diesel1224991600141068CHINIAK CDP	Accident	NOAA 8460 same spill, coordinates nearby; see http://dec.alaska.gov/spar/perp/response/sum_fy12/120608201/120608201_index.htm	not moved	also NOAA	57.756000	-152.432000	93077	862568	Marine
Diesel1223991660341074HOMER CITY	Structural/Mechanical		not moved		59.600000	-151.420000	145121	1070379	Marine
Diesel1224991700141078SHELIKOF STRAIT	Human Factors	Location placed in center of bay.	No coords	WGS84 (Google Ea	57.567777	-153.906090	0	0	Marine
Ammonia847441096Dutch Harbor, AK				NOAA record	53.900000	-166.541667	0	0	Marine
Diesel848441117Cape Chacon, SE Alaska				NOAA record	54.633583	-132.072233	0	0	Marine
Diesel1211992110141119Clarence Strait South	Accident	Moved to NOAA 8485 coordinates; see http://incidentnews.gov/incident/8485.	moved loc	also NOAA	54.831667	-131.928333	1392711	768964	Marine

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Used Oil (all types)9511990120134711Portland Canal	Gallons	1/12/1995	1/12/1995	Primary Responsible Party	56.968540	-133.924975	0.5	784
Diesel707734715Dixon Entrance, southeast Alaska	Gallons				0.000000	0.000000	26.0	41891
Diesel9511990540134753Tongass Narrows	Gallons	2/23/1995	3/7/1995	Primary Responsible Party	55.342369	-131.656341	0.0	0
Diesel9511991110134810Tongass Narrows	Gallons	4/21/1995	9/29/1995	Primary Responsible Party	55.342369	-131.656341	0.1	189
Diesel709934865Kupreanof Island, Alaska	Gallons				0.000000	0.000000	0.3	528
Other9511011740134873Lynn Canal South	Gallons	6/23/1995	9/29/1995	Primary Responsible Party	58.527688	-134.930563	2.1	3405
Diesel9527991860134885Eek	Gallons	7/5/1995	9/11/1998	Primary Responsible Party	60.166667	-162.333333	0.0	0
Diesel9511991980134897Chatham Strait North	Gallons	7/17/1995	9/29/1995	Primary Responsible Party	57.869254	-134.823990	3.8	6179
Diesel9525992030234902CENTRAL CHAIN	Gallons	7/22/1995	8/1/1995	Primary Responsible Party	52.000000	-174.000000	0.0	0
Diesel710634904Sequam Island, Aleutian Island chain, Alask	Gallons				0.000000	0.000000	0.0	0
Diesel9511992210234920Dixon Entrance	Gallons	8/9/1995	8/10/2000	Primary Responsible Party	54.530634	-132.653073	1.7	2701
Other9525992220134921AKUTAN	Gallons	8/10/1995	9/7/1995	Primary Responsible Party	52.000000	-174.000000	0.0	74
Diesel9524992230134922KODIAK UNKNOWN	Gallons	8/11/1995	11/2/1995	Primary Responsible Party	57.587058	-153.095559	0.1	195
Diesel9511992340134933Wrangell Narrows	Gallons	8/22/1995	8/22/1995	Primary Responsible Party	56.773998	-132.861616	0.2	319
Gasoline9511992470134946Tongass Narrows	Gallons	9/4/1995	9/29/1995	Primary Responsible Party	55.342369	-131.656341	0.0	0
Hydraulic oil9525992480234947DUTCH HARBOR	Gallons	9/5/1995	10/23/1995	Primary Responsible Party	52.000000	-174.000000	0.4	709
Other9523992500534949PASSAGE CANAL	Gallons	9/7/1995	10/30/1998	Primary Responsible Party	60.783333	-148.350000	0.0	63
Diesel9511992510234950Chichagof Island NOS	Gallons	9/8/1995	9/8/1995	Primary Responsible Party	57.869254	-134.823990	3.8	6179
Diesel9525992690134968EASTERN CHAIN	Gallons	9/26/1995	10/23/1995	Primary Responsible Party	52.000000	-174.000000	0.2	277
Jet fuel9524992830134982KODIAK CITY	Gallons	10/10/1995	11/21/1995	Primary Responsible Party	57.788889	-152.402778	0.1	128
Diesel9525992880134987EASTERN CHAIN	Gallons	10/15/1995	10/23/1995	Primary Responsible Party	52.000000	-174.000000	0.2	361
Diesel9525992900134989CENTRAL CHAIN	Gallons	10/17/1995	6/15/1996	Primary Responsible Party	52.000000	-174.000000	0.2	361
Diesel9511992990234998Sumner Strait	Gallons	10/26/1995	10/26/1995	Primary Responsible Party	56.296338	-133.632250	0.3	470
Gasoline9511993100135009Tongass Narrows	Gallons	11/6/1995	11/6/1995	Primary Responsible Party	55.342369	-131.656341	0.0	0
Diesel9511993320135031Sumner Strait	Gallons	11/28/1995	11/28/1995	Primary Responsible Party	55.703135	-132.889001	0.5	769
North Slope crude711635038Nikiski, Alaska					0.000000	0.000000	0.9	1516
Gasoline9611990050135069Clarence Strait North	Gallons	1/5/1996	1/5/1996	Primary Responsible Party	55.703135	-132.889001	0.2	346
Diesel9624990250135089KODIAK UNKNOWN	Gallons	1/25/1996	10/30/1996	Primary Responsible Party	57.587058	-153.095559	2.0	3147
Diesel9624990310135095OUZINKIE CITY	Gallons	1/31/1996	3/22/1996	Primary Responsible Party	57.925000	-152.497222	0.3	528
Bunker fuel9625990510135115SAINT PAUL IS.	Gallons	2/20/1996	5/30/1996	Primary Responsible Party	57.122222	-170.275000	0.1	100
Unknown9611990680135132Wrangell area waters	Gallons	3/8/1996	3/8/1996	Primary Responsible Party	56.476860	-132.379532	0.2	318
Diesel9624990950135159CHINIAK CDP	Gallons	4/4/1996	6/1/1996	Primary Responsible Party	57.626389	-152.150000	0.7	1166
Diesel9611991010135165Dixon Entrance	Gallons	4/10/1996	4/10/1996	Primary Responsible Party	54.530634	-132.653073	9.2	14814
Diesel9624991070135171KODIAK UNKNOWN	Gallons	4/16/1996	12/31/1996	Primary Responsible Party	57.587058	-153.095559	0.3	406
Diesel9625991160235180EASTERN CHAIN	Gallons	4/25/1996	6/28/1996	Primary Responsible Party	52.000000	-174.000000	0.2	331
Lead-based paint713935196Unalaska, Alaska	Gallons				0.000000	0.000000	0.0	0
Jet fuel9611991390135203Tongass Narrows	Gallons	5/18/1996	9/29/1996	Primary Responsible Party	55.342369	-131.656341	0.0	0
Diesel9623991510135215KENAI CITY	Gallons	5/30/1996	5/14/1997	Primary Responsible Party	60.550000	-151.266667	0.1	153
Diesel9625991570235221CENTRAL CHAIN	Gallons	6/5/1996	6/11/1996	Primary Responsible Party	52.000000	-174.000000	3.1	4914
Diesel714235224Juneau, Alaska	Gallons				0.000000	0.000000	0.0	0
Diesel9625991820135246CENTRAL CHAIN	Gallons	6/30/1996	12/31/1996	Primary Responsible Party	52.000000	-174.000000	0.2	331
Other9611992020135266Chatham Strait North	Gallons	7/20/1996	8/1/1996	Primary Responsible Party	57.869254	-134.823990	3.8	6179
Diesel9611992080135272Dixon Entrance	Gallons	7/26/1996	7/29/1996	Primary Responsible Party	54.530634	-132.653073	9.2	14814
Diesel9611992090135273Tongass Narrows	Gallons	7/27/1996	9/29/1996	Primary Responsible Party	55.342369	-131.656341	0.0	0
Diesel9611992120135276Tongass Narrows	Gallons	7/30/1996	9/29/1997	Primary Responsible Party	55.342369	-131.656341	0.0	0

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Diesel9622992150235279EVANS ISLAND	Gallons	8/2/1996	9/1/1996	Primary Responsible Party	60.050000	-148.066667	0.2	334	
Diesel9623992200135284WHITTIER	Gallons	8/7/1996	12/31/1996	Primary Responsible Party	60.775000	-148.683333	0.1	91	
Used Oil (all types)9623992270135291HOMER CITY	Gallons	8/14/1996	9/15/1996	Primary Responsible Party	59.644444	-151.550000	0.2	329	
Diesel9611992300135294Sitka Sound	Gallons	8/17/1996	8/17/1996	Primary Responsible Party	57.054329	-135.317719	0.4	690	
Diesel9625992450135309KING COVE CITY	Gallons	9/1/1996	9/11/1996	Primary Responsible Party	55.055556	-161.316667	0.1	100	
Ammonia (anhydrous)9625992490135313EASTERN CHAIN	Gallons	9/5/1996	9/13/1996	Primary Responsible Party	52.000000	-174.000000	0.1	100	0.062137
Diesel9611992780135342Gastineau Channel	Gallons	10/4/1996	10/7/1996	Primary Responsible Party	58.302914	-134.404008	0.1	101	
Ammonia (anhydrous)9625992860135350EASTERN CHAIN	Gallons	10/12/1996	11/13/1996	Primary Responsible Party	52.000000	-174.000000	0.5	882	
Optimer 7128 cation flocculant, or ethyl oxylated alcohol7156	Gallons				0.000000	0.000000	0.4	668	
Diesel9625992980235362EASTERN CHAIN	Gallons	10/24/1996	4/7/1997	Primary Responsible Party	52.000000	-174.000000	3.2	5071	
Used Oil (all types)9611993190135383Gastineau Channel	Gallons	11/14/1996	12/15/1996	Primary Responsible Party	58.325754	-135.905518	3.7	5906	
Diesel9622993200135384HINCHINBROOK IS.	Gallons	11/15/1996	1/15/1997	Primary Responsible Party	60.383333	-146.466667	0.4	582	
Jet fuel9624993520135416KODIAK CITY	Gallons	12/17/1996	1/8/1997	Primary Responsible Party	57.788889	-152.402778	0.1	128	
Multiple: diesel & bunker C717435424Aleutian Island chain, A	Gallons				0.000000	0.000000	72.2	116197	
Diesel9711990020135432Portland Canal	Gallons	1/2/1997	1/2/1997	Primary Responsible Party	56.968540	-133.924975	0.0	0	
Diesel9711990420135472Portland Canal	Gallons	2/11/1997	2/11/1997	Primary Responsible Party	56.968540	-133.924975	0.0	0	
Diesel719035480Akun Island, Aleutian Island Chain, Alaska	Gallons				0.000000	0.000000	0.2	350	
Other9711990560235486Tongass Narrows	Gallons	2/25/1997	2/25/1997	Primary Responsible Party	55.342369	-131.656341	0.0	0	
Diesel9725990950135525AKUTAN CITY	Gallons	4/5/1997	4/10/1997	Primary Responsible Party	54.134722	-165.772222	0.0	74	
Used Oil (all types)9723991130235543PASSAGE CANAL	Gallons	4/23/1997	9/30/1997	Primary Responsible Party	60.783333	-148.350000	0.0	63	
Bunker fuel720135560George Inlet, Ketchikan, Alaska	Gallons				0.000000	0.000000	0.0	0	
Diesel9726991390135569BRISTOL BAY	Gallons	5/19/1997	5/21/1997	Primary Responsible Party	58.000000	-160.000000	5.0	8106	
Diesel9726991420235572LEVELOCK CDP	Gallons	5/22/1997	10/1/1997	Primary Responsible Party	59.116667	-156.850000	0.0	0	
Diesel9725991520135582EASTERN CHAIN	Gallons	6/1/1997	6/6/1997	Primary Responsible Party	52.000000	-174.000000	0.3	562	
Other9711991590235589Gastineau Channel	Gallons	6/8/1997	6/9/1997	Primary Responsible Party	58.302914	-134.404008	0.0	55	
Diesel9711991770135606Clarence Strait North	Gallons	6/25/1997	10/21/1997	Primary Responsible Party	55.659190	-132.524692	0.0	0	
Diesel9711991800335610Revillagigedo Channel	Gallons	6/29/1997	6/30/1997	Primary Responsible Party	55.010777	-131.107740	4.0	6434	
Diesel9711991960435626Hobart Bay	Gallons	7/15/1997	7/17/1997	Primary Responsible Party	57.845689	-133.850293	2.5	4035	
Diesel9722992020135632P.W.S. UNKNOWN	Gallons	7/21/1997	8/13/1997	Primary Responsible Party	60.447599	-147.029227	0.1	183	
Diesel9725992110135641ALEUTIAN E. UNKNOWN	Gallons	7/30/1997	8/12/1997	Primary Responsible Party	55.050103	-162.828792	0.3	435	
Diesel9723992200135650SOUTH COOK INLET	Gallons	8/8/1997	7/17/1998	Primary Responsible Party	59.000000	-153.000000	1.6	2625	
Diesel9726992240135654KING SALMON CDP	Gallons	8/12/1997	11/5/1997	Primary Responsible Party	58.691667	-156.658333	0.0	0	
Diesel9711992260235656Tongass Narrows	Gallons	8/14/1997	8/28/1997	Primary Responsible Party	55.342369	-131.656341	0.0	0	
Asphalt emulsion722335661Haines, Alaska	Gallons				0.000000	0.000000	0.2	386	
Diesel9739992330135663BARROW CITY	Gallons	8/21/1997	8/14/1998	Primary Responsible Party	71.291667	-156.787500	0.5	802	
Diesel9724992420135672KODIAK CITY	Gallons	8/30/1997	9/25/1997	Primary Responsible Party	57.788889	-152.402778	0.1	120	
Diesel9725992510135681DUTCH HARBOR	Gallons	9/8/1997	9/15/1998	Primary Responsible Party	52.000000	-174.000000	1.5	2471	
Diesel9711992680235698Cape Edgecumbe to Icy Bay	Gallons	9/25/1997	9/26/1997	Primary Responsible Party	59.439140	-139.563049	2.3	3716	
Diesel9724992680135698KODIAK CITY	Gallons	9/25/1997	9/29/1997	Primary Responsible Party	57.788889	-152.402778	2.1	3401	
Bilge Oil9725992680235698EASTERN CHAIN	Gallons	9/25/1997	4/1/1998	Primary Responsible Party	52.000000	-174.000000	0.2	361	
Ammonia (anhydrous)9711992770135707Cordova Bay	Gallons	10/4/1997	10/20/1997	Primary Responsible Party	55.361798	-131.599153	3.6	5806	
Bilge Oil9711993080235738Tongass Narrows	Gallons	11/4/1997	11/5/1997	Primary Responsible Party	55.342369	-131.656341	0.0	0	
Ethylene Glycol (Antifreeze)9739993250135755BEAUFORT	Gallons	11/21/1997	12/11/1997	Primary Responsible Party	70.560481	-147.201134	12.9	20698	
IFO-380501135760Unalaska Island, Alaska	Gallons				0.000000	0.000000	0.0	0	
Bunker fuel9725993300135760EASTERN CHAIN	Gallons	11/26/1997	7/15/1998	Primary Responsible Party	52.000000	-174.000000	0.0	0	
Gasoline9724993370135767KODIAK CITY	Gallons	12/3/1997	3/25/1998	Primary Responsible Party	57.788889	-152.402778	0.1	210	

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Gasoline9711993430135773Sitka Sound	Gallons	12/9/1997	12/24/1997	Primary Responsible Party	57.054329	-135.317719	0.2	250
Diesel9711993440135774Sitka Sound	Gallons	12/10/1997	12/31/1997	Primary Responsible Party	57.054329	-135.317719	0.2	250
Ammonia725235788Wrangell, Alaska	Gallons				0.000000	0.000000	0.1	225
Diesel9811990180135813Gastineau Channel	Gallons	1/18/1998	2/4/1998	Primary Responsible Party	58.000000	-134.000000	1.6	2643
Diesel9824990660135861KODIAK CITY	Gallons	3/7/1998	8/10/1998	Primary Responsible Party	57.788889	-152.402778	0.1	128
Used Oil (all types)9811990790135874Portland Canal	Gallons	3/20/1998	4/16/1998	Primary Responsible Party	56.968540	-133.924975	0.0	0
Gasoline9811990820835877Portland Canal	Gallons	3/23/1998	3/25/1998	Primary Responsible Party	56.968540	-133.924975	0.0	0
Diesel9822990830135878PORT OF VALDEZ	Gallons	3/24/1998	4/11/1998	Primary Responsible Party	61.083333	-146.650000	0.6	1018
Diesel9811981060235901Tongass Narrows	Gallons	4/16/1998	4/17/1998	Primary Responsible Party	55.342369	-131.656341	0.0	0
Diesel9811991070135902Tenakee Inlet	Gallons	4/17/1998	4/27/1998	Primary Responsible Party	57.806183	-135.371035	0.4	605
Diesel9826991130135908CHIGNIK CITY	Gallons	4/23/1998	4/23/1998	Primary Responsible Party	56.300000	-158.400000	0.4	588
Diesel9811981480235943Tongass Narrows	Gallons	5/28/1998	5/30/1998	Primary Responsible Party	55.361778	-131.710974	0.0	0
Diesel9822991480135943CULROSS IS.	Gallons	5/28/1998	6/1/1998	Primary Responsible Party	60.716667	-148.150000	1.0	1590
Diesel9811991500235945Glacier Bay	Gallons	5/30/1998	6/15/1998	Primary Responsible Party	58.691242	-136.108171	3.8	6069
Diesel9822991520235947CORDOVA	Gallons	6/1/1998	6/1/1998	Primary Responsible Party	60.550000	-145.750000	1.2	1867
Lube oil9811991620135957Lynn Canal South	Gallons	6/11/1998	6/20/1998	Primary Responsible Party	58.699900	-135.097722	3.1	4998
Diesel9811991750135970Stephens Passage South	Gallons	6/24/1998	7/3/1998	Primary Responsible Party	57.845689	-133.850293	2.5	4035
Ammonia731235977Homer, Alaska	Gallons				0.000000	0.000000	0.0	0
Other9827991890135984St. Matthew Island	Gallons	7/8/1998	8/15/1999	Primary Responsible Party	62.316750	-164.125812	3.6	5744
Diesel9811991910235986Gastineau Channel	Gallons	7/10/1998	7/15/1998	Primary Responsible Party	58.302914	-134.404008	0.1	101
Hydraulic oil9811991970135992Tongass Narrows	Gallons	7/16/1998	12/24/1998	Primary Responsible Party	55.342369	-131.656341	0.0	0
Diesel9811991990135994Icy Strait	Gallons	7/18/1998	7/20/1998	Primary Responsible Party	58.273949	-135.566870	3.6	5736
Gasoline9823992000135995HOMER CITY	Gallons	7/19/1998	7/31/1998	Primary Responsible Party	59.644444	-151.550000	0.2	329
Diesel9811992150136010Sitka Sound	Gallons	8/3/1998	9/30/1998	Primary Responsible Party	57.054329	-135.317719	0.0	24
Diesel9825992240136019CENTRAL CHAIN	Gallons	8/12/1998	8/13/1998	Primary Responsible Party	52.000000	-174.000000	0.2	331
Diesel9827992270136022Napakiak	Gallons	8/15/1998	4/1/1999	Primary Responsible Party	60.281389	-163.142608	0.0	0
Diesel9811992310336026Chatham Strait North	Gallons	8/19/1998	8/30/1998	Primary Responsible Party	57.288708	-134.419805	0.3	517
Diesel732436039Womens Bay, Kodiak, Alaska	Gallons				0.000000	0.000000	0.0	0
Diesel732536039Womens Bay, Kodiak, Alaska	Gallons				0.000000	0.000000	0.0	0
Unknown9811992650136060Lynn Canal South	Gallons	9/22/1998	9/25/1998	Primary Responsible Party	58.488479	-134.778396	0.0	0
Diesel733936062Alaska Peninsula	Gallons				0.000000	0.000000	0.0	0
Other9811992670336062Gastineau Channel	Gallons	9/24/1998	9/25/1998	Primary Responsible Party	58.274850	-134.386094	0.0	0
Diesel9823992690136064CENTRAL COOK INLET	Gallons	9/26/1998	10/15/1998	Primary Responsible Party	60.000000	-152.000000	1.4	2221
Diesel9811992780136073Cross Sound	Gallons	10/5/1998	10/13/1998	Primary Responsible Party	58.186246	-136.336824	0.0	0
Diesel9811992850136080Glacier Bay	Gallons	10/12/1998	11/27/1998	Primary Responsible Party	58.691242	-136.108171	3.8	6069
Other9811993030236098Taiya Inlet	Gallons	10/30/1998	11/16/1998	Primary Responsible Party	59.447100	-135.328400	0.3	443
Diesel9811993130136108Gastineau Channel	Gallons	11/9/1998	12/24/1998	Primary Responsible Party	58.302914	-134.404008	0.1	101
Diesel9811983140136109Tongass Narrows	Gallons	11/10/1998	11/10/1998	Primary Responsible Party	55.342369	-131.656341	0.0	0
Diesel9811993160236111Sitka Sound	Gallons	11/12/1998	1/9/1999	Primary Responsible Party	57.054329	-135.317719	0.1	137
Diesel9822993580136153VALDEZ	Gallons	12/24/1998	1/25/1999	Primary Responsible Party	61.116667	-146.266667	0.0	0
Diesel9911990060136166Gastineau Channel	Gallons	1/6/1999	1/9/1999	Primary Responsible Party	58.302914	-134.404008	0.1	101
Crude9923990370136197CENTRAL COOK INLET	Gallons	2/6/1999	7/14/1999	Primary Responsible Party	60.000000	-152.000000	2.0	3160
Multiple: diesel, lube oil & bunker C738736210Dutch Harbor,	Gallons				0.000000	0.000000	0.0	0
Diesel9925990510136211AKUTAN	Gallons	2/20/1999	3/5/1999	Primary Responsible Party	54.209250	-166.374072	0.0	74
Diesel9911981040136264Tongass Narrows	Gallons	4/14/1999	4/21/1999	Primary Responsible Party	55.361778	-131.710974	0.0	0
Bilge Oil9925991110136271SAND POINT	Gallons	4/21/1999	4/21/1999	Primary Responsible Party	54.593056	-160.810647	0.3	435
Diesel9911981180136278Tongass Narrows	Gallons	4/28/1999	4/28/1999	Primary Responsible Party	55.342369	-131.656341	0.0	0
Ammonia (anhydrous)9925991260136286ADAK	Gallons	5/6/1999	8/15/1999	Primary Responsible Party	52.435044	-177.090139	0.0	0
Diesel9925991280136288CENTRAL CHAIN	Gallons	5/8/1999	10/22/1999	Primary Responsible Party	52.000000	-174.000000	0.5	825
Lube oil9925991300136290COLD BAY	Gallons	5/10/1999	1/25/2001	Primary Responsible Party	55.325925	-162.783333	0.2	289

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Diesel9911981370136297Craig / Klawock area waters	Gallons	5/17/1999	5/17/1999	Primary Responsible Party	55.208956	-132.817397	0.4	572
Diesel9923991570136317EAST KENAI UNKNOWN	Gallons	6/6/1999	9/8/2000	Primary Responsible Party	60.526797	-149.374407	7.1	11488
Multiple: diesel & engine room slops740636323Dundas Bay,	Gallons				0.000000	0.000000	0.2	248
Diesel9911991630136323Glacier Bay	Gallons	6/12/1999	5/1/2000	Primary Responsible Party	58.691242	-136.108171	0.2	248
Gasoline9927991660136326Nunam Iqua (Sheldon Point)	Gallons	6/15/1999	6/29/1999	Primary Responsible Party	62.533333	-164.866667	0.0	0
Diesel9911991670136327Sumner Strait	Gallons	6/16/1999	6/22/1999	Primary Responsible Party	56.396415	-133.712800	0.2	276
Diesel741136342Sitka Sound	Gallons				0.000000	0.000000	2.4	3810
Diesel9923991900536350HOMER CITY	Gallons	7/9/1999	7/12/1999	Primary Responsible Party	59.644444	-151.550000	1.9	3135
Diesel9924991930136353KODIAK CITY	Gallons	7/12/1999	7/15/1999	Primary Responsible Party	57.788889	-152.402778	0.0	0
Diesel9911991940136354Lynn Canal South	Gallons	7/13/1999	8/15/1999	Primary Responsible Party	58.699900	-135.097722	3.1	4998
Multiple: diesel & lube oil742136368Tracey Arm, southeast A	Gallons				0.000000	0.000000	0.0	0
Diesel742236368Tracy Arm, AK	Gallons				0.000000	0.000000	0.4	674
Diesel9911992260136386<Null>	Gallons	8/14/1999	8/16/1999	Primary Responsible Party	55.703135	-132.889001	1.8	2860
Other9922992390136399PRINCE WILLIAM SOUND	Gallons	8/27/1999	8/29/1999	Primary Responsible Party	60.615002	-147.168106	0.3	472
Diesel9911992430236403Annette Island	Gallons	8/31/1999	9/9/1999	Primary Responsible Party	55.042123	-131.585761	0.8	1262
Diesel9924992620136422OLD HARBOR CITY	Gallons	9/19/1999	11/30/1999	Primary Responsible Party	57.204167	-153.300000	0.2	267
Fuel oil743536433Just offshore, village of Mekoryuk, N side N	Gallons				0.000000	0.000000	0.1	148
Middle Ground Shoal crude oil744336456right at the Forelanc					0.000000	0.000000	0.8	1314
Diesel9924993100136470OLD HARBOR CITY	Gallons	11/6/1999	11/18/1999	Primary Responsible Party	57.204167	-153.300000	0.2	288
Diesel9911993470236507Tongass Narrows	Gallons	12/13/1999	12/13/1999	Primary Responsible Party	55.342369	-131.656341	0.0	0
Gasoline23990190136544WEST CENTRAL KENAI	Gallons	1/19/2000	1/21/2000	Primary Responsible Party	60.000000	-153.000000	0.1	113
Gasoline11990250136550Portland Canal	Gallons	1/25/2000	11/22/2000	Primary Responsible Party	56.968540	-133.924975	0.0	0
Multiple: diesel, lube oil & hydraulic oil746736567Unimak Isla	Gallons				0.000000	0.000000	86.5	139131
IFO-380747236582Icy Bay, Northern Gulf of Alaska	Gallons				0.000000	0.000000	0.7	1119
Propane (LPG)747636600Kodiak, AK	Gallons				0.000000	0.000000	0.1	129
Propane (LPG)24990750136600KODIAK UNKNOWN	Gallons	3/15/2000	5/2/2000	Primary Responsible Party	57.587058	-153.095559	1.4	2301
Diesel11990980236623Tongass Narrows	Gallons	4/7/2000	4/7/2000	Primary Responsible Party	55.361778	-131.710974	0.0	0
Diesel24991110136636SHELIKOF STRAIT	Gallons	4/20/2000	5/3/2000	Primary Responsible Party	57.500000	-155.000000	7.2	11663
Other11991330136658Gastineau Channel	Gallons	5/12/2000	5/15/2000	Primary Responsible Party	58.302914	-134.404008	0.1	101
Diesel27991340136659Bethel	Gallons	5/13/2000	6/1/2001	Primary Responsible Party	60.791667	-161.750000	0.0	0
Diesel24991460136671WOMENS BAY	Gallons	5/25/2000	6/8/2000	Primary Responsible Party	48.204167	-152.907869	0.1	128
Other11991480136673Gastineau Channel	Gallons	5/27/2000	5/27/2000	Primary Responsible Party	58.302914	-134.404008	0.1	101
Ammonia (anhydrous)749536677Dutch Harbor, Unalaska Isla	Gallons				0.000000	0.000000	0.2	246
Diesel25991730136698SAND POINT	Gallons	6/21/2000	7/5/2000	Primary Responsible Party	54.593056	-160.810647	0.6	994
Jet fuel11991870236712Tongass Narrows	Gallons	7/5/2000	7/6/2000	Primary Responsible Party	55.342369	-131.656341	0.0	0
Diesel24992040136729SHELIKOF STRAIT	Gallons	7/22/2000	7/31/2000	Primary Responsible Party	57.500000	-155.000000	16.9	27168
Diesel11992280136753Tongass Narrows	Gallons	8/15/2000	8/25/2000	Primary Responsible Party	55.342369	-131.656341	0.4	673
Diesel11992280236753Craig / Klawock area waters	Gallons	8/15/2000	8/25/2000	Primary Responsible Party	55.208956	-132.817397	0.0	58
Diesel11992290136754Annette Island	Gallons	8/16/2000	8/25/2000	Primary Responsible Party	55.042123	-131.585761	0.8	1306
Other23992310136756NORTH COOK INLET	Gallons	8/18/2000	8/18/2000	Primary Responsible Party	61.027272	-150.815336	0.7	1081
Diesel11992320136757Wrangell area waters	Gallons	8/19/2000	8/28/2000	Primary Responsible Party	56.476860	-132.379532	0.2	318
Diesel11992350236760Portland Canal	Gallons	8/22/2000	10/6/2000	Primary Responsible Party	56.968540	-133.924975	0.0	0
Diesel11992360236761Cape Edgecumbe to Icy Bay	Gallons	8/23/2000	8/23/2000	Primary Responsible Party	56.987042	-134.365238	0.2	300
Diesel11992420136767Tongass Narrows	Gallons	8/29/2000	4/6/2001	Primary Responsible Party	55.342369	-131.656341	0.2	254
Other23992640136789WHITTIER	Gallons	9/20/2000	10/9/2000	Primary Responsible Party	60.775000	-148.683333	0.1	91

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Diesel25992830236808DUTCH HARBOR	Gallons	10/9/2000	10/13/2000	Primary Responsible Party	54.494906	-166.889814	0.3	507
Heavy oil752036848Port Walter, AK	Gallons				0.000000	0.000000	0.0	10
Diesel25993280136853SAND POINT	Gallons	11/23/2000	11/28/2000	Primary Responsible Party	54.593056	-160.810647	1.8	2852
Diesel23993350136860KENAI CITY	Gallons	11/30/2000	12/2/2000	Primary Responsible Party	60.550000	-151.266667	0.1	153
Diesel11993440136869Lisianski	Gallons	12/9/2000	4/2/2001	Primary Responsible Party	58.111547	-135.419781	0.0	0
Diesel25993540136879DUTCH HARBOR	Gallons	12/19/2000	9/13/2001	Primary Responsible Party	54.494906	-166.889814	0.0	76
Diesel122990300136921EVANS ISLAND	Gallons	1/30/2001	1/30/2001	Primary Responsible Party	60.050000	-148.066667	0.2	396
Unknown111990850236976Tongass Narrows	Gallons	3/26/2001	3/26/2001	Primary Responsible Party	55.853849	-132.462201	2.8	4515
Diesel111991200337011Clarence Strait North	Gallons	4/30/2001	5/8/2001	Primary Responsible Party	56.008165	-132.839065	0.0	0
Diesel122991290137020P.W.S. UNKNOWN	Gallons	5/9/2001	5/16/2001	Primary Responsible Party	60.447599	-147.029227	1.2	1944
Diesel125991310137022COLD BAY	Gallons	5/11/2001	5/16/2001	Primary Responsible Party	55.325925	-162.783333	0.9	1492
Diesel111991650237056Lynn Canal North	Gallons	6/14/2001	6/7/2002	Primary Responsible Party	0.000000	0.000000	0.1	227
Diesel111991790137070Gastineau Channel	Gallons	6/28/2001	8/29/2001	Primary Responsible Party	58.302914	-134.404008	0.0	0
Diesel111991790337070Tongass Narrows	Gallons	6/28/2001	7/19/2001	Primary Responsible Party	0.000000	0.000000	0.0	0
Diesel111992050137096Glacier Bay	Gallons	7/24/2001	9/4/2001	Primary Responsible Party	58.406090	-135.801085	0.0	0
Diesel122992070137098PRINCE WILLIAM SOUND	Gallons	7/26/2001	8/18/2003	Primary Responsible Party	60.615002	-147.168106	0.6	912
Diesel111992130237104Cordova Bay	Gallons	8/1/2001	8/7/2001	Primary Responsible Party	55.482797	-133.123160	0.3	455
Diesel122992160137107P.W.S. UNKNOWN	Gallons	8/4/2001	10/25/2004	Primary Responsible Party	60.447599	-147.029227	0.9	1412
Diesel111992310137122Chatham Strait North	Gallons	8/19/2001	8/21/2001	Primary Responsible Party	57.869254	-134.823990	3.8	6179
Diesel111992360137127Chatham Strait North	Gallons	8/24/2001	8/27/2001	Primary Responsible Party	57.092003	-134.842652	0.7	1128
Diesel111992390137130Annette Island	Gallons	8/27/2001	8/30/2001	Primary Responsible Party	55.042123	-131.585761	2.0	3221
Diesel111992440137135Sumner Strait	Gallons	9/1/2001	9/4/2001	Primary Responsible Party	55.954209	-133.781982	0.7	1116
Diesel111992560137147Gastineau Channel	Gallons	9/13/2001	11/21/2001	Primary Responsible Party	58.315486	-134.452433	0.1	103
Diesel125992600137151DUTCH HARBOR	Gallons	9/17/2001	9/18/2001	Primary Responsible Party	54.494906	-166.889814	0.3	562
Diesel111992620137153Tongass Narrows	Gallons	9/19/2001	9/21/2001	Primary Responsible Party	55.342369	-131.656341	0.0	0
Crude123993310137222NORTH COOK INLET	Gallons	11/27/2001	5/14/2002	Primary Responsible Party	61.027272	-150.815336	3.5	5565
Diesel225990070137263DUTCH HARBOR	Gallons	1/7/2002	6/3/2004	Primary Responsible Party	54.494906	-166.889814	0.3	562
Diesel224990170137273AFOGNAK IS.	Gallons	1/17/2002	2/27/2002	Primary Responsible Party	0.000000	0.000000	0.7	1120
Diesel211990490137305Tongass Narrows	Gallons	2/18/2002	2/20/2002	Primary Responsible Party	55.342369	-131.656341	0.0	0
Ammonia (anhydrous)211990590137315Tongass Narrows	Gallons	2/28/2002	3/1/2002	Primary Responsible Party	0.000000	0.000000	0.0	0
Diesel211990870237343Tongass Narrows	Gallons	3/28/2002	9/1/2005	Primary Responsible Party	55.342369	-131.656341	0.0	0
Ballast Water (containing oil)222991070137363VALDEZ MAI	Gallons	4/17/2002	11/21/2002	Primary Responsible Party	61.092983	-146.409605	0.6	949
Diesel211992020137458Tongass Narrows	Gallons	7/21/2002	7/29/2002	Primary Responsible Party	0.000000	0.000000	0.0	0
Diesel211992050137461Lynn Canal South	Gallons	7/24/2002	7/26/2002	Primary Responsible Party	58.699900	-135.097722	3.1	4998
Diesel211992060137462Tongass Narrows	Gallons	7/25/2002	7/26/2002	Primary Responsible Party	55.342369	-131.656341	0.0	0
Diesel211992070137463Clarence Strait North	Gallons	7/26/2002	8/9/2002	Primary Responsible Party	0.000000	0.000000	0.2	310
Asphalt211992260137482Ketchikan Region NOS	Gallons	8/14/2002	8/22/2002	Primary Responsible Party	55.361798	-131.599153	0.0	0
Other211992290137485Gastineau Channel	Gallons	8/17/2002	8/21/2002	Primary Responsible Party	0.000000	0.000000	0.0	80

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Diesel211992370237493Cordova Bay	Gallons	8/25/2002	8/26/2002	Primary Responsible Party	0.000000	0.000000	0.6	1001
Diesel224992690137525AFOGNAK IS.	Gallons	9/26/2002	10/1/2002	Primary Responsible Party	0.000000	0.000000	2.2	3520
Diesel211992800137536Chichagof Island NOS	Gallons	10/7/2002	10/21/2002	Primary Responsible Party	57.869254	-134.823990	3.8	6179
Diesel211992880137544Wrangell Narrows	Gallons	10/15/2002	7/17/2003	Primary Responsible Party	0.000000	0.000000	0.0	59
Diesel224993140137570AFOGNAK IS.	Gallons	11/10/2002	8/4/2003	Primary Responsible Party	58.250000	-152.500000	0.6	902
Unknown211993280137584Tongass Narrows	Gallons	11/24/2002	12/1/2002	Primary Responsible Party	55.342369	-131.656341	0.0	0
Drilling Muds223993330137589NORTH COOK INLET	Gallons	11/29/2002	3/4/2003	Primary Responsible Party	0.000000	0.000000	2.1	3340
Diesel224993450137601KODIAK UNKNOWN	Gallons	12/11/2002	1/8/2003	Primary Responsible Party	0.000000	0.000000	1.0	1680
Ballast Water (containing oil)222993460137602VALDEZ MAI	Gallons	12/12/2002	12/13/2002	Primary Responsible Party	61.080585	-146.400210	0.0	0
Diesel311990060237627Sitka Sound	Gallons	1/6/2003	9/1/2005	Primary Responsible Party	57.054329	-135.317719	0.2	250
Diesel311990060537627Tongass Narrows	Gallons	1/6/2003	1/8/2003	Primary Responsible Party	55.342369	-131.656341	0.0	0
Diesel311990090137630Juneau / Douglas	Gallons	1/9/2003	3/5/2003	Primary Responsible Party	0.000000	0.000000	0.1	169
Diesel324991500137771KODIAK UNKNOWN	Gallons	5/30/2003	4/21/2004	Primary Responsible Party	0.000000	0.000000	3.3	5242
Diesel311991890237810Sitka Sound	Gallons	7/8/2003	7/14/2003	Primary Responsible Party	57.250000	-135.900000	2.2	3488
Diesel325991900137811SAINT PAUL IS.	Gallons	7/9/2003	7/11/2003	Primary Responsible Party	57.122222	-170.275000	0.1	100
Diesel108537840Kodiak Island, AK	Gallons				0.000000	0.000000	0.3	480
Diesel322992300137851P.W.S. UNKNOWN	Gallons	8/18/2003	5/1/2006	Primary Responsible Party	60.329570	-145.464380	0.2	375
Diesel109437853Tanglefoot Bay, AK	Gallons				0.000000	0.000000	0.2	303
Diesel109337860Pavlof Bay, AK	Gallons				0.000000	0.000000	0.3	416
Diesel311992500137871Auke Bay / Fritz Cove	Gallons	9/7/2003	9/9/2003	Primary Responsible Party	58.381500	-134.685700	0.0	0
Diesel110737909North of Alaska Peninsula, Bering Sea, AK	Gallons				0.000000	0.000000	12.7	20499
Diesel338993120137933SHAKTOOLIK CITY	Gallons	11/8/2003	11/17/2003	Primary Responsible Party	0.000000	0.000000	0.0	0
Diesel411990090137995Stephens Passage South	Gallons	1/9/2004	1/26/2004	Primary Responsible Party	0.000000	0.000000	0.1	162
Diesel425990290138015DUTCH HARBOR	Gallons	1/29/2004	1/30/2004	Primary Responsible Party	52.000000	-174.000000	0.3	562
Diesel411990340138020Yakutat Bay	Gallons	2/3/2004	10/15/2004	Primary Responsible Party	59.557527	-139.762113	0.3	562
Diesel423990590138045HOMER CITY	Gallons	2/28/2004	4/9/2004	Primary Responsible Party	59.644444	-151.550000	0.2	329
Ammonia (anhydrous)423990700138056HOMER CITY	Gallons	3/10/2004	3/24/2004	Primary Responsible Party	59.644444	-151.550000	0.1	230
Diesel411990720138058Chichagof Island NOS	Gallons	3/12/2004	5/25/2004	Primary Responsible Party	57.960300	-137.227900	5.0	50
Diesel411991060438092Tongass Narrows	Gallons	4/15/2004	4/16/2004	Primary Responsible Party	55.853849	-132.462201	2.8	4515
Diesel426991080138094BRISTOL BAY UNKNOWN	Gallons	4/17/2004	5/10/2004	Primary Responsible Party	0.000000	0.000000	0.0	0
Diesel117238118Peril Strait, AK	Gallons				0.000000	0.000000	0.6	942
Unknown117338119Bering Sea, AK			0.000000	0.000000	120.4	193744		
Unknown117338119Bering Sea, AK	Gallons				0.000000	0.000000	120.4	193744
Diesel411991610238147Hydaburg / Tlevak	Gallons	6/9/2004	6/14/2004	Primary Responsible Party	55.886900	-133.716000	1.1	1717
Diesel120038199Baby Island, AK	Gallons				0.000000	0.000000	0.8	1226
Diesel425992130138199ALEUTIAN E. UNKNOWN	Gallons	7/31/2004	9/14/2004	Primary Responsible Party	0.000000	0.000000	0.1	223
Diesel121338244SE Alaska, AK	Gallons				0.000000	0.000000	0.1	200
Multiple: diesel & gasoline122038251Auke Bay, AK	Gallons				0.000000	0.000000	0.0	0
DieselNOAA ID 12238251Auke Bay / Fritz Cove	Gallons	9/21/2004	7/7/2005	Pot Resp Party	0.000000	0.000000	0.0	0
Gasoline411992690138255Auke Bay / Fritz Cove	Gallons	9/25/2004	10/1/2004	Primary Responsible Party	58.411155	-134.747101	0.0	0
Diesel411992830238269Cape Edgecumbe to Icy Bay	Gallons	10/9/2004	2/10/2005	Primary Responsible Party	58.318000	-136.860000	0.0	0
Crude423993020138288CENTRAL COOK INLET	Gallons	10/28/2004	8/31/2005	Primary Responsible Party	60.000000	-152.000000	2.0	3160
Diesel411993230238309Ketchikan	Gallons	11/18/2004	11/18/2004	Primary Responsible Party	0.000000	0.000000	0.1	202

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Lube oil411993330438319Saxman	Gallons	11/28/2004	12/5/2004	Primary Responsible Party	0.000000	0.000000	0.0	0
Diesel425993430138329EASTERN CHAIN	Gallons	12/8/2004	10/9/2006	Primary Responsible Party	53.000000	-167.000000	0.7	1100
IFO-380425993430138329EASTERN CHAIN	Gallons	12/8/2004	10/9/2006	Primary Responsible Party	53.000000	-167.000000	0.7	1100
Diesel411993620238348Chatham Strait North	Gallons	12/27/2004	1/12/2005	Primary Responsible Party	57.869254	-134.823990	3.8	6179
Bunker fuel525990130138365ATTU	Gallons	1/13/2005	6/21/2005	Primary Responsible Party	53.438889	-173.291667	78.2	125857
Drilling Muds539990590338411CHUKCHI SEA	Gallons	2/28/2005	11/21/2005	Primary Responsible Party	0.000000	0.000000	0.6	966
Other522991150138467VALDEZ	Gallons	4/25/2005	4/25/2005	Primary Responsible Party	0.000000	0.000000	0.0	0
Diesel524992070138559KODIAK UNKNOWN	Gallons	7/26/2005	11/5/2005	Primary Responsible Party	57.587058	-153.095559	2.5	3975
Diesel523992380138590EAST KENAI UNKNOWN	Gallons	8/26/2005	5/1/2006	Primary Responsible Party	0.000000	0.000000	1.9	3040
Diesel525992450138597CENTRAL CHAIN	Gallons	9/2/2005	9/26/2005	Primary Responsible Party	52.000000	-174.000000	0.2	361
Diesel511992530138605Icy Strait	Gallons	9/10/2005	9/15/2005	Primary Responsible Party	58.131700	-135.270800	1.9	2999
Jet fuel524992740138626WOMENS BAY	Gallons	10/1/2005	11/5/2005	Primary Responsible Party	48.204167	-152.907869	0.1	128
Diesel511993040138656Ketchikan	Gallons	10/31/2005	11/2/2009	Primary Responsible Party	0.000000	0.000000	0.0	0
Diesel511993200238672Sitka	Gallons	11/16/2005	9/24/2007	Primary Responsible Party	0.000000	0.000000	0.1	102
Hydraulic oil525993550138707WESTERN CHAIN	Gallons	12/21/2005	3/13/2007	Primary Responsible Party	0.000000	0.000000	0.4	651
Diesel624990130138730KODIAK UNKNOWN	Gallons	1/13/2006	1/17/2006	Primary Responsible Party	0.000000	0.000000	1.6	2562
Diesel611990310138748Cape Edgecumbe to Icy Bay	Gallons	1/31/2006	2/15/2006	Primary Responsible Party	56.100000	-134.400000	5.9	9476
Other623990330138750NIKISKI	Gallons	2/2/2006	10/9/2006	Primary Responsible Party	60.414600	-151.219100	0.1	180
Diesel624990370138754KODIAK CITY	Gallons	2/6/2006	6/28/2006	Primary Responsible Party	57.788889	-152.402778	0.3	539
Jet fuel625990440138761WESTERN CHAIN	Gallons	2/13/2006	4/20/2006	Primary Responsible Party	53.905200	-166.523900	0.0	0
Diesel625990440138761WESTERN CHAIN	Gallons	2/13/2006	4/20/2006	Primary Responsible Party	53.905200	-166.523900	0.0	0
Diesel625990540138771CENTRAL CHAIN	Gallons	2/23/2006	4/11/2006	Primary Responsible Party	53.530000	-167.110000	1.6	2519
Multiple: diesel & lube oil607138807NW Unalaska Island, AK	Gallons				0.000000	0.000000	7.7	12439
Diesel611990930438810Yakutat Bay	Gallons	4/3/2006	5/8/2006	Primary Responsible Party	59.557527	-139.762113	0.3	562
Kerosene611991000138817Gastineau Channel	Gallons	4/10/2006	5/19/2006	Primary Responsible Party	58.315486	-134.452433	0.1	103
Diesel624991110138828KODIAK UNKNOWN	Gallons	4/21/2006	4/25/2006	Primary Responsible Party	56.505000	-154.143600	0.0	0
Diesel624991380138855KODIAK CITY	Gallons	5/18/2006	10/4/2006	Primary Responsible Party	57.788889	-152.411083	0.0	0
Diesel622991720138889Middleton Island	Gallons	6/21/2006	8/31/2006	Primary Responsible Party	59.149720	-146.896550	26.0	41838
Diesel610038910Sitka, AK	Gallons				0.000000	0.000000	3.2	5117
Multiple: fuel oil & gasoline610338921North Pacific Ocean, A	Gallons				0.000000	0.000000	262.9	423029
Multiple: fuel oil & gasoline610338921North Pacific Ocean, A	Gallons				0.000000	0.000000	262.9	423029
Diesel611992160138933Clarence Strait North	Gallons	8/4/2006	8/22/2006	Primary Responsible Party	0.000000	0.000000	0.0	69
Diesel622992250138942PRINCE WILLIAM SOUND	Gallons	8/13/2006	4/16/2008	Primary Responsible Party	0.000000	0.000000	0.3	505
Diesel622992410138958PRINCE WILLIAM SOUND	Gallons	8/29/2006	9/8/2010	Primary Responsible Party	0.000000	0.000000	0.8	1355
Diesel611992700138987Duncan Canal	Gallons	9/27/2006	10/16/2006	Primary Responsible Party	54.704900	-132.118200	0.0	59
Diesel626992830139000DILLINGHAM CITY	Gallons	10/10/2006	5/31/2007	Primary Responsible Party	0.000000	0.000000	0.0	8
Diesel611993010139018Hollis	Gallons	10/28/2006	11/15/2006	Primary Responsible Party	55.556698	-132.636306	0.2	331
Diesel611993230139040Tongass Narrows	Gallons	11/19/2006	11/21/2006	Primary Responsible Party	55.497000	-131.725000	0.0	0

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Fuel Oil & Wheat614139055Adak, Bering Sea, AK	Gallons				0.000000	0.000000	166.0	267119
Diesel611993400339057Juneau / Douglas	Gallons	12/6/2006	2/26/2008	Primary Responsible Party	58.297100	-134.400300	0.0	0
Diesel724990080139090SHELIKOF STRAIT	Gallons	1/8/2007	1/8/2007	Primary Responsible Party	57.160000	-153.833333	10.2	16422
Diesel711990120139094Revillagigedo Channel	Gallons	1/12/2007	5/20/2007	Primary Responsible Party	55.327920	-131.526200	0.0	0
Diesel724990120139094KODIAK CITY	Gallons	1/12/2007	1/12/2007	Primary Responsible Party	57.788889	-152.402778	0.0	17
Diesel711990380139120Wrangell Narrows	Gallons	2/7/2007	2/8/2007	Primary Responsible Party	56.809600	-132.965500	0.2	326
Diesel725990410139123UNALASKA	Gallons	2/10/2007	2/12/2007	Primary Responsible Party	53.793300	-167.250200	4.4	7146
Diesel724990510139133SHELIKOF STRAIT	Gallons	2/20/2007	2/23/2007	Primary Responsible Party	57.160000	-155.330000	21.7	34913
Diesel711990680139150Gastineau Channel	Gallons	3/9/2007	3/22/2007	Primary Responsible Party	58.319330	-134.576000	0.0	0
Diesel711990720239154Thorne Bay	Gallons	3/13/2007	3/21/2007	Primary Responsible Party	55.743206	-132.388842	2.9	4646
Diesel725990770139159ADAK	Gallons	3/18/2007	5/31/2007	Primary Responsible Party	51.872100	-176.618300	0.3	542
Diesel725990830139165CENTRAL CHAIN	Gallons	3/24/2007	4/18/2007	Primary Responsible Party	52.200000	-175.133000	1.8	2867
Diesel723991370139219WHITTIER	Gallons	5/17/2007	10/4/2010	Primary Responsible Party	60.775000	-148.683333	0.1	91
Diesel739991530639235WEST NORTH SLOPE	Gallons	6/2/2007	9/1/2007	Primary Responsible Party	71.050000	-154.733334	0.0	0
Diesel722991540139236P.W.S. UNKNOWN	Gallons	6/3/2007	6/15/2007	Primary Responsible Party	60.430000	-146.430000	1.1	1699
Sheen767139269140 nm WNW St Matthew Island	Gallons				0.000000	0.000000	163.8	263596
Diesel722991970139279P.W.S. UNKNOWN	Gallons	7/16/2007	7/25/2007	Primary Responsible Party	59.871700	-148.716830	3.7	5918
Diesel722992020139284PRINCE WILLIAM SOUND	Gallons	7/21/2007	11/12/2008	Other	60.713333	-146.193833	0.9	1438
Diesel767839288Sunshine Cove, AK	Gallons				0.000000	0.000000	0.4	627
Diesel722992130139295ESTHER IS.	Gallons	8/1/2007	8/15/2007	Other	60.783889	-148.135000	0.2	268
Diesel711992200139302Frederick Sound	Gallons	8/8/2007	8/13/2007	Primary Responsible Party	56.797000	-132.839700	0.1	226
Diesel711992300239312Revillagigedo Channel	Gallons	8/18/2007	8/21/2007	Primary Responsible Party	55.240000	-131.420000	0.5	800
Gasoline711992490239331Wrangell area waters	Gallons	9/6/2007	9/9/2007	Primary Responsible Party	56.275500	-132.225900	0.1	215
Diesel722992540139336PRINCE WILLIAM SOUND	Gallons	9/11/2007		Primary Responsible Party	60.910933	-146.746183	0.3	432
Gasoline722992540139336PRINCE WILLIAM SOUND	Gallons	9/11/2007		Primary Responsible Party	60.910933	-146.746183	0.3	432
Multiple: diesel & gasoline769839360Ugashik Bay, AK	Gallons				0.000000	0.000000	0.1	197
Source water739993060439388WEST NORTH SLOPE	Gallons	11/2/2007	11/7/2007	Primary Responsible Party	70.526920	-150.168750	0.8	1356
Kerosene711993090139391Craig / Klawock area waters	Gallons	11/5/2007	11/10/2007	Primary Responsible Party	55.299000	-132.554000	0.2	298
Propane (LPG)711993090139391Craig / Klawock area water	Gallons	11/5/2007	11/10/2007	Primary Responsible Party	55.299000	-132.554000	0.9	1400
Bunker fuel711993250139407Tongass Narrows	Gallons	11/21/2007		Primary Responsible Party	55.342369	-131.656341	0.0	0
Multiple: diesel & hydraulic oil771739409George Inlet, SE Ala	Gallons				0.000000	0.000000	0.1	222
Diesel725993370239419AKUTAN CITY	Gallons	12/3/2007	12/5/2007	Primary Responsible Party	54.134722	-165.772222	0.0	74
Diesel725993510139433DUTCH HARBOR	Gallons	12/17/2007	1/7/2008	Contractor	53.875167	-166.537333	0.2	355
Ammonia (anhydrous)725993560139438DUTCH HARBOR	Gallons	12/22/2007	3/14/2008	Other	54.494906	-166.889814	0.2	306
Jet fuel824990050139452WOMENS BAY	Gallons	1/5/2008	1/7/2008	Primary Responsible Party	57.750000	-152.494000	0.0	0
Diesel811990160139463Sumner Strait	Gallons	1/16/2008	5/14/2008	Primary Responsible Party	56.339167	-133.199833	0.3	538
Diesel725990260239472CENTRAL CHAIN	Gallons	1/25/2008	1/30/2008	Primary Responsible Party	51.750000	-176.766667	0.0	0
Drilling Muds839990340139481WEST NORTH SLOPE	Gallons	2/3/2008	6/9/2008	Primary Responsible Party	70.526920	-150.168750	0.8	1356
Diesel824990400139487KODIAK CITY	Gallons	2/9/2008	3/4/2008	Primary Responsible Party	57.823333	-152.335000	0.1	180
Diesel811990420339489PELICAN CITY	Gallons	2/11/2008	7/31/2008	Primary Responsible Party	57.960000	-136.233000	0.3	431
Hydraulic oil825990450139492S.E. BERING SEA	Gallons	2/14/2008	2/14/2008	Primary Responsible Party	56.500000	-169.100000	15.3	24679
Diesel811990480139495Craig / Klawock area waters	Gallons	2/17/2008	7/11/2008	Primary Responsible Party	55.575710	-133.270990	0.3	430
Diesel824990630339510KODIAK CITY	Gallons	3/3/2008	7/8/2008	Primary Responsible Party	57.788889	-152.402778	0.0	33
Diesel825990830139530EASTERN CHAIN	Gallons	3/23/2008	5/1/2008	Primary Responsible Party	53.883333	-169.983333	56.3	90631
Jet fuel823990900139537COOK INLET	Gallons	3/30/2008	4/2/2008	Primary Responsible Party	61.240300	-149.886100	0.0	35
Diesel822991150139562PORT OF VALDEZ	Gallons	4/24/2008	5/6/2008	Other	61.126750	-146.430683	0.4	645

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Diesel825991570139604FALSE PASS	Gallons	6/5/2008	7/3/2008	Primary Responsible Party	55.120000	-163.290000	0.2	378
Bilge Oil822991720139619PRINCE WILLIAM SOUND	Gallons	6/20/2008		Primary Responsible Party	60.738333	-147.543333	1.7	2762
Diesel811991850239632Tongass Narrows	Gallons	7/3/2008	8/15/2008	Primary Responsible Party	55.342369	-131.656341	0.0	0
Diesel785239636Glacier Bay, northern extremity	Gallons				0.000000	0.000000	0.6	968
Multiple: diesel, jet fuel & gasoline786239652Togiak, AK	Gallons				0.000000	0.000000	0.0	12
Diesel786939667Prince William Sd., Fleming Isl., Alaska	Gallons				0.000000	0.000000	0.2	323
Diesel811992310139678Kasaan Bay	Gallons	8/18/2008	9/1/2008	Primary Responsible Party	55.402000	-132.330667	0.1	211
Diesel789839718Mekoryuk village beach, Nunivak Isl., AK	Gallons				0.000000	0.000000	0.2	322
Multiple: gasoline & lube oil790339728Wood River, SW Alasl	Gallons				0.000000	0.000000	0.0	0
Diesel791139743100 mi w of Adak Is in Amchitka Pass	Gallons				0.000000	0.000000	34.2	55047
Diesel811993160139763Tongass Narrows	Gallons	11/11/2008	11/19/2008	Primary Responsible Party	55.359000	-131.333000	0.0	0
Diesel794539817Aghiyuk Island, W. Gulf of Alaska	Gallons				0.000000	0.000000	0.1	82
Diesel923990150139828NORTH COOK INLET	Gallons	1/15/2009		Primary Responsible Party	60.958167	-151.335000	3.4	5505
Other923990150139828NORTH COOK INLET	Gallons	1/15/2009		Primary Responsible Party	60.958167	-151.335000	3.4	5505
Diesel925990290139842AKUTAN	Gallons	1/29/2009	1/30/2009	Primary Responsible Party	54.131761	-165.760570	0.0	74
Diesel911990300139843Chatham Strait South	Gallons	1/30/2009	5/21/2009	Primary Responsible Party	55.140667	-131.718500	0.7	1188
Diesel923990440139857SEWARD CITY	Gallons	2/13/2009	7/10/2009	Primary Responsible Party	60.108333	-149.441667	0.3	457
Multiple: diesel, lube oil & hydraulic oil798339869Akutan Isl.,	Gallons				0.000000	0.000000	0.1	99
Diesel925990560139869AKUTAN CITY	Gallons	2/25/2009	9/24/2009	Land Owner	54.216667	-165.966667	0.1	109
Multiple: diesel, lube oil & hydraulic oil798839877St. George	Gallons				0.000000	0.000000	0.0	0
Hydraulic oil939990800239893KUPARUK	Gallons	3/21/2009	4/12/2009	Primary Responsible Party	70.416667	-148.883333	0.2	366
Cook Inlet crude oil800039895Cook Inlet, Alaska					0.000000	0.000000	0.0	0
Diesel925991020139915CENTRAL CHAIN	Gallons	4/12/2009	5/15/2009	Primary Responsible Party	51.750000	-176.766667	0.2	269
Diesel911991070239920Clarence Strait North	Gallons	4/17/2009	4/18/2009	Primary Responsible Party	56.008165	-132.839065	0.0	0
Diesel923991170139930SEWARD CITY	Gallons	4/27/2009	5/15/2009	Primary Responsible Party	60.108333	-149.441667	0.2	395
Gasoline923991470139960KENAI GAS FIELD	Gallons	5/27/2009	6/2/2009	Primary Responsible Party	60.672667	-151.409000	0.4	655
Diesel926991560139969BRISTOL BAY UNKNOWN	Gallons	6/5/2009	11/13/2009	Primary Responsible Party	0.000000	0.000000	4.7	7540
Black algae804640004Kuk River near Wainright, AK	Gallons				0.000000	0.000000	1.8	2905
Diesel911992140140027Port Frederick	Gallons	8/2/2009	11/27/2009	Primary Responsible Party	58.100600	-135.446100	0.4	696
Diesel925992150140028SAINT PAUL IS.	Gallons	8/3/2009	11/12/2009	Other	57.122222	-170.275000	0.1	100
Diesel911992160140029Tongass Narrows	Gallons	8/4/2009	8/4/2009	Primary Responsible Party	55.342369	-131.656341	0.0	0
Diesel911992200140033Chatham Strait North	Gallons	8/8/2009	11/9/2009	Primary Responsible Party	57.869254	-134.823990	3.8	6179
Anhydrous ammonia & chlorine808640045Pelican, AK	Gallons				0.000000	0.000000	0.0	3
Multiple: gasoline & jet fuel809740072Quinhagak, Alaska	Gallons				0.000000	0.000000	0.0	0
Ammonia (anhydrous)926992670140080CHIGNIK CITY	Gallons	9/24/2009	10/22/2010	Contractor	57.047367	-156.527100	0.0	0
Diesel926992670140080CHIGNIK CITY	Gallons	9/24/2009	10/22/2010	Contractor	57.047367	-156.527100	0.0	0
Used Oil (all types)926992670140080CHIGNIK CITY	Gallons	9/24/2009	10/22/2010	Contractor	57.047367	-156.527100	0.0	0
Diesel911992830140096Sitka Sound	Gallons	10/10/2009	11/1/2009	Primary Responsible Party	56.983333	-135.720000	1.4	2315
Diesel812740100Sand Point, Alaska	Gallons				0.000000	0.000000	0.0	0
Diesel925993030140116EASTERN CHAIN	Gallons	10/30/2009	5/12/2010	Primary Responsible Party	53.900000	-166.100000	3.1	5058
Diesel814440122Unimak Isl., E. Aleutians, Alaska	Gallons				0.000000	0.000000	19.8	31880
Diesel922993510140164VALDEZ	Gallons	12/17/2009		Primary Responsible Party	61.126450	-146.340767	0.0	0
Diesel922993570140170BLIGH IS.	Gallons	12/23/2009	6/15/2012	Primary Responsible Party	60.839833	-146.882333	0.9	1463
Diesel817540189Adak Island, Aleutian Isls, Alaska	Gallons				0.000000	0.000000	0.0	0
Diesel1025990110140189WESTERN CHAIN	Gallons	1/11/2010	6/20/2012	Contractor	51.850000	-176.668167	0.0	0
Diesel1011990220140200Holkham Bay Area	Gallons	1/22/2010	2/24/2010	Primary Responsible Party	57.792348	-133.707775	0.4	575
Corrosion Inhibitor1025990370140215DUTCH HARBOR	Gallons	2/6/2010	2/16/2010	Primary Responsible Party	53.890333	-166.551000	0.1	197
Diesel1022991100140288Middleton Island	Gallons	4/20/2010	4/18/2012	Primary Responsible Party	0.000000	0.000000	22.4	35999
Diesel1022991390140317MONTAGUE ISLAND	Gallons	5/19/2010	6/15/2012	Primary Responsible Party	59.750000	-147.866667	1.1	1823
Diesel1011991400140318Sitka Sound	Gallons	5/20/2010	6/29/2010	Primary Responsible Party	57.097300	-135.487100	1.0	1688
Propylene glycol1011991530140331Juneau / Douglas	Gallons	6/2/2010	6/11/2010	Primary Responsible Party	58.357300	-134.489133	0.0	0

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DieselNOAA ID 82340385PRINCE WILLIAM SOUND	Gallons	7/26/2010		Primary Responsible Party	0.000000	0.000000	0.0	0
Diesel1026992260140404NUSHAGAK	Gallons	8/14/2010	8/17/2010	Primary Responsible Party	58.600833	-158.641333	5.0	8106
Diesel1011992390140417Wrangell Narrows	Gallons	8/27/2010	8/31/2010	Primary Responsible Party	56.476860	-132.379532	0.2	370
Diesel1011992630140441Sitka Sound	Gallons	9/20/2010	12/16/2011	Primary Responsible Party	56.995717	-135.444517	2.9	4604
Multiple: diesel, lube oil & IFO82754051570nm North of Adak	Gallons				0.000000	0.000000	42.8	68858
Diesel1011993420140520Craig / Klawock area waters	Gallons	12/8/2010	12/19/2010	Primary Responsible Party	54.452520	-133.260620	16.1	25876
Diesel828340568Latouche Isl, Prince William Sound, Alaska	Gallons				0.000000	0.000000	0.2	284
Diesel829040582Unalaska Isl., Aleutian Isl., Alaska	Gallons				0.000000	0.000000	0.2	244
Diesel1125990390140582EASTERN CHAIN	Gallons	2/8/2011	5/23/2011	Primary Responsible Party	53.260000	-167.230000	0.2	244
Hydraulic oil1125990390140582EASTERN CHAIN	Gallons	2/8/2011	5/23/2011	Primary Responsible Party	53.260000	-167.230000	0.2	244
Diesel1124990420140585SHELIKOF STRAIT	Gallons	2/11/2011	5/1/2011	Primary Responsible Party	56.263667	-153.097167	0.0	46
Hydraulic oil1124990420140585SHELIKOF STRAIT	Gallons	2/11/2011	5/1/2011	Primary Responsible Party	56.263667	-153.097167	0.0	46
Diesel1123990460240589WHITTIER CITY	Gallons	2/15/2011		Primary Responsible Party	60.778080	-148.691500	0.1	124
Diesel1125990460140589UNALASKA	Gallons	2/15/2011	3/25/2011	Contractor	54.479611	-166.910647	0.3	562
Multiple: diesel, lube oil & hydraulic oil829540608King Cove,	Gallons				0.000000	0.000000	0.0	0
Diesel1111990830140626Tongass Narrows	Gallons	3/24/2011	3/26/2011	Primary Responsible Party	55.345010	-131.658950	0.0	0
Ethylene Glycol (Antifreeze)1122991100140653VALDEZ MAI	Gallons	4/20/2011		Primary Responsible Party	61.092983	-146.409605	0.6	949
Multiple: diesel, lube oil, hydraulic oil, gasoline & waste oil832	Gallons				0.000000	0.000000	0.0	0
Gasoline1122991500140693Gulf of Alaska	Gallons	5/30/2011	4/18/2012	Primary Responsible Party	60.172500	-145.111667	4.2	6801
Diesel1125991770140720S.E. BERING SEA	Gallons	6/26/2011		Primary Responsible Party	56.800000	-167.383333	80.2	129030
Diesel1122991840140727PRINCE WILLIAM SOUND	Gallons	7/3/2011	5/7/2012	Other	60.963167	-146.754500	0.4	716
Diesel1122991870140730Gulf of Alaska	Gallons	7/6/2011	7/22/2011	Primary Responsible Party	59.923333	-148.450000	1.3	2027
Diesel1125991880240731DUTCH HARBOR	Gallons	7/7/2011	8/18/2011	Pot Resp Party	53.839333	-166.575167	0.3	562
Diesel1111991910140734Tongass Narrows	Gallons	7/10/2011	7/14/2011	Primary Responsible Party	55.130000	-131.400000	0.4	679
Diesel1122992180140761PRINCE WILLIAM SOUND	Gallons	8/6/2011		Primary Responsible Party	60.602350	-145.792683	0.0	0
Diesel1111992290140772Chatham Strait North	Gallons	8/17/2011	9/30/2011	Primary Responsible Party	57.717140	-134.816670	3.3	5342
Diesel1124992400140783KODIAK CITY	Gallons	8/28/2011	8/31/2011	Primary Responsible Party	57.788889	-152.402778	0.0	17
Lube oil1124992400140783KODIAK CITY	Gallons	8/28/2011	8/31/2011	Primary Responsible Party	57.788889	-152.402778	0.0	17
Diesel1138992530140796NOME CITY	Gallons	9/10/2011	11/25/2011	Primary Responsible Party	0.000000	0.000000	0.0	0
Jet fuel836140807Diomede Islands, AK	Gallons				0.000000	0.000000	1.7	2809
Diesel1124992640140807AFOGNAK IS.	Gallons	9/21/2011	10/5/2011	Primary Responsible Party	58.454750	-152.687417	0.3	511
Bunker fuel1125992710140814CENTRAL CHAIN	Gallons	9/28/2011	4/17/2012	Primary Responsible Party	53.540000	-166.314800	0.1	100
Diesel1111992790140822Chatham Strait North	Gallons	10/6/2011	10/10/2011	Primary Responsible Party	57.869254	-134.823990	3.8	6179
Multiple: diesel & bunker C837940882Aleutian Islands, Alask	Gallons				0.000000	0.000000	34.8	56014
Multiple: diesel & jet fuel838540895NE Gulf of Alaska	Gallons				0.000000	0.000000	27.4	44093
Multiple: diesel & gasoline838940898Winter fuel delivery to N	Gallons				0.000000	0.000000	0.6	915
Diesel1211990230140931Tongass Narrows	Gallons	1/23/2012		Primary Responsible Party	55.399020	-131.725400	0.2	396
Diesel1211990230240931Tongass Narrows	Gallons	1/23/2012	4/5/2012	Primary Responsible Party	55.342369	-131.656341	0.0	0
Multiple: diesel, lube oil, hydraulic fluid & antifreeze83994093	Gallons				0.000000	0.000000	13.3	21348
Diesel1224990250140933KODIAK UNKNOWN	Gallons	1/25/2012	3/15/2012	Primary Responsible Party	56.850000	-154.200000	2.0	3260
Diesel1225990570140965EASTERN CHAIN	Gallons	2/26/2012		Primary Responsible Party	53.462500	-168.359167	0.4	617
Diesel1223990600140968SOUTH COOK INLET	Gallons	2/29/2012	2/29/2012	Primary Responsible Party	60.038333	-151.874667	5.5	8848
Diesel1211990630140971Juneau / Douglas	Gallons	3/3/2012		Primary Responsible Party	58.398217	-134.751383	0.2	313
Diesel1224991600141068CHINIAK CDP	Gallons	6/8/2012	6/25/2012	Primary Responsible Party	57.756000	-152.432000	1.2	1860
Diesel1223991660341074HOMER CITY	Gallons	6/14/2012	6/21/2012	Primary Responsible Party	59.600000	-151.420000	0.1	91
Diesel1224991700141078SHELIKOF STRAIT	Gallons	6/18/2012		Primary Responsible Party	0.000000	0.000000	1.8	2943
Ammonia847441096Dutch Harbor, AK	Gallons				0.000000	0.000000	0.0	0
Diesel848441117Cape Chacon, SE Alaska	Gallons				0.000000	0.000000	4.3	6898
Diesel1211992110141119Clarence Strait South	Gallons	7/29/2012		Primary Responsible Party	54.380000	-132.070000	1.2	1888

ID	spillname	SubArea
Diesel07249900801390090SHELIKOF STRAIT	01/08/2007 F/V Hunter Sinking	Kodiak Island
Diesel0724990120139094KODIAK CITY	01/12/2007 Blackjack Partnership	Kodiak Island
Diesel0722991970139279P.W.S. UNKNOWN	07/16/2007 F/V Miss Carol Sinking	Prince William Sound
Diesel9722992020135632P.W.S. UNKNOWN	49ER BARGE FNT 255	Prince William Sound
Diesel1025990110140189WESTERN CHAIN	Adak Petroleum Tank N7 Diesel Spill	Aleutian
Diesel817540189Adak Island, Aleutian Isls, Alaska	Adak Petroleum tank release	Aleutian
Bunker fuel0711993250139407Tongass Narrows	Ak Trams Bunker Oil Spill	Southeast Alaska
Other9525992220134921AKUTAN	AKUTAN FISH OIL SPILL 8/10/95	Aleutian
Diesel1011990220140200Holkham Bay Area	Alaska Adventurer Grounding	Southeast Alaska
Propylene glycol1011991530140331Juneau / Douglas	Alaskan Brewery Propylene glycol spill	Southeast Alaska
Diesel9811991990135994Icy Strait	AMIGO III SPILL	Southeast Alaska
Asphalt0211992260137482Ketchikan Region NOS	AML Barge Asphault Spill	Southeast Alaska
Gasoline9711993430135773Sitka Sound	ANB GASOLINE	Southeast Alaska
Diesel0211990870237343Tongass Narrows	Andres Oil Co., Ktkn	Southeast Alaska
Diesel0611990930438810Yakutat Bay	Anthony Johnson Jr. spill, Yakutat	Southeast Alaska
Ammonia (anhydrous)9625992490135313EASTERN CHAIN	ARCTIC ENTERPRISE AMMONIA	Aleutian
Bunker fuel0525990130138365ATTU	Attu Tarballs - Mystery Spill	Aleutian
Multiple: diesel & gasoline122038251Auke Bay, AK	Auke Bay	Southeast Alaska
Diesel0911992160140029Tongass Narrows	Bar harbor unknown	Southeast Alaska
Other9711990560235486Tongass Narrows	BARGE KFP-1	Southeast Alaska
Gasoline0923991470139960KENAI GAS FIELD	Barge SCT 282	Cook Inlet
Hydraulic oil0825990450139492S.E. BERING SEA	Bearing Sea Trident Seafoods Hydraulic	Aleutian
Diesel9811992850136080Glacier Bay	BRANT CONTRACTORS, GLACER BAY	Southeast Alaska
Ballast Water (containing oil)0222993460137602VALDEZ MARINE TERMINAL-LAND	BWT East Manifold A Header Leak	Prince William Sound
Diesel0725993510139433DUTCH HARBOR	C/P BARANOF(D598508)Internal Diesel X-fer Overflow	Aleutian
Diesel0739991530639235WEST NORTH SLOPE	Cape Simpson 1st spill this day	North Slope
Diesel0024991460136671WOMENS BAY	CG CUTTER MORGANTHAL	Kodiak Island
Gasoline0411992690138255Auke Bay / Fritz Cove	CG Morale Boats	Southeast Alaska
Diesel9826991130135908CHIGNIK CITY	CHIGNIK PRIDE FISHERIES	Aleutian
Bilge Oil9711993080235738Tongass Narrows	CITY FLOAT SLICK	Southeast Alaska
Other0522991150138467VALDEZ	City of Valdez Sewage release	Prince William Sound
Diesel9811981060235901Tongass Narrows	City pump station	Southeast Alaska
Diesel0425992130138199ALEUTIAN E. UNKNOWN	Clipper Odyssey Grounding	Aleutian
Ammonia (anhydrous)9711992770135707Cordova Bay	COASTAL TRADER	Southeast Alaska
Lube oil9811991620135957Lynn Canal South	COMET BEACH BLACK OIL	Southeast Alaska
Crude0423993020138288CENTRAL COOK INLET	Cook Inlet Oil Stringers	Cook Inlet
Other0023992640136789WHITTIER	CROWLEY AMMONIUM NITRATE	Prince William Sound
DieselNOAA ID 12238251Auke Bay / Fritz Cove	DeHarts Marina, Auke Bay	Southeast Alaska
Diesel0525992450138597CENTRAL CHAIN	Delta Western Dutch Harbor Tank 8 Diesel Spill	Aleutian
Middle Ground Shoal crude oil744336456right at the Forelands in Cook Inlet	Dillon Pipeline	Cook Inlet
Diesel0111991790137070Gastineau Channel	DONOHUES MARINA	Southeast Alaska
Diesel0122991290137020P.W.S. UNKNOWN	DUNLOP TOWING - TUG MALOLO	Prince William Sound
Hydraulic oil0939990800239893KUPARUK	ENI Petroleum Hydraulic Oil	North Slope
Diesel0411993230238309Ketchikan	Erma Bird HHOT Spill	Southeast Alaska
Bunker fuel1125992710140814CENTRAL CHAIN	F/S Nelson Star Dutch Harbor	Aleutian
Ammonia (anhydrous)0423990700138056HOMER CITY	F/T Aurous Ammonia	Cook Inlet
Diesel0811990480139495Craig / Klawock area waters	F/T Westward Aground POW	Southeast Alaska
Diesel0825990830139530EASTERN CHAIN	F/V Alaska Ranger Sinking	Aleutian
Diesel9925990510136211AKUTAN	F/V ALASKAN PACKER - AKUTAN	Aleutian
Diesel707734715Dixon Entrance, southeast Alaska	F/V Alaskan Star	Southeast Alaska
Diesel0711992300239312Revillagigedo Channel	F/V Aldebaran sinking	Southeast Alaska
Diesel1125990460140589UNALASKA	F/V Aleutian Lady spill	Aleutian
Diesel9924992620136422OLD HARBOR CITY	F/V ALEXANDRIA SEA	Kodiak Island
Diesel0523992380138590EAST KENAI UNKNOWN	F/V Alliance Sinking	Cook Inlet
Diesel0711990680139150Gastineau Channel	F/V Alrita, sinking	Southeast Alaska
Diesel794539817Aghiyuk Island, W. Gulf of Alaska	F/V American Way	Kodiak Island
Diesel0825991570139604FALSE PASS	F/V Andromeda Sinking False Pass	Aleutian
Diesel9511992210234920Dixon Entrance	F/V ANNA-K	Southeast Alaska
Diesel9511993320135031Sumner Strait	F/V ANTLER	Southeast Alaska
Diesel1122992180140761PRINCE WILLIAM SOUND	F/V Arctic Lady grounding	Prince William Sound

ID	spillname	SubArea
Diesel0211992070137463Clarence Strait North	F/V Arctic Sun	Southeast Alaska
Diesel9622993200135384HINCHINBROOK IS.	F/V AUNT BRIDGATE	Prince William Sound
Diesel9723992200135650SOUTH COOK INLET	F/V BLUE FOX 8/97	Cook Inlet
Diesel9624990310135095OUZINKIE CITY	F/V BLUE FOX KODIAK	Kodiak Island
Diesel9725991520135582EASTERN CHAIN	F/V BLUE NORTH	Aleutian
Diesel0025993280136853SAND POINT	F/V BOWFIN	Aleutian
Hydraulic oil0525993550138707WESTERN CHAIN	F/V Bristol Leader Hydraulic Oll Spill	Aleutian
Gasoline9611990050135069Clarence Strait North	F/V CAPE CHACON	Southeast Alaska
DieselNOAA ID 82340385PRINCE WILLIAM SOUND	F/V Cape Cross - Main Bay	Prince William Sound
Diesel1022991390140317MONTAGUE ISLAND	F/V Cape Spencer sank	Prince William Sound
Diesel9923991570136317EAST KENAI UNKNOWN	F/V CAPRICE	Cook Inlet
Diesel0925993030140116EASTERN CHAIN	F/V Carley Renee Rollover and Sinking	Aleutian
Diesel9811990180135813Gastineau Channel	F/V CAROL ANN	Southeast Alaska
Diesel0611992160138933Clarence Strait North	F/V Carrie Sinking	Southeast Alaska
Diesel0011992350236760Portland Canal	F/V CASPER	Southeast Alaska
Diesel0024992040136729SHELIKOF STRAIT	F/V CHANNEL SURFER	Kodiak Island
Diesel0111991200337011Clarence Strait North	F/V CHATHAM	Southeast Alaska
Diesel0111992560137147Gastineau Channel	F/V CHEROKEE MAID	Southeast Alaska
Diesel9623991510135215KENAI CITY	F/V CIP - NEW DAY	Cook Inlet
Diesel9925991280136288CENTRAL CHAIN	F/V CONTROLLER BAY	Aleutian
Diesel1122991870140730Gulf of Alaska	F/V Copasetic	Prince William Sound
Diesel9911992260136386<Null>	F/V CREST	Southeast Alaska
Diesel9811992150136010Sitka Sound	F/V CRISTA LEE, SITKA	Southeast Alaska
Diesel0224992690137525AFOGNAK IS.	F/V Dakota Sinking	Kodiak Island
Diesel9624990950135159CHINIAK CDP	F/V DESIREE C. KODIAK	Kodiak Island
Diesel0024991110136636SHELIKOF STRAIT	F/V DESTINY SINKING	Kodiak Island
Diesel0426991080138094BRISTOL BAY UNKNOWN	F/V Dolphin Diesel	Bristol Bay
Diesel0811990160139463Sumner Strait	F/V Dolphin Grounding, POW	Southeast Alaska
Diesel109437853Tanglefoot Bay, AK	F/V Donna Ann Grounding	Kodiak Island
Diesel9822991520235947CORDOVA	F/V DOVE	Prince William Sound
Gasoline9724993370135767KODIAK CITY	F/V DUDEK 'KAZUB ONE'	Kodiak Island
Diesel9624991070135171KODIAK UNKNOWN	F/V DUTCHESS - KODIAK	Kodiak Island
Diesel0111992130237104Cordova Bay	F/V EDITH H. GRACIE	Southeast Alaska
Diesel9625991160235180EASTERN CHAIN	F/V ELIZABETH F. KING COVE	Aleutian
Diesel0011992280236753Craig / Klawock area waters	F/V ERIN LYNN	Southeast Alaska
Diesel0824990630339510KODIAK CITY	F/V Erin Lynn Diesel Overfill	Kodiak Island
Diesel9611991010135165Dixon Entrance	F/V EVELYN MARY LOUISE	Southeast Alaska
Diesel0725990260239472CENTRAL CHAIN	F/V Exito Adak Harbor	Aleutian
Diesel0725990770139159ADAK	F/V Exodus Explorer	Aleutian
Diesel9726991420235572LEVELOCK CDP	F/V FOGGY CAPE - LEVELOCK	Bristol Bay
Diesel0211992880137544Wrangell Narrows	F/V Foggy Cape, Petersburg	Southeast Alaska
Diesel9611992780135342Gastineau Channel	F/V FRANCIS IV	Southeast Alaska
Diesel0011992320136757Wrangell area waters	F/V FRISCO	Southeast Alaska
Diesel0224993140137570AFOGNAK IS.	F/V Genei Maru #7 Grounding	Kodiak Island
Diesel0611993230139040Tongass Narrows	F/V Gloria T sinking	Southeast Alaska
Gasoline1122991500140693Gulf of Alaska	F/V Gulkana capsize	Prince William Sound
Diesel1224990250140933KODIAK UNKNOWN	F/V Heritage	Kodiak Island
Diesel0925991020139915CENTRAL CHAIN	F/V Heritage Adak Harbor	Aleutian
Diesel0611990310138748Cape Edgecumbe to Icy Bay	F/V HERMES II Sinking	Southeast Alaska
Diesel0624990130138730KODIAK UNKNOWN	F/V Horizon Ocean Bay	Kodiak Island
Diesel0025992830236808DUTCH HARBOR	F/V HUSKY	Aleutian
Diesel1122991840140727PRINCE WILLIAM SOUND	F/V Ice Maiden sank	Prince William Sound
Diesel925990560139869AKUTAN CITY	F/V ICY MIST grounding NW Akutan Island	Aleutian
Used Oil (all types)9511990120134711Portland Canal	F/V IDEAL	Southeast Alaska
Diesel0725990410139123UNALASKA	F/V Illusion Sinking	Aleutian
Diesel0925992150140028SAINT PAUL IS.	F/V INTREPID (fuel tank overflow) St Paul Harbor	Aleutian
Diesel1026992260140404NUSHAGAK	F/V Intrepid Sinking	Bristol Bay
Diesel9923991900536350HOMER CITY	F/V IRISH - N. COUNTRY HALIBUT	Cook Inlet
Diesel1011991400140318Sitka Sound	F/V Ironwood	Southeast Alaska
Diesel1011993420140520Craig / Klawock area waters	F/V Izzy B fire	Southeast Alaska

ID	spillname	SubArea
Diesel9811992310336026Chatham Strait North	F/V JACKIE R	Southeast Alaska
Diesel0724990510139133SHELIKOF STRAIT	F/V Jade Alaska Sinking	Kodiak Island
Diesel0111992440137135Sumner Strait	F/V JOCELYN	Southeast Alaska
Diesel0922993510140164VALDEZ	F/V Johnni J founder at slip	Prince William Sound
Diesel9511991980134897Chatham Strait North	F/V JOSEPH	Southeast Alaska
Diesel0722992540139336PRINCE WILLIAM SOUND	F/V Kapella Fire	Prince William Sound
Gasoline0722992540139336PRINCE WILLIAM SOUND	F/V Kapella Fire	Prince William Sound
Diesel0622992410138958PRINCE WILLIAM SOUND	F/V Karen Marie - Diesel Spill to Water	Prince William Sound
Gasoline9823992000135995HOMER CITY	F/V K-BAY 7 SPILL	Cook Inlet
Diesel0125991310137022COLD BAY	F/V KRISTEN	Aleutian
Diesel719035480Akun Island, Aleutian Island Chain, Alaska	F/V Lisa Jo	Aleutian
Diesel9711991770135606Clarence Strait North	F/V LIZ THORNE BAY	Southeast Alaska
Diesel9625991820135246CENTRAL CHAIN	F/V LOWBOY	Aleutian
Bilge Oil9725992680235698EASTERN CHAIN	F/V MARIA N.	Aleutian
Diesel9622992150235279EVANS ISLAND	F/V MARTIE	Prince William Sound
Diesel9822990830135878PORT OF VALDEZ	F/V MATT GUNN	Prince William Sound
Diesel9527991860134885Eek	F/V MATTIE-O	Western Alaska
Diesel9625992450135309KING COVE CITY	F/V MELANIE	Aleutian
Diesel0224990170137273AFOGNAK IS.	F/V Meridian sinking	Kodiak Island
Diesel9822991480135943CULROSS IS.	F/V MERIT FIRE/SINKING	Prince William Sound
Diesel9611992300135294Sitka Sound	F/V MERLE ELAINE	Southeast Alaska
Diesel1124990420140585SHELIKOF STRAIT	F/V Midnite Sun Grounding	Kodiak Island
Hydraulic oil1124990420140585SHELIKOF STRAIT	F/V Midnite Sun Grounding	Kodiak Island
Diesel709934865Kupreanof Island, Alaska	F/V Miss Doreen	Southeast Alaska
Diesel0311991890237810Sitka Sound	F/V Miss Everett	Southeast Alaska
Diesel0011992290136754Annette Island	F/V MISS TRACY	Southeast Alaska
Diesel9924993100136470OLD HARBOR CITY	F/V MITROPHENIA	Kodiak Island
Diesel9811992780136073Cross Sound	F/V MYRTLE	Southeast Alaska
Diesel1225990570140965EASTERN CHAIN	F/V Neptune I Grounding Unimak Island Alaska	Aleutian
Diesel9911992430236403Annette Island	F/V NICOLE MARIE	Southeast Alaska
Diesel0722992020139284PRINCE WILLIAM SOUND	F/V Nordic Viking grounding	Prince William Sound
Diesel610038910Sitka, AK	F/V Norqueen	Southeast Alaska
Diesel1022991100140288Middleton Island	F/V Northern Belle sank	Prince William Sound
Diesel0625990540138771CENTRAL CHAIN	F/V Northern Dawn	Aleutian
Diesel0622992250138942PRINCE WILLIAM SOUND	F/V Northern Endurance Grounding	Prince William Sound
Hydraulic oil9525992480234947DUTCH HARBOR	F/V NORTHERN VICTORY	Aleutian
Diesel9525992030234902CENTRAL CHAIN	F/V NORTHERN WIND 7/22/95	Aleutian
Diesel9825992240136019CENTRAL CHAIN	F/V NOWITNA	Aleutian
Diesel1125991880240731DUTCH HARBOR	F/V Ocean ALaskan 100 gal Diesel Spill Captain Bay	Aleutian
Diesel0011992420136767Tongass Narrows	F/V OLIVUS	Southeast Alaska
Diesel9525992900134989CENTRAL CHAIN	F/V OLYMPIC	Aleutian
Diesel9525992880134987EASTERN CHAIN	F/V OLYMPIC - DUTCH HARBOR	Aleutian
Hydraulic oil9811991970135992Tongass Narrows	F/V PANDAD	Southeast Alaska
Diesel0911992200140033Chatham Strait North	F/V Patty J Grounding	Southeast Alaska
Diesel0511992530138605Icy Strait	F/V Perseverance Grounding	Southeast Alaska
Diesel9625991570235221CENTRAL CHAIN	F/V PROVIDER	Aleutian
Diesel9625992980235362EASTERN CHAIN	F/V REBECCA B. AGROUND	Aleutian
Diesel9726991390135569BRISTOL BAY	F/V REBECCA IRENE	Bristol Bay
Diesel0425990290138015DUTCH HARBOR	F/V Rebecca Irene Diesel	Aleutian
Diesel9511992510234950Chichagof Island NOS	F/V RELIEF	Southeast Alaska
Diesel9724992420135672KODIAK CITY	F/V RENEGADE	Kodiak Island
Diesel0111992360137127Chatham Strait North	F/V REVENGE II	Southeast Alaska
Diesel9911991670136327Sumner Strait	F/V REWARD	Southeast Alaska
Diesel0911992140140027Port Frederick	F/V Robetta J bilge discharge	Southeast Alaska
Diesel0324991500137771KODIAK UNKNOWN	F/V Rocona II sinking	Kodiak Island
Diesel9725992510135681DUTCH HARBOR	F/V RONNY AGROUND	Aleutian
Diesel0025991730136698SAND POINT	F/V SABRINA	Aleutian
Diesel9811991070135902Tenakee Inlet	F/V SAMAQU	Southeast Alaska
Diesel1224991700141078SHELIKOF STRAIT	F/V Scandia Sinking	Kodiak Island
Diesel9811991750135970Stephens Passage South	F/V SEA QUEST, GRAVES PT., STE	Southeast Alaska

ID	spillname	SubArea
Diesel9822993580136153VALDEZ	F/V SEA VENTURE	Prince William Sound
Diesel0624990370138754KODIAK CITY	F/V Sea Warrior Diesel	Kodiak Island
Diesel0911991070239920Clarence Strait North	F/V Sea-Fareer sinking	Southeast Alaska
Diesel0111992310137122Chatham Strait North	F/V SEAGULL SINKING	Southeast Alaska
Diesel9511991110134810Tongass Narrows	F/V SHENANEGAN	Southeast Alaska
Diesel9725992110135641ALEUTIAN E. UNKNOWN	F/V SILENT LADY, SAND POINT	Aleutian
Diesel9711991800335610Revillagigedo Channel	F/V SPARE PARTS II	Southeast Alaska
Diesel9823992690136064CENTRAL COOK INLET	F/V SPUTKIN	Cook Inlet
Diesel741136342Sitka Sound	F/V Su-Ce K	Southeast Alaska
Diesel9524992230134922KODIAK UNKNOWN	F/V SUMMER GAIL	Kodiak Island
Diesel0423990590138045HOMER CITY	F/V Susitna Diesel	Cook Inlet
Diesel0524992070138559KODIAK UNKNOWN	F/V Sylvia Star Sinking	Kodiak Island
Diesel0011992360236761Cape Edgecumbe to Icy Bay	F/V TAMARA	Southeast Alaska
Diesel829040582Unalaska Isl., Aleutian Isl., Alaska	F/V Terrigail	Aleutian
Diesel1125990390140582EASTERN CHAIN	F/V TERRIGALE Grounding Alimuda Bay	Aleutian
Hydraulic oil1125990390140582EASTERN CHAIN	F/V TERRIGALE Grounding Alimuda Bay	Aleutian
Diesel0411993620238348Chatham Strait North	F/V Tillie H capsizing	Southeast Alaska
Diesel9725990950135525AKUTAN CITY	F/V TRAIL BLAZER	Aleutian
Diesel0926991560139969BRISTOL BAY UNKNOWN	F/V Two Boys sinking	Bristol Bay
Ammonia (anhydrous)0926992670140080CHIGNIK CITY	F/V UNIMAK grounded NW David Island 800gal+ Spill	Aleutian
Diesel0926992670140080CHIGNIK CITY	F/V UNIMAK grounded NW David Island 800gal+ Spill	Aleutian
Used Oil (all types)0926992670140080CHIGNIK CITY	F/V UNIMAK grounded NW David Island 800gal+ Spill	Aleutian
Diesel0322992300137851P.W.S. UNKNOWN	F/V Valiant Maid	Prince William Sound
Diesel0824990400139487KODIAK CITY	F/V Velocity Capsize	Kodiak Island
Diesel0122990300136921EVANS ISLAND	F/V VETER	Prince William Sound
Diesel9724992680135698KODIAK CITY	F/V VICTORIA ANNE	Kodiak Island
Bilge Oil9925991110136271SAND POINT	F/V VIKING EXPLORER 4/21/99	Aleutian
Diesel9911991940136354Lynn Canal South	F/V WANDERER	Southeast Alaska
Diesel0111992390137130Annette Island	F/V WESTERN II	Southeast Alaska
Diesel0211990490137305Tongass Narrows	F/V Westward Sinking/Bar Harbor	Southeast Alaska
Diesel0411990340138020Yakutat Bay	F/V Wild Coho	Southeast Alaska
Diesel9911981370136297Craig / Klawock area waters	F/V WINDWARD	Southeast Alaska
Diesel0722991540139236P.W.S. UNKNOWN	F/V Windward Diesel	Prince William Sound
Diesel0122992160137107P.W.S. UNKNOWN	F/V WINDY BAY	Prince William Sound
Ammonia (anhydrous)9925991260136286ADAK	F/V YING FA, ADAK	Aleutian
Diesel0811993160139763Tongass Narrows	F/V Zenith sinking	Southeast Alaska
Diesel1011992630140441Sitka Sound	F/V Zimovia Sinking	Southeast Alaska
Used Oil (all types)9811990790135874Portland Canal	F/V/UNNAMED, KEKU STRAIT, KAKE	Southeast Alaska
Diesel9827992270136022Napakiak	FAULKNER TUG OVERTURNED	Western Alaska
Diesel1111990830140626Tongass Narrows	Ferry hhot release	Southeast Alaska
Kerosene0611991000138817Gastineau Channel	Fuel Barge SCT 282, Juneau	Southeast Alaska
Other9611992020135266Chatham Strait North	FUNTER BAY MYSTERY	Southeast Alaska
Diesel0822991150139562PORT OF VALDEZ	FV City of Seldovia capsize	Prince William Sound
Diesel1011992390140417Wrangell Narrows	FV Emily Jane Sinking	Southeast Alaska
Multiple: diesel, lube oil & hydraulic oil798339869Akutan Isl., Eastern Aleutians, Alaska	FV Icy Mist	Aleutian
Diesel1111992790140822Chatham Strait North	FV Jager sinking	Southeast Alaska
Diesel0722992130139295ESTHER IS.	FV JOHNITA grounded-fire-sank Ester Is Whittier AK	Prince William Sound
Diesel1111991910140734Tongass Narrows	FV Legend grounding/fire	Southeast Alaska
Diesel1111992290140772Chatham Strait North	FV Mabel Capsize	Southeast Alaska
Diesel848441117Cape Chacon, SE Alaska	FV Mary Kay	Southeast Alaska
Diesel0911992830140096Sitka Sound	FV Rascal Sinking	Southeast Alaska
Diesel1211992110141119Clarence Strait South	FV The View Point sinking	Southeast Alaska
Diesel0611992700138987Duncan Canal	FV Top Notch	Southeast Alaska
Other9711991590235589Gastineau Channel	GALAXY SEWAGE DISCHARGE	Southeast Alaska
Diesel0311990060237627Sitka Sound	Gary Jarvil, M/V CJ, Sitka	Southeast Alaska
Other9811992670336062Gastineau Channel	GASTINEAU CHANAL MYSTERY	Southeast Alaska
Unknown9811992650136060Lynn Canal South	GASTINEAU CHANAL MYSTERY SPILL	Southeast Alaska
Diesel0111991790337070Tongass Narrows	Gateway Forest Products	Southeast Alaska
Diesel0111992050137096Glacier Bay	GBNP GENSET	Southeast Alaska
Bunker fuel720135560George Inlet, Ketchikan, Alaska	George Inlet Cannery	Southeast Alaska

ID	spillname	SubArea
Diesel1211990630140971Juneau / Douglas	Glacier Highway 17095, HHOT	Southeast Alaska
Other0023992310136756NORTH COOK INLET	GRANITE POINT TANK FARM	Cook Inlet
Diesel9811991910235986Gastineau Channel	GYPSY SAIL BOAT	Southeast Alaska
Asphalt emulsion722335661Haines, Alaska	Haines Dock Asphalt Spill	Southeast Alaska
Unknown9611990680135132Wrangell area waters	HARBOR DEPT	Southeast Alaska
Diesel0711990120139094Revillagigedo Channel	Heitman Homeheating Oil Tank Release	Southeast Alaska
Diesel0511993040138656Ketchikan	Hoadley Creek Unknown	Southeast Alaska
Diesel0611993010139018Hollis	Hollis Bay Unknown	Southeast Alaska
Used Oil (all types)9623992270135291HOMER CITY	HOMER HARBOR WASTE OIL	Cook Inlet
Ammonia731235977Homer, Alaska	Icicle Seafoods	Cook Inlet
Diesel0624991380138855KODIAK CITY	International Seafoods Kodiak Boiler Fuel Oil	Kodiak Island
Other0011991330136658Gastineau Channel	JUBILEE GRAY WATER	Southeast Alaska
Diesel0311992500137871Auke Bay / Fritz Cove	Juneau Ferry Terminal Spill	Southeast Alaska
Used Oil (all types)9611993190135383Gastineau Channel	JUNEAU HARBOR MASTERS SPILL	Southeast Alaska
Gasoline9811990820835877Portland Canal	KAKE CITY BOAT HARBOR, MYSTERY	Southeast Alaska
Diesel9711990420135472Portland Canal	KAKE FUEL DOCK - 2" line	Southeast Alaska
Gasoline0011990250136550Portland Canal	KAKE TRIBAL FUELS	Southeast Alaska
Diesel0023993350136860KENAI CITY	KENAI DIESEL	Cook Inlet
Optimer 7128 cation flocculant, or ethyl oxylated alcohol715635360Ward Cove, Ketchikan, Alaska	Ketchikan Pulp Mill Chemical Release	Southeast Alaska
Diesel9611992080135272Dixon Entrance	KINCOLITH DIESEL	Southeast Alaska
Diesel9824990660135861KODIAK CITY	KODIAK CG CUTTER STORIS	Kodiak Island
Jet fuel9624993520135416KODIAK CITY	KODIAK COAST GUARD 800 GAL JP	Kodiak Island
Diesel9811983140136109Tongass Narrows	KRD	Southeast Alaska
Jet fuel0823990900139537COOK INLET	K-Sea POL # 1 Jet Fuel 3.30.08	Cook Inlet
Diesel1223990600140968SOUTH COOK INLET	K-Sea Transportation barge day tank release	Cook Inlet
Unknown0211993280137584Tongass Narrows	Ktn. Dry Dock Unknown	Southeast Alaska
Diesel9511992990234998Sumner Strait	LABOUCHERE BAY	Southeast Alaska
Diesel9811993130136108Gastineau Channel	LANDING CRAFT KRD	Southeast Alaska
Diesel9911981040136264Tongass Narrows	LCM 8550	Southeast Alaska
Multiple: diesel & engine room slops740636323Dundas Bay, Alaska	M/V Wilderness Adventurer	Southeast Alaska
Diesel0622991720138889Middleton Island	M/V Aleutian Founder Diesel Bilge Release	Prince William Sound
Multiple: diesel & bunker C717435424Aleutian Island chain, Alaska	M/V Baneasa	Aleutian
Diesel0411992830238269Cape Edgecumbe to Icy Bay	M/V BLUE STAR	Southeast Alaska
Diesel0411991610238147Hydaburg / Tlevak	M/V Captain Jack Grounding	Southeast Alaska
Diesel9611992120135276Tongass Narrows	M/V C-CHIEF	Southeast Alaska
Diesel1211990230140931Tongass Narrows	m/v Chrissara sinking	Southeast Alaska
Diesel1223991660341074HOMER CITY	M/V DANIEL D TAKAK Grounding	Cook Inlet
Diesel9811991500235945Glacier Bay	M/V KINGFISHER	Southeast Alaska
Bunker fuel9725993300135760EASTERN CHAIN	M/V KUROSHIMA	Aleutian
IFO-380501135760Unalaska Island, Alaska	M/V Kuroshima	Aleutian
Diesel9711992680235698Cape Edgecumbe to Icy Bay	M/V LADY NINA	Southeast Alaska
Diesel0911990300139843Chatham Strait South	M/V Lituya Grounding	Southeast Alaska
Diesel9811993160236111Sitka Sound	M/V MELAINE D	Southeast Alaska
Diesel0923990150139828NORTH COOK INLET	M/V Monarch Sinking	Cook Inlet
Other0923990150139828NORTH COOK INLET	M/V Monarch Sinking	Cook Inlet
Diesel1224991600141068CHINIAK CDP	M/V Monterrey Fuel Tank Release	Kodiak Island
Diesel710634904Sequam Island, Aleutian Island chain, Alaska	M/V Northern Wind	Aleutian
Diesel789839718Mekoryuk village beach, Nunivak Isl., AK	M/V Nunaniq	Western Alaska
Diesel0311990060537627Tongass Narrows	M/V Realm	Southeast Alaska
Lube oil9925991300136290COLD BAY	M/V RED FIN	Aleutian
Diesel0425993430138329EASTERN CHAIN	M/V Selendang Ayu	Aleutian
IFO-3800425993430138329EASTERN CHAIN	M/V Selendang Ayu	Aleutian
Ammonia (anhydrous)9625992860135350EASTERN CHAIN	M/V STORFJORD AMMONIA	Aleutian
Diesel0723991370139219WHITTIER	M/V TRADITION sinking Whittier AK	Prince William Sound
Diesel0122992070137098PRINCE WILLIAM SOUND	M/V VANGUARD SINKING	Prince William Sound
Diesel9611992090135273Tongass Narrows	M/V VARSITY	Southeast Alaska
Diesel9726992240135654KING SALMON CDP	M/V WHITE GOLD	Bristol Bay
Diesel9911991630136323Glacier Bay	M/V WILDERNESS ADVENTURER	Southeast Alaska
Jet fuel0625990440138761WESTERN CHAIN	Magone Marine Dutch Harbor Mud Slide Event	Aleutian
Diesel0625990440138761WESTERN CHAIN	Magone Marine Dutch Harbor Mud Slide Event	Aleutian

ID	spillname	SubArea
Diesel714235224Juneau, Alaska	Mendenhall Wetlands	Southeast Alaska
Ammonia (anhydrous)749536677Dutch Harbor, Unalaska Island, Aleutian Island chain	MV Arctic Wind	Aleutian
Diesel732536039Womens Bay, Kodiak, Alaska	MV Cape Douglas	Kodiak Island
Diesel742236368Tracy Arm, AK	MV Spirit of 98	Southeast Alaska
Other0011991480136673Gastineau Channel	MV/ JUBILEE	Southeast Alaska
Other9827991890135984St. Matthew Island	MV/ MILOS REEFER ST. MATTHEWS	Western Alaska
Unknown0111990850236976Tongass Narrows	Mystery Drums	Southeast Alaska
Diesel9911993470236507Tongass Narrows	MYSTERY SHEEN BAR HARBOR	Southeast Alaska
Bilge Oil0822991720139619PRINCE WILLIAM SOUND	Mystery Sheen west of Storey Island Prince William Sound	Prince William Sound
Gasoline0023990190136544WEST CENTRAL KENAI	NIKISKI TESORO	Cook Inlet
Diesel1211990230240931Tongass Narrows	Nordic Tug sinking	Southeast Alaska
Ammonia (anhydrous)0211990590137315Tongass Narrows	Norquest Ammonia KTKN	Southeast Alaska
Diesel9511992340134933Wrangell Narrows	NORQUEST FISHERIES	Southeast Alaska
Diesel0025993540136879DUTCH HARBOR	NORTH PACIFIC FUEL, RESOFF FAC	Aleutian
Diesel0311990090137630Juneau / Douglas	Northland Services Facility	Southeast Alaska
Diesel0624991110138828KODIAK UNKNOWN	Ocean Beauty Seafoods Diesel	Kodiak Island
Diesel0725990830139165CENTRAL CHAIN	Ocean Fury Bilge Spill	Aleutian
Diesel0225990070137263DUTCH HARBOR	OSI Dock Dutch Diesel	Aleutian
Drilling Muds0223993330137589NORTH COOK INLET	Osprey Platform Mud	Cook Inlet
Diesel9911990060136166Gastineau Channel	P/C BEE BOP FIRE	Southeast Alaska
Diesel9711992260235656Tongass Narrows	P/C STEAMER	Southeast Alaska
Diesel0923990440139857SEWARD CITY	P/C The Forty Niner sinking	Cook Inlet
Diesel120038199Baby Island, AK	P/V Clipper Odyssey	Aleutian
Diesel0125992600137151DUTCH HARBOR	PACIFIC STAR DIESEL	Aleutian
Diesel0411990720138058Chichagof Island NOS	Pelican Seafoods Overfill	Southeast Alaska
Diesel0811990420339489PELICAN CITY	Pelican Utiltiy District Fuel Line	Southeast Alaska
Diesel0711990380139120Wrangell Narrows	Petersburg Harbor Mystery	Southeast Alaska
Diesel9811981480235943Tongass Narrows	PETRO ALASKA	Southeast Alaska
Jet fuel9611991390135203Tongass Narrows	PETRO MARINE - AV GAS	Southeast Alaska
Diesel0211992060137462Tongass Narrows	Petro Marine Diesel Spill	Southeast Alaska
Diesel0011990980236623Tongass Narrows	PETRO MARINE DOCK SPILL	Southeast Alaska
Jet fuel0011991870236712Tongass Narrows	PETRO MARINE FUEL MANIFOLD	Southeast Alaska
Diesel0111991650237056Lynn Canal North	Petro Marine Skagway Plant	Southeast Alaska
Diesel0211992370237493Cordova Bay	Phoenix Logging Co.	Southeast Alaska
Jet fuel0824990050139452WOMENS BAY	Piper PA-31 Plane Crash end of Runway 25 Kodiak	Kodiak Island
Gasoline0711992490239331Wrangell area waters	PM230 unleaded gas spill	Southeast Alaska
Diesel0411990090137995Stephens Passage South	Point Arden Fuel Drums	Southeast Alaska
Diesel1138992530140796NOME CITY	Port of Nome LCM Kaktovik II Diesel Release	Northwest Arctic
Other9922992390136399PRINCE WILLIAM SOUND	POTATO POINT BUNKER	Prince William Sound
Diesel0811991850239632Tongass Narrows	Promech Air Jet A release	Southeast Alaska
Diesel0211992020137458Tongass Narrows	Pt Higgins Rd-Boom Truck	Southeast Alaska
Diesel9711990020135432Portland Canal	PT. GARDNER-DIESEL	Southeast Alaska
Diesel0626992830139000DILLINGHAM CITY	Raysson Barge Dillingham	Bristol Bay
Diesel0211992050137461Lynn Canal South	Riptide Sinking, Juneau	Southeast Alaska
Other0211992290137485Gastineau Channel	Ryandam Brown Sludge Spill	Southeast Alaska
Diesel0611993400339057Juneau / Douglas	s. Franklin St., 496 ORCA Ent. HOT	Southeast Alaska
Diesel1124992640140807AFOGNAK IS.	S/V Heide Marie	Kodiak Island
Diesel9711991960435626Hobart Bay	S/V LOREN	Southeast Alaska
Diesel1124992400140783KODIAK CITY	Saint Herman Harbor	Kodiak Island
Lube oil1124992400140783KODIAK CITY	Saint Herman Harbor	Kodiak Island
Diesel0811992310139678Kasaan Bay	Saltery Provider Sinking	Southeast Alaska
Kerosene0711993090139391Craig / Klawock area waters	Samson Tug&Barge Container	Southeast Alaska
Propane (LPG)0711993090139391Craig / Klawock area waters	Samson Tug&Barge Container	Southeast Alaska
Lube oil0411993330438319Saxman	SE Stevedoring Saxman	Southeast Alaska
Diesel0411991060438092Tongass Narrows	SEA 76	Southeast Alaska
Propane (LPG)24990750136600KODIAK UNKNOWN	SEALAND KODIAK	Kodiak Island
Gasoline9511992470134946Tongass Narrows	SELEY BOAT YARD	Southeast Alaska
Diesel0111992620137153Tongass Narrows	Seley Dock Facility	Southeast Alaska
Diesel0338993120137933SHAKTOOLIK CITY	Shaktoolik School	Northwest Arctic
Diesel9511990540134753Tongass Narrows	SHOAL COVE, DRUMS	Southeast Alaska

ID	spillname	SubArea
Diesel0923991170139930SEWARD CITY	Shoreside Petroleum Diesel	Cook Inlet
Diesel9711993440135774Sitka Sound	SITKA 32' TROLLER	Southeast Alaska
Drilling Muds0539990590338411CHUKCHI SEA	Spy Island Sea Floor Mud	North Slope
Diesel0325991900137811SAINT PAUL IS.	St Paul Diesel	Aleutian
Diesel0224993450137601KODIAK UNKNOWN	St Paul Harbor Diesel	Kodiak Island
Bunker fuel9625990510135115SAINT PAUL IS.	ST. PAUL OILY BIRDS/MV CITRUS	Aleutian
Other9511011740134873Lynn Canal South	STAR PRINCESS	Southeast Alaska
Diesel0027991340136659Bethel	STEAMBOAT SLOUGH	Western Alaska
Diesel0511993200238672Sitka	Sunset Drive, 104	Southeast Alaska
Crude9923990370136197CENTRAL COOK INLET	T/V CHESAPEAKE TRADER	Cook Inlet
Other0623990330138750NIKISKI	T/V Seabulk Pride Grounding	Cook Inlet
Gasoline9511993100135009Tongass Narrows	TARA H	Southeast Alaska
Diesel0711992200139302Frederick Sound	Temsco Drum Drop	Southeast Alaska
Diesel0211992800137536Chichagof Island NOS	Tenakee Hot Springs Lodge HHOT	Southeast Alaska
Diesel0725993370239419AKUTAN CITY	Trident Akutan Diesel 12.3.07	Aleutian
Diesel0925990290139842AKUTAN	Trident Seafood spill	Aleutian
Diesel9624990250135089KODIAK UNKNOWN	TROXELL F/V SALLY J. KODIAK	Kodiak Island
Diesel1125991770140720S.E. BERING SEA	Tug Aries	Aleutian
Diesel0922993570140170BLIGH IS.	TUG PATHFINDER GROUNDING Prince William Sound	Prince William Sound
Diesel9924991930136353KODIAK CITY	TUG POWHATAN AT LASH DOCK	Kodiak Island
Diesel0011992280136753Tongass Narrows	TUG SEA BEAR	Southeast Alaska
Diesel9911981180136278Tongass Narrows	TUG THUNDERBIRD	Southeast Alaska
Corrosion Inhibitor1025990370140215DUTCH HARBOR	UNISEA 150 gal Boiler Feed Water Release	Aleutian
Ammonia (anhydrous)0725993560139438DUTCH HARBOR	UNISEA INC Dutch Harbor NH3 Release	Aleutian
Crude0123993310137222NORTH COOK INLET	Unocal Dillon Platform	Cook Inlet
Diesel0711990720239154Thorne Bay	USCGC Elderberry overflow	Southeast Alaska
Jet fuel0524992740138626WOMENS BAY	USCGC Midgett, JP5 Spill	Kodiak Island
Ballast Water (containing oil)0222991070137363VALDEZ MARINE TERMINAL-WATER	VMT - East Ballast Water Manifold Spill	Prince William Sound
Ethylene Glycol (Antifreeze)1122991100140653VALDEZ MARINE TERMINAL-WATER	VMT Berth 4 AFFF concentrate spill to water	Prince William Sound
Other9811993030236098Taiya Inlet	WhitePass&YukonRROil/WaterSep.	Southeast Alaska
Diesel0011993440136869Lisianski	Whitestone Logging, Hoonah	Southeast Alaska
Diesel1123990460240589WHITTIER CITY	Whittier Harbor dredging Project	Prince William Sound
Other9523992500534949PASSAGE CANAL	WHITTIER IMPOUND YARD 9/95	Prince William Sound
Used Oil (all types)9723991130235543PASSAGE CANAL	WHITTIER STORM DRAIN/DELONG DO	Prince William Sound
Gasoline9927991660136326Nunam Iqua (Sheldon Point)	YUTANA SPILL AT SHELDON POINT	Western Alaska
Diesel9739992330135663BARROW CITY	Barrow1	North Slope
Diesel9623992200135284WHITTIER	Whittier1	Prince William Sound
Drilling Muds0839990340139481WEST NORTH SLOPE	WNS1	North Slope
Ethylene Glycol (Antifreeze)9739993250135755BEAUFORT SEA	BEAUFORT SEA1	North Slope
Source water0739993060439388WEST NORTH SLOPE	NORTH SLOPE	North Slope
Jet fuel9524992830134982KODIAK CITY	KODIAK CITY	Kodiak Island
Diesel9525992690134968EASTERN CHAIN	EASTERN CHAIN	Aleutian