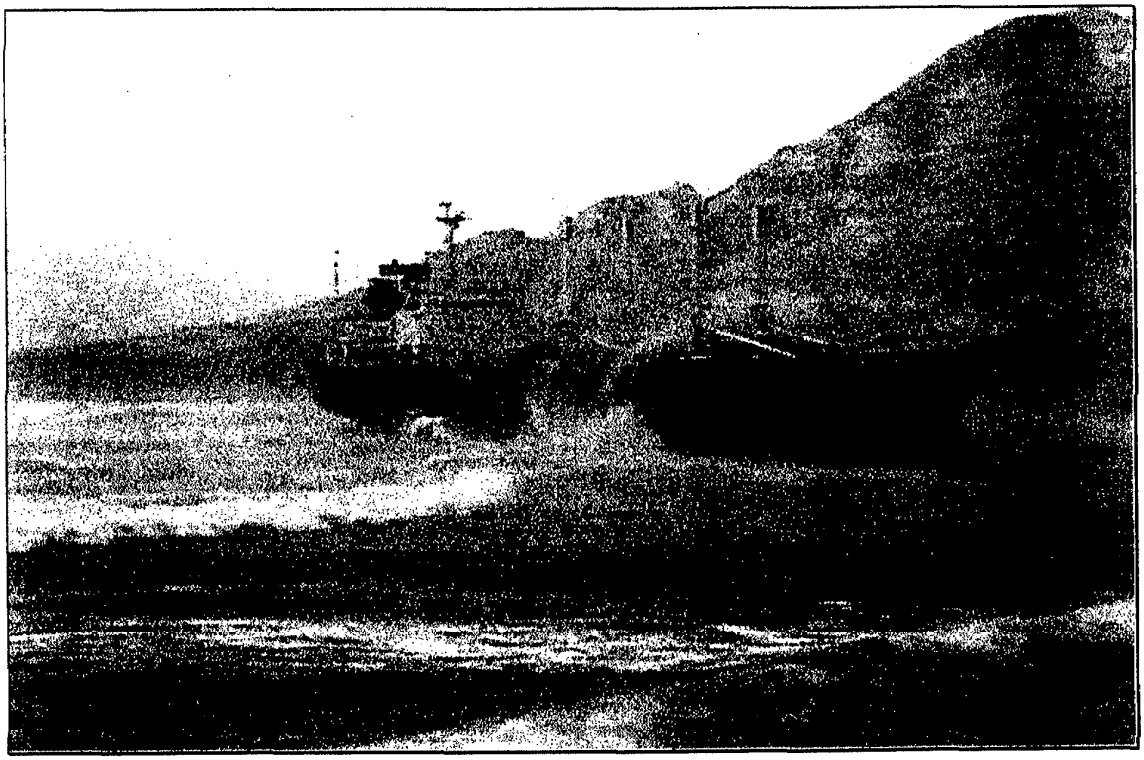
DRAFT RESTORATION PLAN
and
ENVIRONMENTAL ASSESSMENT
for the
M/V Kuroshima Oil Spill
Summer Bay, Unalaska, Alaska



QAWALANGIN
Tribe of Unalaska

DRAFT
RESTORATION PLAN
and
ENVIRONMENTAL ASSESSMENT
for the
M/V Kuroshima Oil Spill
Summer Bay, Unalaska, Alaska

Prepared by:

National Oceanic and Atmospheric Administration
U.S. Fish and Wildlife Service, U.S. Department of the Interior
Alaska Department of Fish and Game
Alaska Department of Natural Resources
Alaska Department of Law
In consultation with the
Qawalangin Tribe of Unalaska

Cover Photo Courtesy of Jim Severns, Port of Dutch Harbor

FACT SHEET

DRAFT RESTORATION PLAN and ENVIRONMENTAL ASSESSMENT for the *M/V Kuroshima* Oil Spill Summer Bay, Unalaska, Alaska

LEAD AGENCY FOR RP/EA: National Oceanic and Atmospheric Administration

COOPERATING AGENCIES:

U.S. Fish and Wildlife Service, U.S. Department of the Interior
Alaska Department of Fish and Game
Alaska Department of Natural Resources
Alaska Department of Law

ABSTRACT: This Draft Restoration Plan and Environmental Assessment (Draft RP/EA) has been prepared by the State and Federal Natural Resource Trustees in consultation with the Qawalangin Tribe of Unalaska to address restoration of natural resources and resource services injured in the November 26, 1997, *M/V Kuroshima* Oil Spill, Summer Bay, Alaska.

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COMMENTS: Comments are due no later than *December 17, 2001.* Comments should be sent in writing to the Contact Person listed above. Comments may be sent via email.

COPIES: Copies of the Draft RP/EA are available by contacting the person listed above or available for download at www.darcnw.noaa.gov/kuro.htm

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1.0 INTRODUCTION: PURPOSE OF AND NEED FOR RESTORATION

1.1 Introduction

This draft Restoration Plan and Environmental Assessment (RP/EA) has been prepared as a proposal for the restoration of natural resources and public use services injured by the M/V *Kuroshima* Grounding and Oil Spill in Summer Bay, Unalaska, Alaska, that commenced on November 26, 1997. The objective of this proposal is to make the public whole for injuries to natural resources and natural resource services resulting from the *M/V Kuroshima* oil spill by returning the injured natural resources and natural resource services to their baseline conditions and compensating for interim losses of those resources and services.

Pursuant to the Oil Pollution Act of 1990 (33 U.S.C. §§ 2701, *et seq.*) ("OPA"), the natural resource trustees (Trustees) are authorized to determine the nature and extent of natural resource injuries, select appropriate restoration projects and implement or oversee restoration. The Trustees for the *M/V Kuroshima* oil spill include the National Oceanic and Atmospheric Administration, the U.S. Department of the Interior through the U.S. Fish and Wildlife Service, the Alaska Department of Fish and Game, the Alaska Department of Natural Resources, and the Alaska Department of Law. This RP/EA documents the information and analyses that support the Trustees' evaluation of:

- Injuries to natural resources and natural resource services caused by the *M/V Kuroshima* spill;
- Restoration alternatives; and
- Rationale for the Trustees' preferred alternative.

This document also serves, in part, as the agencies' compliance with the National Environmental Policy Act (NEPA) (*see* Section 5 for additional information). The Trustees are seeking public review and comments on the proposed restoration alternatives and the Trustees' preferred alternative. In developing these restoration alternatives, the Trustees met with local entities and the Responsible Parties (RPs) and sought input from agency scientists and other restoration and oil spill experts.

The primary purpose of this draft RP/EA is to inform the public of and to solicit public comment on the Trustees' Preferred Alternative. The Trustees will consider written comments received during the public hearing and during the comment period prior to their finalizing the RP/EA. As described in detail below, this Preferred Alternative includes:

- Conducting predator removal and control measures to enhance nesting success for seabird populations affected by the spill;
- Restoration of vegetation oiled by the spill and monitoring to evaluate the success and need for additional replanting;

- Funding beach cleanup activities to remove residual oil and to compensate for lost or diminished human use during the oil spill and subsequent cleanup operations;
- Additional testing of intertidal shellfish contamination and education on seafood safety;
- Salmonid and Lake restoration projects including sediment control, Lakeshore revegetation, limnological survey work and enumeration of salmon smolt outmigration and adult escapement.
- Purchase of tents and other facilities to be available for use by the public year round as well as for a summer environmental education camp; and:
- A community-wide education program designed to reduce adverse impacts of recreation and other public uses that may impede recovery of natural resources or affect restoration efforts.

1.2 *M/V Kuroshima Incident* and Site Overview

On November 26, 1997, the M/V *Kuroshima*, a 368-foot frozen seafood freighter owned by *Kuroshima* Shipping, S.A., broke away from its anchorage in Summer Bay on Unalaska Island, near Dutch Harbor, Alaska (Figure 1: Map of Greater Unalaska Bay). While the vessel was attempting to move to a safer anchorage, winds reported to be in excess of 100 knots blew the freighter into Second Priest Rock, damaging several of the vessel's fuel tanks[1]. The vessel subsequently ran aground on the shore of Summer Bay (Figures 2,3 Grounded Vessel). Two crewmen were killed in the incident and 39,000 gallons of heavy fuel oil were spilled. Much of the oil was blown upstream into Summer Bay Lake, which borders Summer Bay, with the remainder stranding along the shoreline of Summer Bay Beach and nearby Humpy and Morris Coves (Figure 4: Detailed Map of Grounding Site). High winds also blew oil on to the dunes and contaminated vegetation and an archaeological site[2].

Immediate cleanup measures following the *M/V Kuroshima* incident were undertaken at the direction of a Unified Command which included representatives of the United States Coast Guard (USCG), State of Alaska and Kuroshima Shipping. Cleanup and vessel stabilization commenced immediately after the grounding and continued until late December when the

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[1] The sequence of events that led to the grounding and spill are summarized in the U.S. Coast Guard's 1998 investigation report (AR # 22) entitled: *M/V Kuroshima*, Panama, IMO No. 8710699; Multiple Loss of Life and Grounding with Pollution on 26 November 1997, Summer Bay, Unalaska Island, Alaska. General information on the incident and progress of the cleanup can also be found in newspaper coverage of the spill (AR # 77-93, 107).

[2] An archaeological site dating to approximately 2,500 years before present is located in the dunes between Summer Bay and Summer Bay Lake. Site restoration and excavation of the contaminated archaeological site was completed pursuant to an agreement among the owners of *the M/V Kuroshima*, the Qawalangin Tribe, the Ounalashka Corporation and the State of Alaska and is not formally part of this RP/EA. The results of the site work are summarized in a 1999 report by Rick Knecht and Richard Davis entitled: Oil Spill Response and Restoration at the Summer Bay Archaeological Site (UNL-92). See AR # 14 and 57.

response was curtailed because of poor weather conditions. Salvage activities began in January and after several attempts the vessel was finally refloated on March 1, 1998 and towed to Magone Marine in Dutch Harbor for temporary repairs. Throughout the winter the response agencies conducted a maintenance program to check for wildlife activity, remove any tar patties exposed during thaws and monitor the overall status of the impacted area. During the spring, a multi-agency Shoreline Cleanup Assessment Team (SCAT) surveyed the impacted areas and prepared detailed cleanup instructions. Actual cleanup resumed in April and was officially completed in July 1998 (AR# 101). However, shoreline oil continued to be a problem as buried and submerged oil re-stranded on area beaches. Consequently, additional cleanup was also conducted by the RPs during the summer of 1999 (Vanguard, 1999). This effort removed a quantity of oil, but residual contamination remains (see Figures 24, 25, 28, 29, 31, 32). The ADEC final response report, (AR #1), the USCG incident investigation report (AR # 22), and the NOAA HAZMAT Scientific Support Team's Information Management Report (AR # 17) summarize and describe the chronology of events associated with response and cleanup activities. The results of the additional cleanup during the summer of 1999 are summarized in a report from Don Kane of Vanguard Environmental (AR # 25).

1.3 Natural Resource Trustees and Authorities

Both Federal and State of Alaska laws establish liability for natural resource damages to compensate the public for the injury, destruction and loss of such resources and/or their services resulting from oil spills.

This Draft RP/EA has been prepared jointly by the National Oceanic and Atmospheric Administration, the U.S. Department of the Interior through the U. S. Fish and Wildlife Service, the Alaska Department of Natural Resources, the Alaska Department of Fish and Game and the Alaska Department of Law, in consultation with the Qawalangin Tribe of Unalaska.

Natural Resource Trusteeship is defined in the Oil Pollution Act of 1990 (OPA) (33 USC §§ 2701 *et seq.*) and the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) (40 CFR § 300.600). Executive Order (EO) 12777 designates the Federal Trustees for oil spills while the Governor of Alaska designates the State Trustees for oil spills in Alaska. As a designated Trustee, each agency is authorized to act on behalf of the public under Federal law to assess and recover natural resource damages and to plan and implement actions to restore natural resources and resource services injured or lost as the result of a discharge of oil. The Trustees designated NOAA as Lead Administrative Trustee (LAT)(15 CFR § 990.14(a)) (AR# 100).

In addition to its authority to recover natural resource damages under Federal law, the State of Alaska may recover natural resource damages pursuant to Alaska Statutes 46.03.710, 46.03.760, 46.03.780 and 46.03.822.

1.4 Overview of Natural Resource Injuries

Unalaska Bay, Summer Bay and Summer Bay Lake support important recreational, commercial, cultural and subsistence resources. Fish and shellfish are harvested for recreational and subsistence uses. Grasses and other shoreline vegetation are collected for basket making and other traditional uses. Bird watching and wildlife viewing, hiking and beachcombing also rely on the natural resources of the region.

After a review of a variety of potential injuries, the Trustees have identified five categories of natural resources and services affected by the *M/V Kuroshima* spill that warrant restoration. The following is an overview of the injuries. These injury categories are described in more detail in section Three. Preferred and alternative restoration proposals are discussed in Sections Four and Five.

Birds - Many bird species utilize the Summer Bay area, including bald eagle *(Haliaeetus leucocephalus)*, emperor goose *(Chen canagica)*, the Federally listed Steller's eider (*Polysticta stelleri*) and numerous species of sea birds and waterfowl. Between November 1997 and May 1998, over 150 bird carcasses were collected (Figure 5: Oiled Bird at Summer Bay Beach). It is very likely that a significant number of bird carcasses were not found due to sinking, predation, or adverse search conditions. Recorded sightings of live oiled birds were also made throughout the area. Between December 5 and December 23, 1997, fifteen oiled birds were captured and taken to a rehabilitation station in the town of Homer; however, only two of these birds survived. In addition to mortality and sub-lethal effects of oiling, there may be further injury to bald eagles and other predators due to ingestion of oiled carrion (Figure 6: Scavenged Bird Carcass).

Shoreline Vegetation - Extensive oiling of shoreline vegetation, predominantly beach wildrye grass *(Leymus mollis)* resulted from the *M/V Kuroshima* spill. Wetland, riparian and dune vegetation were exposed to oil. Response activities also caused extensive damage to vegetation (Figure: 7: Cleanup of Oiled Vegetation). Elevated lake levels caused by a temporary response dam on the outlet of the lake resulted in the oiling of a band of terrestrial vegetation ringing Summer Bay Lake. Oiled vegetation was cut and other vegetation was trampled or otherwise impaired by cleanup and salvage operations (Figure 8: Temporary Tank Farm at Summer Bay Beach).

Shellfish and Intertidal Biota - A number of shellfish and other invertebrate species inhabit the intertidal areas of the marine shore. These species include mussels, limpets, chitons, clams, sea urchins, snails and other invertebrate species (Figure 9: Tide Pool at Humpy Cove). These species were exposed to dissolved and dispersed petroleum hydrocarbons (polycyclic aromatic hydrocarbons or PAHs) as well as smothering by gross oil accumulations. Dredging and salvage actions also crushed and smothered subtidal shellfish.

Salmonids and Lake Resources - A significant fraction of the oil that migrated into Summer Bay Lake was deposited on the Lake bottom. Oil particles, tar mats, tar patties accumulated on

the Lake bottom, and have contaminated Lake sediments. In addition, the Lake water column was exposed to dissolved PAHs (Figure 10: Shoreline Cleanup along Summer Bay Lake).

Summer Bay Lake provides habitat and spawning grounds for a number of anadromous fish species, including pink (*Oncorhynchus gorbuscha*), coho (*O. kisutch*) and sockeye (*O. nerka*) salmon and Dolly Varden (*Salvelinus malma*). Fish were exposed to *M/V Kuroshima* oil through ingestion and skin and gill contact with dissolved PAHs in the Lake water column. Spawning and rearing habitats were also exposed to oil contamination in the Lake waters and sediments (Figure 11: Map of Shoreline Oiling).

Recreational Uses - The Summer Bay area is one of the most important recreational sites on Unalaska Island (Figure 12: Summer Bay Beach). The beach is the only sandy shoreline on the island that can be accessed by road. Island residents use the lake, beach and surrounding lands for beach-combing, clamming, camping, swimming, picnicking, day hiking, mountain biking, sport fishing and wildlife watching. There are no similar alternative sites on Unalaska Island that are accessible by road.

1.5 Summary of the Natural Resource Damage Assessment

OPA provides for the recovery by Trustees of the cost of restoring, rehabilitating, replacing or acquiring the equivalent of the injured natural resources ("primary restoration"); the diminution in value of those injured natural resources pending restoration ("compensatory restoration"); and reasonable assessment costs. NOAA promulgated regulations for the conduct of damage assessments for oil spills at 15 CFR Part 990 (OPA regulations). In conjunction with this rule-making process, NOAA also developed a series of technical guidance documents on how to structure and conduct oil spill damage assessments. The following provides a summary of the steps taken by the Trustees to develop a restoration plan to address the natural resource injuries associated with this spill. Sections 2.0, 3.0, 4.0 and 5.0 of the Draft RP/EA provide a more detailed analysis.

In compliance with OPA and the OPA regulations, the Trustees determined that legal jurisdiction to pursue restoration under OPA exists for this Incident. The grounding and oil spill constitute an "Incident" pursuant to OPA Section 1001 (14). Because the discharge was not authorized by a permit issued under Federal, state, or local law and did not originate from a public vessel or from an onshore facility subject to the Trans - Alaska Pipeline Authorization Act, the Incident is not an "excluded discharge" within the meaning of OPA Section 1002 (c). Finally, natural resources under the authority of the Trustees have been injured as a result of the Incident. These factors establish jurisdiction to proceed with a natural resource damage assessment (NRDA) under the OPA regulations (See Section 10.2 of the Appendix).

Natural resources are defined as "land, fish, wildlife, biota, air, water, ground water, drinking water supplies and other such resources belonging to, managed by, held in trust by, appertaining to, or otherwise controlled by the United States, any State or local government or Indian tribe, or any foreign government" (33 U.S.C. § 2701.20). Injury is defined as "an observable or

measurable adverse change in a natural resource or impairment of a natural resource service" (15 CFR § 990.30). As described in the OPA regulations, a NRDA consists of three phases -- preassessment, restoration planning and restoration implementation.

Based on information collected during the preassessment phase, the Trustees make a preliminary determination as to whether natural resources and/or services have been injured and/or are likely to be injured by the release. Through coordination with response agencies (*e.g.*, the USCG), the Trustees next determine whether the oil spill response actions will eliminate the injury or the threat of injury to natural resources. Because this spill occurred during the winter, response efforts by the response authorities continued on and off through the Summer of 1998 resulting in an extended pre-assessment. During this time, the Trustees worked actively with the response authorities to evaluate the cleanup, the potential for ongoing injury and the potential for feasible restoration. Upon conclusion of the cleanup, the Trustees determined that injuries and associated interim losses to natural resources and/or their services would continue and that feasible restoration alternatives existed to address these injuries (See Trustee determinations in Section 10.2). Based upon these findings, the Trustees proceeded with restoration planning.

The purpose of the restoration planning phase is to evaluate the potential injuries to natural resources and services and to use that information to determine the need for and scale of associated restoration actions to address those injuries. This phase provides the link between injury and restoration and has two basic components -- injury assessment and restoration selection. The goal of injury assessment is to determine the nature and extent of injuries to natural resources and services thus providing a factual basis for evaluating the need for, type of and scale of restoration actions. The Trustees must identify a reasonable range of restoration alternatives, evaluate and select the preferred alternative(s), develop a draft restoration plan presenting the alternative(s) to the public, solicit public comment on the draft restoration plan and incorporate comments into a final restoration plan.

The Trustees investigated a variety of resource injuries associated with the *M/V Kuroshima* oil spill. In accordance with the OPA regulations the Trustees considered a range of assessment procedures and selected methods for injury assessment and restoration planning that are technically reliable and valid and were cost effective for the Incident (15 CFR § 990.27). The Trustees consulted with a variety of experts in relevant scientific and technical disciplines, reviewed existing literature, participated in field assessments and performed focused studies to support their restoration planning decisions. The Trustees complied with the general requirements for determining and quantifying injuries to natural resources, including establishing exposure and pathway, determining the degree, spatial and temporal extent of injury and selection of injuries to include in the assessment. Although the Trustees could have conducted additional studies to refine the injury estimates and restoration alternatives, in the Trustees' judgment, the information presently available is more than sufficient to provide a technical basis for evaluating the need for, type of and scale of restoration actions and to develop a fair and reasonable restoration plan to achieve timely restoration consistent with the OPA regulations.

In selecting preferred restoration projects for each category of natural resource injury or loss, the Trustees identified and considered a reasonable range of restoration alternatives including natural recovery, primary restoration and compensatory restoration. Primary restoration actions are designed to directly restore natural resources or services to baseline on an accelerated time frame. Compensatory restoration actions seek to compensate the public for interim losses. The OPA regulations identify a variety of methods that may be used for scaling compensatory restoration actions that provide natural resources and /or services of the same type and quality and of comparable value as those lost. In response to this incident, the Trustees identified six categories of natural resources that warrant restoration. For a variety of reasons discussed in more detail later in this document, the Trustees determined that the injured resources would recover over time. However, this recovery, depending on the injury category, may take years. Therefore, the Trustees focused their review of restoration alternatives on compensating for the interim losses resulting from the spill. Consistent with the OPA regulations in scaling the restoration actions the Trustees evaluated both the service-to-service scaling approach and the valuation scaling approach. The scaling, description and evaluation of restoration alternatives in this plan are based upon the technical expertise, judgments and restoration knowledge of the Trustees and other consulting scientific and technical experts.

The OPA regulations authorize the settlement of claims at any time provided that the settlement is adequate to satisfy the goals of OPA and is fair, reasonable, and in the public interest[3]. In other words, the Trustees must ensure that a settlement is adequate to restore, replace, rehabilitate or acquire the equivalent of the injured natural resources and services. The Trustees, acting on behalf of the public, have to weigh the benefits of early settlement vs. delayed recovery of natural resources that might result from long-term studies and protracted litigation[4]. However sums recovered in settlement of NRDA claims may only be expended in accordance with a restoration plan that is made available for public review and comment[5]. For the *M/V Kuroshima* incident, sufficient information on the nature and severity of injuries was collected during the preassessment phase to allow the Trustees to proceed directly to the evaluation of restoration alternatives and selection of a preferred alternative.

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[3] 15 CFR Part 990.25.

[4] Early settlement is discussed in several sections of 15 CFR Part 990. The preamble to the Natural Resource Damage Assessment Final Rule, 61 Fed. Reg. Page 446 (Jan 5, 1996) states that "Trustees may settle claims for natural resource damages under this rule at any time .....In determining the sufficiency of settlements to meet the public interest test under other statutes, reviewing courts have afforded broad deference to the judgment of federal agencies recommending such settlements. Courts have looked to whether the agencies have considered such factors as the benefits of early settlement as opposed to delayed recovery through litigation, litigation risk, certainty in the claim, and attitude of the parties toward the settlement, among other factors".

[5] Excluding reimbursement of Trustees' costs.

1.6 Coordination with the Responsible Parties (RPs)

Under section 1002 of OPA each party responsible (RPs) for a vessel from which oil is discharged, or which poses a substantial threat of a discharge of oil, is liable for natural resource damages resulting from the incident involving such discharge or threat. The RPs for this spill are Kuroshima Shipping, S.A. and Unique Trading Co[6].

The OPA regulations authorize the Trustees to invite the RPs to participate in the damage assessment and restoration process. By working together, restoration of injured resources and services may be achieved rapidly and cost-effectively. Although the RPs may contribute to the process in many ways, final authority to make determinations regarding injury and restoration rests solely with the Trustees.

Within a few weeks of the spill, the RPs proposed a conceptual restoration plan to the Trustees to address natural resource injuries resulting from incident. The Trustees welcomed the RPs' desire to move forward with timely restoration but after reviewing the proposal the Trustees determined that the information available at the time was insufficient to fully evaluate the plan. Furthermore, the response phase of the incident was ongoing and there was a great deal of uncertainty about what would be revealed during the spring thaw and renewed cleanup. However, the proposal began a dialogue between the Trustees and the RPs with the goal of achieving timely and appropriate restoration for the injured natural resources. As part of that dialogue, the Trustees and RPs have shared information with each other in an attempt to present known or potential injuries or losses of natural resources and services and to identify appropriate restoration actions. Coordination between the Trustees and the RPs helped to reduce duplication of studies, increase the cost-effectiveness of the assessment process, increase sharing of information and decrease the likelihood of litigation. The Trustees sought input from the RPs and considered such information, when provided, throughout the NRDA process.

The RPs have evaluated the preferred alternatives proposed in this draft RP/EA and support the implementation of the alternatives.

1.7 Public Participation

Public review of the Draft RP/EA is an integral component of the restoration planning process. Through the public review process, the Trustees seek public comment on the approaches used to define and estimate natural resource injuries and the projects being proposed to restore injured natural resources or replace services provided by those resources.

Public review of the Draft RP/EA is a standard element of Federal and state laws and regulations that apply to the NRDA process, including Section 1006 of OPA, the OPA regulations (15 CFR Part 990), NEPA, as amended (42 USC §§ 4371 *et seq.*) and its implementing regulations (40

[6] AR # 22, 75, 96.

CFR Parts 1500-1508). Following a public notice, the Draft RP/EA will be available to the public for a 30-day comment period. As part of the public review process, the Trustees will conduct a public meeting during this period. The public meeting is scheduled for November 26, 2001, at the Unalaska City Hall. Written comments received during the public comment period will be considered by the Trustees in preparing the Final RP/EA.

An additional opportunity for public review will be provided in the event that the Trustees decide to make significant changes to the plan based on the initial public comments. Comments on this draft should be sent to:

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1.8 Administrative Record

The Trustees have compiled an Administrative Record to support their restoration planning and inform the public of the basis of their decisions. The Administrative Record is available for public review at the public repositories listed below. The Administrative Record index is provided in Appendix A.2 of this draft RP/EA.

The Administrative Record facilitates public participation in the NRDA process. Additional information and documents, including public comments received on the Draft RP/EA, the Final RP/EA and other related restoration planning documents, will become a part of the Administrative Record and will be submitted to a public repository upon their completion.

The documents comprising the Administrative Record can be viewed at the following locations:

NOAA DANW 7600 Sand Point Way, NE Seattle, Washington 98115.
Contact: Doug Helton, (206) 526-4563. Doug.Helton@noaa.gov

Qawalangin Tribe of Unalaska, 205 West Broadway, Unalaska, AK 99685
Contact: Jacob Stepetin (907-581-2920)

US Department of Justice, 801 B Street, Suite 504, Anchorage, Alaska 99501.
Contact: Lorraine Carter, 907-271-5452

Arrangements should be made in advance to review the record.

1.9 Summary of the Natural Resource Damage Claim

The goal of the NRDA process is to make the public whole for injuries to natural resources and their services resulting from the release of oil. The natural resource damages claim for the *M/V Kuroshima* incident seeks restoration of the following natural resources and services:

- Seabirds
- Vegetation
- Shellfish/Intertidal Biota
- Salmonids and Lake resources
- Recreation

The proposed compensatory restoration actions include:

- Conducting predator removal and control measures to enhance nesting success for seabird populations affected by the spill;
- Restoration of vegetation oiled by the spill and monitoring to evaluate the success and need for additional replanting;
- Additional testing of intertidal shellfish contamination and education on seafood safety;
- Sediment control, Lakeshore revegetation, Limnological survey work and Enumeration of salmon smolt outmigration and adult escapement;
- Funding beach cleanup activities to compensate for lost or diminished human use during the oil spill and subsequent cleanup operations;
- Purchase of tents and other facilities to be publicly available for use year around as well as for a summer environmental education camp; and
- A community-wide education program designed to reduce adverse impacts of recreation and other public uses that may impede recovery of natural resources or affect restoration efforts.

2.0 AFFECTED ENVIRONMENT

2.0 AFFECTED ENVIRONMENT

The purpose of this section is to provide a general description of the environment that encompasses the geographic area where the spill occurred and where restoration will be implemented.

2.1 Physical Environment

The Aleutian Islands stretch more than 1100 miles west from the Alaska Peninsula forming the world's longest archipelago. These windblown, rugged and treeless islands are the peaks of a submarine volcanic mountain range that separates the Bering Sea from the North Pacific Ocean. Weather is harsh and very unpredictable. The Aleutian climate is characterized by precipitation, fog, high winds and frequent, often violent, cyclonic storms. Clear, sunny days are rare. Temperatures are mild relative to mainland Alaska and sea ice is rare.

Unalaska Island is the one of the largest of the Fox Islands that forms the eastern group of the Aleutian Island chain. The Island is mountainous and during the greater part of the year the higher elevations are covered with snow. Much of the shoreline is composed of precipitous rocky cliffs, with extensive wave-cut platforms and cobble beaches. The irregular shoreline of the Island is broken by several large embayments. The City of Unalaska and Port of Dutch Harbor sit at the head of Unalaska Bay. The Bay opens into the Bering Sea between Cape Kalekta and Cape Cheerful. Amaknak Island is in the center of Unalaska Bay, the south side of which forms Iliuliuk Harbor, Iliuliuk Bay and Dutch Harbor.

Many small rivers and creeks flow into Unalaska Bay, but strong winds and moderate tidal currents keep the outer bay well-mixed with the marine waters of the Bering Sea. Tides are diurnal and typical tide range is 1.5 meters.

Summer Bay is a wide, shallow and unprotected sandy bay on the Eastern Shore of Unalaska Bay. The head of the Bay has a broad sand beach backed by sand dunes. Second Priest Rock, a dominant rocky headland, demarks the western edge of the bay. Extensive wave-cut rocky platforms and reefs extend from the headlands on both sides of the Bay. The Bay is open to the Bering Sea from the north and often receives high wave energy. The eastern end of Summer Bay includes two shallow coves, Humpy Cove and Morris Cove (Figure 13: Morris Cove). At the head of Summer Bay is a broad valley that includes Summer Bay Lake (Figure 14: Summer Bay Lake and Summer Bay). A small lake also lies above Morris Cove and anadromous fish streams drain into Morris and Humpy Coves and Constantine Bay.

Summer Bay Lake is small, slightly more than a mile long and half a mile wide and shallow, with a maximum depth of 15 meters. The Lake is only a few meters above sea level and the outlet stream is less than 75 meters long. The Lake is typically ice-covered from December through March (Figure 15: Summer Bay Lake).

2.2 Biological Environment

Unalaska Island and Unalaska Bay are home for many species of finfish, shellfish, marine mammals, seabirds, waterfowl, land mammals and other wildlife. Sea lions *(Eumetopias jubatus)*, sea otters *(Enhydra lutris)* and harbor seals *(Phoca vitulina)* inhabit the Bay. Large seabird colonies are found on the Island and nearby islets and the area supports a large population of bald eagles and other raptors. Lush vegetation covers the hillsides and extensive kelp beds exist along the nearshore area. Several species of pacific salmon and Dolly Varden spawn and rear in the lakes and streams that flow into the Bay. The rocky intertidal zone is encrusted with barnacles, mussels, chitons, sea urchins and other marine invertebrates. The sandy shorelines of Summer Bay provide habitat for several species of clams. Crab, halibut, herring, cod and many other commercial, recreational and subsistence species are common in the nearshore waters.

The Summer Bay area is an important recreational and subsistence resource for the residents of Unalaska. Clams are harvested on the beach and limpets, urchins, chitons and other invertebrates are harvested from the rocky intertidal. Pink, coho and sockeye salmon and Dolly Varden spawn in the Lake and streams above Summer Bay (Figure 16: Spawned-out pink salmon). Vegetation along the beach and lakeshore is also harvested.

2.3 Unique and Protected Natural Resources

Unalaska Island and Unalaska Bay are utilized by a number of threatened or endangered species, including the Steller sea lion, the Aleutian Canada goose *(Branta canadensis leucopareia)*, the Steller's eider, the spectacled eider *(Somateria fischeri)* and the Northern fur seal *(Callorhinus ursinus)*. Sea otters are also common in Unalaska Bay.

2.4 National Wildlife Refuge Lands

Nearly all the islands in the Aleutian Island chain, including large portions of Unalaska Island, are part of the Alaska Maritime National Wildlife Refuge, managed by the U.S. Fish and Wildlife Service. These islands exhibit extensive biological diversity closely tied with the surrounding marine environment. The Refuge is managed to conserve, protect and enhance these islands for seabirds, marine mammals, fish, other wildlife, Aleut archaeological resources and World War II historic sites for the benefit of the public. Fortunately, despite the proximity of the Refuge, Refuge lands on Unalaska Island were not significantly affected by the *M/V Kuroshima* spill. However, fish and wildlife species that reside in or utilize the Refuge may have been impacted.

2.5 Cultural Environment and Human Uses

The City of Unalaska is the largest settlement in the Aleutian Islands with approximately 5000 year-round residents. A large seasonal influx in the fishing and seafood processing industries may triple the population. Unalaska has long been the center of Aleut culture and continues to be the largest of the Aleut communities. The native Aleuts or Unangans are believed to have settled the area approximately 8000 years ago. They built villages along the seacoasts and lived on the abundant marine mammals, fish, seabirds, marine invertebrates and seaweed. Evidence of

these villages still exists on nearly every island. In the 1740's, Russian explorers were the first European visitors to Unalaska and its excellent natural harbor led the Russians to establish their first permanent settlement in North America at the head of Iliuliuk Bay. One of the most famous landmarks in Unalaska is the Russian Orthodox Cathedral. In 1867, the U.S. Government purchased Alaska from the Russians and Unalaska became an important regional settlement supporting the lucrative Bering Sea fisheries and fur seal industries. World War II was fought on these islands, with over 10,000 Army and Navy personnel stationed in the area. All of the Aleuts were forced to evacuate and many residents of other Aleut communities moved back to Unalaska after the war. Following World War II, Unalaska subsisted as a relatively minor fishing community until the King Crab fisheries in the 1970's and Americanization of the North Pacific and Bering Sea trawl fisheries in the 1980's led to massive booms in construction and employment. Today, Unalaska is the largest U.S. commercial fishing port, both in terms of pounds landed and in terms of value.

3.0 INJURY DETERMINATION & QUANTIFICATION

3.0 INJURY DETERMINATION & QUANTIFICATION

This chapter describes and quantifies the injuries resulting from the *M/V Kuroshima* oil spill. The chapter begins with an overview of the types of information and data collected during the preassessment phase of the damage assessment process, followed by a description of the Trustees' strategy to identify and quantify specific injuries to natural resources. The OPA NRDA regulations (15 CFR § 990.30) define "injury" as an "observable or measurable adverse change in a natural resource or impairment of a natural resource service." The regulations define "services" as "the functions performed by a natural resource for the benefit of another natural resource and/or the public."

3.1 Assessment Approach

The assessment process occurs in two stages -- injury determination and then injury quantification. The first stage involves evaluating which injuries are the most significant; the second stage involves determining the scale or magnitude of the loss. As discussed in section 1.5, the Trustees may expedite this process if sufficient information is collected during the preassessment phase. Conceptually, however, the Trustees still need to determine the nature and extent of injuries to natural resources and services which will provide a basis for evaluating the need for, type and scale of restoration actions.

Injury determination begins with the identification and selection of potential injuries to investigate. The Trustees considered several factors when making this determination including, but not limited to, the following:

- The natural resources and services of concern;
- The evidence indicating exposure, pathway and injury;
- The mechanism by which injury occurred;
- The type, degree and spatial and temporal extent of injury;
- The adverse change or impairment that constitutes injury;
- Availability of assessment procedures and their time and cost requirements;
- The potential duration of the natural recovery period; and
- The kinds of restoration actions that are feasible.

The Trustees considered a range of assessment procedures and selected methods for injury assessment and restoration planning that were technically reliable and valid and were cost effective for the incident. These included site investigations, field surveys, sampling and surveys of the relevant scientific and economic literature. The Trustees also consulted with academic and other experts.

3.2 Summary of Preassessment Activities

The first responders to the *M/V Kuroshima* incident focused on rescuing the crew, stabilizing the vessel and removing the remaining fuel oil, surveying and protecting sensitive areas, collecting injured wildlife and recovering the spilled oil. These activities were conducted under the direction of the U.S. Coast Guard and the Alaska Department of Environmental Conservation (ADEC). The ADEC final response report, the NOAA HAZMAT Scientific Support Team report and the USCG incident investigation report summarize the response activities, oil fates and preliminary impacts resulting from the *M/V Kuroshima* spill (AR # 1, 17, 22). Where possible, the Trustees utilized information generated by the response rather than implementing duplicative surveys.

Within a few days after the grounding of the *M/V Kuroshima*, the Trustee agencies initiated a preliminary investigation of the potential impacts of the spill on the natural resources in the area. These activities were coordinated with and complemented information and data collected by the response agencies. The preliminary results of the preassessment evaluation are summarized in NOAA's Preassessment Scoping Report dated August 28, 1998 (AR# 18).

The preliminary assessment focused on collecting perishable or ephemeral information necessary to demonstrate the fate of the oil and exposure and potential injuries to natural resources. Resources and services potentially impacted by the discharged oil included:

- Birds;
- Intertidal and subtidal habitats and the biota in those habitats;
- Salmonids and Lake resources;
- Dune and lakeshore vegetation and
- Lost use of recreation.

Various sources of information collected by the Trustees, the Responsible Parties (RPs) and the response agencies was used to help evaluate the potential impacts of the spill on natural resources, identify the need for restoration actions, or determine the need for additional studies. Specific sources of information included:

1. Photo and Video documentation: The Trustees reviewed the photographs and videotapes generated by the Unified Command and collected their own set of images documenting the incident. These images clearly illustrate the range of affected natural resources and the severity of contamination. A database of photographs has been developed. Many of the NOAA, ADEC and USCG images are digitally available in the compact disk version of the 1998 NOAA HAZMAT Scientific Support Team Information Management Report (AR# 17).

2. Oil Trajectory and Overflight Information: During the early days of the response, the Unified Command conducted multiple helicopter overflights to determine the location and quantity of floating oil. Computer trajectories were also developed to predict the spread of the oil. The Trustees gathered and evaluated this information to understand the geographic extent of the spill's impacts. These maps and predictions are summarized in the 1998 NOAA HAZMAT Scientific Support Team Information Management Report (AR# 17).

3. Fingerprinting of Oil Contamination: Samples of oil collected from the *M/V Kuroshima*'s fuel tanks and samples collected immediately adjacent to the grounded ship were chemically analyzed. The results of these analyses were compared to analytical results from biota, sediment and water samples collected throughout Summer Bay and Lake to confirm that the contamination of these resources came from the *M/V Kuroshima* (AR #17, 94, 103).

4. Evaluation of Oil Fates and Weathering: Samples of *M/V Kuroshima* oil collected over time in the environment were analyzed to better understand the potential toxicity, rate of degradation, fates and persistence of the oil. These analyses showed that the oil would degrade slowly in the environment (AR# 18, 94)

5. Collection of Response information, Baseline data and Literature: The Trustees collected and evaluated reports and documentation generated as part of the operational response. A search was also conducted to collect relevant historical research, management plans and other information regarding the Summer Bay and Unalaska region. Baseline data on salmon (AR# 12, 121) and birds was collected (AR# 43, 116). Additionally, a literature search was conducted to collect information on the fate and effects of similar spills (AR# 13, 29, 31, 36, 37, 38, 62, 108, 122).

6. Shoreline Cleanup Assessment Team (SCAT) Surveys: Periodic and comprehensive shoreline surveys of Summer Bay Lake and Summer Bay were undertaken at the direction of the Unified Command. Trustee Agency representatives participated in these SCAT surveys and conducted annual follow-up surveys after the completion of the response. The Trustees used this information to determine the geographic extent, severity and persistence of stranded oil on shorelines. The survey information also was evaluated to help understand the efficacy of the response and to identify areas that suffered collateral harm because of the cleanup operations. These results are summarized in the 1998 NOAA HAZMAT Scientific Support Team Information Management Report (AR# 17) and the 1998 NOAA Damage Assessment Center Preassessment Scoping Report (AR# 18)

7. Dive Survey of Summer Bay Lake: The Trustees reviewed the videotapes and reports generated by the underwater survey of Summer Bay Lake conducted during April 1998 to evaluate the severity of visible oiling and the efficacy of the underwater cleanup operations (AR# 19). This work was contracted by the Responsible Party under the supervision of the Unified Command. The dive operations resulted in the removal of some but not all of the

submerged oil. The results of the dive surveys and underwater cleanup operations are summarized in the July 28, 1998 report entitled "Summer Bay Lake Bottom Survey and Cleanup Report, *M/V Kuroshima* Oil Spill", prepared by Polaris Consultants (AR# 19).

8. Documentation of Wildlife Recovery and Rehabilitation: Collection and recording of dead and injured wildlife began immediately after the incident. This work was contracted by the Responsible Party under the supervision of the Unified Command. Trustee representatives collected data on the total number of dead and injured wildlife. Wildlife Teams also documented predation by foxes and eagles, as well as a number of oiled birds that could not be captured. The Trustees also reviewed information on the fate of the treated animals. The wildlife data clearly demonstrates that a significant number of birds were killed by the incident. The results of the Wildlife Operations are summarized in a 1998 report prepared by the Wildlife Rapid Response Team (WRRT) for the U.S. Fish and Wildlife Service (AR# 28).

9. Vegetation Surveys: In addition to the SCAT surveys, the Trustees conducted surveys of injured and restored vegetation and reviewed reports generated by the RPs on the status of their revegetation efforts. The vegetation data shows that vegetation was contaminated by the spill and that recovery of the vegetation has begun. The results of the vegetation surveys are summarized in the November 1998 report entitled "Vegetation Restoration Project, *M/V Kuroshima* Oil Spill", prepared by Vanguard Environmental (AR# 24).

10. Summer Bay Lake Sediments and Water Quality Studies: Samples of Lake waters and sediments were collected at several intervals during the response phase of the incident. The data clearly demonstrates that the waters and sediments of Summer Bay Lake were contaminated by the incident. The results of the water and sediment sampling are summarized in the 1998 report entitled " *M/V Kuroshima* Incident: Preassessment Scoping Report" prepared for NOAA by Industrial Economics, Inc. (AR# 18). The detailed analytical results and quality assurance reports are in AR# 99 and 103. Rice (1999) prepared a summary interpretation of sediment contamination on persistence, toxicity, risk to fisheries resources in Summer Bay Lake (AR # 117).

11. Subsistence Invertebrate Studies: The Trustees worked with the RPs and the unified command to evaluate the severity of oil contamination of shellfish in Summer Bay. Samples of shellfish commonly harvested by recreational and subsistence users were collected on three occasions. The shellfish tissues were analyzed for PAHs (AR# 103) and the analytical results clearly show that shellfish in Summer Bay and Humpy Cove were contaminated by *M/V Kuroshima* oil (AR# 104). The results of the shellfish sampling are summarized in the 1998 Health Consultation prepared by the Alaska Department of Health and Social Services and the U.S. Department of Health and Human Services, Agency for Toxic Substances and Disease Registry (AR# 4).

12. Salmonid enumeration: The Trustees established a fish weir at the outlet of Summer Bay Lake and enumerated juvenile outmigrants and adult returns. Surveys of spawning areas were also conducted. This information was used to determine the approximate numbers of salmon spawning in the lake and to help evaluate post-spill population changes. Annual reports of the weir operation have been prepared by the Alaska Department of Fish and Game (AR # 2, 3[7], 126, 127).

3.3 Summary of Preassessment Findings

This section discusses the fates and behavior of the spilled oil and describes the natural resources, resource services, and habitats injured as the result of the *M/V Kuroshima* incident including birds, shoreline vegetation, shellfish and intertidal biota, salmonids and lake resources, and recreational uses.

3.4.1 Oil Fates and Behavior[8]

Oil Fates - The *M/V Kuroshima* contained approximately 122,000 gallons of Bunker C fuel oil when it struck Second Priest Rock. Lightering operations conducted in early December removed 97,000 gallons of mixed Bunker C, diesel oil and seawater. The Unified Command estimates that about 39,000 gallons of Bunker C fuel oil spilled from the freighter (Figure 17: Oil Sheens in Summer Bay). Oil was blown onto Summer Bay Beach and stranded oil was observed along the shore in Morris and Humpy Coves and Constantine Bay (Figure 18: Cumulative Footprint of *M/V Kuroshima* Oiling). In addition, a substantial amount of oil flowed into Summer Bay Lake. Over 80% of the lakeshore was impacted by oil and there was significant accumulation of oil on the Lake bottom.

Oil Characteristics - The oil released from *M/V Kuroshima* was Bunker C fuel oil. This oil is very viscous and persistent in the environment. Oil samples were analyzed for saturated/total petroleum hydrocarbons by Gas Chromatography/Flame Ionization Detection (GC/FID) and individual Polynuclear Aromatic Hydrocarbons (PAHs) by Gas Chromatography/Mass Spectrometry (GC/MS). The analysis showed the presence of substantial fraction of a lighter weight petroleum hydrocarbons suggesting that the bunker oil was cut or blended with a lighter fuel oil.

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[7] ADF&G Regional Information Reports No. 4K99-62 and 4K00-63.

[8] Information in this section is summarized from a number of response and assessment documents and technical reports cited in the Administrative record including the ADEC Response Report (AR#1), Shoreline contamination survey data (AR #74), USCG Incident Investigation Reports (AR# 22, 96), the NOAA HAZMAT Information Management Report (AR# 17), the NOAA Damage Assessment Center Preassessment Scoping Report (AR# 18), the Polaris Consultants Lake Bottom Survey Report (AR #19), the Vanguard Consultants Shoreline Cleanup Report (AR #25), NOAA technical reports on Group V (Heavy) Oils (AR # 36,37), NOAA technical reports on cold-water (AR# 38,39, 60, 61, and 62)) and inland spills (AR# 54), literature on persistence of oil in subtidal sediments (AR # 48), Oceanographic characteristics of Unalaska Bay (AR # 52), Survey results of fuel oil on the M/V Kuroshima (AR # 56), chemistry results (AR #94, 99,103, 104) and literature on oil fates from the Exxon Valdez spill (AR# 50, 65, 66, 67, and 122).

Oil Weathering Based on its physical and chemical properties, the oil spilled during the *M/V Kuroshima* incident was expected to undergo a variety of weathering processes. These weathering processes result in dispersion and the physical and biological degradation of the oil.

Under moderate weathering conditions, the lower-molecular-weight hydrocarbons are rapidly lost by a combination of evaporation and dissolution processes such that their lifetime in a spilled-oil slick is generally only a matter of hours to days. The middle-molecular- weight hydrocarbons such as naphthalene are more persistent, but generally can be lost from a surface slick by evaporation and dissolution processes over the time frame of days to weeks. The high-molecular-weight constituents are generally more persistent and can remain in a surface oil slick or stranded on shorelines for months or years.

However, the climatic conditions associated with the *M/V Kuroshima* Spill, while not unusual for the location and season, retarded the weathering process. Instead of floating and spreading on calm seas, the high winds, wave energy and ice conditions are thought to have significantly retarded the weathering of the oil. In the days and weeks immediately following the *M/V Kuroshima* spill, the winds reached hurricane force and massive quantities of the spilled oil were physically dispersed by turbulence into the waters of Summer Bay Lake. Thus, the storms that occurred during the spill event led to significant quantities of relatively fresh oil being buried within the shoreline sediments and deposited in mats and tarballs along the bottom of the Lake. Once buried in shoreline sediments or entrained in the water column, the resulting oil would not be subject to significant weathering by evaporation and only slow dissolution of aromatics would continue. Some moderate evaporation of dissolved constituents from the Lake surface would have occurred initially; however, this too would have been terminated with the formation of a continuous ice cover. Under these conditions, the oil would then be encapsulated or trapped within the ice and/or between the ice and bottom sediments. The oil-phase chemical composition would remain essentially unchanged over the winter months. Bunker C is capable of yielding significant dissolved concentrations of aromatics when exposed to water under equilibrium conditions, as would have been encountered in the Lake. The *M/V Kuroshima* Bunker C fuel oil contained a very high proportion of dissolved naphthalene and other aromatics and it had an unusually large fraction of lighter-molecular-weight alkyl-substituted benzene. These components have significant water solubilities and they would have persisted as dissolved constituents in the cold water under the ice cover for the 4-month period between December and ice breakup in the March/April time frame.

Water samples collected five months after the spill confirmed that persistent low level concentrations persisted through the winter. Although the concentrations were not acutely toxic, they were suggestive that chronic exposure is a highly probable risk (Rice. 1999). Over time, the oil is expected to degrade and concentrations of hydrocarbons are expected to decline, but the persistence of oil on the lake bottom is expected to provide a long-term source of contaminants.

3.4.2 Birds:

The Trustees worked with the Unified Command to survey and enumerate oiled and dead seabirds. Wildlife operations during the spill were directed by the Unified Command, under permits from the State and Federal wildlife agencies. The Bird Treatment Center in Homer, Alaska was chosen to handle, treat, and release cleaned birds. The Wildlife Rapid Response Team worked with State and Federal wildlife scientists and local hires to conduct hazing and collect carcasses. Despite the adverse search conditions, approximately 200 dead or significantly oiled birds were observed. Affected species included red-breasted merganser (*Mergus serrator*), common murre (*Uria aalge*), crested auklet (*Aethia cristatella*), least auklet (*Aethia pusilla*), black scoter (*Melanitta nigra*), storm-petrel (*Oceanodroma sp.*), glaucous-winged gull (*Larus glaucescens*), long-tail duck (*Clangula hyemalis*), harlequin duck (*Histrionicus histrionicus*), Steller's eider, common loon (*Gavia immer*), red-necked grebe (*Podiceps grisegena*), horned grebe (*Podiceps auritus*), cormorant (*Phalacrocorax sp.*), emperor goose, and other birds that were not positively identified. These data are summarized in the USFWS carcass collection report (AR # 42) and Wildlife Rapid Response Team Report prepared for the USFWS (AR# 28)[9]. The preassessment data clearly demonstrates that birds were exposed to and injured by oil from the *M/V Kuroshima*.

In addition to the observed acute mortality, the oil spill literature suggests that the actual mortality would be significantly greater because not all areas could be surveyed and many dead birds would sink, be scavenged or suffer delayed mortality[10]. Oiling of the bird feathers resulted in loss of water-repellency and hypothermia. Oil ingestion, either because of predation on oiled carcasses, or through preening behavior, may also have resulted in mortality. Few of the rescued birds survived the cold temperatures. Most of the birds were recovered dead and few of the live birds survived the cleaning and rehabilitation process. Birds that were observed oiled but were not captured likely did not survive the winter. As a consequence of the bird mortality described above, future bird productivity was likely also lost due to the spill. Because of these concerns, the Trustees concluded that a more thorough quantification of injury and evaluation of restoration alternatives were warranted. These analyses are summarized below in Section 5.2.

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[9] The wildlife operations were contracted by the Responsible Parties under the direction of the Unified Command. The contractor has a requirement to report their activities and findings to the Alaska Department of Fish of Game and the U.S. Fish and Wildlife Service.

[10] The Trustees relied on a number of literature sources in their preassessment evaluation of bird injury including a synthesis of issues in the assessment of mortality of seabirds from oil spills (AR #115), Exxon Valdez seabird injury methods and results (AR# 70), the effects of oil pollution on seabirds in British Columbia (AR# 116), methods for conducting beached-bird surveys (AR # 7), baseline winter bird densities in Unalaska (AR # 43 and 106) and the seabird assessment methodology used for the North Cape Oil Spill (AR# 16).

3.4.3 Shoreline Vegetation:

Information in this section is summarized from a number of response and assessment documents and technical reports[11]. Shoreline vegetation was oiled to various degrees throughout the spill area. The extent of oiling ranged from a light stain to thick tar mats. Vegetation oiling occurred primarily in the upper-intertidal, supratidal and dune areas. The heaviest oiling of the dunes occurred near the outlet of Summer Bay Lake where wind-blown oil formed a thick tar mat along the base of the dunes. Vegetation was also oiled along the shoreline of Summer Bay Lake. The outlet stream of the Lake was blocked during the initial response to prevent additional oil from entering. This resulted in unusually high lake levels for over a week after the spill. Ultimately, the water rose approximately 0.5 meters. Depending on the slope of the shoreline, the slowly increasing water levels resulting in a nearly continuous band of Lakeshore vegetation 1-15 meters wide being oiled (AR# 24).

Vegetation injury resulted from a combination of direct smothering by the oil and trampling, cutting and erosion resulting from the associated response efforts. Because the vegetation was largely dormant at the time of the spill, the primary injury pathway was physical disturbance of the vegetation during response and cleanup, rather than a toxicological response (Figure 19: Trampled Vegetation). The injured vegetation provides habitat for birds, provides shoreline and dune stabilization and provides recreational and subsistence services (e.g., basket-making, etc.). Overhanging and emergent vegetation provides cover/shade and a food source for fish (insects). Preliminary surveys of the area show that 5.9 miles of shoreline were lightly to heavily oiled on Summer Bay and Summer Bay Lake. An estimated 4,719 square meters of vegetation were injured as a result of the response and cleanup activities and an additional 14,281 square meters of vegetation was lightly oiled or impacted by response and cleanup activities (AR# 24).

To evaluate the impacts on vegetation the Trustees consulted with vegetation experts familiar with the flora of Unalaska, reviewed reports prepared by the RPs technical experts and reviewed literature on the recovery of vegetation after oil spills and physical disturbance. Based on this preliminary evaluation, the Trustees concluded that the injured vegetation would likely recover. but that a more thorough quantification of injury and evaluation of restoration alternatives were warranted. These analyses are summarized below in Section 5.3.

3.4.4 Shellfish and Intertidal Biota:

The affected intertidal areas provide important ecological, recreational and subsistence services, including shellfish harvest, beach combing and other uses. The Trustees conducted shoreline

[11] Documents relied upon for the preassessment evaluation of vegetation impacts include the ADEC Response Report (AR # 1), a shoreline plant restoration guidebook for Alaska (AR# 15), the NOAA HAZMAT response report (AR# 17), NOAA Preassessment Scoping Report (AR# 18), the RP's report on the restoration of vegetation impacted by the M/V Kuroshima (AR # 24), Shoreline Cleanup Report (AR # 25), Summary of the effects of oil on Tundra Vegetation (AR #35), the Shoreline contamination survey data (AR #74), and surveys of the replanted areas (AR # 124).

surveys and utilized surveys conducted by the Unified Command to determine the areal extent of contamination (AR # 1, 17, 18, 25, and 74). Shellfish tissues and samples of oil on the shoreline were also collected and chemically analyzed (AR # 4, 94, 99, 102, 103, 104). The chemistry results, combined with professional judgment of the Trustees based on experience and literature on spills involving similar oils (AR # 31, 39, 48, 50, 59, 60, 65, 66, 111), were used to predict the likely persistence of oil in the intertidal zone. Based on these observations and analytical results, the Trustees determined that shoreline oiling extended from the north shoreline of Morris Cove south to Summer Bay Beach and Second Priest Rock in Summer Bay. The degree of oiling ranged from a light stain to a heavy coat on the marine shoreline. In some areas, the oil will likely persist for years. The spill resulted in smothering and tainting of intertidal biota and resulted in low-level, but chronic oiling of area shorelines. Chemical testing confirmed that the oil was from the *M/V Kuroshima*.

Approximately 3.4 miles of marine shoreline were exposed to oil from the *M/V Kuroshima* spill. Tainting of shellfish persisted for at least 6 months after the spill and low-level chronic oiling of cobble beaches is expected to persist for at least the next 5-10 years until winter storms and microbial activity fully degrade the oil. Annual site visits to affected shorelines in the years since the spill reveal a decline in the level of oiling, but oil is still visible as stains and tar among the cobble (Doug Helton, Pers. Obs., AR# 112). Sunken oil from the Lake bottom is expected to continue to slowly remobilize and provide a low level but chronic source of contamination of the marine shoreline (Rice, 1999).

One of the primary concerns raised in public meetings by tribal members, city leaders, and other residents was the wholesomeness and safety of the oiled seafood (ADEC Sit. Rep.22 in AR# 18). Based on these concerns, the Unified Command arranged to have shellfish tissues collected for human health investigation, and recommended that shellfish in the spill area not be harvested pending completion of the cleanup and finalization of the health risk analysis (ADEC Sit Rep 26, in AR# 18). The Alaska DEC and Alaska Fish and Game requested assistance from the Alaska Department of Health and Social Services and the US Department of Health and Human Services regarding the public health implications of the seafood contamination in Summer Bay (AR #4). The risk analysis concluded that PAH levels in the mussels and other sampled shellfish resources were at levels below human health concern, but recommended that subsistence gatherers should avoid consumption of foods on which oil can be seen, smelled or tasted.

The results of the health studies gave some confidence to some local users, but created uncertainty and lingering suspicions for others (Dan Duame, Pers. Comm.). The Department of Heath and Social Services guidance said to avoid oiled shellfish. Although shellfish beds are not visibly oiled, the persistence of nearby oil in the Lake and along the intertidal and supratidal areas of Summer Bay provides a continued visual reminder of the spill and raises questions about whether that residual oil is a source of low-level exposure to intertidal shellfish. Reports from tribal members during the summer of 2001 indicate that local users still find oil along the lake and bay and have questions about exposure risks through direct contact with the oil and through consumption of nearby shellfish (AR# 131, Dan Duame, Pers. Comm.). These concerns are

further intensified by the well publicized persistence of *Exxon Valdez* oil in Prince William Sound (AR# 65, 69, 122) and the long-lasting impacts of the spill on Native communities (AR # 73).

Based on the preliminary surveys and concerns about the loss of use of the intertidal, the Trustees concluded that evaluation of impacts and restoration alternatives was warranted. These analyses are summarized below in Section 5.4.

3.4.5 Salmonids and Lake Resources:

The Summer Bay Lake system supports at least three species of pacific salmon (pink, coho and sockeye) and Dolly Varden. The salmonids that return to Summer Bay Lake are harvested recreationally, and for subsistence. Harvests have been curtailed during recent years because of concerns about stock size. The Trustees have conducted preliminary surveys on the population of salmonids in Summer Bay Lake and have operated a fish weir (Figure 20: Salmon Weir at Outlet of Summer Bay Lake) annually since the spill (AR # 2,3).

Several lines of evidence suggest that anadromous and resident fish in Summer Bay Lake have been exposed to oil and were injured by the *M/V Kuroshima* spill. Underwater surveys showed mats of oil that, on a localized basis, smother spawning and rearing habitats (AR# 19). This submerged oil, as well as oil contamination in lake water and sediments, were chemically fingerprinted and determined to be *M/V Kuroshima* oil (AR # 117). In addition to direct exposure to oil, these fish may also have been injured through physical disruption of spawning habitats resulting from cleanup workers trampling the nearshore areas and increased sedimentation due to response-related erosion, and starvation or reduced growth as a result of injury to their planktonic forage base. The oil spill literature strongly suggests that trace levels of oil left in the Lake may cause low-level injuries, including reduced spawning success, reduced growth and other sub-lethal injuries (AR# 44, 47, 49, 58, 68, 69). The spill occurred in late fall. Consequently, juvenile salmon in Summer Bay Lake may have been exposed as eggs, fry and juveniles. The Trustees considered Sockeye and coho salmon to be at the greatest risk from the oil spill because of their long freshwater residency both in spawning gravels within the Lake and in rearing habitats along the Lakeshore.

Based on the run size information derived from the smolt and adult weir surveys, existing exposure data, oil weathering information and literature on the subject, the Trustees expect salmon runs in Summer Bay Lake to recover, but have concluded that further assessment and evaluation of restoration alternatives are warranted. These analyses are summarized below in Section 5.5.

3.4.6 Recreational Uses:

The *M/V Kuroshima* spill occurred on the prime recreational beach for the City of Unalaska (Figure 21: Sport Fishing at Summer Bay). The Summer Bay area is an important location for

picnicking, fishing, beach combing, swimming, day hiking, wildlife viewing and shellfish harvesting. The beach, Lake and surrounding areas are unique in that they are readily accessible, but relatively undeveloped. The Summer Bay area has the only sand beach on the Island that can be reached via road. The limited number of roads and the steep terrain on the Island severely limit the number of alternative recreation sites. The presence of oil and response operations reduced the number of recreation trips, and residual oil and subsequent response operations diminished the value of the trips taken to the area.

The Trustees conducted a preliminary analysis to evaluate the impacts of the spill on human uses including the number and value of lost user-days and diminished trips to the Summer Bay area (AR# 97). Information on local use patterns was collected from local residents, the Qawalangin Tribe and the City of Unalaska. Data collected by the ADF&G fish weir crew on recreational use of the Summer Bay area was also evaluated (AR # 123). Beach closure and contamination information were derived from reports and information generated by the Unified Command and from the RP's report on the July 1999 cleanup (AR# 25). Values for the affected recreational activities were derived from State of Alaska and national outdoor recreation surveys. Based on this information, the Trustees concluded that there was a recreational lost use of the Summer Bay region and that evaluation of restoration alternatives was warranted. These analyses are summarized below in Section 5.6.

4.0 RESTORATION PLANNING

4.0 RESTORATION PLANNING

Restoration of the affected resources in Unalaska Bay, Summer Bay and Summer Bay Lake requires an approach that focuses on several interconnected issues, including water quality, habitats and living resources. The Trustees have evaluated potential restoration options that will restore the affected natural resources to pre-spill levels and compensate for interim losses.

In developing this plan, the Trustees have taken into consideration the conceptual restoration plan prepared by the RPs and proposals submitted by the City of Unalaska and the Ounalashka Corporation. The Trustees have also taken into consideration the mitigation activities that were conducted as part of response operations. These include actions already taken to address injuries to shoreline vegetation and archaeological resources.

The OPA NRDA regulations require that the Trustees state their preferred alternative and explain the basis for their selection or rejection of alternatives. These Trustee determinations may be modified based on public input and comment.

4.1 Restoration Strategy

The goal of the damage assessment process for the *M/V Kuroshima* spill is restoration of the injured natural resources and compensation of the public for the interim lost uses of those resources. OPA requires that this goal be achieved by returning injured natural resources to their baseline condition and by compensating for any interim losses of natural resources and services during the period of recovery to baseline.

Restoration actions under the OPA regulations are either primary or compensatory. Primary restoration is action(s) taken to return injured natural resources and services to baseline on an accelerated time frame. The OPA regulations require that Trustees consider natural recovery under primary restoration. Trustees may select natural recovery under three conditions: (1) if feasible, (2) if cost-effective primary restoration is not available, or (3) if injured resources will recover quickly to baseline without human intervention. Primary restoration alternatives can range from natural recovery to actions that prevent interference with natural recovery to more intensive actions expected to return injured natural resources and services to baseline faster or with greater certainty than natural recovery alone.

Compensatory restoration includes actions taken to compensate for the interim losses of natural resources and/or services pending recovery. The type and scale of compensatory restoration may depend on the nature of the primary restoration action and the level and rate of recovery of the injured natural resources and/or services, given the primary restoration action. When identifying the compensatory restoration components of the restoration alternatives, Trustees must first consider compensatory restoration actions that provide services of the same type and quality and of comparable value as those lost. If compensatory actions of the same type and quality and comparable value cannot provide a reasonable range of alternatives, Trustees then consider other compensatory restoration actions that will provide services of at least comparable type and quality as those lost.

Compensatory restoration alternatives must be scaled to ensure that the size or quantity of the proposed project reflects the magnitude of the injuries from the spill. The Trustees selected different quantification approaches for the ecological and human lost uses. Those approaches will be discussed in the sections dealing with the proposed restoration alternatives.

Several of the restoration alternatives included in this section are based on conceptual designs rather than detailed engineering design work or operational plans. Therefore, details of specific projects may require additional refinements or adjustments to reflect site conditions or other factors before implementation. Restoration project designs also may change to reflect public comments and further Trustee analysis. The Trustees assume that implementation of restoration will begin in 2002. Should actual implementation occur after this date, the Trustees may revise their quantification calculations.

4.2 Evaluation Criteria

The OPA regulations (15 CFR § 990.54) require that Trustees develop a reasonable range of primary and compensatory restoration alternatives and then identify the preferred alternatives based on the six criteria listed in the regulations:

1. Cost to carry out the alternative;
2. Extent to which each alternative is expected to meet the Trustees' goals and objectives in returning the injured natural resources and services to baseline and/or compensating for interim losses;
3. Likelihood of success of each alternative;
4. Extent to which each alternative will prevent future injury as a result of the incident and avoid collateral injury as a result of implementing the alternative;
5. Extent to which each alternative benefits more than one natural resource and/or service; and
6. Effect of each alternative on public health and safety.

In addition, the Trustees considered several other factors including:

1. Cost effectiveness;
2. Nexus to geographic location of the injuries; and
3. Compliance with applicable Federal and state laws and policies.

NEPA applies to restoration actions taken by Federal Trustees. To reduce transaction costs and avoid delays in restoration, the OPA regulations encourage the Trustees to conduct the NEPA process concurrently with the development of the draft restoration plan.

To comply with the requirements of NEPA, the Trustees analyzed the effects of each preferred alternative on the quality of the human environment. NEPA's implementing regulations direct

Federal agencies to evaluate the potential significance of proposed actions by considering both context and intensity. For the actions proposed in this draft Restoration Plan/ Environmental Assessment, the appropriate context for considering potential significance of the action is local, as opposed to national or world-wide.

With respect to evaluating the intensity of the impacts of the proposed action, the NEPA regulations (40 CFR § 1508.27) suggest consideration of ten factors:

1. Likely impacts of the proposed project;
2. Likely effects of the project on public health and safety;
3. Unique characteristics of the geographic area in which the project are to be implemented;
4. Controversial aspects of the project or its likely effects on the human environment;
5. Degree to which possible effects of implementing the project are highly uncertain or involve unknown risks;
6. Precedential effect of the project on future actions that may significantly affect the human environment;
7. Possible significance of cumulative impacts from implementing this and other similar projects;
8. Effects of the project on National Historic Places, or likely impacts to significant cultural, scientific or historic resources;
9. Degree to which the project may adversely affect endangered or threatened species or their critical habitat; and
10. Likely violations of environmental protection laws.

4.3 Summary of the Proposed and Other Restoration Alternatives

In developing restoration alternatives for the *M/V Kuroshima* incident, the Trustees considered habitat and species-specific restoration projects. As discussed earlier, the Trustees identified five categories of natural resources that warrant restoration. Several alternatives were considered for each category. These alternatives are summarized in Table 1 and described in more detail below.

Although the spill resulted in significant impacts to the resources in the Unalaska Bay region, the Trustees expect the affected resources to recover over time because of the prompt actions taken to clean up and minimize the spill. In most instances, natural recovery will be sufficient to return resources to their pre-spill condition (recovery to baseline). However, this recovery, depending on the injury category, may take years to occur. Therefore, most of the restoration alternatives evaluated in this document are focused on compensating for the interim losses resulting from the spill.

Table 1: Summary of Proposed and Other Restoration Alternatives (Alternatives in bold are elements of the proposed preferred alternative: See Sections 5.2 through 5.6 for details)

Birds	Vegetation	Salmonids	Intertidal	Recreation
Avatanak Predator Removal	**Evaluate recovery of injured vegetation**	**Salmon Enumeration and Limnology**	**Additional testing**	**Camp Structures**
Management	**On-site Planting**	**On-site Habitat Improvement**	**Seafood Safety Education**	**Environmental education**
Removal from other Islands	Off-site Enhancement	**On-site Sediment Control**	Stocking	**Shoreline Cleanup**
Predator Control	Land Acquisition	Off-site Stocking	Artificial Reef	On-site Improvements
Nest Boxes	No Action	On-site Stocking	Land Acquisition	Off-site Improvements
Acquisition		Off-site Habitat Improvement	Environmental education	Improve Site Access
Habitat Creation		Remove migration barriers	Camp Structures	Land Acquisition
Local Rehabilitation Facility		Lake Fertilization	Beach Cleanup	Fishing enhancement
No Action		Land Acquisition	Response Equipment	Treat Beach Sands
		Game Warden	No Action	No Action
		No Action		

4.4 Environmental Consequences (Indirect, Direct, Cumulative)

To restore resources lost as a result of the *M/V Kuroshima* incident, the Trustees examined a variety of proposed projects under the following restoration alternatives: (1) no-action and natural recovery, (2) ecological restoration and (3) lost human use restoration. The Trustees intend to avoid or reduce negative impacts to existing natural resources and services to the greatest extent possible. However, the Trustees could undertake actions that may have short- or long-term effects upon existing habitats or non-injured species. Project-specific environmental consequences for each proposed project are provided in Section 5. This section addresses the potential overall cumulative, direct and indirect impacts and other factors to be considered in both the OPA and the NEPA regulations.

In the Trustees' judgment, the projects selected in this restoration program will not cause significant negative impacts to natural resources or the services that they provide. Further, the Trustees do not expect that the proposed projects will adversely affect the quality of the human environment in ways deemed significant.

Indirect Impacts: Environmental consequences will not be limited to the spill location. Indirect beneficial impacts will occur in other parts of Unalaska Island and other nearby islands. Cumulative impacts at the project locations and in the surrounding areas are expected to increase populations of seabirds, provide improved lakeshore habitat, cleaner intertidal habitats and provide a greater understanding of human interaction with natural resources.

Direct Impacts: Overall, proposed restoration actions included in the draft RP/EA will enhance functionality of ecosystems. However, there will be some short-term impacts from the proposed projects:

- **Noise and Air Pollution** -- Machinery and equipment used during construction and other restoration activities will generate noise. This noise may disturb wildlife and humans. It is not anticipated, however, that the proposed projects will cause significant noise impacts.

- **Water Quality** -- Although implementation of the proposed projects should result in no significant impact to water quality, there will be temporary increases in sedimentation and turbidity related to certain construction projects such as the proposed sediment control project.

- **Visual** -- There will be temporary visual impacts during implementation of some of the proposed projects. Once the Trustees complete those projects, the visual impacts will cease.

- **Public Access** -- Public access may be temporarily affected during construction activities along Summer Bay Lake. Because implementation time for these projects will be relatively short, the impact will be short-lived.

No adverse effects to sediment quality, soil, geologic conditions, energy consumption, wetlands or flood plains are anticipated. The proposed restoration projects will have no adverse social or

economic impacts on neighborhoods or communities. General land use patterns and aesthetic qualities will not be affected by the preferred alternatives. The proposed projects will not adversely affect any known archaeological sites or sites of cultural significance to native Alaskans.

Cumulative Impacts: Since the Trustees designed the projects primarily to improve recovery of injured natural resources, the cumulative environmental consequences will be beneficial. These cumulative impacts include restoration of the injured ecosystem by increasing reproductive success of individual seabirds which will enhance recruitment of seabirds, restoration of dune vegetation, reduction of sedimentation and enhancement of the lakeshore habitats, cleanup of intertidal habitats and educational activities. The Trustees anticipate that monitoring of projects funded under this Restoration Plan will confirm that cumulative impacts will be beneficial rather than adverse. Any unanticipated cumulative adverse effect from a proposed project on an area or other area program, plan, or regulatory regime will result in reconsideration of the project by the Trustees.

5.0 ANALYSIS OF RESTORATION ALTERNATIVES

5.0 ANALYSIS OF RESTORATION ALTERNATIVES

5.1 Evaluation of the No-Action Alternative/Natural Recovery Alternative:

NEPA requires the Trustees to consider a "no-action" alternative and the OPA regulations require consideration of the equivalent, the natural recovery option. Under this alternative, the Trustees would take no direct action to restore injured natural resources or compensate for lost services pending environmental recovery. Instead, the Trustees would rely on natural processes for recovery of the injured natural resources. While natural recovery would occur over varying time scales for the injured resources, the interim losses suffered would not be compensated under the no-action alternative.

The principal advantages of this approach are the ease of implementation and the absence of monetary costs because natural processes rather than humans determine the trajectory of recovery. This approach recognizes the capacity of ecosystems to self-heal if given enough time.

OPA, however, clearly establishes Trustee responsibility to seek compensation for interim losses pending recovery of the natural resources. This responsibility cannot be addressed through a "no-action" alternative. While the Trustees have determined that natural recovery is appropriate as primary restoration for many of the injuries, the "no-action" alternative is rejected for compensatory restoration. Losses occurred during the period of recovery from this spill and technically feasible, cost-effective alternatives exist to compensate for these losses.

5.2 Evaluation of Bird Restoration Alternatives:

The *M/V Kuroshima* oil spill resulted in the direct mortality of birds and impacted several important bird habitats including intertidal shoreline foraging habitats (this includes sandy beaches, rocky shores, etc.). Lost ecological services resulting from the spill include direct mortality of seabirds and reductions in the ability of certain habitats to provide ecological functions, such as the provision of food and refuge for various species of birds.

5.2.1 Quantification Approach:

As noted in Section 3.4, the *M/V Kuroshima* incident clearly resulted in mortality to birds. However, quantification of the bird injury presented a challenge to the Trustees. The spill occurred in a relatively remote area and there was a delay of several days between the date of the spill and the arrival of the Trustees. Many parts of the coastline were not accessible for search and other areas proved difficult to reach. Short daylight, cold weather and storm conditions also hampered the initial assessment. Consequently, oiled wildlife may have been scavenged from the shoreline or may have washed back to the ocean. An unknown number of oiled seabirds undoubtedly perished at sea and their carcasses never washed ashore, washed ashore in remote locations, or were preyed upon by eagles, foxes and other predators.

The Trustees used a mixture of field data[12], the extensive literature on seabirds and oil, and best professional judgment of State and Federal wildlife experts to determine the likely effects of the spill on seabirds. The Trustees also considered additional fieldwork and other studies to provide supplemental injury information. However, the numbers of species, location of bird colonies and complex life history of the various species complicate the evaluation of effects. Bird populations fluctuate for many reasons and that variability may mask the impacts of a single spill event. The Trustees determined that additional studies would not provide information that would significantly improve the accuracy or precision of the injury estimate.

In order to quantify the injury and determine the amount of restoration necessary, the Trustees selected an assessment strategy that used the field survey results in combination with a literature-based adjustment factor or multiplier to estimate the number of birds that were killed but not found. This multiplier accounts for the birds that sank, drifted out to sea, stranded in locations not surveyed, or were scavenged. Burger (1993) found that in remote or poorly documented spills, less than 10% of the dead birds were recovered (AR# 7). Even for spills that have occurred in relatively easy areas to survey, only a small percentage of the birds are found. In the *T/B North Cape* oil spill, which occurred on a broad sandy shoreline in a readily accessible and relatively populated area, the Trustees determined that only 16% (e.g., a multiplier of 6) of the dead birds were found (AR # 16).

There are four main categories of factors that can affect the magnitude of the acute mortality multiplier (AR # 7, 16, 70, 115, 116). These factors are listed below:

Table 2. Summary of Factors that Affect Acute Bird Mortality

Category	Factors
Characteristics of the Oil	How much was spilled, what oil type, did it evaporate or disperse?
Characteristics of the Biological Resources	Where are the aggregations of birds relative to the spill site, how many birds are in the area, what types of birds (size, buoyancy), what ages, how mobile, what predators are in the area, what other known stresses exist (food, temperature, etc.)
Environmental and Site Conditions	Spill location, wind speed, wind direction, currents, tides, temperature, shoreline types, shoreline access
Response efforts	How much oil was recovered, how long was the response, what hazing methods were used, how much effort was placed in searching for birds, how frequent were the surveys, how soon did the surveys start?

Consideration of these factors in the *M/V Kuroshima* incident suggests that the multiplier is higher than most spills because of the remote location, weather conditions and predation.

[12] These results are summarized in the 1998 USFWS carcass collection report (AR# 42) and Wildlife Rapid Response Team Report prepared for the USFWS (AR #28).

Therefore, the Trustees concluded that a multiplier of at least 10 was appropriate. In other words, at least 2000 birds were likely killed by the spill. In addition to the estimated acute injury, the injury to birds would also have generational losses in terms of lost future reproduction.

5.2.2 Preferred Alternative: Restoration of Native Birds by Removing Introduced Foxes at Avatanak Island

Project Description:

To address the injury to birds the Trustees' proposed preferred alternative is to restore native birds by removing introduced foxes at a nearby island[13]. Most of the bird species affected by the spill nest on the ground or nest on rocky cliffs. Though these breeding colonies are largely inaccessible to humans, they have not escaped the impact of various introduced predators. Arctic (*Alopex lagopus*) and red (*Vulpes vulpes*) foxes were introduced on many islands in the Aleutians for fur ranching purposes before 1930. Arctic foxes were introduced to Avatanak by 1920. These predators extirpated or seriously reduced populations of native birds (Bailey, 1993).

Since 1949, the U.S. Fish and Wildlife Service has had a program to eradicate introduced foxes from Refuge-owned islands in the Alaska Maritime National Wildlife Refuge to restore native bird populations (USFWS, 1991). The Refuge plans to continue to eliminate introduced foxes from all Refuge-owned islands. However, some islands within the Refuge are co-owned with village or regional corporations and are not scheduled for predator removal.

The Trustees propose implementing a predator removal program on one of the co-owned islands, Avatanak Island (Figure 22: Site for Proposed Bird Restoration). Avatanak and Unalaska Islands are both within the same island group, the Fox Islands, in the eastern Aleutian Islands. Avatanak is approximately 40 miles east of the spill site. The co-owner, the Akutan Native Corporation, has agreed with the implementation of the project (AR# 132). In addition to the land ownership status, Avatanak Island is preferable to other locations because of its size, location and relative ease of access.

The Trustees considered other islands for removal programs (see non-preferred alternatives below). Predator removal is a very efficient and cost-effective method for seabird restoration (bird populations may increase 2-5 times), but it is difficult to exactly scale the size of the restoration project because to be effective, all the predators need to be removed (AR # 5, 8, 9). The challenge was identifying a small and readily accessible island that had the capacity to restore the approximate number of birds killed by the incident. Avatanak Island is preferred because the expected benefits of the predator removal are expected to equal or exceed the impacts caused by the *M/V Kuroshima* spill. The Island has seabird colonies that would benefit

[13] The Trustees relied on the following documents in their evaluation bird restoration alternatives and selection of their preferred alternative: Introduction of Foxes to Alaskan Islands (AR # 5), Exxon Valdez predator-control restoration projects (AR # 8), removal of introduced foxes (AR # 9), Aleutian Canada Goose Recovery Plan (AR #23), the RP's conceptual restoration proposal (AR # 109), and the Trustees' comments on the RP restoration proposal (AR # 110).

from predator removal, is large enough to ensure that expected increase in bird populations will address the bird injury, yet small enough to be manageable. Furthermore, the introduced status of the foxes on Avatanak Island is well documented, and the Trustees are not aware of any native foxes or other terrestrial predators that might be inadvertently killed.

Methods similar to those used on other islands (e.g., shooting and trapping) would be used to remove introduced foxes from Avatanak. Trappers typically hike where practical, but boating is necessary to set traps everywhere foxes may occur. Trappers would maintain traplines and continue to search for foxes for at least two weeks after any sign of live foxes is detected. The purpose of the extended stay is to minimize the risk that one or more foxes survive the project.

Restoration Objectives:
The goal of this proposed restoration project is to enhance the survivorship and productivity of seabirds on the island. Removing the introduced predators is expected to increase survivorship of all age classes and increase the overall productivity of the birds by greatly expanding areas that the birds can safely nest.

Probability of Success:
Past success with similar and related projects indicates that there is a high probability of success for this project. The removal of introduced foxes from the nesting islands in Aleutians is credited for the recovery of the Aleutian Canada goose populations in North America (AR # 9, 118). Removing foxes also benefited many other bird species including puffins, murres and auklets. The Aleutian Canada goose was formally removed from the endangered species list on March 20, 2001 (AR # 119). The RPs supports implementation of the project and the Akutan Corporation has indicated preliminary support for the project.

The removal of introduced predators is a practical and cost-effective means of increasing seabird populations. Predator removal has been used successfully as a restoration technique after oil spills (AR # 8). Based on monitoring of previous predator removal projects in Alaska, it is anticipated that the following bird species injured by the *M/V Kuroshima* spill would increase substantially at Avatanak Island within five years following fox removal: red-breasted merganser, glaucous-winged gull, cormorant, black oystercatcher (*Haematopus bachmani*), and pigeon guillemot (*Cepphus columba*). In addition, harlequin duck, emperor goose, common eider (*Somateria mollissima*), willow ptarmigan (*Lagopus lagopus*), least sandpiper (*Calidris minutilla*), rock sandpiper (*C. ptilocnemis*), ancient murrelet (*Synthliboramphus antiquus*), and tufted puffin (*Pratercula cirrhata*) would benefit from fox removal. As seabird populations increase, raptors like bald eagle and peregrine falcon (*Falco peregrinus pealei*) may also increase. Predicting the percentage of increases for various bird species is difficult. Similar bird species on an island in the western Aleutian Islands increased from two to more than five-fold within fifteen years (AR # 9). Since most of the bird species injured by the M/V Kuroshima spill nest on Avatanak Island, the probability of success that this project will benefit these species is increased.

Performance Criteria and Monitoring:
Success for this project will be measured by using standard monitoring techniques to ensure complete removal of introduced foxes from Avatanak Island. Pre- and post-removal surveys of

the Island will also be conducted to gather information for efficient planning of the fox removal project. The bird colonies will also be monitored to evaluate the efficacy and benefits of the project in terms of pre- and post-removal abundance of seabirds.

Benefits and Environmental Impacts:
By removing introduced predators, this project is expected to have significant and long-lasting environmental benefits (Bailey, 1993, Byrd et al, 1994, 1996). Limited disturbance may occur to some nesting birds during survey and predator removal activities, but the project is not expected to have any substantial adverse environmental or economic consequences. The foxes on the island are known to have been introduced. There are no native mammals that might be accidentally trapped. Foxes on the island are no longer trapped commercially and an agreement has been reached with the co-owner, the Akutan Native Corporation, not to reintroduce foxes. There is opportunity for local hire to conduct the removal actions.

Evaluation:
Removal of predators on Avatanak should rapidly and cost-effectively compensate for the injuries to birds from the *M/V Kuroshima* Spill. The project will benefit the same species and populations that were injured by the spill. While Avatanak Island was not directly affected by the spill, the island is nearby. There is a high likelihood of success. There are no adverse impacts anticipated. For these reasons, the removal of predators is the Trustees' preferred restoration alternative.

5.2.3 Non-Preferred Bird Restoration Alternatives

The Trustees considered the following bird restoration projects to compensate for bird losses resulting from the spill. The Trustees rejected these alternatives because the alternatives did not meet one or more of the evaluation criteria discussed in Section 4.2.

- **Predator Removal on Other Islands:**

The Trustees considered predator removal on other islands in the Aleutians including Unalaska Island and Rootok Island. Unalaska Island was considered because of the immediate proximity to the spill site. However, Unalaska Island, at 67 miles in length, is one of the largest islands in the eastern Aleutians. The complexity of removing foxes on such a large island did not meet the Trustees' restoration selection criteria for feasibility. Rootok Island was also considered. Rootok is also the site of an abandoned fox farm, but it is unclear whether foxes still live on this island. Rootuk also lacks a secure anchorage making the logistics for field work more difficult[14].

- **Predator Control on Aleutian Islands:**

Rather than predator removal, the Trustees considered steps to control or limit the population of predators on Unalaska or other nearby Aleutian Islands. Predator control activities used

[14] According to the US Coast Pilot #9, 19th Edition for the Pacific and Arctic Coasts of Alaska: Cape Spencer to the Beaufort Sea, Avatanak Island has anchorage areas that provide "good holding ground " and a small cove that provides "temporary protection to small craft" while Rootok Island is "fringed with rocks and kelp and affords no secure anchorage."

successfully elsewhere, such as fencing and exclosures, while beneficial in certain locations, were deemed impractical because of the remoteness, severe winter weather and the difficulty of maintenance, and the large size of the bird colonies. Reducing the number of predators was also considered. However, the Trustees concluded that unless all of the predators were removed, the remaining animals would quickly repopulate the island. Even a few surviving animals would continue to feed on and disrupt the breeding colonies of birds. The Trustees concluded that the benefits of a partial removal or control project would be minimal and therefore rejected this alternative.

- **Seabird Management and Population Surveys:**

Bird populations in the Unalaska Bay area are not well studied. Basic information such as population sizes, distribution, habitat uses and seasonality is not well known. The Trustees considered developing a research plan to obtain annual baseline estimates of the summer and winter populations of marine birds in Unalaska Bay. This information would be useful in helping to determine whether these populations are being influenced by human activities in the Bay and in evaluating the effects of any future oil spill(s). Local development and industrialization may be having detrimental effects on wildlife resources. Increased understanding of bird populations would be an important step towards improving the management of these resources. The Trustees determined that seabird management, while beneficial, would not directly compensate for the injuries from the spill. Furthermore, such survey work is labor intensive and would need to be conducted on an annual basis for several years to be of value. Therefore, the Trustees rejected this alternative.

- **Nest Boxes and Platforms:**

This alternative involves construction of nesting structures to enhance bird productivity as compensation for lost bird resources. Some species of birds may benefit from artificial nesting platforms and boxes. These types of structures are inexpensive to create and could be placed in the immediate vicinity of the spill area. These approaches have been used elsewhere to increase the nesting and fledgling success of birds.

The Trustees evaluated this alternative and concluded that most of the species affected by the spill were seabirds that either nest on the ground on remote cliffs and offshore rocks and islets such as murres and cormorants, or that are burrowing nesters such as petrels, auklets and puffins. These species would not use artificial nesting platforms and boxes and therefore these aids would not address any limiting factors in seabird abundance. Some waterfowl species (e.g., green-winged teal (*Anus crecca*)) might utilize nesting boxes and platforms, but fox predation of fledged young would negate these benefits. Therefore, the Trustees rejected this alternative.

- **Land Acquisition:**

Land acquisition was considered as a restoration activity to compensate for the loss of birds. Habitat protection is an effective way to protect injured species that depend on specific areas during critical parts of their life cycle. Habitat protection through acquisition or conservation easements would be expected to compensate for interim losses if the habitat protected is a

priority habitat and is currently threatened or anticipated to be developed in the future. However, much of the Aleutians is already under protected status under the Alaska Maritime National Wildlife Refuge, managed by the U.S. Fish and Wildlife Service. Other large parcels of remote and undeveloped lands are owned by Native Corporations. The habitat value of these large parcels of Native Corporation land does not appear to be threatened. Therefore, habitat acquisition is not expected to address a limiting factor in bird abundance. There is limited private land near the spill site that would be suitable for acquisition as wildlife habitat and any acquired lands would not significantly increase the availability of wildlife habitat in the Unalaska region.

- **Habitat Creation:**

The Trustees considered artificial wetland construction. The overall goal of this type of project is to provide wetland functional values by creating a wetland that did not previously exist. A created wetland could be designed to maximize benefits for birds and other wildlife. The Trustees rejected this alternative for several reasons. Only a few of the injured bird species would directly benefit from created wetlands. Except for the urban areas around the City of Unalaska, natural wetland habitats are abundant and largely pristine. Therefore, this habitat type is probably not a limiting factor in local abundance of birds in the Unalaska Bay region.

- **Development of a Local Seabird Rehabilitation Capability:**

A rehabilitation facility and a stockpile of wildlife response equipment in Unalaska could improve wildlife response efforts throughout the Aleutians. A local capability to care for injured birds could potentially compensate for injuries from the *M/V Kuroshima* spill by caring for all injured birds on a year-round basis (injured birds are occasionally brought to the National Marine Fisheries Service office in Dutch Harbor: no care facility is available). Having a wildlife care facility and trained personnel in Unalaska could increase the chances of saving birds injured in an oil spill by providing immediate care and reducing the stress imposed by long-distance shipping of birds for treatment.

A rehabilitation center would be a complicated alternative. At a minimum, the project would require equipping a local facility to meet the needs of injured wildlife, training local volunteers, providing an on-call veterinarian (there is no veterinarian in town), supplies and equipment. Care of injured wildlife is a difficult task and even in locations with dedicated wildlife care centers, the survival and prognosis for rehabilitated wildlife is uncertain. The lack of a local veterinarian would significantly delay the treatment of wildlife and it would not be cost-effective to fly a veterinarian into Unalaska unless multiple animals were in need of care. Because of the high cost and uncertain benefits of maintaining a local capability to treat wildlife, and because other more effective restoration alternatives were available, the Trustees rejected this alternative.

5.3 Evaluation of Vegetation Restoration Alternatives:

As noted in Section 3.4.2, the Trustees gathered evidence and data regarding vegetation impacts. Shoreline vegetation was oiled to various degrees throughout the spill area; the extent of oiling ranged from a light stain to thick tar mats. Vegetation was also oiled along the shoreline of Summer Bay Lake. The outlet stream was blocked temporarily to prevent additional oil from entering the Lake. This response action raised the Lake level and depending on the slope of the shoreline, the slowly increasing water levels resulting in a 1-15 meter wide band of Lakeshore vegetation being oiled.

Vegetation injury resulted from a combination of direct smothering by the oil and trampling, as well as cutting and erosion resulting from the response efforts[15]. The injured vegetation provides habitat for birds, provides shoreline and dune stabilization and provides recreational and subsistence services (e.g., basket-making, etc.). Preliminary surveys of the area show that 5.9 miles of shoreline were lightly to heavily oiled on Summer Bay and Summer Bay Lake. An estimated 4,719 square meters of vegetation were injured as a result of the response and cleanup activities and an additional 14,281 square meters of vegetation were lightly oiled or impacted by response and cleanup activities (Vanguard, 1998). In the summer of 1998, the Responsible Party implemented beach wild rye revegetation covering approximately 5480 square meters (1.35 acres).

5.3.1 Quantification Approach:

The Trustees and the RPs conducted surveys to measure areas of affected vegetation and areas that were subject to early replanting efforts. The Trustees and RPs used a restoration quantification tool, Habitat Equivalency Analysis (HEA), to determine how large an area would need to be restored to compensate for the injuries resulting from the incident (AR #129). Based on the preliminary HEA calculations, the Trustees determined that the 1.16 acres of replanting[16] conducted by the Responsible Parties largely addressed the injuries to vegetation resulting from the response actions (e.g., emergency roads, parking and equipment staging areas). Additionally, the Responsible Parties conducted a small replanting project (0.19 acres) to compensate for the injury to vegetation resulting from the oiling. However, the success of the early replanting efforts is uncertain. Therefore, the Trustees have considered several restoration alternatives[17].

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[15] The Trustees conducted photographic surveys of the exposed areas, utilized data generated by the Unified Command and reviewed literature on the effects of oil on vegetation. Documents relied upon for the preassessment evaluation of vegetation impacts include the ADEC Response Report (AR # 1), a shoreline plant restoration guidebook for Alaska (AR# 15), the NOAA HAZMAT response report (AR# 17), NOAA Preassessment Scoping Report (AR# 18), the RP's report on the restoration of vegetation impacted by the M/V Kuroshima (AR # 24), Shoreline Cleanup Report (AR # 25), Summary of the effects of oil on Tundra Vegetation (AR #35), the Shoreline contamination survey data (AR #74), and follow-up surveys of the replanted areas (AR# 124).

[16] The RPs replanting efforts occurred on Summer Bay Beach, Summer Cove Creek, along the hillside on the eastern shore and SE end of the Lake, the tank farm area, and in work sites and staging areas along Summer Bay road and Summer Bay Lake road. Detailed maps of the replanted areas can be found in AR # 24.

[17] The Trustees relied on the following documents in their evaluation of vegetation restoration alternatives and selection of their preferred alternatives: Literature on riparian buffer strips (AR# 6), Streambank revegetation guide for Alaska (AR# 15), Evaluation of Mitigation Opportunities in Unalaska (AR# 21), the RPs' vegetation restoration project (AR# 24), Summary of the effects of oil on Tundra Vegetation (AR #35), the RPs' conceptual restoration

5.3.2 Preferred Alternative: Evaluate Recovery of Injured Vegetation

Project Description:
Because the oiled and replanted areas of vegetation along Summer Bay Lake and Summer Bay Beach are expected to recover rapidly, the Trustees' preferred alternative involves evaluating these areas to ensure that the replanting projects and natural recovery are effective in returning the vegetation to its pre-spill diversity and condition. (Figures 23 and 24: Pre- and Post-Planting of Tank Farm Area). The Trustees' preferred alternative also includes funding for replanting efforts if the monitoring data indicate that planting of additional areas or infilling with different plant species is warranted. Specifically, the project would include the cost to employ biologists, local experts and field assistants to survey the area annually during the growing season to revisit the oiled and restored areas in order to:

- Evaluate and document vegetation recovery
- Evaluate and address factors limiting vegetation recovery, if necessary
- Conduct maintenance activities, such as debris removal, maintaining fences and signs protecting areas from vehicle and foot traffic, etc.

Restoration Objective:
The goal of this proposed restoration project is to track the recovery of the injured vegetation and identify whether an additional replanting or other treatments are necessary.

Probability of Success:
The probability of success for this project is very high. Standard vegetation monitoring methods will be used. Considerable monitoring expertise is available locally and within the State. Furthermore, the State has a restoration and monitoring protocol for beach wild rye, the dominant plant species affected the spill.

Performance Criteria and Monitoring:
The performance criteria will be determined through discussion between the Trustees and the agency or contractor selected to conduct the monitoring. At a minimum, standard monitoring methods will be used to establish permanent vegetation quadrats or transects. These sites will be evaluated visually and photographed annually for five years, with more detailed monitoring conducted at 2-3 year intervals.

Benefits and Environmental Impacts:
This project is expected to have minimal but positive environmental and socio-economic implications. The monitoring effort is not expected to result in any additional disturbance to vegetation. No destructive sampling is anticipated. While some limited fencing and marking may be necessary around monitoring locations, these will restrict human activities in only a very small area.

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proposal (AR # 109), and the Trustees' comments on the RPs' restoration proposal and replanting efforts (AR # 110, 125).

Evaluation:
Minimal monitoring of the affected vegetation and the existing restoration sites is necessary to ensure that vegetation is recovering. If problems are noted, the monitoring should help to identify areas that require replanting or other mid-course corrections.

5.3.3 Preferred Alternative: On-site Planting

Project Description:
The Trustees will evaluate the preliminary monitoring results to determine the amount and species diversity of future on-site planting efforts. The survival and growth rate of replanted vegetation is variable and the Trustees may need to conduct additional plantings in areas where transplants did not survive or did not grow and fill in the area. Planting efforts conducted by the RPs to date have focused on Beach Wild Rye grass. Additional planting efforts using other species may be necessary to reestablish the pre-spill diversity of vegetation types.

Restoration Objective:
The goal of this proposed restoration project is to re-establish the pre-spill vegetative cover and plant diversity in areas affected by the spilled oil and response actions.

Probability of Success:
The probability of success for this project will depend on the reasons for any failure of the initial planting efforts. If the Trustees can determine the limiting factors for planting failure and if those factors can be readily addressed (e.g., lack of sufficient water or nutrients), the probability of success is very high. Considerable restoration expertise is available within the State and Federal agencies.

Performance Criteria and Monitoring:
The performance criteria will be determined through discussion between the Trustees and the agency or contractor selected to conduct the replanting. At a minimum, criteria will be established for percentage survival of vegetation, plant growth (as measured by percentage cover) and species diversity. Any replanted areas will then be monitored as part of the monitoring efforts discussed above.

Benefits and Environmental Impacts:
Restoration of the natural vegetation in the spill area will benefit the ecological and human uses of the region. The replanting of native vegetation should have minimal adverse impacts on the local environment. This activity has already been conducted in the area. One potential impact is the harm that may result from "borrow" sites. These sites would be selected carefully and would be restored to minimize the potential for erosion.

Evaluation:
If necessary, on-site replanting is the Trustees' preferred alternative. This project would directly address injuries resulting from the *M/V Kuroshima* incident. Practical and low-cost planting

techniques are available. No significant adverse effects are anticipated.

5.3.4 Non-Preferred Vegetation Restoration Alternatives

The Trustees considered the following restoration projects to compensate for vegetation losses resulting from the spill. The Trustees rejected these alternatives because the alternatives did not meet one or more of the evaluation criteria discussed in Section 4.2.

- **Off-site Dune Vegetation Restoration:**

The Trustees considered dune restoration projects elsewhere in Unalaska. These projects include stabilizing and revegetating the beach areas along Front Street in Unalaska. Native vegetation, consisting of beach wildrye (*Elymus sp.*), would be transplanted from adjacent areas (where appropriate) or from off-site areas where material is available (future construction sites, roadwork, etc.). The Trustees rejected this alternative because on-site projects were available.

- **Habitat Creation:**

The Trustees considered habitat creation to compensate for injuries to vegetation. This project is similar in concept to the wetland construction project considered for the bird restoration and includes the same advantages and disadvantages. The overall goal of this type of project would be to provide wetland functional values by creating a vegetated wetland that did not previously exist.

The Trustees rejected this alternative for several reasons. Wetland creation can be complicated and subject to failure. Except for the urban areas around Unalaska, natural vegetation is abundant and largely pristine. Therefore, creation of a small additional area would not significantly increase the ecological and human services derived from vegetation in the Summer Bay region.

- **Land Acquisition:**

Land acquisition was considered as a restoration activity to compensate for the loss of vegetation. This project was similar in concept to land acquisition projects proposed to benefit birds and includes the same advantages and disadvantages. Much of the Aleutians is already under protected status under the Alaska Maritime National Wildlife Refuge, managed by the U.S. Fish and Wildlife Service. Large parcels of remote and undeveloped lands are owned by Native Corporations. The habitat values of these large parcels of Native Corporation Land do not appear to be threatened. There is limited private land near the spill site that would be suitable for acquisition. There is also a shortage of suitable land for development in the Unalaska area. Based on the Trustees' understanding of the real estate prices in the area, the Trustees have concluded that this would not be a cost-effective alternative.

5.4 Evaluation of Shellfish and Intertidal Biota Restoration Alternatives:

As noted in Section 3.4.3, over 3.4 miles of intertidal shorelines were exposed to oil from the *M/V Kuroshima* Oil Spill. Additional nearshore subtidal habitat was substantially degraded by the presence of vessel and the associated salvage activities. Lost services include tainting of intertidal biota harvested by recreational and subsistence users and contamination of forage used by other invertebrates, fish, mammals and birds. The persistence of oil in the lake and along the intertidal and supratidal areas of Summer Bay provides a continued visual reminder of the spill and raises questions about whether that residual oil serves as a source of low-level exposure to intertidal shellfish. Reports from tribal members indicate that local users still find oil along the lake and bay and have questions about exposure risks through direct contact with the oil and through consumption of nearby shellfish (Dan Duame, Pers. Comm.).

5.4.1 Quantification Approach:

The Trustees documented exposure of *M/V Kuroshima* oil to intertidal biota in areas used by subsistence and recreational harvesters[18]. Samples were collected for analytical chemistry, and shoreline surveys were conducted along Summer Bay to look for stranded or dead shellfish. The chemistry data and survey results do not indicate that a substantial mortality to shellfish and intertidal biota resulted from the spill. However, petroleum hydrocarbon levels found in the shellfish tissues show that these resources were exposed at levels that have been associated with tainting and reduced growth and fecundity. The shellfish were exposed to a short-term, but high dose of contamination. Monitoring conducted since the spill has shown a rapid and continual drop in the tissue contamination levels (Table 3).

Table 3: Mussel Tissue Concentrations over time:
Summer Bay Station 3: PPB dry weight.

Date	Mussel PAH Level
December 1997	74,750
March 1998	10,333
June 1998	953
National Average	700
Alaska Average	150

[18] Although levels are declining, the last measured levels are slightly above the U.S. Mussel watch average of 700 ppb and well above the average level in Alaskan stations of 150 ppb (AR# 120), but there has been no monitoring since the close-out of the response effort. PAH levels in the Exxon Valdez spill were elevated in many areas for approximately 3-4 years after the spill and remain elevated in a few sites today (AR# 65, 122). Residual oil persists in the intertidal along Summer Bay and is periodically exposed and remobilized during storm events. This chronic source of oil raises concerns that oil will continue to taint shellfish.

In the judgment of the Trustees, the data demonstrates that the biological injuries are relatively minor and do not warrant development of a direct restoration action. However, local users of the resource were advised against harvesting shellfish from Summer Bay, and the concern about the wholesomeness of the intertidal shellfish persists resulting in a substantial lost use of the resource by the local populace. Residual oiling of the intertidal and lakeshore is a reminder of the spill and raises legitimate questions about the bioavailability of stranded oil (Figures 25, 26, 29, 30, 32, 33: Stranded Oil at Humpy Cove and Summer Bay Lake) Because the oiled and crushed shellfish are expect to recover rapidly, the Trustees' preferred alternative involves resource monitoring and education to help restore use of Summer Bay shellfish and intertidal biota[19].

5.4.2 Preferred Alternative: Additional Testing for Shellfish Contamination

Project Description:

This project will involve sampling and chemical analysis of shellfish tissues collected in recreational and subsistence harvesting areas known to have been oiled by the *M/V Kuroshima*. Reference areas will also be sampled. Sampling will be conducted at stations established after the spill in order to build upon the existing time-series of data. The earlier sampling efforts showed that shellfish tissue concentrations in contaminated areas were declining and approaching contamination levels in reference areas. The Trustees anticipate that further sampling will show continued declines in tissue contaminant levels.

Restoration Objectives:
The objective of this restoration project is to chemically evaluate residual contamination of shellfish and intertidal biota in Summer Bay. This information will be important as part of the education and outreach restoration efforts proposed below.

Probability of Success:
This project will utilize standard shellfish monitoring approaches and has a high probability of technical success. However, the ultimate success of this effort will depend on the effectiveness of the educational and outreach activities described below.

Performance Criteria and Monitoring:
Sampling, analysis and quality assurance/quality control protocols used for the response and preliminary assessment sampling of tainted shellfish will be used to ensure comparability of results between different sampling and testing episodes.

[19] Documents relied upon in the evaluation of shellfish and intertidal biota restoration alternatives and selection of the preferred alternatives include: the State Department of Health and Social Services Health Consultation (AR# 4), Evaluation of Mitigation Opportunities in Unalaska (AR# 21), Shoreline Cleanup Data (AR# 1,17,18,25,74), literature on subsistence losses and traditional ecological knowledge (AR# 53), Fish and Shellfish tainting (AR# 59), Data and lessons learned from the Exxon Valdez spill (AR# 65,66, 67,72,73, 111), Kuroshima shellfish tissue data (AR# 103, 104), and suggestions from the Ounalashka Corporation's oil spill consultant (AR #105).

Benefits and Environmental Impacts:
The project is expected to have benefits by providing up-to-date shellfish tissue contamination data that is necessary information for subsequent outreach and education efforts. This project alternative is expected to have minimal environmental implications. The sampling will require some destructive sampling, but the total number of animals required is minimal.

Evaluation:
This alternative is worthwhile if combined with an effective education and risk communication component. This is a high priority project since tainting of shellfish by the *M/V Kuroshima* incident is a significant local concern. This work will be a cost-effective component to an overall plan to prevent additional lost use of shellfish resources in the area.

5.4.3 Preferred Alternative: Seafood Safety Education.

Project Description:
This project will entail bringing a seafood safety expert to Unalaska to communicate the results of the shellfish monitoring project (including data collected as part of the response and preassessment), in order to educate the local users of the resources on the wholesomeness of local shellfish. This individual would also help to design the sampling plan.

Restoration Objective:
The goal of this restoration project is to restore recreational and subsistence harvesting of shellfish in Summer Bay by educating users on the results of the shellfish contamination surveys and by explaining the results of the Health Consultation prepared by the Alaska Department of Health and Social Services and the U.S. Department of Health and Human Services.

Probability of Success:
The probability of success of this project is uncertain. Risk communication is difficult and the agencies have thus far been ineffective in explaining the results of the monitoring studies. However, the Trustees expect that involving appropriate and trusted health officials and experts in risk communication to communicate the information will be beneficial in reducing local concerns and have the greatest long-term benefit to the community.

Performance Criteria and Monitoring:
The Trustees will work with the local community to identify an appropriate individual or team to communicate the information and results. An individual with local knowledge and ties to the community will help to build confidence in the results and interpretation.

Benefits and Environmental Impacts:
The project is expected to have benefits by educating local consumers on the safety of local shellfish. This project is not expected to have any adverse environmental implications.

Evaluation:
Educating local users about the results of the *M/V Kuroshima* shellfish sampling and the consumption risk analysis conducted in the aftermath of the spill is a high priority. The loss

resulting from the spill was primarily a loss of use, rather than a biological injury. Therefore, restoration of public confidence in the use of these resources is a priority.

5.4.4 Non-preferred Shellfish and Intertidal Restoration Alternatives

The Trustees considered the following restoration projects to compensate for Shellfish and Intertidal losses resulting from the spill. The Trustees rejected these alternatives because the alternatives did not meet one or more of the evaluation criteria discussed in Section 4.2.

- **Shellfish stocking:**

A shellfish restocking program could be instituted in Summer Bay or in a nearby location. Several species of shellfish can be commercially raised. A stocking program could compensate for some of the interim loss. However, there is no significant shortage of shellfish, some of the species of concern are not readily cultured, and creation of additional shellfish beds would not necessarily restore the lost use of the resource if concerns over contamination persist.

- **Construction of an Artificial Reef:**

Shellfish resources in other areas of the U.S. have been restored through a variety of artificial reef structures. Hard structures have been deployed to provide an encrusting surface for attaching bivalves. Low relief reefs have been used to enhance production of hard-shell clam resources. However, creation of additional shellfish beds would not necessarily restore the lost use of the resource if concerns over contamination persist.

- **Land Acquisition:**

There may be limited opportunities for land acquisition to secure public access to intertidal areas. Access would provide parking, trails and stairs/ramps. However, access would not address the fundamental factor that appears to be limiting use --public uncertainty over the safety and wholesomeness of the locally harvested shellfish.

- **Acquisition of Response Equipment:**

The Trustees considered procurement of response equipment to be better prepared for future incidents in the Dutch Harbor Area. The rationale for this approach was that the best way to compensate for such incidents is through greater investment in the ability to respond and therefore prevent future injuries to intertidal communities. The Trustees rejected this alternative because other mandates and sources of public and private funding are available in the Dutch Harbor area for acquisition of response equipment[20].

[20] As part of a separate settlement of claims under State law, the RPs have agreed to convey approximately $140,000 worth of response equipment stored in Dutch Harbor to the State of Alaska. The Alaska Department of Environmental Conservation plans to store the equipment in Dutch Harbor for use in future incidents.

5.5 Evaluation of Salmon and Lake Resource Restoration Alternatives.

Summer Bay Lake supports spawning and rearing habitat for salmon and is a migration corridor for upstream habitat. In addition, the Lake is an important recreational and subsistence resource for the residents of Unalaska. Over eighty percent of the Lakeshore was contaminated by the spill. Sheens spread across the entire Lake surface and oil contaminated the Lake bottom, including spawning gravels and adjacent shoreline rearing habitat.

5.5.1 Quantification Approach:

As noted in Section 3.4.4, the Trustees implemented preliminary studies to evaluate the effects of the spill on salmon, including operation of a fish weir at the outlet of the Lake beginning in 1998 to enumerate outmigrating juveniles and returning adults (AR# 2, 3, 126, 127). Escapement stream surveys were also conducted to document spawning activity in the Summer Bay Lake system and to estimate fish runs in adjacent systems. Studies and surveys were also conducted on the impacts of the spill and cleanup on the shoreline along Summer Bay Lake. Historical limnological and fisheries data on the Summer Bay Lake system (AR# 12) were also evaluated (Honnold et al. 1996).

However, the complexity and length of the life history of Pacific Salmon complicate the evaluation of effects. Salmon populations fluctuate for many reasons and that variability may mask the impacts of a single spill event. Furthermore, many of the scientific approaches (AR# 32) to measuring the effect of oil spills on salmon are expensive, time-consuming and destructive (i.e., many fish would have to be captured and analyzed). The Trustees used a combination of historical data (AR# 12, 121), field data (AR# 2, 3, 117), available information on the effects of petroleum on freshwater habitats and organisms (AR# 13, 51), the extensive literature on salmon and oil (AR# 2, 31, 32, 38, 39, 41, 44, 47, 49, 58, 66, 68, 69), and best professional judgment of State and Federal experts with relevant experience on oil spill impacts to estimate the likely effects of the spill on salmon populations. There are a number of factors that together indicate injury to Summer Bay Lake salmonids. These factors are listed below:

Oil Type: The *M/V Kuroshima* oil was an intermediate fuel oil composed of heavy residual oil blended with a lighter diesel-like oil. This oil is very heavy and persistent, with much of the lighter components removed. The loss of these light components means that the oil is less toxic than a gasoline or straight diesel, but the oil is by no means non-toxic. What remains are the intermediate and heavy PAHs, which are known to be toxic, carcinogenic and highly persistent. The *M/V Kuroshima* oil has a particularly high fraction of benzene and naphthalene and the total PAH concentrations are higher than the standard reference North Slope Crude Oil.

Severity of exposure: Oil spills are much less frequent in freshwater environments, and freshwater environments are considered an order of magnitude more sensitive than marine environments. For example, the USCG considers any spill in the marine environment that exceeds 100,000 gallons to be a major spill. For freshwater, the threshold for a major spill is anything over 10,000 gallons. Approximately one-third of the oil spilled from the *M/V*

Kuroshima (Leslie Pearson, ADEC, Pers. Comm.), or approximately 13,000 gallons, entered Summer Bay Lake and oiled over 80% of the lakeshore.

Persistence of Exposure: Most laboratory studies of oil toxicology focus on relatively short term exposure- often in the range of 24-96 hours. The overwintering salmon in Summer Bay were exposed for months, and oil continues to persist in Summer Bay Lake over four years since the spill. Long-term studies of the *Exxon Valdez* oil spill suggest that salmon eggs are very sensitive to low concentrations of persistent oil. Deformities were found in emergent fry which had been exposed months earlier as eggs to PPB concentrations of *Exxon Valdez* oil (AR# 69).

Pathway of Exposure: Most spills affect the surface waters, with slow dissolution of the oil into the water column. The *M/V Kuroshima* spill occurred during storm-force winds and seas. The storm energy dispersed the oil throughout the water column. Oil also sank, resulting in sediment contamination and covering of a portion of the lake bottom. In addition to direct exposure to oil, these fish may also have been injured through physical disruption of spawning habitats resulting from the cleanup, starvation and reduced growth as a result of injury to their planktonic forage base, and increased sedimentation due to response related erosion. Residual oil left in the Lake may cause low level injuries, including reduced spawning success, reduced growth and other sub-lethal injuries. On a localized basis, the submerged oil may smother and kill benthic organisms.

Weathering Processes: Once spilled in the environment, oil begins to physically and chemically change. Lighter fractions of the oil will evaporate and the oil will become denser and less biologically available. The scenario in which the *M/V Kuroshima* oil was spilled resulted in retarded weathering processes. The high-energy mixing into the water column meant that the oil, rather than evaporating, was much more likely to dissolve into the water column or be buried in shoreline sediments. The cold weather and limited sunlight also slowed the biological and photo-chemical weathering processes. Ice cover within a few days of the spill also slowed the weathering[21]. The oil on the Lake bottom will also degrade slowly because it is not subject to normal weathering processes such as evaporation, photodegredation and mechanical degradation from wave energy. The sunken oil also has a potential to cause relatively greater impacts to water-column organisms because more of the water-soluble fraction would dissolve rather than be lost to evaporation.

Cleanup Activities: Although care was taken to minimize the adverse effects of the cleanup, the cleanup did cause further problems. The spill cleanup work resulted in considerable wear and tear on roadways along Summer Bay and Summer Bay Lake. Heavy equipment was used on the lake shore and dunes to remove oily sand and debris, and to maintain and keep the roadways open, resulting in additional sedimentation of the lake (AR #1, 17, 18).

[21] The environmental conditions that occurred in the Lake during the winter after the spill are similar to the standard storage methods used to prevent degradation of oil samples in the laboratory. Oil samples are kept cold, covered and in the dark to prevent sample deterioration (AR # 45).

Clean-up workers also trampled the nearshore areas of the lake potentially damaging salmon redds.

The decision to block the outlet stream likely had several adverse affects on salmon. The weir data indicates that while most salmon spawn in the lake and tributary streams, several hundred pink salmon annually spawn directly in the outlet stream below and downstream of the bridge along Summer Bay Beach (AR # 2,3). Fish that spawned in this area during the fall prior to the spill were subjected to several adverse impacts. First, the entire area was oiled by the spill. Second, the temporary dam built at the lake outlet would have smothered any redds in the footprint of the dam. Third, the outlet stream was then dewatered and eggs in the gravel were subject to desiccation. Fourth, the entire stream was subject to heavy equipment, trampling and/or excavation.

The decision to block the stream also raised water levels and increased the areal extent of lakeshore oiling (ADEC Sit. Rep #2, 6 in AR# 18). Rather than a bathtub ring along the shore, the fluctuating water level resulted in wide band of contamination. Oil stranded above the normal shoreline of the Lake and penetrated the riparian vegetation, gravels and peaty soils, provided a source of chronic exposure. Heavy foot traffic along and in the lakeshore provided a mechanism to force the oil into the substrate. Sediment samples confirmed this pathway of exposure.

Relevant Literature: A substantial body of literature exists on the impacts of oil on salmon and their habitats[22]. Much of the recent literature relates to the Exxon Valdez spill but there is also a considerable literature based on other spill events, academic research and studies conducted in anticipation of offshore oil development. The literature supports the conclusion that a number of acute, chronic, and sublethal impacts may result from exposure to oil including mortality, disease, lesions, genetic malformations, increased vulnerability to predation, loss of prey and reduced growth, reduced reproduction, loss of habitat, tainting, and behavioral changes. These studies indicate that injury would be expected to occur based on the severity and persistence of oil exposure observed in the *M/V Kuroshima* spill (AR #69, 117).

Sensitivity of Resources: The Summer Bay Lake system supports at least three species of pacific salmon (pink, coho and sockeye) as well as char (Dolly Varden). All of the anadromous and resident fish in Summer Bay Lake have been exposed to oil and may have been injured by the *M/V Kuroshima* spill. Coho and sockeye salmon are thought to be at the greatest risk from the oil spill because of their long juvenile freshwater residency.

Sensitivity of eggs and fry: The spill occurred in late fall. Consequently, juvenile salmon in Summer Bay Lake may have been exposed as eggs, fry and juveniles. Studies have shown that even a small change in egg and fry survival (stages that are very sensitive to oil) can cause a population change. Geiger et al. 1996 used a life history approach to predict pink salmon injury from the Exxon Valdez Spill in Prince William Sound, where oiled pink salmon streams had 6.5 % greater egg mortality than unoiled streams. Geiger found that

[22] Literature reviewed included AR # 13, 31, 32, 38, 39, 41, 44, 47, 49, 50, 51, 58, 59, 66, 68, 69, 108, 117.

an additional 5-8% mortality at the embryo stage might translate into a 31% reduction in adult returns. This, of course, does not include any compensatory survival, but also does not include any additional mortality at other life stages.

Water Data: Water samples collected in the Lake showed elevated levels of both dispersed and dissolved hydrocarbons. These samples fingerprint to the *M/V Kuroshima* oil (AR# 18, 103. No contamination was found in reference stations (at the inlet of the Lake) indicating that the contamination was not from another upstream source.

Sediment Data: Sunken oil was confirmed through dive surveys. Sediment data showed that small tarballs and particles, well below the size of tarmats removed by the divers, were common. No contamination was found in reference stations (at the inlet of the Lake) indicating that the contamination was not from another upstream source.

The information and data reviewed by the Trustees suggests that the salmon populations in Summer Bay Lake are not at risk of long-term decline or extirpation, but will incur a relatively short-term reduction in population. Therefore, natural recovery is the preferred alternative for returning the fishery resources to pre-spill levels. Over time, the residual oil will slowly weather, be flushed from the Lake, or become covered by clean sediments. As a result of the cleanup, natural recovery, and other restoration efforts (See section 5.3), riparian vegetation is expected to re-grow, and zooplankton and insect populations will be replenished from upstream sources. Furthermore, the current harvest restrictions will allow more adults to rebuild the stocks. Although active enhancement techniques could be implemented to accelerate recovery, the Trustees predict that these projects would not appreciably change the time frame for recovery and, conversely, would bring with them the risk of adverse effects.

Because the salmonids are expected to recover, the Trustees' preferred alternative involves addressing other human-induced impacts that are known to impair salmonid productivity. While the Trustees are interested in prompt implementation of restoration/compensation actions for Summer Bay Lake, there is also a recognition that many salmonid restoration efforts elsewhere have resulted in mixed and sometimes adverse effects. Therefore, the Trustees have attempted to balance the desire for rapid restoration with appropriate caution. Restoration techniques that might offer quick benefits, such as stocking or fertilization, may be less desirable than projects that result in less risky, smaller, but longer-term benefits such as habitat improvements. Consequently, the Trustees' preferred alternative[23] includes projects to reduce nearshore sedimentation of spawning areas and to improve the shoreline habitats associated with the road along Summer Bay Lake. The Trustees also propose conducting utilizing salmon smolt and adult enumeration and limnological monitoring (lake ecology and chemistry) to provide information that will improve management of these salmon stocks.

[23] In developing and evaluating restoration alternatives for injuries to salmon and lake resources, the Trustees relied on the following documents: Impacts of roads and sediments on salmon production (AR #10, 11, 27, 33); benefits of riparian vegetation (AR #15); prespill restoration plans for the region (AR# 20, 21); Proposals from the RPs, City, and Ounalashka Corporation (AR# 26, 98, 109, 113, 114); and Salmon enhancement and restoration techniques used in other locations (AR# 30, 34, 40).

Over four years have passed since the incident, during which the Trustees have studied salmon outmigration and returns to the lake, and reviewed the substantial body of research regarding the effects of oil spills on salmonids. The Trustees believe the data from the weir study and results of previous research is sufficient to conclude that the acute and sub-lethal injuries were relatively minor, that the lake and creek resources will recover naturally from the effects of the spill, and that restoration projects designed to reduce sedimentation and improve the riparian vegetation on the lake are the most appropriate and cost-effective means of compensating the public for the interim loss of these resources.

The Trustees' best scientific judgment is that the proposed restoration actions will benefit salmonids and lake resources and are appropriately scaled to the injury to natural resources in Summer Bay Lake and Creek. As discussed above, many factors influence the abundance of salmonids in the lake and creek as well as potential benefits from salmonid restoration projects proposed in this DARP. However, the data and information reviewed by the Trustees is sufficient to narrow and evaluate these uncertainties. While additional damage assessment studies and detailed scaling of the injuries and benefits of the restoration projects could be undertaken, the Trustees do not believe that the additional precision obtained from such activities would substantially alter the Trustee's calculation of loss or scale of the proposed restoration projects. In the judgement of the Trustees, the increased precision regarding injuries and benefits that might be gained by further studies in this instance would not justify further delay of restoration and the additional costs [24].

5.5.2 Preferred Alternative: On-site Sediment Control and Road Improvements along Summer Bay Lake.

Project Description:

The Trustees propose to enhance the eastern shoreline along Summer Bay Lake through two related projects: 1) Drainage improvements and road regrading to reduce sedimentation from the Summer Bay Lake road and; 2) reseeding and planting of the lake shoreline (as described below in section 5.5.3) to provide enhanced riparian habitat (Figure 27: Proposed Shoreline Habitat Restoration). In addition to reduced sedimentation, natural riparian vegetation provides important juvenile rearing and overwintering habitats and a significant source of insects and other prey items. Studies of the riparian zone in other anadromous systems have shown that the ecological importance of the riparian zone influences the productivity of the system out of proportion to the small size of the land base. Literature on logging, road construction and rangeland management has shown significant benefits for salmon accruing from the protection and restoration of riparian zones (Everest *et al.*, 1987).

Fish habitat in Summer Bay Lake may already be limited by the proportion of fine sediments in the substrate. Artificial sources of fine sediments can reduce the carrying capacity still further.

[24] 15 CFR § 990.27 states that assessment procedures "must be capable of providing assessment information of use in determining the type and scale of restoration appropriate for a particular injury" and "The additional cost of a more complex procedure must be reasonably related to the expected increase in the quantity and/or quality of relevant information provided by the more complex procedure."

The existing network of unpaved roads in the Unalaska region provides a considerable source of sediments that can damage fish habitats. Studies of the impacts of unpaved roads have shown that road networks can greatly increase erosion in drainage basins. Unpaved roads commonly contribute more sediment to watercourses than the surface area of the road would suggest (Furniss *et al.*, 1991).

Unpaved roads and ditches in a watershed increase fine and coarse sediment loadings to waterways. The porous gravels needed by salmonids for spawning, egg incubation and fry rearing may be covered by fine sediments, blocking the pores, suffocating incubating eggs and preventing fry from emerging (Waters, 1995). Trout and salmon are exceedingly sensitive to such damage. Similarly, fine sediments can block the pores in gravels and cobbles, substantially reducing the habitat available for invertebrates upon which most salmonids rely for food, especially as young juveniles.

Techniques for riparian restoration are well developed in the State of Alaska, and the State has published a guidance manual for shoreline restoration (Muhlberg and Moore, 1998). Based on these techniques and after review of other riparian restoration strategies (Belt *et al.*, 1992), the Trustees proposed a restoration project that involved improvements to the road and eastern shoreline of Summer Bay Lake. In response to this conceptual proposal, the Responsible Parties developed a lakeshore restoration plan (Vanguard, 2000). A detailed engineering plan needs to be developed, but the basic approach will include the following:

1) Changes in grading to the road to reduce erosion;
2) Improvements to existing culverts; and
3) Improvements to existing drainage ditches.

Restoration Objective:
The objective of this restoration alternative is to reduce sedimentation and thereby increase the spawning success and productivity of salmon in Summer Bay Lake. Reducing sedimentation is expected to improve water quality, increase survival of salmon eggs and fry, and improve rearing habitats in the Lake.

Probability of Success:
The Trustees expect no significant problems in implementing the road improvements, but permits and landowner permission will be needed. However, the benefits to the Lake ecosystem will be slower to accrue. Sediment reduction will benefit salmon egg and fry survival. The first generations of fish to benefit from the restoration are not expected to return to the Lake for several years.

Performance Criteria and Monitoring:
Baseline monitoring will document the pre-project condition of the road and lakeshore vegetation. All construction activities will be monitored to ensure that the work is implemented appropriately and in compliance with permits. Finally, the restoration efforts will be monitored for effectiveness and need for maintenance or corrective actions. The road improvements will be documented using video and still photography.

Benefits and Environmental Impacts:
Every effort will be taken to reduce impacts, but the road and culvert construction will have some short-term adverse consequences. These include disturbance of adjacent vegetation, sedimentation and temporary road closures.

Evaluation:
The Trustees considered the various alternatives and concluded that reduction of sedimentation is the safest and most cost-effective restoration project. Sedimentation of spawning and rearing habitats is a known limiting factor for salmon productivity and is a problem that can be addressed with relatively simple and reliable technologies. The project will have direct benefits to the salmon and Lake resources injured by the *M/V Kuroshima* oil spill. The alternative projects (discussed below in section 5.5.5) entail greater risks and/or lower likelihood of success.

5.5.3 Preferred Alternative: On-site Riparian Habitat Improvement

Project Description:
The Eastern shoreline of Summer Bay Lake is bordered by an unpaved road. The lack of a vegetated buffer strip between the road and the Lake results in significant sedimentation of the Lake and spawning grounds. In order to mitigate the impacts of the road on Summer Bay Lake, the Trustees intend to enhance sections of the existing narrow buffer zone using native vegetation. Native vegetation, including grasses and shrubs such as willow, would be seeded along the Lakeshore. In some locations, plants may be transplanted from adjacent areas (where appropriate) or from off-site areas where the same plant species are available.

Restoration Objective:
The goal of this proposed restoration alternative is to improve the vegetative cover and increase plant diversity along Summer Bay Lake to reduce sedimentation and enhance habitat and aesthetic values.

Probability of Success:
Experienced plant restoration scientists have visited the proposed site and helped to develop the restoration strategy. A local plant expert has also been consulted and much of the work may be accomplished with one or more members of the local community. Therefore, the probability of success for this project is high.

Performance Criteria and Monitoring:
The performance criteria will be determined through discussion between the Trustees and the agency or contractor selected to conduct the replanting. At a minimum, criteria will be established for percentage survival of vegetation, plant growth (as measured by percentage cover) and species diversity. Any replanted areas will then be monitored as part of the vegetation monitoring efforts discussed above.

Benefits and Environmental Impacts:
Restoration of the natural vegetation along the Lakeshore will benefit the ecological functioning and human uses of the region. The replanting of native vegetation should have minimal adverse impacts on the local environment. Seed collection is not anticipated to cause any collateral

impacts and, if seedlings or larger plants are used, the "borrow" sites will be selected carefully and will be restored to minimize the potential for erosion. While some limited fencing and marking may be necessary around the newly seeded and planted areas, these will restrict human activities in only a very small area.

Evaluation:
Lakeshore planting is the Trustees' preferred alternative. This project would directly address resources affected by the spill and will have aesthetic benefits. Practical and low-cost planting techniques are available. No significant adverse effects are anticipated.

5.5.4 Preferred Alternative: Salmon Enumeration and Limnological Sampling:

Project Description:
The salmon runs in the Unalaska Bay region are small relative to other areas of Alaska and in most years are too small to support a commercial fishery. Therefore, these systems have been subject to only limited investigation and management (Honnold *et al.* 1996). Increased management, including regular monitoring of escapement and outmigration, rearing habitat surveys, limnological studies, monitoring of subsistence and recreational harvests and other management tools would be beneficial to the salmonids. The management approach would be an important first step towards identifying limiting factors in the productivity of the Lake and would assist in stabilizing and potentially increasing the productivity of the system. The information gained about the system should allow for more accurate decision-making on when to open and close fishing activities.

Specifically, the Trustees have conducted adult and juvenile weirs during the past four summers. The weir projects were conducted annually to maintain continuity of data. The four-year period allowed the Trustees to evaluate all of the potential life stages that may have been exposed or affected by the spill. This same information and data is a cost-effective way of addressing management needs. Because of the sufficiency of existing data, the Trustees do not anticipate further weir operations.

Salmon weirs are a common tool in the assessment and management of anadromous fish populations. The Summer Bay Lake weir studies provided managers with raw data on the timing, abundance, size, condition, sex-ration and age of emigrating juvenile and returning adult sockeye, pink, and coho salmon and Dolly Varden. The weir biologists also conducted foot and small boat surveys to document the location and distribution of the spawning fish in the outlet stream, lake shore, and tributaries to Summer Bay Lake. In addition to the value of this information in determining the potential influences of the *M/V Kuroshima* oil spill, the weir data is also important to fisheries management. The abundance of outmigrants gives managers an early prediction of the strength of future returns of adults. The size and age structure of the outmigrants also provides insight to the productivity of the lake and the likely marine survival of the juvenile salmon. The adult enumeration allows managers to better manage recreational and subsistence harvests of the returning salmon and ensure that adequate escapement is allowed to ensure future runs. For example, the weir count data indicated that sockeye and pink salmon runs were strong, but coho runs were weak. The run timing and enumeration data on the system

allowed harvest of the pink and sockeye stocks until late September when the entire Summer Bay Lake drainage was closed to sport fishing to protect coho runs (AR # 3).

The limnological sampling will continue in 2002 and future management of the system will benefit from the improved understanding of the Summer Lake system.

Restoration Objective:
The goal of this restoration alternative is to improve the management of the Lake and salmon runs by evaluation and collection of additional data on the health of the salmon populations and quality of fish habitat in Summer Bay Lake. The data will allow more effective management that ultimately is expected to increase the productivity of the system.

Probability of Success:
The Trustees expect no significant problems in implementing this alternative. Standard salmon monitoring approaches will be used. Much of the work will be a continuation of work done as part of the preliminary assessment of the spill. Without the information, fisheries managers might be forced to be more conservative in their harvest goals and reduce the allowable harvest below levels that would foster recovery of the injured populations while permitting use of the resource.

Performance Criteria and Monitoring:
The Trustees do not expect any significant performance criteria and monitoring other than a brief annual report on the findings and conclusions of the weir project and limnological sampling. Success for this project will be measured in terms of completion of the proposed monitoring projects.

Benefits and Environmental Impacts:
The Trustees do not expect any significant environmental or socio-economic problems with the proposed monitoring activities. All work will be conducted following established fishery management practices and methods.

Evaluation:
The proposed limnological monitoring of Summer Bay Lake and enumeration of salmon smolt outmigration and adult escapement is necessary to ensure that Summer Bay Lake is recovering and to provide information to help evaluate the success of related restoration efforts. The information will also assist managers in making in-season harvest management decisions. If problems are noted, the monitoring should help to identify what type of mid-course corrections may be necessary.

5.5.5 Non-Preferred Salmon and Lake Restoration Alternatives

The Trustees considered the following Salmon and Lake restoration projects to compensate for injuries to salmon and the Lake ecosystem resulting from the spill. The Trustees rejected these alternatives because the alternatives did not meet one or more of the evaluation criteria discussed in Section 4.2.

- **On-site Stocking:**

The Trustees considered stocking Summer Bay Lake to help restore salmon stocks. The basic approach would be to expand the capacity of the Unalaska Lake salmon hatchery and use the surplus production to stock fry and smolts in Summer Bay Lake. The Trustees rejected hatchery solutions for several reasons:

1) Hatchery supplementation is controversial because of potential adverse impacts to genetic diversity and disease problems;
2) Sockeye salmon are difficult to rear in hatcheries;
3) Artificially increasing the population of salmon will increase the harvest pressure on the native fish stocks;
4) The freshwater rearing capacity of Summer Bay Lake is limited and hatchery supplementation may increase the stress on the Lake ecosystem; and,
5) The State of Alaska's policy regarding salmon hatcheries require extensive monitoring that, given the size of the system, would not be cost-effective.

- **Off-site Stocking:**

As compensation for injury to Summer Bay Lake salmon, the Trustees considered off-site stocking. The Trustees considered stocking other lakes and streams near the spill site. The closest alternative is Unalaska Lake. The salmon populations in Unalaska Lake have declined over the past decades despite an ongoing hatchery stocking program. Because the system is already stocked and because of the issues discussed above related to stocking Summer Bay Lake, the Trustees rejected this alternative.

- **Off-site Habitat Improvements:**

The Trustees considered a number of off-site habitat projects to compensate for injuries to salmonids in Summer Bay Lake. The overall goal of these projects would be to rehabilitate creeks and lakes in the Unalaska Bay region through control of sedimentation and riparian restoration. The Trustees considered specific projects to restore Iliuliuk Creek in Unalaska. This site has been degraded over time because of incremental development activity and heavy use. These efforts would consist of rehabilitating the stream banks through soil stabilization, revegetation, construction of boardwalks to minimize trampling from foot traffic, relocation of skiff landings, etc. The Trustees also considered a series of specific projects to restore Unalaska Lake. These included restoration of circulation within two small bays, known locally as Ballfield Pond and Iliuliuk Lake. These bays were isolated from the main body of Unalaska Lake because of road construction. This project would involve restoring and enhancing the wetland functional values of Iliuliuk Lake and Ballfield Pond by correcting problems with water circulation, adding cover, removing debris; and repairing and maintaining fish passage. Reattaching these bays would provide foraging habitat for juvenile salmon. Because these shallow bays thaw and warm-up faster than the main body of the Lake, these bays would help to extend the growing season and help to "jump start" the productivity of the Lake in the spring.

The Trustees recognize that these projects have merit, but would need to be conducted as part of a long-term commitment to restoration of the Iliuliuk watershed. Based on the magnitude of the injury to Summer Bay Lake, the Trustees could not justify conducting all of the proposed habitat improvements. The benefits of conducting individual projects would not accrue, or would not

meet their maximum potential, unless funding could be secured to address the other problems. The Trustees also have tried to select alternatives that restore the resources directly affected by the spill. Therefore, the Trustees rejected these alternatives.

- **Remove migration barriers:**

These projects would involve maintenance of fish passage in anadromous streams throughout the Unalaska Area. Potential sources of stream blockage include substandard culverts, road crossings, slope failures, rip-rap, driftwood and illegal debris. The Trustees concluded that these projects have merit, but rejected this alternative because the identified migration barrier problems either had been addressed, or were natural barriers.

- **Artificial Habitat Structures:**

The Trustees considered enhancing cover in the open water areas of Summer Bay Lake by placement of natural or artificial submerged structures to provide cover for fish. These structures have been used elsewhere to provide foraging and hiding areas for small fish. This project has merits, but the Trustees rejected this alternative because the road work and shoreline vegetation work is expected to provide greater benefits for the existing fish habitat.

- **Spawning Channel:**

Spawning channels are engineered stream sections that try to mimic ideal salmon spawning conditions through the regulation of water flows, spawner densities and the provision of a clean gravel substrate. Spawning channels have been highly successful for some species and in some locations. By providing optimal spawning conditions but allowing the salmon to select mates and reproduce naturally, spawning channels increase the egg to fry survival of salmon while avoiding the genetic implications of hatcheries. However, spawning channels are complicated to construct and require both in-season management and extensive annual maintenance. Summer Bay Lake may not offer enough rearing habitat to accommodate the production generated by a spawning channel. Additionally, the channel would require acquisition of land and construction of water control structures. Finally, the success of such channels has varied significantly and the success in Alaska has been mixed. For these reasons, the Trustees have rejected this alternative.

- **Lake Fertilization:**

Summer Bay Lake is considered oligotrophic (nutrient poor) and has low zooplankton biomass (Honnold *et al.,* 1996), the primary food supply for juvenile salmon. The addition of nutrients could stimulate the primary productivity of the system and ultimately lead to increased salmonid production. However, nutrient supplementation can be complicated and may not succeed. Furthermore, expensive pre- and post-fertilization monitoring would be necessary. Finally, the benefits would not be long lasting; once fertilization ends, the system would likely revert to its previous level of productivity. Therefore, the Trustees rejected this alternative.

- **Land Acquisition:**

Land acquisition was considered as a restoration activity to compensate for the loss of anadromous fish habitat. This project was similar in concept to land acquisition projects proposed to benefit birds and vegetation and includes the same advantages and disadvantages. Much of the Aleutians are already under protected status under the Alaska Maritime National Wildlife Refuge, managed by the U.S. Fish and Wildlife Service. Large parcels of remote and

undeveloped lands are owned by Native Corporations. The habitat values of these large parcels of Native Corporation Land do not appear to be threatened. There is limited private land near the spill site that would be suitable for acquisition for the restoration or protection of salmon runs. Therefore, the Trustees rejected this alternative.

- **Increased Enforcement:**

Summer Bay Lake is subject to significant legal harvest pressure and poaching, and other illegal harvest activities are alleged to occur. The Trustees considered increased enforcement measures to compensate for the injuries resulting from the spill. The State of Alaska has Fish and Wildlife Protection Officers, but because of the remoteness and small human population, little enforcement effort is allocated to the Aleutian Region. This alternative was rejected because the cost-effectiveness of having an Officer devoted to the Summer Bay Lake area would be prohibitive.

5.6 Evaluation of Recreational Lost Use Restoration Alternatives.

The *M/V Kuroshima* spill occurred on the prime recreational beach for the City of Unalaska. The beach, Lake and surrounding areas are unique in that they are readily accessible, but relatively undeveloped. The beach area is a favorite location for many families in the area because of the broad sand beach, the adjacent lakeshore and stream and the nearby volleyball court and picnic tables (Figure 28: North Shore of Summer Bay Lake). The surrounding area is important for picnicking, sport fishing, beach combing, day hiking, wildlife viewing and shellfish harvesting. The spill closed the area, and residual oil has reduced the uses and enjoyment of the area.

Public use of the area was prohibited from the date of the spill until the end of December 1997. From the end of December until response actions resumed in late March, the gate remained locked. From late March 1998 through July 9, 1998, the gate was open during the day, but closed the rest of the time, restricting public access. Although public access was allowed during the daytime, it was not encouraged, and vehicles were stopped for questioning by security personnel. Furthermore, cleanup operations during the spring and summer of 1998 closed the picnic areas and beaches along Summer Bay and Summer Bay Lake, and other nearby recreational opportunities were substantially diminished as a result of the scattered tar and oil, presence of cleanup operations, and shortage of parking and difficulty of vehicle access.

Cleanup actions taken during the summer of 1998 removed much of the oil, but residual oil remained in sufficient quantity that the Responsible Parties initiated further cleanup during the summer of 1999 (AR# 25). This removed additional contamination, but residual oil remains on the beaches and occasional tar mats are remobilized from the Lake bottom and continue to have an impact on the recreational value of the area (Figures 29-30: Stranded Oil at Summer Bay Lake). Additional oiling was observed in the May of 2001 (Figure 32, 33: Summer Bay Lake Oiling, May 2001), and in September 2001 (Dan Duame, Pers. Comm.)

The Trustees' analysis of the number of lost user-days and diminished trips to the Summer Bay area (AR# 97) assumed that recreational activities were affected through July 9, 1998, the "official" end of the cleanup operation according the USCG (AR # 101). For the purposes of estimating recreational losses, the Trustees assumed that the greatest impact to recreation occurred during the spring and summer 1998 cleanup operations. However, since the RP's secondary cleanup was completed on July 29, 1999 (AR # 25), and because residual oiling is still evident along Summer Bay and Summer Bay Lake, the Trustee's estimates of the loss are conservative.

5.6.1 Quantification Approach:

Because of the *M/V Kuroshima* oil spill, access to the Summer Bay area was closed or restricted for several months. Under OPA, the public is entitled to compensation for the interim lost use of the area. A common approach for assessing recreational losses is to measure the value of the interim lost use. The Trustees conducted a preliminary analysis of the number of lost user-days and diminished trips to the Summer Bay area resulting from the spill (AR# 97). Values for the affected recreational activities were derived from State of Alaska and national outdoor recreation

surveys. Recreational counts were also collected by the ADF&G crew operating the fish weir (AR # 123). The recreational analysis supports over $165,000 in interim lost use of the area resulted from the spill. The Trustees tried to select restoration projects whose cost fell within this estimate of lost value and provided relevant recreational benefits. Because of the recreational and subsistence importance of the spill area, the Trustees propose:

1) Funding for purchase of tent platforms, weather ports and potable water and sanitation facilities to be publicly available and for use for several weeks during the summer by the Qawalangin Tribe's youth camp, Camp Qungaayux;
2) Environmental education aimed at enhancing the effectiveness of the Trustees' restoration projects; and
3) Beach cleanup activities.

5.6.2 Preferred Alternative: Procurement of Tent Platforms, Weather Ports, Potable Water and Sanitation Facilities for Public and Camp Use:

Project Description:
The Qawalangin Tribe runs a summer Camp open to all local students in grades 4-12. The focus of the Camp is participation in traditional subsistence harvesting, cultural activities and environmental activities with Unangan elders. The students learn about local marine life, plants and wildlife, traditional crafts, archaeology and other related activities. The Camp, while broadly supported in the community, has limited capacity and very little base funding. The Trustees would provide funding to procure temporary shelters, platforms and restroom facilities for the Qawalangin Tribe's summer Camp. These structures will be available for other public recreation uses during the remainder of the year. Funding the Camp structures would encompass:

- Purchase or construction of six 12 x 20 foot tent platforms;
- Purchase of six 12 x 20 weather ports (large temporary canvas, Quonset-hut type buildings);
- Purchase or construction of temporary water and sanitation facilities; and
- Limited annual maintenance for a period of 5 years.

Restoration Objective:
The objective of this project is to compensate for recreational losses by providing additional recreational opportunities in the spill area.

Probability of Success:
Discussions with local residents and concerned citizens indicate that the expansion and improvement of the Camp facilities will help compensate the community for losses from the spill. Camp Qungaayux has been in operation for several years and the Trustees expect that the Camp will continue to be successful. The Camp has strong local involvement and is supported by the City as well as State and Federal resource agencies. In addition, the Trustees note that other Alaskan Communities have successfully operated similar camps.

Performance Criteria and Monitoring:
The Trustees do not expect any significant performance criteria and monitoring efforts other than a brief annual report on the Camp operations with a summary of the activities conducted and the items procured.

Benefits and Environmental Impacts:
The Trustees expect that the Camp will provide recreational benefits similar to those lost as a result of the incident, and at location of the loss. The Trustees do not expect any significant environmental or socio-economic problems with the Camp. The Camp structures will have a small footprint and construction-related activities will be minimal. The provision of basic sanitation facilities and site maintenance will benefit both users and the environment.

Evaluation:
The Trustees have considered the various proposals for recreational losses resulting from the *M/V Kuroshima* spill and have concluded that funding structures for use by the public and the Camp is a preferred alternative. The Camp is held in Humpy Cove near the site of the ship grounding. The Camp focuses on the natural resources and resource uses (e.g., harvest and use of plants and animals) that were affected by the spill. The construction of the Camp facilities should allow increased participation and expansion of the curriculum (see below). Over time, the Camp improvements are expected to compensate for the recreational and subsistence losses resulting from the spill.

5.6.3 Preferred Alternative: Development of an Environmental Education Curriculum

Project Description:
The Trustees would provide funding to: 1) supplement and expand the environmental curriculum and activities provided by the Qawalangin Camp; 2) facilitate local involvement and understanding of ongoing assessment, monitoring and restoration projects from the *M/V Kuroshima* incident; and 3) provide education opportunities through public outreach to the community and local schools. Educational efforts will focus on addressing known environmental problems that are affecting or are likely to affect the natural recovery processes or the viability of the Trustees' restoration actions.

The Qawalangin Camp currently focuses on tribal and cultural activities. The Trustees propose strengthening the environmental component of the Camp curriculum[25] by addressing known environmental problems associated with the natural resources affected by the *M/V Kuroshima* incident, with the goal of improving the community's stewardship of the affected natural resources. Funding would allow the tribe to expand the scope of the curriculum and the duration of use of the Camp. The potential educational projects are listed below:

[25] The specific curriculum will need to be developed in conjunction with the Qawalangin tribe, the school district, City Recreation Department and the Trustees.

a) Injury to Salmonids: Salmon are an important recreational and subsistence resource in the Unalaska region. The educational curriculum would focus on awareness of human activities including land use, unlawful harvesting and other existing problems that negatively impact salmon runs. Field activities may include "adoption" of local salmon streams, identification of problems that limit productivity and activities related to the salmon monitoring and restoration projects.

b) Injury to Vegetation: Windblown oil and heavy equipment associated with the *M/V Kuroshima* cleanup resulted in trampling and loss of dune and lakeshore vegetation. The educational curriculum would focus on the ecological and cultural roles of these plants and the effects of human disturbance, etc. Field activities may include identification of species, approaches to reduce unnecessary disturbance and activities related to the vegetation restoration projects.

c) Injury to Intertidal Resources: Oil from the *M/V Kuroshima* impacted shorelines throughout Summer Bay, Humpy Cove and Morris Cove. The education curriculum would focus on the ecological and cultural importance of intertidal biota, the recovery of these resources from oil spills and the effects of human disturbance such as land use, over-harvesting, trampling, debris, etc. Improper intertidal etiquette, such as destructive collecting, turning over rocks and leaving clam holes unfilled, can be a major source of mortality for intertidal organisms, especially in easily accessible recreation areas. Education would help address these problems. The curriculum will be designed to complement the education and outreach efforts regarding seafood safety. Field activities may include identification of species and assistance in the collection of specimens for intertidal monitoring.

d) Injury to Lake Resources: High winds and seas carried oil into Summer Bay Lake and impacted significant portions of the Lakeshore and Lake bottom. The education curriculum would focus on the ecology and biology of the Lake and awareness of human activities that negatively affect local freshwater lakes. Field activities would include participating in Lake surveys and shoreline revegetation projects.

The Trustees propose building upon the Camp curriculum and opportunities related to ongoing assessment, monitoring and restoration projects to conduct community-wide education on natural resource issues[26]. This aspect of the education plan would have the same goals and priorities as the Camp education, but would be designed to reach the broader community. This outreach effort would include both adult and K-12 education during the school year and could include lectures, public meetings, school field trips, development of interpretive displays for the school and museum, on-site signage and local newspaper/radio/television spots or interviews.

Many of the proposed restoration projects for the *M/V Kuroshima* will benefit from broad public understanding and involvement. For example, the vegetation restoration efforts could involve community volunteers in the collection and dispersion of native seeds. Outreach to and education of the local community will also be an important factor in successful vegetation restoration; hikers, fishermen and other recreational users will need to understand that the newly

[26] This could also provide a forum for non-spill related environmental education such as when visiting scientists are working or transiting through Unalaska.

seeded areas are sensitive and should not be disturbed. Similarly, the recovery of the salmon in Summer Bay Lake will require community understanding of the need to respect harvest limits.

Restoration Objective:
The objective of this project is to compensate for recreational losses by addressing known environmental problems associated with the natural resources affected by the *M/V Kuroshima incident*, with the goal of improving the community's stewardship of the affected natural resources.

Probability of Success:
Environmental education programs have been successful in other communities and the Trustees anticipate success in Unalaska. Funding should allow hiring of a part-time educator or mentor to organize, develop and maintain the Camp and community education program.

Performance Criteria and Monitoring:
The Trustees do not expect to utilize any significant performance criteria and monitoring efforts other than a brief annual report to the Trustees with a summary of the activities conducted and any expenditures.

Benefits and Environmental Impacts:
The proposed restoration should benefit the community and environment by improving the community's stewardship of the affected natural resources. The Trustees do not expect any significant adverse environmental impacts or problems with this proposal. The education would benefit all interested members of the community.

Evaluation:
The success of the proposed restoration projects will depend, in part, on community education. In a broader context, education and environmental awareness are important for the sustained environmental health of the Unalaska region. The Trustees have concluded that augmenting and enriching the existing environmental curriculum in the local school system is one way to help restore and compensate for the injuries resulting from the *M/V Kuroshima* spill.

5.6.4 Preferred Alternative: Shoreline Maintenance:

Project Description
The oil spilled by the *M/V Kuroshima* is expected to weather and degrade very slowly and will result in chronic low-level contamination of shorelines in Summer Bay and Summer Bay Lake. These shorelines are also subject to a chronic debris problem, including large amounts of flotsam from shipping and commercial fishing (Figure 31: Marine Debris at Humpy Cove). Trash items may contain residual petroleum, oils, greases and other toxic or nuisance chemicals harmful to aquatic life.

The Trustees propose funding to: a) conduct an annual "Beach Cleanup Day" in the Spring and b) to conduct periodic maintenance of beaches in Summer Bay, Summer Bay Lake, Morris Cove and other recreational shorelines to remove and properly dispose of marine debris and tar[27].

Beach Cleanup Day: The City of Unalaska sponsors a community-wide cleanup week in April. The cleanup focuses primarily on cleanup of yards and public spaces, but the Trustees propose additional funding to plan, publicize and coordinate the beach cleanup day. Additional funds would be necessary for debris disposal, truck rental, purchase of gloves and bags and other supplies.

Routine Beach Maintenance: The beach maintenance component would utilize a local crew to minimize travel and per diem costs. Because of the potential for working in remote areas, cleanup teams would need to be 2-person minimum. The appropriate level of effort will vary over the season. The Trustees recommend a one-day-per-week effort during June through August and a one-day-per-month level of effort during May and September[28]. This would continue for a period of 5 years. Pending approval from the landowners, signs would be placed at Humpy Cove, Morris Cove, Summer Bay and Summer Bay Lake advising users about potential for contamination. The signs would also direct persons to report debris problems to the beach cleanup coordinator.

Restoration Objective:
The goal of this restoration project is to compensate for the aesthetic losses resulting from the spill by cleaning beaches of debris, abandoned fishing nets and oil mats from the general area where the Trustees observed impacts from the oil spill. This project meets the goals of the Trustees by compensating for recreational losses to the shoreline and intertidal habitats and will have positive ecological benefits by reducing smothering of intertidal biota and entanglement of bird and mammals.

Probability of Success:
The probability of success is high. Beach cleanup and debris-removal techniques are cost effective and relatively easy to implement. Periodic removal of such debris should both improve the public enjoyment and overall quality of the environment. Similar projects are conducted elsewhere in coastal Alaska, Hawaii and the mainland U.S. These programs have been successful in improving environmental quality and promoting long-term environmental awareness of the problems associated with marine debris and pollution in general.

Performance Criteria and Monitoring:
The performance criteria and monitoring should be simple. The goal will be to collect all visible tarballs and marine debris from Summer Bay and Summer Bay Lake. If time and funding permits, the crew may also collect debris from other nearby shorelines. The crews will be instructed not to remove any drums, cylinders, or other potentially hazardous materials, but instead refer those problems to the USCG office in Dutch Harbor. A field log should be kept with the types and amounts of debris collected[29] and the method of disposal.

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[28] The dates may need to be adjusted to take into account road access. Snow cover may delay access until June in some years.

[29] The Center for Marine Conservation has established standardized data forms for marine debris.

Benefits and Environmental Impacts:
Removal of the pollution will be beneficial, but, in some cases, may result in short-term disruption to the shoreline habitats. Shoreline disruptions include personnel walking on the shore and dragging bags or debris into vehicles for disposal.

Evaluation:
Residual tar, floating debris and abandoned fishing gear is an aesthetic problem and causes injury to shoreline, intertidal and subtidal habitats by smothering or crushing organisms and by abrading the ocean bottom and shoreline areas. The Trustees have determined that the project's overall environmental impacts are overwhelmingly positive.

5.6.5 Non-Preferred Subsistence and Recreation Use Alternatives

The Trustees considered the following restoration projects to compensate for subsistence and recreational losses resulting from the spill. The Trustees rejected these alternatives because the alternatives did not meet one or more of the evaluation criteria discussed in Section 4.2.

- **Off-site Improvements:**

The Trustees considered off-site recreational improvements in other locations on Unalaska and Amaknak Islands. The off-site concepts included funding ballparks, small neighborhood parks, picnic areas, hiking trails, etc. All of these projects have merit, but the Trustees' preference was to have restoration projects at the site of the spill. Some of the off-site projects, such as basketball courts and ballfields, would not compensate for the types of recreation lost as a result of the spill. Furthermore, many of the off-site projects would require the acquisition of land or interests in land, a process that would likely be very time-consuming and possibly cost-prohibitive.

- **Fishing enhancement:**

Recreational fishing on Summer Bay Lake and at Summer Bay was affected by the spill and the Trustees considered a proposal to construct a pier and/or dock on Summer Bay Lake to improve recreational access. The Trustees rejected this proposal for several reasons: 1) the construction would be expensive and require significant annual maintenance because of the ice on the Lake; 2) the fisheries in the Lake are already heavily exploited and construction of a pier and dock would increase pressure on the stocks; and 3) the project would change the natural setting of the Lake.

- **Treat Beach Sands:**

During the response to the spill, the Unified Command made the decision to treat oily sand using a soil incineration device. Sand was trucked to Dutch Harbor, treated and returned to Summer Bay beach. The returned sand was black as a result of the incineration process and did not match the natural color of the beach sand. It was anticipated that wave and wind energy would blend the sands, but after a year, sands dumped high on the beach remained black. The Trustees considered further treatment (e.g., tilling) of the sand, but decided that, while slower than initially thought, the black band of sand would eventually blend into the beach. Furthermore, the Trustees determined that the costs of further treatment would outweigh the recreational benefits.

- **Land Acquisition:**

Land acquisition was considered as a restoration action to compensate for the lost recreational use. This project was similar in concept to land acquisition projects proposed to benefit birds and vegetation and includes the same advantages and disadvantages. Much of the Aleutians are already under protected status under the Alaska Maritime National Wildlife Refuge, managed by the U.S. Fish and Wildlife Service. Large parcels of remote and undeveloped lands are owned by Native Corporations. The Ounalashka Corporation allows recreational access to their lands under a permit fee arrangement, and public uses of these large parcels of Native Corporation Land does not appear to be threatened. There is limited private land near the spill site that would be suitable for acquisition. The Trustees could not identify any willing landowners in the Summer Bay area.

5.7 Restoration Summary

A total of 45 specific restoration alternatives and/or restoration locations were identified. These restoration alternatives were evaluated for restoration location and site characteristics, restoration description, overall goal of restoration, objectives, implementation issues, economic feasibility issues and methods of monitoring and judgment of success.

The injuries and preferred restoration alternatives for the *M/V Kuroshima* Spill are summarized in Table 4 below.

Table 4: Summary of Preferred Alternatives

Injury Category	Preferred Alternative
Birds	Predator removal on Avatanak
Vegetation	Evaluate recovery of injured vegetation
Vegetation	On-Site Planting
Shellfish/Intertidal Biota	Additional testing for contaminants
Shellfish/Intertidal Biota	Seafood Safety Education
Salmonids/Lake resources	On-site Sediment Control
Salmonids/Lake resources	Lakeshore planting
Salmonids/Lake resources	Lakeshore planting contingency
Salmonids/Lake resources	Salmon Enumeration and Limnology
Subsistence and Recreation	Camp Structures
Subsistence and Recreation	Education
Subsistence and Recreation	Beach Cleanup

6.0 COORDINATION WITH OTHER PROGRAMS, PLANS and REGULATORY AUTHORITIES

6.0 COORDINATION WITH OTHER PROGRAMS, PLANS and REGULATORY AUTHORITIES

6.1 Overview

Two major Federal laws guiding the restoration of the injured resources and services in Alaska are OPA and NEPA. OPA and its regulations provide the basic framework for natural resource damage assessment and restoration. NEPA sets forth a specific process of impact analysis and public review. In addition, the Trustees must comply with other applicable laws, regulations and policies at the Federal, state and local levels. The potentially relevant laws, regulations and policies are set forth below.

In addition to laws and regulations, the Trustees must consider relevant environment or economic programs or plans that are ongoing or planned in or near the affected environment. The Trustees must attempt to ensure that their proposed restoration activities neither impede nor duplicate such programs or plans. By coordinating restoration with other relevant programs and plans, the Trustees can enhance the overall effort to improve the environment affected by the *M/V Kuroshima incident.*

In initiating the Final RP/EA, the Trustees propose to combine the Restoration Plan required under OPA with the environmental review processes required under NEPA. This is expected to enable the Trustees to implement restoration more rapidly than had these processes been undertaken sequentially.

6.2 Key Statutes, Regulations and Policies

Oil Pollution Act of 1990 (OPA), 33 USC §§ 2701, *et seq.*; 15 CFR Part 990

OPA establishes a liability regime for oil spills that injure or are likely to injure natural resources and/or the services that those resources provide to the ecosystem or humans. Federal and State agencies act as Trustees on behalf of the public and Indian Tribal Trustees act on behalf of their members to assess the injuries, scale restoration to compensate for those injuries and implement restoration. Section 1006(e)(1) of OPA (33 USC § 2706(e)(1)) requires the President, acting through the Under Secretary of Commerce for Oceans and Atmosphere (NOAA), to promulgate regulations for the assessment of natural resource damages resulting from a discharge or substantial threat of a discharge of oil. Assessments are intended to provide the basis for restoring, replacing, rehabilitating and acquiring the equivalent of injured natural resources and services.

The OPA damage assessment regulations (15 CFR Part 990) provide a framework for conducting sound natural resource damage assessments that achieve restoration. The process emphasizes both public involvement and participation by the Responsible Party(ies). The Trustees have used these regulations in this assessment.

Alaska Oil Pollution Laws

Alaska has several statutes relating to the discharge of oil or petroleum products. Pollution of air, land, subsurface land, or water of the State is prohibited by AS 46.03.710. The discharge of

oil or petroleum products into or upon the land or waters of the State is prohibited by AS 46.03.740. Civil penalties are assessed for the discharge of petroleum products into the environment of the State pursuant to AS 46.03.758 and, for the discharge of crude oil, pursuant to AS 46.03.759. Under AS 46.03.760 the State may collect civil damages for various forms of pollution including the discharge of petroleum products. Under AS 46.03.760 and AS 46.03.780 the State may collect damages for injuries to the environment and the cost of restoring the environment to its prespill condition. Strict liability for the discharge of hazardous materials, including petroleum products, is imposed pursuant to AS 46.03.822. Additional State statutes governing the discharge of oil and recovery of damages resulting therefrom are located at AS 46.04. Spending accounts for oil spill response and clean up have been established under AS 46.08. The discharge of oil into state waters also violates Alaska's water pollution statutes, AS 46.03.050 et seq., and regulations, 18 AAC 70.

National Environmental Policy Act (NEPA), as amended, 42 USC §§ 4321, *et seq.* 40 CFR Parts 1500-1508

Congress enacted NEPA in 1969 to establish a national policy for the protection of the environment. NEPA applies to Federal agency actions that affect the human environment. NEPA established the Council on Environmental Quality (CEQ) to advise the President and to carry out certain other responsibilities relating to implementation of NEPA by Federal agencies. Pursuant to Presidential Executive Order, Federal agencies are obligated to comply with the NEPA regulations adopted by the CEQ. These regulations outline the responsibilities of Federal agencies under NEPA and provide specific procedures for preparing environmental documentation to comply with NEPA. NEPA requires that an Environmental Assessment (EA) be prepared in order to determine whether the proposed restoration actions will have a significant effect on the quality of the human environment.

Generally, when it is uncertain whether an action will have a significant effect, Federal agencies will begin the NEPA planning process by preparing an EA. The EA may undergo a public review and comment period. Federal agencies may then review the comments and make a determination. Depending on whether an impact is considered significant, an environmental impact statement (EIS) or a Finding of No Significant Impact (FONSI) will be issued.

The Trustees have integrated this Restoration Plan with the NEPA process to comply, in part, with those requirements. This integrated process allows the Trustees to meet the public involvement requirements of OPA and NEPA concurrently. The RP/EA is intended to accomplish NEPA compliance by: (1) summarizing the current environmental setting, (2) describing the purpose and need for restoration action, (3) identifying alternative actions, (4) assessing the preferred actions' environmental consequences, and (5) summarizing opportunities for public participation in the decision process. Project-specific NEPA documents may be needed for some of the proposed restoration projects.

Clean Water Act (CWA) (Federal Water Pollution Control Act), 33 USC §§ 1251, *et seq.*

The CWA is the principal law governing pollution control and water quality of the nation's waterways. Section 404 of the law authorizes a permit program for the disposal of dredged or fill material into navigable waters. The U.S. Army Corps of Engineers (Corps) administers the program. In general, restoration projects that move significant amounts of material into or out of

waters or wetlands -- for example, hydrologic restoration of marshes -- require Section 404 permits.

Under Section 401 of the CWA, restoration projects that involve discharge or fill to wetlands or navigable waters must obtain certification of compliance with state water quality standards. The Alaska Department of Environmental Compliance implements the Section 401 certification program. Generally, restoration projects with minor wetlands impacts (*i.e.*, a project covered by a Corps general permit) do not require Section 401 certification, while projects with potentially large or cumulative impacts must undergo a certification review.

Coastal Zone Management Act (CZMA), 16 USC §§ 1451, *et seq.*, 15 CFR Part 923

The goal of the CZMA is to preserve, protect, develop and, where possible, restore and enhance the nation's coastal resources. The Federal government provides grants to states with federally-approved coastal management programs. The State of Alaska has a federally-approved program. Section 1456 of the CZMA requires that any Federal action inside or outside of the coastal zone that affects any land or water use or natural resources of the coastal zone shall be consistent, to the maximum extent practicable, with the enforceable policies of approved state management programs. It states that no Federal license or permit may be granted without giving the State the opportunity to concur that the project is consistent with the state's coastal policies. The regulations outline the consistency procedures.

The Trustees do not expect that any of the proposed projects will adversely affect the State's coastal zone. However, to comply with the CZMA, the Trustees intend to seek the concurrence of the State of Alaska that their preferred projects are consistent to the maximum extent practicable with the enforceable policies of the State coastal program.

Marine Mammal Protection Act (MMPA), 16 USC §§ 1361, *et seq.*

The Marine Mammal Protection Act is the principal Federal legislation that protects marine mammals. It also recognizes the important role that marine mammals play in the ecosystem as well as their recreational and aesthetic value. The MMPA places a moratorium, with few exceptions, on the taking or importing into the United States of marine mammals or their products. The MMPA defines "take" as "to harass, hunt, capture, or kill or attempt to harass, hunt, capture, or kill any marine mammal." The U.S. Fish and Wildlife Service and the Department of Commerce/NOAA share responsibility for the management and conservation for these species.

Endangered Species Act (ESA), 16 USC §§ 1531, *et seq.*, 50 CFR Parts 17, 222, 224

The ESA directs all Federal agencies to conserve endangered and threatened species and their habitats and encourages such agencies to utilize their authorities to further these purposes. Under the Act, the National Marine Fisheries Service (NMFS) and the USFWS publish lists of endangered and threatened species. Section 7 of the Act requires that Federal agencies consult with these two agencies to minimize the effects of Federal actions on endangered and threatened species. Prior to implementation of the proposed projects, the Trustees will conduct Section 7 consultations in conjunction with Essential Fish Habitat (EFH) consultation as noted below. Should it be determined that any of the proposed projects will adversely affect a threatened or endangered species, the Trustees will either redesign the project or substitute another project.

Magnuson-Stevens Fishery Conservation and Management Act (MSFCMA), 16 USC §§ 1801 *et seq.*

The Magnuson-Stevens Fishery Conservation and Management Act as amended and reauthorized by the Sustainable Fisheries Act (Public Law 104-297) establishes a program to promote the protection of EFH in the review of projects conducted under Federal permits, licenses, or other authorities that affect or have the potential to affect such habitat. After EFH has been described and identified in fishery management plans by the regional fishery management councils, Federal agencies are obligated to consult with the Secretary of Commerce with respect to any action authorized, funded, or undertaken, or proposed to be authorized, funded, or undertaken, by such agency that may adversely affect any EFH.

The Trustees anticipate that the proposed restoration projects will have no adverse effect on EFH and will promote the protection of fish resources and EFH. The Trustees will consult with NMFS prior to implementation of any restoration project.

Fish and Wildlife Coordination Act (FWCA), 16 USC §§ 661, *et seq.*

The FWCA requires that Federal agencies consult with the USFWS, NMFS and state wildlife agencies for activities that affect, control or modify waters of any stream or bodies of water, in order to minimize the adverse impacts of such actions on fish and wildlife resources and habitat. This consultation is generally incorporated into the process of complying with Section 404 of the Clean Water Act, NEPA or other Federal permit, license or review requirements.

In the case of NRDA restoration actions under this draft RP/EA, the fact that the three consulting agencies for the FWCA (*i.e.*, USFWS, NMFS and the State) are represented by the Trustees means that FWCA compliance will be inherent in the Trustee decisionmaking process.

Rivers and Harbors Act, 33 USC §§ 401, *et seq.*

The Rivers and Harbors Act regulates development and use of the nation's navigable waterways. Section 10 of the Act prohibits unauthorized obstruction or alteration of navigable waters and vests the Corps with authority to regulate discharges of fill and other materials into such waters. Restoration actions that require Section 404 Clean Water Act permits are likely also to require permits under Section 10 of the Rivers and Harbors Act. However, a single permit usually serves for both. Therefore, the Trustees can ensure compliance with the Rivers and Harbors Act through the same mechanism.

Executive Order (EO) 12898 - Environmental Justice

On February 11, 1994, President Clinton issued EO 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations. This EO requires each Federal agency to identify and address, as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies and activities on minority and low income populations. EPA and the CEQ have emphasized the importance of incorporating environmental justice review in the analyses conducted by Federal agencies under NEPA and of developing mitigation measures that avoid disproportionate environmental effects on minority and low-income populations. The Trustees have concluded that there are no low-income or

ethnic minority communities that would be adversely affected by the proposed restoration activities.

Executive Order (EO) 11988 -- Construction in Flood Plains

This 1977 Executive Order directs Federal agencies to avoid to the extent possible the long- and short- term adverse impacts associated with the occupancy and modification of flood plains and to avoid direct or indirect support of development in flood plains wherever there is a practicable alternative. Each agency is responsible for evaluating the potential effects of any action it may take in a flood plain.

Before taking an action, the Federal agency must determine whether the proposed action will occur in a flood plain. For major Federal actions significantly affecting the quality of the human environment, the evaluation will be included in the agency's NEPA compliance document(s). The agency must consider alternatives to avoid adverse effects and incompatible development in flood plains. If the only practicable alternative requires siting in a flood plain, the agency must: (1) design or modify the action to minimize potential harm and (2) prepare and circulate a notice containing an explanation of why the action is proposed to be located in the flood plain. The Trustees have determined that none of the proposed projects is located in a flood plain.

6.3 Other Potentially Applicable Laws and Regulations

This section lists other laws that potentially affect the Trustees' restoration activities. The statutes or their implementing regulations may require permits from Federal or state permitting authorities. The permitting process also may require an evaluation of statutes other than those noted below.

- Archaeological Resources Protection Act, 16 USC §§ 470, *et seq.*
- Clean Air Act, 42 USC §§ 7401, *et seq.*
- Migratory Bird Treaty Act, 16 USC §§ 703, *et seq.*
- National Marine Sanctuaries Act, 16 USC §§ 14
- National Wildlife System Administration Act, 16 USC §§ 668dd, *et seq.*
- Executive Order 12996, National Wildlife System Administration

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8.0 REFERENCES

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9.0 BUDGET

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Final costs and allocation of available funds for restoration projects will depend on whether any changes in the proposed projects are necessary based on public comments on the restoration plan. Costs and cost allocations are preliminary and may change pending finalization and approval of associated design documents.

Table 5: Restoration Cost Summary

Injury Category	Preferred Alternative	Estimated Cost
Birds	Predator removal on Avatanak	
Vegetation	Evaluate recovery of injured vegetation	
Vegetation	On-Site Planting	
Shellfish/Intertidal Biota	Additional testing for contaminants	
Shellfish/Intertidal Biota	Seafood Safety Education	
Salmonids/Lake resources	On-site Sediment Control	
Salmonids/Lake resources	Lakeshore planting and Contingency	
Salmonids/Lake resources	Salmon Enumeration and Limnology	
Subsistence and Recreation	Camp Structures	
Subsistence and Recreation	Education	
Subsistence and Recreation	Beach Cleanup	
Total		To be determined

10.0 Appendices

10.0 APPENDICES

10.1 Abbreviations and Acronyms

ADEC	Alaska Department of Environmental Conservation
ADF&G	Alaska Department of Fish and Game
ADOL	Alaska Department of Law
ADNR	Alaska Department of Natural Resources
°C	Centigrade (degrees)
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
CORPS	U.S. Army Corps of Engineers
CZMA	Coastal Zone Management Act
CWA	Clean Water Act
DAC	NOAA's Damage Assessment Center
DOI	U.S. Department of the Interior
DOC	U.S. Department of Commerce
Draft RP/EA	Draft Restoration Plan and Environmental Assessment
EA	Environmental Assessment
EFH	Essential Fish Habitat (under MSFCMA)
EIS	Environmental Impact Statement
EO	Executive Order
EPA	Environmental Protection Agency
ESA	Endangered Species Act
FONSI	Finding of No Significant Impact
FWCA	Fish and Wildlife Coordination Act
HAZMAT	NOAA's Hazardous Materials Response and Assessment Division
HEA	Habitat Equivalency Analysis
KM	Kilometers
LAT	Lead Administrative Trustee
MMPA	Marine Mammal Protection Act
MSFCMA	Magnuson-Stevens Fishery Conservation and Management Act
M/V	Motor Vessel
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NEPA	National Environmental Policy Act
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NRDA	Natural Resource Damage Assessment
NWR	National Wildlife Refuges (USFWS)
OPA	Oil Pollution Act of 1990
PAH	Polycyclic aromatic hydrocarbons
PPM	Parts per million
RP(s)	Responsible Party or Parties
RP/EA	Restoration Plan and Environmental Assessment
§	Section
SCAT	Shoreline Cleanup Assessment Team
USC	United States Code
USCG	U.S. Coast Guard

USFWS	U.S. Fish and Wildlife Service

10.2 Trustee Determinations: Determination of Jurisdiction (February, 1999)

On November 26, 1997, the *M/V Kuroshima* ran aground in Summer Bay, Unalaska resulting in the discharge of oil to the Bay, Summer Bay Lake, Humpy Cove and surrounding areas. The natural resource Trustees for the resources affected by the spill are Alaska Department of Fish and Game, the State of Alaska Department of Law, and the State of Alaska Department of Natural Resources acting on behalf of the State of Alaska, the National Oceanic and Atmospheric Administration (NOAA) of the Department of Commerce, the United States Fish and Wildlife Service on behalf of the Department of the Interior (DOI), in consultation with the Qawalangin Tribe. Pursuant to the Oil Pollution Act of 1990, 33 U.S.C. Section 2706, these governmental entities are collectively referred to as the natural resource Trustees ("Trustees") in recognition of their common interests.

The Trustees make the following findings pursuant to the Oil Pollution Act of 1990 (OPA), 33 U.S.C. 2701 *et seq.*, and the implementing regulations under that Act, specifically 15 C.F.R. Section 990.41:

Section 990.41 Determination of Jurisdiction

1. An "incident" has occurred.

On November 26, 1997 the *M/V Kuroshima*, a privately owned vessel, as defined at 33 U.S.C. Section 2701 (37), ran aground in Summer Bay, Unalaska resulting in the discharge of approximately 40,000 gallons of Bunker fuel and marine diesel oil, as defined at 33 U.S.C. Section 2701 (23), into the navigable waters of Summer Bay and Summer Bay Lake which are part of the Exclusive Economic Zone, as defined at 33 U.S.C. Section 2701 (14) of OPA. See *Certificate of Financial Responsibility filed with U.S. Coast Guard (AR# 75), Alaska Department of Environmental Conservation Situation Reports (AR #1), Alaska Department of Environmental Conservation Final Incident Report, 1/6/98 Caleb Brett report (AR# 56).*

2. The Trustees have determined that:

(A) This Incident was not permitted under federal, state or local law. See *Alaska Department of Environmental Conservation Situation Report, November 26, 1998 (AR# 18).*

(B) The *M/V Kuroshima* is a privately owned vessel and is not a public vessel. See *Certificate of Financial Responsibility filed with the U.S. Coast Guard (AR# 75).*

(C) The discharge of oil from this incident did not occur from an onshore facility subject to the Trans-Alaska pipeline Authority Act. See *Alaska Department of Environmental Conservation Situation Report, November 26, 1998 (AR# 18).*

3. Based upon information gathered during the response, initiation and preassessment phases, the Trustees have determined, in consultation with the Qawalangin Tribe, that, due to the amount

and type of oil spilled, the known toxicity of the oil, the location of the spill and the living and non-living natural resources in the area at the time of the spill (including but not limited to birds, fish, marine biota, sediments and water) natural resources under the trusteeship of NOAA, DOI and the State of Alaska may have been injured, or may be injured as a result of the Incident. See *M/V Kuroshima Incident: Pre-Assessment Scoping Report, NOAA Damage Assessment Center (AR # 18)*.

Determination to Conduct Restoration Planning (February, 1999)

Section 990.42 - Determination to Conduct Restoration Planning

During the preassessment phase of the natural resource damage assessment the natural resource trustees engaged in a number of preassessment activities to secure information regarding the type and scope of potential natural resource injuries associated with the site, the need for additional damage assessment studies and potential for restoration. These activities included:

(1) site visits and sample collection
(2) evaluation of exposure to birds
(3) evaluation of exposure to salmonids
(4) collection of water and sediment samples in Summer Bay Lake
(5) enumeration of salmon smolts from Summer Bay Lake
(6) enumeration of adult fish to Summer Bay Lake

Additionally, the Trustees participated throughout the response efforts and evaluated information obtained during the response effort. Kuroshima Shipping, S.A. agreed to stipulate to the exposure of bald eagles and salmonids to oil. See Stipulation Between Natural Resource Damage Trustees and Kuroshima Shipping, S.A. (AR# 95).

Based upon a review of the information obtained during these efforts, the Trustees have determined, pursuant to 15 C.F.R. Section 990.42 (a), that:

(1) Data collected and analyzed during the preassessment phase pursuant to 15 C.F.R. Section 990.43 demonstrate that injuries to natural resources are likely to have resulted from the Incident, including but not limited to the following:

(A) losses associated with the direct oiling of invertebrate marine communities, including mortality and tainting of intertidal resources and the loss of use of these resources for subsistence;

(B) loss of wildlife, including direct bird mortality, resulting from oiling and predation of injured birds;

(C) losses associated with direct oiling of bird and marine habitats of the Unalaska Bay area including the shorelines of Summer Bay and Summer Bay Lake, including the loss of use of these areas for recreation;

(D) nearshore and Lake salmon and trout fisheries including the loss of use of these fisheries for subsistence, recreational and commercial fishing.

See *NOAA's Preassessment Report (AR# 18), 2/18/98 NOAA "Initiation Request" to the United States Coast Guard National Pollution Funds Center (NPFC) and approval (AR# 71), 6/11/98 NOAA "Revised Initiation Request" and NPFC Approval (AR# 130), Alaska Department of Environmental Conservation Final Response Report (AR# 1).*

(2) Response actions during cleanup have not adequately addressed the natural resource injuries resulting from the Incident. Response actions were primarily limited to containment and removal of oil that was spilled and were not intended to resolve all the natural resource losses associated with the Incident. See *Alaska Department of Environmental Conservation Final Response Report (AR# 1).*

(3) Feasible primary and compensatory restoration actions exist to address injuries from the Incident. Restoration activities are expected to focus on addressing losses associated with the intertidal resources, Lake fisheries, waterfowl and shorebirds, habitat and other losses as identified. Feasible restoration actions relevant to the injuries may include, but are not necessarily limited to:

(A) predator control

(B) habitat improvements

(C) shoreline maintenance

(D) increasing public awareness and education on shellfish contamination.

Based upon the foregoing determinations the Trustees have decided to proceed with restoration planning for the Incident.

10.3 Index to Administrative Record

To facilitate review, the administrative record is presented three ways- by Record Number, Author, and Subject Area

Record Number	Author	Date	Title
1	Alaska Department of Environmental Conservation	1998	*M/V Kuroshima* Response, ADEC, Final Report.
2	Alaska Department of Fish and Game	1998	Juvenile and Adult Fish Production the Summer Following the *M/V Kuroshima* Oil Spill. Regional Information Report No. 4K99-62
3	Alaska Department of Fish and Game	1999	Juvenile and Adult Fish Production the Two Years Following the *M/V Kuroshima* Oil Spill.
4	Alaska Department of Health and Social Services,	1998	Health Consultation, *M/V Kuroshima* Oil Spill, Unalaska, Alaska
5	Bailey, E.	1993	Introduction of Foxes to Alaskan Islands- History, Effects on Avifauna, and Eradication.
6	Belt, G., Laughlin, J., and T. Merrill	1992	Design of Forest Riparian Buffer Strips for the Protection of Water Quality: Analysis of Scientific Literature.
7	Burger, A.E.	1993	Mortality of Seabirds Assessed from Beached-Bird Surveys in Southern British Columbia. Canadian Field
8	Byrd, G.V, Bailey, E., and W. Stahl.	1996	Introduced Predator Removal from Islands. Exxon Valdez Oil Spill Restoration Project Final Report
9	Byrd, G.V., Trapp, J.L., and C. F. Zeillemaker.	1994	Removal of Introduced Foxes: A Case Study in Restoration of Native Birds.
10	Everest, F., Beschta, R., Scrivener, J., Koski, K., Sedell, J. and C.J. Sederholm.	1987	Fine Sediment and Salmonid Production: A Paradox. pp 98-142 in Salo, E., and T. Cundy (Eds.) Streamside Management: Forestry and Fisheries Interactions.
11	Furniss, M., Roelofs, T., and C.S. Yee.	1991	Road Construction and Maintenance. pp 297-323 in Meehan (Ed.) Influences of Forest and Rangeland Management on Salmonid Fishes and Their Habitats.
12	Honnold, S., Edmundson, J., and S. Schrof.	1996	Limnological and Fishery Assessment of 23 Alaska Peninsula and Aleutian Area Lakes, 1993-1995: An Evaluation of Potential Sockeye and Coho Salmon Production.
13	Huyck, V., and E. Paulson (Eds.)	1997	Petroleum in the Freshwater Environment: An Annotated Bibliography.
14	Knecht, R., and R. Davis.	1999	Oil Spill Response and Restoration at the Summer Bay Archaeological Site (UNL-92)
15	Muhlberg, G., and N. Moore.	1998	Streambank Revegetation and Protection Manual - A Guide for Alaska.
16	NOAA	1999	Revised Draft Restoration Plan and Environmental Assessment for the January 19, 1996 North Cape Oil Spill.
17	NOAA	1998	*M/V Kuroshima* Incident Dutch Harbor, Alaska November 1997-July 1998: NOAA HAZMAT Scientific Support Team Information Management Report
18	NOAA	1998	*M/V Kuroshima* Incident: Preassessment Scoping Report NOAA Damage Assessment Center.
19	Polaris Consultants	1998	Summer Bay Lake Bottom Survey and Cleanup Report, *M/V Kuroshima* Oil Spill.
20	QUADRA Engineering, Inc.	1986	Unalaska Park and Recreation Master Plan for the City of Unalaska

21	Tryck Nyman Hayes, Inc.	1996	Evaluation of Mitigation Opportunities in Unalaska
22	U.S. Coast Guard	1998	*M/V Kuroshima*, Panama, IMO No. 8710699; Multiple Loss of Life and Grounding with Pollution on 26 November 1997, Summers Bay, Unalaska Island, Alaska.
23	U.S. Fish and Wildlife Service	1991	Aleutian Canada Goose Recovery Plan.
24	Vanguard Environmental (Kane)	1998	Vegetation Restoration Project, *M/V Kuroshima* Oil Spill
25	Vanguard Environmental (Kane)	1999	Shoreline Cleanup Summer Bay Beach and Headland at Humpy Cove July, 1999, *M/V Kuroshima* Oil Spill.
26	Vanguard Environmental (Kane)	2000	Draft Proposed Sediment Control Project, Summer Bay Lake Road, *M/V Kuroshima* Oil Spill.
27	Waters, T.F	1995	Sediments in Streams: Sources, Biological Effects, and Control.
28	Wildlife Rapid Response Team	1998	*MV Kuroshima* Oil Spill, November 26, 1997, Wildlife Report.
29	Whitney, J and R Yender	1997	References for Pribilof Islands Oil Spill Contingency Planning
30	Bonneville Power Administration	1990	Analysis of Salmon and Steelhead Supplementation
31	Rice, S.D, D Moles et al.	1984	Effects of Petroleum Hydrocarbons on Alaskan Aquatic Organisms
32	Stein, J.E, Krahn, M.M., Collier, T.K. and J.P. Meador	1998	Oil Spill Response: Assessing Exposure and Effects in Fishery Resources
33	U.S .Forest Service	1998	Cost Estimating Guide for Road Construction
34	Stockner, J.G and E.A MacIsaac	1996	British Columbia Lake Enrichment Programme: Two Decades of Habitat Enhancement for Sockeye Salmon
35	Linkins A.E, Johnson, L.A, Everett, K.R. and R.M. Atlas	1984	Oil Spills: Damage and Recovery in Tundra and Taiga
36	NOAA	1994	Assessment of Risks Associated with the Shipment and Transfer of Group V Oils
37	NOAA	1997	Oil beneath the Water Surface and Review of Currently Available Literature on Group V Oils.
38	NOAA	1989	Environmental Impacts of Oil Spills in Polar Waters.
39	NOAA	1997	Literature Review of the Effects of Oil and Oil Spills on Arctic and North Temperate Intertidal and Subtidal Ecosystems
40	Stockner, J.D	1977	Lake Fertilization as a Means of Enhancing Sockeye Salmon Populations
41	National Technical Information Service	1998	Sockeye Salmon: Citations for the NTIS Bibliographic Database
42	U.S. Fish and Wildlife Service	1998	Carcass Collection: *M/V Kuroshima* Oil Spill, Dutch Harbor, Alaska.
43	Fairchild, L.A., and M.R. North	1993	Unalaska Winter Waterbird Surveys, March 1993
44	Bue, B.G, Sharr, S., and J.E Seeb	1998	Evidence of Damage to Pink Salmon Populations Inhabiting Prince William Sound, Alaska, Two Generations after the Exxon Valdez Spill.
45	International Maritime Organization	1996	Final Draft Guidelines for Sampling and Identification of Oil Spill
46	Koenings, J.P., and R.D. Burkett	1987	Population Characteristics of Sockeye Salmon Smolts Relative to Temperature Regimes, Euphotic Volume, Fry Density, and Forage Base within Alaskan Lakes
47	Heintz, R.A. Rice, S.D., and B. Bue	1996	Field and Laboratory Evidence for Reduced Fitness in Pink Salmon that Incubate in Oiled Gravel.
48	Humphrey, B.	1993	Persistence of Oil in Subtidal Sediments

49	Marty, G.D., Heintz, R.A. and D.E. Hinton	1997	Histology and Teratology of Pink Salmon Larvae near the Time of Emergence from Gravel Substrate in the Laboratory
50	Short, J.W., and R.A. Heintz	1997	Identification of Exxon Valdez Oil in Sediments and Tissues from Prince William Sound and the Northwestern Gulf of Alaska based on a PAH Weathering Model
51	Miller, M., Alexander, V., and R.J. Barsgate	1978	Effects of Oil Spills on Phytoplankton in an Arctic Lake and Ponds
52	CH2M Hill	1994	Circulation Study of Unalaska Bay and Contiguous Inshore Marine Waters
53	Wolfley, J.	1998	Ecological Risk Assessment and Management: Their Failure to Value Indigenous Traditional Ecological Knowledge and Protects Tribal Homelands
54	NOAA	1995	Physical Process Affecting the Movement and Spreading of Oils in Inland Waters.
55	U.S. Fish and Wildlife Service	1988	Alaska Maritime National Wildlife Refuge Comprehensive Conservation Plan
56	Intertek Testing Services	1998	*M/V Kuroshima* Report of Survey (Spill Size Calculation)
57	Wooley, C.	1998	Cultural Resource Report *MV Kuroshima* Oil Spill Unalaska Island, Alaska
58	Gieger, H.J., Bue, B.G., Sharr, S., Wertheimer, A.C., and T.M. Willette	1996	A Life History Approach to Estimating Damage to Prince William Sound Pink Salmon Caused by the Exxon Valdez Oil Spill
59	NOAA	1994	Fish and Shellfish Tainting: Questions and Answers
60	NOAA	1999	Pavement in Patagonia, Asphalt in Alaska: Case Studies in Oil Pavement Formation, Fate, and Effects
61	NOAA	1994	Alaska Shoreline Countermeasures Manual
62	NOAA	1996	Kodiak Island and Alaska Peninsula Oceanographic Conditions and NOAA's Eleven-Year Oil Spill History
63	NOAA	1997	Damage Assessment Center Emergency Guidance Manual
64	Sauer, T. and P. Boehm	1991	The Use of Defensible Analytical Chemical Measurements for Oil Spill Natural Resource Damage Assessments
65	Roberts, P., Henry, C.B., Fukuyama, A., and G. Shigenaka	1999	Weathered Petroleum Bioavailability to Intertidal Bivalves after the T/V Exxon Valdez Incident.
66	Spies, R.B., Rice, S.D., Wolfe, D.A., and B.A. Wright	1996	The Effects of the Exxon Valdez Oil Spill on the Alaskan Coastal Environment.
67	Short, J.W., and M.M. Babcock	1996	Prespill and Postspill Concentrations of Hydrocarbons in Mussels and Sediments in Prince William Sound
68	Sharr, S., Moffitt, S.D., and A.K Craig	1996	Effects of the Exxon Valdez on Pink Salmon Embryos and Preemergent Fry
69	Carls, M.G. Heintz, R., Moles, A., Rice, S.D., and J.W. Short	2001	Long-Term Biological Damage: What is Known, and How Should That Influence Decisions on Response, Assessment, and Restoration
70	Ford, R.G., Bonnell, M.L., Varoujean, D.H., Page, G.W., Carter, H.R., Sharp, B.E., Heinemann, D.E., and J.L. Casey	1996	Total Direct Mortality of Seabirds from the Exxon Valdez Oil Spill
71	NOAA	1998	Initiation Request to the National Pollution Funds Center
72	Nighswander, T.S., and N. Peacock	1999	The Communication of Health Risk from Subsistence Food in a Cross-Cultural Setting: Lessons Learned from the Exxon Valdez Oil Spill
73	Fall, J.A., Field, L.J., Nighswander, T., Stein, J.E., and M. Bolger	1999	Overview of Lessons Learned from the Exxon Valdez: A Ten Year Retrospective
74	Alaska Department of	1998	Synthesis of Shoreline Oiling Data and Map (Fax)

	Environmental Conservation		
75	USCG National Pollution Funds Center	1998	Case Management Division Vessel Identification Profile Request
76	Stoker, S.	1998	Proposal for Continued Monitoring and Cleanup
77	Dutch Harbor Fisherman	1998	Thaw Reveals vast amount of oil residue on Summer Bay Beach
78	Reuters News Service	1997	New Fuel Leak Spotted From Grounded Freighter
79	Associated Press	1997	Grounded Freighter Stirs Worry
80	Associated Press	1998	Oil From Freighter Taints Beach
81	Associated Press	1997	Salvage on Freighter in Alaska
82	Reuters News Service	1997	Dutch Harbor Grounding
83	Anchorage Daily News	1997	Working together improves oil spill response
84	Anchorage Daily News	1997	Freighter Owners get Deadline
85	Anchorage Daily News	1997	State Wants Grounded Ship Moved
86	Anchorage Daily News	1997	Summer Bay Cleanup goes on in Freezing Weather
87	Seattle Times	1997	Ship Stays Upright in Wind
88	Anchorage Daily News	1997	Spill crews clean lake, shoreline
89	Anchorage Daily News	1997	Spilled Oil taking toll on Birds
90	Associated Press	1997	Fuel Spill Higher than Thought
91	Associated Press	1997	Oil Spill Total may hit 100,000 gallons
92	Anchorage Daily News	1997	Storm Wallops Unalaska
93	Associated Press	1997	Estimate of Dutch Harbor Fuel Spill increases to 41,000 Gallons
94	Louisiana State University	1997	Characterization of Summer Bay Beach Stranded Oil
95	Co-trustees and RPs	1998	Stipulation between Natural Resource Damage Trustees and Kuroshima Shipping, S.A.
96	U.S. Coast Guard	1998	USCG Marine Violation Report, *M/V Kuroshima*
97	NOAA	2000	M/V Kuroshima Lost Human Use Pre-assessment Report
98	Hecker, M	1997	Memo from the City of Unalaska with Proposed Summer Bay Park Improvements
99	Industrial Economics Inc.	1998	Kuroshima Analytical Data Quality Assurance Review
100	US Department of the Interior	1997	Letter designating NOAA as Lead Administrative Trustee
101	Hahn, B.L., and E.P. Thompson	1998	Letter Certifying Completion of Cleanup Operations
102	EcoChem	1997	PAH Analyte List
103	Woods Hole Group	1997	Case Narrative: *M/V Kuroshima* Oil Spill, Summer Bay, Alaska (Sample Results)
104	Kane, D	1998	*M/V Kuroshima* Oil Spill: Final Shellfish Analytical Data and Double Ratio Plots
105	Stoker, S.	1998	Letter to ADEC with Shellfish Sampling Recommendations
106	Fairchild, L.A., and M.L. Heer	1997	Unalaska Winter Waterbird Surveys, March 1995
107	Anchorage Daily News	1998	Salvager Frees Kuroshima After 3 Months Aground
108	NOAA	1999	Preliminary Kuroshima Literature Review
109	Beak Consultants (Don Kane)	1997	*M/V Kuroshima* Oil Spill: Natural Resource Conceptual Restoration Proposal
110	Helton, D.	1998	Comments on (RPs) Conceptual Natural Resource Restoration Plan
111	Hoff, R.Z., and G. Shigenaka	1999	Lessons from Ten Years of Post-Exxon Valdez Monitoring on Intertidal Shorelines

112	Helton, D.	2000	Summary of Site Visit
113	Blue, K.	1998	Memo from City of Unalaska with Proposed Restoration Projects
114	Ounalashka Corporation	1998	Proposed Restoration Plans for Humpy Cove and Morris Cove
115	Ford, R.G., Page, G., and H. Carter	1987	Estimating Mortality of Seabirds from Oil Spills
116	Burger, A.	1991	The Effects of Oil Pollution on Seabirds off the West Coast of Vancouver Island
117	Rice, S.	1999	Memo on interpretation of benthic sediment sampling from Summer Bay Lake, Sampled in April 1998.
118	USFWS	1999	A Conservation Success Story: Aleutian Canada Goose Wings its Way back from the Brink of Extinction
119	Federal Register	2001	Final rule to remove the Aleutian Canada Goose from the Federal List of Endangered and Threatened Wildlife.
120	Mearns, A., O'Connor, T., and G. Lauenstein	1999	Relevance of the National "mussel watch" Program to Seafood Fisheries Management Issues during Oil Spill Response.
121	Holmes, P.B.	1997	Aleutian Islands and Atka-Amlia Islands Management Areas: Salmon Management Report to the Alaska Board of Fisheries, 1998
122	Peterson, C.H.	2001	The "Exxon Valdez" Oil Spill in Alaska: Acute, Indirect, and Chronic Effects on the Ecosystem.
123	NOAA	1999	Preliminary Analysis of Summer Bay Recreation Counts
124	Wright, S.	1999	Email regarding beach wildrye survival
125	Helton, D.	1999	Response to Vanguard Environmental re: Vegetation Restoration Project Report
126	Alaska Department of Fish and Game	2000	Summer Bay Lake 2000 Season Summary
127	Alaska Department of Fish and Game	2001	Summer Bay Lake 2001 Season Summary
128	Vanguard Environmental (Kane)	1999	Vegetation Restoration Project Addendum
129	Vanguard Environmental (Kane)	1999	Response to Trustee Comments and HEA Calculations
130	NOAA	1998	Supplemental Initiation Request to the National Pollution Funds Center
131	Pletnikoff, G.	2001	Email and attached pictures of residual oil
132	Akutan Corporation	1999	Consent to fox eradication project

Organized by Author

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Akutan Corporation	132	1999	Consent to fox eradication project
Alaska Department of Environmental Conservation	1	1998	*M/V Kuroshima* Response, ADEC, Final Report.
Alaska Department of Environmental Conservation	74	1998	Synthesis of Shoreline Oiling Data and Map (Fax)
Alaska Department of Fish and Game	2	1998	Juvenile and Adult Fish Production the Summer Following the *M/V Kuroshima* Oil Spill. Regional Information Report No. 4K99-62
Alaska Department of Fish and Game	3	1999	Juvenile and Adult Fish Production the Two Years Following the *M/V Kuroshima* Oil Spill.
Alaska Department of Fish and Game	126	2000	Summer Bay Lake 2000 Season Summary
Alaska Department of Fish and Game	127	2001	Summer Bay Lake 2001 Season Summary
Alaska Department of Health and Social Services,	4	1998	Health Consultation, *M/V Kuroshima* Oil Spill, Unalaska, Alaska
Anchorage Daily News	83	1997	Working together improves oil spill response
Anchorage Daily News	84	1997	Freighter Owners get Deadline
Anchorage Daily News	85	1997	State Wants Grounded Ship Moved
Anchorage Daily News	86	1997	Summer Bay Cleanup goes on in Freezing Weather
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Associated Press	81	1997	Salvage on Freighter in Alaska
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Associated Press	91	1997	Oil Spill Total may hit 100,000 gallons
Associated Press	93	1997	Estimate of Dutch Harbor Fuel Spill increases to 41,000 Gallons
Associated Press	80	1998	Oil From Freighter Taints Beach
Bailey, E.	5	1993	Introduction of Foxes to Alaskan Islands- History, Effects on Avifauna, and Eradication.
Beak Consultants (Don Kane)	109	1997	*M/V Kuroshima* Oil Spill; Natural Resource Conceptual Restoration Proposal
Belt, G., Laughlin, J., and T. Merrill	6	1992	Design of Forest Riparian Buffer Strips for the Protection of Water Quality: Analysis of Scientific Literature.
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Federal Register	119	2001	Final rule to remove the Aleutian Canada Goose from the Federal List of Endangered and Threatened Wildlife.
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Heintz, R.A, Rice, S.D., and B. Bue	47	1996	Field and Laboratory Evidence for Reduced Fitness in Pink Salmon that Incubate in Oiled Gravel.
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Helton, D.	125	1999	Response to Vanguard Environmental re: Vegetation Restoration Project Report
Helton, D.	112	2000	Summary of Site Visit
Hoff, R.Z., and G. Shigenaka	111	1999	Lessons from Ten Years of Post-Exxon Valdez Monitoring on Intertidal Shorelines
Holmes, P.B.	121	1997	Aleutian Islands and Atka-Amlia Islands Management Areas: Salmon Management Report to the Alaska Board of Fisheries, 1998
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			Evaluation of Potential Sockeye and Coho Salmon Production.
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Huyck, V., and E. Paulson (Eds.)	13	1997	Petroleum in the Freshwater Environment: An Annotated Bibliography.
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NOAA	17	1998	*M/V Kuroshima* Incident Dutch Harbor, Alaska November

			1997-July 1998: NOAA HAZMAT Scientific Support Team Information Management Report
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NOAA	123	1999	Preliminary Analysis of Summer Bay Recreation Counts
NOAA	130	1999	Supplemental Initiation Request to the National Pollution Funds Center
NOAA	97	2000	M/V Kuroshima Lost Human Use Pre-assessment Report
Ounalashka Corporation	114	1998	Proposed Restoration Plans for Humpy Cove and Morris Cove
Peterson, C.H.	122	2001	The "Exxon Valdez" Oil Spill in Alaska: Acute, Indirect, and Chronic Effects on the Ecosystem.
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Polaris Consultants	19	1998	Summer Bay Lake Bottom Survey and Cleanup Report, *M/V Kuroshima* Oil Spill.
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Reuters News Service	78	1997	New Fuel Leak Spotted From Grounded Freighter
Reuters News Service	82	1997	Dutch Harbor Grounding
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Roberts, P., Henry, C.B., Fukuyama, A., and G. Shigenaka	65	1999	Weathered Petroleum Bioavailability to Intertidal Bivalves after the T/V Exxon Valdez Incident.
Sauer, T. and P. Boehm	64	1991	The Use of Defensible Analytical Chemical Measurements for Oil Spill Natural Resource Damage Assessments
Seattle Times	87	1997	Ship Stays Upright in Wind
Sharr, S., Moffitt, S.D., and A.K Craig	68	1996	Effects of the Exxon Valdez on Pink Salmon Embryos and Preemergent Fry
Short, J.W., and M.M. Babcock	67	1996	Prespill and Postspill Concentrations of Hydrocarbons in Mussels and Sediments in Prince William Sound
Short, J.W., and R.A. Heintz	50	1997	Identification of Exxon Valdez Oil in Sediments and Tissues from Prince William Sound and the Northwestern Gulf of Alaska based on a PAH Weathering Model
Spies, R.B., Rice, S.D., Wolfe, D.A., and B.A. Wright	66	1996	The Effects of the Exxon Valdez Oil Spill on the Alaskan Coastal Environment.
Stein, J.E, Krahn, M.M., Collier, T.K. and J.P. Meador	32	1998	Oil Spill Response: Assessing Exposure and Effects in Fishery Resources
Stockner, J.D	40	1977	Lake Fertilization as a Means of Enhancing Sockeye Salmon Populations
Stockner, J.G and E.A MacIsaac	34	1996	British Columbia Lake Enrichment Programme: Two Decades of Habitat Enhancement for Sockeye Salmon
Stoker, S.	76	1998	Proposal for Continued Monitoring and Cleanup
Stoker, S.	105	1998	Letter to ADEC with Shellfish Sampling Recommendations
Tryck Nyman Hayes, Inc.	21	1996	Evaluation of Mitigation Opportunities in Unalaska
U.S. Coast Guard	22	1998	*M/V Kuroshima*, Panama, IMO No. 8710699; Multiple Loss of Life and Grounding with Pollution on 26 November

			1997. Summers Bay, Unalaska Island, Alaska.
U.S. Coast Guard	96	1998	USCG Marine Violation Report. *M/V Kuroshima*
U.S. Coast Guard National Pollution Funds Center	75	1998	Case Management Division Vessel Identification Profile Request
U.S. Department of the Interior	100	1997	Letter designating NOAA as Lead Administrative Trustee
U.S. Fish and Wildlife Service	55	1988	Alaska Maritime National Wildlife Refuge Comprehensive Conservation Plan
U.S. Fish and Wildlife Service	23	1991	Aleutian Canada Goose Recovery Plan.
U.S. Fish and Wildlife Service	42	1998	Carcass Collection: *M/V Kuroshima* Oil Spill, Dutch Harbor, Alaska.
U.S. Fish and Wildlife Service	118	1999	A Conservation Success Story: Aleutian Canada Goose Wings its Way back from the Brink of Extinction
U.S. Forest Service	33	1998	Cost Estimating Guide for Road Construction
Vanguard Environmental (Kane)	24	1998	Vegetation Restoration Project. *M/V Kuroshima* Oil Spill
Vanguard Environmental (Kane)	25	1999	Shoreline Cleanup Summer Bay Beach and Headland at Humpy Cove July, 1999. *M/V Kuroshima* Oil Spill.
Vanguard Environmental (Kane)	128	1999	Vegetation Restoration Project Addendum
Vanguard Environmental (Kane)	129	1999	Response to Trustee Comments and HEA Calculations
Vanguard Environmental (Kane)	26	2000	Draft Proposed Sediment Control Project, Summer Bay Lake Road, *M/V Kuroshima* Oil Spill.
Waters, T.F	27	1995	Sediments in Streams: Sources, Biological Effects, and Control.
Whitney, J and R Yender	29	1997	References for Pribilof Islands Oil Spill Contingency Planning
Wildlife Rapid Response Team	28	1998	*MV Kuroshima* Oil Spill, November 26, 1997, Wildlife Report.
Wolfley, J.	53	1998	Ecological Risk Assessment and Management: Their Failure to Value Indigenous Traditional Ecological Knowledge and Protects Tribal Homelands
Woods Hole Group	103	1997	Case Narrative: *M/V Kuroshima* Oil Spill, Summer Bay, Alaska (Sample Results)
Wooley, C.	57	1998	Cultural Resource Report *MV Kuroshima* Oil Spill Unalaska Island, Alaska
Wright, S.	124	1999	Email regarding beach wildrye survival

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Archaeology			
Record Number	Author	Date	Title
14	Knecht, R., and R. Davis.	1999	Oil Spill Response and Restoration at the Summer Bay Archaeological Site (UNL-92)
57	Wooley, C.	1998	Cultural Resource Report *MV Kuroshima* Oil Spill Unalaska Island, Alaska

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Record Number	Author	Date	Title
5	Bailey, E.	1993	Introduction of Foxes to Alaskan Islands- History, Effects on Avifauna, and Eradication.
7	Burger, A.E.	1993	Mortality of Seabirds Assessed from Beached-Bird Surveys in Southern British Columbia. Canadian Field
8	Byrd, G.V, Bailey, E., and W. Stahl.	1996	Introduced Predator Removal from Islands, Exxon Valdez Oil Spill Restoration Project Final Report
9	Byrd, G.V., Trapp, J.L., and C. F. Zeillemaker.	1994	Removal of Introduced Foxes: A Case Study in Restoration of Native Birds.
16	NOAA	1999	Revised Draft Restoration Plan and Environmental Assessment for the January 19, 1996 North Cape Oil Spill.
23	U.S. Fish and Wildlife Service	1991	Aleutian Canada Goose Recovery Plan.
28	Wildlife Rapid Response Team	1998	*MV Kuroshima* Oil Spill, November 26, 1997, Wildlife Report.
42	U.S. Fish and Wildlife Service	1998	Carcass Collection: *M/V Kuroshima* Oil Spill, Dutch Harbor, Alaska.
43	Fairchild, L.A., and M.R. North	1993	Unalaska Winter Waterbird Surveys, March 1993
55	U.S. Fish and Wildlife Service	1988	Alaska Maritime National Wildlife Refuge Comprehensive Conservation Plan
70	Ford, R.G., Bonnell, M.L., Varoujean, D.H., Page, G.W., Carter, H.R., Sharp, B.E., Heinemann, D.E., and J.L. Casey	1996	Total Direct Mortality of Seabirds from the Exxon Valdez Oil Spill
106	Fairchild, L.A., and M.L. Heer	1997	Unalaska Winter Waterbird Surveys, March 1995
115	Ford, R.G., Page, G., and H. Carter	1987	Estimating Mortality of Seabirds from Oil Spills
116	Burger, A.	1991	The Effects of Oil Pollution on Seabirds off the West Coast of Vancouver Island
118	USFWS	1999	A Conservation Success Story: Aleutian Canada Goose Wings its Way back from the Brink of Extinction
119	Federal Register	2001	Final rule to remove the Aleutian Canada Goose from the Federal List of Endangered and Threatened Wildlife.
132	Akutan Corporation	1999	Consent to fox eradication project

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Record Number	Author	Date	Title
94	Louisiana State University	1997	Characterization of Summer Bay Beach Stranded Oil
99	Industrial Economics Inc.	1998	Kuroshima Analytical Data Quality Assurance Review
102	EcoChem	1997	PAH Analyte List
103	Woods Hole Group	1997	Case Narrative: *M/V Kuroshima* Oil Spill, Summer Bay, Alaska (Sample Results)

Coordination with RPs			
Record Number	Author	Date	Title
95	Co-trustees and RPs	1998	Stipulation between Natural Resource Damage Trustees and Kuroshima Shipping, S.A.
109	Beak Consultants (Don Kane)	1997	*M/V Kuroshima* Oil Spill; Natural Resource Conceptual Restoration Proposal
110	Helton, D.	1998	Comments on (RPs) Conceptual Natural Resource Restoration Plan

General Information			
Record Number	Author	Date	Title
13	Huyck, V., and E. Paulson (Eds.)	1997	Petroleum in the Freshwater Environment: An Annotated Bibliography.
16	NOAA	1999	Revised Draft Restoration Plan and Environmental Assessment for the January 19, 1996 North Cape Oil Spill.
18	NOAA	1998	*M/V Kuroshima* Incident: Preassessment Scoping Report NOAA Damage Assessment Center.
21	Tryck Nyman Hayes, Inc.	1996	Evaluation of Mitigation Opportunities in Unalaska
29	Whitney, J and R Yender	1997	References for Pribilof Islands Oil Spill Contingency Planning
31	Rice, S.D, D Moles et al.	1984	Effects of Petroleum Hydrocarbons on Alaskan Aquatic Organisms
51	Miller, M., Alexander, V., and R.J. Barsgate	1978	Effects of Oil Spills on Phytoplankton in an Arctic Lake and Ponds
59	NOAA	1994	Fish and Shellfish Tainting: Questions and Answers
62	NOAA	1996	Kodiak Island and Alaska Peninsula Oceanographic Conditions and NOAA's Eleven-Year Oil Spill History
63	NOAA	1997	Damage Assessment Center Emergency Guidance Manual
66	Spies, R.B., Rice, S.D., Wolfe, D.A., and B.A. Wright	1996	The Effects of the Exxon Valdez Oil Spill on the Alaskan Coastal Environment.
71	NOAA	1998	Initiation Request to the National Pollution Funds Center
100	US Department of the Interior	1997	Letter designating NOAA as Lead Administrative Trustee
108	NOAA	1999	Preliminary Kuroshima Literature Review
122	Peterson, C.H.	2001	The "Exxon Valdez" Oil Spill in Alaska: Acute, Indirect, and Chronic Effects on the Ecosystem.
130	NOAA	1998	Supplemental Initiation Request to the National Pollution Funds Center

Newspaper Articles			
Record Number	Author	Date	Title
77	Dutch Harbor Fisherman	1998	Thaw Reveals vast amount of oil residue on Summer Bay Beach
78	Reuters News Service	1997	New Fuel Leak Spotted From Grounded Freighter
79	Associated Press	1997	Grounded Freighter Stirs Worry
80	Associated Press	1998	Oil From Freighter Taints Beach
81	Associated Press	1997	Salvage on Freighter in Alaska
82	Reuters News Service	1997	Dutch Harbor Grounding
83	Anchorage Daily News	1997	Working together improves oil spill response
84	Anchorage Daily News	1997	Freighter Owners get Deadline
85	Anchorage Daily News	1997	State Wants Grounded Ship Moved
86	Anchorage Daily News	1997	Summer Bay Cleanup goes on in Freezing Weather
87	Seattle Times	1997	Ship Stays Upright in Wind
88	Anchorage Daily News	1997	Spill crews clean lake, shoreline
89	Anchorage Daily News	1997	Spilled Oil taking toll on Birds
90	Associated Press	1997	Fuel Spill Higher than Thought
91	Associated Press	1997	Oil Spill Total may hit 100,000 gallons
92	Anchorage Daily News	1997	Storm Wallops Unalaska
93	Associated Press	1997	Estimate of Dutch Harbor Fuel Spill increases to 41,000 Gallons
107	Anchorage Daily News	1998	Salvager Frees Kuroshima After 3 Months Aground

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Record Number	Author	Date	Title
36	NOAA	1994	Assessment of Risks Associated with the Shipment and Transfer of Group V Oils
37	NOAA	1997	Oil beneath the Water Surface and Review of Currently Available Literature on Group V Oils.
38	NOAA	1989	Environmental Impacts of Oil Spills in Polar Waters.
39	NOAA	1997	Literature Review of the Effects of Oil and Oil Spills on Arctic and North Temperate Intertidal and Subtidal Ecosystems
45	International Maritime Organization	1996	Final Draft Guidelines for Sampling and Identification of Oil Spill
48	Humphrey, B.	1993	Persistence of Oil in Subtidal Sediments
52	CH2M Hill	1994	Circulation Study of Unalaska Bay and Contiguous Inshore Marine Waters
54	NOAA	1995	Physical Process Affecting the Movement and Spreading of Oils in Inland Waters.
60	NOAA	1999	Pavement in Patagonia, Asphalt in Alaska: Case Studies in Oil Pavement Formation, Fate, and Effects
64	Sauer, T. and P. Boehm	1991	The Use of Defensible Analytical Chemical Measurements for Oil Spill Natural Resource Damage Assessments

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Record Number	Author	Date	Title

18	NOAA	1998	*M/V Kuroshima* Incident: Preassessment Scoping Report NOAA Damage Assessment Center.
20	QUADRA Engineering, Inc.	1986	Unalaska Park and Recreation Master Plan for the City of Unalaska
76	Stoker, S.	1998	Proposal for Continued Monitoring and Cleanup
97	NOAA	2000	M/V Kuroshima Lost Human Use Pre-assessment Report
98	Hecker, M	1997	Memo from the City of Unalaska with Proposed Summer Bay Park Improvements
113	Blue, K.	1998	Memo from City of Unalaska with Proposed Restoration Projects
114	Ounalashka Corporation	1998	Proposed Restoration Plans for Humpy Cove and Morris Cove
123	NOAA	1999	Preliminary Analysis of Summer Bay Recreation Counts

Response Documents

Record Number	Author	Date	Title
1	Alaska Department of Environmental Conservation	1998	*M/V Kuroshima* Response, ADEC, Final Report.
17	NOAA	1998	*M/V Kuroshima* Incident Dutch Harbor, Alaska November 1997-July 1998: NOAA HAZMAT Scientific Support Team Information Management Report
19	Polaris Consultants	1998	Summer Bay Lake Bottom Survey and Cleanup Report, *M/V Kuroshima* Oil Spill.
22	U.S. Coast Guard	1998	*M/V Kuroshima*, Panama, IMO No. 8710699; Multiple Loss of Life and Grounding with Pollution on 26 November 1997, Summers Bay, Unalaska Island, Alaska.
25	Vanguard Environmental (Kane)	1999	Shoreline Cleanup Summer Bay Beach and Headland at Humpy Cove July, 1999. *M/V Kuroshima* Oil Spill.
56	Intertek Testing Services	1998	*M/V Kuroshima* Report of Survey (Spill Size Calculation)
61	NOAA	1994	Alaska Shoreline Countermeasures Manual
74	Alaska Department of Environmental Conservation	1998	Synthesis of Shoreline Oiling Data and Map (Fax)
75	USCG National Pollution Funds Center	1998	Case Management Division Vessel Identification Profile Request
96	U.S. Coast Guard	1998	USCG Marine Violation Report, *M/V Kuroshima*
101	Hahn, B.L., and E.P. Thompson	1998	Letter Certifying Completion of Cleanup Operations

Salmon

Record Number	Author	Date	Title
2	Alaska Department of Fish and Game	1998	Juvenile and Adult Fish Production the Summer Following the *M/V Kuroshima* Oil Spill. Regional Information Report No. 4K99-62
3	Alaska Department of Fish and Game	1999	Juvenile and Adult Fish Production the Two Years Following the *M/V Kuroshima* Oil Spill.
10	Everest, F., Beschta, R., Scrivener, J., Koski, K., Sedell, J. and C.J. Sederholm.	1987	Fine Sediment and Salmonid Production: A Paradox. Pp 98-142 in Salo, E., and T. Cundy (Eds.) Streamside Management: Forestry and Fisheries Interactions.

11	Furniss, M., Roelofs, T., and C.S. Yee.	1991	Road Construction and Maintenance. pp 297-323 in Meehan (Ed.) Influences of Forest and Rangeland Management on Salmonid Fishes and Their Habitats.
12	Honnold, S., Edmundson, J., and S. Schrof.	1996	Limnological and Fishery Assessment of 23 Alaska Peninsula and Aleutian Area Lakes, 1993-1995: An Evaluation of Potential Sockeye and Coho Salmon Production.
26	Vanguard Environmental (Kane)	2000	Draft Proposed Sediment Control Project, Summer Bay Lake Road, *M/V Kuroshima* Oil Spill.
27	Waters, T.F	1995	Sediments in Streams: Sources, Biological Effects, and Control.
30	Bonneville Power Administration	1990	Analysis of Salmon and Steelhead Supplementation
32	Stein, J.E, Krahn, M.M., Collier, T.K. and J.P. Meador	1998	Oil Spill Response: Assessing Exposure and Effects in Fishery Resources
33	U.S .Forest Service	1998	Cost Estimating Guide for Road Construction
34	Stockner, J.G and E.A MacIsaac	1996	British Columbia Lake Enrichment Programme: Two Decades of Habitat Enhancement for Sockeye Salmon
40	Stockner, J.D	1977	Lake Fertilization as a Means of Enhancing Sockeye Salmon Populations
41	National Technical Information Service	1998	Sockeye Salmon: Citations for the NTIS Bibliographic Database
44	Bue, B.G, Sharr, S., and J.E Seeb	1998	Evidence of Damage to Pink Salmon Populations Inhabiting Prince William Sound, Alaska, Two Generations after the Exxon Valdez Spill.
46	Koenings, J.P., and R.D. Burkett	1987	Population Characteristics of Sockeye Salmon Smolts Relative to Temperature Regimes, Euphotic Volume, Fry Density, and Forage Base within Alaskan Lakes
47	Heintz, R.A, Rice, S.D., and B. Bue	1996	Field and Laboratory Evidence for Reduced Fitness in Pink Salmon that Incubate in Oiled Gravel.
49	Marty, G.D., Heintz, R.A, and D.E. Hinton	1997	Histology and Teratology of Pink Salmon Larvae near the Time of Emergence from Gravel Substrate in the Laboratory
58	Gieger, H.J., Bue, B.G., Sharr, S., Wertheimer, A.C., and T.M. Willette	1996	A Life History Approach to Estimating Damage to Prince William Sound Pink Salmon Caused by the Exxon Valdez Oil Spill
68	Sharr, S., Moffitt, S.D., and A.K Craig	1996	Effects of the Exxon Valdez on Pink Salmon Embryos and Preemergent Fry
69	Carls, M.G, Heintz, R., Moles, A., Rice, S.D., and J.W. Short	2001	Long Term Biological Damage: What is Known, and How Should That Influence Decisions on Response, Assessment, and Restoration
117	Rice, S.	1999	Memo on interpretation of benthic sediment sampling from Summer Bay Lake, Sampled in April 1998.
121	Holmes, P.B.	1997	Aleutian Islands and Atka-Amlia Islands Management Areas: Salmon Management Report to the Alaska Board of Fisheries, 1998
126	Alaska Department of Fish and Game	2000	Summer Bay Lake 2000 Season Summary
127	Alaska Department of Fish and Game	2001	Summer Bay Lake 2001 Season Summary

Shellfish and Intertidal			
Record Number	Author	Date	Title
4	Alaska Department of	1998	Health Consultation, *M/V Kuroshima* Oil Spill, Unalaska, Alaska

	Health and Social Services.		
50	Short, J.W., and R.A. Heintz	1997	Identification of Exxon Valdez Oil in Sediments and Tissues from Prince William Sound and the Northwestern Gulf of Alaska based on a PAH Weathering Model
53	Wolfley, J.	1998	Ecological Risk Assessment and Management: Their Failure to Value Indigenous Traditional Ecological Knowledge and Protects Tribal Homelands
65	Roberts, P., Henry, C.B., Fukuyama, A., and G. Shigenaka	1999	Weathered Petroleum Bioavailability to Intertidal Bivalves after the T/V Exxon Valdez Incident.
67	Short, J.W., and M.M. Babcock	1996	Prespill and Postspill Concentrations of Hydrocarbons in Mussels and Sediments in Prince William Sound
72	Nighswander, T.S., and N. Peacock	1999	The Communication of Health Risk from Subsistence Food in a Cross-Cultural Setting: Lessons Learned from the Exxon Valdez Oil Spill
73	Fall, J.A., Field, L.J., Nighswander, T., Stein, J.E., and M. Bolger	1999	Overview of Lessons Learned from the Exxon Valdez: A Ten Year Retrospective
104	Kane, D	1998	*M/V Kuroshima* Oil Spill: Final Shellfish Analytical Data and Double Ratio Plots
105	Stoker, S.	1998	Letter to ADEC with Shellfish Sampling Recommendations
111	Hoff, R.Z., and G. Shigenaka	1999	Lessons from Ten Years of Post-Exxon Valdez Monitoring on Intertidal Shorelines
120	Mearns, A., O'Connor, T., and G. Lauenstein	1999	Relevance of the National "mussel watch" Program to Seafood Fisheries Management Issues during Oil Spill Response.
131	Pletnikoff, G.	2001	Email and attached pictures of residual oil

Vegetation			
Record Number	Author	Date	Title
6	Belt, G., Laughlin, J., and T. Merrill	1992	Design of Forest Riparian Buffer Strips for the Protection of Water Quality: Analysis of Scientific Literature.
15	Muhlberg, G., and N. Moore.	1998	Streambank Revegetation and Protection Manual - A Guide for Alaska.
24	Vanguard Environmental (Kane)	1998	Vegetation Restoration Project, *M/V Kuroshima* Oil Spill
35	Linkins A.E, Johnson, L.A, Everett, K.R. and R.M. Atlas	1984	Oil Spills: Damage and Recovery in Tundra and Taiga
112	Helton, D.	2000	Summary of Site Visit
124	Wright, S.	1999	Email regarding beach wildrye survival
125	Helton, D.	1999	Response to Vanguard Environmental re: Vegetation Restoration Project Report
128	Vanguard Environmental (Kane)	1999	Vegetation Restoration Project Addendum
129	Vanguard Environmental (Kane)	1999	Response to Trustee Comments and HEA Calculations

10.4 Finding of No Significant Impact (FONSI)

(To be completed after consideration of public comments)