4.0 RESTORATION PLANNING

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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.

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. 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. 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.

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 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 substantial 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 substantial 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 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 in localized areas for limited periods of time. 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

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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. Wildlife response crews were also delayed in arriving at the spill and there were delays in setting up hazing equipment to scare birds away from oiled shorelines. 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 appreciably 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?

[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).

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. 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 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). Avatanak Island is preferable to other locations because of its moderate size, proximity to the spill 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

[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 RPs' conceptual restoration proposal (AR # 109), and the Trustees' comments on the RP restoration proposal (AR # 110).

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 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 guillemont *(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 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 mammals on the island except foxes that might be 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 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.

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[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."

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:**

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 is 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 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 services. 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

[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 RPs' 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).

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].

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 RP-implemented 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.

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

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.

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 alternative 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 appreciably 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 alternative is 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 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 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).

[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.

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

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 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.

[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).

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.

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 an important 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 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 shortage of shellfish, some of the species of concern are not readily cultured, and creation of additional shellfish beds would not address public uncertainty over the safety and wholesomeness of the shellfish harvested from Summer Bay.

- **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 shellfish harvested from Summer Bay.

- **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].

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 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

[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.

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 more than four years after 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). Clean-up workers also trampled the nearshore areas of the Lake, injuring lakeshore vegetation, and 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, providing 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.

[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).

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 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

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

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.

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

[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).

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 an important 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 sizeable 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. 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.

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[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."

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, benefit aquatic vegetation, 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 considerable 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. Healthy shoreline vegetation will also indirectly benefit aquatic vegetation, juvenile fish habitat, and nutrient levels in the Lake. 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 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-ratio 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 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 special 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 appreciably 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:**

Salmon stocks in Summer Bay Lake are subject to sizeable 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 RPs' 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 Trustees' 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. This approach is in accordance with 15 C.F.R. 990.53(d)(3)(ii). 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 resulting from the spill, the amount the Trustees have budgeted for implementation of the recreational projects. 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 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 Trustees propose funding to procure temporary shelters, platforms and restroom facilities for public recreational uses, including groups such as the Qawalangin Tribe. 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. 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.

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 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:

a) Injury to Salmonids: Salmon are an important 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

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