US Army Corps of Engineers
Alaska District

Vol. I

Interim Integrated Feasibility Report
Environmental Assessment
and Finding of No Significant Impact

Navigation Improvements Valdez, Alaska

May 2011

DEPARTMENT OF THE ARMY
U.S. ARMY ENGINEER DISTRICT, ALASKA
P.O. BOX 6898
ANCHORAGE, ALASKA 99506-0898

NAVIGATION IMPROVEMENTS INTERIM INTEGRATED FEASIBILITY REPORT AND ENVIRONMENTAL ASSESSMENT VALDEZ, ALASKA

May 2011

FINDING OF NO SIGNIFICANT IMPACT

In accordance with the National Environmental Policy Act of 1969, as amended, the U.S. Army Corps of Engineers, Alaska District, has assessed the environmental effects of the following action:

Navigation Improvements
Valdez, Alaska

The project will construct a harbor at Valdez, Alaska.

Multiple alternative sites and plans were investigated throughout the course of the feasibility study, with a detailed focus upon five final plans. The East Site Rubblemound 320-Vessel alternative is identified as the National Economic Development plan and the recommended plan in the Valdez Navigation Improvements draft Integrated Interim Feasibility Report and Environmental Assessment and will be constructed as a Federal action.

Harbor Basin. The recommended plan will provide a basin of 5.7 hectares (ha) including the entrance channel and maneuvering basin and will provide moorage for about 320 vessels. The entrance channel depth will be -5.5 meters mean lower low water (MLLW). The mooring basin will be -5.5 to -2.7 meters MLLW.

Breakwater Components. Two of the three breakwaters with crest elevations of +6 meters will be constructed to protect the harbor. The main breakwater will be 473 meters long and protect the south side of the harbor. The eastern-most 70 meters of the south breakwater will angle to the northeast and form the west boundary of the entrance channel. The east breakwater will be approximately 240 meters long and will curve in an arc from the northeast to northwest to form the eastern boundary of the entrance channel and harbor. Side slopes will be 1 vertical: 1.5 horizontal. Both breakwaters will be constructed in 0.0 MLLW to -5 meters MLLW water depths.

Both breakwaters will be breached at the shoreward end to allow fish and other marine biota to move into and out of the harbor near shore. A small stub breakwater will protect the breach in the west breakwater. It will be 30 meters long with a crest elevation of +5 meters.

Material quantities for the three breakwaters are 31,200 cubic meters (m^3) of armor rock, 17,600 m^3 of secondary rock, and 37,570 m^3 of core rock. Materials for the breakwaters will be obtained from existing commercial sources.

Channel and Basin Dredging. All dredging for the East Site will be in the tidal flat south of Hotel Hill and east of the Ship Escort and Response Vessel System (SERVS) dock. Some of the dredged material will be used as fill for construction of a 1.87 ha staging area and the rest will be transported to Two Moon Bay. A total of 186,400 m^3 of material will be dredged for the entrance channel, maneuvering channel, and mooring basin. Dredged material not used in construction will be placed at a formerly used log transfer site at Two Moon Bay to return the bark-covered sea bottom at the site to a more natural and productive state.

Mitigation. Each mitigation measure identified in Section 4.9 of the draft report and environmental assessment is incorporated as an element of the Federal action. Principal features of that plan are as follows: implementation of best management practices to prevent water pollution, design for breaches between the breakwaters and shore to enable near-shore fish passage at most tide stages, design of the harbor for optimal circulation, imposition of seasonal construction/dredging restrictions, and requirements for silt curtains during in-water work when juvenile fish are present.

Construction and operation of the harbor will not substantially affect threatened or endangered species, critical habitat, cultural resources, or other human or biological resources.

The action is consistent with State and local coastal zone management programs to the maximum extent practicable. The accompanying environmental assessment supports the conclusion that the project does not constitute a major Federal action significantly affecting the quality of the human environment. Therefore, an environmental impact statement is not necessary to construct the navigation improvements in Valdez, Alaska.

Reinhard W. Koenig	4 Oct 10
Reinhard W. Koenig Colonel, Corps of Engineers District Commander	Date

EXECUTIVE SUMMARY

This report examines the need for improving navigation facilities in Valdez, Alaska, presents the results of studies conducted to determine the feasibility of Federal participation in potential improvements, and assesses potential environmental effects associated with a range of alternatives. The primary problems addressed in this report are unmet moorage demand and overcrowding in the existing harbor.

This general investigation study is authorized by the U.S. House of Representatives Public Works Committee Resolution for Rivers and Harbors in Alaska, adopted 2 December 1970. The project was authorized by Section 4012 of the Water Resources Development Act of 2007, PL 110-114 at a cost of $20,000,000. Per the WRDA implementation guidance and supporting fact sheet dated 6 June 2008, the total authorized cost of $20,000,000 is for the general navigation features, subject to the 902 limit, and because the project is authorized, the Chief of Engineers report for the project will be replaced by a Director of Civil Works report.

The City of Valdez is approximately 185 kilometers (km) east of Anchorage and is accessible by highway from both Anchorage and the interior City of Fairbanks. The existing mooring basin has capacity for about 500 vessels. During the height of the fishing season, the transient moorage pier can have vessels rafted six deep, dozens of boats using the launch ramp, and all competing with existing users of the marina for the harbor's limited space. Unavailability of moorage has led to harbor congestion, lost income, vessel damages, and lost time.

Multiple alternative sites and plans to provide additional protected moorage capacity were investigated through the course of the feasibility study, with a detailed focus on five final plans. The East Site Rubblemound 320-Vessel plan maximized the net National Economic Development (NED) benefits and was selected as the NED Plan. The NED Plan was supported by the local sponsor and was carried forward as the tentatively recommended plan. The tentatively recommended plan would provide a basin of 5.7 hectares (ha) including the entrance channel and maneuvering basin. The entrance channel depth would be -5.5 meters MLLW and decrease to –2.7 meters at the far end of the basin away from the entrance. The south breakwater would be about 473 meters long. The east breakwater would be constructed in a north-south orientation to the entrance channel and would be approximately 240 meters long, and the stub breakwater would be 30 meters long. The plan also includes beneficial use of dredged material, which would be placed at a formerly used log transfer site at Two Moon Bay to return the bark-covered sea bottom at the site to a more natural and productive state.

The features of the authorized project have a total cost of $24,434,000 which translates to a $19,596,000 Federal cost and a non Federal cost of $4,838,000. In addition, there is an estimated non Federal cost of $31,383,000 for associated local service facilities. The annual NED investment cost of the project, including interest during construction and the cost of operation and maintenance, is $2,968,000 with annual NED benefits of $5,180,000. The project's benefit-to-cost-ratio is 1.75 with net annual benefits of $2,212,000. Construction and operation of the harbor would not substantially affect threatened or endangered species, critical habitat, cultural resources, or other human or biological resources.

The local sponsor, City of Valdez, would pay the non-Federal share of the costs of construction of general navigation features (GNF) and the Beneficial Use of Dredged Material feature. The sponsor would also pay the entire cost of non-GNF, including the float system.

PERTINENT DATA

Recommended Plan

Channel and Basin		Breakwater	
Entrance channel	-5.5 meters MLLW	Design wave	1.4 meters
Mooring basin	Transitions from -5.5 meters to -2.7 meters MLLW	Length, total	743 meters
Maneuvering basin	2.1 ha	Crest elevation	6 meters MLLW
Mooring basin	3.6 ha	Armor rock	31,200 m^3
Total	5.7 ha	Secondary rock	17,600 m^3
Dredging volume	186,400 m^3	Core rock	37,570 m^3

Authorized Project First Cost

Item	Federal ($)	Non-federal ($)	Total ($)
General Navigation Features	20,529,000	2,281,000	22,810,000
Beneficial Use of Dredged Material	512,000	276,000	788,000
Lands, Easements, Rights of Way, and Relocations (LERR)		829,000	829,000
Navigation aids. U.S. Coast Guard	7,000		7,000
Authorized Navigation Project First Cost	21,048,000	3,386,000	24,434,000
Authorized 902(b) Limit			25,692,000

Total Project Cost [a]

Item	Federal ($)	Non-federal ($)	Total ($)
General Navigation Features	21,048,000	3,386,000	24,434,000
Associated costs – Local Service Facilities		31,383,000	31,383,000
Total First Cost	21,048,000	34,769,000	55,817,000
%10 of GNF	-2,281,000	2,281,000	
GNF LERR Credit	829,000	-829,000	
TOTAL PROJECT COST	**19,596,000**	**36,221,000**	**55,817,000**

Annual cost and benefit based on a October 2010 price level, 4 3/8 %, 50-year project life

NED investment cost (includes interest during construction)	$55,707,000
Annualized NED investment	2,651,000
Annual OMRR&R	317,000
Annual NED cost	2,968,000
Annual NED benefits	5,180,000
Net annual NED benefits	2,212,000
Benefit/cost ratio	1.75

[a] Cost sharing reflects provisions of the Water Resources Development Act of 1986 that states the first-cost general navigation feature cost sharing is 90:10 with an additional 10% (minus a GNF LERR credit) paid back over 30 years. Cost sharing for the beneficial use of dredged material is 65:35

All costs are October 2010 price level.

List of Acronyms and Abbreviations

ADOT&PF	Alaska Department of Transportation and Public Facilities
cm	centimeters
dB	decibels
EPA	Environmental Protection Agency
GNF	General Navigation Features
ha	hectares
EC/ICA	Cost Effectiveness and Incremental Cost Analysis
LCRMA	Lower Columbia River Management Area
km	kilometers
LSF	Local Service Features
m^3	cubic meters
MARPOL	Marine Pollution Guidelines
MBA	Marine Benthic Assessment
MLLW	Mean Lower Low Water
Mm	millimeters
NED	National Economic Development
NER	National Ecosystem Restoration
NMFS	National Marine Fisheries Service
PCB	Polychlorinated biphenyls
PDT	Project Delivery Team
PSDDA	Puget Sound Dredged Disposal Analysis
PWS	Prince William Sound
RU	Risk and Uncertainty
spp.	Multiple species
SVOC	Semi-Volatile Organic Compounds

USACE	U.S. Army Corps of Engineers
USFWS	U.S. Fish and Wildlife Service (Service)
VOC	Volatile Organic Compounds

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CONVERSION TABLE FOR SI (METRIC) Units

Units of measurement used in this report can be converted to SI (metric) units as follows:

Multiply	By	To obtain
cubic meters	1.308	cubic yards
hectare	2.471	acre
Celsius degrees	*	Fahrenheit degrees
Meters	3.281	Feet
meters per second	3.281	feet per second
centimeters	0.3937	Inches
meters per second	1.944	knots (international)
km	0.6214	miles (U.S. statute)
kilometers	0.5400	miles (nautical)
kilometers per hour	0.6214	miles per hour
kilograms	0.2192	pounds (mass)

*To obtain Fahrenheit (F) temperature readings from Celsius (C) readings, use the following formula: F = 9/5 C + 32

1.0 INTRODUCTION

1.1 Authority

This general investigation study is authorized by the U.S. House of Representatives Public Works Committee Resolution for Rivers and Harbors in Alaska, adopted 2 December 1970. The resolution states in part:

Resolved by the Committee on Public Works of the House of Representatives, United States, that the Board of Engineers for Rivers and Harbors is hereby requested to review the report of the Chief of Engineers on Rivers and Harbors in Alaska, published as House Document Number 414, 83d Congress, 2d Session; … and other pertinent reports with a view to determine whether any modifications of the recommendations contained therein are advisable at the present time.

The project was authorized by Section 4012 of the Water Resources Development Act of 2007, PL 110-114, which contained the following language.

The Secretary shall conduct a study to determine the feasibility of carrying out a project for navigation, Valdez, Alaska, and if the Secretary determines that the project is feasible, shall carry out the project at a total cost of $20,000,000.

Per the WRDA implementation guidance and supporting fact sheet dated 6 June 2008, the total cost of $20,000,000 is for the general navigation features, and because the project is authorized, the Chief of Engineers report for the project will be replaced by a Director of Civil Works report.

1.2 Scope of Study

This study investigates the feasibility of navigation improvements in Valdez, Alaska and assesses potential environmental effects associated with alternatives that could be implemented to address existing navigation problems. The primary focus of this study is to examine the feasibility of improving navigation, with the additional purpose of beneficially using any material dredged during the development of navigation improvements. The study was conducted and this integrated draft Interim Feasibility Report and Environmental Assessment has been prepared in accordance with the study authority. It is consistent with the goals and procedures for water resources planning as stated in Engineer Regulation (ER) 1105-2-100 and Corps regulations for implementing the National Environmental Policy Act (NEPA). Alternatives were examined for their feasibility, considering engineering, economic, environmental, and other criteria. A determination of Federal interest is presented in accordance with present laws and policies.

1.3 Study Participation and Coordination

The Alaska District, U. S. Army Corps of Engineers (Corps) has primary responsibility for this study. The non-Federal sponsor is City of Valdez. This report was prepared with assistance from many individuals, Alaska Department of Transportation and Public

Facilities (ADOT&PF), and resource agencies. The U.S. Fish and Wildlife Service, National Marine Fisheries Service, Alaska Department of Natural Resources, and Alaska Department of Environmental Conservation, and other resource agencies participated in the study process.

1.4 Related Reports and Studies

The following studies and reports have examined navigation improvements in Valdez.

City of Valdez Small Boat Harbor Expansion Permeable Wave Barrier Feasibility Study, January, 2003. This study, prepared by Peratrovich, Nottingham & Drage, Inc. for the City of Valdez, reviewed and analyzed existing conceptual plans for navigation improvements of the small boat harbor. The report expanded on the conceptual plans by developing alternatives using permeable wave barriers in lieu of rubblemound construction. The study produced conceptual designs that appeared to be economically feasible without reducing existing uplands.

Expedited Reconnaissance Study of Boat Harbor Improvements, Valdez, Alaska, July 1998. Tryck Nyman Hayes, Inc. prepared this study for the Alaska District to determine if there was a Federal interest in feasibility studies of navigation improvements in Valdez, Alaska. This study concentrated on Harbor Cove as the preferred site near the existing harbor as it provided the best natural protection. The study developed several sized harbors and provided an economic analysis. The preliminary economic analysis indicated that there was no Federal interest in navigation improvements at Valdez.

Section 905(b) (WRDA 86) Analysis, Valdez Small Boat Harbor, Alaska, October 1998. The Alaska District further developed the information from the July 1998 reconnaissance report and re-evaluated the potential benefits for navigation improvements based on the Harbor Cove alternative site. Upon this further analysis, it was determined there were sufficient benefits to support a Federal interest in proceeding to a feasibility study. Although there were environmentally sensitive areas in and near Harbor Cove, it was believed an environmentally acceptable alternative could be identified.

Review of Hydraulic Performance, Proposed Valdez Harbor Modification, September 1997. Ronald E. Nece, P.E., ScD, prepared this hydraulic analysis of proposed harbor modifications for the Alaska District. The proposed project was presented as a means of improving the circulation of the existing small boat harbor. This review concluded that the proposed modifications would provide a marginal improvement of the existing condition.

Valdez Harbor Modification, May 1997.
This report, prepared by the Alaska District, U.S. Army Corps of Engineers examined a plan for flushing the existing small boat harbor by means of a constructed containment basin in Harbor Cove and two 1.2-meter-diameter culverts placed under South Harbor Drive into the northeast end of the existing boat harbor. The basic concept was to trap water in the containment basin during high tide. Tidal gates on the entrance to the culverts would then be opened at low tide causing water to flow from the impoundment

basin into the existing harbor, increasing circulation and flushing currents. The report concluded that the concept would not substantially improve flushing.

Comparative Analysis Valdez Boat Harbor, February 1996.
Prince William Sound Economic Development Council Inc. prepared this report for the City of Valdez. The report outlines and compares economic issues for a number of Alaskan ports including Valdez, Seward, and Homer. Capital needs, funding sources, revenues, and expenditures were explored. The report concluded that the Valdez port is an important “economic engine” for the community, that portions of the small boat harbor are near the end of their service life, and alternatives to traditional funding are needed to repair or replace the harbor facilities.

Reconnaissance Report for Boat Harbor Improvements, Valdez, Alaska, November 1995.
Raytheon Infrastructure Services Inc. prepared this report for the Alaska District. The report examined several sites for small boat harbor expansion and a protected boat launch facility. The purpose of this report was to identify a Federal interest and assess a need for further study. The study investigated four “potential” sites: Allison Point, Mineral Creek, Old Valdez, and a southern expansion of the existing harbor. Also considered were three “possible” sites: Allison Creek, an eastern expansion of the existing harbor (Harbor Cove), and a southern expansion of the existing harbor east of the Alyeska Ship Escort and Response Vessel System (SERVS) pier. The report concluded that there were insufficient Federal benefits and that further feasibility studies were not warranted.

2.0 PROBLEMS AND OPPORTUNITIES / PURPOSE AND NEED

2.1 Introduction

Valdez (population 3,475) is at the north end of a 22-km-long fjord (Port Valdez) that opens into Valdez Arm of Prince William Sound (PWS; figure 2-1). Valdez is about 193 km due east of Anchorage, but is about 500 km from Anchorage by highway.

Valdez is nationally important because it is at the southern end of the Trans-Alaska oil pipeline. The pipeline terminal adjacent to Valdez (figure 2-2) loads about 20 percent of the crude oil produced in the United States into tankers for transportation to refineries.

Valdez is regionally important because it is one of only five communities on PWS and one of only four ports that connect the interior of Alaska to the Pacific Ocean. Figure 2-1 shows PWS, Valdez, and the other communities on the coast of PWS. Seward is south of PWS at the head of Resurrection Bay, off the Gulf of Alaska.

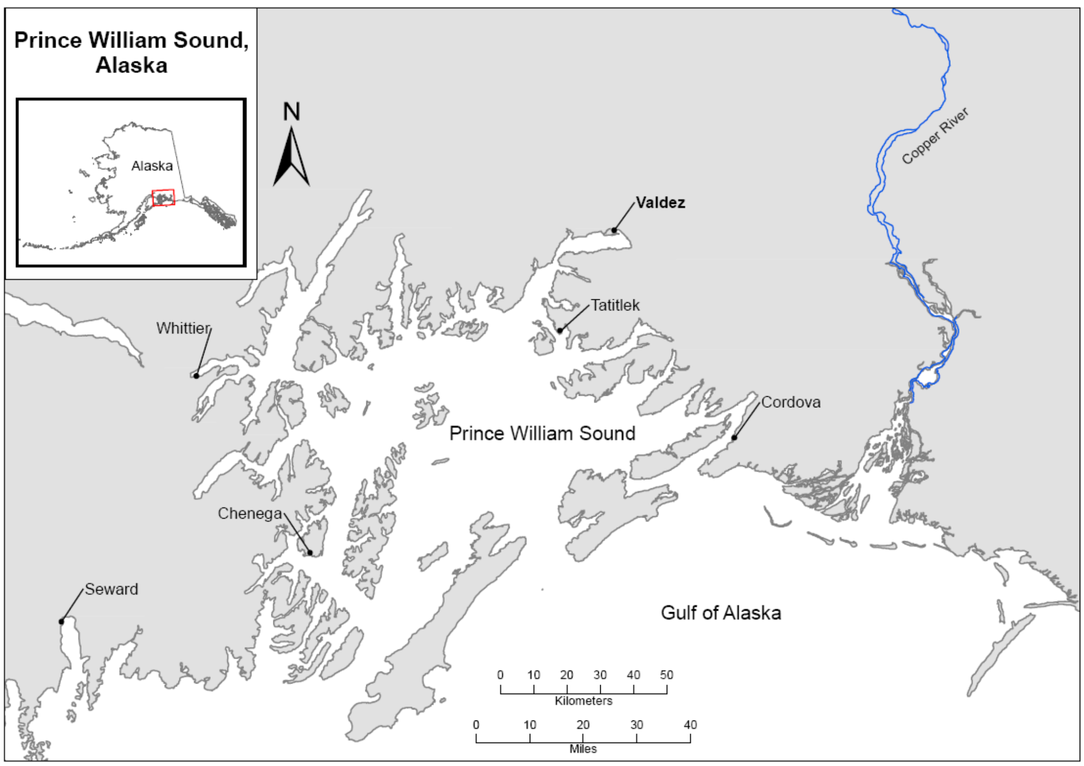

Figure 2- 1. Location and vicinity map

Valdez is at the bottom of a steep-walled canyon that descends into the deep fjord that is Port Valdez. The entire canyon-fjord trench was formed beneath a great ice field that once covered all of PWS. The canyon walls rise to more than 800 meters above the town and the Port Valdez fjord just 500 meters from the entrance to Valdez harbor is 200 meters deep. Figure 2-3 shows Valdez and Valdez Harbor at the base of the Chugach Mountain Range.

Figure 2- 2. Trans-Alaska Pipeline Terminal near Valdez 1998. Photo credit (copyright) from Alaska DCA database

Glaciers have retreated from Valdez, but they still profoundly affect the city and Port Valdez. Active glaciers in the surrounding Chugach Mountains drain into Lowe River, which runs past Valdez to empty into Port Valdez and into other streams in the Port Valdez drainage. Lowe River carries a comparatively large bed load, frequently shifts laterally in its floodplain as the bed is filled, and is very turbid. Most other streams in this watershed have similar characteristics. The breadth of the Lowe River floodplain, threat of erosion, and the wetlands and lakes left behind by glacial recession and deposition all confine development in Valdez to a narrow band in the canyon.

January temperatures range from -6 to -1 degrees C; July temperatures are 8 to 16 degrees C. Average annual precipitation is 160 centimeters. Average snowfall is just over 8 meters, but can be much greater. Figure 2-4 shows snow accumulation near the end of a typical winter in Valdez.

Valdez is one of only two communities on the 40,000 km^2 PWS that can be reached by highway. It is the closest highway access to marine waters from Fairbanks and is a popular destination for people from Fairbanks and elsewhere in eastern interior Alaska. Big returns of hatchery released and wild salmon and the relatively protected boating in Port Valdez add to recreational appeal. Salmon, herring, halibut, and other marine resources of PWS also support substantial commercial fisheries.

Figure 2- 3. The City of Valdez and Valdez Harbor at the base of the Chugach Mountains.

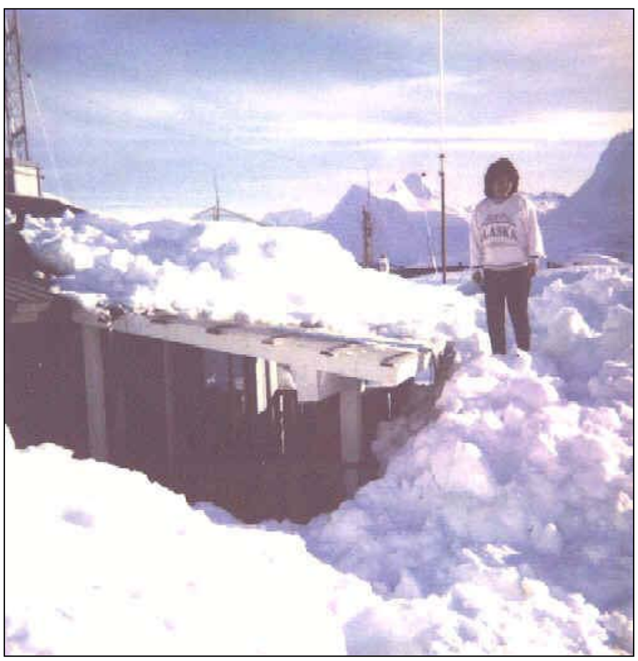

Figure 2- 4. A winter's snow accumulation in Valdez.
Photo credit (copyright) Roy H. Hansen 1997 from Alaska DCA database.

2.2 Problem Description

The small boat harbor in Valdez is overcrowded and congested from insufficient moorage and too much boat traffic.

Use by commercial fishermen, charter boat operators, and recreational boaters has caused demand for year-round moorage to exceed harbor capacity. Boat ramps and transient moorage are in constant use during the commercial fishing and tourist season.

Demand for moorage at the existing small boat harbor in Valdez has steadily increased over the past 20 years. The harbor had only 350 boats in 1979 and no vessels were wait-listed. Currently, the harbor's 500 permanent slips are fully utilized by full-time berth holders, and another 243 boats are wait-listed for permanent moorage. Boaters unable to obtain permanent moorage in Valdez return to their homeport to store their vessels in the off-season. This can be as far away as the Pacific Northwest.

Two harbor management techniques, rafting and hot-berthing, are used to accommodate as many vessels as possible. Rafting is the mooring of several vessels side by side, with only the inner-most vessels attached to the dock. People must cross over several boats to get to the dock to load or unload their vessels. Leaving the raft can be difficult, especially if the owners/operators of the other rafted vessels are not onboard. Hot berthing is the practice of allowing a vessel to use a vacant slip while the slip's designated occupant is out. This can be a problem if the designated occupant returns while the visiting vessel is still using the slip. The harbormaster must then find other accommodations for the visiting vessel and arrange to have it moved if the owner is not available.

There are other inherent delays associated with harbor congestion. If all the commercial fishing vessels leave or return at the same time of day, they are delayed maneuvering and untying when they depart from the rafted moorage and again when they return to be rafted or hot berthed. It is difficult and time-consuming for the harbormaster to keep the commercial fleet; daily arrivals and departures of fishing charters; and day cruisers, recreational boaters, and kayakers, all operating relatively smoothly.

Vessels from Valdez are responsible for preventing and responding to oil spills in PWS, so supporting the SERVS is important. Many commercial and recreational vessels that use Valdez harbor are available to be hired for spill response on short notice in an emergency. The same vessels designated to protect two of the nation's most valuable resources (oil and the seafood that would be impacted by a spill) are moored in a harbor that is so crowded that rapid response cannot be assured.

2.3 Issues and Concerns

Principal issues and concerns were identified by harbor users, residents of Valdez, State and Federal resource agencies, State and Federal petroleum transportation agencies, and major landowners on PWS.

Issues and concerns can be sorted into the following categories:

- Need for efficient moorage and access to resources of PWS
- Need to support efficient oil spill prevention and response
- Concern that harbor development would adversely affect future land uses
- Concern that navigation improvements could directly or indirectly impact important natural resources
- Need to avoid, minimize, and compensate for unavoidable impacts to the maximum extent practicable
- Need to maintain and restore natural resources of PWS

Need for efficient moorage and access to resources of PWS

PWS has been described as a commercial fisher's and sportsman's paradise. Marine resources are abundant, scenery is first class, and although it is accessible by road, it is quite remote from urban areas. During the commercial fishing and busy summer tourist season, boat ramps and transient moorage are highly utilized. Congestion at the harbor occurs from the inherent inefficiencies of rafting and hot-berthing, vessels moored in spaces designed for smaller boats, and the complications of having a high-traffic boat launch within the limited confines of the harbor.

Congestion at the harbor results in problems with delays both entering and exiting the main harbor entrance, travel-related expenses associated with vessels that must travel to distant ports to obtain moorage, damages to vessels, docks and pilings resulting from the abnormally heavy use, and strains on harbor personnel as they attempt to coordinate a smooth-running harbor with multiple user groups. Many operators remove their vessels from the water or seek shelter in distant ports at considerable cost. Slips that are too small for the moored vessels create additional problems as boats must maneuver around obstructions in the fairways.

The long wait-list for permanent moorage at Valdez adds pressure to the lines that form at the launch ramp during the fishing season. Limited access to permanent moorage at the harbor means that users must trailer their boats at the end of the trip. Once in the water, launch ramp users must traverse the length of the harbor to access fishing and recreation opportunities in PWS. These delays impact the income earning capability of commercial fishing and charter boats and impact the recreational experience for charter boat customers and other pleasure craft. Additional details of the various problems at Valdez Harbor are discussed in Economics Appendix B.

Need to support efficient oil spill prevention and response

Alyeska Pipeline's SERVS mission is to prevent oil spills by assisting tankers in safe navigation through PWS. Their goal is to protect the environment by providing effective response services to the Valdez Marine Terminal and Alaska crude oil shippers in accordance with oil spill response agreements and plans. SERVS provides tanker escorts during the 110 km passage through PWS and mobilizes vessels, equipment, and personnel in the event of an oil spill. SERVS is the largest oil spill prevention and response organization in the world.

The PWS Escort System is broken into three zones: Northern PWS, Central PWS, and the Hinchinbrook Entrance. In the Northern PWS zone, two escort vessels must remain within one-quarter of a nautical mile of the tanker, except when one vessel serves as an ice scout. The primary escort, an ocean going tug, must remain tethered to the tanker as it transits Valdez Narrows. The second escort vessel is a specially equipped Escort Response Vessel (ERV). In the Central PWS zone, the primary escort must remain within one-quarter of a nautical mile of the tanker, while the second escort may be stationed underway off Bligh Reef, or east of Naked Island, or off of Montague Point, depending on the tanker's position in the Sound. At Hinchinbrook Entrance, outbound laden tankers must maintain two escorts within one-quarter of a nautical mile of the tanker.

As part of the PWS Tanker Spill Prevention and Response Plan, Alyeska must be able to respond to several spill scenarios, including a large oil spill of 300,000 barrels, within 72 hours. Alyeska provides initial response for a minimum of 72 hours, and then transitions response efforts to the responsible party. Congestion at Valdez Harbor limits timely responses from SERVS vessels during the busy summer season.

Concern that harbor development would adversely affect present and future land uses

Valdez is in the bed of an ancient glacier, walled in by 1,000-meter-high rocky mountain walls, a glacier-fed river system that shifts from side to side in its bed, and the deep waters of Port Valdez. It also is on the seaward face of a mountain range that is inundated with precipitation tracking in from thousands of kilometers across the Pacific Ocean. Valdez gets an average of about 8 meters of snow each winter and can get close to twice that. Just finding places to dump the snow so the city can function is a major problem each winter. Valdez has very little land available for development and no place to grow. The few areas of undeveloped flat land that remain are essential to the city. City representatives and concerned citizens repeatedly said that those remaining lands have value that cannot be adequately defined in monetary terms and that a new harbor should be planned and developed to avoid taking that land.

Concern that navigation improvements could directly or indirectly impact important natural resources

Water Quality - Water quality sufficient to sustain existing diversity and abundance of marine life in habitats surrounding the harbor expansion should be maintained. Primary concerns were dissolved oxygen, turbidity, and fuel spills.

Sea Otters - Sea otters that inhabit Valdez Harbor are part of the PWS population. Disturbance, pollution, and loss of food resources are primary concerns for sea otters recovering from the Exxon Valdez oil spill.

Duck Flats Habitat - The "Duck Flats", sometimes referred to as Island Flats, are expansive tidal flats and marsh at the northeastern head of Valdez Harbor. These tidal flats are home to a diversity of marine invertebrates that seasonally support flocks of migrating shorebirds and waterfowl, and rearing pink, chum and coho salmon. Direct mortality, habitat contamination, and loss of food resources used by migrating birds and juvenile salmon are primary concerns.

Harbor Cove Habitat - Harbor Cove is adjacent to, but separated from, the project site by Hotel Hill. Harbor Cove habitat supports diverse invertebrate species among scattered boulders and patches of eelgrass on a mud-sand substrate. Harbor Cove is a seasonal nursery for juvenile salmon and other marine fish species, and is used seasonally by migrating shorebirds and waterfowl. Harbor Cove is also used for education and recreation. Contamination of habitat and loss of food for important fish, birds, and mammals and potential impacts to recreational resources are primary concerns. In figure 2-5, Harbor Cove is directly beyond the existing Valdez Harbor. Hotel Hill is in the upper right of the figure.

Black-legged Kittiwake - A colony of about 200 black-legged kittiwakes nests on steel beams of the SERVS dock. The number of kittiwakes this colony will support is limited by available nesting space. Disturbance during nesting season and contamination of food resources fed to juveniles are primary concerns.

Marine Vegetation - Patchy eelgrass and marine kelp grow in mud and gravel bottom in areas where a harbor might be constructed. This kelp and vegetation provides support and cover for marine invertebrates that are food resources for juvenile marine fish including salmon, shorebirds, and waterfowl. Potential for loss of this habitat is an important concern.

Marine Invertebrates - Clams, mussels, marine worms, and smaller invertebrates are in the project area. These invertebrates are seasonal food resources for juvenile salmon and other marine fish and for shorebirds and waterfowl. These invertebrates are given a lower priority because they have a relatively low diversity and abundance due to the unfavorable composition of substrate and other environmental factors on the project site. A net loss of invertebrate biomass in the project area is an important concern.

Juvenile Salmon - Juvenile pink, chum, and coho salmon rear seasonally in habitats surrounding the proposed harbor expansion. These salmon are transitory and the amount of time spent in the proposed harbor area is dependant largely on physical environmental conditions and availability of their respective food resources. Juvenile salmon are given a lower priority because they are transitory and will quickly migrate seaward past the proposed harbor expansion site. The harbor design should not impede their seaward migration, and water quality produced by harbor activities should not increase mortality. Maintaining good water quality in the harbor and juvenile salmon migration disruption are important resource concerns.

Adult Salmon - Adult salmon associated with the proposed harbor expansion are large numbers of hatchery raised pink salmon. It is unlikely that wild chum or coho salmon would be affected from the proposed harbor expansion. Adult pink salmon are often

Figure 2- 5. Valdez Harbor, Harbor Cove, and Hotel Hill.

trapped in the existing small boat harbor by the hundreds where they die and degrade water quality as they decompose.

Need to avoid, minimize, and compensate for unavoidable impacts to the maximum extent practicable

This report considers natural resources associated with water resource development at Valdez from two standpoints: mitigation and restoration.

Mitigation can be expressed in three related objectives: avoidance of impact, minimization of impact, and compensation for unavoidable impact. Specific mitigation objectives identified in scoping and consultation for harbor construction and operation in Valdez were:

- Avoid or minimize impacts to high-value habitats, including wetland and estuarine areas of particular importance to waterfowl, rearing salmon, and migratory birds.
- Minimize water quality problems in and near harbors.
- Avoid disturbance of nearby sea bird colonies.
- Minimize effects of the harbor on near-shore fish movement and on dispersal of other near-shore organisms.
- Minimize adverse impact to important sea otter habitat.
- Place project feature so that unavoidable effects are in the least diverse and least productive habitats that are practicable for project needs.
- Compensate for impacts to the maximum extent practicable and focus that type of mitigation on in-kind compensation for impacted resources.
- To the maximum extent practicable, use dredged material beneficially for construction to minimize impacts of extracting and transporting other fill material.

- If possible, use dredged material beneficially so the action avoids impacts to a disposal site.

Need to maintain and restore natural resources of PWS

Restoration objectives in this study focus on bringing affected resources back to or toward pre-impact conditions.

Fewer than 10,000 residents live in the five communities along approximately 5,000 km of PWS shoreline. Commercial fishing and logging are the two principal resource extractive industries in and on the shores of the Sound. Until 1989, runoff from logging, in-water log transfer, fish processing waste, and discharge from the small shoreline communities were the principal, but local, sources of marine habitat impacts. Those effects were limited and were being reduced by tighter permit requirements, better land stewardship, and other institutional controls.

The Exxon Valdez crude oil spill in March 1989 and its effects on PWS habitat vastly overshadowed all other effects. Impacts of the spill linger, although hundreds of millions of dollars were spent to collect spilled oil and restore impacted resources. Scoping and interagency coordination identified only two potential marine habitat restoration opportunities that could be considered in this study.

Logging has been much less important as an industry in PWS than in southeastern Alaska, but some areas of PWS, primarily on Native corporation land, have been logged. The in-water log transfer facilities used to store and load felled timber into vessels have left behind degraded habitat that was identified during scoping as an opportunity for corrective action.

The U.S. Forest Service controls most of the 5,000 km of PWS shoreline and has developed a network of remote cabins for recreational users. Most are accessible only by boat, but many do not have a dock so boats anchor in nearby protected waters while the cabin is in use. Anchor chains of the moored boats damage benthic communities as the boats swing when the tides and winds change. Damaged habitat could be restored and docks or moorings could be installed to avoid further damage.

Scoping also identified habitat degradation in the Valdez watershed that should be considered in water resource development studies. Those impacted resources were considered in an evaluation of watershed needs to determine whether they might be restored as part of a broader water resources project. Potential measures to correct problems in the watershed are considered along with other alternatives in Section 4.

2.4 National Objectives

The objectives of Federal water and land resources planning are to contribute to National Economic Development (NED) in a way that protects the Nation's environment and increases the net value of goods and services provided to the economy of the United States as a whole and to contribute to National Ecosystem Restoration (NER) in a way to increase the net quantity and/or quality of desired ecosystem resources. Benefits contributing to NED or NER may be claimed for economic justification of a project.

Navigation improvements in Valdez represent a high priority under the current administration guidelines for producing NED benefits. Planning for the Valdez project is consistent with the NED objective and considers economic, social, environmental, and engineering factors.

2.5 Planning Objectives

Planning objectives for this study can be grouped as follows:

- Improve navigation through better moorage capacity and efficiency
- Plan for consistency with land use plans and needs
- Provide additional moorage for as many vessels on the moorage wait list as possible.
- Reduce travel costs incurred by vessels using other home ports.
- Decrease vessel delays and damages caused by rafting and hot berthing activities.
- Reduce delays experienced by commercial vessels and SERVS operations.
- Mitigate unavoidable impacts in accordance with Federal water resource development guidance.
- Identify navigation and beneficial use of dredged material strategies consistent with state, regional, and local land use plans.
- Develop harbor and beneficial use of dredged material plans acceptable to the non-Federal sponsor and other stakeholders.

2.6 Planning Constraints

Evaluation of concerns expressed during coordination and scoping, analysis of lessons learned from previous projects, and historical information led to the following planning constraints:

- Avoid transferring navigation issues to another site.
- Avoid correcting problems for one user group at the expense of another group.
- Avoid impacts to the Alyeska Pipeline Terminal.
- Avoid harbor locations that would bring boaters too close to security areas around the Alyeska terminal.
- Avoid harbor construction in locations with high earthquake risk.
- Avoid harbor locations close to river or stream outlets where they will receive excessive freshwater in the winter and freeze or be blocked with ice.
- Avoid restoration or mitigation strategies that are not self-sustaining or that may create liability for operators.
- Avoid interfering with SERVS facilities, mooring for State ferries, or Coast Guard facilities.
- Avoid harbor or restoration strategies that would reduce available developable lands, particularly those near the Valdez waterfront transportation and industrial complex.

3.0 INVENTORY AND FORECAST CONDITIONS

3.1 Existing Conditions

3.1.1 Project Area Description

The City of Valdez is on the northeast end of Port Valdez, the north-easternmost extension of PWS. Figure 3-1 is a sketch map of the City of Valdez and the layout of Valdez Harbor. Figure 3-2 is an aerial photograph of eastern Port Valdez, the City of Valdez and vicinity. Valdez is separated from interior Alaska by the steep Chugach Mountains. In 1790 Don Salvador Fidalgo named Port Valdez after the celebrated Spanish naval officer Antonio Valdes y Basan. Due to its excellent ice-free port, a town developed in 1898 as a debarkation point for men seeking a route to the Eagle Mining District and the Klondike gold fields. Valdez soon became the supply center of its own gold mining region and incorporated as a city in 1901. Fort Liscum was established in 1900, and the U.S. Army constructed a sled and wagon road to Fort Egbert in Eagle. The Alaska Road Commission further developed the road for automobile travel to Fairbanks; it was completed by the early 1920's. A slide of unstable submerged land during the 1964 earthquake destroyed the original city waterfront, killing several residents. The community was rebuilt on a more stable bedrock foundation approximately 7 km to the west. During the 1970's, construction of the Trans-Alaska oil pipeline terminal and other cargo transportation facilities brought rapid growth to Valdez. In March 1989, it was the center for the massive oil-spill cleanup after the "Exxon Valdez" disaster. In a few short days, the population of the town tripled.

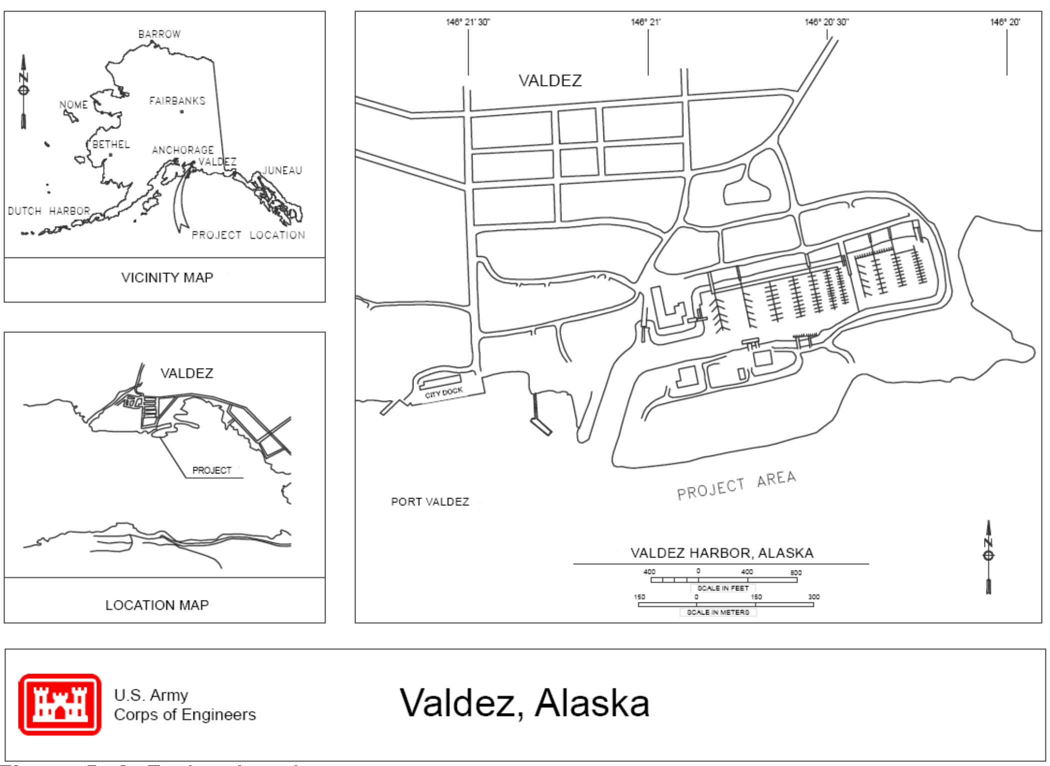

Figure 3- 1. Project location map.

3.1.2 Existing Federal Navigation Project

The original Valdez small boat harbor was constructed in 1939 at the head of Valdez Arm. Breakwaters were added in 1957. The boat harbor along with the community of Valdez was destroyed by a tsunami caused by the March 1964 Alaska earthquake after which the Corps constructed a new basin. Valdez expanded the harbor basin in 1985.

Valdez operates and maintains the harbor. It is approximately 15.4 ha or 585 meters by 264 meters. The harbor slip and float system is designed to accommodate about 500 permanent vessels (depending on the configuration of fish cleaning stations), a boat launch ramp, a tidal repair grid, and a 60-ton Marine Travelift boat haul-out dock. The basin is maintained at -3.7 meters MLLW. The entrance channel is about 37 meters wide and has a maintained depth of -3.7 meters MLLW. Two rock-mound breakwaters of approximately 164 meters and 209 meters in length protect the entrance channel. All slips are under either permanent or transient use lease, with water and electrical services provided to the float system.

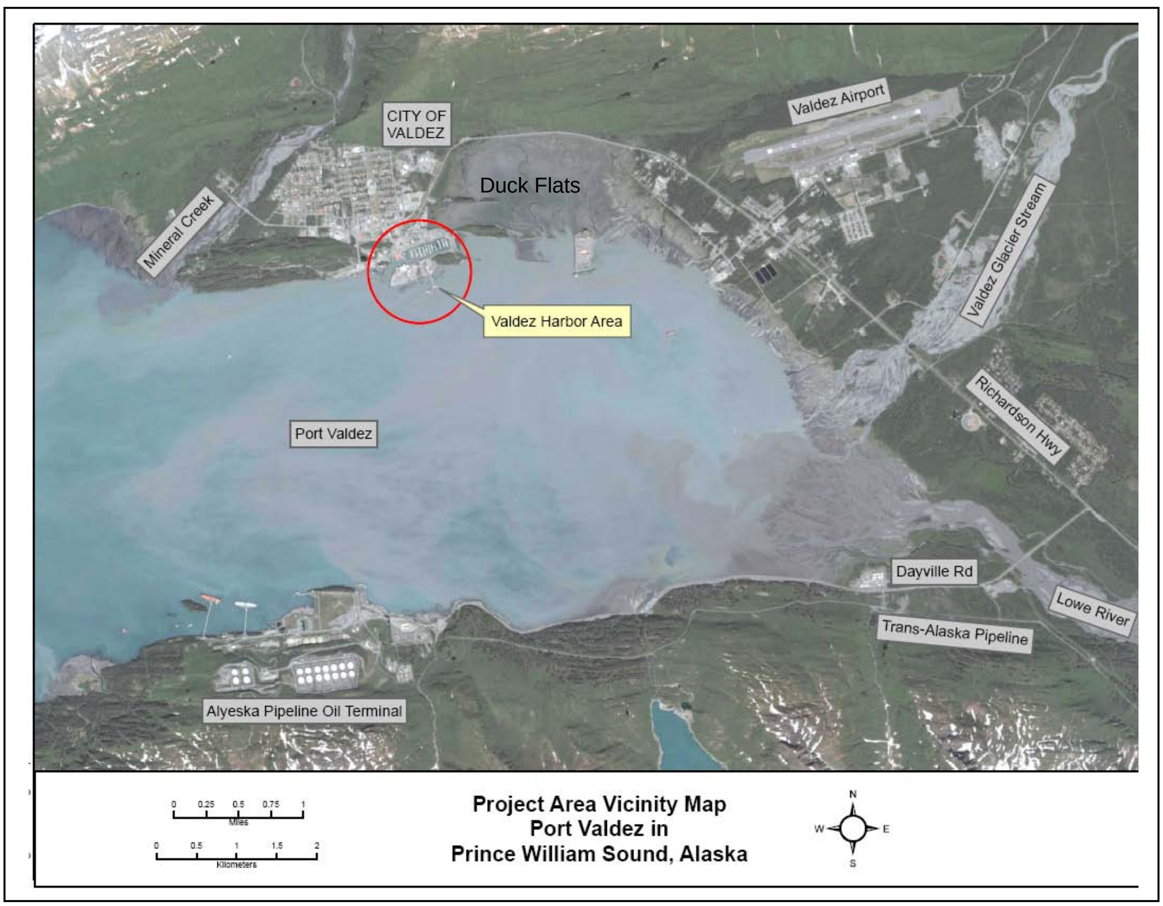

Figure 3- 2. Valdez Harbor Vicinity.

3.1.3 Biological Resources

Much of the upland habitat in and around Valdez is in steep terrain, with upper areas that remain snow covered nearly all year. Most of the area has been glaciated. These factors reduce the value of this habitat for many animals, and these areas generally have low animal population densities. The low-lying deciduous and spruce forests provide a more productive habitat, but are generally limited to small areas along the coastline. Terrestrial species in the Valdez area include mountain goats, wolves, coyotes, red fox, lynx, moose, black bears, brown bears, wolverines, black-tailed deer, river otters, and mink.

The aquatic habitat includes a wide variety of flora and fauna, including more than 200 types of invertebrates and mollusks. Tanner crab and shrimp dominated the catch during trawl sampling done in the 1970's for the nearby Trans-Alaskan Pipeline System. The only commonly occurring ground fish was walleyed pollock. Many other species were also found including Pacific herring, halibut, other species of ground fish, salmon species, and Dungeness, Tanner, and king crab.

The project area supports numerous species of birds. The highest density of winter birds includes goldeneyes, rock sandpipers, common murres, and mallards. Gulls and terns comprise more than 70 percent of the total bird population in the summer. A colony of black-legged Kittiwakes nests underneath the SERVS dock adjacent to the project area.

No listed threatened or endangered species managed by the U.S. Fish and Wildlife Service occurs in any of the proposed alternative sites. Although the Southwest Alaska Distinct Population Segment of sea otters found in marine waters surrounding the Aleutian Islands and Alaska Peninsula are listed as threatened, the sea otter population in PWS, including Port Valdez, is not. Endangered whale species managed by the National Marine Fisheries Service that occur in the project area in deeper waters are humpback, sei, right, blue, and sperm. It is unlikely the whales would come into Valdez Arm. The endangered Steller’s sea lion (western stock) does occur in near-shore waters in Valdez; however, the Corps has determined that this action would not affect listed Steller’s sea lions.

3.1.4 Economic Base

Valdez has one of the highest municipal tax bases in Alaska as the southern terminus and off-loading point of oil extracted from Prudhoe Bay on the North Slope. Four of the top ten employers in Valdez are directly connected to the oil terminus. Alyeska Pipeline Service Co. employs nearly 300 people. Valdez is a major seaport, with a $48 million cargo and container facility. City, State, and Federal agencies combined provide significant employment. Forty-nine residents hold commercial fishing permits. Several fish processing plants operate in Valdez, including Peter Pan and Seahawk Seafoods.

The Richardson Highway connects Valdez to Anchorage, Fairbanks, and Canada. Port Valdez is ice-free year round and is navigated by hundreds of ocean-going oil cargo vessels each year. The State ferry provides transportation to Valdez, Whittier, Cordova, Kodiak, and Homer in summer and only to Cordova in winter. Valdez has the largest floating concrete dock in the world, with a 1,200-foot front and water depths exceeding

80 feet. Valdez also has numerous cargo and container facilities. The State operates the airport, which has a 1,981-meter-long by 46-meter-wide paved runway, instrument landing system, and control tower. A State-owned seaplane base is available at Robe Lake.

The SERVS is an important feature of the Valdez infrastructure and provides escorts for oil tankers through PWS. It was created in the summer of 1989 after the *Exxon Valdez* oil spill. It is administered by the Alyeska Pipeline Service Company and is part of the Trans-Alaska Pipeline System. In addition to tanker escorts, SERVS provides a network of locally based vessels to rapidly respond in the event of another major oil spill. More than a hundred commercial fishing vessels are under contract to act as first responders, many of which are home ported in Valdez, making the efficient and expeditious operation of the port facilities critical.

3.2 Expected Future Conditions

Fairbanks, Alaska and the surrounding North Star Borough is the second most populated area in the State, and Valdez is the closest port for Fairbanks and other Interior Alaska communities on the road system. Over the 50-year period of analysis, the population in this region is expected to grow, which will put further pressure on the Valdez port. Because Valdez is the primary access to PWS for these Interior Alaska communities, it is unlikely delays will decrease.

A lack of moorage space will continue to cause delays to the commercial fishing fleet, recreational users, and emergency response vessels. The Port of Valdez will continue to experience additional costs of operation and maintenance, long lines at boat launches, vessel damages caused by rafting practices of a crowded harbor, and the continued increased safety risk inherent with a facility operating at above capacity. If the disaster of the Exxon Valdez happened again, the overcrowded conditions of the harbor would cause serious delays and slowdowns in the response and cleanup efforts.

Table 3-1 summarizes the damages associated with the expected without-project condition. Total present value of damages for the without project condition are more than $157.2 million with an average annual value of $7.4 million. Categories showing the most damages are the opportunity cost of time, vessel delays, and recreation.

Table 3- 1. Summary of Valdez Harbor Without-Project Conditions

Damages to:	Present Value (FY10$)	Average Annual Value ($)
Harbor Operations		
Harbor personnel time	113,000	5,300
Float and dock repairs	5,664,000	32,700
Commercial Fleet		
Vessel Damage	3,993,000	188,600
Vessel delays	10,407,000	491,600
Harbor of refuge	114,000	5,400
Opportunity Cost of Time	21,848,000	1,032,000
Tender Fleet		
Travel related expenses	2,612,000	123,400
Vessel delays	3,311,000	156,400
Opportunity Cost of Time	644,000	30,400
Charter Fleet		
Vessel Delays	18,238,000	861,500
Opportunity Cost of Time	4,448,000	210,100
Guaranteed space (CV)	1,128,000	53,300
Recreational Fleet		
Recreation experience (UDV)	78,857,000	3,909,500
Subsistence Fleet		
Harvest value	5,819,000	288,500
Total Damages	**$157,196,000**	**$7,388,700**

4.0 FORMULATION AND EVALUATION OF ALTERNATIVES

4.1 Planning Criteria

4.1.1 Plan Formulation

Alternative plans are formulated to meet four study criteria: completeness, efficiency, effectiveness, and acceptability. Completeness is the extent to which alternative plans provide and account for all necessary investments or other actions to ensure planning objectives are met, including actions by other Federal and non-Federal organizations. Effectiveness is the extent to which alternative plans help achieve planning objectives. Efficiency is the extent to which an alternative plan is the most cost-effective means of achieving the objectives. Acceptability is the extent to which alternative plans are acceptable in terms of applicable laws, regulations, and public policies. Mitigation of adverse effects is an integral component of each alternative plan.

The economic evaluation of alternative plans is based on October 2010 prices, a period of analysis of 50 years, and a Federal discount rate of 4-3/8 percent. Beneficial use of dredged material plans are developed with the best available biological information and through incremental cost analysis and in accordance with water resource development policy and guidelines.

4.1.2 Engineering Criteria

Alternative plans should be adequately sized to accommodate user needs and protection against wind-generated waves. Adequate depths and entry should provide for safe navigation. The plans must also be feasible from an engineering standpoint and capable of being economically constructed. Chapter 5 of the Hydraulic Appendix details the engineering criteria, which include:

- Breakwaters are to be positioned so that the waves inside the harbor entrance channel would be minimized to the maximum extent possible. Storm waves should quickly dissipate to less than 0.3 meter before reaching the mooring area.
- Minimum channel width of 5-beam widths for two-way traffic in entrance channels.
- 1.5 times the longest finger pier length factor is the minimum acceptable fairway width.

4.1.3 Economic Criteria

Principles and guidelines for Federal water resources planning require the Corps to identify a plan that produces the greatest contribution to NED. The NED plan is defined as the one that provides the greatest net benefits as determined by subtracting annual costs from annual benefits. Corps policy requires recommendation of the NED plan unless there is adequate justification to do otherwise.

Alternatives considered should be presented in quantitative terms where possible. Benefits attributed to a plan must be expressed in terms of a time value of money and must exceed equivalent economic costs for the project. To be economically feasible each separate portion or purpose of the plan must provide benefits at least equal to the cost of that unit. The scope of development must be such that benefits exceed project costs to the maximum extent possible.

4.1.4 Environmental Criteria

Engineering Regulation ER 1105-2-100 establishes mitigation requirements for Corps of Engineer projects. Other regulations, including Section 404 of the Clean Water Act, also apply. ER 1105-2-100 states: "District commanders shall ensure that project-caused adverse impacts to fish and wildlife resources have been avoided or minimized to the extent practicable, and that remaining, unavoidable impacts have been compensated to the extent justified."

Both the ER and Council on Environmental Quality regulations require Federal agencies to consider mitigation opportunities, including opportunities for compensatory mitigation, in the environmental assessment or environmental impact statement process for each project. Neither regulation requires that compensatory mitigation be implemented to fully mitigate project impacts, and both regulations have the implementing agency consider the cost and effectiveness of the mitigation alternatives along with the impact potential.

Mitigation has been defined by the President's Council on Environmental Quality to include (1) avoiding an impact by not taking an action or parts of an action, (2) minimizing impacts by limiting the degree or magnitude of the action, (3) rectifying an impact by repairing, rehabilitating, or restoring the affected environment, (4) reducing impact over time by preservation and maintenance operations and (5) compensating for the impact by replacing or providing substitute resources or environments (40 CFR 1508.20).

This environmental analysis focuses on potential impacts to resources identified as important during the environmental scoping process. It also looks at avoiding, minimizing, and/or mitigating impacts to these resources that could result from implementation of this project.

4.1.5 Social Criteria

Plans considered should minimize adverse social impacts and should seek consistency, to the greatest extent practicable, with state, regional, and local land use and development plans, both public and private. The selected plan must be acceptable to the non-Federal sponsor.

4.2 Fleet Size

To determine alternative fleet sizes, logical increments in the number of vessels that could be accommodated were identified in design alternatives. To do this, the study team assessed how Valdez manages harbor demand. The harbormaster fills open slips based on whoever has been on the waitlist the longest without preference for commercial, charter, or recreational vessels. It is first come, first served depending on the size of the boat and the waitlist for which the vessel owner paid the fee.

A characteristic of harbor activities in Valdez is that the interaction of the commercial fleet with other users often causes delays and damages. For example, a mixed raft of transient commercial and recreational vessels would require significant effort by harbor staff to maneuver vessels in and out of the raft at the different times these users wish to depart or arrive. Because both commercial and recreational fleets are most active when the fishing is good, there is a greater opportunity for delay and damage during this time. The recreational fleet, must be accommodated to minimize inter-fleet interference. To maximize the commercial NED benefits, moorage slips for recreation, charter, and subsistence also have to be created. It is impossible to get commercial benefits without other user benefits because harbor expansion benefits all. As each increment of slips is added, commercial, charter, subsistence, and recreation benefits that are incidental to commercial benefits accrue.

To develop the first increment in fleet size, the study team evaluated the existing waitlist for a logical way to group vessels on the list to start the harbor design. It was determined that a cluster of commercial vessels had been on the waitlist since the summer of 2005. This oldest group of waitlisted vessels numbered 125 (table 4-1) and formed the basis for the first increment of harbor configuration. The logic here was that a significant amount of commercial benefits could be gained through meeting the needs of this group of vessels. In addition, an increment of recreational benefits could potentially be gained through freeing up the launch facilities from the load of commercial vessels that still launch from Valdez. There would still be large unmet demands for the remainder of vessels on the waitlist and transient vessels.

Table 4- 1. 125 – Vessel Fleet

Vessel Type	< 6.7 meters	6.7-11 meters	11.3-16.8 meters	>16.8 meters	Total
Recreation	42	52	7	1	101
Commercial Fishers	0	2	13	2	16
Charters	0	6	2	0	8
Total	**42**	**60**	**21**	**4**	**125**

The second increment of fleet size is 200, the maximum transient vessels (table 4-2) the harbor can accommodate on any given peak day. This group is a mix of commercial and recreational vessels that use either open spaces along the piers or moor at the transient pier, where vessels often are forced to raft up to six deep. If the new harbor could accommodate these vessels, then there would be fewer delays in the existing harbor and more efficient handling of the transient vessels. In addition, several vessels from the waiting list could be accommodated because of the transient moorage space that would be opened up. Additional benefits for both commercial and recreational vessels would be realized. There would still be large unmet demands from the remaining vessels on the waitlist.

Table 4- 2. 200 – Vessel Fleet

Vessel Type	< 6.7 meters	6.7-11 meters	11.3-16.8 meters	>16.8 meters	Total
Recreation	69	86	11	2	167
Commercial Fishers	0	3	20	3	26
Charters	0	6	1	0	7
Total	**69**	**94**	**32**	**6**	**200**

The third harbor configuration (table 4-3) accommodates all vessels on the existing waitlist (243 vessels). This fleet size would make a significant contribution toward decreasing vessel delays and other damage categories. It is likely that several of the vessels that could be classified as part of the "transient fleet" would be accommodated because they were already on the waitlist. It should be noted that there are likely many other vessels that would be on the moorage waitlist were it not so long or cost $50 per year to stay on it. If just the vessels on the existing waitlist were accommodated, there still would be significant unmet demand and commercial damages. Transient moorage would remain a problem.

Table 4- 3. 243 – Vessel Fleet

Vessel Type	< 6.7 meters	6.7-11 meters	11.3-16.8 meters	>16.8 meters	Total
Recreation	83	99	13	2	197
Commercial Fishers	0	3	24	4	32
Charters	0	11	3	0	14
Total	**83**	**113**	**41**	**7**	**243**

The fourth and largest configuration (table 4-4) would accommodate half of all transient vessels using Valdez Harbor in 2006 (320 of the estimated 640 transient users). It is assumed that many of the additional customers would seek permanent moorage at Valdez if the waitlist were not already so long. Even at this fleet size, there would still be additional demand, especially during specific periods like salmon derbies or unannounced commercial fishing opportunities, although most of the demand would be met most of the time. The important factor that drives the determination of this fleet size is that a 320-vessel configuration is about the maximum size harbor that could be built at Valdez based upon physical and environmental constraints.

Table 4- 4. 320 – Vessel Fleet

Vessel Type	< 6.7 meters	6.7-11 meters	11.3-16.8 meters	>16.8 meters	Total
Recreation	108	131	18	3	260
Commercial Fishers	0	5	32	6	42
Charters	0	14	3	1	18
Total	**108**	**150**	**53**	**9**	**320**

4.3 Harbor Alternatives Initially Considered

Initial consideration of alternatives looked at a broad range of structural and non-structural approaches. The approaches can be roughly arranged in four sets:

No Action
Non-structural solution
Construct moorage in locations other than Valdez
Construct moorage in or near Valdez

Each alternative in this initial evaluation is briefly considered and then is either eliminated or is carried forward for detailed consideration in Section 4.5.

4.3.1 No Action Alternative

The alternative of no Federal action is considered in each Corps water resources project. This alternative is carried forward for detailed consideration.

4.3.2 Non-Structural Alternative - Redesign the Existing Harbor

One of the first alternatives considered to accommodate increased moorage demand was to redesign the float layout in the existing harbor. Redesign would reduce delay costs for some of the remaining vessels, but displaced vessels would completely lose the use of the harbor. The City of Valdez recently completed a $2.2 million upgrade to the existing float facilities in anticipation of new harbor construction. Reconfiguration of the existing harbor to eliminate delays was found to be ineffective and is not carried forward for further consideration.

4.3.3 Moorage in Locations Other Than Valdez

Water resources guidance encourages planning and development in a regional context. New harbor construction at Whittier, Cordova, or even Seward (figure 2-1) might contribute toward meeting at least some of the objectives identified for Valdez Navigation Improvements in Section 2.5. This alternative would expose vessels to additional travel costs and possible storms in PWS. Additional moorage at Whittier (more than 550 highway km. away), Seward (about 700 highway km. away) or Cordova (no highway access) would do little to reduce crowding at Valdez Harbor to meet spill prevention and response needs, or to meet the needs of the City of Valdez, our non-Federal sponsor.

This alternative is not considered in detail.

4.3.4 Create Additional Upland Boat Storage

Two non-structural alternatives were initially considered. Construction of additional boat launching facilities at the existing harbor would allow faster launching but would be limited by congestion already present on roads, in parking lots, and in the harbor itself, and could displace existing mooring spaces. This option would do nothing to decrease existing delays in the harbor and could even increase congestion with more vessels trying to launch into the already overcrowded harbor. In addition, when a large composite or wood vessel is removed from the water, it is subject to dry-docking damages and could cause owners to incur additional expenses. Boats moved to the dry-dock area are also not available for use in the winter fisheries. Land needed for other purposes would be committed if substantial additional parking was provided for more boat trailers. Larger vessels that make up much of the wait list would not benefit from this approach. This alternative would not meet objectives and was eliminated from detailed consideration. Creation of additional launching and upland boat storage facilities was not considered to be a viable alternative and is not carried forward for further consideration.

4.4. Alternative Harbor Sites Initially Considered

In developing structural alternatives to be considered in detail, the following sites were evaluated first and then alternative harbor plans were developed for promising sites. The location of the Mineral Creek, Old Valdez, Allison Point, and Allison Creek sites evaluated in this initial consideration is shown in figures 4-1 and 4-2. The existing harbor, Harbor Cove site, East site, and West site are shown in figure 4-3

Figure 4-1. Alternative sites initially considered.

Mineral Creek. A 200-boat moorage basin with breakwaters and shore-side facilities could be built entirely on glacial and alluvial deposits near the mouth of Mineral Creek northwest of Valdez. A conceptual illustration is shown in figure 4-2. Construction is not expected to encounter extensive bedrock, large boulders, or other conditions that would substantially raise costs. Larger harbor configurations would be difficult to construct in this location because the site is bounded by deep water seaward and rocky terrain shoreward. The site is not served by roads or utilities, so site development would be more expensive than a similar site on existing roads and utilities. The site would require about 1.7 km of access road and utilities to connect to existing services. The Mineral Creek site is about 3 km from the existing harbor, the central business district and the tourist center, so it would require separate harbor management offices and staffing.

Mineral Creek is one of many streams feeding Port Valdez. It presents two substantial problems for a harbor at this site. Most of Port Valdez becomes more saline in the winter when freshwater inflow drops, so Valdez harbor has relatively little problem with freezing, which periodically closes other harbors at this latitude in Alaska. A new harbor positioned at the mouth of Mineral Creek could accumulate fresh water from the creek and would be much more likely to freeze. Mineral Creek also is an anadromous stream with appreciable runs of Pacific salmon and Dolly Varden. Fish migrating to and from the stream would be exposed to more activity and potential for contamination and interruption to their movements. This site was eliminated from detailed consideration because it would be more expensive to develop and operate than other available sites, would be more likely to adversely affect wild salmon, and because adequate mitigation would be difficult to develop and would further add to the expense of construction and operation at this site.

Old Valdez. The original Valdez townsite was wiped out by the great 1964 earthquake and the tsunamis that followed. The modern town of Valdez was established at its current location and the old site was never redeveloped, in part because the 1965 Seismic Task Force reported that the seismic risk was so great that no Federal funding should be used for construction at the old townsite. Risks were considered unacceptable and the Old Valdez site (figure 4-2) was eliminated from further consideration.

Allison Point/Creek. A harbor could be developed in the comparatively shallow water in an alluvial outwash at the mouth of Allison Creek. A conceptual plan view is shown in figure 4-2. The alluvium is limited in extent, so only a small harbor would be feasible. The rocky shoreline and adjacent deep water would make a larger harbor prohibitively costly. The surrounding uplands rise steeply into the Chugach Mountains. There is very little land that could be developed without extensive and costly blasting. There are no utilities to or near this site. A harbor at this site would be adjacent to a salmon hatchery, and a harbor could impede juvenile salmon movement in the critical weeks that follow release into marine waters. This site also is less than 2 km from the Trans Alaska Pipeline Terminal and much closer to the restricted waters surrounding the terminal, and there is a real concern that boats using the harbor could intrude into that security area or that in an emergency the security area could be enlarged to impair access to this site.

This alternative is eliminated from further consideration because costs and potential risks would be prohibitive.

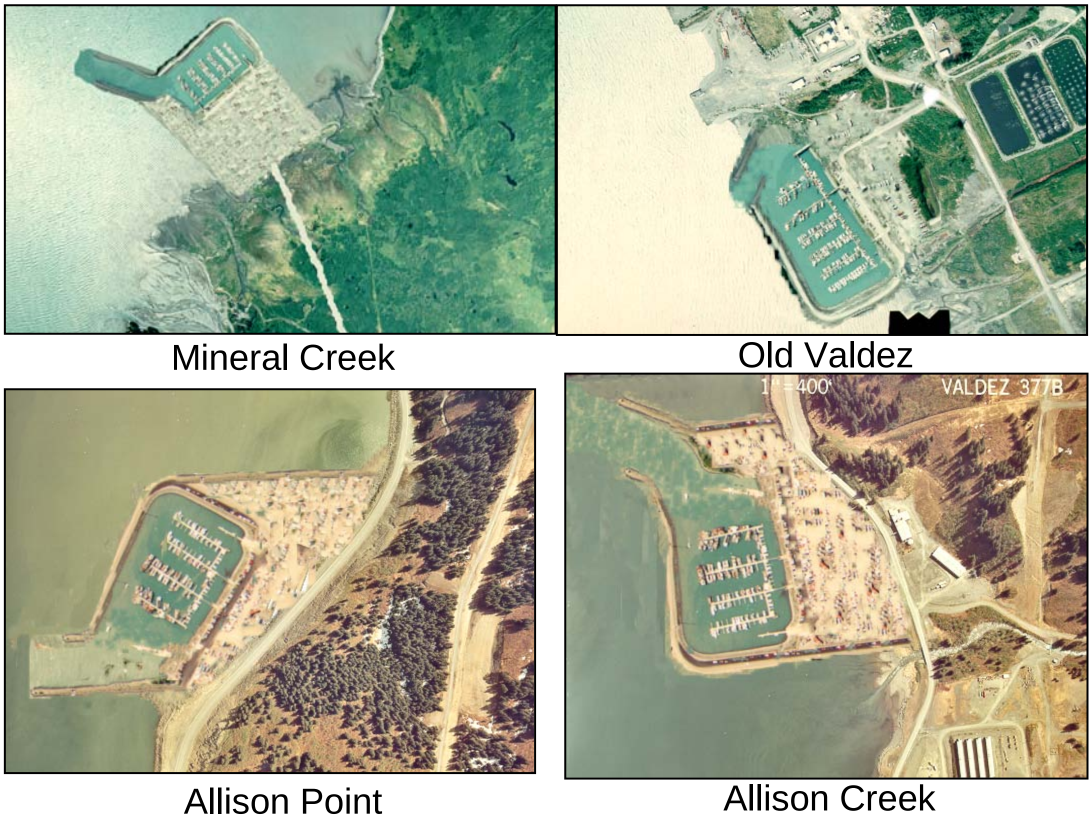

Figure 4-2. Conceptual Alternatives for Sites Eliminated.

Expansion of the Existing Harbor. The existing harbor could be expanded several ways: (1) by dredging shoreward into the existing waterfront, which would be exceptionally disruptive to commercial structures and very costly, (2) dredging seaward into dredged material placed when the harbor was constructed in 1965 and expanded in the 1970's, or (3) by dredging eastward into Harbor Cove, which would make the harbor even longer than it is now. A longer harbor could decrease water circulation and therefore decrease quality within the existing harbor.

Dredging inland would cost substantially more than any benefits that could be realized and is not considered in detail.

Dredging the harbor east into Harbor Cove to make it longer would create a configuration so long and narrow that existing water problem and harbor traffic problems would be greatly exacerbated. Road access to industrial and other facilities on the south side of the harbor would require a bridge that would be prohibitively expensive. Mitigating impacts to the Duck Flats adjacent to Harbor Cove would add further costs and would create controversy that can be avoided. This alternative was eliminated from detailed consideration.

Dredging seaward into lands created when the existing harbor was constructed would eliminate existing moorage on the south side of the present harbor, would eliminate adjacent lands essential for harbor and other water related activities, would disrupt communication lines and other utilities, and could impinge on spill response infrastructure in that area. There also is a very strong likelihood that dredging could encounter contamination and bedrock outcroppings that would make the action economically infeasible. Dredging costs would be high in the congested harbor and disposal would be extremely costly if contamination was encountered. This alternative was eliminated from detailed consideration because it would leave a harbor without lands for essential commercial and industrial activities and because there are unacceptable risks of cost escalation from rock excavation and contamination.

Harbor Cove. This site is just east of the existing harbor, separated only by South Harbor Drive (figure 4-3). It is naturally protected on three sides and has been seen by many local residents as the most logical spot for harbor expansion. Available information indicates that a harbor could be constructed at this site by dredging an entrance channel, turning basin, and mooring space into the intertidal and shallow subtidal flats with relatively little rock excavation.

Harbor Cove is intertidal and very shallow subtidal estuarine habitat that is used by millions of juvenile salmon each year in the critical period when they are adapting to salt water, their mobility is limited, and accessible food sources are essential. The cove also is used heavily by migrating ducks and other migrating birds. Islands at the mouth of the cove are listed sea bird colonies. Sea otters and other animals inhabit the cove or the coastal habitat that would be developed for a harbor at this site.

Harbor Cove is immediately seaward of a broad brackish estuarine wetland complex called the Duck Flats. Its value as habitat for waterfowl and other animals and plants is widely recognized and appreciated. This type of habitat is not common in the mountainous lands around PWS. The Duck Flats is proposed as an area meriting special attention in the Valdez coastal zone management program. Previous permit applications to develop in waters of the United States in the Duck Flats were met with determined resistance by agencies and interested non-government organizations and, as a result, permits were not granted. Development of a harbor in Harbor Cove could adversely affect habitat values in the Duck Flats with petroleum and other contamination, and the noise and activity could displace wildlife.

Developing moorage in Harbor Cove would be controversial and would be perceived as a significant impact by at least some stakeholder agencies. Documenting potentially affected resources, particularly indirect and cumulative effects on those resources, would be difficult and uncertain. Mitigating effects on important resources would be extremely difficult, and probably would be economically infeasible. This alternative was eliminated from detailed consideration because dredging and mitigation costs would be high and because neither the Corps nor the non-Federal sponsor were willing to participate in developing a controversial environmental impact statement with marginal potential for meeting mitigation policy and guidelines.

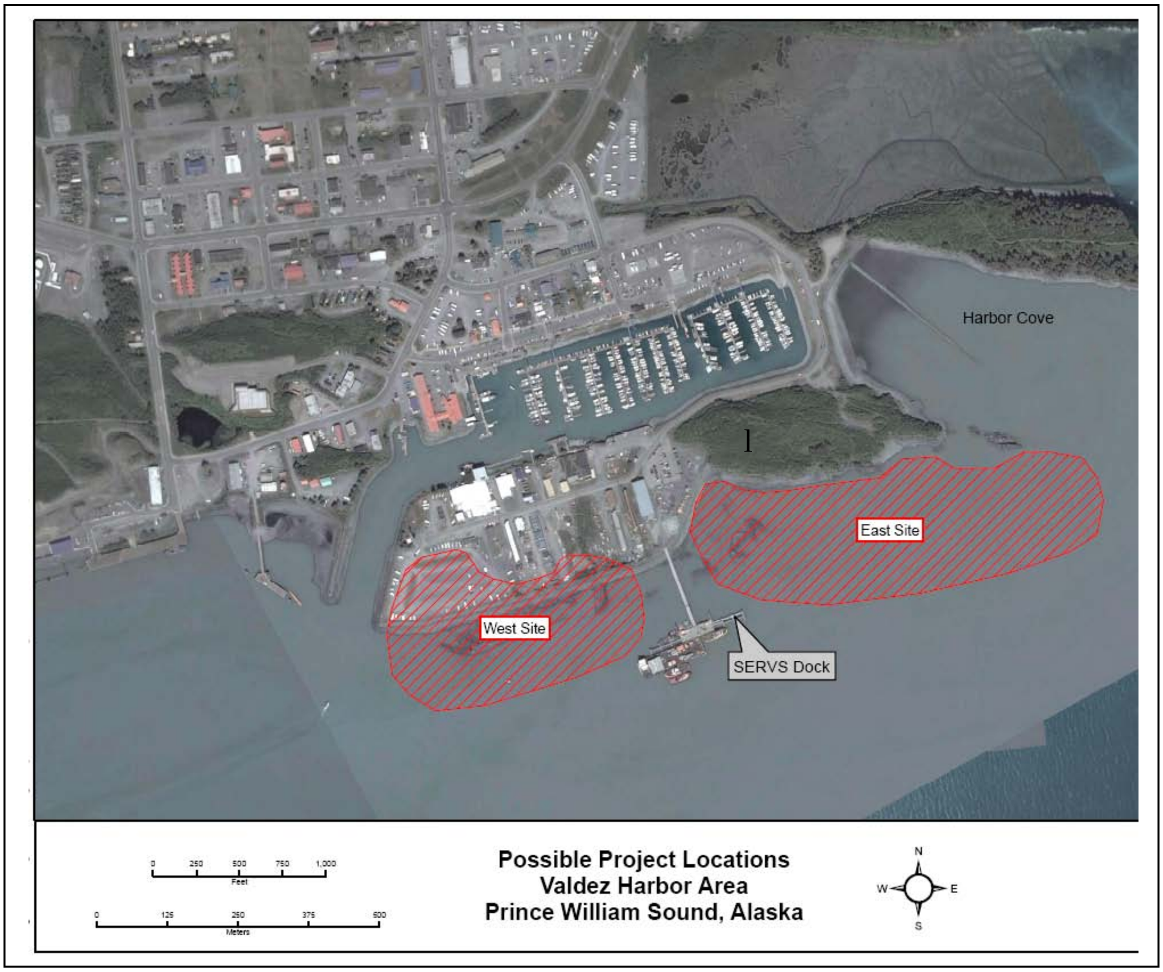

Figure 4-3. Alternative Sites and Harbor Cove.

West Site. This site is west of the SERVS dock and south of the existing harbor on the Port Valdez side of the fill created with the 1982 expansion of the existing harbor. Figure 4-3 shows this site in relation to existing facilities. Because it is near existing harbor facilities and because it has sufficient area for viable alternatives, this site is carried forward for further consideration in Section 4.6.

East Site. This site is east of the SERVS Dock and south of Hotel Hill, a large rock outcropping that was an island before initial harbor construction in 1965. The tidelands and near-shore subtidal zone could be dredged for an entrance channel and moorage for a harbor large enough to moor more than 300 boats. This alternative is considered in detail in Section 4.6.

4.5 Harbor Structural Alternative Measures

Several alternative structural measures were considered for the alternative sites considered in detail study and are described as follows:

Floating Breakwaters. Floating breakwaters are structures that float on the surface of the water, have a shallow draft, and can be anchored with chain systems or piles. The floating structure can be constructed of concrete, logs, tires, or other materials. Floating breakwaters are usually limited to short-fetch water bodies where the design waves are relatively small. Floating breakwaters become exceptionally expensive where waves exceed 1.2 meters or for wave periods greater than 4 seconds. The wave conditions at Valdez would make floating breakwaters more expensive than rubblemound or sheet-pile alternatives, so this option is not considered further.

Rubblemound Breakwaters. These are the most common breakwaters, are often used in shallow water, and are effective against long-period waves. They are typically constructed with three gradations of rock with the outer layer designed to withstand the design waves for the project. They typically require relatively little maintenance. Rubblemound breakwaters are viable structural alternatives and are carried forward for further consideration.

Composite Low Rubble Berm. A composite low rubble berm with vertical sheet-pile wall was considered but was found to have no significant advantage over the rubblemound alternative. The lower weight of the breakwater structure and slightly smaller construction footprint were the only advantages. Cost of materials and constructing a berm from both rock and sheet pile would be more expensive than an all-rock rubblemound breakwater. Maintenance of the sheet pile also would increase costs over the project life. This alternative is not carried forward for further consideration.

Vertical Curtain Wall Wave Barrier. These are walls penetrating a segment of the water column. They can be constructed of steel and have service lives up to 25 years. Use of anodes, thicker steel sections or concrete walls and panels can extend service life. The curtains in this type of wave barrier can be hung from pilings, so this system only places a very narrow footprint on the bottom. This type of wave barrier would be more expensive to construct and maintain in water depths at Valdez and might be less effective in attenuating waves, but might be the most effective measure at sites that could accommodate only a very narrow project footprint. Any alternative harbor design west of the SERVS dock might benefit from this design. The broad base of a rubblemound breakwater at the West site would use so much of the available space that the resulting harbor would not produce enough benefits to be economically feasible. Wave barriers were not found to be viable alternatives at the East site where there is more area of suitable depth for harbor development, and a rubblemound breakwater would produce more net benefits. Vertical wave barriers are considered in detail only for the West site.

4.6 Harbor Alternatives Considered In Detail

The cost of the selected plan in this section is different than the costs in the description of the recommended plan in Section 6. The alternatives were compared utilizing cost estimates prepared in 2006 and inflated to the 2010 price level using the Civil Works Construction Cost Index System for navigation ports and harbors. This cost basis was utilized to ensure all the assumptions and computations used were the same for all the alternatives. When the selected plan was identified, its cost estimate required updates per comments received in Agency Technical Review and have been adjusted to 2010 price levels and resulted in costs for the recommended plan in later sections of the report to be different from those in the alternative analysis.

4.6.1 No-Action Alternative

With no Federal involvement, the no-action alternative would leave the site in its present condition. The identified purpose and need would not be met. The existing Valdez Harbor would continue to be used beyond its design capacity. Damage to vessels and docking facilities from rafting and hot-berthing would continue; economic benefits to the fleet from improved and expanded harbor facilities would not be achieved.

4.6.2 West Site Alternatives

Material dredged during construction of the existing Valdez Harbor was used as fill to construct a broad, flat uplands area seaward of the harbor. This constructed uplands is in shallow water, but is near the seaward limit of the Valdez alluvial fan where the sea bottom plunges to a depth of 200 meters just 500 meters off shore. A harbor constructed seaward at this location would be limited by deep water. A harbor could be dredged into the constructed uplands, but dredging volumes would be high, debris of unknown origin might be encountered, and uplands essential to Valdez's economic existence would be lost. West site harbor alternatives are compromises that would minimize dredging into created uplands, but limit seaward development that would be expensive.

Two harbor configurations were considered initially. Both would use wave barriers rather than rubblemound breakwaters because the narrower wave barrier footprint would make more room for moorage and other harbor functions.

There is no room for future expansion at this location. Two outfalls from the seafood processing plants would be relocated. Dredged material composition is unknown, but would be expected to consist of previous fill that came from expansion of the existing harbor and the underlying in situ ground.

Dredged material would be used beneficially to restore a log transfer site in Two Moon Bay. Access to the new harbor would be by the existing South Harbor Drive.

West Site Wave Barrier 243 -Vessel Alternative. This alternative would accommodate all the vessels from the October 2006 harbormaster’s wait-list. The layout is shown in figure 4-4. This alternative would include breakwaters, wave barrier, dredging, inner harbor floats, bank stabilization, and real estate acquisition for a total project cost of $57.3 million (table 4-5). Operations and maintenance estimates for this alternative are based on 2 percent of the mobilization, demobilization, and wave barrier cost annually to account for annual inspections, cathodic protection, and replacement of worn panels. Operations and maintenance costs for this alternative are estimated at more than $2.2 million annually. That estimate assumes the harbor float system would be completely replaced 30 years after construction and replacement of the wave barrier takes place at 25 years.

Table 4- 5. West Site Wave Barrier 243 -Vessel Alternative Cost Summary

Cost Category	243-slip Wave Barrier
Mob and demobilization	$ 1,880,000
Breakwaters	2,814,000
Wave barrier	14,207,000
Navigation aids	18,000
Dredging	1,410,000
Log transfer mitigation	533,000
Hydro survey	38,000
Inner harbor floats	5,403,000
Bank stabilization	1,274,000
Total Project First Costs	**$ 27,577,000**
Real estate	691,000
Interest During Construction	1,477,000
Preliminary Engineering and Design (PED)	855,000
Supervision and Administration (S&A)	552,000
Contingency (20%)	5,935,000
Total Project Economic Costs	**$ 37,087,000**
Present Value of Operations and Maintenance	**57,267,400**
Average Annual Costs (50 years at 4 3/8%)	**$ 4,677,800**

Source: Alaska District Corps of Engineers Cost Engineering estimate using Tri-Service Automated Cost Engineering System (TRACES) with November 2006 pricing levels updated to August 2010 using the Civil Works Construction Cost Index System for navigation ports and harbors. Present value calculations based on the Federal FY10 discount rate of 4 3/8 percent.

Note: Present value of operations and maintenance costs based on two percent of the wave barrier structure replaced annually. The wave barrier structure is completely replaced at year 25 and the float system is replaced 30 years after construction.

West Site Wave Barrier 320 -Vessel Alternative. This alternative would accommodate half of the transient vessels using the Valdez Harbor in 2006. This alternative would include breakwaters, wave barrier, dredging, inner harbor floats, bank stabilization, and real estate acquisition for a total project cost of $62.5 million (table 4-6). Figure 4-5 shows wave barrier plans. Operations and maintenance for this alternative is based on 2 percent of the mobilization, demobilization, and wave barrier cost annually to account for annual inspections, cathodic protection, and replacement of worn panels. Operations and maintenance costs for this alternative are estimated at more than $2.2 million annually. This estimate assumes the harbor float system would be completely replaced 30 years after construction and the wave barrier is replace at year 25.

Table 4- 6. West Site Wave Barrier 320 -Vessel Alternative Cost

Cost Category	**320-slip Wave Barrier**
Mob and demobilization	$ 1,880,000
Breakwaters	4,812,000
Wave barrier	18,585,000
Navigation aids	18,000
Dredging	1,441,000
Log transfer mitigation	662,000
Hydro survey	73,000
Inner harbor floats	6,870,000
Bank stabilization	252,000
Total Project First Costs	**$ 34,593,000**
Real estate	691,000
Interest During Construction	1,853,000
Preliminary Engineering and Design (PED)	855,000
Supervision and Administration (S&A)	692,000
Construction contingency (20%)	7,366,000
Total Project Economic Costs	**$ 46,050,000**
Present Value of Operations and Maintenance	**62,482,400**
Average Annual Costs (50 years at 4 3/8%)	**$ 5,380,700**

Source: Alaska District Corps of Engineers Cost Engineering estimate using Tri-Service Automated Cost Engineering System (TRACES) with November 2006 pricing levels updated to August 2010 using the Civil Works Construction Cost Index System for navigation ports and harbors. Present value calculations based on the Federal FY10 discount rate of 4 3/8 percent.

Note: Present value of operations and maintenance costs based on two percent of the wave barrier structure replaced annually. The wave barrier structure is completely replaced at year 25 and the float system is replaced 30 years after construction.

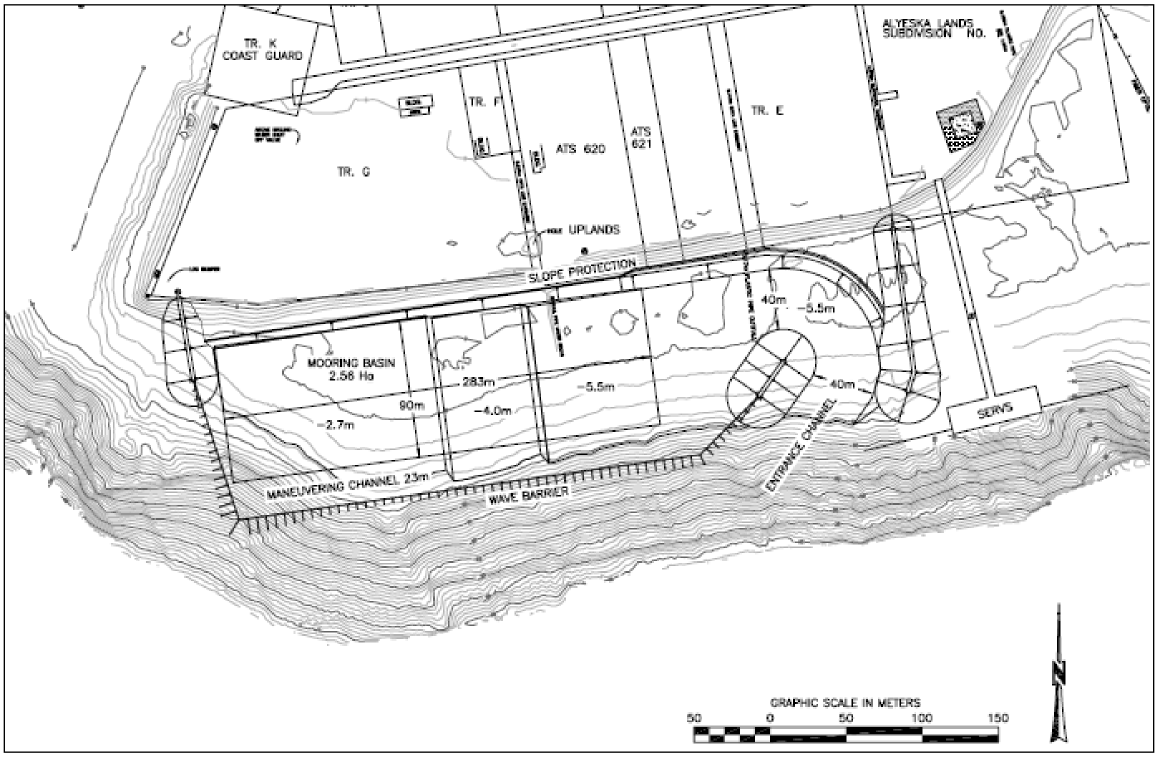

Figure 4- 4. West Site Wave Barrier 243 - Vessel Configuration.

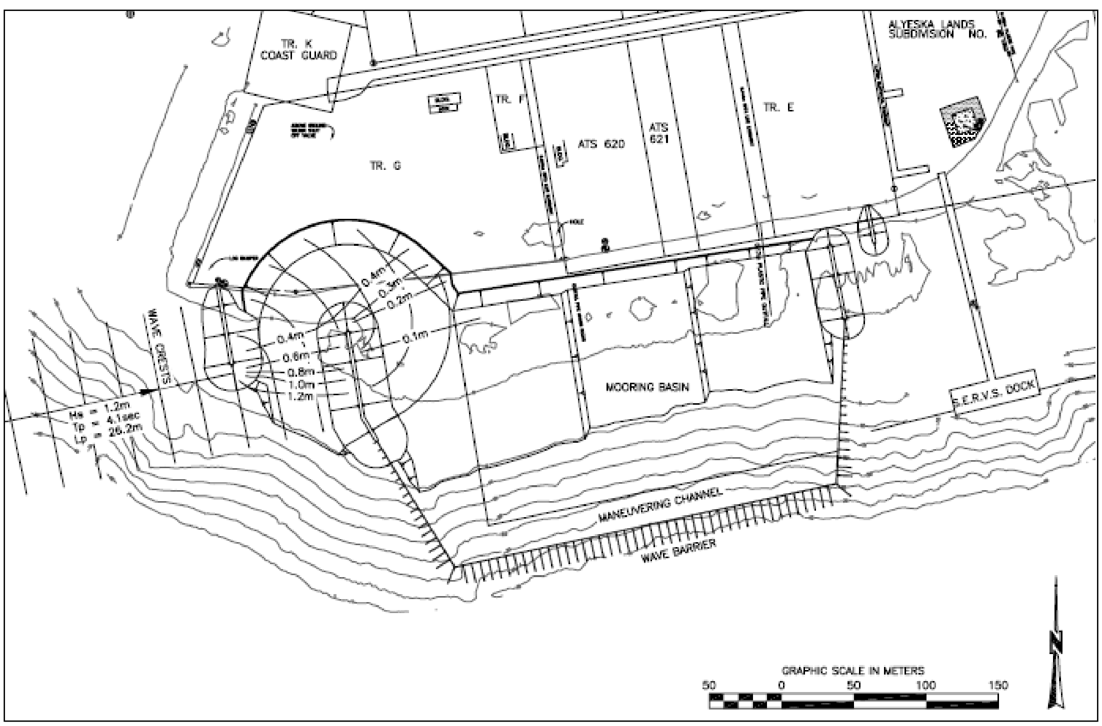

Figure 4- 5. West Site Wave Barrier 320 - Vessel Configuration.

4.6.3 East Site Alternatives

Significantly more area is available for harbor construction east of the SERVS Dock. Water there is shallow enough for economically feasible construction of a rubblemound breakwater considerably farther offshore than at sites west of the SERVS dock. Limited testing indicates bottom material at the East site is primarily sand, gravel, cobbles and boulders, with potential for some large boulders and outcrops. Potential harbor locations are limited by deep water offshore and the SERVS dock to the west. Inshore dredging is limited by Hotel Hill and associated rock terrain. A harbor could be constructed farther east but would impinge on increasingly valuable marine and bird habitat associated with small islands and Harbor Cove. The eastward boundaries of harbor alternatives were limited to avoid potentially significant impacts to those resources.

A major fiber optics communications cable serving much of the population of interior Alaska bisects the East site. The cable would be excavated and relocated before any harbor alternative could be constructed at the East site.

Dredged material would be used to construct the harbor staging area. Remaining material would be placed be at the Two Moon Bay log transfer location.

Rubblemound breakwaters are specified because of wave conditions. Access could be at the west end of Hotel Hill, around the eastern end, or both. A 5-year monitoring plan for the Two Moon Bay disposal site is included in the operations and maintenance for the East site rubblemound alternatives. The alternatives for the East site all have similar configurations, increasing in size from containing 125 vessels up to 320 vessels.

East Site Rubblemound 125-Vessel Alternative. This alternative would provide moorage for vessels that have been on harbormaster's waitlist for many years. Among those waitlisted are several commercial vessels that would realize substantial benefits. This alternative would relocate the communications cable; construct roads, parking areas, breakwaters, and inner harbor floats; stabilize the shoreline, and dredge an entrance channel, turning area, and mooring basin. A 0.2 ha staging and work area would be developed in adjacent uplands and tidelands to allow the harbor to operate efficiently and safely. Material dredged for this alternative would be used to develop the adjacent staging area in a beneficial use action to cap an abandoned log transfer facility in PWS.

Total cost for this alternative is estimated at $20.9 million (table 4-7). Operations and maintenance estimates assume that 2 percent of the breakwater armor rock would be replaced every 5 years at an estimated cost of $31,000 and that harbor floats would be replaced after 30 years.

Table 4- 7. East Site Rubblemound 125 - Vessel Alternative Cost

Cost Category	125-slip Rubblemound
Cable relocation	$ 506,000
Road construction	129,000
Mob and demobilization	426,000
Breakwaters	6,353,000
Navigation aids	18,000
Dredging	1,071,000
Uplands fill	140,000
Log transfer mitigation	393,000
Hydro survey	37,000
Inner harbor floats	5,031,000
Bank stabilization	657,000
Total Project First Costs	**$ 14,761,000**
Real estate	295,000
Interest During Construction	791,000
Preliminary Engineering and Design (PED)	1,283,000
Supervision and Administration (S&A)	443,000
Contingency (20%)	3, 356,000
Total Project Economic Costs	**$ 20,929,000**
Present Value of Operations and	**1,654,800**
Average Annual Costs (50 years at 4 3/8%)	**$ 1,119,600**

Source: Alaska District Corps of Engineers Cost Engineering estimate using Tri-Service Automated Cost Engineering System (TRACES) with November 2006 pricing levels updated to August 2010 using the Civil Works Construction Cost Index System for navigation ports and harbors. Present value calculations based on the Federal FY10 discount rate of 4 3/8 percent.

Note: Present value of operations and maintenance costs based on two percent of the armor rock replaced every five years. Included in the operations and maintenance calculations is a 5-year monitoring plan activity for the Two Moon Bay capping of the log transfer site with dredge material from the East Site alternatives.

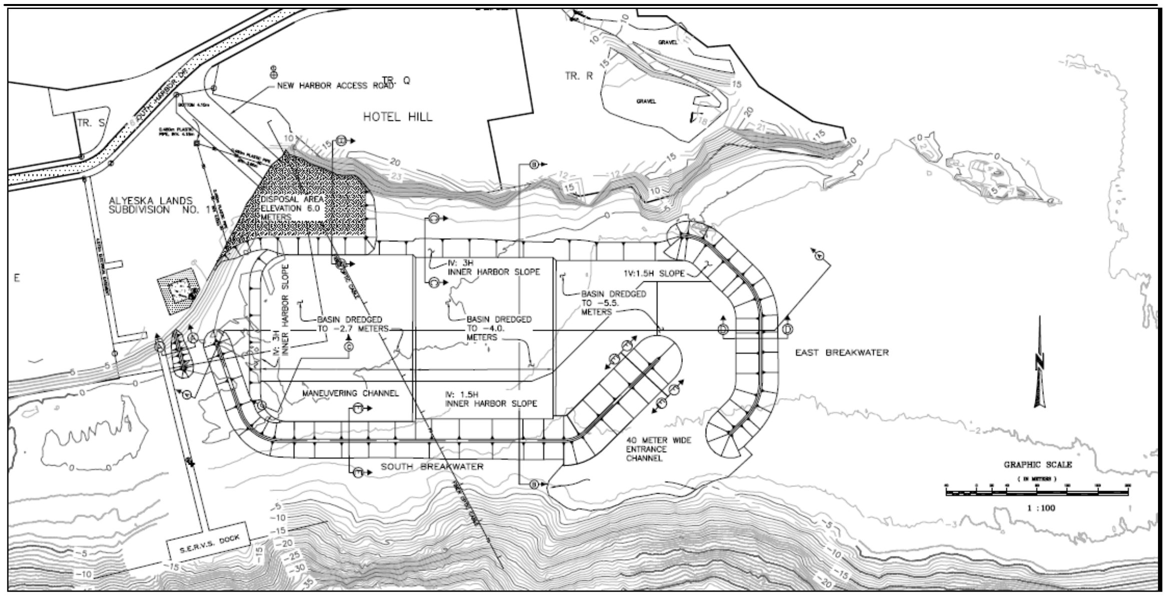

Figure 4-6. Example design for the 200-vessel harbor. The 125-vessel harbor would be proportionally smaller.

East Site Rubblemound 200-Vessel Alternative. This alternative accommodates the maximum number of transient vessels that currently use the existing Valdez Harbor on peak days. This alternative would relocate the communications cable; construct roads, parking areas, breakwaters, and inner harbor floats; stabilize the shoreline, and dredge an entrance channel, turning area, and mooring basin (figure 4-6). A 0.2 ha staging and work area would be developed in adjacent uplands and tidelands to allow the harbor to operate efficiently and safely. Material dredged for this alternative would be used to develop an adjacent staging area.

Total cost for this alternative is estimated at $28.1 million (table 4-8). Operations and maintenance estimates assume that 2 percent of the breakwater armor rock would be replaced every 5 years at an estimated cost of $50,000 and that harbor floats would be replaced after 30 years.

Table 4- 8. East Site Rubblemound 200 - Vessel Alternative Cost

Cost Category	200-slip Rubblemound
Cable relocation	$ 502,000
Road construction	128,000
Mob and demobilization	387,000
Breakwaters	8,644,000
Navigation aids	18,000
Dredging	1,571,000
Uplands fill	128,000
Log transfer mitigation	451,000
Hydro survey	36,000
Inner harbor floats	6,226,000
Bank stabilization	2,222.000
Total Project First Costs	**$ 20,313,000**
Real estate	295,000
Interest During Construction	1,088,000
Preliminary Engineering and Design (PED)	1,283,000
Supervision and Administration (S&A)	609,000
Contingency (20%)	4,500,000
Total Project Economic Costs	**$ 28,088,000**
Present Value of Operations and	**2,054,600**
Average Annual Costs (50 years at 4 3/8%)	**$ 1,494,400**

Source: Alaska District Corps of Engineers Cost Engineering estimate using Tri-Service Automated Cost Engineering System (TRACES) with November 2006 pricing levels updated to August 2010 using the Civil Works Construction Cost Index System for navigation ports and harbors. Present value calculations based on the Federal FY10 discount rate of 4 3/8 percent.

Note: Present value of operations and maintenance costs based on two percent of the armor rock replaced every five years. Included in the operations and maintenance calculations is a 5-year monitoring plan activity for the Two Moon Bay capping of the log transfer site with dredge material from the East Site alternatives.

East Site Rubblemound 243-Vessel Alternative. This alternative is similar to the 320-vessel design in figure 4-7. It would accommodate all the vessels on the harbormaster's October 2006 waitlist. It would relocate the communications cable; construct roads, parking areas, breakwaters, and inner harbor floats; stabilize the shoreline, and dredge an entrance channel, turning area, and mooring basin. A 0.2 ha staging and work area would be developed in adjacent uplands and tidelands to allow the harbor to operate efficiently and safely. Material dredged for this alternative would be used to develop an adjacent staging area and would be used beneficially in Two Moon Bay.

Total cost for this alternative is estimated at $31.4 million (table 4-9). Operations and maintenance estimates assume that 2 percent of the breakwater armor rock would be replaced every 5 years at an estimated cost of $61,000 and that harbor floats would be replaced after 30 years.

Table 4- 9. East Site Rubblemound 243-Vessel Alternative Cost

Cost Category	243-slip Rubblemound
Cable relocation	$ 502,000
Mob and demobilization	394,000
Breakwaters	9,706,000
Navigation aids	18,000
Dredging	1, 815,000
Uplands fill	107,000
Log transfer mitigation	469,000
Hydro survey	36,000
Inner harbor floats	6,712,000
Bank stabilization	3,094,000
Total Project First Costs	**$ 22,853,000**
Real estate	295,000
Interest During Construction	1,224,000
Preliminary Engineering and Design (PED)	1,283,000
Supervision and Administration (S&A)	686,000
Contingency (20%)	5,023,000
Total Project Economic Costs	**$ 31,364,000**
Present Value of Operations and	**2,228,700**
Average Annual Costs (50 years at 4 3/8%)	**$ 1,655,400**

Source: Alaska District Corps of Engineers Cost Engineering estimate using Tri-Service Automated Cost Engineering System (TRACES) with November 2006 pricing levels updated to August 2010 using the Civil Works Construction Cost Index System for navigation ports and harbors. Present value calculations based on the Federal FY10 discount rate of 4 3/8 percent.

Note: Present value of operations and maintenance costs based on two percent of the armor rock replaced every five years. Included in the operations and maintenance calculations is a 5-year monitoring plan activity for the Two Moon Bay capping of the log transfer site with dredge material from the East Site alternatives.

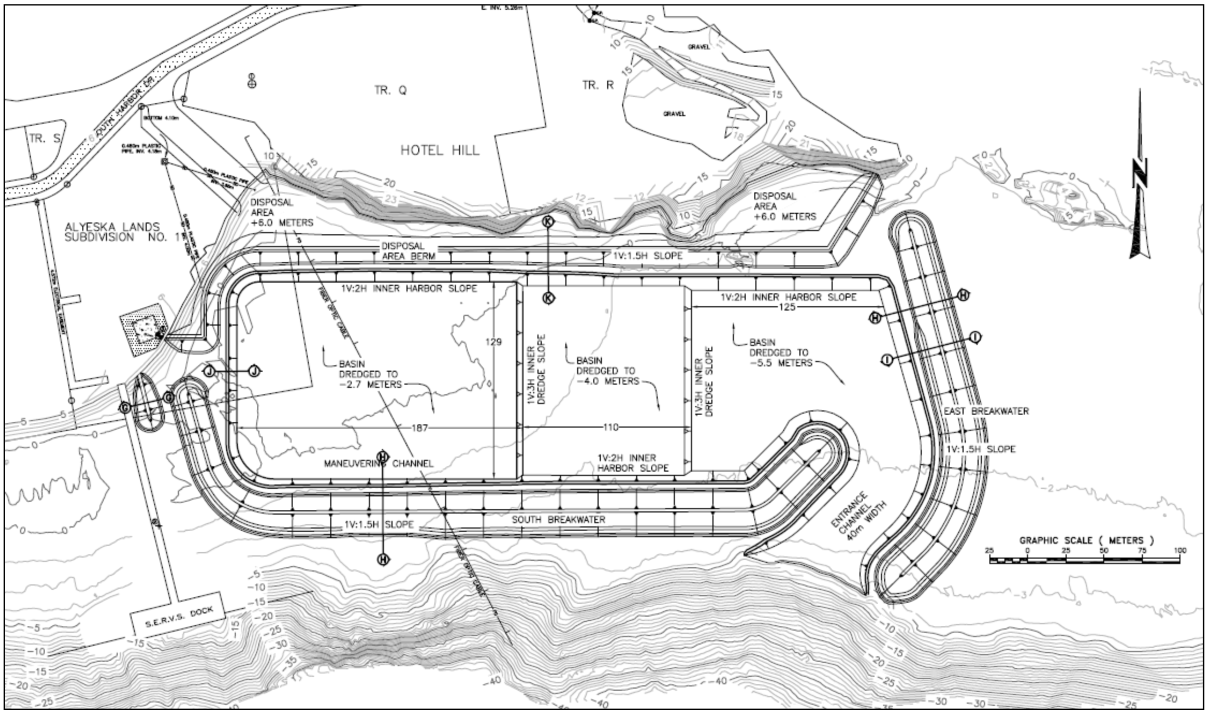

Figure 4-7. East Site Rubblemound 320 - Vessel Alternative

East Site Rubblemound 320-Vessel Alternative. This alternative would accommodate half the transient vessels that used Valdez Harbor in 2006. It would relocate the communications cable; construct roads, parking areas, breakwaters, and inner harbor floats; stabilize the shoreline, and dredge an entrance channel, turning area and mooring basin (figure 4-7). A 0.2 ha. staging and work area would be developed in adjacent uplands and tidelands to allow the harbor to operate efficiently and safely. Material dredged for this alternative would be used to develop an adjacent staging area and in a beneficial use action in Two Moon Bay.

Total cost for this alternative is estimated at $35.1 million (table 4-10). Operations and maintenance estimates assume that 2 percent of the breakwater armor rock would be replaced every 5 years at an estimated cost of $85,000 and that harbor floats would be replaced after 30 years.

Table 4- 10. East Site Rubblemound 320 - Vessel Alternative Cost

Cost Category	**320-slip Rubblemound**
Cable relocation	$ 496,000
Mob and demobilization	331,000
Breakwaters	10,861,000
Navigation Aids	18,000
Dredging	2,107,000
Log transfer mitigation	468,000
Hydro survey	36,000
Inner harbor floats	7,094,000
Bank stabilization	4,354,000
Total Project First Costs	**$ 25,765,000**
Real estate	295,000
Interest During Construction	1,380,000
Preliminary Engineering and Design (PED)	1,283,000
Supervision and Administration (S&A)	773,000
Contingency (20%)	5,623,000
Total Project Economic Costs	**$ 35,119,000**
Present Value of Operations and	**2,423,000**
Average Annual Costs (50 years at 4 3/8%)	**$ 1,861,200**

Source: Alaska District Corps of Engineers Cost Engineering estimate using Tri-Service Automated Cost Engineering System (TRACES) with November 2006 pricing levels updated to August 2010 using the Civil Works Construction Cost Index System for navigation ports and harbors. Present value calculations based on the Federal FY10 discount rate of 4 3/8 percent.

Note: Present value of operations and maintenance costs based on two percent of the armor rock replaced every five years. Included in the operations and maintenance calculations is a 5-year monitoring plan activity for the Two Moon Bay capping of the log transfer site with dredge material from the East Site alternatives.

4.7 Disposition of Dredged Material

Three general alternatives for disposition of dredged material were considered: (1) use dredged material to construct project features or for other construction; (2) discharge dredged material into a cost effective and environmentally acceptable disposal site; and (3) use dredged material beneficially to restore or improve habitat.

4.7.1 Use Dredged Material for Project Features

The West site alternatives would be dredged into existing uplands. No uplands would be created for these alternatives, and none of the material dredged for these alternatives could be used for project construction. No other on-going or proposed projects in the Valdez area could use the material economically, so any material dredged during construction of any West site alternatives would be disposed of as waste or used beneficially for habitat restoration.

Each of the alternatives at the East site would fill intertidal and near-shore lands north of the mooring basin to provide access and parking. Part of the dredged material from each alternative would be used beneficially to develop access and staging areas for the selected harbor project. Using dredged material to construct a staging area would reduce the need for fill material from an upland site and the attendant effects of habitat loss, noise, depletion of resources, and emissions at and on the route from material sites.

4.7.2 Use Dredged Material for Habitat Restoration

State and Federal resource and regulatory agencies participated in scoping and coordination meetings to identify and evaluate potential uses for dredged material. No on-land beneficial use for dredged material (except for construction of project features) could be identified within feasible transportation range of Valdez. Valdez is a small town surrounded by steep mountains, rivers, wetlands, and ocean. Valdez has no use for large quantities of mixed mud, gravel, and larger rock dredged from harbor construction. The closest town of more than 500 people is more than 400 km by road or 150 km by water. No upland uses could be identified even that far away, indicating that there are no upland sites that could benefit from dredged material placement within economic transportation distances. Upland disposal of dredged material for beneficial use or for mitigation was eliminated from further consideration.

Dredged material might be used to raise the existing sea bottom to create new intertidal habitat. Most of PWS drops steeply into sea bottom much too deep for creation of intertidal habitat. Upper subtidal habitat is limited in Valdez Arm and in most other areas of PWS and is valuable to invertebrates, sea otters, salmon, and many other marine resources. Covering that viable and important habitat with dredged material to create intertidal habitat that might not improve habitat value is speculative and is not considered further in this report.

No viable alternatives for beneficial use of excess dredged material were identified on land or in natural, undisturbed in-water sites, so only in-water sites disturbed or contaminated by human use were considered further for beneficial use of dredged material. The only in-water use that could be identified was for capping logging debris. Other in-water habitat restoration measures that were considered for mitigation are discussed in Section 4.9.

The entire population along the shores of PWS, an area about the size of Vermont and New Hampshire together, is less than 10,000 people. The only in-water development or disturbance associated with those populations is from harbors and other marine facilities still in use. Habitat disturbance by those communities offers no beneficial use opportunities for dredged material.

Recreation in PWS is centered on fishing, hunting, boating, and other outdoor activities. Those activities have not disturbed large areas of habitat, but anchor chains from boats moored to buoys at recreational cabins have dragged circular clearings through bottom sea life communities. Those clearings reduce productivity and offer an opportunity for mitigation, but dredged material could not be used to mitigate their effects. No other opportunities to beneficially use dredged material to correct recreation effects could be identified.

Mining, fish processing, transportation, and logging have adversely affected habitat and other resources in PWS. Copper and other mining and transportation related to mining affected shoreline habitat in the late 1800's and early 1900's, but those effects have almost vanished with time. Fish processors in remote locations left a relatively small footprint on the shorelines, but unregulated processing waste fouled the bottoms in some locations. Regulations in the last 30 years and changes in processing have largely ended those impacts, and effects of those earlier practices have almost disappeared. The biggest transportation effect was the 1989 *Exxon Valdez* spill of about 38,000,000 liters of crude oil near the mouth of Valdez Arm. Contamination and its effects were wide spread and required intensive cleanup that cost hundreds of millions of dollars. Effects of the spill remain, but none could be feasibly addressed through the beneficial use of dredged material.

Much of the merchantable timber on non-Federal land adjacent to PWS has been logged. Steep terrain and buffer zone requirements have protected marine habitat from most effects of logging and logging operations. The most notable impacts from logging are at log transfer sites. Steep terrain limits on-shore log yards for timber awaiting transportation to mills, and logs can be loaded efficiently from the water without permanent loading facilities. Most timber logged in coastal Alaska is temporarily stored at in-water log transfer sites. Log transfer sites are regulated by State and Federal permits, which generally limit sites to water 10 or more meters deep and minimize the area affected. Log transfer operations sometimes gouge the sea bottom, and shade from the logs may reduce primary productivity, but bark shed from the stored logs is the biggest problem. The shed bark from coniferous trees soon settles to the bottom where it smothers benthic organisms. Worse, it also degrades into soft, fine material that contains biologically inhibiting chemicals. Biological surveys of former log transfer sites report the bottom is almost void of benthic infauna and epifauna for many years after the site is closed. Recolonization is slow and tends to develop at the margins of the sites and where the deposition is thinnest. Colonization at larger sites tends to be slower. Treatment of the degraded bark would be difficult in remote areas, and it would be difficult to remove degradation compounds that have leached into the sea bottom. Capping is the most effective measure available in most circumstances.

Resource agencies are actively seeking sources of capping material for restoring log transfer sites in PWS. This appears to be the most feasible option for beneficial use of dredged material from harbor construction in Valdez. The Valdez material has been tested and is clean and uncontaminated. It probably contains more fine-grained material, but is otherwise similar to native bottom composition at most log transfer sites.

Formerly used log transfer sites were identified at 17 locations in PWS based on information from permits. The three closest log transfer sites are about 50 km by sea from Valdez. The next two closest sites are about 70 km from Valdez. The major cost for beneficial use of dredged material would be associated with transportation distance, so consideration of capping options focused first on the three closest sites, which are in Port Fidalgo, a fjord south of Valdez (figure 4-8). All three sites were permitted for use by the Tatitlek Corporation.

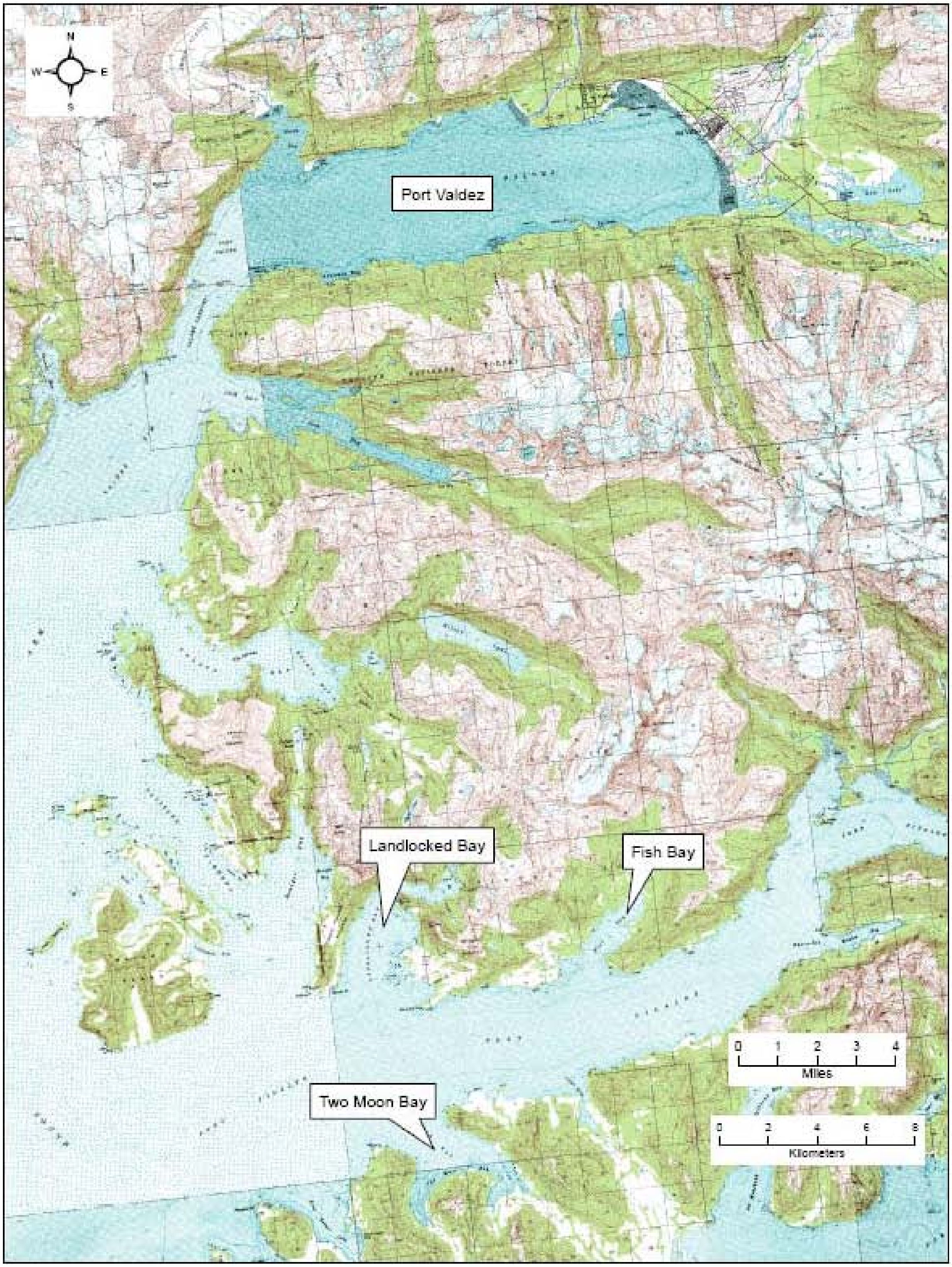

Figure 4-8. Closest former log transfer facilities to Valdez Harbor project site.

The Landlocked Bay log transfer facility is a 4-ha site in water depths greater than 13 meters that was permitted by the State of Alaska in 1995 and closed at the permittee's request in 1999. Available information indicates that the site was only partially used and was not used as intensively as larger sites.

The Fish Bay log transfer site encompasses slightly less than 1 ha of tidal and submerged lands. The State of Alaska permitted the site in 1993, and the permittee relinquished the site back to the State in 1998.

The Two Moon Bay log transfer site is a 10-ha site. The State of Alaska permitted the site in 1986. The facility was closed in 1999 at the permittee's request.

The Two Moon Bay site is by far the largest of the three sites. It was used longer than the others and was used to transfer far more logs than the others. It also has been used more recently. The U.S. Fish and Wildlife Service (Appendix 4) examined log transfer sites in the area. In meetings with the Corps and others, they reported that the other sites were less damaged and are further advanced in natural recovery and recolonization. They reported substantial bottom habitat so degraded that it was not recovering appreciably with natural processes over 81 percent of its area. They recommended Two Moon Bay as the site that would benefit most from any effective restoration effort (Appendix 4). They participated with the Corps in evaluating potential cleanup and restoration options, and they recommend capping for restoration.

In summary, a full range of potential beneficial uses for Valdez Harbor dredged materials was considered. The only feasible and effective use for material not used in harbor construction would be for capping contamination from log bark at a log transfer facility. Two Moon Bay is the most severely impacted and would benefit most of the available sites within reasonable transportation distance from Valdez. The Two Moon Bay log transfer facility is considered in detail for beneficial use of dredged material.

Plan Development for Beneficial Use of Dredged Material at Two Moon Bay Log Transfer Facility

The U.S. Fish and Wildlife Service recommended a depth of at least 30 cm for capping the log transfer site. Some PWS marine species burrow deeper than 30 cm, but the great majority of benthic infaunal species occupy only the upper few centimeters. A 30-cm cap would be expected to allow full site recovery. A thinner cap could be less effective.

If dredged material could be distributed evenly to achieve 30-cm coverage over the 8.3 -ha site, then a total of 30,000 m^3 of dredged material would be sufficient to achieve optimum results. Thin, even distribution of dredged material is not feasible. A scow, barge, or hopper dredges could be used to transport dredged material to the site. Any other transportation would be far more expensive. Scows, barges, and hopper dredges all dump dredged material as a single action. The entire load comes out as a slug of material 2 to 4 meters deep and roughly in the same area as the vessel.
Water depth at the Two Moon Bay log transfer facility is 10 to 20 meters. Dumped

material would disperse a little over that depth, but most of the load would arrive at the bottom in less than 30 seconds and essentially as a single mass. Impact and turbulence would disperse some material, especially finer-grained sands and clays, outward over the surrounding bottom. Most of the material would remain in place in an area not too much larger than the dimensions of the transportation vessel. Slumping, tidal action, waves, and currents would tend to spread the dredged material farther over time, but the bottom of Two Moon Bay is not a dynamic environment, so those mechanisms might not produce much dispersal.

Dispersal can be increased. A load of material discharged at 15 km/hr, for example, can be released over about twice the distance and may be dispersed further by added turbulence and mixing. Calculations for a dredging project in the Chukchi Sea (Corps of Engineers 2004) suggested that this technique could spread dredged material in 20 to 25 meters of water so that maximum accumulated material would be about 2 meters. This would work over a large area, but a tug cannot tow a barge or scow into Two Moon Bay at 15 km/hr, accurately target a specific area of the log transfer facility and turn safely out of the bay. The barge or scow would have to be positioned over a carefully determined location each time it was dumped.

A front-end loader or other earth-moving equipment could be carried on the barge and used to off-load dredged material for thinner, more even bottom coverage. This would add considerable expense for the additional equipment and operator, however, and would greatly expand tug and barge costs. Allowing for error in positioning and variances in quantity, coverage of about 1 meter would be necessary to ensure a minimum of 30 cm over the site. This would indicate a minimum quantity of about 90,000 m^3 of dredged material to achieve full coverage. Barge loads would have to be reduced to carry and operate the loader safely, so more trips would be needed for a given volume. The barge would have to be frequently repositioned to maintain coverage, and overall dredging time would be substantially extended for the project. An additional tug and barge combination might be required. Cursory evaluation indicates that using less material but placing it more precisely would be more costly than simply placing all the excess dredged material at Two Moon Bay.

Placing all the dredged material at Two Moon Bay instead of placing only 90,000 m^3 would not cause unwanted additional effects. Bottom composition would be the same and the minor change in bottom elevation would be biologically meaningless.

4.7.3 Disposal of Dredged Material

Dredged material that could not be used economically for navigation improvements or for beneficial use could be placed in an environmentally acceptable disposal site. Disposal costs would include cost of any required treatment, transportation to the disposal site, construction at the site to retain or otherwise ensure that environmental effects were minimized, and costs for any feasible compensatory mitigation.

Dredged material could not be disposed of at the harbor site. Construction of access and staging facilities would use all room available for dredged material at the harbor site. The search for on-land sites for beneficial use of dredged material did not find any feasible beneficial use sites, and also did not identify any economically feasible on-land disposal sites. Dredged material could be placed in deep water less than 1.6 km from the proposed harbor site. Preliminary analysis suggests that environmental effects would likely be temporary at the site. However, due to lack of data, effects are largely speculative. The affected environment at that site and environmental consequences of using that site were not explored in detail because all the dredged material could be used in construction of navigation facilities for the tentatively recommended harbor and the beneficial use site at Two Moon Bay.

4.7.4 Dredged Material Disposal Alternative Formulation

This section describes the alternatives for dredged material disposal for the Valdez Harbor project. The alternatives utilize dredged material to create fast land at the harbor and for beneficial use to cover wood and bark debris at Two Moon Bay. The beneficial use area at Two Moon Bay is approximately 48 km from Valdez. Approximately 8.3 ha would be covered with dredged material to a minimum depth of 30 cm (the basis for the 30 cm is described later in this analysis). Any material not used at these two sites would be disposed of at a deep water disposal area approximately 1.6 km from the harbor. The amount of material to be dredged is 186,400 m^3. The actual amount dredged may be as much as 3 percent more due to the level of precision to which dredging can be performed. Therefore, for the purposes of the dredged disposal analysis, the quantity of dredged material to be disposed of is up to 192,000 m^3. The local service facility (LSF) quantity of dredged material used in this analysis is 124,400 m^3 while the quantity of general navigation features (GNF) of dredged material is 67,600 m^3.

Dredged Material Disposal Methodologies

Several methods and combinations of placement methods at Two Moon Bay, disposal in deep water, or placement as fill in the new harbor staging area are examined. A summary of the methods are:

(1) Two Moon Bay Scow Dumping: Dredged material placement for this method would use conventional dumping practices for a split-hull scow. These practices incorporate the use of standard GPS equipment to position the scow over the target location within the Two Moon Bay placement area, then opening the scow to release the material and cover the timber debris on the shallow seafloor. By positioning the scow in a gridded method over many placement trips, the dredged material would establish an irregular cover layer over the placement site. This method requires the minimum amount of time for each scow load but lacks the ability to precisely locate each scow load and the ability to control placement thickness on the seafloor. The lack of precision of this method requires that additional material be placed to establish a minimum cover layer of dredged material. With this method there is a small chance that a portion of the less dense bark debris may be suspended with the placement plume generated from the dense dredged material settling to the bottom in a large stream. This possibility can be substantially reduced by limiting the width that the scow can open its hull thus reducing the rate at which the dredged material leaves the scow and the size of the dredged material plume created.

An estimate of the dredged material to establish the minimum cover layer (30 cm) using this method would be 139,200 m^3 to cover the entire 8.3 ha area. The cover layer would vary in thickness from the minimum cover of 30 cm to roughly 2 meters.

(2) Two Moon Bay Scow Dumping with Bed Leveling: This method uses scow dumping to establish windrows along the length of the Two Moon Bay placement site, which can be smoothed out along the bottom using a bed leveler towed by a barge. The bed leveler is a long, heavy blade that can be towed along the length of the windrows, smoothing the dredged material along the bottom in much the same way that a grader blade is used to spread granular soil. Multiple passes would be required by the bed leveler to smooth the windrows and ensure that the minimum cover depth was achieved.

Several difficulties exist for this methodology. Any large boulders or abrupt changes in bathymetry at the site would cause difficulties for the bed leveler. The leveler would easily drag through the timber debris at abrupt edges causing re-suspension of the debris. With this method the bed leveler might inadvertently cut into the timber debris causing re-suspension of the loose material and mixing of the denser debris with dredged material. This method would require several intermediate surveys to determine the progress of the leveling process.

An estimate of the dredged material needed to establish the minimum cover layer (30 cm) using this method would be 75,400 m^3. The cover layer would vary in thickness from the minimum cover of 30 cm to roughly 1.3 meters.

(3) Two Moon Bay Side Casting from Hopper/Scow: The side casting method uses pumps and seawater to suspend the dredged material in the hopper or scow into slurry, which can be pumped out of the hull and side cast or sprayed out over the Two Moon Bay placement area. The side casting method is normally used with hopper dredges that already have the proper equipment installed to suspend the dredged material and pump the material out of the hull. It is likely that a barge or scow would have to have this equipment installed to perform the task of suspending and pumping the dredged material out of the hull.

Once the dredged material was suspended pumps could spray the dredged material over the side in a directed manner. Off loading the dredged material in this manner is a time consuming effort, but establishing the minimum coverage thickness over the timber debris would require the least amount of dredged material. Another advantage to this process is there would be almost no chance of disturbing the timber debris since the rate of placement is much lower and the coverage area of the side casting process would be so large. This alternative would also require an intermediate survey to determine the progress of the side casting process.

A significant concern with this method is turbidity. With the dredged material being suspended in water, the finer grain material would have a greater likelihood of drifting onto surrounding habitat where it could damage healthy benthic communities. The resultant plume of fine grained materials may cause a water quality issue as well.

An estimate of the dredged material to establish the minimum cover layer (30 cm) using this method would be 56,500 m^3. The cover layer would vary in thickness from the minimum cover of 30 cm to roughly 90 cm.

(4) Deep Water Disposal: Disposing of dredged material in deep water assumes the dredged material would be transported by hopper/scow from the construction site to an area of deep water about 1.6 km away. The material would be dumped from the scow/hopper into water 100 to 200 meters deep. This methodology is commonly used for disposal of dredged material. Impacts from this method of disposal are expected to be temporary and minor. However, due to a lack of data, actual impacts to this environment are largely speculative. This option is considered the base dredged material disposal plan.

(5) Fast Land Creation: The fast land site is upland from the dredging site and located between the proposed north harbor berm and Hotel Hill. Dredged material would be moved to the new staging area by front end loaders from intertidal and adjacent upland areas above low tide levels and by barge from areas of greater depth. The staging area would be constructed in a series of lifts to allow for drainage and settling. The seaward side of the staging area would be armored to provide slope stability.

An estimate of the amount of dredged material needed to construct the staging area is 72,280 m^3. Since this is a Local Service Facility (LSF) feature, LSF dredged material would be used for this construction.

Beneficial Use of Dredged Material Disposal Alternatives
These various disposal methodologies have been combined into different dredged disposal alternatives and have been developed with the following parameters:

- Cover the Two Moon Bay site with as much General Navigation Feature (GNF) material as can be incrementally justified, then send the rest to deep water disposal.
- Utilize 72,280 m^3 LSF dredged material to construct the project staging area.
- Send any remaining LSF dredged material to Two Moon Bay per the request of the non Federal sponsor.
- Minimize turbidity released from placement area
- Minimize re-suspension of bark debris

These parameters will allow for the Two Moon Bay site to be restored to a more natural condition. Extra material at Two Moon Bay would likely not provide extra ecosystem restoration benefits but would avoid causing any potential for impact at any other disposal site. The detailed description of the alternatives differentiates between the dredged material related to the GNF features and the LSF features. This distinction is important because any additional cost for disposal of GNF dredged materials above the costs for the base disposal plan has additional requirements for justification and cost sharing.

In addition, two other types of alternatives have been developed to assist in determining the most cost effective and incrementally justified plan. The first type of alternative would be to take only the minimum amount of material to Two Moon Bay as necessary to achieve the desired result. The remaining material would be sent to deep water disposal. Table 4-11 shows the volume of material and the cost associated with each alternative disposal.

Table 4- 11. Alternative Disposal Methods. (2009 Price Level)*

Disposal Plans	Volume of Dredged Material to Establish Fast Land	Volume of Dredged Material to Establish Cover at Two Moon Bay	Volume of Dredged Material to be Disposed of in Deep Water	Cost of Disposal Plans*
No Action Plan	0 m^3	0 m^3	0 m^3	$ 0
Base Disposal Plan	0 m^3	0 m^3	192,000 m^3	$4,169,000
Alternative 1	72,280 m^3	119,720 m^3	0 m^3	$4,369,000
Alternative 2	52,800 m^3	139,200 m^{3**}	0 m^3	$5,197,000
Alternative 3	72,280 m^3	119,720 m^3	0 m^3	$4,800,000
Alternative 4	72,280 m^3	110,860 m^3	8,860 m^3	$10,253,000

*The costs for the dredge disposal analysis were developed in 2009 and are in the 2009 price level. These costs used in the analysis were not adjusted because the relative change in the costs would not affect the results of the analysis because all alternatives would inflate at the same rate. As stated previously, the cost estimate for the selected alternative (including the BUDM components) has been updated and is reflected in Section 6.
** The amount of dredged material required for full coverage at Two Moon Bay.

The no-action plan would not construct a harbor and thus there would be no need for dredged material disposal.

The base disposal plan sends all 192,000 m^3 of dredged material to deep water disposal. Because none of the dredged material would be used for constructing the harbor staging area, the material needed for constructing the harbor staging area would be imported. The cost is included in the base disposal plan because the disposal alternatives provide the beneficial use of dredged material for this purpose, which provides a cost savings for the project. The cost of the base disposal plan is $4,169,000.

Alternative 1 uses beneficial use of dredged material for habitat enhancement at Two Moon Bay and construction of the harbor staging area. All 67,600 m^3 of GNF dredged material would be sent to Two Moon Bay for the purpose of ecosystem restoration. Of the LSF dredged material, 72,280 m^3 would be used to create the project staging area. The remaining 52,120 m^3 of LSF material would be sent to the Two Moon Bay restoration site to complete the restoration and avoid the potential for adverse impacts related to deep water disposal. The material would be dumped by a scow at Two Moon Bay and would achieve desired coverage of approximately 85 percent of the area available for restoration. This plan has a cost of $4,369,000.

Alternative 2 utilizes beneficial use of dredged material and for ecosystem restoration at Two Moon Bay for constructing the harbor staging area. All 67,600 m^3 of GNF dredged material would be sent to Two Moon Bay for the purpose of ecosystem restoration. Only 52,800 m^3 of the LSF dredged material would be used to create the project staging area. The remaining 19,480 m^3 of material for the harbor staging area would be imported. The remaining 71,600 m^3 of LSF material would be sent to the Two Moon Bay restoration site to complete the restoration and avoid adverse impacts related to deep water disposal. One hundred percent of the restoration area will be covered. This plan has a cost of $5,197,000.

Alternative 3 is very similar to Alternative 1, except that the material at Two Moon Bay would be leveled to create a more even surface. All 67,600 m^3 of GNF dredged material would be sent to Two Moon Bay for the purpose of ecosystem restoration. Of the LSF dredged material, 72,280 m^3 would be used to create the project staging area, with the remaining 52,120 m^3 sent to the Two Moon Bay restoration site to complete the restoration and avoid impacts related to deep water disposal. One hundred percent of the restoration area would be covered. This plan has a cost of $4,800,000.

Alternative 4 uses only 56,500 m^3 of the GNF dredged material to achieve the desired coverage. The material at Two Moon Bay would be side cast, thus requiring less material to achieve the desired depth of material. The remainder of GNF material, 8,860 m^3, would be disposed of in deep water. Of the LSF dredged material, 72,280 m^3 would be used to create the project staging area, with the remaining 54,360 m^3 sent to the Two Moon Bay restoration site. One hundred percent of the restoration area would be covered. This plan has a cost of $10,253,000.

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4.8 Evaluation of Alternatives

As stated in section 4.6 the cost of the selected plan in this section is different than the costs in the description of the recommended plan in Section 6. The alternatives were compared utilizing cost estimates prepared in 2006 and inflated to the 2010 price level using the Civil Works Construction Cost Index for navigation ports and harbors. This cost basis was utilized to ensure all the assumptions and computations used were the same for all the alternatives. When the selected plan was identified, its cost estimate required updates per comments received in Agency Technical Review and have been revised based on technical comments. Therefore, the costs for the recommended plan in later sections of the report are different than as presented in the alternative analysis.

4.8.1 Summary of Alternative Costs

These costs were developed based upon design quantities taken from each of the project alternatives utilizing the Tri-Service Automated Cost Engineering System (TRACES) adjusted to fit the current fleet configurations. Table 4-12 summarizes the information presented in the previous section.

Table 4- 12. Summary of Alternative Costs.

Alternatives	Total Project Economic Costs	Average Annual Costs with OMRR&R
West Site Alternatives		
243 Wave Barrier	$ 37,087,000	$ 4,677,800
320 Wave Barrier	46,050,000	5,380,700
East Site Alternatives		
125 Rubblemound	$ 20,929,000	$ 1,119,600
200 Rubblemound	28,088,000	1,494,400
243 Rubblemound	31,364,000	1,655,400
320 Rubblemound	35,119,000	1,861,200

4.8.2 Alternative Benefits

The alternative benefits demonstrate how well each alternative accrues the available benefits for the variety of accounts. Following is a brief summary of the detailed information found in the Economics Appendix.

East Site Rubblemound 125 -Vessel Alternative. The benefits summary (table 4-13) is based on accommodating a natural break in the waitlist vessels for Valdez Harbor. This benefit summary captures a portion of the total benefits that could be realized for each of the benefit categories based on the waitlisted vessels that would be first offered space at the new harbor facility. Total present value of benefits for the East Site Rubblemound 125-Vessel alternative is $73.3 million with average annual benefits of $3.3 million.

Table 4- 13. East Site Rubblemound 125 - Vessel Alternative Benefits Summary

Benefit Categories	Total Present Value of Benefits	Average Annual Benefits
Harbor Operations		
Harbor personnel time	$ 44,200	$ 2,100
Float and dock repairs	270,400	12,800
Commercial Fleet		
Vessel Damage	1,559,700	73,700
Vessel delays	3,827,600	180,800
Harbor of refuge	44,700	2,200
Opportunity Cost of Time	8,301,000	392,100
Tender Fleet		
Travel related expenses	576,000	27,200
Opportunity Cost of Time	52,900	2,500
Charter Fleet		
Vessel delays	13,341,700	630,200
Opportunity Cost of Time	3,137,500	148,200
Guaranteed space premium	1,037,400	49,000
Subsistence Fleet		
Harvest value	2,273,100	112,700
Recreational Vessels		
Recreational experience	38,815,000	1,633,500
Total Benefits With-Project	**$ 73,281,200**	**$ 3,267,000**

East Site Rubblemound 200 -Vessel Alternative. The East Site Rubblemound 200 - Vessel benefits summary (table 4-14) is based on accommodating the maximum number of transient vessels appearing at the Valdez Harbor on peak days. This benefit summary captures a portion of the total benefits that could be realized for each of the benefit categories based on the waitlisted vessels that would be first offered space at the new harbor facility. Total present value of benefits for the 200-Vessel alternative is $84.7 million with average annual benefits of $4.0 million.

Table 4- 14. East Site Rubblemound 200 - Vessel Alternative Benefits Summary

Benefit Categories	Total Present Value of Benefits	Average Annual Benefits
Harbor Operations		
Harbor personnel time	$ 70,700	$ 3,300
Float and dock repairs	432,700	20,400
Commercial Fleet		
Vessel Damage	2,495,500	117,900
Vessel delays	4,797,300	226,600
Harbor of refuge	71,500	3,500
Opportunity Cost of Time	10,308,000	486,900
Tender Fleet		
Travel related expenses	2,036,300	96,200
Opportunity Cost of Time	160,900	7,600
Charter Fleet		
Vessel delays	13,981,000	660,400
Opportunity Cost of Time	3,152,300	148,900
Guaranteed space premium	1,064,900	50,300
Subsistence Fleet		
Harvest value	3,637,000	180,300
Recreational Vessels		
Recreational experience	42,454,000	2,002,300
Total Benefits With-Project	**$ 84,662,100**	**$ 4,004,600**

West Site Wave Barrier 243 -Vessel and East Site Rubblemound 243 -Vessel Alternatives. The 243-Vessel alternative for both the East and West sites benefits summary (table 4-15) is based on accommodating all the waitlisted vessels at Valdez Harbor. This benefit summary captures a portion of total benefits that could be realized for each of the benefit categories based on the waitlisted vessels that would be first offered space at the new harbor facility. Total present value of benefits for both 243-Vessel alternatives is $92.3 million with average annual benefits of $4.5 million.

Table 4- 15. West Site Wave Barrier 243-Vessel and East Site Rubblemound 243-Vessel Alternatives Benefits Summary

Benefit Categories	Total Present Value of Benefits	Average Annual Benefits
Harbor Operations		
Harbor personnel time	$ 85,900	$ 4,100
Float and dock repairs	525,700	24,800
Commercial Fleet		
Vessel Damage	3,032,000	143,200
Vessel delays	5,351,900	252,800
Harbor of refuge	86,900	4,300
Opportunity Cost of Time	11,459,600	541,300
Tender Fleet		
Travel related expenses	2,612,300	123,400
Opportunity Cost of Time	213,800	10,100
Charter Fleet		
Vessel delays	15,361,400	725,600
Opportunity Cost of Time	3,433,900	162,200
Guaranteed space premium	1,075,500	50,800
Subsistence Fleet		
Harvest value	4,419,000	219,100
Recreational Vessels		
Recreational experience	44,675,000	2,214,800
Total Benefits With-Project	**$ 92,332,900**	**$ 4,476,500**

West Site Wave Barrier 320-Vessel and East Site Rubblemound 320-Vessel Alternatives. The 320-Vessel benefits summary for both the East and West site alternatives (table 4-16 is based on accommodating half of all the transient vessels at Valdez Harbor. This benefit summary captures the portion of total benefits that could be realized for each of the benefit categories based on the transient vessels that would be first offered space at the new harbor facility. Total present value of benefits for both 320-Vessel alternatives is $133.4 million with average annual benefits of $5.2 million.

Table 4- 16. West Site Wave Barrier 320-Vessel and East Site Rubblemound 320-Vessel Alternatives Benefits Summary

Benefit Categories	Total Present Value of Benefits	Average Annual Benefits
Harbor Operations		
Harbor personnel time	$ 113,100	$ 5,300
Float and dock repairs	692,300	32,700
Commercial Fleet		
Vessel Damage	3,992,800	188,600
Vessel delays	6,344,800	299,700
Harbor of refuge	114,400	5,400
Opportunity Cost of Time	13,521,600	638,700
Tender Fleet		
Travel related expenses	2,612,300	123,400
Opportunity Cost of Time	321,800	15,200
Charter Fleet		
Vessel delays	16,367,000	773,100
Opportunity Cost of Time	3,556,700	168,000
Guaranteed space premium	1,088,200	51,400
Subsistence Fleet		
Harvest value	5,819,200	288,500
Recreational Vessels		
Recreational experience	78,857,000	2,590,000
Total Benefits With-Project	**$ 133,401,200**	**$ 5,180,000**

4.9 Mitigation Alternatives

ER 1105-2-100 establishes mitigation requirements for Corps of Engineer projects. Other regulations, including Section 404 of the Clean Water Act, also apply. ER 1105-2-100 states: “District commanders shall ensure that project-caused adverse impacts to fish and wildlife resources have been avoided or minimized to the extent practicable, and that remaining, unavoidable impacts have been compensated to the extent justified.”

Both the ER and Council on Environmental Quality regulations require Federal agencies to consider mitigation opportunities, including opportunities for compensatory mitigation, in the environmental assessment or environmental impact statement process for each project. Neither regulation requires that compensatory mitigation be implemented to fully mitigate project impacts, and both regulations have the implementing agency consider the cost and effectiveness of the mitigation alternatives along with the impact potential.

Mitigation has been defined by the President’s Council on Environmental Quality to include (1) avoiding an impact by not taking an action or parts of an action, (2) minimizing impacts by limiting the degree or magnitude of the action, (3) rectifying an impact by repairing, rehabilitating, or restoring the affected environment, (4) reducing impact over time by preservation and maintenance operations and (5) compensating for the impact by replacing or providing substitute resources or environments (40 CFR 1508.20).

The following considerations were instrumental in developing mitigation alternatives:

- Analysis of direct project impacts on resources of concern.
- Cumulative and induced impacts on regional resources.
- Relationship of environmental losses to regional resources.
- Regulations and guidance regarding appropriate mitigation for water resources projects.
- Effectiveness and cost of potential mitigation measures.

Mitigation objectives focus on the following resources of concern

- Water quality (primarily concerns about dissolved oxygen, turbidity, and fuel spills)
- Intertidal and subtidal habitat
- Salmonid juveniles and adults
- Benthic invertebrates
- Duck Flats
- Sea otters
- Waterfowl and seabirds

Mitigation Objectives – The mitigation objectives were identified for the resources of concern as follows:

> Water Quality - Minimize adverse impacts to water quality at disposal sites during construction and in the harbor project area during and after construction.
>
> Intertidal and Subtidal Habitat - Minimize project footprint and disturbance during construction. Compensate for unavoidable losses to the extent justifiable.
>
> Salmonid Young and Adults - Avoid/minimize structures that impede juvenile fish movement or force movement into deeper water. Minimize habitat loss.
>
> Benthic Invertebrates - Minimize project footprint. Compensate for unavoidable losses to the extent justifiable.
>
> Marine Mammals - Minimize habitat loss. Avoid harassment during construction.
>
> Waterfowl and Seabirds - Minimize habitat loss and harassment impacts.

Mitigation Measures Considered. The Coordination Act report specifically recommended restoration of an abandoned log transfer site about 50 km from Valdez. The Corps is addressing that recommendation by proposing restoration through beneficial use of dredged material from proposed Valdez Harbor improvements. This proposed beneficial use of dredged material is evaluated in Sections 4.7. The Coordination Act report suggested consideration of two other mitigation alternatives. One alternative would use zoning restrictions, land swaps, and other mechanisms to limit development at Robe Lake outside Valdez. The other would acquire and set aside conservation lands in the Duck Flats to prevent development. These measures are not considered in detail because the resources that would be affected or restored are not similar to those that would be impacted by harbor improvements.

One additional mitigation measure was considered in detail. The existing Valdez harbor is long and narrow, which leads to poor water circulation in the sections most distant from the entrance. This back end of the harbor is separated from Harbor Cove by road fill about 20 meters across. Connecting the boat harbor to Harbor Cove by a short canal or large culvert was evaluated as a measure to improve exchange of water in the harbor. During technical review, Ronald Nece, one of the nation's leading water circulation experts, expressed his opinion that this alternative would be ineffective because there would be no head difference or other force driving water from one system into the other. A decision to drop this alternative from further consideration was based on Nece's review and the Corps in-house confirmatory review.

The Coordination Act report made 14 specific on-site recommendations to mitigate impacts of a harbor at the East site. Mitigation alternatives from the Coordination Act report and from other sources are considered in the following annotated list.

1. The harbor channel entrance should be located as far as possible away from sensitive bird, fish, and marine mammal habitats to reduce vessel disturbances to these resources.

East site harbor configurations considered in detail would place the entrance at the west end of the harbor away from the kittiwake colony on the SERVS dock, but the entrance would be oriented so that boats would approach from the southwest, away from Harbor Cove and the small islands to the west.

2. To reduce fish migration obstructions, the in-water portions of the breakwater and staging area should be contoured with a slope of 2:1. The use of different types of rock should be further investigated to determine what size and type of rock or combinations of rock can be used to maximize juvenile salmon cover along breakwater structure. Additional measures (i.e., breaches) have been incorporated into breakwater design to avoid fish migration impacts. All breaches need to be designed to prevent dewatering: breaches and breakwaters need to be designed to ensure at least 1 foot of sea water remains at all "lowest low water (LLW)" tides to facilitate fish passage. At this time, it is assumed that the breaches will not need maintenance dredging; however, depending on the final elevations and configurations of breaches, dredging needs for breaches will need to be addressed during later design phases.

The critical shoreward slope of the dredged boat basin would be shaped to a ratio of 3 horizontal to 1 vertical. Breakwater slopes would be constructed to a ratio of 1.5 horizontal to 1 vertical. Broadening the breakwater base to achieve a flatter slope would substantially increase costs and would increase the footprint of harbor impacts. Theoretically, a flatter slope may benefit salmon fry, but differences cannot be quantified to justify additional costs. We were not able to conduct research to determine marine biota recolonization rates on different rock types, but would be happy to participate in this type of study in the future as funding allows. The western breach would be dry at tidal stages lower than about +1 meter MLLW, so the breach would be close to shore. If it were moved farther out, water would be much deeper around it during high tides and two separate breakwaters at the harbor west end would be required, with substantial increases in breakwater footprint and construction cost.

3. The harbor will include an approved waste oil disposal site with adequate containment and maintenance measures to ensure proper disposal. The new harbor will contain a new fuel dock designed and equipped with state-of-the-art protection equipment and measures (e.g., fuel collars, clean up equipment and facilities).

Valdez, the project non-Federal sponsor, has agreed to provide and maintain waste oil receptacles. Any fuel facilities the city constructs in the new harbor would be designed with current best fuel management and spill prevention technology.

4. To reduce the potential for accidental fuel spills, heighten vessel operators' awareness of hydrocarbon impacts to species in the marine environment, and provide tips to help boaters prevent and report fuel spills, signs with large and bold text shall be provided by the local sponsors and installed at the Harbormaster's office and at the new and existing

fuel docks; final design will require approval from the US Fish and Wildlife Service (Service). Additional signage is recommended along walkways and other locations. Signs should clearly communicate the need for using provided facilities to ensure safe and legal deposition of litter, oil products, or other chemicals so that marine waters and resources are protected.

The non-Federal sponsor has agreed to provide signs and other information to meet these objectives.

5. Interpretive signs shall be installed in high traffic areas (such as outside the entrance of the Harbormaster's office) to inform harbor users about the hazards of litter and marine debris impacts to fish and wildlife in the marine environment. The sign contractor will work with the Service to develop text for the sign that will meet or exceed the requirements of Marine Pollution Guidelines (MARPOL); final design will require approval from the Service. A clearly identified and easily accessible collection station will be located within the new harbor area (e.g., fuel dock or entrance to the boat launch) to collect discarded marine boating related debris (e.g., fishing nets, packing bands, ropes, buoys, gas cans, etc.).

The non-Federal sponsor has agreed to provide the interpretive signs and adequate waste receptacles in convenient locations.

6. An existing bilge water treatment plant is located 4 miles away from the current harbor. It is highly recommended that a new, state-of-the-art bilge water treatment facility be constructed within the immediate footprint of the existing and proposed new harbor sites. Design, construction, and signs "advertising" the existence of this facility need to be done to meet or exceed MARPOL regulations to ensure this facility is utilized to its maximum potential.

The non-Federal sponsor has agreed to construct and operate a bilge water treatment facility for use by both the existing harbor and any harbor improvements. Its location will be advertised to boat operators.

7. To reduce the biological impacts of dredging generated turbidity and suspended sediments on out-migrating juvenile salmon, dredging or fill activities should not occur from April 15 to May 15 (fry out-migration) and from June 20 to July 20 (adult return harvest period). It may be possible to arrange to continue construction activities during the "closed timing window" periods if activities can be timed to occur during low tide periods when the site is "de-watered." This will require careful consideration of seasonal and daily cycles and flexible work schedules for contractors. Further consultation with the Alaska Department of Natural Resources Office of Habitat Management and Permitting may be necessary to ensure all work is completed within and is consistent with the fish passage timing window for this region (M. Sommerville, pers. comm.).

Dredging or excavation and other harbor construction activities that produce excessive sediment suspension would not be conducted during the April 15 to May 15 out-migration period unless sediments suspended by construction was contained by silt *curtain or other mechanism. Placing clean rock and other coarse material for breakwater construction does not produce excessive sediment suspension and would be allowed if placed from a vessel that was not allowed to ground. Any restrictions imposed by State resource agencies to protect returning adult salmon also would be incorporated into contract requirements. Adult salmon are far more mobile than salmon fry, have been shown to tolerate high levels of suspended sediment, and are a terminal fish stock in Port Valdez. These returning adults will, with few exceptions, die without successfully spawning regardless of measures to protect them. Silt curtains in June and July appear to be an unnecessary cost.*

8. Disposal of dredged materials into selected inter-tidal/sub-tidal areas should include methods to filter or settle out silt-laden water (i.e., the use of silt curtains, where feasible) prior to their discharge at a disposal site. Dredged materials shall be discharged below the water surface to minimize the spreading of suspended particles.

Contractors would be required to employ silt curtains during in-water placement if any dredged material is placed to construct staging/access lands shoreward of the harbor basin. Placing dredged material for beneficial use coverage at Two Moon Bay would require discharge from a moving barge or scow. The size of the Two Moon Bay site, frequency of entry into and out of the disposal site, and need for barge and tug mobility would make silt curtains impractical at that site, but any material placed there would be discharged well below the surface to reduce potential for near-surface turbidity.

9. Valuable “preconditioned” shale and its attached marine infaunal community found along the base of southern and eastern shore of Hotel Hill should be collected prior to harbor construction. This material should be carefully collected and stored in-water so attached fauna does not die. The material would then be placed at the toe of the newly constructed harbor bulwarks or breakwaters as “seed” material to provide some habitat value.

We certainly respect and support the intent to promote redevelopment of diverse and productive benthic communities on project breakwaters as early as possible. We have had poor success in previous attempts to test this concept. Rocks with attached biota are difficult to identify accurately for contractor action, difficult to recover undamaged, difficult to successfully store for the 2 years or more typically required for harbor construction, and difficult to place right-side-up and in optimum locations. We were unable to successfully implement the same measure at another Alaska harbor that is now nearing completion. Most marine biota present on rocks at the East site are highly mobile during some life stage and would readily reach the new breakwater without being "seeded" against or adjacent to it. We will continue to look for ways to improve productivity on breakwaters, but we have seen no convincing evidence that "seeding" as suggested here appreciably increases recolonization rates on structures as extensive as breakwaters. We are not able to recommend this measure for this project.

10. To reduce adverse impacts to nesting kittiwakes and their young located on the SERVS pier and to comply with the Migratory Bird Treaty Act, the Service recommends

construction activities be initiated August 21 (when chicks will have fledged or have left the area) or May 7 (prior to egg laying). Once construction begins it should be able to continue with no date restrictions because it is likely the birds will avoid the area and will relocate to nearby colonies elsewhere within the Valdez Arm region. Following these guidelines will reduce the potential for loss of young of the year. It is unknown whether the birds will continue utilizing or will abandon the site in the presence of harbor related construction activity.

Contractors would be required to observe the stated timing windows.

11. To reduce adverse impacts to sea otters, the Service recommends that Corps Quality Assurance personnel/observers be stationed at the project site during dredging, in advance of when any blasting might be anticipated, and during breakwater rock installation/construction phases of this project. Such construction related activities should be suspended when sea otters are observed within 0.4 km of the project site.

The contractor would be required to prepare a blasting plan before using any in-water explosives. The plan would be consistent with resource agency recommendations and state standards. A monitor would be used as needed and sea otters would be fully protected.

12. As planning and design of the east harbor expansion progresses, the Service will use our Migratory Birds Management annual surveys conducted throughout PWS to ascertain the presence of Kittlitz's murrelets in the Valdez Arm and project areas, subject to funding limitations. The Service will provide any updated information to the Corps for use in harbor planning.

The Corps will re-evaluate plans if needed to protect Kittlitz's murrelets in Port Valdez.

13. Updated studies to determine circulation patterns within eastern Port Valdez would be useful to assess cumulative changes resulting from the potential expanded harbor, SERVS dock, Alyeska Marine Terminal, and the Container Terminal dock. This information would help assess resource impacts associated with water quality issues and potential fuel spills within the proposed harbor and adjacent valuable habitats, such as the Valdez Duck Flats. Information on circulation patterns within eastern PWS could also assist in defining additional mitigation measures to offset new harbor impacts. The Service will work with the City of Valdez and resource agencies to update all local spill prevention plans.

We concur. Circulation studies might be useful for future evaluations. They would not reduce, avoid, or compensate for project effects, so they are not proposed for project mitigation.

14. Preliminary water circulation modeling has been conducted for the proposed harbor designs. However, the Alaska Department of Environmental Conservation has indicated additional modeling and reviews may be necessary and appropriate prior to finalizing the

Corps design and before State of Alaska permits are issued for the proposed project. The Service encourages and supports further review and analysis because continuance of high water quality is necessary for the protection and maintenance of trust resources present in the project area.

We will continue to work with State agencies to ensure that they have the data they require to evaluate project impacts. The project will be constructed only after the State has issued a certificate of reasonable assurance to the Corps.

5.0 COMPARISON AND SELECTION OF PLAN

5.1 Alternative Comparisons

To determine which alternative would net the greatest amount of benefits, a comparison between the costs and benefits for each alternative fleet size was developed (table 5-1). Benefits for each fleet size consists of navigation benefits (time delay prevented, damages prevented, etc.) and incidental recreational benefits. Details of this analysis can be found in the Economics Appendix.

Table 5- 1. Summary of benefits and costs for Valdez Harbor alternatives

Alternatives	Number of Additional Slips	Average Annual Benefits	Average Annual Costs	B/C Ratio	Net Benefits
West Site Alternatives					
Alt 2 Wave Barrier	243	$ 4,476,500	$ 4,677,800	0.96	$ (201,300)
Alt 3 Wave Barrier	320	5,180,000	5,380,700	0.96	(200,700)
East Site Alternatives					
Alt 1 Rubblemound	125	$ 3,267,000	$ 1,119,600	2.92	$ 2,147,400
Alt 2 Rubblemound	200	4,004,600	1,494,400	2.68	2,510,200
Alt 3 Rubblemound	243	4,476,500	1,665,400	2.69	2,811,100
Alt 4 Rubblemound	320	5,180,000	1,861,200	2.78	3,318,800

The alternative with the greatest net NED benefits is the East Site Rubblemound 320-Vessel alternative.

5.2 Alternative Optimization

Alternatives were optimized to maintain design criteria while providing benefits for the given fleet size at the least cost. The harbor shape and breakwater height were designed to standards necessary to provide protected moorage and circulation for water quality, leaving little room for optimization.

The entrance channel was one area where alternative optimization was done (table 5-2). This was briefly analyzed to determine the percent of time the design vessel could transit the entrance channel while remaining within the safety zone as defined by the above criteria related to entrance channel depths and the lowest predicted tide elevation. This analysis shows that the -5.5-meter channel depth provides 98 percent accessibility for a 50-year storm event and lowest predicted tide occurring at the same time.

Table 5- 2. Entrance Channel Optimization

Percent Safe Accessibility	
Channel Depth meters	**Percent Accessibility**
-4.6	89
-4.9	93
-5.2	96
-5.5	**98**
-5.8	99
-6.1	100
-6.4	100

Decreasing the channel depth would lead to a decrease in benefits greater than the decrease in cost. For example, removing 0.3 meter of channel depth (the standard increment for optimization) would yield a present value cost savings of about $15,200. If this decrease in channel depth caused a delay of just 1 hour per year for just four of the larger vessels (in this case the 30-meter tenders), it would create a present value decrease in benefits of about $19,200, showing that the 0.3 meter in channel loss would not be justified. This is an extremely low estimate of potential impacts to the project and does not take into account any of the larger charter vessels, emergency response vessels, large recreational vessels etc.

The 5.5-meter depth is computed as the minimum allowable depth based upon Corps standards for entrance channels. This depth includes factors such as design vessel depth, wave height, and factor of safety. At 98 percent availability, the average delay for any given low tide would be 15 minutes. Not every low tide would demonstrate a delay, and some would be longer than 15 minutes, but the average time computed is 15 minutes. The assumption made for this study is that a 15-minute delay is about the longest amount of time that a vessel operator would be willing to endure without changing their behavior in such a way that an economic benefit would be gained. Therefore, going any deeper than the 98 percent available depth does not appear to be warranted and having a channel shallower than the recommendation of Corps technical guidance would allow does not appear to be justified either.

Optimization of the harbor would follow much the same reasoning as the entrance channel optimization. Certain areas of the harbor are not dredged as deep because not all vessels require the full 5.5-meter depth of the entrance channel. The harbor was designed to accommodate the depth of the 320-vessel fleet. The largest section, 187 meters by 129 meters, would be dredged to -2.7 meters. The next largest section is 110 meters by 129 meters dredged to -4.0 meters. The smallest section is 125 meters by 129 meters, subtracting a substantial portion of the area to accommodate the entrance channel, effectively diminishing the size of this area by a third. Decreasing the size of any of these sections would begin to diminish the benefits gained by vessels in a greater rate than the cost would decrease (see the example illustrated for the entrance channel). Likewise, there would be no economic gain for increasing the depth or size of the areas. Effectively, the basin is optimized by selecting the smallest basin area needed for the three classes of vessels using the harbor.

5.3 Evaluation of Dredge Material Disposal Options

This section evaluates the different disposal options for the disposal of dredged materials including an assessment of the costs, a cost effectiveness analysis, an incremental cost analysis, and identification of the tentatively recommended dredged material disposal plan.

5.3.1 Development of the Cost Effectiveness and Incremental Cost Analysis

The base dredged material disposal plan for Valdez would be to dump the material in the deep water area near the proposed harbor site. Table 2 shows the difference in the GNF dredging costs between the base plan and the various beneficial use of dredged material options.

Table 5- 3. Disposal Alternative Costs

Plan	Cost: ($)	BUDM Cost: ($)
No Action Plan	$ -	$ -
Base Disposal Plan	4,169,000	-
Alternative 1	4,369,000	200,000
Alternative 2	5,197,000	1,028,000
Alternative 3	4,800,000	631,000
Alternative 4	10,253,000	6,084,000

Because the cost of the beneficial use of dredged material plan could exceed $300,000, a Cost Effectiveness and Incremental Cost Analysis (CE/ICA) is needed to justify the plan. To develop a CE/ICA for beneficial use of dredged material plan, an assessment of potential gains and losses to habitat of the base dredging plan and the proposed beneficial use plan was conducted. The decision making criteria is whether the incremental cost is reasonable in relation to the environmental benefits achieved.

There are a number of ways of conducting CE/ICA, thereby determining which plans are cost effective, and from the set of cost effective plans, identifying those plans that are most efficient in production (i.e. "best buys"). These best buy plans are then analyzed to compare the incremental costs and incremental benefits to see what plan has the most reasonable amount of output for an amount of cost. The result of this analysis aids in the identification of the recommended plan.

5.3.2 Development of the Cost Effectiveness and Incremental Cost Analysis

The measure of the habitat's existing condition—gains or losses—is the habitat unit. The habitat unit is the product value of a particular habitat multiplied by some physical dimension. For the analysis of the Valdez Navigation Improvements beneficial use of dredged materials, the value of the habitat was generated using a marine benthic assessment (MBA).

The marine benthic value (MBV) was developed by identifying reference condition to which conditions at other sites can be compared. This reference condition represents an assumption that the habitat is functioning as optimally as can be expected for a given geographic location and environment. This reference condition is assigned a value of 1.0.

Other conditions are given values between zero and one representing the site's MBV compared with the reference site. In the case of the Valdez Navigation Improvements Beneficial Use of Dredge Material plan, MBVs have been developed to represent the without- and with-project conditions at Two Moon Bay and the deep water disposal site. The MBVs were generated using input, judgment, and opinions of knowledgeable experts from the Corps and other agencies familiar with the sites and PWS habitat related issues (see Appendix 6).

The reference condition for this analysis is defined as a properly functioning benthic habitat characterized by a diverse population of locally common species including:

- diatoms and single cell algae
- marine worms
- barnacle, mussel, bivalve, urchin, limpet, snail, and decapod larvae, juveniles, and adults immature and mature kelp
- larvae, juvenile and adult fin fish, sea cucumbers, sea stars, and octopus

A complex set of factors contribute to habitat functionality. This analysis concentrates on the natural conditions, the factors that have been influenced by existing and previous use of the sites, and the factors that would be influenced and have an enduring habitat-related effect as a result of a proposed action.

As part of the site selection and permitting process for the log transfer facility, the Two Moon Bay site and two other nearby sites were surveyed. The Two Moon Bay site was selected because of its lower near-shore productivity, its proximity to deep water, and its longer distances from bald eagle nests and anadromous streams, relative to the other sites that were being considered. The Two Moon Bay site was described as having a gravel shelf extending to about 18 meters offshore from the water's edge where a steep drop off to a depth of about 8 meters to silt/mud occurred. The most important factor that would be influenced by the placement of dredged material is the substrate. Placement of the dredged material at the site would likely improve the chemical and physical nature of the substrate.

The habitat at Two Moon Bay has been altered by the covering of the seafloor with wood and bark debris. The debris, being slow to degrade, smothered the habitat and prevented self recovery. The MBV for the existing condition at Two Moon Bay was determined to be 0.05 because of a lack of attachment potential and the toxic conditions presented by the fine-particle size and water chemistry within the exposed substrate.

To quantify the MBV for the restored Two Moon Bay site, other projects of similar condition were investigated including disposal sites from dredging projects in Portland, Maine, and Long Island Sound (ERDC 2001). The results of these projects show that marine invertebrates only colonize the material to about 30 cm deep and it would make no difference if it were stockpiled as a mound on a disposal site or if used for capping the bark debris at Two Moon Bay. The recommended minimum capping depth is 30 cm because the majority of invertebrates live on the surface or colonizes to about the top 30 cm. Some invertebrates burrow down farther, but substrates generally become increasingly anaerobic with depth.

Colonization is rather rapid (1 to 3 years) in some of these examples. This is probably due to the softer consistency of the dredged materials and the abundance of seed invertebrates occupying the surrounding habitat. The dredged material from Valdez is resorted glacial till ranging from silt to cobble with occasional small boulders that would be expected to show similar results with colonization starting within 1 to 2 years with maximum recovery in about 10 years. Table 5-4 shows how the Two Moon Bay site would be expected to develop over time.

Table 5- 4. Two Moon Bay Expected Habitat Improvement

Successional Stage	Estimated Number of Summers to Reach	Estimated Percent of Community Recovery [1]	Organisms Expected to be Present in the Two Moon Bay Site
Stage I	1 – 2	To 20 %	Diatoms and single cell algae; marine worms, barnacle, mussel, bivalve, urchin, limpet, snail, and decapod larvae
Stage II	2 – 5	20 to 80%	Diatoms and single cell algae; marine worms; barnacle, mussel, bivalve, urchin, limpet, snail, and decapod larvae, juveniles, and adults; immature and mature kelp; larvae, juvenile and adult fin fish
Stage III	5 – 10	80 to 100%	Diatoms and single cell algae; marine worms; barnacle, mussel, bivalve, urchin, limpet, snail, and decapod larvae, juveniles, and adults; immature and mature kelp; larvae, juvenile and adult fin fish; sea cumbers; sea stars; octopus.

1. As compared with ecosystems comparable to the environment found at Two Moon Bay. The diversity of the post-project Stage III (climax) succession at Two Moon Bay is expected to exceed that found at the material source in Valdez because the water quality at Two Moon Bay allows the presence of species that cannot survive in the relatively turbid environment of lower salinity often present at Valdez.

The capping of Two Moon Bay with 30 cm would ensure sufficient coverage for re-colonization and would use all the dredged material. The habitat value after capping is assigned values of 0.5 or 0.7 depending on the methodology of placing dredged material. Table 5-5 is a summary of the assigned marine benthic values.

The capping methodologies (scow dumping, dump and level, side cast) are expected to have different levels of effectiveness. Scow dumping is expected to be the most effective with the least amount of escaping turbidity, loss of fines, and re-suspension of the bark debris, warranting the MBV of 0.7 assigned to capping. The dump and spread methodology has a risk of re-suspending the bark debris with the potential of having bark in the cap or on the cap surface, decreasing the effect of the restoration. To account for this, the MBV for dump and level is decreased to 0.5. The side cast method, due to the remixing of the dredged material with water, would likely cause a plume of fine materials to drift off site, covering existing good habitat, thus decreasing the good habitat production. To account for this effect, the side cast method MBV is decreased to 0.5 as well.

Table 5- 5. Summary of MBA Utilized in the Beneficial Use of Dredged Material CE/ICA

Type of Habitat	MBV
Existing Two Moon Bay	0.05
Two Moon Bay with Scow Dumping	0.7
Two Moon Bay with Dump and Level	0.5
Two Moon Bay with Side Cast	0.5
Existing Deepwater	1.0
Dumped on Deepwater	0.7

Habitat associated with deep water disposal of dredged material was considered the least preferable method. Deep water habitat throughout PWS is generally characterized as undisturbed benthic habitat. The MBV of deep water habitat in this region is generally assumed to be excellent and assigned a value of 1.0. The assumption for the MBA is that dumping material in deep water would likely exceed a 30 cm cap and would likely have short-term adverse impacts. As a result, a value of 0.7 was assigned to the deep water benthic environment to allow for recovery of lost habitat function.

Habitat Units (HUs) for the Two Moon Bay beneficial use of dredged material plan were developed by multiplying the acreage of the various habitat types for each alternative by its corresponding MBV. As more dredged material was placed at a location, proportionally less of the existing condition MBV was utilized as proportionately more of the new habitat was created and the new MBV used. All of the HU's for each alternative were then summed. The following table and graph show the HU and cost for each of the disposal options.

The next step in the CE/ICA is the Cost Effectiveness analysis, which identifies those plans that are inefficient in production. Plans that are inefficient in production are defined as those where the same level of output can be provided at a lesser cost by another plan.

Table 5-6 and Figure 5-1 show that there are three cost effective plans, No Action, Alternative 1 and Alternative 2 that can be carried forward into the incremental analysis. Alternatives 3 and 4 are not considered efficient because greater output can be produced at a lesser cost.

Table 5- 6. Disposal Plans Costs and Outputs (2009 Price Level)*

Plan	Output: (HUs)	Cost: ($)	Cost Per HU: ($)
No Action Plan	10.8	$ 0	$ 0
Base Disposal Plan	7.7	$ 4,169,000	$ 541,000
Disposal Alternative 1	15.5	$ 4,369,000	$ 282,000
Disposal Alternative 2	16.2	$ 5,197,000	$ 321,000
Disposal Alternative 3	14.6	$ 4,800,000	$ 329,000
Disposal Alternative 4	11.3	$ 10,253,000	$ 907,000

**The costs for the dredge disposal analysis were developed in 2009 and are in the 2009 price level. These costs used in the analysis were not adjusted because the relative change in the costs would not affect the results of the analysis because all alternatives would inflate at the same rate. As stated previously, the cost estimate for the selected alternative (including the BUDM components) has been updated and is reflected in Section 6. This comment applies also to all the remaining BUDM analysis in this section.*

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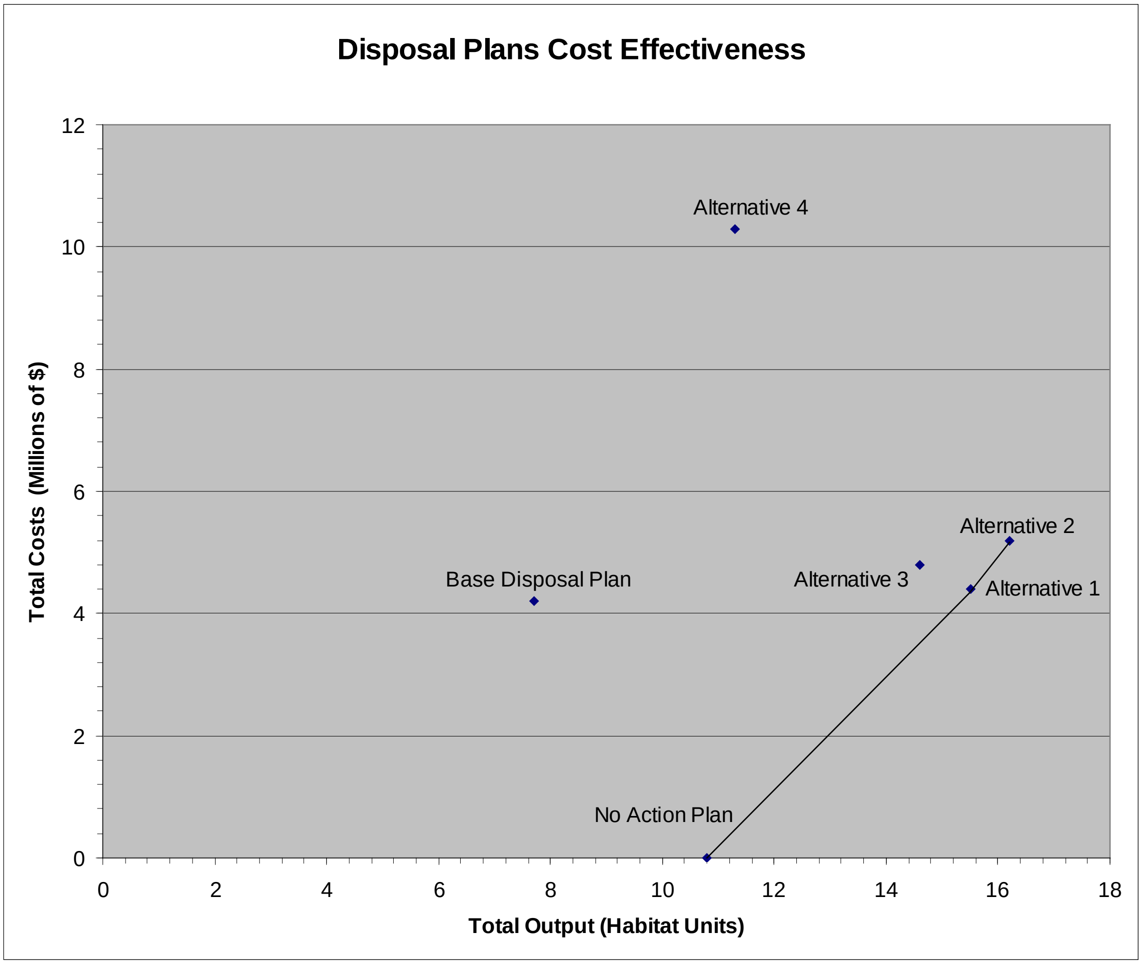

Figure 5- 1. Plan Cost Effectiveness

The next step in the CE/ICA is to perform the incremental cost analysis. The ICA is performed by computing the incremental cost, incremental output, and incremental cost per unit of advancing to each successive cost effective alternative. The Table 5-7 and Figure 5-2 show the result of the incremental cost analysis. Alternative 1 is selected as Alternative 2 adds additional HUs but at a greater cost per unit.

Table 5- 7. Cost Effective Plans with Incremental Costs and Benefits (2009 Price Level)

Plan	Output: (HUs)	Incremental output (HU)	Incremental cost ($)	Incremental cost per unit: ($/HU)
No Action Plan	10.8	0	0	0
Alternative 1	15.5	4.7	$ 4,369,000	$ 930,000
Alternative 2	16.2	0.6	828,000	1,183,000

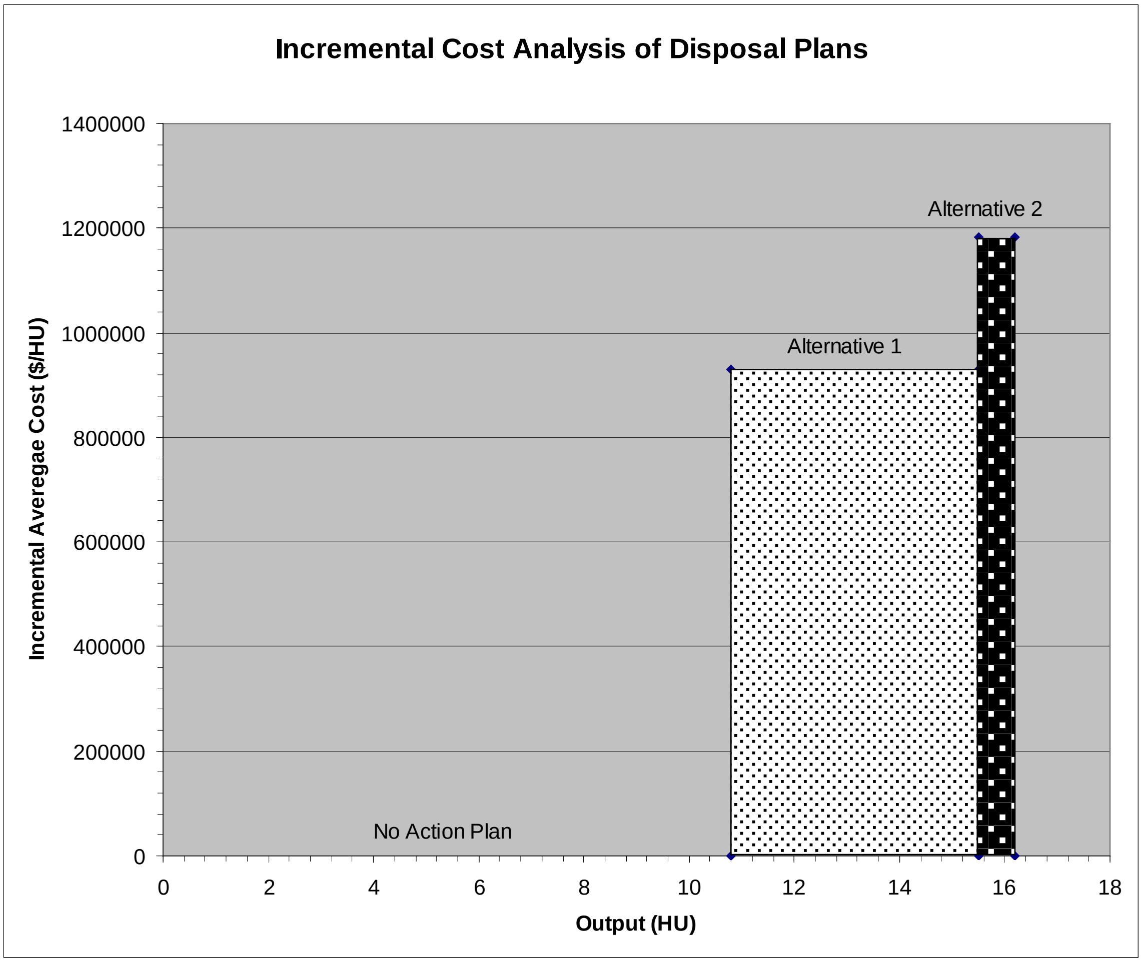

Figure 5- 2. Incremental Cost Analysis for Beneficial Use Plans.

5.4 Plan Selection

5.4.1 Identification of NED Plan

The non-Federal sponsor has identified a constraint to the maximum physical project size, and the District has shown that net benefits are increasing as that constraint is reached and that in accordance with planning regulations the requirement to formulate larger scale plans in an effort to identify the NED plan can be suspended.

The non-Federal sponsor does not want to pursue a project larger than the East Site Rubblemound 320-Vessel alternative. The sponsor deals with water quality and debris issues at the existing Valdez Harbor and wants the new harbor to meet State guidelines that call for an aspect ratio (length divided by width) between 0.3 and 3.0. The aspect ratio of the East Site Rubblemound 320-Vessel alternative is 2.9. Expanding the harbor design would exceed the guidelines unless it could be widened to the north or to the south. Expanding to the north would cut into the steep bedrock of Hotel Hill, which would be prohibitively expensive. Expanding to the south is not practicable because the bathymetry drops off rapidly. A rubblemound breakwater would be unstable and infeasible. The wave environment would not allow a cost-effective floating breakwater.

Beyond water quality, there are other reasons the sponsor prefers not to expand the design to the east or to the west. Expanding the harbor design to the west would interfere with (or require moving) the SERVS dock. Expanding the harbor to the east would be seen as encroaching upon an area recognized as being environmentally important. The USFWS has identified nearby Harbor Cove and adjacent islands as an area with high natural productivity, plant and animal diversity, and essential habitat for biological resources. The USFWS is concerned that expansion farther east would impinge on those resources. Our non-Federal sponsor does not wish to pursue an environmentally controversial project when the environmentally acceptable East Site Rubblemound 320-Vessel alternative resolves many navigation issues at Valdez.

For these two reasons, the local sponsor has identified a constraint to the maximum physical project size.

As demonstrated in table 5-8, net average annual benefits continue to increase as the sponsor-defined constraint is reached.

Table 5- 8. Net average benefits, incremental benefits and justified increment. (2010 Price Level)

Alternative	Net Average Annual Benefits	Incremental Benefits	Increment Justified
East 125	$2,147,400	NA	Yes
East 200	2,510,200	$ 362,800	Yes
East 243	2,811,100	300,900	Yes
East 320	3,318,800	507,700	Yes

5.4.2 Selection of the Beneficial Use of Dredged Material Plan

Before a selection can be made, CE/ICA guidance recommends an “is it worth it” examination be done. This project’s beneficial use of dredged material plan indicates there are multiple factors that demonstrate the worth.

The Valdez Navigation Improvements and associated Two Moon Bay Beneficial Use of Dredged Material plan, agency collaboration, potential for cost savings at the harbor, and need for more data at a deep water site are additional factors that make the plan worthwhile. Significant agency collaboration has been done to determine the best potential use of the dredged materials. The USFWS in particular has stated they wish to get as much material to Two Moon Bay as possible in hopes of not only capping the site, but potentially creating eel grass habitat in areas where water depth was less. Taking more material to Two Moon Bay would be regarded as a positive effect. Disposal plans that utilize dredged material for construction of the harbor staging area provide a cost savings for the overall project. By utilizing dredged material, 72,280 m^3 of fill material is no longer needed for the harbor staging area. This represents a savings for the LSF features.

The factors of agency collaboration, a cost savings for the harbor staging area, and not having to develop a deep water disposal site show a beneficial use of dredged material plan is worth it. Therefore, disposal Alternative 1, the cost effective and incrementally justified plan, is selected as the preferred disposal option.

5.4.3 Identification of the Tentatively Recommended Plan

The locally preferred plan, the East Site Rubblemound 320-Vessel plan, is the tentatively recommended plan. Section 6 describes this plan and its components in detail.

6.0 DESCRIPTION OF TENTATIVELY RECOMMENDED PLAN

As stated previously the cost of the selected plan in this section is different than the costs in the recommended plan in Sections 4 and 5. The alternatives were compared utilizing cost estimates prepared in 2006 and inflated to the 2010 price level. This cost basis was utilized to ensure all the assumptions and computations used to compute the alternative costs were the same for all the alternatives. When the selected plan was identified, its cost estimate required updates per comments received in Agency Technical Review and have been adjusted based on those comments and updated to 2010 price levels. Therefore, the costs for the recommended plan in later sections of the report are different than they are in the alternative analysis.

6.1 Components

The East Site Rubblemound 320-Vessel plan includes three rubblemound breakwaters, dredged entrance channel, maneuvering channel and mooring basin, and a small upland disposal area. The upland disposal site has an area of 1.87 ha located along much of the length of the north edge of the mooring basin. The 5.7-ha mooring basin would provide moorage for 320 vessels ranging in size from 9 meters to 30 meters in length. The entrance channel on the east end of the harbor is 40 meters wide. Vessels enter to the northeast and turn from 135 to 180 degrees to enter the maneuvering channel to access the fairways and floating docks. Breakwater quantities for the south, east, and stub breakwaters are 31,200 m^3 armor rock, 17,600 m^3 secondary rock, and 37,570 m^3 core rock. The side slopes of the break waters are 1V:1.5H. Figures 6-1 and 6-2 show the plan and section views. Figure 6-3 shows which features are GNF or LSF.

6.1.1 Harbor Basin

The basin is approximately 130 meters by 435 meters with depths of -2.7 meters, -4.0 meters, and –5.5 meters. The dredged slopes would be separate from the breakwater footprint. No dredging under the toe berm of the breakwaters or the upland disposal area would occur. The inner harbor slope, within and above the tidal prism, would be dredged to 1V:2H and covered with protection. The slopes that transition between the differing harbor depths would remain unprotected and dredged at a 1V:3H slope.

6.1.2 Breakwaters

Three breakwaters would be constructed to protect the harbor. The main south breakwater is 473 meters long. The eastern most 70 meters of the south breakwater angles to the northeast forming the west side of the entrance channel. The east breakwater, approximately 240 meters long, curves in an arc from the northeast to northwest to form the eastern side of the entrance and harbor. The east breakwater stops short of Hotel Hill forming the eastern breach. Side slopes are 1V:1.5H. Both breakwaters would be constructed in 0.0 MLLW to -5 meters MLLW and have crest elevations of +6 meters. A small stub breakwater protects the western breach. It is 30 meters long with a crest elevation of +5 meters.

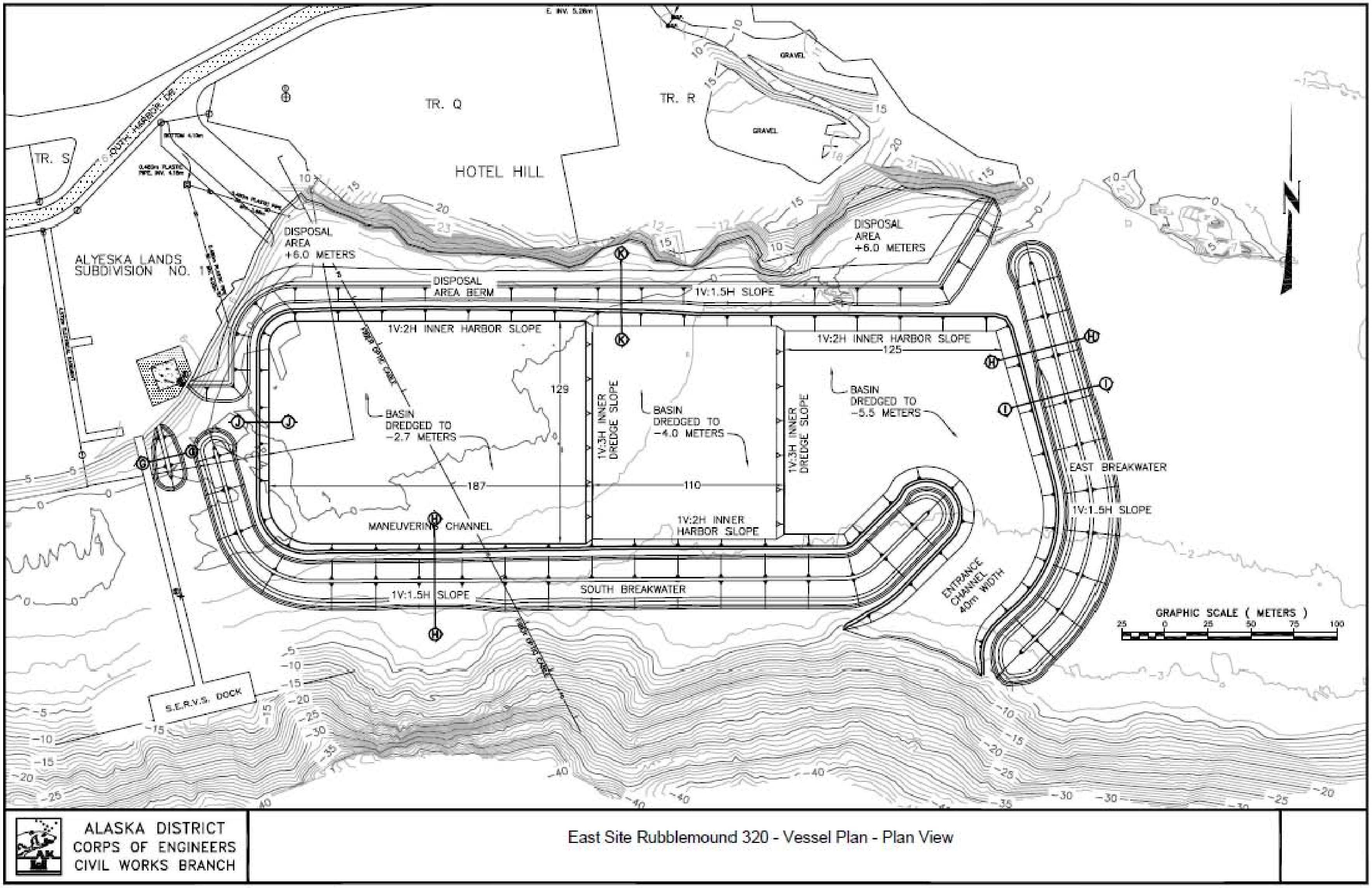

Figure 6- 1. East Site Rubblemound 320–Vessel Plan View

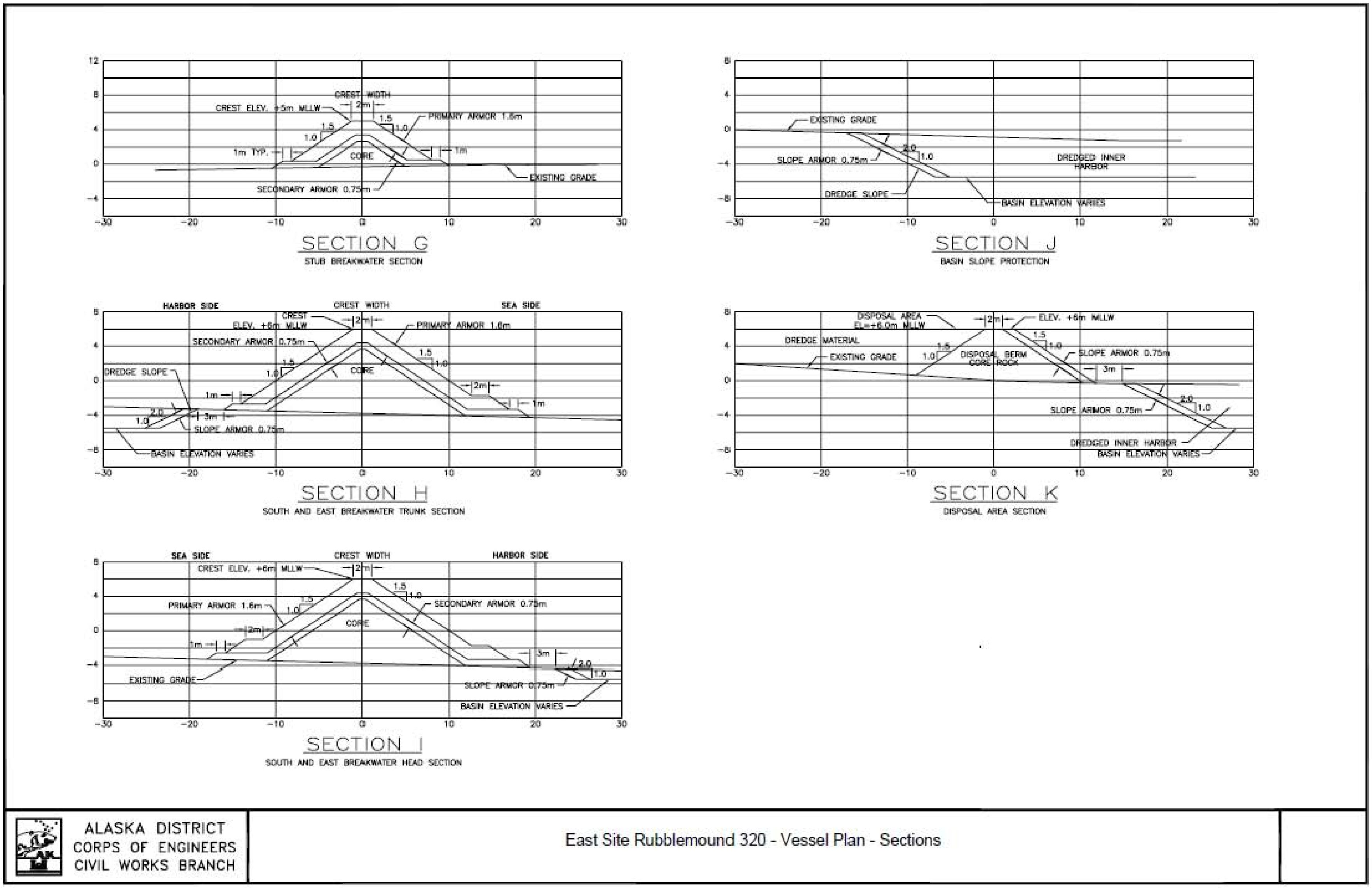

Figure 6- 2. East Site Rubblemound 320–Vessel Sections

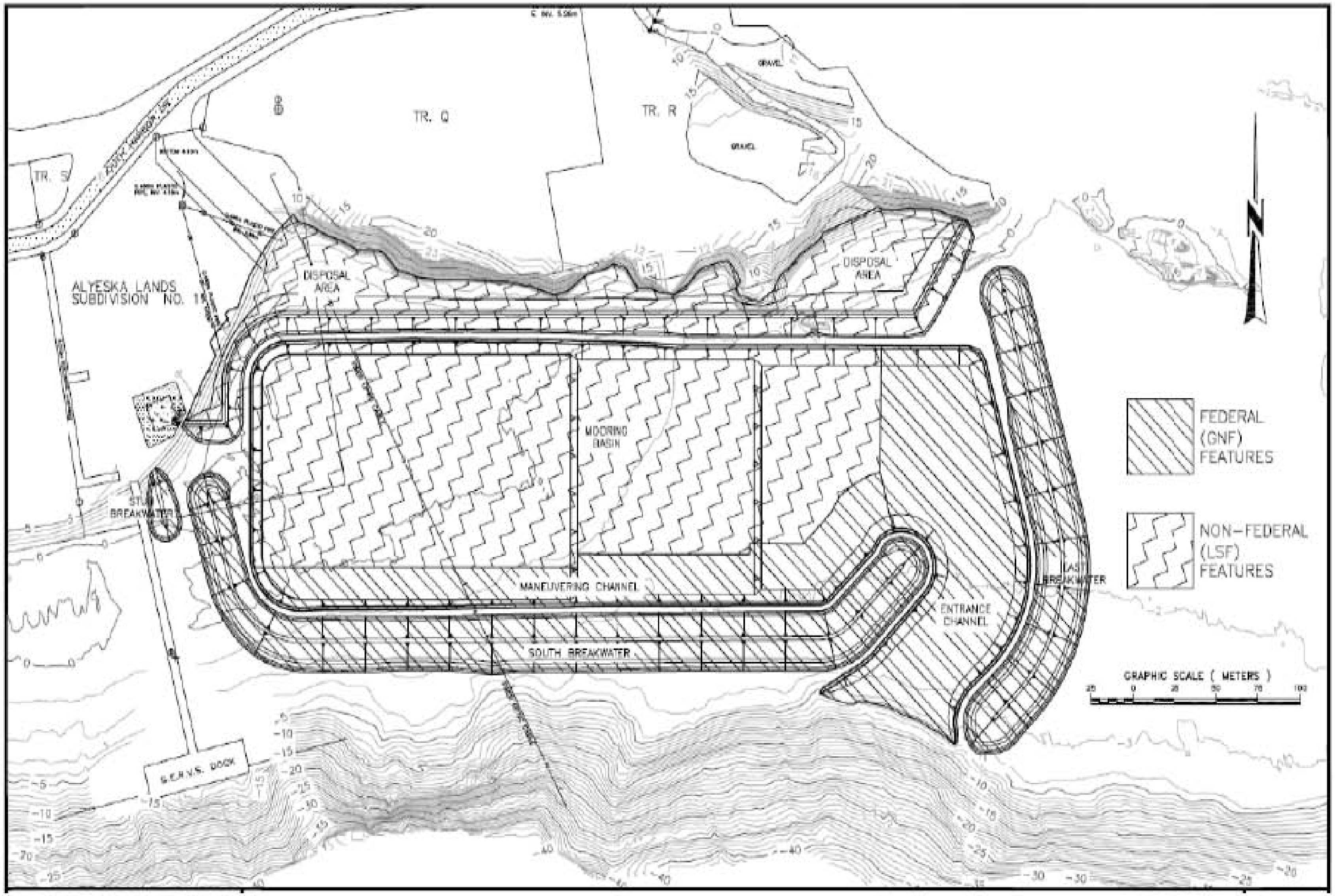

Figure 6- 3. East Site Rubblemound 320–Vessel GNF and LSF Features

6.1.3 Mitigation Plan

The recommended plan would place the entrance at the east end of the harbor away from the kittiwake colony on the SERVS dock, but the entrance would be oriented so that boats would approach from the southwest, away from Harbor Cove and the small islands to the west.

Breaches would be constructed through the east and west breakwaters near shore to minimize potential for fish entrapment, habitat segmentation, and predation losses of juvenile fish. Breaches would be designed to minimize dewatering during low tides. The western breach would be designed to ensure bottom coverage by at least 30 cm of seawater at lowest predicted tides. The eastern breach would be exposed during some low tides.

The non-Federal sponsor will provide and maintain a waste oil disposal site with adequate containment and maintenance measures to ensure proper disposal and to provide a clearly identified and accessible collection station for boating related debris and waste.

If a fueling facility is constructed in the harbor, the non-Federal sponsor will incorporate best available technology for spill prevention, containment, and recovery.

The non-Federal sponsor will post prominent signs at appropriate locations in the tentatively recommended harbor to clearly communicate the need for using provided facilities to ensure safe and legal deposition of litter, oil products, or other chemicals so that marine waters and resources are protected.

The non-Federal sponsor will construct and operate a bilge water treatment facility for use by both the existing harbor and any harbor improvements. Its location will be advertised to boat operators.

Dredging or excavation and other harbor construction activities that produce excessive sediment suspension will not be conducted during the April 15 to May 15 out-migration period unless sediments suspended by construction were contained by a silt curtain or other mechanism. Placing clean rock and other coarse material for breakwater construction does not produce excessive sediment suspension and will be allowed if the native bottom material is not disturbed by equipment used for placement. Any restrictions imposed by State resource agencies to protect returning adult salmon will be incorporated into contract requirements.

Contractors will be required to employ silt curtains or other silt containment measures if dredged material was placed in water to construct harbor support lands or facilities.

Dredged material for beneficial use at the tentatively recommended Two Moon Bay site will be discharged below the surface to reduce potential for near-surface turbidity.

Construction of the tentatively recommended plan will begin before kittiwakes begin egg laying at the adjacent SERVS dock (assumed to be May 7 unless site inspection indicates a later date). Alternatively, construction will begin after August 21, when fledging is assumed to be completed. This measure will ensure compliance with the Migratory Bird Treaty Act.

The contractor will be required to prepare a blasting plan before using any in-water explosives. The plan will be consistent with resource agency recommendations and State standards. A monitor will be used as needed and sea otters would be fully protected.

6.1.4 Dredged Material Disposal Plan

All dredged material would be used beneficially to restore habitat at Two Moon Bay or as fill material to create a harbor staging area.

The non-Federal sponsor would pay the full cost of all LSF dredged material regardless of use. Of the LSF dredged material, 72,280 m^3 would be used to create a project staging area. The remaining 52,120 m^3 of LSF material would be sent to the Two Moon Bay restoration site.

All 67,600 m^3 of GNF dredged material would be sent to Two Moon Bay at a cost of $999,000. The cost of disposing the GNF dredged material is cost shared at the same rate as the GNF features up to the cost of the base disposal plan regardless of use. The cost of the beneficial use of dredged GNF material is the difference in the cost of the GNF disposal between the beneficial use and the base plan. The cost of utilizing the GNF material for beneficial use is shared 65 percent Federal and 35 percent non-Federal.

Table 6- 1. Cost of Beneficial Use of Dredged GNF Material (2010 price level)*

	Base Disposal Plan	Alternative 1	Difference in Costs
GNF Costs	$ 211,000	$ 999,000	$ 788,000

Table 6- 2. Cost Apportionment of the Beneficial Use of Dredged GNF Material

Beneficial Use Cost	Alternative 1
Total GNF Increase	$ 788,000
Federal Share	$ 512,000
Non Federal Share	$ 276,000

*The costs shown in these tables differ from the BUDM CE/ICA analysis because only the recommended plan had its costs updated to current price levels. The total cost of all BUDM including the material from the LSF is $2,129.000. Only the GNF BUDM can be cost shared.

6.2 NED Benefits

The East Site 320-Vessel plan benefits summary (table 6-3) is based on accommodating half of all the transient vessel users at Valdez Harbor in 2006. This assumes some of these vessel owners would be on the waitlist but for the large number already on the list. This benefit summary captures the portion of total benefits that could be realized for each of the benefit categories based on the transient vessels that would be first offered space at the new harbor facility. Total present value of benefits for the 320-vessel alternative is $133.4 million with average annual benefits of about $5.2 million.

Table 6- 3. East Site Rubblemound 320-Vessel Plan Benefits Summary

Benefit Categories	Total Present Value of Benefits	Average Annual Benefits
Harbor Operations		
Harbor personnel time	$ 113,100	$ 5,300
Float and dock repairs	692,300	32,700
Commercial Fleet		
Vessel Damage	3,992,800	188,600
Vessel delays	6,344,800	299,700
Harbor of refuge	114,400	5,400
Opportunity Cost of Time	13,521,600	638,700
Tender Fleet		
Travel related expenses	2,612,300	123,400
Opportunity Cost of Time	321,800	15,200
Charter Fleet		
Vessel delays	16,367,000	773,100
Opportunity Cost of Time	3,556,700	168,000
Guaranteed space premium	1,088,200	51,400
Subsistence Fleet		
Harvest value	5,819,200	288,500
Recreational Vessels		
Recreational experience	78,857,000	2,590,000
Total Benefits With-Project	**$ 133,401,200**	**$ 5,180,000**

6.3 Costs

The cost estimate for the tentatively recommended plan was updated in 2010 and reflects a price level as of June 2010. As mentioned in Chapter 4, the alternative analysis was accomplished utilizing 2006 cost estimates updated to August 2010 using the Civil Works Construction Cost Index. The recommended plan was reworked based on Agency Technical Review comments and current price levels.

The NED first cost is $41,733,000. Cost for beneficial use of dredged material in the amount of $2,212,000 is counted as a NER cost and is therefore removed from the NED analysis.

The cost of the project, which represents that cost of construction including design, real estate, interest during construction, and contingency is $55,707,000, as shown in table 6-4. The price level is August 2010.

Table 6- 4. 320-Vessel East Site Rubblemound Plan Updated NED Cost Summary

Cost Category	320-slip Rubblemound
Mobilization/Demobilization	$ 1,983,000
Cable relocation	668,000
Breakwaters	11,739,000
Navigation Aids	6,000
Dredging and ocean disposal	2,775,000
Land disposal	783,000
Hydro survey	143,000
Inner harbor floats	21,460,000
Bank stabilization	2,264,000
Total NED First Costs	**$ 41,821,000**
Real estate	335,000
Contingency (20%)	8,911,000
Preliminary Engineering and Design (PED)	950,000
Supervision and Administration (S&A)	1,450,000
Total NED Costs prior to IDC	**$ 53,467,000**
Interest During Construction	2,240,000
Total NED Costs with IDC	**$ 55,707,000**
Present Value of Operations and Maintenance [2]	**$ 6,398,900**
Average Annual Costs (50 years at 4 3/8%)	**$ 2,968,000**

Note: Costs in this table have been updated to the August 2010 pricing level. Based on Fiscal Year 2010 Federal discount rate of 4 3/8 percent.

1. Placement of material at Two Moon Bay is estimated at $2,212,000 prior to IDC. These costs are NER and therefore not included in the NED total.
2. Operations and maintenance based on two percent of armor rock replacement every five years.

6.4 Risk and Uncertainty

As in any planning process, some of the assumptions made in this report are subject to complex social, economic, and natural variables. These assumptions are also prone to risk and uncertainty. Therefore, the intent of this analysis is to test the sensitivity of project justification and scoping to changes in the major variables used to compute project benefits. The value of this test is to reveal how the economic analysis results might vary if inputs selected for the benefit evaluation are selected differently or applied differently, thereby providing insight to the amount of confidence one can have in the economic analysis. Issues that deal with variations in data and methods are sometimes referred to as risk and uncertainty (RU) issues, and one of the techniques of revealing their significance is referred to as Sensitivity Analysis.

Methodology used in this analysis is often based on more than one available choice, and selection may be influenced by time and dollar budgets or by the anticipated significance of a variable in the overall study. Even in cases where data is based on a 100 percent sample, the results can be distorted by being out of date or by being inappropriately applied or misinterpreted. There is rarely such a thing as perfect certainty, zero risk, or strictly up-to-date information.

Taken to the extreme one would need to examine and test the risk and uncertainty of every concept, assumption, bit of data, analysis, and conclusion, separately and in combination with each other to satisfy all possible outcomes. This effort would be impractical, so the scope and intent in the RU discussion is oriented toward identification of the degree to which changes in some of the major aspects of this analysis would have a material effect on the outcome.

Major categories of benefits for this evaluation are recreational experience, vessel delays, opportunity cost of time for commercial vessels, and subsistence harvest. Additionally, project costs might increase or decrease in the time from study completion to actual construction. Table 6-5 examines the change to net benefits and the benefit/cost ratio from a 20 percent increase or decrease in the major categories along with a change in total benefits. Changes to total benefits are based on the NED plan for the East Site alternative that will accommodate 320 additional vessels.

Table 6-5 also tests the sensitivity of the major benefits categories and the total benefit category along with the major cost categories and the total cost category to the annual net benefits before and after a 20 percent change for the East Site 320-Vessel alternative.

In the worst case scenario, with a 20 percent increase in costs accompanied by a 20 percent decrease in benefits (highly unlikely), the benefit/cost ratio drops to 1.16 with net benefits of $582,400. In the best case scenario, with a 20 percent increase in benefits accompanied by a 20 percent decrease in costs (also highly unlikely), the benefit/cost ratio rises to 2.62 with net benefits of $3.8 million.

Table 6- 5. Sensitivity Analysis – East Site 320 Additional Slipholders Alternative

Category	Average Annual Claimed	20% Increase	Net Benefits after Increase	BCR	20% Decrease	Net Benefits after Decrease	BCR
Changes to Benefit							
Recreation Experience	$ 2,590,000	$ 3,108,000	$ 2,730,000	1.92	$ 2,072,000	$ 1,694,000	1.57
Charter Fleet Delays	773,100	927,720	2,366,620	1.80	618,480	2,057,380	1.69
Commercial Vessel OCT	638,700	766,440	2,339,740	1.79	510,960	2,084,260	1.70
Subsistence Harvest	288,500	346,200	2,269,700	1.76	230,800	2,154,300	1.73
Total Benefits	$ 5,180,000	$ 6,216,000	$ 3,248,000	2.09	$ 4,144,000	$ 1,176,000	1.40

	Average Annual Claimed	20% Increase	Net Benefits after Increase	BCR	20% Decrease	Net Benefits after Decrease	BCR
Changes to Cost							
Breakwaters	$ 582,000	$ 698,400	$ 2,095,600	1.68	$ 465,600	$ 2,328,400	1.82
Operations and Maintenance	317,200	380,640	2,148,560	1.71	253,760	2,275,440	1.78
Total Costs	$ 2,968,000	$ 3,561,600	$ 1,618,400	1.45	$ 2,374,400	$ 2,805,600	2.18

Worst and Best Case Scenarios	Benefits	Costs	Net Benefits after Change	New BCR
Decrease benefits and increase costs (20% each)	$ 4,144,000	$ 3,561,600	$ 582,400	1.16
Increase benefits and decrease costs (20% each)	$ 6,216,000	$ 2,374,400	$ 3,841,600	2.62

Note: Costs in these tables have been updated to the August 2010 pricing level. Based on 50-year period of analysis and Fiscal Year 2010 Federal discount rate of 4 3/8 percent.

The previous table makes adjustments to the large benefit and cost categories to test the sensitivity to the net benefits for reasonable increases and decreases to particular categories. Were the project to drop to just parity (1:1) for the benefit to cost ratio, the benefits would have to decrease by 43 percent or the costs would have to increase by 75 percent.

The most volatile factor in the costs of the project (fuel prices) would affect benefits in the same direction as the costs. That is, an increase in fuel costs would both increase the costs and the benefits for the project. To demonstrate this effect, the price of fuel in both the cost estimate and the project benefits were increased by 10 percent. The 10 percent increase in fuel costs yielded a 1.6 percent increase in project costs and a 2.5 percent increase in project benefits. Therefore, increases in the cost of fuel would not make the Valdez project less economically justified.

6.5 Accomplishments

The tentatively recommended plan would meet the project objectives in the following ways:

- Provide additional moorage to reduce time delays experienced by the commercial fishing fleet and SERVS operations.
- Provide additional moorage to reduce travel costs incurred from the overcrowded conditions.
- Provide additional moorage for vessels on the moorage waitlist.
- Design and construct breakwaters to minimize adverse impacts to water circulation and environmental resources.
- Provide additional moorage, which would decrease vessel damages caused by rafting activities.
- Provide a plan that is consistent with state, regional, and local land use plans.
- Provide a plan that is acceptable to the non-Federal sponsor.

6.6 Implementation

6.6.1 Construction

Major harbor construction items include the breakwaters, dredging, and disposal area. The breakwater toe trenches would be dredged first, followed by construction of the breakwaters. Basin dredging would then proceed as the breakwaters are constructed or would wait until they are fully completed. Dredging may be limited seasonally to reduce impacts to fish or migratory birds. Construction time is estimated to be 24 months. Construction restrictions would be detailed in plans and specifications.

6.6.2 Operation, Maintenance, Repair, Replacement, & Rehabilitation (OMRR&R)

Operation and maintenance of the local service facilities would be accomplished by the City of Valdez. These include the mooring basin and float system and disposal berms. The Federal Government would be responsible for the breakwaters, entrance channel, and maneuvering channel for the project. The Alaska District would visit the site periodically to inspect the breakwaters and accomplish hydrographic surveys of the harbor at approximately 5-year intervals. Inspections and surveys provide the information to determine if maintenance of the breakwater or dredging of the basin, maneuvering channel or entrance channel is needed. The existing harbor and entrance channel have not required dredging since their completion more than 40 years ago. Based on past experience with the existing harbor, it is assumed that the harbor alternatives would not require maintenance dredging.

The breakwater was designed to be stable in storm conditions that could be expected in Port Valdez. Little, if any, loss of armor rock or other maintenance of the breakwater would be expected over the life of the project (50 years). Historically, breakwaters designed to the conservative criteria used for these new breakwaters for Valdez have experienced no deterioration requiring maintenance for approximately 35 years. However, a value of 2 percent of the armor stone has been assumed for evaluation of the alternatives.

Shoaling has not been a problem at the existing harbor entrance or within the existing harbor. Any littoral drift material will tend to move into deeper waters off the breakwaters. Suspended sediments, most likely from the Lowe River, also have not been a problem in the existing harbor and, therefore, are unlikely to be a problem in the new harbor.

Since there is little expectation that there will be any requirement for maintenance dredging, it has been determined that if any unforeseen maintenance dredging were needed, the current Two Moon Bay restoration site contains more than sufficient capacity to meet the 20-year material capacity requirement.

Monitoring will be required for the Two Moon Bay site. Qualified biologists would conduct biological surveys at the site before construction and in years 2, 3, and 5 after construction to determine baseline conditions and recovery success.

The estimated average annual cost for OMRR&R has been calculated to be about $317,000 based upon a value of 2% loss of armor stone per year.

6.6.3 Dredged Material Maintenance Plan

The District does not expect any maintenance dredging to be required so a dredged material maintenance plan is unnecessary. The existing Valdez Harbor has not required any maintenance dredging due to very little sediment transport in the project area. The same situation is expected for the new harbor at Valdez; therefore, no dredging maintenance plan is required. If the physical conditions of the new harbor were to change in the future in some unforeseen way requiring maintenance dredging, a dredged material maintenance plan would be written then.

6.6.4 Real Property Interest

Following is a brief summary of the real estate interest necessary for the project. Details can be found in the Real Estate Appendix.

Valdez owns the majority of the East site. Only two parcels are needed: one temporary construction easement totaling 0.08 ha and one permanent access easement totaling 0.34 ha. The original mean high water line (MHW) as determined by the State of Alaska places this project below the new MHW line, meaning the sponsor bears the entire burden for acquiring the required real estate for the East Site. There is no crediting for lands provided below MHW.

A fiber optics line identified as crossing through the middle of the project would need to be relocated. No other Public Law 91-646 relocations (relocation of persons) are anticipated nor are any other utility relocations anticipated.

No interest is required for lands below MHW as these areas are subject to the Federal Right of Navigational Servitude. This would include the lands required for the Two Moon Bay disposal site.

6.6.5 Cost Apportionment

Construction costs for the project would be apportioned in accordance with the Water Resources Development Act of 1986. The fully funded cost apportionment for the project features is summarized in Table 6-6.

Table 6- 6. Cost Apportionment for East Site Rubblemound 320–Vessel Plan(Recommended Plan)

	Construction cost contribution (%)	
Portion of project	Federal	Local
General navigation features (includes entrance channel, maneuvering basin, and breakwaters)	80	20[a]
Local Service Facilities (includes floats, mooring basin, beneficial use of LSF dredged material)	0	100
Coast Guard navigation aids	100	0
Benefical Use of GNF dredged material up to cost of base disposal plan	80	20[a]
Benefical Use of GNF dredged material above cost of base disposal plan	65	35

[a]Non-federal interests must provide cash contributions toward the costs for construction of the GNF of the project, paid during construction (PDC) as follows: For project depths of up 6 meters–10%; for project depths over 6 meters and up to 14 meters–25%, and for project depths exceeding 14 meters–50%. For all depths, they must provide an additional cash contribution equal to 10% of GNF costs (which may be financed over a period not exceeding 30 years), against which the sponsor's costs for LERRD (except utilities) shall be credited. *Note:* Costs for general navigation features include associated costs, such as mobilization.

Table 6-7 provides a breakdown of the initial Federal and non-Federal project costs of the tentatively recommended plan.

The Federal government would assume 100 percent of the operation and maintenance costs for the breakwaters, entrance channel, maneuvering channel, and turning basin. The non-Federal sponsor would assume all other operation and maintenance costs. The sponsor would be responsible for providing LERRD for construction and future maintenance of the inner harbor facilities.

The non-Federal sponsor is responsible for its share of the GNF costs and 100 percent of the non-GNF costs. The pertinent data table in the front of this report provides a summary of all shared costs.

Table 6- 7. Cost Allocation for East Site Rubblemound 320–Vessel plan (Recommended Plan) (2010 price level)

	Valdez Small Boat Harbor					
	Federal/Non-Federal Initial Cost Apportionment for Potential East Site 320					
	Items	**Total Project Cost ($000)**	**Implementation Costs ($000)**			
			Federal	**%**	**Non-Federal**	**%**
WBS	**General Navigation Features (GNF):**					
10	BREAKWATERS & SEAWALLS - Mobilization	2,840	2,556		284	
10	BREAKWATERS & SEAWALLS	14,168	12,751		1,417	
12	NAVIGATION PORTS & HARBORS	2,882	2,594		288	
16	BANK STABILIZATION	1,391	1,252		139	
30	PED	669	602		67	
31	S&A	823	741		82	
01	LERR (GNF) - Fed admin cost	37	33		4	
	Subtotal 90/10 GNF	22,810	20,529	90	2,281	10
	Other GNF Features					
	Beneficial Use of GNF Dredged Material	788	512	65	276	35
	LERR (GNF) - Acquisition credit	27		0	27	100
	Relocations	802		0	802	100
	Aids to navigation (Associated Cost)	7	7	100	0	0
	Subtotal Other GNF Items	1,624	519		1,105	
	Subtotal of GNF Related Items	24,434	21,048		3,386	
WBS	**Local Service Facilities (LSF)**					
02	RELOCATIONS - Mobilization	2,396	0		2,396	
10	BREAKWATERS & SEAWALLS	0	0		0	
12	NAVIGATION PORTS & HARBORS	24,518	0		24,518	
16	BANK STABILIZATION	1,340	0		1,340	
30	PED	495	0		495	
31	S&A	917	0		917	
01	LERR (LSF)	376	0		376	
	Subtotal LSF Navigation Features	30,042	0	0	30,042	100
	Other LSF Features					
	Beneficial Use of LSF Dredged Material	1,341	-		1,341	100
	Subtotal of LSF Related Items	31,383	0		31,383	
	TOTAL FIRST COST ALLOCATION					
		55,817	21,048		34,769	
	Additional Local Funding Requirement		**Federal**		**Non-Federal**	
	10% of GNF		-2,281		2,281	
	GNF LERR credit (RE, Admin, Relocation)		829		-829	
	Adjustment for GNF with LERR credit		-1,452		1,452	
	FINAL COST ALLOCATION		**Federal**		**Non-Federal**	
			19,596		36,221	
	All Costs are October 2010 price level					

6.7 Views of Local Sponsor

The local sponsor is very supportive of this project and is eager for the Corps to complete this feasibility study. During development of the feasibility study, the local sponsor had indicated their preferred plan was a harbor that would be constructed to the maximum size possible to the east of the SERVS facility without causing undue environmental consequences, and that they would request that plan be their locally preferred alternative. Further information regarding local sponsor views can be found in Section 9.0 Public Involvement.

6.8 Financial Analysis

The sponsor has completed their self certification of financial capability, which is included in the Correspondence Appendix.

7.0 AFFECTED ENVIRONMENT

This section focuses on the principal issues and concerns identified in Section 2.3 and on conditions that constrain or otherwise affect planning for navigation improvements at Valdez and beneficial use of dredged material at Two Moon Bay.

7.1 Physical Environment

The physical environment includes the landform, topography, bathymetry, soils, rocks, aquatic/marine bottom material (sediments), climate, air, and water. Principal concerns about the physical environment are related to constraints on planning, constructing, and operating a project and about issues and concerns related to potential project impacts.

Principal identified constructing and operating constraints are seismicity, water depth, site topography, foundation material composition, potential for icing, waves, and tides. Principal environmental concerns are linked to water quality, air quality, and contamination in sediments.

Port Valdez and Valdez Arm together form a 46-km northeasterly extension of PWS. Port Valdez is a relatively deep, narrow, east-west oriented, glaciated formation that is properly termed a fjord. It extends about 23 km eastward from Valdez Narrows. Port Valdez is about 5 km wide by 18 km long and is shaped somewhat like a bathtub, bounded by steep sides on the north and south with a flat horizontal bottom at a depth of about 240 meters over three-quarters of its length. In the easternmost quarter of the fjord, the bottom rises to the shore at the former townsite of Valdez.

Two Moon Bay is a divided and comparatively narrow bay near the mouth of Port Fidalgo off Prince William Sound. It slopes rapidly from the rocky shoreline into water more than 20 meters deep. Two Moon Bay is relatively distant from glacial inflows and the natural bottom is generally rocky or mixed substrate.

7.1.1 Geology

The geomorphology of northeastern PWS results from a combination of extensive tectonic forces, including regional uplift and intrusion of igneous rocks and massive glaciation. The tectonic forces at work in the Valdez area are associated with its location in the circum-Pacific Seismic Belt and, more specifically, in a tectonic subduction zone where two tectonic plates collide.

The rocks in northeastern PWS are mainly graywacke, slate, and argillite of the Valdez Group, mildly metamorphosed locally to phyllite or green schist facies. Since the last glaciers that covered the region began to recede, these rocks have been rebounding (rising upward toward pre-glacial elevations). Both the depressing process and the ongoing rebounding have created a complex system of joints (regularly occurring cracks) in the rocks.

Seismic Hazards. PWS, including Valdez, is in a seismically active zone. Earthquakes in this zone can be severe and have caused loss of human life and extensive damage to structures and facilities. Earthquakes present hazards from ground rupture, ground shaking, ground failure, and tsunamis. Ground rupture opens the ground surface as the result of fault displacement or ground failures beneath the surface. Ground shaking is movement induced by the energy released by an earthquake. Ground failure is the loss of ground strength by liquefaction, sliding, and other effects of earthquake shaking. Tsunamis are the seismic sea waves caused by the energy release of an earthquake. Eleven major active fault systems within 390 km of Port Valdez are capable of producing earthquakes strong enough to affect Valdez. The dominant earthquake source for Valdez is the tectonic plate boundary that underlies the region around Valdez at a depth of about 12 km.

Most economic and social damage during the 1964 earthquake was along the shoreline of Port Valdez and was caused by ground failures and seiches (mass water movements that may cause damage like tsunamis) generated by submarine ground failures. Ground shaking led to liquefaction of the unsupported delta deposits and submarine sliding, which in turn generated, or at least amplified, the seiches. Most damage was within 1,500 meters of the pre-quake shoreline. The principal causes of damage to structures away from the waterfront were ground rupture and failure liquefaction of saturated sands and gravels underlying structures. About 40 percent of the homes and most of the commercial buildings in Valdez were destroyed or seriously damaged.

Two Moon Bay is a less confined water body than Port Valdez, but is subject to the same seismic forces and to tsunamis from any seismic activity that would affect PWS.

7.1.2 Soils and Sediments

Soil-forming processes have not progressed much in the area. The dominance of mechanical weathering and the steepness of the slopes have allowed formation of only a thin mantle of soil. Below about the 610-meter elevation, vegetation dominated by alder shrub binds the soils. Above this elevation, soil is removed rapidly by landslides and soil creep, thus retarding or preventing the development of soil-holding vegetation. Without benefit of supporting vegetation, the accumulated debris is drawn down by gravity and precipitation, causing active mass wasting.

Marine Sediments. Most of the Port Valdez shoreline is steep and rocky, except where major streams and rivers have formed deltas where they discharge into the fjord. At the eastern end of Port Valdez, the Lowe and Robe rivers and Valdez Glacier Stream have formed the extensive Valdez outwash delta upon which the town of Valdez was located until the 1964 earthquake. The present site of Valdez is an alluvial fan deposited by Mineral Creek. Both the Valdez outwash delta and the Mineral Creek alluvial fan consist of poorly consolidated alluvial and glacial deposits of silt, sand, and gravel. Finer sediments transported into Port Valdez by the streams and rivers have formed tidal flats at the seaward edge of these deltas.

Intertidal and subtidal bottom material at the East harbor site is pro-grading glacial-fluvial sand and gravel that overlies marine deposits consisting primarily of silt with silty sand interbedded. A deeper unit of sand and gravel underlies this layer at depths of 23 to 30 meters. The depth to bedrock is not known, but is assumed to be 100 meters or more. The near-surface sand and gravel materials were deposited as glacially-derived outwash and alluvium. This subangular to subround material is gray to black, ranges from loose to dense, and is poorly sorted. Boulders were not encountered in limited site evaluations except along the shoreline.

Marine bottom material at the East Site is primarily black, non-plastic silt with interbedded silty fine sand. Traces of gravel and organic material are present. Material from soil borings was poorly graded sand with gravel, poorly graded sand with silt and gravel, poorly graded sand with silt, and silty sand. The percent fines (amount of material passing through a No. 200 screen) ranged from 2 to 20 percent. Figure 7-1 shows intertidal shoreline at the West site.

The USFWS Coordination Act report (Appendix 4) noted: "There is a high silt load traveling via the slow, predominantly west flowing current, resulting in moderate deposition and high turbidity throughout the project area. Substrate within the subtidal areas includes muddy sands, cobbles and a mixture of shale rock, mud, and sand. Adjacent slopes are composed of muddy rock." USFWS SCUBA dive transects in both the East and West site alternatives (Appendix 4) found extensive fine grey mud near shore, grading to very fine soft mud in deeper water (20 meters below MLLW) at the deep end of the transects. Divers noted scattered gravel and individual rocks out to depths of about 8 meters MLLW, but silt evidently covered any hard substrates at greater depths they examined.

Two Moon Bay is far from glaciers and rivers carrying glacial sediment, so there is almost no discernable accumulation of this material. The natural bottom is mostly rocky with relatively small areas where gravel and silt have collected. At the log transfer site, the bottom is largely covered by fine, soft, loose, organic material from decayed coniferous tree bark and woody debris.

Soil and Marine Contaminants. The *Evaluation of Dredged Material Proposed for Discharge in Waters of the U.S. - Testing Manual* (U.S. Environmental Protection Agency [EPA] and USACE, 1998) is used to determine whether sediments should be tested for contaminants before dredging. Nine sediment samples were collected from the East alternative site in October 1997 and were tested for total organic carbon, nitrate and nitrite, sulfate, volatile organic compounds (VOC), semi-volatile organic compounds (SVOC), arsenic, barium, cadmium, chromium, copper, lead, mercury, selenium, silver, zinc, eight polychlorinated biphenyls (PCB’s), and pesticides (Chemical Data Report, Materials Section, Alaska District U.S. Army Corps of Engineers, 1997).

Figure 7- 1. Intertidal shoreline at the West Site.

Sampling results indicate that the material at the East Site is suitable for inland water disposal. All sediments in the proposed expansion area meet the strictest State of Washington (SMS) and Puget Sound Dredged Disposal Analysis (PSDDA) sediment management levels. The only chemical contamination of concern was found in the surface sample, -01SD, collected in the parking lot north of the East harbor site. Sample -01SD exceeded the PSDDA screening levels for mercury, silver, indeno (1,2,3,-cd) pyrene, total PCB's, total xylenes, and ethylbenzene. This contamination is believed to be from surface spills in the parking lot and the nearby trash pickup container. This sample was collected outside the area that would be dredged for the East site alternative. Screening levels for contaminants were established in the Pacific Northwest as a basis for deciding whether further, more elaborate chemical or biological testing should be conducted before deciding whether material dredged from a site could be discharged into the open marine environment without harming marine biota.

On May 5 and 6, 2000, sediments samples were collected from test pits at the East and West harbor sites. The sediment samples were analyzed for VOCs, SVOCs, diesel range organics, residual range organics, metals, pesticides, PCBs and total organic carbon, and sulfate. Analytical results were compared with PSDDA, SMS, and Lower Columbia River Management Area (LCRMA) guidance documents. No reported results or method detection limits from this sampling series were above the PSDDA or LCRMA maximum levels or biological trigger values (Chemical Data Report, Materials Section, Alaska District U.S. Army Corps of Engineers, 2000).

The Corps prepared a Final Chemical Report in 2004 for the West harbor alternative site. This effort was performed concurrently with the geotechnical survey of the site. Three auger points were drilled and field screened for volatile contaminants. Selected composite samples were analyzed for fuels, volatile organic compounds, semi-volatile organic compounds, total organic carbon, ammonia, sulfides, organo-tins, total volatile solids, metals, pesticides, and PCB’s. This limited effort showed no evidence of soil contamination in the field screening or analytical results.

Chemical sampling on these three separate occasions found contaminants at one sampling site outside the tentatively proposed harbor area, but none were at screening levels in the area where the harbor would be constructed.

The Two Moon Bay log transfer site was permitted by the Alaska Department of Natural Resources to the Tatitlek Corporation between 1986, when the initial letter of entry was issued, and about 1999, when the site lease was relinquished and the State closed the file. During that time it expanded from an initial 0.4 ha lease to a final lease of about 10 ha, making it one of the larger log transfer sites in PWS. Divers surveying the site estimated that about 70 to 80 percent of sea bottom at the site was substantially covered with bark and other debris from the coniferous logs that were yarded and rafted together to be towed to processing facilities or transferred onto barges and ships.

Studies of log transfer sites summarized by The Rivers and Smith Salmon Ecosystems Planning Group (RSSEPS) (2004) define a slow process of bark and debris decomposition that may span decades. Initial decomposition produces hydrogen sulfide, ammonia, terpenes, tropolones, and other toxic compounds that may limit biota in and on the substrate. Ammonia and hydrogen sulfide are produced by the anaerobic breakdown of most organic material. Bottom muck disturbed in even the cleanest marine environments is likely to release the characteristic "rotten egg" odor of hydrogen sulfide. Exchange of seawater and oxygen through the interstitial space between soil particles tends to allow this material to slowly diffuse from bottom mud. Diffusion reportedly is slower from bark and debris beneath log transfer facilities, presumably because the decomposing bark forms tighter substrates with less interstitial space for diffusion and exchange. This property also tends to lessen oxygen transfer, which may prolong anaerobic conditions in that substrate. Cellulose and lignin apparently are the most enduring of the debris components at the end of the biodegradation process and may be present a decade or more after bacteria have broken down almost all other organic constituents of the debris.

Coordination with the Alaska Department of Environmental Conservation during initial evaluation of restoration alternatives determined that this decomposing bark is not suitable for in-water disposal. Earlier evaluations of habitat restoration alternatives found that it would be infeasible to collect this material for remediation on-shore at Two Moon Bay or at an off-site facility.

7.1.3 Climate

Summers typically are cool and winter temperatures usually are relatively mild in Valdez. The mean annual temperature is 3.5 °C; the average summer temperature is 10.3 °C, while winter mean temperature is -4.2 °C. Cold polar air masses often meet warm, moist maritime air masses in this region. These combine to produce average annual precipitation of more than 1.6 meters annually. Winds are generally from the north-northwest between October and March and from the southwest-west between May and August.

Climatic conditions have not been recorded at Two Moon Bay. Temperatures, precipitation, and other conditions there probably are about like those of Valdez, but with less extreme temperatures in the winter and more precipitation because it is closer to large marine water masses.

7.1.4 Freshwater Inflow

Major freshwater inflow sources to Port Valdez include Shoup Glacier Stream, Mineral Creek, Valdez Glacier Stream, and Lowe River. Shoup Glacier Stream discharges into the northeast corner of Port Valdez. Mineral Creek flows along the western edge of Valdez before discharging into Port Valdez. It drains about 119 km^2. Lowe River originates in the mountains approximately 45 km east of Valdez, draining an area of 896 km^2, 35 percent of which is covered by glaciers. Lowe River discharges into the southeast corner of Port Valdez.

Valdez Glacier Stream flows approximately 6 km from the terminus of Valdez Glacier to the northeast corner of Port Valdez. It flows across a wide outwash delta composed primarily of silty sand and gravel. The old Valdez townsite was located on this outwash until it was destroyed by the 1964 earthquake. Valdez Glacier Stream drains an area of 412 km^2, over half of which is covered by glacier.

Both the East and West harbor alternative sites at Valdez are away from direct freshwater inflow from streams that could cause or exacerbate icing in a new harbor.

Two Moon Bay receives fresh water from small, local intermittent, and perennial streams. Freshwater inflow is too minor to substantially affect marine characteristics of Two Moon Bay.

Groundwater at Valdez is limited to glacially formed stream valleys containing deposits of mixed alluvium, colluvium, and glacial outwash deposits. Those deposits serve as aquifers that are recharged by snowmelt, glacier melt, and rainfall from late spring through late fall.

7.1.5 Marine Water Characteristics and Movement

Especially notable are the large amounts of glacial silt and sediment deposited in Port Valdez by Lowe River and Valdez Glacier Stream. Figure 7-2 shows summer turbidity at the project site.

Figure 7- 2. Turbidity at the project site.

Divers noted strong turbidity stratification in the summer, with the highly turbid glacially influenced water in the upper 3 meters and less turbid water beneath.

Barron and Barron (2005) reported that in some parts of Port Valdez, 99 percent of ultraviolet light was attenuated in the first centimeter of surface water, while in outer PWS it penetrated more than 5 meters before the same level of attenuation.

7.1.6 Circulation

The Port Valdez fjord is a "positive" estuary; it receives more fresh water by runoff and precipitation than is lost through evaporation. Each summer, this sets up typical estuarine circulation, with seaward movement of a warmer, brackish upper layer and landward movement of cooler, deeper, more saline ocean waters. The tidal prism (ratio of water that comes in with each high tide) is about 1.6 percent of the total volume of Port Valdez. Recent estimates of freshwater inputs to the fjord during maximum runoff (July) suggest a mean value of about 7 percent of the tidal prism with extreme values of 2 to 15 percent. The major portion of freshwater input is from Lowe River, Valdez Glacier Stream, and Mineral Creek.

Brackish water is confined to the top 15 meters of the water column during the summer, overlaying the heavier, saltier water from PWS (Valdez Coastal Management Program report, 1982). As freshwater inflow declines in the autumn, stratification breaks down and water temperature and salinity become more uniform through the water column.

Tidal and weather-induced flows create a fairly vigorous current structure in Valdez Narrows. Current measurements at the eastern end of Port Valdez have suggested water movement there is sluggish.

Port Valdez tides are mixed (both diurnal and semi-diurnal). Table 7-1 lists the tidal data.

Table 7- 1. Tidal Data, Measured, from Mean Lower Low Water in Meters

Extreme High Tide	5.20
Mean Higher High Water	3.70
Mean High Water	3.42
Mean Tide	1.98
Mean Low Water	0.46
Mean Lower Low Water	0.00
Lowest Observed Water Level	-1.51

7.1.7 Air Quality

Air quality in Valdez is strongly influenced by sources of contaminants and the topographic/meteorological characteristics that affect air movement and the dispersion of pollutants. Contaminants are from combustion of fossil fuels for transportation and power generation and fugitive hydrocarbon compounds from fuel storage and transfer at the Alyeska Terminal complex and associated tanker traffic. Port Valdez is surrounded by steep mountains. Several glacial and river valleys feed into Valdez. These topographic characteristics create a complex "bowl-like" effect that reduces air circulation and mixing. The relatively high frequency of calm surface winds accompanied by early morning surface inversions and stable above-surface layers can allow air pollutants to accumulate. Overall, however, air quality in Port Valdez is good, and Valdez is not in a non-attainment area.

Two Moon Bay is distant from industry, populations, mining, and transportation. Air quality is unimpaired by local or regional sources.

7.2 Biological Environment

Public and agency scoping, field observations, and literature identified principal biological resources of concern at Valdez and in Two Moon Bay. The importance of some biota is defined or implied by statute. The following biota are represented in Port Valdez and/or Two Moon Bay and are specifically protected:

Fish (Magnuson-Stevens Act)
Marine Mammals (Marine Mammal Protection Act)
Birds (Migratory Bird Act)
Threatened and Endangered Species (Endangered Species Act)
Bald Eagles (Bald and Golden Eagle Protection Act)

Department of Interior Coordination Act reports also may identify important biological resources. The Valdez U.S Fish and Wildlife Coordination Act report (Appendix 4) identified important resources in terms of assemblages and habitats. It focused on birds (primarily sea birds, waterfowl, and shorebirds), marine mammals, and salmon. It also briefly identified some of the important habitat at harbor sites considered in detail, but focused more on nearby tidelands and wetlands (Duck Flats and Harbor Cove) that could be affected by coastal development.

Coastal management plans identify important resources and develop policies to protect them. Navigation improvements at Valdez could affect six habitats classified in Coastal Zone Management Act planning and addressed by the Magnuson-Stevens Act. They are as follows:

Essential fish habitats
Estuaries
Wetlands and tide flats
Intertidal and near-shore subtidal communities
Rocky islands and sea cliffs
Deep-water communities (offshore habitats)

Literature reviews, public and agency scoping, and review of the resources protected by statute were synthesized into the following list of resources that are of particular concern for the Port Valdez and Two Moon Bay areas:

Wetlands and tidal flats
Marine algae and eelgrass
Marine invertebrate assemblages important to fish, birds, and sea mammals
Marine and anadromous fish
Birds
Marine mammals

This section of the Valdez report describes those resources and focuses on species, communities, and habitats that are of particular concern. The next section (Section 8) addresses potential effects a new navigation project and dredged material placement could cause to those resources.

7.2.1 Wetlands and Tidal Flats

Wetlands and tidal flats are freshwater and saltwater habitats with and without vegetation. Wetlands are vegetated areas that are partially submerged either continuously or periodically. Saltwater wetlands are coastal areas along sheltered shorelines characterized by halophytic hydrophytes (moisture-tolerant plants growing in a saline soil) and macroalgae extending from extreme low tide to an area above extreme high tide that is influenced by sea spray or tidally influenced water table changes. Freshwater wetlands contain water of less than 0.5 parts per thousand salt content and do not exceed 3 meters in depth. Tidal flats are unvegetated areas that are alternately exposed and inundated by falling and rising tides.

Saltwater wetlands and the associated tidal flats are common in eastern Port Valdez, but less common west of the Alyeska Terminal and Gold Creek. Major saltwater wetlands and tidal flats in Port Valdez extend from the southwest portion of the Duck Flats to the northwest edge of the Duck Flats. Additional significant wetlands and tidal flats in Port Valdez are at Mineral Creek Flats and Gold Creek.

The generally estuarine condition of Port Valdez is evident in the vegetation communities of the saltwater wetlands. They typically contain vegetation and algae common to fresh or brackish water rather than marine vegetation and algae.

The Duck Flats. These are northeast of the harbor sites considered in detail and consist of about 400 ha of highly productive intertidal fish and wildlife habitat. Predominant wetlands in the Duck Flats are intertidal estuarine salt marsh, which depends on daily tidal inundation and freshwater flow from coastal streams. The salt marsh segment of the flats is the largest salt marsh in Valdez Arm. This area has been called the most productive biological community in Port Valdez. Its high natural productivity, plant and animal diversity, and habitat value for biological resources all contribute to its regional importance. The Duck Flats has been nominated as a coastal area meriting special attention in coastal management planning for the Valdez area.

Harbor Cove. This is a 20-ha water body east of the existing Valdez Harbor. It is protected by reefs and reef-like islands to the south, the existing Valdez Harbor to the west and southwest, and bounded by the Duck Flats to the north (figures 3-2 and 4-3). It is shallow, less than 3 meters deep at low tide, and mostly soft bottomed. It contributes to the intertidal characteristics of the Duck Flats and is significant habitat in its own right. It is influenced more by freshwater runoff than the main body of Port Valdez. It tends to be warmer and is less subject to waves and currents than most of Port Valdez.

Tide Pool Habitat. Depressions in the intertidal shoreline retain water and remain immersed during each tidal cycle. Those depressions may be small, a few centimeters across in the space between rocks for example, or may be several meters across. Organisms in tide pools may be separated from the main water body for hours each tidal cycle or for only a few minutes at the lowest tides of the year. Temperatures, dissolved oxygen, salinity, and turbidity in tide pools may be markedly different from the larger water body during the periods when they are isolated. Tide pools can be lush habitats on shorelines where marine waters are clear and may contain biological assemblages that are uncommon elsewhere. Tide pools on the silty shores of Port Valdez typically are shallow and less abundantly populated. They may, however, be a distinct habitat type and may function as habitat for invertebrates and small fish. Those mudflat tide pools also may offer shorebirds feeding opportunities they might not find elsewhere.

Tide pools were mapped at the east and west alternative harbor sites. Their locations are shown in figures 7-5, 7-8, 7-10 and 7-11. Tide pools are not present at or near the proposed dredged material disposal site in Two Moon Bay. Biologists surveying the East and West alternative harbor sites mapped tide pools in the mudflats there but did not note any substantial difference between biota in the tide pools and in the surrounding exposed mudflats. Shorebirds may feed more often or more successfully in the tide pools than in the surrounding habitat, but observations at the project site alternatives were inconclusive. Tide pools are treated as potentially valuable habitat because that function cannot be dismissed with available information.

7.2.2 Marine Algae and Eelgrass

Phytoplankton in PWS peaks in April, then declines in late spring and summer as suspended glacial flour (finely ground rock particles that are easily suspended in water) diffracts and limits sunlight penetration, which limits algal photosynthesis. Barron and Barron (2005) reported that 99 percent of ultraviolet light is attenuated about 2.5 meters deep in outer Valdez Arm and at about twice that depth in the open marine waters of central PWS. The same source reported that the same degree of attenuation was observed in the first few centimeters of surface water at some observation points in Port Valdez.

The clearer waters of outer Valdez Arm support dense beds of eelgrass (*Zostera* sp.), with individual plants more than 2 meters long and highly diverse and productive kelp assemblages on almost all of the abundant rocky bottom habitat down to depths of 20 meters or more. As might be expected, the limited light penetration in Port Valdez profoundly reduces primary productivity by phytoplankton, kelps, and eelgrass (the only vascular marine plant in Port Valdez).

Distribution, abundance, and diversity of kelp, other marine algae, and eelgrass in the alternative sites considered in detail may be largely determined by three abotic factors:

1. Desiccation, temperature, and ice scouring limit community development in the upper intertidal range;
2. Soft or shifting bottom material in most of the habitat provides limited anchoring sites for the larger kelps, and suitable bottom composition for eelgrass is comparatively rare;
3. Restricted light penetration limits photoproduction by attached algae and plants so that they can survive only in intertidal or the very shallow subtidal habitats, where they are exposed to light frequently enough to allow enough productivity for survival. Photosynthesis in this comparatively limited vertical range is further limited by silt that settles on eelgrass and kelp and further reduces available sunlight.

Feder and Keiser (1980) and Feder and Bryson-Schwafel (1988), Lees et al. (1979), USFWS appendix), and Corps biologists have at various times in the last 3 decades identified eelgrass and algae, and their distribution in or near the alternative project sites in Port Valdez. Their general observations can be summarized as follows:

The limited rocky intertidal habitat supports comparatively dense patches of rockweed (*Fucus distichus*) along a band at the -1-meter contour. Green algae *Monostroma* sp.) and other algae also are present. The mud and sand in this intertidal reach support sparse ribbon kelp other scattered (mostly brown) algae. A noteworthy band of kelp (*Laminaria saccharina*) runs along the lower margin of the tide line (deeper than about 0.5 meter MLLW) nearly continuously through the alternative sites. Figure 7-3 shows the laminaria kelp band in the project area. Several small and relatively sparse (4-square-meter) eelgrass patches are in the subtidal regions both west and east of the SERVS pier. Figure 7-4 shows an unusually luxuriant patch of eelgrass in the project area.

East Site. Feder and Keiser (1980) described algae at the East alternative site from their Island Flats (Duck Flats) station as follows:

> "The high intertidal zone at Island Flat is dominated throughout the year by the brown alga kelp *Fucus distichus*; the green alga *Ulothrix flacca* fluctuates seasonally in abundance. Other algae, which also appear in the high intertidal zone during summer and fall, are *Pylaiella littoralis* and *Enteromorpha* spp. *Fucus distichus* extends down into the mid-intertidal zone.
>
> In early spring diatoms form a noticeable brown cover on low intertidal rocks and sediment, and subsequently disappear by early summer. The characteristic low intertidal band of *Monostroma spp*. undergoes a spring-summer proliferation, with subsequent reduction in abundance in the fall and winter. The filamentous red alga, *Pterosiphonia bipinnata*, persists as a low intertidal species throughout most of the year, much the same as the rare yet consistent occurrence of the snail *L. scutulata*.

Figure 7- 3. Laminaria kelp band in the project area.

FFigure 7- 4. Eelgrass patch in the project area.

> *Collisella pelta* reaches its highest densities at the 0.0-meter height at Island Flats, and exhibits seasonal fluctuations. The additional agal species sampled are primarily low intertidal in distribution and early spring-summer ephemerals."

Lees et al. (1979) also investigated intertidal and shallow subtidal habitat in Port Valdez and summarized their findings as infaunal and visually observed species assemblages.

Corps and NMFS biologists' observations matched those of Feder and Keiser (1980); *Fucus distichus* grew abundantly in a narrow band along the higher intertidal zone at the base of Hotel Hill but less abundantly down to about 0 meter MLLW on the tide flat. *Monostroma* and *Ulothrix* were present in low abundance, and *Laminaria* grew in a narrow band starting about the -0.9-meter depth and probably grew in water deeper than -1 meter.

Feder and Keiser (1980) did not mention eelgrass (*Zostera marina*) at the East harbor site during their 1976 to 1978 study. Lee et al. (1979) reported small patches of eelgrass at this site, and biologists reported the same in August 2005. The 2005 report noted that eelgrass at the East harbor site was limited to depressions in the *M. edulis* bed where silt has collected to sufficient depth for the plant to take root.

Figures 7-6 and 7-7 show the distribution of rockweed and laminaria, the two principal kelps in the area and of eelgrass at the East site.

West Site. Figures 7-9 and 7-12 map the distribution of the two principal kelps (rockweed and laminaria) and eelgrass at the West site. That figure indicates the total extent of laminaria habitat is about the same at both sites. The West site had about the same extent of rockweed as the East site, but rockweed was not as dense, and there was no heavy rockweed cover along the shoreline that figures 7-6 and 7-7 show at the East site. Species diversity was judged to be richer at the East site during the 2005 Corps-NMFS surveys, but the differences were not quantified.

7.2.3 Intertidal invertebrates

The intertidal and shallow subtidal habitats of PWS were profoundly altered by the great 1964 Alaska earthquake, which raised the sea floor by 7 meters at some locations. Scouring by tsunamis and seiches set up by that event wiped out major communities, altered bottom composition over wide areas, and produced wide-spread sediment movement that buried other habitats. Much of PWS shoreline is still evolving into a new substrate and biological equilibrium.

Invertebrates in the intertidal and shallow subtidal habitats in Port Valdez range in size from tiny crustaceans less than 1 mm long to much larger sea stars, bivalves, and other mollusks. Harpacticoid copepods are the smallest of the invertebrates specifically reported in the alternative harbor sites. These little crustaceans typically feed on filamentous diatom algae, were abundant throughout both the East and West sites, and are important to several species of juvenile fish, including chum salmon. They typically live on or close to the bottom.

East Site. Amphipods, a group of small crustaceans, were abundant in the heavier rockweed (*Fucus*) community in the upper tidal range at the East alternative site (figures 7-5 and 7-8). Several types of snails, including periwinkles (primarily *Littorina sitkiana)* and whelks *(Nucella lamellose)*, also crawl slowly over the bottom feeding on mussels, clams, and other bottom organisms. They are widely spread over the area but winter in deeper water and are more abundant in the shallows only during the summer (Feder and Keiser 1980).

Barnacles *(Balanus* spp.) are abundant, but typically small. Their spat settle on hard surfaces in mid summer and grow well into autumn, but few survive the rigors of winter. Limpets (*Collisella pelta)* and blue mussels (*Mytilus edulis)* attach to hard surfaces in intertidal and subtidal habitats throughout the area and are moderately abundant. In optimum habitat, mussels may attach to each other and aggregate with rockweed and other kelp to form dense blankets more than 20 cm thick. Mussels at the harbor site alternatives are much more modest in size, typically less than 3 cm long, and are most densely aggregated where the bottom has more gravel and less soft mud. Even in this firmer substrate they were partially smothered in mud. In this habitat, they have not colonized into the thick beds that would be found in less turbid areas of PWS. Mussel beds mapped at the East alternative harbor site are shown in figures 7-5 and 7-8.

Sea stars were absent from the East alternative site during summer field surveys, but have been reported there in the spring. Sea stars typically prefer salinity at close to marine levels, so they may have moved out of the warmer, less saline shallower water and into deeper water during the summer. Isopods, limpets, and shore crabs (*Hemigrapsus oregonensis*) were present, but not abundant, at the upper tidal range during the August 2005 survey, but urchins and predatory snails seen by Feder and Keiser (1980) were not seen in the August survey, possibly because salinity is low along the shoreline during the summer.

Worms and clams are the predominant infauna (biomass below the surface of the sea bottom) in most of the intertidal range at the East site. Lees et al. (1979) defined the infaunal assemblage in the East site and in the Harbor Cove area as the *Polydora-Macoma-Haploscoloplos* complex. *Polydora* and *Haploscoloplos* are genera of polychaetes (segmented worms widely distributed in marine waters and as burrowing animals in marine bottom habitat). *Macoma* is a genus of small clams that are widely distributed along the Alaska coast. Small, *Macoma balthica* clams were abundant at the East alternative site during the 2005 survey. *Mya* (a genus of small clams) a maximum of about 7.5 cm long were also present about 15 cm deep in soft substrate.

Feder and Keiser (1980) did not mention cockles (*Clinocardium spp.*), but small numbers of cockles were also found at the East site during the 2005 survey. This suggests that some bivalves are recolonizing as the intertidal shoreline at Port Valdez continues to recover from the 1964 earthquake. Hard-shelled, littleneck clams (*Prothaca staminea*) were not seen during the August 2005 survey, but they might be present in the lower intertidal or near subtidal zones. A species of soft-shelled clam, *Mya arenaria* was apparently widespread in Port Valdez prior to the 1964 earthquake and its devastating tsunami, but was limited in post earthquake distribution to small sandy areas near Mineral Creek and Island Flats (Feder and Bryson-Schwafel 1988, Lee et al. 1979). They are present, but apparently are not abundant, in the areas shown as sea otter digs in figures 7-5 and 7-8.

The polychaete worm species *Polydora quadrilobata* and *P. panamensis* and the spoonworm species *Echinurus* were more common in the lower intertidal and near-subtidal habitat. They were most abundant in association with *Laminaria* kelp, so they were most abundant in the area shown as *Laminaria* habitat in figures 7-6 and 7-7.

West Site. The August 2005 survey found no apparent significant differences between invertebrate species makeup at the East and West alternative sites. The West site is similar to the East except that mussels cover more of the West site, and they appear to have less silt cover. While mussels and other epifaunal species tended to be more abundant at the West site, there was less muddy habitat and sparser populations of borrowing clams and worms.

Two Moon Bay Site. The intertidal habitat at Two Moon Bay is a narrow band that drops steeply into deeper water. It is well separated from the site proposed for beneficial use of dredged material and was not surveyed for biological resources for this project.

7.2.4 Subtidal Biota

The subtidal habitat in Port Valdez includes areas of subtidal rocks and mud slopes and the deep basin ocean floor (Feder at al 1973). Two Moon Bay has a sloping bottom that drops into deeper water that has been substantially modified by deposited logging debris.

Near-shore subtidal habitats are similar at both the East and West alternative sites. Neither site is inhabited by diverse or highly productive biological assemblages. The areas examined can be divided into shelf and slope habitats on the basis of slope gradient and sediment consolidation. The biological assemblage inhabiting the shelf is basically the same as that described for the lower intertidal zone, but extends out to a depth of about -4 meters MLLW. Laminaria kelp is in a distinctive band.

On the slope, the most important organisms are polychaete worms and clams. As is the case for the intertidal assemblages, the slope and shelf assemblage depends heavily on organic debris, and deposit feeders are dominant fauna. Biomass and productivity of the worms *Nephtys* and *Lumbrineris* and the clam *Axinopsida* appear low. Utilization appears slight with tanner crabs apparently constituting the most important predator. Moderate numbers of very small juvenile tanner crabs inhabit the slope. Animals living on the shelf and on the slope are characteristic of mud bottom biotic assemblages. Slope habitat may be a nursery area for juvenile tanner crabs.

The near-shore shelf that bounds the Port Valdez shoreline drops steeply into water more than 200 meters deep. That deep water habitat is beyond any of the harbor improvement alternatives considered for this action, but it was evaluated as a disposal area for dredged material. More than 200 invertebrate taxa were reported from benthic sampling throughout Port Valdez from 1971 to 1985, (Hood et al., 1973), Feder and Matheke (1980a), (Feder et al 1973), (Feder and Shaw, 1986), (Feder and Jewett, 1988). Those sources reported that annelids were the most diverse invertebrates. Various species were widely distributed throughout Port Valdez. Polychaetes were the most abundant annelids in that habitat.

Clams, snails, and other mollusks were second in importance. Echinoderms (sea stars and sand dollars) were the only other significant group. These worms and other invertebrates that live in bottom material are primarily deposit-feeding organisms that are adapted to soft-bottom environments. The composition, distribution, and abundance of organisms in this habitat appear to be controlled primarily by the deposition of glacially derived sediments. They are less abundant in eastern Port Valdez where sedimentation rates are high. The general diversity, biomass, and abundance are lower in Port Valdez than similar substrates in the Gulf of Alaska.

Feder and Paul (1977) took several trawl samples in Port Valdez in the vicinity of the Trans-Alaska Pipeline System terminal in depths of 38 to 73 meters. Young tanner crab (*Chionoecetes bairdii)* and shrimp (*Pandalus borealis* and *Pandalopsis dispar*) dominated the catches. They also collected small numbers of Dungeness and king crab. There is a recreational fishery for Dungeness crab in the shallow eastern part of Port Valdez. Lower salinity, higher suspended solids, and warmer temperatures may displace some motile species during the summer, as has been observed in other Alaska estuaries.

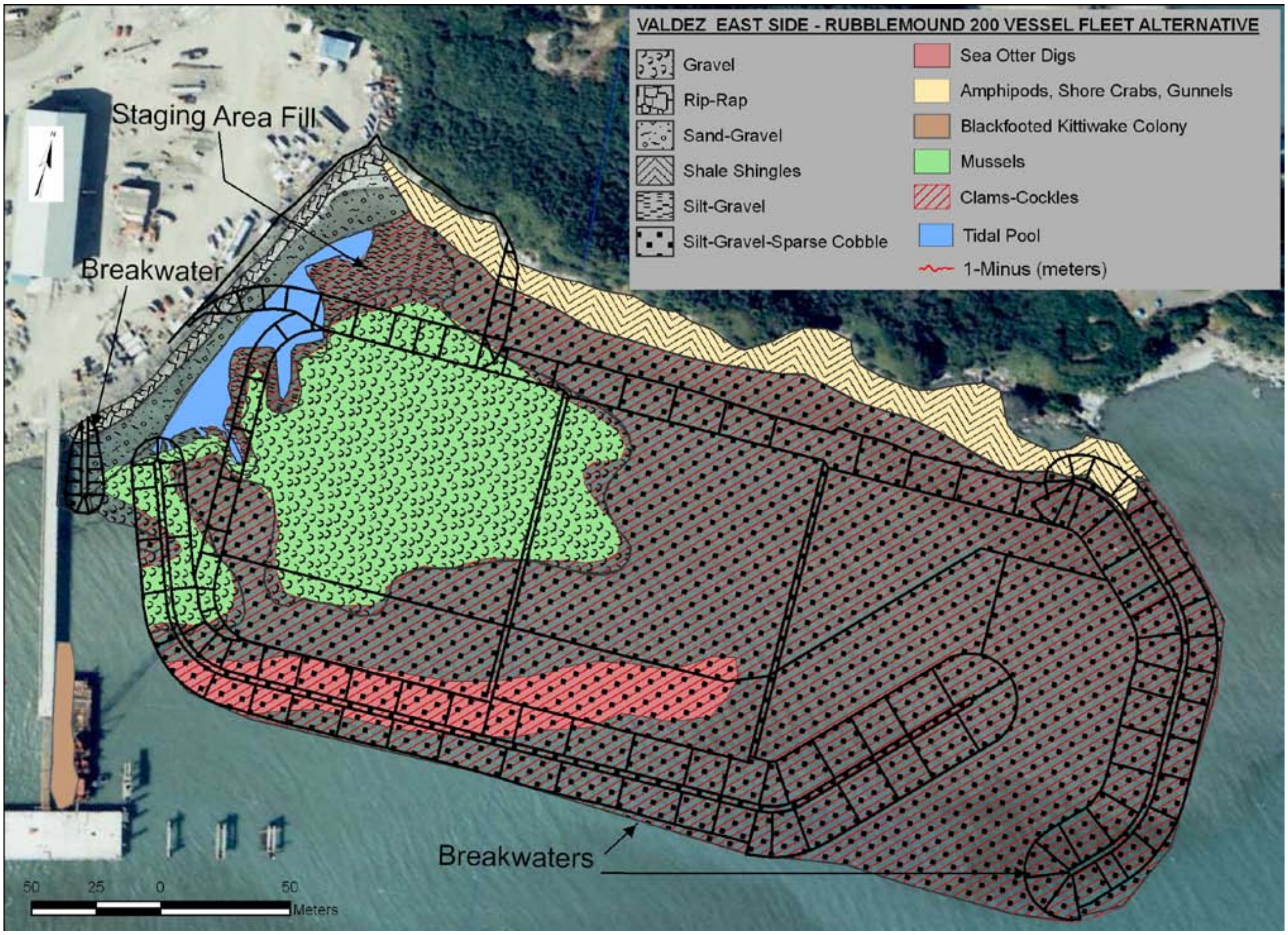

Figure 7- 5. Substrate types and biotic associations of the East Site, 200–Vessel Alternative Plan.

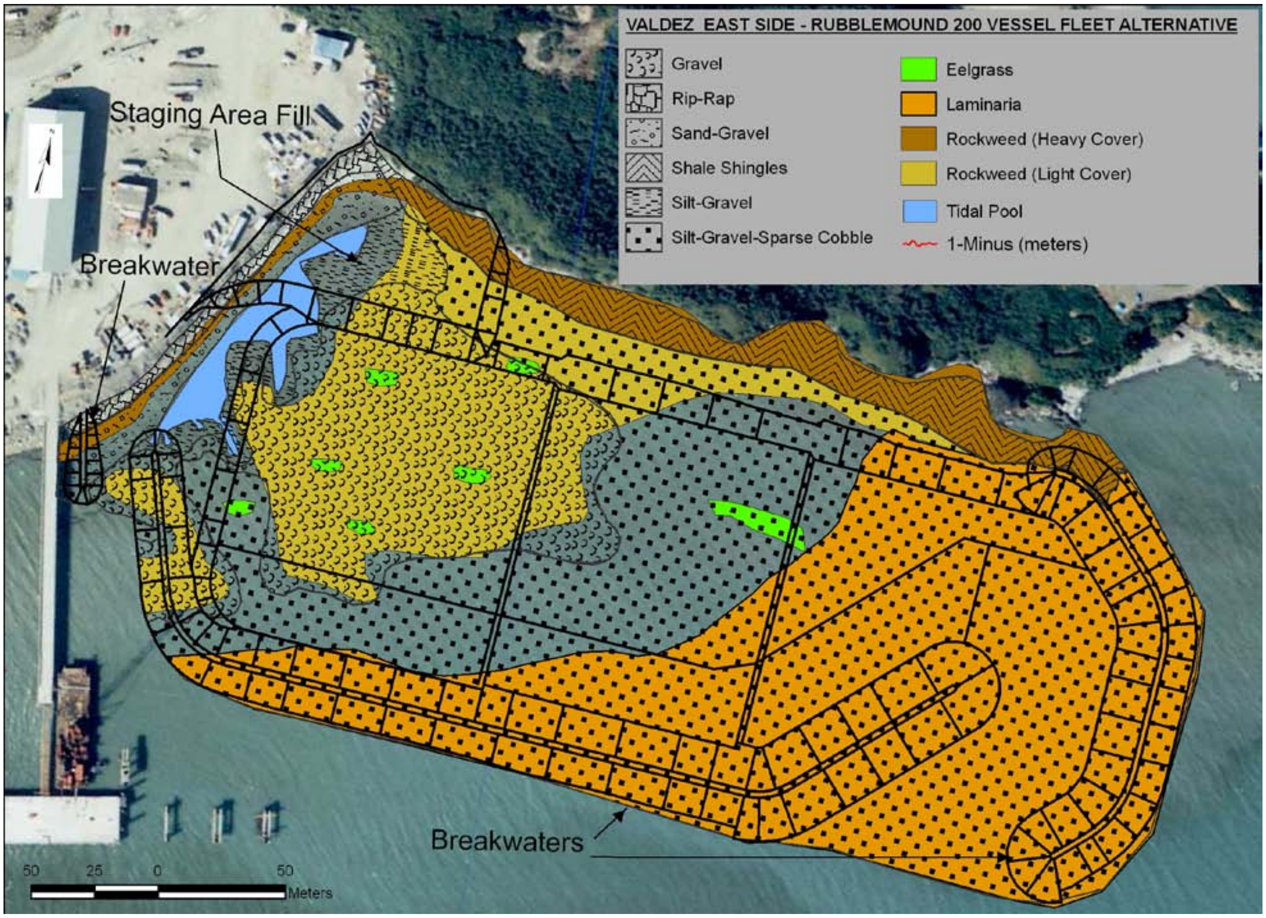

Figure 7- 6. Substrate Types and vegetative associations for the East Site, 200–Vessel Alternative Plan.

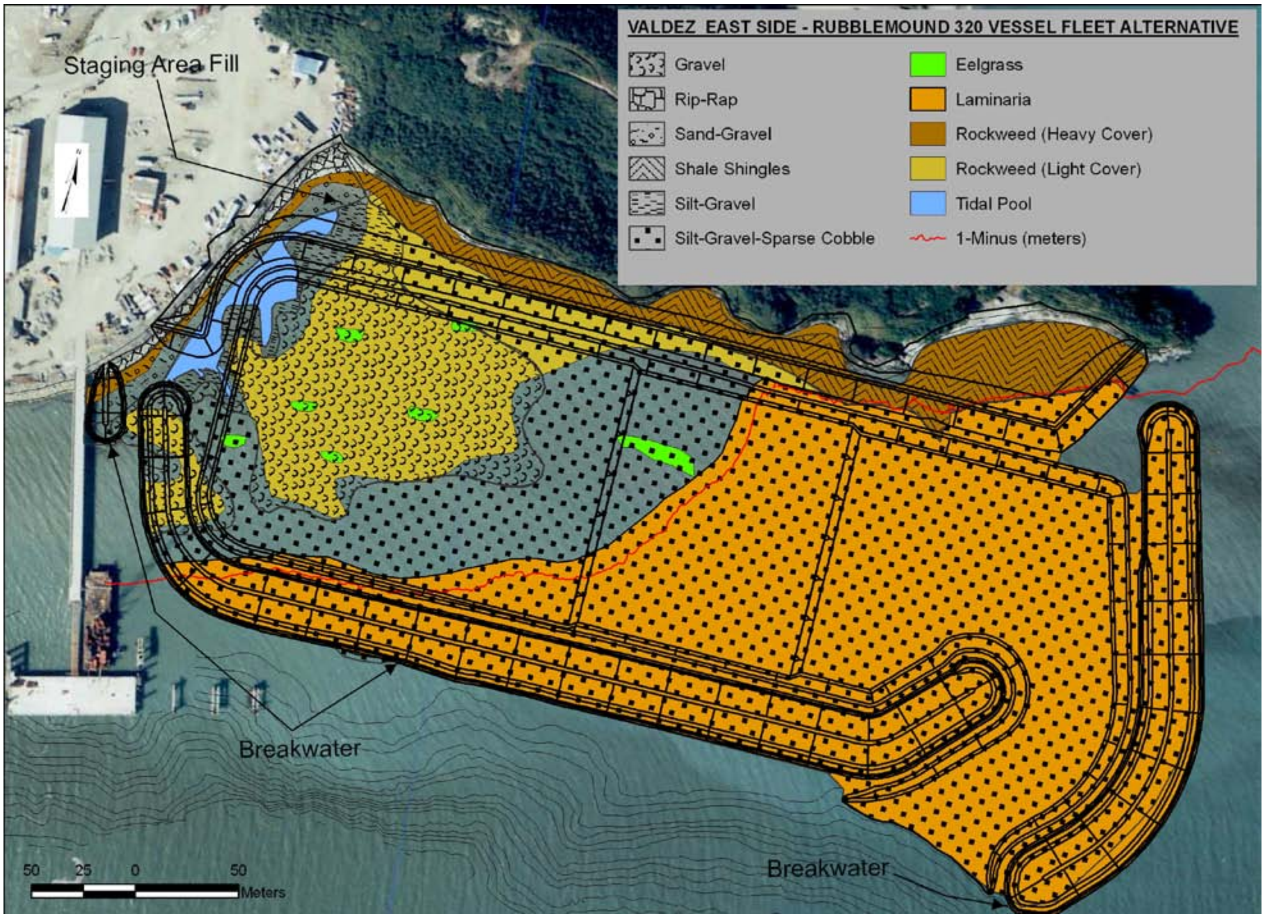

Figure 7- 7. Substrate types and vegetative associations for the East Site, 320–Vessel Alternative Plan.

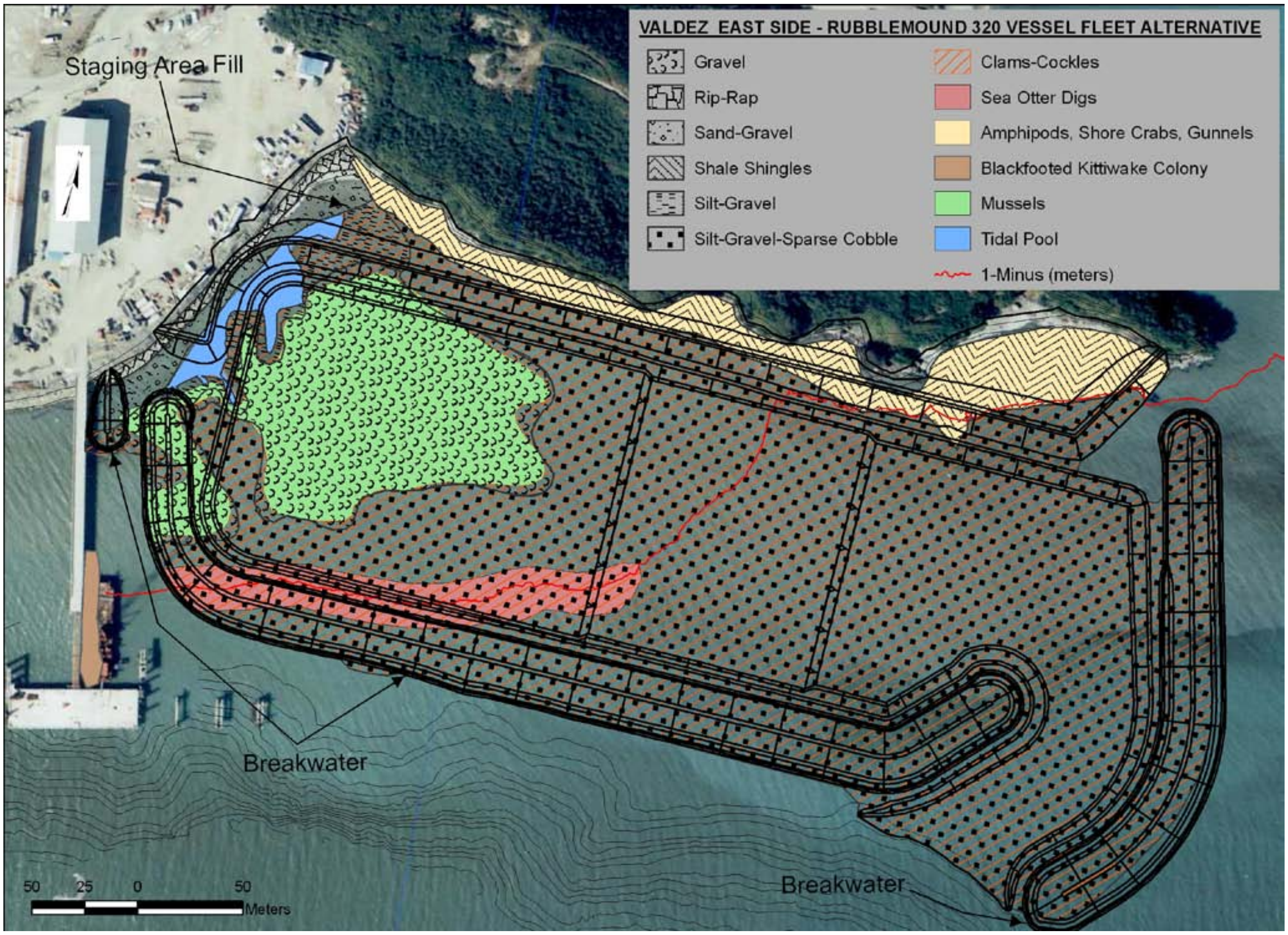

Figure 7- 8. Substrate types and biotic associations for the East Site, 320–Vessel Alternative Plan

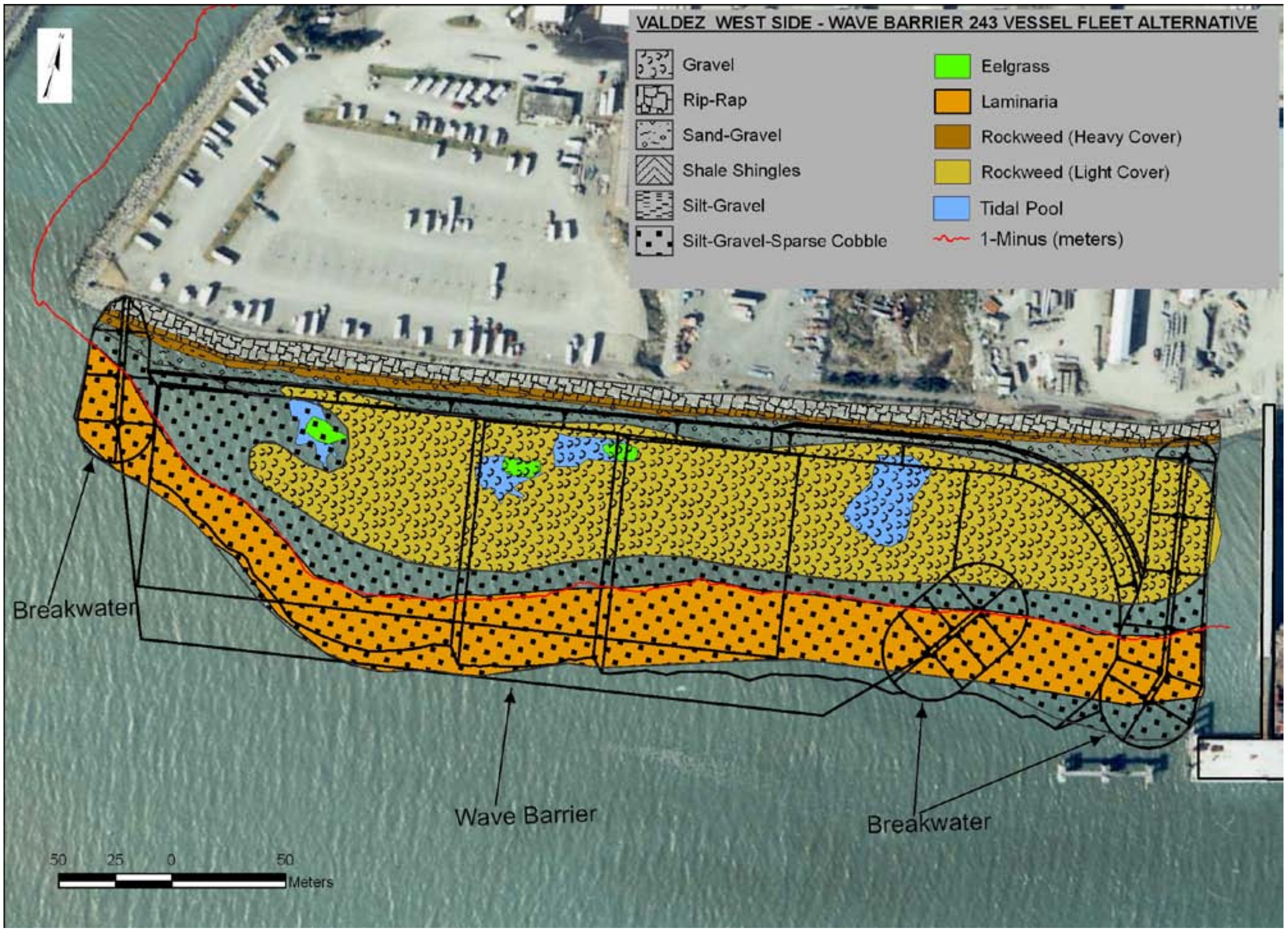

Figure 7- 9. Substrate types and vegetative associations for the West Site, 243–Vessel Alternative Plan.

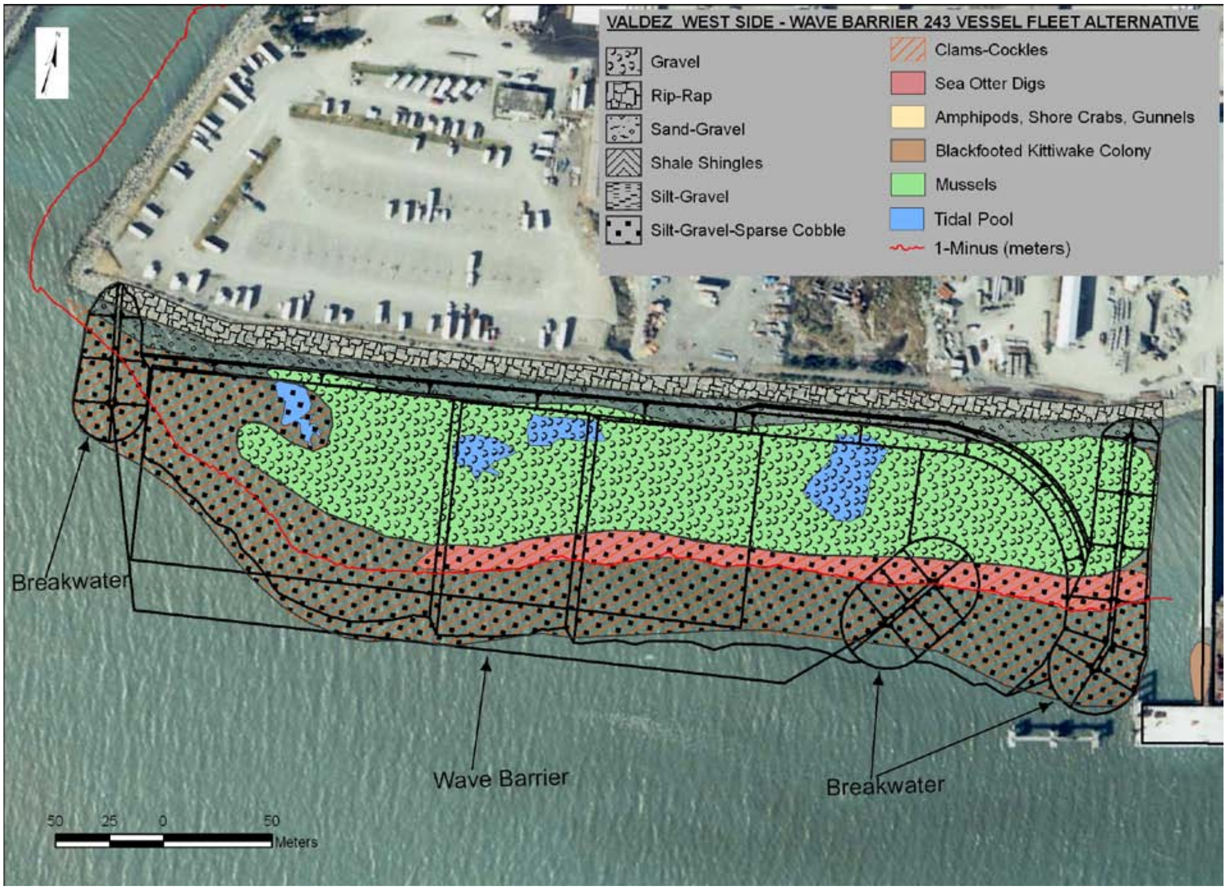

Figure 7- 10. Substrate types and biotic associations for the West Site, 243-Vessel Alternative Plan.

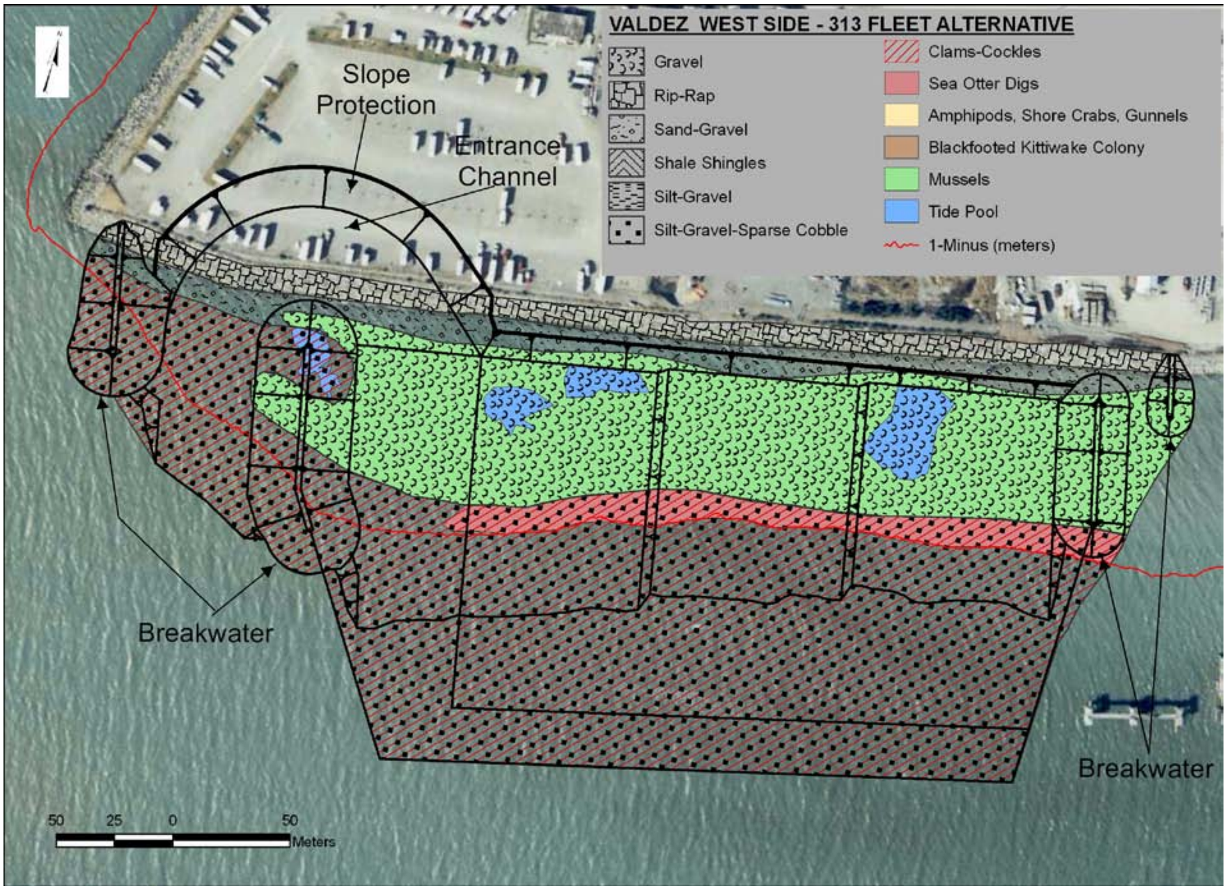

Figure 7- 11. Substrate types and biotic associations for the West Site, 320-Vessel Alternative plan.

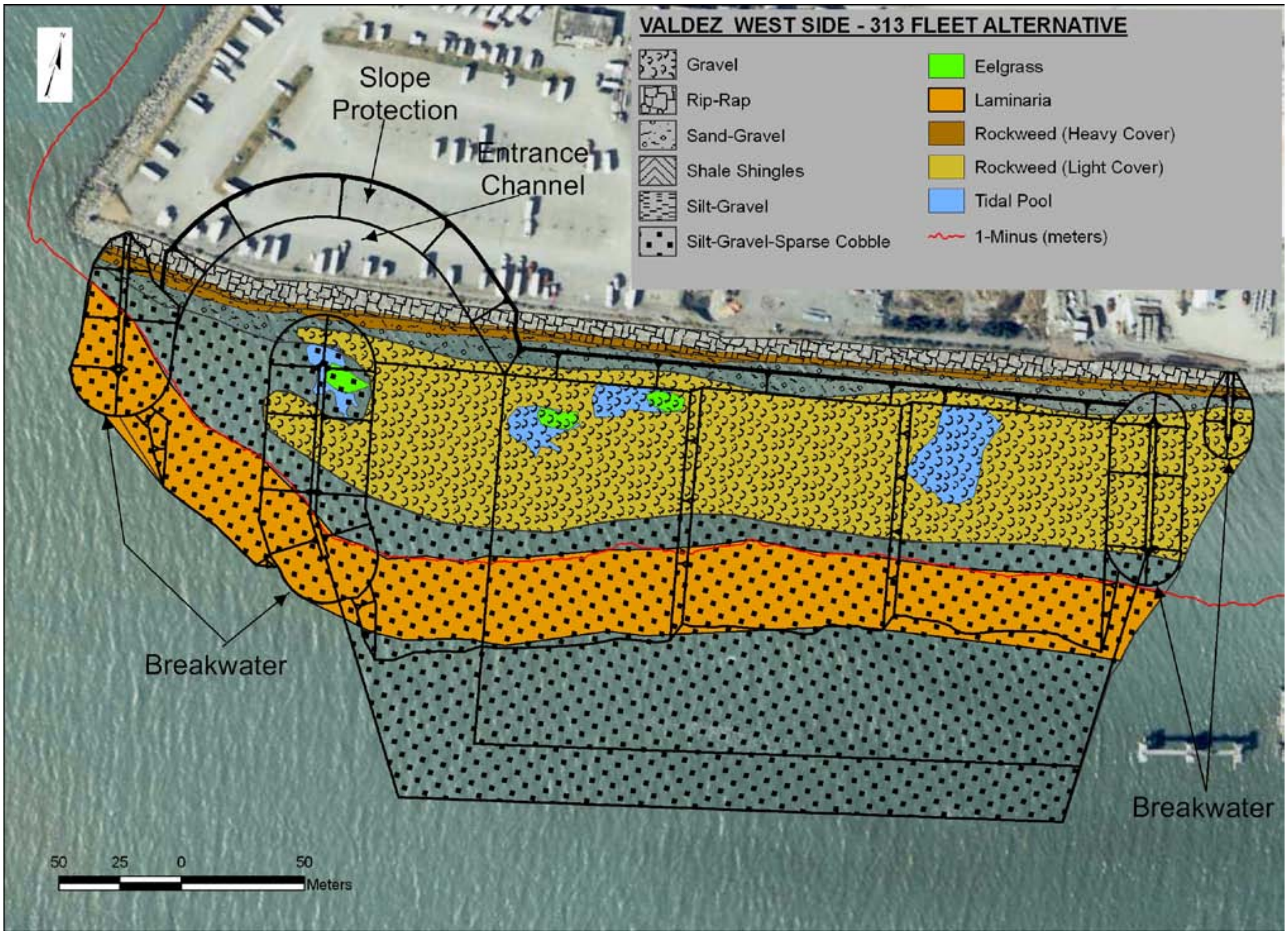

Figure 7- 12. Substrate types and vegetative associations for the West Site. 320–Vessel Alternative Plan.

7.2.5 Marine and Anadromous Fish

Marine Fish. Marine fish species in the deep Port Valdez offshore area are low in abundance but reasonably diverse in species. Twenty-three species including five species of flounder, one species of skate, and members of the cod and sculpin families are found in the offshore waters of Port Valdez. Pacific Ocean perch and yellow-eye rockfish suggest there is some hard bottom in the area. Shallow regions of the offshore area are more diverse, with both rocky and soft subtidal habitats. Herring spawn in the shallow subtidal algal beds of Jack Bay and Valdez Arm, primarily in April and May, but are not known to spawn in Port Valdez.

Anadromous Fish. Four species of Pacific salmon (pink, chum, coho, and sockeye) inhabit eastern Port Valdez during part of their life history and use tributary streams for spawning. During the summer, adult salmon enter Port Valdez and spend a period of up to 6 weeks in Port Valdez prior to entering their spawning streams. City Limits, Ess, Siwash, Mineral, and Sewage Lagoon creeks, Loop Road Streams 1 and 2, and the Robe Lake and Lowe River systems are the largest producers.

Pink and chum salmon fry emerge from the gravels of their home streams in the spring and shortly after proceed down into the estuarine environment. Solomon Gulch Hatchery releases fry directly into the estuarine environment. Chum salmon fry outmigrate from about April 15 until the end of May, with a peak in late April. Pink salmon outmigration peaks around the middle of May.

Chum fry spend at least 2 weeks and perhaps longer in the Island Flat area and in other near-shore habitats while they feed heavily on copepods, other small benthic, and free swimming crustaceans. They often feed within 1 meter of shore and follow the water's edge as the tide goes in and out.

Pink salmon may not remain in the near-shore shallows as long as the chum fry (Dames and Moore 1979). Coho and sockeye salmon live a year or more in freshwater before outmigrating into Port Valdez. These larger and more motile juveniles are less dependant on near-shore habitat than the much younger and smaller pink and chum juveniles.

Essential Fish Habitat. The 1996 reauthorization of the Magnuson-Stevens Fishery Conservation and Management Act (MSA) amendments mandate that Federal agencies assess the effects of Federal projects on essential fish habitat (EFH [commercial fish stocks in all life stages and associated habitats]) and consult with the Department of Commerce (50 CFR 600.905-930). Groundfish Fishery Management Plans (FMP) list four species categories and the forage fish category. The four categories are the target species category (pollock, cod, etc.); the other species category (sculpins, skates, etc.); the prohibited species category (halibut, herring, etc.); and the nonspecified species category (urchin, rattails, etc.). EFH must be described and identified for species listed in the target species and the other species categories. The prohibited species and the nonspecified species categories are not considered EFH for the purposes of sections 303(a)(7) and 305(b) of the MSA.

Habitats of particular concern are areas known to be important to species in need of additional levels of protection from adverse effects. Sensitivity, exposure, rarity, and the importance of the ecological function of the habitats are considered in determining habitat types of particular concern, which include near-shore areas of intertidal and submerged vegetation, rock, and other substrates. Those areas provide food and rearing habitat for juvenile groundfish and spawning areas for some species. All near-shore marine and estuarine habitats used by Pacific salmon, such as eelgrass beds, submerged aquatic vegetation (seaweeds), emergent vegetated wetlands, and certain intertidal zones, are sensitive to natural or human induced environmental degradation, especially in urban areas and in other areas adjacent to intensive human-induced developmental activities.

Essential fish habitat means waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity. For the purpose of interpreting the definition of essential fish habitat: "waters" include aquatic areas and their associated physical, chemical, and biological properties that are used by fish, and may include areas historically used by fish where appropriate; "substrate" includes sediment, hard bottom, structures underlying the waters, and associated biological communities; "necessary" means the habitat required to support a sustainable fishery and a healthy ecosystem; and "spawning, breeding, feeding, or growth to maturity" covers a species' full life cycle.

Species that could be expected to use the near-shore habitats in the project area during primarily juvenile life stages include four species of Pacific salmon and fish species such as arrowtooth flounder juveniles and adults, rex sole juveniles and adults, flathead sole adults and juveniles, sablefish adults and juveniles, yellowfin sole adults and juveniles, walleye pollock adults and juveniles, Pacific cod adults and juveniles, sculpin spp. adults and juveniles, tanner crab early juveniles, and various forage fish (National Marine Fisheries Service, et al., Habitat Assessment Reports for Essential Fish Habitat, 1998).

Pacific Salmon. They migrate, spawn, and rear in the near-shore area and streams that drain into Port Valdez. Juvenile salmon use near-shore migration corridors and can be expected to be in the project site seasonally.

Arrowtooth Flounder. This species is distributed in North American waters from central California to the eastern Bering Sea on the continental shelf and upper slope. Adults exhibit a benthic lifestyle. From the over-wintering grounds near the shelf margins and upper slope areas, adults begin a migration onto the middle and inner shelf in April or early May each year with the onset of warmer water temperatures. A protracted and variable spawning period may range from as early as September through March. Juveniles are separate from the adult population, remaining in shallow areas until they reach the 10 to15 cm range. The preferred substrate for juvenile and adults is gravel, mud, and sand.

Flathead, Rex, and Yellowfin Sole**.** (General distribution adults and late juveniles) Adults exhibit a benthic lifestyle and occupy separate winter spawning and summertime feeding distributions. Over wintering grounds are near the shelf margins, and the adults migrate to the mid and outer continental shelf in April or May of each year for feeding. Spawning starts as early as January, primarily in deeper waters near the margins of the shelf. Eggs and larvae are planktonic.

Sablefish. Adults occur along the continental slope and shelf gullies at depths generally greater than 200 meters and are generally known to prefer soft bottoms. Adults are assumed to be demersal. Spawning occurs in late winter or early spring along the continental slope. Eggs are released near the bottom where they incubate. Larvae rise to the surface and are oceanic through the spring and late summer. Feeding areas are those containing meopelagic and benthic fishes, benthic invertebrates, and jellyfish. Juveniles have been observed in many inshore areas during their second summer. They may occasionally enter Port Valdez but are unlikely to be present in appreciable numbers.

Walleye Pollock. Walleye pollock spawn in open waters of PWS about mid-March. Egg development is water temperature dependent. The species goes through a larval stage that is distributed in the upper 40 meters of the water column. Early juveniles are found both pelagically and on the bottom. Strong year classes are found from the outer to inner shelf, while weak year classes are found only on the outer continental shelf. Adults occur both pelagically and demersally on the outer and mid-continental shelf. Adults usually are not associated with coastal waters. Walleye pollock juveniles occur on the outer shelf, upper slope, and basin. They are pelagic fish that could occasionally enter Port Valdez but would not be present in appreciable numbers.

Pacific Cod. Pacific cod is a transoceanic species, occurring at depths from shoreline to 500 meters and associated with mud/silt/clay to gravel substrate. Adults are demersal and form aggregations during the peak spawning season, which extends approximately from January through May. Eggs are demersal and adhesive and hatch in about 15 to 20 days. The next life stage is larval, which undergoes metamorphosis at about 25 to 35 mm. Small cod mainly feed on invertebrates while the large adults mainly eat fish. First-year cod feed on copepods, small mollusks, and other invertebrates associated with marine algae and vegetation. Turbidity and silt in the summer may limit populations along the Port Valdez shoreline, but intertidal and near-subtidal communities are suitable habitat for these fish.

Sculpin. This is a large circumboreal family of demersal fishes inhabiting a wide range of habitats in the North Pacific Ocean and Bering Sea. Habitats range from tide pools to water depths of 1,000 meters. Adult and juvenile sculpins are mainly known to be associated with substrates from mud/silt/clay to gravel. Most sculpins spawn in the winter. Eggs are generally laid among rocks and are guarded by the males. The larval stage is found across broad areas of the continental shelf and slope. Sculpins generally eat small invertebrates and fish. Sculpins inhabit near-shore bottom habitat in Port Valdez and are present at harbor site alternatives.

Tanner Crab. Tanner crabs (*C. bairdi* species) prefer soft, muddy bottoms. They migrate inshore to water generally less than 50 meters deep in February where they remain until June to molt and mate. Tanner crab larvae are planktonic and migrate vertically to feed in the water column. After several molts, the larvae settle to the bottom as juvenile crabs. The juvenile crabs begin a seaward migration soon after settling and are found farther offshore by the late juvenile stage. They are present as juveniles, but the project alternative sites are not typical adult crab habitat.

Forage Fish. Eulachon are found pelagically from the middle shelf to over the slope on unconsolidated bottom. They spawn in rivers on coarse sandy bottom. The larvae drift and develop at sea. Capelin is a coastal fish rarely deeper than 200 meters.

They spawn in spring and summer on coarse sand/fine gravel beaches. Sand lance is an inner shelf (1 to 50 meters) and middle shelf (50 to 100 meters) semi-demersal species associated with sand and gravel habitats. All may be seasonally present in Port Valdez and may use the near-shore and intertidal habitat identified as project alternative sites.

7.2.6 Birds

Black-footed kittiwakes have formed a nesting colony on the SERVS dock between the East and West project sites. They nest on the lower outside flanges of the main structural I-beams of the dock (figure 7-13). Black-footed kittiwakes are indigenous to Alaska, Arctic Canada, and Eurasia where they form large breeding colonies on sea cliffs and man-made structures. The world-wide population of black-footed kittiwakes appears to be stable or increasing. They eat small fish and invertebrates snatched from the water surface. In Southcentral Alaska, from 1 to 3 eggs are laid in late May, and the young birds are normally fledged by the end of July. There are several large colonies of black-footed kittiwakes in PWS. The kittiwakes nesting on the SERVS dock are likely an expansion from nearby colonies.

The small islands east of the alternative sites considered in detail are used by about 30 nesting terns and other birds.

A variety of birds are associated with the salt marshes and tidal flats at Port Valdez. They stage, feed, and nest in that habitat. Canada geese and many species of ducks have been observed in the saltmarsh-tidal flat communities around Port Valdez. Because of its size, the Duck Flats marsh in particular has been identified as important habitat for many species. Fifty-three species of birds were reported from the Duck Flats in a 1979 survey.

Sea birds may loiter in the Port Valdez deep water disposal site, but would not feed on the bottom and would not find habitat there that was not abundant elsewhere in Port Valdez.

One bald eagle nesting site is reported to be in a tree near the Two Moon Bay beneficial dredged material disposal site. Incidental observations at the site indicate that sea birds loiter on the surface at least occasionally, but that Two Moon Bay does not offer habitat that is not at least equally productive and abundant in adjacent waters.

Figure 7- 13. Black-footed kittiwakes nesting on the SERVS dock.

7.2.7 Marine Mammals

Marine Mammals. Harbor seals, sea otters, and sea lions at least use Harbor Cove, the Duck Flats and adjacent islands occasionally, and the surrounding marine waters for feeding and resting. Intertidal habitat between the Valdez Duck Flats and Mineral Creek has been identified as an important area for sea otters (NOAA 2000). Sea otters have been observed to make feeding dives along the outer margin of the East alternative site. Feeding sea otters dig to get mussels and other marine invertebrates, leaving bowl-shaped depressions throughout Port Valdez in waters less than 100 meters deep. Figure 7-14 shows a typical sea otter dig at the project site. These depressions are associated with prey species and the communities that support them. Feeding depressions were observed at both project alternative sites, especially at the East site. Quantitative information is not available to compare sea otter usage of the two sites, but the East site has more invertebrates and better feeding habitat than the West site.

Harbor seals have been observed hauling out on the islands approximately 0.8 km east of the East site alternative. Issacs (1992) reported about 27 harbor seals hauled out at the east end of the Mineral Islands. The USFWS (Appendix 4) counted 20 harbor seals in the same area about 1 km east of the East project site alternative.

Figure 7- 14. Sea otter dig at the project site.

Harbor seals follow and prey upon starry flounder and other estuarine fishes as they forage into shallow water with the rising tide. They also prey on adult salmon as the salmon return to Port Valdez to spawn. Their feeding range includes both the East and West project sites. The East site is marginally closer to seal haulouts, but there is no other indication of relative values of the two sites to harbor seals.

Sea lions are only present occasionally in the general area of project alternative sites, but are common seasonally near salmon hatcheries. Figure 7-15 shows a sea lion near the Salmon Gulch hatchery about 3 km south of Valdez. There are no habitats of particular importance at or near alternative project sites.

Sea mammal use of Two Moon Bay and the surrounding waters is not well documented. There are no rookeries or substantial haulouts in Two Moon Bay, but harbor seals, sea lions, and sea otters can be expected to be present at least occasionally. Biological productivity at the log transfer site is poorer than in surrounding habitat, and the site is unlikely to be important to feeding sea mammals.

Figure 7- 15. Sea lion with salmon in general area of project alternative sites.

7.2.8 Biological Resources-Important Communities and Species

Birds. The Duck Flats and Harbor Cove near the East and West harbor alternative sites are important habitat for ducks and other migratory waterfowl. The US Fish and Wildlife Service Coordination Act report listed northern pintail, goldeneye, bufflehead, harlequin, longtail, surf and white-winged scoter, red-breasted merganser, and gadwall, mallard, widgeon ducks, cormorants, marbled murrelets, black-legged kittiwake, black oystercatcher, marbled murrelet, pigeon guillemot, glaucous-winged and herring gulls, and other sea birds.

A full list of birds observed and areas surveyed is in the U.S. Fish and Wildlife Service Coordination Act report (Appendix 4). Their bird counts included the East and West sites in with counts of birds in Harbor Cove and the Duck Flats, which is easily the best waterfowl habitat in all of Port Valdez and possibly in all of Valdez Arm. The habitat at the harbor site alternatives is primarily mud flats, colonized sparsely with algae and invertebrates. This is used by far fewer ducks and other water birds than Harbor Cove and the Duck Flats. Although it is flanked by excellent bird habitat, the alternative harbor site area is not itself particularly important for most species of water birds. The single exception is the nesting colony of about 120 nesting black-legged kittiwakes on the SERVS dock between the East and West sites.

No eagle nests or identified nests of other raptors are near potential harbor sites.

Sea ducks, gulls, and other sea birds use the waters around Two Moon Bay. One eagle nest is reported to be near the shoreline adjacent to the site that could be designated for beneficial use of dredged material. The site would be surveyed before project activities were initiated in the bay.

Endangered, Threatened and Candidate Species. Steller's sea lions in PWS are listed as endangered. They range through Valdez Arm and Port Valdez and are occasionally observed near the project site. No sea lion haulouts or other critical habitats are in the area.

No listed threatened or endangered species managed by the U.S. Fish and Wildlife Service ranges into any of the proposed alternative sites (Fish and Wildlife Coordination Act report, Appendix 4). The southwest Alaska Distinct Population Segment of sea otters found in marine waters surrounding the Aleutian Islands and Alaska Peninsula is listed as threatened (70 FR 46366), but the sea otter population in PWS, including Port Valdez, is not listed.

Whale species that range into deeper waters of PWS and the Gulf of Alaska are humpback, sei, right, blue, and sperm. It is unlikely the whales would come into Valdez Arm. Steller’s sea lions are occasionally reported in the Harbor Cove and Duck Flats areas and can be assumed to range occasionally into the East and West Site project areas.

Marine mammals travel occasionally through the potential deep water disposal site in Port Valdez, but the site is not reported to be important habitat for any marine mammal. Sea lions could feed at that depth (200 meters), but the disposal site is too deep for sea otter feeding.

Two Moon Bay is closer to open waters of PWS than the potential harbor sites. It is more likely to be visited by sea lions than the harbor sites, but is not near any sea lion haulouts or other critical sea lion habitats. The potential beneficial use disposal site would be of no feeding or other habitat value to sea mammals.

Kittlitz's murrelets and yellow billed loons are candidate species for listing and occasionally may be in the general project area. Kittlitz's murrelets would not nest near the harbor site or at elevations like those at the Two Moon Bay site. They might occasionally feed or rest at either site. Yellow billed loons would not be present near any of the project sites during the summer, but may range occasionally into the area during migration.

7.3 Air Quality and Noise

Air quality around Valdez is generally considered good despite the presence of a large crude oil storage and shipping terminal and the super tankers that call to load crude oil for transportation to the lower 48 states. Other potential sources of air pollution in the Valdez area are the fleet of diesel-powered vessels and fishing boats that ply the Port of

Valdez, diesel trucks, generators, gasoline powered automobiles, aircraft, and home heating appliances including wood burning stoves during winter. The Port of Valdez is well outside any non-attainment area, and air quality meets standards.

Atmospheric noise pollution in the Port of Valdez area is generally low, although occasional loud noise may be disruptive to a small and local area. Marine vessels, associated on-shore facilities, trucks, heavy equipment, and vehicles are sources of noise.

Sources of underwater noise include tankers, ferries, tugs, support vessels, and the many smaller commercial and recreational vessels that use Valdez Harbor.

Two Moon Bay is not affected by any substantial human activity. Air quality is typical of PWS conditions. Noise from human activities is rarely introduced and is temporary.

7.4 Cultural Resources

Prehistory. PWS has long been inhabited by humans; archaeological studies suggest that Chugach Eskimos and neighboring groups were present in the region during the early Holocene Period. Separate from the Athabaskan-speaking Eyak and the Ahtna peoples, the Chugachmuit consisted of eight subgroups with an estimated total population of less than 500. The Tatitlek group was the nearest to Valdez. Villages usually occupied protected shoreline sites with unobstructed views of all approaches; closed bays were considered traps and were avoided. It is unlikely that Port Valdez was used for anything more than sporadic foraging and hunting activities.

Nearly all activities revolved around the sea. The Chugachmuit hunted the abundant populations of marine mammals, fish, and shellfish. Trade routes to the Eyak, Ahtna, and Port Graham Eskimos also depended on the sea.

Historic Background. Valdez was a trading settlement during Russian occupancy. Under American administration, the settlement first acquired notoriety in 1898 when thousands of stampeders to the Klondike gold fields departed Valdez from an “All-American” overland route. Valdez later became a vital link to Fairbanks and the mining districts of interior Alaska. In the early years of the 20th century, Valdez was the center of considerable gold and copper mining activity. Until the Alaska Railroad was completed in 1923, Valdez was the only all-season port of entry to the interior. In the winter, freight and passengers were hauled weekly to Fairbanks in horse-drawn sleds over the “Valdez Trail.”

The role of Valdez as a trans-shipment and supply point for the interior was revived twice for brief periods after the town’s eclipse by the ports of Seward and Anchorage. During and shortly after World War II, the town served as a point of entry for military cargo headed to military installations in the interior. During construction of the trans-Alaska pipeline, Valdez was the supply depot for pipe and material used to construct the southern segments of the line. Valdez also became the site of the marine terminal of the pipeline.

Cultural Resources. No resources at any of the alternatives considered for development are listed in the Federal Register of Historic places or recorded by the State Historic Officer. None were identified in a cultural resource survey of those sites.

7.5 Environmental Justice and Protection of Children

Environmental Justice Consideration. On February 11, 1994, President Clinton issued Executive Order 12898, Federal Actions to Address Environmental Justice in Minority and Low-income Populations. The order directsFederal agencies to identify and address disproportionately high and adverse human health and environmental effects on minority and low-income populations. For this reason, demographic information on ethnicity, race, and poverty status is provided in Appendix B.

The ratio of minority residents in Valdez is not meaningfully greater than the surrounding area. The number of individuals and families living below the weighted average poverty level in Valdez also is not meaningfully greater than the other communities in the Valdez-Cordova Census Area.

Protection of Children. On April 21, 1997, Executive Order 13045, Protection of Children from Environmental Health and Safety Risks was issued to identify and assess environmental health and safety risks that may disproportionately affect children. There are no large daycare centers, residences, or schools in the immediate area of the project site alternatives.

7.6 Coastal Zone Management

The Valdez Coastal District is a part of the statewide Alaska Coastal Management Program (ACMP). Formation of the district provided local residents a direct role in planning for development of coastal resource policies that affect the Valdez area. Federal, State and local policies must be consistent with policies of the Valdez Coastal Management Program. The goals of the Valdez Coastal Management reflect a wide spectrum of issues pertaining to coastal management and the economic well-being of Valdez. They are:

- To enhance the economic productivity and diversification of the region;
- To provide for public safety and the economic welfare of the community when siting future industrial, commercial, and residential development;
- To protect and enhance all coastal habitats and air and water quality in accordance with Federal and State statutes and in concert with desired industrial expansion;
- To enhance the scenic beauty, uniqueness, and historical significance of the Valdez area;
- To sensibly open up new land for residential and industrial use;

- To strive for compatible use of coastal lands and waters for residential, industrial, commercial, recreation, fish and wildlife needs, and open space activities;
- To seek, through appropriate channels, continued navigational safety and recreational opportunities in PWS; and,
- To expedite and simplify permit procedures and governmental agency project review and implementation of the district program.

The coastal management program supports the development of fish and fisheries related facilities in an environmentally sound manner. To be consistent with the coastal management program, development must avoid or minimize significant adverse effects on the social, historical, or natural environments.

8.0 ENVIRONMENTAL CONSEQUENCES

8.1 Introduction

This section discusses how navigation improvements at Valdez (and the alternative of no action) might affect environmental resources of concern. This section brings together the following:

- Concerns identified during scoping and interagency coordination described in Section 2, Purpose and Need (Problem Identification);
- The no-action and construction alternatives and adverse effects of mitigation alternatives considered in detail in Section 5;
- The resources of concern described in Section 7, Affected Environment.

Material in Section 8 is presented in the same general sequence as in Section 7 to help readers compare information in the two sections. Impact analysis focuses on the resources that are of particular concern and on the alternatives considered in detail in Section 5. The alternatives in Section 8 include integral mitigation measures but do not include features added specifically to compensate for impacts. Direct construction impacts are addressed under each resource heading. Cumulative and other indirect impacts are discussed near the end of this section.

The environmental consequences of the no-action alternative and each of the six action alternatives considered in detail (described in Section 4) are addressed in the sections that follow. For some resources of concern, each of the six action alternatives would cause the same environmental consequences. In those instances, the consequences for all six are addressed together rather than by repeating the same consequences information six times.

Corps biologists and representatives from other agencies recorded site-specific information at both harbor sites considered in detail so potential effects of alternatives can be compared. Information they gathered at both the East and West alternative sites is presented in figures 7-5 through 7-12. The figures are overlaid with project configurations for the following four alternatives: East site 200-vessel, East site 320-vessel, West site 243-vessel, and West site 320-vessel.

This section also discusses two other alternatives that are considered in detail but that are not represented in the figures. Those two configurations are a 125-boat alternative and a 243-boat alternative, both for the East site. Those two alternatives were considered primarily as tools for evaluating relative costs and potential economic benefits among the alternatives. Near-shore areas directly affected by the footprints of those two alternatives would approximate those of the East site 200 and 320-boat alternatives. Indirect and cumulative effects also would be similar to alternatives considered in detail. Environmental effects information was computed and presented for each of the six action alternatives, but the East site 125 and 243-boat information is presented only in the tables.

8.2 Physical Environment

The physical environment at Valdez was important to, and was carefully considered in, development of project features for each of the alternatives considered in detail. Each of the action alternatives would, in turn, affect the soils and sediments, marine water quality and characteristics, water quality, and air quality. Beneficial use of dredged material also would beneficially affect existing sediment contamination at Two Moon Bay.

8.2.1 Water Quality

Breakwaters and moorage facilities at each alternative site would cause minor localized impacts to the predominantly wind-driven, near-shore currents along the western coast of Port Valdez. Construction and operation of any of the harbor alternatives would not impact existing area-wide currents and circulation patterns.

Circulation and flushing in any harbor at Valdez would be greatly influenced by the 3.7-meter tidal exchange with a mean tide height of 1.98 meters. Circulation in the proposed alternatives was estimated using the methods outlined in *Effects of Planform Geometry on Tidal Flushing and Mixing in Marinas*, (Nece, et al, 1979). Tides in the Nece study area of Puget Sound, WA ranged from 0.6 to 2 meters, so the larger Valdez tides should provide better mixing. Each harbor configuration considered in detail meets informal guidelines to ensure that water in it would be adequately exchanged.

The parameters that most affect circulation and water quality are (1) tidal prism ratio (TPR), (2) planform aspect ratio of the basin (AR), (3) ratio of the basin area to the channel cross-section (A/a), and (4) the relative roundness of the basin.

The TPR is governed by both the local tide conditions and the basin depth required for the design fleet. A shallow basin has a larger TPR and, therefore, a greater exchange of ambient water. The TPR is equivalent to an exchange coefficient in which all the water in the harbor at low tide is thoroughly mixed with ambient water entering on the flood tide.

The ratio of basin area to channel area A/a is governed strongly by the requirement for moorage and navigation. The size of the fleet and mooring density will determine the basin size (A) and the vessel draft, beam, wave conditions, and tides will determine the channel cross-section (a). A large A/a value is preferred to achieve the momentum necessary for driving circulation cells. This can be improved by reducing the channel width or depth; however, this can restrict navigation. The A/a parameter can also be improved by increasing the basin area.

The aspect ratio (AR) should normally be no greater than 3 to 1 and preferably less than 2 to 1; however, like the other design parameters, this is determined primarily by site specific constraints. The existing harbor in Valdez is a good example of inefficient circulation caused by planform geometry. This harbor is too long and narrow, about double the recommended length to width ratio.

The exchange coefficient is the average per-cycle exchange of water in a harbor that is flushed out and replaced with ambient water during each tide cycle. Exchange efficiency for a harbor is defined as the ratio of average exchange coefficient over the tidal prism ratio. It is recommended that at least 95 percent of the basin exceed an exchange value of 0.15 (Cardwell and Koons, 1981). Lower values indicate potential for stagnation zones. Rounding basin corners may reduce local stagnation zones and help mixing.

Improved safety, operational controls, and related efficiencies in a new harbor could improve long-term marine water quality in the Valdez area. Fewer vessels would be subjected to overcrowded conditions that currently increase the risk of petroleum spills. However, water quality in the immediate vicinity of any new harbor would be degraded by harbor construction and operation. Dredging, dredged material disposal, and placement of breakwaters may cause short-term impacts to localized water quality. Chronic petroleum spills, inadvertent waste disposal, and fish cleaning in a harbor may cause longer-term water quality impacts.

West Site Alternatives. Tidal flushing calculations developed by Nece cannot be used for unconfined basins. The partial depth vertical wave barrier section would not block water from flowing under the wave barrier panels. Either alternative considered in detail would have tidal flushing conditions near those of the undisturbed site. Floating debris and surface contamination such as oil and other petroleum products would not leave under the wave barrier and could still be trapped in the harbor.

East Site Alternatives. The TPR's for the East site plans are influenced by the shallow tideland area at the base of Hotel Hill. The TPR for the alternatives at this site are approximately the same: about .53 to .58. The smaller alternatives are slightly better than the 320-vessel alternative. All the East site alternatives are much better than Nece's recommended minimum value of 0.3. The TPR indicates that roughly half the harbor volume would be exchanged with each tide cycle. The harbor alternatives are rectangular with an aspect ratio of 2.5 to 1 to 2.9 to 1.0. The estimated average exchange coefficient based on Nece's calculations would be about 0.43. The harbor has three tidal openings into the basin (entrance and two breaches) so the ‘a’ value would be more; however, because of the added tidelands the ‘A’ would also increase; therefore, the resulting A/a for these alternatives ranges from 136 to 138. Based on these calculations, the harbor plan’s circulation and flushing should be adequate.

From the results of the four important circulation parameters, this harbor would have acceptable circulation and flushing.

Impacts Related to Construction Activities. Each of the action alternatives considered in detail would require dredging for access and mooring and for breakwater construction. Dredging and placement of dredged materials would temporarily increase turbidity levels and suspended solids in adjacent waters. The time it takes suspended material to precipitate and the current velocities within the impacted water body determine the size and migration characteristics of construction-related turbidity/suspended solids plumes. Precipitation times are highly dependent on, and are inversely related to, particle size. Dissolved oxygen levels in aquatic habitats are usually reduced by organic material suspended by dredging operations. This would not be meaningful in Port Valdez, where organic material is sparse in bottom material and where dissolved oxygen levels are high. Effects would be temporary and associated turbidity would not significantly affect water quality.

Impacts Related to Harbor Operation. Water quality in harbors typically is impacted to some degree by lighter parts of spilled fuel floating on the surface and heavier petroleum constituents accumulated on the bottom. Sampling in water columns in Alaska harbors indicates that comparatively little of spilled hydrocarbons is usually held in the water column. Specific appropriate measures would be adopted to minimize harbor operation effects on water quality. Those measures are listed in Section 6, Description of Tentatively Recommended Plan. Data collected at other harbors in Alaska indicate that chronic water quality effects of operations are confined generally to the harbor itself and sometimes to a small area just outside the entrance.

8.2.2 Air Quality and Noise

Air quality in the immediate project area would be affected by emissions from harbor construction and operational activities. The proposed dredging and construction activities would involve primarily the use of diesel-powered dredging equipment and land-based heavy construction equipment and haul trucks. Fugitive dust emissions during construction are minimized generally by the wet working conditions associated with dredging operations and the natural meteorological conditions that predominate. Collectively, construction-related emissions would be temporary and intermittent, and would stop at the end of the construction period. Vessels using the mooring basins would be the primary source of continuing air emissions during harbor operations. Pollutants of primary concern at harbors are nitrogen oxides, sulfur dioxide, and particulate matter less than 10 microns in diameter from diesel fuel combustion and carbon monoxide from gasoline combustion. Air quality in the Valdez area is not expected to be impacted significantly by new harbor construction or operational activities. No new emission sources are anticipated, and because of the strong meteorological influences in the area, National Ambient Air Quality Standards are not likely to be exceeded.

The harbor alternative sites are adjacent to the existing harbor and therefore harbor related noise is part of the existing condition and accepted in the community. The addition of vessels in the new harbor may increase the noise levels in a general way although not significantly.

Noise during construction would be elevated above normal levels from diesel engine powered equipment and rock placement. Driving sheet pile for the wave barrier alternatives would be a very strong and continuing sound that would reverberate in the water column. The water column noise reverberations could affect fish and marine mammals. Threshold noise levels and buffer zones are common mitigation measures to minimize affects. National Marine Fisheries Service has established a threshold noise level for behavioral and physical effect to marine mammals at 160 dB and 190 dB (re:1 micoPascals at 10 meters), respectively. Bubble curtains can attenuate the sound impacts as well as including a conservation measure whereby the pile driving activity would cease if an animal is present within a certain distance threshold. Threshold levels should not exceed 220 dB or 180 dB during juvenile and adult salmon migration periods.

People from the nearby hotel and recreational vehicles may be disturbed temporarily by construction noise, but sounds of operation would be similar to on-going, nearby harbor and industrial noise. No residential homes would be affected by the noise.

Blasting is unlikely but could be required to break up large boulders in the moorage basin area. Advance notification of any blasting to the community and a notice to mariners is standard procedure. Coordination would be conducted with responsible resource agencies to ensure effects to fish, birds, and marine mammals were mitigated appropriately.

8.2.3 Contamination at Two Moon Bay

Discharging dredged material to cover decayed logging debris at Two Moon Bay is expected to disperse briefly small amounts of the decayed material into the water column. This would increase briefly dissolved oxygen demand in the surrounding waters. Marine waters at Two Moon Bay are well oxygenated, so biochemical oxygen demand effects would be short-lived. Most of the debris would be capped, which would prevent any further release.

Effects of dredged material placement in Two Moon Bay have been evaluated as required by Section 404(b)(1) of the Clean Water Act. The evaluation is in Appendix 2.

8.3 Biological Environment

Public and agency scoping, field observations, and literature identified principal biological resources of concern in Valdez and in Two Moon Bay. The importance of some biota is defined or implied by statute. The following biota and habitats were identified as resources of particular concern:

Wetlands and tidal flats
Marine algae and eelgrass
Marine invertebrate assemblages important to fish, birds, and sea mammals
Marine and anadromous fish
Marine mammals
Birds
Threatened and endangered species

This section of the Valdez report focuses on species, communities, and habitats that are of particular concern and addresses potential effects that a new navigation project in Valdez and the placement of dredged material from that project would cause to those resources.

8.3.1 Wetlands and Tidal flats

The no-action alternative would have no effect on wetlands and tidal flats.

None of the action alternatives considered in detail would adversely affect freshwater wetlands. Both the East and West sites contain intertidal habitat that includes rocky substrates in the upper intertidal and mudflats in the lower intertidal zone. Shallow, muddy tide pools are in the tide flats at both sites. Figures 7-5 through 7-12 show tidal flats and rocky intertidal extent for four of the alternatives considered in detail. The rockweed (heavy cover) in those figures is rocky intertidal habitat. Land seaward of the rockweed (heavy cover), out to the red 1-meter minus line can be classified as tidal flats. Shallow tide pools are identified at each site. There are no saltwater wetlands in the areas that would be directly affected by any of the alternatives considered in detail, but there are important saltwater wetlands in the vicinity. Potential project effects to biota in those offsite wetlands are addressed later in Section 8.3.

Computed areas that would be directly impacted by the six action alternatives considered in detail are in table 8-1.

Table 8- 1. Areas directly impacted by alternatives considered in detail.

	Area Affected (Hectares)		
Alternative	Tidal Flats	Tide Pools *	Rocky Intertidal
East Site 125 Vessels	5.5	0.3	1.0
East Site 200 Vessels	6.0	0.3	1.2
East Site 243 Vessels	6.2	0.3	1.4
East Site 320 Vessels	6.5	0.3	1.6
West Site 243 Vessels	3.6	0.3	0.2
West Site 320 Vessels	3.9	0.3	0.2

*Tide pool area is within tidal flats area

The East site alternatives would directly impact about 80 percent more tidal flats, about the same area of tide pool habitat, and about 6 times as much rocky habitat as alternatives for similar numbers of vessels at the West site. There are two principal reasons for the difference: (1) the West site would use a wave barrier, which would have a much smaller footprint to protect the harbor, and (2) a greater percentage of the West site would be in water deeper than the intertidal zone.

Tidal Flats. The tidal flats at Valdez were described in Section 7.2..
This habitat within the project footprint would be destroyed or extensively modified by harbor construction. Tidal flats habitat within the harbor footprint would be covered by breakwaters and converted to rocky intertidal and subtidal habitat or dredged to produce deeper subtidal habitat. Tidal flat functions would be lost.

Tide Pools. Tide pools would drain into the deeper harbor basin or would be covered by project features. They would lose this function as habitat. Tide pools appear to sometimes form where energy from water movement scours shallow depressions. Some of the tide pools mapped at Valdez were close to the rocky shoreline where wave action may have scoured the bottom. Tide pools might develop in tide flats near breakwaters constructed for the action alternative, but probability cannot be estimated.

Rocky Intertidal Habitat. Most of this habitat in Port Valdez is at the upper tidal limit and hosts a rockweed assemblage that is dense by comparison with local conditions but is unremarkable by comparison with rockweed in the marine waters of PWS proper. This habitat is fully exposed by diurnal tides and is inhabited by barnacles, amphipods, shore crabs, gunnels and other small fish, and by other intertidal species. They, in turn, are prey to birds, larger fish, and other marine predators.

Most of this habitat in the project footprint would be covered by staging and access features for the project or would be directly affected by changes in circulation, sedimentation, or water quality.

Regional Intertidal and Wetland Habitats. Project alternatives were placed to avoid wetlands and tidal flats of regional importance. None of the alternatives would directly affect tide flats or wetland habitat in Harbor Cove or the Duck Flats.

Created Habitat. None of the harbor alternatives can be expected to produce new tidal flats, tide pools, or eelgrass habitat. Most of those habitat types would be lost irreplaceably in the harbor footprint. The rubblemound breakwater features could be excellent substitutes for lost rocky intertidal habitat. Breakwater rock would provide good attachment surface for typical intertidal species, would be cleaned of sediment by the waves, and would be an inter-connected band that would encourage colonization. Within the 6.7-meter tidal range at Valdez, each linear meter of breakwater would produce up to about 10 square meters of rocky intertidal habitat on each face (inner and outer harbor faces) of the breakwater. Habitat area produced per linear meter would be less in shallower water.

The wave barrier at the West site would do little to replace lost habitat. The steel wave barrier would be a poor substitute for intertidal rocky habitat.

Allowing for water depth variation, total rocky intertidal habitat produced by breakwater construction for each alternative would be approximately as shown in table 8-2.

Table 8- 2. Total rocky intertidal habitat produced by breakwater construction for each alternative

Alternative		(hectares)
East Site 125	Vessels	0.9
East Site 200	Vessels	1.0
East Site 243	Vessels	1.1
East Site 320	Vessels	1.2
West Site 243	Vessels	0.3
West Site 320	Vessels	0.3

This is roughly equivalent to the area of rocky intertidal habitat that would be lost at each of the alternatives considered in detail. The natural rocky habitat consists of rock partially buried in silt and interspaced with silty material. The breakwater would present considerably more rock surface per square meter for colonization.

Summary of Effects. Any action alternative at the East site would replace existing rocky intertidal habitat with constructed rocky habitat. Tide flat and tide pool habitat would be lost and would not be replaced. About 5.5 ha of tide flats for the 125-vessel alternative to about 6.5 ha for the 320-vessel alternative would be lost. At the West site, about 3.6 to 3.9 ha of tide flats and about 0.2 ha of rocky intertidal habitat would be lost.

8.3.2 Marine Algae and Eelgrass

Eelgrass. Bottom material (substrate) and water quality in the project area are far from ideal for eelgrass, but there are sparse assemblages of small plants in limited areas in the mid to upper intertidal range. National Marine Fisheries Service noted (Letter: Robert Mecum 2007): *"Eelgrass is present; however, density is extremely sparse with only a scattering of single rooted plants."* Eelgrass would be substantially lost as habitat within the footprint of any action alternative. Section 7.2.2 noted the presence of small (up to 4 square meters) sparse eelgrass patches. A total of less than 0.1 ha of sparse eelgrass habitat scattered over the project alternative footprints would be lost with any of the action alternatives.

Marine Algae. Section 7.2.2 noted that rockweed (*Fucus distichus*), a species of green algae (*Ulothrix*), and other algae species, form a distinct but not especially dense band of marine algae at the upper tidal range and that rockweed extends down into the mid tidal elevations. These and other marine algae also are present in scattered clumps across the tidal flats. Rockweed is an extremely hardy kelp that survives high wave energy, wide ranges of salinity, icing, and considerable siltation, but it needs to anchor onto clean, hard substrates. There is not much rock or other hard substrate suitable for holdfast attachment in either the East or West sites. National Marine Fisheries Service noted (Letter: Robert Mecum 2007) *"These gravel, cobble, and mud substrates are not colonized with marine algae or vegetation, except for a few high-tidal, boulders extensively covered with rockweed."* Another distinct band of laminaria, a brown kelp, is at and below the lowest tidal range (about -1 meter below MLLW). Marine algae do not grow much deeper in the silty waters of Port Valdez.

Algae would be destroyed in the footprint of any action alternative by breakwater placement, dredging, and other project features. Section 8.3.1 identified the area of intertidal habitat that would be affected by the action alternatives. It also noted that the intertidal habitat created by breakwaters at the East site would replace upper intertidal habitat lost to construction with an equal or greater area of rock surface. This indicates that rockweed and other intertidal algae colonization at the East site alternatives would replace marine algae lost to construction for those alternatives. At the West site, there would be little marine algae colonization.

Dredging and breakwater construction also would affect laminaria and other marine algae in a band at the lower limits of the tide range. Laminaria is less hardy in wave environments than rockweed, but like rockweed, needs to attach to hard surfaces, which are not abundant in the lower intertidal zone at the East or West sites. Dredging and breakwater construction for any of the East site alternatives would destroy about 0.3 ha of laminaria kelp and its habitat. Construction of either West site alternatives would destroy about 0.2 ha of laminaria and its habitat.

Breakwaters at the East site would create rocky substrate in the lower intertidal and upper subtidal zone that could be used for anchoring substrate for laminaria and other marine algae that occupy those zones. The East site breakwaters would create about 0.1 to 0.2 ha of clean rocky substrate at depths suitable for laminaria colonization.

The small stub breakwaters required for the West site alternatives would create a small area (less than 0.05 ha) of lower intertidal/upper subtidal rocky substrate at depths suitable for laminaria and other marine algae.

Summary of Effects. Construction of any action alternative would destroy less than 0.1 ha of sparse, patchy eelgrass in the upper and middle intertidal zone.

Construction of an East site alternative would destroy about 0.9 to about 1.2 ha of rocky habitat in the upper tidal zone and would largely replace it with an approximately equal area of new rocky habitat that could be colonized by the same algae. Construction would destroy about 0.3 ha of laminaria and associated algae in the lower tidal range and would replace it with 0.1 to 0.2 ha of clean rocky substrate that is expected to support the same species assemblage.

Construction of any alternative in the West site would destroy or substantially modify about 0.2 ha of rocky intertidal habitat and about 0.2 ha of habitat in the lower tidal range used by laminaria and associated algae species. Little of that would be replaced by colonization on project structures.

8.3.3 Intertidal Invertebrates

Marine invertebrates in the upper intertidal zone at both the East and West sites are predominantly animals that live on the surface or in the sparse marine algae. Small crustaceans, including isopods, shore crabs and barnacles; and mollusks, including mussels, limpets, and snails are associated with the rockweed in that zone and occupy about the same habitat and area of this zone in both the East and West alternative sites. Construction at the East site that affected rockweed algae also would equally affect the invertebrates associated with it, so construction would eliminate 1.0 to 1.6 ha of invertebrate habitat in the upper intertidal zone.

In the middle and lower tidal zones, small mussels are scattered over the surface, so invertebrates that live in the bottom material, including polychaete worms, small clams, and cockles are more important. Spoon worms and polychaete worms are more common lower in the intertidal zone. Isopods, amphipods, and other very small invertebrates also live in lower densities across the barren flats that make up most of the middle and lower intertidal zone. East site alternatives would eliminate 3.5 to 5 ha of that habitat, including about 1.5 ha of the low-density mussel habitat in that zone (figures 7-5 and 7-8). West site alternatives would eliminate about 3 ha of that middle and lower intertidal habitat, including about 2 ha of sparse mussel populations in the areas shown in figures 7-10 and 7-11.

8.3.4 Subtidal Invertebrates

Section 7.2.4 describes shelf and slope subtidal habitat in Port Valdez. The deeper sections of each action alternative would be constructed on the subtidal shelf seaward of the intertidal zone. This upper subtidal zone is similar to the lower intertidal with similar invertebrates and other biota, except that laminaria do not grow very far into this zone. Additional species of worms may be present and small tanner crabs occasionally may be present. About 1.2 to 4.3 ha of the East site alternatives and about 1.7 to 4.5 ha of the West site alternatives would be in this near-shore subtidal habitat. Those areas would be substantially modified by harbor construction. Soft-bottom biota would be largely eliminated by dredging and by breakwater or wave barrier placement.

The near-shore subtidal shelf drops steeply into about 200 meters of water. The deeper, more saline water of the lower slope and the bottom of the fjord at least seasonally hosts tanner crabs, sea stars, shrimp, and other invertebrates. This area would not be affected by any of the harbor alternatives considered in detail. The least cost alternative for disposal of dredged material would discharge that material into up to 11.4 ha of this deep water habitat. The bottom-living invertebrates in the disposal site would be buried under several meters of mixed material ranging in particle size from fine silt to boulder. Up to about 11.4 ha of sessile invertebrates on the substrate of the existing bottom and most of the worms and clams in that habitat would be killed. The disposal site would likely recolonize with similar organisms, but rates of successional change cannot be estimated with available information. Some of the more motile organisms, including crabs, shrimp, and other crustaceans could escape from the site, but escape rates cannot be estimated.

The Two Moon Bay dredged material placement site is all well below the intertidal zone. This subtidal habitat is heavily impacted by decaying bark and wood debris from log holding and transfer operations. Divers reported a diverse and productive assemblage of sea stars, nudibranchs, tanner crabs, and sea anemone where there was no bark but few invertebrates in the impacted log transfer site (Sargent, 2000). Divers noted dead tanner crabs in the bark covered area but not in areas away from the wood debris.

Dredged material would cover the limited subtidal invertebrate community at the log transfer site. Small areas of more productive communities also would be impacted because the wood debris areas are not precisely defined and because there are scattered areas free of bark within the transfer site. Altogether, about 5 ha of largely depaupate benthic invertebrate community would be displaced or destroyed by dredged material placement. That core degraded area is surrounded by bottom that is covered less completely or where the wood debris is patchier. Smaller amounts of silt and fine sand would disperse outside the core target area of the log transfer site and could cover habitat that was not substantially degraded by logging debris. Modern navigation and positioning instruments should minimize placement outside the intended placement area, but there would be some dispersal of dredged material onto less damaged invertebrate communities.

The placed dredged material would be largely silt, sand, and other material that is smaller in grain size than the predominant bottom material in Two Moon Bay. Invertebrates would be expected to begin colonizing it soon after placement was completed and to produce a strong infaunal and epifaunal invertebrate community that would include clams, shrimp, tanner crabs, snails, and other invertebrates typical of both hard-bottom and soft-bottom communities in PWS.

8.3.5 Marine and Anadromous Fish

The no-action alternative would leave the environment as it is for the foreseeable future and would have little effect on fish. The harbor projects considered in detail are at the north end of Port Valdez in an area that lacks water conditions or habitat that is attractive to most marine fish. The National Marine Fisheries Service (letter in Appendix 3) Robert D. Mecum 23 April 2007) stated:

> *Marine fish habitat within the project area appears to have low value. This rating is based on low density and diversity of fish, and a minimal amount of suitable habitat utilized by fish, as documented by both historical studies and recent on-site investigations by my staff. The substrates within the project area are heavily silt-laden from the nearby Lowe River.*

A few gunnels and other small fish that hide in kelp are in the rockweed habitat in the upper intertidal zone. They would be likely to escape habitat disruption and might find similar habitat later in rockweed on the new breakwaters of any action alternative. Larger marine fish are not reported in the project area. Habitat in the project area is not regularly used by or important habitat for rock bass, cod, ling cod, herring, sole, or any other marine species of commercial or recreational importance. The bottom is not sandy enough to serve as spawning habitat for capelin, sand lance, or eulachon. It may serve as general feeding/resting habitat for sculpins, pricklebacks, and other small marine fish. Loss of a maximum of 10.8 ha of this relatively low value marine fish habitat would have no discernable effect on local or regional populations of any marine fish species.

Marine fish in the alternative project sites considered in detail are relatively unimportant in regional ecological systems and economic value. Anadromous salmon, however, are abundant in the alternative project sites and are ecologically and economically important. Tens of thousands of mature salmon, including coho, pink, chum, and sockeye return to Port Valdez each year where they stage to spawn. Port Valdez, therefore, including the alternative harbor sites, is important pre-spawning habitat for mature Pacific salmon. Mature salmon move through the alternative project sites as they often school and move along the shoreline relatively close to shore.

Project alternatives considered in detail would, however, have little direct effect on those mature fish. Mature salmon are strong swimmers and can easily swim a little farther off shore to avoid any of the harbor alternatives considered in detail or to avoid boat traffic or other activity or noise. Pacific salmon cease feeding as they approach their spawning phase, so harbor effects on food organisms would have little effect on adult salmon feeding. All harbor configurations considered in detail would be relatively open structures that would allow salmon into and out of each harbor alternative at both the east and west ends, as well as through the entrance channel.

Salmon juveniles out-migrate from natal streams into Port Valdez beginning in April. They are much less mobile than adults and may be more affected by changes in their environment. The young of two species, coho and sockeye, live a year or more in freshwater streams, lakes, or hatchery ponds. They enter Port Valdez as strong-swimming juveniles that are likely to acclimate close to shore for relatively short periods and then migrate out into marine waters of Valdez Arm and PWS where plankton and smaller fish are more abundant.

Chum and pink salmon both enter Port Valdez in April and May or early June in their first year of life. They are small, weak swimmers that may be present in the shallower waters of Port Valdez longer than coho or sockeye juveniles. They also are much more abundant.

Several concerns about potential harbor effects on juvenile salmonids have been raised for harbor projects in Alaska. Those concerns can be grouped as follows:

1) Loss of feeding habitat. This is generally a relatively minor concern, but may be important where feeding habitat is limited.
2) Juveniles may enter a harbor and be trapped when they cannot find their way back out.
3) Harbor breakwaters or other structures may force juveniles into deep water where they may be prey for other salmonids or marine fish.
4) Juveniles may be exposed to contaminants in harbors.

Feeding habitat loss would have little effect on coho and sockeye juveniles, which do not preferentially feed in muddy tidal flats and soon migrate into more marine waters. Pink and chum juveniles do feed on tidal flats. The intertidal habitat in the harbor footprint, which ranges from 3.6 to 6.5 ha in alternatives considered in detail (table 8-1), would be potentially lost to those juveniles.

Large aggregations of salmon young, usually pink salmon, may be seen every summer in many Alaska harbors. Some biologists interpret this to mean that those fish cannot find their way out of the harbors or that they are unwilling to go into deeper water. This interpretation has not been proven or disproven. This should not be a meaningful adverse effect at any of the Valdez Harbor alternatives considered in detail. All the alternative layouts would open into shallow water at each end of the harbor during at least part of each tidal cycle.

Small fish forced to migrate around breakwaters and other natural and man-made obstructions may go into deeper water where they are prey for Dolly Varden, other salmonids, cod, rock bass, other fish, and predatory invertebrates. Active and perhaps substantial predation has been observed at some harbors and around natural rocky points of land. Young of the year pink and chum salmon tend to swim in the upper part of the water column, so the most successful predators tend to be those that feed effectively near the surface. Starry flounder and sculpins probably are the two predatory fishes most likely to hold near breakwater structures in Port Valdez. Both species, and most others that would be encountered at a harbor there, are typically bottom-feeding fish. They would be unlikely to find and prey on fish in the upper water column of deeper water, but could be effective predators of salmon juveniles in shallow water. A harbor would be unlikely to substantially increase predation on young salmon in the turbid, estuarine waters of Port Valdez where predators are relatively sparse.

Contaminants generally are related to heavy hydrocarbons, other organic chemicals, and heavy metals that accumulate in sediments on the bottom or are lighter hydrocarbon fuels floating on the surface. Bottom-feeding fish are generally sparse in harbors, but marine species tolerant to lower salinity conditions could occasionally be present and would be exposed to bottom contaminants. Most marine and anadromous species are unlikely to feed in the surface film and become exposed to substantial amounts of floating fuel. Detectable fuel contamination in the water column of harbors we have tested in Alaska is rare. When present, it would most likely be from benzene, which is highly soluble, but breaks down or dissipates quickly in natural conditions. Short-term exposure from substantial fuel spills could occasionally threaten salmon young and other fish in the water column. Adult salmon preparing for spawning also could be exposed, but adult fish generally are less likely to be harmed by comparable levels of exposure, and adult salmon in Port Valdez have only a short life span left, so long-term or chronic effects are less important concerns.

Two Moon Bay. Placement of dredged material to cover wood debris in Two Moon Bay would displace the marine fish in that habitat. Rock bass, flounder, Pacific cod, and other species are likely to be present in that degraded habitat, but that habitat has no specific attributes that would make it especially attractive to any marine or anadromous species. Most fish are mobile enough to escape from beneath discharged dredged material. So, adverse effects from dredged material discharge would be related primarily to temporary site avoidance. In the longer term, the restored habitat in Two Moon Bay should become better habitat for most fish species.

Deep Water Disposal Site. If the deep water disposal site in Port Valdez was selected, the dredged material would be discharged into about 200 meters of water. Boulders, cobbles, and other larger rocks would fall rapidly to the bottom, followed by the main mass of dredged material. Fish would be displaced by the first material to arrive, so there would be little chance of substantial adverse effect. Marine bottomfish might avoid the site after disposal, but the site would begin recolonizing almost immediately. Adverse effects would be relatively short term and would not be meaningful in the much larger area of Port Valdez. Salmon and other fish in the middle and upper water column would not be affected substantially.

8.3.6 Birds

Birds would be displaced from the immediate project vicinity during construction. Without construction timing windows, black-legged kittiwake success might be expected to decline at the adjacent SERVS dock nesting colony. There is no other known nesting habitat in the immediate harbor project area, so additional effects to nesting birds are not expected. Ducks, other water birds, and shorebirds would lose 5.3 to 10.7 ha of general purpose resting and feeding habitat.

Perhaps the greatest concern about a harbor project at the sites considered in detail was that it might impact birds and other resources in Harbor Cove or on the Duck Flats. The U.S. Fish and Wildlife Service may have favored the West Site based in large part on that concern. The West Site is farther from Harbor Cove, which would create a larger buffer for fuel spills, and between bird habitat at the Duck Flats and the noise and activity from a harbor.

Harbor Cove is less than 50 meters from the east end of the existing Valdez Harbor, within 100 meters of the very busy boat launching ramp in the harbor, and immediately adjacent to the road around the existing harbor. Seafood processors and other industrial users also are between the East alternative site and Harbor Cove. The East Site would be screened from Harbor Cove by the mass of Hotel Hill (figure 4-3) and Mineral Creek Islands, but boat traffic to and from the East Site would be closer to Harbor Cove than from the existing harbor or from the West Site.

8.3.7 Marine Mammals

Harbor seals, sea lions, and sea otters are the principal marine mammal species of concern in Port Valdez. None of the harbor alternatives would directly affect harbor seal or sea lion feeding, haulout, or other important habitat, but boats traveling to any harbor at the East or West sites might go closer to the more heavily used habitat of Harbor Cove and the islands off the entrance to the cove. The East Site harbor alternatives would be closer to that habitat and would be more likely to have an indirect effect on those resources from boat traffic. Relative differences between the alternatives cannot be quantified. Boat traffic can displace seals and sea lions, so this could cause an observable effect on behavior. Reefs and shallow water would tend to discourage boat traffic, but there could be some level of unquantifiable effect. There is relatively abundant shallow habitat that would serve as a refuge for any seals or sea lions that were disturbed.

Sea otters may be present almost anywhere in Port Valdez and appear to be relatively undisturbed by boat traffic that is not close enough to be a direct threat. The only habitat type specifically identified as important to them is feeding habitat. In the project area they dig for clams and mussels in a narrow band near the lower tidal limits. Figures 7-5, 7-8, 7-10, and 7-11 show this band of feeding habitat in both the East and West alternative sites. This habitat amounts to about 0.5 ha in each alternative site. Bivalves in that band are sparse and are at the lower end of the sizes used by sea otters, but the habitat has at least some value. The bivalves and the substrate they inhabit would be destroyed by any of the action alternatives, so about 0.5 ha of sea otter feeding habitat would be lost to any of the alternatives considered in detail. Blue mussels, the apparent principal bivalve in the feeding habitat, would likely colonize the rocky breakwater, which would provide substantially more holdfast substrate than the existing feeding band. Replacement habitat from alternatives in the East Site could be substantially better than existing sea otter habitat. Alternatives at the West Site would not be expected to provide appreciable amounts of replacement feeding habitat.

8.3.8 Endangered, Threatened, and Candidate Species

Endangered whale species that may be in Gulf of Alaska waters—humpback, sei, right, blue, and sperm—are all deeper water species and would not be affected by any of the harbor, disposal, or beneficial use of dredged material alternatives.

Steller’s sea lions are occasionally reported in the Harbor Cove and Duck Flats areas and can be assumed to range occasionally through the waters of East and West site project areas. No sea lion haulouts or sea lion critical habitat occur near any of the harbor, disposal, or beneficial use of dredged material alternative sites. The Corps has determined that this action would not affect listed Steller's sea lions. National Marine Fisheries Service concurrence is expected.

Candidate species for listing, yellow billed loon and Kittlitz's murrelets, may visit project areas occasionally, but none of the project features would affect any known nesting or other important habitat of these species. The action would not adversely affect either candidate species.

None of the listed species within the jurisdiction of the U.S Fish and Wildlife Service would be adversely affected by this action. The Service concurred with this determination during informal consultation for this report.

8.4 Cultural Resources

The project area was examined and records were researched by a qualified archeologist who also coordinated with the State Historic Preservation Officer. None of the alternatives considered in detail would adversely affect any historic or other cultural resource site.

Harbor construction would affect aesthetics of the immediate area. The alternatives considered in detail are all in a commercial waterfront setting. Any of the alternatives considered in detail would be similar to and consistent with the appearance of surrounding structures, facilities, and activities. Aesthetics would not be significantly affected.

8.5 Environmental Justice and Protection of Children

All the alternatives considered in detail are in a developed commercial or light-industrial area away from homes, schools, and playgrounds. No racial, ethnic, age, or other population group would be affected disproportionately. Children would not be put at risk by any project alternative.

8.6 Coastal Zone Management Resources

The goals of the Valdez Coastal Management Plan are listed in Section 7.6. Those goals are similar to many of the project objectives identified in Section 2. The no action alternative would not produce substantial positive or negative results. The relative success of the action alternative in meeting those goals would be as follows:

- To enhance the economic productivity and diversification of the region;
  Fully consistent

- To provide for public safety and the economic welfare of the community when siting future industrial, commercial, and residential development;
  Fully consistent

- To protect and enhance all coastal habitats and air and water quality in accordance with Federal and State statutes and in concert with desired industrial expansion;
  Impacts minimized. Consistent to the maximum extent practicable.

- To enhance the scenic beauty, uniqueness, and historical significance of the Valdez area;
  Impacts minimized. Consistent to the maximum extent practicable.

- To sensibly open up new land for residential and industrial use;
  Fully consistent

- To strive for compatible use of coastal lands and waters for residential, industrial, commercial, recreation, fish and wildlife needs, and open space activities;
  Fully consistent

- To seek, through appropriate channels, continued navigational safety and recreational opportunities in PWS; and,
  Fully consistent

- To expedite and simplify permit procedures and governmental agency project review and implementation of the district program.
  Fully consistent

The coastal management program supports the development of fish and fisheries related facilities in an environmentally sound manner. To be consistent with the coastal management program, development must avoid or minimize significant adverse effects on the social, historical, or natural environments.

A full analysis of consistency with enforceable standards is presented in Appendix 5.

8.7 Cumulative Impacts

The Council on Environmental Quality defines cumulative impacts as follows:

> "Cumulative impacts" is the impact on the environment that results from the incremental impact of the action when added to past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions. Cumulative impacts can result from individual minor but collectively significant actions taking place over a period of time (40 CFR 1508.7). Cumulative impacts can be added to those of existing, past, and predicted future effects."

Previous coastal development in Port Valdez has been related primarily to transportation. The Alyeska Pipeline Terminal has developed about 2 km of shoreline for receiving, storing, and transshipping crude petroleum from the Alaska Pipeline from the North Slope of Alaska. About a half-kilometer of shoreline was developed in the mid 1960's to create the existing Valdez Harbor and to create new shoreline seaward of the harbor. Container transshipment facilities, docking for the State ferry and other large commercial vessels, shore facilities for the tugs and cleanup vessels that support crude petroleum shipping, and other shoreline development account for another 0.5 km of industrial shoreline development. Coastal resources of Port Valdez also are affected by development of hydropower and fish hatchery facilities. Valdez Arm was historically logged, mined, and fished but little remains of that earlier development except for a few scattered shoreline buildings.

Future development in Port Valdez is limited by terrain, which is very steep along most of the shoreline; security restrictions that protect the oil pipeline and terminal facilities and the supertankers that haul the crude oil out for refining; conservation designations that protect lands from further development; and protected wildlife habitat and other resources that make development unlikely (e.g. the 400-ha Duck Flats just outside Valdez).

The remainder of Valdez Arm is even more protected from development. Almost the entire shoreline is too steep for more than an occasional cabin site. Almost all of it is in State or Federal conservation status or was reserved from development by purchase of rights with *Exxon Valdez* oil spill settlement funds. Almost none of the Valdez Arm shoreline outside the City of Valdez is likely to be developed in the foreseeable future.

Harbor construction and use of a new harbor would cause additional increments of use and of effects to infrastructure and natural resources. Principal concerns related to that type of cumulative effects on resources at Valdez and in the broader area of eastern PWS might be summarized as follows:

- Additional traffic and demand for goods and services in Valdez
- Adverse effects on air and water quality
- Additional demand for and pressure on fish and other consumable resources
- Additional recreational access to and use of wilderness areas in eastern PWS

Valdez is a small town with lots of summer visitors. The existing harbor is close to the main business district. Traffic is congested and parking is limited near the waterfront. Boat launching may be difficult and time consuming, and boat trailer parking is extremely limited near the boat launch. A new harbor could increase the numbers of visitors, traffic coming into Valdez, and pressure on local camping and other support facilities. A new harbor would be expected to increase highway traffic into town. A new harbor at the alternative sites considered in detail, however, would pull traffic away from the congested area around the existing harbor. There is ample parking and area to stage near the harbor site alternatives considered in detail, so downtown congestion would not be expected to increase and could be lessened.

Summer air quality is generally good. Additional small watercraft and automobiles are not likely to appreciably contribute to long-term air quality degradation. Additional harbor usage would add an increment of fuel leakage and other water quality effects to these from existing harbors and from industrial uses. This would affect water quality inside the harbor and would add an increment to Port Valdez. Existing water quality is good, and the minor contaminant contribution from a relatively small harbor employing best management practices would not lead to significant water quality impacts. Future contaminant sources could be managed to prevent significant impacts.

This project, along with other development in Valdez, is part of a recent history of increased commerce and recreation in PWS. There is a growing demand in Alaska for tourism destinations and development of additional recreational outlets, particularly sport and personal use fishing. Salmon stocked from local hatcheries has supported more independent recreation and small boat charter fishing as well as commercial fishing. Tour boat operation, particularly to Columbia Glacier, also has increased. Additional harbor space and launching capacity would allow more boaters to fish and participate in other recreational activities. There would be greater pressure on marine fisheries and recreational use sites within range of Valdez. Fish stocks are maintained by regulation, so additional pressure would not affect viability of regional stocks, but could lead to tighter limits on harvest. Those effects would be social rather than biological.

The Valdez Fisheries Development Association at Solomon Gulch stocks pink and coho salmon. The returning adults attract many anglers with trailer-hauled pleasure craft, many from Fairbanks. Transient boats operators can reach 200 per day on peak-use months. It is expected that moorage demand by recreational vessels is well represented by those currently using the harbor facilities and would be accommodated in the new harbor. There are 77 permanent charter boat berth holders in the harbor at this time. Economics analysis predicts 10 more charter vessels in the future (Appendix B). Commercial fishing is limited by available permits and is fully utilized, but a new harbor would allow more permanent moorage. In 2005 there were 1,244 PWS permits, 48 belonging to local residents. The commercial vessels would not be likely to increase but may become more efficient.

Recreational boating is relatively light in eastern PWS outside Valdez Arm. There are protected anchorages, but few good campsites and public use cabins. Boaters who stay out for several days may be able to find little or no traffic at beautiful anchorages. A new harbor at Valdez would be expected to increase recreational boating in eastern PWS. This could add an increment of additional boaters to eastern PWS outside Port Valdez. There are no landowner plans to increase numbers of public cabins or improved campsites. Cabins are fully used now, so cabin occupancy would not increase. There might be small increases in on-shore camping, but most additional users would sleep aboard if they remained out overnight. This could add additional users to remote, lightly used sites and could diminish the value of the experience for some. This could be important to individual boaters but would not be a significant regional impact.

9.0 PUBLIC INVOLVMENT AND AGENCY COORDINATION

U.S. Fish and Wildlife Service (USFWS) participation in this study under the Coordination Act started in 2000. A Planning Aid report was received in March 2000. In this report the USFWS recommended an environmentally preferred site on the west side of the Alyeska Service dock or on the East site with appropriate mitigation. Harbor Cove was considered significant habitat because it borders the Duck Flats. A draft Coordination Act report was received in May 2001. Several scoping meetings and a design charrett were held (March 4, 1999, January 26-27, 2000, October 22, 2001, March 2002, and July 22, 2002) with resource agencies and City of Valdez representatives to discuss issues and formulate appropriate mitigation. Some of the meeting minutes are contained in Appendix 3, Correspondence. A site survey of a log transfer facility at Two Moon Bay was conducted in November 2001. A final Coordination Act Report was submitted informally in April 2002 with the USFWS recommending the East Site and extensive mitigation.

Coordination under the Coordination Act was re-initiated with a meeting in May 2005. An agency meeting was held on July 19, 2005, to discuss harbor and mitigation alternatives. A multi-agency meeting was held on October 4, 2005, to present the Corps planning process, evaluate designs, and discuss mitigation options. Agencies in attendance were the USFWS, National Marine Fisheries Service, Environmental Protection Agency, State Departments of Natural Resources, Fish and Game and Environmental Conservation. The city manager of Valdez spoke to the group about the existing and future harbor's importance to the city's economy. The agencies agreed that a new harbor was needed and agreed to work toward common goals to develop effective mitigation and to use dredged material beneficially.

A facilitated meeting was held on November 4, 2005, to sort through the mitigation alternatives. Avoidance and minimization measures were an agreed part of the design to the extent practical. A fuel facility was determined to be necessary for efficient operation of a new harbor and would include best management practices. On November 21, 2005, the Corps met with the Valdez city council to present the harbor alternatives, including beneficial use and mitigation alternatives. The council agreed to support the beneficial use of dredged material at Two Moon Bay; to construct a bilge disposal facility; and to a number of design, construction, and operation measures for a harbor at the East Site. At the December 4, 2005, agency meeting, the recommended plan, including mitigation and beneficial use, was presented and accepted, with some reservations, by the participating agencies. Another meeting was held with USFWS on January 29, 2009 to again discuss the project and make sure mitigation and methodologies were agreeable. After the ongoing public and agency coordination effort, the Alaska District received the Final Coordination Act Report from USFWS in September 2006.

The City of Valdez has conducted public meetings throughout the planning process. In February 2007, a city survey on capital project was mailed to Valdez citizens. Three out of four respondents favored a new harbor and said a harbor was a top priority.

This feasibility report and environmental assessment were distributed for the public and agency review as part of the NEPA process in February 1, 2010. In addition, a public meeting was held on February 17, 2010, in Valdez during the review period, to discuss the project alternatives and solicit public views and opinions. Comments received were mostly supportive. Collaboration with the public and agencies will be ongoing throughout the life cycle of the project.

10.0 PERMITS AND AUTHORIZATIONS

The Corps or project sponsor (Valdez) would likely need the following permits from various State of Alaska agencies:

1. Alaska Department of Natural Resources
   a. ACMP Consistency Determination. This consistency review and determination is described in Section 7.6.

2. Alaska Department of Environmental Conservation
   a. 401 Water Quality Certification. This certification is issued after the State of Alaska ACMP review and final consistency determination. The certification states that the there is reasonable assurance that Alaska Water Quality standards will be met and maintained.

A checklist of project compliance with relevant Federal, state, and local statutes and regulations is shown in table 10-1.

Table 10- 1. Environmental Compliance Checklist

FEDERAL	Compliance
Archeological & Historical Preservation Act of 1974	FC
Clean Air Act	FC
Clean Water Act	PC
Coastal Zone Management Act of 1972 *	PC
Endangered Species Act of 1973	FC
Estuary Protection Act	FC
Federal Water Project Recreation Act	FC
Fish and Wildlife Coordination Act	FC
National Environmental Policy Act *	PC
Land and Water Conservation Fund Act	FC
Marine Protection, Research & Sanctuaries Act of 1972	FC
National Historic Preservation Act of 1972	FC
River and Harbors Act of 1899	FC
Magnuson-Stevens Fishery Conservation & Management Act *	FC
Marine Mammal Protection Act	FC
Bald Eagle Protection Act	FC
Watershed Protection and Flood Preservation Act	FC
Wild & Scenic Rivers Act	N/A
Executive Order 11593, Protection of Cultural Environment	FC
Executive Order 11988, Flood Plain Management	FC
Executive Order 11990, Protection of Wetlands	FC
Executive Order 12898, Environmental Justice	FC
Executive Order 13045, Protection of Children	FC
STATE AND LOCAL	
State Water Quality Certification *	PC
Alaska Coastal Management Program *	PC

PC = Partial compliance, FC = Full compliance

*Full compliance will be attained upon completion of the permitting process which is dependent upon completion of plans and specifications

11.0 CONCLUSIONS AND RECOMMENDATIONS

11.1 Conclusions

The studies documented in this report indicate that Federal construction of navigation improvements with rubblemound breakwaters, as described in the recommended plan, is technically possible, economically justified, and environmentally and socially acceptable. Of the alternatives evaluated in this study, the East Site Rubblemound 320-Vessel alternative was chosen by the local sponsor as the locally preferred plan due to physical limitations at the project site. The NED benefits for this alternative are found to be increasing in size over the next smaller alternative thus indicating that the NED plan is larger than the locally preferred plan. Valdez is willing to act as the non-Federal sponsor for the project and fulfill all the necessary local cooperation requirements. Thus, it is concluded that the navigation improvements described herein should be pursued by the Federal government in cooperation with the city.

11.2 Consistency with the Chief of Engineers Actions for Change for Applying Lessons Learned during Hurricanes Katrina and Rita

This section explains how the selected plan for the Navigation Improvements, Valdez, Alaska is consistent with each of the Chief of Engineers Action for Change for Applying Lessons Learned during Hurricanes Katrina and Rita.

11.2.1 Effectively Implement a Comprehensive Systems Approach

This item of change describes how the Corps will comprehensively design, construct, maintain and update engineered systems to be more robust, with full stakeholder participation.

11.2.1.1 Item of Change 1 - Employ Integrated, Comprehensive and Systems-based Approach

In planning for this project the study examined the system of commercial and recreational vessel usage in the PWS region. We considered how the system of Valdez Harbor was utilized for various purposes, where the system inefficiencies were, and what measures could be implemented to improve those inefficiencies.

11.2.1.2 Item of Change 2 - Employ Risk-based Concepts in Planning, Design, Construction, Operations, and Major Maintenance

The analysis of this study investigated what would happen if the costs or benefits of the project would increase or decrease and how that may affect project justification. We also examined the impact of hydraulic conditions on the breakwater to determine the most appropriate dimension and gradations of this structure. We also examined how the tidal cycle would affect the performance of the project to determine what the appropriate depth of dredging would be in order to achieve the desired project benefits. However, when taken into the greater context of projects that provide physical protection from damages, this is a very low risk project in terms of likelihood of physical damages and the magnitude of potential damages.

11.2.1.3 Item of Change 3 - Continuously Reassess and Update Policy for Program Development, Planning Guidance, Design and Construction Standards

This Item of Change is not directly applicable to the navigation improvements project for Valdez, Alaska.

11.2.1.4 Item of Change 4 - Employ Dynamic Independent Review

This project was one of the first District projects to have an ATR performed not only by a different District, but by an entirely different Division as well. Just performing required reviews was not considered sufficient. At several times throughout project formulation, the PDT called upon national experts in the formulation of small boat harbors to identify key policy issues and how best to ensure the project was in compliance with current policy and practice.

11.2.1.5 Item of Change 5 - Employ Adaptive Planning and Engineering Systems

The District employed a project charrett meeting and many other collaborative meetings as part of the planning process to identify the needs and concerns of the community, project stakeholders, and environmental resource agencies to develop a plan that met the many needs of the community, the environment, and the harbor users.

11.2.1.6 Item of Change 6 - Focus on Sustainability

As part of the project, an agreement was reached with the USFWS to dispose of dredged materials in an area that was damaged by its former use as a log boom holding facility. By depositing the dredged materials at this site, a more suitable material for the aquatic environment would be recreated. In addition, the new project examined the ability of the harbor to naturally provide the appropriate circulation and flushing needed for maintaining water quality.

11.2.1.7 Item of Change 7 - Review and Inspect Completed Works

As part of the planning and design of this project, the PDT used a variety of lessons learned from historical projects and ones that have recently gone through formulation and approval processes. We also examined the existing harbor and associated revetment projects to ensure that anything we would incorporate into our designs would not propagate inefficiencies or shortcomings of previous projects.

11.2.1.8. Item of Change 8 - Assess and Modify Organizational Behavior

This Item of Change is not directly applicable to the navigation improvements project for Valdez, Alaska.

11.2.2 Communication

This Item of Change discusses the effective and transparent communication with the public, and within the Corps, about risk and reliability.

11.2.2.1 Item of Change 8 - Effectively Communicate Risk

The PDT met with stakeholders, the local sponsor, and resource agencies to discuss the planning process, plan selection methodology, and the recommended plan and its expected performance. As mentioned previously, this is a low risk project.

11.2.2.2 Item of Change 9 - Establish Public Involvement Risk Reduction Strategies

The public will be able to review the project and public meetings will be held to discuss the findings and recommendations of this report. As mentioned previously, this is a low risk project.

11.2.3 Reliable Public Service Professionalism

Improve the state-of-the-art and the Corps' dedication to a competent, capable workforce on a continuing basis. Make the commitment to being a "learning organization" a reality.

11.2.3.1 Item of Change 11 - Manage and Enhance Technical Expertise and Professionalism.

This Item of Change is not directly applicable to the navigation improvements project for Valdez, Alaska.

11.2.3.2 Item of Change 12. - Invest in Research

This Item of Change is not directly applicable to the navigation improvements project for Valdez, Alaska.

11.3 Consistency with the Environmental Operating Principles

The recommended plan maximizes the balance of human need and impacts to the environment. The community and harbor users were involved in the planning process and endorse the recommended plan. Mitigation of impacts to the environment was incorporated to place dredged material in a location in need of such material to help generate a more natural aquatic environment. The breakwater layout maximizes circulation within the harbor to provide sustainable water quality. The environmental operating principles were addressed in the project as follows:

Environmental Sustainability

- Self-flushing harbor – ensures adequate water quality
- Breakwater design – minimal O&M

Interdependence of Life and the Physical Environment

- Minimized impacts to the marine environment
  - Putting dredged material into an impacted area to generate aquatic habitat
  - Provided near-shore gaps for fish passage

Seek Balance and Synergy between Human and Natural Systems

- Coordinated alternative development with the community members, harbor users, and State and Federal agencies

Continue to Accept Corporate Responsibility and Accountability

- Addressed agency and public concerns
- Identified and mitigated all project impacts

Assess and Mitigate Cumulative Impacts to Environment

- Project designed to minimize impacts
  - Minimize project footprint
- Unavoidable impacts mitigated
- Construction windows to avoid salmon migration
- Isolate in-water construction as necessary to minimize turbidity

Build and Share Knowledge

- Multi-partner effort to obtain study information to arrive at a recommended plan
- Utilized local knowledge of wind and wave conditions
- Utilized local and regional knowledge of vessel practices

Respect the Views of Individuals and Groups

- Listened to and incorporated views of others through public and team meetings

11.4 Recommendations

I recommend that the navigational improvements in Valdez, Alaska, be constructed generally in accordance with the plan herein, and with such modifications thereof as at the discretion of the Chief of Engineers may be advisable at an estimated Federal cost of $19,596,000 and non Federal cost of $36,221,000 provided that prior to construction the local sponsor agrees to the following:

a. Provide, during the period of design, 25 percent of design costs allocated by the Government to commercial navigation in accordance with the terms of a design agreement entered into prior to commencement of design work for the project; and provide, during the first year of construction, any additional funds necessary to pay the full non-Federal share of design costs allocated by the Government to commercial navigation in accordance with the cost sharing as set out in paragraph b. below;

b. Provide, during construction, 10 percent of the total cost of construction of the general navigation features attributable to dredging to a depth not in excess of 20 feet; plus 25 percent of the total cost of construction of the general navigation features attributable to dredging to a depth in excess of 20 feet but not in excess of 45 feet; plus 50 percent of the total cost of construction of the general navigation features attributable to dredging to a depth in excess of 45 feet;

c. Pay with interest, over a period not to exceed 30 years following completion of the period of construction of the project, up to an additional 10 percent of the total cost of construction of the general navigation features. The value of lands, easements, rights-of-way, and relocations provided by the non-Federal sponsor for the general navigation features, described below, may be credited toward this required payment. If the amount of credit exceeds 10 percent of the total cost of construction of the general navigation features, the non-Federal sponsor shall not be required to make any contribution under this paragraph, nor shall it be entitled to any refund for the value of lands, easements, rights-of-way, and relocations in excess of 10 percent of the total cost of construction of the general navigation features;

d. Provide all lands, easements, and rights-of-way, and perform or ensure the performance of all relocations determined by the Federal Government to be necessary for the construction or operation and maintenance of the general navigation features (including all lands easements, and rights-of-way, and relocations necessary for dredged material disposal facilities);

e. Accomplish all removals determined necessary by the Federal Government other than those removals specifically assigned to the Federal Government;

f. Provide, operate, maintain, repair, replace, and rehabilitate, at its own expense, the local service facilities consisting of the existing float system and additional floats added to accommodate the fleet designed for the recommended project in a manner compatible with the project’s authorized purposes and in accordance with applicable Federal and State laws and regulations and any specific directions prescribed by the Federal Government;

g. Shall not use funds from other Federal programs, including any non-Federal contribution required as a matching share thereof, to meet any of the non-Federal obligations for the project unless the Federal agency providing the Federal portion of such funds verifies in writing that expenditure of such funds for such purpose is authorized;

h. Shall prepare and implement a harbor management plan that incorporates best management practices to control water pollution at the project site and to coordinate such plan with local interests;

i. Comply with all applicable provisions of the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970, Public Law 91-646, as amended (42 U.S.C. 4601-4655), and the Uniform Regulations contained in 49 CFR Part 24, in acquiring lands, easements, and rights-of-way required for construction or operation and maintenance of the general navigation features and the local service facilities, including those necessary for relocations, the borrowing of materials, or the disposal of dredged or excavated material and inform all affected persons of applicable benefits, policies, and procedures in connection with said Act;

j. Give the Federal Government a right to enter, at reasonable times and in a reasonable manner, upon property that the non-Federal sponsor owns or controls for access to the project for the purpose of operating and maintaining the general navigation features;

k. Hold and save the United States free from all damages arising from the construction or operation and maintenance of the project, any betterments, and the local service facilities, except for damages due to the fault or negligence of the United States or its contractors;

l. Keep and maintain books, records, documents, or other evidence pertaining to costs and expenses incurred pursuant to the project, for a minimum of 3 years after completion of the accounting for which such books, records, documents, or other evidence are required, to the extent and in such detail as will properly reflect total costs of construction of the general navigation features, and in accordance with the standards for financial management systems set forth in the Uniform Administrative Requirements for Grants and Cooperative Agreements to State and Local Governments at 32 Code of Federal Regulations (CFR) Section 33.20;

m. Comply with all applicable Federal and State laws and regulations, including, but not limited to: Section 601 of the Civil Rights Act of 1964, Public Law 88-352 (42 U.S.C. 2000d) and Department of Defense Directive 5500.11 issued pursuant thereto; Army Regulation 600-7, entitled "Nondiscrimination on the Basis of Handicap in Programs and Activities Assisted or Conducted by the Department of the Army"; and all applicable Federal labor standards requirements including, but not limited to, 40 U.S.C. 3141- 3148 and 40 U.S.C. 3701 – 3708 (revising, codifying and enacting without substantial change the provisions of the Davis-Bacon Act (formerly 40 U.S.C. 276a *et seq.*), the Contract Work Hours and Safety Standards Act (formerly 40 U.S.C. 327 *et seq.*) and the Copeland Anti-Kickback Act (formerly 40 U.S.C. 276c *et seq.*);

n. Perform, or ensure performance of, any investigations for hazardous substances that are determined necessary to identify the existence and extent of any hazardous substances regulated under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), Public Law 96-510, as amended (42 U.S.C. 9601-9675), that may exist in, on, or under lands, easements, or rights-of-way that the Federal Government determines to be required for construction or operation and maintenance of the general navigation features. However, for lands that the Federal Government determines to be subject to the navigation servitude, only the Federal Government shall perform such investigations unless the Federal Government provides the non-Federal sponsor with prior specific written direction, in which case the non-Federal sponsor shall perform such investigations in accordance with such written direction;

o. Assume, as between the Federal Government and the non-Federal sponsor, complete financial responsibility for all necessary cleanup and response costs of any hazardous substances regulated under CERCLA that are located in, on, or under lands, easements, or rights-of-way that the Federal Government determines to be required for construction or operation and maintenance of the general navigation features;

p. To the maximum extent practicable, perform its obligations in a manner that will not cause liability to arise under CERCLA; and

q. Comply with Section 221 of Public Law 91-611, Flood Control Act of 1970, as amended (42 U.S.C. 1962d-5b), and Section 101(e) of the Water Resources Development Act of 1986, Public Law 99-662, as amended (33 U.S.C. 2211), which provides that the Secretary of the Army shall not commence the construction of any water resources project, or separable element thereof, until each non-Federal sponsor has entered into a written agreement to furnish its required cooperation for the project or separable element.

r. Ensure that lands created for the proposed project are retained in public ownership for uses compatible with the authorized purposes of the project. The non-Federal sponsor shall regulate the use, growth and development on such lands for the industries whose activities are dependent upon water transportation.

The recommendations for implementation of navigation improvements in Valdez, Alaska reflect the policies governing formulation of individual projects and the information available at this time. They do not necessarily reflect the program and budgeting priorities inherent in the local and State programs or the formulation of a national civil works water resources program. Consequently, the recommendations may be changed at higher review levels of the executive branch outside Alaska before they are used to support funding.

Reinhard W. Koenig

Reinhard W. Koenig
Colonel, Corps of Engineers
District Commander

4 Oct 10

Date

12.0 DOCUMENT PREPARERS

The persons listed in this table contributed to the preparation of this study through planning, research, data collection, writing, editing, and reviewing the feasibility report and environmental assessment.

Merlin Peterson, PE, Coastal Engineer, Alaska District, U.S. Army Corps of Engineers. Mr. Peterson prepared the Hydraulics Design appendix.

Bruce Sexauer PE, Senior Plan Formulator, Alaska District Corps of Engineers. Mr. Sexauer is the current plan formulator for this project and a principal preparer of the planning report.

Dave Martinson, Project Manager, Alaska District, U.S. Army Corps of Engineers. Mr. Martinson was the previous plan formulator for the study. He is currently the Project Manager.

Lorraine Cordova, Economist, Alaska District Corps of Engineers. Ms. Cordova prepared the economic appendix.

Guy McConnell, Biologist, Alaska District Corps of Engineers. Mr. McConnell is the current lead biologist for this project and a principal preparer of the planning document and the principal preparer of the environmental assessment.

Chris Hoffman, Biologist, Alaska District Corps of Engineers. Mr. Hoffman prepared the marine benthic assessment for the beneficial use of dredged material analysis

Diane Walters, writer-editor Alaska District, Corps of Engineers. Ms. Walters edited and organized this document.

Neil Rodriguez, Economist, formerly with the Alaska District Corps of Engineers. Mr. Rodriquez assisted in the preparation the economic appendix.

Jeff Lamb, Economist, formerly with the Alaska District Corps of Engineers. Mr. Lamb assisted in the preparation of the economic appendix.

Tryck, Nyman, and Hayes. Architect and Engineering Consultant assisted in designing alternatives.

Jon Brown, Economist with the Buffalo District, U.S, Army Corps of Engineers contributed to the economic analysis for the study.

Estrella Campellone, Biologist, Alaska District Corps of Engineers. Ms. Campellone prepared figures used in the environmental assessment.

John Burns. Mr. Burns (retired) worked as a biologist in Alaska for 30 years including 26 years with the Alaska District Corps of Engineers. Mr. Burns did the early environmental analysis for the study.

Larry Bartlett, Biologist (deceased), Alaska District Corps of Engineers biologist for 10 years and retired as a fisheries biologist from the Alaska Department of Fish and Game. Mr. Bartlett conducted field analysis, mapped habitat, contributed photographs, and wrote sections of the document.

Lizette Boyer, Biologist (retired), Alaska District Corps of Engineers. Ms. Boyer compiled data, worked with and was the principal preparer of initial versions of the Environmental Assessment.

Margan Grover, Archeologist, formerly with the Alaska District Corps of Engineers. Ms. Grover contributed to the cultural resources, existing environment and consequences sections of the environmental assessment.

Marcia Heer, Biologist, formerly with the USFWS wrote the Fish and Wildlife draft Coordination Act Report.

Dana Seagars, Ann Rappoport and Mary Lynn Nation of USFWS contributed to the final (revised) Coordination Act Report.

Jon Hozey and Nancy Peterson, City of Valdez project sponsor, contributed significant time and energy to seeing this project completed.

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