Crystal Orr

From:	Stacy Scott [sscott@ctclusi.org]
Sent:	Monday, June 24, 2019 2:19 PM
To:	Planning Department
Subject:	Fwd: Supplemental Comments on Coos County Remand File Number REM-19-001
Attachments:	6.24.2019 CTCLUSI Supplemental Comments on Coos County Remand File Number REM-19-001.pdf; ATT00001.htm; CTCLUSI Supplemental Comments on Coos County Remand File Number REM-19-001 Exh B.pdf; ATT00002.htm

Sent from my iPhone

Begin forwarded message:

> **From:** "Rick Eichstaedt" <rick@wheatlawoffices.com>
> **To:** "Jill Rolfe" <jrolfe@co.coos.or.us>
> **Cc:** "King, Seth J. (Perkins Coie)" <sking@perkinscoie.com>, "Stacy Scott" <sscott@ctclusi.org>, "Scott Wheat" <scott@wheatlawoffices.com>, "Margaret Corvi" <MCorvi@ctclusi.org>, "David Owens" <dowens@pembina.com>
> **Subject: Supplemental Comments on Coos County Remand File Number REM-19-001**
>
> Find attached supplemental comments of the Confederated Tribes of the Coos, Lower Umpqua and Siuslaw Indians on **Coos County Remand File Number REM-19-001.**
>
> Please confirm receipt of this email. Exhibits A and C will be hand delivered. Remainder will be sent via separate emails.
>
> --
> Rick Eichstaedt
> Attorney at Law
> Wheat Law Offices
> (509) 251-1424
> www.wheatlawoffices.com

Exhibit: 42
Date: 6/24/19

June 20, 2019

Jill Rolfe, Director
Coos County Planning Department
225 N Adams St
Coquille, Oregon 97423

SENT VIA EMAIL (planning@co.coos.or.us)

RE: Comments on Coos County Remand File Number REM-19-001

Dear Ms. Rolfe:

The Confederated Tribes of Coos, Lower Umpqua, and Siuslaw Indians ("Tribe") respectfully submits these supplemental comments on Coos County Remand File Number REM-19-001. These comments intend to supplement the Tribe's previously submitted comments on this matter.

Specifically, the Tribe has the following comments:

1. Ocean Shores' Sixth Assignment of Error

In the Sixth Assignment of Error in the Ocean Shores claims, the Land Use Board of Appeals ("LUBA") found that the County erred by adopting findings of compliance with local approval standards predicated upon Applicant obtaining a FERC permit without addressing whether FERC's 2016 denial of the permit application precluded Applicant, as a matter of law, from obtaining a FERC permit for the Project.

In response, the Applicant has requested that the County adopt findings that the "Applicant is not precluded as a matter of law from obtaining a FERC permit for the Project." *See* Staff Report. The Applicant further asserts and requests that the County determine:

> FERC's decision did not preclude Applicant from applying for another FERC certificate for an LNG export terminal and related pipeline on the North Spit. The Board should also rely upon the fact that, subsequent to FERC's denial, Applicant applied for a new FERC permit, and that application is currently pending. See FERC Notice of Applications dated October 2017 in Exhibit 3. As explained above, the County is not required to ascertain whether it is feasible for Applicant's new application to satisfy FERC's approval standards. Therefore, a reasonable person would rely upon this evidence to show that a FERC permit is "available" and thus not precluded as a matter of law.

Id.

However, as discussed at the public hearing on this matter, this argument disregards that the Project has significantly changed and is not identical to what was previously considered and approved by the County. As provided in Exhibit A (submitted in person to the County), the Project has changed significantly. As described in FERC's draft Environmental Impact Statement ("DEIS")[1], there are significant changes to this project:

> The primary differences between the previously proposed LNG terminal facilities (in Docket No. CP13-483-000) from the currently proposed Project are as follows:
>
> - The South Dunes Power Plant has been eliminated from the current proposal.
> - The locations of the workforce housing facility, the SORSC, and the project related Fire Department have been relocated.
> - New staging areas have been added at Oregon International Port of Coos Bay (Port) Laydown and Boxcar Hill sites.
> - The Al Pierce Company (APCO) sites (APCO 1 and 2) would be used for some Project related dredge disposal.
> - The number of LNG carriers that would visit the terminal has increased to 110 to 120 vessels per year.
> - The proposal now includes the excavation of four submerged areas (removing about 700,000 cubic yards of material) lying adjacent to the existing federally-authorized Federal Navigation Channel, and dredge slurry pipelines in Coos Bay; and
> - The habitat mitigation areas at West Jordan Cove and West Bridge locations have been eliminated.

DEIS at 1-4.

Given these changes, it is fundamentally impossible for FERC to approve the proposal currently before the County in this proceeding. It is moot. There is no legal precedent for the consideration of a proposal that is no longer valid. The Applicant must submit the most current proposal to the County for consideration.

2. Ocean Shores' Second Assignment of Error

During the hearing on this matter, there was significant discussion about the need for the Project.

In reviewing Ocean Shores' Second Assignment of Error, LUBA determined, in part, that the County erred in evaluating the public benefit of the Project.

There is no evidence in the record to support a valid need for this Project. In May 2018, the Coast Guard indicated "that the waterway in its current state" is "considered suitable for the LNG marine traffic associated with the proposed project" and can accommodate vessels with a maximum length of 300 meters or approximately 984 feet which is over 200 feet longer than any of the proposed current LNG vessels. *See* Exhibit B. Additionally, "simulated transits were

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[1] Available at https://www.ferc.gov/industries/gas/enviro/eis/2019/03-29-19-DEIS.asp.

piloted by the Coos Bay Pilots and witnessed by the USCG…these successful simulations expand the ability for Jordan Cove LNG to use any class of LNG carrier (membrane, Moss, or SBT) with physical dimensions equal to or smaller than observed during the simulated transits." *Id.*

In 1994, the Army Corps of Engineers completed its Navigation Improvements Final Feasibility Report and Environmental Impact Statement, *see* Exhibit C (hand delivered to the County), which similarly question the need for widening of the channel or turning basins:

- Page 39: "During the last several years, about 300 deep draft vessels have used the channel annually. This number is not expected to increase over the life of the project to a point where there would be a general need to design for two-way deep draft traffic." Today there are fewer ships around 60 annually, which is a significant drop from the numbers recorded around 1994 during this study and even with the LNG vessel traffic of approximately 120 vessels annually would not match what was observed during this Corp EIS analysis.
- Page 39: "Even with the trend toward larger vessels, the pilots indicate that the existing width of the entrance channel is sufficient"
- Page 39: "The lower channel to RM 9 is nominally 300 feet wide, but it varies considerable because of the use of wideners at bends. The pilots are satisfied with the existing width of the lower channel and do not recommend any changes.
- Pg. 40: "The pilots indicate that there have been little difficulties in operating within the existing turning basins and there have been no accidents associated with turning maneuvers."
- Pg. 40: Minimal delays: "The actual time recorded for the turning maneuver was 7 minutes."

There is substantial evidence that indicates a lack of need for the dredging associated with the Project.

3. Tribe's First Assignment of Error

During the hearing, there was debate as to whether the County must only look to the County's inventory of cultural resources in meeting its CBEMP Policy #18 obligations. This argument fails for three reasons.

First, the face of the Memorandum of Agreement ("MOA") and Cultural Resource Protection Agreement ("CRPA") between the Tribe and the Applicant are broadly defined to include all resources and are not limited merely to cultural resources on the County's inventory -- "The Parties agree that compliance with this MOA shall become a condition of any County and/or City issued land use permit for activities within the Project area that involve a Cultural Resource." Applicant's Exhibit 5 at 3.

Second, CBEMP Policy #18 is not limited to just inventories sites broadly defining its applicability, even to include sites discovered after approval – "If a previously unknown or unrecorded archaeological site is encountered in the development process, the above measures shall still apply." There simply is nothing on the face of CBEMP Policy #18 to limit it to inventoried sites.

Third, because there is an agreement between the Parties, the County must adopt the MOA and CRPA as a condition of approval. CBEMP Policy #18 states "the local government shall conduct an administrative review of the development proposal and shall … approve the development proposal subject to appropriate measures agreed upon by the landowner and the Tribe, as well as any additional measures deemed necessary by the local government to protect the historical and archaeological values of the site." There is no discretion to take an action other than include the MOA and CRPA as a condition of approval.

Moreover, if there were no MOA and CRPA and the parties disagreed about the scope of impacts, the County, as clearly stated by LUBA, conduct a hearing – "If the property owner and the Tribe cannot agree on the appropriate measures, then the governing body shall hold a quasi-judicial hearing to resolve the dispute. The hearing shall be a public hearing at which the governing body shall determine by preponderance of evidence whether the development project may be allowed to proceed, subject to any modifications deemed necessary by the governing body to protect the historical and archaeological values of the site."

CBEMP Policy #18 requires adoption of the MOA and CRPA as a condition of approval.

4. Ocean Shores' Third Assignment of Error

The Ocean Shores' Third Assignment of Error raises issues with CBEMP Policies #4 and #4a. In response, the Applicant has "proposed to comply with many measures to avoid and minimize adverse impacts, including the following: … Limiting work to the Oregon Department of Fish and Wildlife-approved in-water work window, which extends from October 1 through February 15." Narrative at 16.

The proposed limitation on in-water work needs to be extended to begin February 1, not February 15. As indicated by the photos taken below by the Tribe's Natural Resource Department staff of herring spawn by Fossil Point taken this last February, the Bay serves as an important spawning area for herring. Herring spawning in the Bay occurs during February.

This evidence is supported by Exhibits D, E, and F that indicate that herring spawning occurs earlier in the month. *See* Exhibit D ("Spawning occurs from January through April, and herring remain in the bay through summer.), Exhibit E ("Herring occasionally spawn in most all of Oregon's bays but spawn consistently in Coos Bay, Umpqua Bay and Yaquina Bay from February through early April but most consistently during March."), Exhibit F ("Pacific herring enter the bay to spawn in February, March and into April.").

Accordingly, in order to avoid adverse impacts to herring spawning as required by CBEMP Policies, the County must adopt a condition of approval that provides that in-water work should end by February 1.

Thanks for consideration of these comments.

Sincerely,

Rick Eichstaedt
Attorney for the Confederated Tribes of Coos,
Lower Umpqua and Siuslaw Indians

Jordan Cove Energy Project L.P.

Resource Report No. 1

General Project Description

Jordan Cove Energy Project

July 2017

JCEP LNG TERMINAL PROJECT

Resource Report 1 - General Project Description

MINIMUM FILING REQUIREMENTS	See the Following Resource Report Section :
• Provide a detailed description and location map of the project facilities –18 CFR § 380.12(c)(1)	Section 1.3 Figure 1.1-1
2. Describe any nonjurisdictional facilities that would be built in association with the project – 18 CFR § 380.12(c)(2)	Section 1.9
3. Provide current original U.S. Geological Survey (USGS) 7.5-minute-series topographic maps with mileposts showing the project facilities – 18 CFR § 380.12(c)(3)	Figure 1.10-1
4. Provide aerial images or photographs or alignment sheets based on these sources with mileposts showing the project facilities 18 CFR § 380.12(c)(3)	Figure 1.10-2
5. Provide plot/site plans of compressor stations showing the location of the nearest noise-sensitive areas (NSA) within 1 mile – 18 CFR § 380.12(c)(3,4)	Figure 1.1-2 and Resource Report 9
6. Describe construction and restoration methods – 18 CFR § 380.12(c)(6)	Section 1.5
7. Identify the permits required for construction across surface waters – 18 CFR § 380.12(c)(9)	Section 1.8 Table 1.6-1
8. Provide the names and address of all affected landowners and certify that all affected landowners will be notified as required in § 157.6(d) – 18 CFR § 380.12(c)(10)	Section 1.8.1.1 Appendix A.1 (to be provided in a subsequent filing)

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INFORMATION OFTEN MISSING AND RESULTING IN DATA REQUESTS	See the Following Resource Report Section:
• Describe all authorizations required to complete the proposed action and the status of applications for such authorizations, including actual or anticipated submittal and receipt dates.	Section 1.8 and Table 1.6-1
• Provide plot/site plans of all aboveground facilities that are not completely within the right-of-way.	Figure 1.1-2
• Provide detailed typical construction right-of-way cross-section diagrams for each proposed right-of-way configuration showing information such as widths and relative locations of existing rights-of-way, new permanent rights-of-way, and temporary construction rights-of-way. Clearly identify any overlap of existing rights-of-way for projects involving collocation. Identify by pipeline facility and milepost where each right-of-way configuration would apply.	Figure 1.1-5
• Summarize the total acreage of land affected by construction and operation of the project.	Table 1.4-1
• Describe cathodic protection system; include associated land requirements as appropriate.	Not Applicable
• Describe construction and restoration methods for offshore facilities as well as onshore facilities.	Section 1.5
• For proposed abandonments, describe how the right-of-way would be restored, who would own the site or right-of-way after abandonments, who would be responsible for facilities that would be abandoned in place, and whether landowners were given the opportunity to request removal.	Not Applicable
• If Resource Report 5, Socioeconomics is not provided, provide the start and end dates of construction, the number of pipeline spreads that would be used, and the workforce per spread.	Section 1.5.1
• If project includes construction in the federal offshore area, include in the discussion of required authorizations and clearances the status of consultations with the Bureau of Ocean Energy Management, Regulation and Enforcement. File with the Bureau of Ocean Energy Management, Regulation and Enforcement for right-of-way grants at the same time or before filing the Federal Energy Regulatory Commission (FERC) application.	Not Applicable
• For project involvement the import or export of natural gas/liquefied natural gas and construction of liquefied natural gas facilities, include in the discussion of required authorizations and clearances the status of consultations and authorizations required from the U.S. Department of Energy, U.S. Coast Guard, and the Federal Aviation Administration, as applicable.	Section 1.8 and Table 1.6-1
• Send two (2) additional copies of topographic maps and aerial images/photographs directly to the environmental staff of the Office of Energy Projects.	Figures 1.10-1 and 1.10-2
• Provide an electronic copy of the landowner list directly to the FERC environmental staff (check with FERC staff for required format).	Appendix A.1

RESOURCE REPORT 1
GENERAL PROJECT DESCRIPTION

CONTENTS

CTCLUSI Exhibit A

RESOURCE REPORT 1
GENERAL PROJECT DESCRIPTION

CONTENTS (Continued)

RESOURCE REPORT 1
GENERAL PROJECT DESCRIPTION

CONTENTS (Continued)

TABLES

FIGURES

CTCLUSI Exhibit A

RESOURCE REPORT 1
GENERAL PROJECT DESCRIPTION

CONTENTS (Continued)

CTCLUSI Exhibit A

RESOURCE REPORT 1
GENERAL PROJECT DESCRIPTION

CONTENTS (Continued)

APPENDICES

RESOURCE REPORT 1
GENERAL PROJECT DESCRIPTION

ACRONYMS

μg/Nm³	Micrograms per Normal Cubic Meter
ACC	Air Cooled Condenser
API	American Petroleum Institute
BOG	Boil-off Gas
Bcf/d	Billion Cubic Feet Per Day
C&H	Coast and Harbor Engineering
CBEMP	Coos Bay Estuary Management Plan
CBNBWB	Coos Bay-North Bend Water Board
CCM	Concrete Cellular Mattress
CO_2	Carbon Dioxide
cy	Cubic Yards
DCS	Distributed Control System
DLCD	Oregon Department of Land Conservation and Development
DOE	United States Department of Energy
DOE/FE	United States Department of Energy Office of Fossil Energy
DOT	United States Department of Transportation
Dth/d	Dekatherms Per Day
EIA	Energy Information Administration
ERP	Emergency Response Plan
ESD	Emergency Shutdown System
FEIS	Final Environmental Impact Statement
FERC	Federal Energy Regulatory Commission
FGS	Fire and Gas Systems
FTA	Free Trade Agreement
gpm	Gallons Per Minute
H	Horizontal
H_2S	Hydrogen Sulfide
HIPPS	High Integrity Pressure Protection System
HMT	Highest Measured Tide
HRSG	Heat Recovery Steam Generator
ICSS	Instrument Control and Safeguarding System
I/O	Input/Output
IWWP	Industrial Waste Water Pipeline
JCEP	Jordan Cove Energy Project, L.P.
kV	Kilovolt
LNG	Liquefied Natural Gas
LOI	Letter of Intent
LOR	Letter of Recommendation
m^3	Cubic Meter
m^3/hr	Cubic Meter Per Hour
mcy	Million Cubic Yards
MLLW	Mean Lower Low Water
mtpa	Million Tonnes Per Annum
MOF	Material Offloading Facility

RESOURCE REPORT 1
GENERAL PROJECT DESCRIPTION

ACRONYMS (Continued)

MW	Megawatt
NAVD88	North American Vertical Datum of 1988
NEPA	National Environmental Policy Act
NFPA	National Fire Protection Association
NGA	Natural Gas Act
NMFS	National Marine Fisheries Service
O&M	Operations and Maintenance
ODEQ	Oregon Department of Environmental Quality
ODSL	Oregon Department of State Lands
PCGP	Pacific Connector Gas Pipeline, LP
PHE	Powerhouse Enclosure
PLF	Project Loading Facility
ppbv	Parts Per Billion Volume
ppmv	Parts Per Million Volume
psig	Pounds Per Square Inch Gauge
PSV	Pressure Safety Valve
RFP	Roseburg Forest Products Company
SIS	Safety Instrumented Systems
SMR	Single Mixed Refrigerant
SORSC	Southwest Oregon Regional Safety Center
STG	Steam Turbine Generator
Tcf	Trillion Cubic Feet
TPP	Transpacific Parkway
US 101	U.S. Highway 101
USACE	U.S. Army Corps of Engineers
USCG	U.S. Coast Guard
USGS	U.S. Geological Survey
V	Vertical
WSA	Waterway Suitability Assessment
WSR	Waterway Suitability Report

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RESOURCE REPORT 1
GENERAL PROJECT DESCRIPTION

1.0 INTRODUCTION

Jordan Cove Energy Project, L.P. ("JCEP") is seeking authorization from the Federal Energy Regulatory Commission ("FERC" or "Commission") under Section 3 of the Natural Gas Act ("NGA") to site, construct, and operate a natural gas liquefaction and liquefied natural gas ("LNG") export facility ("LNG Terminal"), located on the bay side of the North Spit of Coos Bay, Oregon. JCEP will design the LNG Terminal to receive a maximum of 1,200,000 dekatherms per day ("dth/d") of natural gas and produce a maximum of 7.8 million tons per annum ("mtpa") of LNG for export. The LNG terminal will turn natural gas into its liquid form via cooling to about -260ºF, and in doing so it will reduce in volume to approximately 1/600th of its original volume, making it easier and more efficient to transport.

In order to supply the LNG Terminal with natural gas, Pacific Connector Gas Pipeline, LP ("PCGP") is proposing to contemporaneously construct and operate a new, approximately 229-mile-long, 36-inch-diameter natural gas transmission pipeline from interconnections with the existing Ruby Pipeline LLC and Gas Transmission Northwest LLC systems near Malin, Oregon, to the LNG Terminal ("Pipeline," and collectively with the LNG Terminal, the "Project"). PCGP will submit a contemporaneous application to FERC that will include its own set of resource reports with references to certain materials in the LNG Terminal resource reports.

FERC's National Environmental Policy Act ("NEPA") review process requires that an applicant submit an Environmental Report consisting of up to 13 individual resource reports. While the LNG Terminal and the Pipeline are interrelated projects, this Resource Report 1 provides a description of only the LNG Terminal and its purpose and need, as well as a specific description of the LNG Terminal facilities and certain non-jurisdictional facilities. This resource report also includes a description of the benefits to the local LNG Terminal area, land requirements, construction and operation procedures, and applicable regulatory approvals and coordination, as well as the current construction schedule for the LNG Terminal. Additionally, Appendix B.1 provides a discussion of the potential cumulative impacts that may result when the environmental effects associated with the Project are added to the impacts associated with other past, present, or reasonably foreseeable future actions.

The general location of the proposed LNG Terminal is shown on Figure 1.1-1. Also, Figure 1.1-2 includes a general layout of the proposed LNG Terminal and surrounding area and identifies the names of various geographic areas referenced in the resource reports.

This resource report is consistent with and meets or exceeds all applicable FERC filing requirements. A checklist showing the status of FERC's filing requirements for Resource Report 1 (18 CFR § 380.12) is included before the table of contents.

1.1 STATEMENT OF PURPOSE AND NEED

The Project is a market-driven response to the burgeoning and abundant natural gas supply in the US Rocky Mountain and Western Canada markets, and the growth of international demand, particularly in Asia.

The overall Project purpose and need is to construct a natural gas liquefaction and deep-water export terminal capable of receiving and loading ocean-going LNG carriers, that receives its natural gas supply from a point near the intersections of the GTN Pipeline system and Ruby Pipeline system in Malin, Oregon.

The Pipeline receipt point in Malin is strategically located to give international customers in Asia access to abundant supplies of natural gas from two burgeoning natural gas supply basins – one in the U.S. Rocky Mountains (through the existing Ruby Pipeline) and a second in western Canada (through the existing GTN Pipeline). The LNG Terminal, on the bay side of the North Spit of Coos Bay, would support receipt, liquefaction, storage, and loading of LNG onto ocean-going LNG carriers for delivery to export markets giving those supplies an efficient and cost-effective outlet.

The Pipeline is needed to transport natural gas from the hub near Malin, Oregon to the LNG Terminal to provide the feedstock necessary to produce 7.8 mtpa of LNG. PCGP intends to hold an open season for transportation service on the Pipeline in July 2017, prior to the submission of its certificate application. When PCGP submits its certificate application, PCGP will have executed precedent agreement(s) totaling at least 68% of the Pipeline's capacity. PCGP expects to execute contracts for substantially all of the available capacity prior to the issuance of a final environmental review document by FERC.

1.2 PROJECT SUMMARY

1.2.1 Background

On September 4, 2007, JCEP filed an application with FERC to construct and operate an LNG import terminal at Coos Bay, Oregon, in Docket No. CP07-444-000. That same day, PCGP, in Docket No. CP07-441-000, filed an application with FERC to construct and operate a natural gas sendout pipeline connecting the JCEP LNG import terminal with existing natural gas transportation systems. In May 2009, FERC produced a final environmental impact statement ("FEIS") for Docket Nos. CP07-441-000 and CP07-444-000. The Commission authorized both the import terminal and the natural gas sendout pipeline on December 17, 2009. On April 16, 2012, the Commission vacated the previously issued certificates for the LNG import terminal in Docket No. CP07-444-000 and the associated sendout pipeline in Docket No. CP07-441-000.

On May 21, 2013, JCEP filed an application seeking authorization for its proposed LNG export terminal on the North Spit of Coos Bay in Coos County, Oregon, in Docket No CP13-483-000. PCGP filed its companion application with FERC for the supply pipeline to the proposed terminal on June 6, 2013, in Docket No. CP13-492-000. FERC conducted an extensive environmental review thereunder, issuing an FEIS in September 2015. On March 11, 2016, the Commission denied the applications for certificates in Docket Nos. CP13-483-000 and CP13-492-000, without prejudice to JCEP's and PCGP's refiling of new applications.

On January 23, 2017, JCEP and PCGP requested approval to participate in FERC's Pre-Filing Review Process to assist in the identification and proper assessment of issues and to obtain input on the development of the environmental resource reports. FERC granted this request on February 10, 2017, and assigned Docket No. PF17-4-000.

JCEP currently anticipates that construction for the Project would begin in the first half of 2019, with a target in-service date in the first half of 2024. Major differences between the 2013 and 2017 export terminal proposals are further described below.

1.2.2 Market Demand and Economic Support for the Project

The Project would provide clean burning natural gas to Asian markets, which would reduce the amount of coal currently being burned in these markets for electric power generation and increase cleaner-burning supplies to other commercial and residential markets. The Project would also provide new market access for natural gas producers in the Rocky Mountains and Western Canada. These producers have seen their access to markets in the eastern and central regions of the United States and Canada erode with the development and ramp-up of natural gas from the Marcellus and Utica shales.

Two large under-utilized pipeline systems, the Ruby pipeline and the GTN pipeline, already exist to transport natural gas from these large gas supply basins to the Malin hub in southern Oregon. The Pipeline would be able to access these supplies and transport them to the LNG Terminal for export.

Global LNG Market Demand and Supply

Demand for LNG is expected to grow 4% to 5% per year between 2015 and 2030, and LNG demand growth has exceeded expectations recently.[1] While many expected the market to be oversupplied in 2016, demand in Asia and the Middle East absorbed the increase in supply from Australia and the U.S. Chinese imports of LNG increased 33% in 2016 over the prior year, and India saw an increase of 25% over the same period. There were also six new importing countries in 2016 (Colombia, Egypt, Jamaica, Jordan, Pakistan and Poland), bringing the total number of LNG importing countries to 35. Shortages in domestic gas supplies in Egypt, Jordan and Pakistan led those countries to be among the fasting growing importers, importing a total of 13.9 million tons of LNG in 2016 during their first year of imports.

Despite the resurgent LNG demand, global LNG prices fell dramatically over the last two years following the slump in oil prices. This has led to new LNG supply projects being deferred or cancelled, and it will undoubtedly lead to a tightening of the global market post 2020. With few new supply projects and strong demand growth driven by India, China and Southeast Asia, the market is expected to recover by 2023, and LNG demand is expected to almost double by 2030, requiring an incremental 150 mtpa of new supply by the end of the next decade.

U.S. LNG exports are one of the lowest cost supply sources in the world and are expected to maintain their competitive advantage going forward due to the size and quality of the upstream natural gas resources in North America and the availability of infrastructure. Projects such as JCEP and PCGP on the west coast of the US offer a particular strategic advantage in being able to supply the strong Asian market demand with shorter shipping distances relative to other US export projects. The distance from the Port of Coos Bay to Tokyo Bay requires nine days shipping as compared to 22 days from the Gulf of Mexico utilizing the Panama Canal.

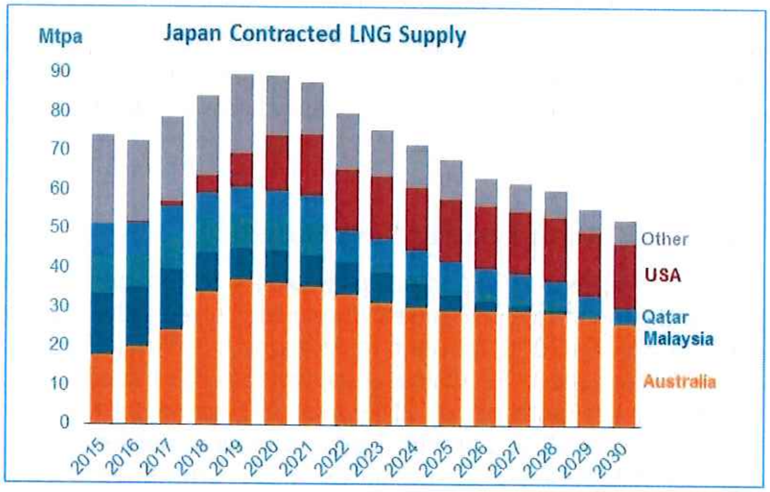
CTCLUSI Exhibit A

The Japanese Demand

Demand in Japan is not dependent upon demand growth but is driven by the re-balancing of the supply portfolios held by Japanese companies. Twenty-five percent of Japan's long term contracts expire between 2020 and 2025. U.S. LNG exports to Japan are positive from a number of standpoints. Japan is the most important U.S. ally in Asia, and increased U.S. imports will strengthen this alliance and improve the balance of trade between these two countries.

The figure below shows the current and predicted Japanese contracted LNG supply and demonstrates the increasing demand from US export supplies.

On March 22, 2016, JCEP announced that it had executed a preliminary agreement with JERA Co., Inc., the largest LNG buyer in the world, for the acquisition of at least 1.5 mtpa of LNG capacity from the Project. JERA was formed on April 1, 2015, and is a joint venture between Tokyo Electric Power Company and Chubu Electric Power Company, two of the largest Japanese power utilities. The joint venture was formed to combine the international energy assets of the two companies, including energy procurement and shipping. At formation, JERA had 40 mtpa of LNG supplies under contract. Following the announcement of the JERA agreement, JCEP announced the execution of a preliminary agreement with ITOCHU Corporation, a significant Japanese investment and trading firm, for the procurement of 1.5 mtpa of LNG capacity from the Project.



Negotiations continue with other LNG buyers for the balance of the marketed plant capacity.

U.S. and Canadian Market Supply

The development of ultra tight shales and siltstones through horizontal drilling and hydraulic fracking has revolutionized the U.S. and Canadian long-term natural gas outlook. Resource estimates continue to climb as new and advanced exploration, well drilling, completion and stimulation technologies allow access to and delineation of more technically recoverable natural gas resources. The U.S. Energy Information Agency ("EIA") is an independent agency of the U.S. Federal Statistical System responsible for collecting, analyzing, and disseminating energy information to promote sound policymaking, efficient markets, and public understanding of energy and its interaction with the economy and the environment. As of January 1, 2014, the EIA estimated there was 2,136 trillion cubic feet ("Tcf") of technically recoverable natural gas resources yet to be delineated in the U.S., with natural gas from shale plays an increasingly large part of the mix. The Potential Gas Committee sponsored by the Colorado School of Mines in its biennial resource assessment estimated that at the end of 2014 technically recoverable resources were 2,515 Tcf. When combined with EIA's estimate of proved natural gas reserves of 308 Tcf of dry gas at the end of 2015, total U.S. natural gas resources are estimated at 2,444

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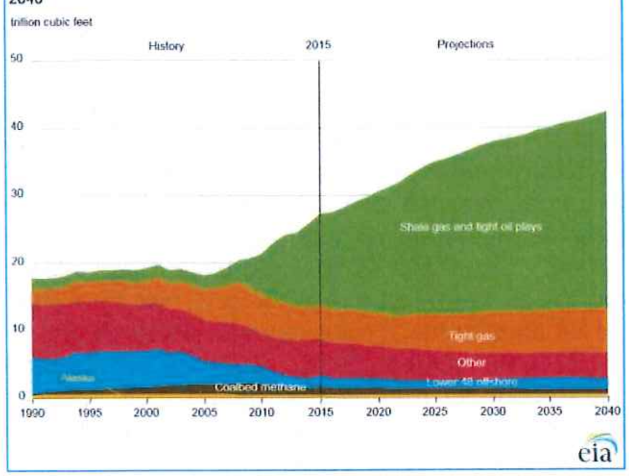
Tcf to 2,823 Tcf, or approximately 100 years of natural gas supply at current rates of consumption.

Of particular importance to the Project, the U.S. Geological Society ("USGS") upgraded its assessment of technically recoverable natural gas resources in the Mancos Shale in the Piceance Basin of Colorado to 66 Tcf as compared to the USGS' 2003 assessment of 1.6 Tcf. The Piceance Basin is a key natural gas province that can be sourced by the Project through the Ruby pipeline for delivery to the Malin, Oregon gas hub.

The figure below shows natural gas production in the Piceance Basin, one of the supply basins within the U.S Rockies.

Technically recoverable natural gas resources from the Western Canadian Sedimentary Basin ("WCSB"), which the Project can access via the GTN pipeline system exceeds 1,000 Tcf with 449 Tcf of this from the Montney Formation as estimated in a joint report by the Canadian National Energy Board, the British Columbia Oil and Gas Commission, the Alberta Energy Regulator and the British Columbia Ministry of Natural Gas Development published in November 2013.

Figure MT-46. U.S. dry natural gas production by source in the Reference case, 1990–2040



In May 2014, the U.S. Department of Energy Office of Fossil Energy ("DOE/FE") announced its intention to undertake an updated economic study in order to gain a better understanding of how potential U.S. LNG exports between 12 and 20 Bcf/d could affect the public interest i.e. could exports impact natural gas availability and pricing in the U.S.

Specifically, DOE/FE commissioned the EIA to update its 2012 LNG Export Study. This document is titled Effect of Increased Levels of Liquefied Natural Gas Exports on U.S. Energy Markets, dated October 2014 (USEIA 2014). Further, DOE/FE determined that it would follow the EIA Study with an additional study that would evaluate the macroeconomic impacts of the exports evaluated in the EIA Study and directed the National Energy Technology Laboratory to facilitate this additional analysis. To carry out this task, The Center for Energy Studies at Rice University's Baker Institute and Oxford Economics were commissioned on behalf of the DOE/FE to undertake a scenario-based assessment of the macroeconomic impact of alternative levels of U.S. LNG exports under different assumptions for U.S. resource endowment, U.S. gas demand, and the international market environment. This document is titled The Macroeconomic Impact of Increasing U.S. LNG Exports ("Economic Study"), dated October 29, 2015 (USDOE 2015).

As related by the Economic Study, the outlook on North American gas supplies has undergone a dramatic reversal since 2008, when the general consensus was that supplies would be insufficient to keep pace with growing demand and that foreign-sourced LNG would need to be imported. As discussed above, the Economic Study identifies shale gas production growth as the biggest contributor to overall gas supply abundance due to the ramp-up in production of natural gas extracted from ultralow permeability and ultralow porosity shale formations in the U.S. The development and continuing improvement of hydraulic fracturing technology have led to increasingly efficient shale gas production, and shale gas production "has grown in less than

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a decade to comprise about one-half of U.S. domestic production" (USDOE 2015). Estimates of dry natural gas resources in the U.S. have likewise grown, reflecting significantly increased estimates of shale gas resources. The EIA's Annual Energy Outlook 2016 ("AEO 2016") (USEIA 2016) estimates that total U.S. dry natural gas production was 27.2 Tcf in 2015. Of this total amount of production for 2015, it is estimated that 13.6 Tcf, or 50 percent, came from shale gas and tight oil plays. Based on the AEO 2016 Reference Case, total U.S. dry natural gas production is projected to increase to 42.1 Tcf by 2040, of which approximately 69 percent is derived from shale gas and tight oil plays, leading the share of U.S. dry natural gas production growth (see EIA graph above).

The Economic Study also states that gas production will continue to grow steadily throughout the forecast period to 2040, as "the majority of the increase in LNG exports is accommodated by expanded production rather than reductions in domestic demand, a result that reflects the very elastic long-run supply curve in North America" (USDOE 2015). The Economic Study also states that increased production will also have a positive spillover to "key suppliers of the sector such as machinery and engineering services, and rising employment in the gas sector also leads to increased demand for goods and services more broadly" (USDOE 2015). Indeed, the growth potential is enhanced by the fact that the reduced geologic risk and resulting reliability of shale gas discovery and production make it responsive to demand and by the fact that the presence of natural gas liquids in some shale formations creates an added incentive for development.

For the demand outlook, the Economic Study projects steady growth, driven by demand in the industrial and power-generation sectors in the near term, and continued growth in power generation longer term. This projected growth is "driven by emerging environmental policies that target the use of coal" (USDOE 2015). Additionally, the AEO 2016 Reference Case estimates that total U.S. natural gas consumption will increase from 27.5 Tcf in 2015 to 34.4 Tcf in 2040. The AEO 2016 Reference Case also estimates that the U.S. will become a net exporter of natural gas in 2018 and that "growing natural gas production from shale gas and tight oil formations at relatively low prices support an increase in U.S. LNG exports of 6.7 Tcf from 2015-40" (USEIA 2016). Even as both domestic demand and net exports are projected to grow throughout the forecast period, U.S. natural gas production is sufficient to meet these increases. As technology improves in the development of shale resources, higher rates of recovery at lower costs occur.

According to both the Economic Study and the AEO 2016 report, growing natural gas demand in the industrial and electric power sectors and increasing exports of LNG place upward pressure on U.S. natural gas pricing. While this is occurring, the AEO 2016 report notes that improvements in drilling technology allow production to keep pace with demand, "resulting in relatively stable prices throughout the projection period." Examples of technology improvements include better rigs and drill bits, resulting in lower unit costs and the expansion of tight and shale gas formations. The Economic Study expects higher U.S. gas production and increased profitability of U.S. gas producers to "typically exceed the negative impacts of higher domestic natural gas prices associated with increased LNG exports" (USDOE 2015).

The Economic Study concludes that the overall macroeconomic impact of increasing U.S. LNG exports from 12 Bcf/d to 20 Bcf/d is marginally positive. "In aggregate the size of the economy is little changed in the long run, with GDP less than 0.1 percent ($7.7 billion USD annually in today's prices) higher on average over 2026-2040 than in the 12 Bcf/d export case" (USDOE 2015). While an increase in LNG exports from the U.S. will yield small declines in output for some energy-intensive industries, such as cement, concrete, and glass, "the estimated impact on sector output is very small compared to expected sector growth to 2040" (USDOE 2015).

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Also, since most of any U.S. LNG exports would be derived from increased extraction rather than diverted natural gas supplies, "other sectors benefit from increasing U.S. LNG exports, especially the industries that supply the natural gas sector or benefit from the capex needed to increase production. This includes some energy-intensive sectors such as cement and helps offset some of the impact of higher energy prices" (USDOE 2015). These conclusions are also consistent with the results from the EIA Study, which determined that "increasing LNG exports leads to higher economic output, as measured by real gross domestic product, as increased energy production spurs investment. This higher economic output is enough to overcome the negative impact of higher domestic energy prices over the projection period" (USEIA 2016).

1.2.3 Current LNG Terminal Proposal

The design of the proposed LNG Terminal reflects several enhancements from the prior proposal in Docket No. CP13-483. Hydrocarbon processing and combustion, including pre-treatment, will be located on Ingram Yard in an effort to create a more efficient footprint. The LNG Terminal will now utilize a direct drive configuration by relocating the gas turbines adjacent to the refrigerant compressors, thereby eliminating the need for the South Dunes Power Plant and associated transmission line, making the facility simpler, more efficient, and easier to operate. The workforce housing facility has been consolidated onto the South Dunes Site, reducing land and traffic impacts in the area of the previously proposed location at the North Point Site in North Bend adjacent to the suburb of Simpson Heights. The Southwest Oregon Regional Safety Center building has been relocated to the northeast portion of the South Dunes Site and the Fire Department has been relocated to the Access and Utility Corridor, both relocations further reducing land and wetland impacts while improving emergency response time.

JCEP proposes herein a number of design enhancements to the proposal under Docket No.CP13-483-000. These changes will result in an enhanced system design and a reduction in overall environmental impacts.

The Project under Docket No. CP13-483-000 included the 420-megawatt ("MW") South Dunes Power Plant. Within the current proposal, the project proposes to use direct combustion-turbine liquefaction-drive instead of motor liquefaction-drive driven by electric power provided by the South Dunes Power Plant. A direct drive configuration is simpler, more efficient and easier to operate; and results in a number of reductions in environmental impact, including:

- Eliminates hydrocarbon processing combustion equipment from the South Dunes Site, which results in a single compact and consolidated facility process area on Ingram Yard;
- Eliminates the need for a railroad spur road overpass, reducing wetland impacts;
- Reduces combustion-turbine count from six to five, and maintains, and in some cases reduces, point source air emissions from the existing conditions permitted by the Oregon Department of Environmental Quality ("ODEQ");
- Reduces water consumption by 1 million gallons per day by eliminating the need for gas turbine water injection;
- Increases the distance from the nearest noise-sensitive receptors;
- Eliminates impacts on estuarine wetlands on the South Dunes Site;

- Allows for relocation of the workforce housing facility to the South Dunes Site addressing community concerns and significantly reducing workforce traffic movements on U.S. Highway 101 ("US 101") during the working week; and,
- Allows for the relocation of the Southwest Oregon Regional Safety Center building to the northeast corner of the South Dunes Site and the elimination of 1 acre of wetland impacts.

In addition to the above enhancements, the following changes have been made to the design and construction of the LNG Terminal:

- Fire and other emergency incident response time has been improved by splitting the Fire Department building from the Southwest Oregon Regional Safety Center ("SORSC") building and relocating the Fire Department to the Utility Corridor from the South Dunes Site.
- The design now incorporates black-start capability; reducing impacts from the Project on local utilities by eliminating the need to draw and export electricity from the local grid for operations, except the SORSC building. Limited temporary construction power within the capacity of the existing grid system will be utilized.
- The expansion of the Kentuck Mitigation Site from 33 acres to a more comprehensive Kentuck Project encompassing over 100 acres of wide-ranging habitat of mudflats, salt marsh, willowed scrub/shrubs and fish structures addressing a number of the key limiting factors Coho salmon face in this region; assisting in the species' removal from the endangered species list

Table 1.1-1 – Major Changes between CP13-483-000 and PF17-4-000 for the JCEP LNG Terminal Facilities

Element[i]	Proposed Size/Location	Reasons for the Changes
Elements Deleted From the Project		
Firewater Ponds	The firewater ponds have been deleted from the design and replaced with two (2) firewater tanks.	Reduces footprint, increased sanitation and fulfills multiple uses.
Gas Compressor Area	Gas compression is not included in the proposed design.	Gas compression is not required in the current design.
South Dunes Power Plant	The South Dunes Power Plant and the South Dunes Site Control Room (Control Room #2) have been eliminated.	Liquefaction will now be powered directly by gas-fired turbines, rather than by electric motors that previously would have required electricity generated at a separate, onsite power plant. Reduced footprint due to bringing development boundary south of Old Jordan Cove Road.

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Table 1.1-1 – Major Changes between CP13-483-000 and PF17-4-000 for the JCEP LNG Terminal Facilities

Element[i]	Proposed Size/Location	Reasons for the Changes
South Dunes Power Plant	The railroad spur bridge on the northwest corner of the South Dunes site has been eliminated.	Due to decrease in footprint size from the South Dunes Power Plant the existing rail line does not need to be shifted. Reduces wetland impacts.
Access/Utility Corridor	The 115kV overhead power transmission lines from the South Dunes Power Plant to the JCEP Facility have been deleted as the South Dunes Power Plant has been eliminated.	Transmission of electric power is no longer necessary due to direct turbine drive configuration.
Access/Utility Corridor	The backup pilot gas line to the South Dunes Power Plant have been deleted as the South Dunes Power Plant has been eliminated.	No process fuel gas is required on South Dunes due to deletion of the South Dunes Power Plant.
Access/Utility Corridor	The access bridge from South Dunes to LNG Terminal in the Utility Access corridor east of Jordan Cove Road and the Roseburg Forest Products rail spur has been deleted.	Fire Department has been relocated to Utility and Access Corridor negating the need for an access route provided by the bridge.
North Point Workforce Housing	The Workforce Housing Facility has been moved from North Point and relocated to the South Dunes site.	Addresses community concerns and reduces workforce traffic movements on US 101 during the working week.
Site F offshore dredge disposal site	Site F will no longer be used for construction Dredged Material Disposal; instead dredged material will be disposed on-site and off-site at the Kentuck Project.	The site has been cut and fill balanced and Site F is no longer necessary for construction related or maintenance dredge material disposal.
SORSC	The SORSC building has been relocated beside the administration building in the northeast corner of the South Dunes site. No fill will be placed on the previous site of the SORSC.	SORSC has been relocated, reduces wetland impacts.
Elements Added to the Project		

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Table 1.1-1 – Major Changes between CP13-483-000 and PF17-4-000 for the JCEP LNG Terminal Facilities

Element[i]	Proposed Size/Location	Reasons for the Changes
Off-site Temporary Construction Laydown and Staging Areas	Additional construction laydown area may be required off-site on brownfield land suitably zoned for industrial purposes, at the RFP property, Box Car Hill, Port Laydown Site and APCO properties.	Facilitation of safe and efficient construction methods.
Steam System	Black start capacity implemented by two (2) diesel generators.	Avoids drawing on local grid. Reduces impact on local utilities.
Slip and Access Channel– Lay Berth	An emergency lay berth for LNG carriers has been added to the west side of the marine slip. Dedicated access road on western boundary added for emergency lay berth access.	In response to USCG concerns, the emergency lay berth was added to mitigate the scenario of where to berth a temporarily disabled LNG tanker during port call.
Access/Utility Corridor	The Utility Corridor will include additional lines for the fire water supply to Admin and SORSC buildings; power to the Admin building.	Fire water protection systems and power generation on South Dunes were removed with deletion of South Dunes Power Plant.
Workforce Housing Facility	The Workforce Housing Facility has been relocated to the South Dunes site.	Addresses community concerns and reduces workforce traffic movements on US 101 during the working week.
South Dunes Site	Added helicopter pad adjacent to the proposed SORSC building.	Agency requirement in ERP process.
Elements Modified in the Project		
Terminal Site Access	Previous primary site access was from Transpacific Parkway. Now, primary site access is from Jordan Cove Road with secondary access from Transpacific Parkway.	Improved access safety.
LNG Transfer Line/Loading Platform	LNG design loading rate has increased to 12,000m³/hr. This was previously 10,000m³/hr.	Decreased loading time. Still in compliance with PHMSA Vapor Dispersion requirements.

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Table 1.1-1 – Major Changes between CP13-483-000 and PF17-4-000 for the JCEP LNG Terminal Facilities

Element[i]	Proposed Size/Location	Reasons for the Changes
Liquefaction Process Area	The previous design included four (4) liquefaction trains and the current proposal includes five (5) liquefaction trains.	5 liquefactions trains efficiently match the gas turbine driver sizes selected.
Liquefaction Process Area	The LNG production capacity of the LNG Terminal has been increased to 7.8 Mtpa. This was previously 6.8 Mtpa.	Liquefaction production capacity increased to reflect the production output expected with the site-specific ambient conditions.
Liquefaction Process Area	Liquefaction will now be powered directly by gas-fired turbines, rather than by electric motors that required electricity generated at a separate, onsite power plant.	Reduced equipment count and increased efficiency.
Liquefaction Process Area	Reduction of the number of gas turbines from six (6) to five (5).	5 liquefactions trains efficiently match the gas turbine driver sizes selected.
Liquefaction Process Area	Water injection is no longer required on the gas turbines, saving approximately 1 million gallons of water a day.	Replaced with inlet chilling to meet same liquefaction power requirements.
On-site Laydown Areas	On-site laydown areas have been reconfigured.	Facilitation of safe and efficient construction methods.

Table 1.1-1 – Major Changes between CP13-483-000 and PF17-4-000 for the JCEP LNG Terminal Facilities

Element[i]	Proposed Size/Location	Reasons for the Changes
Flare Area	There will be three (3) separate flare systems: one for warm (wet) reliefs, one for cold, cryogenic (dry) reliefs, and one marine flare for low-pressure cryogenic relief. The low-pressure cryogenic relief fully enclosed ground flare (marine flare) has been located at the southwest side of the LNG tank area. The warm and cold flare systems have been combined into one multi-point ground flare and moved to the north end of the facility. These were previously positioned north of the refrigerant storage area and in the South Dunes Power Plant area.	Evaluation of loading and LNGC requirements led to marine flare addition. Gas processing area relocation from South Dunes allowed consolidation of warm and cold flares,
Barge Berth	The barge berth has been renamed to Material Offloading Facility (MOF).	Slight reconfiguration to facilitate safer and efficient unloading.
Gas Processing Area	Gas conditioning is now located on the LNG Terminal. The Gas Processing Area was formerly located at the South Dunes site.	Consolidate all gas processing to the Liquefaction Area.
South Dunes Site - Grading	The grading of the South Dunes Site has been modified to avoid impacts to estuarine wetlands.	Eliminates impacts on estuarine wetlands on the South Dunes Site.
Stormwater Pond/Laydown	The Stormwater Pond has been eliminated and laydown area has been expanded.	Stormwater pond not necessary due to decrease in impermeable surface area at South Dunes.
Slip and Access Channel - Access Channel	The access channel walls will be sloped to meet the existing bottom contours. Approximate slope of 3:1 will be used.	Increased usable footprint.

Table 1.1-1 – Major Changes between CP13-483-000 and PF17-4-000 for the JCEP LNG Terminal Facilities

Element[i]	Proposed Size/Location	Reasons for the Changes
Slip and Access Channel - Marine Slip Basin	About 5.3 million cubic yards of material will be removed to create the marine slip basin. Approximately 1.23 million cubic yards will be land based excavation (dry upland material) and the remaining 4.07 million cubic yards will be wet material.	Optimized cut and fill balancing.
Slip and Access Channel - LNG Carriers	The number of ship calls at the LNG vessel berth has increased to 110 to 120. This number was previously 90 to 100.	Increase in LNG production capacity from 6.8 Mtpa to 7.8 Mtpa.
LNG Unloading Berth Dune	Previously this area was to be recontoured post-construction. Now, the area will not be recontoured post-construction.	Optimized cut and fill balancing.
Pacific Connector Gas Pipeline Meter Station	The location has been shifted slightly northeast on the South Dunes Site.	Maximize land utilization, safe access and efficient operations.
Southwest Oregon Regional Safety Center	SORSC building has been relocated to the northeast corner of the South Dunes site and separated Fire Department to Access and Utility Corridor.	Reduces wetland impacts.
Access and Utility Corridor	The Fire Department has been relocated to the Access and Utility Corridor	Improves emergency response time. Reduces wetland impact at former location near SORSC building location.
Access and Utility Corridor	The 2-foot and 10-foot shoulders have been retained. The road itself will increase to a 36-foot-wide permanent roadway at grade.	Increase accessibility.
Control Building/Maintenance Building	Footprint has changed.	Efficient operational footprint.
Refrigerant Storage Area	Capacity and area are the same. The site has shifted to the interior of the LNG Terminal.	Increase distance to property boundary.

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Table 1.1-1 – Major Changes between CP13-483-000 and PF17-4-000 for the JCEP LNG Terminal Facilities

Element[i]	Proposed Size/Location	Reasons for the Changes
Site Elevations	Site elevation variances have decreased. Sight elevations are different in multiple areas.	Improved constructability and operational layout. Site elevations comply with functional and operational requirements.
Kentuck Project	Kentuck Mitigation Site expanded from 33 acres to a more comprehensive Kentuck Project encompassing over 100 acres of wide-ranging habitat.	A more comprehensive project has been developed.
Elements Unmodified in the Project		
Liquefaction Process	The liquefaction process is unchanged and still utilizes a single mixed refrigerant circuit with a two-stage compressor and a refrigerant exchanger.	
LNG Tank Area	The construction design and storage volume of the LNG storage tanks is unchanged at 160,000m^3 each.	
Gas Processing Area	Feed gas supply remains unchanged. Pipeline quality feed gas will be supplied to the facility via the 36-inch-diameter Pacific Connector Gas Pipeline.	
Gas Processing Area	The pre-treatment of pipeline feed gas before it enters the liquefaction process is unchanged. The feed gas still undergoes Mercury (Hg) and Acid Gas (CO_2 and H_2S) removal and dehydration to remove moisture.	
Slip and Access Channel - LNG Vessel Berth	The size of LNG carrier that can be accommodated by the LNG berth is unchanged at 89,000m^3 to 217,000m^3.	

Table 1.1-1 – Major Changes between CP13-483-000 and PF17-4-000 for the JCEP LNG Terminal Facilities

Element[i]	Proposed Size/Location	Reasons for the Changes
Slip and Access Channel - LNG Loading Arms	The number and size of the LNG loading arms at the LNG berth remain unchanged at three 16-inch diameter loading arms plus one 16-inch diameter vapor return arm.	
Preserved Wetlands Area	Unchanged	
Industrial Wastewater Pipeline Relocation	Unchanged	
Mill Casino Off-site Parking	Unchanged	
Myrtlewood Off-site Parking	Unchanged	
Eelgrass Mitigation Site	Unchanged	

In addition to meeting the statement of purpose and need discussed in Section 1, completion of the Project would result in these additional benefits:

- Result in additional investment in and modernization of the Port of Coos Bay, which was once the largest timber port in the world but has seen utilization and investment steadily decline over time. JCEP and PCGP would directly invest in improving marine-related infrastructure and capability, such as the procurement of four state-of-the-art tractor tugs with firefighting, active ship escort and emergency towing and rescue capability, procurement and set up of a private vessel traffic information system, and installation of three meteorological ocean data collection buoys to measure wind speed and direction, current speed and direction and tide height in real time.
- Pipeline property tax would amount to additional contributions in excess of $20 million.
- Facilitate the re-building of the industrial and property tax base of the County of Coos and the towns of Coos Bay and North Bend. The decline in timber and wood products has had a significant negative impact on the local economy. JCEP has agreed to execute a Community Enhancement Plan (CEP) under which property tax benefits available at the site would be re-sculpted by JCEP such that the tax benefit would be returned to the County, the communities and the Port of Coos Bay under a formula that accelerates payments at the start of construction and levelizes payments from the commencement of operations for 15 years. The CEP will result in JCEP's payment of over $500 million over the first 20 years (five plus 15) to be used for capital projects for the schools, the SW Oregon Community College, and rehabilitation of the waterfront and for the Port of Coos Bay.

1.3 PROJECT LOCATION AND DESCRIPTION OF FACILITIES

JCEP proposes to site, construct, and operate a new LNG export terminal on the bay side of the North Spit of Coos Bay in southwest Oregon. The general location of the proposed LNG

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Terminal is shown on Figure 1.1-1. The proposed LNG Terminal will be located in unincorporated Coos County, Oregon, primarily within land owned by Fort Chicago LNG II U.S. L.P., an affiliate of JCEP, across two contiguous parcels (Ingram Yard and South Dunes) which are connected by an Access and Utility Corridor (shown on Figure 1.1-2). The primary site for the LNG Terminal is about 7.5 miles up the existing Federal Navigation Channel, approximately 1,000 feet north of the city limit of North Bend, in Coos County, Oregon, more than 1 mile away from the nearest residence.

The proposed LNG Terminal will be located near the Pacific Ocean in the coastal lowlands ecozone. The primary site is a combination of brownfield decommissioned industrial facilities, an existing landfill requiring closure, and some open land covered by grasslands and brush (including some wetlands), as well as an area of forested dunes. Portions of the primary site have also previously been used for disposal of dredged material.

Land ownership as well as land use and zoning requirements are discussed in section 1.4.

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1.3.1 LNG Terminal Components and Facilities

In addition to the primary LNG Terminal site comprised of South Dunes, Ingram Yard, and the Access and Utility Corridor, the LNG Terminal will include several permanent and temporary construction facilities located near the primary site. The location of all permanent and temporary construction LNG Terminal facilities is shown on Figure 1.1-1 and includes the following:

- South Dunes (includes temporary construction and permanent facilities including the temporary Workforce Housing Facility and the non-jurisdictional SORSC)
- Ingram Yard (includes temporary construction and permanent facilities including LNG tanks, liquefaction equipment and the slip and access channel)
- Access and Utility Corridor (includes temporary construction and permanent facilities including the non-jurisdictional Fire Department)
- Meteorological Station (permanent facility)
- Industrial Wastewater Pipeline ("IWWP") (non-jurisdictional facility)
- Dredge Area 1, 2, 3, and 4 (temporary construction facility)
- Transpacific Parkway ("TPP")/US 101 Intersection Widening (temporary construction facility)
- Boxcar Hill (temporary construction facility)
- Roseburg Forest Products (RFP) Laydown Sites (temporary construction facilities)
- Port Laydown Site (temporary construction facility)
- APCO Sites 1 and 2 (temporary construction facility)
- Myrtlewood Offsite Park and Ride (temporary construction facility)
- Mill Casino Offsite Park and Ride (temporary construction facility)
- Kentuck Project (environmental area including mitigation site)
- Eelgrass Mitigation Site (mitigation site)

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The LNG Terminal will receive a maximum of 1,200,000 dekatherms per day ("dth/d") of natural gas from the Pipeline and produce a maximum of 7.8 million tons per annum ("mtpa") of LNG for export. The LNG Terminal will receive natural gas from the Pipeline, process the gas, liquefy the gas into LNG, store the LNG, and load the LNG onto ocean-going LNG carriers at its marine dock. The main operational components of the LNG Terminal are shown on Figure 1.1-2 (Plot Plan of the LNG Terminal) and include a connection to the Pipeline metering station, gas inlet facilities, a gas conditioning plant, an access and utility corridor, liquefaction facilities (including five liquefaction trains), two full-containment LNG storage tanks, an LNG loading line, LNG loading facilities, a marine slip, and an access channel for LNG carriers. The interface point between the Pipeline and the LNG Terminal occurs at the flange immediately downstream of the metering station located on the South Dunes Site. Sections 1.3.3 through 1.3.7 of this document describe all of the main LNG Terminal operational components downstream of this interface point.

All FERC jurisdictional permanent facilities are described in detail within sections 1.3.3 through 1.3.8. Temporary construction facilities are described in detail in Section 1.5. FERC non-jurisdictional facilities are described in detail in Section 1.9. Site elevations and tsunami protection for the LNG Terminal facilities are discussed in section 1.3.2. Required maps and plans are discussed in section 1.3.9.

All LNG Terminal facilities and components will be constructed in accordance with governing regulations, including the regulations of the U.S. Coast Guard ("USCG") for Liquefied Natural Gas Waterfront Facilities, 33 CFR Part 127; the U.S. Department of Transportation ("DOT") Federal Safety Standards for Liquefied Natural Gas Facilities, 49 CFR Part 193; and the National Fire Protection Association ("NFPA") Standard 59A for LNG facilities, and the codes and standards referenced therein.

1.3.2 Site Elevations and Tsunami Protection

Site elevations (see Table 1.3-1) are selected to mitigate flooding due to storm surge, estuarine flooding, and tsunami. Tsunami hazard, because it is the most critical of these hazards, typically dictates the minimum elevation. Elevations have been selected to cater for life safety in case of an event that exceeds the design-level tsunami, and to ensure that the facility remains functional and operational in case of the design-level tsunami.

The design-level tsunami is consistent with the criteria given in Resource Report 6 – Geological Resources. Numerous hydrodynamic modelling efforts (ZHANG 2008, 2012; CHE 2017; MAN 2017) have demonstrated that the minimum elevation required to mitigate the design-level tsunami is +34.5 feet using North American Vertical Datum of 1988 ("NAVD88").

Typically, and due to the functional requirements of the facility, the facility will be at or above +46 feet. Exceptions include the LNG tanks and water-dependent facilities such as the marine terminal and Material Offloading Facility ("MOF"). The parts of the marine facilities that are normally occupied or operational will typically be at an elevation of 34.5 feet or greater, whereas normally unoccupied/non-operational parts of the marine facilities may be at a lower elevation.

The LNG tanks, which are founded at approximately +27 feet, will be surrounded by a tertiary protective berm approximately +46 feet high. The design tsunami inundation elevation is determined to be no more than 34.5ft. The design provides for continuous protection by way of the containment berms at an elevation no less than +46ft high allowing the LNG Tanks to be founded below 34.5ft. The protective berm will be designed to contain the contents of a single LNG storage tank.

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Given the seismicity of the site, soil type, and subsequently the need for shallow sloping berms, berm elevations greater than +46ft are not considered practical and would not fit within the physical constraints of the site.

Life safety is provided for by tsunami evacuation muster points at the LNG Terminal and South Dunes Site, which will be at elevations significantly greater than the design-level tsunami and consistent with the basis for current inundation (DOGAMI 2012a) and evacuation maps (DOGAMI 2012b) for the cities of Coos Bay and North Bend. Buildings, such as the SORSC building, operations building and Fire Department have been identified as "shelter-in-place" buildings for essential personnel in case of tsunami events. As such, these buildings will also be elevated to ensure they are above the design-level tsunami and consistent with the tsunami evacuation muster points discussed above.

1.3.3 Gas Inlet Facilities and Gas Conditioning

1.3.3.1 Gas Inlet Facilities and Metering

Pipeline quality feed gas will be supplied to JCEP via the PCGP 36-inch-diameter natural gas transmission pipeline. The interface point between the PCGP and JCEP facilities occurs at the flange immediately downstream of the metering skid located on the South Dunes Site.

Inlet pipeline metering facilities consist of a pipeline pig receiver, inlet filter/separator, and flow meter, which are in PCGP scope. The pipe connecting the metering station to the liquefaction facilities will be buried from South Dunes through the Access Corridor, and then will resurface within the LNG Terminal facilities.

A High Integrity Pressure Protection System ("HIPPS") will be installed, in a 2 x 100 percent configuration, downstream of the metering station and upstream of any piping branches with the exception of the fuel supply for start-up and LNG Storage Tank vacuum breaker.

Additionally, a feed inlet heater will provide heating of the high pressure feed gas on cold days to prevent formation of natural gas hydrates resulting from Joule-Thomson cooling when gas pressure is let down by the pressure reduction unit or units. A pressure reduction unit functions as an inlet pressure control station before the gas enters the gas conditioning unit.

1.3.3.2 Gas Conditioning Train

The feed gas from the Pipeline will be treated before the gas enters the liquefaction trains. A Gas Conditioning train, in a 1 x 100 percent configuration, will be provided and will include a system for mercury removal via sulfur impregnated activated carbon, carbon dioxide ("CO_2") and other acid gases removal via an amine system, and dehydration via a molecular sieve adsorbent system.

Mercury is first removed to prevent corrosion in downstream cryogenic aluminum equipment and minimize exposure of other equipment and vent streams to mercury contamination. The feed gas will then be treated by passing through the acid gas removal unit to remove CO_2 to prevent freezing in the liquefaction process. Trace amounts of hydrogen sulfide ("H_2S") will also be removed.

The amine solution of the acid gas removal process saturates the dry feed gas with water. The dehydration system removes the water content of the feed gas to prevent water freeze out in the liquefaction process.

Figures 1.3-3 and 1.3-4 provide simplified block flow diagrams of the major components of the proposed gas conditioning train. The sections below describe the mercury removal, acid gas removal and dehydration systems in further detail.

1.3.3.2.1 Mercury Removal

Mercury is removed via adsorption onto sulfur-impregnated activated carbon beds, in a 3 x 33 percent configuration, in order to prevent cold box corrosion during gas liquefaction and to minimize the exposure of other equipment and vent streams to mercury contamination. The mercury removal beds will be located downstream of the inlet filter/separator and upstream of the amine contactor, and will reduce the amount of mercury in the treated pipeline gas down to less than 0.01 micrograms per Normal cubic meter ("$\mu g/Nm^3$").

The life of the mercury removal beds is designed to be three years, assuming a mercury concentration in the feed gas of 0.05 parts per billion by volume ("ppbv"). Spent catalyst from the mercury removal vessels will be removed periodically and sent off-site for disposal at a licensed hazardous waste management contractor.

1.3.3.2.2 Acid Gas Removal

Acid gas removal involves a closed-loop system that circulates a promoted methyl-diethanolamine solution to absorb CO_2 and sulfur species from the feed gas. The process reduces the feed gas CO_2 concentration from a maximum of approximately 2 percent on a molar basis to less than 50 parts per million on a volumetric basis ("ppmv").

The CO_2 removed from the feed gas is to be vented to the atmosphere, but the vent stream must first be treated for co-absorbed contaminants. To limit emissions, absorbed H_2S and other sulfur species in the vent stream will be thermally oxidized after passing through the sulfur scavenger unit. Co-absorbed hydrocarbons, including benzene, toluene, ethylbenzene, and xylenes, will also be combusted and destroyed in the thermal oxidizer.

1.3.3.2.3 Dehydration

The water removal system is located immediately downstream of the acid gas removal system and employs four molecular sieve adsorption beds. The water removal system will reduce water in the treated feed gas to less than 0.1 parts per million on a volumetric basis ("ppmv"). At any time, two beds will be in adsorption mode, one bed will be in regeneration/cooling mode, and bed will be on stand- by. Regeneration of a bed involves passing dehydrated heated feed gas through it, in an up-flow direction, which drives the adsorbed water out of the bed. This water-loaded regeneration gas is then cooled to condense and remove the water, which is collected and recycled back into the acid gas removal system. This regeneration gas is then compressed and recycled upstream of the dehydration units. The regenerated bed will then be cooled by non-heated dehydrated feed gas until a low enough temperature is achieved to place it back into adsorption service.

1.3.4 Liquefaction Facilities

1.3.4.1 Liquefaction Trains

The LNG Terminal includes five liquefaction trains utilizing the Black & Veatch proprietary PRICO® LNG technology to produce a maximum of 7.8 mtpa (1,077 MMscf/d) of LNG production net, after deduction for Boil-Off Gas ("BOG") generation. Each liquefaction train will have an anticipated maximum annual capacity of 1.56 mtpa (215.5 MMscf/d). The nominal annual capacity may be less than this value due to annual ambient temperature variation, planned non-major facility maintenance outages, unplanned facility outages, and the expected degradation of the combustion gas turbines.

The PRICO® LNG technology (see Figure 1.3-4) utilizes a single mixed refrigerant ("SMR") circuit with a two-stage compressor and a brazed aluminum refrigerant exchanger. The dry treated gas from the gas conditioning train is divided equally among the five liquefaction trains. In each liquefaction train, the dry treated gas stream flows into a refrigerant exchanger where it is turned into liquid by cooling it to approximately -260ºF with the mixed refrigerant. The refrigerant exchanger consists of multiple brazed aluminum heat exchanger cores arranged in parallel inside a perlite insulated cold box. An aerial cooling system (fin-fan) rejects heat from the mixed refrigerant that is gained from the liquefaction of feed gas and compression. The cold box is purged with nitrogen gas to prevent moisture intrusion and eliminate the potential for a flammable atmosphere inside.

The refrigeration cycle is a closed-loop process that utilizes a single-body, two-stage refrigerant compressor. An aero-derivative combustion turbine directly provides the power to drive the refrigerant compressor. Exhaust-gas waste heat recovery in the form of steam generation maximizes the overall thermal efficiency of the LNG Terminal.

Heavy hydrocarbons (generally referred to as C5+ components) will be removed from the feed gas before the final liquefaction step to meet the LNG specification and prevent possible freezing at subcooled temperatures. The following section describes the process for removing heavy hydrocarbons.

1.3.4.2 Heavies Removal

Heavy hydrocarbons, or "heavies" (generally referred to as C5+ components), will be removed from the feed gas before the final liquefaction step in order to meet the LNG specification and prevent possible freezing at subcooled temperatures. The system will be designed to remove the most likely-to-freeze components—benzene and octane—to less than 1 ppmv while recovering as much of the C4 and lighter molecules as economically as possible into the gas going to the final liquefaction step.

The total volume of heavies removed across the range of feed compositions is not enough to produce economically viable natural gas liquids product for sale or export; however, it will be blended into the fuel gas stream, so no tankage or disposal logistics need to be considered.

1.3.4.3 Refrigerant Makeup System

For many technologies, refrigerant losses occur from the closed-loop refrigeration loops primarily due to normal compressor seal leakage. However, the Black & Veatch patented seal gas recovery system will be utilized to minimize the refrigerant losses to flare by returning the normal leakage to the refrigerant compressor suction. Even with seal gas recovery, the refrigeration loop components must be replenished periodically to normal operation inventory levels. The hydrocarbons that provide make-up to the SMR circuit used in the liquefaction trains cannot be generated on-site (with the exception of methane, which comes from the treated feed gas), and will be delivered to the LNG Terminal via ISO containers and stored in pressurized vessels for intermittent makeup to the SMR circuit.

1.3.5 LNG Storage and Containment

The LNG will be stored in two full-containment insulated LNG storage tanks, each of which is designed for a working capacity of 160,000 cubic meters ("m^3") (42,232,000 gallons) of LNG. Each tank will have a primary 9 percent nickel inner tank and a secondary concrete outer containment wall with a steel vapor barrier.

The LNG storage tanks will have top connections only with piping that will permit top and bottom loading. Top loading operation will be done via a spray device/splash plate in order to obtain flashing and mixing of the LNG as it combines with LNG inventory. The bottom loading operation will be achieved via a standpipe to ensure effective mixing. The separated flash vapor

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combines with vapors from tank displacement and heat leak and flows to the boil-off gas compressors for use a fuel.

The two full-containment LNG storage tanks are each equipped with three fully submerged LNG in-tank pumps, each rated for approximately 2,400 cubic meters per hour ("m^3/hr"), and one spare well fully piped and instrumented. LNG is pumped, using five of the six installed pumps, to the marine berth and into an LNG carrier at a normal loading rate of 12,000 m^3/h. An LNG transfer line will connect the shore-based storage system with the LNG loading system. A smaller recirculation, "keep cool" line is provided from the LNG storage tank area to the marine berth in order to maintain the LNG transfer piping at cryogenic temperatures to avoid excessive boil-off losses and potential damage from thermal cycling between carrier arrivals.

LNG spills will be contained, and the bermed area around the LNG storage tanks will gravity drain to an LNG impoundment basin. An LNG spill containment trench will also collect any LNG from spills outside of the bermed area around the LNG storage tank area and gravity drain to the same LNG impoundment basin. A separate LNG trench and impoundment basin located near the marine loading system will also be provided to collect any LNG spills from the LNG transfer line or the recirculation line that occur south of the liquefaction trains; this separate impoundment is required due to slope requirements to allow effective gravity drainage that cannot be achieved with a single impoundment basin. The LNG impoundment basins will include sump pumps to pump out rain water. In accordance with 49 CFR 193.2173, the water removal system will have the capacity to remove water at a rate of 25 percent of the maximum predictable collection rate from a storm of ten-year frequency and one-hour duration. The discharged rainwater will be piped to the stormwater drainage system.

1.3.6 Marine Facilities

1.3.6.1 Overview

The LNG Terminal will include a single-use marine slip dedicated to supporting LNG exports. The east side of the slip will be utilized for the LNG carrier-loading berth and LNG loading facilities. Berths for tugboats and security vessels will be located on the north side of the slip. An emergency lay berth will be provided on the west side of the slip to allow for berthing a temporarily disabled LNG carrier in an emergency. This berth will have no product loading facility, but it will comply with and be designed to meet all of the safety and security standards of the Oil Companies International Marine Forum ("OCIMF") and the USCG. A Material Offloading Facility ("MOF") will be constructed outside of the slip to deliver components of the LNG facility that are too large or heavy to be delivered by road or rail.

The LNG carrier loading berth will be capable of accommodating LNG carriers with a cargo capacity range of 89,000 m^3 to 217,000 m^3. The USCG Letter of Recommendation ("LOR") and Waterway Suitability Report ("WSR") currently allows LNG carriers up to 148,000 m^3 to dock at the LNG Terminal berth.

1.3.6.2 Access Channel

Access to the marine slip will be via a newly constructed access channel that will connect the slip to the Federal Navigation Channel at approximate Channel Mile 7.3 at the beginning of the confluence between the Jarvis Turn and the Upper Jarvis Range A. The access channel will flare from the narrowest portion at the mouth of the slip, with a minimum width of 780 feet, to the intersection with the Federal Navigation Channel with an approximate width of 2,200 feet. The proposed access channel will allow for the safe transit of vessels between the berth and the Federal Navigation Channel, and allow the safe turning of vessels during an inbound transit so that the LNG carrier can be backed into the slip and berthed bow out, according to industry best practice requirements.

The total access channel would cover approximately 22 acres below the Highest Measured Tide (HMT) elevation of 10.26 feet (NAVD88). The walls of the access channel would be sloped to meet the existing bottom contours at an angle of 3 feet horizontal to 1 foot vertical (3:1). The marine slip and access channel will have a minimum depth of -45 feet below the mean lower low water ("MLLW" (-45.97 feet NAVD 88)) to ensure minimum under-keel clearance is achieved for the safe maneuvering and berthing of loaded LNG carriers. An allowance over and above the minimum depth will be made for advanced maintenance dredge and incidental over-dredge, in accordance with industry best practices. Dredging of the access channel would affect about 15 acres of currently existing deep subtidal area below -15.3 feet in depth.

1.3.6.3 Marine Slip

The new marine slip will be constructed by excavating an existing upland area. The majority of the terminal marine slip will be excavated from existing uplands owned by JCEP. Part of the marine slip would be constructed within state waters of Coos Bay to the MLLW line, for which the Port has obtained an easement from the ODSL.

The slip will be bounded on the east and west sides by sheet pile walls, creating a vertical face to support mooring structures. The northern side of the slip will be sloped to meet the existing bottom contours at an angle of 3 feet horizontal to one foot vertical (3:1). The inside dimensions at the toe of the slope of the slip will measure a minimum of 800 feet between the vertical sheet pile walls along the east/west axis, and approximately 1,500 feet and 1,200 feet along the western and eastern boundaries, respectively. Figure 1.1-3 shows a plot plan of the marine slip. The slip is sized to provide the flexibility needed to safely maneuver an LNG carrier from the access channel into the slip when another LNG carrier is already berthed on the east or west sides and for tugs to move a temporarily disabled LNG vessel away from the loading berth on the east side of the slip to the emergency lay berth on the west side of the slip if necessary.

1.3.6.4 LNG Loading Berth

The LNG berth consists of a number of elements: the sheet pile wall, mooring structures, breasting structures, and the Product Loading Facility ("PLF"). In general, the LNG loading berth will be about 1,280 feet long between the centers of the end mooring structures, and 312 feet long from the center of the northernmost breasting structure to the center of the southernmost breasting structure. Figure 1.1-4 shows the elevation view of the LNG berth.

1.3.6.4.1 Sheet Pile Walls

The physical berth will be constructed of steel sheet piles to support surface structures (i.e., the loading area) or provide the foundation for the breasting and mooring structures. Under the loading facility, the wall will extend from the bottom of the slip at elevation -45.9 to elevation +34.5. This face will extend north and south to capture the outermost breasting structures and then turn to the east, creating a setback wall for the remainder of the slip.

1.3.6.4.2 Mooring Structures

Mooring and breasting (see Section 1.3.6.4.2) structures will be provided at both the loading berth and the emergency lay berth for the safe breasting, berthing, and mooring of the LNG carriers docked at either berth.

Six mooring structures (three on each side of the LNG berth centerline) will be used to secure the LNG carrier at both the LNG loading berth and the emergency lay berth. The structures will be behind the sheet pile wall, set back approximately 150 feet from the face of each berth. These structures will have concrete platforms founded on steel pilings and will each have

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remote release mooring hooks with capstans, as well as all required equipment and instrumentation for safe mooring operations.

1.3.6.4.3 Breasting Structures

There will be four breasting structures located adjacent to the PLF; two will be located north of the PLF and two to the south. Like the mooring structures, each breasting structure will have a concrete platform founded on steel pilings and will have remote release mooring hooks with capstans, as well as all required equipment and instrumentation for safe mooring operations. Each breasting structure will also support a fender assembly sized to absorb and distribute berthing and mooring loads for the full range of LNG carriers that the LNG Terminal berth is designed for, thus preventing damage to the LNG carriers or the LNG berth. The fender system will allow the carriers to be moored approximately 3 feet off the vertical face of the sheet pile wall at the PLF. The emergency lay berth will have four breasting structures with fenders and capstans spaced equally about the mid-ship. There will be additional breasting fender structures, two to the north and two to the south of the main breasting structures, for a total of eight. The exact type and location of the breasting structures for the emergency lay berth will be defined during detail design to meet OCIMF requirements for non-parallel vessel approach and the full range of vessel sizes.

1.3.6.4.4 Product Loading Facility

The PLF comprises a pile-supported concrete slab and provides structural support to the marine loading arms, terminal gangway, and other ancillary equipment. The PLF is designed to support a number of elements that facilitate the safe transfer of LNG product between the LNG plant and the LNG carriers.

The PLF will be constructed on top of the sheet pile wall, and will be about 130 feet long and 86 feet wide with a top elevation of +34.5 feet. The platform will be reinforced concrete supported by steel pilings.

The transfer equipment consists of four marine loading arms installed on top of the PLF. There will be two dedicated liquid loading arms, one hybrid arm, and one ship vapor return arm to meet the design loading rate of 12,000 m^3/h. The hybrid arm will be designed for dual service capable of transferring LNG to the LNG carriers or returning vapor from the LNG carriers to the BOG vapor management system. During normal operation the hybrid arm will be used in liquid service along with the two liquid arms, and the vapor return arm will be used to return vapor to the BOG vapor management system.

The loading arms are designed with swivel joints to provide the required range of movement between the LNG carrier and the shore connections. Each arm will be fitted with a hydraulically interlocked double ball valve and powered emergency release coupling to isolate the arm and the LNG carrier in the event of an emergency condition in which rapid disconnection of the connected arms is required. Each arm will be fully balanced in the empty condition by a counterweight system and maneuvered by hydraulic cylinder drives. A mezzanine-type elevated steel platform above the PLF concrete support deck will be installed for maintenance of the triple-swivel assembly of the arms.

LNG spill containment will be addressed at the main PLF concrete lower level, where a concrete curbed and sloped area will contain any LNG spillage and allow the spill to safely flow away from the loading area. Drainage from this point will be via the LNG spill collection trough to the marine area LNG impoundment basin.

Additional structures at the LNG loading berth will include an LNG carrier gangway, area lighting facilities, aids to navigation, firewater monitors, and a dry chemical firefighting system.

1.3.6.5 Emergency Lay Berth

An emergency lay berth on the west side of the slip will be provided with facilities to safely moor a temporarily disabled LNG carrier. Berthing facilities will be supported by the west side sheetpile wall with a top-of-wall elevation of (+20 feet NAVD 88). The lay berth will have pile-supported breasting structures with fenders extending above the vertical sheet pile and mooring structures on the land side of the sheet pile. A grated platform with a gangway will be placed behind the berthing breasting structures to allow for safe access and egress from the disabled LNG carrier at berth. Support infrastructure will include an access road down from the area of the tug berth building, duct bank with cabling for powering the mooring hooks and capstans, and limited lighting of the ship access area.

Along the western property line, but on the Project side of the Henderson Property buffer zone, a tsunami flow control wall will be constructed. The flow control wall shall be of sufficient height and strength to prevent overtopping into Henderson Property and limit the drag due to the tsunami current loads on LNG carriers within the marine slip. The wall height shall be approximately 34.5 feet and determined in accordance with the design tsunami criteria. The wall will run from the vapor dispersion wall on the west side of the LNG tank impoundment area down to the entrance to the slip.

1.3.6.6 Material Offloading Facility

The Material Offloading Facility ("MOF") will be constructed to deliver components of the LNG Terminal that are too large or heavy to be delivered by road or rail. The MOF will cover about 3 acres on the southeast side of the slip, adjacent to the Roseburg Forest Products Company ("RFP") property (Figure 1.1-3). The MOF will be constructed using the same sheet pile wall system as the LNG loading berth and the emergency lay-berth. The top of the MOF will be at elevation +13.0 feet NAVD88, and the bottom of the exposed wall will be at the access channel elevation. The MOF will provide approximately 450 feet of dock face for the mooring and unloading of a variety of vessel types.

During construction of the LNG Terminal, in addition to receiving equipment and large modules (upwards of 6,000 short tons) by break bulk cargo carriers, roll on roll off cargo carriers, and barges, the MOF will allow other bulk materials to be delivered by sea to minimize impacts on the local road network. After project construction, the MOF will be retained as a permanent feature of the LNG Terminal to support maintenance and replacement for large equipment components that are too large to be transported by rail and road.

1.3.6.7 Tug Berth

The tug berth at the north side of the marine slip will accommodate four tugboats, as well as two sheriff's boats and six other visitor boats with similar characteristics as the sheriff's boats. For design purposes, the tugs are assumed to be 80-metric-ton bollard pull boats approximately 100 feet long with a beam of 40 feet. The basis for the sheriff's boat is the Willard USCG Long Range Interceptor. The tug dock will generally be about 470 feet long and 18 feet wide; in addition, there is 360 feet of 8-foot-wide floats for mooring and accessing the security vessels.

The tug dock will be concrete supported by steel piles. The security vessel docks will be precast concrete floats anchored by steel pile. The security boat dock will support two separate boat houses. The tug dock will be accessible from land by a pile-founded trestle, thus allowing vehicle and pedestrian access for service and support of operations. An onshore tug operations building will provide storage, meeting, and sanitary facilities for the crews of the tug and security boats.

1.3.6.8 Vessel Transit

LNG carriers would access the LNG Terminal through a waterway for LNG marine traffic, which is defined by the USCG for the Project as extending from the outer limits of the U.S. territorial waters 12 nautical miles off the coast of Oregon, and up the existing Federal Navigation Channel about 7.5 miles to the LNG Terminal.

The Project's plans for the LNG carriers calling on the LNG Terminal and their transit route in Coos Bay, as described below, are primarily within the jurisdiction of the USCG. Because the USCG has authorized carriers of approximately 950 feet length, 150 feet beam, and loaded draft of 40 feet (nominal 148,000 m^3)[2] as the size of LNG carrier, the LNG Terminal could generate a maximum of 120 LNG carrier calls per year, although the average is expected to be between 110 and 120 LNG carriers per year. The actual number of LNG carriers per year will be dependent on the capacity of the LNG carriers calling on the LNG Terminal and the actual output production of the LNG Terminal. The LNG loading berth is designed so that it could accommodate LNG carriers up to 217,000 m^3 if larger-sized carriers were to be authorized by the USCG in the future, resulting in a reduced number of LNG carrier calls each year.

The total average LNG carrier port time is estimated to be approximately 36 hours, assuming there are no delays caused by natural environmental conditions. This estimate includes the 1.5 hours transit time from the Pilot boarding to arrival at the LNG loading berth to the Pilot drop-off at departure, time of mooring, unmooring and cast off, the bulk LNG loading time of approximately 15 hours (using the 12,000 m^3/hr loading rate), and the 8 hours of time waiting for the next available high tide cycle needed for safe departure transit of the Federal Navigation Channel.

The LNG carrier transit route is shown in Figure 1.1-6. An LNG ship traffic study conducted by Moffatt & Nichol International (M&N 2006) concluded that the additional LNG carrier traffic associated with the Project can be accommodated in the Port and the Federal Navigation Channel. The ship traffic conditions in the Port that existed when the LNG carrier traffic study was conducted have not changed, approximately 110 to 120 LNG carrier calls are anticipated due to the inclusion of some smaller capacity LNG carriers.

Resources, such as high bollard pull tractor tugs and pilots, will be required to handle the planned number of LNG carriers. JCEP has committed to provide the following marine resources as identified by the USCG in the current version of the WSR:

- Four (three operation, one standby) 80-bollard-ton tractor tugs with Class 1, firefighting capability;
- A Port differential Global Positioning System navigation system for use by the Pilots and LNG carrier bridge team while transiting the channel en route to the Project;
- Physical Oceanographic Real Time System to provide real-time channel water level, current, and weather data;
- A Vessel Traffic Information System consisting of an Automatic Identification System receiver, 2 land-based radars, and 12 low light cameras (with zoom, pan, and tilt) to monitor the transit of the LNG carriers while in Coos Bay;
- Emergency response notification system;
- Installation of private navigation aids (e.g., channel centerline range markers); and

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[2] Depending upon the approved LNG containment system type, carriers with these approximate dimensions may range in LNG cargo capacity from 135,000 m^3 to 170,000 m^3.

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- Gas detection capability along the LNG carrier waterway transit route.

1.3.7 Terminal Support Systems

1.3.7.1 Vapor Handling System

BOG is primarily generated from the LNG storage and loading system, and consists of flash gas from the LNG product stream entering the LNG flash drum, vapors from the heat leak into the LNG storage tanks, piping and pump systems, vapor displaced as the LNG storage tanks are filled, and vapor return from the LNG carrier during LNG loading. The BOG will be consumed as fuel. Two BOG compressor trains are included to compress the vapor from LNG storage tank pressure to fuel gas pressure. The mode of operation of the liquefaction plant when not loading an LNG carrier is known as "holding mode." The mode of operation during LNG carrier loading is known as "loading mode." One BOG compression train will be operating continuously to handle holding mode BOG volumes; the second will be needed only during loading mode or during an off-design condition that results in increased BOG generation.

During normal operation, fuel gas will be supplied from BOG and vaporized heavy hydrocarbon streams, and supplemented with gas from the inlet pipeline upstream of the gas conditioning train. After mixture in the high-pressure fuel gas mixing drum, this high-pressure fuel gas stream primarily feeds the combustion gas turbines to drive the refrigerant compressors. Some high-pressure fuel gas is let down from the high-pressure fuel gas header to the low-pressure fuel gas knockout drum before going to other smaller consumers, such as thermal oxidizer, duct burners, and flare pilots.

Normally, a small amount of makeup to the high-pressure fuel from the pipeline feed gas is required to meet demands; if the BOG/heavies mixture results in excess fuel for the demand, it can be recycled upstream of the amine unit and re-liquefied.

1.3.7.2 Steam System

The LNG Terminal will use steam as a heat transfer fluid for process heating. High pressure steam is provided to the facility from Heat Recovery Steam Generators ("HRSGs"), which utilizes waste heat from refrigerant compressor driver exhaust gases. High-pressure steam supplies the gas conditioning train and Steam Turbine Generators ("STGs"), where the steam pressure is let down from 725 pounds per square inch gauge ("psig") to produce low-pressure steam at 50 psig and generate electricity for the plant. Any low-pressure steam requirement in excess of this can be made up by "de-superheating" a letdown of high-pressure steam. Process condensate is de-aerated and treated, and then returned to the cycle as boiler feed-water for the HRSGs. An auxiliary boiler is available to provide high-pressure steam to meet the requirements for one STG and any additional steam required for when the facility is not producing LNG.

1.3.7.3 Instrument Air

Instrument air will be provided through compression and drying packages. Air will be compressed in two x 100 percent centrifugal compressors. There will be one additional centrifugal compressor with the ability to provide essential instrument air duty. Air will be dried in two x 100 percent air dryer packages, with each package containing four air dryers designed for full, continuous operation. During operations, one dryer will be in absorption mode while the other dryer regenerates. Instrument air will be used for pneumatic control of automated instrumentation, utility air, and supply for nitrogen generation.

1.3.7.4 Utility Air

Utility air will be used for normal maintenance activities (utility stations, control panel purges, building purges, etc.). Utility air will be dried with the instrument air but will be supplied throughout the facility from a separate header. The utility air header will be provided with a pressure regulator and on-off valve to shut off flow if the main header pressure drops to the minimum for proper functioning of actuators.

1.3.7.5 Nitrogen

Nitrogen will be provided through vaporization of liquid nitrogen and a pressure swing adsorption site generation package unit. Pressure swing adsorption units use swings in pressure to separate nitrogen from air; the pressure swing adsorption swings from high pressure, where nitrogen is adsorbed from air, to low pressure, where it is desorbed. Liquid nitrogen will be the only source of nitrogen used for refrigerant makeup, while the site-generated nitrogen will supply continuous utility users, such as compressor seals, cold box purges and LNG loading arm swivel joints, as well as intermittent users, such as LNG loading arm purges and utility stations. Nitrogen packages will be sized to fulfill peak demand and to handle the maximum expected instantaneous flow.

1.3.7.6 Utility and Potable Water System

An interconnect to the Coos Bay-North Bend Water Board ("CBNBWB") potable water pipeline will be used for all normal operational water needs in the LNG Terminal, which includes fire water makeup, utility water used for such items as equipment and area cleaning, and potable water required to supply buildings and eyewash/safety shower stations.

Utility water is fed to the demineralized water package, but storage of utility water will be combined with fire water supply in the fire water tanks.

The CBNBWB raw water pipeline (in addition to the potable water pipeline) will be used for construction water, including LNG tank hydrotesting. The pipeline tap at the LNG Terminal site will remain connected after construction, but there are no normal operational uses anticipated for this raw water supply.

Resource Report 2 provides the estimated potable and raw water demand during the construction and operation of the LNG Terminal.

1.3.7.7 Fire Suppression System

Fire suppression and protection measures will be provided to ensure the safety of personnel and property. Fire water systems at the LNG Terminal including fire water supply storage tanks, stationary fire water pumps, fire hydrant mains, fixed water spray systems, automatic sprinkler extinguishing systems, high expansion foam system, and remotely controlled monitored spray systems will meet the requirements of 49 CFR Part 193, NFPA 59A, American Petroleum Institute ("API") 2510, API 2510A, and 33 CFR Part 127.

The function of the fire water system is to provide water under pressure to the fire hydrants, monitors, and fixed water suppression systems throughout the LNG Terminal. The fire water supply will also be used to provide water for on-site firefighting trucks. The fire suppression distribution piping network will comprise the following:

- Underground fire water mains
- Aboveground fire water hydrant mains;
- Fixed fire water sprinkler and spray systems;
- Fixed high-expansion foam systems;
- Portable fire suppression equipment;
- Appurtenances, including all piping and valves connecting the pumps and water supply to the plant fire suppression systems; and
- Hydrants and monitors.

The main fire water supply for the LNG Terminal is provided by two x 100 percent capacity aboveground atmospheric storage tanks (located in the Access and Utility Corridor), which allow for redundancy if one of the tanks is unavailable. This redundancy is an acceptable precautionary measure for preparing for fire water tank repairs, in accordance with NFPA 22, and to perform regular maintenance and inspection of fire water tanks in accordance with NFPA 25. Water supply for the two fire water tanks is potable water from the local CBNBWB.

The fire water tanks are dual-service supply tanks and will provide the standpipe system to ensure dedicated fire water volume for fire protection systems. Each tank will hold a minimum usable capacity of 3,240,000 gal to supply four hours of fire water supply for the Maximum Probable Fire Water Demand, which is the demand for the largest fire scenario including 1,000 gpm hose stream allowance in accordance with NFPA 59A. Providing four hours of water supply is in accordance with API 2510 which exceeds the two hours of water supply required by NFPA 59A. The atmospheric tank design will follow API Standard 650 and NFPA 22.

The fire water distribution network will be supplied via three x 33 percent capacity fire water pumps with a fourth pump of 33 percent capacity provided as backup. One fire pump will be electric motor driven while three will be diesel engine driven, to ensure at least three pumps remain available in the event of power failure. Two x 100 percent electric-motor-driven jockey pumps will be provided to maintain pressure in the main fire water distribution system. The entire pump installation will be designed in accordance with NFPA 20 and the fire water distribution network will be designed in accordance with NFPA 24.

Further fire water system details can be found in Resource Report 13 (Section 13.38.1).

1.3.7.8 Flare, Relief, and Blowdown System

Flare systems are a necessary safety feature of all LNG export facilities. The LNG Terminal will have three separate flare systems for pressure relief plant-protection conditions: one for warm (wet) reliefs, one for cold, cryogenic (dry) reliefs, and one for low-pressure cryogenic reliefs from the marine loading system. The "warm" relief loads are separated to ensure that wet fluids cannot freeze in the header if there were a cryogenic relieving event. The "cold" and "marine" relief loads are separated to ensure that the relief of near-atmospheric pressure vapors is not affected by back-pressure in the header if an unrelated release were to occur.

The warm and cold flares will both be within a multi-point enclosed ground flare, while the marine flare will be an enclosed cylindrical ground flare. A small pilot with electronic ignition is provided on each flare.

The flare system will be used only during plant-protection situations, maintenance activities, cases of purging and gassing-up an LNG carrier, and initial commissioning/start-up.

1.3.7.9 Stormwater and Wastewater Systems

The LNG facility and marine LNG loading area will include various drainage elements to manage segregated networks for contaminated and uncontaminated water from designated areas. Liquid effluent from the LNG facility and marine LNG loading area consists mainly of water from rainfall, protection of equipment with fire water, processing areas, storage areas, domestic areas, and utilities units. Water from all oil-filled equipment in LNG spill impounding basins will be pumped by submersible pumps to the oily water treatment system.

Stormwater collected in areas other than LNG spill impounding basins will be allowed to flow or will be pumped to a system of stormwater swales, infiltration basins, and other treatment facilities. Stormwater facility overflow outfalls will ultimately connect to the Coos Bay. The initial runoff from all storms of a 2-year return period and 24-hour duration or less will be infiltrated. Excess stormwater during storms of longer return periods will be allowed to discharge directly to the slip without being infiltrated or treated.

Stormwater collected in areas that are potentially contaminated with oil or grease will be pumped or will flow to the oily water collection sumps. Collected stormwater from these sumps will flow to the oily water separator package(s) before being treated and discharged to the IWWP.

The facility will be designed to provide drainage of surface water to designated areas for disposal in accordance with 49 CFR § 193.2159. Stormwater collection and treatment facilities will be designed to meet regulatory requirement from the National Marine Fisheries Service ("NMFS") and ODEQ.

A detailed stormwater management plan will be provided with subsequent filing.

1.3.7.10 Sewage and Sanitary Waste Treatment

Sanitary waste from the northwest guard house and tug building will be directed to a holding tank. A sanitary waste contractor will remove the contents of the tank as necessary and dispose of the contents at authorized disposal sites through the sanitary waste contractor's permits. Sanitary waste from the remainder of buildings will be treated by a packaged treatment system. The effluent will be directed to the IWWP. Solids will be removed from the packaged treatment system periodically by a sanitary waste contractor and will be disposed of at authorized disposal sites through the sanitary waste contractor's permits.

1.3.7.11 Hazard Detection and Response

Safety controls, including hazard detection and response systems, are briefly summarized below. The Project will contain "passive" and "active" hazard prevention and mitigation systems and controls.

Passive systems will generally include those that do not require human intervention, such as spill drainage and collection systems, ignition source control, and fireproofing. Thermal proofing will be considered for application to support structures, components, and equipment, as required, to maintain structural stability in a fire hazard zone, cryogenic spill zone, or area where a failure could affect a safety-related system, provide additional fuel to a fire, or cause additional damage to the unit or facility.

Active systems normally are either automatic or require some action by an operator. Active fire control systems and equipment will consist of a looped, underground fire water distribution piping system serving hydrants, fire water monitors, hose reels, water-spray, or deluge and sprinkler systems. Active spill control systems will include fixed high-expansion foam and dry chemical systems. They will also include portable and wheeled fire extinguishers that employ dry chemicals and CO_2. Fire protection in buildings will generally consist of smoke detectors, flame detectors, portable fire extinguishers, sprinkler systems, and an emergency shutdown ("ESD") system.

Process instruments will routinely monitor for potentially hazardous conditions. Specialized automatic hazard detection and alarm notification devices will be installed to provide an early warning. The Project will also contain hazard detectors designed to sense a variety of conditions, including combustible gas, low temperatures (LNG spill), smoke, heat, and flame.

Each of these detector systems will trigger visual and audible alarms at specific site locations and in the control room areas to facilitate effective and immediate response.

The safety of the LNG carriers while docked and loading is a major design consideration for hazard detection and response. Safety measures include ESD spill containment and provisions to protect piping from the effects of surges. In addition, JCEP will have a Fire Department with three pumping trucks, one ladder truck, and one hazardous materials truck that can be mobilized to attend to a fire in the facility in less than 4 minutes.

1.3.7.12 Process Control System

Operators will control and monitor the facility through a distributed control system ("DCS"). Vendor-supplied packaged units with local control panels and numerous field-mounted instruments will be connected to remote Input/Output ("I/O") cabinets located throughout the facility. These remote I/O cabinets interface with the DCS controllers through cabling run through the plant to the control room. The DCS also includes a local historian that historicizes all process data on-site. Overall plant process control and monitoring will be performed at consoles located in the central control room, with monitoring capabilities from the remote I/O rooms.

Integrated into the DCS will be the Safety Instrumented Systems ("SIS"), Fire and Gas Systems ("FGS"), process analyzers, and other machine monitoring and control systems such as those used for the refrigerant compressors. The SIS will utilize separate, dedicated controllers to control safety functions such as those that are required for emergency shutdown safety functions. DCS controllers will monitor the present value of a designated process parameter and adjust actuated control valves to maintain the process setpoint. Limits will be defined to alert operators of deviation away from setpoint, and the SIS will take action if further deviation occurs. The FGS will permit activation of critical firefighting equipment from the control room and will utilize various flame, smoke, and temperature detectors as well as sirens, beacons, and manual alarm call points.

1.3.7.13 Electrical Systems

JCEP plans to obtain limited power from the regional electric grid for the SORSC and temporary construction activities as described in Section 1.9. With the exception of the SORSC, the LNG Terminal facilities will be islanded (with black-start capability) and will not have the means, infrastructure, or need to import or export power during operations.

The total power requirements for the LNG Terminal are 39.2 MW (holding mode) and 49.5 MW (loading mode). Electrical power will be via two 30 MW STGs and one spare 30 MW generator. The steam is efficiently generated by HRSGs using exhaust from the refrigerant compressor combustion turbine drivers. A black-start auxiliary boiler will be used to generate steam for power when gas turbines are not in operation. In addition, there are two standby diesel generators for the LNG facility and one for the SORSC. The facility will not be connected to the local grid, and will not import or export power. Two switchgear buses, in a main-tie-main configuration, will be connected to the STGs (minimum of one turbine to each bus). These switchgear buses will feed the plant distribution 13.8 kilovolt ("kV") switchgear, 6.9 kV switchgear and motor control center, and 480-volt switchgears and motor control center buses located throughout the plant. The plant distribution buses will contain two 6.9 kV essential power buses that power all of the essential plant loads. The LNG facility diesel generators have 100 percent redundancy and are connected to the 6.9 kV essential power buses.

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1.3.7.14 Buildings

Buildings and structures required for the operation of the LNG Terminal facility include:

- Administration Building
- SORSC Building
- Fire Department
- Operations Building/Control Room/Laboratory/First Aid Facility
- Main Gate Guard House and Security Building
- Secondary Entrance Security Gate/Terminal Guard Building
- Plant Warehouse/Receiving Building
- Maintenance Building
- Tugboat, Storage, and Crew Building
- Lube Oil, Paint and Compressed Gas Storage
- Water Treatment Building
- Inspection Station Shelter
- Fire Water Pump Buildings
- Fire Water Valve Buildings
- Marine Control Room Building
- Electrical Powerhouses
- Equipment Shelters/Buildings
- Analyzer Buildings

The siting of occupied buildings will be evaluated for overpressure, toxic release, and fire hazards. Occupied buildings will be sited in accordance with industry standards. Loads, analysis, design, and construction will be in accordance with all statutory and regulatory requirements.

1.3.7.15 Lighting System

The lighting levels will be based on API standards. Lighting around equipment and facilities where routine maintenance activities could occur on a 24-hour basis would range from 1 to 20 foot-candles, with 20 foot-candle lighting levels within the compressor enclosures.

General process area lighting would be kept to a minimum, on the order of 2 foot-candles. Access and Utility Corridor lighting for the LNG Terminal would be 0.4 foot-candle. Perimeter security would be on the order of 1.3 foot-candles, using evenly spaced 400 watt floodlights. As a point of reference, 20 foot-candles is close to the indoor lighting in a typical home, 2 foot-candles is typical of that found in a store parking lot, and 0.4 foot-candle is typical of residential street lighting. The final lighting plan would be developed during detailed design.

Only lighting required for operation and maintenance, safety, security, and meeting Federal Aviation Administration requirements would be used on the LNG storage tanks. The light will be localized to minimize off-site effects.

1.3.7.16 Access and Utility Corridor, Haul Road, Access Roads, and Parking Lots

The Access and Utility Corridor will be constructed between Ingram Yard and the South Dunes Site. The corridor will be approximately 1 mile long. It will be located entirely on property owned by JCEP. The Access and Utility Corridor will cover about 26 acres.

The primary purpose of the Access and Utility Corridor is to provide a conduit for the underground feed gas supply to the LNG Terminal and a number of utility services required between the LNG Terminal and South Dunes. Utilities in the corridor will include underground power lines, fire water supply, communications lines, and metering skid control lines.

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The full length of the corridor will be used during construction for the movement of equipment and materials. The road will be used to haul materials excavated from the LNG Terminal to South Dunes and the RFP property. Use of the corridor for mass earth moving will reduce impacts to the Trans Pacific Parkway and the existing RFP facility.

The western portion of the Access and Utility Corridor between the LNG Terminal and Jordan Cove Road will be paved and provide primary permanent access; it will include two lanes into the LNG Terminal and a single lane out. The remainder of the corridor, east of Jordan Cove Road, will be provided with a crushed rock track for infrequent maintenance access. Paved access between the South Dunes Site and the western portion of the Access and Utility Corridor will be provided by the existing Jordan Cove Road. Bridges will be used where required to reduce impacts to wetlands and all roads and bridges will be designed to meet Oregon Department of Transportation requirements. A two-lane access road will be provided to the northwest of Ingram Yard to provide emergency, marine terminal, and occasional maintenance access from Trans Pacific Parkway.

To the west of the Access and Utility Corridor and within the secured footprint of the LNG Terminal will be the guard house, security building, firefighting facility, operations building, warehouse building, maintenance building, and parking for operations personnel. Both the South Dunes Site and Ingram Yard will be provided with sufficient parking.

1.3.8 Mitigation Measures and Environmental Project

JCEP has worked with agencies since the inception of the Project to identify measures to enhance the environment or avoid, minimize, or mitigate for adverse environmental effects. Such measures include the Kentuck Project (that includes wetland mitigation from both JCEP and PCGP) and the Eelgrass Mitigation Site within the Coos Bay.

The potential environmental impacts of the Project, along with proposed mitigation measures, are detailed in Resource Reports 2 through 12.

1.3.9 Location Maps, Detailed Route Maps, and Plot/Site Plans

In addition to Figure 1.1-1, Figures 1.10-1 and 1.10-2 show the regional location of the LNG Terminal facilities on a USGS topographic map and an aerial map, respectively.

LNG Terminal plot plans are displayed on Figure 1.1-2 (Plot Plan of the LNG Terminal).

A typical cross-section diagram for the Access and Utility Corridor is illustrated in Figure 1.1-5.

Additional maps, illustrations, and plans of LNG Terminal components are found throughout the environmental resource reports, including the detailed design plans contained in Resource Report 13 (Engineering and Design Material).

1.4 LAND REQUIREMENTS AND LAND USE

Table 1.4-1 summarizes the land requirements for the facilities proposed as part of the LNG Terminal. Land requirements for each component of the LNG Terminal are described below.

1.4.1 Land Ownership, Existing Land Use, and Zoning

During construction of the LNG Terminal and related facilities, about 700 acres would be disturbed. Approximately 200 acres would be retained for operational facilities. JCEP owns about 295 acres at the LNG Terminal site, with additional temporary construction areas leased from other private landowners. Table 1.4-1 lists the land requirements for the LNG Terminal.

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TABLE 1.4-1
Summary of Land Requirements for the LNG Terminal Project

Area(1)	Land Area (acres)	Comments
PROJECT FACILITIES (FIGURE 1.2-1)		
Terminal Site Access	3.4	
Refrigerant Storage Area	3.0	
LNG Loading	10.2	
Liquefaction Process Area	12.1	
LNG Tank Area	28.2	
Flare Area	3.4	
MOF	3.2	
Gas Processing Area	5.5	
Slip and Access Channel	74.2	
Utilities	5.7	
Admin Building	5.4	
Access and Utility Corridor	26.7	
PCGP M&R Station	1.7	
Heavy Truck Haul Route	16.2	
Project Facilities	**198.9**	
NONJURISDICTIONAL FACILITIES		
Southwest Oregon Regional Safety Center (SORSC) (13)	4.6	
Fire Department (FD)	0.8	
Nonjurisdictional Facilities	**5.4**	
TEMPORARY CONSTRUCTION AND ENVIRONMENTAL AREAS (FIGURE 1.2-1)		
Laydown	28.7	Ingram Yard
Laydown	82.6	
Laydown, Workforce Housing Facility and Parking	71.9	South Dunes
TPP/US 101 Intersection	5.1	
Industrial Wastewater Pipeline	14.2	
Water/Raw Water Line	14.2	
Eelgrass Mitigation Area	32.6	environmental area

TABLE 1.4-1

Summary of Land Requirements for the LNG Terminal Project

Area[(1)]	**Land Area (acres)**	**Comments**
Boxcar Hill Laydown and Parking Area	19.9	
Kentuck Project	144.6	environmental area
APCO Site 1	19.4	
APCO Site 2	20.4	
Port Laydown Site	33.2	
Myrtlewood Facility Park and Ride	6.6	
Mill Casino Park and Ride	6.4	
Temporary Construction Areas	**499.8**	
TOTAL PROJECT AREA	**704.1**	

(1) Numbers or letters in brackets refer to area designations shown on Figures 1.2-1 and 1.2-2.

Virtually all of the upland elements of the LNG Terminal are on privately owned lands. No federal lands would be utilized for the LNG Terminal. The majority of the waterway for LNG vessel marine traffic and the access channel to the LNG Terminal would be located in Coos Bay. The bottom of the bay is owned by the State of Oregon and managed by the ODSL.

The LNG Terminal would be located on the bay side of the North Spit, about 7.5 miles up the existing Federal Navigation Channel, approximately 1,000 feet north of the city limit of North Bend, in Coos County, Oregon. The various components of the LNG Terminal, except for the waterway for LNG vessel traffic in Coos Bay, are illustrated on Figure 1.1-2.

The LNG Terminal would be within Section 5, Township (T.) 25 South (S.), Range (R.) 13 West (W.), shown on Coos County Assessor's map as tax lots 100/200/300. The zoning for the LNG Terminal site is established in the Coos County Comprehensive Plan, which includes the Coos Bay Estuary Management Plan ("CBEMP"). The current Comprehensive Plan and zoning designations allow for the development of the LNG Terminal. No zone or Comprehensive Plan map amendments will be required for development of the LNG Terminal. The necessary land use entitlements are limited to the receipt of discretionary permits that implement the applicable Comprehensive Plan and zone map designations.

The LNG Terminal, slip, and access channel are located within the aquatic and shoreline segments of the CBEMP. The access channel and inter-tidal portion of the slip fall within zoning districts 5 and 6 – Development Aquatic (5-DA and 6-DA). The purpose of the 6-DA zone is to provide areas for navigation and other water-dependent uses. The upland portions of the LNG Terminal are located within the Coastal Shorelands Boundary and are designated districts 5 and 6 – Water Dependent Development Shorelands (5-WD and 6-WD). The purpose of zoning district 6-WD is to protect the shoreline and provide areas suitable for water-dependent industrial uses. On August 30, 2016, the Coos County Board of County Commissioners approved JCEP's request for a conditional use permit to site and construct an LNG Terminal.

The Port obtained a removal-fill permit from ODSL to dredge an access channel that will connect the LNG Terminal slip to the Federal Navigation Channel within Coos Bay.

Historically, the LNG Terminal tract was once part of the Henderson Ranch, which dates back to the 1860s. In the 1880s, the Henderson Ranch was acquired by the Luse family, who later sold it to the Southern Oregon Improvement Company. William Luse was the son of H.H. Luse, who founded the first sawmill at Empire in 1856 (Dodge 1898). William Luse, John Henderson, Henry Barrett, Sam Crawford, and James Jordan were all acquaintances who married native Coos women, sought refuge on the North Spit, and were tangentially involved in the operation of the stage line from Jarvis Landing north along the beach to the Umpqua River. The Peterson family operated a dairy farm in the area in the early twentieth century, and continued to run cattle on the North Spit until the late 1950s (Byram 2006a). The terminal tract, then referred to as the Ingram Yard, was acquired by the Menasha Wood Ware Corporation and sold to Weyerhaeuser in 1981. The Ingram Yard was used for log sorting and disposal of debris from operation of the mill. In the early 1970s, the USACE deposited materials dredged during maintenance of the Federal Navigation Channel at the Ingram Yard.

JCEP proposes to construct and operate an approximately 1-mile access and utility corridor between the LNG Terminal and the South Dunes Site, in the Northeast (NE) Quarter of Section 5, T.25S., R.13W., and Northwest (NW) Quarter of Section 4. This corridor would be north of the existing RFP property, on land JCEP acquired from Weyerhaeuser. On the south side of the Access and Utility Corridor, adjacent to the eastern boundary of the LNG Terminal tract, JCEP would install support buildings, including the terminal control building, and a warehouse and maintenance building. Table 1.1-2 shows the support buildings proposed for the JCEP LNG Terminal. Historically, this parcel was once part of the Henry Barrett and Sam Crawford Ranch and the James Jordan Ranch, which were established in the 1860s and consolidated by the Luse family in the 1880s.

TABLE 1.1-2

Support Buildings for the JCEP LNG Terminal Project

Building Location / Function	Approx. Floor Area (ft²) / Eaves Height (ft.)	Form of Construction	Other Additional Elements
South Dunes / Southwest Oregon Regional Safety Center	26,110 / 15	Type1 – Engineered stick built building with interior finishes.	One story, architect designed.
South Dunes / Administration Building	24,769 / 15	Type 2 – Pre-engineered metal building with interior finishes.	One story.
Access Corridor / Fire Department	21,560 / 14-28	Type 2 – Pre-engineered metal building with interior finishes.	Two story.
Access Corridor / Operation Building	41,590 / 18-36	Type 2 – Pre-engineered metal building with interior	Two story building will include the Control Room, Laboratory and

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TABLE 1.1-2

Support Buildings for the JCEP LNG Terminal Project

Building Location / Function	Approx. Floor Area (ft²) / Eaves Height (ft.)	Form of Construction	Other Additional Elements
		finishes.	First Aid Facility.
Access Corridor / Plant Warehouse/Receiving Building	30,000 / 28	Type 2 – Pre-engineered metal building with interior finishes.	One story with mezzanine.
Access Corridor / Maintenance Building	30,000 / 28	Type 2 – Pre-engineered metal building with interior finishes.	One story with mezzanine.
LNG Terminal / Tugboat, Storage and Crew Building	2,664 / 17	Type 2 – Pre-engineered metal building with interior finishes.	One story.
Access Corridor / Inspection Station Shelter	4,950 / 23	Type 3 – Pre-engineered metal building without finishes.	One story, roof only.
Access Corridor / Chemical Storage and Hazardous Waste Storage Building	1,050 / 23	Type 3 – Pre-engineered metal building without finishes.	One story storage facility with air exchange handling units and wet sprinkler system to store hazardous materials such as paints, oils, greases, etc. for the facility
LNG Terminal / Water Treatment Building	9,188 / 23	Type 3 – Pre-engineered metal building without finishes.	One story.
Access Corridor / Guard House and Security Building	960 / 12	Type 4 – Pre-manufactured metal building. Completely fabricated, utilities installed and brought to site in one piece and set on foundation.	One story.
LNG Terminal & South Dunes / Auxiliary Guard Buildings	360 / 12	Type 4 – Pre-manufactured metal building. Completely fabricated, utilities installed and brought to site in one	One story.

TABLE 1.1-2

Support Buildings for the JCEP LNG Terminal Project

Building Location / Function	Approx. Floor Area (ft²) / Eaves Height (ft.)	Form of Construction	Other Additional Elements
		piece and set on foundation.	
LNG Terminal / Marine Control Building	2,030 / 12	Type 4 – Pre-manufactured metal building. Completely fabricated, utilities installed and brought to site in one piece and set on foundation.	One story.
LNG Terminal / Firewater Valve Housing (x22).	104 / 9 (x10) 372 / 10 (x10) 787 / 14 (x2)	Type 4 – Pre-manufactured metal building. Completely fabricated, utilities installed and brought to site in one piece and set on foundation.	One story.
LNG Terminal / Firewater Pump Housing (x1).	1,328 / 9 (x1)	Type 4 – Pre-manufactured metal building. Completely fabricated, utilities installed and brought to site in one piece and set on foundation.	One story, Two Buildings.
LNG Terminal / Powerhouse Housing (x12)	3,600 / 12 (x5) 4,284 / 12 (x1) 1,689 / 12 (x1) 4,480 / 12 (x1) 3,500 / 12 (x1) 2,000 / 12 (x3)	Type 4 – Pre-manufactured metal building. Completely fabricated, utilities installed and brought to site in one piece and set on foundation.	One story.
LNG Terminal / Continuous Emissions Monitoring Systems Housing (x7)	120 / 8	Type 4 – Pre-manufactured metal building. Completely fabricated, utilities installed and brought to site in one piece and set on foundation.	One story.
LNG Terminal / Backup Generator Housing (x2)	188 / 9	Type 4 – Pre-manufactured metal building. Completely fabricated, utilities installed	One story.

TABLE 1.1-2

Support Buildings for the JCEP LNG Terminal Project

Building Location / Function	Approx. Floor Area (ft²) / Eaves Height (ft.)	Form of Construction	Other Additional Elements
		and brought to site in one piece and set on foundation.	
LNG Terminal / VFD Housing (x2)	1,800 / 12	Type 4 – Pre-manufactured metal building. Completely fabricated, utilities installed and brought to site in one piece and set on foundation.	Single story, one each for the BOG and the LNG Tank Expander. Currently area of VFD for LNG Tank Expander is unknown.
LNG Terminal / Analyzer Housing (x1)	120 / 8	Type 4 – Pre-manufactured metal building. Completely fabricated, utilities installed and brought to site in one piece and set on foundation.	One story.
LNG Terminal – BOG Compressor Shelter (x1)	7,225 / 45	Type 5 – Pre-engineered metal building with roof and partial side panels only.	One story shelter will provide weather protection for compressor, lube oil consoles and maintenance cranes.
LNG Terminal – Refrigerant Compressor Shelters (x5)	3,233 / 64	Type 5 – Pre-engineered metal building with roof and partial side panels only.	One story shelter will provide weather protection for compressor, lube oil consoles and maintenance cranes.
LNG Terminal – Air Compressor Shelter (x1)	1,800 / 30	Type 5 – Pre-engineered metal building with roof and partial side panels only.	One story shelter will provide weather protection for compressor, lube oil consoles and maintenance cranes.
LNG Terminal / Steam Turbine Generator Shelter (x3)	3,150 / 45	Type 5 – Pre-engineered metal building with roof and partial side panels only.	One story.
LNG Terminal / Boiler Feed Water Pump Shelter (x1)	1,800 / 30	Type 5 – Pre-engineered metal building with roof and partial side panels	One story.

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TABLE 1.1-2 Support Buildings for the JCEP LNG Terminal Project			
Building Location / Function	**Approx. Floor Area (ft²) / Eaves Height (ft.)**	**Form of Construction**	**Other Additional Elements**
		only.	

The eastern portion of the LNG Terminal on South Dunes is the site of the former linerboard mill property. This location is primarily zoned industrial and would include administration buildings, a workforce housing facility, and the metering station.

JCEP would also lease about 83 acres of industrial land within the existing 229-acre RFP property for temporary construction staging activities. The haul road and dredge slurry and return water lines from the slip, to be used temporarily during construction of the terminal, would also cross RFP industrial land. The proposed relocations of the IWWP and the raw water pipeline would be routed along the existing Trans Pacific Parkway (the road on the north side of the LNG Terminal). The relocations of the water lines would impact about 28 acres of industrial land and less than half an acre of forest land during construction.

JCEP has proposed mitigating the loss of wetlands within the design of the Kentuck Project.

The Kentuck Project would cover about 140 acres of uplands, some of which will constitute JCEP and PCGP wetland mitigation, on the western shore of Coos Bay at the mouth of Kentuck Slough. Kentuck Project is to the west of North Cardinal Mark 11 along the Federal Navigation Channel, including parts of Sections 6 and 7, T.25S, R.12W, tax lots 100/799 and Sections 1 and 12, T.25S, R.13W tax lots 400/100. Formerly, this was the Kentuck Golf Course, zoned for Recreation (REC) and Forest (F). However, on September 23, 2009, the Coos County Board of Commissioners rezoned this land to Exclusive Farm Use (EFU), and amended the Coos County Comprehensive Plan for this tract from Recreation and Forest use to Agriculture. On August 30, 2016, the Coos County Board of County Commissioners granted JCEP's request for a conditional use permit to allow for mitigation and restoration within Segment 15-RS of Rural Shore lands identified in the CBEMP. This property is currently owned by JCEP.

The waterway for LNG vessel marine traffic would traverse 7.5 miles of the existing Federal Navigation Channel within Coos Bay. The Federal Navigation Channel is zoned "Deep-Draft Navigation Channel" in the CBEMP. The Federal Navigation Channel, which is generally 300 feet wide and 37 feet deep, is maintained by the USACE on behalf of the Port. It is used by deep-draft commercial ships and barges, a commercial fishing fleet, and recreational boats. The Federal Navigation Channel does not need to be improved for the Project. Also within Coos Bay, adjacent to the Southwest Oregon Regional Airport, would be the Eelgrass Mitigation Site, which would cover approximately 7.5 acres of open water and bay bottom.

On the north side of the McCullough Bridge, the Project would make improvements to the intersection of US 101 with the TPP, in accordance with its Transportation Impact Analysis (DEA 2012).

JCEP proposes to use two temporary off-site parking lots during terminal construction for commuting workers not residing at the worker housing at the South Dunes Site. One lot, approximately 6 acres, would be at the Mill Casino in the city of North Bend and is zoned Heavy Industrial (M-H). A parking lot likely is permitted outright, although the use is not specifically

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listed (North Bend City Code Chapter 18.44010). The other lot, approximately 6 acres, would be at the Myrtlewood Facility along US 101 near the community of Hauser. It is in Coos County jurisdiction and zoned Industrial (IND). "Parking lot/structure" is a use that is permitted outright (Coos County Zoning and Land Development Ordinance 4.4.200 (27)).

Construction and operation of the LNG Terminal and related facilities should have no significant adverse impacts on existing land use. JCEP's facilities would be consistent and compatible with existing zoning. The LNG Terminal tract is zoned for water-dependent industrial use and the adjacent South Dunes property is zoned for industrial use. JCEP has obtained or is in the process of obtaining local and state permits necessary for use of the Project component areas (see Table 1.4-1).

1.4.2 Land Use Effects

Virtually all of the Project's upland elements are on privately owned lands. The majority of the waterway for LNG vessel marine traffic and the access channel to the LNG Terminal would be located in Coos Bay, considered to be waters of the State, with the bottom of the bay managed by ODSL. The waterway is zoned "Deep-Draft Navigation Channel," and LNG vessel traffic would be consistent with this use. The access channel and inter-tidal portion of the slip are zoned Development Aquatic; the upland portions of the LNG Terminal are zoned Water Dependent Development Shorelands; and the South Dunes Site with administration buildings and workforce housing facility is zoned Industrial. Therefore, the LNG Terminal would be consistent with these water-dependent industrial uses. JCEP has received all of the necessary conditional use permits, and a Land Use Compatibility Statement.

Construction of the LNG Terminal, the SORSC, and associated facilities would affect a total of approximately 700 acres. The nearest residential structure to the proposed LNG Terminal is about 1.1 miles to the southeast, while the closest commercial buildings are part of the existing RFP industrial operation adjacent to the proposed LNG Terminal site.

The LNG Terminal and the western 52 miles of the pipeline route would be within Oregon's Designated Coastal Zone. JCEP and PCGP will submit an application to the Oregon Department of Land Conservation and Development ("DLCD") to obtain a coastal zone consistency determination. It is recommended that the construction not be allowed to proceed until after the Oregon DLCD makes a finding that the Project is consistent with the Coastal Zone Management Act.

The LNG Terminal and the South Dunes Site will be located on the bay side of the North Spit of Coos Bay, Oregon, located in unincorporated Coos County and to the north of the Cities of North Bend and Coos Bay, Oregon. A plot plan of the construction facilities is shown in Figure 1.2-1; a plot plan of the temporary construction facilities is shown in Figure 1.2-1. A summary of the land areas affected by the construction and operation of the LNG Terminal is provided in Table 1.2-1 and shown on Figures 1.2-1 and 1.2-2.

During construction, approximately 700 acres will be disturbed. Of the approximately 700 acres, 295 acres will be within the land owned by Fort Chicago LNG II U.S. L.P., an affiliate of JCEP. The remaining 405 acres outside of the land owned by Fort Chicago LNG II U.S. L.P. will be used for temporary construction areas and will be leased from private owners. Specifically, an additional area of about 83 acres will be leased on the RFP property and used for temporary construction areas including office, laydown, fabrication, craft break/lunchroom, parking, a heavy equipment truck haul route, and a slurry/decant water pipeline route. In addition, approximately 28 acres for the industrial wastewater line and raw water/water line relocation (Figure 1.3-1) will be in an existing utility easement on land owned by the Port.

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Following construction, approximately 200 acres on the LNG Terminal and South Dunes Site will be required for the permanent facilities.

The slip will be constructed on land owned by Fort Chicago LNG II U.S. L.P. JCEP will construct the slip and the LNG carrier and tug berths.

The access channel will be on land owned by the State of Oregon. JCEP will obtain an easement from the State of Oregon for the use and maintenance of the access channel. JCEP will construct the access channel.

1.5 CONSTRUCTION METHODS AND RESTORATION

1.5.1 Schedule

To meet an in-service date of the first half of 2024, construction activities for the Project are expected to begin in the first half of 2019 after the issuance of a FERC order. Construction of the LNG Terminal and slip is expected to take five years. All in-water work, including placement of material to construct the MOF, dredging, and specifically that required to remove the berm separating the slip and the access channel will occur during the allowable in-water work window (October 1 through February 15).

1.5.2 Construction Procedures

This section describes the general procedures proposed by JCEP for construction of the LNG Terminal facilities.

Under the provisions of the Natural Gas Pipeline Safety Act of 1968, as amended, JCEP would design, construct, operate, and maintain the LNG Terminal facilities in accordance with the U.S. DOT's/Pipeline and Hazardous Materials Safety Administration's ("PHMSA") Liquefied Natural Gas Facilities: Federal Safety Standards (49 CFR Part 193). The loading facilities and any appurtenances located between the LNG carriers and the last valve immediately before the LNG storage tank would be required to comply with applicable sections of the USCG regulations in Waterfront Facilities Handling Liquefied Natural Gas (33 CFR Part 127).

JCEP would construct the LNG Terminal facilities in accordance with its project-specific Erosion and Sediment Control Plan; its Upland Erosion Control, Revegetation, and Maintenance Plan ("JCEP's Plan"); and its Wetland and Waterbody Construction and Mitigation Procedures ("JCEP's Procedures"). JCEP has adopted the FERC's Plan and Procedures (May 2013 versions), as modified for the Project, into JCEP's Plan and Procedures as modified for this Project; therefore, there are no differences between JCEP's and FERC's Plan and Procedures. In addition, JCEP has prepared a Construction Spill Plan and Operations Spill Prevention Control and Countermeasures Plan.

JCEP's proposed LNG Terminal and associated aboveground facilities would be constructed in various phases. A description of the key elements of construction are provided below.

1.5.3 Site Preparation – Demolition and Clearing

Site preparation will commence with demolition, clearing and removal and relocation of existing functional and redundant infrastructure to enable earthworks to progress. During this time, the IWWP and several existing utilities will be relocated, as discussed in section 1.9. Other demolition and clearing activities include the following:

- <u>Hydrocarbon contaminated soils</u> - The South Dunes Site contains small areas of hydrocarbon contaminated soils remaining after the decommissioning of the former Weyerhaeuser paper mill. The contamination is located in the vicinity of the proposed site for the permanent buildings and would likely be disturbed during possible soil

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improvement activities. Following further delineation work, JCEP will develop a disposal plan for the approval of ODEQ and will dispose of the contaminated soils.

- Clearing - The dune areas at the LNG Terminal site currently contain low-grade timber. Before mobilizing earthmoving equipment, the trees will be felled and selectively processed for commercial timber. Scrub and stumps from across the site will be processed into mulch for use during construction operations. Wildlife monitoring will be undertaken before and during tree felling and site clearing activities according to the relevant regulations and permitting requirements.

1.5.3.1 Site Preparation – MOF Construction and Material Deliveries

Final transportation of materials, supplies, and staff to the Project site will be undertaken by a combination of road, marine transport, and rail. The kinds of materials and the mode of delivery to the site will depend on the origin, size, and weight of the material. The larger and heavier pieces of equipment can be delivered only by marine transport, and for that reason, JCEP will be constructing the MOF (Material Offloading Facility).

Until the MOF is constructed, the logistical difficulties presented within southwestern Oregon will mean that the majority of equipment will need to be delivered to the Project site by road. Therefore, the MOF will be completed as early as possible in order to reduce the impacts of road haulage on the local community and environment. Once constructed, the MOF will facilitate the receipt of large equipment, modules and general cargo.

The MOF will be placed at the southeastern corner of the slip, and will utilize the area dredged for the slip and access channel. The berth area behind the sheet pile walls will be used as the dock surface. Heavy equipment haul roads will be constructed from the construction dock face to the process area of the site.

Although marine transport is preferable, JCEP anticipates that some bulk materials, such as temporary buildings, construction equipment, steel reinforcement, pipe spools, cable drums, and insulation, will be delivered by road, according to the construction schedule, in order to minimize laydown requirements.

An existing rail line is located adjacent to the Project site and will be utilized where infrastructure restrictions allow. The rail line, which has been acquired by the Port, is now called the Coos Bay Rail Link and currently services the RFP facility adjacent to the proposed leased construction laydown areas.

Traffic surveys have been conducted of the anticipated construction-related traffic, and measures have been proposed to mitigate adverse effects of that traffic including upgrade of the intersection with US 101. These impacts and mitigation will be discussed in detail in Resource Report 5 - Socioeconomics.

MOF construction will be sequenced as follows, and as shown in Figure 1.5-1:

- In the first available in-water work window (October 1 to February 15), earthwork consisting of a small excavator and 40-ton articulated trucks will cut soil from the southern portion of the existing dune. Clean sand will be placed within the channel and extending 30 feet outside of the MOF footprint. Rip-rap will be temporarily placed on the face of the slope to protect sandy material from tidal erosion.
- Using the placed fill to locate construction equipment, sheet piles will be driven as a land-based activity without further impact to the marine environment. Following installation of the sheet pile wall, the MOF will be filled to elevation 13 feet (NAVD88), and fender piles

will be installed during the allowable in-water construction window between October 1 and February 15.

- In the next available in-water work window, a clam-shell dredge operation will remove all material from the front of the MOF to achieve operational depth requirements. After the sheet piles have relaxed, a topping-off operation behind the sheetpile wall will occur before concrete and rock are placed on top of the MOF to make it fully operational.

1.5.3.2 Site Preparation – Earthworks

Earthworks will require removal of topsoil and storage for re-use, cut (excavation and dredging), fill (placement of excavated material), and grading of approximately 9 million cubic yards ("mcy") of material to the approximate elevations detailed in Table 1.3-1.

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TABLE 1.3-1
JCEP LNG Terminal Project Elevations

Facility	Critical Minimum Elevation Required (ft)	Minimum Finished Grade Elevation (ft)	Critical Elevation
Marine Terminal (Typical)	34.5	34.5	Design Level Tsunami (L1)
LNG Tanks	34.5	27*	Design Level Tsunami (L1)
*LNG Tank Protection/Containment Berm	34.5	46	Design Level Tsunami (L1)
Liquefaction Trains	34.5	46	Design Level Tsunami (L1)
Gas Conditioning	34.5	46	Design Level Tsunami (L1)
Corridor and Roseburg Forestry Products	34.5	46 to 62	Design Level Tsunami (L1)
South Dunes (Typical)	32	51 to 58	Design Level Tsunami (L1)
Tsunami Evacuation Muster (Terminal)	60	60	Life Safety Tsunami (XXL1)
Tsunami Evacuation Muster (South Dunes)	52	52	Life Safety Tsunami (XXL1)
Operations Building	60	60	Life Safety Tsunami (XXL1)
Fire Department	60	60	Life Safety Tsunami (XXL1)
SORSC Building	52	52	Life Safety Tsunami (XXL1)

* The design tsunami inundation elevation is determined to be approximately 34.5ft. LNG Tanks which are founded at approximately +27 feet will be surrounded entirely by a tertiary protective berm approximately +46 feet high. The continuous protection provided by the containment berm allows the LNG Tanks to be founded below the design tsunami elevation.

The upland earthworks phase will require the handling of large volumes of material. This phase of the works is highly mechanized and will require periods of 24-hour operation. The Project will implement specific safety measures to control person/machine interfaces, including a temporary bridge or traffic overpass that will be constructed to segregate traffic travelling to and from the RFP facility from the large, off-road haul trucks and equipment, as detailed in Figure 1.5-2.

A detailed site preparation study has been undertaken to ensure all material can be accommodated within the Site and thus prevent any potential impacts of off-site disposal.

Approximately half of the 4 mcy of material moved onto the South Dunes Site and RFP property areas will be moved by hydraulic means, either using an upland dredge from the future slip area or a marine dredge from the access channel, as described in more detail within Section 1.5.4.

The planned rehabilitation of the Kentuck Golf Course into Coho salmon habitat will require approximately 300,000 cy of material to be transported from the dredge activities adjacent to the slip area to the Kentuck Project Site via marine transport barges.

Boiler ash previously disposed on the site of the LNG Terminal will be relocated to the South Dunes Site, where it will be buried within the fill.

The following erosion prevention best management practices will be employed to ensure local, state, and federal laws and regulations are met:

- Slopes stabilized by means of hydro seed, gravel, wood chips, or erosion control blankets.
- Existing vegetation preserved by limiting the amount of area disturbed during construction and maintaining existing vegetation on areas not disturbed by construction.
- Sediment protection devices set on all storm drains, catch basins, and other storm water conveyance structures that are susceptible to sediment collection.
- Temporary seeding performed to re-establish the vegetative cover on a disturbed area to prevent erosion of exposed soils.
- Compost wood chips or peat cover placed on disturbed areas to absorb wind and rain forces, and to develop an excellent growing medium for vegetation.
- Maintenance of best management practices by a dedicated crew will be ongoing through all phases of construction.

1.5.3.3 Site Preparation – Dredge Placement

Description of dredge placement within upland areas to be provided with subsequent filing.

1.5.3.4 Site Preparation – Soil Improvement

The subsurface conditions at the site require soil improvement before the start of construction of the LNG facilities. These conditions include peat, clay, buried driftwood, and liquefiable soil, which could cause excessive settlement and stability concerns or issues associated with liquefiable soils occur during seismic events.

Liquefiable soils are present throughout the LNG Terminal site, and their depths vary with the location. The liquefiable soils at Ingram Yard and along the Utility and Access Corridor have been delineated in distinct soil layers from the groundwater table to a maximum of approximately elevation -30 feet (NAVD88). At the LNG Terminal and the Utility and Access

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Corridor, the liquefiable layers are predicted to extend below the dunes present on the site. At the South Dunes Site, liquefaction is estimated in a soil zone that starts at the groundwater table and extends to variable depths from elevation 0 feet to approximately elevation -25 feet (NAVD88).

Peat is present under the non-dune portions of Ingram Yard (locations are detailed in Figure 1.5-3). The peat is generally understood to be located close to or just below the groundwater table at depths of about 7 to 15 feet below the existing grade, and has an estimated thickness of approximately 2 feet. At the South Dunes, the peat is generally understood to be located in the central portion of the site, as shown on Figure 1.5-4. The estimated peat thickness is generally 2 feet, except for one area where the peat is up to 4 feet thick. The level of decomposition of the material in the peat layer is variable, with wood in the form of branch-size material and wood chips dispersed throughout much of the peat layer. The long-term secondary consolidation settlement from the peat layer is estimated to be up to 7 inches.

A layer of clay has been identified in the South Dunes Site, as shown on Figure 1.5-4. The thickness of the clay layer is estimated to range from 0.3 feet up to 2.5 feet and would likely cause settlement by consolidation of up to 7 inches due to the fill placed on the South Dunes Site. Clay has not been identified at Ingram Yard or Utility and Access Corridor.

There are several areas in the South Dunes Site that are detailed on Figure 1.5-4 where accumulations of buried driftwood are estimated to be present. The driftwood will decompose over time, causing settlement of soils overlying the driftwood. Buried driftwood has not been identified at Ingram Yard or Utility and Access Corridor.

A detailed review of the potential methods of soil improvement has been undertaken, and a number of these proven methods could be employed for the Project, depending on the results of the final site investigations planned for 2018. Some of these methods are:

- Soil Densification Method 1 – Vibro-compaction will be the principal method utilized to condition soils that are believed to show potential for soil liquefaction under seismic activity. This method consists of driving a vibration device, assisted by compressed air and water, into the sand layers to compact the soils.
- Soil Densification Method 2 – Sand compaction piles are technically comparable to vibro-compaction; however, the availability of resources and resulting commercial variances will likely preclude their use.
- Organic Material Treatment Method 1 – Dry excavation and removal will be favored for larger peat deposits where localized dewatering would not impact the adjacent wetland bodies.
- Organic Material Treatment Method 2 – Adjacent to wetlands, wet excavation and removal will be tried, and based on the trials, it will be used only where a good quality result can be ensured.
- Organic Material Treatment Method 3 – Soil mixing, with pre-excavation, above organic material will be utilized in instances when the extent of the addition of binder can be minimized to achieve the necessary result, or where wet excavation does not prove acceptable.

Localized deposits of boiler ash that are on-site, which are a legacy of the Weyerhaeuser paper mill, will be hauled to the South Dunes Site and buried within the fill.

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1.5.4 Anchor Bolts Down – Civil Work

Geotechnical studies have been completed to determine the properties of the existing subsurface soils and to identify the foundation design criteria and solutions (see Resource Report 13).

1.5.4.1 Piling

A number of piling solutions will be utilized on the Project, and will include driven and replacement pile systems. Typically, conventional pipe pile, sheet pile, or drilled piles will be used where required for earth retaining structures and deep foundations. It is anticipated that soil improvements will be sufficient to provide the bearing capacity for typical design loads. If additional bearing or lateral resistance is required to resist extraordinary/seismic lateral loads, it is likely that driven pipe pile foundations will be used. Driven piles will typically be driven to a depth that provides the required resistance and in some instances may require predrilling to reach the desired depth.

Given the seismic loading requirements and the height of the walls required for the marine slip, a steel sheet pile system is proposed for construction of the marine slip. The sheet pile system uses interlaced sheet piles in a U-shaped configuration to provide better overturning and sliding resistance than conventional sheet pile walls. In some instances, predrilling may be required to reach the desired depth. See Section 1.5.4 for more details.

1.5.4.2 Underground Services

Underground work consists of storm drains, gravity drains, utilities, fire water, process piping, and duct banks. The main fire water header, raw water supply, and feed gas supply will be close to the permanent roadways and temporary haul roads. Early completion of underground work will facilitate completion of site grading for stormwater control, completion of plant roadways, and installation of foundations and aboveground work.

Underground work will be closely coordinated with the mass earthwork movements to install as much of the piping and duct bank as possible while the site is still being brought to grade. Areas where piping densities are higher will be left open as fill work continues. This sequencing will minimize the amount of trenching, trenching depth, and double handling of fill material as well as the overall duration of the work.

Ground improvement operations will precede underground utility work in all cases. Work adjacent to roadways will be completed before the road base course. Installation of underground pipe in the corridor between the LNG Terminal and South Dunes will be sequenced around the construction and use of the corridor as a haul road. Underground pipe testing will be completed in segments to allow backfill operations to follow.

1.5.4.3 Foundations

The foundations for all equipment and structures, including the LNG storage tanks, process equipment, and pipe racks, will use either a shallow or deep foundation system. Typically, shallow isolated or raft foundations will be used unless the design requires the use of deep foundations. All foundation loads, analysis, design, and construction will be in accordance with statutory and regulatory requirements. Where required, foundations will be evaluated and designed to mitigate the hazards associated with settlement, bearing capacity, overturning, sliding, buoyancy, erosion, and scour.

Major foundation work will generally follow the installation of piling and underground utilities.

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Formwork for foundations will comprise a mix of metal form systems and job-built wooden forms. Rebar will be fabricated off-site, delivered, and tied into place on-site. LNG containment basins will utilize sheet pile cofferdams. Seal slabs will be poured to prevent ground water infiltration. Formwork for the interior walls and shoring will be designed and stamped by a Professional Engineer. The sheet piles will serve as the outer form of the sump and remain in place (and be cut off below grade) or be pulled at a later date.

A concrete batch plant will be established to supply the LNG Terminal's needs. Local aggregate sources have been investigated and have been found to have deficiencies (chert inclusions) that preclude their use for concrete. Regional sourcing of on-spec aggregates has been confirmed. A concrete washout area will be located adjacent to the batch plant to allow for containment and disposal of waste water related to concrete batching operations. The disposal of concrete waste water will follow all necessary environmental regulations.

1.5.4.4 Restoration and Civil Finishes

Areas disturbed by construction of the LNG Terminal's facilities will be stabilized with temporary erosion controls until construction is complete, unless they are covered by equipment, gravel or other covering.

Following construction, the site will be brought up to final grade, and best management practices will be applied to prevent erosion. To minimize the potential for erosion, JCEP has modified the FERC's Upland Erosion Control, Revegetation, and Maintenance Plan (JCEP's Plan) and Wetland and Waterbody Construction and Mitigation Procedures (JCEP's Procedures), thereby creating Project-specific Plan and Procedures. A copy of JCEP's Procedures is provided in Appendix B.2 of Resource Report 2 – Water Use and Quality, and a copy of JCEP's Plan is provided in Appendix B.7 of Resource Report 7 – Soils.

After the foundations are completed, the site will be brought up to final grade. Final grading and surfacing will consist of gravel-surfaced areas, asphalt-surfaced areas, concrete-paved surfaces, grass areas, and placement of salvaged topsoil and mulch.

1.5.5 Marine Facilities

1.5.5.1 Marine Equipment for Construction

A description of the applicable marine equipment to be mobilized and the duration and location of activity will be provided with subsequent filing.

1.5.5.2 Dredging and Shore Protection

About 4.5 mcy of material will be removed to create the slip basin. Of this, about 1.5 mcy would be dry excavated and about 3.0 mcy would be hydraulically dredged. The excavated and dredged materials would be transported to the planned locations on Ingram Yard and the South Dunes Site, and used to raise the elevations.

During the "fresh water" construction phase of the slip (see Section 1.5.4.2, Slip Construction, below for a description of the construction of the slip), up to about 2.5 mcy of material would be dredged in the pocket behind a temporary construction berm, as shown in Figure 1.5-5. During the "salt water" construction phase of the slip, about 0.5 mcy of material would be dredged during removal of the temporary construction berm of which about 0.3 mcy will be used for the Kentuck mitigation project. Last, about 1.5 mcy of material would be cutter-suction dredged from the bay during construction of the access channel and MOF between the Federal

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Navigation Channel and the proposed LNG Terminal marine slip. The northern slip face would be armored after the slip is dredged but before the temporary construction berm is removed. The south slip would remain unarmored, because the temporary construction berm would be removed during the later stages of slip construction.

The estimated excavated and dredged material volumes and their proposed placement locations are summarized in Table 1.1-3.

Table 1.1-3

Estimated Excavated and Dredged Material Volumes

Facility	Construction Phase	Volume (mcy)	Disposition Site
Slip	Upland Excavation	1.4	LNG Terminal site
	Fresh Water Dredge	2.2	LNG Terminal site and Roseburg site
	Salt Water Dredge	0.2	
Protective Berm	Upland Excavation	0.03	LNG Terminal site
	Fresh Water Dredge	0	
	Salt Water Dredge	0.5	LNG Terminal site (0.2 mcy) Kentuck Project site (0.3 mcy)
Access Channel	Upland Excavation	0.004	LNG Terminal site and Roseburg site
	Fresh Water Dredge	0	
	Salt Water Dredge	1.4	LNG Terminal site and Roseburg site

Modelling conducted by Coast and Harbor Engineering ("CHE") (see Resource Report 2 attachments for details) of sedimentation over time in the access channel and slip estimates that the access channel would accumulate about 0.56 feet of sediment per year, equivalent to about 29,200 cy of material, while the terminal slip would accumulate about 0.16 feet per year of sediment, equivalent to about 8,500 cy of material. Approximately a total of 37,700 cy of material could be dredged for maintenance of the access channel and slip combined in year one of operation of the LNG Terminal, and 34,600 cy in year ten. In the first ten years of operation of the LNG Terminal, about 360,000 cy of material would need to be removed to maintain the proper depth of the access channel and slip, while in the next ten years about 330,000 cy would need to be removed. The recommended maintenance is to conduct dredging about every 3 years, with about 115,000 cy of material removed for the first 12 years of operation, and after that maintenance dredging could be done about every 5 years with up to 160,000 cy of materials removed. Reference RR2, Dredge Material Management Plan and RR7, Section 7.3.2.5 for more information.

Maintenance dredge materials will be placed at the APCO East upland site and will be the subject of additional future approvals.

1.5.5.3 Construction of Sheetpile Wall

Before the excavation work for the slip begins, the sheet pile bulkhead and retaining wall will be installed. The sheetpile system will serve as a retaining wall for the shoreline on the east and west sides. The east side will support the LNG carrier loading facility and associated berthing and mooring facilities. The sheetpile system will be designed to support the dead loads of the soils and structures, and the live loads of the LNG carrier at berth and LNG transfer equipment, and is also designed to meet the seismic criteria for the facility and water-imposed loads. The west side will provide an emergency lay berth and the sheetpile system will be designed to support the dead loads of the soils and structures and the live loads of the LNG carrier at berth.

The sheetpile wall system consists of face sheet piles for retaining the soils as well as tail-walls for anchorage of the retaining wall. All sheet piles and tail-walls will be driven from the land while the slip construction activities are isolated from Coos Bay.

1.5.5.4 Slip Construction

To minimize the impacts of construction of the marine facilities on fisheries, reduce the total period of estuary turbidity, and extend the time available for construction, a two-phase construction methodology will be used to construct the slip. The basic concept of the two-phase construction methodology is to excavate (either wet or dry) the majority of the slip area and construct the structures while maintaining a natural physical barrier between the excavated/dredged slip and the water of Coos Bay (see Figure 1.5-5). This methodology will be accomplished by retaining a natural earthen berm to provide a physical partition between the water of Coos Bay and the Phase 1 (fresh water) construction activities for the marine facilities. This construction methodology will allow year-round work on the northern portion of the slip without being in contact with or causing an impact to the waters of Coos Bay. Phase 2 work will include excavating the access channel and excavation/dredging of the berm and MOF in-water construction. Phase 2 will be constructed during periods when fisheries considerations allow in-water work, between October 1 and February 15.

1.5.5.5 Slip Upland Construction Details

Details of each of the steps involved during upland construction are outlined below.

1.5.5.5.1 Dry Excavation

The existing natural ground surface is at an elevation of approximately +20 feet NAVD88. The water table across the slip occurs at an elevation of approximately +10 feet NAVD88. All excavated material above an elevation of approximately +10 feet NAVD88 will be removed by conventional earthmoving equipment such as excavators, scrapers, bulldozers, and front-end loaders. A berm will be maintained as a barrier to the bay during this construction phase. In all areas other than where the sheet pile is installed, a side slope of 2.5 Horizontal ("H") to 1 Vertical ("V") (2.5H:1V) will be maintained on the slip side to preserve the integrity of the berm during excavation and dredging, as shown in Figure 1.5-5. Excavation during this step will remove only material that is essential for creating the slip and constructing upland structures. Contouring of the slip perimeter above +10 feet NAVD88 will be performed during this step. Side slopes of 2.5H:1V where the sheet piling is not used will be maintained around the perimeter of the slip to maintain slope stability.

The volume of material to be excavated and dredged from the slip is 4.3 mcy (2.3 mcy excavated and 2.0 mcy dredged), and the volume to be dredged from the access channel is 1.3 mcy for a total of 5.6 mcy. Current plans for management of the material involve the placement of the 1.9 mcy of excavated material on Ingram Yard and the placement of 3.7 mcy on the South Dunes Site (see Table 1.1-3).

Excavated material will be hauled by trucks to the South Dunes Site. The excavated material truck haul route will go to the north of the slip through Ingram Yard and then follow the route of the Access and Utility Corridor to the South Dunes Site. The route will not cross the Trans Pacific Parkway at any time, and the only potential conflict will be with chip truck traffic to the RFP wood chip facility, which will be mitigated by construction of a temporary bridge or traffic overpass. The excavated material truck haul route will be on JCEP-owned land.

1.5.5.5.2 Excavation of Dredge Launch Pond

Several wide-tread excavators will be used to remove material down to elevation 0.0 feet NAVD88, thereby creating a 300-foot-long by 200-foot-wide by 10-foot-deep launch pond. The launch pond preferably will be located near the slip perimeter and road access. The material will be moved to the upland disposal sites by trucks, as described in the previous section.

The dredge barge will be delivered by ocean-going barge to the channel, then pulled over the berm to facilitate hydraulic dredging of the slip. All of the material to be excavated that is located at or below the level of the water table will be removed by means of hydraulic dredging and transported to the South Dunes Site.

The slurry pipeline used for hydraulic transportation of excavated materials (including the decant water return line) will follow the shoreline of the RFP property until the point where it follows the route of the future Access and Utility Corridor. The route will be approximately 8,650 feet long and will have an approximate construction right-of-way width of 8 feet. This pipeline will not result in additional land disturbance. From the slip site across the RFP property, the pipes will be placed directly on the ground surface. From the point where they follow the route of the Access and Utility Corridor, the pipeline will be covered with the fill used to develop the Access and Utility Corridor. No excavation of the existing ground surface will occur to install the slurry pipeline, because the pipeline will be placed on fill material and temporarily covered by additional fill material. Where not covered, the pipeline will be held in place by cross bracing anchored into the soil. In the area of the RFP chip ship berth, the pipeline will be placed on the rip-rap along the shoreline, so that it does not affect the docking and loading of the chip ships. The pipeline will be able to span any affected wetlands or waterbodies without the need to place any structures in the wetlands or waterbodies. At all points along the pipeline route where the slurry pipeline could rupture and the contents could potentially enter the waters of Coos Bay, secondary containment will be provided around the slurry pipeline.

The slurry pipeline and decant water return pipelines will be made of 18- to 20-inch-diameter fused polypropylene (seamless) pipeline, and will be provided with secondary containment at any wetland and waterbody crossings to ensure that those bodies will not be affected by any breaks or leaks. The decant water return pipeline will be placed along, and directly adjacent to, the slurry pipeline (no spacing between the two pipelines). The decant water pipeline will be used to convey the decanted water from the settling areas back to the dredge pond. When the hydraulic transport has been completed, the pipelines will be drained, flushed with clean water, and cut apart only in those areas where any residual material in the pipeline could not potentially be released into the bay, wetlands, or other waterbodies. The pipeline will be removed by the contractor and taken off-site for reuse, recycling, or disposal in a permitted landfill. Since the pipelines will be on existing developed surfaces (grassed, paved, graveled, and rip-rap area of the RFP property) and areas to be developed for the Project (Access and Utility Corridor), post-construction restoration will include reseeding of grassed areas that were disturbed by the location of the pipelines on the grassed area.

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1.5.5.5.3 Slip Dredging

One or more disassembled hydraulic dredge plants will be transported to the slip site by barge. The hydraulic dredge plants may be in the 18-inch to 24-inch size range, since this is the maximum size range for transportability and the minimum size range capable of dredging to an elevation of -45.9 feet NAVD88. The plants will be assembled on-site and lifted by crane into the dredge launch pond. A hydraulic transport pipeline will connect the dredge or dredges to the South Dunes Site, and a decant water return pipeline will return the water to the slip area or purpose-built decant basin.

The hydraulic dredges, which are capable of transporting a slurry of 30 percent solids by weight at a flow rate of 6,000 gallons per minute ("gpm") or greater, will create an ever-increasing dredge prism that will, in the end, create the fully defined slip within the confines of the berm. The hydraulic dredges are capable of dredging to the final slip depth of -45.9 feet NAVD88, while creating side slopes for the slip at a ratio of 3H:1V where the sheet piling is not used. Dredging of the slip prism will be conducted outside of the normal Coos Bay dredging window, because the slip will be isolated from the waters of Coos Bay by the berm.

1.5.5.5.4 Driving of Piling for Marine Structures

All of the mooring structures will be constructed "in-the-dry" and, as such, piles can be driven prior to or concurrent with the dredging of the slip. Land-based mobile cranes with pile-driving equipment will be located on the land-side of the sheetpile walls. All piles required for the LNG loading structure as well as for all of the mooring structures will be driven on dry land. Fender piles are required at the MOF, and would be installed before excavation and during the allowable in-water construction window between October 1 and February 15.

1.5.5.5.5 Slope Armoring

The northern slip face will then be armored. The south slip face created by the berm will remain unarmored, because it will be removed during the next construction step to create the final configuration of the slip and the access channel. The sequence for pile driving, slope dressing, and armoring may vary depending upon the means and methods chosen by the contractor performing the work.

1.5.5.6 Marine Construction Details

Details of each of the steps involved during Marine Construction are outlined below.

1.5.5.6.1 Breaching and Removing the Berm

Once all of the Phase 1 construction is complete, work will begin on breaching and removing the berm (500,000 cy) and the remaining area of the slip. Dredging may be conducted from both the Coos Bay side and the slip side to reduce the duration of the breaching and removal activity. Material will be removed by hydraulic dredge or clam-shell dredge. Material (approximately 300,000 cy) will be transported to the Kentuck Project to be used as fill.

1.5.5.6.2 Final Contouring and Slope Armoring

Removing the berm will open the slip to Coos Bay. Additional dredging to contour the access channel will complete the construction dredging activities. Armoring of the remaining unarmored slip side slopes will be completed. Although not anticipated at this time, any additional in-water structures required to complete the slip and associated in-water structures will be installed. In-water work will be performed during the allowable construction window between October 1 and February 15.

1.5.5.6.3 Dredging Access Channel

The access channel connecting the slip to the Federal Navigation Channel will be dredged either before or after the berm is removed. This work, along with all in-water removal activities performed from the Coos Bay (southerly) side of the berm, will be performed during an allowable in-water construction window between October 1 and February 15.

1.5.5.6.4 Restoration

Following the excavation activities, all exposed areas, including exposed slopes, will be stabilized with an approved seed mixture specified as being capable of surviving in highly permeable, xeric regimes, binding loose sand, and withstanding burial and deflation from aeolian processes.

The slurry and decant water return pipelines will be removed as described above. Any areas that are disturbed by the haul truck or pipelines route that do not become part of the Access and Utility Corridor, will be restored to pre-construction condition.

The route of the slurry/decant water return pipelines on the developed RFP property will not require restoration, because the pipelines will be placed on areas that are graveled, concrete, or rip-rapped. If there are any areas of the route where ground disturbance occurs, these areas will be returned to pre-construction conditions.

1.5.5.7 LNG Carrier Loading Facilities

The LNG carrier loading facilities will be constructed once the installation of the eastern sheet pile wall system is complete. All of the loading facilities will be on the shore side of the slip, with no facilities located in the water of the slip. The platform with the loading arms (inclusive of the loading and vapor return arms) will be installed on a concrete pad located at the edge of the slip. The foundation of the pad will contain a number of piles to provide a stable foundation for the loading arm platform. Separate piles, typically steel pipe, will be driven for the breasting and mooring structure platforms. The loading arm platform will be constructed on columns raised from the concrete pad and accessed through stairways. The LNG transfer piping will be located over LNG troughs that will contain any spills and divert the LNG to a containment basin.

The LNG carrier loading facilities will be constructed using land-based equipment to install the required structural elements for the loading platform and mooring structures. Installation of berth piping and equipment, and hookup and commissioning of the loading system and utilities will follow.

1.5.5.8 Shoreline Protection

The LNG basin shoreline will be protected from wave action and wind erosion using stone or articulated block reinforcement. Extensive hydrodynamic modeling (by CHE) has indicated that LNG carrier and tug propeller scour protection will not be required on the east side of the slip, see Resource Report 2, Section 2.2.6.1.3 for details. The north side and east side will be protected by extending from the toe trench to above the water line, where it will be tied into other slope stabilization structures using various techniques (concrete cellular mattresses ("CCMs"), grout-injected geotextile fabric mattresses (fabriform), soil improvement techniques, and/or geotextile reinforced vegetative planting). For the portion of the berth basin that is not expected to be subjected to wind, wave and water level conditions under operating conditions, alternative erosion protection means will be used. This portion of the berth basin includes the area above elevation +25 feet NAVD88. This area may be protected using CCMs, grout-injected geotextile fabric mattresses (fabriform), and/or geotextile-reinforced vegetative planting. The erosion control methods will be designed to withstand expected rainfall runoff.

1.5.6 LNG Storage Tank Construction

The description below provides an outline of the construction sequence for the erection of the seismically isolated double-containment LNG storage tanks.

1.5.6.1 Concrete Work

Foundation Slab - Before the base slab is installed, there will be a levelling pad poured to ensure a level working surface for the base slab. The slab installation will be performed in sections. The first activity will be to form, install rebar, and pour the outer sections, and then the interior sections. Forming of the pedestals for the bearings will follow the bottom slab pours. During installation of the seismic isolation bearings, the upper slab shoring and formwork will be started. The upper slab pour sequence will be the same as for the bottom slab and only occur after the bottom slab has cured enough to achieve the proper compressive strength. The same work sequence will follow for the second tank.

Formwork Fabrication - A jump-form system will be utilized for the concrete walls. The jump forms will be assembled on-site from pre-fabricated panels. The wall will be straight without any taper to minimize complexity until the top ring beam is installed. The top ring beam will require a modification to the inside formwork to allow for the installation of the compression ring.

Rebar Fabrication - The rebar will be pre-assembled into mats on-site prior to installation. There will be two assembly areas set up, each within the radius of both tower cranes. The rebar for the ring beam will be tied in place.

Wall Construction - The walls will be constructed in quarter-sections. Wall pouring will start once the outer sections of the elevated slab have cured adequately. The pre-assembled rebar mats will be flown into place. The rebar crews will be installing the post-tensioning ducts with each mat of rebar. Embeds for attachment of the vapor liner will be installed in this operation as well. The formwork will then be erected, and the concrete will be poured. To facilitate construction, tower cranes, placing booms, and pump trucks will be used.

Ring Beam - The ring beam will be partially completed before raising the roof. Mechanical couplers will be utilized to allow for an effective tie-in to the roof structure. Once the steel roof structure is air raised and welded to the compression ring, the ring beam will be finished as it is tied into the concrete on the roof. The post-tensioning ducts in the ring beam will be stressed before the roof is poured.

Concrete Roof - Once the steel roof structure is welded in place, the rebar will be installed on the structure. Concrete placing booms will be utilized for the roof pours.

1.5.6.2 Steel Plate Work

Tank Floor - The floor is the first steel plate activity (the first steel layer on the concrete) that can start without interfering with the concrete work. Once the concrete outer wall is high enough, the temporary roof supports will be installed. A freestanding support at the center of the dome roof and knee brace style supports at the perimeter of the roof will be installed high enough off the floor to allow access under the roof. The outer tank roof assembly starts once these supports are installed. The roof petals are flown into the tank using a large crawler crane and set onto their temporary supports. While the assembly of the petals is occurring, the concrete crews will continue to install rebar and formwork, and pour concrete for the outer wall, as shown in Figure 1.5-6.

Dome Roof - The dome roof is composed of pre-fabricated petals that are assembled and welded on temporary supports on the floor of the tank (Figure 1.5-6). An aluminum suspended deck forms the top of the inner tank and is installed once the temporary supports are removed. This includes all openings and nozzles between the inner and outer tanks. Insulation is placed on the suspended deck for installation later. JCEP will utilize a specialty air lift subcontractor for raising the roof. The pressure required to lift the dome roof is about 0.5 psi. Once the roof reaches the compression ring, fit-up of the roof to the compression ring is completed and welding starts. Once the roof is secured, the tank is depressurized and the door plate is removed to provide access inside the tank to complete welding of the roof to the underside of the compression ring. The safety of the workers is the number one priority. Absolutely no one will be allowed to go inside the tank until all of the required checks have been performed and the tank has been declared safe to enter. The top of the ring beam will be poured as the welding on the underside of the compression ring is being performed. Before pouring the roof, the door plate is re-installed and the pressure is re-applied. During the pour and cure, no work can be performed in the interior of the tank because it remains under pressure.

Example of Wall Liner and Floor Insulation - After the door plate is re-opened, the outer wall liner plate and floor insulation can start. The plates are double jointed lengthwise and tacked to the embedded steel that was placed in the wall forms. Plates are then seal welded together to form the vapor barrier. Similarly, plates are installed on the elevated slab that forms the bottom of the tank. Precise welding procedures are followed to ensure a quality weld and (non-destructive examination is performed as a quality check. Scissor lifts and aerial work platforms are used for access. While the wall liner plates are being installed, insulation of the floor begins. A layer of leveling concrete is placed on the floor liner plate, followed by layers of damp proofing, cellular glass block, and floor plate. Thermal corner protection will be installed to ensure that heat leakage stays within the design parameters.

Inner Tank - The inner tank will be erected using a hydraulic rough terrain crane inside the tank. The door plate design will take into consideration the width and height of the equipment that needs to access the interior of the tank. The first piece of the inner tank is the annular bottom plate. Once the annular bottom plate is welded, the inner tank shell erection can begin. Until the last course of the inner tank is installed and welded, the floor cannot be completed because of the utilization of the crane in the center of the tank. The crews will utilize a gondola for access between the wall liner and the inner tank shell for welding. After all equipment is removed, the final floor plates, inner door, and outer door are installed.

1.5.6.3 Tank Pressure Test

A hydrostatic test of the inner tank will be carried out in accordance with API 620 Section R.6 using fresh water. The outer tank will be pneumatically tested in accordance with API 620 Section R.7.

Test water will be transferred between tanks and disposed of according to the methods described in Section 1.5.6.8.

1.5.6.4 Tank Insulation

Floor – The floor will be insulated as described for the wall liner above.

Inner Wall - Once the inner wall quality check is completed, a hoist will be used to install the liner insulation on the inner tank wall. Stainless steel wire is used to tie the insulation layer along the inner tank wall.

Suspended Deck - The suspended deck is insulated with a glass fiber blanket after the installation of the perlite in between the wall liner and the inner tank wall.

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Perlite - This portion of the work will be performed by a specialty perlite installation subcontractor. The perlite will be filled through the roof nozzles into the annulus between the wall liner and the inner tank plates.

1.5.6.5 Purging

Once the insulation is completed, the outer temporary construction opening will be closed, and an air compressor will introduce dry air into the inner tank and dome space. Nitrogen will then be introduced and vented through a roof nozzle.

1.5.7 Anchor Bolts Up – Mechanical, Electrical and Finishes

Construction of the pipe racks, terminal buildings, major mechanical equipment, process and utility piping, and electrical equipment and instrumentation will follow the concrete foundation work. These facilities will be completed and pre-commissioned in readiness for mechanical completion.

1.5.7.1 Module Installation

The construction of the process facilities will be composed of both modularized and stick-built structures. Because the Project site must utilize water delivery for the major equipment, large modularized structures can also be delivered, providing the Project access to overseas fabrication yards. Modularized structures allow for major portions of the work to be fabricated off-site before the civil and concrete work is completed, which will allow labor requirements to be balanced with availability and reduce overall impacts in the local community.

The modules will be delivered to the site mechanically complete, with all coatings, proofing, and insulation fully installed. The unitized design of the modules for the Project allows for the stick-built portion of the work to proceed independent of the delivery of the modules. This decoupling of the stick-built work from the modules allows the off-module work to proceed in a productive and uninterrupted manner right up to the start of testing and commissioning activities.

The work to connect the modules is minimal, because the unitized design requires a limited number of tie points.

The process equipment modules include five identical modules for the liquefaction trains, an LNG handling module, three gas conditioning modules (one each for AGRU, dehydration, and mercury removal units), and the LNG loading module. The bulk of pipe racks will also be modularized. The design of the modules allows them to be off-loaded directly from the Self-Propelled Modular Trailers to their foundations, or picked up and set by crane. The site plot plan and sequencing of the module installation has been designed to provide flexibility in the module delivery schedule while minimizing the impact of module installations to ongoing site activities. Figure 1.5-7 outlines the planned installation sequence for the modules. The delivery and installation of the first pipe rack modules will begin shortly after the completion of the MOF, where all modules will be unloaded before they are moved to the site. Before the installation of the modules, all underground and foundation construction will be complete to the furthest extent practical.

The approach of the foundation design and construction schedule is to minimize the overlapping of the civil and concrete trades with the structural, mechanical, and electrical and instrumentation trades once the modules are in position. The module installation begins with the pipe rack modules along the liquefaction trains and in the LNG tank area, and is followed by the modules in the utility and refrigerant make-up areas. The pipe rack modules at the intersection of the liquefaction and utility areas will be held out until the modules and other

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major equipment have passed through this area. The equipment modules, starting with the LNG handling module, will be installed next. The installation of the LNG handling module will be followed by the liquefaction modules, alternating with the gas conditioning modules until all module installations are complete. The detailed installation sequence has been coordinated between the module fabrication schedule, logistics plan, required cargo arrangement on each transportation vessel, and the site construction schedule.

1.5.7.2 Steelwork Erection

Many of the structures needed for the LNG Terminal are not suited for modularization, and will therefore be stick-built on-site. Steel shapes will be fabricated with all finish painting, galvanizing, and fire/coldproofing shop-applied. All stick-built steel will be fabricated with bolted connections to facilitate erection. Stick-built structures include:

- STG and flare area pipe racks
- STG shelters
- LNG train pipe racks
- LNG refrigerant compressor shelters
- Shelters for BOG compressors, air compressors, and boiler feed pumps
- Pre-engineered buildings
- Miscellaneous sleeper racks, equipment platforms, T-stands, and vapor barriers will make up the balance of the steel erection work at the site.

Pipe racks will be erected in levels to facilitate pipe installation. This work will be highly orchestrated between the trades. Equipment shelters over rotating equipment include a bridge crane and architectural paneling on the roof with partially enclosed walls. After shelter erection, JCEP will commission and certify the overhead cranes and place them into service for use in erecting the piping and other work inside the shelter. The cranes will be inspected and recertified by the vendor at turnover.

1.5.7.3 Mechanical Equipment Installation

Key process equipment utilized for the LNG Terminal will be installed in the modules. However, a significant element has been excluded, specifically the major rotating equipment and long-lead items. The mechanical equipment that will be installed on-site includes:

- Refrigerant compressors and combustion turbine drives
- Heat recovery steam generators
- BOG compressors
- Steam turbine generators
- Air-cooled condensers
- Thermal oxidizer
- Prefabricated equipment buildings
- Electrical powerhouses
- Fire water pumps
- Guard shacks, CEMS building, and valve houses

- Carriers and tanks
- Pumps
- Miscellaneous vendor skids
- Field-erected tanks
- Flares – warm, cold, marine

1.5.7.4 Major Stick-Built Equipment

Refrigerant Compressors and Combustion Turbine Drivers – Equipment will be skid-mounted by the vendor and fully assembled, tested, and disassembled prior to shipping. The compressor, turbine, control equipment, lube oil pumps and reservoir, and associated piping are included in this package and will be installed on-site. After the large pieces are set, the building steel will be erected. Remaining vendor piping and accessories for the compressor/combustion turbine will then be installed.

Heat Recovery Steam Generators (HRSGs) – Units will arrive with the tube bundles installed in the casing section at the shop. The casing sections will be up-righted and lifted into place on the foundation with crawler cranes. Casework splice plates and interior liner plates will be installed and seal welded. The stack will be then be installed. The steam drum, tube bundle jumpers, down-comers, and drain piping will follow.

BOG Compressors – Equipment will be skid-mounted and set using a large crawler crane. The electric drivers will be fully assembled but likely not be shipped on the skid and will require installation in the field. Installation of accessory skids, lube oil piping, and coolers will follow. After the large pieces are set, the building steel will be erected.

Steam Turbine Generators (STGs) – Each piece of equipment will have its own baseplate and foundation. The STGs will be set with a large crawler crane. After the large pieces are set, the building steel will be erected. The accessory modules sit outside the shelter and will be set by crane. Lube oil piping and remaining accessories will be installed after the steel.

Air Cooled Condensers – Equipment is fabricated as an A-frame-type steam condenser. Each STG will have its own independent ACC. The fan cells will be pre-assembled at ground level and lifted into place upon stick-built steel legs with a large crawler crane. After the cells are in place, the A-frame panels will be pre-assembled and lifted into place along with the collector pipe and steam header on top. The connecting ductwork back to the axial flow turbines will be pre-assembled and set by crane.

Thermal Oxidizer – Equipment will arrive in several pieces. The combustion chamber sections will have shop-installed refractory. The sections will be preassembled and set by crane. Combustion air ductwork and FD fan will be installed and sealed. Finally, the stack will be erected. Burners, other accessories, and joint insulation will follow.

Prefabricated Equipment Buildings – Units will arrive via truck or ship depending on the final sourcing. In general, these units will be fully completed building shells with equipment, lighting, controls, etc. fully installed and tested. These will be set by crane and secured to a concrete foundation.

Electrical Powerhouses – These units are too large to ship fully assembled and will come in two to six sections, depending on the amount of electrical equipment contained. These buildings will set directly on pipe piles that are roughly 8 feet above finished grade. After the pieces are set, the shell splice plates will be installed and sealed, and electrical jumpers installed. The HVAC

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systems will be installed and commissioned on temporary power to provide climate control for the electrical equipment.

<u>Shop Fabricated Vessels and Tanks</u> – Equipment will be set by crane. Equipment will be dressed out with insulation, platforms, pipe support and piping, cable tray, etc. at site before setting.

The amine regenerator will be lifted with a large crawler crane and will require another crawler crane for tailing.

The amine contactor and regenerator vessels will have the internal trays shop- installed. The amine contactor is too heavy to set with the cranes currently planned for the Project and instead a specialty heavy lift subcontractor and equipment will set it. Packing will be installed at site during pre-commissioning just before degreasing of the AGRU. Pumps will be installed as the piping work progresses through each area.

The pumps in the LNG impoundment basins and waste water sump will be installed and commissioned on temporary power early in the Project schedule, because they handle storm water from all of the concrete paved areas under LNG service lines. There are numerous miscellaneous vendor packages and skidded equipment that will be installed around the site as the work progresses. Setting will utilize forklifts, mobile cranes, and even permanent overhead bridge cranes.

There are two large field-erected tanks on the site for fire water service. A specialty tank erection subcontractor will be utilized for this work.

There are two ground flares on the Project: one (warm and cold flare) multipoint enclosed ground flare and one (marine flare) cylindrical enclosed ground flare. Both will be field-erected on-site.

1.5.7.5 Heavy Lifting and Heavy Transport

A Heavy Lift and Haul Plan will be prepared for safely receiving, transporting, and installing all major equipment and modules. The plan focuses on the movement and lifting of major equipment and modules that require extra attention due to physical configuration, size, and weight. The plan concentrates on the movement of the major module assemblies from the MOF to the Project site. The heavy lift portion of the plan focuses on the crane equipment sizing, lift plan categorization (critical or general lifts), preliminary critical lift plans, crane pad design, and plot plan locations for major crane operations. Each type of heavy haul or lifting operation will require a specific level of planning, coordination, and approval prior to field execution.

1.5.7.6 Piping

While piping will be a major component of off-site modules, there remains a significant amount of stick-built piping work on-site, including:

- Low-density pipe racks and sleeper racks
- Piping coming-off modules to field-installed equipment
- Piping in field-erected buildings
- Module-to-module interconnections
- Module ship loose spools
- Piping associated with site-erected tanks, mechanical systems, and equipment installations,

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- including vendor-supplied piping
- Inspection and testing

Early piping installation will focus on the stick-built portions in the STG rack and the LNG load-out rack. These racks will install steel and piping in alternating layers. This method allows for unencumbered access to the work and no overhead obstructions for crane-setting material. Remaining piping work will commence as available work faces open up from equipment or module setting.

1.5.7.7 Piping Fabrication

Stick-built piping and pipe supports will be fabricated into spools and finish painted off-site to minimize the need for on-site fabrication labor and facilities. This work will be contracted to a union fabrication shop located in the U.S. in accordance with the Project Labor Agreement (PLA).

1.5.7.8 Pressure Testing

Pressure testing, wherever possible, will be hydrostatic; however, pneumatic testing of piping systems and pressure equipment will take place in cases where residual water would impact subsequent operations.

A project-specific pneumatic test procedure that adheres to all applicable jurisdictional safety, and code requirements will be developed and implemented. Pneumatic pressure testing is performed only when hydrostatic testing is not an option due to system configuration and/or potential contamination issues. Safety is of primary concern with such testing. Engineering will perform stored energy and safe distance calculations per ASME PCC-2, with exclusion zones clearly communicated and monitored to manage the potential dangers associated with pneumatic pressure testing.

Potable and raw water sourced from the CBNBWB will be used for pressure testing of piping systems, unless restricted by piping metallurgy. Given the climatic conditions in southern Oregon, no additives are anticipated for freeze or other protection.

Water used in pressure testing will be locally discharged, following testing and the approval of ODEQ, to the stormwater system for infiltration or discharged to the Industrial Waste Water Pipeline (IWWP) according to the applicable National Pollutant Discharge Elimination System permit requirements. To initiate this process, JCEP would submit a formal request accompanied with information on the type of testing to be conducted, the source of the water, the chemicals to be added to the hydrotest water (if any), the potential for the test water to acquire contaminants during the hydrotest, and the types of chemical analyses to be conducted on the hydrotest water prior to discharge to ensure that JCEP meets ODEQ's discharge requirements.

1.5.7.9 Closure Welds

All welds will be subject to pressure testing unless that testing will put personnel or equipment in danger of injury or damage. In these circumstances a closure weld will be approved, and the requirements of ASME B31.3-2014 345.2.3 will apply. A Project-specific procedure will be developed to describe the controls that will be implemented for closure welds.

1.5.7.10 Electrical and Instrumentation

- Electrical and instrumentation work includes:
- Temporary construction power
- Underground raceway (duct bank) installation

- Grounding infrastructure installation
- Aboveground raceway (cable tray, channel tray, conduit) installation
- Wire and cable installation (cable pulling, glanding, testing, and termination)
- Equipment installation (large pre-fabricated and smaller field equipment)
- Instrumentation (instruments, instrument control and safeguarding system ("ICSS")
- Specialty systems (lighting, cathodic protection, lightning protection)
- Security and telecommunications

Modules - Electrical and instrumentation cabling installed on the modules will terminate in a combination of power terminal boxes, instrument junction boxes and remote I/O cabinets for the ICSS scope. These terminal cabinets will be the tie-in point between the modules and the site cables. At the module yard, electrical equipment and instruments will be installed along with the cabling to the terminal cabinets. Before shipment to the site, cable verification and some equipment pre-testing will be done. Pipe rack and equipment modules will have cable tray pre-installed; therefore, careful planning is needed to make sure that the module-installed tray and the field-installed tray line up properly.

Underground - Electrical and instrumentation underground work consists of duct bank and grounding systems. The duct bank system will provide pathways for the electrical circuits where pipe rack or structural steel is not available for use of a cable tray. Duct bank is also used to provide redundant pathways for the fiber optic networks and to connect the main process site and the South Dunes (SORSC and administration) buildings. Electrical vaults will be placed strategically to provide pull points for some of the longer cable. Site grounding will also be phased and coordinated with civil and structural scopes of work. The site grounding is generally in a grid configuration that also has ground wire ties bonded to steel and equipment above the ground.

Aboveground - Most of the electrical and instrumentation work will follow along in the sequence with the piping, mechanical equipment, and module installation. As mechanical equipment is set and the pipe rack is built, cable tray and channel will be installed to provide a pathway for the power, control, and instrumentation circuits. Cable tray will generally be installed on the top level of the pipe rack except where it transitions from beneath the elevated powerhouse enclosures. Cable tray cover will be provided as necessary to protect installed cables from damage. The channel tray provides a transition from the cable tray to the circuit termination point.

As the equipment and pipe rack modules are placed in the field, home run cables between the modules and the local powerhouse enclosure ("PHE") will be installed and terminated at the module terminal cabinets. The homerun cables will consist of multi-conductor power cable, instrument and control cable, and fiber optic cabling. All medium-voltage circuits are pulled from the source directly to equipment located on modules rather than to module terminal cabinets.

The medium-voltage distribution backbone will extend out from the facility auxiliary powerhouse to the PHEs and support buildings. The cabling will travel both on cable tray and through the duct bank systems. The plant fiber optic backbone will follow the same pathways except that it will originate at the operations building. Redundancy has been provided by routing the redundant fiber through a different pathway if possible. In some areas, the redundant fiber is routed in the same cable tray as the primary fiber, but the redundant fiber is installed in aluminum conduit to provide a secondary pathway. Because the PHE is the origination point for the majority of circuits, cable reels will be set up at the PHE and pulled out to the plant loads and equipment.

In addition to power, instrumentation, and fiber backbone circuits, cable through the pathways will be provided to power field-installed electrical equipment and lighting and receptacles. Process area, roadway, and general site lighting and receptacle power installation will follow the structural installations. The lighting and receptacle cable will utilize armored cable both underground and above the ground. After installation, all cable in cable tray will be secured to the tray.

Equipment - The main electrical equipment is the prefabricated electrical buildings (PHEs) that are pre-packaged with the majority of the electrical and control equipment installed at the manufacturer's facility. They will be shipped to the site in sections and installed, as discussed in the Mechanical Equipment Installation section above. Final scope to assemble the PHEs will be a composite mechanical and electrical crew. The powerhouses will be elevated and cable tray will be installed underneath the buildings to provide a route for the cabling after they are set in place. Other site-installed equipment includes large pad-mounted transformers, generators for emergency/backup power for critical systems, and miscellaneous field panels and transformers. Equipment installed in classified areas will meet the required area hazardous classification.

1.5.7.11 Instrumentation and Control

Instrumentation - The instrumentation work will include instrument installation, instrument stands, process and air tubing and supports, Continuous Emissions Monitoring System (CEMS), and sample systems. The instruments and tubing will be installed following equipment and piping installation. Factory-calibrated instruments will be procured that meet the area hazardous classification requirements. Enclosures for instruments will be provided where the anticipated operating temperature range exceeds the instrument operating range. As instruments are installed, their associated cable will be pulled and terminated.

Integrated Control and Safeguarding Systems - The ICSS will be made up of the process control systems, the safety instrumented systems, and the fire and gas systems. Each system will be independent of the others. Redundancy within these systems has been provided. The ICSS equipment will be installed within the plant control room located at the operations building. This equipment will be made up of workstations, cabinets, and consoles. In addition, Distributed Control System (DCS cabinets will be installed in the powerhouses and in the process areas as required. Fiber optic cabling will be used for the main backbone of the system as well as to field-installed remote I/O cabinets. Field devices will be hardwired back to either remote I/O cabinet or an instrument junction box. The cabinets will then be wired back to DCS cabinets located at the PHE. The integration of multiple plants systems including machine monitoring, continuous emissions monitoring, and LNG sampling will be part of the ICSS.

Specialty Systems - The electrical and instrumentation work includes the following specialty systems:

- Lightning protection system
- Heat trace system
- Cathodic protection system for buried piping
- Leak detection

Generally, the installation of these systems will follow the same sequence as the main electrical and instrumentation scope; therefore, when a particular area has electrical and instrumentation cable installed, it would also include the scope for these other specialty systems. The unique nature of these systems has special vendor technical requirements for installation and testing.

Security and Telecommunications - Security and telecommunications wire and cable and devices will be installed following the base project schedule as facilities or areas of the plant become available. Whereas outside on the site, the security and telecommunications pathways are the same as electrical (underground or in cable tray, as applicable to the plant area), inside the facilities, the cabling for the security and telecommunications systems generally will be in open pathways. The equipment will be from quality manufacturers with a proven track record. JCEP will utilize a specialty telecommunications systems integrator. This specialty subcontractor will procure the selected equipment and begin assembly and programming for a Factory Acceptance Test of the systems that will be performed off-site at the system integrator's facility before equipment is shipped to the site.

Generally, the equipment will be provided rack-mounted, and complete factory acceptance-tested racks will be shipped to the site for installation in facilities. Once the racks are installed, final device terminations can be done on-site. The performance of each device will be verified before Site Acceptance Testing begins. JCEP recognizes the importance of communication with multiple stakeholders for the security and telecommunications scope, particularly with respect to the SORSC and Fire Department, which will house facilities for JCEP as well as for other state and federal entities.

1.5.8 Temporary Workforce Housing and Bussing, and Logistics

JCEP has responded to community concerns regarding potential impacts that the influx of the temporary workforce may have on housing availability and pricing. JCEP has planned a holistic approach to workforce housing that strikes a balance between community impacts and community benefits. Measures include modularization to lower peak labor, hiring local employees who do not require temporary housing, utilizing existing hotel, motel, and RV Parks as well as potential future privately developed accommodations, and a JCEP full-service workforce housing facility located at South Dunes.

A Workforce Housing and Bussing and a Logistics Plan will be developed to address issues related to the housing and transportation of workers to and from the Project. Resource Report 5 includes additional information regarding socioeconomic impacts of the workforce housing, bussing, and logistics of the Project.

This plan will also detail steps to minimize the impact of the additional traffic from construction by utilizing off-site parking lots for worker travel by bus to and from the Project site each day.

1.5.8.1 Workforce Housing Facility

The workforce housing facility was originally planned for the North Point Site in North Bend adjacent to the suburb of Simpson Heights. After consultation with the community and further design development of the facility, an alternate site on South Dunes has been allocated.

The workforce housing facility will house Project personnel, primarily tradesman and supervision who do not live within the community or within private accommodations. The current plan is for a facility that can be built out in 100-bed phases, from an initial 200 to a maximum of 700 with all common facilities built out in the first phase. Details are provided in Figure 1.5-8 (to be provided in subsequent filing).

Parking will be provided on-site, and shuttle buses to and from local communities will reduce traffic on the road network after working hours.

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After completion of construction and commissioning activities the entire facility would be decommissioned and removed from Site.

1.5.8.2 Off-site Parking

To further reduce the traffic along the main US 101 commuter route through local communities, park-and-ride facilities will be established to bus employees to the Project site from locations north and south of the US 101 McCullough Bridge (Mill Casino and Myrtlewood Facility). Private RV parks that house sufficient Project personnel will also be serviced by dedicated buses subject to demand.

1.5.9 Temporary Facilities and Construction Laydown Areas

Temporary facilities and construction laydown areas will be required during construction of the Project to house construction offices, crafts lunchrooms, warehousing, equipment maintenance, and laydown of materials after delivery to the Project site. These facilities have been located to maximize use of land owned by JCEP within the overall site boundary and minimize impact on wetland environments through use of brownfield land, suitably zoned for industrial purposes, at the RFP property, Box Car Hill, Port Laydown Site and APCO properties.

1.5.10 Kentuck Project

Construction activities at the Kentuck Project include earthwork and civil infrastructure improvements to re-establish connection to the former golf course site.

Because the Kentuck Slough has subsided approximately two to three feet from its historical profile as a result of diking and drainage, earthwork activities will include importing approximately 300,000 cubic yards of dredge sand from the LNG Terminal site to raise the subgrade to a profile conducive to establishing appropriate estuarine and some freshwater habitats. JCLNG anticipates that imported dredge sand will be mobilized to the site by barge (main haul) and hydraulic dredge pipeline (from barge to site) to minimize traffic and safety impacts to the local road system. Historical drainage patterns will be re-established to the extent practical given site constraints.

Civil infrastructure improvements include constructing a new bridge in East Bay Drive to allow tidal exchange between Kentuck Inlet and the Kentuck Project; improving the existing dike separating the site from Kentuck Slough; constructing a new muted tidal regulator (i.e., "fish friendly" tide gate) in the upper portion of the Kentuck Project to redirect a portion of Kentuck Slough flows into the Kentuck Project; and raising the profile of East Bay Drive and approximately 1,900 lineal feet of Golf Course Lane to be above the zone of tidal influence. A fish-friendly culvert or other structure will be constructed within Golf Course Lane to allow passage into the drainage above the former golf course irrigation sump pond.

Construction will require a variety of temporary structures and detour facilities to isolate work areas from aquatic resources and provide access to adjacent private property. The proposed work would also remove to the greatest extent practicable relic golf course facilities such as fencing, ditches, foot bridges, and culverts.

1.5.11 TPP/US 101 Intersection Widening

Traffic surveys and studies of projected construction traffic have determined that the intersection of highway 101 and Trans-pacific parkway will need to be improved.

The proposed design will provide a turning lane to manage traffic entering highway 101 from the west and automated traffic control.

1.6 OPERATION AND MAINTENANCE

1.6.1 LNG Terminal Facilities

The LNG Terminal will be operated and maintained in accordance with DOT Federal Safety Standards for LNG Facilities (49 CFR Part 193) and NFPA 59A standard. In addition, the marine facilities will be operated and maintained in accordance with the USCG regulations for LNG Waterfront Facilities, 33 CFR Part 127.

Operations and Maintenance ("O&M") procedures will be developed to promote personnel safety and plant operability. Details of all procedures and training associated with the LNG Terminal will be developed during the detailed design phase.

The O&M procedures for the LNG Terminal will be developed to comply with the applicable requirements of:

- 49 CFR Part 193 Subpart F – Operations and NFPA 59A. This will include policies for operating procedures, monitoring of operations, emergency procedures, personnel safety, and investigation of failures, communication systems, and operating records.
- 49 CFR Part 193 Subpart G – Maintenance and NFPA 59A. This will include policies for maintenance procedures, fire protection, isolating and purging, repairs, control systems, corrosion control, and maintenance records.
- 49 CFR Part 193 Subpart J – Security and NFPA 59A Annex C – Security. This will include policies for security procedures, protective enclosures, security communications, and security monitoring and warning signs.
- 33 CFR Part 105 – Maritime Security: Facilities. This will include policies for security procedures, communication systems and procedures, and security monitoring of access points to the LNG Terminal.
- 33 CFR Part 127 – Waterfront Facilities Handling Liquefied Natural Gas and Liquefied Hazardous Gas. This will include policies for development of operations and emergency manuals for the LNG marine transfer area.

All permanent O&M personnel employed at the LNG Terminal will undergo thorough training for their assigned duties and will be sufficiently qualified to operate the LNG Terminal in accordance with the requirements of 49 CFR Part 193, Subpart H – Personnel Qualifications and Training, and also the operating, maintenance, and personnel training requirements of NFPA 59A. JCEP will ensure that personnel are trained in accordance with applicable requirements of the USCG, DOT, Oregon Department of Energy, Oregon State Fire Marshall, Coos Bay, and Coos County Fire Department.

JCEP will prepare and submit an Emergency Response Plan ("ERP") to be approved by FERC prior to any final approval to begin construction. The ERP will establish the procedures for responding to specific emergencies that could occur at the LNG Terminal as well as procedures for emergency situations that could affect the public along the LNG carrier transit routes. The ERP will include a comprehensive training program in emergency management for all JCEP LNG Terminal employees as well as the supporting emergency management agencies.

The LNG Terminal will be staffed with about 180 full-time equivalent direct employees. The LNG Terminal will be operated on a permanent 24-hour basis, 365 days a year. Full-time staff will conduct routine maintenance and minor overhauls. Major overhauls and other major maintenance would be handled by bringing in personnel specifically trained to perform the required tasks. All scheduled and unscheduled maintenance will be entered into a computerized maintenance management system.

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1.7 FUTURE PLANS AND ABANDONMENT

The proposed action does not include the abandonment of existing FERC jurisdictional facilities.

JCEP does not anticipate abandonment of the proposed LNG Terminal facility in the foreseeable future (less than 30 years). Robust construction techniques and proper maintenance and operating procedures can result in LNG facilities whose useful life surpasses their design life.

1.8 PERMITS, APPROVALS, AND CONSULTATIONS

Construction, operation, and maintenance of the Project will be executed in accordance with all applicable permits and approvals. Applicable permits and approvals for the LNG Terminal are summarized in Table 1.6-1 along with the schedule and status for filing of all major applications or appropriate documentation.

Table 1.6-1

Major Permits, Approvals, and Consultations for the LNG Terminal Project

Agency	Permit/Approval/Agency Action	Contact	Status
FEDERAL			
U.S. Department of Energy (DOE)	Order Granting Long Term, Multi-Contract Authorization to Export Natural Gas to Free Trade Agreement Nations under Section 3 of the Natural Gas Act	Amy Sweeney (202) 586-2627	Received December 7, 2011
DOE	Order Conditionally Granting Long-Term Multi-Contract Authorization To Export Liquefied Natural Gas To Non-Free Trade Agreement Nations under Section 3 of the Natural Gas Act.	Amy Sweeney (202) 586-2627	Conditionally received March 24, 2014

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Table 1.6-1

Major Permits, Approvals, and Consultations for the LNG Terminal Project

Agency	Permit/Approval/Agency Action	Contact	Status
U.S. Federal Energy Regulatory Commission (FERC)	Section 3 of the Natural Gas Act. Order granting Section 3 authorization and issuance of Certificate of Public Convenience and Necessity	John Peconom (202) 502-6352	To be filed August 2017
U.S. Army Corps of Engineers (USACE)	Section 404 of the Clean Water Act (CWA) – permit issued to allow placement of dredged or fill material into the waters of the United States Section 10 of the Rivers and Harbors Act – permit issued to allow structures or work in or affecting navigable waters of the United States	Tyler Krug (541) 756-2097	To Be Filed August 2017
USACE	Section 408 of the Clean Water Act – permit allowing the alteration of Army Corps of Engineer civil works projects	Marci Johnson (503) 808-4765	Filed May 2014
U.S. Coast Guard (USCG)	Letter of Recommendation and Water Suitability Analysis under the Ports and Waterway Safety Act.	LCDR Laura Springer	Ongoing
	Navigation Aids – private aids to navigation		Prior to Operation
FERC (as lead agency)	National Historic Preservation Act § 106 Review/Memorandum of Agreement among federal agencies, consulting parties, and SHPO	Paul Friedman (202) 502-8059	

Table 1.6-1

Major Permits, Approvals, and Consultations for the LNG Terminal Project

Agency	Permit/Approval/Agency Action	Contact	Status
U.S. Fish and Wildlife Service (USFWS)	–Consultation under Section 7 of Endangered Species Act Consultation – issuance of Biological Opinion; Consultation under the Fish and Wildlife Coordination Act – consultation with federal agencies to prevent loss or damage to wildlife resources; Migratory Bird Treaty Act – review for compliance with MBTA.	Joe Zisa (503) 231-6179	Biological Assessment To Be Filed November 2017
National Marine Fisheries Service (NMFS)	–Consultation under Section 7 of Endangered Species Act Consultation issuance of Biological Opinion. Magnuson-Stevens Fishery Management and Conservation Act – consultation on Essential Fish Habitat (EFH) Marine Mammal Protection Act – issuance of Incidental Harassment Authorization	Chuck Wheeler 541-957-3379	Biological Assessment To Be Filed November 2017 To be filed November 2017
Federal Aviation Administration (FAA)	Determination of No Hazard to Air Navigation pursuant to 14 CFR Part 77.	Dan Shoemaker (425) 227-2791	
Federal Communications Commission	Section 303 of Communications Act of 1934 – review and authorize use of existing communication towers or new towers for radio use		Prior to Construction

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Table 1.6-1

Major Permits, Approvals, and Consultations for the LNG Terminal Project

Agency	**Permit/Approval/Agency Action**	**Contact**	**Status**
STATE			
Oregon Department of Environmental Quality (DEQ) Air Quality Division	Clean Air Act issuance of Air Contaminate Discharge Permit	Mary Camarata 541-687-7435	Filed March 2013. Issued. Applicant requesting modification, meeting on 3/13/2017.
	Clean Air Act – issuance of Title V Operating Air Permit		To Be Filed one year after operation.
Oregon Department of Environmental Quality (DEQ) Water Quality Division	Clean Water Act – issuance of Construction Storm Water Discharge Permit	Mary Camarata 541-687-7435	Prior to Construction
	Hydrostatic Test Water Disposal Permit	Mary Camarata 541-687-7435	Prior to Construction
	Clean Water Act – issuance of Operation Storm Water Discharge Permit	Mary Camarata 541-687-7435	Prior to Operation
	Industrial Discharge Permit	Mary Camarata 541-687-7435	Prior to Operation
	Clean Water Act – issuance of section 401 Water Quality Certification	Mary Camarata 541-687-7435	To Be Filed May 2017; requires approved SWMP
	Resource Conservation and Recovery Act- issuance of Site Identification Number for hazardous waste activities	Mary Camarata 541-687-7435	Prior to Operation

Table 1.6-1

Major Permits, Approvals, and Consultations for the LNG Terminal Project

Agency	Permit/Approval/Agency Action	Contact	Status
	Solid Waste Disposal – for ash removal prior to NTP	Mary Camarata 541-687-7435	Prior to Construction
	Clean Water Act – issuance of permit under the National Pollutant Discharge Elimination System ("NPDES") - 1200A General Permit for Concrete Batch Plant	Mary Camarata 541-687-7435	Prior to Construction
	Clean Water Act – issuance of NPDES - 1200-C General Permit for any Contiguous Sites	Mary Camarata 541-687-7435	Prior to Construction
	Clean Water Act – issuance of NPDES Wastewater Permit for current site conditions – allows discharge of treatment of leachate from landfill through the ocean outfall	Mary Camarata 541-687-7435	Renewed July 26, 2015. Expires June 30, 2020.
Oregon Department of Land Conservation and Development	Coastal Zone Management Act Compliance – issuance of consistency determination with CZMA	Dave Perry (541) 574-1584	To Be Filed Summer 2017
Oregon Division of State Lands (DSL) Removal/Fill Program	Removal-Fill Individual Permit	Bob Lobdell (503) 986-5282	To Be Filed August 2017
DSL Removal/Fill Program	General Authorization – for tide gate cleaning to remove logs which prevent an existing tide gate flap from opening and draining Wetland J.		Ongoing

Table 1.6-1

Major Permits, Approvals, and Consultations for the LNG Terminal Project

Agency	Permit/Approval/Agency Action	Contact	Status
DSL Land Management Program	Proprietary easements and licenses for land access and gravel use.		To Be Filed May 2017
Oregon Department of Fish and Wildlife (ODFW)	Threatened and Endangered Species Consultation (State-listed species)	Jon Gormond 503-947-6088	Ongoing
ODFW	Fish Passage Approval	Greg Apke	To Be Filed May 2017
Oregon State Building Codes Division (BCD)	Building Permits – for various permanent structures.	Mark Long (503) 373-7235	Prior to Construction
BCD	Temporary Building Permit – for any temporary structures.	Mark Long (503) 373-7235	Prior to Construction
Oregon State Historic Preservation Office (SHPO)	Section 106 Consultation	John O. Pouley 503-986-0675	Ongoing – required prior to 404 approval
Oregon Water Resources Department (OWRD)	Limited License – for dewatering system and any other drilled wells	Greg Wacker (541) 297-6157	To Be Filed 2019-2020
Oregon Department of Transportation	Railroad Flagging Permit		Prior to Construction
	Oversize Load Permit		Prior to Construction
	Overweight Load Permit		Prior to Construction
	Street Use Permit		Prior to Construction
LOCAL			

Table 1.6-1

Major Permits, Approvals, and Consultations for the LNG Terminal Project

Agency	Permit/Approval/Agency Action	Contact	Status
Coos County Planning Department	Conditional Use Permit - the LNG Export Terminal, mitigation site, and associated components.	Jill Rolfe (541) 396-7772	Final Decision and Adoption by Board of County Commissioners August 30, 2016. Appeal pending at the Land Use Board of Appeals.
	Conditional Use Permit – various associated components of Project	Jill Rolfe (541) 396-7772	To Be Filed Summer 2017
Coos Bay Rail Link	Rail Road Crossing Permit		Prior to Construction

In December 2011, the U.S. Department of Energy ("DOE") authorized exports by JCEP from the LNG Terminal to Free Trade Agreement nations. In March 2014, the DOE conditionally authorized exports by JCEP from the LNG Terminal to Non-Free Trade Agreement nations. In 2012, the Project received all local Coos County approvals for the LNG Terminal (except the building permit that will be obtained when construction is to commence), including some import facility permits that were amended for the JCEP LNG Terminal Project and permits that were obtained anew for the currently proposed Project. Coos County approvals were superseded by the LNG Export Terminal Omnibus package submitted and approved in 2016. An ODSL removal/fill permit was issued for the slip and access channel; the removal/fill permit will remain in effect through Project permitting. There is also a current ODEQ Air Contaminant Discharge Permit (ACDP) that requires modifications to reflect the optimized design. The Project will not otherwise rely on permits or approvals obtained in connection with the previously proposed import facility or export facility.

JCEP has actively participated in the Waterway Suitability Assessment ("WSA") process with the USCG to ensure that the LNG Terminal is in full compliance with all safety and security regulations applicable to LNG carrier transits and the WSA will be updated via the annual update process to reflect the changes discussed in Section 1.3.6.8. In connection with the import facility, JCEP had submitted to the USCG a Letter of Intent ("LOI") pursuant to 33 CFR §127.007, and its preliminary WSA, as required by the Commission's regulations (18 CFR § 157.21(a)(1) and (d)(12)). The USCG issued a WSR and an LOR for the Federal Navigation Channel, finding that the channel can be made suitable for LNG marine traffic if a number of conditions are met. In connection with the export facility proposal, JCEP notified the USCG Captain of the Port that any changes created by the Project would be addressed in the annual

WSA update. The Captain of the Port affirmed this approach and requested that the LOI, the WSA, and the Emergency Response Plan be amended to reflect any design changes or updates to the Project. The WSA for the year 2012 was updated to provide for the loading of LNG at the LNG Terminal. The LOI likewise was updated. Copies of the LOI Update, and all related correspondence with USGG were filed with FERC on January 23, 2017 as part of the Request for Approval of Pre-Filing Review; however, as stated in the correspondence, the WSA and its transmittal are considered to be Security Sensitive Information and therefore have been submitted solely to the USCG.

Approved permits and related agency communications are included as appendices to Resource Report 8 – Land Use, Recreation and Aesthetics. Moving forward, permit applications and agency correspondence will by heavily informed and influenced by past work on the export project. In some cases, agency communications have been ongoing. Specifically, communications with the NMFS regarding the Kentuck Project have continued, and JCEP will continue to engage with other agencies such as ODSL, USACE, NMFS, and ODEQ regarding permit applications.

Major permit and approval actions for the LNG Terminal involving multiple regulatory agencies will include environmental reviews by the FERC for authorization of the LNG Terminal under Section 3 of the NGA, the USACE for permits in or affecting navigational water, discharges of dredged or fill material, and occupation or alterations of civil works projects, the NMFS and FWS for a Biological Opinion under the Endangered Species Act, NMFS for the Marine Mammal Protection Act authorization, the Oregon DLCD for a coastal zone management consistency determination, the ODSL for an Oregon Removal/Fill Law permit, and the ODEQ for an Air Quality Permit, and Water Discharge and Water Quality Permit.

1.8.1.1 Affected Landowners

Property owners within both a one-half-mile radius and a one-mile radius of the LNG Terminal site (defined as the distance from the center of the southernmost LNG storage tank) have been notified.

All of the activities associated with the LNG Terminal will occur on land owned by Fort Chicago LNG II U.S. L.P., an affiliate of JCEP or land leased from adjacent landowners. Adjacent landowners—Oregon International Port of Coos Bay, Roseburg Forest Products Company, Weyerhaeuser NR Company, ODSL, Oregon Dunes National Recreation Area, and the U.S. Bureau of Land Management were contacted. The names and mailing addresses of landowners within both a one-half-mile and a one-mile radius of the Project site are listed in Appendix A.1 (to be submitted in a subsequent filing).

Landowners adjacent to remote Sites (e.g. park and ride facilities) will be contacted once JCEP have secured lease agreements.

1.9 NON-JURISDICTIONAL FACILITIES

The siting, construction, and operation of the LNG Terminal involves facilities that do not fall under the Commission's jurisdiction. These include the SORSC and Fire Department, communication lines and utility connections, and LNG vessel traffic.

Under certain circumstances, non-jurisdictional facilities may be subject to FERC's environmental review. In making this determination, FERC requires applicants to address four factors that indicate the need for FERC to do an environmental review of project-related non-jurisdictional facilities. These factors include:

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1. Whether or not the regulated activity comprises "merely a link" in a corridor-type project (such as a transportation or utility transmission project);
2. Whether there are aspects of the non-jurisdictional facility in the immediate vicinity of the regulated activity that affect the location and configuration of the regulated activity;
3. The extent to which the entire project will be within FERC's jurisdiction; and
4. The extent of cumulative federal control and responsibility.

Analysis of the factors listed above weighs against the FERC treating the SORSC and Fire Department, communication lines and utility connections, and LNG vessel traffic as a jurisdictional component of the LNG Terminal.

1.9.1 LNG Carriers

LNG to be exported from the LNG Terminal to overseas markets would be transported in carriers specially designed and built for that task. JCEP expects that its LNG Terminal would be visited by about 110 to 120 LNG carriers per year. These carriers, chartered by JCEP's customers, would be loaded with LNG at the LNG Terminal and would deliver the cargo to overseas markets. LNG carriers would be under the ownership and control of third parties, not JCEP, and would not be regulated by the FERC. As per JCEP agreements with its customers, the third-party owners and operators of the LNG carriers calling at the LNG Terminal would have to comply with U.S. regulatory requirements governing LNG carriers and with JCEP's terminal regulations and requirements in order to be granted access to the Port and to JCEP's LNG Terminal. Although JCEP does not currently have any information about the exact LNG carriers that would be used to transport the LNG from the LNG Terminal, the current USCG WSR and LOR limit the size of LNG carriers that would call at the LNG Terminal to carriers of approximately 950 feet in length, 150 feet in breadth, and 40 feet loaded drafts (nominal 148,000 m^3 capacity). Neither the exact destinations for the LNG cargo nor the specific routes across the Pacific Ocean to customers that would be taken by LNG carriers are known, outside of the waterway within 12 miles of the Oregon Coast.

1.9.2 Southwest Oregon Regional Safety Center (SORSC)

JCEP will construct a building dedicated to managing safety and security in the event of emergencies for incident management and response known as the SORSC. The SORSC will be home to:

- Jordan Cove Security Center
- Coos County Dispatch Center
- Coos County Emergency Operations Center
- Offices for various businesses and agencies

The SORSC will be located adjacent to the LNG Terminal administration building on the South Dunes Site. Although this building does not come under the jurisdiction of the FERC, this environmental report analyzes potential impacts resulting from its construction.

1.9.3 Fire Department

JCEP will construct a standalone Fire Department building to be located in the Access and Utility Corridor adjacent to the LNG Terminal fire water tanks. The Fire Department will house Jordan Cove Fire Department chief and staff. Electric power for operation of the Fire Station will be provided from the LNG Terminal. Although this building does not come under the jurisdiction

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of the FERC, this environmental report analyzes potential impacts resulting from its construction.

1.9.4 Utilities

Various communication and utility connections, abandonments, and relocations, which do not come under the jurisdiction of the FERC, will be necessary to support the construction and operation of the LNG Terminal, SORSC, and Fire Department. Associated construction activities that will occur within the proposed LNG Terminal or within the existing easements located on both sides of TPP from South Dunes to the Lagoon site are included in discussions of temporary impacts within this environmental report.

Electrical power for LNG Terminal temporary construction activities and for permanent operation of the SORSC will be provided by the local distribution company (PacifiCorp) through a connection to an existing powerline located adjacent to the TPP southwest of Ingram Yard.

Three communication connections, from existing networks, will be required to support the operation of the LNG Terminal, Fire Department, and SORSC. One fiber optic connection will be provided by ORCA Communications; one fiber optic connection will be provided by LS Networks; and one telecommunications connection will be provided by Frontier. An existing Frontier telecommunications cable will be relocated from the proposed LNG Terminal site to easements along the TPP for subsequent tie-in to the LNG Terminal, SORSC, and Fire Department. In addition, an existing ORCA fiber optic cable that is currently located aboveground along TPP will be relocated underground within an easement along TPP for subsequent tie-in to the LNG Terminal, SORSC, and Fire Department. The LS networks cable will be extended from Hauser along US 101 and TPP to the Terminal Site.

Portions of existing CBNBWB potable water and raw water pipelines will be relocated to easements along the TPP or abandoned in place (see Figure 1.3-1) in order to construct the LNG Terminal. In addition, an interconnect to an existing CBNBWB potable water pipeline will be used for all normal operational water needs in the LNG Terminal, SORSC, and Fire Department, as well as most construction water needs. The tie-point to the 12-inch diameter potable water pipeline will be located near the north-west corner of the LNG Terminal along the south side of the TPP. A connection to an existing CBNBWB 8-inch diameter raw water pipeline will also be used for construction water, including LNG tank hydrotesting. The raw water pipeline tap, to be located near the north-west corner of the LNG Terminal on the north side of the TPP, will remain connected after construction, but there are no normal operational uses anticipated for this raw water supply.

Portions of the existing IWWP will be relocated or abandoned in place (see Figure 1.3-1) in order to construct the LNG Terminal. Currently, the IWWP carries water from the two existing bio-solids ponds to the existing ocean outfall via the Lagoon site that is northwest of the proposed LNG Terminal. Occasionally the water passing through the IWWP is supplemented by water purchased from CBNBWB to maintain permitted pH levels in the Lagoon system and ensure the ocean outfall remains open. The IWWP will be relocated to an easement along TPP to connect the Lagoon site to both Ingram Yard and South Dunes Site. Several connections will be made to the relocated IWWP to serve LNG Terminal construction and LNG Terminal, SORSC, and Fire Department operation.

All proposed permanent and temporary utility connections are detailed in Figure 1.9-1 (to be provided in subsequent filing).

1.10 CUMULATIVE IMPACT ANALYSIS

The Cumulative Impact Analysis for the Project (LNG Terminal and Pipeline) is provided in Appendix B.1.

1.11 REFERENCES

Coast and Harbor Engineering. 2017. Tsunami Hydrodynamic Modelling Coast and Harbor Engineering.

Coast and Harbor Engineering. 2011. Technical Report – DRAFT Volume 3 – Jordan Cove Terminal and Access Channel, Sedimentation and Maintenance Dredging Requirements.

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U.S. Energy Information Administration (USEIA). 2016. Annual Energy Outlook 2016 with Projections to 2040. August 2016. Washington, D.C.

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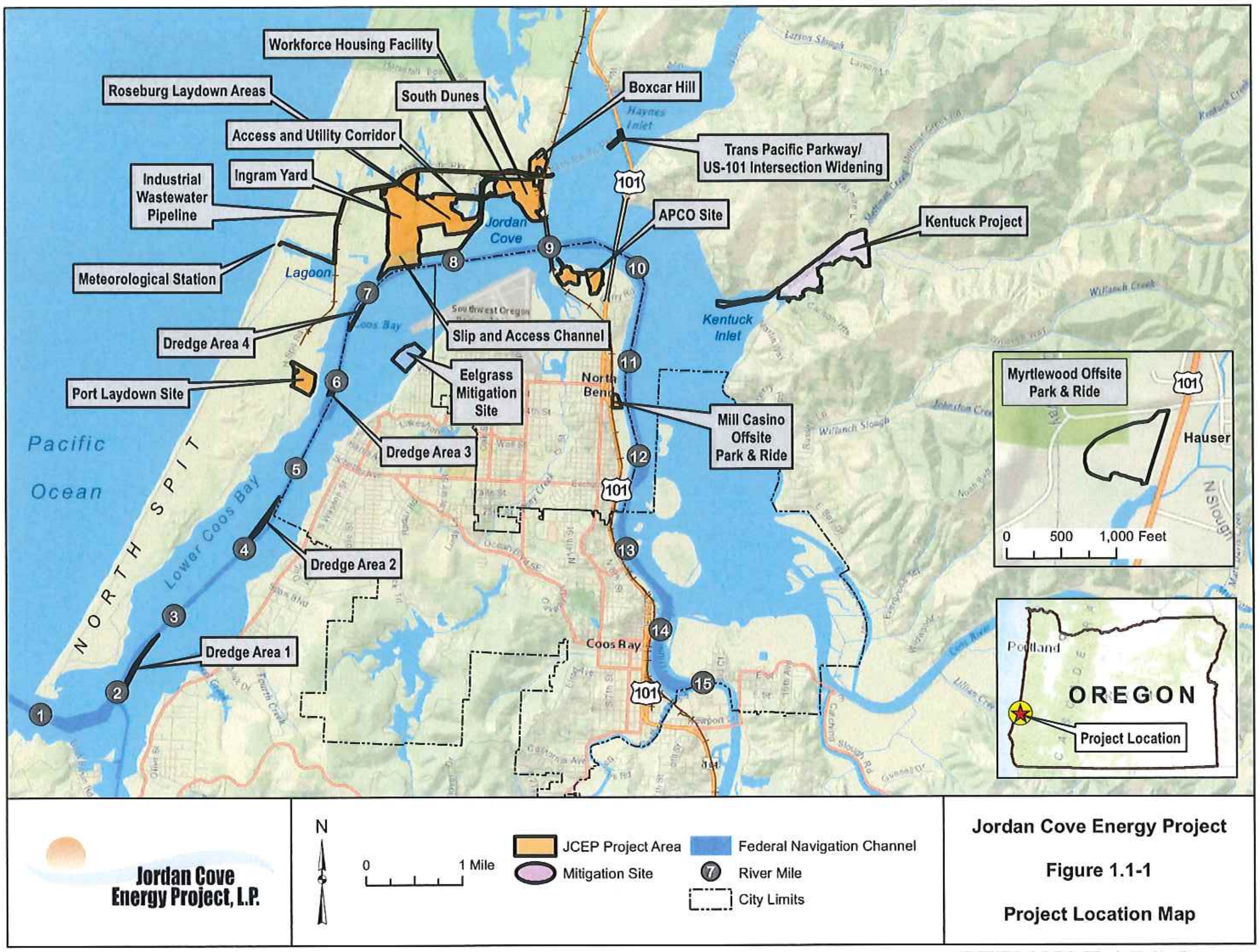
FIGURES

Figure 1.1-1
Project Location Map



Jordan Cove Energy Project

Figure 1.1-1

Project Location Map

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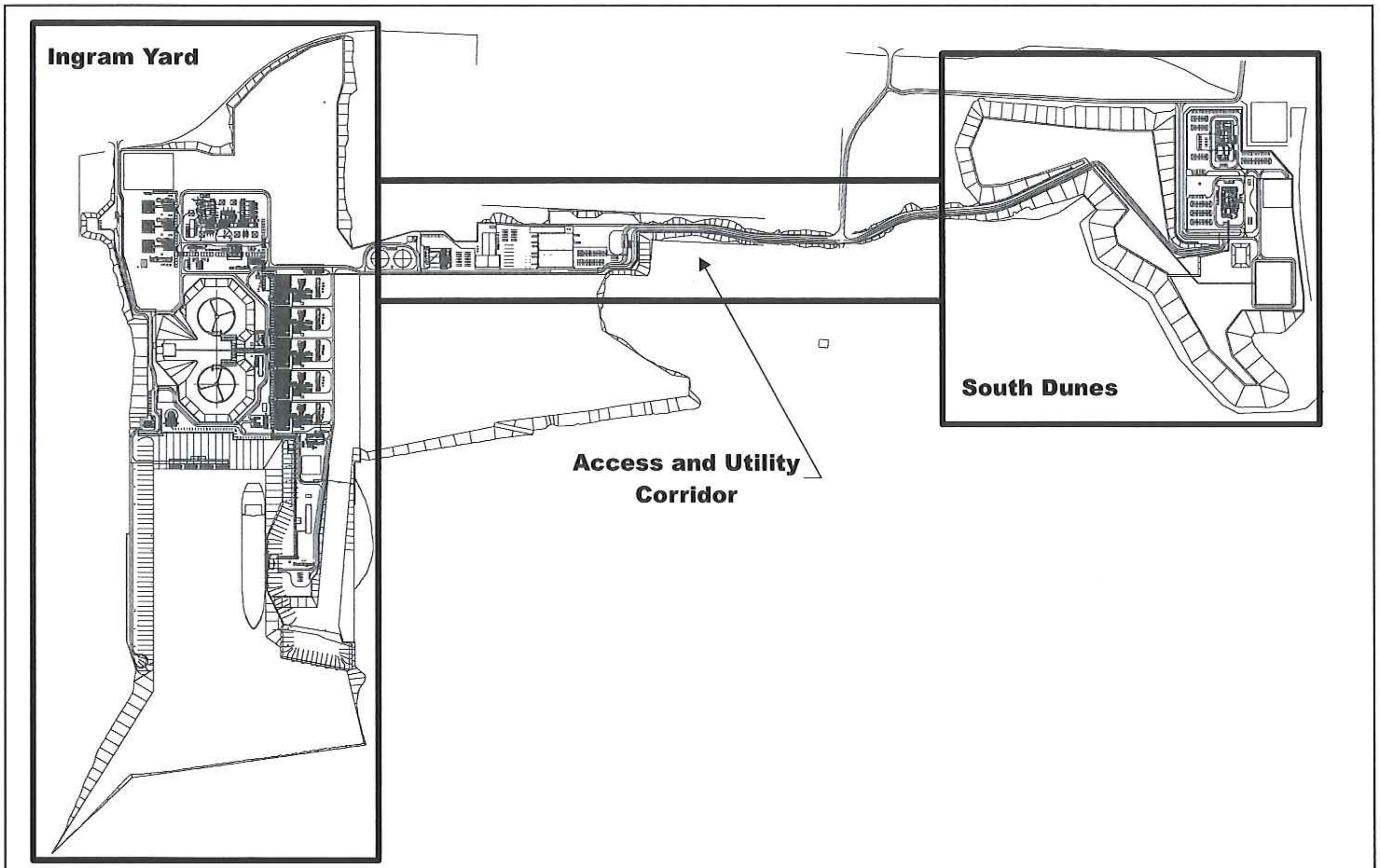
Figure 1.1-2

Plot Plan of the LNG Terminal



Jordan Cove Energy Project, L.P.

N

0 0.1 0.2 Miles

Jordan Cove Energy Project

Figure 1.1-2

Plot Plan of the LNG Terminal Site

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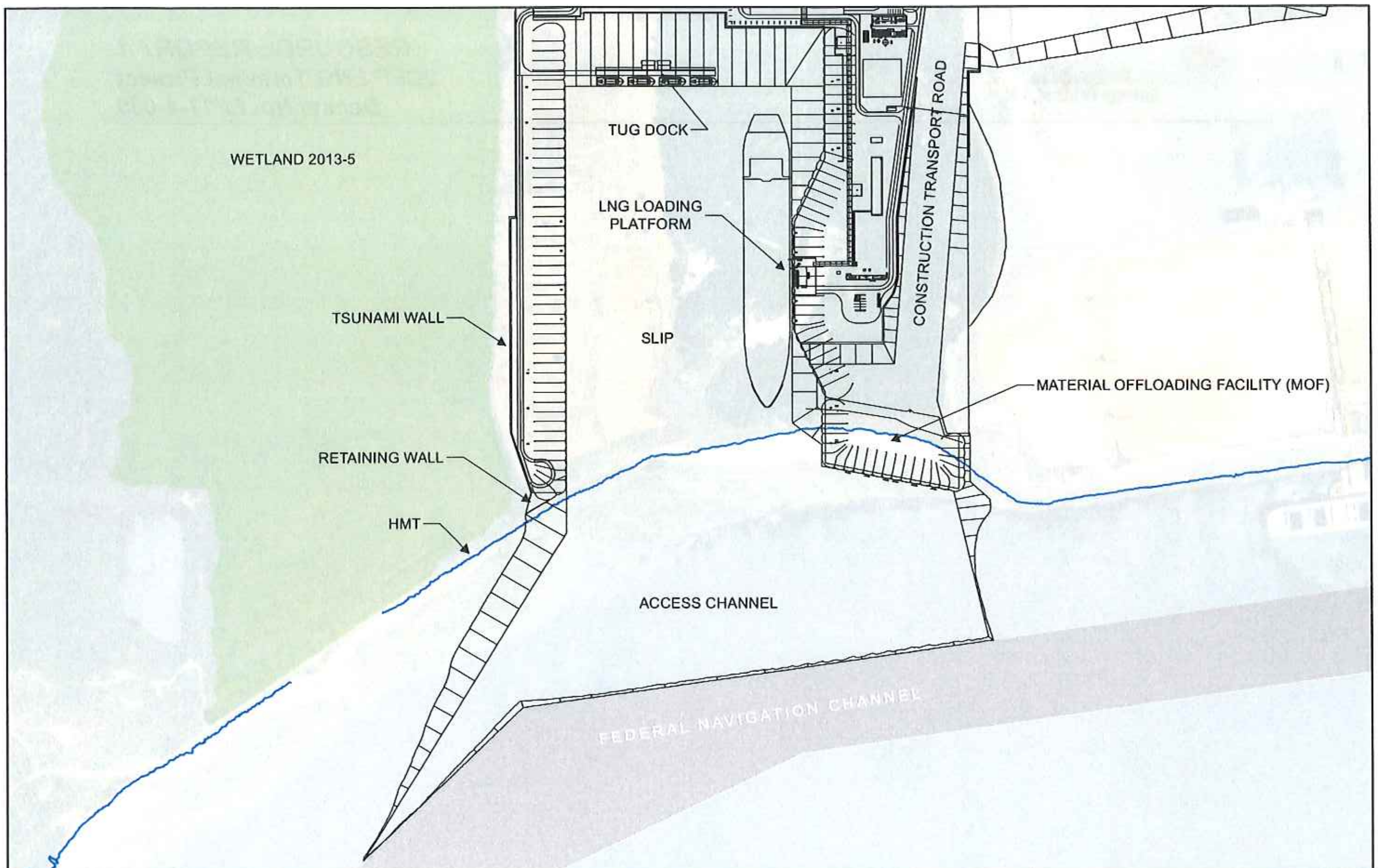
Figure 1.1-3
Plot Plan of Marine Facilities



Jordan Cove Energy Project, L.P.

N

0 250 500 Feet

Federal Navigation Channel

Highest Measured Tide (HMT) (10.26 ft NAVD88)

Delineated Wetland

Jordan Cove Energy Project

Figure 1.1-3

Plot Plan of Marine Facilities

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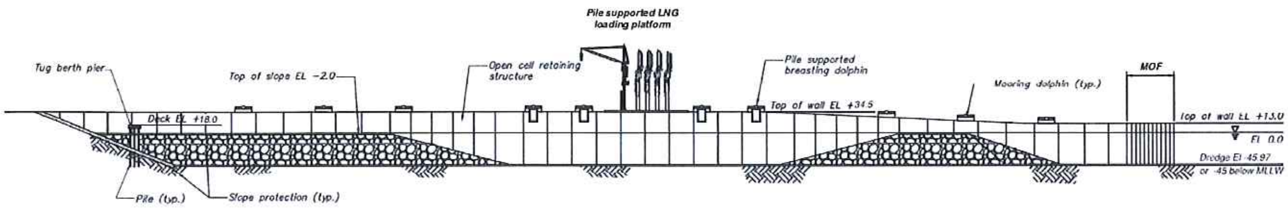
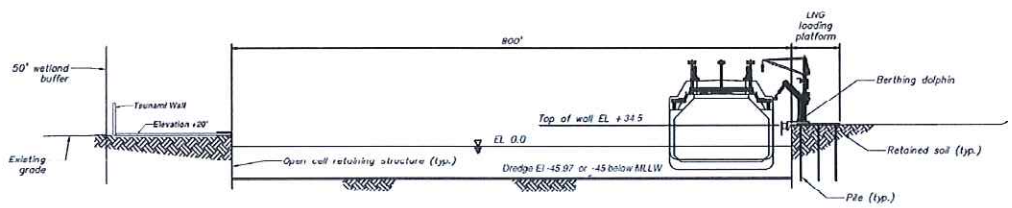
Figure 1.1-4
Marine Berth Elevation View





All elevations are to the NAVD88 datum

Jordan Cove Energy Project, L.P.	NOT TO SCALE	**Jordan Cove Energy Project** **Figure 1.1-4** **Marine Berth Elevation View**

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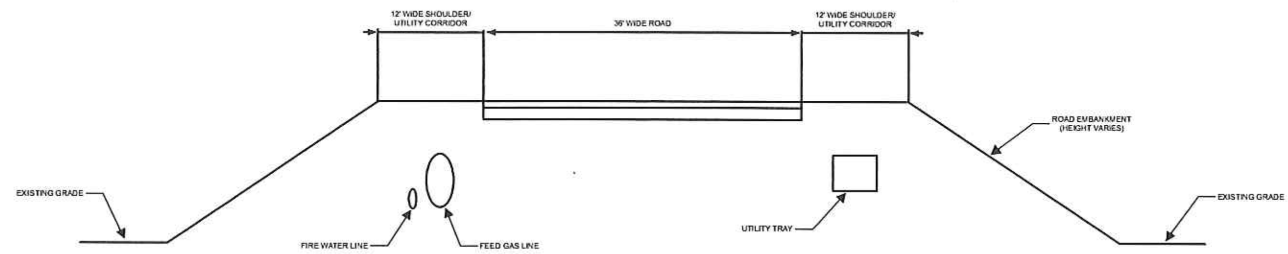
Figure 1.1-5

Cross Section Drawing of the Access and Utility Corridor



Jordan Cove Energy Project, L.P.	NOT TO SCALE	**Jordan Cove Energy Project** **Figure 1.1-5** **Cross Section Drawing of the Access and Utility Corridor**

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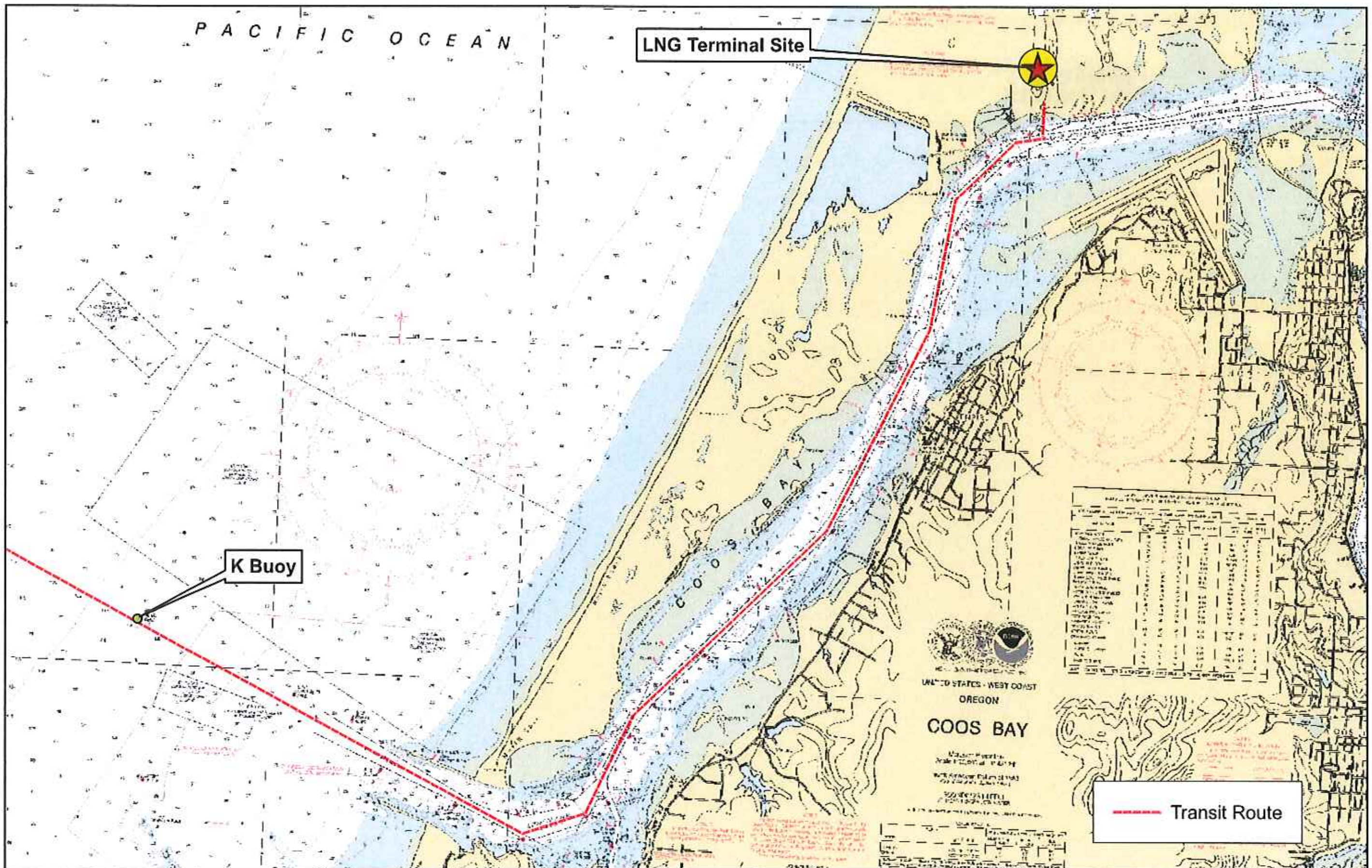
Figure 1.1-6
LNG Carrier Transit Route



Jordan Cove Energy Project, L.P.

Jordan Cove Energy Project

Figure 1.1-6

LNG Ship Transit Route

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Figure 1.2-1

Plot Plan of the Construction Facilities

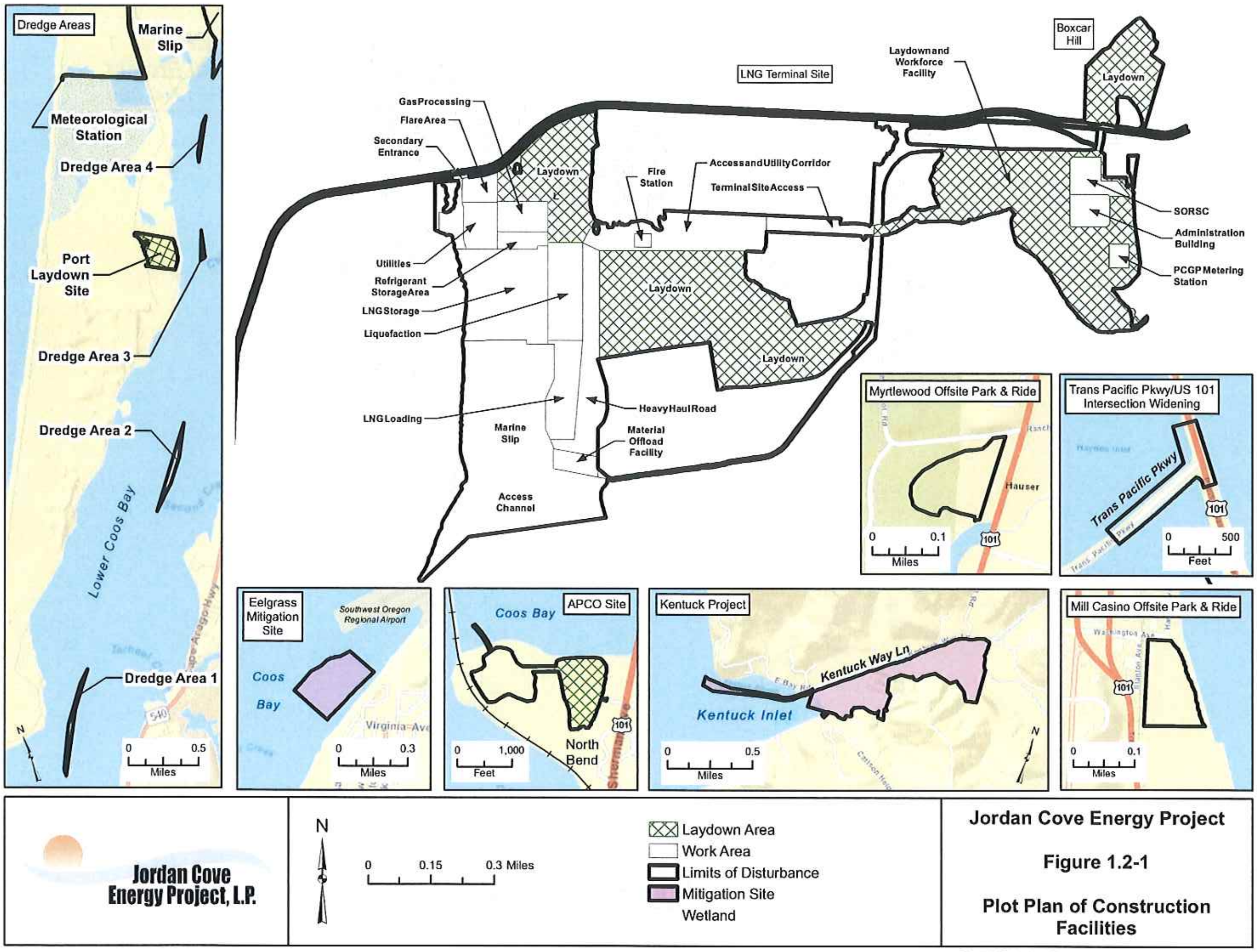

Figure 1.2-1

Plot Plan of Construction Facilities

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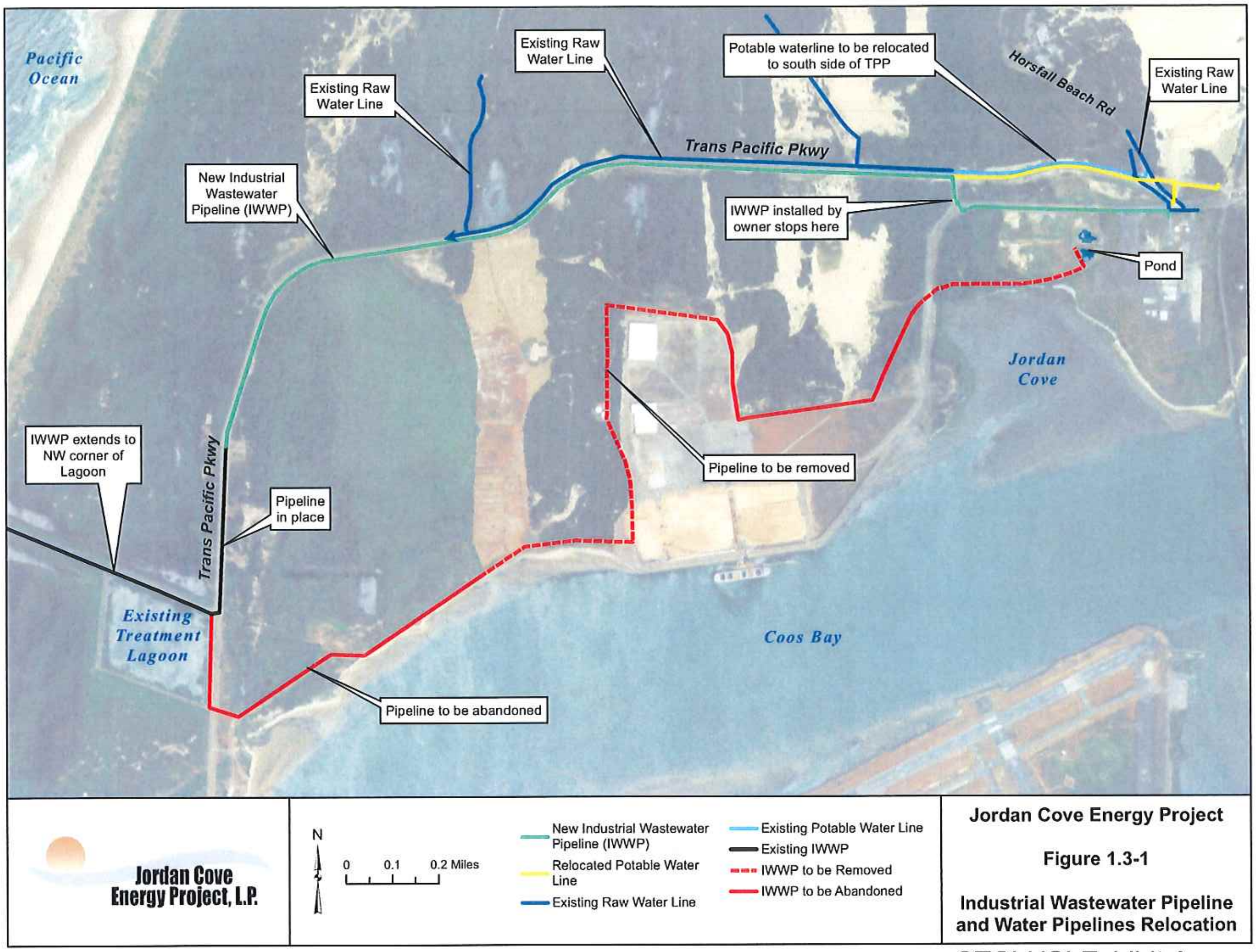
Figure 1.3-1

Industrial Wastewater Pipeline and Water Pipelines Relocation



Jordan Cove Energy Project

Figure 1.3-1

Industrial Wastewater Pipeline and Water Pipelines Relocation

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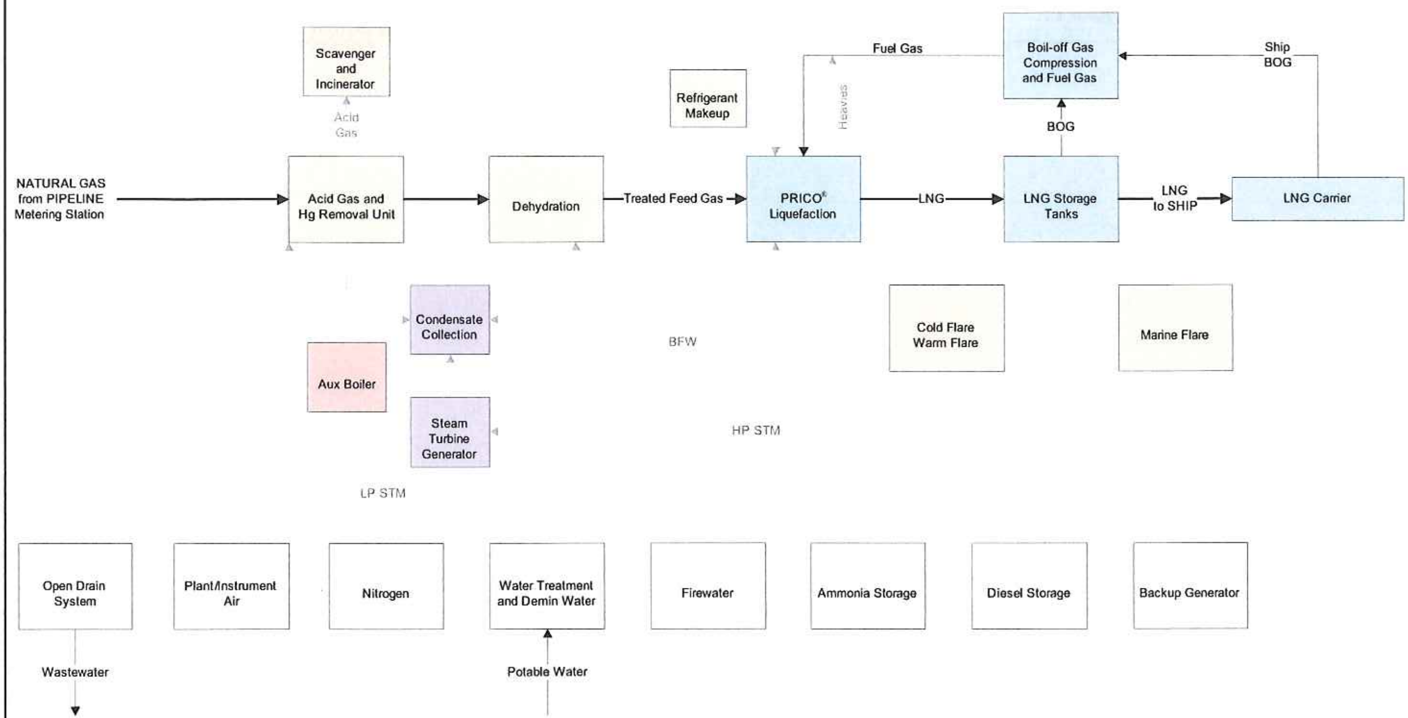
Figure 1.3-2
Block Flow Diagram



Jordan Cove Energy Project, L.P.

Jordan Cove Energy Project

Figure 1.3-2

Block Flow Diagram

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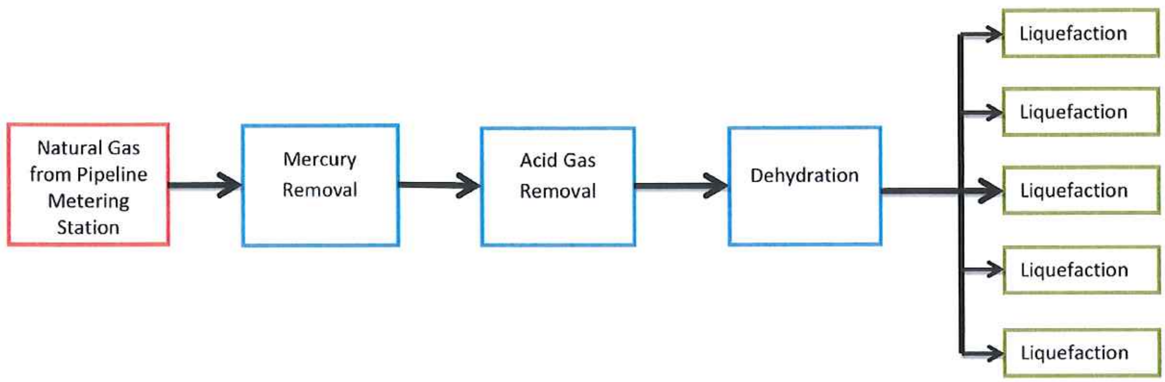
Figure 1.3-3

Gas Conditioning Train



Jordan Cove Energy Project, L.P.

Jordan Cove Energy Project

Figure 1.3-3

Gas Conditioning Train

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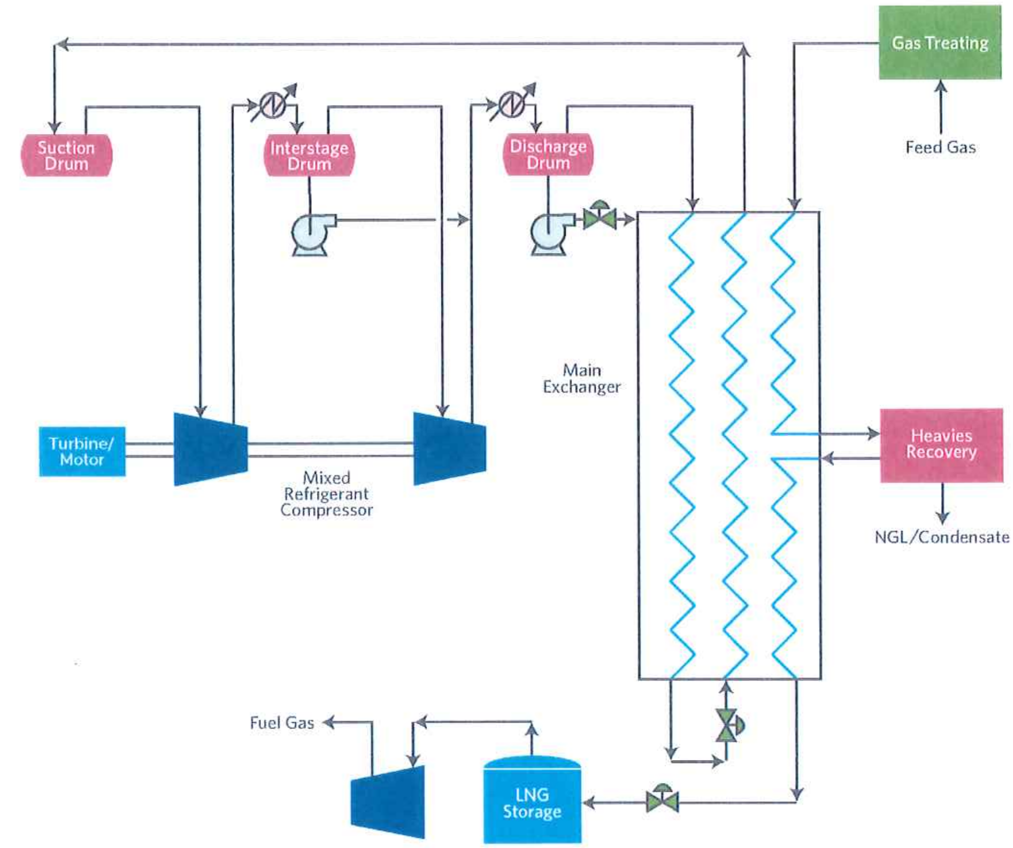
Figure 1.3-4
PRICO LNG Process



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Jordan Cove Energy Project

Figure 1.3-4

PRICO LNG Process

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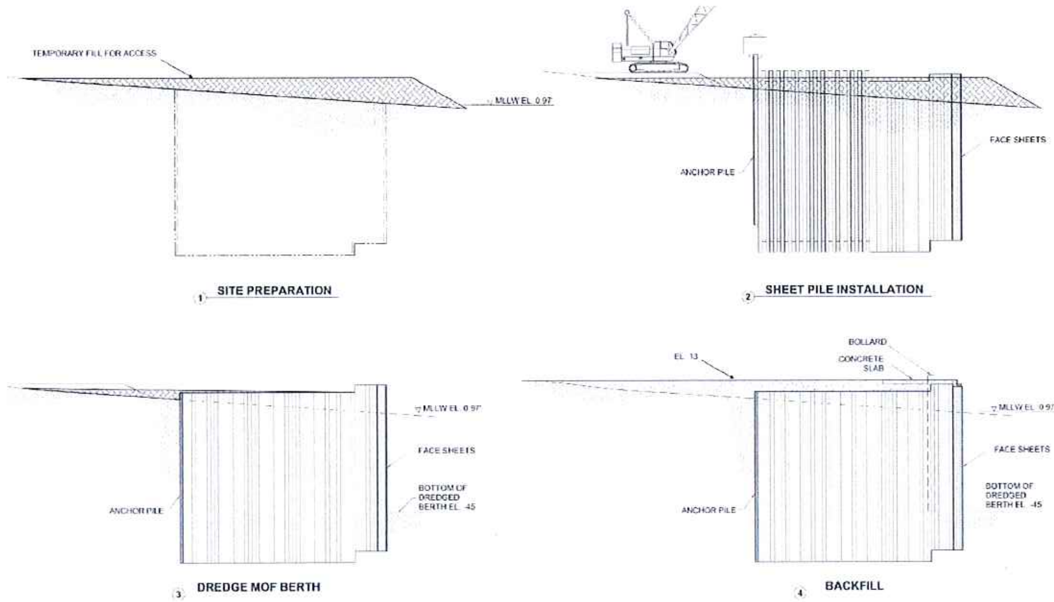
Figure 1.5-1
MOF Construction



Jordan Cove Energy Project, L.P.		**Jordan Cove Energy Project** **Figure 1.5-1** **MOF Construction**

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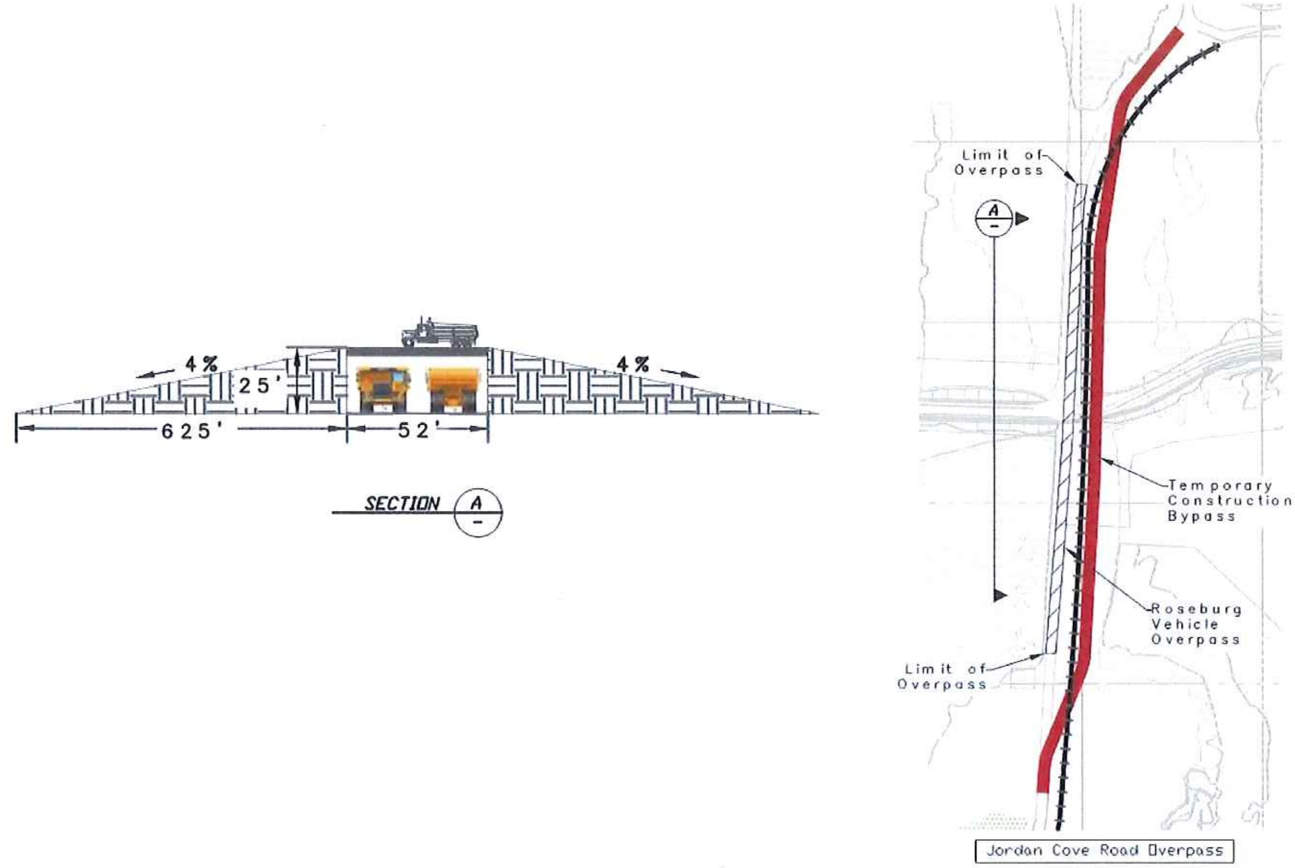
Figure 1.5-2
Earthwork Traffic Segregation



Jordan Cove Energy Project, L.P.

Jordan Cove Energy Project

Figure 1.5-2

Earthwork Traffic Segregation

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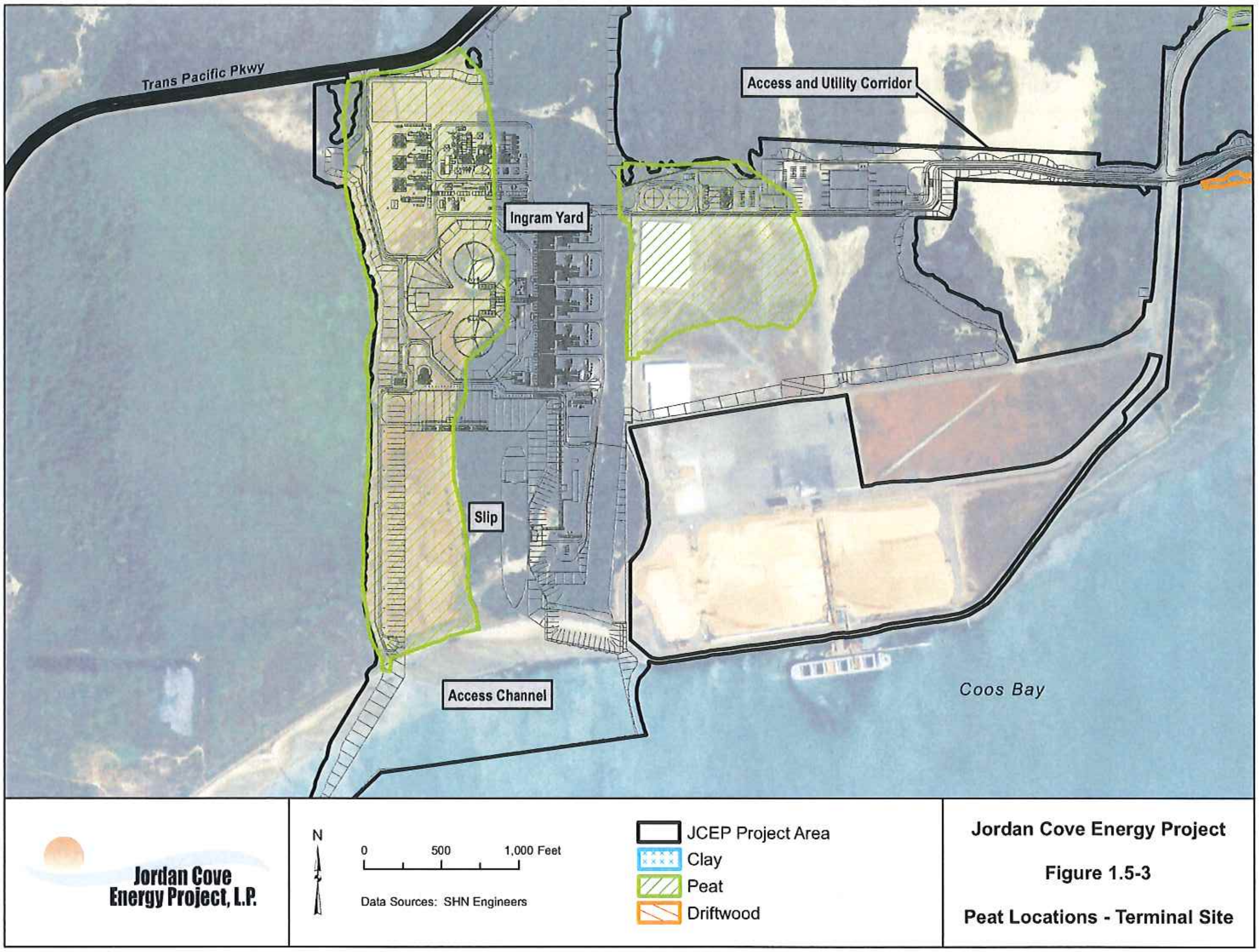
Figure 1.5-3
Peat Location – Terminal Site



Jordan Cove Energy Project, L.P.

Jordan Cove Energy Project

Figure 1.5-3

Peat Locations - Terminal Site

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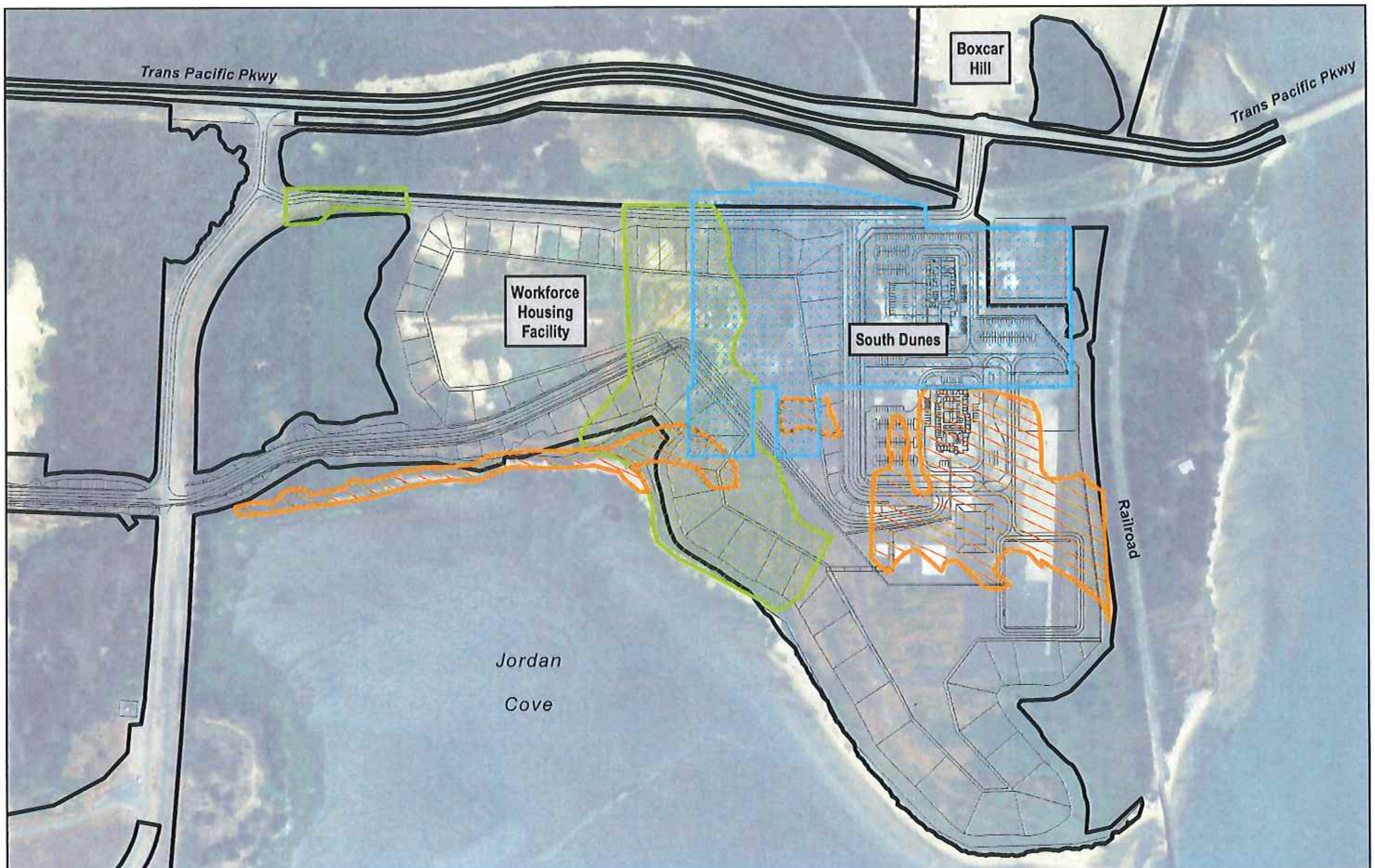
Figure 1.5-4

Peat, Driftwood, and Clay Locations – South Dunes



Jordan Cove Energy Project, L.P.

N

0 250 500 Feet

Data Sources: SHN Engineers

JCEP Project Area
Clay
Peat
Driftwood

Jordan Cove Energy Project

Figure 1.5-4

Peat, Driftwood, and Clay Locations - South Dunes

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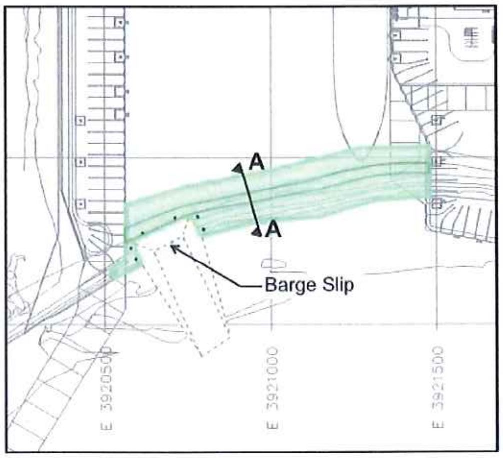
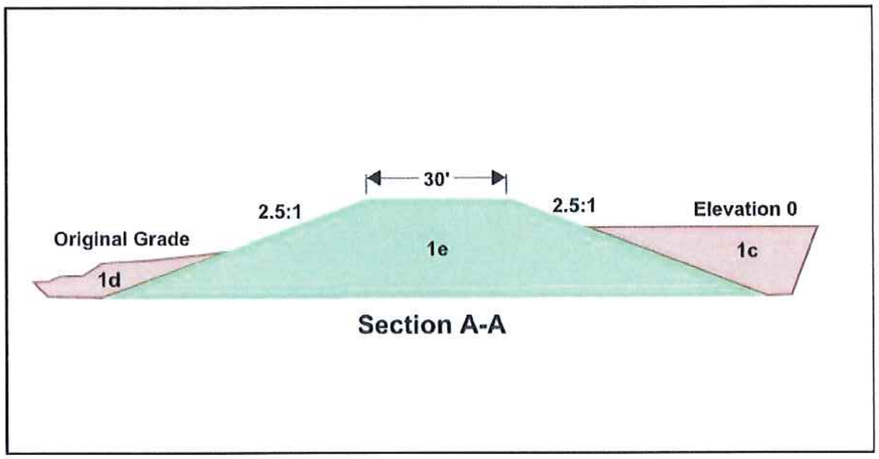
Figure 1.5-5

Conceptual Layout of Slip Construction Berm





Jordan Cove Energy Project, L.P.	NOT TO SCALE	Jordan Cove Energy Project Figure 1.5-5 Conceptual Layout of Slip Construction Berm

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Figure 1.5-6
Installation of Roof Petals

Jordan Cove Energy Project, L.P.

Jordan Cove Energy Project, L.P.		**Jordan Cove Energy Project** **Figure 1.5-6** **Installation of Roof Petals**

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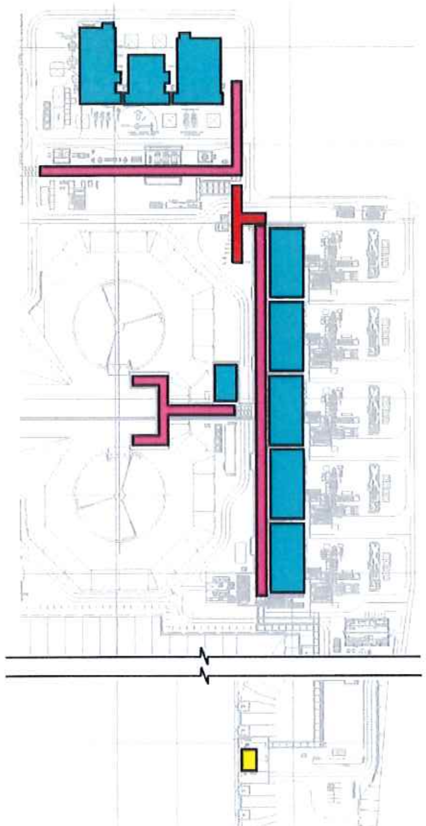
Figure 1.5-7

Example of Module Installation Phasing



Module Sequence Phase I:
Pipe rack modules in Liquefaction, Tank, Utility & Refrigerant Make-up areas installed.

Module Sequence Phase II:
LNG Loadout Module installed at Marine Berth

Module Sequence Phase III:
Equipment Modules installed starting with LNG Loadout Module, continued by the Liquefaction Train Modules with the Gas Conditioning modules alternating in.

Module Sequence Phase IV:
Remaining Pipe Rack modules installed at intersection

Jordan Cove Energy Project, L.P.	NOT TO SCALE	**Jordan Cove Energy Project** **Figure 1.5-7** **Example of Module Installation Phasing**

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Figure 1.5-8

Workforce Housing Facility – South Dunes

(to be provided in subsequent filing)

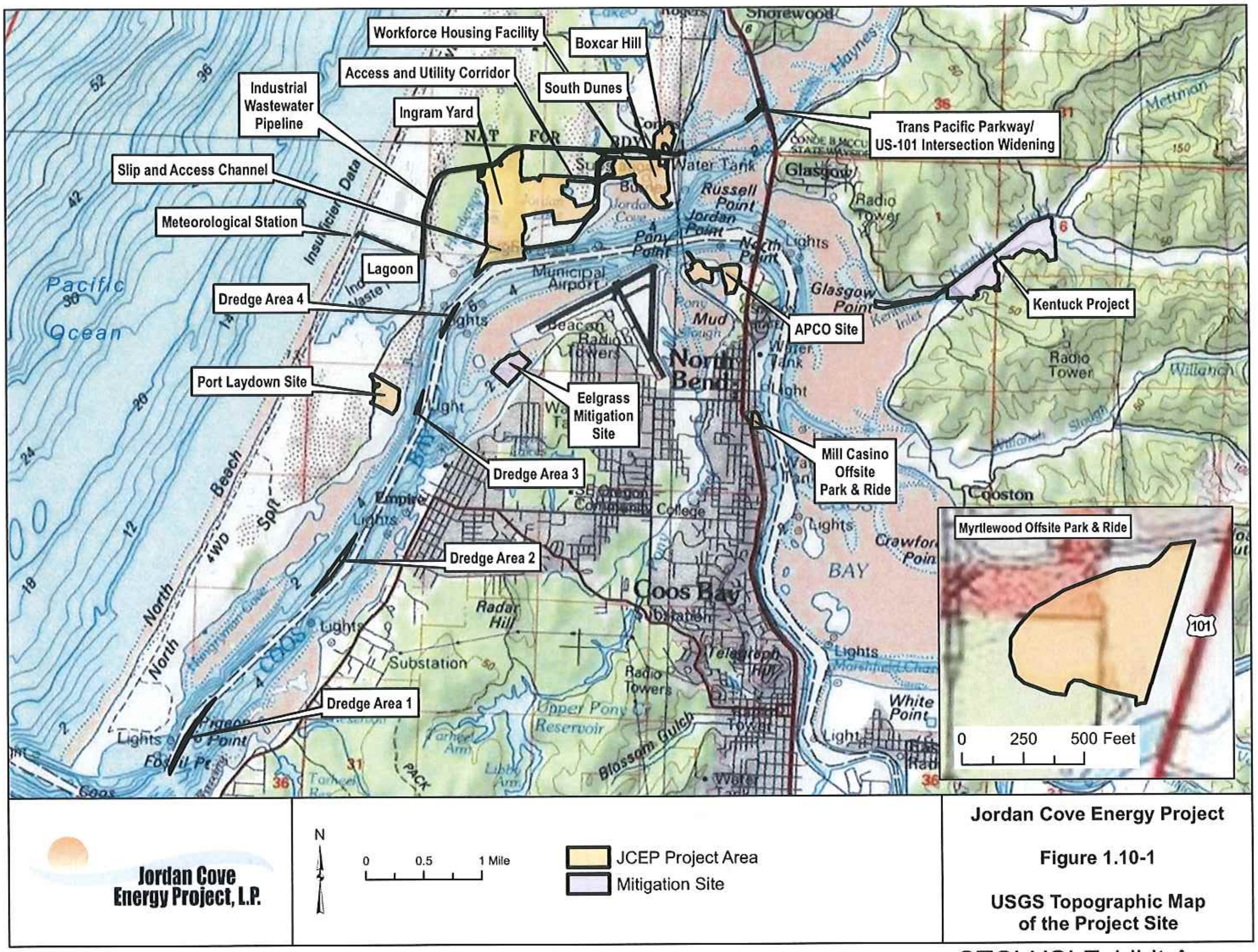
Figure 1.9-1

Proposed utility connections

(to be provided in subsequent filing)

Figure 1.10-1

USGS Topographic Map of the JCEP LNG Terminal Project Site



Jordan Cove Energy Project

Figure 1.10-1

USGS Topographic Map of the Project Site

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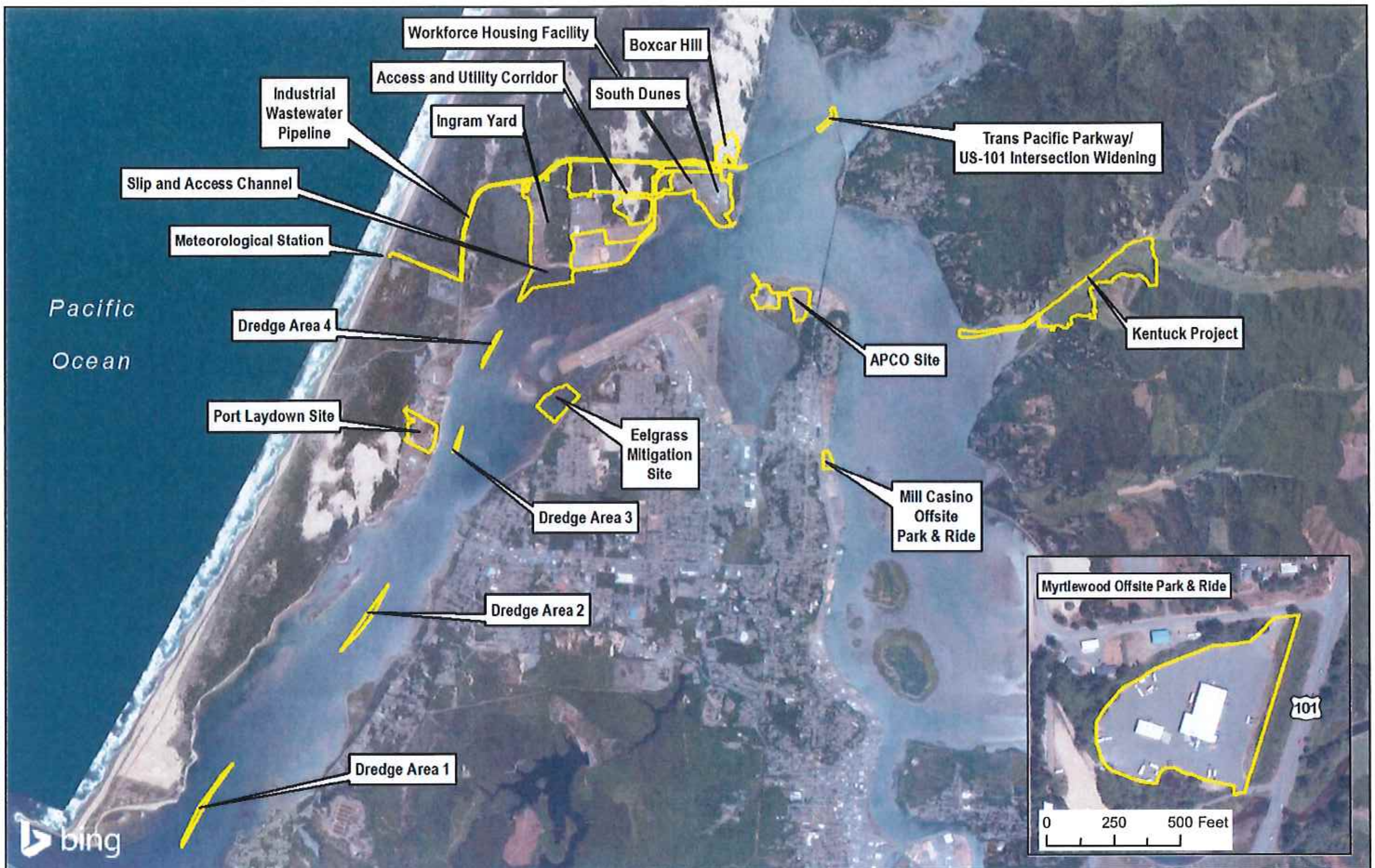
Figure 1.10-2

Aerial Photography of the JCEP LNG Terminal Project Site



Jordan Cove Energy Project, L.P.	N 0 0.5 1 Mile JCEP Project Area Data Source: ArcGIS Bing Aerial Imagery	**Jordan Cove Energy Project** **Figure 1.10-2** **Aerial Photography of the Project Site**

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APPENDICES

APPENDIX A.1

Landowner List

(to be provided in subsequent filing)

APPENDIX B.1
Cumulative Impact Analysis

Jordan Cove Energy Project, L.P.

Pacific Connector GAS PIPELINE

Appendix B.1

Draft Cumulative Impact Analysis

Jordan Cove Energy Project and Pacific Connector Gas Pipeline

July 2017

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APPENDIX B.1
DRAFT CUMULATIVE IMPACT ANALYSIS

CONTENTS

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APPENDIX B.1
DRAFT CUMULATIVE IMPACT ANALYSIS

CONTENTS (CONTINUED)

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APPENDIX B.1

DRAFT CUMULATIVE IMPACT ANALYSIS

CONTENTS (CONTINUED)

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APPENDIX B.1

DRAFT CUMULATIVE IMPACT ANALYSIS

CONTENTS (CONTINUED)

TABLES

FIGURES

APPENDIX B.1

DRAFT CUMULATIVE IMPACT ANALYSIS

CONTENTS (CONTINUED)

Attachments

APPENDIX B.1
DRAFT CUMULATIVE IMPACT ANALYSIS

ACRONYMS

APE	area of potential effect
BLM	U.S. Department of the Interior Bureau of Land Management
BMP	best management practice
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
Commission	Federal Energy Regulatory Commission
ECRP	Erosion Control and Revegetation Plan
EPA	U.S. Environmental Protection Agency
ESCP	Erosion and Sedimentation Control Plan
FERC	Federal Energy Regulatory Commission
FWS	U.S. Department of the Interior Fish and Wildlife Service
HDD	horizontal directional drill
HUC	Hydraulic Unit Code
JCEP	Jordan Cove Energy Project, L.P.
LNG	Liquefied natural gas
LRMP	Land and Resource Management Plan
MAMU	marbled murrelet
MOA	Memorandum of Agreement
NEPA	National Environmental Policy Act
NFS	National Forest System
NOAA	National Oceanic and Atmospheric Administration

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RESOURCE REPORT 1
GENERAL PROJECT DESCRIPTION

ACRONYMS (Continued)

NRHP	National Register of Historic Places
NSO	northern spotted owl
ODEQ	Oregon Department of Environmental Quality
ORS	Oregon Revised Statutes
PCGP	Pacific Connector Gas Pipeline, LP
PCT	Pacific Crest Trail
Plan	FERC's Upland Erosion Control, Revegetation, and Maintenance Plan
Procedures	FERC's Upland Plan and Wetland and Waterbody Procedures
Project	Pipeline and LNG Terminal
RMP	Resource Management Plan
RV	recreational vehicle
SONCC	Southern Oregon/Northern California Coast
SPCC Plan	Spill Prevention, Containment, and Countermeasures Plan
USACE	U.S. Army Corps of Engineers
USFS	U.S. Forest Service

APPENDIX B.1
DRAFT CUMULATIVE IMPACT ANALYSIS

1.0 INTRODUCTION

Jordan Cove Energy Project, L.P. ("JCEP") is seeking authorization from the Federal Energy Regulatory Commission ("FERC" or "Commission") to site, construct, and operate a natural gas liquefaction and liquefied natural gas ("LNG") export facility ("LNG Terminal"), located on the bay side of the North Spit of Coos Bay, Oregon. Concurrently, Pacific Connector Gas Pipeline, LP ("PCGP") is proposing to construct and operate a new approximately 229-mile-long, 36-inch-diameter natural gas transmission pipeline from interconnections with the existing Ruby Pipeline LLC and Gas Transmission Northwest LLC system near Malin, Oregon to the LNG Terminal ("Pipeline", and collectively with the LNG Terminal, the "Project").

The purpose of this analysis is to describe cumulative impacts that may result from the Project. Cumulative impacts, or effects, are defined as "the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such actions" (40 Code of Federal Regulations ["CFR"] Part 1508.7). Although the individual impact of each separate project may be minor, the additive or synergistic effects of multiple projects could be significant. This analysis includes:

- the basis for the assessment, including the regulatory framework, the list of potentially relevant actions, and the process and criteria used in selecting relevant actions for this evaluation;
- the potential cumulative effects associated with the proposed action when considered together with the relevant past, present, and reasonably foreseeable actions; and
- the conclusions reached in this evaluation.

Based on the regulatory framework and the assessment area, and input from external parties such as local governments, The Confederated Tribes of Coos, Lower Umpqua and Siuslaw Indians, the Coquille Indian Tribe, the Cow Creek Band of Umpqua Tribe of Indians, the Confederated Tribes of the Grande Ronde, the Klamath Tribes and the Confederated Tribes of Siletz Indians (collectively referred to as "Tribes"), and land management agencies, a cumulative impact analysis was conducted for the resources that would be potentially impacted by the Project. The conclusions reached in each of those analyses are presented here. This appendix also addresses the cumulative effects of mitigation projects associated with the U.S. Department of the Interior Bureau of Land Management ("BLM") and U.S. Forest Service ("USFS") land management plan amendments.

[Pending information from BLM and USFS, to be included in a subsequent submittal.]

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2.0 BASIS FOR ASSESSMENT

2.1. REGULATORY FRAMEWORK

This evaluation of potential cumulative impacts is consistent with the following regulations and guidance:

- Council on Environmental Quality ("CEQ") *Regulations for Implementing the Procedural Provisions of the National Environmental Policy Act* (40 CFR Part 1500-1508, 1978 as amended) (CEQ 1986);
- U.S. Environmental Protection Agency's ("EPA") *Procedures for Implementing the Requirements of the Council on Environmental Quality on the National Environmental Policy Act* (40 CFR Part 6 [2009]);
- CEQ's *Considering Cumulative Effects under the National Environmental Policy Act ("NEPA")* (January 1997) (CEQ 1997);
- EPA's *Consideration of Cumulative Impacts in EPA Review of NEPA Documents*, EPA315-R-99-002 (May 1999); and
-
- FERC's *Guidance Manual for Environmental Report Preparation, Volume 1* (February 2017) (2017 FERC Manual).

2.2. PAST ACTIONS THAT CONTRIBUTED TO THE CURRENT ENVIRONMENTAL BASELINE

Existing environmental conditions in the Project area (generally including the environments that would be affected by the proposed LNG Terminal and Pipeline) reflect extensive changes to natural resources brought about by past human activities. Native Americans have resided in Oregon for many thousands of years and their activities have modified the environment, such as using fire to burn brush and create meadows. European-American settlement of Oregon beginning in the 19^{th} century continued these changes in the affected environment.

In 1850, there were about 432,808 acres of farmland in Oregon. By 1954, that increased to 21 million acres. The number of farms in the state peaked at 65,000 by 1935. In 2012, 16.3 million acres in Oregon were used for agriculture, with 35,439 farms (Ballard 1959; U.S. Department of Agriculture National Agricultural Statistics Service 2012). Table 2.2-1 shows the number of farms and farm acres in the counties crossed by the Project. Farming activities have modified the environment through land clearing and planting of non-native species.

Small agricultural villages evolved into market centers after they were connected by roads and railroads. By 1920, half of the state's population was considered to be urban. In 2014, about 576,000 acres of non-federal land was urban, and 1.3 million acres was in low-density residential use in Oregon (Letterman 2016).

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Oregon has lost an estimated 38 percent of its original wetlands (Morlan 2000). Most Oregon estuaries have been significantly altered historically, mostly through the diking and draining of marshes in the early to mid-1900s for agricultural use and urban development. Between 1870 and 1970, tidal wetlands within the Coos Bay estuary decreased an estimated 66 percent (Oregon Progress Board 2009).

Table 2.2-1
Farms in the Counties Crossed by the Project

County	Number of Farms	Land in Farms (acres)
Coos	654	157,496
Douglas	1,927	382,386
Jackson	1,722	214,079
Klamath	955	650,416
Four County Total	**5,258**	**1,404,377**

Source: U.S. Department of Agriculture National Agriculture Statistical Service (2012)

Cutting of forests in the region began with Euro-American settlement. Initially, forests in the valley floors were cleared to make way for agriculture. Lowland areas close to population centers were logged first, followed eventually by less accessible areas in more mountainous terrain.

Shortly after World War II, improvements in the gas-powered chain saw and transportation led to increased logging in the Pacific Northwest, with a shift to timber sales on federal lands. There was a boom in demand for wood products during the 1950s and 1960s, with a post-war need for framing lumber and plywood for new housing. More than 70 plywood plants opened in Oregon between 1940 and 1960, including plants in North Bend, Coos Bay, and Coquille. As timber was removed from private lands, proportionately more was cut on federal lands. In 1952, western Oregon's peak year for cutting timber, about one-third of the 10.4 billion board feet harvested came from federal lands. By 1963, more timber was cut on federal than private lands.

In 1994, the Northwest Forest Plan went into effect, protecting up to 80 percent of the remaining old growth forest on federal lands and setting a cap of harvest at 1.2 billion board feet, down 70 percent from 1970s levels. In Oregon, about 10.5 million acres of non-federal land was forested in 2014, a decrease of less than 2 percent from the amount of non-federal forested land in 1979 (Letterman 2016).

As a result of over a century of logging and fire control, the forests of the Pacific Northwest now comprise a mosaic of recent clear-cuts, thinned stands, and young plantations interspersed with uncut natural stands. The remaining natural stands range in age from greater than 1,000 years old to relatively young, even-aged stands that have regenerated following wildfires. Because wildfires and windstorms often kill only some of the trees in a stand, natural stands are frequently characterized by a mixture of trees that survived a catastrophic event and overstory. These stands are usually referred to as "old growth," "late successional," or "ancient" forests (FEMAT 1993). Stands having only scattered individuals or patches of large old trees and consisting of young or mature trees are referred to as "mixed age" or even "young." Mixed-age stands are particularly common in the Coast Range, where extensive fires occurred in the 1800s. Species associated with or dependent on these late-successional and old-growth forests, such as the northern spotted owl ("NSO") and marbled murrelet ("MAMU") have been negatively impacted by habitat loss.

Today, Oregon's environment reflects a mixture of natural processes and human influences across a range of conditions, from areas defined by relatively natural structures and functions to areas completely dominated by human activities (Oregon Progress Board 2000). Federal lands are managed today primarily for aquatic and terrestrial wildlife habitats, with emphasis on hazardous forest fuels reductions. In the past decade, large, stand-replacing wild fires have been among the central issues affecting public lands in southwestern Oregon. Since the inception of the Northwest Forest Plan in 1994, the majority of the NSO habitat loss in the region has been the result of stand-replacing wildfire.

In order to understand the contribution of past actions to the cumulative effects of the proposed Project, this analysis relies on current environmental conditions as a baseline reflecting the impacts of past actions. This is because existing conditions reflect the aggregate impact of all prior human actions and natural events that have affected the environment and might contribute to cumulative effects.

This cumulative impact analysis does not attempt to quantify the effects of past human actions by adding up all prior actions on an action-by-action basis. There are several reasons for not taking this approach. A catalog and analysis of all past actions is impractical to compile. Current conditions have been affected by innumerable past actions, and trying to isolate the individual actions that continue to have residual impacts would be nearly impossible. Finally, the CEQ issued an interpretive memorandum on June 24, 2005, regarding analysis of past actions, which states, "agencies can conduct an adequate cumulative impact analysis by focusing on the current aggregate effects of past actions without delving into the historical details of individual past actions."

This cumulative impact analysis is also consistent with the USFS NEPA Regulations (36 CFR 220.4(f)) (July 24, 2008), which state, in part:

> *CEQ regulations do not require the consideration of the individual effects of all past actions to determine the present effects of past actions. Once the agency has identified those present effects of past actions that warrant consideration, the agency assesses the extent that the effects of the proposal for agency action or its alternatives will add to, modify, or mitigate those effects. The final analysis documents an agency assessment of the cumulative effects of the actions considered (including past, present, and reasonable foreseeable future actions) on the affected environment. With respect to past actions, during the scoping process and subsequent preparation of the analysis, the agency must determine what information regarding past actions is useful and relevant to the required analysis of cumulative effects. Cataloging past actions and specific information about the direct and indirect effects of their design and implementation could in some contexts be*

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useful to predict the cumulative effects of the proposal. The CEQ regulations, however, do not require agencies to catalogue or exhaustively list and analyze all available or obtained with reasonable effort does not mean that it is relevant and necessary to inform decision making. (40 CFR 1508.7)

For these reasons, this cumulative impact analysis recognizes past impacts as expressed by current environmental conditions as described in the resource reports.

2.3. SCOPE OF THE ANALYSIS

As described in various resource reports, construction and operation of the Project will have temporary and permanent environmental impacts, with most impacts generally localized. The Project has the potential to impact geological resources and hazards, soils and sediments, surface water, groundwater, wetlands, vegetation, wildlife, aquatic resources, special status species, land use, timber, recreational and visual resources, socioeconomics, transportation, cultural resources, air quality, noise, and climate change. Based on the minimization and mitigation measures described in the Project design and the various Erosion Control and Revegetation Plan ("ECRP"); Erosion and Sedimentation Control Plan ("ESCP"); Spill Prevention, Containment, and Countermeasures Plan ("SPCC Plan"); and other specialized plans, including Groundwater Supply Monitoring and Mitigation Plan, Unanticipated Discovery Plan, and Transportation Management Plan for Non-Federal Lands the majority of impacts will be largely limited to areas of disturbance associated with Project rights-of-way, construction workspaces, and adjacent areas.

This cumulative impact analysis includes other actions meeting the following three criteria:

- the action impacts a resource that is also potentially impacted by the Project;
- the action causes impacts within all or part of the same geographic impact area as the Project; and
- the action causes impacts within all or part of the same temporal period as the Project impacts.

Recent past, current, and future actions were identified through communications with federal agencies and local cities and counties. "Reasonably foreseeable actions" are proposed projects or developments that have applied for a permit from local, state, or federal authorities or which are publicly known. For the purposes of this analysis, the temporal extent of other projects will start in the recent past and extend outward for the expected duration of the impacts caused by the Project. Resource-specific temporal scopes are listed in table 2.3-1. Construction of the LNG Terminal is currently scheduled to begin in the first half of 2019 and is expected to be completed in 5 years. Construction of the Pipeline is scheduled to begin in the fourth quarter of 2019 with civil surveys and access road improvements. Tree clearing will start in 2020 before mainline construction begins in 2021. As currently scheduled, the Pipeline is expected to be in service by the end of 2022.

Table 2.3-1
Resource-Specific Temporal Scopes for Determining Cumulative Impacts of the Project

Resource(s)	Cumulative Impact Temporal Scope	Justification for Temporal Scope
Geological resources and hazards	Construction only	Impacts on geologic resources and hazards will be limited to the time of active construction. Other projects being constructed at the same time as active construction for the proposed Project have the potential for cumulative effects.
Soils and Sediments	Construction and restoration	Impacts on soils will be limited to the time of active construction until soil stabilization has been achieved during restoration. Other projects being constructed at the same time as active construction and restoration for the proposed Project have the potential for cumulative effects.
Surface Water, Groundwater, Wetlands,	Construction and restoration, until successful revegetation. Operation for Coos Bay	Impacts on surface water, groundwater, and wetlands will be limited to the period of construction through successful revegetation. Exception includes Coos Bay where impacts could extend through operation of the Project.
Vegetation	Construction and restoration, until successful revegetation for herbaceous vegetation. Operation for forest vegetation	Impacts on herbaceous vegetation will be temporary and limited to the period of construction through successful revegetation. Forest vegetation impacts along the Pipeline will continue through operation of the Project as the permanent right-of-way will need to be maintained.
Wildlife, aquatic resources, and threatened and endangered ("T&E") species	Construction and restoration, until successful revegetation. Operation for aquatic species in Coos Bay	Impacts on wildlife, aquatic resources, and T&E species will primarily be temporary and limited to the period of construction through successful revegetation. Operational impacts may also occur to species within Coos Bay.
Cultural Resources	During active construction and operation for aboveground facilities within viewshed	Impacts on cultural resources will be limited to the time of active construction. Potential impacts on historic properties or historic districts within the Project viewshed may also extend into operations through the physical presence of the facilities.
Land Use	Construction and operation	Impacts on land use will occur during construction only for some Project areas and during construction and operation for others. Where a permanent conversion from one land use type to another will occur, the temporal scope is expanded to included operation.
Transportation	Construction and operation	Impacts on transportation will occur during construction only for some Project areas and during construction and operation for others (i.e., LNG carriers).

Resource(s)	Cumulative Impact Temporal Scope	Justification for Temporal Scope
Recreation	Construction and operation	Impacts on recreation will primarily occur during active construction with portions of the Project (LNG Terminal) extending through operation.
Timber	Construction and operation	Impacts on timber will occur during both construction and operation of the Project.
Socioeconomics	Construction and operation	Impacts on socioeconomics will occur during both construction and operation of the Project.
Environmental Justice	Construction and operation	Impacts on environmental justice communities will occur during construction of the Project and during operation in vicinity of permanent aboveground facilities (i.e., LNG Terminal, compressor station) where air quality, noise, and visual impacts may occur.
Visual	Construction and operation	Impacts on visual resources will be limited to construction for some areas along the Pipeline, and operation for areas with permanent aboveground facilities (i.e., LNG Terminal, compressor station).
Noise	Construction and operation	Impacts on ambient noise will be associated with construction and operations, dependent on the nature of the activities (e.g. noise from earthmoving equipment during construction and gas turbine generators during operations).
Air Quality	Construction and operation	Impacts on ambient air quality will be associated with construction and operations, dependent on the nature of the activities (e.g. dust emissions from earthmoving equipment and combustion emissions from gas turbine generators).

The geographic extent of the area considered in the cumulative impact analysis varies by resource. The cumulative impact analysis area for a resource may be substantially greater than the corresponding Project-specific area of impact in order to consider an area large enough to encompass likely effects from other projects on the same resource and the potential for migration of impacts. The 2017 FERC Manual recommends setting the geographic scope based on a variety of factors including: natural and administrative boundaries, type of resource impact, modeling or measurement distances, and cumulative analyses performed for other permitting processes. Table 2.3-1 summarizes the resource-specific geographic scopes that were considered in this analysis and justification for each. Figure 2.3-1 is an overview map showing project facilities and the two broadest scale geographic scopes (i.e., counties and fifth-field watersheds/Hydraulic Unit Code ["HUC"]-10). Actions located outside of these boundaries are generally not evaluated because their potential to contribute to a cumulative impact diminishes with increasing distance from the Project.

Table 2.3-2
Resource-Specific Geographic Scopes for Determining Cumulative Impacts of the Project

Resource(s)	**Cumulative Impact Geographic Scope**	**Justification for Geographic Scope**
Geological resources and hazards	Project construction footprint	Impacts on geological resources and hazards will be highly localized and limited to the Project footprints during active construction. Cumulative impacts will only occur if other geographically overlapping or abutting projects were constructed.
Soils and Sediments	Project construction footprint	Impacts on soils will be highly localized and limited to the Project footprints during active construction. Cumulative impacts will only occur if other geographically overlapping or abutting projects were constructed.
Surface Water, Groundwater, Wetlands,	HUC-10 watershed boundary	Impacts on surface waters can result in downstream contamination or turbidity; therefore, the geographic scope used to assess cumulative impacts on surface water, groundwater, and wetlands includes the HUC-10 watersheds crossed by the Project.
Vegetation	HUC-10 watershed boundary	Due to the range in vegetation types present in the Project area, we considered the cumulative impacts on vegetation within the HUC-10 watershed boundaries. This is a conservative approach that will allow for the capture of all projects with the potential for cumulative vegetation impacts.
Wildlife, aquatic resources, and T&E species	HUC-10 watershed boundary	Due to the transient nature of wildlife and the forested setting that exists for portions of the Project, we considered cumulative impacts on wildlife, aquatic resources, and T&E species within the HUC-10 watershed boundaries. This allows us to consider impacts on interior forest habitat, and the wildlife therein, at a scope appropriate for these resources.
Cultural Resources	Defined Area of Potential Effect (APE)	Impacts on cultural resources will be limited to the APE, which may differ based on the type of resource considered; for example, impacts on buried artifacts will generally be considered only within the direct footprint where project impacts overlap, while impacts on an historic district may necessitate a wider scope.
Land Use	1 mile from Project footprint	Impacts on general land uses will be restricted to the construction workspaces and immediate surrounding vicinity; therefore, the geographic scope of 1 mile from the Project footprint is a conservative scope that will encompass all potential cumulative impacts on land use.

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Resource(s)	Cumulative Impact Geographic Scope	Justification for Geographic Scope
Transportation	County boundaries and Coos Bay Federal Navigation Channel	Impacts on transportation will be limited to the counties where Project facilities will be located. The geographic scope for assessing cumulative impacts on transportation impacts includes the four counties crossed by Project facilities and the Coos Bay Federal Navigation Channel for marine transportation.
Recreation	1 mile from Project footprint	Impacts on recreation will be restricted to the construction workspaces and immediate surrounding vicinity; therefore, the geographic scope of 1 mile from the Project footprint is a conservative scope that will encompass all potential cumulative impacts on recreation.
Timber	HUC-10 watershed boundary	Impacts on timber will be restricted to the construction workspaces and immediate surrounding vicinity; however some impacts may migrate outside of the Project area due to sedimentation; therefore the geographic scope of HUC-10 footprint is a conservative scope that will encompass all potential cumulative impacts on timber.
Socioeconomics	County boundaries	The geographic scope for assessing cumulative impacts on socioeconomic impacts includes the four counties crossed by Project facilities. Metrics for assessing the resources that may be affected are generally collected at the regional level, and services such as healthcare, education, and public safety are usually provided on a regional basis.
Environmental Justice	Nineteen census tracts crossed by Project facilities within affected counties	Census tracts provide the nearest approximation to neighborhoods for which reliable socioeconomic data is available. The geographic scope for Environmental Justice will be the 19 census tracts crossed by Project facilities.
Visual	Viewshed	The geographic scope for assessing cumulative impacts on a viewshed includes the surrounding area from where a new facility will be visible. Therefore, the geographic scope will be limited to the areas where clearing of mature trees of installation of new aboveground facilities will occur. The distance may vary depending on surrounding topography.

Resource(s)	Cumulative Impact Geographic Scope	Justification for Geographic Scope
Noise (construction)	0.25 mile – daytime only construction 0.5 mile – nighttime and 24-hour construction, horizontal directional drill ("HDD"), direct pipe, well drilling, dredging, pile driving	Based on guidance from the 2017 FERC Manual, the geographic scope for construction related noise impacts varies from 0.25 to 0.5 mile depending on the type of construction activity. Other projects will have to impact the same noise sensitive areas as impacted by the Project for cumulative impacts to occur.
Noise (operational)	0.5 mile – meter stations 1 mile – other permanent aboveground facilities	Based on guidance from the 2017 FERC Manual, the geographic scope for operational related noise impacts varies from 0.5 to 1 mile depending on the type of operational activity. Other projects will have to impact the same noise sensitive areas as impacted by the Project for cumulative impacts to occur.
Air Quality (construction)	0.25 mile of construction footprint	Due to the limited amount of emissions generated by construction equipment, the geographic scope used to assess potential cumulative impacts on air quality from construction was set at 0.25 mile from the Project area.
Air Quality (operational)	50 kilometer of project facilities with operational emissions such as gas-fired compressor station and LNG Terminal	The geographic scope adopted the distance used by the EPA for cumulative modeling for large Prevention of Significant Deterioration sources during permitting and following 40 CFR 51, appendix W, section 4.1. We consider this a conservative geographic scope for the purpose of identifying other projects which could contribute to a cumulative impact on air quality.

Current and reasonably foreseeable projects within the 4 counties and 24 fifth-field watersheds (HUC-10) crossed by the Project that may cumulatively impact resources that will be affected by construction and operation of the Project are listed in Attachment A.1 and depicted in Attachment B.1.

JCEP and PCGP corresponded with the BLM, USFS, USACE, Coos County, Douglas County, Jackson County, Klamath County, City of Coos Bay, City of North Bend, and Tribes to identify current and reasonably foreseeable projects. To date we have received feedback from USFS, Douglas County, Coos County, and the City of North Bend. JCEP and PCGP will continue to correspond with these groups and correspondences will be included in Attachment C.1 of the final Cumulative Impact Analysis. Per the 2017 FERC Manual, Attachment D.1 includes a list of the anticipated permits, authorizations, and consultations required for projects listed in Attachment A.1.

Additional projects within the proposed geographic scopes of this analysis are anticipated to occur as population growth continues in the Project area. Since 2010, the population in the four counties crossed by the Project has increased by about 3 percent (U.S. Census 2017). Associated with continued population growth will be the construction of residential subdivisions, commercial developments, roads and utilities, and maintenance and upgrade of existing

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infrastructure. These actions could affect a range of natural resources including soils, waterbodies, wetlands, vegetation, and wildlife. Over time, federal and state agencies, along with private conservation organizations, may implement measures that could gradually improve wildlife habitat, water quality, and air quality throughout the Project area. It is not possible to quantify or assess the potential cumulative impacts or benefits that may accumulate from all possible future actions within the geographic areas of influence of the Project.

Actions and events that may occur but are not practical to predict or identify in Attachment A.1 are described below.

- Reciprocal Rights-of-Way Actions – All of the fifth-field watersheds are covered by multiple reciprocal road use and rights-of-way agreements enacted between the BLM and/or USFS and adjoining industrial forest landowners. While requests are frequently received, under the terms of these agreements, to construct new roads or to renovate, improve, and use existing roads, there is no practicable means to forecast the timing and location of such requests. Historically, the BLM Districts receive between about 5 and 10 crossing requests annually from major timber companies, which may or may not involve construction of new roads. National Forest System ("NFS") lands generally consist of large, contiguous blocks of land, rather than the checkerboard pattern typical of BLM lands; therefore, the National Forests receive few requests for new road access.

- Temporary Hauling Permits – Requests are received from time to time from private individuals without reciprocal road use and rights-of-way agreements for permits to haul forest products over BLM- and USFS-controlled roads. As with non-discretionary actions permitted under reciprocal road use and rights-of-way agreements, there is no practical means by which to forecast the timing and location for such requests. Historically, the BLM Districts receive less than five requests per year from small landowners, which may or may not involve the construction of new roads.

- Other Actions on Federal Lands – Within the Coos Bay BLM District, Bonneville Power Administration has ongoing access road improvement work (rocking). It is anticipated this action will continue for the next several years. Additionally, the BLM and USFS have programs to actively control noxious weeds. The BLM is exploring the possibility of expanding its herbicide control program to include invasive species in the future.

- Ongoing Operation and Maintenance – Originally authorized in 1905, the Klamath Project now includes three storage reservoirs, 1,400 miles of canals and drains, 37 pumping plants and two tunnels to provide service to water users in the Klamath Basin.

- Road Maintenance – Road maintenance activities will be conducted by the state and counties, and private timber companies.

- Ongoing Commercial Activities – Many activities on private land that go unreported could affect resources, including timber harvest and commercial fishing.

- Wildfires – Wildfires and the corresponding actions to suppress these fires on federal, state, and private lands are anticipated to continue at or above the rate experienced during past decades. Adverse effects include the loss of mature and old growth forest and the associated habitat they provide.

In addition to the projects identified in Attachment A.1, restoration and enhancement projects have occurred and are expected to continue to occur across the environments affected, which will help offset the cumulative impact of past, present, and reasonably foreseeable actions. This will include mitigation measures required by the USFS, BLM, U.S. Department of the Interior Fish and Wildlife Service ("FWS"), National Oceanic and Atmospheric Administration, National Marine Fisheries Service, U.S. Army Corps of Engineers ("USACE"), and other agencies to offset unavoidable impacts due to the Project.

JCEP and PCGP are working with the appropriate agencies to revise the Compensatory Mitigation Plan to account for changes in the Project since 2015 as well as changes resulting from BLM's new Resource Management Plans. This will include discussions with BLM and USFS to address:

- Compliance with the Aquatic Conservation Strategy of the Northwest Forest Plan and 2016 Resource Management Plans ("RMP");
- Potential effects to T&E species and their habitat including NSO, MAMU, and coho; and
-
- Specific resource issues as they occur.

These mitigation projects are being analyzed programmatically as a part of the proposed action. Some of these projects may require a secondary site-specific project-level NEPA analysis prior to implementation. Those secondary site-specific NEPA analyses will tier to the NEPA document for the Project as provided in the CEQ NEPA regulations at 40 CFR 1502.20 and 1508.28(b). Mitigation proposed as part of the Project will be available in the revised Compensatory Mitigation Plan, along with the potential effects of each type of action.

2.4. NONJURISTICTIONAL PROJECT-RELATED FACILITIES

JCEP and PCGP have identified associated facilities that do not fall under the jurisdiction of the Commission but are integral to the Project and/or are minor components that will be built as a result of the jurisdictional facilities (see JCEP Resource Report 1 Section 1.9 and PCCP Resource Report 1 Section 1.8). These facilities will be included in the Final Cumulative Impact Analysis.

2.5. CUMULATIVE EFFECTS FROM U.S. ARMY CORPS OF ENGINEERS PORTLAND DISTRICT REGULATORY BRANCH ACTIONS

This section identifies actions authorized by the USACE Portland District Regulatory Branch within the affected watersheds. The USACE's Regulatory Program is based upon two primary statutory authorities. Under Section 404 of the Clean Water Act, the USACE authorizes the discharges of dredged and fill materials into waters of the United States; and under its Section 10 of the Rivers and Harbors Act authority, the USACE regulates structures in navigable waters.

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Additionally, under Section 14 of the Rivers and Harbors Act of 1899 (33 U.S. Code 408) the USACE may grant permission for the occupation or alteration of any sea wall, bulkhead, jetty, dike, levee, wharf, pier, or other work built by the United States. When reviewing projects for potentials authorization, the USACE Portland District Regulatory Branch utilizes mitigation sequencing. Project proponents are required to demonstrate they have avoided and minimized impacts where practicable and then mitigated any remaining unavoidable impacts. The USACE considers the need for compensatory mitigation for those impacts that are unavoidable. Compensatory mitigation is a third step in a sequence of actions that must be followed to offset impacts on aquatic resources.

The 1990 Memorandum of Agreement ("MOA") between the EPA and the U.S. Department of the Army establishes the three-part mitigation sequencing process composed of avoidance, minimization, and compensation. The goal for the USACE and EPA is to facilitate and execute a "No Net Loss" aquatic resource protection policy to ensure aquatic resources of the U.S. do not decrease in size but are offset or increased through land development processes. The impacts listed below include projects whose purpose may include commercial, residential, or public development and may include wetland or stream restoration or other actions. The USACE Operations and Maintenance Business Information Link Regulatory Module currently uses the fourth-field watershed (HUC-8) to track cumulative effects to wetlands. Fourth-field watersheds are a higher order than fifth-field (e.g., a fourth-field watershed generally includes more than one fifth-field watershed). Therefore, the USACE tracks wetland impacts over a larger area than would be the case if fifth-field watersheds were used.

3.0 CUMULATIVE EFFECTS ON RESOURCES

Cumulative effects are discussed by resource in Section 3.0 of this cumulative impact analysis. For each resource, the potential direct and indirect impacts associated with the Project are discussed in relation to the cumulative effects that may occur if other current or reasonably foreseeable project impacts overlap in geographic or temporal scope with those of the Project.

3.1. GEOLOGICAL RESOURCES AND HAZARDS

The cumulative impact area for geologic resources and hazards was considered to be the construction footprint for the LNG Terminal and Pipeline. Construction of the Project will require excavation within the project area, resulting in minor temporary impacts on geological resources. There are three ways that the Project, in addition to other projects in the same geographic and temporal scopes, may have cumulative impacts on geologic resources: (1) they may require significant grading in an area that overlaps the active construction footprint and within the same timeframe; (2) they may affect existing mineral resources such as mines, quarries, or oil and gas wells; or (3) they may be subject to natural geological hazards.

There are no existing mines or mineral extraction activities in close proximity to the LNG Terminal. PCGP identified 29 mines or mineral extraction locations within 500 feet of the Pipeline right-of-way, of which 16 were aggregate or quarry-related mines. The Pipeline could potentially interfere with future mining and reclamation activities on lands adjacent to the right-of-way and cumulatively contribute to limiting the future expansion of surface mines or the development of new mineral resources lands adjacent to the right-of-way. PCGP will utilize 20 locations as rock sources or disposal areas, totaling about 86 acres. Of these, five sites

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(44.8 acres) are existing quarries. PCGP will not expand these sites beyond the existing or previously disturbed footprints. Additionally, PCGP's use of these sites for rock sources or rock disposal does not preclude their use for similar purposes by other entities in the future, after the Pipeline is installed and the right-of-way restored. Others may utilize BLM and USFS quarries for road construction/maintenance, off-site mitigation/restoration projects and other purposes. Material removal from quarries on federal lands is at the discretion of the land management agency, and material needed for use by the land management agencies will be reserved. Rock disposed of in quarries as a result of Pipeline construction could be used or sold by the land management agencies in the future.

No blasting is expected to be required for construction of the LNG Terminal. Blasting operations associated with the Pipeline will be conducted in accordance with the blasting impact mitigation measures and safety best management practices ("BMP") outlined in Section 5.4 of Appendix 6A to Resource Report 6. Blasting will be conducted by state-licensed professionals in accordance with all federal, state, and local regulations and PCGP Construction Specifications.

Geologic hazards including seismicity, landslides, stream channel migration and scour, tsunamis and storm surge, and flooding were reviewed as part of various geotechnical evaluations and studies completed for the Project (see Resource Report 6 for JCEP and PCGP). The Project will be designed to comply with the U.S Department of Transportation's regulations in 49 CFR Part 192 and B31.8 guidelines and a Project-specific fault mitigation design. The Pipeline was routed to avoid existing landslides and areas susceptible to landslide. Construction BMPs to reduce impacts on slope stability will be implemented during construction including landslide monitoring. To minimize impacts from stream migration and scour, PCGP will bury the Pipeline below the estimated depth of streambed scour and/or depth of channel thalweg. The LNG Terminal has been designed for facility components to be located above Federal Emergency Management Agency flood levels, storm surge levels, and to factor in sea level rise. The LNG Terminal has also been designed so all critical components are located at elevations higher than the tsunami hazard level for the Project area. Additionally, LNG storage tanks will be located within an area enclosed by a berm with a peak crest elevation higher than that presented in the rupture scenario L1 (which includes coastal subsidence) discussed in Resource Report 6.

PCGP conducted field surveys for paleontological resources on portions of the Pipeline right-of-way on BLM lands. These surveys were used to classify the potential for encountering paleontological resources on BLM lands during construction. About 25 miles will be subject to limited spot monitoring during construction and about 1 mile will be subject to continuous monitoring for the potential presence of paleontological resources during pipeline construction.

Overall, the Project will result in temporary and minor impacts on existing geological conditions and any potential impacts will be highly localized and limited to the Project footprint and will not have a significant contribution towards cumulative impacts from other past, present, and reasonably foreseeable projects and actions on geological resources. The following projects listed in Attachment A.1 have potential to result in a cumulative impact on geological resources when combined with the minor impacts on geological resources resulting from construction of the Project.

[Discussion of potential cumulative impacts with Projects listed in Attachment A.1 to be provided in subsequent submittal]

3.2. SOILS AND SEDIMENTS

The cumulative impact area for soils was considered to be the construction footprint for the LNG Terminal and Pipeline. Cumulative impacts on soils include erosion and compaction resulting from the Project and other past, present, and reasonably foreseeable projects. For the Project to contribute to cumulative impact on soils, other projects/actions listed in Attachment A.1 will need to also result in soil exposure within an area that overlaps the active construction footprint and occur within the same timeframe that Project soils will be exposed.

While the Project will have some direct impacts on soil resources, the impacts will be minor, localized, and temporary, limited primarily to the period of construction. None of the soils associated with the LNG Terminal are considered prime farmland. About 140.9 acres are considered farmland of statewide importance; however, none of these areas are currently being used for cropland, and they have been modified by historic industrial activities or placement of dredged materials. The Pipeline crosses about 71.4 miles (1,297 acres) of prime farmland and farmland of statewide importance. Additional acreage of prime farmland and farmland of statewide importance will be impacted by aboveground facilities and access roads. Not all of these areas are currently in agricultural production. With the exception of about 17.8 acres associated with aboveground facility construction, these impacts will be temporary.

The following projects listed in Attachment A.1 have potential to result in a cumulative impact on soils when combined with the minor impacts on soil resources resulting from construction of the Project.

[Discussion of potential cumulative impacts with Projects listed in Attachment A.1 to be provided in subsequent submittal]

The above-listed projects will also likely require excavation and grading and thus result in temporary, direct impacts on soils. Like the Project, the duration and effect of impacts on soils from these projects will be minimized by the implementation of erosion controls and restoration measures to offset impacts. JCEP will minimize impacts on soils by following the FERC's Upland Erosion Control, Revegetation, and Maintenance Plan ("Plan") and its project-specific ESCP. PCGP will minimize impacts on soils by following FERC's Plan and its project-specific ECRP that incorporates supplemental information on sensitive soils. Implementation of these plans and the measures discussed in Resource Report 7 will minimize incremental impacts on soils. Other federal projects will also employ BMPs limiting effects on soil and sediment. USFS LRMPs include specific standards designed to avoid detrimental soil impacts and sediment delivery to streams. These standards are designed for the specific site conditions found in each prescription area. Other non-federal projects will be monitored throughout the process to verify compliance with local and state erosion control and restoration requirements. Therefore, any contribution to a cumulative impact on soil resources from the Project will likely be minor, temporary, and limited to the immediate vicinity of construction activities.

Low-level contaminated soils were found within the LNG Terminal site (within the Ingram Yard and Mill site). The Oregon Department of Environmental Quality ("ODEQ") issued

Weyerhaeuser a "No Further Action" determination for the Ingram Yard and Mill site, and included conditions that certain wastes be managed appropriately if they are disturbed (SHN 2015). A solid waste authorization letter was submitted to ODEQ in July 2014. This letter stated, per guidance from ODEQ, JCEP will provide prior notice to ODEQ should any grading or ground disturbance activities be planned to occur on Ingram Yard. Provisions for long-term disposal of disturbed Ingram Yard soils and any other specific mitigation measures will be specified in the final engineering design. Additionally, mercury is present at levels above Clean Fill screening criteria in sediments within portions of the Kentuck Slough mitigation site (within the golf course irrigation pond). These sediments will be removed to an off-site disposal facility. JCEP has prepared a Contaminated Media Management Plan that will be implemented if unanticipated soil contamination were discovered during construction of the LNG Terminal. Given the list of projects that occur within the same geographic and temporal scope for soil resources and adherence to Project plans, it is expected that cumulative impacts on contaminated soils will be minor.

[Discussion to be updated in subsequent submittal based on results of projects located within geographic and temporal scopes.]

3.3. WATER RESOURCES AND WETLANDS

For the Project to contribute to a cumulative impact on groundwater, surface water, or wetlands, other unrelated projects/actions must also result in impacts on those water resources within the same geographic and temporal scope. For the Project, the water resources geographic scope is the HUC-10 watersheds where the Project facilities will be installed. Project activities will occur across 24 HUC-10 watersheds. The northeast corner of the Rogue Aggregates contractor and pipe storage yard extends into the Bear Creek Watershed. This is the only Project facility located in this watershed and it extends into the watershed for 0.25 acre. Given that the facility does not impact Bear Creek or any other waterbody in this watershed, the area is open land and no forest clearing will be required, and no wetlands are present this watershed was not included in the analysis or the number of HUC-10 watersheds crossed. The following past, present, or reasonably foreseeable future actions/projects are located within the same HUC-10 watersheds as portions of the Project and will involve ground disturbance or excavation; therefore, they could result in cumulative impacts on groundwater, surface water, and/or wetlands:

[List to be populated in subsequent submittal based on results of projects located within geographic and temporal scopes]

3.3.1. Groundwater

Impacts on groundwater associated with the Project may occur from the clearing of vegetation, excavation of the pipeline trench and facility foundations, blasting, dewatering of the trench and groundwater for peat removal and other deep excavations, soil mixing and compaction, hazardous material handling, and potential changes to the Coos Bay-North Bend Water Board well field from changes in shoreline and seawater intrusion. These impacts will be minimized through the implementation of erosion controls, topsoil segregation, measures to reduce or avoid compaction, and revegetation of disturbed areas, as well as through the implementation of measures outline in the Groundwater Supply Monitoring and Mitigation Plan, and SPCC Plan.

No EPA-designated sole source aquifers will be affected by the Project. The foundations for structures at the LNG Terminal and the Pipeline trench will be too shallow to affect local aquifers. The LNG Terminal will result in 175 acres of impervious surface, which when compared with the total surface area of the Coos Bay-Frontal Pacific Ocean Watershed (151,641 acres), should not have significant impacts on the recharge of the watershed. About 22 acres of land will become impervious due to construction of Pipeline aboveground facilities and communication towers. These facilities will be spread across 15 watersheds (totaling over 1.2 million acres) and will not have significant impacts on the recharge of the watersheds.

Water to be used during construction of the LNG Terminal will be obtained from the Coos Bay-North Bend Water Board water line whose supply is derived from groundwater wells on the North Spit. About [TBD] million gallons of water will be used during construction of the LNG Terminal, and about [TBD] million gallons will be required each year for operation of the facilities. In Docket numbers CP13-483 and CP13-492, FERC reviewed a U.S. Geological Survey study analyzing the watershed's rainfall, geology, and hydrology for the North Dune aquifer that concluded10 million gallons per day may be safely withdrawn, out of the 17 million gallons available per day.

A maximum of 61 million gallons of water will be required for the hydrostatic testing of the Pipeline and about 75,000 gallons for dust control. This water will be obtained from a combination of commercial and municipal sources, private supply wells, and surface water sources. Hydrostatic test water will be discharged in vegetated uplands to promote infiltration and recharge of groundwater resources. However, some water will likely be discharged in a watershed that differs from the one from which the water was drawn. PCGP identified 8 water wells within 200 feet of the pipeline route; all of which are used for irrigation, not drinking water.

[Discussion of potential cumulative impacts with Projects listed in Attachment A.1 to be provided in subsequent submittal]

3.3.2. Surface Water

Construction and operation of the Project will primarily result in short-term impacts on surface water resources. These impacts, such as increased turbidity, will return to baseline levels over a short-term period following construction. Longer-term impacts will also occur in Coos Bay due to maintenance dredging, propwash scour, wave heights and shoreline changes, and along the Pipeline until adjacent disturbed areas are stabilized through revegetation. These impacts will be minimized by implementing specific waterbody construction and mitigation measures, including temporary and permanent erosion controls, and implementation of project-specific plans including SPCC Plan, Horizontal Directional Drilling ("HDD") Mud Contingency and Failure Mode Procedures, ECRP, ESCP, and by complying with applicable federal and state permit requirements.

Within the Project area, Lower Coos Bay is listed on the Oregon 303(d) list as water quality limited for fecal coliform. There will be no discharge of sanitary waste from the Project to Coos Bay; therefore, the Project will not contribute to cumulative impacts on fecal coliform levels. Within the Coos Bay estuary, short-term cumulative impacts can be expected from the access channel construction and USACE channel maintenance dredging. Construction of the access channel will be scheduled during the recommended Oregon Department of Fish and Wildlife in-

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water work periods between October and mid-February to minimize impacts on aquatic species in the estuary. Pipeline installation across Coos Bay Estuary – North Slough, and Haynes Inlet will utilize the HDD construction method to minimize impacts to the waterbodies including sedimentation and turbidity.

As discussed in Resource Report 2 for JCEP, LNG carriers will release ballast water and engine cooling water into the marine slip in accordance with all applicable rules and regulations. An initial full exchange of ballast water will be completed in the open ocean at least 200 miles from U.S. waters. Therefore, water being released at the marine slip will have originated from Open Ocean rather than a foreign port. The physio-chemical composition of this water will be very similar to that which occurs in Coos Bay and the slip. Dissolved oxygen, pH, and temperature levels may experience minor fluctuations due to the release of ballast water and engine cooling; however, no significant impacts are expected.

The Pipeline will cross 19 fifth-field watersheds, with proposed access roads and ancillary facilities crossing an additional 5 watersheds. The construction of the Pipeline will affect waterbodies at 371 locations; 63 of which are not directly crossed by the Pipeline, but are located within the right-of-way or workspaces. Thirty-five waterbodies crossed are listed as Category 4 and 5 with impaired water quality. PCGP will cross 29 waterbodies with limited water quality using dry-crossing techniques, while 6 others will be crossed with bores, HDD, or direct pipe technologies. Potential cumulative impacts within the fifth-field watersheds could include turbidity and sediment from construction and runoff from areas cleared during construction. The majority of dry crossings will be done within a 48-hour time frame, during the Oregon Department of Fish and Wildlife recommended in-water work windows. Suspended sediment levels in streams will return to background levels within 100 feet of a crossing. PCGP will reduce erosion and sedimentation into streams by following measures outlined in the FERC's Upland Plan and Wetland and Waterbody Procedures ("Procedures") and the project-specific ESCP.

Removal of riparian vegetation that provides shade at the edge of streams can increase water temperatures. PCGP's water temperature studies predicted a maximum increase of about 0.2°C within one 75-foot clearing. The analysis showed that elevated water temperatures will return to ambient levels within a maximum distance of 25 feet downstream of the Pipeline corridor. All temperature impacts were predicted to decrease over time as vegetation returns to provide shade, with significant recovery occurring between 5 and 10 years following disturbance. If another project resulted in shade removal along the same waterbody, at or near the proposed crossing location, there could be a cumulative effect to stream temperature. However, because measurable temperature increases are only expected to occur within streams with extremely small flow volumes, the contribution of the Project to cumulative stream temperature changes will be minimal.

[Discussion of potential cumulative impacts with Projects listed in Attachment A.1 to be provided in subsequent submittal]

3.3.3. Wetlands

About [TBD] acres of wetlands will be impacted by construction of the LNG Terminal. JCEP is developing a Compensatory Wetland Mitigation Plan to address unavoidable impacts to

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wetlands. Impacts on freshwater and estuarine wetland resources will be mitigated via various wetland mitigation sites to be outlined in this plan.

The Pipeline route will cross about 6.5 miles of wetlands. Construction of the Pipeline will impact about 117.1 acres of wetlands. During operation of the Pipeline, emergent and scrub-shrub wetlands will be returned to their preconstruction condition, use, and function. However, about 1.5 acres of wetland (1.4 forested, 0.1 scrub-shrub) will have permanent vegetation type conversion representing a permanent impact on wetland function. PCGP will reduce impacts on wetlands by following FERC's Procedures. Approval of Project-specific wetland mitigation plans by agencies will be required prior to issuance of permits.

[Discussion of potential cumulative impacts with Projects listed in Attachment A.1 to be provided in subsequent submittal]

3.4. VEGETATION

[Section to be completed in subsequent submittal of Cumulative Impact Analysis]

3.5. WILDLIFE AND AQUATIC RESOURCES

[Section to be completed in subsequent submittal of Cumulative Impact Analysis]

3.5.1. Wildlife

[Section to be completed in subsequent submittal of Cumulative Impact Analysis]

3.5.2. Aquatic Resources

[Section to be completed in subsequent submittal of Cumulative Impact Analysis]

3.6. LAND USE, RECREATION, AND TIMBER

3.6.1. Land Use

Impacts on land use will occur when a project results in a permanent or long-term change in the way a property is used; for example, the conversion of one type of land use to another type. Construction of new permanent access roads and new permanent aboveground facilities may create a land use change, if they will be located in areas that are currently forested or farmed, for example. These same types of facilities located within industrial areas will not constitute a land use change, however. A pipeline right-of-way through a commercial forest or an orchard will restrict those uses, and therefore constitute a land use change, whereas the same right-of-way crossing field or row crops will not restrict those uses, and consequently will not change the existing land use.

Cumulative land use impacts could result if numerous permanent land use conversions, over time, result in changing the overall land use character of an area. On non-federal lands, a one-mile radius surrounding the LNG terminal and pipeline facilities was identified as a conservative distance within which other current of reasonably foreseeable future projects might contribute to a cumulative impact on land use. Because cumulative land use impacts can occur gradually

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and are viewed as more-or-less permanent alterations of the landscape, the appropriate temporal scope for the analysis is the operational life of the project.

Construction of the LNG Terminal and terminal-related facilities will affect about 236 acres of open land, 126 acres of forest, seven acres of residential land, and 170 acres of industrial/commercial land. After construction, the operational footprint of the terminal and related facilities will occupy about 197.8 acres. Of this total, 72 acres of forest and 76 acres of open land will be converted to industrial uses. Therefore, land use will change for about 148 acres of land for the LNG Terminal and related facilities.

The proposed route for the Pipeline will cross about 146 miles of forest, 32 miles of agricultural land, 34 miles of range land, and 19 miles of urban/developed land. However, land use changes related to the pipeline right-of-way are limited to currently forested areas occupying the 30-foot corridor that will be maintained in a non-forested state for pipeline operations and maintenance purposes. Land use changes related to forest resources are discussed below in the Timber subsection.

The other locations where land use will change over the long term are where PCGP will construct and operate new permanent access roads and new aboveground facilities. PCGP proposes to construct 18 new permanent access roads, affecting just over two acres (less than an acre of each land use type cropland, forest, and range land). Permanent aboveground facilities appurtenant to the Pipeline will convert to industrial use less than an acre of forest, less than an acre of agricultural land, and approximately 17 acres of range. These land use conversions are relatively small in comparison to the total acres of existing land use types in southwestern Oregon.

Local planning offices, the BLM, USFS, and Tribes in the four counties crossed by the Pipeline and the LNG Terminal were contacted to help identify current or reasonably foreseeable activities, to assess cumulative land use impacts. These projects are identified in Attachment A.1.

Within the city of Coos Bay, projects with land use impacts were identified within a mile of the proposed facilities.

[Discussion of potential cumulative impacts with projects listed in Attachment A.1 to be provided in subsequent submittal]

In 2009, in the four counties crossed by the proposed Pipeline route (Klamath, Jackson, Douglas, and Coos), there were about 2,107,000 acres of non-federal forest, 343,000 acres of mixed forest and agricultural land, and 290,000 acres of intensive agricultural land. In Klamath County alone, there was 302,000 acres of rangeland in 2009 (Letterman et al. 2011). According to the Oregon Department of Forestry, between 1973 and 2014, a total of 703,000 acres of Oregon non-federal lands shifted from resource land uses (wildland forest, wildland range, intensive agriculture, mixed forest/agricultural and mixed range/agriculture uses) to low-density residential or urban uses (Letterman, et al. 2016). According to the National Oceanic and Atmospheric Administration ("NOAA") Coastal Services Center (2014) data, there has been a loss of about 2,586 acres of agricultural land in Jackson County, and a net gain of about 858 and 257 acres in Douglas and Coos Counties, respectively, since 1996 (NOAA Coastal Services Center's 2014 analysis does not include Klamath County).

The Pipeline route crosses about 31 miles of NFS lands on three National Forests, and about 40 miles of BLM lands in four districts. Both agencies will make a determination regarding the Project's consistency with their respective LRMPs on Forest Service lands and RMPs on BLM lands. It is likely that any decision to grant the Project a right-of-way to cross federal lands will require certain amendments to the respective LRMPs and RMPs. Such amendments may include the establishment of a utility corridor in areas not currently allowing such use, and reallocation of Forest Service "Matrix" management prescriptions to "Late Successional Reserve" prescriptions. If amendments or exceptions to the LRMPs or RMPs are approved by the USFS and BLM, any inconsistencies with the land use plans are thereby resolved.

[Discussion of potential cumulative impacts with projects listed in Attachment A.1 to be provided in subsequent submittal]

The Project will include measures that will minimize impacts on land use, such as co-locating the pipeline adjacent to existing rights-of-way where feasible, and replanting forested areas within the temporary construction corridor.

3.6.2. Recreation

Impacts to recreational use associated with the Project could temporarily impede some recreational activities, but these impacts will be temporary and represent minor inconveniences rather than significant disruptions. No long term impacts on recreational use are anticipated.

The Pipeline route will cross the beneath the Hayes Inlet Water Trail, a small segment of the Upper Rock Creek Area of Critical Environmental Concern, three National Scenic Byways (U.S. Highway 101, State Highway 62, and U.S. Highway 97), and one National Scenic Trail, i.e. the Pacific Crest Trail ("PCT"). PCGP would implement the measures outlined in its Recreation Management Plan to minimize impacts on the PCT and the Haynes Inlet Water Trail and their recreational users. These include utilizing an HDD to install the pipeline crossing of the Coos Bay-North Slough and Haynes Inlet, which will avoid impacts to the Hayes Inlet Water Trail, and crossing the PCT at a location chosen to minimize visual impacts. Impacts to recreational users, if not entirely avoided, will be limited to short-term restrictions or inconveniences during construction.

Recreational boaters in Coos Bay spent an estimated total of 22,134 activity days during the period of 2005 to 2008, mostly fishing, crabbing, and clamming. Dispersed recreational activities, such as hiking, biking, horseback riding, off-highway vehicles and snowmobile use, hunting, boating, fishing, swimming, and cross-country skiing, occur on public lands throughout southern Oregon, including within the four BLM Districts and three National Forests that would be crossed by the Pipeline route. In 2008 there were about 311,000 hunting trips and about 1.8 million wildlife viewing trips in Douglas, Jackson, Josephine, Klamath, and Lake Counties, Oregon, combined (Dean Runyan Associates 2009).

Attachment 1.A identifies current or reasonably foreseeable actions within a mile of the proposed Project that may result in cumulative impacts on recreational resources.

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[Discussion of potential cumulative impacts with Projects listed in Attachment A.1 to be provided in subsequent submittal]

Impacts from the proposed Project on recreational use will be localized of temporary duration, during the period of active construction and limited during operation of the LNG Terminal to Coos Bay.

Cumulative impacts on recreational use could result if other actions with similar impacts are being implemented both during the same time frame as well as in the same locale as the proposed project.

3.6.3. Timber

On federal lands, cumulative land use impacts may extend further than a mile, to the extent that any reallocations of management prescription areas as defined in each BLM RMP or National Forest LRMP may affect long-term management objectives. Consequently, for the four BLM districts and three National Forests crossed by the Pipeline, the entire watershed was considered to be within the area of influence for the timber portion of the cumulative impact analysis. The watershed was also used as the basis for the analysis of cumulative timber impacts on private lands, to be consistent with the analysis on federal lands.

Construction of the LNG Terminal and its related facilities will affect 126 acres of forested land. Permanent conversion of about 72 acres of forest to industrial use will be associated with the operating LNG Terminal facilities.

Construction of the Pipeline will affect approximately 2,793 acres of forested land. During operation of the Pipeline, a 30-foot-wide strip within the 50-foot pipeline right-of-way will be kept clear of trees, resulting in a long-term conversion of forested land of about 532 acres. While the loss of mature forest cleared in other portions of the construction right-of-way will be a long-term impact on vegetation, due to the time required for trees to regrow, the area outside the 30-foot-wide right-of-way will not see a permanent change in land use. The area will be replanted with suitable tree species and will continue to support forests.

On federal lands, about 27,786 thousand board feet of timber will be cut and sold. This includes about 13,384 thousand board feet on BLM land and 14,402 thousand board feet on USFS land. Federal and private owners of the timber will be compensated for its commercial value.

With respect to permanent forest losses, private timber owners will be compensated for the loss of future potential timber revenue. On federal lands, PCGP will work with the BLM and USFS to develop any necessary mitigation measures, such as projects to improve forest structure and health and reduce the effects of wildfires.

NOAA Coastal Services Center (2014) data indicate that there has been a net loss of about 47,270 acres of forest in Jackson, Douglas, and Coos Counties (and a corresponding gain in shrubland) since 1996. Implementation of Northwest Forest Plan on BLM and NFS lands in the 1990s resulted in a substantial reduction in lands available for timber harvest due to the establishment of LSRs and Riparian Reserves. Regrowth in previously harvested areas will, over time, result in more lands supporting late successional old growth forests. The actual rate of regrowth will be affected by the level of management activity by land allocations as well as

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the level of disturbance from fires, insects, and diseases. Therefore, Project impacts due to timber removal are not expected to be cumulatively significant at either the region or watershed level due to size of the Project footprint relative to the extent of vegetation cover in the analysis area.

[Discussion of potential cumulative impacts with Projects listed in Attachment A.1 to be provided in subsequent submittal]

Projects that may result in permanent or long-term losses of forested lands, and within the Project's area of influence are identified in Attachment A.1.

3.7. VISUAL RESOURCES

[Section to be completed in subsequent submittal of Cumulative Impact Analysis]

3.8. SOCIOECONOMICS

Past, present and reasonably foreseeable future projects and activities could cumulatively impact socioeconomic conditions in the region of influence for the Project. The socioeconomic issues considered in the area of the Project were employment and workforce, housing, economy and tax revenues, public services, and environmental justice. For evaluating cumulative impacts on socioeconomics for the Project, county boundaries were used as the geographic scope because metrics for assessing the resources that may be affected are generally collected at the regional level, and services such as healthcare, education, and public safety are usually provided on a regional basis. The exception is impacts on environmental justice, which has a smaller geographic scope and is confined to the census tracts impacted by the Project.

The temporal scope for socioeconomics is both during construction and operation of the Project, with the majority of impacts occurring during construction when an influx of workers will be present in Coos, Douglas, Jackson, and Klamath counties. While 20 permanent jobs will be located in Multnomah County, this represents a negligible contribution any socioeconomic impacts and is not included in the analysis below.

The past, present, or reasonably foreseeable future actions/projects listed below are located within the same geographic and temporal scopes as portions of the Project.

[List to be populated in subsequent submittal based on results of projects located within geographic and temporal scopes]

3.8.1. Employment/Workforce

JCEP and PCGP anticipate that an average of 1,023 and 646 workers will be required for construction of the LNG Terminal and Pipeline respectively each month during construction. About 78 percent of the LNG Terminal jobs and 60 percent of the Pipeline jobs are expected to be filled by Oregon hires. This will result in substantial changes to local employment and a temporary increase in income taxes generated in the counties. Cumulative impacts on employment and workforce will largely depend on how much temporary construction workforce

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is sourced locally and the number of permanent positions that will be needed to operate the Project.

Short-term construction laborers will be in high demand during the construction cycles of the Project.

Impacts on the local workforce will depend on the percentage of workers hired locally for the projects listed in Attachment A.1. When combined with the demand for temporary workers with the same general skill sets for the other projects in the same geographic scope, the short-term cumulative impacts will be beneficial to the counties directly affected by the Project. These effects will only occur during the construction cycle of these projects; once construction winds down, the smaller demand for workers needed to operate these facilities will likely be met by local labor resources. It is currently projected that the Project will employ 195 workers for the operation of the Project in the four counties crossed by the Project.

[Discussion of potential cumulative impacts with Projects listed in Attachment A.1 to be provided in subsequent submittal]

3.8.2. Housing

The largest impacts on housing from the Project will be from non-local workers relocating to the Project area during construction, requiring temporary housing. The four affected counties contain a substantial inventory of temporary housing. However, depending on the timing of construction and temporary labor forces for the present and future projects listed above, the temporary housing demand could reach capacity. To reduce the pressure on local housing that may be in demand during the tourist season in Coos County, JCEP will have some of the non-local workers reside at the South Dunes Workforce Housing Complex. PCGP will not provide temporary housing along the Pipeline route to house non-local workers, however; given that LNG Terminal construction will occur prior to Pipeline construction, the South Dunes Workforce Housing Complex will be available for Pipeline construction crews in Coos County. Because family members are not expected to accompany non-local workers to the Pipeline area, it is expected that the majority of workers will secure temporary housing in facilities such as hotels, motels, short-term apartments, recreational vehicle ("RV") parks, and campgrounds. In the four counties crossed by the pipeline, there are a total of 9,696 hotel and motel rooms, 7,710 RV hook-ups, and about 2,816 vacant rental units available to house non-local workers (EcoNorthwest 2017).

The amount of impact the temporary construction workforce will have on the counties affected by the Project will depend on the number of other projects that actually go to construction, the amount of labor sourced locally, and the amount of overlap in construction schedules. The demand for construction worker housing may restrict the supply available to other users, such as vacationers and other visitors, and may increase the prices of short-term housing during the construction period.

The majority (186 or 95 percent) of permanent operational jobs will be located in Coos County. Of these 186 jobs, 180 will be for the LNG Terminal and 6 for the Pipeline. It is estimated that about 108 workers will require new permanent housing. Based on the available vacant units for rent and sale in Coos County (660 and 480 units respectively), this increase in demand for

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housing will not significantly impact housing in the Coos County and will not contribute to cumulative impacts on housing.

[Discussion of potential cumulative impacts with Projects listed in Attachment A.1 to be provided in subsequent submittal]

The majority of the reasonably foreseeable projects within the four county geographic scope of cumulative impacts for socioeconomics are forest practices projects identified by the BLM and USFS. The workers for these projects will likely be predominantly local staff and will not require temporary housing, and therefore should not cumulatively impact housing resources for the Project.

3.8.3. Economy and Tax Revenues

JCEP and PCGP will spend about $10.3 billion on construction and facility expenses, of which $4.4 billion will be from Oregon sources. The Project will support about $4.9 billion in indirect and induced economic output in Oregon between 2019 and 2023. It is expected that PCGP will contribute about $20 million in property taxes in 2024 and JCEP will pay a Community Service Fee of about $40 million as part of a Community Enhancement Plan in Coos County.

Property taxes generated from the Project components will provide local governments with revenue to fund public facilities and services. In addition to property tax revenue, the temporary and permanent workforce associated with the Project will contribute to income taxes to the local economy, thereby leading to a compounding positive cumulative impact on the regional economy.

There will also be a long-term cumulative impact on the economy from property and income taxes associated with the Project and those projects listed in Attachment A.1. The Projects contribution toward cumulative economic impact is anticipated to be positive through increased tax revenues generated within the project's geographic scope.

[Discussion of potential cumulative impacts with Projects listed in Attachment A.1 to be provided in subsequent submittal]

3.8.4. Public Services

The cumulative impact on public services from the Project and the other projects listed in Attachment A.1 will depend on the number of projects under construction at one time. The small incremental demands of several projects occurring at the same time could become difficult for police, fire, and emergency personnel to address. With proper planning, emergency and other public services generally are able to handle additional service needs. JCEP has committed to building and funding the Southwest Oregon Regional Safety Center within the LNG Terminal site. The Southwest Oregon Regional Safety Center will house the Coos County Sheriff's Office, Coos County Emergency Management, Port of Coos Bay, and Emergency Planners from the state, county, and cities of North Bend and Coos Bay. A continuously manned Jordan Cove Fire Station will be located at a separate facility between Ingram Yard and South Dunes. The station will be commanded by a Jordan Cove Fire Chief and staffed with fully trained industrial fire fighters. JCEP will also be responsible for funding additional security

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measures outlined in the U.S. Coast Guards Waterway Suitability Report and LSR which will include escort boats operated by the County's Sheriff's Department.

PCGP is committed to working with local law enforcement, fire departments, and emergency medical services to coordinate effective emergency responses. PCGP will implement a health and safety program, Emergency Response Plan for the Pipeline, and fire prevention and control program to reduce demands on local service providers.

Short-term construction workers will likely not bring their families with them for the duration of the construction cycle. Thus, short-term impacts on educational resources in the four counties will be insignificant. The number of permanent employees planned for the Project is also minor when compared to the total population and size of the Project's geographic scope. The small increase in population resulting from new permanent employees, if they were to transfer from outside of the Project area, will not contribute to a cumulative impact on educational resources.

[Discussion of potential cumulative impacts with Projects listed in Attachment A.1 to be provided in subsequent submittal]

3.8.5. Environmental Justice

The primary issues associated with Environmental Justice Communities for the Project are air quality, noise, and visual impacts. For more detailed information specific to cumulative impacts associated with these resource topics refer to the appropriate subsections within this analysis. Construction and operation of the Project should not have a significant adverse environmental impact on communities with a disproportionate percentage of minority, low-income, other vulnerable populations, or Tribes.

[Expanded discussion, including potential cumulative impacts with Projects listed in Attachment A.1 to be provided in subsequent submittal]

3.9. TRANSPORTATION

[Section to be completed in subsequent submittal of Cumulative Impact Analysis]

3.10. CULTURAL RESOURCES

The cumulative impact area for cultural resources was considered to be the defined area of potential effects ("APE"). As defined in the Resource Report 4s, the direct APE for the Project includes all areas that will potentially experience ground-disturbing activities associated with the LNG Terminal, including the off-site mitigation areas, and the Pipeline. The indirect APE includes all geographic areas that will potentially experience visual, atmospheric, or audible intrusions or changes as a result of construction, operation, and maintenance of the Project. Cumulative impacts on cultural resources will only occur if other projects or activities were to impact the same geographic area as the direct or indirect APE.

Disturbances to cultural resources in the project area not related to the construction, operation, maintenance, and decommissioning of the Project could include illegal artifact collecting; intentional destruction or vandalism; and accidental impacts from agricultural logging, mining, recreational activities, or new infrastructure construction and maintenance operations. The

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Antiquities Act of 1906, National Historic Preservation Act, Archaeological and Historic Preservation Act of 1974, and Archaeological Resources Protection Act protect cultural resources on federal and tribal lands. The Native American Graves Protection and Repatriation Act will provide for treatment of Native American graves and items of cultural patrimony found on federal lands. Additionally, Oregon state law (Oregon Revised Statute ["ORS"] 358.905-955) protects archaeological sites on non-federal lands from damages. It is also Oregon state policy (under ORS 390.805-925) to protect historic and archaeological sites located adjacent to designated scenic waterways. On non-federal lands, Native American graves and associated cultural items are protected under ORS 97.740-760.

The following projects listed in Attachment A.1 have potential to result in a cumulative impact on cultural resources when combined with the impacts on cultural resources resulting from construction of the Project. [Discussion of potential cumulative impacts with Projects listed in Attachment A.1 to be provided in subsequent submittal]

The projects listed in Attachment A.1 that are defined as federal actions will include mitigation measures designed to avoid or minimize additional direct or indirect impacts on cultural resources. Where direct impacts on significant cultural resources are unavoidable, mitigation (e.g., recovery of data and curation of materials) will take place prior to construction. Any project that qualifies as a federal action will have to adhere to Section 106 of the National Historic Preservation Act, including those projects listed in Attachment A.1. The federal agencies that will manage those projects will have to follow the regulatory requirements of 36 CFR 800. Under those regulations, the lead federal agency, in consultation with the State Historic Preservation Office, will have to identify historic properties in the APE, assess potential effects, and resolve adverse effects through an agreement document that outlines a treatment plan.

Non-federal actions will need to comply with any mitigation measures required by the State of Oregon. Nearly the entire APE for JCEP has been surveyed for archaeological resources; however additional surveys are intended to more fully identify the geo-archaeology of the project site within the APE. The entire JCEP APE will be re-surveyed for historic-period resources because it has been more than 10 years since the initial surveys, and many resources within the APE are now, or will soon be, 50 years old. For PCGP, 90 percent of the Pipeline has been surveyed (Phase Is) with some additional access roads, additional temporary workspaces, and contractor and pipe storage yards and rock source and permanent disposal sites also requiring additional survey.

At this time, the Pipeline will have adverse impacts on 17 historic properties (National Register of Historic Places ["NRHP"] eligible) and may have adverse impacts on at an additional 64 potential historic properties (25 NRHP-eligibility undetermined requiring Phase II testing; 16 NRHP-eligibility undetermined requiring additional consultation, survey, and/or documentation; and 23 NRHP-eligible or NRHP-eligibility undetermined for which avoidance and protection plans have been requested). One known archaeological site, recommended not eligible but currently considered unevaluated for the NRHP, will be impacted during construction of the LNG Terminal. Several historic-period resources will also be impacted by construction of the LNG Terminal, however, they have not yet been evaluated for the NRHP. Once evaluations are complete, adverse effects to historic properties will be resolved by implementing the procedures outlined in a Project-specific MOA. The MOA will also include provisions for inventorying areas

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not yet surveyed to identify other historic properties that may be affected by the Project. A project-specific plan has been developed to address the unanticipated discovery of cultural resources and human remains in the event they are discovered during construction.

[Discussion of potential cumulative impacts with Projects listed in Attachment A.1 to be provided in subsequent submittal]

3.11. AIR QUALITY, CLIMATE CHANGE, AND NOISE

3.11.1. Air Quality

[Section to be completed in subsequent submittal of Cumulative Impact Analysis]

3.11.2. Climate Change

[Section to be completed in subsequent submittal of Cumulative Impact Analysis]

3.11.3. Noise

[Section to be completed in subsequent submittal of Cumulative Impact Analysis]

4.0 CUMULATIVE IMPACT ANALYSIS CONCLUSIONS

[Section to be completed in subsequent submittal of Cumulative Impact Analysis]

5.0 REFERENCES

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FIGURES

Figure 2.3-1
Watersheds and Counties Crossed by the Project (to be provided in subsequent version)

ATTACHMENTS

CTCLUSI Exhibit A

ATTACHMENT A.1

Table of Past, Present, and Reasonably Foreseeable Future Actions with Potential for Cumulative Impacts when Combined with the Project

ATTACHMENT A.1

[Completed table to be provided in subsequent submittal]

Recent, Current, or Proposed Actions That May Cumulatively Affect Resources

Project	County	Description	Total Acres	Status	Location Relative to Project	Resources Affected
Coos Bay Frontal Pacific Ocean Watershed						
Principle Power Windfloat Pacific Demonstration Project	Coos	Principle Power proposed to deploy five floating platforms that could support wind turbines capable of generating a total of up to 30 MW. The platforms would be located in deep water in the Pacific Ocean about 15 miles offshore of Coos Bay, Oregon.	N/A	2013-2016 (project abandoned)		

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[Completed table to be provided in subsequent submittal]

Recent, Current, or Proposed Actions That May Cumulatively Affect Resources

Project	County	Description	Total Acres	Status	Location Relative to Project	Resources Affected
Port - Coos Bay Railroad Bridge Rehabilitation, Port of Coos Bay	Coos	In February 2005, the Port completed Phase One of its rehabilitation of the railroad bridge over Coos Bay. The Port has applied for $12.7 million in Tiger III transportation grant funding for Phase Two of the project. Phase Two would consist of additional structural steel repair and replacement, application of a protective coating, and other work as needed. The Port realigned portions of the Trans-Pacific Parkway on the North Spit during the planning and engineering for the North Spit Rail Spur. Construction was completed in 2010. In 2014, load ratings for the three swing span bridges were completed, and in 2015 the ratings for the additional steel structures were completed. The Port of Coos Bay plans to get the needed $14 million from Federally funded grants to complete the project.	N/A	2005-2017		
Port - Trans-Pacific Parkway Realignment, Port of Coos Bay	Coos	The Port realigned portions of the Trans-Pacific Parkway on the North Spit during the planning and engineering for the North Spit Rail Spur. Construction was completed in 2010.	3	Completed in 2010.		

CTCLUSI Exhibit A

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[Completed table to be provided in subsequent submittal]

Recent, Current, or Proposed Actions That May Cumulatively Affect Resources

Project	County	Description	Total Acres	Status	Location Relative to Project	Resources Affected
Port – North Spit Barge Slip at Southport, Port of Coos Bay	Coos	The Port partnered with Southport Forest Products to develop a multimodal barge facility with access to the North Spit Spur Railroad Line and the Trans-Pacific Parkway, and the privately owned barge slip is now in use for intermodal cargo movements, and can handle ocean going barges able to move inbound logs, outboard wood chips, and a variety of break bulk general cargo.	1	2007-2012. Completed.		
Port - Charleston Marina Master Plan and Improvements	Coos	The Port completed an interbasin restroom; 2,400 lineal feet of curbing, sidewalks, landscaping, lighting, and storm drains to Boat Basin Road; constructed a paddlecraft launch site near the entrance to South Slough; placed utilities underground at the Charleston Shipyard; constructed a new fish cleaning station near the Charleston Marina boat launch; and partly completed paving, parking, sidewalk, curbing, and other enhancements around the Oregon Institute of Marine Biology's interpretive center. Master plan updated in 2013.	1.	2007-2014. Completed.		

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ATTACHMENT A.1

[Completed table to be provided in subsequent submittal]

Recent, Current, or Proposed Actions That May Cumulatively Affect Resources

Project	County	Description	Total Acres	Status	Location Relative to Project	Resources Affected
Port – Maintenance Dredging, Port of Coos Bay	Coos	The Port is currently seeking Department of Army authorization to conduct maintenance dredging in and around the Charleston marina, shipyard, and deep water fleet mooring area as well as at 18 independent terminal locations in the Coos Bay estuary. Port completed this work and removed high spots within the marina and shipyard to keep the appropriate water depth throughout the area.	31	Ongoing		
Port – Channel Modification, Port of Coos Bay	Coos	In 2007, the Port received authorization from the US Army Corp of Engineers (USACE) to pursue studies necessary to determine whether or not a channel modification project should be recommended to the U.S. Congress for funding. In 2014, Jordan Cove Energy Project agreed to help pay for project. The Port of Coos Bay is now working with the USACE to complete a project that would both deepen and widen the existing channel.	33	2007-2022. Currently in permitting stage		

ATTACHMENT A.1

[Completed table to be provided in subsequent submittal]

Recent, Current, or Proposed Actions That May Cumulatively Affect Resources

Project	County	Description	Total Acres	Status	Location Relative to Project	Resources Affected
USACE Coos Bay Jetties Rehabilitation Project	Coos	USACE Civil Works is currently investigating several repair design alternatives with the primary goal of extending the functional life of the north and south jetties and maintaining deep-draft navigation through the Coos Bay navigation channel entrance.	120	2015 to 2025		
Confederated Tribes of Coos, Lower Umpqua & Siuslaw Indians (CTCLUSI) - Museum	Coos	Planning for a village at Hollering Place, a 20-30,000 square foot hotel, convention center, and spa bordering Hollering Place Wayside in the city of Coos Bay.	1	2016-2016		
Confederated Tribes of Coos, Lower Umpqua & Siuslaw Indians (CTCLUSI) — Tribal Gaming Facility	Coos	Casino Approximately (10,000 sq. ft.) at Ocean Grove Blvd, Coos Bay. Completed May 2015, final size is 15,000 square feet.	1	2014		

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[Completed table to be provided in subsequent submittal]

Recent, Current, or Proposed Actions That May Cumulatively Affect Resources

Project	County	Description	Total Acres	Status	Location Relative to Project	Resources Affected
Confederated Tribes of Coos, Lower Umpqua & Siuslaw Indians (CTCLUSI) - Coos Head Area Master Plan	Coos	Current program detail includes: Tribal housing (limited number of 1-2 bedroom units); Conference and Retreat Center; Interpretive Museum; trails; roads; and utilities	150	March 2016 kick-off meeting		
City of Coos Bay — Downtown Revitalization Project	Coos	Redevelopment of four downtown buildings and the McAuley Hospital in the city of Coos Bay	1	2015		
City of North Bend – Department of Human Services Building Relocation	Coos	The Department of Human Services building will be relocated from 2025 Sheridan to a property off of Airport Lane.	0.5	In progress		

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[Completed table to be provided in subsequent submittal]

Recent, Current, or Proposed Actions That May Cumulatively Affect Resources

Project	County	Description	Total Acres	Status	Location Relative to Project	Resources Affected
USACE Coos Bay Navigation Channel Maintenance Dredging	Coos	The USACE conducts annual dredging of the Coos Bay Federal Navigation channel in four areas: (1) Coos River Entrance Channel (500,000 to 1 million cubic yards [CY] removed annually from river mile [RM] -1 to 1); (2) Coos River Navigation Channel (150,000 to 300,000 CY removed annually from RM 1 to 12); (3) Coos River Navigation Channel (1 million CY removed every 5-7 years from RM 12 to 15); and (4) Charleston Access Channel (50,000 CY removed annually from the Charleston Channel). Dredged material is placed within multiple authorized and approved in-water material placement locations, including both ocean and in-bay sites.	Acres vary by river condition and year.	Ongoing, annually between April and November		
Coos County Airport District — Southwest Oregon Regional Airport Expansion	Coos	In 2013, the Airport District prepared an update to its Airport Master Plan. The Master Plan calls for the extension of Runway 4-22 by an additional 400 feet, sometime in the near future. 30,000 square-foot hangar built in 2014.	1	2014-2019		

ATTACHMENT A.1

[Completed table to be provided in subsequent submittal]

Recent, Current, or Proposed Actions That May Cumulatively Affect Resources

Project	County	Description	Total Acres	Status	Location Relative to Project	Resources Affected
Ocean Grove Housing Development, Coos Bay	Coos	In 2013, Ocean Grove Development Group broke ground for its residential subdivision that over the next several years could include about 634 houses in the city of Coos Bay.	72	2013-unknown		
BLM — Catching Creek Conversion Timber Sale	Coos	Hardwood conversion CI 0.4 mile temporary road construction 1.8 miles renovation. Protest period runs from 03/30/2017-04/14/2017, Sale date 04/28/2017	61 (24 RR d/) 1 5	2017		
BLM —Wilson Creek 4 Timber Sale	Coos	Stand density management Hardwood conversion 1.0 mile temporary road construction 1.9 miles renovation	138 (34 RR d/) 119 (84 RR d/) 3 5	2018		
BLM — Whistle Stop Timber Sale	Coos	Stand density management Hardwood conversion 0.2 mile temporary road construction 0.6 mile renovation	75 (31 RR d/) 96 (45 RR d/) <1	Sold April 2016		
BLM — Other CT Timber Sales	Coos	Commercial Thinning Density Management Thinning	19 (3 RR d/)	2016		

ATTACHMENT A.1

[Completed table to be provided in subsequent submittal]

Recent, Current, or Proposed Actions That May Cumulatively Affect Resources

Project	County	Description	Total Acres	Status	Location Relative to Project	Resources Affected
BLM — Whiskey Train Timber Sale	Coos	Stand density management 0.2 mile new construction 0.2 mile of improvement 0.7 mile of renovation	85 (22 RR d/) 1 1 2	Ongoing (Sold 2013).		
BLM — Pathfinder Timber Sale	Coos	Stand density management 0.1 mile new construction 0.1 mile of improvement 0.1 mile of renovation	42 (34 RR d/) 1 1 1	Ongoing (Sold 2013).		
Coquille (Middle Main) Watershed						
BLM – Calloway Creek Timber Sale	Coos	Stand density management Hardwood conversion 2.2 miles temporary road construction 1.1 miles road improvement, and 1.7 miles renovation	265 (110 RR d/) 127 (56 RR d/) 6 7	2018		
BLM – Whistle Stop Conversion Timber Sale	Coos	Hardwood conversion 0.2 mile road renovation	2 (1 RR d/) <1	Sold April 2016		

ATTACHMENT A.1

[Completed table to be provided in subsequent submittal]

Recent, Current, or Proposed Actions That May Cumulatively Affect Resources

Project	County	Description	Total Acres	Status	Location Relative to Project	Resources Affected
BLM — Hungry Mountain Timber Sale	Coos	Hardwood conversion 1.5 miles temporary road construction Stand density management (2 acres are within the pipeline ROW; 1 of which is in RR)	178 (77 RR d/) 57 (26) 4	2018		
BLM — West Cunningham Timber Sale	Coos	Stand density management (2 acres are within the pipeline ROW; 1 of which is in RR) Hardwood conversion.	222 (66 RR d/) 67 (34 RR d/)	Sale date July 2017		
BLM — Wilson Creek 4 Timber Sale	Coos	Stand density management Hardwood conversion 0.2 mile temporary road construction 0.6 mile renovation	69 (20 RR d/) 4 <1 2	2017		
BLM- Other CT Timber Sales	Coos	Commercial Thinning Density Management Thinning	19 3 RR	2016		

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[Completed table to be provided in subsequent submittal]

Recent, Current, or Proposed Actions That May Cumulatively Affect Resources

Project	County	Description	Total Acres	Status	Location Relative to Project	Resources Affected
North Fork Coquille River Watershed						
BLM — Manual Maintenance	Coos	Brush and hardwood control of young stands (<11 years old)	36 (1 RR d/)	Unknown		
BLM — Cloud 19 CT Timber Sale	Coos	Stand density management 0.1 mile temporary road construction 0.3 mile renovation	180 (105 RR d/) <1 <1	Sold October 2015		
BLM — Hungry Mountain Timber Sale	Coos	Sand density management Hardwood conversion including 0.5 mile temporary road construction 1.9 miles renovation	37 (10 RR d/) 38 (17 RR d/) 1 5	2018		
BLM — Iron Monkey CT Timber Sale	Coos	Stand density management (96 are within the pipeline ROW, 5 of which are in Riparian Reserve)	173 (100 RR d/)	Ongoing (Sold 2014)		
BLM — North Fork 25 Timber Sale	Coos	223 acres of stand density management, inducing 50 acres in Riparian Reserve (9 acres of the 223 are within the pipeline ROW, 1 of which is in Riparian Reserve) 0.7 mile temporary road construction (0.2 of which is in the pipeline ROW) 0.2 mile renovation (0.1 of which is in the pipeline ROW)	223 (50 RR d/) 2	Ongoing (Sold 2014)		

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[Completed table to be provided in subsequent submittal]

Recent, Current, or Proposed Actions That May Cumulatively Affect Resources

Project	County	Description	Total Acres	Status	Location Relative to Project	Resources Affected
BLM — Steele 23 CT Timber Sale	Coos	Stand density management (7 acres of the 278 are within the pipeline ROW, 2 of which are in Riparian Reserve) 1.2 miles road construction 1.1 miles improvement (0.2 of which are in the pipeline ROW)	278 (118RR d/) 3	Ongoing (Sold 2015)		
BLM — Cloud 19 CT Timber Sale	Coos	Stand density management OA mile temporary road construction 0.5 mile improvement	77 (22 RR d/) <1 1	Sold October 2015		
BLM — Woodward 11 Timber Sale	Coos	Stand density management Hardwood conversion 0.5 mile temporary road construction 1.1 miles improvement, and 3.1 miles renovation	171 (100 RR d/) 75 (18 RR d) 1 11	Sold March 2017		
BLM — North Coquille Junction Timber Sale	Coos	1.5 miles renovation (0.2 of which are in the pipeline ROW) Combined with Big Bend project and sold as Hidden Gem CT	121	Sold January 2017		

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[Completed table to be provided in subsequent submittal]

Recent, Current, or Proposed Actions That May Cumulatively Affect Resources

Project	County	Description	Total Acres	Status	Location Relative to Project	Resources Affected
Rock Prairie Timber Sale	Coos	Hardwood conversion 0.2 mile temporary road construction 0.3 mile renovation Analysis included in Lone Pine EA	30 (10 RR d) <1 <1	2016		
BLM — Parkview Timber Sale	Coos	Stand density management Hardwood conversion 0.4 mile temporary road construction 5.4 miles renovation	251 (119 RR d/) 43 (23 RR d/) 1 14	Ongoing (sold 2013)		
BLM — S. Bridge Timber Sale	Coos	Stand density management Hardwood conversion 0.6 mile temporary road construction, 4.1 miles renovation 0.4 mile existing road decommission	322 (100 RR d/) 9 (5 RR d) 2 10 1	Completed (2014)		
BLM — Vaughns Junction Sale	Coos	Stand density management Hardwood conversion 0.1 mile temporary road construction 0.5 mile improvement and 0.5 miles renovation.	109 (71 RR d/) 9 (5 RR d/) <1 3	Completed (2014)		

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[Completed table to be provided in subsequent submittal]

Recent, Current, or Proposed Actions That May Cumulatively Affect Resources

Project	County	Description	Total Acres	Status	Location Relative to Project	Resources Affected
BLM — Dora Timber Sale	Coos	Stand density management Hardwood conversion 0.3 mile temporary road construction, 0.1 mile improvement, and 0.5 miles renovation	67 (36 RR d/) 9(6 RR d/) 1 <1	Sold June 2014		
BLM — Hidden Gem Timber Sale	Coos	Stand density management Hardwood conversion (4 acres are in pipeline ROW, 1 acre of which is Riparian Reserve 0.5 mile temporary road construction 2.6 miles renovation (0.2 of which is in the pipeline ROW)	121 (59 RR d/) 44 (26 RR d/) 1 5	Sold January 2017		
BLM — Steele Cherry Timber Sale	Coos	Stand density management Hardwood conversion Analysis included in Lone Pine EA	31 (16 RR d/) 40 (12 RR d/)	Sold June 2016		
BLM — Yankee Timber Sale Yankee Panky CT	Coos	Stand density management Hardwood conversion 0.1 mile temporary road construction and 2.9 miles renovation Analysis included in Lone Pine EA	88 (46 RR df) 68 (39 RR d/) <1 7	Sold April 2016		

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[Completed table to be provided in subsequent submittal]

Recent, Current, or Proposed Actions That May Cumulatively Affect Resources

Project	County	Description	Total Acres	Status	Location Relative to Project	Resources Affected
BLM — Honcho Creek Fish Culvert Replacement	Coos	Replace a culvert on Honcho Creek with a fish passage design. EA completed March 2014, and ROD release April 2014.	1 RR	2015		
BLM — ERFO Road repairs	Coos	Repair 2014 storm damage on 2 sites: Middle Creek Rd — repair fill slope (riparian); Blue Ridge - replace culvert (riparian). EA completed March 2014, and ROD release April 2014.	2 RR	2016		
BLM —Steel Trap Density Management Thinning (DM)	Coos	Stand density management Hardwood Conversion 0.81 mile of New Road Construction 4.4 miles of renovation	295 (98 RR) 38 3 10	Ongoing (Sold 2014)		
BLM — Zumwalt CT Commercial thinning	Coos	Stand density management Hardwood Conversion 1.2 miles of New Road Construction 1.6 miles of renovation	202 (4 RR) 18 (6RR) 4 3	Sold November 2015		
BLM — Maintenance Shop CT Commercial thinning	Coos	Stand density management 0.55 mile of New Road Construction 2.85 miles of renovation	34 (51RR) 2 6	Ongoing (Sold 2015)		

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[Completed table to be provided in subsequent submittal]

Recent, Current, or Proposed Actions That May Cumulatively Affect Resources

Project	County	Description	Total Acres	Status	Location Relative to Project	Resources Affected
BLM — Johns Creek CT Commercial thinning	Coos	Stand density management 0.47 mile of New Road Construction 5.96 miles of renovation Analysis included in Lone Pine EA	87 (60 RR) 2 13	Sold June 2015		
BLM — 2 Buck Shuck CT Commercial thinning	Coos	Stand density management 0.93 mile of New Road Construction 4.7 miles of renovation	129 (69 RR) 3 10	Ongoing (Sold 2014)		
BLM — Hidden Gem CT Commercial thinning	Coos	Stand density management Hardwood Conversion 1.2 miles of New Road Construction 6.3 miles of renovation	121 (100 RR) 43 (21 RR) 4 14	Sold January 2017		
BLM — Wimer CT Commercial thinning	Coos	Stand density management 0.29 mile of New Road Construction 2.4 miles of renovation Decision Rationale posted October 2015	34 (45 RR) 1 5	2017		
BLM — Llewellyn CT Commercial thinning	Coos	Stand density management Hardwood Conversion 0.97 mile of New Road Construction 3.12 miles of renovation Analysis included in Lone Pine EA	72 (33 RR) 69 (30 RR) 4 7	2017		

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Recent, Current, or Proposed Actions That May Cumulatively Affect Resources

Project	County	Description	Total Acres	Status	Location Relative to Project	Resources Affected
BLM — Other CT TMther Sales (TS were analyzed in the Lone Pine EA)	Coos	Stand density management 0.56 mile of New Road Construction 4.6 miles of renovation	98 (8 RR) 2 10	Planning within 5 years		
BLM — Whiskey Train Timber Sale	Coos	Stand density management 0.1 mile new construction 0.1 mile of improvement 0.1 mile of renovation	42 (34 RR) 1 1 1	Ongoing (Sold 2013)		
BLM — Pathfinder Timber Sale	Coos	Stand density management 8.9 miles of new construction 1.0 mile of improvement	178 (82 RR) 23 3	Ongoing (Sold 2014)		
BLM — Thunderbolt Timber Sale	Coos	Stand density management 0.9 mile of new construction 3.0 miles of renovation	211 (91 RR) 2 8	Ongoing (Sold 2013)		
BLM — Blue 35 Timber Sale	Coos	Stand density management 1.4 miles of new construction 4.3 miles of renovation	261 (102 RR) 4 11	Ongoing (Sold 2013)		
East Fork Coquille Watershed						

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[Completed table to be provided in subsequent submittal]

Recent, Current, or Proposed Actions That May Cumulatively Affect Resources

Project	County	Description	Total Acres	Status	Location Relative to Project	Resources Affected
BLM — Scattered Skeeter Density Management Thinning	Coos	Thin mid-seral forest in LSR and Riparian Reserves, includes 52 acres of alder conversion 1.1 miles of temporary new road construction 0.2 mile of road improvement, 24.4 miles of road renovation 11.3 miles of road decommissioning.	568 (113 RR d/) 3 63 28	Completed		
BLM — Broken Wagon Density Management Thinning	Coos	Thin mid-seral forest in LSR and Riparian Reserves (includes 126 acres of alder conversion in LSR and Riparian Reserves) 1.3 miles of temporary new road construction 0.1 mile road improvement, 20.6 miles road renovation 3.1 miles of road decommissioning.	178 3 18 8	Completed (2011)		
BLM — Crosby Timber Sale	Coos	Stand density management Hardwood conversion 1.4 miles temporary road construction and 1.8 miles renovation	226 (90 RR d/) 25 (5 RR d/) 8	Ongoing (Sold 2014)		
BLM — Steele Cherry Timber Sale	Coos	Stand density management Hardwood conversion	159 (80 RR d/) 28 (17 RR d/)	Sold June 2016		

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[Completed table to be provided in subsequent submittal]

Recent, Current, or Proposed Actions That May Cumulatively Affect Resources

Project	County	Description	Total Acres	Status	Location Relative to Project	Resources Affected
BLM — Yankee Timber Sale Yankee Panky Timber Sale	Coos	Stand density management Hardwood conversion 1.5 miles temporary road construction, 0.6 miles improvement, and 6.7 miles renovation. Analysis included in Lone Pine EA	260 (130 RR d/) 64 (30 RR d/) 22	Sold April 2016		
BLM — East Cherry Timber Sale	Coos	Hardwood Conversion	64 (20 RR d/)	Ongoing (sold in 2014)		
BLM — Wagon Road Pilot Timber Sale	Coos	Regeneration harvest Stand density management in Riparian Reserve Hardwood conversion in Riparian Reserves 1.1 miles temporary road construction 1.1 miles improvement, and 2.9 miles renovation.	96 5 9 3 10	Ongoing (sold in 2012)		
BLM — ERFO Road repairs	Coos	repair 2014 storm damage on 2 sites: W. Fk Brummet — repair fill slope (riparian); Weaver Sitkum - repair fill slope, replace two culverts (riparian); EA completed March 2014, and ROD release April 2014.	2 RR	2016		

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[Completed table to be provided in subsequent submittal]

Recent, Current, or Proposed Actions That May Cumulatively Affect Resources

Project	County	Description	Total Acres	Status	Location Relative to Project	Resources Affected
BLM — Weed Treatment	Coos	Herbicide treatment of roadside noxious weeds (55 acres on BLM, 3 of which are in the pipeline ROW, 57 on private lands)	112	Unknown		
BLM — Steel Trap DM Density Management Thinning	Coos	Stand density management 0.43 mile of renovation	24 (4 RR) 2	Sold (2014)		
BLM — Weed Treatment	Coos	Herbicide treatment of roadside noxious weeds (132 acres on BLM land, 3 of which are in the pipeline right-of-way, 39 acres on private lands)	171	Unknown		
BLM — Suicide Bar Commercial Thinning	Coos	Thinning; Temporary Road Construction; Road Renovation, Improvement and Maintenance. Proposed sale date of September 16, 2016	327 acres	2011-2016		
BLM — Brownstone CT Commercial thinning	Coos	Stand density management 1.3 miles of New Road Construction 9.4 miles of renovation	231 (112 RR) 5 21	Sold (2014)		

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[Completed table to be provided in subsequent submittal]

Recent, Current, or Proposed Actions That May Cumulatively Affect Resources

Project	County	Description	Total Acres	Status	Location Relative to Project	Resources Affected
BLM —My Frona CT Commercial thinning (Was Frona Flats CT)	Coos	Stand density management 1.09 miles of New Road Construction 4.65 miles of renovation	150 (23 RR) 4 10	Ongoing (Sold 2014)		
BLM — Weekly CT Commercial thinning	Coos	Stand density management 0.16 mile of New Road Construction 4.85 miles of renovation	86 (95 RR) 1 11	Ongoing (Sold 2014)		
BLM — Steel Cherry CT Commercial thinning	Coos	Stand density management Hardwood Conversion 0.19 mile of New Road Construction 6.8 miles of renovation	97 (70 RR) 26 (23 RR) 1 15	2016		
Middle Fork Coquille Watershed						
BLM — Bear Creek Campground Decommission	Coos/ Douglas	Decommission previously closed campground adjacent to the Middle Fork Coquille River.	2 RR	2015		
BLM — Manual Maintenance	Coos/ Douglas	Brush and hardwood control (stands <11 yrs old); 3 acres of which are within the pipeline ROW	65	Unknown		

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Recent, Current, or Proposed Actions That May Cumulatively Affect Resources

Project	County	Description	Total Acres	Status	Location Relative to Project	Resources Affected
BLM —Weaver Tie Timber Sale	Coos/ Douglas	Stand density management Hardwood conversion 0.2 mile temporary road construction 0.3 mile renovation	27 (7RR d/) 43 (21 RR d/) <1 <1	Sold February 2016		
BLM — Weed Treatment	Coos/ Douglas	Herbicide treatment of roadside noxious weeds (132 acres on BLM land, 3 of which are in the pipeline right-of-way, 39 acres on private lands)	171	Unknown		
BLM — Suicide Bar Commercial Thinning	Coos/ Douglas	Thinning: Temporary Road Construction; Road Renovation, Improvement and Maintenance.	253 Acres	2011-2016		
BLM — ERFO Road repairs	Coos/ Douglas	Repair 2014 storm damage on 3 sites: Camas weaver Tie — repair fill slope; Lower Signal Tree - replace culvert (riparian); Big Creek — repair fill slope (riparian)	2 RR	2016		
Olalla Creek-Lookingglass Watershed						
BLM — Suicide Bar Commercial Thinning	Douglas	Thinning; Temporary Road Construction; Road Renovation, Improvement and Maintenance	70 Acres	Unknown		

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[Completed table to be provided in subsequent submittal]

Recent, Current, or Proposed Actions That May Cumulatively Affect Resources

Project	County	Description	Total Acres	Status	Location Relative to Project	Resources Affected
Clark Branch-South Umpqua River Watershed						
No identified projects	N/A					
Lower Cow Creek Watershed						
No identified projects	N/A					
Myrtle Creek Watershed						
No identified projects	N/A					
Days Creek-South Umpqua River Watershed						
No identified projects	N/A					
Deer Creek South Umpqua River Watershed						
Taco Bell	Douglas	Taco Bell restaurant and a minimum of 27 parking spaces at 200 Grant Smith Road.	2	2017		

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[Completed table to be provided in subsequent submittal]

Recent, Current, or Proposed Actions That May Cumulatively Affect Resources

Project	County	Description	Total Acres	Status	Location Relative to Project	Resources Affected
Grange Road Development	Douglas	46-lot phased subdivision; 24-lot Phase 1 is final, approval date for Phase 2 is August 2019	10	2017-2019		
Lower North Umpqua River Watershed						
No identified projects	N/A					
Elk Creek Watershed						
Forest Service — Noxious Weed Treatment	Douglas	50 acres per year. Hand pulling and cutting.	50/year	Ongoing		
Forest Service – Livestock Grazing	Douglas	Cattle grazing	9,963	Ongoing		
Forest Service— Tiller Aquatic Restoration Project	Douglas	2 culvert replacements, 8 miles instream habitat improvement, 5 sump maintenance sites, Drew Lake Habitat Improvement	N/A	Ongoing		

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[Completed table to be provided in subsequent submittal]

Recent, Current, or Proposed Actions That May Cumulatively Affect Resources

Project	County	Description	Total Acres	Status	Location Relative to Project	Resources Affected
Forest Service—Elk Creek Watershed Restoration Project	Douglas	Commercial Thinning Non-commercial thinning Activity fuels treatment Shed fuel breaks Prescribed burning Temporary Road construction/removal Road removal 22 Culvert replacements	3,629 551 4,305 513 3,176 9 9.5 N/A	Expect implementation to being in 2018 and project to continue through 2023		
Anticipated Clear Cutting on Private Land	Douglas	Timber harvest	150	Unknown		
Upper Cow Creek Watershed						
Forest Service—Livestock Grazing	Douglas/ Jackson	Grazing	8,250	Ongoing		
Anticipated Clear Cutting on Private Land	Douglas/ Jackson	Timber Harvest	270	Unknown		
Forest Service – Tiller Aquatic Restoration Project	Douglas/ Jackson	1 culvert replacement	N/A	Expect implementation to begin in 2019		

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Recent, Current, or Proposed Actions That May Cumulatively Affect Resources

Project	County	Description	Total Acres	Status	Location Relative to Project	Resources Affected
Cow Creek Fuel Break Project	Douglas/ Jackson	Non-commercial shaded fuel break	600	2017-2018		
Trail Creek Watershed						
Forest Service-Cattle Grazing	Jackson	Grazing	4,230	Ongoing		
BLM — Tiller-Trail Highway "Realignment Project (BLM lands)"	Jackson	Highway realignment	7	Implemented in 2014		
BLM — Proposed Trail Creek Forest Management	Jackson	Restoration thinning Riparian thinning Hazardous fuels treatment Precommercial thinning 8 pump chances restored, block 4 roads, replace 1 culvert "decommission 0.5 mile of road, stream restoration on 0.5 miles"	336 13 414 263 N/A 1 N/A	Implementation in 2015		

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[Completed table to be provided in subsequent submittal]

Recent, Current, or Proposed Actions That May Cumulatively Affect Resources

Project	County	Description	Total Acres	Status	Location Relative to Project	Resources Affected
BLM — Proposed Trail Creek Forest Management	Jackson	Restoration thinning, Riparian thinning, Hazardous fuels treatment, Meadow restoration, Small diameter thinning, 6 pump chances restored," Roadside firewood cutting, 0.8 mile of temporary road construction."	714 75 1,075 282 50 N/A 259 2	Implementation in 2015		
BLM — Proposed Trail Creek Forest Management	Jackson	Restoration thinning, Hazardous fuels treatment, 2 pump chances restored.	20 1,044 N/A	Implementation in 2015		
BLM — Mouse Trail Timber Sale	Jackson	Restoration thinning, Pre-commercial thinning	1,000 500	Sold 08/28/2014		
Shady Cover-Rogue River Watershed						
No identified projects	N/A					
Gold-Hill Rogue River Watershed						

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[Completed table to be provided in subsequent submittal]

Recent, Current, or Proposed Actions That May Cumulatively Affect Resources

Project	County	Description	Total Acres	Status	Location Relative to Project	Resources Affected
Rogue River Drive Estates Subdivision	Jackson	Rogue River Drive Estates, LLC and Rogue Oak, LLC have proposed a 5-Lot residential subdivision which will include the construction of a private road.	Southwest corner of the Dry Creek Road and Rogue River Drive intersection immediately west of 3095 Rogue River Drive.	Ongoing		
Saddlebrook Meadows Subdivision, Phase 2	Jackson	Jon Janakes is proposing a 5-Lot residential subdivision which will include the creation of a half street public road	Northeast corner of 29th Street and Antelope Road	Ongoing		
Valley Meadows Estates	Jackson	FB Owen Inc. is proposing a 13-Lot residential subdivision which will include the creation of both a private and a public road	Southwest corner of Avenue G and Atlantic Avenue, White City.	Ongoing		
Big Butte Creek Watershed						
Forest Service-Livestock Grazing	Jackson	Grazing	63,364	Ongoing		

ATTACHMENT A.1

[Completed table to be provided in subsequent submittal]

Recent, Current, or Proposed Actions That May Cumulatively Affect Resources

Project	County	Description	Total Acres	Status	Location Relative to Project	Resources Affected
Forest Service – 2009 Rancheria Allotment Management Plan Update	Jackson	TBD	TBD	Expected implementation 10/2009		
Little Butte Creek Watershed						
BLM —2004 Deadwood Complex EA (Allotment Management Plan Update for Five Allotments	Jackson/ Klamath	Grazing on the South Butte Allotment Grazing on the Conde Allotment Grazing on the Deadwood Allotment	25,700 3,300 18,300	Unknown		
Forest Service — 2009 Fish Lake Management Plan Update	Jackson/ Klamath	Grazing on the Fish Lake Allotment	7,500	Expected implementation 10/2009		
Forest Service — 2013 Big Elk Cinder Pit CE	Jackson/ Klamath	Excavation of cinders from an existing cinder quarry DM released 01/13/2014	5	2013-2024		

ATTACHMENT A.1

[Completed table to be provided in subsequent submittal]

Recent, Current, or Proposed Actions That May Cumulatively Affect Resources

Project	County	Description	Total Acres	Status	Location Relative to Project	Resources Affected
BLM — Salty Gardner DNA	Jackson/ Klamath	Hazardous fuels treatment	540	DNA released July 2013		
Bieber Salt Forest Management FY 2016, Salty Gardner DNA	Jackson/ Klamath	Upland vegetation treatment, Hazardous fuels treatment	756 721	FY 2016		
BLM — Bieber Salt Forest Management FY 2016, Salty Gardner DNA	Jackson/ Klamath	Upland vegetation treatment, Hazardous fuels treatment	763 932	FY 2016		
Forest Service-Livestock Grazing	Jackson/ Klamath	Grazing	87,620	Ongoing		
Fourmile Creek Watershed						
No identified projects	N/A					
Spencer Creek Watershed						
Forest Service – Livestock Grazing	Klamath	Grazing	30,646	Ongoing		

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ATTACHMENT A.1

[Completed table to be provided in subsequent submittal]

Recent, Current, or Proposed Actions That May Cumulatively Affect Resources

Project	County	Description	Total Acres	Status	Location Relative to Project	Resources Affected
Forest Service — Dead Indian Memorial and Clover Creek Roads Noxious Weed Treatment	Klamath	7 miles of weed treatment	70	Ongoing annually		
Forest Service — Lake of the Woods WUI Project	Klamath	Fuels treatments for private home protection	100	2020		
Forest Service — Road Maintenance	Klamath	Variety of routine road maintenance activities	No Estimate	Unknown		
Forest Service – Roadside Firewood Collection	Klamath	Downed or dead firewood collection w/in 300 feet along open roads	1000	Ongoing		
BLM — Walters Glade Timber Sale and Vegetation Management	Klamath	Commercial and pm-commercial vegetation management	1,271	2016-2020		
BLM — Spencer Creek Thinning	Klamath	Small Diameter thinning	300	2015-2020		

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ATTACHMENT A.1

[Completed table to be provided in subsequent submittal]

Recent, Current, or Proposed Actions That May Cumulatively Affect Resources

Project	County	Description	Total Acres	Status	Location Relative to Project	Resources Affected
John C. Boyle Reservoir-Klamath River/Lake Ewauna-Upper Klamath River/Mills Creek-Lost River Watersheds						
BLM — Keno Timber Sale	Klamath	Vegetation Treatment, timber Sales and Small diameter thinning	3,863	2015-2021		
BLM — Swan Lake Hydro Electric Pumped Storage Project	Klamath	Hydro-electric pumped storage project on BLM and Private 500 kV power line Swan Lake Rim to Malin public and private	400 110	2020		
BLM — Bryant Mountain Timber Sale	Klamath	Vegetation Treatment	1,372	2015		
BLM — Bryant Mountain Juniper Treatment	Klamath	Vegetation Treatment Fuels Reduction	1,761	2015		

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ATTACHMENT A.1

[Completed table to be provided in subsequent submittal]

Recent, Current, or Proposed Actions That May Cumulatively Affect Resources

Project	County	Description	Total Acres	Status	Location Relative to Project	Resources Affected
PacifiCorp. Klamath Dam Removal	Klamath	In April 2013, the U.S. Department of the Interior released a Final EIS for the Klamath Dam Removal Project. Congressional approval is needed prior to removing the dams, as well as actions by FERC and other regulatory agencies. April 2016, US Department of the Interior, US Department of Commerce, PacifiCorp and the states of Oregon and California signed an agreement following a process created by the Federal Energy Regulatory Commission		2020		
Velocitel Cell Tower	Klamath	Construction of a cell tower on Stukel Mountain, in south-central Oregon.	<1	2015		
Memory Care Center	Klamath	A new 28-unit (38-bed) memory care center on Jade Terrace adjacent to the Sky Lakes Medical Center and the Oregon Institute of Technology. Quail Park Memory Care Residences of Klamath Falls	1	Opened April 2015		

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ATTACHMENT A.1

[Completed table to be provided in subsequent submittal]

Recent, Current, or Proposed Actions That May Cumulatively Affect Resources

Project	County	Description	Total Acres	Status	Location Relative to Project	Resources Affected
FedEx Company	Klamath	New FedEx distribution center and office on the western side of Altamont Drive just west of the Klamath Regional Airport. 12,000 square-foot distribution warehouse	4	Opened September 2014		

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ATTACHMENT B.1

Map Set of Past, Present, and Reasonably Foreseeable Future Actions with Potential for Cumulative Impacts when Combined with the Project

[To be included with a later submittal]

ATTACHMENT C.1

Correspondence

[To be included with a later submittal]

ATTACHMENT D.1

Summary of Anticipated Permits, Authorizations, and Consultations for Past, Present, and Reasonably Foreseeable Projects within the Cumulative Impact Analysis Area

ATTACHMENT D.1

[Completed table to be provided in subsequent submittal]

Summary of Anticipated Permits, Authorizations, and Consultations for Existing/Proposed Projects within the Cumulative Impact Analysis Area

	Federal											State										
	Federal Energy Regulatory Commission (NEPA, Sec 3 of the Natural Gas Act, National Historic Preservation Act)	U.S. Army Corps of Engineers(Sec 10, 404, and 408)	U.S. Coast Guard (Letter of Recommendation and Analysis pursuant to 33 C.F.R. Part 127, Navigation Aids)	U.S. Department of Energy (Order Conditionally Granting Long-Term Multi-contract Authorization to Export Liquefied Natural Gas to Free Trade and Non-Free Trade Agreement Nations)	U.S. Fish and Wildlife Service (ESA Section 7 Consultation, Fish and Wildlife Coordination Act)	National Marine Fisheries Service (ESA Section 7 Consultation, Magnuson-Stevens Fishery Conservation and Management Act, Marine Mammal Protection Act)	USDI Bureau of Land Management (Temporary Use Permit, Right-of-Way Grant, Amendments to Existing Resource Management Plans)	USDA Forest Service (Right-of-Way Letter, Amendments to Existing Forest Plans)	USDI Bureau of Reclamation (Right-of-Way Grant Letter of Concurrence)	Federal Aviation Administration (Determination of No Hazard to Air navigation pursuant to 14 CFR Part 77.)	Federal Communications Commission (Radio License)	Oregon Division of State Parks Office of Historic Preservation (Section 106 Consultation)	Oregon Department of Environmental Quality Permits [a]	Oregon Department of Land Conservation and Development (Coastal Zone Management Act Compliance)	Oregon Department of Water Resources (Permit to appropriate water, Limited License)	Oregon Department of Fish and Wildlife (In-Water Blasting Permit, Fish Passage Approval, Threatened and Endangered Species Consultation)	Oregon Department of Transportation (state Highway Crossing Permit, Railroad Flagging Permit, Oversize Load Permit, Overweight Load Permit, Street Use Permit)	Oregon Department of State Lands (Joint Removal/Fill Permit, Archaeological Permit, Wetland Report Concurrence)	Oregon Department of Forestry (Operate Mechanical Equipment, Written Plan & Alternate Plan)	Oregon Division of State Lands (Removal-Fill Individual Permit, Proprietary easements and licenses for land access and gravel use)	Oregon State Building Codes Division (Building Permits, Temporary Building Permits)	Oregon State Historic Preservation Office (Sec 106 Consultation)
Coos Bay Frontal Pacific Ocean Watershed																						
Principle Power Windfloat Pacific Demonstration Project																						
Port - Coos Bay Railroad Bridge Rehabilitation, Port of Coos Bay																						
Port - Trans-Pacific Parkway Realignment, Port of Coos Bay																						
Port – North Spit Barge Slip at Southport, Port of Coos Bay																						
Port - Charleston Marina Master Plan and Improvements																						
Port – Maintenance Dredging, Port of Coos Bay																						
Port – Channel Modification																						
USACE Coos Bay Jetties Rehabilitation Project																						

ATTACHMENT D.1

[Completed table to be provided in subsequent submittal]

Summary of Anticipated Permits, Authorizations, and Consultations for Existing/Proposed Projects within the Cumulative Impact Analysis Area

	Federal												State											
	Federal Energy Regulatory Commission (NEPA, Sec 3 of the Natural Gas Act, National Historic Preservation Act)	U.S. Army Corps of Engineers(Sec 10, 404, and 408)	U.S. Coast Guard (Letter of Recommendation and Analysis pursuant to 33 C.F.R. Part 127, Navigation Aids)	U.S. Department of Energy (Order Conditionally Granting Long-Term Multi-contract Authorization to Export Liquefied Natural Gas to Free Trade and Non-Free Trade Agreement Nations)	U.S. Fish and Wildlife Service (ESA Section 7 Consultation, Fish and Wildlife Coordination Act)	National Marine Fisheries Service (ESA Section 7 Consultation, Magnuson-Stevens Fishery Conservation and Management Act, Marine Mammal Protection Act)	USDI Bureau of Land Management (Temporary Use Permit, Right-of-Way Grant, Amendments to Existing Resource Management Plans)	USDA Forest Service (Right-of-Way Letter, Amendments to Existing Forest Plans)	USDI Bureau of Reclamation (Right-of-Way Grant Letter of Concurrence)	Federal Aviation Administration (Determination of No Hazard to Air navigation pursuant to 14 CFR Part 77.)	Federal Communications Commission (Radio License)	Oregon Division of State Parks Office of Historic Preservation (Section 106 Consultation)	Oregon Department of Environmental Quality Permits [a]	Oregon Department of Land Conservation and Development (Coastal Zone Management Act Compliance)	Oregon Department of Water Resources (Permit to appropriate water, Limited License)	Oregon Department of Fish and Wildlife (In-Water Blasting Permit, Fish Passage Approval, Threatened and Endangered Species Consultation)	Oregon Department of Transportation (state Highway Crossing Permit, Railroad Flagging Permit, Oversize Load Permit, Overweight Load Permit, Street Use Permit)	Oregon Department of State Lands (Joint Removal/Fill Permit, Archaeological Permit, Wetland Report Concurrence)	Oregon Department of Forestry (Operate Mechanical Equipment, Written Plan & Alternate Plan)	Oregon Division of State Lands (Removal-Fill Individual Permit, Proprietary easements and licenses for land access and gravel use)	Oregon State Building Codes Division (Building Permits, Temporary Building Permits)	Oregon State Historic Preservation Office (Sec 106 Consultation)
Confederated Tribes of Coos, Lower Umpqua & Siuslaw Indians (CTCLUSI) – Museum																								
Confederated Tribes of Coos, Lower Umpqua & Siuslaw Indians (CTCLUSI) — Tribal Gaming Facility																								
Confederated Tribes of Coos, Lower Umpqua & Siuslaw Indians (CTCLUSI) - Coos Head Area Master Plan																								
City of Coos Bay — Downtown Revitalization Project																								
City of North Bend – Department of Human Services Building Relocation																								
USACE Coos Bay Navigation Channel Maintenance Dredging																								
Coos County Airport District — Southwest Oregon Regional Airport Expansion																								

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ATTACHMENT D.1

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Ocean Grove Housing Development, Coos Bay																						
BLM — Catching Creek Conversion Timber Sale																						
BLM — Wilson Creek 4 Timber Sale																						
BLM — Whistle Stop Timber Sale																						
BLM — Other CT Timber Sales																						
BLM — Whiskey Train Timber Sale																						
BLM — Pathfinder Timber Sale																						
Coquille (Middle Main) Watershed																						
BLM – Calloway Creek Timber Sale																						

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BLM – Whistle Stop Conversion Timber Sale																						
BLM — Hungry Mountain Timber Sale																						
BLM — West Cunningham Timber Sale																						
BLM —Wilson Creek 4 Timber Sale																						
BLM- Other CT Timber Sales																						
North Fork Coquille River Watershed																						
BLM — Manual Maintenance																						
BLM — Cloud 19 CT Timber Sale																						
BLM — Hungry Mountain Timber Sale																						

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BLM — Iron Monkey CT Timber Sale																								
BLM — North Fork 25 Timber Sale																								
BLM — Steele 23 CT Timber Sale																								
BLM — Woodward 11 Timber Sale																								
BLM — North Coquille Junction Timber Sale																								
Rock Prairie Timber Sale																								
BLM — Parkview Timber Sale																								
BLM — S. Bridge Timber Sale																								
BLM — Vaughns Junction Sale																								

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BLM — Dora Timber Sale																								
BLM — Hidden Gem Timber Sale																								
BLM — Steele Cherry Timber Sale																								
BLM — Yankee Timber Sale Yankee Panky CT																								
BLM — Honcho Creek Fish Culvert Replacement																								
BLM — ERFO Road repairs																								
BLM —Steel Trap Density Management Thinning (DM)																								
BLM — Zumwalt CT Commercial thinning																								
BLM —Maintence Shop CT Commercial thinning																								

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BLM — Johns Creek CT Commercial thinning																						
BLM — 2 Buck Shuck CT Commercial thinning																						
BLM — Hidden Gem CT Commercial thinning																						
BLM — Wimer CT Commercial thinning																						
BLM — Llewellyn CT Commercial thinning																						
BLM — Other CT TMther Sales (TS were analyzed in the Lone Pine EA)																						
BLM — Whiskey Train Timber Sale																						
BLM — Pathfinder Timber Sale																						
BLM — Thunderbolt Timber Sale																						

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BLM — Blue 35 Timber Sale																						
East Fork Coquille Watershed																						
BLM — Scattered Skeeter Density Management Thinning																						
BLM — Broken Wagon Density Management Thinning																						
BLM — Crosby Timber Sale																						
BLM — Steele Cherry Timber Sale																						
BLM — Yankee Timber Sale Yankee Panky Timber Sale																						
BLM — East Cherry Timber Sale																						
BLM — Wagon Road Pilot Timber Sale																						

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BLM — ERFO Road repairs																						
BLM — Weed Treatment																						
BLM — Steel Trap DM Density Management Thinning																						
BLM — Weed Treatment																						
BLM — Suicide Bar Commercial Thinning																						
BLM — Brownstone CT Commercial thinning																						
BLM —My Frona CT Commercial thinning (Was Frona Flats CT)																						
BLM — Weekly CT Commercial thinning																						
BLM — Steel Cherry CT Commercial thinning																						

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Middle Fork Coquille Watershed																						
BLM — Bear Creek Campground Decommission																						
BLM — Manual Maintenance																						
BLM —Weaver Tie Timber Sale																						
BLM — Weed Treatment																						
BLM — Suicide Bar Commercial Thinning																						
BLM — ERFO Road repairs																						
Olalla Creek-Lookingglass Watershed																						
BLM — Suicide Bar Commercial Thinning																						

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Clark Branch-South Umpqua River Watershed																						
No identified projects																						
Lower Cow Creek Watershed																						
No identified projects																						
Myrtle Creek Watershed																						
No identified projects																						
Days Creek-South Umpqua River Watershed																						
No identified projects																						
Deer Creek South Umpqua River Watershed																						

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Taco Bell																						
Grange Road Development																						
Lower North Umpqua River Watershed																						
No identified projects																						
Elk Creek Watershed																						
Forest Service — Noxious Weed Treatment																						
Forest Service – Livestock Grazing																						
Forest Service—Tiller Aquatic Restoration Project																						
Forest Service—Elk Creek Watershed Restoration Project																						

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Anticipated Clear Cutting on Private Land																						
Upper Cow Creek Watershed																						
Forest Service—Livestock Grazing																						
Anticipated Clear Cutting on Private Land																						
Forest Service – Tiller Aquatic Restoration Project																						
Cow Creek Fuel Break Project																						
Trail Creek Watershed																						
Forest Service- Cattle Grazing																						
BLM — Tiller-Trail Highway "Realignment Project (BLM lands)"																						

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BLM — Proposed Trail Creek Forest Management																								
BLM — Mouse Trail Timber Sale																								
Shady Cover-Rogue River Watershed																								
No identified projects																								
Gold-Hill Rogue River Watershed																								
Rogue River Drive Estates Subdivision																								
Saddlebrook Meadows Subdivision, Phase 2																								
Valley Meadows Estates																								
Big Butte Creek Watershed																								

CTCLUSI Exhibit A

ATTACHMENT D.1

[Completed table to be provided in subsequent submittal]

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Forest Service – Livestock Grazing																						
Forest Service – 2009 Rancheria Allotment Management Plan Update																						
Little Butte Creek Watershed																						
BLM and Forest Service —2004 Deadwood Complex EA (Allotment Management Plan Update for Five Allotments																						
Forest Service —2009 Fish Lake Allotment Management Plan Update																						
Forest Service —2013 Big Elk Cinder Pit CE																						
BLM — Salty Gardner DNA																						
Bieber Salt Forest Management FY 2016, Salty Gardner DNA																						

CTCLUSI Exhibit A

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BLM — Bieber Salt Forest Management FY 2016, Salty Gardner DNA																						
Forest Service-Livestock Grazing																						
Fourmile Creek Watershed																						
No identified projects																						
Spencer Creek Watershed																						
Forest Service – Livestock Grazing																						
Forest Service — Dead Indian Memorial and Clover Creek Roads Noxious Weed Treatment																						
Forest Service — Lake of the Woods WUI Harvest Project																						

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Forest Service — Road Maintenance																						
Forest Service – Roadside Firewood Collection																						
BLM — Walters Glade Timber Sale and Vegetation Management																						
BLM — Spencer Creek Thinning																						
John C. Boyle Reservoir-Klamath River/ Lake Ewauna-Upper Klamath River/Mills Creek-Lost River Watersheds																						
BLM — Keno Timber Sale																						
BLM — Swan Lake Hydro Electric Pumped Storage Project																						
BLM — Bryant Mountain Timber Sale																						

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BLM — Bryant Mountain Juniper Treatment																								
PacifiCorp. Klamath Dam Removal																								
Velocitel Cell Tower																								
Memory Care Center																								
FedEx Company																								

[a] Including CWA 401, CWA 402 and Air Contaminant Discharge Permit for Compression Facilities, Title V Operating Permit, Construction of Storm Water Discharge Permit, Hydrostatic Test Water Discharge Permit, Operation Storm Water Discharge Permit, Industrial Discharge Permit, Industrial Landfill Closure, RCRA Site Identification Number, Solid Waste Disposal, NPDES Permits

APPENDIX C.1

Correspondence

(to be provided in subsequent filing of this resource report)

U.S. Department of Homeland Security
United States Coast Guard

Captain of the Port
U. S. Coast Guard
Sector Columbia River

2185 SE 12th Place
Warrenton, Oregon 97146-9693
Staff Symbol: s
Phone: (503) 861-6211

16611
May 10, 2018

Director of Gas Environment and Engineering, PJ 11
Attn: Mr. Rich McGuire
Federal Energy Regulatory Commission
888 First Street NE
Washington, DC 20426

Dear Mr. McGuire:

This Letter of Recommendation (LOR) is issued pursuant to 33 Code of Federal Regulations (CFR) 127.009 in response to the Letter of Intent submitted by Jordan Cove Energy Project. L.P. (Jordan Cove) on January 9, 2017. Jordan Cove proposes to construct and operate the Jordan Cove LNG facility in Coos Bay, Oregon from which Liquefied Natural Gas (LNG) is proposed to be transferred in bulk to a vessel for export. This LOR conveys the Coast Guard's recommendation on the suitability of the Coos Bay Channel for LNG marine traffic as it relates to safety and security. In addition to meeting the requirements of 33 CFR 127.009, this LOR fulfills the Coast Guard's commitment for providing information to your agency under the Interagency Agreement signed in February 2004.

After reviewing the information in the applicant's Letter of Intent (LOI) and Waterway Suitability Assessment (WSA) with subsequent annual updates and completing an evaluation of the waterway in consultation with a variety of state and local port stakeholders, I recommend that the Coos Bay Channel be considered suitable for LNG marine traffic. My recommendation is based on review of the factors listed in 33 CFR 127.007 and 33 CFR 127.009. The reasons supporting my recommendation are outlined below.

On November 1, 2017, I completed a review of the WSA for the Jordan Cove Energy Project, submitted to the Coast Guard by KSEAS Consulting on behalf of Jordan Cove in February 2007. This review was conducted following the guidance provided in U.S. Coast Guard Navigation and Vessel Inspection Circular (NVIC) 01-2011, dated January 24, 2011. In conducting this review and analysis, I focused on the navigation safety and maritime security aspects of LNG vessel transits along the affected waterway. My analysis included an assessment of the risks posed by these transits and validation of the risk management measures proposed by the applicant in the WSA. During the review, I consulted a variety of stakeholders including the Area Maritime Security Committees, Harbor Safety Committees, State representatives, Pilot Organizations, and local emergency responders.

Based upon a comprehensive review of Jordan Cove's WSA, and after consultation with State and Local port stakeholders, I recommend that the Coos Bay Channel be considered suitable for accommodating the type and frequency of LNG marine traffic associated with this project.

The attached LOR Analysis contains a detailed summary of the WSA review process that has guided this recommendation. It documents the assumptions made during the analysis of Jordan Cove's WSA. It discusses details of potential vulnerabilities and operational safety and security measures that were analyzed during the review. The portion of the LOR Analysis which addresses matters that affect maritime security is marked as Sensitive Security Information and is withheld from distribution.[1] The LOR Analysis sets forth the navigational safety and maritime security resource gaps that currently exist in, on, and adjacent to the waterway, including the marine transfer area of the proposed facility, and which, to the extent allowable under FERC's existing legal authority, may be addressed in its Commission Order if one is issued. To the extent implementation of specific mitigation measures fall outside the scope of FERC's legal authority, the applicant is expected to examine the feasibility of implementing such mitigation measures, in consultation with the Coast Guard and State and Local agencies as applicable.

This recommendation is provided to assist in the Commission's determination of whether the proposed facility should be authorized. This Letter of Recommendation is not an enforceable order, permit, or authorization that allows any party, including the applicant, to operate a facility or a vessel on the affected waterway. Similarly, it does not impose any legally enforceable obligations on any party to undertake any future action be it on the waterway or at the proposed facility. It does not authorize, nor in any way restrict, the possible future transit of properly certificated vessels on the Coos Bay Channel. As with all issues related to waterway safety and security, I will assess each vessel transit on a case by case basis to identify what, if any, safety and security measures are necessary to safeguard the public health and welfare, critical marine infrastructure and key resources, the port, the marine environment, and vessels. In the event the facility begins operation and LNG vessel transits commence, if matters arise concerning the safety or security of any aspect of the proposed operation, a Captain of the Port Order could be issued pursuant to my authority under the Ports and Waterways Safety Act of 1972, as amended by the Port and Tanker Safety Act of 1978, 33 U.S.C. § 1221 – 1232, among other authorities, to address those matters.

Please note that Enclosures (4) is Sensitive Security Information (SSI) and shall be disseminated, handled and safeguarded in accordance with 49 CFR Part 1520, "Protection of Sensitive Security Information."

If you have any questions on this recommendation, my point of contact is Lieutenant Commander Laura Springer. She can be reached at the address listed above, by phone at (503) 209-2468, or by email at Laura.M.Springer@uscg.mil.

Sincerely,

W. R. TIMMONS,
Captain, U. S. Coast Guard
Captain of the Port, Sector Columbia River

Enclosure (1) LOR Analysis
(2) LOR issued by Sector Portland on April 24, 2009
(3) U.S.C.G.'s Waterway Suitability Report for the Jordan Cove Energy Project
(4) LOR Analysis (SSI Portion)

[1] Documents containing SSI may be made available upon certification that the requestor has a need to know and appropriate document handling and non-disclosure protocols have been established.

Copy: Commander, Coast Guard District Thirteen (dp)
Commander, Pacific Area (PAC-54)
Commandant (CG-OES), (CG-ODO), (CG-FAC), (CG-741), (CG-CVC), (CG-ENG), (LNGNCOE)
Marine Safety Center (CG MSC)
Jordan Cove

UNITED STATES COAST GUARD

Jordan Cove LNG

ANALYSIS SUPPORTING THE LETTER OF RECOMMENDATION ISSUED BY COTP SECTOR COLUMBIA RIVER ON MAY 10, 2018

Introduction

1. This analysis is a supplement to my Letter of Recommendation (LOR) dated May 10, 2018, that conveys my recommendation on the suitability of the Coos Bay Ship Channel for liquefied natural gas (LNG) marine traffic associated with the Jordan Cove LNG (JCLNG) export terminal project Coos Bay, Oregon. It documents the processes followed in analyzing JCLNG's Waterway Suitability Assessment (WSA) and the suitability of the waterway for LNG marine traffic.

2. For the purposes of this analysis, the following assumptions were made:

    a. The applicant is fully capable of, and would fully implement, any and all risk management measures identified in their WSA.
    b. The conditions of the port identified in the WSA fully and accurately describe the actual conditions of the port at the time of the WSA submission.
    c. The conditions of the port have not changed substantially during the analysis process.
    d. The applicant will fully meet all regulatory requirements including the development and submission of a Facility Security Plan, Emergency Manual, and Operations Manual.

3. The Port of Coos Bay is a deepwater port located in Coos Bay, Oregon on the Pacific Coast of the United States. The Port of Coos Bay offers easy access to Asian markets and facilitates the international movement of goods between the United States and Asia. The Port of Coos Bay is managed under the jurisdiction of the Portland Navigation District and has an authorized channel depth of 37 feet. The channel width is 300 nominal feet. The principal exports are logs, wood chips, lumber, and plywood. The Port of Coos Bay is currently conducting a feasibility study to examine widening and deepening its ship channel.

4. The Port of Coos Bay is approximately 173 nautical miles south of the Columbia River and 367 miles north of the entrance to San Francisco Bay. The Port has seen declining arrivals and is not currently heavily trafficked.

5. Inbound and outbound traffic density in the Port of Coos Bay is currently minimal. In the summer months and during fishing season there are a number of commercial fishing vessels working in the region. The maximum anticipated LNG Carrier port calls per year is expected to be around 120. These projections are based on a maximum nominal LNG output of 7.8 MTPA. Other traffic transiting through the Port of Coos Bay include fishing vessels, recreational vessels, and towing vessels.

6. The Terminal will be sited at the north end of the Coos Bay Channel near Jordan Cove. All Terminal facilities will be located within an approximately 200-acre parcel of land. The approximate locations of the coordinates of the facility are: 43 degrees-25.5' North and 124 degrees 15.7' West.

7. The U.S. Coast Guard regulates the port under the Maritime Transportation Security Act (MTSA), Security and Accountability for Every Port Act (SAFE Port Act), Ports and Waterways Safety Act (PWSA) and other laws applicable to maritime safety and security. U.S. Coast Guard regulated facilities in the area include chip terminals and fuel transfer facilities.

8. Ships entering or departing Coos Bay require a pilot. The Coos Bay Pilots are state licensed Oregon pilots responsible for ensuring the safe transit of vessels transiting through the Port of Coos Bay. They handle approximately 50 vessel transits through the Port of Coos Bay each year.

9. In order to support operations associated with the facility, the applicant will provide additional towing vessels as outlined in their WSA. All tractor tugs must be at least 80 Ton Astern Bollard or larger and equipped with Class 1 Fire Fighting equipment.

10. The applicant established an emergency response planning group in preparation for facility construction and operation in 2006. This group is tasked with education and preparedness concerning this facility. It must be noted that there are schools located in the zones of concern.

Impact to Coast Guard Operations

1. The U.S. Coast Guard is responsible for screening LNG Carriers transiting from foreign ports prior to arrival and will screen all vessels in accordance with existing policies and procedures. The vessels calling on the facility will be foreign flagged and the flag state is yet to be determined. I do not intend to require additional government conducted safety inspections beyond those which already apply to deep draft LNG vessels.

2. Facility and vessel inspection activities will be supported by Marine Safety Unit Portland personnel.

3. Limited access areas (LAA) associated with the project have yet to be established. Sector Columbia River will use risk based decision making and work with existing policy to determine the appropriate LAAs. The proposed LAA in enclosure (3) was not put out for regulatory review and is not in effect.

4. LNG is not considered oil and all vessels calling on the facility will be required to comply with non-tank vessel response plan requirements. The applicant is highly encouraged to work with the Area Committees established under the National Contingency Plan to address issues associated with response in Coos Bay.

5. The Facility will be in the Sector Columbia River Captain of the Port Zone and falls under the purview of the Federal Maritime Security Coordinator who is also the Sector Columbia River Captain of the Port. Specific issues related to this are outlined in Enclosure (4).

Figure 1. Jordan Cove Conceptual rendering of facility

Decision Making Process

1. The following factors regarding the condition of the waterway, vessel traffic, and facilities upon the waterway, were taken into consideration during the LOR process. The processes used are detailed in this section.

2. To ensure all regulatory processes were met, Sector Columbia River took a systematic approach in the WSA validation process. To streamline and ensure transparency, Sector Columbia River worked with Jordan Cove, the Consulting Group KSEAS, and port partners though a series of ad hoc meetings and a one day workshop.

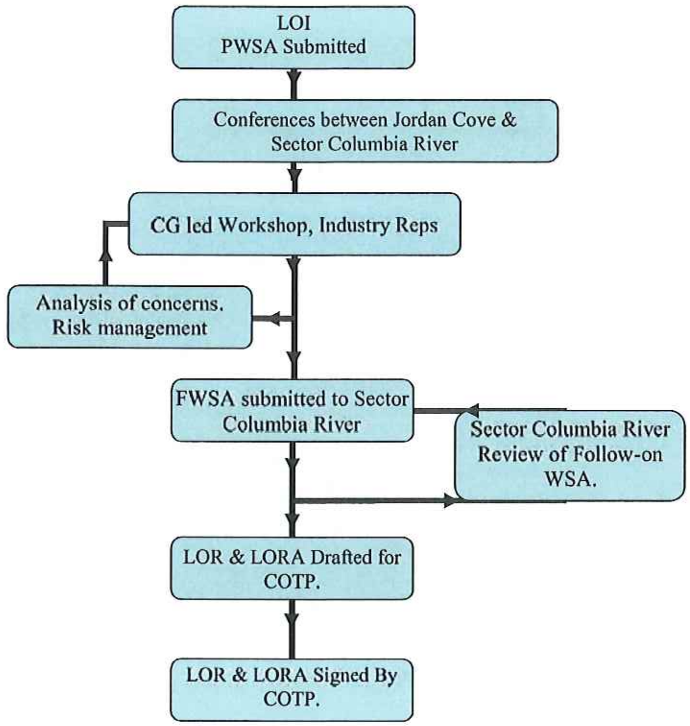

Figure 2 - LNG LOR Process
(Sector Columbia River)

3. NVIC 01-2011 provides guidance on the review and validation of a WSA. Applying NVIC 01-2011's procedural framework, my staff held several in-house reviews of the WSA, and facilitated discussions during a workshop held in Coos Bay, OR on October 16, 2017. The workshop included a wide range of participants, including representatives from; the USCG; Coos Bay Pilots Association; Port Authorities, the State of Oregon and law enforcement agencies.

Members	Position/Role
LCDR Laura Springer	Waterways Management Division Chief, MSU Portland
LCDR Ben Crowell	Surface Operations, Sector North Bend
LCDR Andrew Madjeska	Incident Management Division Chief, Sector Columbia River
LCDR Xochitl Castaneda	District Thirteen Prevention
Ms. Deanna Henry	Oregon Department of Energy
George Wales	Coos Bay Pilots
Richard Dybevik	Roseburg Forest Products
Doug Strain	Coos Bay Sheriff
Jim Brown	North Bend Fire Department
Doug Eberlein	Coos Bay Response Co-op (CBRC)
LT Ethan Lewallen	USCG LNG NCOE

Table 1 – Jordan Cove WSA Team 1 Nov 2017
(Port of Coos Bay)

4. The participants of this "ad-hoc" workshop, recommended by NVIC 01-2011, utilized their expertise on the physical characteristics and traffic patterns of the waterway, as well as their respective specialty knowledge of the marine environment, LNG, safety, security, and facility operations, to analyze the suitability of the waterway to support LNG marine traffic associated with JCLNG.

5. Participants considered the changes in the area's safety and security dynamics which may result from the introduction of LNG ship traffic associated with the JCLNG Project. Jordan Cove used the American National Standards Institute (ANSI)/American Petroleum Institute (API) Standard 780 Security Risk Assessment (SRA) Methodology, as the basic approach for assessing risk. The standard was published in June of 2013 as a U. S. standard for security risk assessments on petroleum and petrochemical facilities. The standard is a tool used to evaluate all security risks associated with petroleum and petrochemical infrastructure and operations, and assists owners and operators through the process of conducting thorough and consistent SRAs. For security purposes, participants considered potential threats and consequences of intentional act of aggression to the facility and developed security measures to mitigate the risks.

    a. Please see Enclosure (4) if you have a need to know concerning the results of this

6. During the above mentioned workshop held in Coos Bay, OR on October 16, 2017, the ad-hoc working group also evaluated safety factors including the potential impacts of groundings, collisions, and allisions and thoroughly examined the simulator data presented in the WSA.

7. Each of the recommended risk management measures from enclosure (7) of NVIC 01-2011 were considered. In the WSA workshop, additional risks and recommendations were discussed related to a Cascadia Subduction Zone Earthquake and associated implications for the facility and region if a laden vessel was tied up at the layberth.

8. The ad-hoc working group considered each scenario along each transit segment and evaluated the causes of accidental or intentional events. The workshop analyzed the contributing factors for each scenario and their likelihood of occurrence given the adequacy of safety and security layers.

9. Sector Columbia River followed the checklist found in NVIC 01-2011 during the review. Through this review, Sector Columbia River clarified certain points in the WSA to ensure that the document contained accurate information and that references were applicable. With the 2017 update to the WSA, Jordan Cove has satisfied the requirements of the LOR process.

10. Based on my review of the WSA completed on November 1, 2017, and input from state and local port stakeholders, and taking into account previously reviewed expansion projects, I recommend to the Federal Energy Regulatory Commission

that the waterway in its current state be considered suitable for the LNG marine traffic associated with the proposed project.

11. This recommendation is contingent upon the applicant completing all actions outlined in the Waterways Suitability Assessment as submitted, and actions associated with subsequent annual updates, and completing all actions outlined in the most current WSA and actions under the control of the applicant from the July 1, 2008, Waterway Suitability Report.

Waterway Conditions Adjacent to the Facility

1. **Depth of Water**. The channel is currently maintained at a 37' depth.
2. **Tidal Range**. The tides of Coos Bay are of the mixed semi-diurnal type with paired highs and lows of unequal duration and amplitude. The tidal range increases upstream to the City of Coos Bay and the time difference between peak tides at the entrance and City of Coos Bay is about 40-90 minutes, depending on the location. The head of the tide is located at River Mile 27 on both the Millicoma and South Fork Coos Rivers. The tidal range is 7.5 feet near the open sea channel and 6.7 feet at the entrance to Charleston Harbor.

Table 2 Tidal Datums, Coos Bay, OR NOAA Tide Stations 9432895, 9432879, and 9432780

Tide Level	Abbreviation	Tide Level (ft) North Bend	Tide Level (ft) Empire	Tide Level (ft) Charleston
Tide Station ID #		9432895	9432879	9432780
Latitude		43° 24.6'N	43° 22.6'N	43° 20.7'N
Longitude		124° 13.1'W	124° 17.8'W	124° 19.3'W
Extreme High Water	EHW	-	-	+10.5
Mean Higher High Water	MHHW	+8.4	+7.7	+7.6
Mean High Water	MHW	+7.8	+7.1	+7.0
Mean Sea Level	MSL	+4.7	+4.2	+4.1
Mean Low Water	MLW	+1.3	+1.3	+1.3
Mean Lower Low Water	MLLW	+0.0	+0.0	+0.0
Extreme Low Water	ELW	-	-	-3.0

3. **Protection from High Seas**. The entrance to Coos Bay is similar to most harbors along the Pacific Coastline of Northern California, Oregon, and Washington. Strong winds are often experienced at North Bend on Coos Bay during the months of June, July, and August. These winds blow at 17 knots or greater 15-20 percent of the time and at 28 knots or greater 1 to 2 percent of the time. The harbor consists of a river estuary at the mouth of the Coos River. Sand and silt

from the river are carried out to the sea from this entrance. As a result of this material meeting the predominantly westerly seas and swells of the Pacific, a sandy ridge bar is formed at the mouth. This sand ridge causes the channel to be known as "a Bar Channel". As such, a breaking bar does occur in this port.

4. **Natural Hazards**. The navigational hazards in the vicinity of the project site are rock jetties on either side of the channel entrance extending into the Pacific Ocean, and a submerged jetty which extends 50 yards off the east shore of Coos Bay. Discussions and simulations with the Coos Bay Pilots Association have shown that these hazards will not interfere with normal navigation and mooring operations and the applicant has developed transit mitigations to address this issue such as not bringing vessels in or leaving them at the lay berth during conditions that are not conducive to safe navigation i.e. restricted visibility, severe weather and and/or low tides.

5. **Fishing Vessels**. Heavy concentrations of fishing gear may be expected between December 1 and August 15, from shore to about 30 fathoms.

6. **Underwater Pipelines and Cables**. Based on current pipeline charts that are available, there are three cables which are submerged approximately 20 feet running across/underneath the channel in the vicinity of the town of Empire which is on the LNG Carrier transit route.

7. **Maximum Vessel Size by Dock**. The primary dock can accommodate a vessel with a maximum length of 300 meters, 52 meters in breadth, and a draft which can be accommodated by the existing channel. Although the facility dock is able to accommodate vessels drafting up to 12m (39ft), current channel draft is 11m (37ft) with future plans to dredge the channel to accommodate larger deep draft vessels. Jordan Cove Energy Project and the local pilots must ensure transiting LNG vessels are able to maintain 10% under keel clearance as required by JCEP's LNG Transit Management Plan.

    a. The dock must be able to accommodate all vessels calling on the facility.
    b. It must be equipped with adequate numbers of mooring hooks, fendering, and mooring dolphins.
    c. The mooring arrangement must also be able to accommodate safe working loads.
    d. In coordination with appropriate stakeholders, JCLNG must develop and implement vessel mooring/unmooring procedures to ensure safe and environmentally protective operations for LNG Carriers arriving and departing the JCLNG facility.

8. **Vessel Routing**. Included in the WSA, was a plan to divide the LNG Carrier transit route into five (5) inbound, one (1) loading at berth, and five (5) outbound segments. The total inbound transit from the Sea Buoy (pilot boarding area) to the terminal berth is approximately eight (8) miles and will take between 1.5 and 2.0

hours to berth, pilots will be transiting at around 4.5 knots. The route has been divided into segments in order to manage vessel traffic and increase the safety of LNG carrier transits. This was done in conjunction with the Coos Bay Pilots Association.

The route is reversed for outbound LNG Carrier transits with the exception of the turning/maneuvering basin which is bypassed on the outbound transit where the LNG Carrier is moved directly into the Coos Bay Ship Channel. The route and segments are shown in Figure 3.

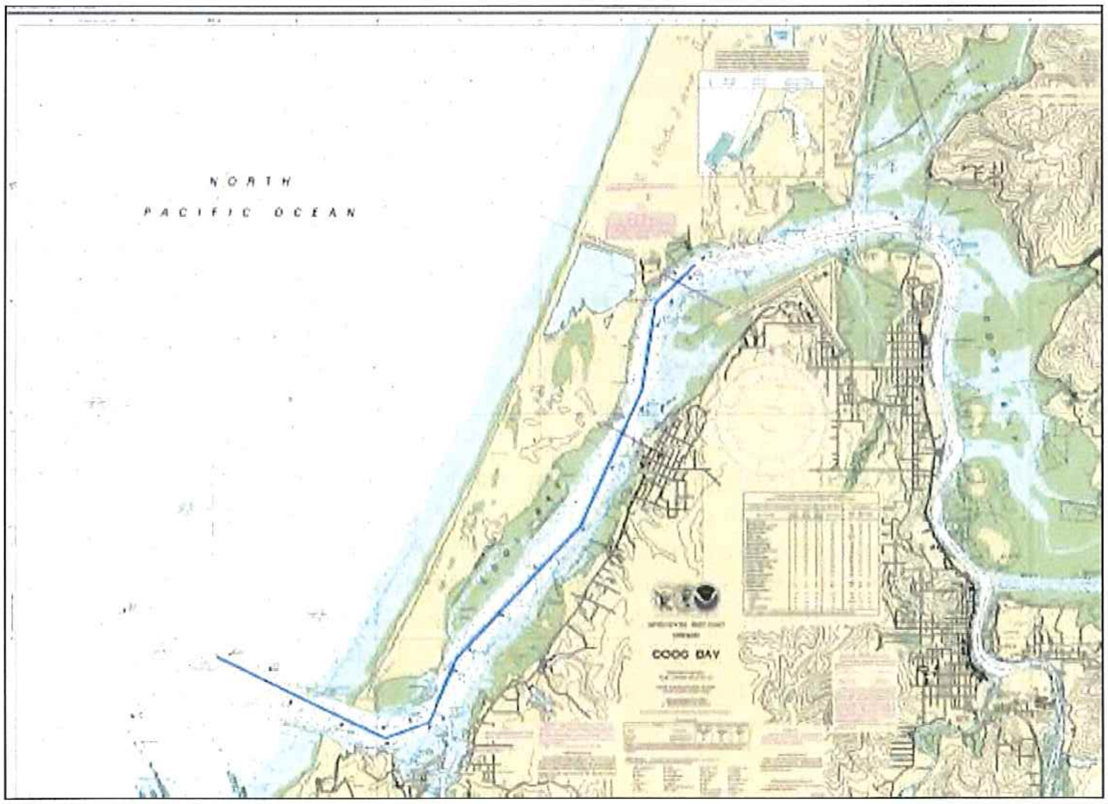

Figure 3. Overview of LNG Carrier Transit Route

9. **Vessel Operations** –LNG vessels will load cargo at the facility. 110-120 arrivals are expected at the facility annually with a dedicated fleet of LNG Carriers conducting cargo operations at the facility. A lay berth will be constructed to accommodate delays, repairs, and maintenance issues associated with Trans-Pacific Trade. Cargo operations will not be permitted at the lay berth and the applicant will outline procedures for the lay berth after the permitting process is complete.

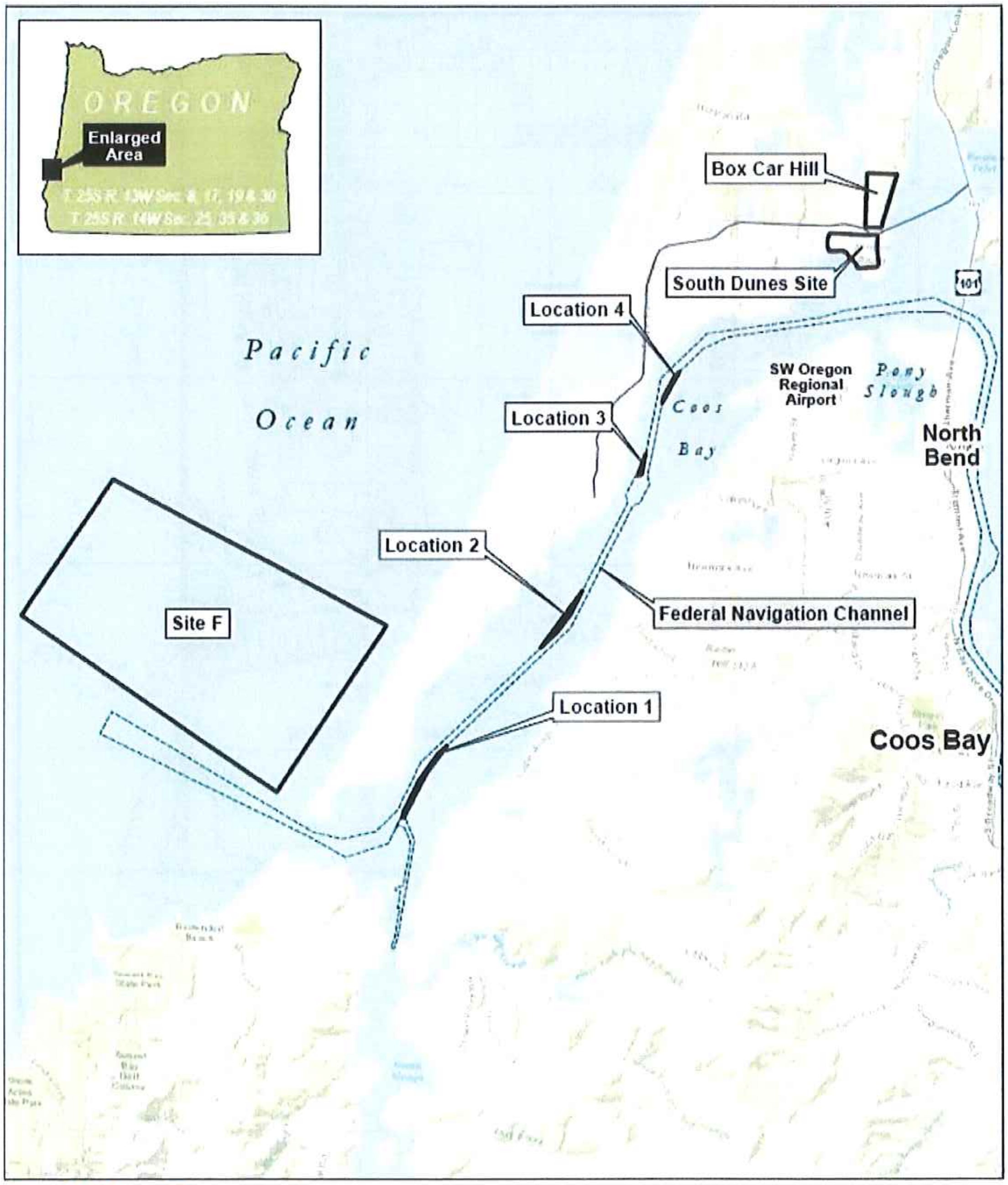

Figure 4. Channel Improvements

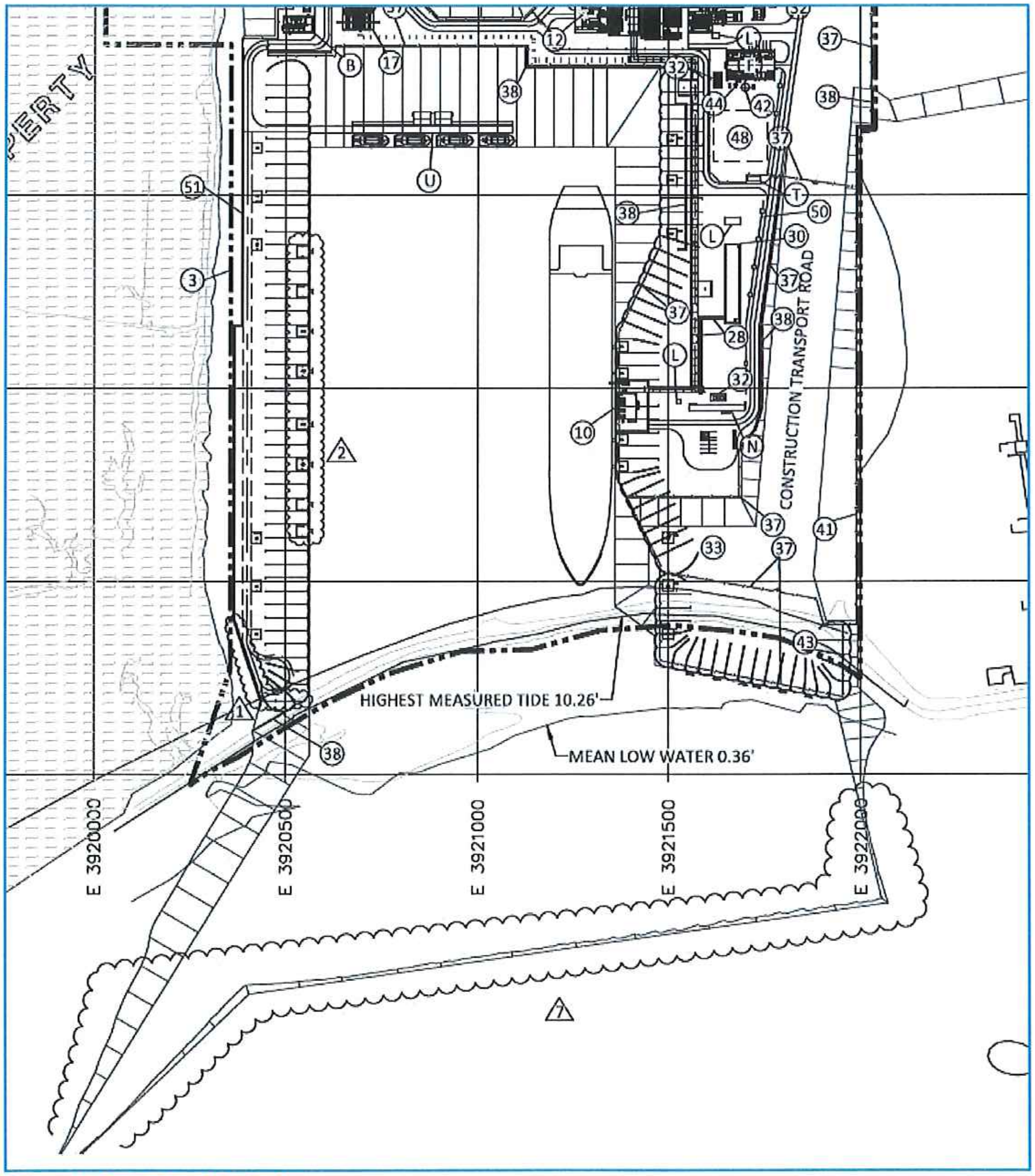

Figure 5. Dredging at the berth

U.S. Department of Homeland Security
United States Coast Guard

Captain of the Port
United States Coast Guard
Sector Columbia River

2185 SE 12th Place
Warrenton, OR 97146-9693
Staff Symbol: s
Phone: (503) 861-6206
Fax: (503) 861-6355

16611

NOV 07 2018

Tony Diocee, Vice President, Projects
Jordan Cove Energy Project, L. P.
5615 Kirby, Suite 500
Houston, TX 77005

Dear Mr Diocee:

The USCG Waterways Suitability Report provided to the Federal Energy Regulatory Commission (FERC) on July 1, 2008 and a subsequent Letter of Recommendation provided to FERC on May 10, 2018 required the applicant, Jordon Cove Energy Project, L.P. (JCEP), to conduct additional ship transit simulator studies for liquid natural gas (LNG) carriers that exceed a 148,000 m^3 spherical containment class vessel or for any increase in physical dimensions.

Since the initial Waterway Suitability Analysis was submitted to the USCG in 2007 LNG Tanker technology has improved and tanker sizes and capacities have changed. As a result, additional simulator studies were required. In response, JCEP conducted additional vessel transit simulations during September 26-27, 2018 using modern ship design and carrying capacities.

The simulated transits were piloted by the Coos Bay Pilots and witnessed by the USCG. They were conducted at California Maritime Academy in Vallejo, CA using a Transas Simulator. They were conducted to demonstrate that the Coos Bay Pilots can safely and successfully maneuver LNG carriers up to 299.9 x 49m x 11.9m dimensionally while transiting the channel.

These successful simulations expand the ability for Jordan Cove LNG to use any class of LNG carrier (membrane, Moss, or SBT) with physical dimensions equal to or smaller than observed during the simulated transits. JCEP will continue development of the Transit Management Plan and work with the Coos Bay Pilots in establishing any other operating parameters.

Sincerely,

J. C. SMITH
Commander, Sector Columbia River
Captain of the Port
Captain, U. S. Coast Guard

Enclosure: 1) Jordon Cove LNG Terminal Simulation Plan, September 2018
2) TRANSAS Simulation Printouts

Copy: FERC
Commander, Coast Guard District Thirteen (dp)
Commander, Pacific Area (PAC-54)
Commandant (CG-OES), (CG-ODO), (CG-FAC), (CG-741), (CG-CVC), (CG-ENG), (LNGNCOE)
Marine Safety Center (CG MSC)

Portland District

Feasibility Report On Navigation Improvements

With Environmental Impact Statement

January 1994

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Proposed Report*

DEPARTMENT OF THE ARMY
OFFICE OF THE CHIEF OF ENGINEERS
WASHINGTON, D.C. 20314-1000

REPLY TO
ATTENTION OF:

CECW-PM (10-1-7a)

SUBJECT: Coos Bay, Oregon (Deep-Draft Navigation)

THE SECRETARY OF THE ARMY

1. I submit for transmission to Congress my report on Coos Bay, Oregon, navigation improvements. It is accompanied by the report of the district and division engineers. These reports are in final response to a resolution by the Committee on Environment and Public Works of the United States Senate dated 2 November 1983. The study resolution requested review of the reports of the Chief of Engineers on Coos Bay, Oregon, published as House Document 151, 91st Congress, First Session, and other pertinent reports, with a view to determining whether any modification of the existing project is advisable at the present time. Preconstruction engineering and design activities for this proposed project will be continued under the authority provided by the 2 November 1983 resolution.

2. The existing Federal navigation project at Coos Bay provides a 45-foot-deep entrance channel approximately 1 mile long. The channel transitions to a 35-foot-deep inner channel extending 15 miles to the city of Coos Bay. The existing channel depths constrain the draft of vessels, prohibit vessels from taking on a full load of cargo, and/or force the vessels to wait at sea for favorable tide conditions. The feasibility study evaluated five alternative channel deepening plans, along with channel width and alignment options. The reporting officers recommend a plan which would deepen the existing channels by 2 feet, to 47 feet at the entrance and 37 feet in the inner channel. Also, the plan would provide for widening the existing 800-foot-wide by 1000-foot-long turning basin at river mile 12 to a width of 900 feet. The proposed plan is the national economic development plan.

3. The total first cost of the recommended improvements is estimated to be $13,698,000 of which $10,151,000 would be Federal and $3,547,000 would be non-Federal (based on October 1993 price levels). Average annual benefits and costs at an interest rate of 8 percent are estimated to be $2,002,000 and $1,266,000, respectively, with a resulting benefit-to-cost ratio of 1.6.

*This report contains the proposed recommendation of the Chief of Engineers. The recommendation is subject to change to reflect Washington level review and comments from Federal and State agencies.

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4. I concur in the findings, conclusions, and recommendation of the reporting officers.

5. The recommendation contained herein reflects the information available at this time and current departmental policies governing formulation of individual projects. It does not reflect program and budgeting priorities inherent in the formulation of a national civil works construction program nor the perspective of higher review levels within the executive branch. Consequently, the recommendation may be modified before it is transmitted to the Congress as a proposal for authorization and implementation funding. However, prior to transmittal to the Congress, the sponsor, the State, interested Federal agencies, and other parties will be advised of any modifications and will be afforded an opportunity to comment further.

ARTHUR E. WILLIAMS
Lieutenant General, USA
Chief of Engineers

DEPARTMENT OF THE ARMY
PORTLAND DISTRICT, CORPS OF ENGINEERS
P. O. BOX 2946
PORTLAND, OREGON 97208-2946

Reply to
Attention of:

COOS BAY, OREGON

NAVIGATION IMPROVEMENTS

FINAL FEASIBILITY REPORT

AND

ENVIRONMENTAL IMPACT STATEMENT

January 1994

EXECUTIVE SUMMARY

This study is conducted in response to a resolution of the Committee on Environment and Public Works of the United States Senate, adopted Nov. 2, 1983, which requested investigation of possible modifications to the navigation channel at Coos Bay, Oregon. Planning, Engineering and Design (PED) studies will be continued under this authority.

The existing project at Coos Bay provides an entrance channel that is 1 mile long and 45 feet deep. The channel, which is stabilized by jetties to the north and south, transitions to a 35-feet-deep inner channel extending 15 miles to the city of Coos Bay, Ore. The project provides access to docks and terminals at the Oregon International Port of Coos Bay, the non-Federal sponsor for the study. Coos Bay is one of the world's largest shipping ports for timber products. Future supplies of these products will be impacted by current environmental and political issues. A new import, nickel ore, has been a significant addition to commerce at the port. Existing channel depths constrain the draft of vessels able to use the port. Larger, deeper draft vessels would be able to take advantage of economies of scale to reduce transportation costs and a deeper channel could reduce vessel delay costs. Five deepening alternatives and other improvement measures were considered. Also, studies and recommendations for designation (by the Environmental Protection Agency) of permanent offshore disposal sites for dredged material from this deepening project and ongoing channel maintenance are included.

Alternative 2, with a total project cost of $13,697,900 (October 1993 price level), which would deepen the existing channel by 2 feet to 47 feet at the entrance and 37 feet in the inner channel, was the identified National Economic Development (NED) plan. Also, one of the two existing turning basins would be widened by 100 feet under this plan. This alternative, supported by the sponsor, would have total annual benefits of $2 million, and annual costs of $1.3 million, including increased maintenance costs. The annual net benefits are $0.7 million and the benefit-to-cost ratio (BCR) is 1.5.

A Baseline Cost Estimate has been prepared. Project construction is scheduled to start in fiscal year 1995. The fully-funded cost, based on this construction schedule, including inflation, is estimated to be $14,583,000. Of this amount, $3,776,200 would be the initial non-Federal cost share for 25 percent of the first cost for general navigation features (GNF) and 100 percent of the associated improvements. The initial Federal share of the first cost would be $10,806,800. In addition the non-Federal interest would pay an additional 10 percent ($1,440,900) less credit for any lands, easements, rights of way, relocations, and disposal areas (LERRD) plus interest over a period not to exceed 30 years.

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COOS BAY, OREGON
NAVIGATION IMPROVEMENTS
FINAL FEASIBILITY REPORT

VOLUME I
<u>CONTENTS</u>

VOLUME II
<u>CONTENTS</u>

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COOS BAY, OREGON
NAVIGATION IMPROVEMENTS
FINAL FEASIBILITY REPORT

CONTENTS

CTCLUSI Exhibit C

CONTENTS--Continued

CONTENTS--Continued

CONTENTS--Continued

FIGURES

TABLES

CONTENTS--Continued

EXHIBIT

PLATES

CTCLUSI Exhibit C

COOS BAY, OREGON
NAVIGATION IMPROVEMENTS
FINAL FEASIBILITY REPORT

1. INTRODUCTION

1.1 Study Authority

This investigation was authorized by Congress pursuant to local requests for navigation assistance. On Feb. 8, 1983, the Port of Coos Bay Commission passed a resolution describing navigation problems and supporting a feasibility study of improvements to its existing navigation channel. On Nov. 2, 1983, the US Senate Committee on Environment and Public Works passed a resolution which states:

> *...that the Board of Engineers for Rivers and Harbors, created under Section 3 of the River and Harbor Act, approved June 13, 1902, be, and is hereby requested to review the reports of Chief of Engineers on Coos Bay, Oregon, published as House Document Numbered 151, Ninety-First Congress, First Session, and other pertinent reports, with a view to determining whether any modification of the existing project is advisable at the present time, with particular reference to providing increased depths and widths for the outer bar channel and the bay channel from the entrance to Isthmus Slough and increased clearances through the existing Southern Pacific railroad bridge to accommodate existing and prospective traffic.*

In 1993, the Board was disbanded as required by Public Law 102-580, Section 223. Responsibility for the review now rests with the Assistant Secretary of the Army for Civil Works.

A reconnaissance report was approved in December 1988, which formed the basis for initiating the feasibility phase of studies. The detailed studies leading to this feasibility report proceeded upon the execution of a Feasibility Cost Sharing Agreement (FCSA) between the United States of America (the "Government") and the Oregon International Port of Coos Bay (the "Sponsor"), dated Dec. 13, 1988. This report presents the results of the final feasibility studies in response to the resolution. Preconstruction engineering and design (PED) activities would continue under the authority provided by the Nov. 2, 1983, resolution.

1.2 Study Purpose and Scope

The purpose of the investigation was to determine whether the existing deep-draft Coos Bay Federal Navigation Project should be modified, and if so, to identify a project for implementation. Additional investigations and Congressional authorization would be needed for project implementation. The scope of this feasibility study involves documentation of existing conditions, identification of opportunities for improvements, formulation and design of project alternatives, evaluation of their economic viability and delineation of their potential environmental impacts.

1.3 Non-Federal Sponsor

The Oregon International Port of Coos Bay is the non-Federal sponsor. It is southwest Oregon's principal outlet to the sea. Recognizing the port's importance to the State's economy, the Oregon State Legislature in 1987 established a new governance structure for the port. The port's new legislative charter was subsequently ratified by 71.5 percent of the voters in the port district. Formerly managed by an elected port commission but now managed by a commission appointed by the Governor of Oregon, the port is viewed by the State as a catalyst for economic development of southwestern Oregon. It has been assigned a large role in economic planning and development for the general region.

1.4 Evaluation Criteria

1.4.1 Regulations and Guidance. Authority for the Corps of Engineers to investigate the need for navigation improvements and to construct those improvements is derived from Federal legislation and executive orders. These laws and orders are implemented by regulations that establish the engineering, economic, and environmental criteria used to determine whether the Federal Government can participate in a potential project. The principal Corps of Engineers regulations that determine the scope of the present study are as follows: *Economic Principles and Guidelines for Water Resources and Related Land Resources Implementation Guidelines* (Water Resources Council, March 10, 1983); Engineering Regulation (ER) 1105-2-100, *Guidance for*

Conducting Civil Works Planning Studies; and ER 200-2-2, *Policy and Procedures for Implementing NEPA* (NEPA is the National Environmental Policy Act of 1969). The following paragraphs describe conditions placed by regulation on Corps of Engineers construction of navigation improvements.

1.4.2 Engineering Criteria. The project must meet local needs and Corps of Engineers criteria established by regulation. Projects should be adequately sized to meet user needs and provide sufficient depth and entrance dimensions for safe access.

1.4.3 Economic Benefits. National Economic Development (NED) benefits, defined principally as effects of a plan that increase the national output of goods and services, must exceed the combined Federal and local costs of constructing, maintaining, and operating the project. Benefits and costs must be expressed in terms of constant time and value of money. Benefits generally include items such as fuel savings, reduced labor costs, and reduced maintenance costs. Federal interest in the project exists if the benefits exceed the costs, resulting in a benefit-to-cost ratio (BCR) greater than 1.0.

1.4.4 Environmental Impacts. Federal law and environmental regulations require identifying forms of aquatic life and wildlife that might be impacted by the project, minimizing disruption of natural resources, maintaining consistency with the Oregon Coastal Zone Management Act and State and local plans, and using measures to protect or preserve existing environmental values. Social effects must be considered, and adverse effects must be minimized. The effects of each alternative on the social and natural environment must be defined, and that information must be provided to the public for review.

1.4.5 Non-Federal Sponsor Interests. The alternative must be acceptable to the non-Federal sponsor. The level of the sponsor's interest in and support for the recommended alternative must be assessed as well as the sponsor's financial capability to fund its share of the cost to implement the project.

1.5 Previous and Current Studies

1.5.1 Prior Studies and Reports. Before the first Federal navigation project was constructed in 1880, the original outlet channel of Coos Bay to the Pacific Ocean crossed a bar at the baymouth and was about 10 feet deep by 200 feet wide. Access from the ocean to a natural harbor channel (about 22 feet deep) was obstructed by the baymouth bar and also by one river shoal a quarter-mile long and 15 feet wide. The Corps of Engineers first studied Coos Bay in 1878. Seeking to stabilize the bay entrance, Congress authorized the north and south jetties in 1879. Construction of the jetties began the following year. See table 1.1 for a list of previous studies and reports.

The deep-draft Coos Bay Federal Navigation Project, originally authorized by the River and Harbor Act of March 3, 1879, has been modified by subsequent River and Harbor Acts, the last on Dec. 30, 1970. This act authorized the improvements recommended by the Corps of Engineers in House Document 91-151, dated Sept. 3, 1969. These improvements are described in Section 3, Plan Formulation.

1.5.2 Reconnaissance Study. The reconnaissance phase study was completed in December 1987. That study examined eight alternative plans of improvement and concluded that several of them appeared viable and that a feasibility phase study was warranted. The more promising alternatives included a 3-foot channel deepening, both with and without a small anchorage, and the anchorage alternative alone.

Also investigated in the reconnaissance study was replacement of the Southern Pacific Railroad bridge, located at about river mile (RM) 9. The narrow passage for vessel traffic through the bridge (197 feet) causes delays for larger vessels, predominately wood chip vessels. The Coos Bay pilots do not attempt to navigate large vessels through the bridge at night or when weather conditions make it hazardous, primarily due to impaired visibility. The reconnaissance study found that replacement or reconstruction of the bridge was not economically justified. Replacement was estimated to be $27.8 million; $2.4 million annually. The average annual benefit was determined to be $656,000. The BCR was 0.27.

TABLE 1-1.–*Previous Studies and Reports; Coos Bay, Oregon, Federal Navigation Project*

Date Submitted	Recommendation	Reference
3 Sep 1969	Deepen outer bar channel to 45 feet and inner channel to 35 feet, new anchorage, modify turning basins.	H.D. 91-51
26 Apr 1948	Mooring basin and connecting channel at Charleston.	H.D. 80-646
24 Jul 1946	Deepen outer bar channel to 40 feet, inner channel to 30 feet, two turn-basins and two anchorages.	S.D. 79-253
26 Apr 1934	24-foot-deep channel from Pigeon Point Reef to Smith's Mill, and turning basin above Marshfield (now City of Coos Bay)	S. Com. Prt 73rd Congress 2nd session
13 Dec 1927	Channel 24 feet deep, 300 feet wide through Pigeon Point Reef, following a location along the westerly side of bay.	H.D. 70-110
29 Oct 1921	Coos Bay, Oregon and Isthmus Slough.	H.D. 67-150
29 Mar 1917	Entrance to Smith's Mill.	H.D. 65-325
19 Feb 1908	South Slough, Oregon, channel and bar.	H.D. 60-958
16 May 1891	Inner harbor channel.	H. Ex. D. 52-42
30 Sep 1878	Entrance bar improvements, north and south jetties.	S. Ex. D. 45-14

Note:

H.D. = House Document
S.D. = Senate Document
S. Comm. Prt. = Senate Committee Print
H. Ex. D. = House Executive Document
S. Ex. D. = Senate Executive Document

2. DESCRIPTION OF THE STUDY AREA

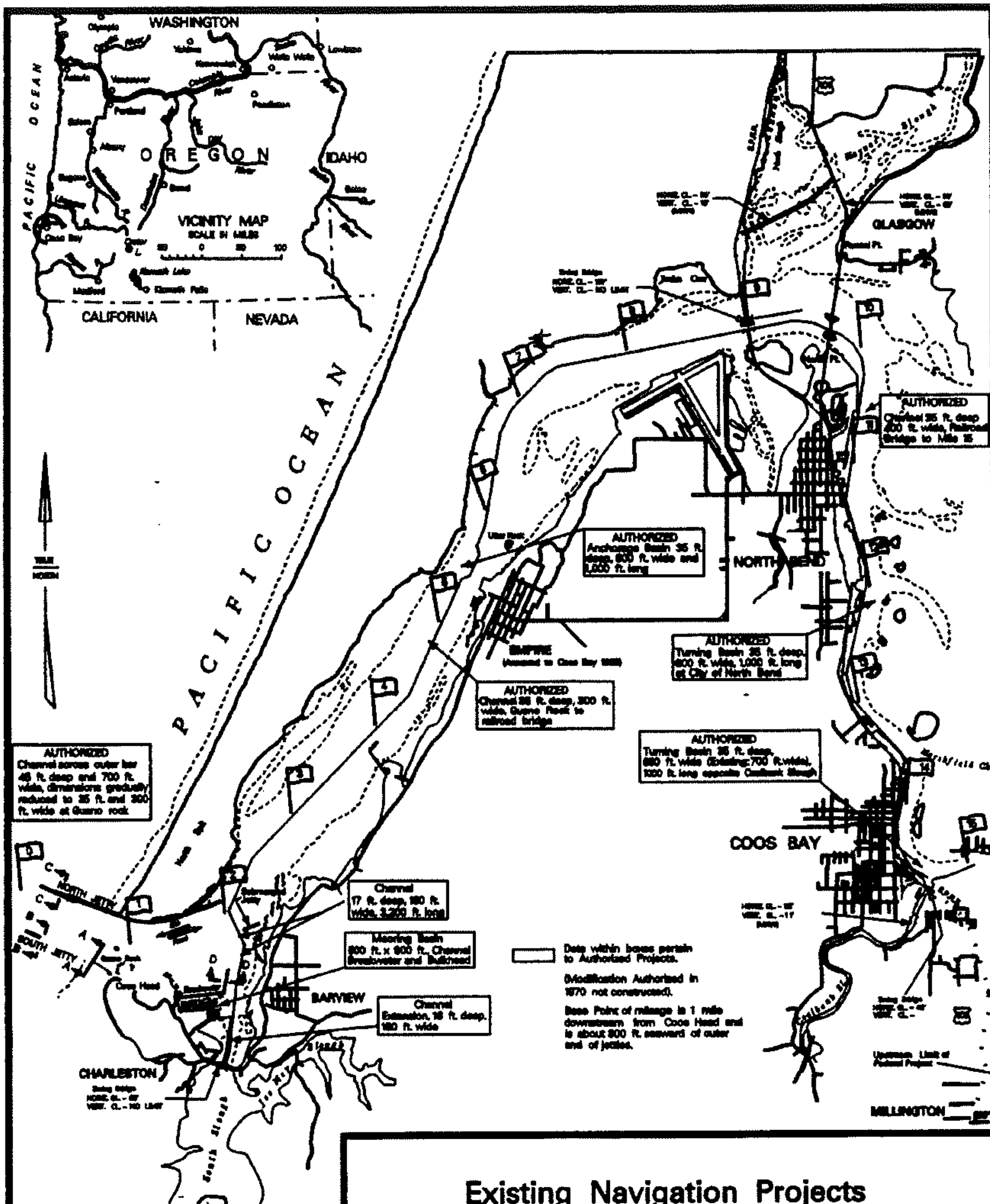
2.1 Regional Characteristics

2.1.1 Location. Coos Bay is located in Coos County, Ore., on the southern Oregon coast, about 200 miles south of the Columbia River mouth and 445 miles north of San Francisco Bay. It is the navigational approach to Charleston, Empire, North Bend, Glasgow, Coos Bay and Eastside (figure 1). The bay is formed by the junction of Isthmus Slough, Coos River, South Slough, Kentuck Slough, Haynes Slough and Winchester Creek, which rise on the western slopes of the Coast Range. Deep-draft navigation is limited to the lower 15 miles of the estuary.

2.1.2 Coos Bay Estuary. The surface area of the Coos Bay estuary is about 12,000 acres (about 19 square miles). Tidelands, situated primarily between the mouth and RM 15, about 1 RM above the city of Coos Bay, contain 20 percent to 30 percent of the estuary area. Between the entrance and RM 1, the estuary's depth varies from 25 feet to 45 feet below mean lower low water (MLLW). Upstream, the average estuary depth is 30 feet below MLLW. Within the present channel, water depth ranges from 35 feet to 45 feet below MLLW. The entrance of the estuary is fully exposed to waves.

2.1.3 Climate. The project area has cool, comparatively dry summers and mild, cloudy, wet winters. Average monthly temperatures for Coos Bay have ranged from a low of 44 °F to a high of 61 °F. Precipitation occurs primarily between October and April, with average monthly rainfall of 16 inches in January, the wettest month, and less than 1 inch in July, the driest month. Average annual snowfall is from 1 inch to 3 inches, and fog is experienced on an average of 43 days per year. The Coos Bay coastal area receives the full force of storms moving inland from the ocean, and winds can reach hurricane speed (greater than 74 miles per hour) during such storms. The most severe storms occur during the winter (November through March), come from the northwest, and can generate waves up to 15 feet high. In the daytime, sea breezes sweep up the river valleys; nocturnal winds sweep down the valleys.

2.1.4 Topography and Geology. The topography of the lower Coos River area is a combination of rugged mountain terrain, extensive sand dunes adjacent to the ocean, and relatively flat pasture land along the river. Terrain of the basin is quite rugged as



Existing Navigation Projects

US Army Corps of Engineers Portland District

Coos Bay Navigation Improvements

Figure 1

Produced by GIS, Survey and Mapping Section, Geotechnical Engineering Branch

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the mountains are relatively young, denoted by the typical narrow, sinuous valleys and steep side slopes. Relief varies from sea level to just under 3,000 feet National Geodetic Vertical Datum (NGVD); however, most of the land lies between 500 and 1,500 feet in elevation. The principal stream in the region is Coos River.

During the channel deepening performed in 1978-79, numerous sandstone layers were identified within the lower reaches of Coos Bay. Geological investigations performed in 1974 indicate the rock types to be claystone, siltstone and sandstone from RM 2 to RM 6, with outcrops from RM 0.7 to RM 0.9 and from RM 15 to RM 15.3 above the end of the navigation channel. All known rock sources produce rock that is considerably softer and much less resistant to erosion than basalt.

2.2 Resources

Western Coos County, the immediate area of the project, is generally considered rich in natural resources. Among these resources are an adequate water supply, wildlife, commercial and game fish, outdoor recreational opportunities, major timber stands and some agricultural land. Water is used for navigation, irrigation, recreation, fish and wildlife, and municipal and industrial water supplies.

Southwest Oregon, considered the hinterland of Coos Bay, includes five counties: Coos, Curry, Douglas, Josephine and Jackson. The Port of Coos Bay timber resource boundaries tend to vary with the commodity to be exported as indicated in Appendix C, Economics Analysis. The resource boundary for logs, for example, is estimated to be about 50 miles to 75 miles from the port, whereas for lumber the boundary is about 250 miles. Wood product exports from the Port of Coos Bay have remained essentially stable during the past 10 years. Environmental issues with regard to the Northern Spotted Owl and log exports will influence the future supplies of timber products in the region.

2.3 Economic Base

The Coos Bay economy is heavily resource-based, relying on timber and fish resources. The Pacific Northwest region has been cited as the greatest softwood timber growing region of the world. The lumber and wood product industry is the largest industry in

Coos County. The principal markets for forest products transported by waterborne commerce from the Coos Bay area include Asia, the South Pacific and Europe.

Commercial and recreational fishing are major industries in the Coos Bay area. In general, the commercial fishing resource area immediately attributable to the Port of Coos Bay extends 30 miles to the north and south of the mouth of the estuary and 30 miles offshore. The fishery resources of the area include salmon, tuna, sturgeon, cod, sole, clams, shrimp and crab. Numerous full-time commercial fishing boats are berthed in Coos Bay and operate from there. Charter operation and recreational boating are also popular activities.

2.3.1 Demographics. The Coos County population grew 6.6 percent between 1970 and 1990. It peaked at 64,000 in 1980, declined over most of the 1980s to a low of 57,500 in 1987, and grew again to 60,300 in 1990. Employment trends have been similar to population, with growth during the 1970s and a decline in the 1980s. Decreasing lumber and wood products employment opportunities were a factor in the population decline. The 1990 unemployment rate in Coos County was 8.9 percent.

2.3.2 Commerce. Outbound deep draft traffic through the channel consisted of 333 transits in 1988. Principal exports shipped from the Port of Coos Bay are wood chips, logs, lumber and other wood and paper products. Major imports consist primarily of petroleum products. Some containerized products also are shipped and received.

The port is used by commercial fishing vessels on a year-round basis, when bar conditions allow winter transit. It is used by charter, sport fishing, and pleasure craft seasonally.

In October 1992, the Glenbrook Nickel Company began to import nickel ore into Coos Bay from New Caledonia, a small island near Australia. From the Port, the ore is transported about 100 miles to the company's smelter at Riddle, Ore. The nickel ore facilities are discussed in more detail in paragraph 3.2.5.

In 1991, 4.6 million tons of commodities moved through the Port of Coos Bay. Export activity at the Port of Coos Bay is linked to the forest products industries of the region. The port did not provide data on other commodities for 1991; however, in 1989, *Waterborne Commerce of the United States* data indicated less than 1 percent of exports were commodities other than forest products.

Deep-draft commerce is supported by excellent supplemental transportation facilities. Rail service is provided by the Southern Pacific Transportation Company. North-south and easterly highways serve the project area. The International Port of Coos Bay is connected to a network of well-maintained and recently improved State and Federal highways. U.S. Highway 101 serves the Port of Coos Bay by providing north-south access, and Interstate 5 is accessible by State highways 38 and 42. Highway 42 and Interstate 5 will be used to transport nickel ore to Riddle, Ore.

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3. PLAN FORMULATION

3.1 Overview

Plan formulation involves a systematic process of identifying and analyzing water resource needs and problems, establishing objectives and developing and evaluating alternatives to meet those needs and problems. Plan formulation is guided by the Corps of Engineers' policy on multi-objective planning in accordance with legislative and executive authorities.

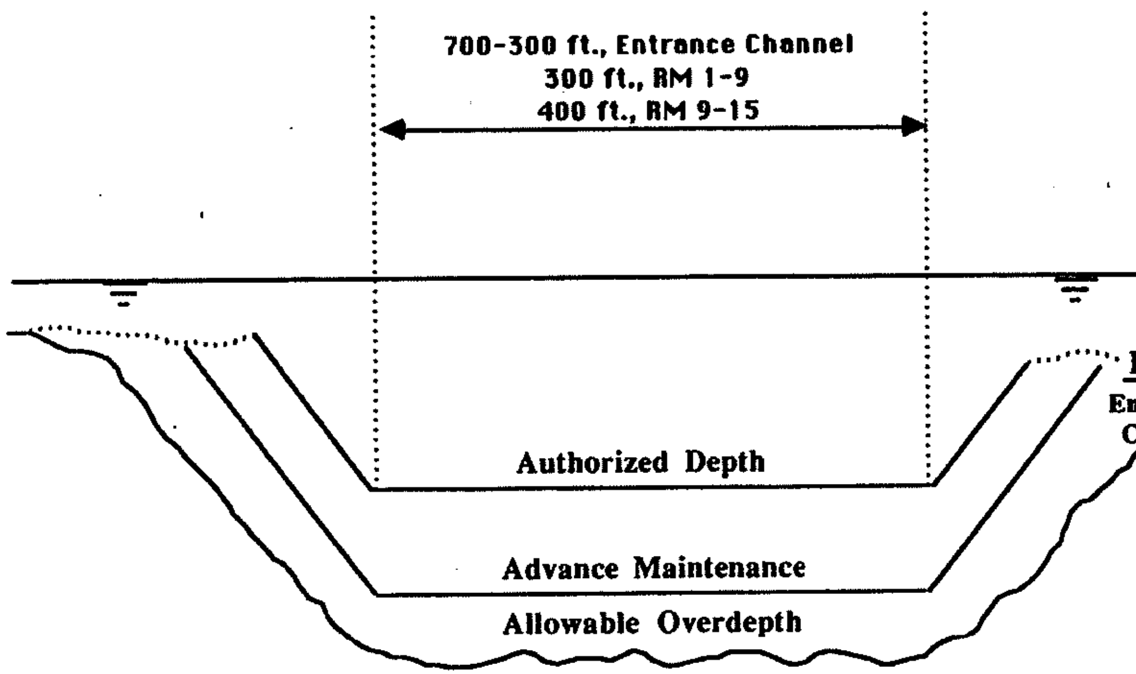
Baseline conditions with regard to the existing Coos Bay Federal Navigation project, timber supply issues, deep draft commerce, and the environment will be established in the following paragraphs. Problems and opportunities will then be identified and alternatives to address those problems developed for further evaluation.

3.2 Existing Physical and Environmental Conditions

3.2.1 Existing Navigation Improvements. The Federal Government constructed and maintains the existing Coos Bay Federal Navigation Project, consisting of the two jetties and the deep-draft navigation channel.

Jetties. The north jetty is 10,400 feet long; the south is 9,000 feet long. The south jetty was last rehabilitated in 1962-63, requiring 235,000 tons of stone. It is currently being monitored by Portland District, and is in good condition. The north jetty was rehabilitated in 1989 with about 96,500 tons of stone. This rehabilitation was primarily centered between stations 78+00 to 83+00, where a notch had developed and a breach was then thought to be imminent. The north jetty is being monitored. No problems are known to exist with the north jetty at this time.

Deep Draft Channel. The deep draft navigation channel, completed in 1979, is 45 feet deep, 700 feet wide outside the entrance bar, transitioning to 35 feet deep and 300 feet wide near Guano Rock (RM 1). The inner channel is 35 feet deep and 300 feet wide to about RM 9 (the Southern Pacific Transportation Company railroad bridge), where it widens to 400 feet wide to RM 15, the upper end of the project. A diagram depicting existing channel dimensions is shown in figure 2.



Elevations (-MLLW)

Entrance Channel	RM 1-12	RM 12-15
45	35	35
49	N/A	36
51	37	38

EXISTING CHANNEL DIMENSIONS
(NO SCALE)

US Army Corps of Engineers Portland District

Coos Bay
Navigation Improvements

Figure 2

The channel is designed for one-way traffic. There is an 800-foot- wide by 1,000-foot-long turning basin at the city of North Bend (RM 12) and a 700-foot-wide by 1,000-foot-long turning basin at the city of Coos Bay (RM 14.7). Both turning basins are maintained to the project depth.

Anchorage. An anchorage area 35 feet deep, 1,200 feet wide and 2,000 feet long at RM 6 (near the community of Empire) was authorized. Subsequently, this anchorage was designated an emergency anchorage, relocated to RM 5.5, and reduced in size. This anchorage is 800 feet wide, 1,000 feet long and has no mooring buoys or dolphins. It is significantly undersized by Corps of Engineers' standards for a free-swinging single point mooring and its designated width spans the channel. It has not been used by the pilots, except for occasional turning of vessels.

A reconnaissance anchorage study was initiated under Section 107 authority in 1988 at the request of the sponsor. Subsequently, the study was terminated. Currently, a study of an anchorage does not have sponsor support. Therefore, funding has not been requested or provided; no work has been conducted to investigate the justification for an anchorage under this feasibility study.

3.2.2 Project Maintenance. The existing project is maintained to the authorized project depth, -35 feet MLLW, through a maintenance dredging program employing in-house dredging plant and contract dredges. Routine annual maintenance is normally required at the entrance bar and in the inner channel to RM 12. From RM 12 to RM 15, routine maintenance dredging is scheduled for alternate years. Advance maintenance is performed at the entrance and in the upper RM 12 to RM 15 reach. The authorized advance maintenance program is intended to assure that safe entrance channel depths with minimal delays are provided during the critical winter storm periods and for overall economy in maintaining the project. The advance maintenance program depths are displayed in table 3-1 and shown in figure 2. A complete discussion of the justification for the advance maintenance program is provided in Appendix B, Engineering Analysis, Section 2.2. Briefly, the advance maintenance program has been developed based on available dredging equipment for the District's overall west coast dredging program, costs to provide alternative maintenance programs, and assurance of project depths and safe operating conditions, particularly in the entrance during winter conditions. The program is justified based on costs of additional equipment mobilization and other costs which would be incurred for alternative maintenance programs.

TABLE 3-1.--*Authorized Advance Maintenance in Coos Bay Channel*

Location	Advance Maintenance Depth
Entrance Bar	4 feet, to -49 feet MLLW
RM 1-12	None
RM 12	1 foot, to -36 feet MLLW

A dredging tolerance of 2 feet is generally allowed in accordance with maintenance dredging regulations. Maintenance dredging is performed only where and when shoaling above the authorized channel depth occurs. In the inner channel, shoaling to depths less than authorized project depth can occur between dredging cycles but it will not be allowed to extend to the point of restricting vessel traffic, and the authorized depth is maintained as the controlling depth for vessel traffic. Where problem shoaling occasionally occurs in a critical area such as in the approaches to the railroad bridge, non-scheduled dredging by the hopper dredge *Yaquina*, or by contract clamshell dredge, has been performed to restore channel depths. In the entrance the intent is to maintain authorized depths through the winter when storms and wave effects can be expected to be most critical.

The Coos Bay channel is maintained by Portland District and contract hopper dredges below RM 12, and by contract clamshell dredges above RM 12. Pipeline dredging in the upper channel is no longer practiced due to lack of suitable upland disposal sites. Sea conditions normally limit dredging opportunities from May through October, extending into November with favorable bar conditions. The volumes of dredged material removed from the Coos Bay entrance channel from 1969 to 1992 are listed in Appendix B. The previous deepening project was constructed in 1977 through 1979. Since then, the average quantity of material dredged from 1980 through 1992 has been about 1.7 million cubic yards (cy) per year.

3.2.3 Ocean Disposal Sites. Generally, all material from maintenance dredging is deposited at three ocean disposal sites. A flow lane sump at RM 8.4 is also used to temporarily store material dredged by the District's hopper dredge *Yaquina* for later ocean disposal by contracted clamshell and barge dredging. This allows more effective use of the *Yaquina* by significantly reducing its non-productive time spent hauling loads to disposal. The round trip to the ocean disposal site from the channel above the railroad bridge is more than 20 miles. A flowlane site just inside the entrance is used occasionally for disposal if entrance conditions are too hazardous for the dredges.

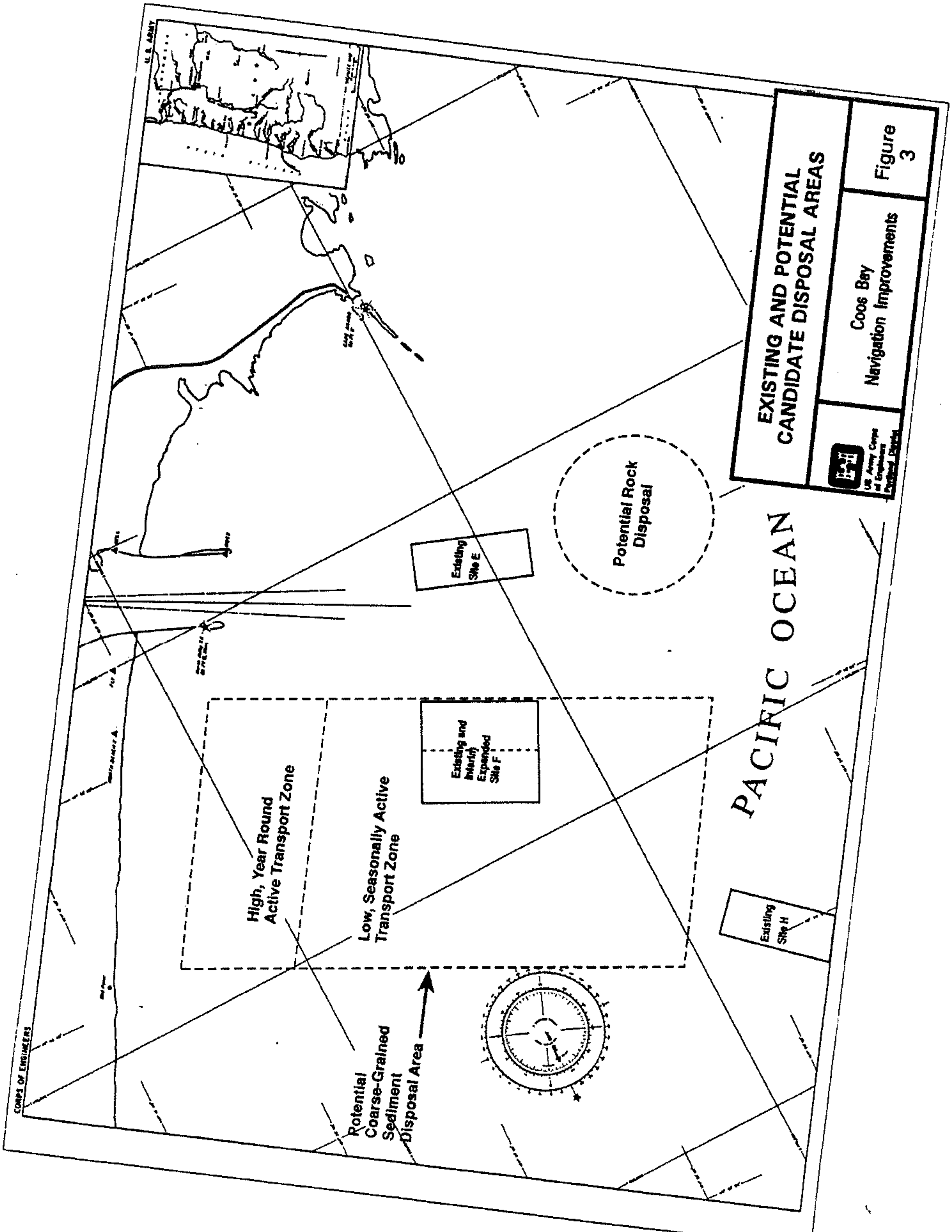
Three ocean disposal sites, identified as E, F and H respectively, have been designated by the Environmental Protection Agency (EPA) under authority of Section 102 of the Marine Protection Research and Sanctuaries Act (MPRSA). These sites are shown on figure 3. Specific dimensions and depths of these sites are indicated in table 3-2.

TABLE 3-2.–*Offshore Disposal Site Characteristics*

Site	Dimensions (ft)	Area (acres)	Ave. Depth (ft)
E	3,600 x 1,400	116	51
F	3,600 x 1,400	116	80
H	3,600 x 1,450	120	180

Sites E and F are used for disposal of sand material dredged from below RM 12. Site E is located about 1.5 miles southwest of the entrance channel. Site F is located north of the entrance channel about the same distance from the entrance. Mounding at site E has caused sharp curtailment of disposal at that site since about 1986. Disposal at site F was increased to compensate. Beginning in 1986 and continuing through 1989, almost 1 million cy have been deposited at site F annually. By 1989, persistent mounding had become apparent at site F. The site has been temporarily expanded (doubled) to the north under the Corps of Engineers' Section 103 authority to alleviate the immediate problem while disposal site studies were conducted. EPA will use the disposal studies to make a final designation of additional disposal sites to meet long-term needs. The capacity of the existing expanded site F is limited and may only be useable in its present configuration for two or three more years.

Site H has been used since its designation in 1986 for disposal of finer-grained sand and silt materials from above RM 12. Monitoring at this site indicates no adverse impacts or appreciable mounding. It is expected that continued use of site H for dredged materials, including suitable dredged materials generated by a new project, will not result in a need for expansion.



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Disposal Studies. Site F has not proven to be adequate for long-term disposal. New or expanded disposal sites for sandy material are necessary for the long-term maintenance of the project with or without the channel modifications being considered in this feasibility study. The object of disposal site studies and designation is to establish sufficient site capacity and management to provide for disposal of dredged material for the life of the project.

The disposal area under consideration involves expanding the boundaries of site F to include areas nearshore (marked as potential coarse-grained sediment disposal area in figure 3). These nearshore areas are believed to have better sediment dispersal characteristics. The original sizing of site F was based on the assumption that, at the time of site selection, material disposed at this location and depth would also be dispersed, particularly by winter storm activity. A minimum "footprint" was designed based on the maneuvering capabilities of the disposal equipment with the intent to minimize the extent of immediate biological impacts.

A number of studies of the offshore area have been conducted and monitoring of conditions at disposal sites is ongoing. Three new studies have been conducted to develop disposal site requirements and determine impacts. The studies include an analysis of site F sediment dispersal and mounding conducted by Ogden Beeman and Associates, Inc., in 1989 (see Appendix G, Site F Study), a side-scan sonar and sub-bottom profiling by Geo Recon International, Ltd., in 1989 (see Appendix F, Geologic Study), and biological sampling and characterization conducted in 1992 by the National Marine Fisheries Service (NMFS).

Disposal Alternatives. The study area is shown on figure 3. Several alternative approaches have been considered. One would involve use of the nearshore area. This would place the material in a high energy, active wave environment where the material would be expected to readily disperse within the littoral system. Another alternative would be expansion offshore, next to site F. Because of the less active environment and experience with site F and its recent expansion, mounding would be expected and the size of the site would need to be designed accordingly. A combination of the nearshore and offshore expansion is the third alternative. This alternative would allow for more management options and flexibility for long-term disposal activities within a much larger site.

Biological Studies and Disposal Impacts. Several biological studies have been conducted since 1979 for site designation and placement of dredged material from Coos Bay. The latest biological sampling was initiated in 1992 for the current site designation study. Studies of invertebrates, fish and wildlife organisms and communities were conducted in the offshore areas prior to the designation of sites E, F and H. Impacts to benthic communities from the disposal activities were of primary interest. Surveys found the vicinity of site F to be generally of lower productivity than other areas surveyed further offshore and that no unique biological communities would be impacted. It was determined that the effects of disposal would be short term for benthic organisms and would be followed by rapid re-establishment.

Site H is described as a transition habitat supporting species from both the higher-energy near shore and deeper offshore environments. In general, species abundance and richness were higher at site H than at site F. The results of monitoring of benthic organisms at site H since disposal was initiated found minor or no impacts to most species.

To assess biological impacts for expanding site F for continued maintenance disposal and any materials resulting from potential channel improvements, additional sampling surveys have been conducted. One survey was conducted in April 1992 to characterize organisms in and around site F and in the nearshore area. A second survey of this area was conducted in October 1992. The results of these surveys were compared to surveys conducted in 1979 to determine whether there have been changes in these communities. Results of both samplings indicate that the area evaluated for proposed expansion of site F is similar in species composition to that described by the 1979 studies. Based on the 1979 testing and more recent confirmation studies, the proposed site (larger area) appears suitable for dredged material disposal.

A site for a one-time disposal of any rock materials excavated from the channel for deepening alternatives will be required.

3.2.4 Environmental Conditions. Environmental conditions of the Coos Bay estuary and offshore disposal sites are briefly summarized below. Complete descriptions of physical, biological and human resources are contained in the EIS, Chapter 3, and the appendices indicated.

Physical Features. Coos Bay is a typical drowned river valley estuary on the Oregon coast. It is relatively shallow with gently-sloping sides and a well-established deeper channel. During the rise in sea level which produced the estuary there was a great increase in sedimentation which produced the broad expanse of tidal flats and marshes now found. North Spit was formed from sand deposited by "long shore drift" or ocean currents running parallel to the shore.

Tides. Coos Bay tides are mixed semidiurnal. The mean tidal range to mean higher high water is 7.5 feet MLLW at the Coos Bay entrance and 7.3 feet above MLLW at the city of Coos Bay. The highest estimated tide is 10.5 feet MLLW. Extreme low water is estimated to be -3.0 feet MLLW.

Water Quality. Water quality in Coos Bay is generally described as mildly polluted, typical of an industrially-developed estuary. Various chemical constituents have been identified and are of general concern, particularly levels of tributyltin, a contaminant derived from marine paints. Water quality problems are also derived from the shallowness of the bay and low river flow into the bay in summer. Low dissolved oxygen, high temperatures and high coliform and turbidity levels are found at various locations. These problems are most prevalent in Isthmus Slough above RM 12. Turbidity levels temporarily increase during maintenance dredging above RM 12, but return to normal levels soon after the activity stops. Dredging in the upper bay also can bring about a temporary reduction in dissolved oxygen levels.

Sediments. Channel sediments vary from coarse-grained sand materials in the lower channel to finer grained sand and silts in the upper channel above RM 12. Levels of chemical and metal constituents in channel sediments are analyzed periodically in conjunction with maintenance dredging. The channel sediments have consistently been found to be suitable for unconfined in-water disposal under the guidelines established under Section 404 of the Clean Water Act and Section 103 of the MPRSA. Periodic testing, required for permitting of dredging of berthing areas adjacent to the channel, has yielded some higher level of contaminants, however, the levels have been such that the bulk of the sediments have been found to be suitable for in-water disposal. Sampling and testing performed for this study and other related studies are described in the EIS; the results are shown in Appendix D, Sediment Quality.

Hazardous, Toxic and Radioactive Waste (HTRW) Sites. Three existing hazardous waste sites in the vicinity of the project in the upper channel are noted. Two sites (Chevron USA and Chambers Oil) are bulk fuel storage sites with historical onshore fuel spills. The other site (Hillstrom's) is a former ship repair facility with onshore and sediment contamination from sandblasting, painting, and other repair activities. Levels of tributyltin are of concern at this site. Based on sampling data to date and location relative to the channel these sites are not expected to affect ongoing maintenance nor deepening of the channel. The berth at the Hillstrom dock would not be slated for deepening in association with a channel deepening project. It is noted however that in 1991 sediments in the berthing area adjacent to the channel were tested and found to be suitable for in-water disposal. A more detailed discussion of information on these sites may be found in the EIS, paragraph 3.2.f.

Salinity. The salinity regime of the Coos Bay estuary is generally described as a "well mixed" or "vertically homogeneous" system. This system is characterized by relatively thorough mixing of fresh and salt water throughout the water column, caused by the turbulence of tidal action and/or low freshwater flows. This is distinguished from a "stratified" system in which the denser salt water moves up and down the estuary in a "salt wedge." In a study by the Oregon Graduate Center, the water downstream of North Bend is described as typically saline, and freshwater mixing became increasingly important upstream. That study concluded that the estuary is vertically well-mixed for low river flows and only becomes stratified during infrequent high river flows. Refer to the EIS and Appendices E, Salinity Analysis, and H, Salinity Workshop, for more detailed information on salinity.

Biological Resources. A complete description of the flora and fauna biological resources of Coos Bay and offshore disposal sites are described in detail in paragraphs 3.4 and 3.5 of the EIS.

Threatened and Endangered Species. There are 15 Federally listed species, under the administration of NMFS, which may occur in or near the offshore disposal sites. These include gray, fin, humpback, blue, Sei, sperm and right whales; northern (Steller) sea lions; leatherback, loggerhead and green sea turtles; Snake River sockeye salmon, Snake River fall and spring/summer chinook salmon; and Sacramento River winter-run chinook salmon. These species, with the exception of northern sea lions, are not expected to occur in the Coos Bay estuary. They are normally present in offshore waters or occur in limited numbers on a seasonal basis.

Five Federally listed species administered by the U.S. Fish and Wildlife Service (USFWS) occur in the project area: brown pelican, peregrine falcon, bald eagle, western snowy plover and the marbled murrelet. Snowy plovers occur on beaches and upland dredged material disposal sites on Coos Bay North Spit. Brown pelicans forage within the bay and nearshore waters; this species also uses waters of the bay, headlands, beaches, islands, rocks and jetties for loafing. Brown pelicans are present from mid-late spring into the fall. Peregrine falcons may forage in the area, however neither site F nor the rock disposal site are considered significant foraging areas. Peregrine falcons generally occur in the Coos Bay area during spring and fall migration; a few wintering birds may be present. Bald eagles have established nesting territories in the Coos Bay area but occurrence of this species in the lower bay is infrequent.

Cultural Resources. The Coos Bay estuary and region contain extensive evidence of prehistoric occupation. Although only two prehistoric sites have been formally documented, at least nine other sites have been reported along the shoreline of the North Spit (from RMs 1 to 9). In addition, prehistoric sites have been identified on some of the low marshy mudflats and islands within the bay.

There have been 114 documented shipwrecks in the Coos Bay area. The majority of these wrecks occurred along the beaches and at the entrance to Coos Bay. Thirteen vessels wrecked within Coos Bay. Of these, nine vessels sank and were not salvaged and presumably are preserved within the sediments of the bay.

3.2.5 Port Facilities. There are 13 existing deep-draft berths from which ocean going cargo is received and dispatched. One deep draft terminal, Roseburg Timber Products, is located on the north side of the channel at about RM 8, just downstream of the railroad bridge. The remaining major deep draft docks and terminals are located upstream of the bridge on the west side of the channel between RM 11 and 15. The new nickel ore import facility is located at the Pierce Dock. Glenbrook Nickel Company has invested about $36 million in facilities. The installation at the port includes drying, crushing, loading and unloading facilities. The imported ore contains up to 2.3 percent nickel, whereas local ores contain from 1 percent to 1.3 percent. Ore processed at the dock is transported by truck to the company's smelter in Riddle. This is the only nickel smelter in the United States. Earlier test shipments of ore confirmed the compatibility of the imported ore with the existing smelter. Using imported ore will allow doubling of the smelter output.

These berths are listed in table 3-3 and located on figure 4. Of the 13 docks on the channel, 10 are public access docks.

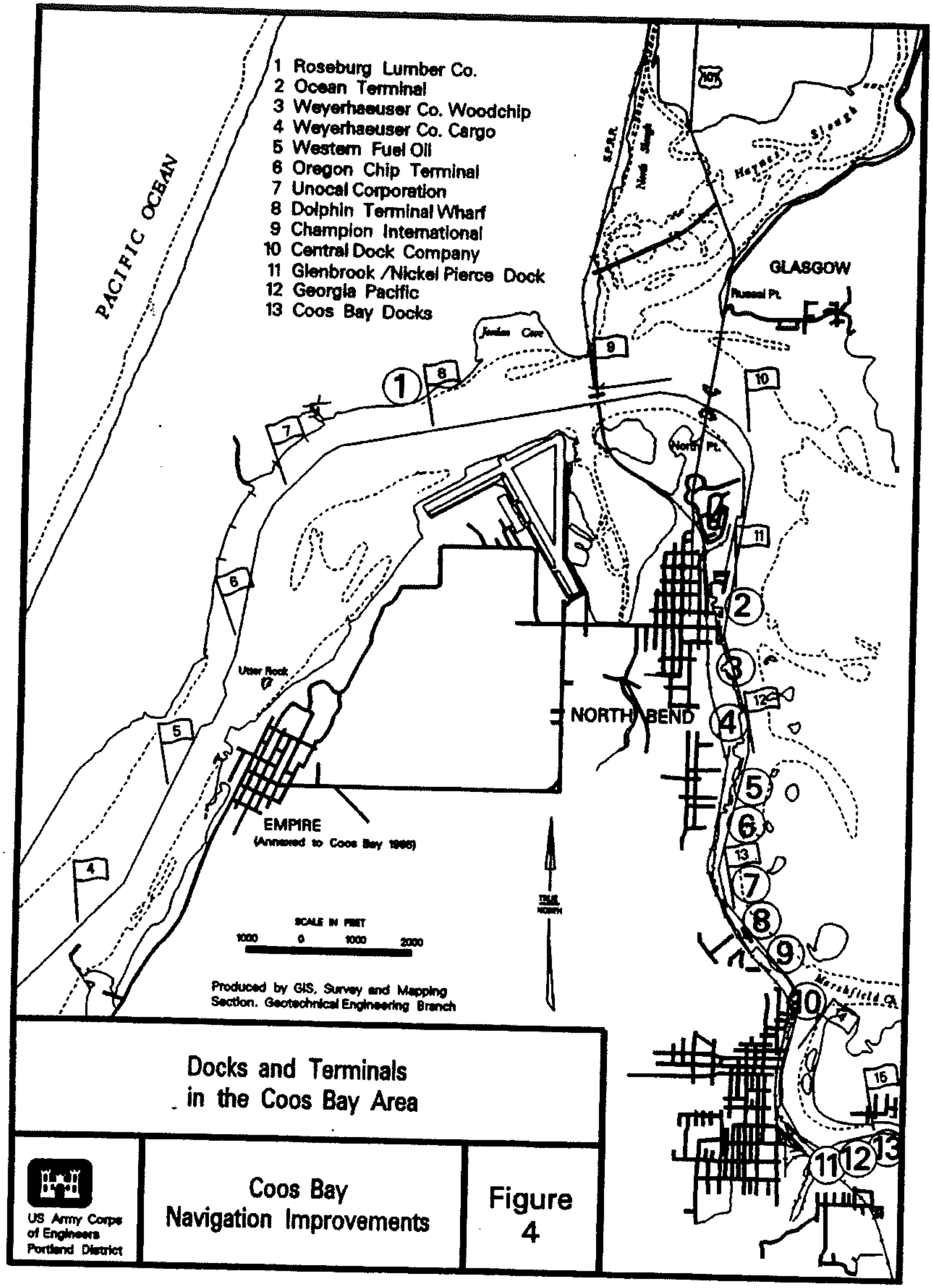
TABLE 3-3.--*Docks and Terminals, Port of Coos Bay*

Name	RM	Length	Width	Depth	Public Access
Roseburg Timber Products	8.0	1,000	100	39	yes
Ocean Terminal	11.5	700	100	38	yes
Weyerhaeuser Co. Wood Chip	11.7	800	100	36	yes
Weyerhaeuser Co. Cargo	12.2	1,400	100	35	yes
Western Fuel Oil	12.5	200	100	24	yes
Oregon Chip Terminal	12.8	1,000	100	36	no
Unocal Corp	13.2	800	100	35	no
Dolphin Terminal Wharf	13.4	700	100	37	yes
Champion Int.	13.6	690	100	35	yes
Central Dock	13.8	690	100	35	yes
Glenbrook Nickel/Pierce Dock	14.7	576	100	37	no
Georgia Pacific	14.8	660	100	36	yes
Coos Bay Docks	15.2	660	100	38	yes

3.3 Deep Draft Commerce

3.3.1 Existing Versus Future Without-Project Overview. The following paragraphs address issues involving existing and future supplies of timber, and their effect on commodities exported from Coos Bay. Timber product commodity projections were based on the analysis of past and future timber supply issues. These projections will be required to compare the without-project and other alternatives. To simplify the analysis, it was assumed that commodity projections would not vary with the alternatives.

3.3.2 Existing Activity. Coos Bay is one of the world's largest shipping ports for forest products. As discussed earlier, the primary commodities are wood chips, logs and lumber. Coos Bay's share of total wood product exports from the Pacific Northwest was about 20 percent for the last 20 years. Table 3-4 presents major commodity movements



Docks and Terminals in the Coos Bay Area

US Army Corps of Engineers Portland District

Coos Bay Navigation Improvements

Figure 4

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for Coos Bay in 1990 and 1991. The data was provided by the Port of Coos Bay. Appendix C, Economic Analysis, also presents data for the years 1976-1989, from the *Waterborne Commerce Statistics of the United States.*

TABLE 3-4.--*Major Commodity Exports 1990 and 1991 (Short Tons)*

Commodity	1990	1991
Wood chips	2,988,000	3,233,000
Logs	1,136,000	805,000
Lumber	522,000	462,000
Plywood	64,000	57,000
Paper products	19,000	75,000
TOTAL	4,729,000	4,633,000

In 1988, records indicate that 333 deep draft vessels transited the channel exporting timber products or importing petroleum. The numbers and percentages by commodity group are shown in table 3-5.

TABLE 3-5.--*Vessel Transits by Commodity in 1988*

Commodity	Number	Percentage
Wood chips	95	29%
Logs	91	27%
Lumber, Paper, Plywood	135	41%
Petroleum	12	4%
TOTAL	333	100%

To date exports have been much more significant than imports. Further, petroleum tankers have been relatively small; 12 in 1988 drafted between 21 feet and 28 feet, and 10 in 1989 drafted between 20 feet and 25 feet. There have been deeper drafts in the past, but tanker traffic is not expected to be constrained by existing channel depths. The existing channel depth is a factor with respect to the new imports of nickel ore, however.

3.3.3 Timber Supplies. The region's future timber supply is significant in developing the without-project condition and evaluating alternatives for improvements to the project. A number of sources and reports were reviewed to analyze the timber supply situation and develop commodity projections for the port.

Environmental and political issues involving old growth forests, listing of the Northern Spotted Owl as a threatened species and bans on log exports are very complex. A detailed discussion and analysis of those issues and anticipated impacts on exports from Coos Bay is presented in the Economic Analysis appendix. Data on timber supply issues, future domestic and foreign demand for timber products and the effects on exports from Coos Bay were collected from a number of sources. These include the report, *A Conservation Strategy for the Northern Spotted Owl* (the Jack Ward Thomas Report), by the Interagency Scientific Committee To Address the Conservation of the Northern Spotted Owl; the U.S. Forest Service (USFS); the Bureau of Land Management (BLM); the World Forestry Institute; the Oregon Economic Development Department; and the Office of Economic Analysis of the State of Oregon.

It is anticipated that setting aside old growth forest reserves for the spotted owl would result in a decline in supply of timber from public lands in the region. Several of the sources project that increases in lumber and finished product exports would partially offset reductions in log exports due to log embargoes and Spotted Owl timber set-asides.

3.3.4 Timber Commodity Projections. Overseas demand for timber products is expected to grow. The Pacific Northwest region competes with the southern United States and Canada for export of these products. Based on the collective information from the sources identified above, it is assumed that the price for regional products will remain competitive and that long-run market forces will prevent a dramatic change in the region's share of the export market. The Port of Coos Bay is expected to retain its competitive position relative to other forest product exporting ports in the Pacific Northwest, as impacts of timber supply will be similar throughout the region.

After thorough review of all data available, the basic commodity projections were developed through discussions with USFS personnel. The USFS expert assessment projects that wood chip exports should remain relatively constant from 1996 to 2046, the economic period of analysis, with log exports declining by about 4 percent over the same period. For lumber products, the USFS projected a growth of about 10 percent over 50 years.

These trends were modified in the economic analysis in that the projections were considered reliable for the first 20 years to 2016. For the next 30 years, commodity exports were assumed to remain at their 2016 level. The timber commodity projections are summarized in table 3-6. Also, because of the current uncertainties with regard to timber supply issues and the effects on commodity exports from Coos Bay, a risk and uncertainty analysis and tests of the sensitivities of the projections were conducted. These analyses are summarized at the end of Section 4 and discussed in detail in the Economic Analysis Appendix.

TABLE 3-6.--*Timber Commodity Projections (metric tons)*

Commodity Exported	1985-89 Average Exports	USFS Projection to 2016
Wood Chips	2,538,200	2,538,200
Logs	1,155,000	1,131,400
Lumber, Paper and Plywood	368,100	385,000

3.4 Deep-Draft Fleet

3.4.1 Historical Trend. Response to the previous channel improvements in 1979, Coos Bay has seen an increase in the operating drafts of vessels calling at the port. This trend is evident in table 3-7 which shows the percentage of dry cargo vessels outbound from Coos Bay with drafts 33 feet or greater between 1976 and 1988. This increase reflects the response to the deepened channel and a general trend toward more efficient, larger, and deeper-draft vessels to reduce transportation costs.

TABLE 3-7.--*Vessels Outbound from Coos Bay with Drafts 33 Feet or Greater*

Year	Number	Total Traffic	% of Total
1976	4	353	1
1977	2	316	1
1978	6	289	2
1979	53	321	16
1980	84	310	27
1981	52	269	19
1982	124	282	44
1983	96	267	36
1984	68	260	26
1985	112	259	43
1986	106	275	38
1987	101	287	35
1988	111	333	33

3.4.2 Current Operating Practices. Deep draft vessels are moved into and out of the Coos Bay project by five licensed pilots, members of the Coos Bay Pilots Association. All deep draft vessel movements into and through the Federal navigation project are the responsibility of the members of this association. The following information on operating practices has been developed primarily through discussions with them.

Historically, deep draft vessel traffic entering Coos Bay mostly consisted of empty or partially loaded cargo vessels and loaded tankers. The tanker vessels comprise a small fraction of the vessels and generally are relatively smaller in size and draft, and are not of concern with regard to deepening the project. The recent new imports of nickel ore is, however, a factor with regard to incoming vessel dimensions and drafts.

Outbound Transits. The outbound transit is the most demanding of the vessel movements on the project. The railroad bridge at RM 9 is particularly difficult to negotiate. The pilots plan outbound departures to reach the entrance bar by high-water slack tide. The departure on a rising flood tide provides a margin of safety from grounding should there be any delays or problems with the transit and provides a safer bar crossing for the vessel and its accompanying pilot boat. The incoming currents provide for steerage to maintain alignments through the turns in the upper channel, and

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particularly through the bridges. Continuous turning maneuvers are used while approaching these structures. First, the vessel must be aligned for passing under the center of the highway bridge in the middle of the North Bend turn (see Plate 5). Then it must be aligned for passage through the narrow opening of the railroad bridge while completing the turn. Because of the turns and lower speeds required in the upper channel above the bridges, two tugs assist in all movements there, including turning and berthing. Under adverse conditions additional tugs are sometimes employed. At the very least, the pilots pass through the railroad bridge before the high water slack to avoid the reduced steerage while navigating through the bridges which would occur with an ebbing current.

Transit times for departing vessels average about 1 1/2 hours to 2 hours. This includes about 3/4 hour to 1 hour to reach the railroad bridge and another 3/4 hour to 1 hour in the lower channel to reach the entrance. As described in more detail in Section 4, vessels are normally turned upon arrival to avoid delays in the outbound transit. Transit speeds in the upper channel are about 5 1/2 knots to 7 knots, except when passing moored vessels, when speeds are reduced to 2 knots to 2 1/2 knots. In the lower channel, vessels travel at 9 knots to 11 knots. Another important factor affecting operating practices is the relative timing of the tides between the entrance and the upper channel. The average tidal variation is 7.5 feet. Tides in the upper river lag the entrance tides by about 1 1/2 hours. The departure window, transit time, tidal variation and lag combine to result in a typical maximum "useable" tide variation of about 4 feet for vessel departures.

Coos Bay pilots generally require about 3 feet of underkeel clearance at the dock for departure. The pilots indicate that conditions such as weather and pilot judgement may call for variances from this general "rule" on a case-by-case basis, which would be decided at the time of departure.

<u>Inbound Transits</u>. The inbound passage is less difficult, though the draft of the vessel and tides are a factor. It is estimated that annually about 25 incoming vessels are partially loaded to a draft where tides are used to provide adequate underkeel clearance. With projected nickel ore imports, this number would increase to about 50. Inbound vessels loaded to a deeper draft incur a greater risk during an ebbing tide if there are delays. Pilots will bring deeper draft vessels in with the tide and follow the

high water into the upper channel. The inbound approach to the railroad bridge is on a long tangent, so establishing and maintaining alignment for inbound passage through that structure presents no special concerns.

Railroad Bridge. Passing through the railroad bridge can be difficult for larger vessels and for all vessels during adverse weather conditions. The pilots' primary concern is visibility. Adverse weather conditions and the superstructure on some larger vessels can obscure the view for aligning and passing through the bridge. These factors can delay otherwise routine arrival and departures. This happens most often with larger wood chip vessels calling at Coos Bay. Visibility concerns in passing through the bridge preclude nighttime passage for some of these vessels. With the variation in the tidal cycles, these factors can cause varying amounts of delay. A notification by the pilots to shippers, dated March 9, 1990, regarding this condition is included in Appendix I, Correspondence.

Turning Basins. There are two authorized turning basins at the project. The larger, located at RM 12, is maintained to dimensions of 800 feet by 1,000 feet and the other, at RM 14.6 near the head of the project, is maintained to 730 feet by 1,000 feet.

The most common and advantageous operation is to turn inbound vessels facing outbound before docking. There are two predominant reasons. The first is a physical requirement; many of the dock facilities in the upper channel are designed for port-side berthing and loading. This is usually the situation for wood chip terminals as it is for the new nickel ore facility. The other factor is that, of the two transits, departure is the most critical with respect to the time available as discussed previously. The pilots prefer to have as much time available for the outbound transit as possible. About 1/2 hour is required to turn a vessel. Therefore, vessels are most often turned prior to docking.

As discussed in more detail in the Engineering Analysis appendix, while turning upon arrival is preferred, an estimated 40 to 50 vessels per year are turned after loading.

The turning basin to be used is dictated by proximity to the destination dock and size of the vessel. For all but the largest vessels, the breakpoint for use of a turning basin is generally at Dolphin Terminal, RM 13.4. Below that point vessels would use the lower turning basin. About 60 percent of the vessels call at docks below that point. The upper basin would be used for docks above that point unless a vessel is too large, though the pilots report they have turned vessels of up to 700 feet in length in the upper basin.

3.5 Problems and Opportunities

3.5.1 Transportation Efficiencies. The Coos Bay navigation project channel depths limit the actual drafts of vessels that use the project to about 36 feet. Table 3-7 shows that the draft of the vessels in the fleet calling on Coos Bay has increased and that the channel depth is a constraint. Deepening and other improvements to the navigation channel at Coos Bay could enable larger, more efficient vessels to call on the Port and vessels to load closer to design drafts. Transportation of more commodities on larger vessels could reduce costs per unit of product delivered.

3.5.2 Delays. Delays for tides to provide underkeel clearances are necessary when the drafts of vessels are deeper than 32 feet. The pilots generally must delay transit until tidal conditions provide at least 3 feet of underkeel clearance, depending on vessel characteristics. In 1980, after the previous deepening, 84 vessels, 27 percent of the fleet calling on Coos Bay, had drafts of 33 feet or greater. In 1988, there were 111 such vessels, representing 33 percent of the fleet. The length of delay depends on the draft, the tides, and timing. Delays also are encountered due to the Southern Pacific Railroad bridge, as discussed in paragraph 1.5.2.

3.5.3 Disposal of Dredged Materials. As discussed in paragraph 3.2.3, permanent ocean disposal areas must be established for continued existing project maintenance, as well as for the alternatives developed in this study. There is an opportunity to consider beneficial uses of dredged material.

3.6 Formulation of Alternatives

The following alternatives were considered to address the problems and opportunities identified at Coos Bay. The alternatives are evaluated in accordance with Corps of Engineers criteria established by regulation.

3.6.1 Without-Project Condition. The without-project condition assumes no change to the existing Federal navigation project, which would remain at 35 feet deep for the inner channel and at 45 feet over the entrance. The without-project condition is used to evaluate the benefits which would result from other alternatives.

3.6.2 Channel Modifications at Railroad Bridge. As discussed in the reconnaissance report, the approach and passage through the Southern Pacific Transportation Company railroad bridge at RM 9 is hazardous and causes delays due to its restricted horizontal clearance of 197 feet. The reconnaissance study concluded, however, that replacing the bridge was not feasible.

Approaches to the railroad bridge were considered. Both inbound and outbound vessels are affected by tidal currents in approaching this bridge, particularly in the reach between it and the highway bridge below RM 10. Because of the relative proximity of the two bridges and the limitations of each with regard to clearances, there would be little opportunity for any meaningful realignment of the channel to improve the current condition. Off-channel underwater groins could potentially help with the adverse currents.

In spite of the hazards, there is no record of accidents involving deep draft vessels at the bridge. The Coos Bay Pilots, as the only pilots' organization on the bay moving all of the vessels that call on the port, have established the special procedures necessary to navigate this reach. The pilots do not anticipate any benefit from modifications. Another factor is the age and condition of the railroad bridge structure. The bridge will require reconditioning or replacement in the near future, though a time frame cannot be firmly established.

3.6.3 Nonstructural Alternatives. The most reasonable nonstructural alternative would be to maximize vessel loads and drafts through timing of vessel movements to coincide with optimum tidal conditions. Such a program, called "Loadmax," was developed for the Columbia River. The system employs a network of tidal gauges and tidal data to produce a precise schedule for transiting critical points in the 100-mile-plus channel to arrive at the entrance at desired slack tides. This automated system would not be warranted for only a 15-mile channel where the pilots already employ such a system using tide tables.

Use of additional tug assist is a potential alternative to increasing channel dimensions.

No other nonstructural alternatives were identified which would reasonably address the problems identified for this study.

3.6.4 Channel Deepening. All deepening alternatives would require investigations pursuant to designation and use of additional ocean disposal areas. All deepening alternatives also would consider requirements for other modifications to the existing channel dimensions and alignment.

Alternative 1. This alternative would increase the authorized entrance depth to taper from 46 feet deep (oceanward) to 36 feet deep at RM 1, and increase the authorized channel depth to 36 feet from RM 1 to RM 15.

Alternative 2. This alternative would increase the authorized entrance depth to taper from 47 feet deep (oceanward) to 37 feet deep at RM 1, and increase the authorized channel depth to 37 feet from RM 1 to RM 15.

Alternative 3. This alternative would increase the authorized entrance depth to taper from 48 feet deep (oceanward) to 38 feet deep at RM 1, and increase the authorized channel depth to 38 feet from RM 1 to RM 15.

Alternative 4. This alternative would increase the authorized entrance depth to taper from 49 feet deep (oceanward) to 39 feet deep at RM 1, and increase the authorized channel depth to 39 feet from RM 1 to RM 15.

Alternative 5. This alternative would increase the authorized entrance depth to taper from 50 feet deep (oceanward) to 40 feet deep at RM 1, and increase the authorized channel depth to 40 feet from RM 1 to RM 15.

3.6.5 Staged Construction. Staged construction of the 3-foot, 4-foot and 5-foot deepening alternatives was considered in response to a recommendation by the USFWS out of concern for salinity intrusion. The recommendation called for a 1 foot deepening every 5 years, with an evaluation of the effects. The difficulties inherent in excavating 1 foot of rock at a time, such as additional costs for mobilization and demobilization, larger contingencies and interest during construction costs, institutional difficulties with negotiation of local cost sharing agreements and provision of non-Federal funding, would make such a plan infeasible as it would be extremely impractical to implement. Also, the staged construction for the deeper alternatives would adversely impact the environment because each increment of dredging would re-disturb benthic organisms and habitat that had reestablished following the previous deepening. Staged construction was not favored by the sponsor and was not considered further.

3.7 Beneficial Use of Dredged Material

Beneficial uses of dredged material were considered for several purposes, but not included in any specific alternatives at this time, for the reasons indicated in subsections 3.7.1, 3.7.2 and 3.7.3.

3.7.1 Beach Nourishment. This has not been pursued under this study because, as indicated in the previous discussion on existing conditions, a need has not been identified. This, however, would be one of the potential effects of disposal in a nearshore berm or shallow water site, which is an alternative in the ocean disposal site designation process.

3.7.2 Artificial (Rock) Reef Creation. There is no perceived need for additional rock reef habitat in the area. In addition, the sandstone rock to be excavated would not be suitable for this purpose because it would be expected to weather rapidly.

3.7.3 Western Snowy Plover Habitat Development. Portland District, in conjunction with the resource agencies and potential local sponsors, is developing a environmental restoration proposal under authority of Section 1135 Water Resources Development Act (WRDA) of 1986 for using dredged material to develop nesting habitat on Coos Bay North Spit for the endangered western snowy plover. The North Spit location can be seen on figure 1. Through coordination of dredging actions (i.e., Section 1135 and channel deepening), substantial use of both new and existing project maintenance materials could be made to develop the habitat. This option was not included in the alternatives because of the added costs to mobilize additional pipeline

dredge equipment. This disposal option will be further considered for ongoing maintenance dredging.

4. COMPARISON OF ALTERNATIVES

4.1 Design Considerations

Each of the alternatives have been examined to establish design requirements to accommodate vessel traffic associated with each increment of deepening, construction methods and quantities, and maintenance requirements. Comparative cost estimates were then derived to be used in conjunction with the benefits for each alternative in evaluating the feasibility of making improvements to the existing project. Since release of the draft report, a Global Positioning Survey (GPS) study has been completed. The study was conducted by the Corps' Waterways Experiment Station (WES). The intent of the study was to verify conclusions herein, and to ascertain whether there were any navigation problems for which ship simulator studies should be conducted. The GPS summary report is provided at Appendix K. See Section 5, The Preferred Plan, for discussion of the GPS results.

4.1.1 Design Vessel. As indicated, the Coos Bay Pilots' general operating rule is to require 3 feet of underkeel clearance for a channel transit. For the existing 35-foot channel and a useable tide of 4 feet, a practical limit on departure drafts at the dock would therefore be 36 feet. Pilot information and historical data presented in the Economics Analysis appendix supports 36 feet as a practical limit on operating drafts under existing conditions. The data shows that vessel departures at a draft of 37 feet have occurred, but only rarely. On at least one of those occasions, when a vessel was loaded to 37 feet, pilots reported a delay of several days while awaiting conditions for a safe departure. Departure drafts in excess of 37 feet have not been recorded.

Economic Guidance Memorandum 93-4 was consulted to obtain representative vessel dimensions to be considered for design of the alternatives between the existing 35-foot project and the maximum 40-foot depth. This representative vessel was then compared to existing vessels calling on Coos Bay. Based on data in this document and for the existing project condition, a representative 40,000-dead-weight-ton (DWT) bulk carrier drafting 36 feet would be 612 feet long with a beam of 88 feet. A representative 50,000 DWT bulk carrier drafting 40.2 feet would be 680 feet long and have a beam of 99 feet.

Wood chip vessels calling at Coos Bay are typically specially designed for this commodity and represent the largest vessels in horizontal dimensions calling on Coos Bay. Twenty-one of the 26 wood chip carriers calling in 1988 for which length data was available ranged in length from 640 feet to 675 feet. Only one vessel was longer at 736 feet. The majority of the wood chip vessel beams ranged from 96 feet to 106 feet (14 of 18 for which data was available). Only one vessel was broader at 115 feet.

The design dimensions selected for channel design are based on consideration of the representative bulk carriers from Memorandum 93-4 and the representative wood chip vessels calling at Coos Bay, as follows;

Draft----- Channel depth plus 1-foot (see discussion below)
Length----- 680 feet
Beam------ 106 feet

The likely response to a deeper channel would be to increase vessel drafts, accordingly. Therefore, the existing 3-foot clearance operating rule of the pilots has been used in the analysis of alternatives in accordance with guidance of ER 1105-2-100, *Guidance for Conducting Civil Works Planning Studies*. Based on the tides and operating practices at Coos Bay, the following typical maximum operating drafts for channel design result.

TABLE 4-1.--*Typical Maximum Operating Drafts for Channel Design*

	W/O Proj.	1	2	3	4	5
Channel Depth, ft., MLLW	35	36	37	38	39	40
Typ. Max. Useable Tide, ft.	+4	+4	+4	+4	+4	+4
Avail. Max. Total Depth	39	40	41	42	43	44
Less Underkeel Requirement	-3	-3	-3	-3	-3	-3
Typ. Max. Operating Draft	36	37	38	39	40	41

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4.1.2 Channel Design. During the last several years, about 300 deep draft vessels have used the channel annually. This number is not expected to increase over the life of the project to a point where there would be a general need to design for two-way deep draft traffic.

Channel Depth. Channel depth requirements are based on the established operating practices, the useable tides for transiting, and the general 3-foot "at dock" rule of the Coos Bay pilots. Each succeeding alternative channel depth will provide for a typical maximum operating draft 1 foot deeper than the corresponding channel depth (see Appendix B, Engineering Analysis). At typical transit speeds, the 3-foot underkeel clearance at the dock (including any vessel trim) would provide about 1.5 feet for squat and 1.5 feet for safety clearance. In rock areas, the channel will be dredged an additional 2 feet to provide about 3.5 feet of safety clearance. The entrance depth requirement for each plan will be 10 feet deeper than the inner channel based on the existing condition.

The currently authorized advance maintenance program is described in subsection 3.2.2 and discussed in detail in Appendix B, Engineering Analysis, subsection 2.2. This program is assumed for each of the alternatives, because shoaling patterns are anticipated to be similar and the same considerations would apply.

Lower Channel Width and Alignment. The entrance channel was 900 feet wide before the 1978 deepening project. The existing entrance channel was then reduced to 700 feet wide at the outer bar and transitions to 300 feet wide at Guano Rock. This design was based on the sea, wave, tidal current and wind conditions and vessel characteristics, with input from the Coos Bay pilots. Even with the trend toward larger vessels, the pilots indicate that the existing width of the entrance channel is sufficient.

The lower channel to RM 9 is nominally 300 feet wide, but it varies considerably because of the use of wideners at bends. The pilots are satisfied with the existing width of the lower channel and do not recommend any changes. Results of GPS studies are discussed in Section 5, The Selected Plan.

Upper Channel Width and Alignment. The channel above the railroad bridge, RM 9 to RM 15, is nominally 400 feet wide. There are six major bends in the upper channel including the turn above the highway bridge and two turns which also involve turning basins. The straight reaches of the channel above the bridges were widened to 400 feet as part of the most recent channel modification project authorized by the River and Harbors Act of 1970. Wideners at turns in the upper channel were also increased, as were the width of berthing areas between the channel and harbor lines. A complete discussion of design considerations for the upper channel width is contained in Appendix B, Engineering Analysis, subsection 3.3.2. A summary of the conclusions is contained in Section 5, The Selected Plan. The alternative deepening plans have been developed assuming no change to the existing width.

4.1.3 Turning Basins. Reference is made to the previous discussion of turning practices in subsection 3.4.2 and the analysis of turning basin dimensions in the Engineering Analysis Appendix, section 4.1.

The pilots indicate that there have been little difficulties in operating within the existing turning basins and there have been no accidents associated with turning maneuvers. About 1/2 hour is required to turn a vessel. This includes the time for slowing the vessel in the channel, positioning the tugs as the vessel approaches the turning basin and the time to execute the turn. The pilots report that the turn itself requires about 10 minutes. During the GPS study, one of the vessels was monitored while executing a turn in the lower turning basin. The actual time recorded for the turning maneuver was 7 minutes. If only one turning basin were to be widened, the pilots indicate preference for the lower turning basin, as it is most used and the basin closer to the docks for the majority of the larger (wood chip) vessels.

Based on EM guidance, a turning basin of 1.5 to 2 times vessel length was prescribed. The revised draft EM indicates 1.2 to 1.5 times vessel length. For the design vessel, this would indicate a turning basin width of 800 to 1,000 feet. As reported in the Engineering Analysis appendix, in considering the costs, widening at RM 12 to 1,000 feet does not appear to be justified based on the limited opportunity to save time in turning in turning. Also, there would be no cost savings for tug assistance because this service would continue to be used for general operations in the upper channel. Further, additional tugs could be employed to assist with the larger vessels at a lower equivalent annual cost than widening to 1,000 feet. Widening beyond about 900 feet also would encroach into biologically productive shallow tidal and intertidal habitat which is zoned as a "Natural Aquatic" area in the Coos Bay Estuary Plan. This would raise significant environmental concerns as discussed in the EIS.

Widening of the turning basin from 800 to 900 feet was evaluated in consideration of tidal current conditions, as recommended in the revised draft EM, and to provide an added margin of safety for turning the larger vessels. Widening to this dimension could be accomplished with only minor environmental impacts. This would provide a width 1.3 times the length of the design vessel, within the range of the revised guidance. Widening the lower turning basin to 900 feet appears to be feasible.

The upper turning basin is located in a very confined area (see Plate 7). Expansion of the turning basin would extend into upland areas, potentially impacting existing dock and storage yards, as well as other improvements. Expanding this basin in addition to the lower basin is not required as larger vessels can be turned in the lower basin as discussed in the Engineering appendix, and therefore is not justified.

Consideration of the appropriate depth for the additional width of turning basins beyond channel lines is discussed in the Engineering Analysis appendix, paragraph 4.1.3. The revised draft EM indicates that normally turning basin depths should be the same as the channel depths. Costs to deepen the full width of the turning basins are minimal and there would be no long-term maintenance cost savings. In consideration of the costs, turning and docking practices, and the number of loaded vessels arriving at the port, deepening turning basins to the same depth as the channel is justified.

4.1.4 Anchorages. As indicated in paragraph 3.2.1, anchorage modifications will not be studied under this feasibility study.

4.1.5 Dredging Quantities. Deepening would extend 1 feet, 2 feet, 3 feet, 4 feet and 5 feet respectively for each alternative below the overdepth prism of the existing channel through each reach. Figure 5 depicts dredging quantities for each alternative. Total material to be removed for each alternative was derived from fathometry (condition) surveys conducted during 1991 and are described in Appendix B, Engineering Analysis. Quantities for each of the alternatives were derived by deducting the without-

Common & Rock Dredging Quantities For Alternative Plans

PLAN	CHANNEL DEPTH (-MLLW)		ENTRANCE & TRANSITION	R.M. 1-10 COMMON / *ROCK*	R.M. 12-10	R.M. 12-15	TOTAL COMMON QUANTITIES
	Entrance	Inner Channel					
Without Project	45	35					
1	46	36	81,500	133,500 *32,000*	44,500	367,100	626,600
2	47	37	182,400	367,600 *90,000*	131,100	684,100	1,365,200
3	48	38	316,000	661,600 *242,000*	264,500	1,012,400	2,254,500
4	49	39	480,700	1,004,100 *450,000*	425,700	1,353,300	3,263,800
5	50	40	674,100	1,351,400 *749,000*	600,400	1,704,600	4,330,500

NOTE: Common quantities for R.M. 1-10 do not include rock
All quantities are in cubic yards and includes allowable overdepth
RM 12-15 quantities include widening of the RM12 Turning Basin

CHANNEL DEEPENING QUANTITIES

US Army Corps of Engineers Portland District

Coos Bay Navigation Improvements

Figure 5

project (maintenance) quantity from the respective deepening prism. Turning basin widening quantities are in addition to the quantities derived from the surveys and are included in the figure 5 totals.

All alternatives involve deepening of the existing project within the existing horizontal dimensions plus widening the turning basin by 100 feet, as described earlier and depicted on plates 1 through 7. Channel side slopes are assumed to be 1 vertical on 3 horizontal, except for rock excavation where slopes would be essentially vertical.

4.1.6 Rock Quantities. Rock quantities were developed from estimates of the existing top-of-rock through comparison of rock probe data obtained prior to the deepening of the existing project, post-construction surveys from that project, and a series of recent fathometer surveys. Rock is found within channel excavation depths between about RM 1 and RM 6. All rock excavation would be performed to a required depth of 2 feet below the respective channel depths for each alternative. Rock quantities also are shown on figure 5. This would provide an additional 1-foot margin of safety for underkeel clearances in the rock areas and is necessary to assure the ability to maintain the new channel. An assumption of an average 1-foot of dredging tolerance for the rock excavation is assumed based on the material qualities, assumed mechanical excavation methods, and the previous deepening experience (see Appendix B, Engineering Analysis).

For each alternative, all common and rock quantities are assumed to be deposited in the ocean (see Section 5, subsection 5.2 for a discussion of disposal site designation).

4.1.7 Right-of-Way, Relocations. No additional right-of-way is anticipated for construction or operation of any of the alternative plans. All dredged material would be disposed at existing or new ocean disposal sites. A sub-marine cable crossing was identified near RM 5.5 (see plate 3). The reconnaissance study concluded that the cable would not be impacted by the deepening alternatives. Buried U.S. Coast Guard cable and Navy sewer pipes, both abandoned, were identified in the crossing. There are four cables buried at RM 9. They are owned by Southern Pacific Transportation Company, Western Union and Cen-Lincoln Public Utilities District. These cables were relocated to -45 feet MLLW during the previous deepening of the existing project. This is 3 feet below the overdepth elevation for Alternative 5, the deepest alternative, and therefore the cables will not require relocation.

4.1.8 Increased Annual Maintenance. Analysis supporting the estimate of increased annual maintenance quantities due to the deepening is presented in Appendix B, Engineering Analysis. It is based on the maintenance history before and after the previous channel deepening considering shoaling sources and changes in maintenance practices. The analysis included comparison of 3-year average maintenance quantities and review of channel cross-sections before and after the previous deepening project.

No permanent change in maintenance requirements or quantities is projected as a result of the deepening alternatives. An initial increase in maintenance quantities is projected due to slope adjustments in the sand materials of the lower channel. The increased quantities will gradually reduce over time approaching the without-project maintenance condition. Table 4-2 shows the increased average first 3-year maintenance quantities for each alternative under this assumption. The curve displayed at figure B-2 in the Engineering Analysis appendix was used to project the decline in increased maintenance quantities over time for each alternative as side slopes stabilize.

TABLE 4-2.--*Maintenance Quantities Due to Deepening (cy)*

Alternative	First 3-Year Ave.	Total
1	60,800	454,000
2	121,700	907,000
3	182,500	1,361,000
4	243,400	1,814,000
5	304,200	2,268,000

4.1.9 Associated Improvements. The sponsor conducted surveys of existing dock owners to provide data for required improvements associated with the deepening alternatives. Improvements primarily involve deepening the adjacent berths consistent with the respective deepening alternative. At the Weyerhaeuser cargo dock, the owner reported a need for structural improvements at an estimated cost of $65,000. This information was assumed to be applicable to all alternatives. Other owners did not report a need for structural improvements. Dredging quantities for the associated improvements are shown in table 4-3.

TABLE 4-3.–*Associated Dredging Requirements*

Alternative	Depth	Quantity (cy)
W/O Proj	35	-
1	36	15,700
2	37	31,300
3	38	47,000
4	39	62,800
5	40	78,400

4.2 Project Costs

4.2.1 Construction Cost Estimates. A baseline cost estimate has been prepared based on the selected alternative discussed in the following section. Information and unit costs developed in that effort are based on October 1993 price levels and have been used in the comparative cost estimates for each alternative plan. The barge mounted backhoe "Oski" was used to excavate rock in the previous deepening project for the existing channel. Unit costs for rock excavation were developed using information on production rates from that project for this study and through discussions with the contractor. It is anticipated that other equipment could be used for the mechanical excavation. Blasting was considered earlier in the study, but is not expected to be necessary based on the previous experience and would have a much higher unit cost. Blasting also would be opposed by environmental agencies, particularly where an alternative method is feasible. Detailed cost estimates for each of the alternatives are attached at the end of the Engineering Analysis appendix. Table 4-4 is a summary of the construction cost data from those tables, including contingencies. Dredging costs in this table refer to removal of all sand and silt materials.

TABLE 4-4.–*Construction Cost Summary* (October 1993 price level)

Alt.	Depth*	Mob/Demob Cost	Rock Exc Cost	Dredging Cost	Associated Cost	Total Const Cost
1	46/36	$1,177,400	$2,687,300	$1,521,500	$42,500	$5,428,700
2	47/37	$1,177,400	$7,557,800	$3,265,400	$162,900	$12,163,500
3	48/38	$1,537,200	$20,322,000	$5,342,500	$205,500	$27,407,200
4	49/39	$1,896,000	$37,788,800	$7,679,600	$248,300	$47,612,700
5	50/40	$3,840,000	$62,897,300	$10,132,700	$290,700	$77,160,700

* entrance/inner channel depth in feet below MLLW, typical for all tables

4.2.2 Project and Investment Costs. Total project costs include the construction costs above, as well as engineering and design (E&D), and supervision and administration (S&A). E&D and S&A costs for each alternative are shown on the detailed estimates in the Engineering Analysis appendix. The total investment cost for each alternative, which also includes interest during construction (IDC) is shown in table 4-5. The construction period is 6 months for Alternative 1, 10 months for Alternative 2, 22 months for Alternative 3, and 34 months for Alternatives 4 and 5. Production rates for the rock excavation are the critical factor in the duration of these construction periods. For Alternative 5, mobilization of additional rock excavation equipment is assumed to reduce the required construction period. As would be expected for alternatives of this nature, the differences in quantities are the factors that distinguish the alternatives. In this case, the differences in rock quantities and the high unit costs to remove the rock are critical to the differences between the alternatives. The rock quantities significantly impact the construction schedules, and thus the IDC cost for each of the alternatives as well.

TABLE 4-5.--*Total Investment Costs* (October 1993 price level)

Alt	Depth	Total Project Cost	IDC	Total Investment Cost
1	46/36	$6,542,700	$113,500	$6,656,200
2	47/37	$13,697,900	$441,500	$14,139,400
3	48/38	$30,107,200	$2,276,300	$32,383,500
4	49/39	$51,661,700	$6,314,000	$57,975,700
5	50/40	$82,623,000	$10,098,000	$92,721,000

4.2.3 Maintenance Costs. The cost for increased maintenance for each alternative must be derived from converting the initial maintenance quantities following deepening, as described above, to an equivalent annual cost over 50 years. A unit cost of $2.20 per cubic yard was used, based on weighted averages for dredging operations in 1991 and 1992. The resulting annual maintenance costs for each alternative is shown in table 4-6.

TABLE 4-6.--*Increase in Maintenance Cost Over the Without-Project Condition*

Alt.	Depth	Annual Maintenance Cost
1	46/36	$54,900
2	47/37	$109,800
3	48/38	$164,700
4	49/39	$219,600
5	50/40	$274,500

4.2.4 Annual Costs. Table 4-7 summarizes the estimated investment costs (total project costs plus IDC), the average annual construction cost, increased maintenance cost and total annual cost for each alternative evaluated. Costs were estimated at October 1993 price levels and amortized for a project life of 50 years at a current Federal interest rate of 8.25 percent.

TABLE 4-7.–*Cost of Alternative Improvements (Oct 93 price level, 8.25 percent interest)*

Alt.	Investment Cost	Annual Cost	Maint Cost	Total Annual Cost
1	$6,656,200	$559,800	$54,900	$614,700
2	$14,139,400	$1,189,100	$109,800	$1,298,900
3	$32,383,500	$2,723,400	$164,700	$2,888,100
4	$57,975,700	$4,875,600	$219,600	$5,095,200
5	$92,721,000	$7,797,600	$274,500	$8,072,100

4.3 Comparative Environmental Effects

The environmental impacts of the alternative plans are similar, as the nature of the construction and operation activities under each alternative are the same, only varying in degree and duration. Physically, each successively deeper alternative would involve disturbing more sideslope area beyond existing channel cutlines. Once the slopes stabilize, sedimentation and maintenance dredging for the alternative plans would all be similar and not unlike the without-project condition.

Each alternative would involve disposal of a successively greater amount of dredged material, thereby creating a one-time immediate impact over more area than is disturbed by the disposal activity under existing and future project maintenance dredging. Based on the average annual maintenance dredging volumes, this would amount to an increase in disposal volumes of 30 percent to 250 percent, between Alternative 1 and Alternative 5 during the year of initial construction. The deeper alternatives would be constructed over several dredging seasons, so the extent of disposal site impacts during any given year would not be as great as would be the case if it were all dredged in one season. A relatively small short-term increase in maintenance dredging material also is predicted for each alternative.

4.3.1 Water Quality. Dredging of the new channel and disposal of the materials, would cause temporary turbidity problems and re-suspension of silty organic materials above RM 12 in the estuary and at ocean disposal sites of increasingly longer duration for each successively deeper alternative.

4.3.2 Sediment Quality. Sediment quality evaluations indicate that no unacceptable environmental impacts from dredging and disposal for the alternative plans due to sediment contamination is expected. All sediments would be suitable for unconfined in-water disposal. Analysis of materials in berthing areas indicate that while some areas contain higher levels of contamination, the bulk of the material is also suitable for unconfined in-water disposal.

4.3.3 Salinity. A slight to moderate increase in salinity intrusion and estuarine salinity would be expected, depending on the alternative. The mixing zone could move further upriver for each successively deeper alternative. For the maximum 5-foot deepening alternative, however, increases in salinity upriver are predicted to be negligible based on the modeling studies. For details, see the EIS following this main report, Appendices E, Oregon Graduate Center Salinity Analysis, and H, Salinity Workshop.

4.3.4 Biological Impacts. Temporary water quality impacts on organisms would involve a greater duration for each successive level of deepening. A greater amount of benthic organisms and habitat for benthic and epibenthic organisms would be impacted by the construction of each successively deeper alternative as side slopes are disturbed. With stabilization of side slopes, communities will reestablish. Upriver salinity changes are predicted to be negligible and fresh water organisms would not be impacted.

Each successively deeper alternative would generate more disposal quantities. Disposal at offshore sites, therefore, would cover more previously undisturbed benthic organisms during the deepening activity. Most species would be expected to recolonize the area after the disposal activity was completed.

None of the proposed project alternatives are likely to adversely impact a Federally listed threatened or endangered species.

4.4 Benefits Analysis

4.4.1 Overview. Commodity and fleet projections were developed and combined with vessel operating costs to compare the without-project condition and the alternative plans beginning in 1996 and 50 years thereafter. For the without-project condition and each alternative plan, a projected distribution of tonnage of each commodity by operating draft is developed. Based on a typical relationship between vessel operating and design drafts derived from the experience at the port for each commodity, the differences in costs to transport the commodities for the without-project and each alternative channel depth were calculated. The benefits resulted from the opportunity provided by the respective channel depths to employ larger, deeper design and operating draft vessels to transport the commodities at a lower operating cost per unit of product shipped. For each successive deepening alternative, a small benefit is also derived from reduced delays.

4.4.2 Incremental Analysis and Single Beneficiary Consideration. A reach-by-reach incremental analysis was not considered for this study. This type of analysis would not be appropriate as the 15-mile channel is relatively short, and all but one of the 13 terminals are located along the reach from RM 11 to RM 15. The Roseburg Lumber Co., terminal is downstream at about RM 8. Three facilities are clustered at the upstream end of the project, as shown in Section 3. Two of these provide public access. There are no single beneficiaries.

4.4.3 Multi-Port Competition. As discussed in the Economics Appendix, there is little or no competition with other ports for the same supply area for timber products, due to proximity of the supply area to the export port. There is no multiport competition for nickel ore due to the proximity of the Riddle, Ore., nickel smelter, which is the only nickel smelter in the United States.

4.4.4 Last-Port-of-call Analysis for Lumber/Paper/Plywood (LPP). Benefit evaluations for LPP presents a unique situation in that movement of these commodities is made up of small loadings at more than one port by liner and tramp charter operations. A number of calls can be made at various west coast ports before a shipment is transported to destination ports. Several possible responses to a deeper channel at Coos Bay could result. Deepening alternatives could cause shippers to load more cargo at Coos Bay or another previous port. Coos Bay could also become the last port-of-call more frequently. In general, the volume of these commodities which could be loaded on the fleet calling on Coos Bay could be increased incrementally with each depth. The loading would not necessarily have to be performed at Coos Bay in order to have NED benefits.

It was agreed at the Feasibility Review Conference that due to the time and expense of conducting a complete detailed multi-port analysis for LPP that would fully define potential benefits, a last-port-of-call analysis would be substituted. It was recognized that some unquantified amount of benefits would not be accounted for with this approach. With this approach only the projected tonnage carried on vessels that call on Coos Bay as the last-port-of-call was used in the analysis. The resultant last port-of-call tonnage used in the analysis, determined from 1988 data which was considered to be representative, was 32% of the total tonnage projected.

It is noted that there was a significant reduction in benefits for LPP compared to the draft report, due in part to the last-port-of-call analysis.

4.4.5 Nickel Ore Projection. There is only one nickel ore smelter in the United States, located at Riddle, Ore. Importing nickel ore will be a significant addition to commerce at the Port of Coos Bay. Since it is a new import, no historical data exists for projections. Glenbrook indicates that it plans to import about 1 million metric tons annually initially, with potential to increase the volume in the future. Because these future plans are not firm, the economic analysis assumes nickel ore import quantities at the 1 million metric tons per year average over the project life.

4.4.6 Fleet Projections-Timber Products. Fleet projections for the study consist of a series of distributions of commodity tonnage by vessel operating drafts for the years 1996, 2006 and 2016 for the without project and each alternative channel depth. The fleet distributions were derived from judgement and experience based on the historical record of vessel draft distribution at Coos Bay in response to the previous deepening, the tendency to shift toward larger vessels and other factors, some of which would tend to keep drafts shallow. The shape of the distribution varies for each of the commodities based on the historic distribution of operating drafts, degree to which the current distribution is constrained by the existing channel and the expected response to a deeper channel.
For example, data for 1988 indicated that the log and LPP fleet was constrained by channel depths, with 54 percent and 41 percent respectively of the tonnage departing at operating drafts of 33 feet or greater. The distribution of LPP tonnage is, however, much broader; 37 percent departed at an operating draft of 29 feet or shallower. Woodchips were not as constrained, in that in 1988 only 15% of the tonnage departed at 33 feet or greater.

The existing distributions and other factors were used to project tonnage distributions in response to the alternative channel depths. Some of the tonnage would continue to be carried at shallow operating drafts with some gradually shifting to deeper operating draft vessels in varying proportions by commodity. Initially, a distribution was constructed for the 40-foot channel which would be considered relatively unconstrained. This distribution was then constrained downward for each of the other alternative depths.

4.4.7 Nickel Ore. No historical fleet distribution exists for nickel ore. Assumptions can be made, however, based on the projected shipments as previously described, and through information provided by Glenbrook. For the without-project condition and Alternatives 1 and 2, a foreign flag 46,000 DWT ton dry bulk carrier, with a design draft of about 37 feet and lightloaded accordingly, is assumed. For Alternatives 3, 4, and 5, a 55,000 DWT vessel could be used, also lightloaded for the shallower alternatives. Table 4-8 shows the loading of these vessels with each channel alternative. Metric tons are displayed for the ore quantities in this table to be consistent with the vessel DWT designations.

TABLE 4-8.--*Nickel Ore Vessel Loads at Alternative Channel Depths (metric tons)*

Alternative	Depth	Vessel DWT	Feet Lightloaded	Load
W/O Project	35	46,000	2'	38,000
1	36	46,000	1'	39,900
2	37	46,000	0'	41,800
3	38	55,000	2'	47,100
4	39	55,000	1'	48,900
5	40	55,000	0'	50,600

4.4.8 Design Drafts and Vessel Operating Costs. For the timber products a relationship between operating drafts and design drafts was established. For each operating draft there would be a range of possible design drafts. While larger vessels (requiring a greater degree of lightloading) would be expected to continue to call, a typical design draft/operating draft relationship was established for each commodity to develop transportation costs. Logs and LPP are generally carried on foreign flag bulk vessels. Log vessels are generally loaded deeply and an average difference of one foot between design and operating drafts was used. Based on 1988 data for LPP, the difference was estimated at 2-feet for vessels operating at a draft of 30 feet or deeper and 4-feet for vessels operating at 29 feet or shallower.

Due to the low density when loaded, woodchips are transported on vessels designed specifically for this commodity. The estimated difference between operating and design draft is 2 feet for vessels operating at 33 feet or deeper and 3 feet for vessels operating at 32 feet or shallower.

Operating costs for the vessels were obtained from Economic Guidance Memorandum No. 93-4, *Deep Draft Vessel Cost Estimates* (fiscal year 1993). Table 4-9 displays a sampling of data from the Economics Analysis appendix to illustrate how benefits were derived.

TABLE 4-9.--*Sample Loading and Operating Costs, Bulk Vessels.*

Design Draft (ft)	DWT (met tons)	Operating Costs in Port (daily)	Operating Costs at Sea (daily)
33	26,600	$10,300	$12,900
35	32,100	$10,800	$13,600
37	38,300	$11,300	$14,300
39	45,400	$11,900	$15,100

4.4.9 Destination Ports. A significant factor in the transportation costs is the destination of the specific commodities and the days at sea. Typical destinations are: wood chips to Japan; logs to Japan and China; paper to the Philippines and Japan; lumber to Australia and Europe; and plywood to Europe. Time in port also is a factor for each commodity. Wood chip and log vessels take on full loads and travel directly from Coos Bay to destination ports. Lumber, paper and plywood vessels may stop at several ports. A weighted average of the days at sea (based on the percentage of the commodity being transported to the destinations above) and typical days in port for each commodity is shown in table 4-10.

TABLE 4-10.—*Days at Sea and in Port by Commodity*

Commodity	At Sea	In Port
Wood Chips	27.2	6.0
Logs	26.7	17.0
Lumber, Paper, Plywood	21.4	15.0
Nickel Ore	33.3	10.0

4.4.10 Transportation Benefits. Transportation costs are derived for each alternative from the distributed tonnage by operating drafts, the corresponding typical design draft vessel and operating costs and the average days at sea and in port. The difference in total transportation costs to move the commodities for the without-project condition and each successive channel depth yields the transportation benefit for each alternative plan. Table 4-11 displays the differences in the average costs per ton to move each commodity in the year 2016.

TABLE 4-11.—*Transportation Costs per Ton by Commodity, Year 2016*

Alternative	Depth	Woodchips	Logs	Lumber, Paper Plywood	Nickel Ore
W/O Project	35	$12.47	$20.87	$19.01	$16.42
1	36	$12.45	$20.57	$18.81	$15.74
2	37	$12.44	$20.40	$18.70	$15.12
3	38	$12.44	$20.31	$18.63	$14.57
4	39	$12.44	$20.26	$18.58	$14.14
5	40	$12.44	$20.24	$18.57	$13.74

Note that the cost per ton for woodchips does not decrease for alternatives deeper than 37 feet. This is based on the assumption that, due to the low density of the commodity as it is loaded, vessel operating drafts are not projected to be deeper than 37 feet. For all commodities, the improvement in cost per ton diminishes with each depth increment, reflecting the assumptions inherent in the fleet projections, which show that vessels will shift toward only moderately deeper drafts at Coos Bay, and will do so over time, not all at once. Because the expected increase in drafts is moderate, more benefits are recognized in the moderate increases in channel depth which would accommodate those vessels. Because the deepest alternative channel depths typically exceed the majority of expected vessel drafts, limited incremental benefits are attributable to the deepest incremental channel depths. Incremental transportation benefits for the various commodities and each alternative are displayed in table 4-12.

TABLE 4-12.--*Incremental Transportation Benefits By Commodity*

Alt.	Wood Chips	Logs	Lumber, Paper Plywood	Nickel Ore
W/O Proj.	-	-	-	-
1	$33,200	$273,600	$124,000	$680,000
2	$13,200	$145,500	$67,600	$620,000
3	0	$64,800	$41,200	$550,000
4	0	$31,900	$22,700	$430,000
5	0	$14,600	$8,700	$400,000

4.4.11 Delay Benefits. Delay benefits are derived from applying the pilots' operating requirements for 3 feet of underkeel clearance and, for departures, sailing on a rising tide to be at the entrance at high slack water. A loaded vessel would be delayed until favorable tidal conditions produced the required clearance. The delay costs are derived through an analysis of vessel drafts, the probability of delay based on tidal cycles and the average delay period, as presented in the Economic Appendix. Table 4-13 displays the incremental reduction in vessel operating costs due to the delay realized by each successive channel depth greater than the without-project condition.

TABLE 4-13.--*Incremental Delay Cost Reduction By Alternative, All Commodities*

Alt.	Delay Cost Reduction
1	$23,800
2	$17,800
3	$11,300
4	$ 5,600
5	$ 3,700

4.4.12 Total Benefits. The difference in total incremental vessel transportation and delay operating costs between the without-project condition and each successive deepening alternative constitute the incremental benefits for each alternative. Table 4-15 presents this information and the total benefits for each alternative.

TABLE 4-14.--*Incremental and Total Benefits for Each Alternative*

Alternative	Incremental Benefit	Total Annual Benefit
1	$1,134,600	$1,134,600
2	$864,100	$1,998,700
3	$667,300	$2,666,000
4	$490,200	$3,156,200
5	$427,000	$3,583,200

4.5 Benefit-to-Cost Evaluation

4.5.1 Benefit-to-Cost Analysis. Annual project benefits were divided by annual project costs to yield the estimated BCR. Annual project costs were subtracted from annual project benefits to yield average annual net benefits. BCRs and annual net benefits are summarized in table 4-15.

TABLE 4-15.--*Summary of BCRs and Net Benefits for Each Alternative (8.25 percent, 50-yr. project life)*

Alt.	Annual Benefits	Annual Costs	BCR	Annual Net Benefits
1	$1,134,600	$614,700	1.8	$519,900
2	$1,998,700	$1,298,900	1.5	$699,700
3	$2,666,000	$2,888,100	0.9	($222,100)
4	$3,156,200	$5,095,200	0.6	($1,939,000)
5	$3,583,200	$8,072,100	0.4	($4,488,900)

4.5.2 NED Plan. Alternatives 1 and 2 yielded BCRs above unity. With rounding Alternative 3 is just at unity. Alternative 2, yielding the greatest annual net benefits, is the NED plan. The NED plan is normally the preferred alternative selected for Federal implementation as it maximizes the benefits to the nation and the return on the investment.

It is noted that the Federal interest rate to be used in FY 1994 has been reduced to 8%. and that analyses in this report were completed based on 8-1/4%. It is further noted that the NED plan would remain the same under the new interest rate.

4.5.3 Sensitivity Analysis. In the Economic Appendix a number of scenarios are tested to determine the sensitivity of the 2-foot deepening NED plan. The scenarios employ risk and uncertainty modeling techniques for the timber commodity projections in combination with alternative assumptions with respect to nickel ore imports. Issues surrounding timber harvest are volatile and projections can vary widely. Current information is presented in the Economic appendix regarding developments in timber harvests including projections from the most recent forest plan announced by President Clinton in July 1993.

Discussion of the current (1993) market situation for nickel, in light of the temporary suspension of imports at Coos Bay, the history and prospects for that market in the future and the impact on the nickel ore imports at Coos Bay are discussed in detail in the Economic Appendix, Section 9.1.4. In summary, the current depressed nickel prices are expected to rebound. Short-term fluctuations occur in most commodity markets, and there have been two other historic declines in nickel prices, in 1975 and 1982. The market is expected to have recovered by the project-on-line date of 1996. The analyses detailed in the Economic appendix are summarized in the following paragraphs.

Risk and Uncertainty. In order to account for uncertainties due to environmental and political resource constraints, risk analysis modeling was applied to the timber commodity projections. The program @Risk was used to convert the projections into variable distributions. For each commodity projection, a range and distribution (shape) of potential variables was determined. From each projected range a mean value (expected value) is determined. For example, in considering recent developments in the region, the range of projections for future log exports includes the possibility of extremely low export quantities. The resulting mean value for log exports was about 24 percent less than the original projection. For LPP, the range of possible outcomes were based on a general consensus that lumber exports would not decline, but also would not increase dramatically. For woodchips, the range was based on assumption that future exports would not vary greatly from the original projection. The analysis for the latter two commodities resulted slight increases over the original projections. The results of the timber commodity projections analyses are summarized in table 4-16 which also displays the original information from table 3-6.

TABLE 4-16.--*Commodity Projections with Risk and Uncertainty Analysis (metric tons)*

Commodity Exported	1985-89 Average Exports	USFS Projection to 2016	Mean Value w/Risk & Uncertainty, 2016
Wood chips	2,538,200	2,538,200	2,553,200
Logs	1,155,000	1,131,400	858,200
Lumber, Paper, & Ply	368,100	385,000	395,500

The benefits derived from the resulting timber commodity values were used in conjunction with two nickel ore scenarios to test the NED plan. In the first scenario, it was determined that to sustain the 2-foot deepening as the NED plan with ore import quantities at an average 1 million metric ton annually, this quantity of ore would need to be imported for a minimum of 20 years. In the other scenario, the analysis shows that, if imported for 40 years, ore imports would have to average 800,000 metric tons annually to sustain the NED plan, given the timber values.

Additional NED Plan Sensitivities. Several other analyses were performed to determine the amount of nickel ore imports required to sustain the NED plan under selected combinations of timber commodity export reductions. The nickel ore base projection is 1 million metric tons. These scenarios are displayed in table 4-17.

TABLE 4-17.--*Ore Quantities Required to Maintain NED Plan for Various Timber Commodity Scenarios*

	Timber Quantities (1,000 Metric Tons)			Nickel Ore (1,000 Metric Tons)
	Woodchips	Logs	LPP	
Base Projection: (1996)	2,540	1,150	370	1,000
Scenario	Assumed Quantity			Required Quantity
1	2,000	350	280	920
2	2,100	600	250	875
3	2,540	635	375	825

The NED plan would remain at 2 feet under each of the scenarios listed above. Scenario 1 represents a dramatic reduction in all timber commodities of 20 percent, 70 percent and 25 percent for woodchips, logs and LPP, respectively. The most realistic reduced export scenario is estimated to be number 3, as the log exports quantities are considered to have considerably more risk than the other timber products.

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5. THE SELECTED PLAN

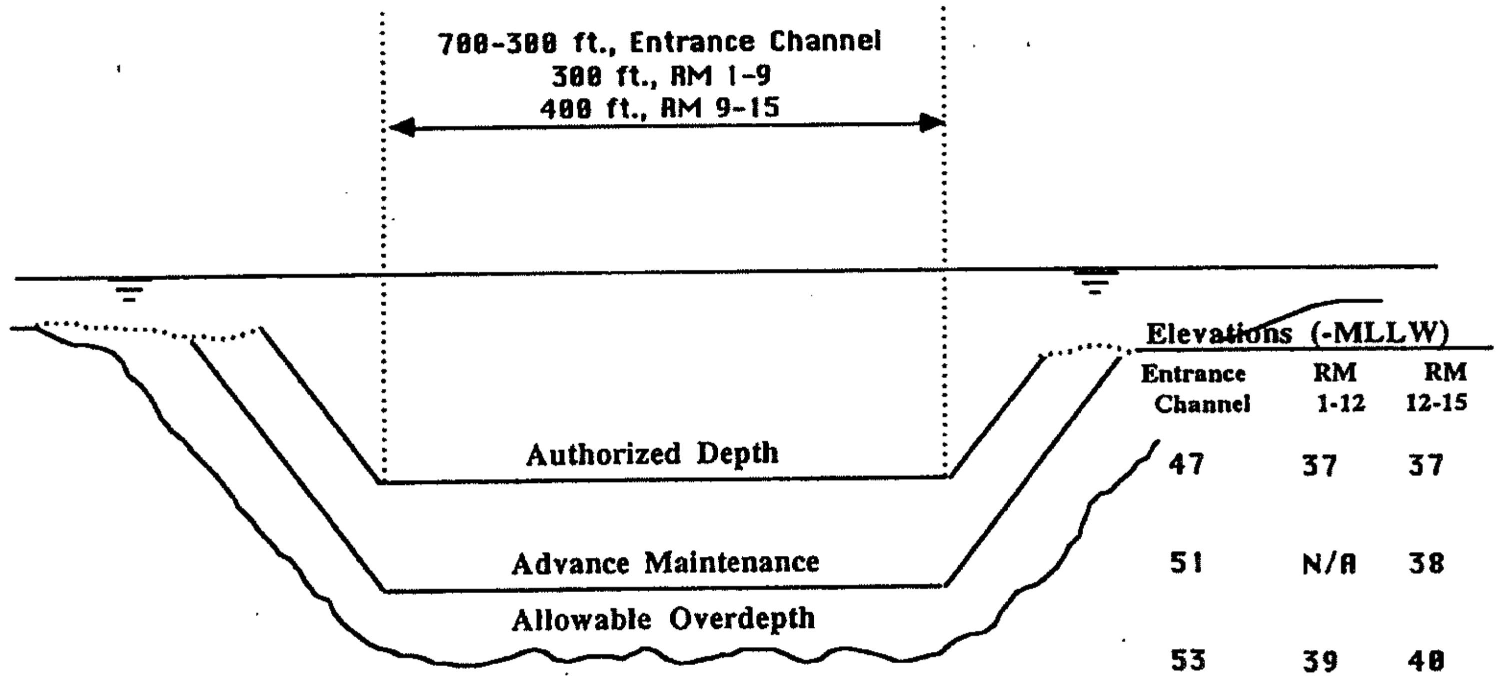
5.1 Plan Components

5.1.1 Descriptions and Justifications. Alternative 2 is the selected plan, as well as the NED plan. It would consist of a 2-foot channel deepening from the entrance to RM 15 (see plates 1-7). The new authorized depth at the entrance would be 47 feet and transition from 47 feet to 37 feet deep at Guano Rock (about RM 1). The depth would continue at 37 feet in the inner channel to the end of the project at RM 15. See figure 6. The width of the turning basin at RM 12 would be increased from 800 feet to 900 feet. About 1,365,000 cy of sand and silt materials and 90,000 cy of rock would be excavated.

Global Positioning Survey (GPS) Studies. The GPS studies were conducted during the summer of 1993. A summary report by the Waterways Experiment Station (WES) is provided in Appendix K. Four deep draft vessels, 3 outbound and one inbound, were tracked in the study. The overall conclusion by WES is that, while navigating in the channel requires constant attention, the pilots had few problems. Results of the GPS study showed that the four vessels monitored tracked consistently and well within the channel lines with one exception. At the turn between RM 1 and RM 2, the pilots tended to use the naturally deeper water on the outside of the turn. No dredging would be required to extend the channel lines in the turn to correspond with this track. A corresponding inward adjustment of the inside of the turn was not favored by the pilots out of concern that the additional shoaling would cause difficulties in the turn. See subsection 6.1.1 regarding the status of ship simulator studies.

Entrance Depth. To account for pitch, roll and heave effects, an additional 10 feet to of depth is required at the entrance to provide underkeel clearances for the design vessel. This is conservative based on potential wave conditions and consistent with past experience at this entrance and other west coast entrances.

Advance Maintenance. The currently authorized advance maintenance program is described in subsection 3.2.2 and discussed in detail in Appendix B, Engineering Analysis, subsection 2.2. As shown on figure 6, advance maintenance dredging program would be the same as in the existing without-project condition. The program should be maintained because shoaling patterns are anticipated to be similar and the same justifications are applicable.



PROPOSED CHANNEL DIMENSIONS

(NO SCALE)

US Army Corps of Engineers Portland District

Coos Bay Navigation Improvements

Figure 6

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Upper Channel Width. In consideration of a number of factors discussed in detail in Appendix B, Engineering Analysis, subsection 3.3.2., it is concluded that the upper channel should be maintained. The analysis references guidance from the recently revised draft EM 1110-2-1613, Hydraulic Design of Deep-Draft Navigation Projects, dated 8 January 1993. Reference also is made to a paper entitled "Ship Navigation Considerations in Design of a Port or Harbor Waterway System, " by Leonard Van Houten. The analysis examines the width of the upper channel in both the straight reaches and bends in light of the EM guidance, effects on deepening and maintenance costs, potential impacts to navigation, safety and pilots' views.

The existing channel above the railroad bridge, RM 9 to RM 15, is nominally 400 feet wide. There are six major bends in the upper channel including two turns in which turning basins are co-located. From RM 10 to RM 15, above the highway bridge, straight reaches comprise about 32 percent of the upper channel. See Plates 6 and 7 attached at the end of this main report. The straight reaches above the bridges were widened to 400 feet as part of the channel modifications authorized by the River and Harbors Act of 1970 and completed in 1979. Wideners at turns in the upper channel also were increased, as were the width of turning basins and berthing areas between the channel and harbor lines.

The District Engineers' review report of 1969, upon which the authorization for improvements was based, cited difficult navigation conditions and safety hazards due to the then existing channel dimensions, larger vessels, congestion and the proximity of deep draft berthing spaces immediately adjacent and parallel to the channel. Near-groundings also were reported due to these conditions. In a consultants report to the Port of Coos Bay, completed prior to the District's report, it was reported that currents at entrances to tidal sloughs tended to set vessels against the banks. A retired pilot from that period was consulted who acknowledged the problems, noting in particular difficulties in negotiating the turn at the mouth of the Coos River (at RM 14) and a general concern with the growing size of vessels. The consultant's report also cited two of nine accidents occurring during 1962 and 1963 as being groundings attributable to the width of the channel. This accident data was not cited in the Corps' justification, however. Reducing the entire width of the upper channel by 100 feet (excluding turning basins) from about RM 10 to RM 15 could reduce initial construction costs for the selected plan by about 4 percent, or $500,000.

If the wideners at bends are maintained, construction costs could only be reduced about 1.2 percent or about $140,000. At best a decrease in maintenance costs of $22,000 annually in the straight reaches of RM 10 to RM 12 reach may be achieved. Maintenance costs in the upper RM 12 to RM 15 reach, however, could actually increase over time as the same quantity of sedimentation would be expected, but in a reduced channel cross-section. Estimating the impacts to navigation is difficult, particularly with regard to increased risks due to operating constraints and congestion. In consideration of the potential cost savings in the straight reaches, a simplified analysis shows that, based on vessel operating costs, a small increase in transit time of 10 percent could offset the equivalent annual costs of the construction and maintenance savings, without accounting for the greater risks and potential increase in maintenance.

The analysis presented in Appendix B demonstrates that the wideners in the upper channel are, in general, designed appropriately. Based on guidance, the width of the straight reaches is not found to be excessive under the conditions in the upper channel. It is recognized that it would be highly unlikely that a recommendation to increase the width of the upper channel from 300 feet to 400 feet would be made today without benefit of detailed studies, including possible simulator studies, due to the significant costs for widening and environmental concerns.

The channel was widened previously because of difficulties in navigation in this reach and the increasing size of vessels. It would not be prudent to abandon the existing width and increase risks unless it were demonstrated to be unnecessary and there would be a significant financial benefit. The cost of simulator studies would not likely be offset by savings to the project and could possibly identify alignment improvements which would increase construction costs.

Pilots must rely on extreme care and well established procedures for navigating the upper channel. While generally satisfied and able to operate safely under the existing channel conditions, they believe the reduction of width would be counterproductive with respect to the deepening project and are concerned modifications would return the upper channel to the pre-1979 difficulties and reduced margins of safety, particularly in light of even larger vessels. A letter from the pilots on this issue, dated May 29, 1992, may be found in Appendix I, Correspondence.

No adjustments to berthing widths are necessary. These were widened to 100 feet during the previous deepening project, which is considered sufficient. Only two docks are generally involved with loading from log rafts in the water and often onto vessels with beams less than 100 foot. These are transient operations and there have been no known navigation conflicts.

5.1.2 Costs. The total FY 1994 investment cost estimate of $14,139,400 for the selected plan is detailed in table 5-1. IDC computations for the plan are in the Engineering Analysis appendix. In accordance with the Corps of Engineers Engineering Circular (EC) 1110-2-538, a baseline cost estimate to implement the project, if authorized for construction, has been developed. Fully-funded costs and Federal/non-Federal cost sharing are discussed in Section 6, Plan Implementation.

Associated (non-Federal) costs would consist of dredging berths adjacent to the new channel. Non-Federal costs are shown in table 5.2. The Weyerhaeuser dock will require structural improvements. No other work is anticipated at this time. Sediment quality is discussed in subsection 5.3.2.

5.1.3 Construction Methods. Hopper dredges would probably be used in the entrance and inner channel below RM 10. A clamshell and barge operation is anticipated from RM 10 to RM 15. Rock excavation would be accomplished by mechanical means without drilling or blasting as was discussed in subsection 4.2.1 and the Engineering Analysis appendix. The plan anticipates that all materials excavated would be transported to one of three ocean disposal sites. The contract for the work would provide an option for the disposal of sand on the North Spit to provide nesting habitat for western snowy plovers.

5.1.4 Operation and Maintenance. ER 1165-2-131, *Local Cooperation Agreements for New Start Projects*, requires that where advance maintenance is practiced, the advanced maintenance quantities become part of the without-project condition. Removal of the material within the dimensions of the existing project should be treated as part of operations and maintenance. However, this principle applies only to that portion of the channel where advance maintenance dredging has been historically required for economic maintenance of the existing project.

TABLE 5-1.--*Federal/Non-Federal Costs, Alternative 2--37-foot Authorized Depth*
(October 1993 Price levels)

	Quantity	Unit Price	Amount	Contingency	Total Project
DREDGING					
Mob & Demob	1 Job	$981,200	$981,200	$196,200	$1,177,400
Hopper Dredging					
Exc & Disp (RM 1-10)	367,600cy	1.78	654,300	130,900	785,200
Exc & Disp. (Entrance)	182,400cy	1.23	224,400	44,900	269,300
Mechanical Dredging					
Exc.& Disp.					
Clamshell (RM 10-15)	815,200cy	2.26	1,842,400	368,500	2,210,900
Exc.&Disp. Rock (RM 0-5)	90,000cy	67.18	6,046,200	1,511,600	7,557,800
Total Construction Cost			$9,748,500		
Contingencies				$2,252,100	
FEDERAL/NONFEDERAL COST SHARED DREDGING TOTAL					$12,000,600
NONFEDERAL, NON COST SHARED (ACCESS DREDGING)					162,900
Engineering and Design					966,400
Supervision and Administration					568,000
TOTAL PROJECT COST					$13,697,900
Interest During Construction					441,500
TOTAL INVESTMENT COST FOR ALTERNATIVE 2					$14,139,400

TABLE 5-2.--*Non-Federal Costs, Alternative 2--37-Foot Authorized Depth*

	Quantity (cy)	Unit Price	Amount	Contingency	Total Project
NONFEDERAL, NON COST SHARED (ACCESS DREDGING)					
Ocean Terminal	1500	2.26	$3,390	$680	$4,070
Weyerhaeuser Co. Wharf	5200	2.26	11,750	2350	14,100
Dolphin Terminals Wharf	2600	2.26	5,880	1180	7,060
Central Dock Co. Wharf	10,100	2.26	22,830	4570	27,400
Pierce Dock (Glenbrook)	2,100	2.26	4,750	950	5,700
Geo. Pac. C.B. Dock	4,900	2.26	11,070	2210	13,280
Coos Bay Docks Wharf	4,900	2.26	11,070	2210	13,280
Subtotal			$70,740	$14,150	
NONFEDERAL ACCESS DREDGING, NON COST SHARED					84,900
NONFED DOCK MODIFICATIONS, NON COST SHARED			65,000	13,000	78,000
TOTAL NONFEDERAL (100% LOCAL COST)					$162,900

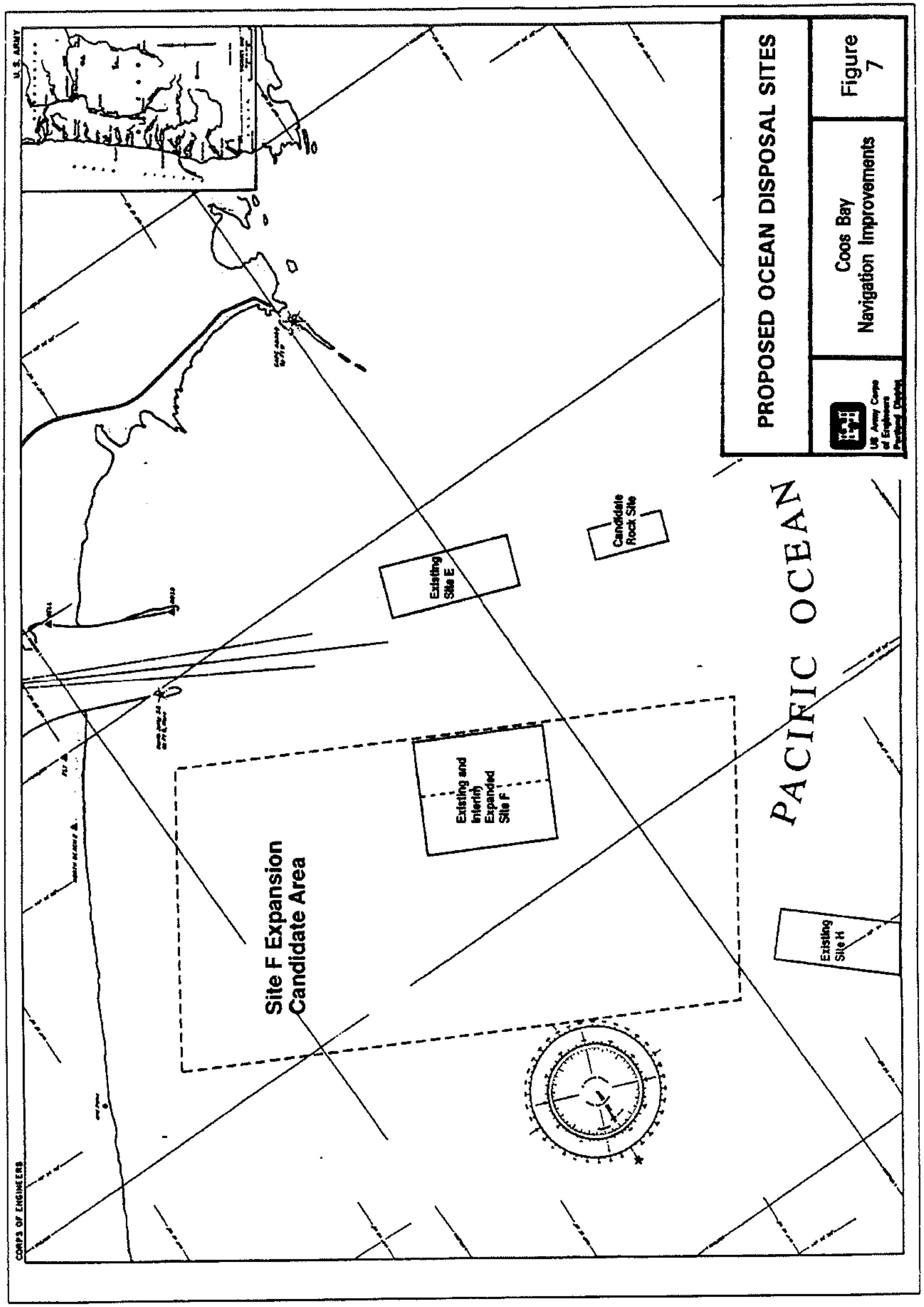
The deepening project would fund dredging quantities to the new channel depths, less the quantities of sediment in the channel which would be dredged for normal maintenance of the existing project. A calculation of maintenance quantities and costs would be performed before the dredging. The calculation would be based on usual pre-dredge survey and identification of maintenance quantities based on the shoaling condition at that time.

5.1.5 Annual Maintenance. After a period of slope adjustment, shoaling patterns and maintenance dredging requirements would be expected to be similar to the without-project condition, and current advance maintenance practices would be continued at the new level. The first three-year average additional annual maintenance quantities after deepening would be 122,000 cy, and declining thereafter. The equivalent total annual maintenance costs increase over the life of the project would be $109,800.

5.2 Ocean Disposal Site Selection

The combined nearshore and offshore site as shown on Figure 7 is the preferred site for disposal of coarse-grained material for the deepening alternative and long-term maintenance. Proposal of the large site represents a change in the approach to management of ocean disposal sites at Coos Bay. This approach is more consistent with disposal site management practices nationwide and provides an alternative which would ensure long-term disposal capability while minimizing the impacts of the activity. This site would provide the flexibility for long-term management of dredged material. It would take advantage of the dispersal capability of the higher energy nearshore zone and reduce or eliminate mounding further offshore, thus avoiding creation of potential navigation hazards. Material can be placed in a thinner layer over a broader area, reducing immediate impacts, providing a longer duration between disposal events at any particular location within the site, and allowing seasonal avoidance of particular locations within the site if warranted for biological or human-use reasons.

Designation of the site for disposal of coarse-grained dredged material for long-term maintenance and quantities generated by the selected deepening alternative, will be accomplished by the EPA under its Section 102 authority. EPA is a cooperating agency in the preparation of the EIS for this study and has been working closely with the Corps of Engineers in developing this alternative. The draft and final EIS for this study is



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anticipated to be used by the EPA in formal rule-making for the site designation process. After reviewing the results of the biological samples EPA will determine whether any additional data will be needed for final site designation. The formal Section 102 designation process by EPA, which will include development of management and monitoring plans for long-term maintenance disposal in accordance with WRDA 1992, also will be accomplished during PED. Study costs for the site designation process will be apportioned equally between existing project operations and maintenance and general investigation (GI) accounts.

In the event that final site designation by EPA were delayed and disposal of deepening and/or maintenance materials would exceed the short-term capacity of the existing and expanded site F, an interim site would be proposed by the District Commander under the Corps of Engineers' Section 103 authority. This interim use would provide for disposal of deepening and maintenance dredging materials.

Monitoring of disposal at site H indicates that no appreciable mounding has occurred from disposal over more than a 10-year time frame. Fine-grained sediments from the channel deepening and associated berthing areas would not contribute significant additional sediments over current maintenance dredging quantities. The existing site is therefore considered adequate for disposal of all fine-grained materials for channel deepening and future maintenance needs.

The area preferred for potential one-time rock disposal was selected initially on the basis of the physical bottom characteristics of substrate and depth. The substrate at this location is principally gravel and cobbles intermixed with coarse sand and rock outcrops. The depth is such that rock material placed at this location would either remain at the site or slowly move further offshore.

5.3 Environmental Impacts of Selected Plan

The EIS presents a detailed discussion of the environmental impacts of the selected plan. The following is a summary of that information.

5.3.1 Physical. Dredging for the new project would remove about 1.4 million cy of sand, silt and rock material from the estuary. An estimated 25 acres of previously undisturbed side slope area over the entire length of the channel and about 6 acres in the expanded turning basin would be immediately disturbed by the deepening. Disposal of the 1.4 million cy of new material will cause a one-time increase in disposal volume of 76 percent based on average annual maintenance dredging volumes for the existing project. In the first years after the deepening, the estimated average increase in maintenance dredging volumes is estimated to be about 120,000 cy declining in subsequent years. The total estimated volume of additional material placed in ocean disposal sites due to the deepening, including initial and additional maintenance dredging, is about 2.3 million cy. For the life of the project, this would be a 2.6 percent increase in dredged material disposal over continued maintenance of the existing project.

5.3.2 Water Quality. Dredging of the new channel would cause a temporary increase in water turbidity similar to those experienced during annual maintenance dredging, but over a proportionally longer period. This generally occurs only above RM 12, where the material is fine sand and silt. Dissolved oxygen levels could decline temporarily due to resuspension of organic material during the dredging of the fine materials.

Turbidity at ocean disposal sites due to the initial deposits and subsequent reworking of material as it disperses also would be similar to existing maintenance dredging conditions. A one-time temporary turbid condition would also exist at the rock disposal site because of sediments that would be excavated with the rock.

5.3.3 Sediment Quality. Sediment quality evaluations indicate that channel excavation for the new construction would present no unacceptable adverse environmental impacts due to sediment contamination and that unconfined in-water disposal is acceptable. Sediment evaluations are discussed in the EIS and test results are displayed in Appendix D, Sediment Quality. The most recent series of testing of sediment materials in the upper channel (November 1993) was consistent with past testing and indicate levels of most metals and chemicals below concern levels. Tributyltin was detected at concern levels in some samples, however not at levels which would preclude unconfined in-water disposal under MPRSA. Contamination above established levels of concern have been observed in sediments located next to various docks adjacent to the navigation channel. Local dock owners have noted the higher levels when conducting sediment quality evaluations related to permit actions. Evaluations, including bioassays, indicate that the bulk of the material dredged by non-Federal interests associated with this project to be suitable for unconfined in-water disposal. Prior to dredging and disposal of sediments from berthing areas, dock owners will require permits obtained through the usual regulatory permit process, including testing of the materials.

5.3.4 Salinity. The salinity distribution in Coos Bay is highly variable and dependent on river flow and tidal forces. The selected deepening plan would not alter the general well-mixed salinity regime and would cause only a slight increase in estuarine salinity. The upriver mixing zone could move farther upstream. Model studies predict that in the upper reaches of the estuary salinity increases would be less than one part per thousand, which is the level of accuracy for the model.

5.3.5 Biological Impacts--Coos Bay. There would be immediate impacts directly associated with dredging the channel. Benthic organisms within the channel and along the side slopes of the channel would be destroyed or displaced by the dredging operations. Following construction of the project, most areas would be expected to recolonize rapidly and be back to pre-dredge conditions shortly after dredging was complete. Impacts to epibenthic invertebrate populations and fish are expected to be minimal.

Organisms in the predominately freshwater part of the estuary, which would most likely be impacted by a change in salinity, are adapted to periodic episodes of salt water intrusion. Organisms that could be impacted by increases in salinity in the upriver areas are juvenile salmonids, striped bass, resident freshwater fish species and invertebrate and phytoplankton populations. Though the impact to these organisms is expected to be minor, a monitoring program will likely be conducted to verify the level of impact.

Increased salinity in the lower estuary may result in the increase in range of marine species and the upriver distribution of eel grass. Increase in eel grass populations could benefit many species since eel grass beds provide productive habitat for a variety of species.

5.3.6 Biological Impacts--Disposal Sites. In comparison to the other sites investigated in previous studies, the area near site F was the most suitable for location of new or expanded disposal sites. The nearshore transition zone supported the lowest average abundance of organisms and was the most homogeneous in species composition of the sites investigated. Expansion of the disposal area for coarse-grained material would impact areas previously undisturbed by dredged material disposal. Distribution of the material over a larger area, however, would reduce long-term impacts to a particular site by allowing a longer time for recolonization between disposal events. Disposal over a larger area, either nearshore or offshore in a thin layer, would produce the least impact. The depth of coverage would be minimal and the material would disperse more rapidly.

Potential impacts to organisms, particularly benthic invertebrates, is greater at site H than at site F. However, as described earlier and in the EIS, the impacts from existing and ongoing maintenance dredging disposal are relatively minor.

Though data on the proposed rock disposal site is less extensive than site H, it is a preferred site biologically because it is located within the transition zone and should exhibit similar characteristics to site F. This conclusion is supported by samples from 1986 EIS studies. One-time disposal of rock would temporarily impact organisms in the immediate disposal site. Recolonization would begin shortly following disposal.

5.3.7 Threatened and Endangered Species. The selected plan would have no adverse affect on threatened or endangered species which may be present in the estuary or near ocean disposal sites. For species administered by NMFS, biological assessments have been forwarded (December 1990) and letters of concurrence have been received from NMFS (January 1991) for all species except loggerhead and green sea turtles and Snake River sockeye and fall and spring/summer chinook salmon. Biological assessments for these additional species have been prepared and forwarded to NMFS for concurrence. Previously submitted biological assessments have been resubmitted to NMFS for review and concurrence due to enlargement of the offshore disposal area and the length of time since they were prepared and their associated concurrence letters received.

Concurrence with the Corps' determination of no effect for the above listed species has been received from NMFS.

Biological assessments have been forwarded to the USFWS (May and June 1990) and concurrence letters received (July 1991) for all species administered by that agency except for marbled murrelets, which were only recently listed. A biological assessment has been prepared for murrelets and was forwarded to the USFWS in August 1993. Additional information has come to light since that submittal and therefore a revised biological assessment for marbled murrelets was forwarded to the USFWS in December 1993. The cover letter forwarding the marbled murrelet biological assessment acknowledges some project-related changes (e.g. an enlargement of the offshore disposal site F; no consideration of blasting for rock-removal). These changes do not alter the (no effect) determination for bald eagles, peregrine falcons, brown pelicans or western snowy plovers made in the 1990 biological assessments. The December 1993 biological assessment concludes that the project is not likely to adversely effect marbled murrelets. A concurrence from USFWS has not as been received as of final publication of this report.

5.3.8 Cultural Resources. The generalized locations of shipwrecks within Coos Bay have been evaluated and it was determined that dredging activities would not impact known sites within the bay. The candidate ocean disposal site will require further cultural resource evaluation as part of the final site selection process.

5.3.9 Mitigation. Significant losses are not expected with construction of the selected plan. Habitat impacted in the channel and widened turning basin would recover naturally to near existing conditions and, therefore, no mitigation would be required. A small loss of shallow tidal habitat due to turning basin expansion would occur, however, the expansion has been minimized to reduce impacts. During construction, mitigative measures related to confining in-water work to a single season and avoidance of blasting for rock excavation will be employed.

The cumulative effects of ongoing project maintenance, related shipping and port facilities and operations, and the proposed deepening result in continued and potential future impacts in Coos Bay. The extent of impacts are not clear and mitigation beyond existing means is difficult to identify. Through continued discussions with resource agencies during PED, consideration will be given to potential measures such as in-bay disposal of rock or shell materials from dredging which might provide shallow subtidal habitat while saving disposal costs. Also, measures to provide environmental restoration under other authorities have been discussed and will be further explored with the resource agencies.

Mitigation for ocean disposal will be accomplished through reducing or avoiding impacts. No other form of mitigation is proposed. A larger ocean disposal site for coarse-grained material is preferred to minimize the impacts associated with dumping in a single location. Using a larger area would allow the material to be more thinly dispersed, reducing impacts to benthic organisms. Designation of a larger area also would allow an individual location within the disposal areas more time for recovery before the next disposal event, and provide flexibility to avoid seasonally productive areas.

Monitoring the effects of ocean disposal will be implemented, as has been done at existing disposal sites. A site management and monitoring plan will be developed before site designation by the Corps of Engineers and EPA.

5.4 Plan Benefits

The selected 37-foot channel plan, the NED plan, would provide significant economic benefits related to waterborne commerce over the without-project condition. The plan would reduce commodity transportation costs by accommodating an increase in more efficient, deep-draft vessels. Improvements of the entrance and inner channel to Coos Bay would serve to sustain current levels of basic economic activity as well as encourage expansion. Transportation cost reduction over the existing without-project channel is estimated to be $1,957,000 annually. Delay costs would be reduced $41,600 annually. Total estimated average annual benefits are $1,998,700. With the estimated annual cost of $1,298,900, including operations and maintenance costs of $109,800, the BCR is 1.5.

6. PLAN IMPLEMENTATION

6.1 Design and Construction

A schedule for implementation of the selected plan is shown on figure 8. PED is scheduled to begin in February of fiscal year (FY) 1994 and construction in FY 1995. During the PED phase, primary activities will involve geological investigations to establish channel rock locations for construction, completion of the ocean disposal site designation, and preparation of plans and specifications.

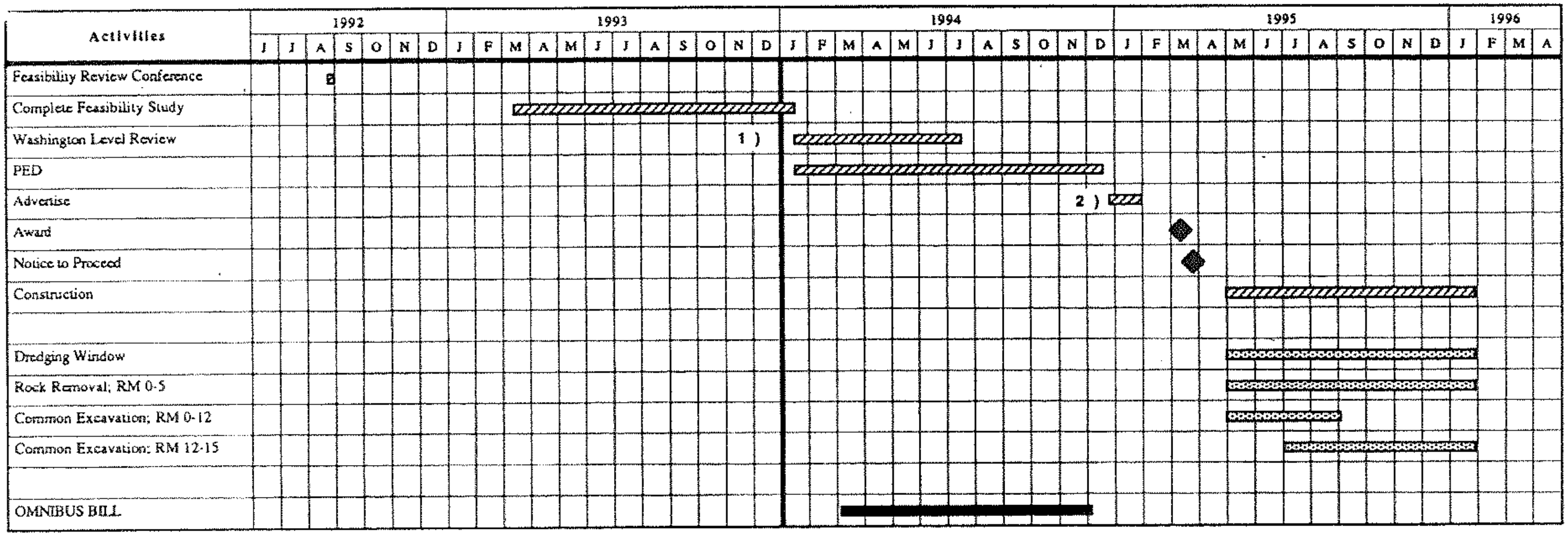
6.1.1 Ship Simulator Studies. ER 1110-2-1461, *Design of Channels Using Ship Simulator Techniques*, requires that ship simulator studies be conducted in the planning of navigation channels. As discussed in Engineering Analysis appendix, no adjustment to the alignment of the existing channel at the railroad bridge or elsewhere is proposed. During a site visit in April 1992, representatives from the Corps of Engineers Research Center, Corps of Engineers Headquarters, North Pacific Division and Portland District, identified several potential areas which may benefit from a model study. In addition to further consideration of the potential alignment adjustments mentioned above, the study also could provide information with regard to the width of the upper channel.

The opportunity to achieve meaningful benefits to the pilots navigating at the bridge is limited, however, and the pilots do not support reducing the width of the upper channel. It is possible that the study simulator, estimated to cost about $400,000, would not produce cost savings to offset the expenditure. For these reasons, coupled with the fact that there have been no deep-draft vessel accidents at the bridge, the District has requested a waiver from conducting the ship simulator study for this project. The cost for the study is not included in the estimates used to derive the selected plan.

From the GPS study, the Waterways Experiment Station concluded that, while requiring constant attention, the pilots had few problems navigating the channel and that there were not sufficient indications of significant navigation impacts with regard to the 2-foot deepening plan to warrant a simulation study.

The ship simulator study, if required, would be conducted during the PED phase.

Coos Bay G.I., Project Schedule Summary



1) Subject to higher level review, USACE, ASA
2) Start subject to OMB and Project Authorization

Project Schedule Summary

US Army Corps of Engineers Portland District

Coos Bay Navigation Improvements

Figure 8

6.1.2 Construction Period. Construction is estimated to require 10 months to complete, with an assumed May through February schedule. In-water work periods for the selected plan have been negotiated with the resource agencies. Resource agencies have agreed to extend in-water work periods so the work can be completed in one season to minimize the duration of impact to the environment. The in-water work periods for the reaches are: July 1 to Jan. 31 for RM 12 to RM 15; May 1 to Aug. 31 for dredging below RM 12; and May 1 to Jan. 31 for rock excavation.

6.2 Cost Apportionment

The total FY 1994 project investment cost for the selected plan is estimated to be $14,139,400. See table 5-1 in section 5 for development of the investment cost.

6.2.1 Fully-Funded Cost. Table 6-1 is a reproduction of the Executive Cost Summary from the baseline cost estimate. The current fully-funded cost estimate for this project includes an estimate of inflation based on Office of Management and Budget guidelines and the tentative construction schedule. The Federal and non-Federal shares in the cost of the construction are derived from the fully-funded cost estimate.

6.2.2 Non-Federal Cost Sharing. For construction of general navigation features (GNF) between 20 feet and 45 feet in authorized project depth, the non-Federal cost share is 25 percent of the construction cost plus 10 percent additional cash with credit for any lands, easements, rights of way, relocations, and disposal areas (LERRD) applied against the additional cash. Based on the guidance provided in EC 1165-2-141, March 15, 1988, this cost share formula also applies to the entrance channel which is dredged to depths below 45 feet (to 47 feet, exclusive of overdepth). The increased depth is needed for safe passage in the entrance and therefore as provided in the EC, the cost sharing should be based on the deepest depths of the protected inner channels.

The non-Federal sponsor also would be responsible for 100 percent of costs for features or development in excess of that required for the NED plan, such as a deeper or wider channel.

As provided in Section 101 of the Water Resources Development Act of 1986, the non-Federal share consists of 25 percent to be paid during the construction and an additional 10 percent, less any LERRD, to be paid over a period not to exceed 30 years at an

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TABLE 6-1.--*Total Project Cost Summary*

****TOTAL PROJECT COST SUMMARY**** PAGE 1 OF 1

THIS ESTIMATE IS BASED ON THE SCOPE CONTAINED IN THE DRAFT FEASIBILITY REPORT, DATED SEPTEMBER 1993

PROJECT: COOS BAY CHANNEL DEEPENING — DISTRICT: PORTLAND

LOCATION: COOS BAY, OREGON — P.O.C.: PAT JONES, CHIEF, COST ENGINEERING BRANCH

CURRENT MCACES ESTIMATE PREPARED: from 1990 to 1993 — AUTHORIZ./BUDGET YEAR: 1994 — FULLY FUNDED ESTIMATE

EFFECTIVE PRICING LEVEL: Oct-93 — EFFECT. PRICING LEVEL: OCT 93

ACCOUNT NUMBER	FEATURE DESCRIPTION	COST ($K)	CNTG ($K)	CNTG (%)	TOTAL ($K)	OMB (%)	COST ($K)	CNTG ($K)	TOTAL ($K)	FEATURE MID PT	OMB (%)	COST ($K)	CNTG ($K)	FULL ($K)
09 - - -	DREDGING	9,748	2,252	23%	12,000	0.0%	9,748	2,252	12,000	Sep-95	6.6%	10,391	2,401	12,792
	TOTAL CONSTRUCTION COSTS = = = = = >	9,748	2,252	23%	12,000	0.0%	9,748	2,252	12,000		6.6%	10,391	2,401	12,792
01 - - -	LANDS AND DAMAGES		N/A											
30 - - -	PLANNING, ENGINEERING AND DESIGN	823	144	17%	967	0.0%	823	144	967	Dec-94	3.4%	851	149	1,000
31 - - -	CONSTRUCTION MANAGEMENT	447	121	27%	568	0.0%	447	121	568	Sep-95	8.7%	486	132	617
	TOTAL COST = = = = = = = = = >	11,018	2,517	23%	13,535	0.0%	11,018	2,517	13,535		6.5%	11,728	2,681	14,409
	Non-Federal Dredge Cost to Private Docks	133	30	23%	163	0.0%	133	30	163		6.6%	142	32	174
	TOTAL PROJECT COSTS = = = = = = = = = >	11,151	2,547	0	13,698	0	11,151	2,547	13,698	0	0	11,870	2,713	14,583

TOTAL FEDERAL COSTS = = = = = = = = = > 10,807

TOTAL NON-FEDERAL COSTS = = = = = = = 3,776

THE MAXIMUM PROJECT COST IS = = = = = = = = = = = 16,438
(EXCLUSIVE OF INFLATION)

interest rate pursuant to Section 106 of the Act of 1986. The fully funded cost estimate for the selected plan, inflated to mid-point of construction (September 1995), is $14,583,000. Table 6-2 indicates the estimated cost share amounts for this project.

TABLE 6-2.--*Initial Construction Cost Share Amounts*

Non-Federal, 100% (Associated Costs)	$ 174,000
Non-Federal, 25%	3,602,200
Federal, 75%	10,806,800
Total Fully Funded Costs	$14,583,000

The additional 10 percent cash contribution to be paid by non-Federal interests over a period not to exceed 30 years is estimated at $1,440,900 plus interest. No LERRD costs are anticipated.

6.3 Division of Responsibilities

In addition to the cost sharing responsibilities discussed in the previous paragraph, the following paragraphs outline additional Federal and non-Federal responsibilities in connection with development of general navigation projects, as mandated by WRDA 1986, Public Law 99-662, and other pertinent laws and policy guidance.

6.3.1 Federal Responsibility. The Corps of Engineers would be responsible for preparing detailed plans and specifications necessary to award a contract, and constructing and maintaining the project resulting from implementation of the selected plan. Congress would authorize the project and appropriate Federal funds for its construction.

6.3.2 Non-Federal Responsibilities. Based on guidance contained in ER 1165-2-131, *Local Cooperation Agreements for New Start Construction Projects*, non-Federal interests, in addition to contributing the funds described in paragraph 6.2.2, must:

a) Provide, without cost to the United States, all lands, easements, and rights-of-way, including upland dredge material disposal areas, and perform (or assure performance of) all alterations and relocations of facilities and utilities (except for highway and railroad bridges) necessary for the construction of the project and for aids to navigation upon the request of the Chief of Engineers. The project is not expected to require navigation aids.

b) The value of any lands, easements and rights-of-way, relocations disposal areas (if needed) provided by the sponsor would be credited towards their additional 10 percent payment described in para. 6.2.2, above.

c) Provide and maintain, at its own expense, all project features other than those for GNF needed to implement the proposed project (e.g. local access channels, berthing areas, docks).

d) Comply with the applicable provisions of the Uniform Relocation Assistance and Real Estate Property Acquisition Policies Act of 1970, Public Law 91-646, as amended by Title IV of the Surface Transportation and Uniform Relocation Assistance Act of 1987 (Public Law 100-17), and the Uniform Regulation contained in 49 CFR, Part 24.

e) Maintain and operate all the non-Federal features after completion in accordance with regulations prescribed by the Secretary of the Army.

f) Assume financial responsibility for the cleanup of hazardous materials located on project lands and covered under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) without cost sharing.

g) Be responsible for operating, maintaining, repairing, replacing, and rehabilitating the project in a manner so that liability will not arise under CERCLA.

h) Provide berthing areas, floats, piers, slips, and similar marina facilities as needed for transient and local vessels, as well as necessary access roads, parking areas, and other needed public use shore facilities open and available to all on equal terms.

6.4 Sponsor's Support

6.4.1 Sponsor's Views. The Oregon International Port of Coos Bay supports implementation of the 37-foot channel deepening plan and anticipates an expedited processing towards authorization and construction, as evidenced by the letter of intent dated January 27, 1994 attached as an exhibit to this report. The Port states that the proposed improvements provide a critical component in the development plans and capabilities of the harbor and the Port Authority. The letter sites new developments in ore imports and other commodities, as well as new mill construction to handle second-growth timber as evidence of its vitality and expansion potential beyond previous reliance on traditional forest products exports. The Port indicates it is clearly financially capable and fully prepared to perform its responsibilities as the non-Federal partner as prescribed in the report and draft Project Cooperation Agreement.

6.4.2 Sponsor Financing. The non-Federal sponsor has provided a statement of financial capability and a financing plan. This information is located at Appendix J, Port of Coos Bay Financial Plan. The plan has been reviewed and found to be in compliance with requirements for ensuring that the non-Federal sponsor has a reasonable plan for meeting its financial commitment. The Sponsor's plan is to fund the non-Federal share of construction and the additional 10% payment from the State of Oregon's Marine Navigation Improvement Fund (MNIF). A letter from the Director of the Oregon Economic Development Department that indicates the Port's eligibility to receive these funds is provided in the financing package. This fund was established by the Oregon Legislature for the express purpose of providing a long-term funding mechanism for ports and other entities to cost share the construction of authorized navigation improvement projects of the Corps of Engineers. MNIF funds for the current biennium (1993-1995) are committed for the non-Federal share of construction. The plan is to fund the additional 10% payment with MNIF funds from the next biennium (1995-1997). However, this portion cannot be committed during this biennium. Therefore, to assure financial capability at this time, the Port commits to provide alternative funding for the additional 10% payment through its bonding authorities.

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7. LOCAL COOPERATION AND AGENCY COORDINATION

7.1 Public Views

Public meetings were held in connection with the study to obtain the views of local interests. In addition, area business interests were contacted individually to obtain their views on growth trends of industries dependent on water transportation; on alternative methods of improving navigation conditions; and on general trends in waterborne commerce. Local business interests appear to favor the project. Several written public comments were received during public review of the draft report and EIS. These have been reproduced and along with District responses are attached to the EIS. Some concerns were raised with the economic feasibility in light of timber supply issues and suggestions were made for alternative development in the lower bay in lieu of deepening the upper end of the channel. A meeting was held with the Oregon Natural Resources Council to discuss their comments, which were primarily directed at the economics of the plan. Additional concerns were raised with regard to effects of deepening on the integrity of the railroad bridge piers (by the Southern Pacific Transportation Company), while some comments were received regarding possible subsidence of land or erosion caused by the deepening project.

7.2 Agency Coordination

The U.S. Fish and Wildlife Service (USFWS) Coordination Act Report is attached to the EIS, along with the District's response to the recommendations therein. Region 10 of the Environmental Protection Agency (EPA) is a cooperating agency for this study. Agency responses to the District's scoping letter may be found in Appendix I. Early in the study, resource agencies expressed concerns over salinity intrusion and the methodology for rock removal, preferring mechanical excavation to blasting. A salinity workshop was held in July 1989, which was attended by state and Federal fish and wildlife agencies and EPA. Appendix H includes the minutes from the workshop. Resource agencies have indicated that they would like the work completed in the shortest possible time to minimize the disruption to habitat and species. Agencies also seek a balance between long-term ocean disposal requirements and minimizing the quantity of habitat impacted by the disposal.

The draft feasibility report and EIS were released for public and agency review in September 1993. Agency comments and District responses to the comments are attached to the EIS. The USFWS had no additional comments on the recommended plan. Written comments from the EPA have not been received as of the publication of this report. Verbal communication with EPA staff indicates there are no major concerns. Oregon Department of Fish and Wildlife provided comments and a meeting was held with that agency to discuss impacts of the deepening plan, cumulative impacts, in-water work dates, and mitigation. Discussions will continue with that agency with regard to details of post-construction monitoring of effects, potential measures for habitat development in the bay through use of dredged rock or shell materials, and potential future investigations under other authorities with regard to cumulative impacts. Oregon Department of Environmental Quality (DEQ) commented on dredging and disposal of contaminated sediment materials and HTRW sites. Additional information was obtained on the HTRW sites in cooperation with DEQ. This information is presented in the EIS.

8. CONCLUSIONS AND RECOMMENDATIONS

I have given careful consideration to all significant aspects of this study in the overall public interest, including engineering and economic feasibility, as well as social and environmental effects. The selected plan for improvement described in the report provides the optimum solution for navigation improvements at Coos Bay, Oregon.

I have also assessed the Oregon International Port of Coos Bay's financial capability and ascertained that it is reasonable to expect that ample funds will be available to satisfy the non-Federal sponsor's financial obligation for the project. The Port's letter of intent to sponsor the project is included as an exhibit to this report.

For construction of general navigation features (GNF) between 20 feet and 45 feet in depth, the non-Federal cost share is 25 percent of the construction cost plus 10 percent additional cash with credit for any lands, easements, rights of way, relocations, and disposal areas (LERRD) applied against the additional cash. I have determined this cost share formula also applies to the entrance channel, which is dredged to depths below 45 feet (to 47 feet plus advance maintenance). The increased depth is needed for safe passage in the entrance and, therefore, as provided in the guidance provided in EC 1165-2-141, March 15, 1988, the cost sharing should be based on the deepest depth of the protected inner channel.

I recommend that the existing Federal navigation project at Coos Bay, authorized by the River and Harbor Act of 1970, be modified to provide a 47 foot deep entrance channel transitioning to a 37 foot deep inner channel near RM 1 and continuing at that depth upstream to RM 15, and an enlarged turning basin at RM 12 from 800 feet by 1,000 feet to 900 feet by 1,000 feet, with such further modifications thereto as in the discretion of the Chief of Engineers may be advisable. The total investment cost is estimated to be $14,139,400. It is further estimated that additional annual costs of $109,800 will be incurred for increased Federal maintenance dredging. Including maintenance costs, the estimated total project annual cost is $1,298,900. With estimated average annual benefits of $1,998,700 in commodity transportation and delay savings, the proposed project is economically feasible with a benefit-to-cost ratio of 1.5 and annual net benefits of $699,800, thereby warranting Federal participation.

The fully-funded cost estimate is presently estimated at $14,583,000, based on a scheduled construction completion in FY 1996. Accordingly, the non-Federal cost share is estimated to be $3,602,200 for 25 percent of the general navigation features (GNF), $174,000 for 100 percent of associated improvements, and $1,440,900 plus interest for an additional 10 percent of GNF payable over a period not to exceed 30 years.

The recommendations contained herein reflect the information available at this time and current Departmental policies governing formulation of individual projects. They do not reflect program and budgeting priorities inherent in the formulation of national Civil Works Construction program nor the perspective of higher review levels within the Executive Branch. Consequently, the recommendations may be modified before they are transmitted to the Congress as proposals for authorization and/or implementation of funding.

Charles A. W. Hines

Date: 25 Jan 94

CHARLES A.W. HINES
Colonel, Corps of Engineers
Commanding

CENPD-PE-PF (CENPP-PE-P/Jan 94) (1105b) 1st End
Mr. Weaver/kb/(503)323-3826
SUBJECT: Coos Bay, OR, Feasibility Study

CDR, North Pacific Division, Corps of Engineers, P.O. Box 2870,
Portland, Oregon 97208-2870

01 FEB 1994

FOR CDR, USACE (CEWRC-WLR-M), Kingman Building, Ft. Belvoir, VA

I concur in the conclusions and recommendations of the District Commander.

ERNEST J. HARRELL
Major General, USA
Commanding

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CTCLUSI Exhibit C

EXHIBIT

CTCLUSI Exhibit C

OREGON INTERNATIONAL PORT OF COOS BAY
Front & Market Streets • Coos Bay, Oregon 97420 • Telephone: 503/267-7678 • Fax: 503/269-1475

January 27, 1994

Colonel Charles A. W. Hines, District Engineer
U.S. Army Corps of Engineers
Portland District
PO Box 2946
Portland, OR 97208-2946

Dear Colonel Hines:

The Oregon International Port of Coos Bay is pleased to have reached this milestone in our joint efforts with the Corps of Engineers to complete the Coos Bay Channel Deepening Feasibility Study. At the same time, we are anxious to keep pressing for continued, expeditious progress toward final authorization of the report and project. As we have discussed many times, there have been significant challenges and tense moments along the way. We believe that more recent joint efforts and coordination have put those times in the past and that we are moving forward together.

The Port has thoroughly reviewed the Draft Report and EIS, and fully support the findings. Based on seven years of study and analysis, we believe the study and findings to be based on sound engineering, economic and environmental principles. The proposed improvements provide a critical component in the development plans and capabilities of the harbor and the Port Authority, which are of vital importance to the economy of this region, the State and the nation. At the core of the economic analysis and benefits is a clear shift and expansion from what was once an almost pure reliance on forest products cargo. The substantial development represented by ore and other dry bulk imports, exports, and handling facilities is strategic and beneficial.

While this traditional forest products community embraces new cargoes and manufacturing, however, we also see a resurgence in second-growth and secondary timber manufacturing represented by projects such as the Georgia-Pacific metric mill now under construction in Coos Bay. That project is significant for two major reasons: 1) It does not rely on an unstable federal timber supply, and 2) It is the first new mill built in Oregon by Georgia-Pacific in decades. Both of those elements demonstrate a new economic and strategic picture in Northwest forest products.

The Port finds the terms of the Project Cooperation Agreement acceptable at this time, and is fully prepared to perform its responsibilities as the non-federal partner, spelled out in the PCA and the feasibility report.

Please consider this letter our statement of intent and commitment to enter into a final agreement at the appropriate point in the construction phase of the project. Our financing plan clearly demonstrates that the Port has, and will have, the necessary funding in place to meet its obligation for cost-sharing the project.

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Since surviving a very difficult period during this study, we have been encouraged by the focus and timeliness the Corps has demonstrated. Nevertheless, it has been a very long trip, and we anticipate an expedited processing of the report through Washington. As we have all been aiming for authorization this fiscal year, we know the Corps of Engineers shares our urgency, and that of our Congressional delegation. Our further commitment is to assist the process any way possible.

We speak for the maritime interests in this harbor and Oregon when we assure you that we look forward to continuing our association to a successful and timely conclusion of the authorization phase, as we move forward together toward full construction of the project.

Sincerely,

Allan E. Rumbaugh
General Manager

AER:dcb

cc Senator Mark O. Hatfield
Senator Bob Packwood
Congressman Peter DeFazio
Governor Barbara Roberts
Interested Parties

PLATES

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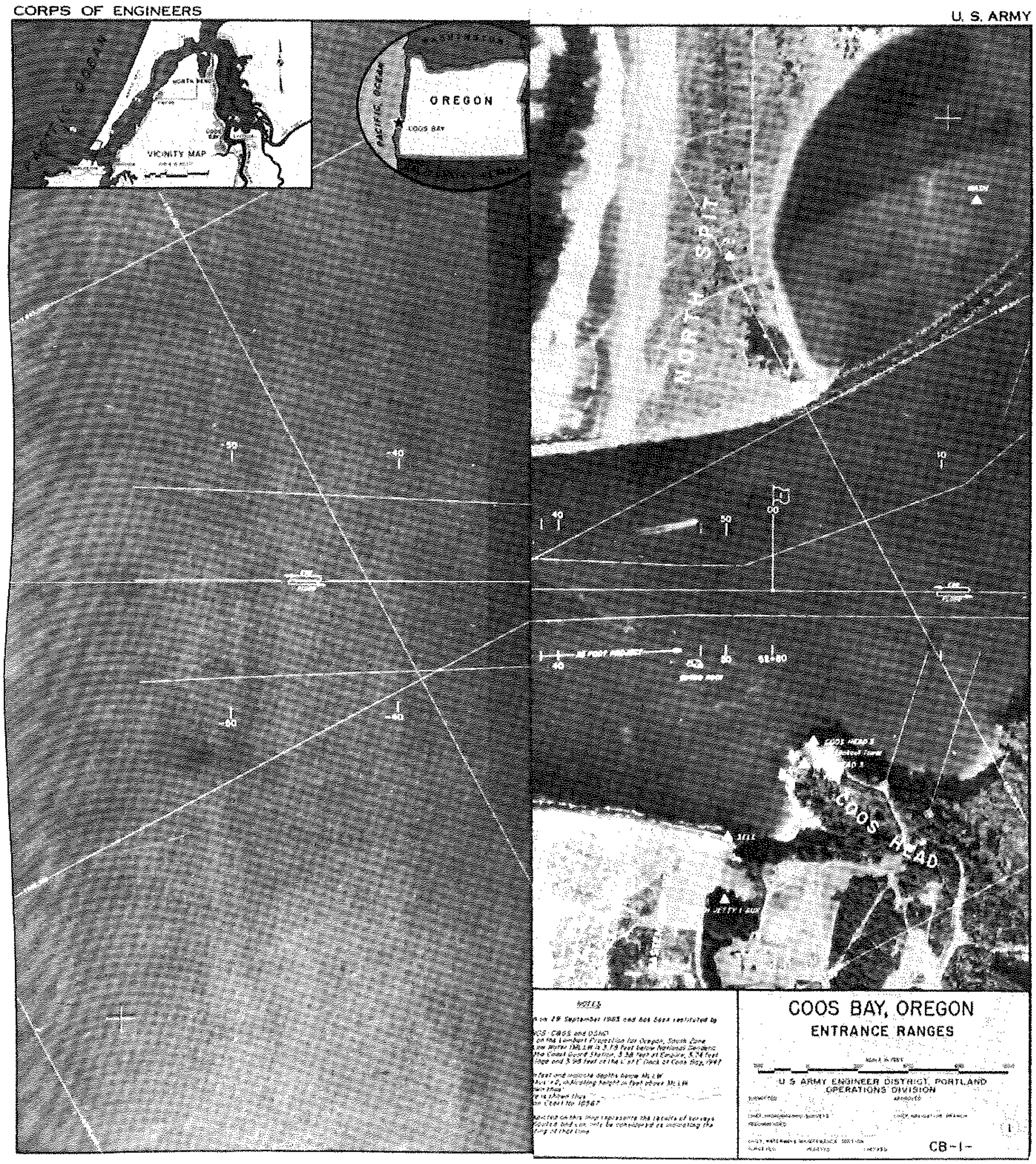

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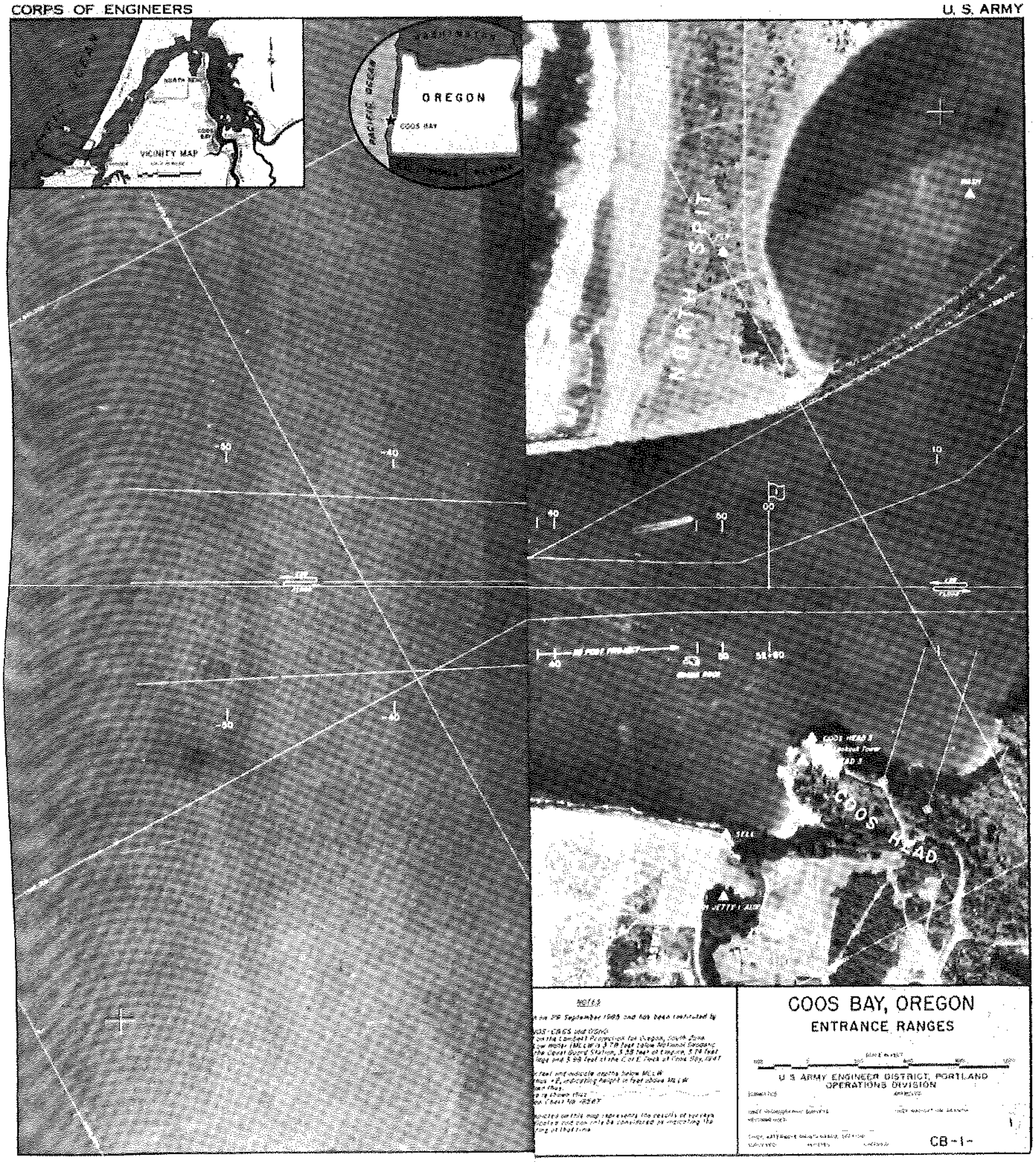

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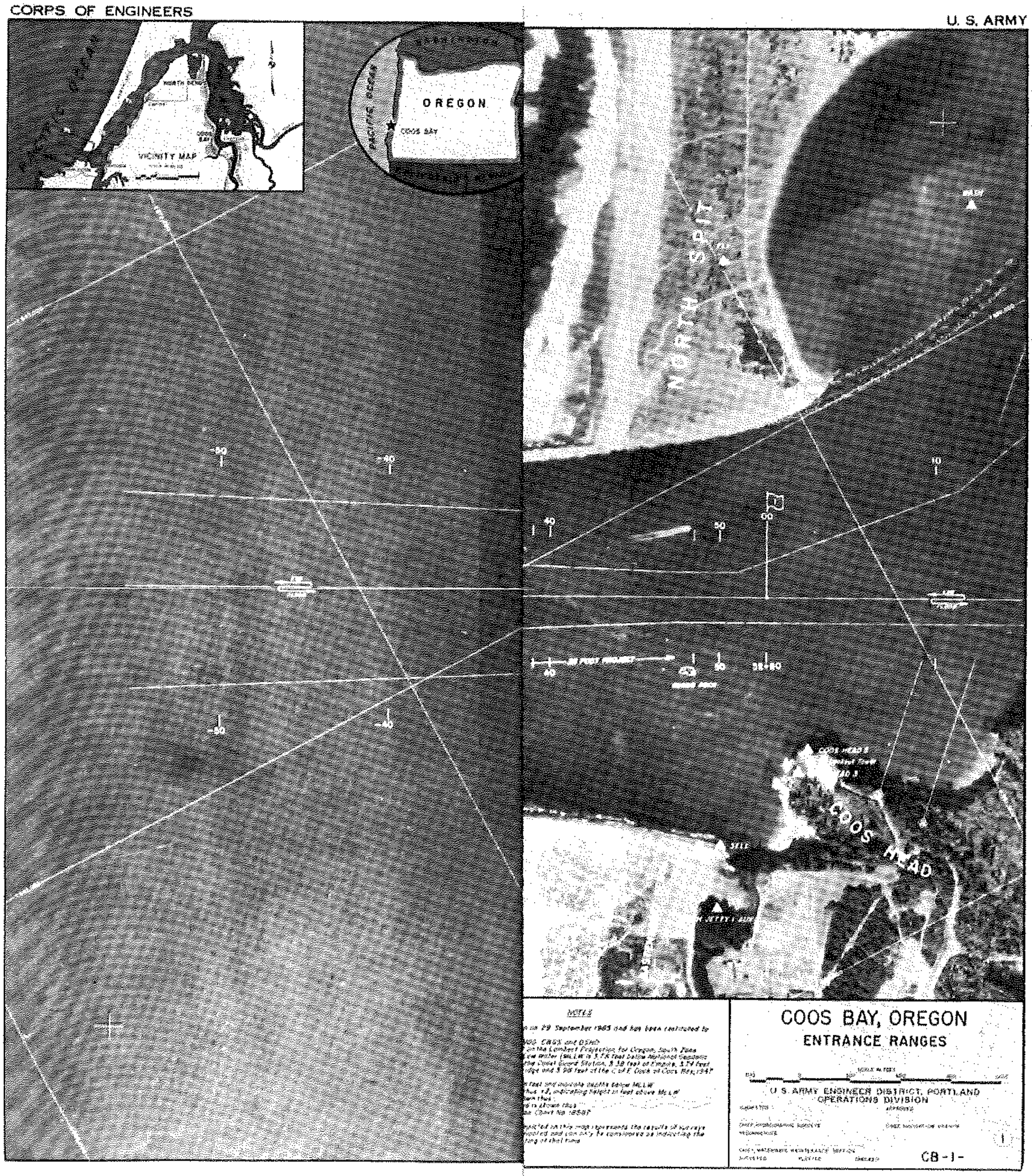

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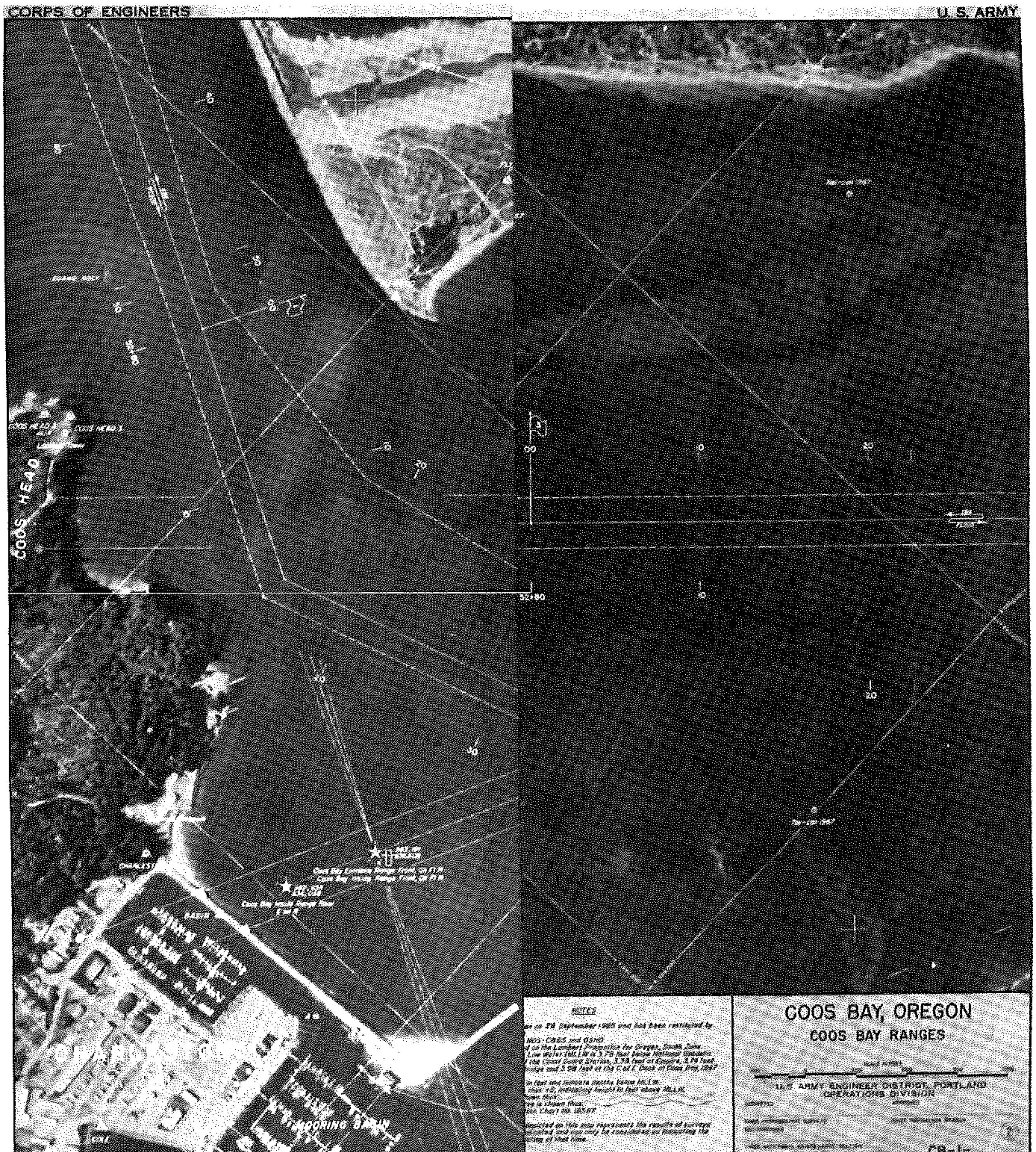

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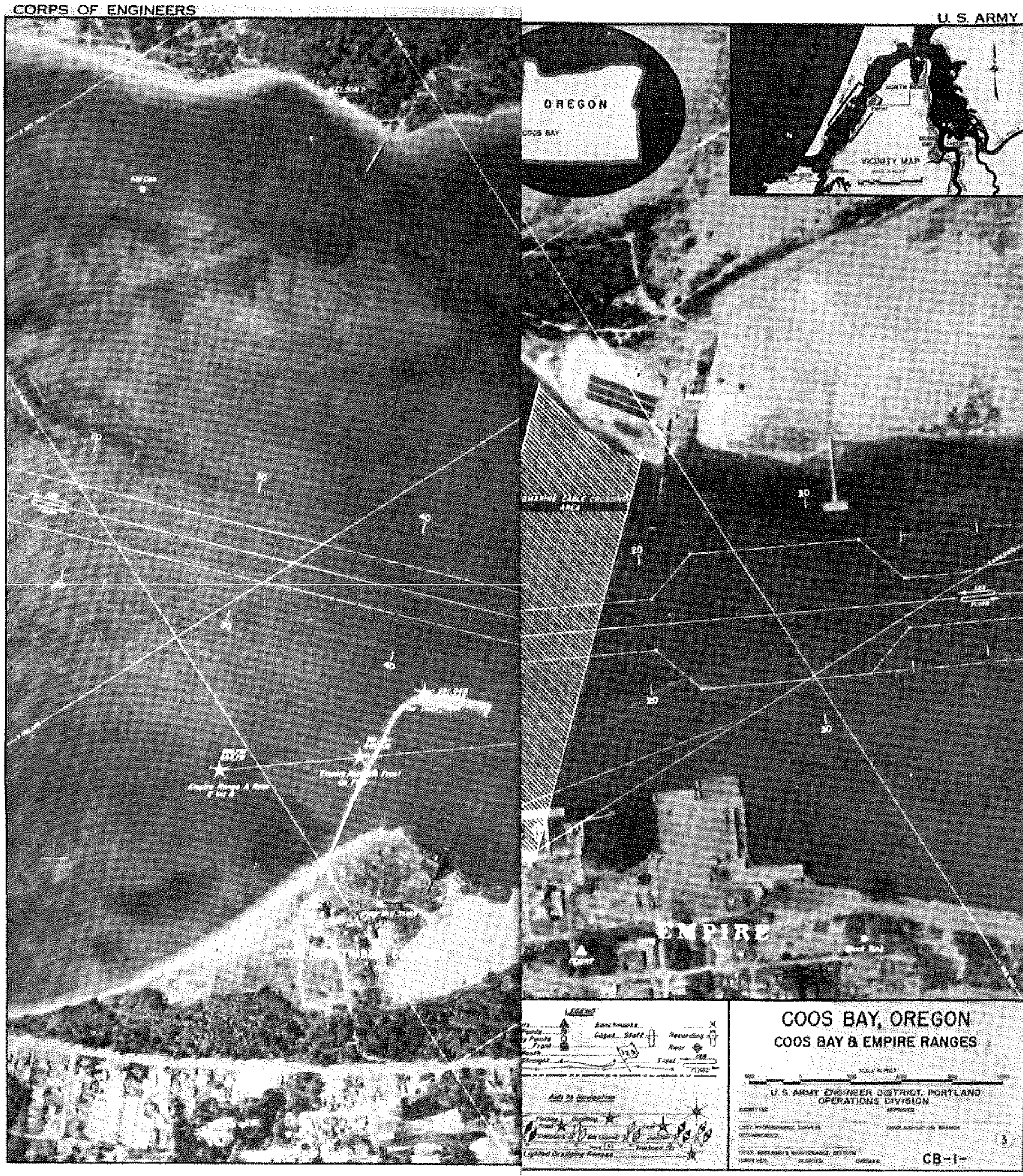

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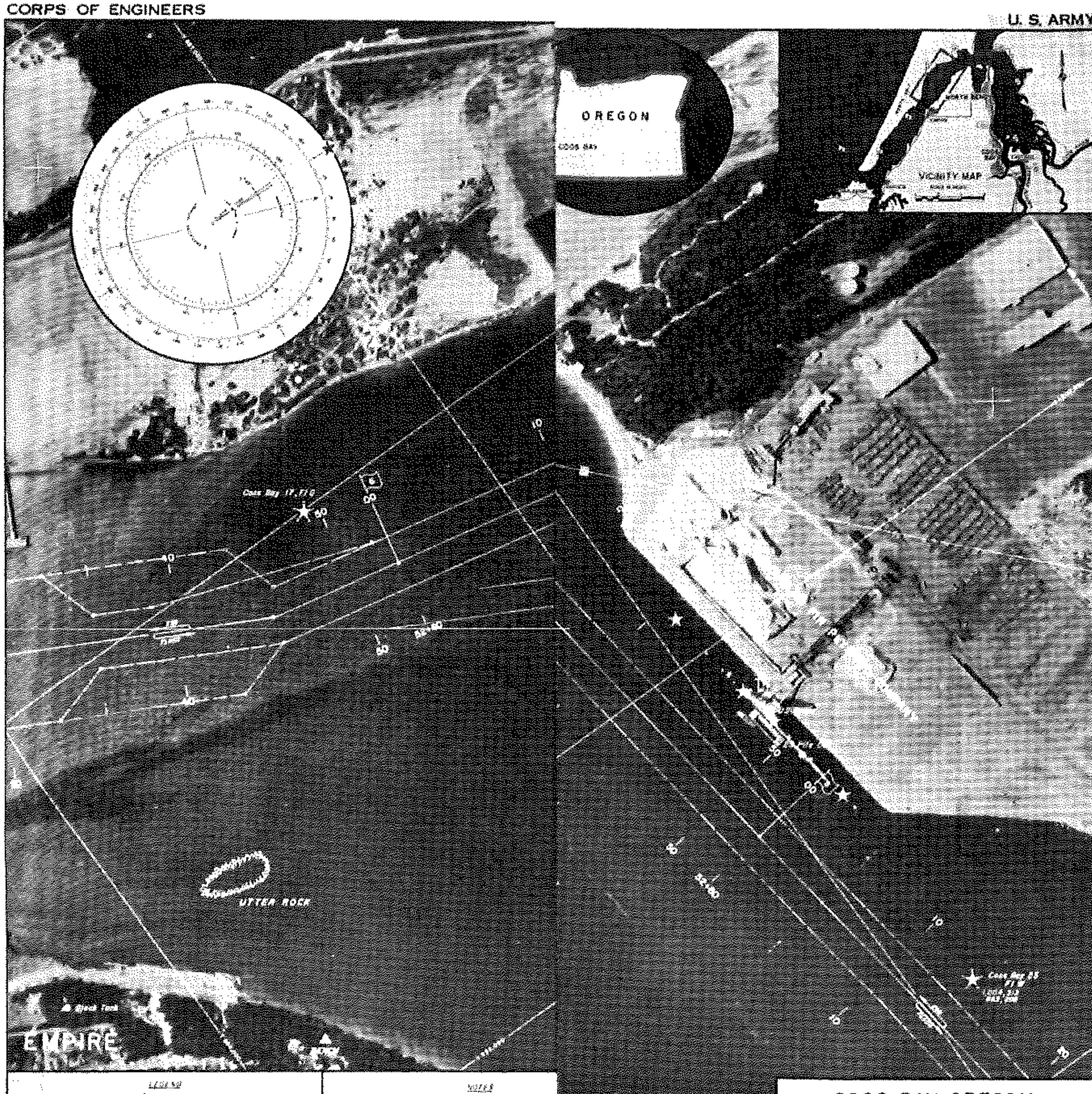

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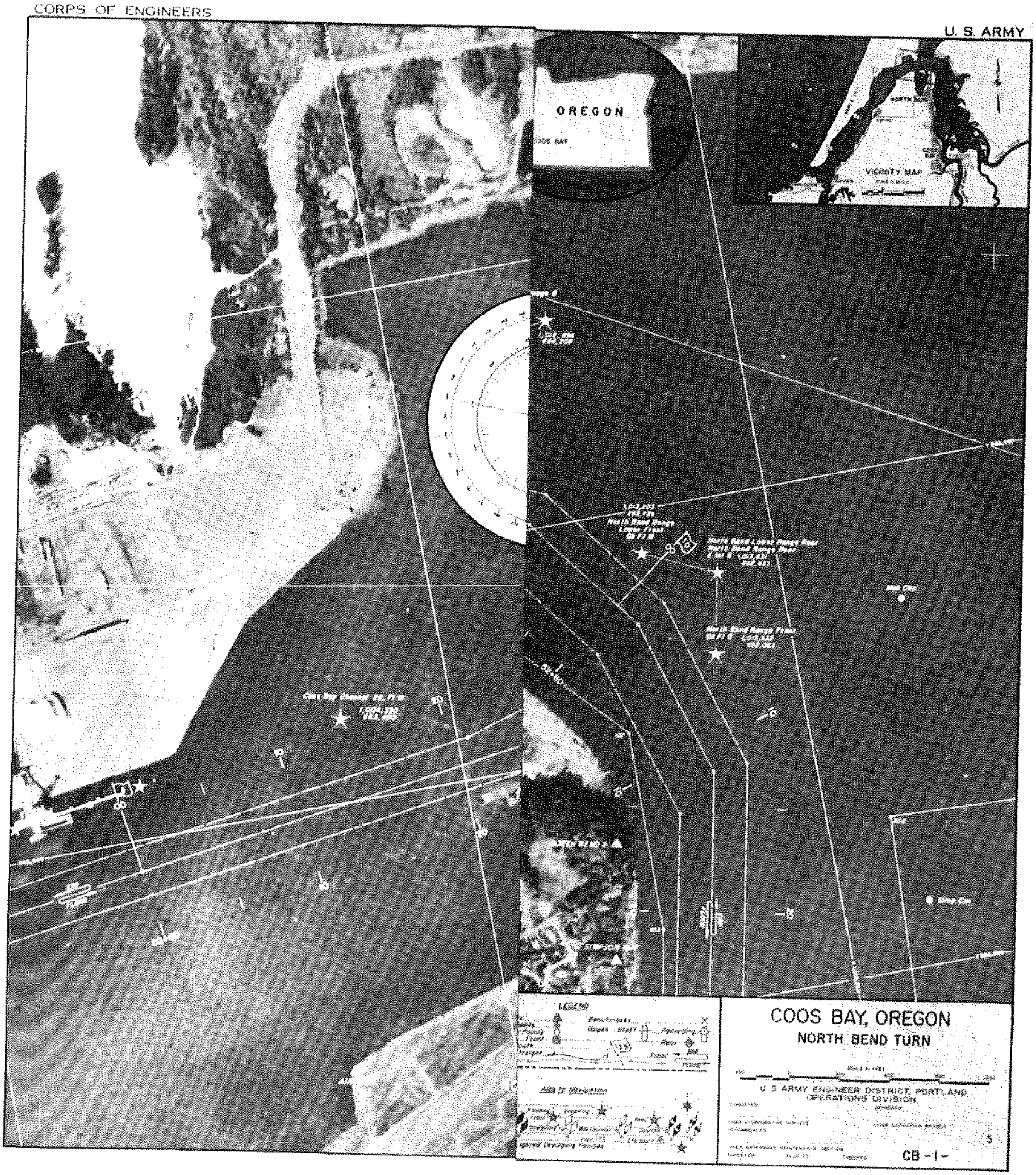

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COOS BAY NAVIGATION IMPROVEMENTS
COOS BAY, OREGON

FINAL
ENVIRONMENTAL IMPACT STATEMENT
FEASIBILITY REPORT

Prepared by
U.S. Army Corps of Engineers
Portland, District

In cooperation with
U.S. Environmental Protection Agency
Region X
Seattle, Washington

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FINAL
COOS BAY CHANNEL DEEPENING
ENVIRONMENTAL IMPACT STATEMENT
FEASIBILITY REPORT

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SYLLABUS

Lead Agency. U.S. Army Corps of Engineers, Portland District.

Cooperating Agency. U.S. Environmental Protection Agency, Region 10.

Type of Action. Administrative.

Background. A significant part of the proposed action is the use of ocean disposal sites for the placement of material dredged from the proposed navigation channel improvements. The Environmental Protection Agency (EPA) has agreed to assist in the preparation of this Environmental Impact Statement (EIS) Feasibility Report because of their expertise and responsibilities in administering the provisions of the Marine Protection, Research, and Sanctuaries Act (MPRSA) of 1972 as amended. EPA and the Corps jointly prepared an EIS addressing the designation of existing ocean disposal sites for Coos Bay. The final EIS document was issued February 7, 1986. This EIS utilizes information from that document, as well as more recent studies, to assess impacts of placement of dredged material at the existing disposal sites as well as disposal at new or expanded sites. This 'tiered' approach conforms to the guidance provided by CEQ Regulations, 40 CFR Parts 1502.20 and 1508.28.

Description of the Proposed Action and Purpose. The Federal Government has constructed and maintains an outer bar channel 45 feet deep and 700 feet wide transitioning to a channel 35 feet deep and 300 feet wide entering the jetties and through to approximately River Mile (RM) 1, a channel 35 feet deep and 300 feet wide from river RM's 1 to 9, a 35 foot deep by 400 foot wide channel from river RM's 9 to 15 upstream of Coos Bay, Oregon. An anchorage (currently used as a turning basin) 800 feet wide by 1,000 feet long at Empire, Oregon, and two 650- by 1,000-foot turning basins at North Bend and Coos Bay, Oregon are also authorized. The plan of improvement proposed by the Portland District Engineer consists of modification of the existing navigation project to provide for the following:

a. An outer bar approach 47 feet deep and 700 feet wide.

b. An entrance through the jetties 47 feet deep by 700 feet wide tapering to 300 feet wide by 37 feet deep.

c. A lower channel 37 feet deep by 300 feet wide to RM 9 and an upper channel 37 feet deep by 400 feet wide to RM 15.

d. Expanding the North Bend (RM 12) turning basin width from 800 feet to 900 feet.

The purpose of the proposed action is to improve navigation conditions for larger ships utilizing the channel and reduce transportation delays.

Summary of Major Environmental Impacts. The proposed action would alter present topography along the 15-mile length of the navigation channel and at the ocean disposal sites; remove or bury benthic organisms at these sites; disturb fish and wildlife habitat and food sources through dredging, mechanical rock removal, and disposal; temporarily increase estuarine turbidity; slightly increase estuarine salinity; slightly change estuarine circulation and sedimentation patterns; and slightly increase maintenance dredging requirements.

Final Copy. The final copy of this EIS was officially filed with the Director, Office of Federal Activities, EPA on MAR 08 1994.

Comments. Comments on the final copy of this EIS are due 30 days from the date of EPA's publication of Notice of Availability in the Federal Register which is expected to be MAR 18 1994. Such comments are to be addressed to the following:

U.S. Army Corps of Engineers
Washington Level Review Center
Kingman Building
For Belvoir, Virginia 22060

Copies of the draft EIS may be obtained from the following:

U.S. Army Corps of Engineers, Portland District
CENPP-PE-RP ATTN: Steven J. Stevens
P.O. Box 2946
Portland, Oregon 97208-2946
Phone: (503) 326-6094

SUMMARY

1. Major Conclusions and Findings. The preferred plan for the Coos Bay Navigation Project is to deepen the existing entrance and inner channel by 2 feet to reduce commercial shipping delays and allow full loading of ships. This plan, which is cosponsored by the International Port of Coos Bay, would have total annual benefits of $2 million, and total annual costs of $1.3 million.

Disposal of the new work and annual maintenance dredged material would occur primarily at currently designated or proposed ocean disposal sites. All channel dredged material is considered suitable for in-water disposal. Additional estuarine disposal is not considered environmentally acceptable by the resource agencies, and upland sites are extremely scarce and should be reserved for contaminated material, although none is expected from the proposed project.

2. Areas of Controversy. Comments on the draft EIS were received from Federal and State resource agencies, local agencies, one environmental group, local businesses, and individuals. Concerns expressed in their comments included impacts to benthic populations and habitat in Coos Bay; salinity effects on fish, clam, and crab populations; comulative impacts on the ecology of Coos Bay estuary; potential impacts on endangered species; economic justification for deepening; concern for channel slope stabilization and shoreline erosion; alternative port developments to be considered; possible introduciton of contaminated sediments into the water column; and commercial uses for dredged material. This EIS addresses all of these ocncerns, either in direct response to their letters or as revisions to the Feasibility Report/EIS.

The magnitude of these resource concerns is reduced as proposed channel depth decreases. The preferred 2-foot deepening represents a significant reduction in adverse impacts from the deepening of up to 5 feet addressed in the Coordination Act Report. A 2-foot deepening would likely not increase ship traffic but would increase shipping efficiency. In addition, no rock blasting would be required under the preferred plan, which would eliminate a major concern identified by the agencies.

3. Issues to be Resolved. The primary issue known at this time to be resolved is the determination of long term ocean disposal site requirements. This EIS identifies sites suitable for new work and long term maintenance dredging. Information for new site designations for new work and maintenance dredging quantities is included in the EIS. Additional procedural issues remain to be completed to meet EPA requirements for final site designation.

Table of Contents

Table of Contents

CHAPTER 4 - ENVIRONMENTAL EFFECTS OF ALTERNATIVES

Table of Contents

CHAPTER 5 - REVIEW AND CONSULTATION REQUIREMENTS

Table of Contents

Figures

Table of Contents

Tables

EXHIBITS

CTCLUSI Exhibit C

FINAL
COOS BAY CHANNEL DEEPENING
ENVIRONMENTAL IMPACT STATEMENT
FEASIBILITY REPORT

CHAPTER 1

PURPOSE AND NEED

1.1 Purpose. The purpose of the proposed channel deepening is to reduce shipping costs through reduction of delays and to permit larger vessels to use the port resulting in fewer ships carrying the same or increased cargo volumes at lower cost per ton. Channel deepening would also allow the port to maintain it's competitive position in the world market.

The purpose of this EIS is to address impacts of the proposed channel deepening and ocean disposal alternatives. Ocean disposal of the dredged material for this project is a critical economic and environmental component of the overall navigation improvement project. This EIS contains an evaluation of the proposed ocean disposal and alternatives based on the criteria and factors in the Ocean Dumping Regulations (40 CFR 228.5 and 228.6). This EIS also provides documentation in support of the Environmental Protection Agency's ocean disposal site designation process for continuing long-term use with the Coos Bay, Oregon, Federal navigation project and related dredged material disposal activities. Previous Environmental Impact Statements prepared for the Coos Bay navigation project include Coos Bay, Oregon Deep Draft Navigation Project SEIS, July 1975; Coos Bay Channel Maintenance Dredging EIS, August 1976; and Coos Bay, Oregon Dredged Material Disposal Site Designation EIS, February 1986. Several references to these environmental documents are made throughout this EIS.

1.2 Need. Coos Bay is Oregon's second largest port and one of the world's largest shipping ports for forest products. It is the point of departure for forest products from all over the northwest. Within the Coos Bay region, approximately 50 percent of the 20,000 available jobs are directly or indirectly dependent on shipping activities. In 1988, the total volume of trade through Coos Bay was 5 million tons. A deeper channel would allow the Port of Coos Bay to operate economically and maintain a viable, competitive position as a West Coast import/export center primarily for timber products. Maintaining an active shipping trade is a necessary component for a healthy economy in the Coos Bay region. The economic justification for the proposed action is based on shipping vessel economies of scale and reduced delays. Detailed discussion of current and projected need for the deep-draft channel are described in Section 3 of the preceding feasibility report.

CHAPTER 2

ALTERNATIVES

2.1 Introduction. This section discusses the alternative actions studied during the reconnaissance phase, those eliminated from further study, and those studied in more detail during this feasibility phase including no action and the preferred alternative. The primary purpose of this section is to present a comparative environmental evaluation of the alternatives including any proposed mitigation plans, clearly describing the issues and trade-offs associated with each alternative.

2.2 Alternative Plans Considered. The reconnaissance phase of the study developed nine alternative plans related to channel modifications. The plans analyzed included deepening the Coos Bay navigation channel to various depths removing up to a maximum of 5 feet of sediments along its full 15-mile length, reconstructing the Southern Pacific railroad bridge, raising the Highway 101 bridge, dredging a shorter, deeper channel, constructing a small or large anchorage near RM 7, various combinations of the preceding, and a no-action alternative.

The no-action alternative is a continuation of the existing practice of maintaining the existing Federal channel to the authorized project depths of -45 feet at the entrance and -35 feet for the inner channel. Annual maintenance dredging is normally required for the entrance bar and inner channel to RM 12. Maintenance dredging is normally performed every other year from RM's 12 to RM 15. Overdepth dredging routinely occurs as part of channel maintenance practices. Overdepth includes 2 feet for dredging tolerances based on physical conditions and equipment used during dredging. Advance maintenance is also performed above RM 12 to assure that the authorized depths are provided for a long period between dredging cycles. Advance maintenance depths at Coos bay are 4 feet at the entrance and 1 foot above RM 12. Total dredging depth with overdepth allowances and advance maintenance are -51 feet at the entrance, -37 feet between RM's 1 and 12 and -38 feet above RM 12.

Current annual maintenance dredging quantities are presented in appendix B of the feasibility report.

2.3 Plans Eliminated From Further Consideration. Raising the highway bridge and widening the Southern Pacific railroad bridge proved to be prohibitively expensive and could not be economically justified. Dredging a shorter channel could not be economically justified as, at present, most facilities requiring a deeper channel are concentrated along the upper reaches of the authorized channel, between RM's 12 and 15. Moving existing facilities and attendant infrastructure from the upper channel reaches to the lower bay would likewise be prohibitively expensive. Development of additional deep-draft facilities in the lower bay could not be justified in the foreseeable future. Construction of an anchorage basin in the vicinity of RM 7 was also considered but was not economically feasible for depths greater than 35 feet. The reconnaissance report also included an evaluation of disposal site alternatives. Utilizing information contained in the 1976 Coos Bay Channel Deepening EIS and subsequent surveys, existing upland and estuary sites were determined to have limited capacity. The estimated 1.3 to 1.4 million y^3 of new dredged material, let alone subsequent maintenance dredging material, far exceeds the capacity of these sites. Potential ocean disposal sites were studied in further detail for disposal of both rock and sand sediments. Table 2.1 displays the features of the nine alternative plans evaluated in the reconnaissance report and three of the six alternatives being considered in the feasibility phase.

2.4 Alternatives Considered In Detail. The alternatives recommended in the reconnaissance report to be studied in detail during this feasibility study phase are deepening the channel by 1 to 5 feet from the entrance to RM 15, and disposal of the material in designated ocean disposal sites. Associated channel width in the vicinity of the railroad bridge, and widening the existing turning basin at RM 12 were also investigated with each alternative. Overdepth dredging allowances would remain as currently practiced. Dredging efforts would likely utilize a combination of hopper and clamshell dredge. Hopper dredges would remove the primarily sandy material from below RM 12.

TABLE 2.1, ALTERNATIVE PLANS EVALUATED

Alternative Plans, Reconnaissance Report										Feasibility Report Alternatives
	Entrance Channel			Bay Channel			Anchorage		Reconstructed Railroad Bridge	
	Depth in Feet			Depth in Feet						
Plan	48	50	52	38	40	42	Large	Small		■
1	●			●			●		●	
2	●			●			●			
3	●			●				●		
4	●			●						●
5		●			●					●
6			●			●				
7							●			
8								●		
9 (no action)										●

■ *47' entrance, 37' channel; 46' entrance, 36' channel.*

A clamshell dredge would likely be used to dredge the finer material upstream of RM 12. The rock material, located in the vicinity of and below RM 5, would be mechanically dug and loaded into bottom dumping barges. Sediments removed from the channel would be transported by barge or hopper dredge to one of three ocean disposal sites. Beneficial uses of dredged material such as the possibility of pipeline dredging in the vicinity of RM's 1 to 3 with disposal of sandy material for snowy plover habitat on North Spit is being investigated. Implementation of this measure will also be pursued under separate authority for restoration of habitat through the O&M dredging program. Commercial uses of dredged material were also investigated and determined that there is no current value or market demand for this material. Additional discussion of the alternatives investigated and the preferred plan is included in sections 3, 4, and 5 of the feasibility report.

2.5 Preferred Alternative. The preferred alternative is to deepen the channel by two feet from the entrance to RM 15 and widen the turning basin at RM 12 by 100 feet with disposal of the dredged material at designated ocean disposal sites. The preferred ocean disposal sites are expanded Site F for primarily coarse-grained material; existing Site H which would receive fine-grained material from above RM 12; and a site for one-time disposal of rock material removed from channel deepening. Existing Sites E and F lack capacity for the quantities of coarse-grained material currently disposed at these locations. Expanded or new sites would provide the necessary capacity to accommodate both new work and maintenance dredging sediments. Larger site capacity would also increase available site management options. Final site designation for expanded Site F will be developed through EPA's site designation process to meet long-term maintenance dredging requirements (paragraph 2.7). Removal of the sandy sediments and silts would be accomplished by clamshell and/or hopper dredge, and removal of rock would be accomplished by mechanical equipment and loaded on to barges for disposal.

2.6 Alternatives Comparison. The impacts of the channel deepening alternatives considered in the feasibility report would essentially increase in severity with increased depth. One- or 2-foot-depth increases would result in some additional adverse effects but not significantly different from existing practices. A relatively small additional area of benthic habitat would be removed during dredging operations, estuarine salinity and circulation would essentially be unchanged, and, except for a new ocean disposal site for rock material and expansion of existing Site F for long-term maintenance requirements, disposal operations would not change from current practices. The 3- to 5-foot depth increases would, on the other hand, result in potentially moderate to severe impacts with greater benthic habitat affected by dredging, changes in estuarine salinity and circulation, additional disturbance to the estuary during construction, including greater channel sideslope effects, and more disposal area required for new work dredged material.

The 2-foot-deepening alternative was selected on the basis of achieving maximum national economic development benefits with minimal environmental impact. Ocean disposal is the only viable alternative for channel deepening compared to upland or estuarine disposal. Dredged material quantities for a 2-foot deepening, estimated at between 1.3 and 1.4 million cubic yards (y^3), are not significantly greater than the average of 1.2 million y^3 of sediments removed during one year of maintenance dredging. Estimated increase in maintenance dredging quantities is 122,000 y^3 on average for the first 3 years after deepening, decreasing to 2,000 y^3 in 20 years.

Maintenance dredging, with or without channel deepening, will require additional site capacity and further evaluation under EPA's site designation procedures. An evaluation of new ocean disposal site requirements for new work and maintenance dredging of the Coos Bay channel concludes that viable ocean disposal site capacity exists in the Coos Bay offshore area to accommodate dredged material disposal over the 50-year life of the project (1996-2046). EPA Region 10 concurs with this finding and has provided assurance that final site designation for long-term maintenance needs can be achieved in a timely manner. Additional discussion of the new ocean disposal site evaluations, including evaluation of existing disposal practices and alternatives, is included in the following sections.

Table 2.2 presents a summary comparison of environmental effects for each of the alternatives considered in detail including the no action alternative.

2.7 Existing Ocean Disposal Site Evaluation.

a. General. EPA designated the three current ocean disposal sites (E, F and H) in 1986 for disposal of channel maintenance dredged material. The selection and eventual designation of these sites, documented in the 1986 Site Designation EIS, was based on studies of the physical, chemical, and biological conditions of the Coos Bay offshore area (figure 2.1). The primary criteria used in selecting candidate sites were physical and chemical similarities of sediments; avoidance of impacts on unique biological communities; and avoidance of important human use areas. These three basic criteria constitute the significant elements of the five general and 11 specific Marine Protection, Research and Sanctuaries Act (MPRSA) site selection criteria.

General conclusions reached in these disposal site candidate studies were that the area in the vicinity of existing Site H was most suitable for disposal of fine-grained material dredged from above RM 12; the area in the vicinity of Site F was most suitable for disposal of coarse-grained material dredged from below RM 12; near-shore areas including Site F, were populated with aquatic organisms adapted to a high energy environment; areas further offshore, including Site H, contained higher densities of organisms adapted to a more stable environment.

b. Non-Ocean Disposal Alternatives. The 1986 Ocean Disposal Site Designation EIS and subsequent Section 103 Evaluation for expansion of Site F have evaluated the need for ocean disposal as well as alternatives to ocean disposal. Alternatives investigated included upland disposal, estuarine open-water disposal, and no action. The studies concluded that upland disposal sites are limited and should be reserved for disposal of contaminated materials, estuarine disposal was more environmentally damaging than ocean disposal, and no action would reduce navigation in Coos Bay to economically

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Table 2.2

Coos Bay Channel Deepening Comparison of Alternatives

	No Action	Plan 1	Plan 2 (preferred)	Plan 3	Plan 4	Plan 5
Physical Resources: Coos Bay Estuary						
Sediment:	Approximately 1.7 million cubic yards annually in navigation channel.	Slight increase initially tapering to no additional sedimentation in 5–10 years.	Slight increase initially tapering to no additional sedimentation in 5–10 years.	Slight increase with estimated 2% additional sediment accumulation primarily at entrance	Slight increase with estimated 2% additional sediment accumulation primarily at entrance	Same as Plan 4
Water Quality:	Current water quality described as mildly polluted, typical of industrially (wood products) developed estuary. Channel sediments are mildly contaminated (above RM12) or uncontaminated and suitable for ocean disposal. Short-term turbidity during dredging operation.	Short term turbidity during dredging operations. Minor release of contaminants above RM12.	Same as Plan 1	Same as Plan 1	Same as Plan 1	Same as Plan 1
Circulation:	Primary influences are riverflow (upper bay) and tidal propagation.	Slight increase in channel currents and volume of ocean water entering estuary.	Slight increase in channel currents and volume of ocean water entering estuary.	Same as Plan 2	Same as Plan 2	Moderate increase in channel currents and volume of ocean water entering estuary.
Salinity:	Salinity intrusion extends throughout the bay and sloughs and into the lower riverine systems, seasonally creating brackish conditions.	Slight increase in lower bay salinity intrusion.	Same as Plan 1	Slight increase in riverine and slough salinity intrusion	Moderate increase in riverine and slough salinity intrusion	Same as Plan 4
Physical Resources: Ocean Disposal Sites						
Bathymetry:	Site F avg depth 24 meters. Site H avg depth 55 meters. Rock site avg depth 37 meters. Contours generally trend N/S.	Slight change in bottom contours at Sites F and H, with mounding at Site F. Slight change at Rock Site.	Same as Plan 1	Moderate change in bottom contours at Sites F and H with mounding at Site F. Slight change at site. Expand Site F to reduce mounding.	Moderate change in bottom contours at all	Significant increase in mounding at Sites F and H. Expand Sites F and H to reduce mounding.
Sediment Transport:	Current mounding problem at Site F. Sediments move offshore at Sites F and H.	Sediments would slowly erode in offshore and longshore direction. Rock disposal to essentially remain in place.	Same as Plan 1	Same as plan 2	Same as Plan 3	Same as Plan 4
Water Quality:	Typical for marine waters of Oregon coast. Short-term turbidity effects from disposal of dredged material.	Slight turbidity during disposal. Dissipating shortly after. Little or no impacts on esthetics, recreation or commercial activity.	Same as Plan 1	Same as Plan 1 Slightly extended duration.	Same as Plan 3	Same as Plan 3

Table 2.2 Con't.

	No Action	Plan 1	Plan 2 (preferred)	Plan 3	Plan 4	Plan 5
Biological Resources : Coos Bay Estuary						
Macroinvertebrates:	Current maintenance dredging has minor impact on shellfish species	Minor additional impact from initial and maintenance dredging. Some habitat removal with deeper channel.	Same as Plan 1	Same as Plan 1	Moderate additional impact from initial and maintenance dredging. Habitat removal	Same as Plan 4
Fish:	Current maintenance dredging has minor impact on fish.	Some minor impact on some resident species and habitat.	Minor impact to aquatic species.	Same as Plan 2	Potential major impact on some resident species if rock is blasted.	Same as Plan 4
Wildlife:	Current maintenance dredging has minor impact on birds and marine mammals.	minor impacts.	Minor impacts.	Same as Plan 2	Potential major impact with rock blasting	Same as Plan 4
Threatened and Endangered Species:	Maintenance dredging activities periodically reviewed for impacts on endangered species. No current problems.	Dredging activites would be controlled to avoid impacting endangered species. Deeper channel would have no measurable impact.	Same as Plan 1	Same as Plan 1	Same as Plan 1	Same as Plan 1
Biological Resources: Ocean Disposal Sites						
Macroinvertebrates:	Current ocean disposal has minor impact on shellfish species.	Minor additional impact from initial disposal at all sites. No impact on commercial species.	Same as Plan 1	Moderate additional impact from initial and maintenance disposal. Minor impact on commercial species.	Same as Plan 3	Same as Plan 3
Fish:	Current ocean disposal has minor impact on commercial and non-commercial species.	Short-term additional minor impact (primarily turbidity) during initial disposal. Rock disposal will slightly modify habitat.	Same as Plan 1 with additional habitat modification at expanded Site F	Same as Plan 2	Short-term moderate impacts during initial disposal. Minor additional maintenance dredging impacts. Habitat modification.	Same as Plan 4 with minor additional impacts during initial disposal.
Wildlife:	Current ocean disposal has minor impact on marine mammals and birds.	Minor additional impact from initial disposal.	Same as Plan 1	Moderate additional impact from initial and maintenance disposal.	Same as Plan 3	Same as Plan 3
Threatened and Endangered Species:	Current ocean disposal has no impact on endangered species	No impact.	No impact	No impact	No impact	No impact

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Table 2.2 Con't.

	No Action	Plan 1	Plan 2 (preferred)	Plan 3	Plan 4	Plan 5
Human Resources						
Economy:	Coos Bay economy is highly dependent on wood products industries. Navigation channel is critical to transport of wood products	Maintain current economic conditions.	Same as Plan 1	Same as Plan 1	Potential for inducing additional economic activity	Same as Plan 4
Transportation:	Coos Bay served by major rail, highway and navigation facilities.	Ship traffic improvements. Accommodate larger ships.	Same as Plan 1	Same as Plan 1	Same as Plan 1	Same Plan 1
Population:	Current population trends show slight decline.	No Change.	Possibly help stabilize population.	Same as Plan 2	Same as Plan 2	Same as Plan 2
Land Use:	Land use patterns have been stable for the past 10 years. Some land use changes anticipated for North Spit. No other changes anticipated.	Minor impacts during initial dredging and disposal.	Same as Plan 1	Same as Plan 2	Same as Plan 2	Same as Plan 2
Esthetics:	Coos Bay environment is a mix of natural and highly industrial conditions	Minor noise impacts.	Same as Plan 1	Moderate impact (if blasting occurs) during initial dredging.	Same as Plan 3	Same as Plan 3
Cultural Resources:	Current maintenance practices have no impact on historical or archeological resources.	No impact to known historical or archeological sites, dredging and disposal.	Same as Plan 1	Same as Plan 1	Same as Plan 1	Same as Plan 1

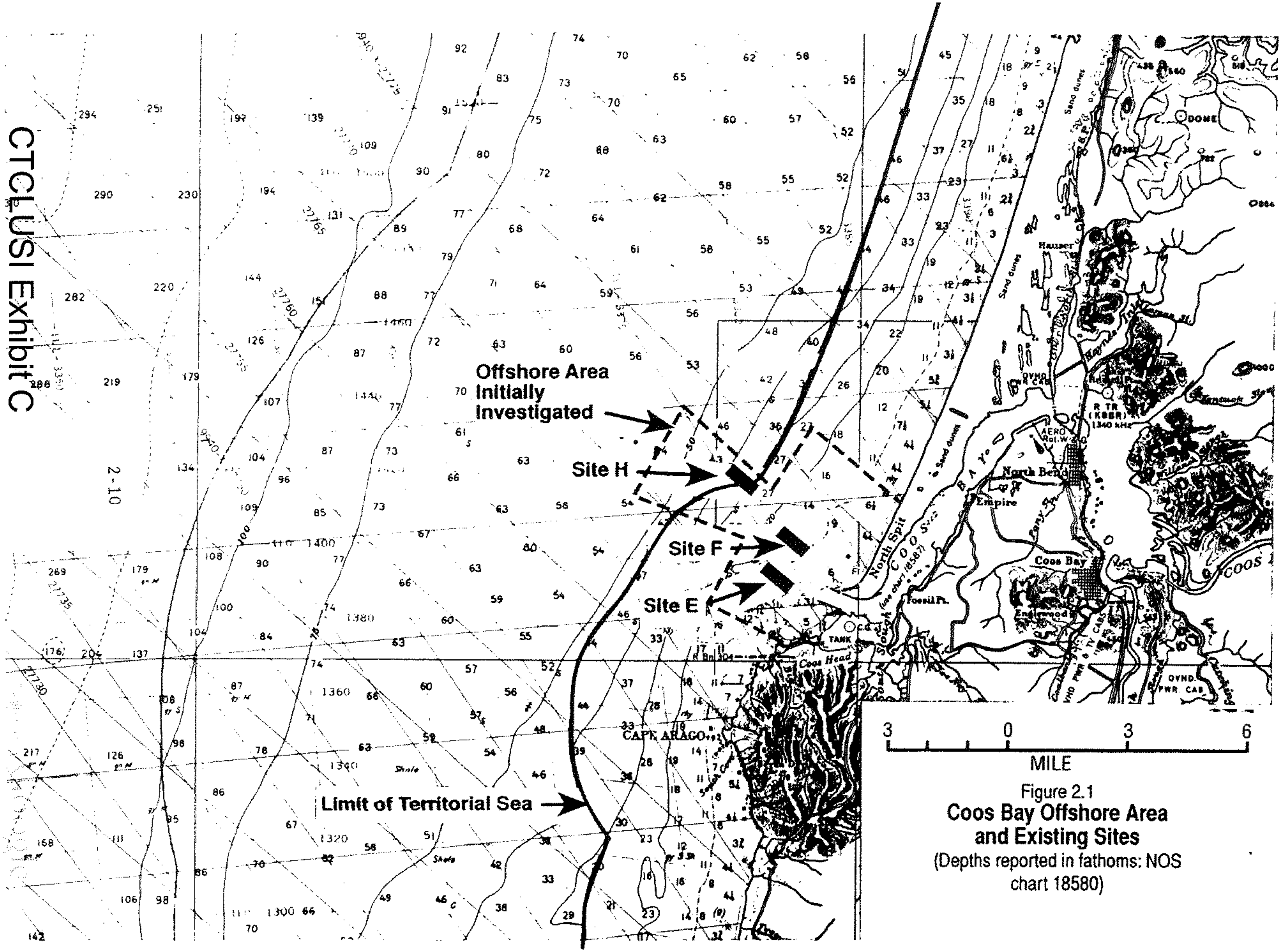

Figure 2.1
Coos Bay Offshore Area and Existing Sites
(Depths reported in fathoms: NOS chart 18580)

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unacceptable levels. The Corps and EPA have reviewed these documents and concluded that these findings remain valid.

There are currently two estuarine disposal sites in Coos Bay which essentially supplement ocean disposal of maintenance dredging sediments. These sites include a flowlane site at RM 8.4 and Site G, a disposal site at RM 1.5 which is used as a backup site when rough sea conditions prevent ocean disposal. The flowlane site is used for temporary storage of material which is later removed and placed in ocean disposal sites when weather and sea conditions permit.

Approximately 68,000 y^3 have been disposed at the flowlane site annually, and disposal at Site G has totalled about 155,000 y^3 over the past 5 years. In-bay disposal is being restricted to minimize environmental impacts in the estuary and three previously used sites are no longer being used.

c. Current Ocean Disposal Site Status. The currently designated sites (Sites E, F, and H) have been used for disposal of channel maintenance dredged material for more than 10 years. Recent ocean disposal site studies (Ogden Beeman, 1989; Geo-Recon, 1989) and monitoring indicate that dispersion rates from Sites E and F have been much less than predicted in the earlier studies. Mounding at Site E has limited disposal to less than 100,000 y^3 annually due to its proximity to the entrance channel. The site is generally used only when sea conditions preclude use of Site F. Site F has experienced similar low dispersive rates and because of mounding conditions at the site, EPA granted interim approval for doubling the size of Site F in 1989 until more detailed studies could be undertaken to resolve final site capacity needs and ultimate final site requirements. Information currently being obtained through this channel deepening study will provide the data necessary to select and recommend final site candidates (paragraph 2.8). Monitoring at Site H indicates no appreciable mounding occurring at the site.

2.8 Ocean Disposal Candidate Site Selection.

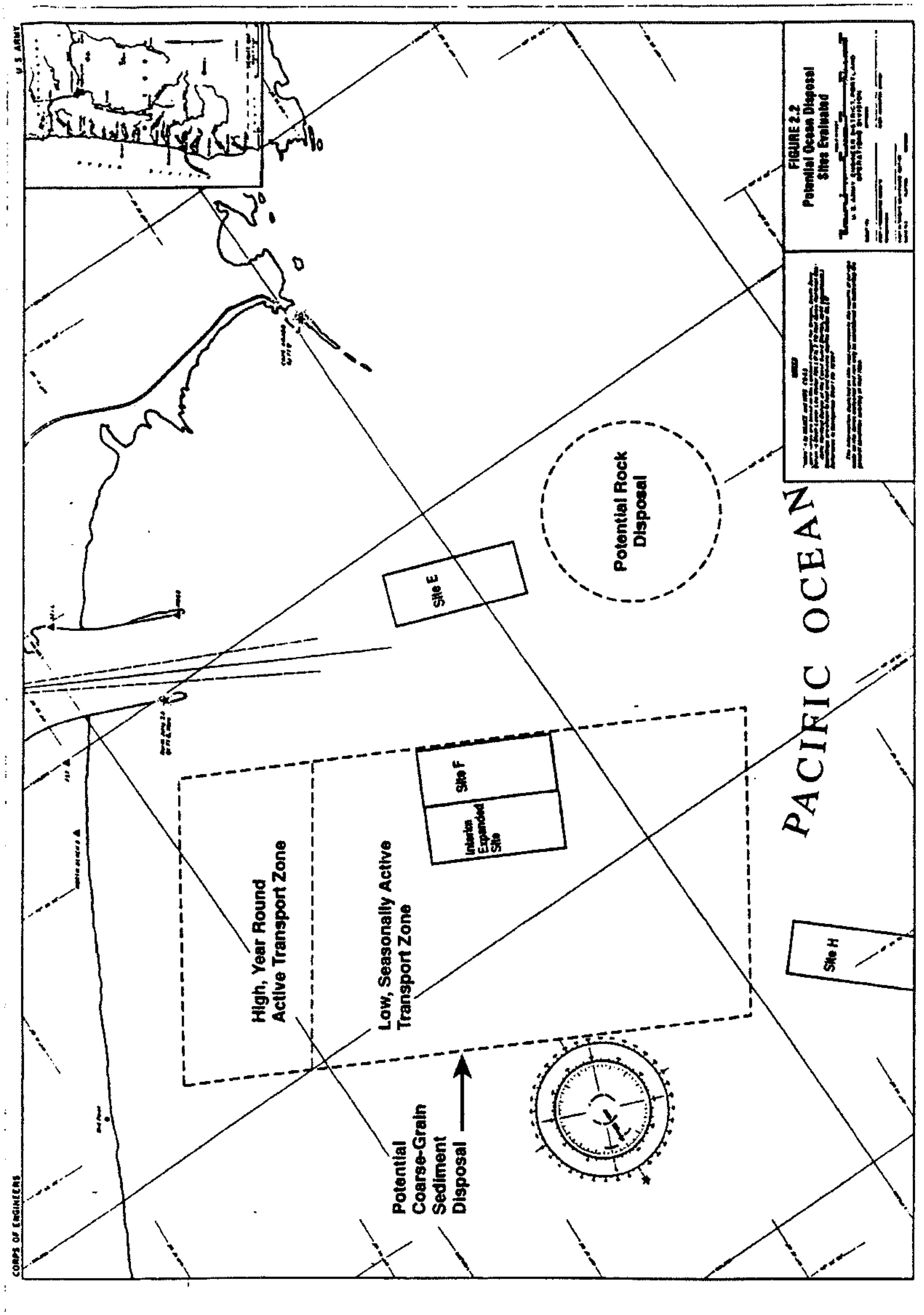
a. General. Ocean disposal site evaluation is required for the selection of a site for one-time disposal of rock material and review of existing site capacity and suitability for disposal of new work and maintenance dredging quantities.

The alternatives reviewed for channel deepening and long-term maintenance dredging ocean disposal are number, location and size of sites, including existing Sites E and F, primarily for disposal of coarse-grained material, evaluation of Site H for continued disposal of primarily fine-grained material, and location of a disposal site for rock excavated from the channel deepening (figure 2.2). Alternative site management practices such as limited disposal of coarse-grained material at Site H were also considered.

Location and size of sites for disposal of fine-grained and rock material involve a relatively straightforward process. An EPA-designated site (Site H) with long-term capacity currently exists for disposal of fine-grained material, and rock disposal is proposed as a one time event of limited quantity.

Modifying current management practices would entail implementing new measures such as use of a site designated to receive fine-grained material for disposal of coarse-grained material. The value of this practice is essentially untested. Evaluation of innovative site management practices such as technologies developed under the Corps' Dredging Research Program could provide results with greater site management flexibility.

Location and size of sites for disposal of higher volume, primarily coarse-grained material involves a more complex process of evaluation and selection. The currently designated Sites E and F are experiencing mounding problems and long-term capacity is limited. Projected quantities of dredged material, even without channel deepening, exceed the long-term capacity of these sites. The boundary outlined in figure 2.2 defines the area selected for evaluation of primarily coarse-grained sediment disposal. The principal factors defining



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this boundary are physical substrate, biological communities and reasonable economic range of dredges as described in the 1986 Site Designation EIS.

The area investigated for potential rock disposal was selected initially on the basis of the physical bottom characteristics of substrate and depth. The substrate at this location is principally gravel and cobbles intermixed with coarse sand and rock outcrops. The depth is such that rock material placed at this location would either remain at the site or slowly move further offshore. Biological productivity is fairly uniform throughout the area and at these depths.

Ongoing evaluation of Site H shows that it remains a highly suitable disposal site. No appreciable mounding has occurred and biological communities remain as productive as pre-disposal conditions at the site.

b. <u>Continued Use of Site F</u>. The disposal site area required for primarily coarse-grained sediments dredged for channel deepening and future maintenance dredging was evaluated based on the Ogden Beeman study and further evaluation by the Corps (see chapter 3 for further discussion). The results of the Ogden Beeman study indicate that an area three times the size of current Site F, and continued use of Site E at present levels, would provide sufficient capacity for the estimated quantities dredged for the next 25 years. The study does not, however, address the potential navigation hazard caused by disposal within this area and eventual creation of a mound from the original bottom elevation of -24 meters up to -15 meters. The estimated usable life of the existing site, based on current disposal quantities and dispersion rates is 2 to 3 years. New site designation would be required for an expanded Site F with or without the channel deepening.

Mounding problems and possible navigation hazards at Coos Bay and at the mouth of the Columbia River have modified previous assumptions of dispersal rates from coarse-grained sediment disposal sites. Current data indicate that very slow dispersion from sites at depths greater than 18 meters should be assumed. Disposal mounds should have gradual side slopes and preferably not exceed

-17 meter elevation to minimize wave generation and navigation hazards. Much higher dispersion rates are expected to occur within the nearshore area at depths under -18 meters. Mounding should be minimized in this area as well although it is outside navigation lanes and within the active wave environment. Using this criteria, with continued use of Site E at present levels, disposal site requirements for primarily coarse-grained material are evaluated for the area described in figure 2.2.

The physical substrate at this location is principally coarse-grained sand with depths varying from 8 to 46 meters. Disposal within this depth range would essentially keep this sandy material within the littoral zone similar to that occurring under natural conditions. The area can be divided into 2 basic sediment transport zones, with active, year-round transport within the 8- to 15-meter zone, and a less active zone from 15 to 46 meters with transport gradually diminishing with season and depth. Biological communities within this area have generally adapted to a high energy and transient environment.

Alternative disposal site options evaluated included nearshore active transport zone, offshore low dispersion zone and a larger combination area including both zones.

Nearshore dispersive site depths which are feasible for hopper dredge disposal range from approximately 8 to 15 meters. The northerly extent for the dispersive site area is based on a reasonable economic range of hopper dredges from the entrance extending for approximately 2 miles. Sediment disposal within this active transport zone would disperse rapidly both onshore and alongshore. Mounding would be minimized by disposal over a larger area. A small portion of sediments could redeposit in the entrance channel. From a physical perspective, a disposal site within the 8 to 15 meters depth range extending approximately 2 miles to the north could potentially be used indefinitely at estimated dispersion rates.

The offshore zone at depths ranging from 15 to 46 meters is progressively less dispersive with greater depth. Mounding would occur over time at any location within this zone if the site area is restricted. Generally speaking, sites further from shore would require a larger disposal area than sites closer to shore. The estimated minimum site area within this offshore zone for the 50-year timeframe would be twice that required for the nearshore zone to avoid unacceptable mounding conditions.

Another option considered is that of combining disposal at nearshore and offshore sites. This option would encompass a larger area, allowing for a smoother and thinner distribution of sediments. This option would avoid creation of mounding features; would increase flexibility of disposal site management; and would also affect a larger area of ocean bottom than the more limited site options. The estimated site area under this option would occupy a minimum of about half to a maximum of the full site area shown in figure 2.2.

General evaluation of biological effects from disposal at these locations are based on the 1986 EIS and related studies and more recent site characterization studies conducted by the National Marine Fisheries Service (NMFS) for Portland District (Hinton, et al, 1993). Disposal of primarily coarse-grained sediments at the 8-46 m depths would disturb or destroy benthic organisms by smothering from direct burial and modification of the benthic communities with temporary bottom elevation changes. Increased management options over a larger site area would avoid or minimize these impacts. Most of these organisms and communities which are adapted to a higher energy environment tend to recolonize quickly following the disposal operation. No unique biological communities would be impacted at any of the potential sites.

Each of the disposal site options have more than adequate capacity to absorb sediments from channel deepening and projected maintenance dredging over the next 50 years. Estimated channel deepening sediment quantity for this location is 735,000 y^3. Subsequent maintenance dredging quantities will remain virtually at current levels. Selection of one option over another or identifying a preferred option entails a process of comparing physical, biological and human resource effects and identifying tradeoffs between shallow depth active transport sites, deeper, less active transport sites or combination of these over a wider area.

The deeper, less active site option is an extension of current practices with disposal at similar depths and in a similar physical and biological environment. The advantages of this option are wider dispersion of sediments with each disposal operation, unlikely return of sediments to the entrance channel and predictability of impacts. The disadvantage is creation of mounding features at disposal sites if disposal area is limited.

The active transport site option is a departure from current practice with disposal in a shallow depth environment. The advantages of this option are that more of the sediment would disperse and remain in the littoral system and is available to replenish the Coos Bay-Umpqua beach/dune system, and a somewhat smaller site area would be required. The disadvantages are that some of the sediments may return to the entrance channel and would require redredging, and the immediate vicinity of the disposal site would be more heavily impacted during disposal.

The combination option is also a departure from current practice at Coos Bay in that it entails disposal over a wider area rather than seeking the smallest possible area. The advantages of this option are that impacts at any one location are reduced and recovery time between disposal events is increased, disposal management options are increased, and bottom topography effects are reduced. Possible disadvantages include disposal impacts which would cover a wider area and nearshore sediments potentially returning to the entrance channel.

Although biological impacts would occur with any of these options, long-term effects would not be severe and none of these options would impact unique biological communities. All of the options would involve site management practices (principally timing) to avoid impacts to areas which may be seasonally productive and commercial fishing activities. The larger site option would allow for greater site management flexibility.

c. Continued Use of Disposal Site H. Ongoing monitoring of disposal at Site H indicates that no appreciable mounding has occurred from disposal over more than a ten year timeframe. Fine-grained sediments from the channel deepening, estimated at 585,000 y^3, would not contribute significant additional sediments over current maintenance dredging quantities. The existing site is therefore considered adequate for future disposal needs. Continued disposal of fine-grained sediments at Site H would have short-term impacts on benthic organisms during and following disposal operations.

d. Rock Disposal Site Selection. Selection of a rock disposal site utilized information from the 1986 Site Designation EIS and supporting studies to initially select an area potentially suitable for disposal and then to evaluate alternative disposal sites within that area (figure 2.2).

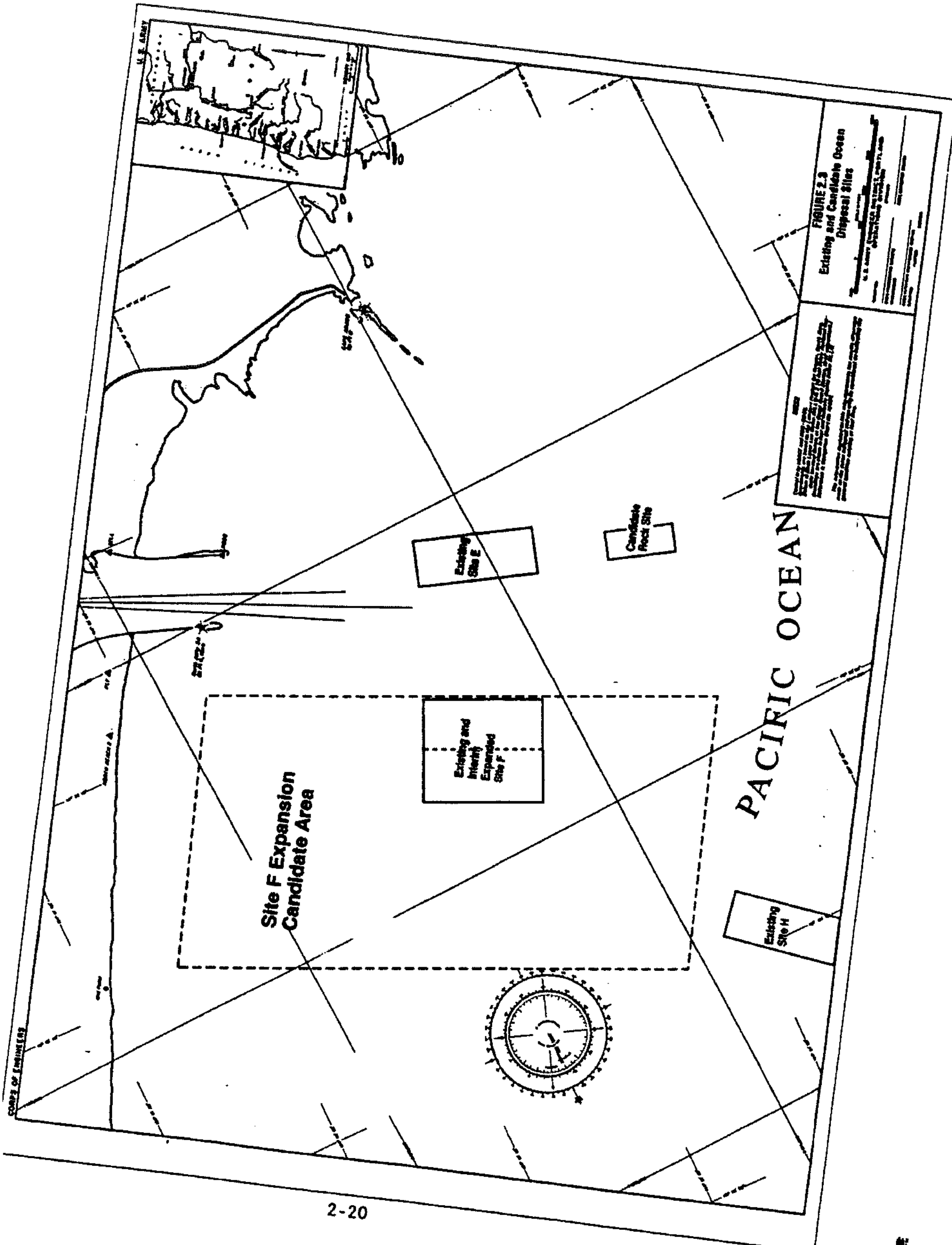
One-time disposal of the estimated 90,000 y^3 of rock would temporarily impact organisms in the immediate disposal site. Recolonization would begin shortly following disposal.

Potential for beneficial use of the rock such as building a reef to improve habitat productivity was also considered. Generally, the rock is relatively soft sandstone and is not considered durable enough to last any appreciable length of time before deteriorating. The rock would provide some structure and benefit to aquatic organisms at least temporarily. The candidate site was selected based on similar sediment (rock) characteristics, offshore dispersion from the site and lower biological productivity compared to the surrounding area.

e. Recommended Candidate Sites. Formal designation of ocean dumping sites will be the responsibility of Region 10, EPA, under Section 102 of the MPRSA. EPA is a cooperating agency in preparation of this EIS under NEPA and has been working closely with the Corps in design of designation studies and evaluation of data.

The final selection of sites for disposal of dredged material from initial construction and subsequent maintenance dredging of the federal navigation project (including berthing areas) occurs through application of the 5 general and 11 specific criteria in the MPRSA. Additionally, the recently enacted Water Resources Development Act of 1992 (WRDA 92) requires that all new ocean dumping sites must include site management plans as part of the designation package. While the Corps and EPA are in agreement that specific new or expanded site(s) will be designated for the long term requirements of this project, at this time, data analysis has not been completed to confirm final long-term site locations and size. The October 1992 data confirms the results of the April 1992 data and the earlier studies conducted by Oregon State University for designation of existing sites. Additional analyses, if needed, would be conducted during the Preliminary Engineering and Design Phase (PED) prior to initiating any action and discussed in a joint Corps/EPA EIS supplement. If it is determined that no additional studies would be required, then the results and completed evaluation of candidate sites could be incorporated in the Final EIS for this project. EPA site designation rulemaking, along with site management and monitoring plans in accordance with WRDA 92, would be completed during the PED phase and prior to initiating any new work.

Existing or candidate sites identified for disposal of channel deepening new work and long-term maintenance dredging requirements are shown in figure 2.3. In projecting for long-term capacity, it is expected that Site H will be able to contain anticipated volumes of fine-grained sediments generated by initial construction and maintenance dredging as well as suitable material dredged from port berthing areas and permit actions; however, development of a site management plan per WRDA 92 will occur during PED. A separate site for disposal of rock from the project is necessary and has been identified based on the estimated quantity of rock. The most apparent shortcoming in capacity over the long-term is for the coarse-grained material. Existing Sites E and F have limited remaining capacity. Several alternatives, described earlier, are under consideration to meet the need to develop additional long-term capacity and improved site management. The candidate area, which is proposed for final site selection and eventual designation, is identified as Site F Expansion Candidate Area in figure 2.3. The long-term viability of Site E will be re-evaluated during the final site selection process.



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A preliminary Section 103 Evaluation addressing the disposal of channel deepening and subsequent maintenance dredging sediments at existing and candidate ocean disposal sites has been prepared and is provided as Exhibit 4 to this EIS. The evaluation concludes that these sites are suitable for disposal of these sediments.

2.9 Mitigation. Significant impacts to fish and wildlife resources in the project area are not expected to occur from either the dredging or disposal activities. Most aquatic habitat in the channel which would be directly impacted by the project would recover naturally to preconstruction conditions; therefore, mitigation would not be required. A small loss of shallow subtidal habitat would occur in the area of the proposed turning basin expansion, however, the size of the turning basin has been minimized in order to reduce impacts. This area would also recover to similar conditions following project construction. Other mitigative measures such as timing of in-water work to minimize impacts to aquatic resources and human use activities such as fishing and clamming in the estuary and the ocean disposal sites, would be continued to the maximum extent practicable.

The cumulative effects of dredging the existing channel, the proposed 2-foot deepening, and related shipping and port facilities and activities would result in continued and potential future impacts to Coos Bay aquatic resources. The extent of impact is not clear and appropriate mitigation beyond existing methods is difficult to identify. The State of Oregon Department of Fish and Wildlife has recommended monitoring as a means to identify the extent of some of these impacts. The feasibility of conducting a monitoring program is being reviewed by Portland District. Other proposals suggested to reduce impacts from channel dredging include in-bay disposal of rock or shell material at specific locations to improve habitat, or various means to create additional shallow subtidal habitat. These proposals would most likely be evaluated under other authorities such as Section 1135 of the Water Resources Development Act of 1992, as amended. This authority allows for environmental restoration at existing projects.

Larger ocean disposal sites are also being considered in order to minimize the impacts associated with confining placement to a single location. Using a larger area would allow the material to be more thinly dispersed reducing impacts to benthic organisms. Having a larger area would also allow individual disposal areas more time for recovery before the next disposal event and would provide greater flexibility for avoiding seasonally productive areas or commercial fishing activities.

Monitoring the effects of ocean disposal will be implemented as has been done at the existing disposal sites. Monitoring at the selected ocean disposal sites will be conducted using a monitoring plan to be developed in accordance with the requirements of WRDA 92. The Corps and EPA are currently working on the development of site management plans. Fine-grained sediments to be disposed at Site H would continue to be monitored on a 3- to 5-year cycle to identify any changes in contaminant levels. In the interim, monitoring will conform to currently agreed upon Corps/EPA monitoring program which includes annual bathymetric surveys and may include periodic benthic surveys.

CHAPTER 3

AFFECTED ENVIRONMENT

3.1 Introduction. The Coos Bay estuary encompasses an area of approximately 12,380 acres. The bay itself averages a mile in width and is 15 miles in length to the head of deep draft navigation. The bay receives an average annual runoff of approximately 2.3 million acre-feet, two-thirds of which is derived from the Coos and Millicoma Rivers. The main embayment, to the east of the cities of North Bend and Coos Bay, contains most of the bay's 6,200 feet of tidelands. Other tidal areas are in North, South, Pony, and Isthmus Sloughs and Haines Inlet. The Coos Bay estuary has undergone extensive change since settlement and subsequent development was initiated in the 1850's. The following section describes the current condition of Coos Bay's physical, biological, and human environments relevant to the development of the navigation channel.

3.2 Physical Resources: Coos Bay Estuary.

a. General Description. Coos Bay is a typical drowned river valley estuary of the Oregon coast. It is relatively shallow with gently-sloping sides and a well established deeper channel. During the rise in sea level which produced the estuary there was a great increase in sedimentation which has produced the broad expanse of tidal flats and marshes now found. North Spit was formed from sand deposited by "long shore drift" or ocean currents running parallel to the shore. Coos Bay is the largest estuary on the Oregon coast excluding the Columbia River. It covers over 12,000 acres of which almost 9,000 acres are tide flats and tidal marshes. There are some 30 tributaries with the largest being the Coos River draining over 400 square miles. The total drainage area for all tributaries is about 600 square miles of Coast Range forests (see figure 3.1).

b. Geologic Setting. The Oregon Coast owes much of its present form and topography to the submergence of coast valleys by the release of water from

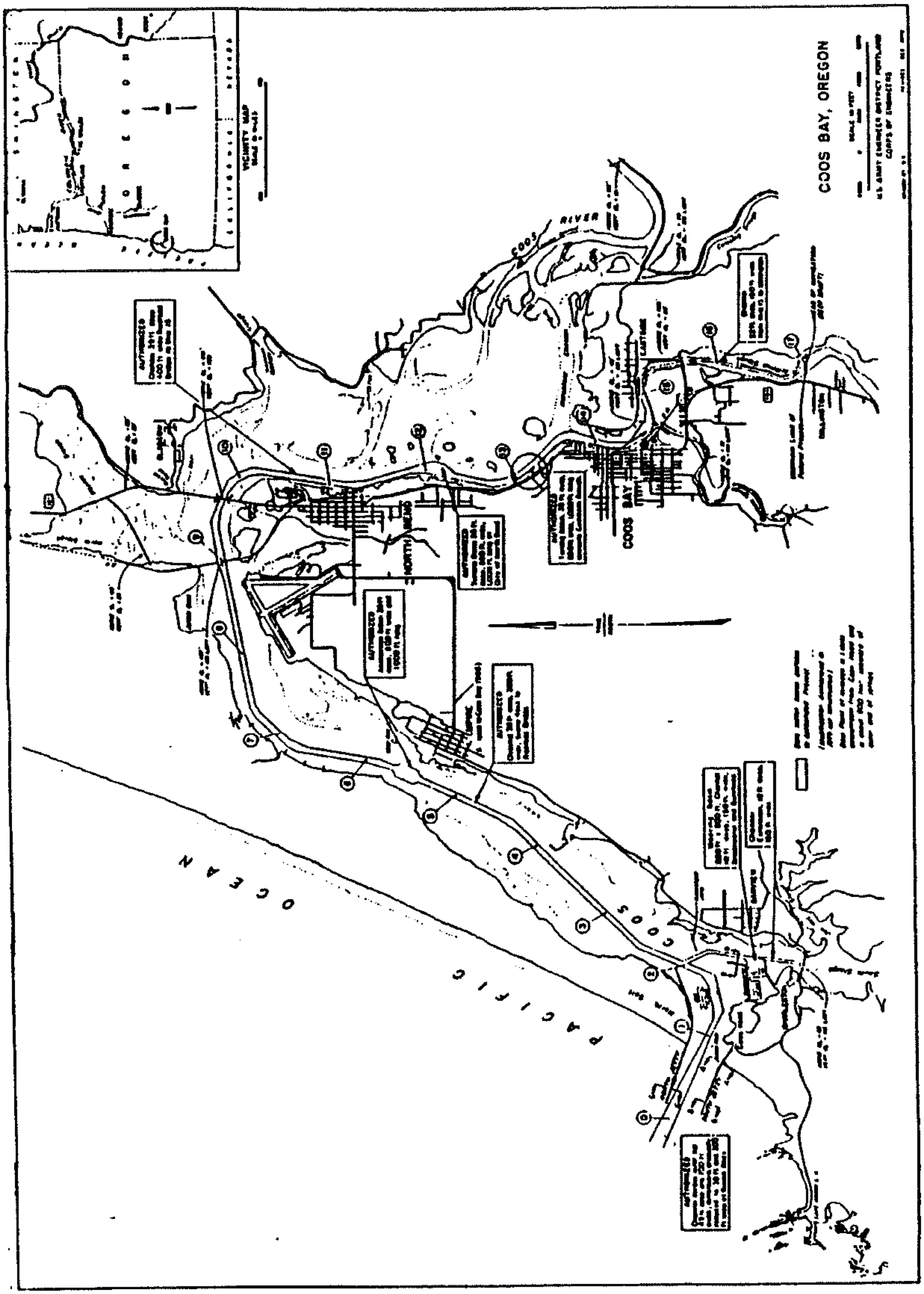

Figure 3.1 Coos Bay area map with existing deep draft navigation project information.

continental glaciers approximately one million years ago. The sea level at that time was about 400 feet lower than present. Estuaries between the Columbia River and Coos Bay lie in an area of weak, erodible marine sediments having structural down-warp or fault related structures (USACE, 1974).

The Coos River/estuary is an aggrading system. Sediment deposition is greater than the natural removal rate. The estuary has been filling with sand, silt and other sediments carried by the flow of the river and ocean tidal currents. The principal streams have survived repeated uplifts of the coastal range and have aided in bringing large quantities of sediment into the bay and out into the ocean. Scour and sediment removal are a local phenomena which generally result in redeposition at other estuarine locations (USACE, 1975).

c. Estuary Dynamics. Water quality, salinity and sedimentation are the primary areas of concern for potential impacts from channel deepening. These factors are, in turn, related to tidal dynamics, riverflow, bathymetry and sediment quality. Coos Bay's tides are of the "mixed, semi-diurnal" type (figure 3.2). This type of tides means that there are two high and two low tides during each "tidal day" (about 24.8 hours). There is a marked variation in height between the two high tides and the two low tides. The mean tidal range to mean high water is 7.0 feet above mean low lower water (m.l.l.w.) at the Coos Bay entrance and 7.3 feet at the city of Coos Bay. The highest predicted tide is 10.5 feet above m.l.l.w. Extreme low water (e.l.w) is predicted to be -3.0 feet below m.l.l.w.

Johnson (1972) calculated the tidal prism for Coos Bay based on a mean surface area between "high water" and "low water" of 10,973 acres and a mean tidal range of 5.2 feet, as 1.86 times 10^9 cubic feet. While other figures could be calculated based on different tidal levels (e.g. between m.l.l.w. and mean high higher water [m.h.h.w.]), it is significant that Coos Bay has the second largest tidal prism (next to Tillamook Bay) of 12 Oregon estuaries excluding the Columbia River. The tidal flow generates substantial tidal currents in the Bay. The average tidal current at City of Coos Bay is 3.4 feet per second (fps) and flood tide currents as high as 5.7 fps have been measured.

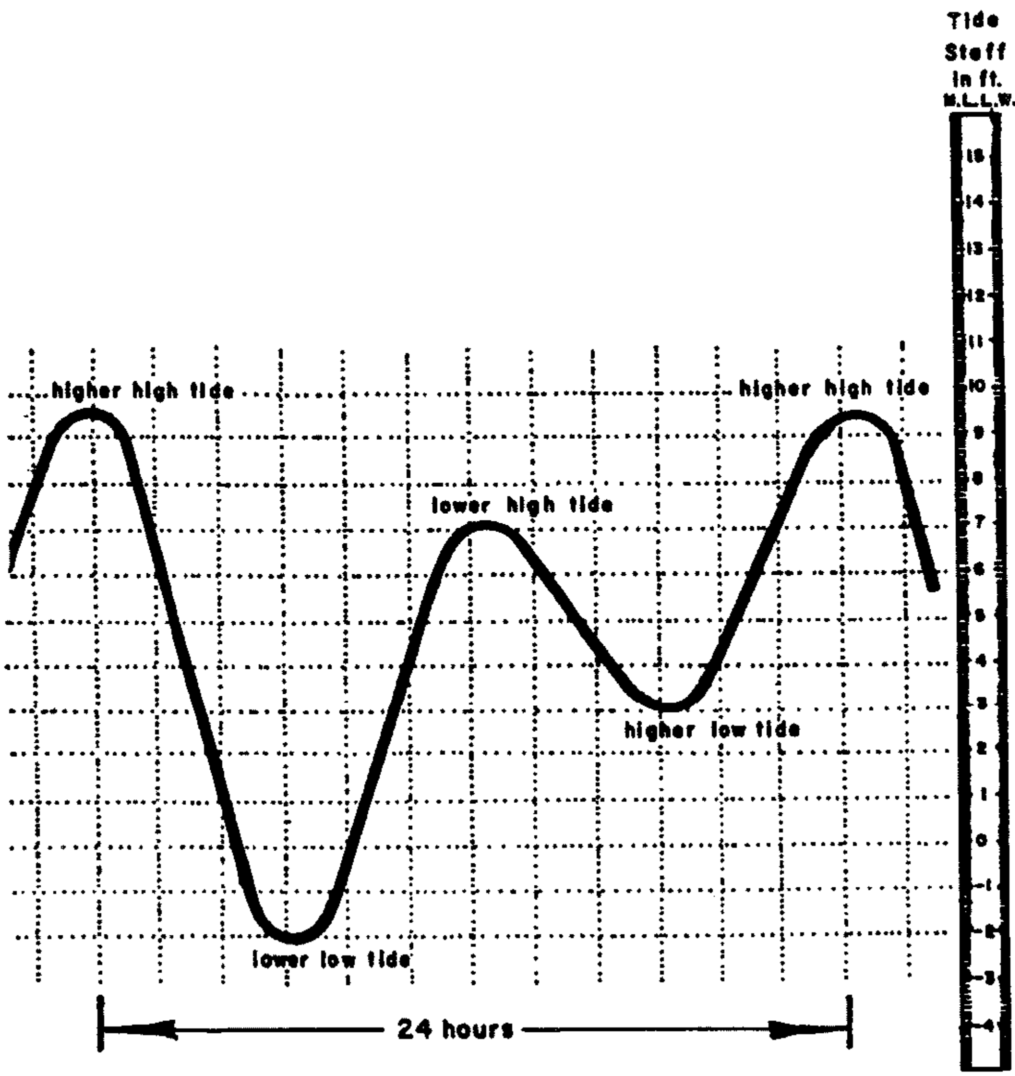

Figure 3.2. Typical Daily Tidal Cycle for Mixed Semi-Diurnal Tide (DSL 1973).

d. Riverflow. Riverflow into Coos Bay is strongly related to regional weather patterns which are characterized by marked wet and dry seasons. The wet season typically begins in October and continues through March. The dry season begins in April and continues through September. For 80 years of record at North Bend, average monthly precipitation is 5 inches with the range from a maximum of 25 inches per month to zero (Baptista, 1989). Because of the effect of the Coast Range, these values may be much higher over the majority of the drainage basin. Figure 3.3 illustrates the relationship between precipitation and riverflow.

e. Bathymetry. The bathymetry of Coos Bay strongly influences circulation with over half of the estuary exposed at low tide on a daily basis can result in strong temperature differentials between the shallow surface waters and the deeper channels. The channels act to confine the denser, saline water brought into the estuary by tidal action. This results in salinity intrusion far up the major tributaries.

f. Sediment Quality. Sediment samples from the Coos Bay Estuary were collected by the USACE, Portland District in May of 1989. The samples were collected with a stainless steel modified 0.096 m^2 Gray O'Hare box-core or a 3.25 inch Benthos gravity core with acid rinsed cellulose butyrate acetate core liners. Samples for chemical analysis were placed in specially cleaned glass containers with teflon lined lids the jars were then placed into ziplock freezer bags. Samples for physical analysis were placed directly into ziplock freezer bags. All samples were placed in an ice chest with ice for transport to the USACE, North Pacific Division Materials Testing Laboratory (NPDMT) in Troutdale. Sample locations, located by three point intersection by sextant, are shown in appendix D, figure D-1.

Physical sediment analyses were completed in June 1989, by NPDMT, for 20 samples from stations in the estuary from RM's 0 to 15. Results showed a mixture of sediment types with coarser sediments located from RM's 0 to 10, and fine sediments within RM's 10 to 15. The sediments have organic content ranging from 0.4 to 14.5 percent volatile solids (appendix D,table D-1). The results of the analysis are similar to the finding in the Coos Bay, Oregon

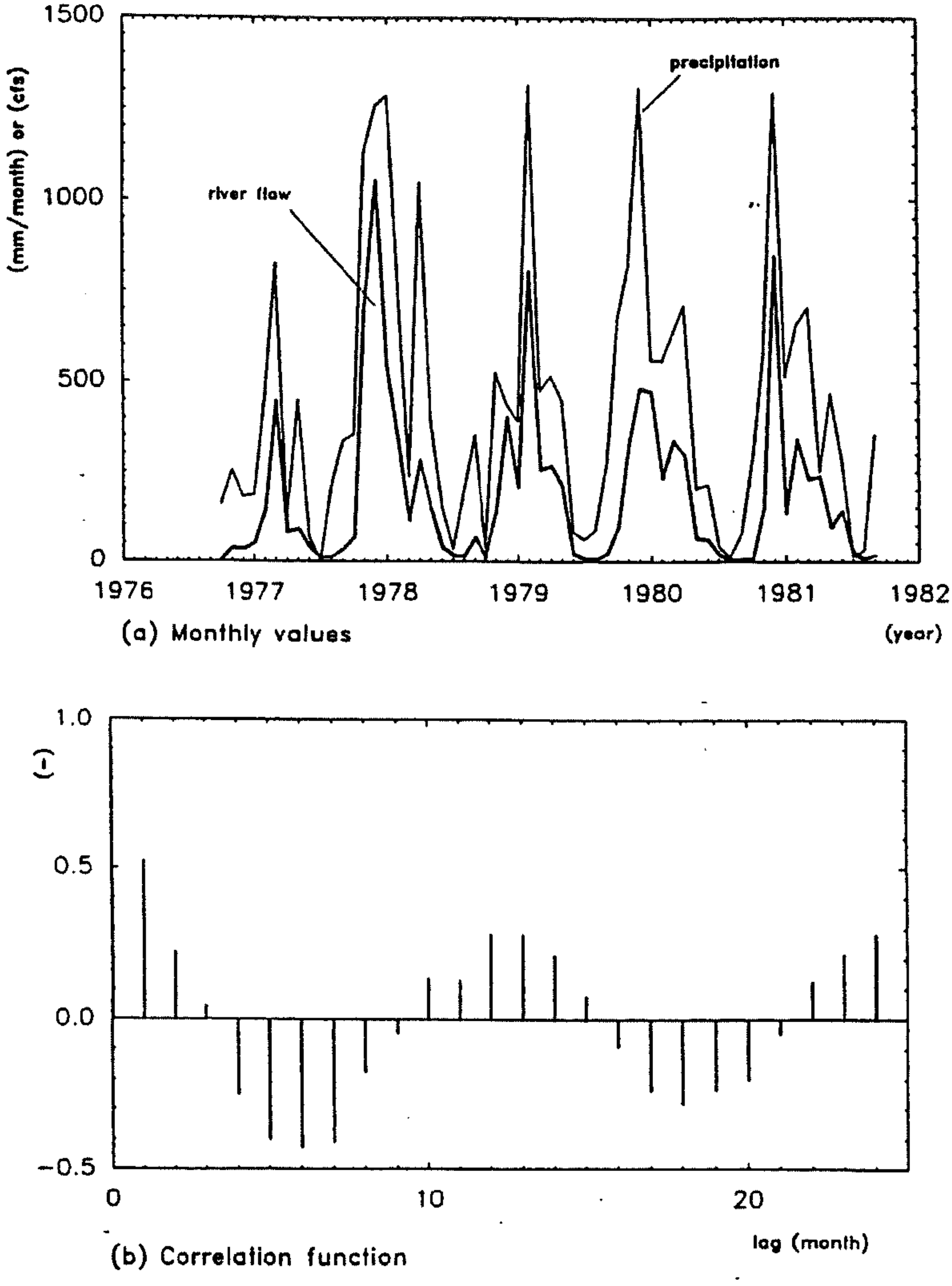

Figure 3.3. Correlation Between Precipitation at North Bend and Flow at West Fork Millicoma River.

Dredged Material Disposal Site Designation, Final Environmental Impact Statement, 1986 (USACE/EPA, 1986).

The physical characteristics for each sample are shown in appendix D, figure D-2. A transition from poorly graded sand to fine grained material occurs above sample station CB-13. This transition corresponds to a major bend in the estuary near the highway bridge. At this location the estuary turns 90 degrees to the south. The gradation curves are presented in appendix D, figures D-4 to D-29.

The fine grained May 1989 gravity core samples (CB-16 through CB-20) were chemically analyzed by Battelle's Pacific NW Marine Sciences Laboratory, Sequim, Washington, for heavy metals (EPA Method 3050) and organic contaminants including pesticides/PCBs (EPA Method 8080), PAHs (EPA Method 8100) and dioxin (EPA method 8290). Results indicates PAH, pesticides/PCBs, metals, ammonia (Standard Method 417), TOC (Standard Method 502) and oil and grease (Standard Method 502) concentrations were undetected or low and typical for uncontaminated coastal and estuarine sediment. Results of dioxin analysis on two Coos Bay sediment samples show levels of 2378 TCDD to be below method detection limits. Only dioxins and furans with six or more chlorines were actually detected. These levels are less toxic than 2378 TCDD and occur naturally in the environment as combustion by-products. The concentrations of dioxins and furans found are considered to be typical of background values and do not represent contamination from an industrial source. The results of the chemical testing are presented in appendix D,tables D-2 and D-3.

Sediment samples were again collected in April 1993 as part of three separate studies; the Coos Bay Channel Deepening Feasibility Study, a routinely scheduled (approximately every 5 years) O&M sediment quality evaluation (USACE, 1993), and a special TBT (tributyltin) study funded by the USACE, EPA, and DEQ (USACE, report in preparation).

Samples were collected at RM 12 as part of the Coos Bay Channel Deepening Feasibility study to assess the sediment quality of material proposed to be removed to widen the RM 12 turning basin. Four box core samples and two gravity core samples were collected on April 28, 1993. Sediment samples are considered to be representative of the material to be dredged. Physical analyses were conducted on all samples while bulk chemical analyses were conducted on material collected by the gravity cores. The two gravity core samples were sub-sampled along their entire length for the chemical and physical analyses.

Chemical analyses included metals, pesticides/PCB's, TOC's, AVS's, PAH's and butyltins. All chemical analyses are considered acceptable. No element or chemical exceeded USACE, Portland District's established "levels of concern". No USACE, Portland District "levels of concern" have been established for butyltin. All levels except one (DDT) are also below EPA, Region 10's screening levels (SL) for disposal in 404 waters, including the butyltin. Sample CBCD-GC-2 contained 4,4'-DDT at 10 ppb which exceeds EPA's total DDT SL of 6.9 ppb (Portland District's "level of concern" is 15-20 ppb total DDT). Sample CBCD-GC-1 contains <6.0 ppb 4,4'-DDT, the method detection limit for this sample. The material to be dredged to widen the turning basin is considered to be suitable for ocean disposal without further testing.

Three gravity core samples were collected between RM 12.8 and RM 15 at the location discribed in the Coos Bay (Isthmus Slough) Sediment Evaluation report dated 18 November 1993 presented in appendix D (USACE, 1993). These locations were sampled orginally in 1987 then again in 1989 as Stations CB-18, CB-19, and CB-20 as part of the Coos Bay Channel Deepening reconnasance study.

Metal concentrations found in 1993 were very similar to those found in 1989 and 1987. Aldrin, endrin, and DDT were found but at levels below USACE, Portland District concern levels. DDT slightly exceeded the EPA, Region 10 screening level of 6.9 ppb. PCBs were undetected at the method detection limit of 40 ppb. Nine PAHs were quantified but none exceeded established concern or screening levels.

Sediment samples were collected in 1992 and 1993 by the Oregon Department of Environmental Quality (DEQ) and the USACE, Portland District to evaluate the existence and degree of butyltin contamination in Coos Bay (USACE, TBT report in preparation). Butyltin including tetrabutyltin (TTBT), tributyltin (TBT), dibutyltin (DBT), and monobutyltin (MBT) were not screened for in previous analyses of project sediments. Tributyltin (TBT) is the active ingredient used in antifouling paints and the most toxic of the butyltins. The other butyltins are either manufacturing impurities or degradation by-products. Its presence and ecologic importance was not fully known in 1989. TBT concentrations are presented in the 1993 Sediment Quality Report in appendix D for all of the samples collected. Except for one sample CB-GC-2 (33 ppb TBT) TBT levels for sediments collected from within the project boundaries were below EPA, Region 10's screening level of 30 ppb. Butyltins readily degrade in the environment. In the water-column half-lives are measured in days while in the sediments it is measured in weeks or months. Samples collected outside of the project boundaries by DEQ and analysed by the USACE, Portland District in 1993 showed concentrations as high as 3,270 ppb. High TBT values are associated with boat works and marinas especially where boat repair and painting is conducted.

Sediment quality evaluations from outside of the project area but directly related to the project have been conducted by Port of Coos Bay and various dock owners. See appendix D, figure D-30 for sample locations. Results from the 1989 Port of Coos Bay testing, required under a regulatory permit action for various commercial docks, are located in appendix D, tables D-4 and D-5. The Port of Coos Bay's 1989 test results shows the existence of higher contamination level in sediments located from RM's 12 to 14 outside but adjacent to the Federal Navigation Channel limits.

Continued chemical and biological testing at various docks were conducted in 1990, 1991 and 1993 as part of the ongoing permit process. The bulk of the material for those particular docks tested, was determined to be suitable for ocean disposal without management restrictions.

Three known hazardous and toxic waste (HTW) sites adjacent to the project are being investigated by the Oregon Department of Environmental Quality. Two sites (Chevron USA and Chambers Oil) are bulk fuel storage sites with historical onshore fuel spills. The other site (Hillstrom's) is a former ship repair facility with onshore and sediment contamination from sandblasting, painting, and other repair activities. The extent of HTW contamination toward the main channel from the Chevron and Hillstrom's sites has been somewhat characterized. HTW analyses at the Chambers Oil site is preliminary.

A Remedial Investigation has been completed at the Chevron site. Historical onshore releases of gasoline and diesel have migrated to nearshore river sediments. The level of PAH sediment contamination drops rapidly within 60 feet offshore which is more than 100 feet from the edge of the main channel. Although contaminant levels are high at the shore, levels in sediments 60 feet offshore are within acceptable limits for unconfined in-water disposal. It is unlikely that contaminants have moved to sediments at the edge of the channel. The channel depth at this site in the October 1993 hydrographic survey is near the proposed depth, so minimal dredging will occur adjacent to this site.

Some historical sediment HTW analyses has been conducted at the Hillstrom's site. Sandblasting and other ship painting and maintenance activities have occurred at the site contributing to metals and TBT contamination of sediments. The extent of site specific contaminants is not completely known. Hydrosurvey information indicates minor dredging will be done in the channel near the site since the channel is close to the proposed project depth. In addition the Hillstrom,s berthing area is only maintained to a depth of 25 feet. Material to be dredged from the berthing area at Hillstrom's was evaluated in 1989 and 1991 in accordance with criteria established under the Ocean Dumping Act. Based upon the 1991 test results, which included physical, chemical, and biological analyses, the Hillstrom's sediment was found to be suitable for unconfined in-water disposal without management restrictions. The berthing area is not a part of this project.

Some limited HTW evaluations have been conducted at the Chambers Oil site. Samples indicate fuel contamination in onshore soils and nearshore sediments but sampling has not been comprehensive. DEQ is anticipating additional sediment sampling early in 1994. Although definitive conclusions regarding this site cannot be drawn, several items indicate that the site contaminants are unlikely to be disturbed by dredging the proposed project. The channel edge is over 300 feet from the shore and will not be extensively dredged because the channel is near the proposed depth. Sloughing of sediments outside the channel should be negligible. Additional information gathered by DEQ will be used to further assess the potential affects of the dredging in this area.

g. Water Quality. The shallowness and variability in riverflow contribute to water quality problems in Coos Bay. Water quality in Coos Bay is highly variable, by location and by season. The quality of water in Isthmus slough is consistently worse than elsewhere with dissolved oxygen concentrations as low as 3.0 milligrams per liter as well as organic sediment problems. At various sampling locations within Coos Bay, the dissolved oxygen levels are low and the temperatures, coliform, and turbidity levels are high. In general water quality is worse during summer months due to low freshwater flows and warmer temperatures. Increased stream sedimentation, leachates, and organic material carried into the rivers and Bay exert increased biochemical oxygen demand (BOD), thereby creating oxygen deficiencies and lower DO.

h. Salinity. Ocean tides provide the principal source of energy for the mixing of saline and fresh water which gives rise to the patterns of salinity typical of an estuary. The tributaries provide freshwater inflow and the seasonal variations in rates of flow greatly affect mixing patterns and salinity levels. The most important physical principle to bear in mind is that salt water is denser than fresh water. Therefore, there is a natural tendency for salinity to be higher at the bottom than at the surface.

Bruce McAllister (1963) identified a phenomena at Coos Bay where the surface salinity was actually higher (denser) than the salinity at the bottom of the water column. This phenomena was called tidal over mixing. This condition was also described in Arneson, R. J. (1976) data for the Coos Bay estuary.

There are three basic types of mixing patterns in Oregon estuaries, each of which may be exhibited in the same estuary at different times of the year (Burt and McAllister, 1958). These types are as follows:

(1) Stratified or Two Layered System. This type of pattern, has a pronounced layer of undiluted saline water at the base, which moves up and down the estuary with the tide like a "salt wedge". Little mixing occurs between this layer and the practically fresh water upper layer.

(2) Partly Mixed System. This system is a degree of mixing of salt and fresh-water, but there is still a marked difference in salinity between surface and bottom. In this type of system, tides provide enough energy to cause turbulence and mixing within the water column.

(3) Well-mixed or Vertically Homogenous System. This system is where the conditions are the reverse of the 'vertically stratified' estuary. Fresh-water inflow is relatively small compared to the tidal inflow. Tides provide enough energy to cause turbulent mixing throughout the entire water column, together with the effect of density. Salinity levels are within a few parts per thousand at top and bottom.

Burt and McAllister characterize Coos Bay as essentially a "well-mixed" estuary for all months except November, when it was "partly-mixed." They define "well-mixed" on the basis of a vertical salinity change from top to bottom of three parts per thousand (ppt) or less, and partly mixed as 4 to 19 ppt. These measurements were taken at the point where mean salinity was 17 ppt or half fresh and half salt water; however, a longitudinal study showed that in October the estuary was well mixed up to RM 10 and tending to be partly mixed above RM 10, in spite of a low river flow.

A study by the Oregon Graduate Center (OGC) (Appendix E) reviewed three sets of salinity data taken by various researchers in 1930-31, 1973-74 and 1982. OGC concluded that the water downstream of North Bend is typically saline and that freshwater mixing became increasingly important upstream. They concluded that the estuary is vertically well-mixed for low river flows and only becomes stratified during infrequent high river flows.

i. Sedimentation. Sedimentation in Coos Bay channel has averaged about 1,300,000 y^3 annually downstream of RM 12. Entrance sediments comprise some

800,000 y^3 of predominantly marine sand annually. The remaining 500,000 y^3 of sediment becomes increasingly finer upstream. Sedimentation upstream of RM 12 depends upon annual rainfall and runoff impacts on the local drainage basin. Between RM's 12 and 14 some 289,000 y^3 may accumulate in a given year.

Sedimentation above RM 14 is more variable but may be as much as 164,000 y^3 in a given year. Volumes shown in table 3.1 are assumed to be representative of general accumulation rates.

Table 3.1. Sediment Accumulation Within Upper Coos Bay (Cubic Yards).

PERIOD	COOS RIVER RM'S 12 TO 14	ISTHMUS SLOUGH RM'S 14 TO 15
5/80 to 10/80	121,000	149,000
10/80 to 10/81	194,000	21,000
10/81 to 10/82	289,000	164,000

3.3 Physical Resources: Ocean Disposal Sites.

a. Introduction. All of the various dredging scenarios for the proposed Coos Bay channel deepening project assume ocean disposal of dredged material at four existing or potential ocean disposal sites. There have been extensive studies conducted for the offshore area encompassing these sites. Most of the information that follows is from those studies. In addition, three studies were specifically contracted for the proposed deepening project. One was a geologic and geophysical examination of much of the area offshore from water depths of 12 to 46 meters. Another was a detailed study of disposal and sediment dispersal at existing Site F. The third study was biological sampling to update information obtained from the original site designation studies.

b. Geographic Locations. There are four areas evaluated in detail for ocean disposal (figure 3.4). Alternatives eliminated from detailed studies and additional discussion of current alternatives are discussed in Chapter 2. The areas considered in detail are existing Site H for disposal of primarily fine-grained material dredged from above RM 12 and from port berthing areas; a

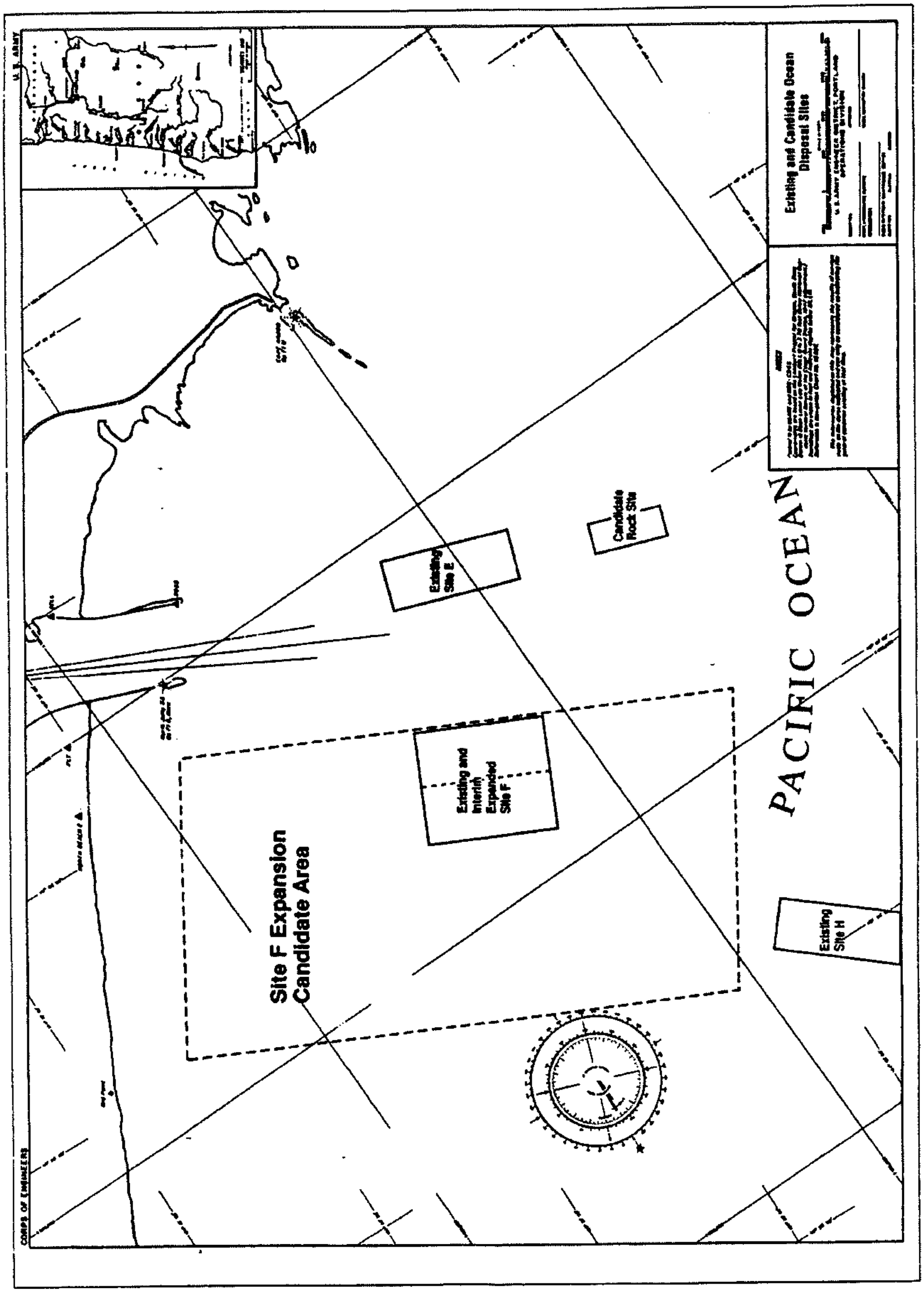

FIGURE 3.4 OCEAN DISPOSAL SITES

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site for one time disposal of rock excavated for channel deepening; existing Site E; and a large area which includes existing and expanded Site F for disposal of primarily coarse-grained material removed from the channel below RM 12. Existing Site E is located approximately 1.5 statute miles offshore of the entrance to Coos Bay around the depth of 24 meters. The approximate center of the area investigated for disposal of primarily coarse-grained sediments is located 1.7 miles from the entrance with depths ranging from 8 to 46 meters. Site H is approximately 3.4 miles offshore around the depth of 55 meters. The proposed site for one-time disposal of rock excavated during channel deepening is located approximately 3.4 miles offshore around the depth of 34 meters.

c. Geological Characteristics. In the fall of 1989, a geologic and geophysical survey was performed by Geo Recon Inc (appendix F). The on-shore geology was extrapolated in interpreting the results of the sidescan and seismic surveys. Most of the study area is probably fine sand. There appears to be a broad band of coarser sand/gravel at depths of from 30 to 40 meters. Rock was found to extend in an almost straight line seaward from Lighthouse Point and Yoakam Point. There was a large bottom area several times larger than Area E characterized as partially buried rock/dredged material. The sub-bottom profile through this area shows a sediment thickness of 15 meters through most of the area however. Sediment cover is thinner further offshore approximately where the proposed rock site is located. The exposed rock offshore of Lighthouse Point was also cause for siting a disposal site far enough away for navigation safety.

d. Bathymetry. Regional offshore bathymetric contours generally run northeast-southwest parallel to the coastline. Near-shore contours bulge seaward off the entrance to Coos Bay, reflecting the influence of the tidal delta, the disposal of dredged materials, and the Cape Arago landmass. The top of the foreslope of the tidal delta is at about 24 meters and its base is at about 42 meters. Site F is located on the tidal delta while Site H is not influenced by the tidal delta and is in an area of parallel contours. The Rock Site is located south of the approach channel at a depth of at least 37 meters to avoid on-shore transport.

e. Sediment Characteristics. Hancock et al (1981) and Nelson et al (1983) report that near-shore sediments to approximately 70 meters in depth are clean fine sands of marine origin with median grain diameters of 0.15 to 0.20 millimeters and less than 1.5 percent of volatile solids (figures 3.5 through 3.8). The uniform nature of these highly mobile sands reflects the winnowing action of surface waves and tidal and wind-driven currents. Coarser sediments are found in the tidal delta to depths of about 42 meters. These sediments have median grain diameters in excess of 0.20 millimeters volatile solids concentrations are as low as 0.2 percent and owe their character to the combined influences of their nearness to the source of coarser river materials, strong ebb currents from the estuary, and the disposal of river and entrance materials during dredging operations.

Volatile solids concentrations increase rapidly beyond the tidal delta to between 2 and 3 percent and gradually increase with increasing depth. Between the foreslope of the tidal delta and 70 meters, the sediment is relatively uniform in grain size and volatile solids content. Below 70 meters in depth, grain size decreases and volatile solids concentrations continue to increase due to the decreasing influence of surface waves and ebb currents from the estuary entrance as depth increases.

Figure 3.8 presents averaged median grain sizes and volatile solids percentages for three seasons of resampling at 5 stations in the vicinity of Sites F and H. The error bars indicate the standard deviation. Also included are graphic boundaries that contain all sample medians for each site. The seasonally-averaged median grain sizes for the areas around Sites F and H are 0.26, 0.16, and 0.08 millimeters, respectively, and volatile solids average 0.53, 1.06, and 2.56 percent by weight. Winter sediments are somewhat more poorly sorted than average due to the presence of fines settled from discharged estuarine waters. The average volatile solids content at all sites is at a minimum in summer and at a maximum in winter with the contrast most clearly developed near Site H. Spatial variability in volatile solids content is also highest near Site H with the area near Site F having least-spatial variability. The greater seasonal and spatial changes in volatile solids near

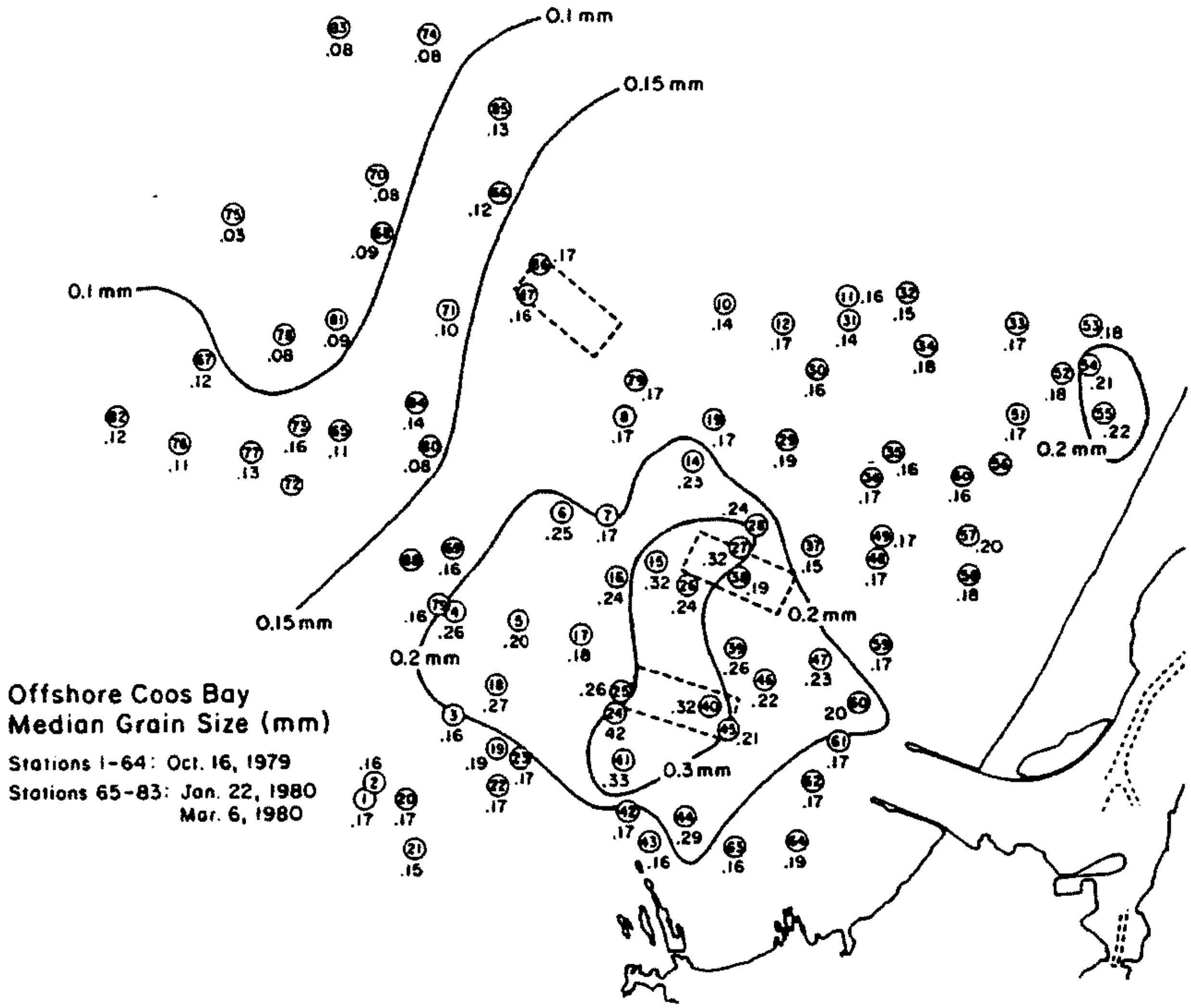

Figure 3.5 **Extended offshore area median grain size distribution (Hancock, et al. 1981).**

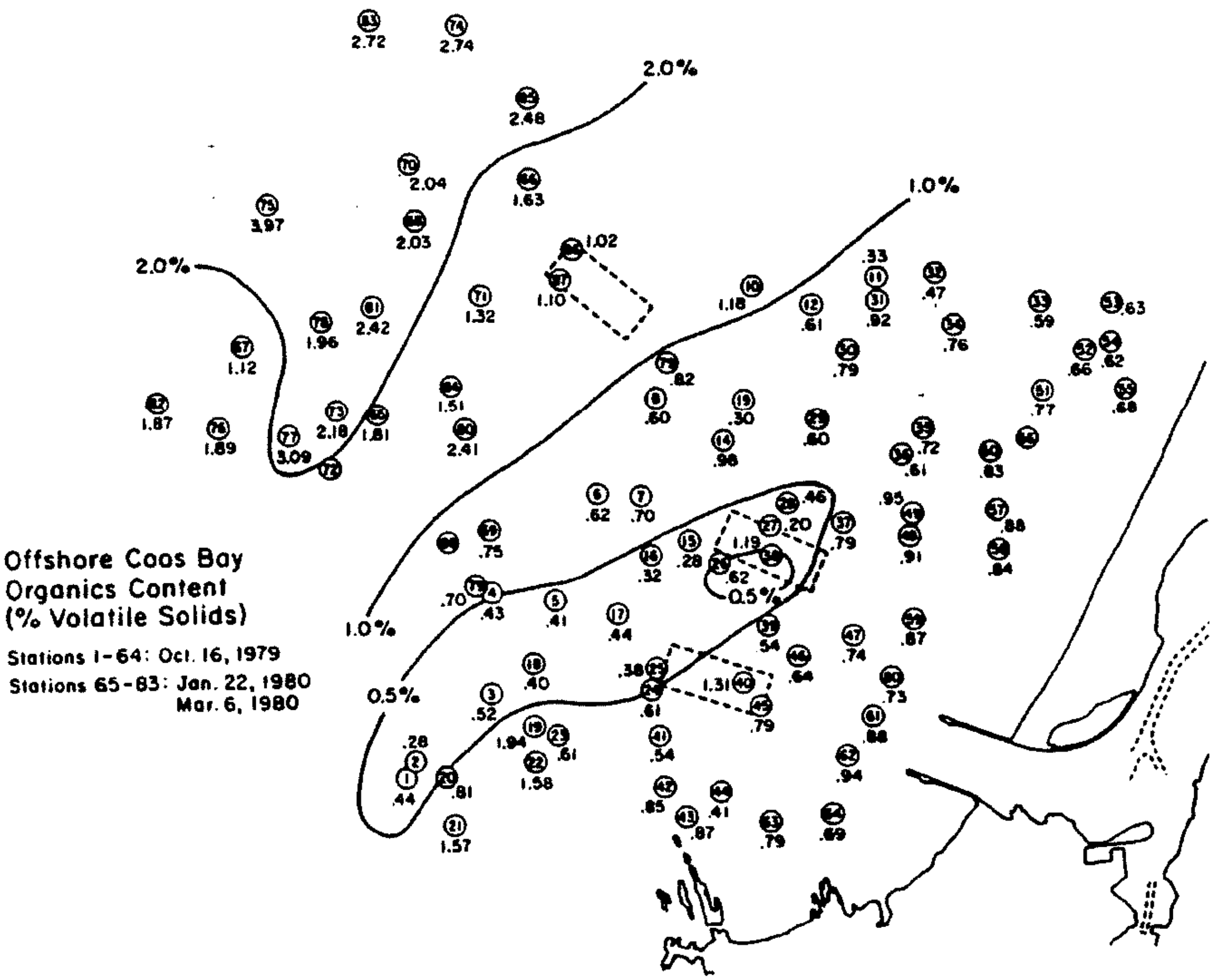

Figure 3.6 -Extended offshore area volatile solids (Hancock, et al. 1981).

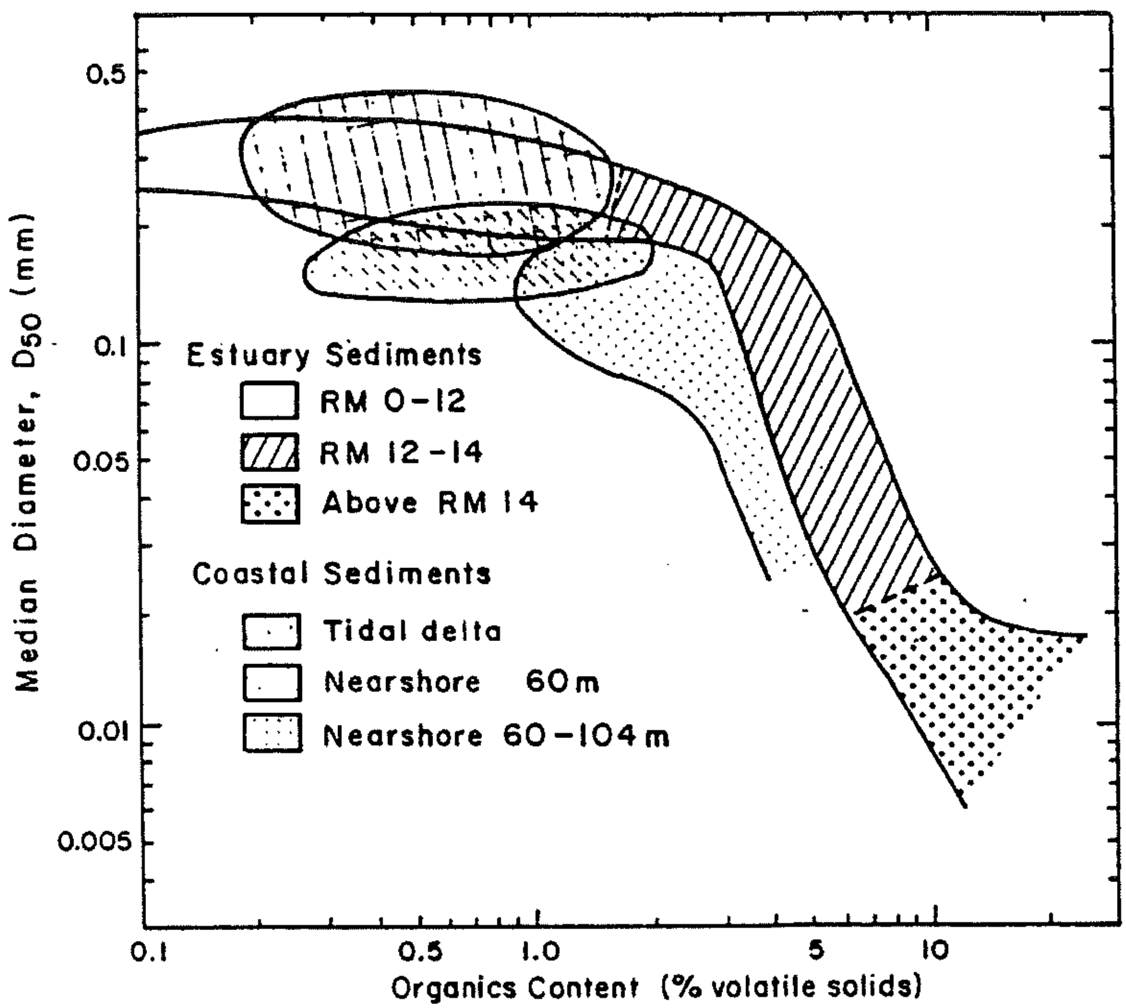

Figure 3.7 Median grain size vs. organics content in estuarine and coastal sediments (Hancock, et al. 1981).

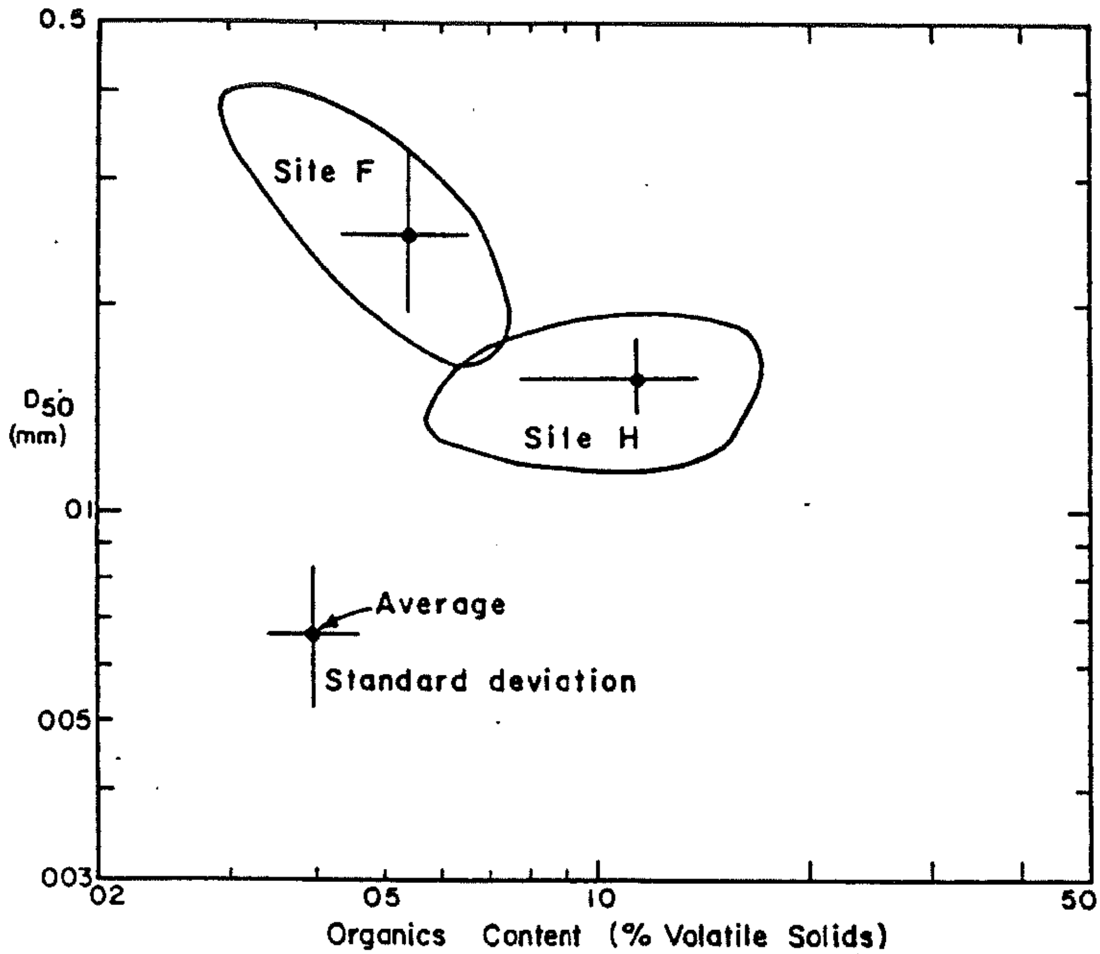

Figure 3.8 Median grain size vs. volatile solids with site average and standard deviation (after Nelson, et. al. 1983).

Site H and various grain size statistics suggest that the area near Site H experiences a greater variability in fine-grained material than the area around Site F. Site F sediments are more poorly sorted than sediments near Site H. The variability near Site F reflects the nature of the river delta sediments and the effects of dredged material disposal. The well sorted nature of material near Site H is consistent with the nature of near-shore fine marine sands.

Hancock et al. (1981) performed detailed bulk sediment chemical analysis on offshore sediments. In general, both water and volatile solids fractions increase with distance from the estuary entrance. This fact correlates with decreasing grain size. Chemical concentrations in these offshore sediments are similar to those of the less contaminated lower estuary sediments and significantly lower than concentrations in upper estuary sediments.

Nelson et al. (1983) present detailed sediment chemical analyses for the study area. Parameter levels are consistent within a site and obvious differences exist between sites. No chemical analysis at any site appeared atypical or indicative of a polluted condition. Site F sediments have higher solids content, lower volatile solids, and generally lower levels of all chemical parameters as compared to the other two sites. Volatile solids levels and most chemical parameter levels increase with depth and decreasing grain size such that Site H has levels intermediate with Sites F. Concentrations of copper, iron, lead, manganese, and zinc showed a strong inverse correlation with mean grain size.

f. Sediment Transport. Continued ocean disposal of dredged material at Coos Bay requires knowledge of the quantities of material to be disposed, as well as the short- and long-term fate of the dredged material. This section describes the sediment transport characteristics at existing ocean disposal sites and within the larger context of the Coos Bay offshore littoral cell.

Bathymetric monitoring of the Coos Bay ocean disposal sites over the past several years has concluded that dispersion rates from Sites E and F has been less than earlier predictions and persistent mounding is occurring at these sites. As continued mounding may pose a navigational hazard, site modification for the disposal of coarse-grained material will be necessary. The disposal of fine-grained material at Site H will not be modified from present practices as bathymetric records indicate little or no mounding.

Coos Bay lies at the southern boundary of the Winchester littoral cell, which extends for 90 kilometers from Cape Arago north to Heceta Head. This littoral cell is the largest on the Oregon coast. Except for the headlands at both ends of the cell, the entire coastline is made of beach fronting sand dunes. Three major river systems enter the cell. From south to north these are the Coos River, the Umpqua River, which is the largest and provides the major source of sediment to the cell, and the Siuslaw River. Mineral assemblages of the Umpqua River correlate with the littoral sand mineralogies, which indicates that the primary source of sand within the cell is from the Umpqua River. Various sedimentological studies based upon sand mineralogies have suggested an offshore limit of modern sand movement at the 18 meters depth, while others push this limit out to over 30 meters. The Coos River is situated at the southern boundary of the Winchester littoral cell. Material dredged from the lower Coos Bay channel are very similar in their major mineral composition and grain size relative to local the beach sands.

Sediment transport on the Oregon continental shelf consists of two mechanisms depending upon the size of the sediment. Anything finer than sand size is carried in suspension in the water and is relatively quickly removed offshore. Sediments sand size or coarser may be occasionally suspended by bottom currents or moved directly as bedload. Komar (1972) found evidence of wave induced bottom sand movement as deep as 204 meters (670 feet) off Oregon and concluded that summer wave action reached 50 to 100 meters (164 to 328 feet).

Hallermeier (1981) defined two zones of sand transport, inner and outer, based on wave conditions. The inner littoral zone is the area of significant year-round alongshore and onshore-offshore transport by breaking waves. The outer shoal zone is affected by wave conditions regularly enough to cause significant onshore-offshore transport. A similar model is described by Komar (1975) and Tunon (1977) for the Oregon coast where winter storms erode and transport sand offshore and summer swell moves sand onshore. Comparison of aerial photographs along the Oregon coast shows a dramatic increase in width of the surf zone during the winter.

Using Hallermeier (1981) and long-term wave data from Newport (Creech, 1981) the limit for strong long-shore transport varies from -8.5 meters in summer to -15.5 meters in winter on the Oregon coast. Significant onshore-offshore transport occurs to depths of -25 meters in summer and to -82 meters in winter; however, Hancock, et al (1981) calculated the probability for wave-induced current velocities at various depths off Coos Bay. Using the Coos Bay data the probability of wave-induced sand movement is very small beyond a depth of about 46 meters. Sand movement induced by wave action is further influenced by near-bottom currents and downslope gravitational movement.

Coarse-grained sediments, between 0 and 15 meters deep, experience strong onshore and long-shore transport during most of the year. Coarse-grained sediments at depths greater than 46 meters based upon Hancock, et al (1984), are little influenced by waves and currents strong enough to cause significant movement. This is a non-dispersive area. The area between 46 and 15 meters is progressively influenced by waves and current sufficiently strong enough to cause movement with decreasing depth.

For the purpose of comparing static volumes of active sand bodies in the beach, dune and near-shore environments and predicted Coos Bay dredged material volumes, Peterson et al. (1993) identified the area of interest, from the Mouth of the Umpqua River to Coos Bay, as the Coos Bay-Umpqua littoral subcell to the Winchester littoral cell. Peterson found that the total estimated volume of beach sand above the m.l.l.w. datum to be 24 MY (million cubic yards) and the total foredune sand volume to be 7.2 MCY. The total volume of active dune sheet sand is estimated to be 704 MCY. The total volume of active near-shore sand, between 0 meters and 15 meters of water and 1 meters thick, is estimated to be 38 MCY. Active sand volumes at water depths from 15 to 46 meters has not been established do to a lack of information on the thickness of the active sand transport zone. Beyond water depths of 46 meters active sand movement is assumed to be negligible.

Based upon dredging records from 1986 to 1992 an average 983,898 y^3 of dredged material has been placed at Sites E and F annually. Yearly quantities have ranged from a low of 617,649 y^3 in 1989 to a high of 1,247,693 y^3 in 1991. Over a 50 year project life an estimated 49 MCY of sand would be required to be placed at an ocean dredged material disposal site suitable for sandy material.

g. Currents and Tides. Coastal circulation reflects the combined influences of seasonally-reversing regional currents and winds, the tides, and other periodic phenomena. The California and Davidson currents determine seasonal transport along the Oregon coast. The 500-kilometer-wide California current flows southward parallel to bathymetric contours over the entire Oregon continental shelf during the spring and summer with average speeds of 10 centimeters per second (cm/s). Northerly and northwesterly winds reinforce this flow with maximum current strength in the spring. Strong vertical velocity gradients characterized the lower half of the flow (Huyer et. al. 1975).

Under the influence of southeasterly winter winds, this shear layer expands upward and shoreward until northward flow results (Sobey 1977). Ultimately, this northward flow develops into the 150-kilometer-wide Davidson current that lies between the shore and the southerly flowing California current. Circulation over the continental shelf is now northward parallel to isobaths and currents are nearly uniform throughout the water column.

Upwelling from February through July weakens and ultimately destroys the Davidson Current to some 200 meters in depth. Net transport above this depth is thereafter southward as an extension of the California current. The Davidson current persists below that depth on the outer continental shelf with speeds up to 20 cm/s and is probably responsible for the strong velocity gradients that develop in the deeper inner shelf waters in summer.

Detailed current measurements in the study area by Hancock et. al. (1981) and Nelson et. al. (1983) conform to the generalized circulation scheme just presented. Current strength and directional variability reflect the variability of local surface winds. Mid-water currents (those measured at one-third the depth) and near-bottom currents are generally between 10 and 20 cm/s in the vicinity of Sites F and H. Mid-depth summer median currents near Site F are slightly stronger (20 to 30 cm/s) while median winter and spring currents near Sites F and H may be between 30 and 60 cm/s.

Water transport is generally parallel to bathymetric contours although estuarine circulation and the shoreline configuration tend to produce significant on-shore and offshore flow in the upper water column near Site F and the rock disposal site. Springtime upwelling may also be responsible for shoreward-directed mid-depth mean currents affecting presumably Site H.

Annual and seasonal variations in atmospheric conditions determine the regional circulation just described. Superimposed upon this slowly-varying circulation are periodic currents due to the tides, inertial currents, internal waves, etc. While variations in wind speed and direction for periods longer than 2.5 days are reflected in surface currents, shorter period variations can give rise to inertial currents (Huyer and Patullo, 1972).

Inertial currents have periods of 17.4 hours and speeds up to 10 cm/s (Cutchin and Smith, 1973). Tidal currents with amplitudes of several tens of cm/s occur at periods of 12.4 and 24.8 hours. Other periodic circulation features include shelf or topographic (Rossby) waves that propagate northward with periods of 4.5 days and, possibly, southward with periods of 7.1 days. Internal waves of varying periods and wavelengths can propagate along the permanent and seasonal pycnoclines, causing short-term current oscillations in the order of an hour. When stratification abruptly decreases, as during upwelling events, internal waves become unstable and cause increased vertical mixing in the water column.

h. <u>Surface Waves</u>. The prevailing wave direction off Coos Bay is from the west. Summer waves approach from the west-northwest and littoral transport of beach sediments is to the south. During the remainder of the year, waves approach from the west and southwest driving littoral transport to the north.

Significant wave heights (the average of the highest one-third of all waves) range from a little over 1 meter during the summer to over 3.5 meters in winter with corresponding changes on wave period. Detailed observations have shown that wave-induced currents average between 30 and 60 cm/s year-round in the study area (Hancock et al. 1981). Speeds up to 120 cm/s or more were observed during the winter.

i. Wind Direction and Speed. Prevailing winds are from the south-southeast in January, averaging 5.5 meters per second (m/s), from the north-northeast for June through September at 5.2 m/s, and from the southeast at 4.6 m/s during the remaining months (figure 3.9). Wind speeds and directions are most variable during March, April and September. Significant geomorphic effects of Cape Arago headland and different methods of observation cause local wind statistics to differ significantly in direction and speed from observations at the offshore National Oceanic and Atmospheric Administration (NOAA) data buoy. Since the Coos Head records appear more similar to those of earlier observations (Duxbury et al. , 1966), the Coos Head observations are considered more appropriate for the study of local processes (Hancock et al 1981). The NOAA buoy records are likewise more appropriate to open ocean studies of wind generated waves and currents.

j. Water Quality. Table 3.2 presents the results of water quality analyses for surface and bottom waters on the vicinity of Sites F and H for each of the four seasons (Nelson et al. 1983). Tests for heavy metals and pesticides did not indicate an atypical or polluted condition for any water sample. Salinities characteristic of the surface water mass were observed throughout the water column at all three sites in June 1980, at all but the bottom near Site H in August and December 1980.

3.3 Biological Resources: Coos Bay Estuary.

a. Introduction. Because the interaction of the physical parameters within the system is highly variable, the Coos Bay estuary is best described by division into subsystems (figure 3.10). Much of the descriptiveinformation on these subsystems is contained in the Coos Bay Estuary Inventory Report

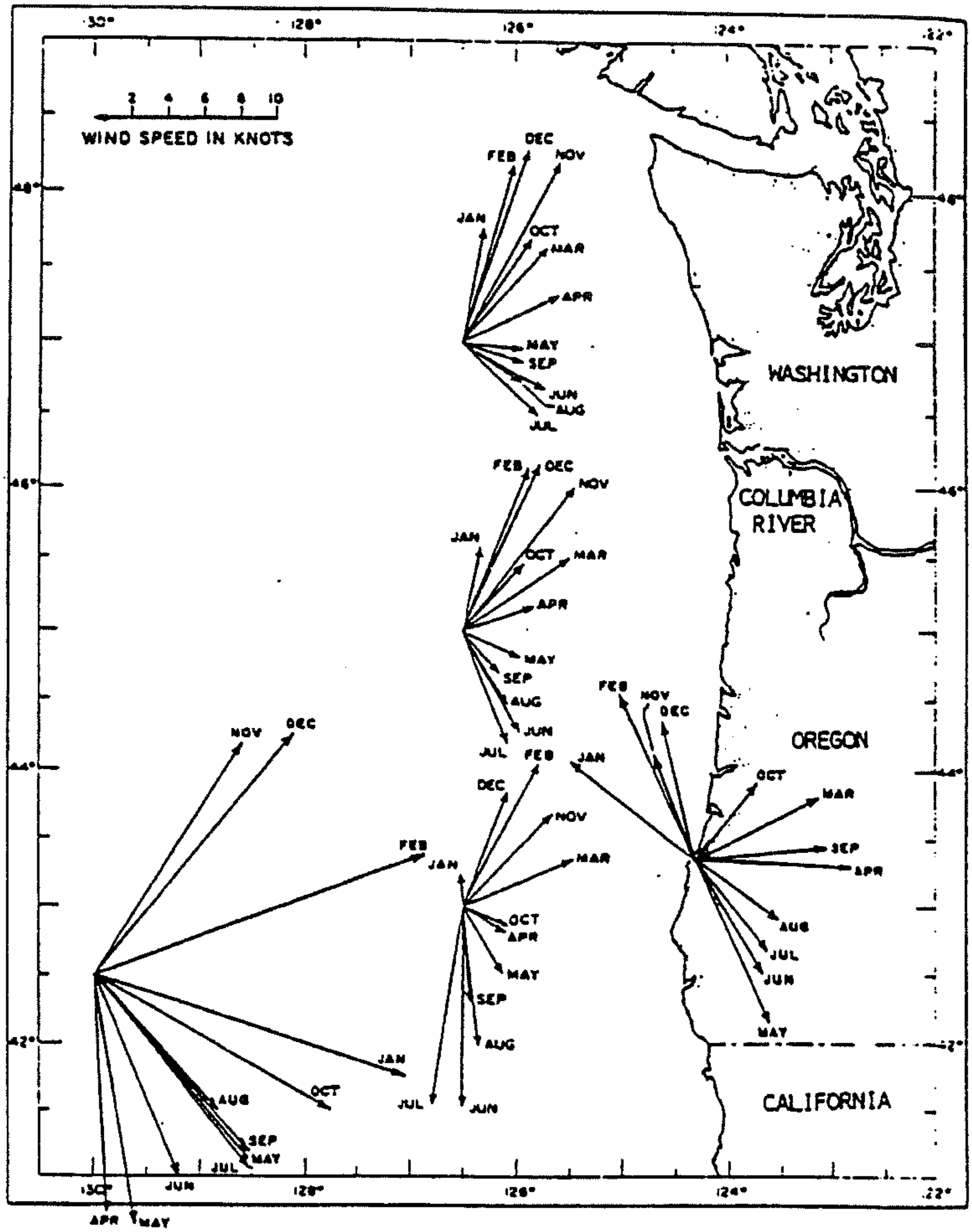

Figure 3.9 Monthly wind vectors observed at North Bend Airport and NOAA offshore data buoys.

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TABLE 3.2 Chemical Analysis of Marine Waters at Offshore Sites F, G & H Coos Bay, Oregon (From Nelson, et.al. 1983)

Date	STATION	BOTTOM DEPTH (fathoms)	pH	SALINITY (mg/ml)	NH4-N (ug/ml)	TURBIDITY (NTU)	TSS (ug/ml)	VSS (ug/ml)	As (ug/ml)	Hg (ug/ml)
June 1980	F3B	13	7.85	32	BD	2.9	22	6	BD	ND
	F3T	13	8.00	30	BD	3.7	19	6	ND	BD
	G3B	50	7.70	33	0.10	7.0	52	12	ND	ND
	G3T	50	8.00	31	BD	3.6	26	8	ND	ND
	H3B	33	7.45	33	BD	6.0	27	7	ND	BD
	H3T	33	8.00	31	BD	1.2	26	8	BD	ND
August 1980	F3B	ND	7.70	33	BD	4.2	26	10	ND	BD
	F3T	ND	7.80	33	BD	2.0	23	8	BD	ND
	G3B	ND	7.60	33	BD	1.3	36	9.	BD	ND
	G3T	ND	7.90	30	0.03	4.1	20	1	ND	ND
	H3B	ND	7.55	35	BD	2.6	23	8	BD	ND
	H3T	ND	7.70	32	BD	1.2	24	7	ND	BD
December 1980	F3B	13	7.70	33	BD	4.2	26	10	ND	BD
	F3T	13	7.80	33	0.01	2.0	23	8	BD	ND
	G3B	50	7.60	33	BD	1.3	36	9	BD	ND
	G3T	50	7.90	30	0.03	4.1	20	1	ND	ND
	H3B	33	7.55	35	BD	2.6	23	8	BD	ND
	H3T	33	7.70	32	BD	1.2	24	7	ND	BD
April 1981	F3B	13	7.50	35	BD	4.0	ND	ND	BD	ND
	F3T	13	7.50	31	BD	3.8	ND	ND	BD	BD
	G3B	50	7.60	35	BD	2.8	ND	ND	BD	BD
	G3T	50	7.60	32	BD	2.9	ND	ND	BD	ND
	H3B	33	7.50	35	BD	3.2	ND	ND	BD	ND
	H3T	33	ND	ND	BD	ND	ND	ND	BD	BD
LLD					0.03				0.04	0.05

TABLE 3.2 (Continued)

Date	STATION	METAL CONCENTRATION (ng/ml)						PESTICIDE CONCENTRATION (ng/ml)						
		Cd	Cu	Fe	Mn	Pb	Zn	Aldrin	DDE	Dieldrin	DDD	DDT	Ar1254	Ar1260
June 1980	F3B	ND	ND	ND	ND	ND	ND	0.010	BD	0.005	0.003	0.004	BD	BD
	F3T	1.60	14.00	6	18	3.50	·0.50	0.004	BD	0.005	BD	0.010	BD	BD
	G3B	ND	ND	ND	ND	ND	ND	0.005	0.002	0.005	0.002	0.004	BD	BD
	G3T	ND	ND	ND	ND	ND	ND	0.001	0.002	BD	0.002	0.004	BD	BD
	H3B	1.80	8.60	33	14	3.50	7.00	0.005	BD	0.006	0.010	0.008	BD	BD
	H3T	ND	ND	6	5	ND	ND	BD	0.004	BD	0.003	BD	BD	BD
August 1980	F3B	1.40	11.20	18	16	5.00	2.50	0.001	0.001	BD	0.001	0.004	BD	BD
	F3T	ND	ND	ND	ND	ND	ND	0.002	BD	BD	BD	0.005	BD	BD
	G3B	ND	ND	ND	ND	ND	ND	0.001	BD	BD	0.002	0.001	BD	BD
	G3T	ND	ND	ND	ND	ND	ND	0.002	BD	0.001	0.001	BD	BD	BD
	H3B	ND	ND	69	112	ND	ND	0.001	BD	0.001	BD	0.003	BD	BD
	H3T	3.50	18.20	11	21	5.00	7.00	0.001	BD	BD	BD	0.002	BD	BD
December 1980	F3B	2.80	34.00	18	16	7.00	9.00	0.001	0.001	BD	0.001	0.004	BD	BD
	F3T	ND	ND	ND	ND	ND	ND	0.002	BD	BD	BD	0.005	BD	BD
	G3B	ND	ND	ND	ND	ND	ND	0.001	BD	BD	0.002	0.001	BD	BD
	G3T	2.50	28.80	ND	ND	7.00	7.50	0.002	BD	0.001	0.001	BD	BD	BD
	H3B	1.40	12.60	69	112	3.50	5.00	0.001	BD	0.001	BD	0.003	BD	BD
	H3T	3.10	13.00	11	21	7.00	18.50	0.001	BD	BD	BD	0.002	BD	BD
April 1981	F3B	ND	ND	ND	ND	ND	ND	BD	BD	ND	BD	BD	BD	BD
	F3T	1.30	9.70	14	18	3.50	18.50	BD	BD	ND	BD	0.002	BD	BD
	G3B	1.40	9.50	38	76	3.50	15.00	BD	BD	ND	BD	BD	BD	BD
	G3T	ND	ND	ND	ND	ND	ND	BD	0.001	ND	0.002	0.004	BD	BD
	H3B	2.20	12.50	ND	ND	2.70	79.00	BD	ND	BD	0.002	BD	BD	BD
	H3T	4.40	13.50	11	12	3.50	5.00	BD	ND	BD	BD	BD	BD	BD
	LLD							0.020	0.001		0.001	0.002	0.020	0.020

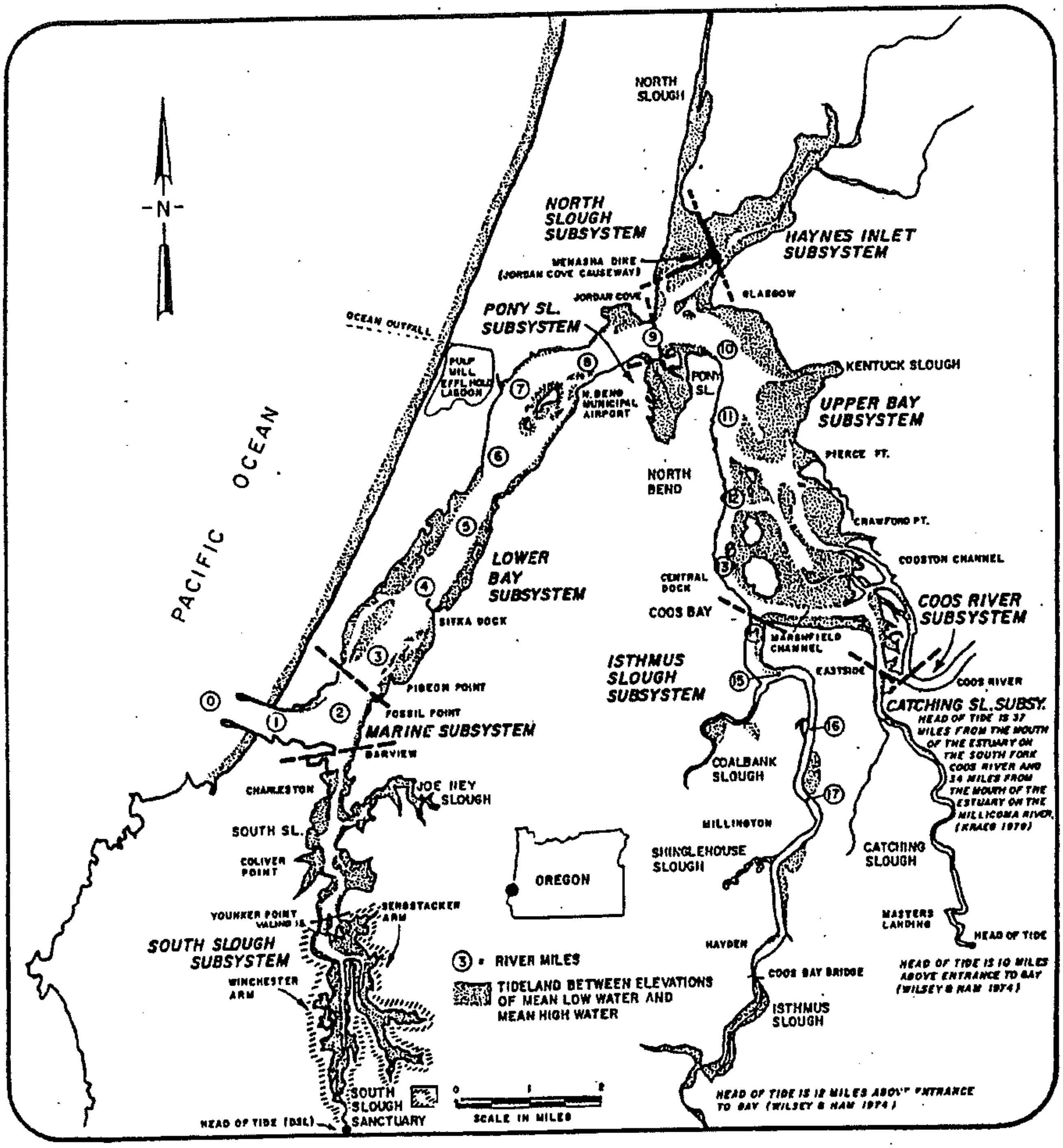

FIGURE 3.10 COOS BAY SUBSYSTEMS

(Roye 1979). Delineations were made between the following subsystems: marine, RM's 0 to 2.5; lower bay, RM's 2.5 to 9; and upper bay, RM's 9 to 17. Riverine and slough subsystem are also characterized individually. These divisions are based on physical and biological characteristics of the individual subsystems which in turn vary with degree of freshwater input, estuarine circulation (wave and current action), salinity gradients, nutrient fluxes, sediment structure and geographical location. Within each subsystem these characteristics vary with time, and in so doing determine the seasonal distribution and standing stock of estuarine biota. Other factors which determine species composition and abundance within the estuary include effects of predation, harvesting, environmental contaminants, human disturbance, and competition between organisms occupying similar niches. The subsystems are as follows:

(1) Marine Subsystems. The marine subsystem (RM's 0 to 2.5) contains a large diversity of habitats (i.e. shorelines, eelgrass, intertidal marsh/mudflat and subtidal channel), with a similarly diverse assemblage of fish and wildlife species. Shorelines are composed of sand, cobble, boulder and bedrock. Intertidal areas, consisting of sand, sandy mudflats, bedrock and unconsolidated material are largely covered with eelgrass and algae beds. Shallow subtidal areas also support eelgrass and algae beds. The bottom of the navigation channel in the marine subsystem is composed mostly of clean sand (> 95 percent [Jefferts 1977]). Small shell hash and small pieces of wood are prevalent between RM's 1 and 2, with increasingly larger amounts of rock up to RM 3 (Moehl and Barton 1989). This subsystem is the most biologically diverse of the entire bay. Of thirteen species collected during sampling of dredged material in the navigation channel, eight were most frequently encountered between RM 1 and 3 (Moehl and Barton 1989). The large species diversity in this subsystem is attributable to the prevailing oceanic influence, as well as to the variety of available habitat.

(2) Lower Bay Subsystem. The Lower Bay subsystem extends along the channel from approximately RM 2.5 to the railroad bridge at RM 9. Although still under considerable oceanic influence, it is not as strongly affected by wave action as is the marine subsystem. The sediments of this reach are

predominantly marine sands, though a relatively high concentration of rocks occur in the navigation channel between RM 2.5 and 4 (Moehl and Barton). Other than rock, shell fragments and wood are common in the channel. The rock concentration diminishes at approximately RM 5, wood debris becomes very prevalent thereafter, particularly between RM's 7 and 9.

(3) <u>Upper Bay Subsystem</u>. The Upper Bay subsystem of Coos Bay has been altered more than any other subsystems. This reach, which extends from RM's 9 through 17, broadens into a system of wide, shallow tideflats through which the navigation channel is maintained along the west side. The broad shallow nature of the upper bay forms a vast intertidal system which supports large eelgrass beds and tidal marshes. These tidal flats are composed largely of mud, with sand occurring near dredge material islands. These flats are an important feeding area for a variety of juvenile and adult fish including striped bass, shad and salmon. It is suspected that these species use this area to adjust to fresh water and wait for proper river conditions to migrate upstream (Cummings and Schwartz 1971). Debris from the local wood products industries is common throughout this system, particularly at the downstream end of the channel, and on the southern tideflats. Higher concentrations of sand occur near the dredge material disposal islands.

(4) <u>Slough And Riverine Subsystems</u>. The sloughs of the Coos Bay estuary are considered as independent subsystems, though they share many similar characteristics. Water quality generally varies with distance from the mouth of the bay and freshwater inflow. The ecological characteristics of the sloughs are largely determined by water quality. With distance from the ocean, tidal forces decrease, therefore, water at the upper reaches is relatively stagnant, particularly during periods of low fresh water runoff.

The riverine subsystems in Coos Bay include the South Fork Coos River and the Millicoma River. These rivers converge to form the Coos River approximately 5.5 miles from the upper bay subsystem. The head of the tide extends approximately 10.5 miles up this system in the Millicoma River and 11 miles up the South Fork of the Coos (Roye 1979). The Coos River is the largest of all tributaries entering Coos Bay. It drains approximately 70 percent of the entire Coos Bay drainage system (which comprises 1,502 square kilometers). These systems provide important fish habitats, and are critical in the hatching and rearing stages of the life cycle of many commercially and recreationally important species of fish including salmon, striped bass and shad.

b. Flora And Fauna of Coos Bay. There are a number of factors involved in determining distribution and abundance of flora and fauna in Coos Bay. These factors include substrate type, chemical and physical properties of the water (i.e. salinity, dissolved oxygen, and temperature), tidal forces and degree of tidal exposure (wave and current action), habitat stability, predation and harvesting, and competition between organisms.

Distribution of many organisms is seasonally dependant with wide fluctuations in abundance not uncommon. Non-native organisms have been introduced by the local shipping and fishing industries.

(1) Flora.

(a) Algae. Estuarine algae and vascular plants are the major estuarine primary producers in Coos Bay. Ulva and Fucus are two genera of macroalgae which commonly occur in Coos Bay. Ulva occurs on sandstone-clay substrates or floating on mudflats, while Fucus occurs on intertidal rock within the splash zone (USFWS,1987). Bull kelp (Nereocystis leutkeana) occurs in beds off of Pigeon Point in the lower part of the estuary. The great abundance of algae occurs near the mouth of the estuary in locations where moderate wave action allows for attachment to hard substrates. In the quieter waters of the inner bay algae attaches to pilings and outcroppings. Algae diversity and abundance decreases with distance from the mouth, due primarily to decreasing water clarity.

Diatoms are a very common type of algae which are distributed throughout the bay. Diatom distribution is seasonal and correlated with salinity. There are two species assemblages divided by a transition zone which occurs between

RM's 5 and 9 (USACE 1975 from McGowen and Lyons, 1973). The dominant genera of diatoms in the upper bay are Skeletonema and Melosisra, while the principal genera nearer the mouth include Chaetoceros, Skeletonema, and Thalassiosira.

Epiphytic diatoms contribute significantly to estuarine primary production, constituting up to 18 percent of the annual production of carbon in eelgrass primary production system (Phillips 1984). Often forming a felt-like coating on eelgrass leaves, epiphytic algae is preyed upon by a variety of organisms. Epiphytic algae is also found in association with macroalgae and on rocky substrates. Approximately 200 species of epiphytic diatoms have been identified in Yaquina Bay located roughly 150 miles north of Coos Bay. Detailed surveys of this nature have not been conducted in Coos Bay, though a similarly diverse assemblage of species would be expected here. There is a strong correlation between the presence of epiphytic algae and herbivorous epifauna such as amphipods. Amphipods are in turn fed upon by many species of fish and invertebrates including Dungeness crabs and salmon.

(b) Vascular Plants. There are approximately 1,726 acres of tidal marshes in Coos Bay, most of these occur in adjoining sloughs and inlets. These marshes are dominated by a variety of vascular plant species ranging from eelgrass to bulrush and sedge. Marshes act to contain pollutants and sediments, as well as to control buffer the flow of water during flood events.

North-coast birds beak (Cordylanthus maritimus spp. palustris) is a vulnerable plant species which occurs in salt marshes in Oregon and California. It is found locally in a bay-side salt marsh on the North Spit. At this location it is threatened by off-road vehicle traffic.

Eelgrass (Zostera marina L.) is associated with the lower intertidal and shallow subtidal flats in the bay. Coos Bay contains about 1,400 acres of eelgrass tideflats (USFWS 1987). Eelgrass habitat represents one of the richest and most productive of ecosystems. Organic detritus from the decay of eelgrass provides food for a host of benthic invertebrates. Not only are the primary producing capabilities of this plant tremendous, but it also provides a sheltered habitat for a variety of organisms.

Eelgrass occurs in pure stands in areas of high salinity, and with ditch grass in less saline zones. It achieves optimum growth in salinities ranging from 10 to 30 ppt (Phillips 1984). Eelgrass roots in unconsolidated substrate, creating a relatively structured habitat, or eelgrass bed. Eelgrass is not tolerant of currents greater than 3.5 knots; moderate current speeds (0.0 to 0.8 knots) enhance eelgrass growth (Phillips 1984). If currents are too slow, algae tends to dominate and eelgrass grows poorly. Faster currents tend to tear the leaves from the plant and erode the substrate. Eelgrass does not occur at depths greater than 6.6 meters.

(2) Fauna.

(a) Invertebrates. Eelgrass habitat supports a large diversity of invertebrate species particularly when compared to adjacent unvegetated areas. Studies conducted by Oregon Institute of Marine Biology (OIMB) in summer 1971, compared various habitat types in the Upper Bay subsystem of Coos Bay. This study revealed a strong correlation between dense eelgrass beds and high animal biomass and diversity. Habitats studied included the periphery of the dredge material islands, mud, light eelgrass beds and dense eelgrass beds. Organisms were collected and weighed, and biomass (grams per square meter [g/m2]) calculated for species groups within each habitat type. Mean biomass for each habitat type was reported as: 13.0 g/m2 dredge island perimeter, 16.8 g/m2 mud, 34.7 g/m2 light eelgrass, 59.8 g/m2 dense eelgrass.

Clams, amphipods, and worms were the most commonly encountered organisms. Most commonly encountered clams were Mya arenaria, Macoma balthica, and Tellina salmonea. Amphipods consisted of Corophium spinicorns and Anisogammarus spp. Commonly identified worms were Nereis brandti, Heteromastus filiformis, and Eteone lighti. Miscellaneous organisms which were encountered in relatively high numbers were Calianassa californiensis (ghost shrimp) in the dredge island perimeters. Tectibranchs were common in the mud, C. Californiensis in the light eelgrass and tectibranchs, Dungeness crabs (Cancer magister) and fish fry in the dense eelgrass.

(b) Zooplankton. Zooplankton in Coos Bay are comprised of such organisms as benthic infauna larvae, fish larvae and a variety of crustaceans including mysids, cumaceans, and cladocerans. Zooplankton play an important role in the food web by their conversion of organic detrital matter and transfer of energy to higher trophic levels. Along with consuming detritus, zooplankton are also herbivorous and/or carnivorous. Zooplankton are capable of exploiting the wide variety of food particles which occur during different tide stages and seasons.

Salinity is the most important factor in determining distribution of plankton, with salinity extremes being more important than average salinity (Simentstad 1984). Zooplankton diversity is greatest at the mouth of Coos Bay with a gradual decline up to RM 10. The low species diversity at RM 10 may be related to the occurrence of a salinity gradient (Chirarochana 1977). Species diversity is suppressed by environmental stresses (Chirarochana 1977, from Carriker 1967), such as salinity gradients. Between RM's 10 and 15, zooplankton diversity gradually increases, and is maintained at a relatively high level up to RM 20 (Chirarochana 1977).

(c) Benthic Invertebrates. Benthic invertebrate sampling conducted in Coos Bay has revealed a notable contrast with regard to species diversity throughout the estuary. In general the upper bay supports a large number of individuals and low species diversity. The lower bay however, supports a large number of individuals and species (Jefferts 1977, NMFS 1990). South Slough faunas were consistently distributed to deeper levels in the sediment, probably due to the lower frequency of disturbance (Jefferts 1977). Benthic infauna of the upper bay was nondiverse, cosmopolitan, and opportunistic; which was attributed to several factors including increased organic content, decreased grain size, and regular physical disturbance by dredging. The effects of dredging on benthic infauna in the upper bay was studied by Parr (1973). Samples were taken both in the channel and at disposal sites, before and after dredging. The study revealed the presence of a stable community consisting largely of polychaetes (<u>Streblospio</u> <u>benedicti</u> being overwhelmingly dominant) which are largely associated with polluted environments (Parr 1973).

In May of 1989 benthic samples were taken at various locations in Coos Bay (figure 3.11), (Miller et al, April 1990). The species composition appears to have changed in the last 15 years, maximum diversity was observed near RM 5 in May 1975 and in May 1989. High species diversity was also encountered in samples taken in December 1989 near RM 4 (Jones 1990). The apparent change in species composition may be related to the limits of the sampling and identification effort, rather than in actual presence of a species.

Additional samples were taken at 20 locations in and adjacent to the navigation channel. In May 1989, benthic invertebrate density ranged from between 375 per square meter to 13,546 per square meter (table 3.3).

Recreational clam harvest information from Coos Bay provides the majority of current information regarding clam distribution in the estuary. Gaper, cockles, littleneck, and Washington clams are the most commonly harvested clams (Gaumer 1989). Surveys of recreational diggers from 1988 to 1989, revealed general clam distribution to be unaltered from that reported in earlier studies (Roye 1979), although average size and abundance of gaper clams has declined in the past 15 years. An area formed by dredged material known as Clam Island, located between approximately between RM's 3 and 4 on the west side of the channel, is the most productive gaper clam area in the bay. Cockles, littlenecks, and Washington clams are also found here. A similar distribution of clams occurs on tide flats of the North Spit, between approximately RM's 5 and 6. The lower South Slough also supports a population of gaper clams and cockles. The sandbar west of Charleston channel contains a viable population of razor clams. This was thought to be the only population of razor clams in the bay, until this species was discovered in dredged material at RM 7 in Coos Bay (Moehl and Barton 1989). Littleneck and Washington clams are most abundant on the flats near Pigeon Point. Soft shelled clams are found between South Slough and the upper bay subsystem. The broad muddy sand flats between RM's 10 and 16 support large numbers of soft-shelled clams. This species is tolerant of a wide range of salinity (Rudy and Rudy OIMB 1983).

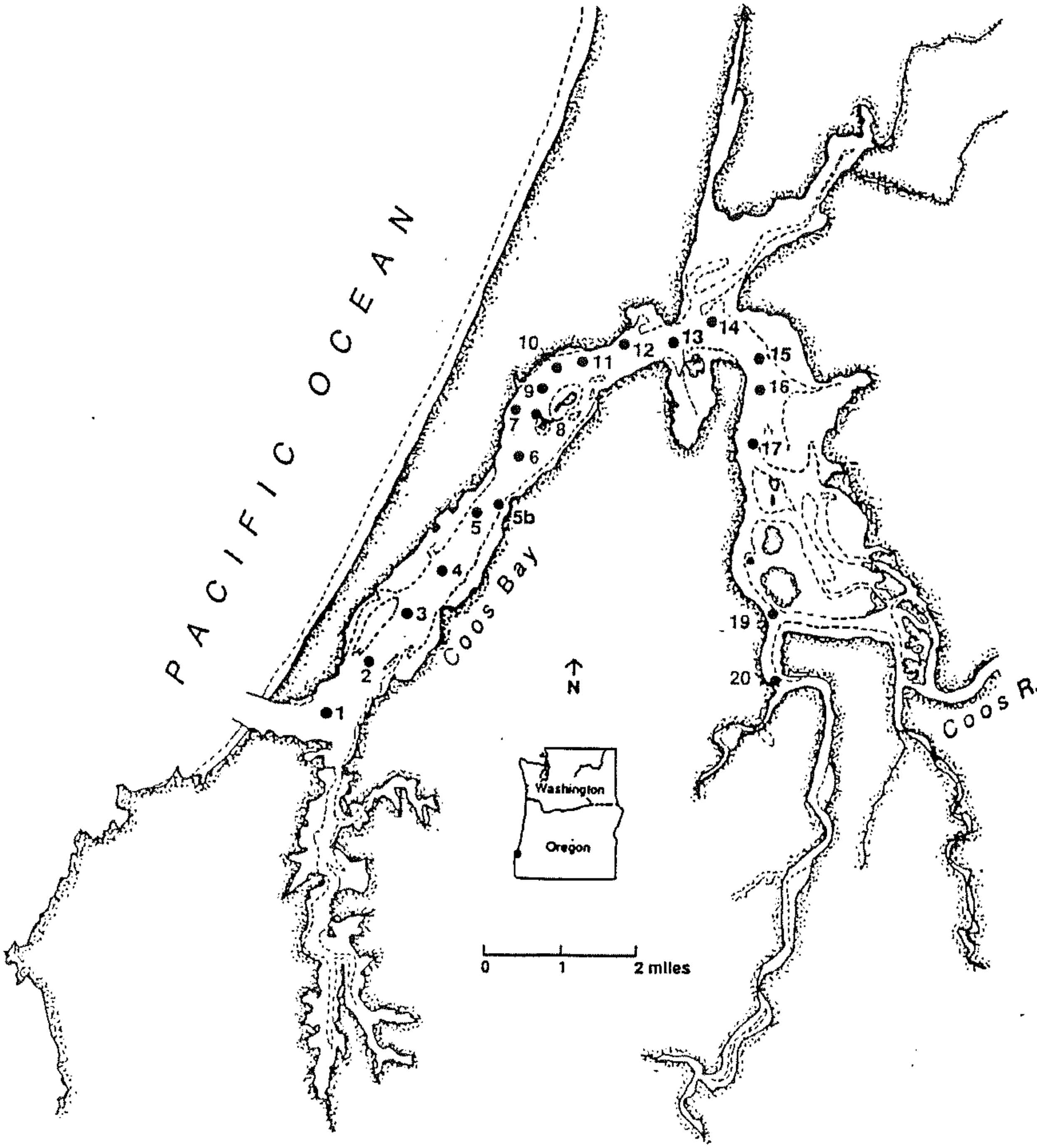

Figure 3.11. Benthic invertebrate sampling stations along the Coos Bay, Oregon navigation channel. 22-23 May 1989.

Table 3.3. Benthic invertebrates at 20 Sampling Stations in and Adjacent to the Coos Bay, Oregon, Navigation Channel, 22-23 May 1989.

STATION	NUMBER OF TAXA	DENSITY OF INVERTEBRATES (NUMBER/M^2)	H'[1]	SDV[2]	SR[3]	J'[4]
1	16	11,764	2.11	0.61	2.13	0.53
2	12	657	2.45	0.73	2.65	0.69
3	10	479	2.45	0.75	2.35	0.74
4	22	13,546	2.02	0.64	2.93	0.45
5	50	5,450	2.54	0.93	7.83	0.80
5b	53	11,004	3.57	0.80	7.47	0.62
6	12	375	2.56	0.74	3.07	0.72
7	7	427	1.77	0.62	1.62	0.63
8	7	1,105	1.59	0.55	1.29	0.57
9	11	667	2.27	0.70	2.40	0.65
10	6	500	1.57	0.59	1.29	0.61
11	16	552	3.03	0.78	3.78	0.76
12	14	1,521	2.06	0.57	2.61	0.54
13	8	469	2.18	0.70	1.84	0.73
14	17	563	3.71	0.90	4.01	0.91
15	20	1,000	3.04	0.77	4.16	0.70
16	17	563	3.45	0.88	4.01	0.84
17	15	490	3.16	0.84	3.64	0.81
19	10	386	2.79	0.82	2.49	0.84
20	11	823	2.25	0.66	2.29	0.65
Means	17	2,617				

[1]Shannon-Weaver Diversity Index
[2]Simpson Diversity Value
[3]Species Richness
[4]Species Evenness

Other species of clams which are not of commercial or recreational value include Macoma balthica, M. nasuta, M. inquinata, and Transennella tantilla (Karen Elardo, OIMB personal comm. 1989). The lower Coos Bay channel is composed of coarse grained sand, rocks, and steep mudstone walls where the navigation channel has been cut. These rocky areas create habitat for such clam species as paddocks and pea pod borers.

(d) Fish. Due to the close proximity of the ocean, fish species diversity is greatest in the Marine and Lower Bay subsystems. Many species which are more commonly associated with the ocean occur here. A total of 66 species of fish have been recorded from throughout the Coos Bay estuary; of these, 91 percent can be found in the lower 5 miles of the estuary at some stage of their life cycle (Cummings and Schwartz 1971).

The Coos Bay estuary provides a nursery for numerous migratory fish species. The broad shallow nature of the upper bay, with large intertidal areas and expansive eelgrass beds provides exceptional fish rearing habitat, and an abundance of prey. Gut content was analyzed in a variety of fish seined from the upper bay by OIMB in 1971. These fish were found to be feeding on diatoms, copepods, amphipods (including Corophium and Anisogammarus), mysids, shrimp, worms, and clams including soft-shelled and Tellina. (McConnaughey 1971).

Pacific herring use the bay as a spawning and nursery ground. Herring eggs can be found between January and March on rocks, pilings, seaweed and eelgrass. Mature and immature herring occur in the bay during spring and summer months. Young herring, with an average length of 6 to 9 centimeters have been found as far up as RM 20, though they are more numerous below RM 15 (Cummings 1971). They prey upon copepods, larval crustaceans, mollusks, and diatoms. Their predators include striped bass, cutthroat trout, salmon, halibut, albacore, dogfish, squid, and seals (OIMB 1971).

After spawning in the open ocean, young and adult northern anchovies enter Coos Bay where they occur in high numbers between April and September in most years. Large numbers of anchovies have been observed between RM's 10 and 14 during April and May (Cummings 1971). Anchovies feed on small crustaceans, fish larvae, copepods and diatoms. Salmon and striped bass are common anchovy predators (McConnaughey 1971).

Silver smelt, longfin smelt, and whitebait top smelt occur in the Coos Bay estuary. Smelt inhabit the plankton-rich upper water level of the bay and are abundant over the tidal flats on the incoming tide (McConnaughey 1971).

American shad adults migrate through the bay during late spring and early summer on their way to spawning areas in the Coos River. Some shad arrive in early spring and spend several weeks in the estuary feeding on mysids, copepods, Crangon, fish larvae, and Corophium (McConnaughey 1971). The shad population, estimated at 55,000 fish (USFWS 1987), arrives at the spawning area (RM's 23 and 30) by mid-June (Cummings 1971). Yearling shad are present in the river in June occur between RM's 15 and 25 (Cummings 1971). They move downstream in mid-July and arrive at the ocean by the end of August. Young of the year shad occur throughout the upper estuary as far down as RM 9 in August and as far up as RM 31 in September (Cummings and Schwartz 1971).

Chinook, coho, and chum salmon and steelhead and cutthroat trout utilize Coos Bay as a feeding and nursery area, as well as a migration route to spawning areas in the tributary streams. Steelhead, cutthroat trout and salmon can be found in the bay during most of the year. Migration of these species varies and is as follows: chinook, July through November; coho, September through December; chum, October through November; steelhead, November through February; searun cutthroat trout, July through October. (USFWS 1987).

Depending on the species, young enter or pass through the bay when only a few days to two years old. Juveniles, particularly of chinook salmon utilize the bay as a nursery area throughout the year. Emigration of chinook salmon occurs during May through July; coho, April through June; chum, March through May; steelhead and cutthroat, April-June. Emigration of yearling coho salmon, steelhead, and cutthroat trout also occurs during early fall freshets (USFWS 1987).

Chinook from the previous years brood have been seined from throughout the estuary during the following June. Average length of these fish was 10 centimeters (Cummings and Schwartz 1971). By August most of these fish take on the silvery appearance of smolts and leave the upper bay. They appear to remain below RM 8 through September at which time they are approximately 14 to 19 cm in length (Cummings 1971). Coho apparently remain in the river or fresh-water portion of the estuary during the summer. Coho yearlings have been collected from the estuary en route to the ocean between March and May (Cummings and Schwartz 1971). Because of significant declines in coho salmon returns to Pacific coastal streams, it has been petitioned for listing under the Endangered Species Act. The decision for listing is currently under consideration.

Striped bass are a migratory fish, native to the Atlantic Coast. They were introduced to the Pacific coast via the Sacramento River in 1879. Striped bass were first noted in Oregon waters in 1914; by 1930, a substantial commercial and sport fishery had evolved (Anderson 1985). There is a popular sport fishery at RM 30 on the Coos River during the winter and early spring. Striped bass also occur in Joe Ney and South Slough during the winter. This species feeds over tide flats throughout the bay, and near the mouths of rivers and streams (Cummings and Schwartz 1971).

Spawning begins in May and June when various groups of bass begin to school and move upriver towards the spawning grounds in the Coos River. The spawning grounds occur between the fork and Dellwood, and in the Millicoma River from the fork upstream to Allegheny (USFWS 1987). Spawning extends into mid-July in some years (Cummings and Schwartz 1971). The spawning population is estimated at 3,000 fish (USFWS 1987). Hatchlings rear throughout the bay and in the tidewater section of the Coos River (USFWS 1987). They are thought to migrate to the ocean by the end of their first year (Cummings and Schwartz 1971). Adults feed on shrimp (Crangon), surfperch, shad, chinook salmon, young striped bass, anchovies, herring, and sculpins. Young striped bass feed on mysids, amphipods, isopods, Crangon, annelids, shad, and younger striped bass (McConnaughey 1971).

The striped bass population in the Coos River has experienced a noticeable decline in recent years. This decline has been attributed to poor recruitment in the system within the first two months of life. The reason for poor recruitment is not clear, though eggs, larvae, and juveniles are extremely vulnerable to high river flow conditions and low zooplankton availability (Anderson 1985). Anderson (1985) suggests that the Coos Bay striped bass spawning strategies may be ill-adapted for the existing hydrographic conditions. He also observed an unusually high number of hermaphroditic bass in the Coos Bay population, suggesting a small gene pool may be limiting the adaptive capabilities of this population.

A variety of demersal fish occur in Coos Bay, particularly in the Marine and Lower Bay subsystems. These fish include starry flounder, English sole, sand dab, black rockfish, kelp greenling, Pacific sand lance, gunnels, and sculpins. Starry flounder are found in the bay throughout most of the year, with large numbers moving in from the ocean during the winter. During the summer, young flounder are found scattered throughout the estuary to RM 25. Young English sole, approximately 3 centimeters in length occur in the estuary in July, and are particularly abundant in the lower bay by August; roughly 1,000 juveniles per seine haul were collected in 1970. Smaller numbers occurred in samples up to RM 17 (Cummings 1971). Young sand sole were found up to RM 15 along with English sole, but were only 20 percent as numerous as English sole. A number of perch species are found throughout Coos Bay including striped, white, pile, walleye, redtail, shiner, and surf perches. Shiner perches, however, form the bulk of the perch population in Coos Bay. Both juveniles and adults occur up to RM 25 throughout the summer. The numbers of juvenile often exceeded 1,000 fish per seine haul in the lower bay with peak catches after mid-July from RM's 7 through 9. Other species of perch were scattered throughout the estuary; only shiner perch were found above RM 16 (Cummings and Schwartz 1971).

Green and white sturgeon both occur in Coos Bay. The green sturgeon appears to be the most abundant, and is found in the Coos River up to RM 25. White sturgeon have been found as far up as RM 10 (Cummings and Schwartz 1971). Both of these species prey upon Crangon, Macoma, Corophium, isopods, mysids, crabs, and fish (McConnaughey 1971).

Fish which inhabit the bottom of the navigation channel in Coos Bay are subject to entrainment by dredging activities. A total of four species or species groups of fish were found to be entrained by the hopper dredge YAQUINA in Coos Bay. The sampling took place between RM's 1+25 and 10+10 in the navigation channel. Pacific sand lance comprised 98 percent of all fish entrained by the dredge. Sand lance burrow into sandy substrates in an attempt to escape from predators or for rest, hence, they are very susceptible to entrainment. Other fish which were entrained by the dredge include juvenile flatfish, staghorn sculpins, saddleback gunnels, and miscellaneous gunnels (Moehl and Barton 1989).

(e) Birds. There are a wide variety of habitats available for use by birds in and around the Coos Bay estuary. In the marine subsystem, the area between the jetties provides storm refuge for a variety of marine birds including auklets, murres, puffins, cormorants, and pigeon guillemots. The cliffs of Coos Head provide nesting habitat for pelagic cormorants, pigeon guillemots, cliff swallows, and belted kingfishers. Waterfowl which occur here include harlequin ducks, oldsquaws, goldeneyes, buffleheads, scaup, scoters, cormorants, loons, grebes, and mergansers. Shorebirds are abundant on the rock bedrock shore near Fossil Point. Common species here include black oystercatchers, wandering tattlers, rock sandpipers, and black turnstones. The largest concentration of spring migratory black brant in the state are found almost exclusively in the tidewater area between fossil point and pigeon point, and across the bay on the North Spit.

The lower bay subsystem is used intensively by a variety of birds. The intertidal and shallow subtidal flats between Pigeon Point and the bend in the bay (RM 8) provide a heavily used wintering area and migratory stopover for Pacific flyway waterfowl, as well as shorebirds. Pigeon Point and the areas across the bay along the North Spit are used heavily by waterfowl. These areas are unique in the lower bay, as they are shallow and not affected by the strong tidal flow typical of the rest of this system. The islands along the North Spit in this subsystem provide nesting habitat for gulls, Caspian terns and double-crested cormorants as well as roosting areas for brown pelicans and various shorebirds. The area to the west of the islands is relatively sheltered, providing a feeding and resting area for a variety of waterfowl, including higher concentrations of puddle ducks than are found in the lower bay. Jordan Cove, located between RM's 8 and 9, is a heavily used wintering area for shorebirds and waterfowl. The high concentrations of waterfowl and shorebirds in these areas reflect a rich local invertebrate and fish community.

The tideflats of upper Coos Bay support relatively large numbers of feeding puddle ducks throughout the year. Substantial numbers of puddle ducks are also found on the tide flats of lower Coos Bay and Pony Slough in the fall and winter. Wintering waterfowl which occur in high numbers, include American wigeon, northern pintails, gadwalls, green-winged teal, mallards, northern shovelers, canvasbacks, and red-heads (Coos County Task Force 1980). Diving and sea ducks are most abundant in the channels of South Slough and lower Coos Bay though they are also common in the Glasgow/Kentuck region of the upper bay. These birds feed over tide flats on epibenthic organisms during high tide. Numerous species of shorebirds occur in the upper bay including; whimbrels, willets, marbled godwits, dunlins, sanderlings, least sandpipers, and western sandpipers (Coos County Task Force 1980). Other common birds in the upper bay subsystem include double-crested cormorants, western grebes, great blue herons, and great egrets.

Gulls and crows are common throughout Coos Bay. These birds are attracted by the output from fish-processing plants in Charleston and Empire and are frequent scavengers over the intertidal and open water areas.

(f) Marine Mammals. Harbor seals are the only resident pinniped, and most common marine mammal in the Coos Bay estuary. Harbor seals frequently haul out in large numbers on the dredge built islands of the lower bay. California and Northern (Steller) sea lions also occur in the estuary. These species are most abundant in the summer near the Charleston boat basin where they feed on fish and fish parts from the local fish processing facility. Important prey items include fish, and to a lesser extent crabs.

California and northern sea lions, elephant seals, and harbor seals frequently haulout on the offshore rocks between Coos Head and Cape Arago. Despite efforts at reestablishment, sea otters have been extirpated from throughout the State of Oregon. In 1970 and 1971 a total of 93 sea otters were released at Port Orford. Following this reintroduction, otters were observed at Cape Arago near Coos Bay; however, as of 1980 no sea otters have been observed in Oregon (Kenyon 1982).

Harbor porpoises are the only resident cetaceans in Coos Bay. Killer whales, which are occasionally observed in the lower bay, are probably attracted by the availability of prey resources including harbor seals and fish. Gray whales do not typically enter the estuary though they do occur in migration offshore. Gray whales and northern sea lions are the only marine mammals found in Coos Bay which are protected under the Endangered Species Act.

3.4 Biological Resources: Ocean Disposal Sites.

a. Introduction. Three studies have been completed over four seasons since 1979 for site designation and placement of material dredged from Coos Bay. The initial studies were conducted by Oregon State University (OSU) with follow up confirmation studies conducted by NMFS (Hinton and Emmett, 1993). The area investigated is shown on figure 3.12. The physical, chemical, and biological characteristics of this area were described in the OSU reports by Hancock et al. (1981), Nelson et al. (1983), and Sollitt et al. (1984). In the first phase of the study, baseline data was established for the entire area off of Coos Bay, from near-shore to offshore (170 meters, approximately 560 feet). The most extensive data was taken to a depth of 46 meters, (150 feet) which includes the area encompassed by the rock site. In the second phase of the study, the benthic invertebrates of three sites (F, G, and H) were examined and compared in detail; five sampling stations were used at each site. In the final phase, Site H was examined in detail with respect to spatial, temporal, and physical changes in species composition, abundance, and variance.

This examination was followed by a benthic sampling begun in 1980 at Site H to monitor changes at the site resulting from disposal activities. Bathymetric, sediment quality, and benthic invertebrate data were collected to characterize the changes at the site following repeated disposal of fine-grained material from the Coos Bay channel maintenance dredging program.

The 1992 benthic and fisheries studies were conducted to further evaluate the effects of utilizing additional area beyond the existing Site F boundaries to accommodate coarse-grained material (new work and maintenance) from the

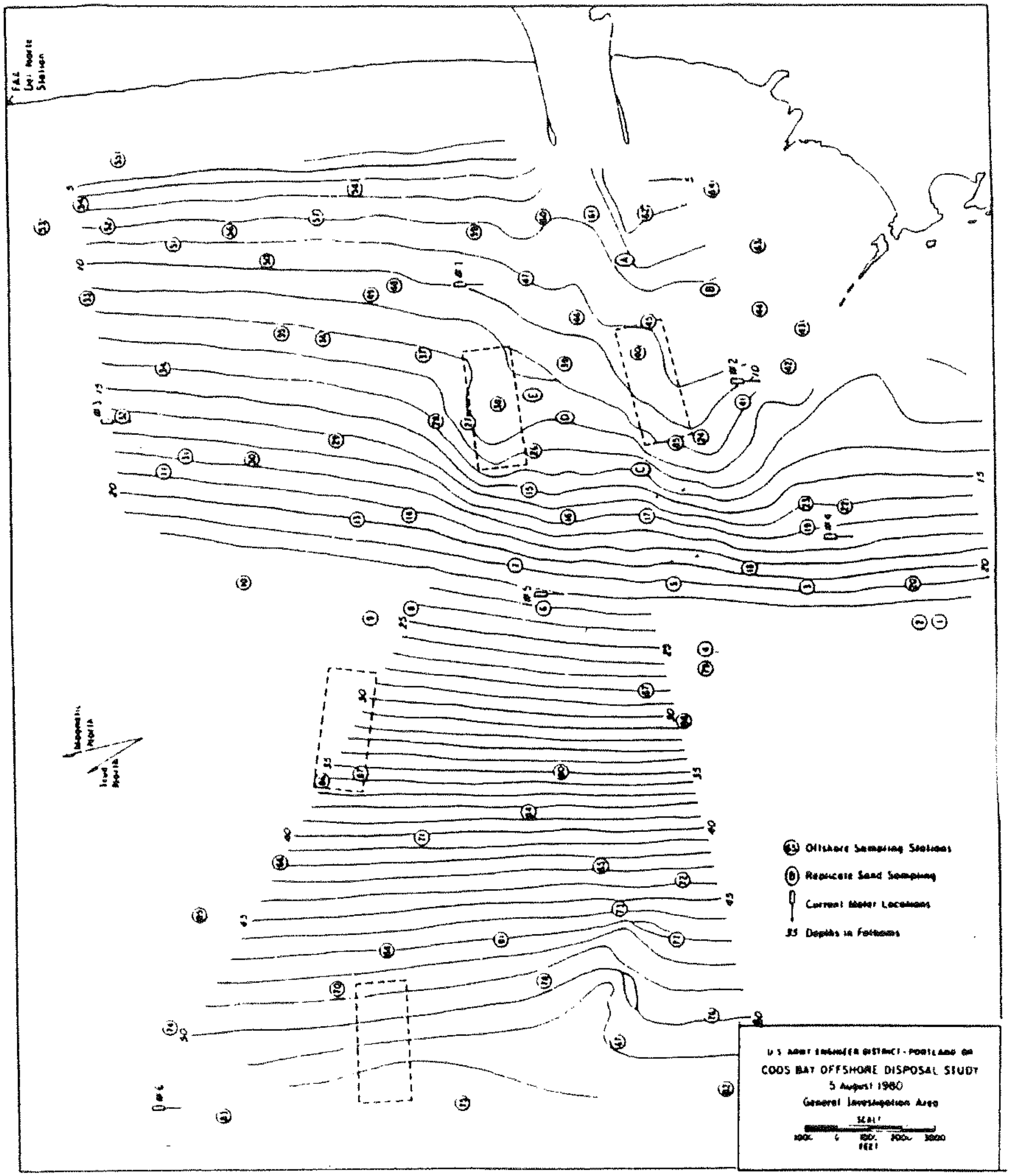

FIGURE 3.12 Coos Bay offshore study area, 1979–1983.

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channel deepening. Samples were also taken within the near-shore active transport area (9 to 18 meters depth) to determine the potential effects of disposal at this location. Benthic invertebrate and fish samples were collected in both April and October at the stations shown in figure 3.13. Methodologies are described in Hinton and Emmett (1993).

The area being evaluated for disposal of coarse-grained sediments (figure 3.14) ranges from a depth of 8 meters to 46 meters and contains two benthic invertebrate communities. The inshore, high dispersive area (8 to 15 meters), is characterized by stations 1 through 4 in the 1992 study and partially by the Shallow North Channel Eye grouping of the 1979 study. It generally consists of species tolerant of a high energy wave environment that are adapted to continued disturbance. The 15- to 46-meter depth area is less dispersive and has a benthic invertebrate community typical of that described for Site F and vicinity. It generally has greater species diversity than the inshore area.

b. Benthic Invertebrates.

(1) Site F and Vicinity. The 1978 studies described the area in the vicinity of Site F as the most homogeneous in community structure of the sites investigated during the two studies. The uniformity was attributed to the consistent conditions at the site, the small depth change (22 to 36 meters, and the consistency of the coarse, well-sorted sand at the site (Hancock *et al*. 1980).

The most abundant polychaete encountered at Site F was *Spiophanes bombvx*, followed by *Glycera tenuis*, *Ophelia* sp., *Notomastus lineatus*, and *Magelona sacculata*, respectively (figure 3.15). Table 3.4 lists the most common polychaetes encountered at Site F. *Spiophanes bombyx* displayed large variations in density throughout the site which were not explicable with the data obtained in the study. A variety of additional polychaetes were also encountered at Site F.

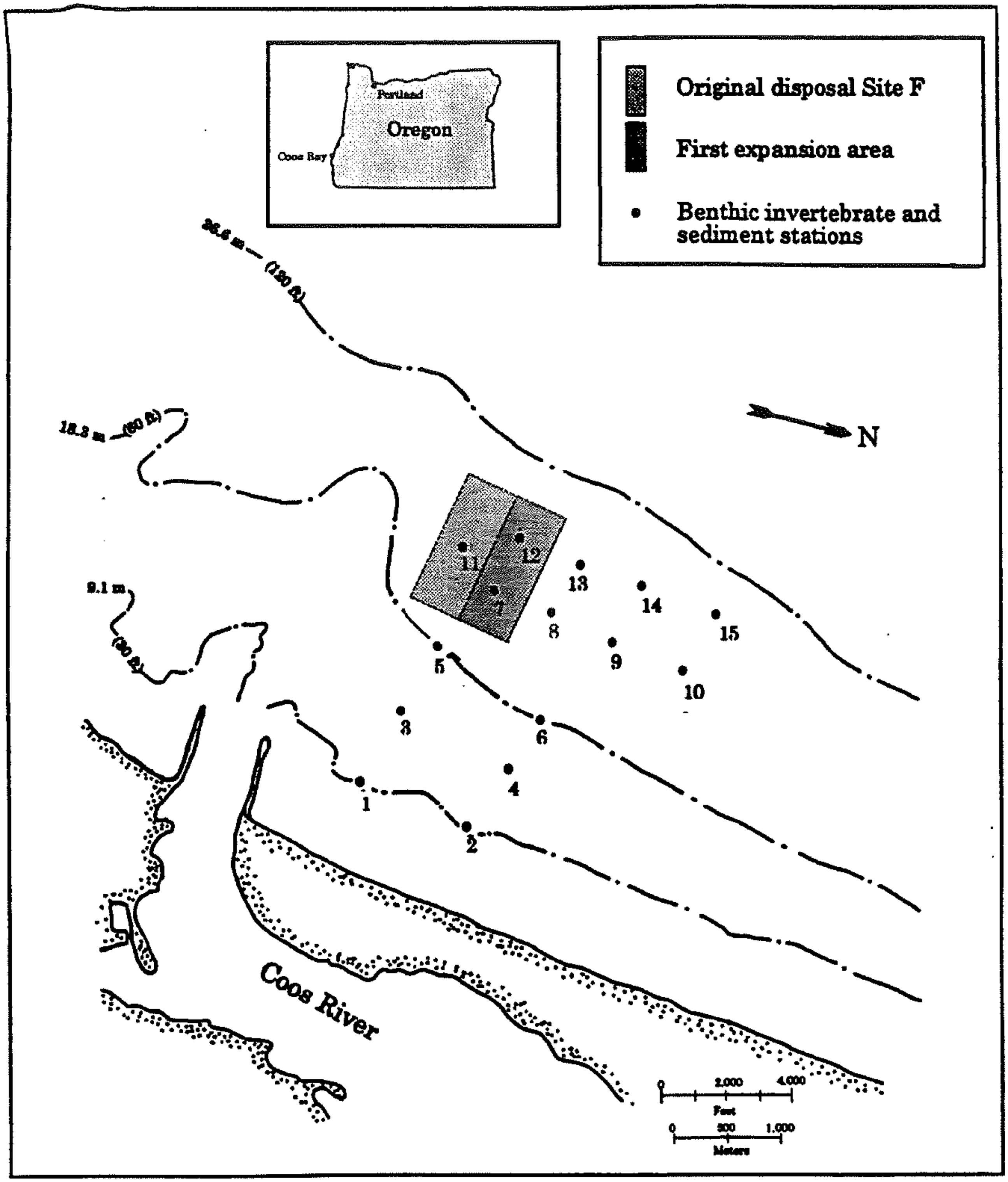

Figure 3.13. Locations of benthic invertebrate and sediment stations at and adjacent to offshore disposal Site F off Coos Bay, Oregon, April 1992.

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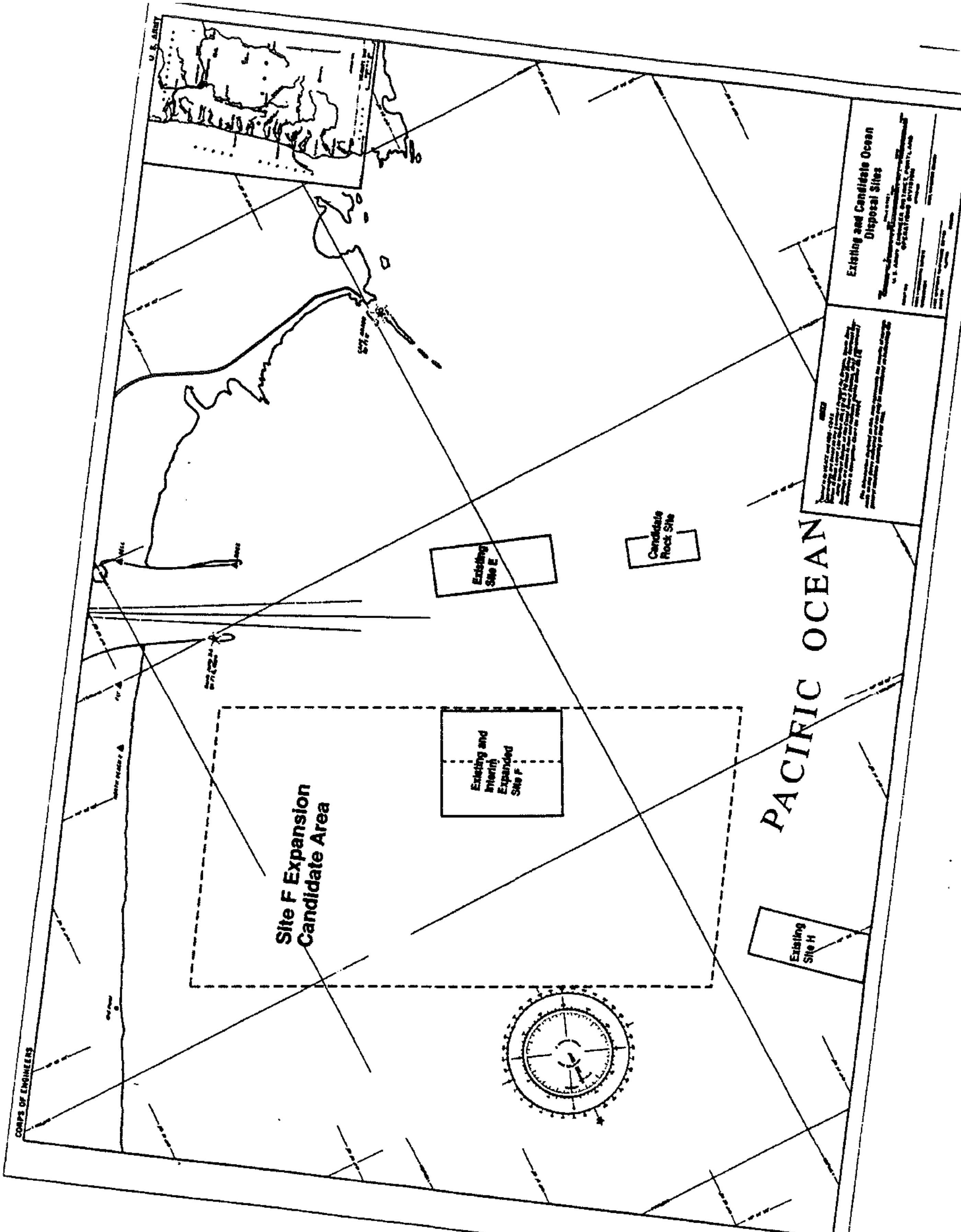

FIGURE 3.14

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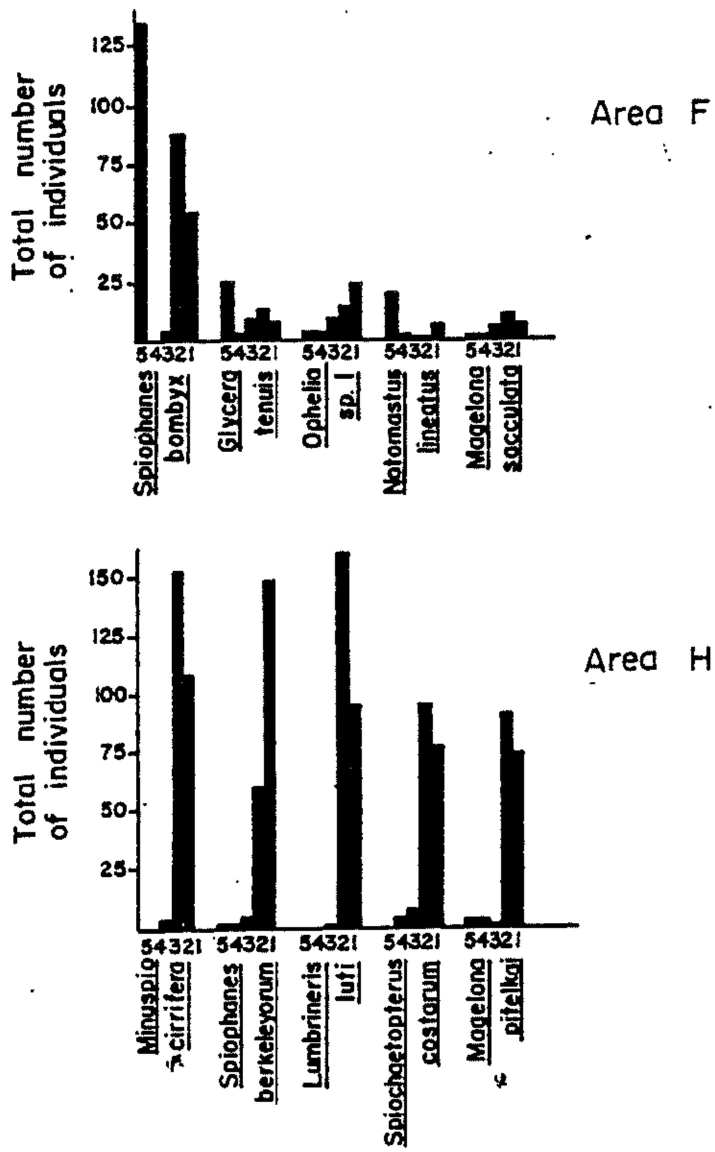

FIGURE 3.15 NUMBERS OF MOST ABUNDANT POLYCHAETES AT STATIONS WITHIN SITE F AND H, APRIL AND OCTOBER, 1979 (HANCOCK et al., 1981).

Table 3-4. Polychaete Species From Site F, Coos Bay, Oregon, 1980-81.

Spiophanes bombyx	Scoloplos armiger
Magelona sacculata	Thalanessa spinosa
Glycera tenuis	Notomastus 19ineatus
Chaetozone setosa	Onuphis iridescens
glycinde armiger	Paraonella platybranchia
Nephtys caecoides	Ophelia sp.
Haploscoloplos elongatus	Eteone sp.
Ceilonereis cyclurus	Nephtys caeca

The most abundant mollusks encountered at Site F included Olivella pycna, Olivella biplicata, and Tellina nuculoides (figure 3.16), which comprised over 95 percent of all mollusks encountered at the Site. None of these species were common at the other sites surveyed. Olivella biplicata was the only species which exhibited varied density within the site, occurring only in the three shallowest depths surveyed and with highest density occurring at the southeast corner of the disposal area. In general, mollusks demonstrated low numbers of species at Site F. This absence was probably due to the sandy, turbulent nature of the site.

The five amphipod species of greatest abundance included Foxiphalus major, Mandibulophoxus unicirostratus, Ampelisca macrocephala, and Hippomedon denticulatus (figure 3.17). Hippomedon denticulatus, Foxiphalus major, and Ampelisca macrocephala were low in numbers and exhibited uneven distribution.

Another benthic crustacean present at Site F was the cumacean Anchicolurus occidentalis. It was suggested by Nelson et al. (1980) that the low abundance and even distribution of some of the crustaceans would cause them to be sensitive to disposal activities at the site. This condition would be expected in that any large disturbance could conceivably wipe out a portion of the population. The uniformly low numbers over the site suggest that the area is not able to support a large population. Disturbances may not only adversely affect the population, but also cause a decrease in resources to support recolonization of the area.

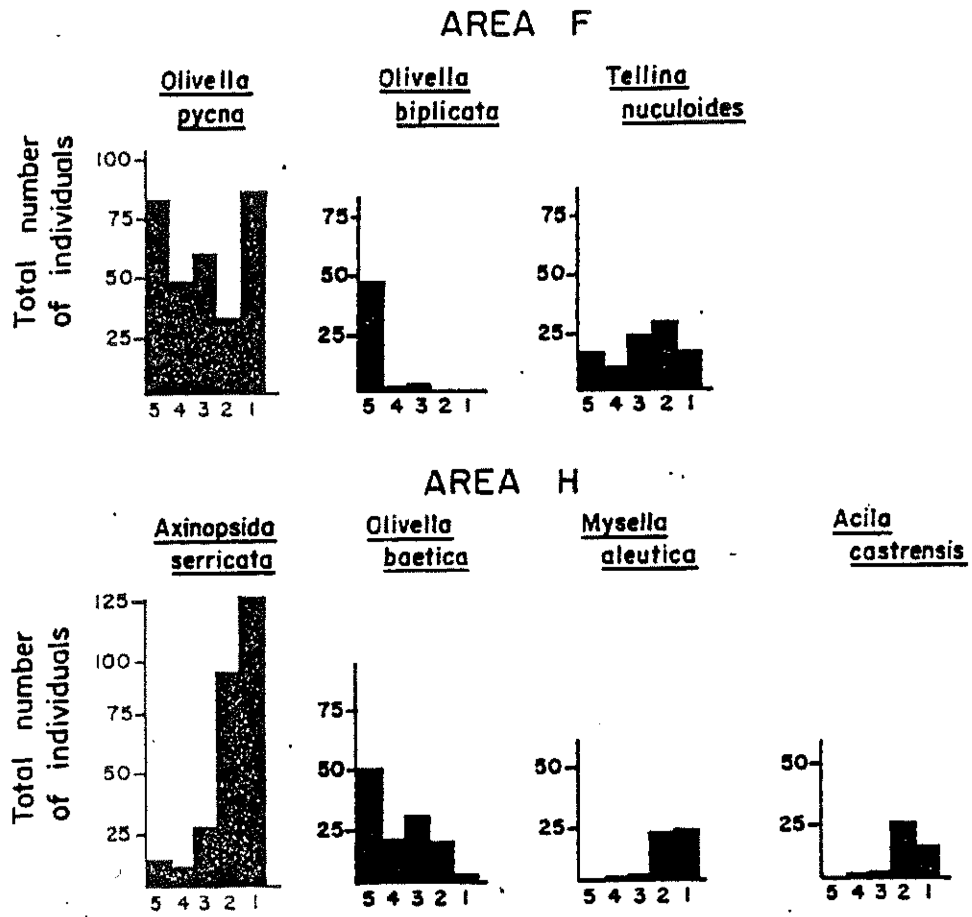

FIGURE 3-16. NUMBERS OF MOST ABUNDANT MOLLUSKS AT STATIONS WITHIN SITE F AND H, APRIL AND OCTOBER, 1979 (HANCOCK et al., 1981).

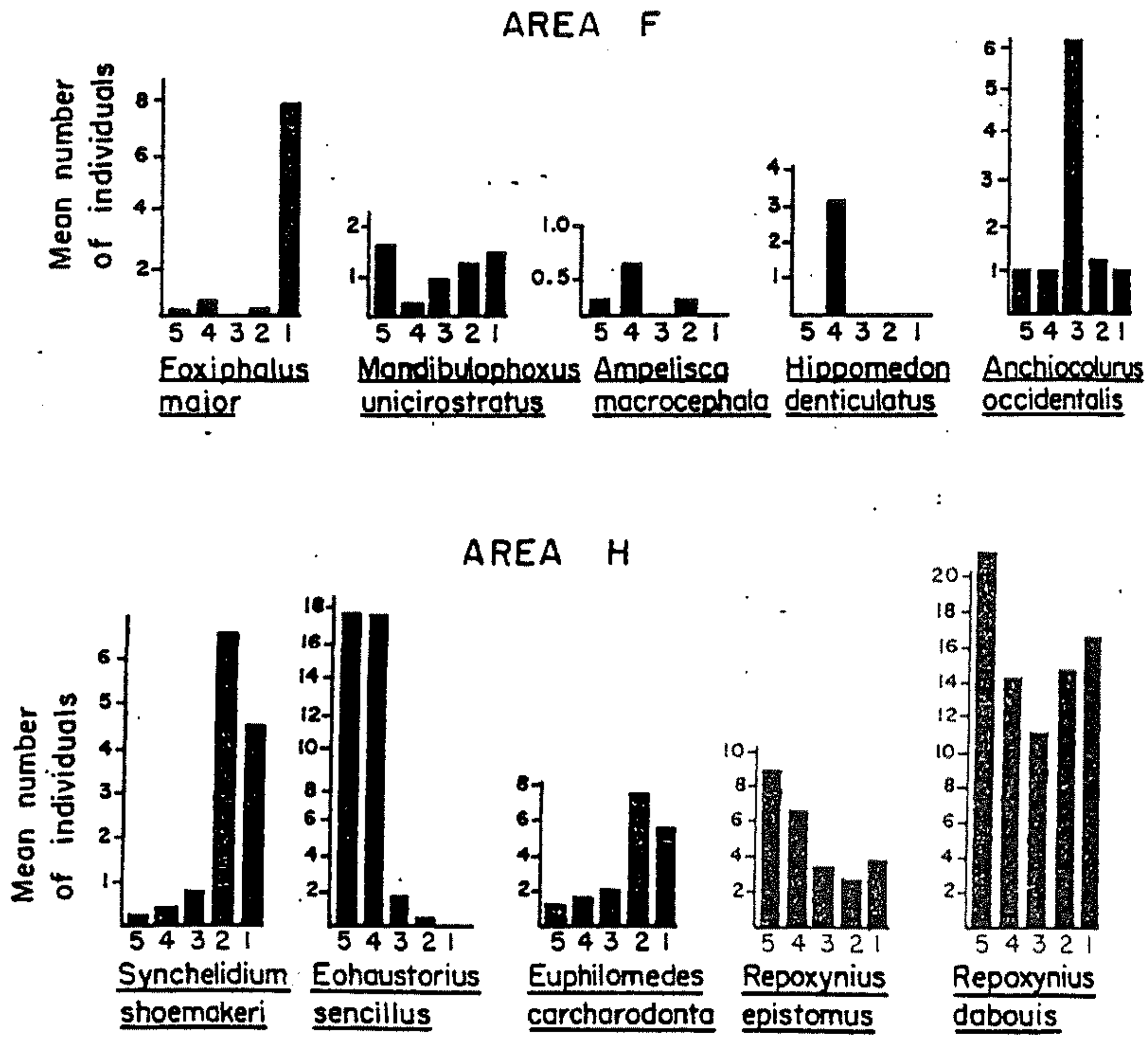

FIGURE 3-17 NUMBERS OF MOST ABUNDANT CRUSTACEANS AT STATIONS WITH SITE F AND H, APRIL AND OCTOBER, 1979 (HANCOCK et al., 1981).

The study concluded that the species richness and abundance was lower at the near-shore Site F than at the two sites surveyed further offshore. The homogeneity of the site was concluded to be due to the uniformity of the sediment in the site, the small variation in depth, and the turbulent environment of the area. It was determined that the effects of disposal would be short term and would be followed by rapid recruitment of benthic species due to: lack of evidence of disposal impacts, highly variable distribution of near-shore species, conformance of dominant benthic species to a high energy environment, and the primary source of recruitment being plankton (USEPA, 1984).

Results of the April 1992 sampling indicate that the area evaluated for proposed expansion of Site F is similar in species composition to that described by the 1979 studies. The data for the October 1992 sampling is expected to be available for the final EIS. The October data is likely to be similar to the 1979 results based on the results from the April sampling. In the 1979 and 1992 studies, *Magelona* spp. was the most abundant polychaete species and *Olivella pycna* was the most abundant mollusca species present in April. Both species are typical of benthic communities found in inshore high energy areas.

The inshore area identified as a high energy active transport zone had a similar benthic invertebrate community as the areas in the vicinity of Site F except for stations 1 and 2 where the species composition was slightly different. *Nephtys* spp. and an unidentified Nemertea were the dominant organisms present. Stations 5 and 6 also had much higher benthic invertebrate abundance than any of the other stations sampled (see figure 3.13). The reason for this is unknown, but the polychaete species *Magelona* spp. and *Spiophanes bombyx* were the species responsible for the large abundance and may represent a recent recruitment of juveniles to the area.

(2) . Site H. Disposal Site H is a transition habitat, supporting species from both the high energy near-shore and the deeper offshore environments (USEPA, 1984). The sediments at Site H are intermediate between the finer sediments at offshore Site G and the coarser-grained sediments at

Site F (Sollitt et al., 1984). The greater diversity of habitat types allows for a greater diversity of organisms at Site H. Nelson et al. (1981) and Sollitt et al. (1984), determined that the species occurring at Site H were a combination of near-shore and offshore species found at Sites F and G, respectively. In general, the abundance and species richness were higher at Site H than for the vicinity of Site F, and species were found to vary greatly between time and stations within Site H (Nelson et al. 1981).

There were five numerically dominant polychaete species: Minuspio cirrifera, Spiophanes berkeleyorum, Lumbrinereis luti, Spiochaetopterus costarum, and Magelona pitelkai (see figure 3.15). Unlike Site F, 24 species accounted for significant variations between stations at Site H (Sollitt et al. , 1984). Of the most abundant species, Minuspio cirrifera and Magelona pitelkai varied significantly between stations at all cruises. In the later study (Sollitt et al., 1984), L. luti was also found to vary significantly between stations. These species were all highly mobile detritivores which prefer fine-grained sediments (Sollitt et al. , 1984). Numbers of most abundant crustaceans at stations with Site F and H, April and October, 1979 are shown on figure 3.17 (Hancock et al. , 1981).

Of the mollusks encountered, Olivella pycna and O. baetica were the most abundant (figure 3.16). They are carnivorous gastropods which seem to prefer the more shallow stations and were the only two species which varied significantly between stations (Nelson et al., 1984). Site H also supported a larger number of bivalve species than did Sites F or G, the majority of which were filter or surface feeders. Most of these were found at the deeper stations. The lower energy and more settled sediments would provide a less vulnerable habitat for feeding and respiration (Nelson et al., 1983; Sollitt et al., 1984). The diversity and abundance of mollusk species was much greater at Site H than that for the Site F vicinity. The differences were thought to possibly be due to finer-grained sediments and less wave disturbance..

Crustacean species did not vary greatly between the five sampling stations at Site H (USEPA, 1984), but were in greater abundance at Site H than Site F (figure 3.17) (Nelson et al. , 1983). The crustaceans also showed a seasonal variation in abundance, reflecting strong seasonal variations normally occurring in the study area and along the Oregon Coast. Euphilomedese carcharodonta and Synchelidium shoemakeri were most abundant at the deeper stations while Eohaustorius sencillus was found at the more shallow stations. Repoxymius epistomus and R. dabouis were also abundant but were evenly distributed between the five stations (Nelson et al. , 1983).

The results of the monitoring study at Site H is described in detail in Jones and Siipola (1992). In general the short term impact of fine grained material disposal at Site H was minimal for some species and large for others. Polychaetes which are highly mobile, can dig out after a disposal event and not be greatly impacted. The molluscan species *Olivella baetica* and *O. pycna* are less able to recover immediately after a disposal event and were more heavily impacted. *O. baetica* is adapted to finer sediments and recovered to pre-disposal abundance, while *O. pycna* is more adapted to coarser sand sediments and did not fully recover to pre-disposal levels. Crustacea species were too high in natural variation to determine if there was an impact from disposal. Many of the species found in this area, however, are highly mobile and were probably not greatly effected.

After disposal events there was also an increase in abundance of estuarine species, presumably transported to the area from the dredge site. Most of these species are not adapted to high energy environments and did not survive at the disposal site.

Disposal activities seem to be one more perturbation that occurs to these organisms and though disposal is a fairly dramatic event most organisms seem adapted to being able to cope with this impact. The organisms most affected are the ones that are not adapted to the altered sediment type and they appear to not survive.

(3) Rock Disposal Site. The site currently being proposed for disposal of rock offshore at a depth of 46 to 60 meters is considered to be within the transition zone between the near-shore and offshore environments. The

transition zone is characterized as being intermediate between the low productivity of the near-shore area and the higher productivity of the offshore area.

An evaluation of the benthic species distribution indicated that the in-shore portion of the transition zone is less productive than the offshore portion of the zone. Benthic abundance is generally low except for a few species that are abundant throughout the zone such as some species of amphipods and shrimp.

c. Macroinvertebrates. Macroinvertebrates and fish were surveyed in October and April 1979 with follow up NMFS studies conducted in April and October 1992. The 1979 studies utilized twelve otter trawls consisting of a 7.3 meters semi-balloon type trawl net lined with 6 mm mesh liner were taken along depth contours in the near-shore area around the disposal sites (figure 3.18). Trawls T-01 through T-06 were taken in April 1979. Trawls T-07 through T-12 were taken in October 1979. The results were combined to characterize the macroinvertebrate and fish species of the area. No Dungeness crab were found in the vicinity of Site F and decapod zoea which would include megalops were in low numbers around the site as well (figure 3.19). Six crabs with an average length of 2 mm were caught by four 15-minute trawls in the vicinity of the proposed rock disposal site in April and October of 1979 (Hancock et al. 1981). Five Dungeness crab (Cancer magister) were found at Site H.

All were females less than 5.75 inches the legal harvest size for male Dungeness crab.

In the same sampling period, 1,008 shrimp of various species were also caught in four 15-minute trawls (described in paragraph 3.5c(1). In an area near the proposed rock site, 1,289 shrimp were caught in three 15-minute trawls (figure 3.20). Only small numbers of shrimp were caught in the offshore sites.

The low numbers of crab, shrimp, and adult fish were attributed to sampling bias due to the small sweep of the beam trawl and avoidance of the net by the more mobile organisms.

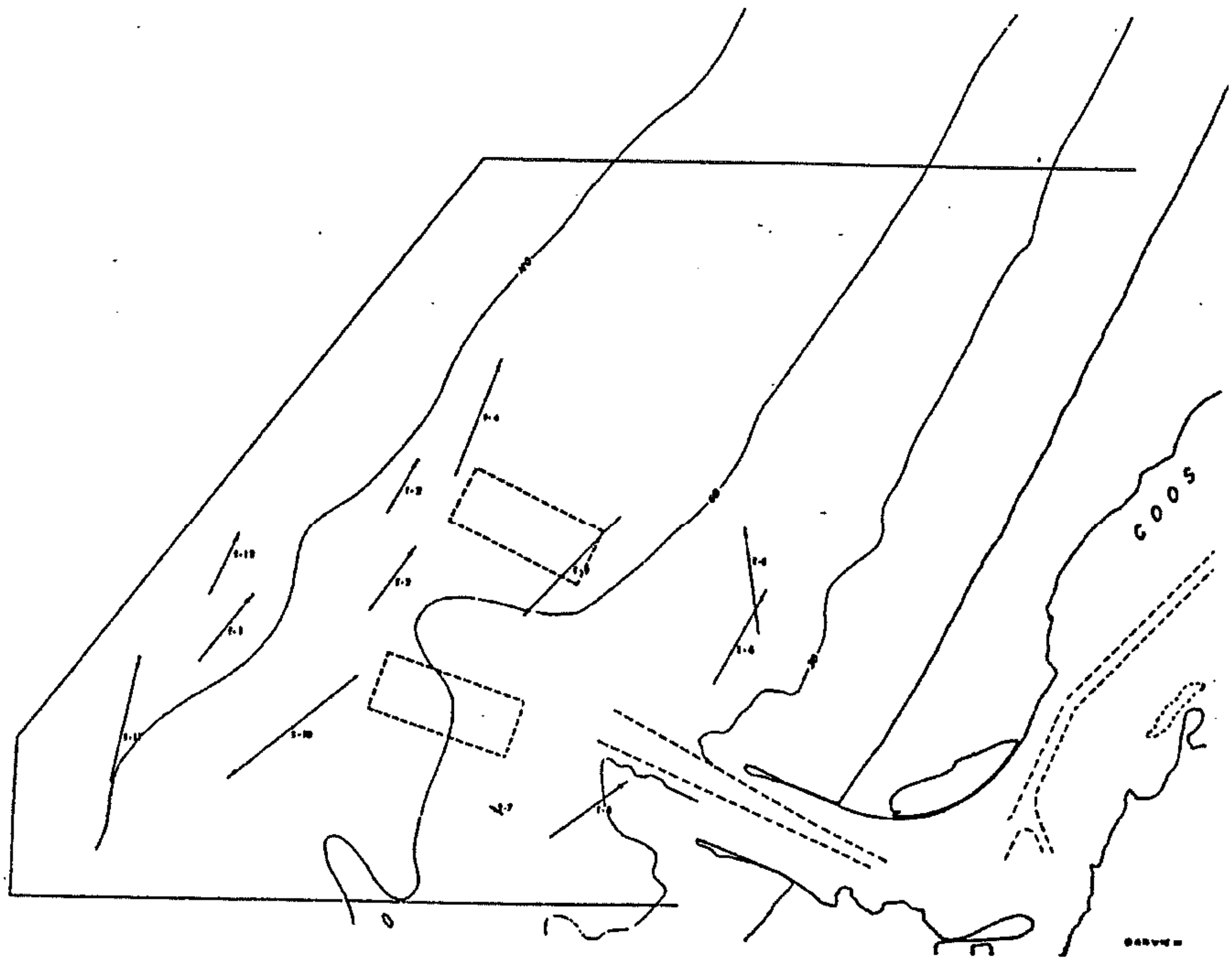

FIGURE 3-18 APRIL AND OCTOBER TRAWL TRANSECTS (HANCOCK et al., 1981).

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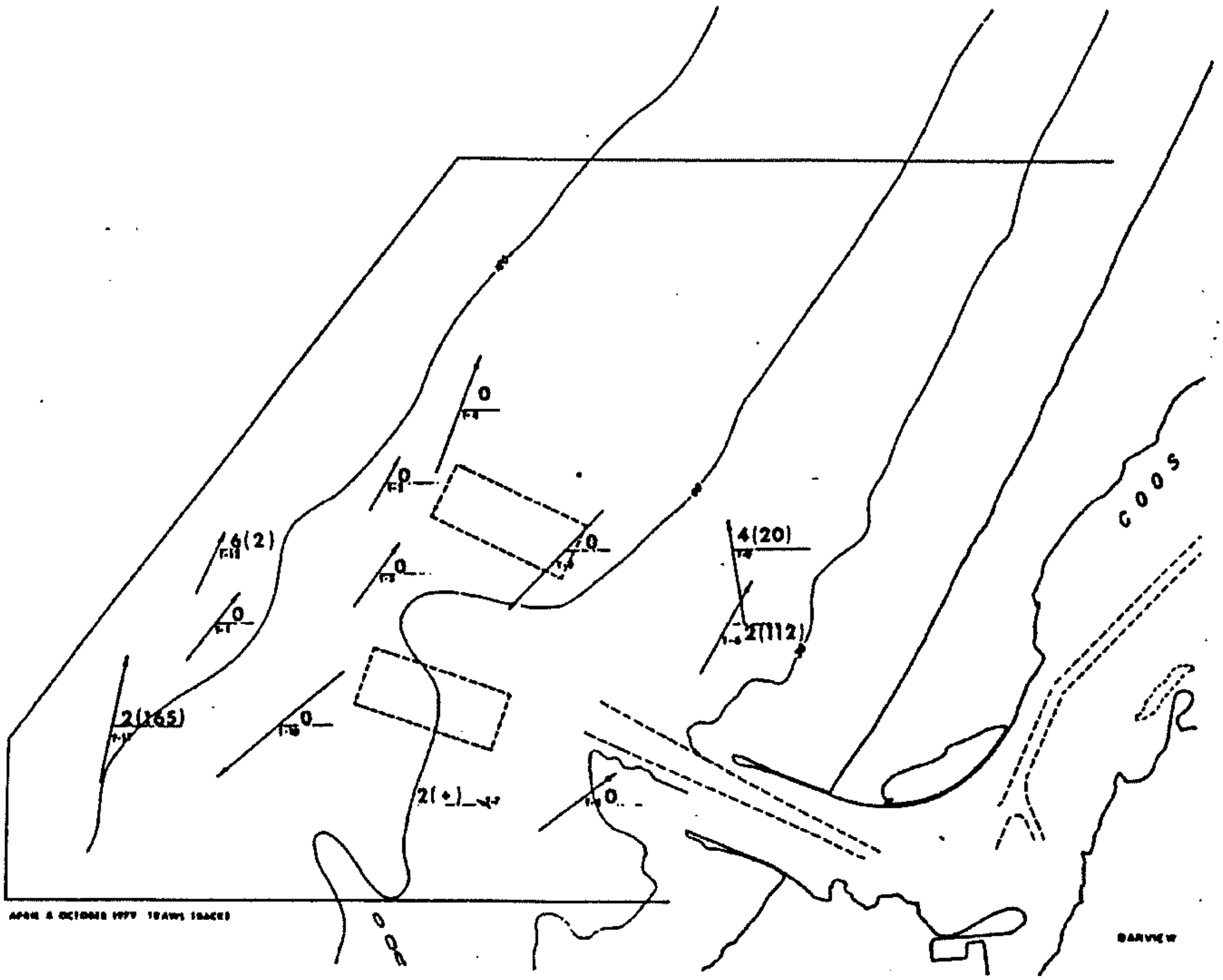

FIGURE 3-19 NUMBERS AND LENGTHS (IN PARENTHESES) OF DUNGENESS CRABS FOR EACH TRAWL TRANSECT, APRIL AND OCTOBER, 1979 (HANCOCK et al., 1981).

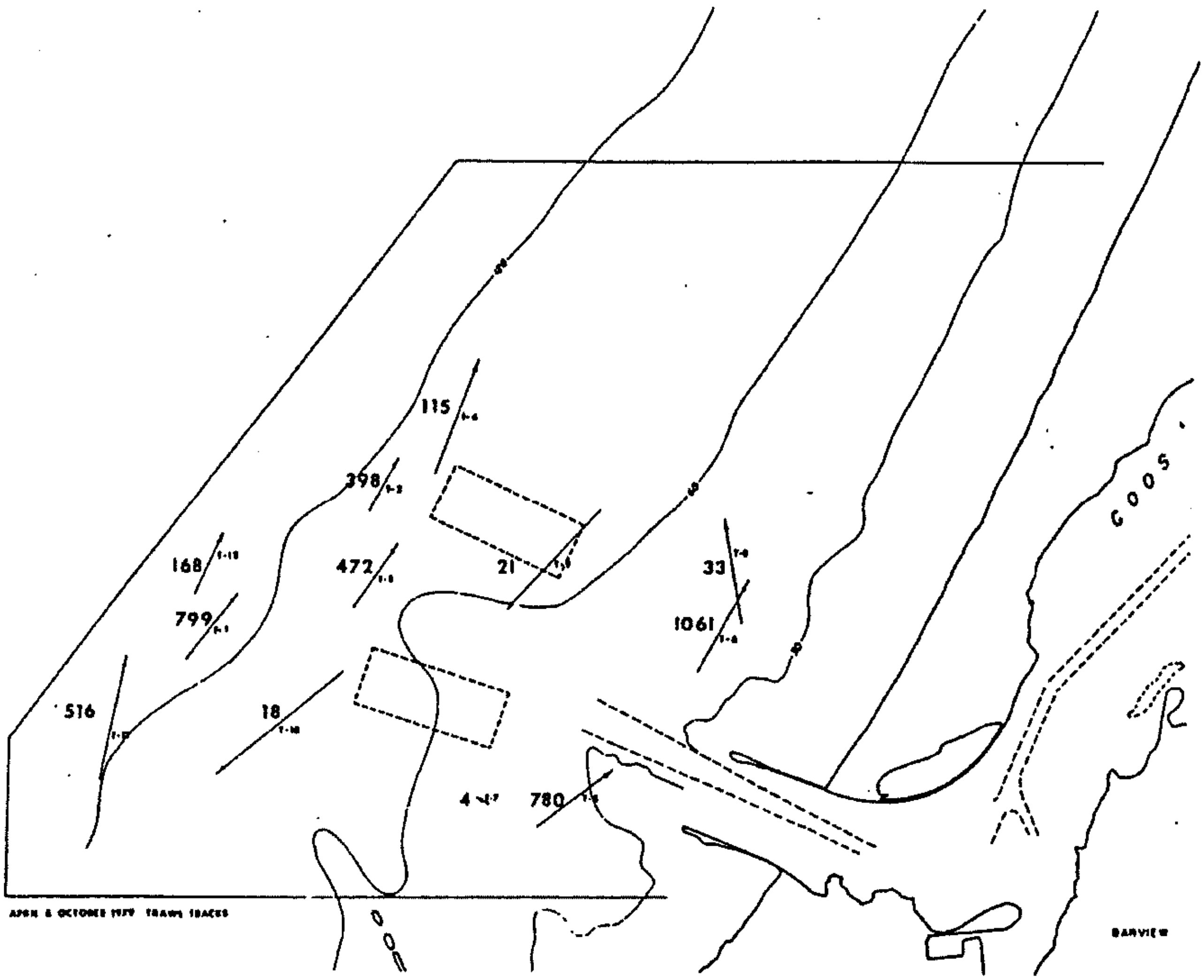

FIGURE 3-20 NUMBERS OF SHRIMP CAUGHT IN FIFTEEN MINUTE TRAWLS AT EACH TRANSECT, APRIL AND OCTOBER, 1979 (HANCOCK et al., 1981).

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d. <u>Fish</u>. Trawl samples were taken from 1980-81 (Hancock et al. 1981). Cruise I examined the near-shore area for epibenthic organisms in the vicinity of the disposal sites (figure 3.18). Trawl A combines T-1 and T-2; trawl B combines T-3 and T-4; and trawl E combines T-9 and T-10. Trawls F, G, H, and I represent the offshore sites, comprised of the transects T-14 through T-17. In 1982 and 1983, Site H was resampled to determine long term recovery of the site. Demersal fishes at the disposal areas were not sampled as disposal should have little effect on these species other than temporary avoidance of the sediment plume during disposal operations.

The 1992 studies (April results) concluded that fish species and abundance were similar to the results of the 1979 studies. The dominate species in both studies was juvenile speckled sanddab (*Citharichthys stigmaeus*) and the whitebait smelt (*Allosmerus elongatus*) as well as the northern anchovy (*Engraulis mordax*) in the 1992 study. The area inshore of the 36 meters contour is an important rearing area for juvenile flatfish in the spring and sanddab constituted over 70 percent of the fish collected in the April sampling in 1992. In the October sampling in 1979 speckled sanddab though still one the more dominant species was much reduced in abundance, indicating that the juveniles had moved offshore after rearing. The other dominant species was the night smelt (*Spirinchus starksi*). Based on the similarity of the April samples it is expected that the October samples will also be similar between the two studies.

The most abundant fish species (table 3.5) in the vicinity of existing Site F were juvenile flatfish. A large proportion of the sanddab encountered during sampling were juveniles. Sanddab are of marginal commercial importance. More important commercially, although found in lower numbers around the disposal sites, were sand, butter, and English sole. All of these fish were found in much lower numbers than occurred at the offshore sites.

Abundance of fish species at Site H (table 3.6) was similar to those found near Site F. Speckled (<u>Citharichthys</u> <u>stigmaeus</u>) and Pacific (<u>C</u>. <u>sordidus</u>) sanddab were found during each of the four trawls at Site H but were much lower abundance in the Site F vicinity. Rex sole <u>Glyptoceohalus</u> <u>zachirus</u>)

Table 3.5. Most Abundant Demersal Fishes at Site F.

COMMON NAME	SPECIES
Speckled sanddab	Citharichthys sigmaeus
Pacific sanddab	Citharichthys sordidus
Butter sole	Isopsetta isolepis
Night smelt	Spirinchus starski
English sole	Parophrys vetulus
Pacific tomcod	Microgadus proximus

Table 3.6. Most Numerous Fish Species Caught in Trawls at Disposal Site H, May, August, and December 1980, and May 1981 (Sollitt et al., 1984).

COMMON NAME	SPECIES
Pacific sanddab	Citharichthys sordidus
Speckled sanddab	Citharichthys sigmaeus
Slender sole	Lyopsetta exilis
Slim sculpin	Radulinus asprellus
Rex sole	Glyptocephalus zachirus
English sole	Parophrys vetulus
Sand sole	Psettichthys melanostictus
Pacific tomcod	Microgadus proximus

occurred at Site H but not at Site F. However, English sole Parophrys vetulus) occurred in less than 75 percent of the samples obtained at Site H, but in over 75 percent of the samples in the vicinity of Site F (Sollitt et al. , 1984). The absence or low catches of some species in trawls was probably the result of avoidance of the trawl (Sollitt et al., 1984). Site H appeared to be intermediate in species composition between Site F and the deeper offshore areas, but closer in abundance and catch rate to Site F (Sollitt et al., 1984).

The proposed rock site supports low numbers of fish species, although Pacific and speckled sanddab are present. However they were much less abundant than populations occurring in near-shore areas (Hancock et al. 1981). There were also 43 juvenile rockfish (Scorpaenidae) caught in one 15-minute trawl transect during the April and October 1979 surveys (Hancock et al. 1981). Rockfish are fished commercially and recreationally in the area.

e. Wildlife. Published reports of birds occurring offshore of Coos Bay are lacking. Varoujean and Williams (1987) reported near-shore areas off Coos Bay to be among the areas supporting the highest concentrations of marbled murrelets along the Oregon coast. Although there are few formal reports of bird species present in the vicinity of the disposal sites, casual observations of birds were made by Corps biologists in the summer of 1989 while aboard the dredge Yaquina. The fact that the dredge was actively disposing of dredged material at the time may have influenced some observations as it appeared that some birds were actually attracted by disposal operations. Birds that were observed at the disposal site include cormorants, common murres, and gulls. Also observed further inshore, closer to the jetties, were pigeon guillemots, brown pelicans, and tufted puffins. These species would be expected to occur at Site F as well. Other birds which are expected to occur in the area include scoters, phalaropes, common loons, Western grebes, storm-petrels, auklets, and snowy plovers. An important wintering and breeding area for snowy plovers is located on North Spit, directly inland from Site F.

A number of marine mammals occur off Coos Bay within the vicinity of the disposal site. In early spring and late fall, gray whales migrate off the Oregon coast. Some gray whales also summer along the coast of Oregon, but the numbers which may occur in the Coos Bay area are not documented. California and Northern sea lions, elephant seals, and harbor seals have been sighted in Coos Bay and haul out on the North Spit beaches. California and Northern sea lions and harbor and elephant seals haul out on rocky areas south of the disposal sites, at Cape Arago. Harbor porpoises have been observed swimming in the wake of ships in Coos Bay and probably occur within the disposal areas.

f. Threatened And Endangered Species. Federally listed species, under the administration of the NMFS, which may occur in or near the offshore disposal sites include: gray, fin, humpback, blue, Sei, sperm and right whales, northern (Steller) sea lions, leatherback, loggerhead and green sea turtles, Snake River sockeye salmon, Snake River fall and spring/summer chinook salmon and Sacramento River winter-run chinook salmon. These species, with the exception of northern sea lions, are not expected to occur in the

Coos Bay estuary. They are normally present in offshore waters and occur in limited numbers on a seasonal basis. More detailed information on these listed species can be found in the biological assessments situated in exhibit 7. Biological assessments have been forwarded (December 1990) and letters of concurrence have been received from NMFS (January 1991) for all species except loggerhead and green sea turtles and Snake River sockeye salmon and Snake River fall and spring/summer chinook salmon. Biological assessments for these additional species have been prepared and forwarded to NMFS for concurrence. We are also forwarding the previously submitted biological assessments to NMFS for review and concurrence due to the length of time since they were prepared and their associated concurrence letters received.

Five Federally listed species administered by the U.S. Fish and Wildlife Service (USFWS) occur in the project area. Species present are the brown pelican, peregrine falcon, bald eagle, western snowy plover and the marbled murrelet. Snowy plovers occur on beaches and upland dredged material sites and Coos Bay North Spit. Brown pelicans forage within the bay and near shore waters. This species also uses the bay, headlands, beaches, islands, rocks, and jetties for loafing. They are present from mid to late spring into the fall. Peregrine falcons generally occur in the Coos Bay area during spring and fall migration; a few wintering birds may be present. Bald eagles have established nesting territories in the Coos Bay area, but their occurence in the lower bay is infrequent.

Biological assessments have been forwarded to the USFWS (May and June 1990) and concurrence letters received for all species (July 1991) except for marbled murrelets which were only recently listed. A biological assessment has been prepared for murrelets and forwarded to the USFWS. We are also forwarding the previously submitted biological assessments to NMFS for review and concurrence due to the length of time since they were prepared and their associated concurrence letters received.

3.5 Human Resources.

a. Introduction. Euro-American settlement initially occurred in Coos Bay largely because of its protected natural harbor and strategic location relative to timber stands along the southwest Oregon coast. The first recorded shipment of wood products from Coos Bay was by the Simpson Lumber Company in the early 1860's. Since that time waterborne transport and the wood products industries have been the primary elements contributing to the social and economic conditions of Coos Bay and surrounding region. Today, Coos Bay is one of the largest water-based exporters of forest products in the United States. This position has been achieved through extensive development of industrial processing and handling facilities around the bay, and through publicly and privately financed improvements to the harbor. The wood products industry relies on waterborne transport both for local log movement and for export trade. The progressive deepening of the Coos Bay navigation system over the years has permitted successful use of larger export vessels.

b. Local Economy. Forest products, tourism, and fishing dominate the Coos Bay area economy. Agriculture, ship repair, and light manufacturing also play an important role. Lumber and wood products, although declining in recent years, is by far the largest contributor to the Coos Bay area economy. The industry accounts for nearly two-thirds of the area's employment and payrolls. Commercial and recreational fishing account for the next largest share of the economy with 1988 commercial landings exceeding 30 million pounds. The majority of the commercial and recreational fishing fleet is located at Charleston. In addition to recreational fishing, the tourist industry is sustained by other excellent natural resources of the Coos Bay area including numerous rivers, streams, mountains, forests, and the 10,000-acre Oregon Dunes National Recreation Area. These areas have been enhanced by the addition of camping, picnicking, fishing, hiking, golfing, and boating facilities. These natural resources and facilities have yielded a modest tourist industry which is aided by Coos Bay's location on U.S. Highway 101.

c. Waterborne Transport. The Coos Bay estuary, in conjunction with port developments, harbor facilities, and improvements in inland waterways, has been primarily responsible for the area's ocean-borne transportation and the related land-side trucking and warehousing, a large share of commercial fishing and fish and seafood processing, and some share of tourism. The natural waterway permits efficient movement and storage of economically important locally-handled bulk commodities. A total of 333 deep-draft vessels called on port facilities in 1988. The port and related transportation facilities are in a position to ship large amounts of these commodities (primarily wood products) to world markets. Waterborne exports in 1989 totalled nearly 4.7 million tons. A new import expected to benefit the economy of the region is nickel ore. Projected ore quantities are 1.1 million short tons per year beginning in 1993. U.S. Forest Service analysis of the wood products industry concludes that the market for these products will remain at about current levels for the foreseeable future. Waterborne transport would likewise remain near current levels.

The major docks in Coos Bay are concentrated along the 3- to 4-mile eastern waterfront of Coos Bay/North Bend. In addition, a major wood chip dock is located at RM 7, and smaller docks are located on the north spit and at Empire. The dock facilities are primarily equipped to export wood products and secondarily are outfitted to receive petroleum imports. There are a total of 13 major docks from which ocean-going cargo in deep draft vessels is received and dispatched.

d. Population. The population of Coos County in 1988 was 58,800. The largest city in the county is Coos Bay (population 14,220) with 24.2 percent of the county's population based on 1988 figures, followed by North Bend with a population of 8,850. According to U. S. Census figures, the average growth rate of Coos County for the years 1970 to 1986 was .2 percent. Table 3.7 presents a comparison of population between Coos County and the State of Oregon for the years 1970 to 1988. The Bureau of Economic Analysis, U.S. Department of Commerce, projects that southwest Oregon will have a population growth rate of 1.15 percent from 1985 to 2030.

Table 3.7 Population 1970 to 1988.

YEAR	OREGON	COOS COUNTY
1970	2,091,400	56,515
1980	2,633,200	64,047
1981	2,660,700	63,300
1982	2,665,200	61,750
1983	2,635,000	61,450
1984	2,660,000	61,000
1985	2,675,800	60,150
1986	2,661,500	57,500
1987	2,690,000	57,500
1988	2,741,000	58,800

Source: U.S. Bureau of Census

e. Land Use. Land use patterns of the Coos Bay estuary are a mixture of high-and low density commercial and industrial development, residential development and open space. Most of the high density developments are located along the Coos Bay/North Bend waterfront to about RM 8, which includes the Coos Bay/North Bend airport. Other, less intensively developed commercial and industrial areas are located at Eastside, Jordan Cove, Empire, and Charleston. Land use patterns are not expected to change appreciably for the foreseeable future.

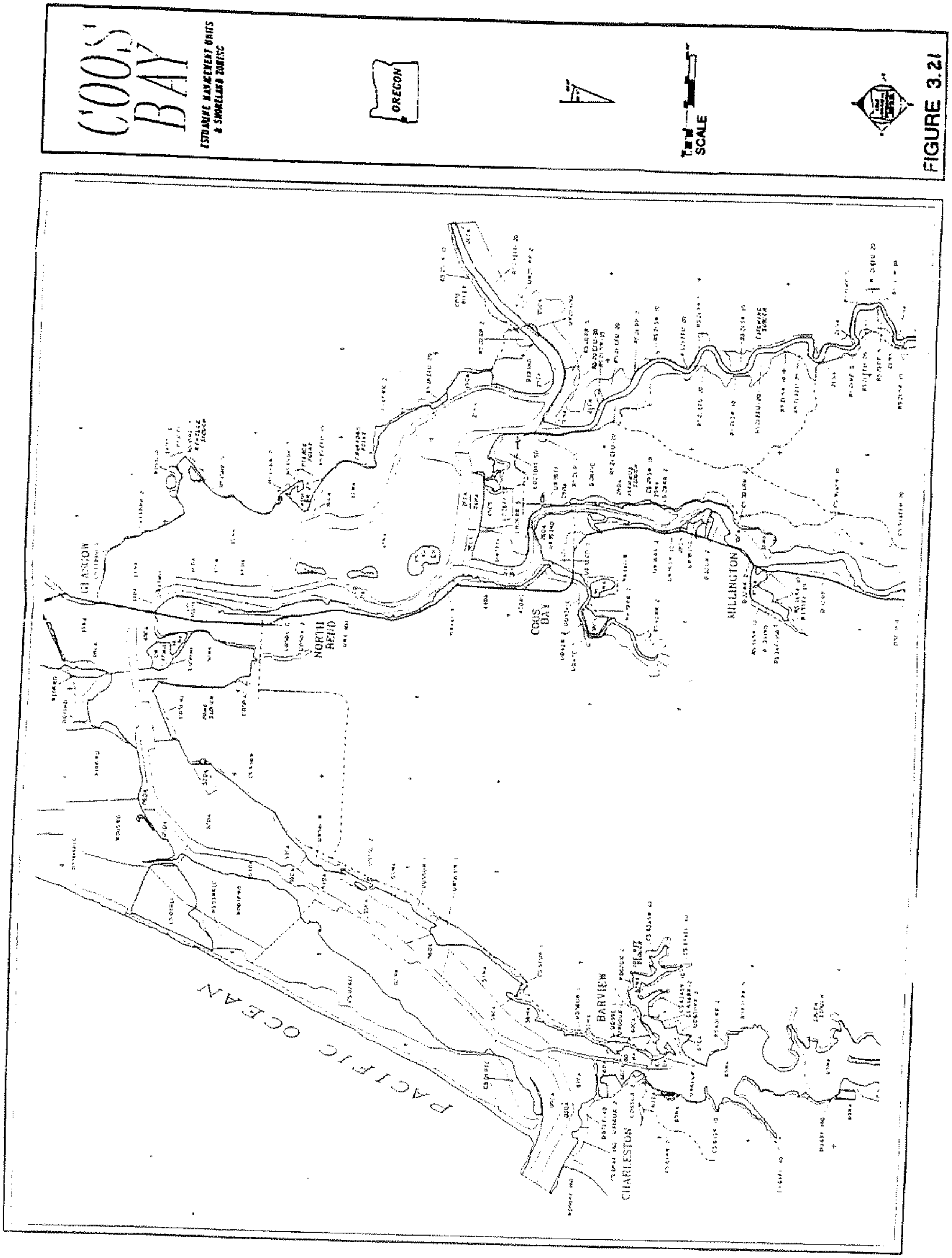
f. State and Local Land Use Plans. Coos Bay is identified in the Oregon estuary classification system as a deep-draft development estuary. As such, and as stipulated in Goal 16, Estuarine Resources, the Oregon Coastal Management Program (OCMP) recognizes that deep-draft port developments, navigation channels, and associated dredging and dredged material disposal are allowed and will continue. In addition, under Goal 19, Ocean Resources, the OCMP recognizes the need to "provide for suitable sites and practices for the open sea discharge of dredged materials which do not substantially interfere with or detract from the use of the continental shelf for fishing, navigation, or recreation, or from the long-term protection of natural resources."

The Coos County Comprehensive Plan contains policies, standards and estuarine management plans which describe the local plan for maintaining deep-draft navigation in Coos Bay. As mandated by the State of Oregon DLCD Goal No. 16, the Coos Bay Estuary Management Plan has designated management units for the shore-land and aquatic areas of Coos Bay. These management units are delineated in natural, conservation or development segments. The Coos Bay navigation channel, including the segment proposed for turning basin expansion near RM 12, is classified as a "Development Aquatic" segment.

Development Aquatic areas are managed for navigation and other water-dependent uses, consistent with the need to minimize damage to the estuarine system. Development Aquatic areas include areas suitable for deep or shallow draft navigation and in-water dredged material disposal sites. Figure 3.21 delineates all of the management segments for the estuary. Further discussion of local plan elements specific to proposed channel deepening are contained in the attached Coastal Zone Management Consistency Determination.

g. Aesthetics. The aesthetic character of Coos Bay is a mixture of the natural and the human in all aspects of sight, sound, smell, and character. Some areas of the upper bay are dominated by port and industrial development and attendant noise, congestion, diesel and wood product smells, and visual distraction. But this apparently negative aesthetic environment is somewhat relieved by the sights and sounds of seabirds, the natural backdrop of the east bay and the visual "interest" of port and industrial activities. Cargo ships and other vessels at dock or moving in the channel are also an integral part of this scene. Other areas, such as the lower bay, are dominated by natural amenities, particularly by views of the bay and the north spit. This part of the bay also contains the South Slough Sanctuary, a natural preserve where one can be totally absorbed in surroundings of water, forest and wildlife.

h. Cultural Resources. The Coos Bay estuary and region contain extensive evidence of prehistoric occupation. Although only two prehistoric sites have been formally documented, at least nine other sites have been reported along the shoreline of the North spit (from RM's 1 to 9). In addition, prehistoric sites have been identified on some of the low marshy mudflats and islands within the bay.



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During the early settlement period, Coos Bay was a center of pioneer settlement and economic development. The main method of traveling and supplying the settlements and military posts of Coos Bay was by sailing and steam ships. In addition, as the port facilities expanded and the lumber industry grew, Coos Bay developed its own ship building trade along the upper end of Coos Bay. As vessel traffic increased within the bay, a few vessels ran aground and were lost, and, depending on their age, contents and state of preservation may be significant cultural resources.

A shipwreck list for the Coos Bay area resulted in the documentation of 114 shipwrecks. The majority of these wrecks occurred along the beaches and at the entrance to Coos Bay. Thirteen of these vessels wrecked within Coos Bay. Of these, nine vessels sank and were not salvaged and presumably are preserved within the sediments of the bay.

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CHAPTER 4

ENVIRONMENTAL EFFECTS OF ALTERNATIVES

4.1 Physical Impacts: Coos Bay Estuary.

a. Predicting Future Changes. Predicting physical impacts on estuarine systems from dredging requires basic knowledge of the system based on historical data. Because of the importance of circulation and salinity changes, the Oregon Graduate Center was contracted to review the available historical data and assess the adequacy of that data to estimate changes in salinity due to channel deepening (appendix E). The expected impacts on the Coos Bay estuary involve decreases in water quality, and slight salinity and sedimentation changes. All of these changes are related to changes in estuarine circulation. Many of these changes were discussed at a workshop in July 1989 at the Oregon Institute of Marine Biology in Charleston, Oregon. The proceedings of this workshop are in appendix H.

The Oregon Graduate Center found seven sets of data from 1932 to present. Of these only four sets were readily available and only three sets were evaluated due to time and funding limitations. Rainfall and related river flow data and tidal data were also evaluated. These data were related to the timing of the data collection for comparability of data. The focus was on data related to salinity, but this focus would also apply to water quality and sedimentation. In 1930-32 water quality and currents were measured at 11 stations every two weeks. Tides, currents and water quality were measured at various stations for selected periods in 1973 and 1974.

Currents and water quality were measured at 11 stations during September and October 1982. Although this data is available, further analysis would require fairly extensive effort. Table 4.1 shows the relationship between some of the available data and past channel changes in Coos Bay.

Table 4.1. Relationship Between Available Data and Past Channel Changes.

DATE	ACTIVITY/REFERENCE
1930-32	Queen and Burt, 1955
1937	Navigation channel dredged to 24 feet deep
1951	Navigation channel dredged to 30 feet
1952	Entrance channel dredged to 40 feet
1956	Charleston channel dredged to 10 feet
1956-58	Burt and McAllister, 1958
1960-63	McAllister and Blanton, 1963
1966	Coos and Millicoma River channels to 5 feet
1970	Charleston channel extended up South Slough
1973-74	Arneson, 1975
1976	Butler, 1978
1979	Navigation channel dredged to 35 feet Entrance channel dredged to 45 feet
1982	NOAA data, unpublished

b. Circulation Changes. The only major circulation factor which will be affected by a deeper channel is tidal propagation. Tidal range predictions are based on data taken over 40 years ago. Arneson (1976) found that measured tidal ranges at the channel entrance were consistently greater than predicted ranges though the error was usually less than 15 percent. This data meant that high tides were higher and low tides, lower. The same results were found further upstream at the city of Coos Bay. Arneson hypothesized that extensive disposal islands and fills which have reduced the surface area of the bay since the original calculations were made, are the cause of the greater tidal ranges. Although the channel has been deepened, which might be expected to offset the effect of the fills, Arneson theorized that this has produced a more hydraulically efficient cross-section, so that there is less drag or dampening exerted on the tidal wave as it sweeps through the bay.

The rate of progress of the tidal wave means that the high and low tides occur progressively later the further from the mouth. Arneson also compared his measurements of timing of high and low tides to those predicted by the National Ocean Survey. At the mouth, actual tides were generally a little earlier than predicted but within 20 minutes of predicted times 80 percent of the time; however, tides were considerably earlier than predicted at the city of Coos Bay, with only 25 percent falling within 20 minutes. The official predicted time of high tide is 1 1\2 hours later at downtown Coos Bay than at the mouth.

Arneson again suggests that channel deepening may be responsible for this change, as shallow wave theory predicts that tidal waves move more rapidly at increased depth due to decreased frictional drag. One significance of the discrepancy between measured and predicted tidal ranges and timing means that ships, relying on high tide for sufficient clearance, may have to allow a wider margin of error when using the official tidal charts. During the Charleston workshop the effects of a deeper channel on tidal propagation were discussed and were similar to Arneson's predictions. Since Arneson's measurements, the channel has been further dredged to its present 35-foot depth, but the effects of this work on tidal propagation have not been assessed. Other potential physical effects of changes in tidal propagation include changes in tidal fluctuations over intertidal areas, changes in intertidal areas further upstream, increased salinity intrusion, increased sediment flocculation upstream, some increase in upstream bottom currents and concurrent sediment influx from the ocean, and overall increase in tidal prism volume.

c. Salinity. The salinity analysis for the proposed channel deepening is based on a survey of existing information (appendix E), a technical workshop, and results of the one dimensional computer model SALPLOT. This computer model was developed by the U.S. Army Waterways Experiment Station (appendix H) for determining salinity concentration profiles and lengths of intrusion within an estuary. SALPLOT was selected as being able to satisfactorily predict salinity shifts due to the proposed action. This determination was made based on the fact that Coos Bay is a well mixed system with low contributions of freshwater discharge and exhibits high tidal variation. Examining the observed salinity data shows that the salinity at Coos Bay is a high variable dependent upon tidal condition and seasonality. SALPLOT parameters include cross sectional area at the entrance, depth of the navigation channel, fresh water discharge, in addition to tidal velocity, range, and period as well as observed salinity values.

The SALPLOT computer model makes two basic assumptions: (1) the stream velocity and salinity distributions are assumed constant over each cross-section and vary only along the length of the estuary; and (2) the geometric cross section is constant over the length of the estuary. For this study, the computer model for existing conditions is based on salinity measurements (taken at bottom, mid-depth, and surface for both low and high tidal cycles) that were developed by Arneson in 1973 and 1974 prior to the most recent 5-foot channel deepening effort in 1978. The existing conditions model was then adjusted and updated to predict salinity conditions following the 1978 channel deepening. For verification purposes, the updated existing conditions model was then compared to the Oregon Division of State Lands average salinity measurements taken in 1983, and the new existing conditions model generally agreed with those measurements.

Because the SALPLOT computer program has some limitations previously discussed including the assumption of only one cross section at the entrance and one average depth, overestimated salinity values upstream River Mile (RM) 13+40 were reported for the proposed deepening. This overestimated salinity value is a result of model input not considering the shift in channel thalweg geometry for the proposed navigation channel at -34 feet mean low lower water (m.l.l.w.) to the authorized project upstream on the Coos and Millicoma Rivers at -5 feet m.l.l.w.. Figure 4.1 graphically illustrate this major shift in channel thalweg geometry at RM 13+40.

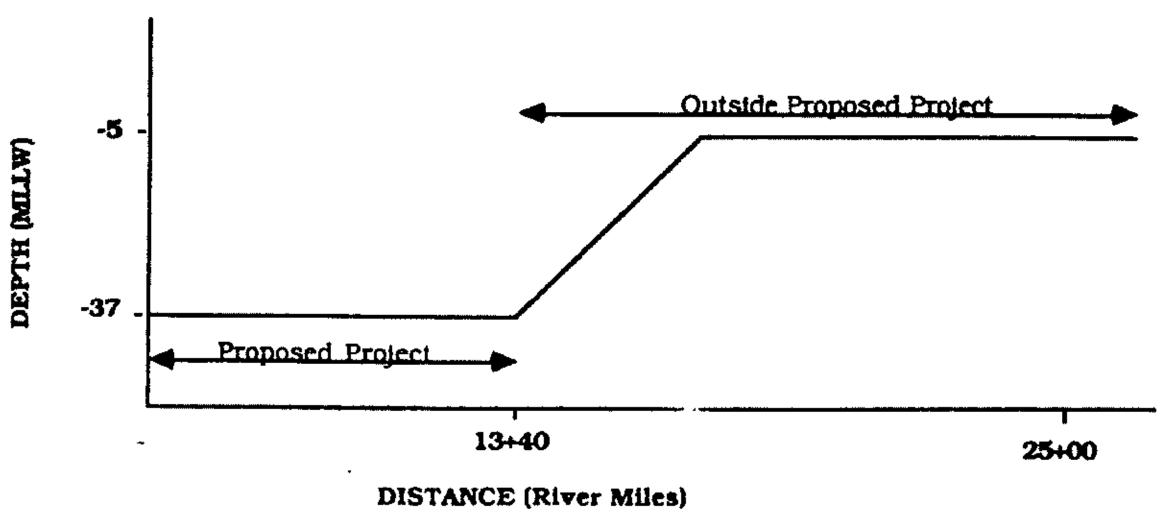

FIGURE 4-1. COOS RIVER PROFILE

To correct for this shift, the existing conditions model was run in a two-step iteration process to obtain salinity values upstream RM 13+40 for both existing and proposed channel conditions. First, the computer model was run for existing high and low flow conditions between the ocean entrance and RM 13+10. The model was then able to estimate the salinity at RM 13+40. This estimated salinity value was used as an input parameter for a second computer model run from RM 13+40 upstream to RM 25+00 on the Coos and Millicoma Rivers using the authorized channel dimensions. The second model for the upstream reach was able to project salinity measurements upstream to RM 25+00 and beyond for both low and high tidal conditions.

Table 4.2 displays the results of the computer run for the stations used by Arneson. The location of the stations as well as the observed salinity values for the low and high tide conditions for September 1973 are also displayed.

Table 4.2. SALPLOT Salinity Modeling Results.

Arneson September 1973 Data

RIVER MILE	LOW TIDE	HIGH TIDE
0.43	33.3	33.5
2.48	32.9	33.5
5.70	32.7	33.5
8.13	32.0	33.5
10.06	31.7	----
11.07	31.5	33.2
13.10	30.8	32.5
15.00	-----	
16.28	25.4	30.5
17.17	21.7	30.4

SALPLOT Prediction

STATION	RM	2-FOOT	5-FOOT	2-FOOT	5-FOOT
		DEEPENING			
Existing Condition (1973)	13+40	30.68	30.78	32.70	32.81
Proposed Condition (1995)	13+40	30.75	30.80	32.75	32.78
Existing Condition (1973)	25+00	0.40	0.41	27.11	29.34
Proposed Condition (1995)	25+00	0.41	0.42	27.13	29.34

The model calculated the salinity value at the confluence of the Coos River (RM 13.76) at high and low tide for the 1973 and 1995 condition. This resulted in a change from 30.68 to 30.75 ppt in the low tide condition and 30.70 to 32.75 ppt for the high tide condition. The salinity prediction 25 miles up the Coos River showed an increase from .40 to .41 for the low tide condition and 27.11 to 27.13 for the high tide condition.

Results of this two-step computer iteration process show only slight increases in salinity conditions (less than 0.1 parts per thousand or PPT) for both the main estuary downstream of RM 13+40, and the riverine portion of the estuary upstream of RM 13+40. Comparison of existing and future conditions-model results upstream of RM 25 shows very little if any detectable shift in salinity. Based on the accuracy of the model these two values should be interpreted as no change in salinity.

d. Water Quality. The water quality impacts from dredging are addressed in the Channel Maintenance Dredging EIS (COE, 1975). One of the impacts is a temporary increase in turbidity during dredging operations. Below RM 12 the bottom material is clean sand and produces only slight turbidity effects; however, extremely high turbidity were recorded in the upper bay during dredging operations. Turbidity levels as high as 500 Jackson Turbidity Units (JTU) were recorded.

Such levels are within the range shown to be harmful to benthic species and fish; however, the effects are temporary and return to acceptable values within minutes. Dredging in the upper bay can also bring about a temporary reduction in dissolved oxygen (DO) levels. The causal mechanism is the re-suspension of silty organic material in the channel sediments. This re-suspension may cause DO levels to fall below the minimum necessary to sustain life in some benthic species and fish for short periods.

e. Sedimentation And Sediment Transport. The 1976 EIS recognized that sedimentation was poorly understood in Coos Bay. Accordingly, a recommendation was made to monitor sediment transport and hydraulics as well as develop a numerical hydraulic model for Coos Bay. The 1976 EIS conceptual model of Coos Bay sedimentation describes accumulation of finer, river-borne sediments upstream of RM 12 and intrusion of marine sands to about RM 2. There is no net input of sediment between RM's 2 and 12; instead, hydraulic forces redistribute available sediment causing recurrent shoals in the navigation channel or changes in the natural channels, which, based upon experience in the Columbia estuary, is likely.

Additional channel deepening could lead to mobilization of sideslopes in areas presently stable and new shoals at those locations. A deeper channel will convey more riverflow and slightly lower current velocities in shallow areas of the estuary, which could lead to increased deposition of fine grained sediments, especially above RM 12.

Deepening of the authorized channel will directly lower that portion of the estuary. There will also be some redistribution or readjustment of channel side slope material outside the channel. These effects have been shown to be important in the Columbia River. The distance of this effect from the channel as related to the angle of the sideslope and the depth of the proposed channel. These effects usually occur during the first few years following dredging. Another effect could be recurring shoals at fixed locations which are continually fed by sideslope material which will contribute to some increase in long-term dredging, but dredging volumes before and after the last channel deepening in 1979 did not show a clear increase. There could be some increase in marine sediment intrusion, but would be less significant because of the magnitude of existing dredging.

f. Sediment Quality. Based on sediment testing throughout the channel in Coos Bay, there should be no sediment quality problem from dredged material during initial construction. The coarser sand sediments below RM 12 should cause minimal turbidity during dredging, quickly settling out and allowing water quality to return to ambient conditions. The finer sediments above RM 12 contain more organic material.

Turbidity impacts during dredging will be more severe above RM 12, but will not differ from those experienced during routine maintenance dredging.

Because of the hydrophobic nature and low concentrations of the contaminants present in the sediments, water quality standards should not be exceeded because of the dredging activities. In addition, dredging, disposal, and subsequent dispersal of the dredged material at the ocean dredged material disposal site would reduce the concentrations still further. Fine-grained material from the Federal Navigation Channel including the present turning basin at RM 12.0 has been deposited at ODMDS H since 1985. Based upon extensive evaluation of the sediment and the benthic community at ODMDS H, no unacceptable adverse environmental impacts are anticipated by the proposed widening of the turning basin due to sediment contamination.

Sediment quality evaluations from outside of the project area, but directly related to the project have been conducted by the Port of Coos Bay and various dock owners. Test results showed the existence of higher contamination levels in sediments located from RM's 12 to 14 outside, but adjacent to the Federal Navigation Channel limits. The bulk of the material for those particular docks tested was determined to be suitable for ocean disposal without management restrictions.

4.2 Physical Impacts: Ocean Disposal Sites.

a. Introduction. There are three ocean disposal sites being considered for the three types of material to be excavated during the proposed channel deepening. Sand size material from the mouth to RM 12 will go to expanded Site F. Finer material upstream of RM 12 will go to existing Site H. Rock material from below RM 5 will go to a new rock disposal site (see figure 3.4). Sites E, F, and H have been previously evaluated and most of the following information is from that work. There are specific and general criteria required to be evaluated for ocean disposal site evaluation. Those pertaining to the physical environment include site geography, size and location, sediment transport, water quality, and monitoring.

b. Location, Size, and Geography. Site H is the furthest offshore and would have the least conflict with navigation or competing uses of the ocean. There would also be no potential for impacts on adjacent recreational beaches.

Site H was selected as the optimum location for an Ocean Dredged Material Disposal Site (ODMDS) for fine sediments, and monitoring studies have been conducted to monitor the effect of ocean disposal of the fine-grained material.

As of July 1988, over 1.2 million y^3 of material has been disposed of at Site H. The first disposal action was carried out as a limited test dump in 1981 in conjunction with the U.S. Army Corps of Engineers-OSU study of Coos Bay offshore disposal sites. Routine disposal began in 1985. The disposal action in November 1987 was the largest to date (658,065 y^3). During September and October 1989, 400,000 y^3 of dredged material were deposited on Site H. Site H is located about 3.08 nautical miles northwest of the entrance to Coos Bay, Oregon. The site is 442 meters wide and 1,097 meters long with the long axis parallel to the slope. The site depth runs from 172.8 feet (54 meters) to 245.4 feet (76.7 meters). The bottom sediments at site H were shown to be uniformly fine sand (about 0.18 millimeters in size). The percentage of fines in the disposal site varies between 0.7 and 66 percent. The volatile solids range from 0.32 to 9.9 percent.

Site F has been expanded (doubled) to reduce potential navigation impacts resulting from mounding at the site. The site expansion has been to the north to reduce potential sediment transport back into the entrance channel. The proposed further expansion of Site F would potentially cover an area 4,450 by 2,450 meters. The center of this expanded site location is about 2.5 nautical miles northwest from the entrance. Site depths range from 8 to 47 meters.

The proposed rock site was located as near to existing rocky bottom as possible and still minimize navigation and biological hazards. It is in a depth of water which will prevent or minimize any impacts on adjacent beaches. The site size will accommodate the proposed disposal volumes with an evenly distributed mound under 1 meter in depth.

c. Sediment Transport. The disposal of fine grained material at Site H need not be modified from present practices as bathymeteric records indicate no persistent mounding. Movement has been to the north and downslope. No unacceptable adverse environmental impacts have been documented at Site H after extensive biological monitoring. Rock material placed in the "designated rock disposal site" should be immobile under all but the most severe storm conditions. Continued mounding at Site F may pose a navigational hazard, site modification for the long-term disposal of coarse-grained material will be necessary. The following discussion evaluates the likely sediment transport effects for coarse-grained material disposed within the area identified for potential long-term maintenance. See figures 2.3 or 3.14.

Coarse-grained sediments placed in a near-shore site, between 8 and 17 meters deep, will experience strong onshore and longshore transport during most of the year which will tend to disperse the dredged material. Dredged material placed at depths greater than 47 meters based upon Hancock, et al (1981) will be little influenced by waves and currents strong enough to cause significant movement. This would be a non-dispersive area. The area between 47 meters and 15 meters would be progressively influenced by waves and current sufficiently strong enough to cause movement with decreasing depth.

A test nearshore disposal of 836,000 y^3 of sand in 1988, and 585,000 y^3 of sand in 1989 was conducted by the USACE, San Francisco District at a site south of Humboldt Bay, California. The dredged material placed in a 4,500- by 1,100-foot nearshore site (between -15 and -18 meters m.l.l.w.) appeared to migrate shoreward, and in part, disperse. Of the 585,000 y^3 of material placed in 1989, one half had moved towards shore out of the disposal area by June 1990. By March 1991 only one fourth of the original 585,000 y^3 of dredged material remained in the disposal area (Hands 1993). Similar results would be expected for nearshore disposal at Coos Bay though dispersion rates would be greater if material is placed in shallower water.

Scheffner (1991) numerically modeled short-term and long-term fate of both fine-grained and coarse-grained dredged material at a disposal site off the entrance to Humboldt Bay. The disposal site, approximately 3 nautical miles northwest of the bay entrance, is located in 49 to 55 meters of water. Short-term numerical simulations of a single 2,500 y^3 disposal event showed that the coarse-grained material descended rapidly to the ocean floor, leaving no material in suspension. The maximum thickness of deposition was approximately 0.23 feet, covering an approximate 400- to 500-foot diameter area. This condition is similar to results calculated for Coos Bay sediments using an earlier version of the numeric model (Sollitt 1984). Long-term simulation indicated the coarse-grained material to be non-dispersive with normal wave and tidal/circulation currents. Storm events however initiated some movement. The simulation of a moderate storm event with an 8-day duration showed the centroid of the coarse-grained mound to migrate approximately 3.0 feet. The report concluded that a disposal site at those depths was non-dispersive for coarse-grained material.

The present Site F located between El. -20 and -26 meters m.l.l.w. as a calculated maximum transport rate based upon one directional flow and effective transport width equal to disposal Site F boundaries (1,097 by 427 meters) of approximately 100 to 1,000 cubic yards per day (Beeman 1990). Wave induced bedload movement would only occur at these depths for the months of November, December, January, and February. Further, the calculated transport rates are optimistic maximum values based on shear stress theory and continuous one directional flow. Actual near bed velocities are not sustained nor one directional. Transport rates based upon bathymetric surveys and dredged quantities indicates an average of 165,000 y^3 per year were transported away from the mound over a ten year time period (June 1979 to August 1988). Beeman (1990) gave the average annual disposal rates for this time period at Site F as 600,000 y^3. Based upon dredging records from 1986 to 1992 an average 983,898 y^3 of dredged material has been placed at Sites E and F annually. Yearly quantities have ranged from a low of 617,649 y^3 in 1989 to a high of 1,247,693 y^3 in 1991.

The Beeman (1990) study concluded that 71 percent of the material placed at Site F during the past 10 years remained in the disposal mound. Limited expansion of the site to the north would not increase the dispersive ability of the site until the bed elevation exceeded approximately 15 meters. Limiting mound heights to depths of 15 meters would provide 25 MCY of site capacity. At present disposal rates this would approximate a 25-year site life. It might be assumed that a six fold increase would provide a minimum

50-year project life. Larger (greater than six fold), deeper (non-dispersive) or shallower (dispersive) disposal areas would provide more dredged material disposal options including the ability of avoid navigation hazards caused by excessive mounding.

Transport of fine sediment back into the estuary can occur from Site F, but the percentage of fines in material disposed there is small. On-shore transport from the vicinity of Site H is highly unlikely and dispersion would scatter the sediments to the point that detectable volumes of material would not reach the coastline.

d. Water Quality. Water quality impacts may be divided into physical and chemical aspects. Increased turbidity is the principal physical effect. Disposal of the clean Type 1 sands would produce a very local short term increase in water column turbidity which would quickly be dissipated by local currents at all sites under consideration. Reworking of materials in any bottom mound would produce longer term impacts. Reworking of sediments at Site F is expected to occur during the dredging season while complete reworking at Site H may not be completed until the winter storm period. Consequently, resuspension of any fine material from Site F can be expected to be strong and continuous following disposal, where as deeper sites may have continual but weaker erosion of fines during the summer but rapid winnowing in the winter. Fine material associated with rock disposed at the rock site will also be winnowed rapidly.

Nelson et al. (1983) applied an experimental version of the Koh-Chang (1973) computer model for dredged material plume dispersion of Type 3 sediments. While their results are yet to be verified, the study suggested that the disposal of 3,000 y^3 of sediments under summer conditions could produce maximum vertically-averaged suspended sediment concentrations after 1 hour of 0.04 percent by volume at Site F and 0.004 percent at Site H. These values represent dilutions by factors of 500 and 5,000, respectively. These levels may be compared to summer field measurements by Plank and Pak (1973) off Newport. Averaging surface, mid-depth and bottom concentration for three stations less than 110 meters deep yields volume concentrations between 0.05

and 0.12 percent. The lower figure is approximately equal to the model's highest-projected vertically-averaged concentration after one hour. Consequently, it may be assumed that disposal operations will, under worst case conditions, produce a local turbidity impact comparable to natural events.

Since the majority of chemical contaminants appear to correlate strongly with the finer size fractions, it is reasonable to assume that the dispersal of the chemical contaminants would be proportional to the dispersion of the fine fractions. The final report from preliminary estimates by Nelson et al (1983) suggested that between 50 and 75 percent of the fine sediment would remain in suspension when dumped and would be transported from the disposal sites by mean currents. This material would likely contain much of the chemical contaminants with dilution comparable to those just mentioned. Elutriate analyses (Hancock et al. 1981) indicate that only ammonium-nitrogen, manganese, and cadmium may be released to seawater in sufficient concentration to possibly exceed EPA water quality criteria. Considering the dilutions measured during the 1981 test dump, these concentrations would be well below the levels of concern prior to exceeding the boundaries established by the 4-hour mixing zone. In addition, no significant differences were observed between tests and controls of the bioassay tests conducted. Bioaccumulation in test animals was lower than but in proportion to the concentration of chemicals and metals in the sediments (Nelson et al. 1983). The bioassay and bioaccumulation tests showed that the material is environmentally acceptable for ocean dumping.

4.3 Biological Impacts: Coos Bay Estuary.

a. Primary Impacts. Immediate impacts would be directly associated with the dredging of the channel. Benthic organisms within the channel, as well as along the side slopes of the channel would be destroyed or displaced by the dredging operations. The proposed deepening of the navigation channel between RM's 0 and 15 would entail the complete removal of 2 feet of material from the bottom of the channel, with removal of about 12 feet of relatively shallow material along the sides of the channel. (For every 1 foot of deepening there is assumed to be a concurrent 6-foot-lateral expansion of the side slope.) Throughout the length of the project, the maximum extent of subtidal habitat which would be directly impacted is estimated at less than 25 acres. Established populations of benthic organisms, as well as habitat for benthic and epibenthic organisms would be removed. Expansion of the turning basin at RM 12 would also result in the loss of benthic invertebrate populations and reduction of shallow water habitat. An estimated 6 acres of total habitat would be impacted.

Impacts to benthic invertebrate populations would probably be greater in the lower estuary (below RM 6). Densities and diversity of benthic invertebrate species were higher in the lower portion of the estuary than in the upper reaches [Jones, 1990 and Miller et.al., 1990]. These species, however, may recolonize rapidly since Jones (1990) found that the species composition at the lower estuary transect had changed distinctly between the December 1989 and April 1990 sampling due a change in sediment type. In December, Mytilidae, which are typical of a coarse bottom of rocks and shell debris were the dominant group while in April the sediment had switched to predominately sand and the dominate species were the sand dwelling polychaetes *Polygordius* sp. and *Saccocirrus eroticus*. The shift in sediment type is probably due to the winter storms bringing sand into the lower bay. This rapid shift in species types indicates that the organisms are adapted to major disturbances and can recolonize rapidly. Consequently, after the initial dredging the benthic community would likely reestablish quickly. In the transect at RM 4 benthic invertebrate densities and diversities were also high and the two side slope stations showed a similar switch in species from December to April, though it was to a more hard bottom type species in April. The mid-channel station consisted of species typical of a sand bottom.

The middle bay transect located at RM 8 had low density and diversity of organisms probably due to the substrate, which consisted of large chunks of shell and very coarse grained sediment. This type of sediment is very unstable and shifts considerable with wave and tide action. Consequently few if any organisms can survive this type of habitat and dredging in this area would probably have little if any impact on the benthic community. It may in fact improve conditions by removing some of the unsuitable substrate which could create more stable habitat. This area, however, is probably a collection point for this type of material in the estuary and this type of habitat would probably reestablish unless the dredging changes the current conditions.

The upper estuary had a benthic invertebrate community typical of fine grained sand and silts (Jones, 1990). Densities of organisms were generally low except for the station by RM 14 which had large numbers of oligochaetes which is typical of sediments with large percentage of organic material. Other dominant organisms included the spionid polychaetes *Polydora* sp. and *Streblosoma benedicti* and the cumacean *Lamprops quadriplicata*. At RM 9.5 dominant species were the polychaetes *Mediomastus californiensis*, *Spio butleri* and *Scoloplos armiger* in December. In April, the dominant species was *Tharyx multifilis* was has been used to as an indicator of large concentrations of organic material which in this region could be from pollution sources or the currents around the railroad and highway bridge causing the organic material to accumulate. Dredging in this area would probably have minimal impact. Parr (1973) studied the impact of a dredging project at RM 13-14 in Coos Bay and indicated that benthic organisms in the main channel recovered within 28 days of the dredging but did not experience natural population increases as the areas off the main channel possibly because of the condition of the newly exposed sediment. Once sediment conditions had reestablished benthic production would be similar to pre-dredging conditions.

Following the construction of the project, most channel areas would be expected to recolonize rapidly and be back to pre-dredge conditions shortly after dredging was complete. Reestablishment of benthic communities on the channel side slopes would not occur until they reach a natural angle of repose and provide a more stable habitat.

The area proposed for the expansion of the turning basin has a benthic invertebrate community typical of that described for the upper estuary. Species present are typical of those found in fine grain silty sediment. Initial construction would destroy some of the existing population, but recolonization would occur rapidly following dredging. A small amount of shallow water habitat may be impacted in the side slope area, however this is not considered to be a significant amount and recolonization of the shallower areas on the side slope would occur once they stabilize.

Impacts to the clam population may occur with the proposed deepening project in both the channel and side slopes and the area of the expanded turning basin. No estimate of the clam populations in the these areas are available, consequently the extent of the impact is not known. In-bay disposal of dredged material and/or resuspension of sediments may also affect local clam reproduction. Clam spawning occurs primarily in the spring and summer months. Dredging activities at this time could effect the recruitment of gaper clams which depend on hard objects on the substrate such as shells, and rocks or eelgrass on which they can attach. If these materials are covered with dredged material, recruitment is inhibited. Other clam species do not require similar substrates on which to attach, but they are nevertheless susceptible to smothering at the larval stage.

Maintaining the existing subtidal clam beds and avoidance of in-bay disposal in clam bed areas would minimize impacts to the local clam population. It is important that populations of mature clams are maintained as they are important seed sources for replenishing the clam populations throughout the bay.

Impacts to epibenthic invertebrate populations and fish are expected to be minimal. Some entrainment of epibenthic invertebrates and marine and euryhaline fish would occur during initial construction. The number of these organisms entrained is expected to be small compared to existing populations (Moehl and Barton, 1989). No salmonids are expected to be entrained during construction, since none were caught in the sampling done on the dredge during maintenance dredging in 1989 (Moehl and Barton, 1989). Impacts to salmonid food sources would be temporary and short term.

Most threatened and endangered species would not be present in the estuary (i.e., whales, sea turtles, salmonids) or would be present in off-channel areas. Northern sea lions and brown pelicans would be present in the navigation channel and off-channel areas. Dredging operations would only preclude these two species from a very limited amount of the overall estuarine habitat used by these species. Bald eagles and peregrine falcons are more associated with intertidal marshes and mudflats, shallow subtidal areas of various inlets and sloughs and adjacent uplands than the navigation channel. No impact to these species or their prey base is anticipated. Western snowy plovers are associated with sandy beach habitat and barren uplands and should not be impacted by construction actions in the navigation channel. We have concluded in the biological assessments developed for threatened and endangered species that the proposed action would have no adverse affect on the listed species.

Work will be conducted during in-water work periods coordinated with the USFWS and ODFW. Rock removal from RM's 0 through 5 will occur from 1 May through 31 January. Common excavation of material from RM's 0 through 12 would occur from 1 May through 31 August; removal of material from RM's 12 through 15 would occur from 1 July through 31 January.

b. Salinity Impacts. Results of the one dimensional salinity model indicated that the salinity change in the estuary would remain unchanged from the previous deepening done in 1978. The model showed, however, that this previous five foot deepening had resulted in an average salinity increase of 2-3 ppt in the upper river (RM 14-25). The effect of this change was not evaluated, consequently it is not known what change in the ecosystem occurred from this increase.

Coos Bay is, however, a predominately euryhaline system with the head of tide extending 11 miles upstream into the South Fork Coos River and the Millicoma River. Salinities from 2 to 14 ppt were recorded in the South Fork Coos River by Anderson (1985) during a low flow period in July. Consequently, organisms in the predominately freshwater part of the estuary which would most likely be impacted by a change in salinity are adapted to periodic episodes of salt water intrusion. An increase in salinity of 2-3 ppt from the original deepening then is not likely to have a significant impact to the ecosystem unless the duration of salt water intrusion increases. No estimate is available of the pre 1978 deepening or current duration of salt water intrusion in the upriver areas, consequently, no assessment of the change can be made for either the earlier deepening or the proposed deepening. It is unlikely that the change is significant this far upriver since there are already periodic intrusions of salt water into this area during low flows.

Organisms that could be impacted by increases in salinity in the upriver areas are juvenile salmonids, striped bass (*Morone saxatilis*), resident freshwater fish species and invertebrate and phytoplankton populations.

Juvenile salmonids utilize the freshwater saltwater interface areas as a transition area to adapt to saltwater conditions. Fall chinook juveniles may also rear in these areas for extended periods of time while adapting to salt water conditions. Alteration of these areas by changing salinity patterns could reduce the value of a particular area as a rearing/transition zone. No information is available on the extent or value of any of this rearing/transitional habitat so no assessment of the extent of the impact can be made, though it is likely that it is minor since the changes expected in both amount and duration of salinity change is minimal.

Striped bass use the upriver areas for spawning and rearing. Though they spawn in fresh or near fresh water, striped bass eggs can tolerate salinity of up to 10 ppt. Larval striped bass can tolerate salinities up to 15 ppt, but survival can actually be improved if salinity is between 10 and 12 ppt (Anderson, 1985).Consequently, changes in salinity in upriver areas affect striped bass survival.

Resident freshwater fish and invertebrates may be shifted slightly upriver with the estimated extent and duration of the salinity change. Since the impacts predicted for downriver are minor it is expected that impacts will also be minor in the upriver areas.

Increased salinity in the lower estuary may result in the increase in range of marine species and the upriver distribution of eel grass. Increase in eel grass populations could be a benefit to many species since eel grass beds provide productive habitat for a variety of species. Increased salinity in the lower bay could also spread the incidence of nuisance species such as the boring shipworm clam which will attack pilings further upriver if the salinity is increased to a level they can tolerate. Based on the SALPLOT model results, salinity increases are expected to be minor, consequently, this is not expected to be a problem.

c. <u>Secondary Impacts</u>. The deepening of the channel would slightly affect existing tidal and freshwater currents and the sediment deposition patterns within the system. As indicated by the salinity analysis (paragraph 4.1c.), a 2-foot deepening would not cause a perceptible change in salinity, either vertically or horizontally. Likewise, other water chemistry changes would be minimal. Sedimentation patterns resulting from tidal or freshwater flow, or modified tidal prism would not likely change with a 2-foot deepening. Studies of potential salinity changes conducted for the proposed Columbia River Coal Channel (USACE, October 1987) concluded that tidal fluctuations and velocity changes for up to 5 feet of depth increase could not be accurately measured. The salinity analysis conducted for the 2-foot deepening at Coos Bay tends to confirm this. Additional secondary impacts would be related to the promoting of the status of the International Port of Coos Bay. Continued use of the estuary by foreign ships will increase the incidence of inadvertent introduction of foreign organisms through fouling on the hulls of ships, which could effect native species by increasing competition for habitat and food. Other disturbances to the estuary related to shipping include propeller wash, anchor drag and wave action. Propeller wash and anchor drag create a situation whereby opportunistic or introduced species can gain a competitive advantage. Wave action from moving ships can contribute to shoreline erosion potentially impacting marsh habitat and species. The proposed deepening would not contribute any substantive increase in these disturbances.

4.4 <u>Biological Impacts: Ocean Disposal Sites</u>.

a. <u>Site E</u>. No additional impacts at this site are anticipated as quantities and type of material would not change from current disposal practices.

b. Site F. In comparison to the other sites investigated in previous studies, the area in the vicinity of Site F appeared to be the most suitable for location of new or expanded disposal sites. The near-shore, transition zone supported the lowest average abundance of organisms and was the most homogeneous in species composition of the sites investigated. Dispersal rates of the site are also higher due to the more extensive current and wave action, particularly in the nearshore areas. Expansion of the disposal area for coarse-grained material would impact areas previously undisturbed by dredged material disposal. Distribution of the material over a larger area, however, would reduce long-term impacts to a particular site by allowing a longer time for recolonization between disposal events. Disposal in the nearshore area would likely result in lesser impact than the offshore area since this is a high energy environment and the material would disperse rapidly. This would reduce the burial of organisms and allow them to reestablish more rapidly. Disposal over a larger area, either nearshore or offshore in a thin layer, would produce the least impact. The organisms would not be buried to any depth and the material would disperse more rapidly.

Juvenile flatfish were encountered at Site F as well as most other depths, however they were found in higher quantities at the deeper trawl sites. The area may be an important area for the rearing of juvenile flatfish, but it appears that disposal in the Site F vicinity would have less impacts to the fish than other, deeper sites.

c. Site H. Impacts to organisms, particularly benthic invertebrates, is greater at Site H than at Site F. During 1979 through 1983, the benthics of Site H tended to be surface and filter feeders. Disposal over these species would reduce their keeping capability; however, physical and biological characteristics of the site have resulted in only short-term impacts to species and allowed high recruitment rates.

It was observed by Sollitt et al. (1984) that there appeared to be little significant difference in species abundance or composition before and after the limited test disposal. The site has been monitored and a report prepared which identifies impacts of continued disposal on benthic organisms (Marine

Taxonomic Services, 1990). The monitoring results show little or no impacts to polychaetes and relatively minor impacts to molluscan species. In general, the species found in this area tend to be very motile and able to cope with the dynamics of the area of impact. New work disposal impacts would be similar to those which currently exist under the maintenance dredging program.

d. Rock Site. Although data on this area is less extensive than Site H, it is a preferred site biologically due to the fact that it is located within the transition zone and should exhibit similar characteristics to Site F. This fact is supported by some samples taken in the area (Hancock et al. 1981). It has also been seismically and geologically examined and has been determined to be comprised of gravel and sand; therefore, the proposed site has been determined to be a suitable site for the one time disposal of dredged rock.

Offshore disposal of dredged material and rock excavated from the navigation channel should have no adverse affect to threatened and endangered species. Disposal actions are limited in time and space which lessens potential impact to species present. Occurrence of whales is sporadic and/or seasonal in nature. Gray whales may occasionally be present in the disposal area during the southward migration. Northern sea lion occurrence in the disposal area is expected occasionally. Salmonids are expected to occur in the disposal area but the extent to which listed species would be expected is minimal. Presence of other listed species would be very limited in nature. Given the brief nature and limited spatial extent of disposal actions, the lack of contaminants in the material to be disposed, and the opportunity for either animals to avoid the disposal action or disposal operations to be delayed briefly as gray whales or other species pass through, no affect to listed species is anticipated.

4.5 Human Resource Impacts.

a. Local Economy. It is expected that the major impact of the channel deepening would be to improve the efficiency of waterborne transport. It is not anticipated that the project would result in major changes in the modes or relative scale of truck, rail, and waterborne shipments such that the Coos Bay timber service area would be changed. The primary service area of Coos Bay's wood products industry would continue to be Coos County ; the secondary area would remain the six-county region of Coos, Curry, Douglas, Lane, Josephine, and Jackson Counties.

The primary direct long-term effects of the proposed action would be related to wood products manufacturing and waterborne shipments. With shipping economics calling for progressively larger ships, shipping costs have increased rapidly at the Port of Coos Bay as a result of delays for favorable tides and "light loading." This condition is tenable only under the most favorable wood products market conditions. Even if the deeper draft channel is constructed, the wood products industry will be subject to short-term market fluctuations, and ultimately limited by timber supply. Employment, productivity, and investment in wood products industries are highly susceptible to national and international market instabilities. The project's positive economic effects would be realized largely during periods of rapid expansion of the market.

No new terminal construction is anticipated along the Coos Bay/North Bend waterfront, although rejuvenation of older facilities can be expected based upon current activity. No expansion is expected in the vicinity of Empire. Expansion is anticipated on the Port's North Spit property. The extent or nature of this expansion is uncertain. This potential development would occur with or without a deeper channel to different degrees and is addressed in the County Comprehensive Land Use and Estuary Plan.

The proposed action would disturb commercial and recreational fishing in the estuary during construction, and during periods of subsequent maintenance dredging. It is anticipated that these impacts would be minimal.

No short term or long term changes in retail or wholesale trade patterns or levels are expected to result directly from the project in Coos County.

b. Waterborne Transportation. Improved channel conditions at the Port of Coos Bay would facilitate the passage of ships through the Port. Larger vessels would be capable of embarking from Coos Bay with more cargo than they presently handle. Fewer large ships would have to delay their departures from the Port in order to take advantage of high tide conditions. As a result, channel improvements would reduce transport costs incurred by the shipping companies serving Coos Bay. The major long range result of improving the Coos Bay channel by the proposed dredging project would be to preserve the Port's position in relation to all other ports on the Oregon coast and the other modes of bulk transport--especially rail and truck. Channel deepening measures would not likely lead to large increases in the export of lumber and wood products, nor to the related import of petroleum products, since harvesting of timber in the Port's resource area is not expected to increase materially and may even decline over an extended period. Primary exports expected to benefit from channel deepening are wood chips, logs, lumber, paper, and plywood. The absence of channel improvements would lead to absolute declines in port traffic in the future.

c. Population and Employment. It is unlikely that the project would affect the total population size or distribution. In the short term, the project would have little impact on age structure or population mobility. In the long term, the project might afford greater economic opportunity or prevent declines in economic productivity which, in turn, might discourage the out-migration of some young people.

The impact of the project on employment depends on how shipping companies respond to improved access to Coos Bay. If wood product shipments increased as a result of the project, employment in the dependent sectors of the economy would rise. However, the major impact of the project would be to reduce the incidence of "light loading" and delays for the existing level of waterborne commerce. Thus, shipping cost savings would be the primary result of the project.

d. Land Use and Land Use Plans. The proposed channel deepening would have little effect on land use in the Coos Bay area. The deepening would allow for continued maintenance of existing patterns. Economic factors, particularly related to wood products industries would determine future land use changes. As discussed in the attached CZM Consistency Determination, the Coos Bay Estuary Management Plan would not need to be modified to address channel deepening.

e. Cultural Resources. The cultural resource most likely to be directly impacted by the proposed project would be submerged shipwrecks in the estuary and/or in the ocean disposal sites. Potential project impacts may include exposure and destruction of remnants of shipwrecks if present in the locations of areas scheduled for dredging or impacts from disposal at new ocean disposal sites.

The generalized locations of shipwrecks within Coos Bay have been evaluated and determined that dredging activities would not impact known sites within the bay. The new ocean disposal sites required for channel deepening and short-term maintenance requirements (rock disposal site and expanded Site F) have been evaluated and no shipwrecks are known to exist at these locations. The area being investigated for long-term maintenance requirements will require further cultural resource evaluation as part of the final site selection process.

f. Aesthetics. The aesthetic environment of Coos Bay with the exception of short-term turbidity from dredging would not be affected by the proposed channel deepening.

4.6 Unavoidable Adverse Impacts.

a. Dredging Impacts. Deepening the navigation channel and associated berthing areas would slightly modify the bottom topography of Coos Bay. This would modify subtidal habitat and adversely impact benthic species which, in turn, are a food source for a variety of species higher in the food chain. A deepened channel would also result in minor salinity changes which would likewise affect benthic and other aquatic resources. Dredging activity and turbidity would temporarily disturb and displace motile aquatic species. An undetermined percentage of less motile species such as clams or sand-burrowing species such as sand lance would be removed by the dredges and displaced to the disposal sites. The majority of these impacts would occur during the initial deepening activities. Most populations would re-establish and conditions would revert to near pre-deepening with periodic disturbance from maintenance dredging.

b. Disposal Impacts. Ocean disposal would alter the bathymetry at the described disposal sites, altering habitat and burying some benthic organisms. Disposal activities and resulting turbidity would also temporarily disturb and displace motile aquatic species. Commercial and recreational fishing activities would be temporarily affected by disposal activities.

If material dredged from berthing areas is determined unsuitable for in-water disposal, an upland disposal site would be provided by the Port of Coos Bay. The most likely site to be used for disposal would be the Eastside peninsula area. This site is identified for water dependent development in the Coos Bay Estuary Plan has been previously used for dredged material disposal. Low-lying portions of the site have converted to wetlands but remaining uplands area appears adequate for any foreseeable dredged material quantities.

4.7 Cumulative Impacts. Cumulative impacts are defined by CEQ Guidelines as "...the impact on the environment which results from the incremental impact of the proposed action when added to other past, present and reasonably foreseeable future actions regardless of what agency or person undertakes such other actions." Actions related to the proposed channel deepening are past and present channel deepening and maintenance actions, port and community development actions, and potential future actions related to navigation development. This and earlier referenced EIS documents, fully address past, present and potential future actions directly related to navigation development in Coos Bay. The following discussion addresses reasonably foreseeable future actions related to channel deepening which could indirectly affect physical, biological or human resources.

a. Physical Impacts. Future port developments could result in reduced water and air quality in Coos Bay through introduction of pollutants from increased ship traffic and new industries. This trend could in turn lead to additional population growth and further sources of pollution. Additional port berthing areas may require dredging and disposal of additional sediments. Port developments could alter shorelines and adjacent upland locations.

b. Biological Impacts. Reduction of air and water quality as well as increased development and activity in Coos Bay would impact several aquatic and non-aquatic species. Productivity of the aquatic environment would be reduced with increased ship traffic and pollutants. The severity of impacts from these sources would be relatively higher than from currently existing sources. Additional port and industrial development could impact previously undeveloped shoreline sites. The most likely locations would be on the Coos Bay north spit. These potential developments could remove several acres of valuable habitat for a variety of birds and mammals. Specific impacts from potential future development in this area is included in the North Bay Marine Industrial Park EIS prepared for the Port of Coos Bay in 1982.

c. Human Impacts. The navigation channel is a key component in maintaining the economic viability of the Coos Bay area. Local population growth would likely continue at current rates and ongoing needs for community services would likewise continue. The aesthetic environment of Coos Bay would be slightly modified by additional waterfront development and urban infilling. Auto and commercial truck traffic would likely increase slightly. Air and water quality would be modified. Some archaeologic or historic resources may be impacted by future developments.

4.8 Relationship Between Local Short-Term Uses of the Environment and Maintenance and Enhancement of Long-Term Productivity. Maintaining a deep draft channel at Coos Bay is a continuation and extension of past and present patterns of estuarine use. Many of the natural components of the estuary have been shaped or used to meet particular human requirements. The economic well-being of the Coos Bay region has been heavily dependant on the waterborne trade generated by the navigation channel. The local economy is also dependant upon the continued productivity of Coos Bay's fisheries. Although the deep draft channel reduces the overall productivity of the bay, a balance has been maintained to protect areas of clam, crab and fish production as well as habitats and food sources on which they depend. A 2-foot deepening with ocean disposal would not significantly alter this balance between use and productivity.

4.9 Irreversible and Irretrievable Commitments of the Resources. The capital and labor necessary to dredge the channel and dispose of the material would be committed irreversibly and irretrievable. This includes the capital and labor associated with construction activities, administration, personnel, operations, maintenance, and petroleum and other products used. Subtidal lands dredged would be committed throughout the life of the project. Restoration of this substrate and reuse of the discharged dredged material (directly) would not be possible.

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CHAPTER 5

REVIEW AND CONSULTATION REQUIREMENTS

5.1 Public Involvement. Public and agency comment was sought throughout the preparation of the Reconnaissance and Feasibility studies. The Feasibility Study/Environmental Impact Statement were initiated with a Notice of Intent published in the Federal Register and a scoping letter outlining the alternatives under consideration and requesting comments on issues to be considered. Agency and public comments were received, expressing concerns on a variety of issues. A summary of these concerns and copies of the letters received are included in appendix I.

The following is a generalized list of federal, state and local agencies and interested public to whom copies of the Draft EIS have been sent:

(1) Federal.

Department of Agriculture
Bureau of Land Management
Coast Guard
Environmental Protection Agency
Fish and Wildlife Service
Department of Interior
Members of Congress
National Marine Fisheries Service
National Oceanic and Atmospheric Administration
Department of Transportation

(2) State.

Oregon Dept. of Economic Development
Oregon Dept. of Environmental Quality
Oregon Dept. of Fish and Wildlife
Oregon Dept. of Human Resources

Oregon Dept. of Land Conservation and Development
Oregon Parks and Recreation Division
Oregon Division of State Lands
Oregon State Historic Preservation Office
Oregon Dept. of Transportation
Office of the Governor
State Legistators

(3) Local

Coos County
City of Coos Bay
City of Charleston
City of Eastside
City of North Bend
International Port of Coos Bay
Local Schools and Libraries
Indian Tribes

(4) Interested Public

Businesses and Industries
Commercial and Recreational Fisheries Groups
Environmental Groups
Marine Navigation Association
News Media
Recreational Groups
Interested Individuals

5.2 Compliance with Environmental Laws and Executive Orders.

a. Clean Air Act of 1970, as Amended. The Clean Air Act establishes a comprehensive program for improving and maintaining air quality throughout the United States. The goals of the Act are achieved through permitting of stationary sources, restricting the emission of toxic substances from stationary and mobile sources, and establishing National Ambient Air Quality

Standards. Title IV of the Act includes provisions for complying with noise pollution standards. Alternatives described in the EIS would not likely increase particulate matter in the Coos Bay area or jeopardize its status as an air quality attainment area. Noise created by dredge operations would not exceed current industrial and maintenance dredging noise levels. The proposed channel deepening would be in compliance with the requirements of this Act.

b. Clean Water Act 1977 as amended. No disposal would be considered fill. Ocean disposal has been evaluated under the criteria established by Section 103 of the Marine Protection, Research and Sanctuaries Act. Water Quality Certification will be requested from the State of Oregon for sites within the limits 0-4 the territorial sea based on this evaluation. All requirements of the Clean Water Act will be met.

c. Coastal Zone Management Act of 1972 as Amended. A Federal Determination of Consistency for this project is included with this report (Exhibit 5). The Oregon Department of Land Conservation and Development will be requested to concur with the determination regarding compliance with Oregon's Coastal Zone Management Program and local land use plans.

d. Comprehensive Environmental Response, Compensation and Liability Act. Provisions for evaluation and cleanup of hazardous, toxic and radioactive wastes (HTRW) are included in this Act. In general, dredged material and sediments beneath navigable waters proposed for dredging qualify as HTRW only if they are within the boundaries of a site designated by EPA or the state for a response action or if they are part of a National Priority List site under CERCLA. No HTRW sites have been identified which would impact the navigation channel area. All sediments have been evaluated for suitability for disposal under the guidelines established by Section 404 of the Clean Water Act, and Section 103 of the Marine Protection, Research and Sanctuaries Act. All requirements under this Act have been met.

e. Endangered Species Act of 1973 as Amended. The USFWS and NMFS have been consulted. Biological assessments have been prepared and forwarded to the USFWS and NMFS regarding listed species. Concurrence with our assessment that listed species will not be adversely affected is anticipated based upon previous consultations and review of project and species information. Bald eagle, peregrine falcon, marbled murrelet, brown pelican, leatherback, green sea and loggerhead sea turtles, northern sea lion, and gray, humpback, blue, right, fin, sei, and sperm whales, Sacramento winter chinook, Snake River sockeye, Snake River fall chinook, and spring/summer chinook salmon are endangered or threatened species identified as potentially affected by the proposed action. Concurrence letters were received for bald eagle, peregrine falcon, brown pelican, and western snowy plover on July 3, 1990; and for gray, humpback, blue, fin, sei, right, and sperm whales; and leatherback sea turtles, northern sea lions, and Sacramento River winter-run chinook salmon on January 22, 1991. Due to changes in the proposed ocean disposal site dimensions, a new Biological Assessment was prepared for the marine and salmonid species and submitted to NMFS on August 16, 1993. Concurrence letters were received on September 21 and 22, 1993. A Biological Assessment for the more recently listed marbled murrelet has been prepared and submitted to USFWS with a determination of no adverse effect. The concurrence letter has not yet been received as of this date. The biological assessments and concurrence letters are included in exhibit 7.

f. Estuary Protection Act. The purpose of the Estuary Protection Act is to establish a program to protect, conserve and restore estuaries. The Act does not affect an Agency's authority for existing programs within an estuary. Coos Bay is designated as a Deep Draft Development Estuary within Oregon's Estuary Management System. This designation seeks to protect the integrity of the estuary's natural resources while recognizing and allowing for deep draft port development. The proposed channel deepening complies with the Act.

g. Fishery Conservation and Management Act of 1976. Law 99-659, Section 104, amended Section 302 of the 1976 Act to require all Federal agencies to respond within 45 days to comments and recommendations made by the Regional Fishery Management Council relative to the impacts a federal activity have on fishery resources under the Council's jurisdiction.

The Pacific Fisheries Management Council will be provided a copy of the Draft Feasibility Report/EIS for review. Their comments on the impacts of the channel deepening on harvest quotas and management plans will be incorporated into the final document. All requirements of the Act will be met.

h. Fish and Wildlife Coordination Act. A Fish and Wildlife Service Coordination Act report was prepared for the proposed action. This report together with Portland District Response Letter is included in Exhibit 6. This report will be coordinated with other Federal and State resource agencies and comply with the Act as required.

i. Marine Mammal Protection Act of 1972. The Marine Mammal Protection Act is the principal U.S. statute for conserving and protecting marine mammals. The alternatives described in the EIS are not likely to adversely impact marine mammals. Dredging and disposal actions are localized in nature and of short duration at any specific location. Thus, marine mammals can avoid these work areas. Impacts to prey resources are expected to be ephemeral. No work is occurring near haulout or pumping areas. Sediments have been evaluated for contaminants; contaminated sediments would be disposed of in a manner consistent with the requirements of the Clean Water Act and the Ocean Dumping Act. Therefore, introduction of contaminants into the marine system is not anticipated nor or contaminant impacts to marine mammals expected.

j. Marine Protection Research and Sanctuaries Act of 1972, as Amended. A Section 103 evaluation for designation of the rock disposal site and disposal at Sites F and H has been prepared in compliance with this Act and is included with this report (Exhibit 4). Expansion of Site F is being evaluated for formal designation by EPA under Section 102 of the Act. All proposed actions would comply with the requirements of this Act.

k. Migratory Bird Conservation Act This authorized a national system of waterfowl refuges. The Migratory Bird Conservation Act provided the Federal government the authority to acquire lands, with the consent the affected states, for migratory bird refuges. The proposed project would have no bearing on the Migratory Bird Conservation Act of implementation of provisions of the Act.

l. Migratory Bird Treaty Act (1918). The Migratory Bird Treaty Act represents congressional ratification of the 1916 Migratory Bird Treaty with Canada. Similar treaties were later established with Mexico, Japan, and the U.S.S.R. These treaties provide, in part, protection of songbirds, prohibits traffic in all wild migratory birds and establishes management of migratory game birds. The Coos Bay Navigation Channel Deepening Project should not result in the take or loss of migratory birds. Thus, the project would not violate the provisions of the Migratory Bird Treaty Act.

m. Submerged Lands Act of 1953. This Act confirms and establishes titles to the States to lands beneath navigable waters within the State boundaries and to the natural resources within such lands and waters. It also confirms the jurisdiction and control of the United States over the natural resources of the seabed of the Continental Shelf seaward of State boundaries. Development of the deep draft navigation channel at Coos Bay, including ocean disposal of dredged material is considered a suitable activity under the State of Oregon Estuary Management Plan. Further discussion of State jurisdiction is included under the Coastal Zone Management Act requirements.

n. Cultural Resources Acts. Cultural resources investigations and literature search have been conducted and determined that no resources would be affected or can be avoided. The results of the investigation has been coordinated with the State Historic Preservation Office (SHPO). Copies of correspondence with the Oregon SHPO is included in Appendix I. The proposed action has met the requirements of pertinent cultural resources Acts.

o. Analysis of Impacts on Prime and Unique Farmlands, CEQ Memorandum, 1976. No prime or unique farmlands would be affected by the proposed action.

p. Executive Order 11990, Protection of Wetlands, 24 May 1977. No dredging or filling would occur in wetland areas. Salinity increases resulting from a deeper channel could have a minor affect on marshes in upper Coos Bay. Distribution and densities of eelgrass would increase with the project, which could increase total estuarine productivity slightly. It would also provide additional cover for many species of marine organisms. The amount and species of marine algae would increase in the estuary. Of particular importance would be Enteromorpha sp. Some species of this green algae form dense mats in the late summer and are highly productive. The proposed action conforms to the requirements of this executive order.

q. Executive Order 11988, Floodplain Management, 24 May 1977. Deepening of the Coos Bay channel would take place within the confines of Coos Bay and extend outward into the Pacific Ocean. No dredged material disposal would occur on land with the possible exception of material dredged from port berthing areas as regulatory permit activities. No dredged material would be placed into the estuary. Deepening of the navigation channel would have no adverse impact on the adjacent floodplain nor would it attract any new development into that floodplain.

CTCLUSI Exhibit C

INDEX

CTCLUSI Exhibit C

EXHIBIT 1
LIST OF PREPARERS

PRINCIPAL AUTHORS	EXPERIENCE AND BACKGROUND	CONTRIBUTION TO THIS REPORT
Steven J. Stevens BS, Landscape Architecture	Land use planning, EIS preparation (20 years)	EIS coordination and preparation
Dan Winslow BS, Economics MS, Economics	Regional and resource economic analysis for planning studies (14 years)	Economic environment and impacts; cost analysis
Pat McCrae BS, Humanities	Regional economics (17 years)	Economic environment; cost analysis
Brian Shenk BS, Economics	Economist (4 years)	Economic Analysis
Steve Chesser BS, Geology MS, Oceanography	Physical and geological oceanography (15 years) Coastal navigation project planning and maintenance (10 years)	Physical environment description and impacts assessments
Mark Siipola BS, Oceanography MS, Marine Science Physical/chemical Coastal Engineering	Beach restoration dredge operations (14 years)	Water quality, sediment chemistry analysis, sediment analysis
Kim Larson BS, Zoology MS, Fishery Biology	Biological (fisheries) studies; environmental impact assessment (12 years)	Biological environment description and impacts assessment
Michael A. Martin MA, Anthropology	Archeological investigation and cultural resources management (10 years)	Cultural resources
Geoffrey L. Dorsey BS, Wildlife Science MA, Wildlife Science	Wildlife Biology (12 years)	Endangered species assessments
Laura L. Barton BS, Biology	Biological studies (1 1/2 years)	Ocean disposal sites biological resources
Christine E. Moehl BS, Biology	Biological studies (2 years)	Coos Bay Estuary biological resources
John Malek BA, MA	EPA Ocean Dumping Coordinator (19 years)	Ocean disposal issues, procedures

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EXHIBIT 2

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CTCLUSI Exhibit C

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EXHIBIT 3

DEIS COMMENTS AND RESPONSES

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United States Department of the Interior

TAKE PRIDE IN AMERICA

OFFICE OF THE SECRETARY
Office of Environmental Affairs
500 NE Multnomah Street, Suite 600
Portland, Oregon 97232-2036

RECEIVED
NOV 18 1993
REG & ENV RES BR

November 17, 1993

ER 93/792

Colonel Charles A. W. Hines, District Engineer
U.S. Army Corps of Engineers
Portland District, CENPP-PE-RP
P.O. Box 2946
Portland, Oregon 97208-2946

Dear Colonel Hines;

1 The Department of the Interior (Department) reviewed the Draft Feasibility Report (Report) and the Environmental Impact Statement (DEIS) for the Navigation Improvements, Coos Bay, Coos County, Oregon. The Department does not have any comments to offer.

We appreciated the opportunity to comment.

Sincerely,

Charles S. Polityka
Charles S. Polityka
Regional Environmental Officer

1 Comments Noted.

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United States Department of the Interior

BUREAU OF MINES
Western Field Operations Center
East 360 3rd Avenue
Spokane, Washington 99202-1413

October 14, 1993

Charles A.W. Hines
District Engineer
ATTN: CENPP-PE-RP
P.O. Box 2946
Portland, OR 97208-2946

Dear Mr. Hines:

SUBJECT: Navigation Improvements, Coos Bay, Coos County, Oregon

The U.S. Bureau of Mines would like the Corps of Engineers to consider an alternative to the ocean disposal of dredged material from the Coos Bay navigation improvement project. Since the decision to perform this work should reflect the national concern for both protection and utilization of important resources, our recommendation is to investigate the economic viability of marketing this coarse-grained sandy material in metropolitan areas along the coast such as nearby Portland, Oregon. The investigation should include a suitability test on the material for industrial use, as well as a market study and an operations cost study. Some of the results from the study could also be applicable to other dredging operations along the Pacific coast. Not only would the sale of this material be a wise use of an important and needed resource, but the potential environmental impacts caused by ocean disposal of this material would no longer be a needed concern. 2

Please consider this comment letter as part of the Department of Interior's response from the Office of Environmental Affairs. We did not receive the document for review until October 12, one day after our required response date. Therefore, to ensure that these comments are timely, we decided to send them directly to you.

Sincerely,

Burton B. Gosling

Burton B. Gosling, Supervisor
Environmental and Regulatory Analysis

2 Commercial use of dredged material from Corps' maintenance dredging has been and continues to be an available option, if a demand for the material is expressed. For instance, sands dredged above RM 50 on the Columbia River are commonly used for commercial development. Generally, the material is found to be only suitable for fill and not for other commercial uses, such as concrete aggregate. Studies associated with the Columbia River have shown that a market would have potential in larger population areas with associated development activity. It has also been shown that barge hauling the material over 30 miles is not economical. It would therefore not be feasible to test market Coos Bay material in Portland or other metropolitan areas due to the distance involved and the fact that there would be much closer sources.

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Oregon

DEPARTMENT OF
FISH AND
WILDLIFE

November 24, 1993

Colonel Charles A.W. Hines
District Engineer, Portland District
U.S. Army Corps of Engineers
P.O. Box 2946
Portland, OR 97208-2946

Subject: Feasibility Report on Navigation Improvements with Environmental Impact Statement

Dear Colonel Hines:

Our Department has reviewed the subject report. We appreciate the Corps effort to address concerns that we raised earlier in the review process. We continue to be concerned for the health of the estuary on a larger scale and our needs to continue to work together for better long range management of this estuary.

3 A prime concern is the incremental but continual modification to the estuarine subtidal benthic habitat. As we commented in Tom Gaumer's letter of October 12, 1989, there may be substantial invertebrate, particularly clam, production within these areas. Many of these sites once impacted may not recover to the same level of production or with the same level of biological diversity. There is sufficient speculation in the Environmental Impact Statement (EIS) concerning minimal impacts and reestablishment of the benthic biological communities. Although we concur that recolonization of the benthic substrate would occur, there is sufficient change to the physical conditions that the total modification to the estuary may be substantial. Cumulative effects from the activities of the Corps and others have significantly effect the physical and ecological system of Coos Bay. As previously stated in our letter of October 1989, there is a distinct need to develop distribution and abundance of invertebrates within the estuary. This information is essential to determine true impacts from this project and cumulative impacts over time.

4 Additional concerns involve the effect of salinity on striped bass and other managed species of fish. There has been a substantial decline in the striped bass population and relative recruitment. The EIS speculates that the increased

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3 The cumulative effects of dredging the existing channel, the proposed 2-foot deepening and related port facilities and shipping activities would result in continued and potential future impacts to Coos Bay aquatic resources. The extent of impact is not clear and appropriate mitigation beyond existing methods is difficult to identify. The feasibility of conducting a monitoring program per your recommendation is being reviewed by Portland District. Other proposals suggested to reduce impacts from channel dredging include in-bay disposal of rock or shell material at specific locations to improve habitat, or various means to create additional shallow subtidal habitat. These proposals would most likely be evaluated under other authorities such as Section 1135 of the Water Resources Development Act of 1992, as amended. This authority allows for environmental restoration at existing projects.

4 The statement that striped bass survival and habitat may improve was based on the study by Anderson (1985) of habitat requirements of juvenile striped bass in the upriver areas. The statement was based on his conclusion that striped bass larvae survive better at salinites slightly higher than what currently occurs in the upriver areas. We concur that additional research may be needed on striped bass populations to determine the reasons for their decline, however, since the deepening project is likely to have little or no impact on striped bass populations we would have no reason to fund such studies.

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4 salinity may improve habitat and survival for striped bass. We do not necessarily agree. There may be a need to further, assess these fish requirements and further assess the reasons for their decline.

5 The feasibility study and the EIS have not adequately evaluated the effects of the extended dredging proposal from an ecosystem perspective. Habitat losses and modification over time have affected the Coos Bay ecosystem. The present proposal implies that the additional deepening and broadening of the channel would have minimal effect. The significance of the additional project requires a broader evaluation of the Coos Bay ecological system over time and space. This evaluation would provide the basis for evaluating the significance of the proposed actions. This evaluation would further lead to developing of mitigation goals and objectives.

6 A strong mitigation plan and monitoring effort are essential. Our Department's Fish and Wildlife Habitat Mitigation Policy, (OAR 635-415-0000, enclosed), requires adequate assessment of the habitat losses and determining its significance within the ecological system. We appreciate that the Corps will take steps to mitigate the immediate and short term impacts. We anticipate that the Corps will work with our Department to dredge within our recommended in water work period of October 1 to January 31. Yet, the long term impacts of habitat loss and impacts to the esturarine ecosystem needs further consideration. Habitat restoration and enhancement are critical elements to a mitigation plan to maintain the estuary as a deep water port and a functioning ecological system.

Thank you for the opportunity to comment. We welcome working cooperatively with the Corps to consider mitigation needs for Coos Bay.

Sincerely,

James C. Turner
Waterways Alteration Coordinator
Habitat Conservation Division

jct
ENC
cc: Patty Snow, John Johnson (marine), Neil Richmond, Jim Muck

5 The EIS included a discussion of the resources of Coos Bay from an ecosystem standpoint (see page 3-27 to 3-30). The impacts of the proposed project were also fully discussed in Section 4 of the EIS. The impacts of previous actions are referenced in the EIS as tiered documents, i.e., Coos Bay, Oregon Deep Draft Navigation Project SEIS, July 1975. The cumulative impact of the proposed 2-foot deepening on the Coos Bay ecosystem represents a relatively minor incremental change.

6 As indicated above, a thorough discussion of the impacts of the proposed project was provided in the EIS. Additional mitigation beyond avoidance of impacts was determined not to be necessary because of the extent of the impacts. In-water work timing has been coordinated previously and the dates listed on page 73 of the main report were agreed to by your agency. Dredging the channel during the winter is not feasible since adverse weather conditions would preclude safe operation of the dredges and ocean disposal.

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Oregon

DEPARTMENT OF ENVIRONMENTAL QUALITY

RECEIVED
JAN 5 1993
REG & ENV RES BR

January 3, 1994

Department of the Army
Portland District, Corps of Engineers
PO Box 2946
Portland OR 97208-2946

Re: Coos Bay Feasibility Report/EIS

ATTN: CENPP-PE-RP

As stated in the Department's November 29 letter to General Ernest Harrell, we did not receive the Coos Bay EIS for review during the allotted review period. Please consider this letter our comments.

7 We have five general areas of concern with the Coos Bay Navigational Improvements Project, all relating to the levels of toxic materials in the Coos Bay: (1) the non-Federal dredging of the berthing sites from RM 10 to RM 15, (2) the transfer of potentially contaminated dredged material to RM 8.4, (3) the channel dredging from RM 8 to RM 12.5, (4) in-lane disposal of sediments at the mouth of the bay, (5) and the proposed upland disposal of contaminated sediments. The information on the levels of the toxics in the bay was taken from the EIS, DEQ's data from 1989 and 1991-1992 sampling, sampling and analysis for TBT by Glenbrook Nickel, and the 1993 "Tributyltin Levels in Coos Bay Sediment" by Jim Britton, USACE.

8 1. Sampling of water and sediment around the berthing areas from RM 10 to RM 15 shows levels of TBT, PCBs, and metals above accepted criteria. Specifically: at Bay Shore Dock, chromium and copper in sediment; at Hilstrom's, chromium, zinc, lead, nickel, PCBs, polynuclear aromatic hydrocarbons (PAHs), and total butyltins in sediment and TBT, copper, nickel, and zinc in the interstitial waters (all metals exceed acute water quality criterion); at Mid Coast Marine, chromium, zinc, lead, nickel, copper, PCBs, and total butyltin in sediment; and at Glenbrook Nickel, TBT in sediment.

DEQ is also currently overseeing the clean-up of hazardous waste at three sites in this area, Hilstrom's, Chambers Oil, and Chevron Oil. (The EIS does not consider the impact of channel slumping on these sites when non-disturbance of sediments has been selected as appropriate at a site or when ongoing cleanup evaluations of contaminant levels are underway.)

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Portland, OR 97204-1390
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TDD (503) 229-6993
DEQ-1

7 Several comments are related to dredging of berthing areas or disposal of dredged material from berthing areas. As discussed with Oregon DEQ staff, although dredging of the berthing areas are related to the proposed action and are appropriately discussed in the EIS as indirect or cumulative impacts, they are not part of the proposed Federal action. The sediment sampling suggested in the comments would be more appropriately conducted as a requirement under the Section 404 Regulatory Permit authority. Further, except for the Glenbrook Nickel dock, the berthing areas mentioned are not dependent on greater channel depth and are not proposed for dredging beyond current depths.

8 Bay Shore Dock is maintained at 30 feet, Hillstrom is maintained at 25 feet, and Mid Coast Marine (@ RM 15.0) does not require maintenance dredging at this time. Glenbrook Dock (formally Portland Dock) is currently maintained to a depth of 39 feet. Each of these docks except Mid Coast Marine has been evaluated for in-water disposal of dredged material under an 18 member joint USACE permit. Due to concerns regarding sediment contamination, prior to each removal action sediments are collected and evaluated from most of these 18 docks. Material was collected and evaluated in 1989, 1991, and 1993. Evaluations have included physical, chemical and biological testing in a tiered testing approach. Sediment evaluation of the privately owned berthing areas, docks, and property is the responsibility of the individual property owners.

Sediment samples were collected in 1993 from the proposed expanded turning basin at RM 12 by this office. Results of the 1993 sediment evaluation for this area as well as the Federal Channel will be included in Appendix D.

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8 DEQ wants to be assured that the dredging at these berthing areas does not resuspend the contaminated sediments. Resuspension would make the contamination more available for bioaccumulation in the aquatic organisms. We recommend additional sampling at three sites: Chevron tank farm (RM 12.5), Hillstroms shipyard (RM 13.75) and the active Mid Coast Marine (RM 15), for chemical and biological parameters on a gradient from the docks to the existing channel to better determine the probable impact of the dredging.

(The EIS also mentions turning basin sites in this stretch that may be expanded. However, the location of these sites is not clear. Dredging at these sites may also resuspend contaminated sediments documented to occur in tidal areas of the bay. We also recommend cross sectional sampling work at the turning basin sites.)

9 2. Sampling in shellfish from RM 8 through RM 10 shows extremely high levels of TBT. The county health department, in conjunction with other agencies, is considering closing identified recreational areas to harvest and initiating the evaluation of TBT levels in commercial shellfish growing areas. This is the area of the proposed transfer site for sediment if weather prohibits going to sea. Again, we are concerned about the resuspension of contaminated sediments. We strongly recommend that sediment transfer not be allowed to this area.

10 3. We are also concerned about the channel dredging from RM 8 to RM 12.5 for the same reasons discussed in item number 2. We recommend additional chemical and biological sampling on a gradient from the shoreline to the channel to determine the extent of the contamination that may be resuspended during dredging.

11 4. The EIS addresses in-lane disposal of the sediments in the area of the jetties when bad weather prohibits the dredge from entering the ocean. We want this material to go out of the bay, outside of the jetties. In-lane disposal has been problematic in the past. Although the disposal is to occur on an outgoing tide, resuspension of the sediments can occur as they are being swept to sea. Also, if the tide does turn with the sediments placed at the jetties, the contaminants re-enter the bay.

9 As stated in USACE, Portland District's Federal Navigation Projects: The Oregon Coast Maintenance Program book (page 82), "Site 8.4 is used for sediment dredged from between RM 6 and RM 12 to reduce transit times and costs. Capacity of the site is limited, and, if time allows, material is often transported to ocean disposal sites E or F." The material placed at this disposal site is similar to and subject to the same environmental conditions as the material existing at the site. The material is sandy, low in organics, and uncontaminated. The fine grained material found above RM 12 is never placed at this site but is transported directly to ocean disposal site H.

10 The USACE evaluates material to be dredged from areas within the boundaries of its Federal projects or regulates material under its various regulatory authorities. The evaluation of material or biological community called for in comment 3 is beyond the scope of the project and authority of the USACE, Portland District.

11 Dredged material placed at the flow lane disposal site has been found to be suitable for unconfined in-water disposal. No contaminated dredged material that would cause an unacceptable adverse environmental impact is allowed to be placed at this or any other unconfined in-water disposal site.

12

5. The proposed upland disposal site for contaminated sediments is in the area of the Hilstrom's, Glenbrook Nickel, and Mid Coast Marine sitds which have contamination as discussed in paragraph 1. Also, bass caught in this area show elevated levels of TBT. We are concerned that possible leaching of contaminants from the sediments in the disposal site would add to the already high level of contamination in the bay in this area. More clarification of the location of this site and proposed controls and monitoring is needed.

Any questions or comments may be directed to me at (503)229-6982.

Sincerely,

Barbara L. Stifel

Barbara L. Stifel
Toxics Program Specialist

BLS:bls

cc: Ron Marg
Michael Rylko

12

The upland disposal site mentioned in the EIS was identified as a potential disposal site by the Port of Coos Bay. Actual use of the site by the Port or private dock owners would be subject to further evaluation and compliance under the regulatory review requirements.

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Oregon
DEPARTMENT OF
HUMAN
RESOURCES
HEALTH DIVISION

January 14, 1994

Colonel Charles A. W. Hines
District Engineer
US Army Corps of Engineers
PO Box 2946
Portland, Oregon 97208-2946

RE: Draft Feasibility Report of Navigation Improvements with EIS, September 1993, Coos Bay, Oregon

Dear Colonel Hines:

13 Copies of Volumes 1 and 2 of the above draft report and Environmental Impact statement came to our office for review and comment in late September, 1993. Our office does not have regulatory authority or legal standing to impose regulation on this project, but we would like to alert you to a specific and serious concern that we have in Coos Bay. The ongoing dredge work and any future modification to dredging and maintenance operations will have impacts on this problem, and it will be very difficult at this point to predict what these impacts might be. It is a subject which should be addressed in the EIS, we believe.

There is a growing realization and concern in Coos Bay among environmental, wildlife and health officials about ongoing tributyltin contamination. Current Oregon and national standards relative to TBT have consisted of setting a legal limitation on the kinds and sizes of craft on which TBT-containing paints may be used. The assumption behind those regulations is that if we limit new contributions of TBT to waterways, environmental degradation of TBT will largely resolve the problem of environmental residuals. In some areas of the country this theory seems to be working. For reasons, largely unknown to us, these spontaneous reductions in TBT residuals (in water and in sediments) have not occurred in most of Coos Bay. Current testing is finding as much TBT as was found at the time the use restrictions were adopted in 1987.

Additional testing and characterization work is underway to better define the problem, identify the key environmental factors, and to characterize the environmental and human health risks that currently exist due to TBT.

Barbara Roberts
Governor

800 NE Oregon Street # 21
Portland, OR 97232-2162
(503) 731-4030 Emergency
(503) 252-7978 TDD
Emergency
24-26 (Rev. 1-92)

13 See responses to comments from Oregon Department of Environmental Quality.

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13 We are troubled by the fact that the draft EIS does not address the issue of tributyltin in any manner. We see it as a contaminant of key concern in the project and one that will be significantly impacted by maintenance dredging, deepening of shipping channels, storage and disposal of spoils, and resultant changes in flow dynamics due to the dredging work.

Please feel free to contact me if you wish to discuss this issue or this letter. Thank you for including our agency in your review process.

Sincerely,

Kenneth W. Kauffman, R.S.
Environmental Health Specialist
Environmental Services & Consultation Section
Center for Environment & Health Systems

KWK:ab

CC: Ron Hall, ESC, Oregon Health Division
Pam Blake, DEQ, Coos Bay Region
Neal Coenen, Oregon Department of Fish & Wildlife, Marine Region

CH0167KK.LTR

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OREGON INTERNATIONAL PORT OF COOS BAY
Front & Market Streets • Coos Bay, Oregon 97420 • Telephone 503/267-7678 • Fax: 503/269-1475

November 22, 1993

Colonel Charles A. W. Hines
District Engineer
Portland District, U.S. Army Corps of Engineers
PO Box 2946
Portland, OR 97208-2946

Dear Colonel Hines:

The Oregon International Port of Coos Bay has reviewed the revised draft (August 1993) Feasibility Report and Environmental Impact Statement for the Coos Bay channel deepening project, and continues to support Alternative Two as proposed in the study. The Port greatly appreciates the extensive time and effort undertaken by the Corps to provide a clear and thoughtful analysis for public review. We offer the following additional comments for your consideration:

14
1. The Port had understood that the "Ship Simulator Study" would not be required for this project, and I believe that is the current understanding with the Corps. Unfortunately, the Feasibility Study still refers to the "Ship Simulator Study." The final report should clearly explain the fact that the "Ship Simulator Study" is no longer required, and should list the justification for its removal.

15
2. Our understanding of the offshore disposal site usage is that the deepening project will share the cost with operations and maintenance on a 50/50 basis. In turn, the Port, as local sponsor, will share on a 50/50 basis for the deepening project (because of the greater than 45-foot depth), so that the Port's effective share is 25 percent. The local sponsor would also, under the proposal, be required to provide a similar 25 percent cost share for the entrance channel work. Assuming these figures are correct, I believe a small clarification would be appropriate.

3. The entire project is now being very ably managed by Ms. Laura Hicks, and the Port feels very comfortable with the rest of the project team. I have been particularly impressed at the District's commitment to overcoming past mistakes by previous personnel, and the District's laudable success-oriented style. Given past problems from prior years that caused the project to slip significantly, the Port urges you to continue to give this project your highest priority for an expeditious approval. The Port stands ready to assist you in any fashion to enable the project construction to start on schedule and on budget in May, 1995.

14 See response to letter from Mr.Vogel.

15 Noted, we will revise the text to clarify.

Thank you for the opportunity to comment. We urge your approval of the draft Feasibility Study and EIS so that the project may move forward.

Sincerely,

Allan E. Rumbaugh
General Manager

AER:dcb

cc Laura Hicks, Project Manager
Congressman Peter DeFazio
Senator Mark O. Hatfield
Senator Bob Packwood
Ports Section, Oregon Economic Development Department
Port Commission

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OREGON NATURAL RESOURCES COUNCIL

MAIN OFFICE

Protecting Oregon's lands, waters and natural resources

December 10, 1993

Colonel Charles A.W. Hines
District Engineer,
U.S. Army Corps of Engineers
Portland District Office
P.O. Box 2946 (ATTN: Stevens)
Portland, OR 97208-2946

RE: Final Comments, DEIS
Coos Bay Deep Water Dredging

Dear Colonel Hines;

16 The Oregon Natural Resources Council (ONRC) is a non-profit public interest organization dedicated to the protection of Oregon's lands, waters, and natural resources. We focus on a wide spectrum of natural resource protection issues, including forest health; sensitive, petitioned, threatened and endangered species; fish and wildlife concerns; water issues; wetland and riparian protection; and conservation of related resources. We have also been involved in preliminary discussions for a potential land exchange on the North Spit of Coos Bay involving numerous issues, multi-jurisdictional players and a comprehensive analysis of the ecology of the North Spit and Coos Bay area. We hope that the knowledge we have acquired in this endeavor will contribute to a more comprehensive understanding of the issues involved in this project.

We are extremely concerned that the Corps has based the adequacy of its preferred alternative on outdated assumptions and obsolete studies which fail to address major changes and new information since at least 1991. We are concerned that the Corps' rush to complete the FEIS by December 15 of this year to meet alleged fiscal budget constraints may divert the Corps from revisiting basic assumptions critical to the reassessment of project impacts and the possibility of project success. We strongly urge the Corps to reconsider its project purpose and need, as well as the alternatives analysis in terms new information presented in these comments.

A. The Economic Viability Analysis in the DEIS is Critically Outdated

17 At page C-12 of Volume II, the DEIS makes clear that the economic justification for channel deepening is based on favorable commodity projections for timber products (logs, woodchips, and lumber/paper/plywood) and nickel ore. The DEIS assumes that

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16 **Several revisions have been made in the Final Feasibility Report and EIS based on your letter comments and subsequent meeting with members of Portland District staff. Most of these changes are in the form of clarifications of issues with modifications of some report text based on new information. These changes are noted in the following responses.**

17 **The reference is to page C-12 of Volume II. Concur that the paragraph indicates that economic justification is directly tied to commodity projections for timber products and nickel ore. It is also noted in the same paragraph that commodity projections are necessary inputs to fleet projections, which are directly related to project benefits. However, economic analysis indicates that potential growth in the size of vessels calling at Coos Bay can in and of itself provide economic efficiencies, due to the economies of scale.**

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17 sustained or increased exports and imports of these goods will account for "nearly all, if not all, of the shipments projected to be impacted by the channel deepening." The DEIS assumes that this projected increase justifies project benefits. We question this assumption because most, if not all, of these imports and exports are not sustainable at levels reported in the DEIS. Rather, most of these commodities have markedly declined in the past two years and are not expected to increase or even recover in the foreseeable future.

18 **1. The Nickel ore import market has collapsed.**

Based on a 1991 feasibility study, the DEIS projected that new nickel ore imports would offset any decline in timber product exports (DEIS § 2.2). However, the nickel ore market collapsed in 1992. No shipments of nickel ore have arrived in Coos Bay this year and the smelter used to process the ore has shut down as well. Market recovery is not expected in the foreseeable future and no new commodity has been identified to replace the loss of that market. Reliance on nickel ore to justify economic benefit now or in the foreseeable future, is no longer valid.

19 **2. Timber product exports are in serious decline. Projections in the DEIS identifying timber products as a stable export base are grounded in predictions from outdated, incomplete or legally inadequate studies.**

a. Vol. II at page C-18 of the DEIS relies on a U.S. Forest Service (FS) study from 1988 to predict that Douglas fir subregion harvest in the Pacific Northwest (PNW) will decline from its all time high in 1986-1988 (3.14 bbf/yr) through the year 2000, but will subsequently increase slowly out to the year 2040 as industry land and other private managed stands mature to offset the declining natural forests on our public lands. The FS study projects that the transition from natural stands to managed stands is expected to be completed in the PNW by the year 2010. However, this study predates the listing of the Northern Spotted Owl, the Marbled Murelett and other recently listed or identified sensitive species. The federal mandates to manage for multiple uses and protect threatened and endangered species will continue to impact forest production as emphasis shifts from maximum cuts to habitat restoration and preservation. This new reality, prompted by years of non-sustainable timber harvests culminating in the late 1980's, is expected to drastically limit timber sales and exports throughout the PNW, including the Coos Bay area, for many years to come.

b. Vol. II at page C-21, discusses predictions formulated in May 1990 by a BLM/FS working group. The working group projected that federal timber for sale in Oregon, Washington and California, with owl set-asides as outlined in the Jack Ward Thomas Report, was estimated to decline from 5.0 bbf (average 1980-1988), to 2.6 bbf (projected 1995-2000), a 48% reduction. However, under Option 9 as currently interpreted, available federal timber for sale on

17 The comment also indicates that it "is assumed that sustained or increased exports and imports of these goods...will justify project benefits." In fact, the projections vary by commodity. Log exports are projected to decline; woodchips, paper, and plywood are projected to be sustained; and lumber exports are projected to show slow growth. These projectons are summarized on page C-31, Table 10, of the Economic Appendix that accompanied the DEIS.

18 Actually, nickel ore has been imported and delivered to the Glenbrook Nickel site at Coos Bay this year. The Economic Appendix has been revised to discuss the current decline in the nickel market, and to address the expected recovery. In the last 30 years, prior to the current market decline, there have been two nickel market declines. One occured in 1975, the other in 1982. Glenbrook officials indicated that it took them 18 months to two years to recover from the historical declines. They have indicated that they anticipate starting up operations again in 1994. Forecasts by nickel experts indicate that there should be a slight deficit in the nickel supply and demand balance in 1994, with a strong deficit in 1995, to fuel the recovery of the nickel market.

It should also be noted that a sensitivity analysis has been added to the revised document that shows the impact of various levels of nickel ore imports, to provide decision-makers an indication of the sensitivity of the project benefits to assumptions about nickel ore, as well as the other commodities.

19 The description of timber commodity projections in the subject appendix recognizes the complexity of making projections in a changing environment. Page C-30 of the appendix in the DEIS notes that: "This overview of existing information demonstrates the complexity of the issues surrounding projections of timber product exports at this time. It also demonstrates some variabilitiy in expert opinions about future scenarios." Despite the variability, future projections are a required element in this study. The specific citations in the ONRC comments reference studies that were provided in the economic appendix to help the reader (and decision-makers) understand the issues, and also to see the variability in the conclusions reached by various analysts. It is clear that the timber commodity projections are not made in a static environment. On pages C-31 and C-32, commodity ranges are discussed as a vehicle to account for some of the variability that may occur: "As discussed throughout the section on timber export projections, several potential future conditions may occur....Because of the potential for changes in future commodity tonnage movements, a risk and uncertainty analysis has been developed for these timber-related commodities."

19 federal lands in Oregon, Washington and California would not be 2.6 bbf, but only 1.0 bbf (plus or minus .2). This represents a reduction of 80% from the historic excess levels of 1980-1988. FS/BLM timber harvest information from May 1990 is no longer adequate for predicting economic feasibility and benefits of future timber product exports. This is especially true because the Ninth Circuit found that both the BML's and FS's 1990 management plans were legally inadequate.

Page C-23 of Vol. II goes beyond the above 1990 information by discussing the Forest Services "recently issued" 1992 EIS on the spotted owl. The document states that adopting the Jack Ward Thomas Plan will reduce harvest levels 27 percent to 3.5 billion board feet in 1995 from all national forests in Washington, Oregon and California. As stated above, allowable cuts under Option 9 are only about 1 billion board feet, far lower than the 2.6 bbf quoted by the FS in 1990 and the 3.5 bbf quoted by the FS in 1992. The 1992 FS EIS was also successfully challenged for legal adequacy as the Ninth Circuit found that it violated federal laws.

The DEIS update continues with a discussion of the BLM's 1992 forest plans. The DEIS states:

> 20 The Bureau of Land Management (BLM) has not yet defined its spotted own management plan. It is possible the BLM will obtain an exemption from the requirements of the Endangered Species Act for 44 timber sale units in Southwest Oregon, which account for 30 percent of 1991 BLM sales. For the long run, BLM has proposed a draft "owl preservation plan" that would reduce or eliminate protection for large parts of the owl's habitat and allow logging to go forward in an attempt to reduce economic costs of owl preservation.

Id. at C-23. BLM's ESA challenge failed for all but 13 of the 44 sales. As of this writing, none of the 13 sales have gone forward because the BLM has yet to produce a legally adequate owl plan. Its "owl preservation plan" was soundly rejected as bad science in 1992. None of the above FS or BLM projections can therefore be used to justify high, sustainable timber cuts for export from Coos Bay. The Corps must reevaluate its timber export projections based on current information under Option 9, with an additional view to the ever increasing evidence of logging-related damage to fisheries in the PNW.

c. The DEIS states at C-12 that actual wood products export projections selected for use in the analysis are based on information from the U.S. Forest Service which predicts that "lumber exports will show slow growth over the forecasted horizon of 1996-2046." Compare this finding with new information now available under Option 9 which predicts outright decline, not "slow growth." Consider also recent information stating that the Forest Service has routinely suppressed scientific information on

A sensitivity analysis has been added to the revised document that shows the impact of various levels of timber product exports, to provide decision-makers an indication of the sensitivity of the project benefits to assumptions about timber product exports.

20 **Additionally, information excerpted from "Forest Ecoysystem Management: An Ecological, Economic, and Social Assessment Report of the Forest Ecosystem Management Assessment Team" (FEMAT report) Appendix A, dated July 1993, has been included in the section on risk and uncertainty. It addresses the most recent estimates of timber harvests, including Option 9 (the preferred alternative in the FEMAT Report).**

20 analyzed in the EIS. Marsh v. Oregon Natural Resources Council, 109 S.C. 1851 (1989). The Corps has the opportunity to supplement the DEIS to update old options which may no longer apply. The Corps should take this time to cure the DEIS before making any final decisions.

B. Other Assumptions in the DEIS

1. Inadequate Water Supply

21 The DEIS states at § 2.2 that the area has an adequate water supply to accommodate uses and development triggered by the deep water dredging. However, our investigations show that the area has few, if any, viable alternatives for increased water supply and that using water from the Oregon Dunes NRA is not one of those alternatives. This likely water shortage also undercuts the assumption that BLM land on the North Spit will soon be exchanged to allow the development of a deep water industrial port. Inadequate water resources to sustain new or expanded marine industrial infrastructure also undercuts the need for the preferred deep water dredging alternative. We have submitted our comments to the Forest Service on the proposed diversion of water from Beale Lake to support this claim.

2. Impacts on Fisheries and Aquatic Habitat

22 The DEIS at § 2.2 correctly states that fishing is one of the primary economic resources for the Coos Bay area. This statement assumes that Coos Bay has an adequate supply of fish to sustain commercial and recreational fisheries into the future. However, new information shows a dramatic decline in fishery resources which now threatens the economic viability of the local fishing industries. The bay population of starry flounder shows a population decline over the past 5 to 8 years. Many salmon species are now in rapid decline and Coho have recently been petitioned under the ESA. Although not yet protected under the ESA, NEPA requires that a federal project not further impact a petitioned species. The benthic community at the dredge site is also doomed. One particular clam species, Tresus, is in danger of local extinction and the dredging would definitely constitute habitat loss over the short and possibly long term. The Corps needs to reassess the project's potential environmental impacts on the Coos Bay fisheries and marine habitat.

3. Shoreline and Bay Erosion

23 The DEIS states at pages 47 and 49 in two cursory sentences that the proposed deep water dredging will have no serious or lasting effect on shore erosion. We respectfully disagree with this non-analysis. Delane Munson, the first Director of the Sough Slough Estuarine Sanctuary, determined that dredging of the channel into South Slough near Charleston has caused a measurable increase in tidal fluctuations in Sough Slough. There, Munson documented that increased dredging has caused the high tides

21 The DEIS statement in Section 2.2 is referring to current water supply sources and their adequacy to meet existing and projected port operations as described in the feasibility report. Additional new water sources would not be required.

22 Chapters 3 and 4 of the DEIS discuss anadromous fish (including coho salmon) and their habitats. The primary issue regarding impacts to these species from dredging operations is removal or disturbance of their food sources, principally benthic invertebrates. As stated in the DEIS, some impacts to benthic invertebrates would occur during initial dredging with species recolonizing rapidly following dredging. We have concluded that the proposed 2-foot deepening would not likely have an adverse impact on anadromous fish species, including coho salmon.

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23

became higher and the low tides lower, as compared to historical tidal levels. Such increases can be expected to occur with each incremental increase in channel depth and width. The movement of progressively larger volumes of water into and out of the estuary an impact on salinity, wave action and beach erosion, and inundation of adjacent wetlands and marshes.

Studies of the shorelands on the east side of the estuary near the # 12 buoy, for example, show the presence of offshore stumps of old growth spruce trees, now sitting ten meters from the current line of permanent vegetation. Some of these stumps were WITHIN the zone of permanent terrestrial vegetation as recently as 1978. Requests for permits (including emergency permits) for rip rap in this area have also escalated substantially since 1983, as local residents and/or property owners struggle with the problems of increased shoreline erosion. This increased shoreline erosion has several sources besides channel dredging, including poor land management practices carried out by the land owners themselves. However, all direct and indirect impacts of dredging on shoreline erosion must still be addressed.

Further, the introduction of <u>Ammophila arenaria</u> (European beach grass) (EBG) by Oregon Department of Transportation has led to the interruption of the historical sand stream which continually brought wind-borne sediments from Pacific beaches on the west side of the North Spit. The sand historically moved eastward across the spit and into the estuary, where some sediments were carried by water transport onto the beaches on the eastern shore of the estuary. This replenished the shoreline lost to erosion (mainly during winter storms).[1] While the introduction of EBG has been responsible for increased erosion on the east shore of the estuary for some 50 or 60 years, the increased erosion due to the channel dredging is, of course, more recent. Observations of the geomorphology of the eastern shore of the North Spit (including comparisons with older aerial photos), show that the sand stream traveling into the estuary from the Pacific beaches, while substantially reduced due to exotic vegetation, is still a potential factor in offsetting the erosion on the east shore of the estuary. But this potential source of material to counteract the effects of beach erosion is largely trapped by the channel, acting as a "sediment bowl," and now reaches the shoreline in reduced quantities. Deepening and widening the channel will further reduce this sediment stream from the North Spit to the east shore. This will further increase erosion, thus having an additional "social impact" not addressed in the DEIS. This will probably further impact habitat for one or more threatened, endangered, or sensitive plant taxa (discussed below).

[1] In the area east of the # 12 buoy, the region of such unconsolidated sediment, which constitutes essentially the 100 year flood plain, extends over approximately 200 meters to where the bedrock emerges above sea level (under Cape Argo highway). This is the area mentioned above where erosion of up to $5 of the 200 meters of unconsolidated sediment has occurred since the channel deepening of 1978-79.

23

Shoreline erosion in Coos Bay results from a variety of factors as you have indicated, most of which are unrelated to the navigation channel, such as wind generated waves, cyclical climate changes, shoreline developments and land use changes. We concur that one of the contributing factors is ship-generated waves. We do not conclude, however, that the proposed 2-foot deepening would add to this source of erosion. The deepening would allow the existing fleet to load deeper and navigate the channel more efficiently but would not, in itself, lead to more commodities and more ships. Increases in tidal fluctuation from the proposed deepening and resulting increase in shoreline erosion are also not likely. From a purely physical standpoint, the change in the cross-sectional area of Coos Bay from deepening the channel by 2 feet is so small as to be negligible. The South Slough experience which you have cited represents a much larger change in cross-sectional area as channel depths were increased from an average of 10 feet to 17 feet within a much smaller area. Attempting to calculate any increase (or decrease) in tidal fluctuation based on a 2-foot depth increase is beyond the capability of available physical or numerical models.

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4. **Biological Impacts of Dredging**

The DEIS states at page 22 that no federally listed species will be impacted and that all federally listed fish stay out of the estuary. Coho, likely to be listed soon, are commonly found in the estuary. In addition, four federally-listed threatened or endangered birds (brown pelicans, peregrine falcons, bald eagles and Western snowy plovers), and at least one endangered plant are found on the North Spit of Coos Bay. The Spit has been found to support the largest numbers of snowy plovers on the Oregon coast. We trust that the DEIS will incorporate the comments and recommendations of the U.S. Fish and Wildlife Service in their, entirety, including the Service's recent Western snowy plover Recovery Plan.

24 The "Biological Impacts" section of the DEIS did not address the issue of protected plant species potentially affected by this project. Most significant of these is Cordylanthus Maritimus ssp. palustris, Saltmarsh Birdsbeak, a federal candidate species and a state listed species which has significant populations in the estuary below the railroad bridge and one significant population in the North Slough, just north of the bridge. In addition, the federal candidate species Abronia umbellata ssp. breviflora has historical habitation in the estuary and is a candidate for re-introduction to suitable habitat. Limonium californicum (recently added to Oregon Natural Heritage Program's List # 2), also has significant populations at several locations in the estuary below the railroad bridge. All of these species live in portions of the tidelands and/or marsh where they will be strongly effected by even minor changes in 1) salinity, 2) tide level and/or 3) wave action. One or more of these plant species live in areas which are relatively protected by wave action. They appear to need the higher salinities characteristic of the lower estuary, while they are vulnerable to wave action from storms and ship traffic. It seems likely that these and other marsh plants WILL be affected by the proposed project. This issue needs to be addressed.

The DEIS acknowledges in Vol. 1, page 48, that there will be effects on salinity, but determines that such effects will be "negligible." This conclusion can not be substantiated without reference to impacts on the above referenced threatened, endangered or sensitive plants which will be affected by changes in salinity, tide levels, wave action, and land use patterns in consequence of this proposed action.

5. **Impacts from Induced Land Use Changes**

25 1. The DEIS must address indirect impacts of growth inducing effects related to changes in land use patterns, changes in population density, and indirect adverse effects on air and water as well as the ecosystem. We would like to elaborate on this issue when we sit down together.

The DEIS (now FEIS) addresses the effects of the proposed channel deepening on salmonids utilizing the Coos Bay estuary, including coho salmon. The Federally-listed birds are also discussed in the FEIS. Biological Assessments were prepared for these species with a determination of no effect. The USFWS has provided a letter concurring with our determination. Refer to Exhibit 7.

24 Cordylanthus maritimus palustris and Limonium Californicum are not a listed species per Endangered and Threatened Wildlife and Plants, 50 CFR 17.11 & 17.12, August 29, 1992 or on a more recent list from USFWS. Abronia umbellata ssp. breviflora is also not listed and does not occur in Coos Bay to our knowledge. Their status as species of concern is recognized and they are discussed in the EIS. As stated in the EIS, the proposed channel deepening would not adversely affect these species as no perceptible change in ship-induced waves, salinity or tide levels is anticipated. See additional discussion in Section 4.1 of the EIS.

25 Topics related to land use, growth and population are discussed in Sections 3.5, 4.5 and 4.7 of the EIS.

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6. Benefits of the No-Action Alternative

26 In addition, the DEIS should address the possible benefits to the environment under a no-action alternative. This should include a discussion of benefits if channel depth, ship traffic, land uses and dredging activities remain essentially the same unless and until updated studies show renewed economic feasibility and public need for channel deepening and widening in Coos Bay.

We have some news clippings for the file which will better explain the comments in this document.

Thank you for your patience and cooperation. We look forward discussing these issues with you soon.

Sincerely Yours,

Lyn Mattei
ONRC Land Use Coordinator

C:
Andy Kerr, Oregon Natural Resources Council
Dr. Ray Noland, Cape Argo Audubon
Dennis Phillips, Biologist
Liz Frenkel, Oregon Chapter Sierra Club
Mike Graybill, South Slough National Estuarine Reserve
Alice Pfand, Kalmioposis Audubon
Wally Johnson, Oregon Shores Conservation Council
Dick Vander Schaff, Nature Conservancy
Ron Garth, U.S. Fish and Wildlife Service

26 **The effects of the no-action alternative (also described as the without-project condition) are discussed in Section 3 of the Main Report, Section 2 of the EIS and in the Economics Appendix, Volume II.**

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Southern Pacific Lines

Southern Pacific Building • One Market Plaza • San Francisco, California 94105 — Room 1007

J. T. Reilly
Vice President and
Chief Engineer

File No.

November 11,1993

Colonel Charles A.W. Hines
District Engineer
U.S. Army Corp of Engineers
Portland District
P.O.Box 2946
Portland,Oregon 97208-2946

Dear Sir:

On behalf of the Southern Pacific Transportation Company, I am writing to comment on the Feasibility Report/EIS for the proposed navigation improvements at Coos Bay, Oregon.

27

As you are aware, the Southern Pacific Transportation Company (SPTC) North Bend Drawbridge is within the limits of this project. Deepening the channel near the bridge piers and fender system has the potential to cause deterioration in the bridge support structure. Previous channel dredging caused undermining of the south rest pier. Further channel lowering could have serious consequences for the pivot and north rest piers.

Also, despite the statement on page 33, the railroad bridge has been struck at least four times since 1987. The encouragement of larger vessels in this waterway seems to be at odds with the known hazards of traversing the railroad bridge crossing.

Therefore, the SPTC Bridge Department opposes any deepening of the existing channel until it is satisfied that there will be no negative effects on our structure.

If you have any questions regarding these comments, please call either myself (415-541-1504) or Mr. Roger Boraas of my staff (415-541-1493).

Sincerely,

K.L. Wammel

Kenneth L. Wammel
Engineer-Structures

** TOTAL PAGE.001 **

27

Based on current survey information, modification of the channel as proposed would not require dredging in the vicinity of the bridge piers. The existing channel bottom through the bridge opening is already at or below the deepening level. While it has been an issue, we cannot agree with the conclusion that previous dredging had caused undermining of the south pier. The reference to the number of accidents at the bridge will be revised, but it is noted that there have been no accidents involving deep draft vessels. Deepening the channel by 2-feet, as proposed will allow some deeper draft vessels and/or loading of existing vessels to a deeper draft. A significant increase in the size of vessels above those entering today would not be expected to result. While it is acknowledged that there are risks with the clearance through the bridge, the Coos Bay pilots' established procedures and policies to assure safe navigation through the bridge will continue under the proposed project and there would be little increased risk.

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November 15, 1993

Colonel Charles A.W. Hines
District Engineer, Portland District
U.S. Army Corps of Engineers
P.O. Box 2946
Portland, Oregon 97206-2946

TRANSMITTED BY FAX THIS DATE
ORIGINAL BY MAIL SAME DATE

Dear Col. Hines;

This letter is in response to the request for public comment regarding the Draft EIS and Feasibility Report: Coos Bay Oregon. My interest is as the former General Manager of the Oregon International Port of Coos Bay, and my lingering personal and professional desire to see the Coos Bay Project completed.

There is nothing contained in the Draft EIS and Feasibility Report to suggest that the Coos Bay Project has lost any degree of feasibility, national or local interest and benefit. In fact, just the opposite appears to be clear. I wish to comment on three areas of concern.

28 1) As you know, that has not always been the case, and this project has suffered at times due to the changes in the manner by which the Corps performs Local Cost Shared projects. Many of those issues have been resolved and the study is nearly ready for approval by the Board of Rivers and Harbors, prior to submission to Congress for Authorization and Appropriation. I appeal once again, however, for the Corps to give discretionary review of this project in light of the many obstacles and issues which have hampered timely progress and were NOT the fault of the local sponsor.

28 Your comment will be included in the final package which goes forward for review. We will do everything we can to assure the project stays on schedule.

29 2) Furthermore, I am concerned that the issue of a Ship Simulator study or Model has not been conclusively stricken from the body of the report. There was prior agreement that such would occur. That was reneged, then a Global Positioning Study was performed. It is my understanding that the results of that Corps study confirmed what the local sponsor and local maritime interests have maintained consistently throughout : that the swing span railroad bridge is not a navigation obstruction which needs to be studied or otherwise addressed as an element of this project. I strongly urge the Corps to permanently strike all open-ended reference to the star-crossed Ship Simulator Study notion, and rely instead upon the satellite-based data and charts.

29 This past summer Waterways Experiment Station (WES) conducted Differential Global Positioning System (DGPS) Survey on ships navigating in Coos Bay. As a result of the DGPS, WES concluded there was not sufficient indications of significant navigation impact to warrant a simulation study concerning the proposed additional two feet of ship draft. This conclusion was supported by the Portland District. Before the reference can be stricken from the report, however, the District must be granted a waiver by HQUSACE from the ship simulator model. To date we have not received such a waiver.

30 3) Also under the heading of "Costly and Unnecessary" seems to be the notion of a supplemental EIS to deal further with offshore disposal. It is suggested that such further study be performed during the PED Phase. It is my view that the existing Draft EIS is complete and comprehensive enough that such further study is unnecessary, costly, and further jeopardizes the timely completion of this Channel Improvement Project. The estimated additional $100,000 will not bear any conclusive new results and could even be addressed as part of on-going O&M research and planning. Please do not continue to jeopardize this project for the wrong reasons. Certainly the capability and authority exist within the Corps of Engineers to designate the off-shore disposal site with approval of this study. I strongly urge you to do so, in the national interest of moving this project forward in a timely and cost-effective manner.

30 A supplemental EIS (SEIS) is included in the PED schedule and cost estimate in the event it is determined through review that the EIS does not provide sufficient information to designate the off-shore disposal site. After all the comments are received the need for a SEIS will be reevaluated.

31 Perhaps it is untimely, but please allow me to take this opportunity to once again point out that the southern tip of the North Spit of Coos Bay continues to erode, threatening the

31 integrity of the federal jetty project at the mouth of Coos Bay. The concept of beach nourishment to stabilize the documented erosion process is not included in this project,the construction of which will generate hundreds of thousands of yards of suitable resource material. I raise the issue not as a request for this action to be included in the project EIS or Report, simply to once again go on record as having raised it to the attention of the Corps of Engineers at the District, Division, and D.C. Headquarters levels.

In summary, thank you for the opportunity to comment as an interested member of the public. I strongly urge the Corps of Engineers to approve the Draft EIS, designate the off-shore disposal site within the study approval, and eliminate any future confusion regarding Ship Simulator Studies at the railroad bridge by clearly stating that all previous and contemporary data render it unnecessary.

Sincerely,

Paul W. Vogel
16760 SW 108th Avenue
Tigard, Oregon 97224

cc: Oregon International Port of Coos Bay
U.S. Representative Peter DeFazio
U.S. Senator Mark O. Hatfield
U.S. Senator Bob Packwood
Ports Section, Oregon Economic Development Department

31 As you mentioned, this is a separate Operation and Maintenance (O&M) issue. Our Operations Division is evaluating this situation and will take appropriate action under their O&M authority.

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NOV 15 1993
REG & ENV RES BR

Rudy Gorsch
Rt. 2 Box 2155
Coos Bay, Ore.
97420
1-503-888-5327

To Steve Stevens
U.S.Army Corps of Engineers

Sir;

My concern with the deepening of the Coos Bay channel is environmental and the cost.

32 On the environmental end, will the added salt water bring unwanted changes in the aquatic life of the bay?

33 The crab in the bay may find it easier to feed on the oysters planted at and above the North Bend bridge.

34 The gaper clam will have a better set with the higher salt content. Will the gaper clam overpower the other types in the upper bay?

35 Mud shrimp are found in the higher salt content of the lower tide zone say plus 2 feet down to 30 feet deep at Rocky Point. They do not need any more help.

36 Water in the bay that is loaded with silt may cause a problem with crab larvae that are in the bay in spring and summer. Buy early fall the crab are around the 1 inch size and a little harder for fish to eat.

37 Blasting of any type at buoy 7 to 10 and at buoy 16 is a great fear of mine. Both areas have seed beds of commercial clams (gaper,butter, and littleneck). All are dug tidally buy sport diggers as well. The lose at Charleston Channel buoy #1 (Cribs) was between 3 and 10 million pounds in the blasting that was done in 83-84 to deepen the Charleston Channel. At todays price that is in the millions of dollars lost to the fisherman. The fishing boats had 2 to 4 man crews and a home based sales force. Add to that a state poundage fee of .006 cents per pound and the income tax, you don't get to great an picture.

The cost is the other factor. I have no doubt that the port will find the money to do the job. The port will put use deeper in ddt for a project that will cost use more jobs and add to the cost to maintain. Wood products of any type will have to drop in the next few years to much lower levels than now. The copper ore will be gone in 2 years or so says the export company. What shipping will be need our nice deep channel then? The railroad may close the line down coming to Coos Bay (planed by Southern Pacific as a down sizing measure).

32 As indicated on page 4-17 of the EIS, only minor changes are expected in salinity and then only in the upper portions of the Bay. It is unlikely that these changes will be of sufficient duration or magnitude to effect the aquatic life of the Bay.

33 The proposed 2-foot channel deepening would not effect the distribution or feeding habits of crabs in the Bay.

34 As previously indicated, the only salinity changes predicted to occur are in the upper reaches of the Bay where gaper clams do not occur.

35 See previous response for salinity changes.

36 Dredging the channel will not increase suspended sediment loads in the Bay to any extent.

37 No blasting is currently planned for channel deepening. Rock will be removed by mechanical means.

38 These are some of my concerns as to why I am asking for a public meeting or hearing that will force the disclosure of information so the people can see the real cost of this project. I ask that it be held in Coos Bay. I ask that information use as bases for this project be sent the me so I can make sure the information is correct.,

TRULY
Rudy Gorsch

38 If our responses to your comments do not fully address your issues, please contact Alan Rumbaugh, General Manager of Oregon International Port of Coos Bay, to discuss any further need for a public hearing.

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Wim de Vriend
573 South 12th
Coos Bay, OR 97420
(503) 267-6177

RECEIVED
NOV 15 1993
REG & ENV RES BR

November 10, 1993

Department of the Army
Portland District, Corps of Engineers
P.O. Box 2946
Portland, OR 97208-2946

Dear Sirs: CENPP-PE-RP - Coos Bay Channel Deepening Project

I have reviewed your draft *"Feasibility Report On Navigation Improvements"* for Coos Bay, Oregon.

I am not an engineer but a local resident who has studied the operations of the Port of Coos Bay for some time. I have no quarrel with the report's recommendation that the Coos Bay channel be deepened by two feet, but I feel some aspects of this project have received insufficient consideration. The first one may be minor: the effect of the channel modifications on downtown Coos Bay. The second one is the need to take a bigger view of the industrial layout of the area and to consider modifying the channel project accordingly.

39 1. Most of the downtown area of the city of Coos Bay was built on filled mud flats. It is common knowledge that for many years, the ground in this part of town has been sinking around the buildings, with the latter staying in place since they rest on pilings. Repairs of streets and sidewalks have obscured much evidence of sinking ground, but observable examples remain: I would cite the sharply tilted sidewalk along the first block of North Broadway; a large broken conduit on the left front of the old city hall, with a gap of three inches; sunk ground, separated from the building of Dr. Uno on Commercial, and similar phenomena all around Blossom Gulch School.

The explanation I have heard for this phenomenon is that subterranean layers of muck are being squeezed out into the deep shipping channel, which runs immediately along the Coos Bay downtown waterfront, and that this is one of the reasons why regular maintenance dredging of the channel is needed. If this is so, one would think the process may get worse if the channel is enlarged as proposed. If further settling occurs it is bound to have costly impacts on public streets and utility lines in Coos Bay, but I don't see any consideration of it in the environmental impact statement

40 2. If enlarging of the upper bay channel is inevitable, some further settling of downtown Coos Bay may be a fact of life. But I'm not sure of the inevitability of enlarging all of the present channel. The report, while very complete in some aspects, is short on considerations of harbor topography and planning. For instance, on page 2-2 of Volume I, the authors state:

39 In 1987 the Portland District Corps of Engineers contracted the services of Geotechnical Resources, Inc., to addresses this possibility. They produced a report titled "Analysis of Relationship Between Dredging and Subsidence Along the Coos Bay Channel". The conclusions of that report state, "Based on the information developed during the field program, slope stability analyses, and our conversations with private and government entities along Coos Bay waterfront, it is our overall conclusion that dredging within the limits of the navigation channel has not contributed to slope instability or subsidence of the landward slopes west of the navigation channel. It is also our opinion that deepening the channel by about 8 feet, from elevation -35 feet to elevation -43 feet MLLW, will not adversely affect the stability of the landward slopes west of the navigation channel.

"Raising the highway bridge and widening the Southern Pacific Railroad bridge proved to be prohibitively expensive and could not be economically justified. Dredging a shorter channel could not be economically justified as, at present, most facilities requiring a deeper channel are concentrated along the upper reaches of the authorized channel, between RM's 12 and 15. Moving existing facilities and attendant infrastructure from the upper channel reaches to the lower bay would likewise be prohibitively expensive. Development of additional deep-draft facilities in the lower bay could not be justified in the foreseeable future."

Nowhere in the report's two volumes do I find information to back up these assertions. Without such data, one is left with the impression that things must stay as they are because they always have been.

To start with the idea of "raising" the McCullough bridge: this implies that the height of the bridge is starting to be a hazard to the superstructure of ocean vessels, as perhaps was demonstrated by the collision of a few years ago. If this is the case, it would argue for a shortening of the channel.

40 Furthermore, it is well known that the 1917 SP bay bridge only has a couple of years of useful life left. Such statements have been made by the railroad company itself, and I have heard this was the reason why the SP placed a limit of a few years on its service to the Hal-Buck copper ore export facility at Central Dock. I also note the railroad's statement that past channel dredging has already undermined the bridge supports. (Volume II of the report, page I-37).

According to a recent estimate by the Port of Coos Bay, it would cost $40 million to replace the SP bay bridge, plus another $1.75 million to replace a smaller SP bridge over Coalbank Slough. The SP is on record as unwilling to pay these expenses, an understandable attitude in view of the low volume of traffic on the line. Chances also seem slim that the taxpayers will buy new bridges for the railroad. (Besides, the bridge at Coos Bay is not the only old structure on the branch line. There are numerous other bridges and trestles, along with nine tunnels.)

If the bridge goes, so does railroad service along the present Coos Bay waterfront. Not assessing the consequences of the coming discontinuance of rail south of the bay may appear like severe myopia to future observers. Granted that not all ship loading facilities require rail service, some do. With the increasing emphasis on container service in large ports, small ones like Coos Bay may see more bulk cargoes (like ore) diverted to them. Such cargoes are most economically shipped by rail.

41 Assuming that the SP branch continues to operate under the present, non-union lessee but its bridge is abandoned, then the future railhead will be on the North Spit, not in Coquille as at present. This will require the construction of a sorting yard on the North Spit, a perfectly feasible move.

Farsighted planners should consider tieing in to this with the construction of several ship berths (and dockside rail extensions) on the Port's North Spit property. These berths

40 In 1987, during earlier reconnaissance studies, these potential measures were considered. The cost of reconstructing the RR bridge was then estimated at $27.8 million and found not to be feasible in terms of benefits to navigation. This information is presented in Section 1, page 4 of the main report. No estimate is currently available for the cost of raising the McCullough bridge nor was an estimate generated at the time. This will be clarified in the text. Raising that bridge would not be feasible in that although the pilots must be diligent in passing under the bridge it does not impose a constraint on deep draft navigation as was considered in the case of the RR bridge. This would be the case even with vessel fleets projected for the future under this study.

41 Detailed studies were not made with regard to moving facilities and shortening the channel. However, while future expansion of port facilities to other areas such as the North Spit may be possible there were no firm plans for such development that the Corps could include in its analysis. Even without detailed analysis it does not appear possible that the cost of relocating the existing facilities from above the bridge to new locations below would be comparable with the cost of this deepening project. The total project cost of the preferred 2-foot deepening plan is just over $13 million. Of the $11 million construction cost, almost $8 million would be expended on the channel up to the bridges, or 70%. Excavating rock in the lower channel is more than 1/2 of that cost. The remaining $3 million could not begin to cover the cost of moving facilities. For instance, the new Glenbrook nickel ore facility alone cost over $30 million to construct at the Pierce dock. This cost was mentioned in the report. In addition, new facilities on North Spit would require the dredging of new access channels with potential for more rock removal, berths, and a turning basin through previously undisturbed areas. There would be additional environmental concerns and potential mitigation involved as well.

About one-half of the maintenance dredging at Coos Bay takes place at the entrance. The cost of maintaining the upper channel is about $1 million per year on average. The present value of the maintenance, at 8 1/4% Federal interest rate, would be about $14 million. The cost of relocating the facilities would not be offset by the combined upper channel construction and maintenance.

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could be leased to the present operators of dock facilities in the upper bay, thus enabling a shortening of the channel. I would also think the Port of Coos Bay would like to turn its vacant North Spit land into a revenue-producer.

The Corps should bear in mind that Coos Bay's concentration of shipping docks in the upper bay is historically based; that's where most of the (vanished) lumber mills were located. Besides, the long-term trend Has been to shorten the dredged channel. In the 1950s, for instance, ocean freighters were able to dock at the McKenna/Coos Head mill up Isthmus Slough.

It would seem that a further shortening of the shipping channel could achieve enormous cost savings for the taxpayers. If the new 37-foot channel stopped near the McCullough bridge, the cost of relocating upper-bay shipping operators to the North Spit could be subsidized out of funds freed by cutting the cost of the proposed deepening project in half. Additional future dredging expenses would be avoided by cutting annual maintenance, which, I believe, costs around $5 million a year.

It seems to me that the Corps should explore the costs and benefits of such developments in some detail, particularly the extent to which future savings in dredging could help pay for the changes I outlined. Such calculations should take into account that the properties of present shipping operators in the upper bay would not lose all their value. Some could still be used for industrial projects, while others could be developed for waterfront commercial purposes and use by shallow-draft vessels, commercial as well as recreational.

Coos Bay's potential for recreational development along the waterfront has always been frustrated by the presence of industrial facilities, and particularly by the railroad. Once these barriers are gone, the town would do very well. The same would be true of North Bend. As an illustration, the Sun Plywood plant on the North Bend waterfront has been vacant for several years, and no one has shown an interest in reviving the old mill. Recently, however, there has been a proposal by the Coquille Indians to turn the site into a gambling casino - obviously not a water-dependent industry. But perhaps this is the way the world is moving, and the Corps should take heed.

It disturbs me that the Corps has summarily dismissed all such considerations from its report. All I see are assertions that changes along these lines would be "prohibitively expensive". I don't doubt that they would cost a lot of money, but so would deepening and maintaining the entire 15-mile channel. I sincerely recommend that the costs associated with the relocation of shipping facilities be explored, so the Corps and local officials can make a more informed decision.

Very truly yours,

Wim de Vriend

cc.: Port of Coos Bay

EXHIBIT 4

SECTION 103 EVALUATION

SECTION 103 EVALUATION
OCEAN DISPOSAL SITE USE
COOS BAY CHANNEL DEEPENING

INTRODUCTION

This evaluation addresses ocean disposal and site expansion actions related to the proposed Coos Bay navigation channel deepening and maintenance dredging as provided by EPA regulations (40 CFR 228.4(e) (2)). Specific actions addressed include, disposal of sandy material within an expanded area replacing existing Site F, disposal of fine-grained material at existing Site H and one-time disposal of rock for the channel deepening. Section 103 of the Marine Protection, Research and Sanctuaries Act of 1972 (MPRSA) requires that all transportation of dredged material with the intent to dispose the material in ocean waters be evaluated for environmental effects prior to making the disposal. This evaluation assessess the effects of the discharge using the criteria set forth by the Environmental Protection Agency (EPA) under the authority of Section 102 (a) of the act.

The Corps of Engineers and EPA previously prepared an Environmental Impact Statement (EIS) in 1986 which evaluated the designation of three ocean disposal sites off the Coos Bay entrance, Sites E, F and H. The Corps of Engineers also previously prepared a Section 103 Evaluation addressing doubling the size of Site F for disposal of future maintenance dredging quantities.

PROPOSED ACTION

The proposed action is the disposal of sandy material at a new location replacing existing Site F, a rock disposal site (one-time disposal during channel deepening), and the transportation of dredged material for disposal at the new site, existing Site H and the rock disposal site. The dredged material would be obtained from the deepening of the Coos Bay navigation channel (entrance to RM 15) and subsequent maintenance dredging. The dredging involves removal of sedimentary material principally composed of sand and rock by hopper or clamshell dredge and barge.

Expansion of site F would increase the length of the east and west boundaries to approximately 8,000 feet to the north and the north-south boundaries have been extended to 14,500 feet (Figure 1). This is a new disposal area not previously used for disposal of dredged material, although sediments placed within the existing boundaries of Site F move into the expanded area as a result of littoral drift. Site F has been used annually since 1977, and received final site designation on August 21, 1986. The present size of Site F is no longer considered adequate because of persistent mounding which is creating a hazardous situation. Apparently, waves are formed by the shallower conditions at the mound which create breakers in the vicinity of the entrance channel. Both the U.S. Coast Guard and the Coos Bay pilots have expressed concern over this situation. A management plan would be developed with the expansion of Site F to distribute dredged material over the entire area, thereby reducing the mounding problem.

The area offshore of the Coos Bay entrance has been studied and reported in the above-mentioned site designation EIS. Further discussion regarding the area and resources affected by the proposed channel deepening project is included in the channel deepening EIS.

LOCATION OF THE DISPOSAL SITES

Site E is located approximately 1.5 statute miles offshore of the entrance to Coos Bay. It's northern and southern boundaries are 3600 feet and eastern and western boundaries 1400 feet long. Site F is also located about 1.5 miles offshore with proposed expanded site dimensions of 14,500 feet and east-west and 8,000 feet north-south. Site H is located approximately 3.4 miles offshore with boundaries of approximately 3600 feet by 1400 feet. The rock disposal site is located approximately 2.5 miles offshore with dimensions of 2000 feet by 600 feet. See Figure 1 for the location and configuration of these sites.

DISPOSAL PLAN

Prior to use of the disposal sites, a management plan would be developed to provide for even distribution of dredged material over the entire area. The dredges would be required to deposit material in a dispersive manner. This would minimize mounding at sites E, F and H which would be removed by littoral currents. The rock material is expected to remain essentially in place, and slowly deteriorate with time and disperse in an offshore direction.

EVALUATION OF DISPOSAL SITES

EPA regulations require the evaluation of ocean disposal sites based on 11 specific criteria and 5 general criteria as shown in 40 CFR 228.5 and 228.6. This evaluation, addressing an expanded Site F and the rock disposal site, is based on information published in the site designation EIS, monitoring studies and the Channel Deepening EIS.

Specific Criteria (40 CFR 228.6)

1. Geographic Location. Site E is located approximately 1.5 statute miles offshore of the entrance to Coos Bay at a depth of

20 meters (m). Site F is also located 1.5 miles offshore at a depths of 24 m. Site H is located approximately 3.4 miles offshore at a depth of 55 m, and the rock disposal site is located approximately 2.5 miles offshore at a depth of about 34 m. General locations of these sites are shown on Figure 1 and specific site coordinates are as follows:

Site	Depth (m)	Size (m)	Coordinates
H	55	1097 x 442	43° 23'53"N, 124° 22'48"W
			43° 23'42'N, 124° 23'01"W
			43° 24'16"N, 124° 23'26"W
			43° 24'05"N, 124° 23'38"W
E	17	1097 x 427	43° 21'59"N, 124° 22'45"W
			43° 21'48"N, 124° 21'59"W
			43° 21'35"N, 124° 22'05"W
			43° 21'46"N, 124° 22'51"W
F (existing)	24	1097 x 427	43° 22'44"N, 124° 22'18"W
			43° 22'29"N, 124° 21'34"W
			43° 22'16"N, 124° 21'42"W
			43° 22'31"N, 124° 22'26"W
F (expanded)	24(avg)	4450 x 2450	43° 22'56"N, 124° 19'34"W
			43° 21'50'N, 124° 20'29"W
			43° 22'51"N, 124° 23'26"W
			43° 23'57"N, 124° 22'31"W
ROCK SITE	34	650 x 180	43° 22'08"N, 124° 24'50"W
			43° 22'58"N, 124° 24'45"W
			43° 22'15"N, 124° 24'28"W
			43° 22'08"N, 124° 24'26"W

2. Distance from Important Living Resources. Species diversity and abundance of benthic invertebrates were directly related to water depth and sediment characteristics within the Coos Bay offshore study area. As depth increased and average sediment size decreased, species diversity and abundance of benthic organisms increased. Sites E and F are characterized by benthic species adapted to a high wave energy environment. Seasonal variability of benthic species is large. The benthic fauna in the vicinity of Site H is more diverse and has a greater number of filter feeding bivalves indicative of a less dynamic environment. The rock disposal site exhibits characteristics of both the nearshore and

offshore environments with species numbers increasingly with depth. The nearby rocky reef area off Lighthouse Point is used by commercial and recreational fishermen for rockfish species. Additional discussion of biological resources is contained in the channel deepening EIS.

3. Distance from Beaches. Sites E and F are located within 1.5 miles of the shoreline, Site H is located within 3.4 miles and the rock disposal site is within 2.5 miles. Limited onshore transport of material from Sites E and F would be expected due to the nature of currents and wave transport in that vicinity. Because of the increasing depths, distance from shore,and frequency of offshore currents, onshore transport of sediments from Site H and the rock disposal site is less likely, The majority of disposed rock material would remain essentially in place.

4. Types and Quantities of Material to be Disposed. There are three basic types of material to be dredged for the proposed channel deepening. These are, sandy sediments from the entrance to RM 12, finer sediments from above RM 12 and rock from the entrance to about RM 6. Estimated quantities of sandy material are 735,000 cubic yards (cy) for the channel deepening, with additional annual maintenance dredged material declining from 122,000 to 2,000 cy, and 700,000 cy of current annual maintenance dredged material. Estimated quantities of fine-grained material are 584,000 cy for the channel deepening, with no additional annual maintenance and 300,000 cy of current annual maintenance dredged material. Estimated quantity of rock is 90,000 cy with no maintenance dredging quantities.

Dredged material would be transported by hopper dredge or sea-going tug and barge.

5. Feasibility of Surveillance and Monitoring. Surveillance of the disposal sites can be made from shore facilities or vessels. Approaches to the Coos Bay entrance, including the disposal areas, are surveyed annually by the Corps. Surveillance during heavy weather conditions is expected to be unnecessary since heavy sea conditions curtails ocean disposal operations.

6. Disposal. Horizontal Transport, and Vertical Mixing Characteristics of the Area. Average currents in the region generally flow parallel to bathymetric contours. Local current strength and direction, however, reflect the variability of local winds. Sediments are observed to settle rapidly with no persistent turbidity plumes. Resuspension of sediments would be at maximum during winter storms.

7. Effects of Previous Disposal. Disposal at Site E and F has resulted in mounding at these sites. Continued disposal at current rates and under current sediment transport conditions would result in unacceptable mounding conditions. Site F has already been doubled to meet existing O & M needs.The recommended

expansion of Site F would permit distribution over a larger area and reduce or eliminate mounding problems. Disposal at Site E will remain at the present minimal disposal quantity of less than 100,000 cy annually to minimize mounding. Disposal at Site H has resulted in little or no mounding with only minor short-term turbidity effects. Sediments disposed at Site H are gradually transported offshore. No significant biological impacts have been associated with disposal at these sites. Additional discussion of these sites is included in the Channel Deepening EIS. No disposal has occurred at the expanded area of Site F or at the rock disposal site.

8. Interference with Other Uses of the Ocean. The only known commercial and recreational uses occurring in the vicinity of the disposal sites are fishing and marine navigation. No significant impact to these activities is anticipated.

9. Existing Water Qualily and Ecology. Water quality at the proposed disposal sites is discussed in the EIS. In summary, the water quality analysis indicates unpolluted conditions typical for seawater of the Pacific Northwest.

10. Potential for Recruitment of Nuisance Species. The major component of dredged material which might attract nuisance species is the organic material. The only material containing any appreciable amounts of organic material is that dredged between RM 12 and 15. This material has historically been disposed at Site H. No nuisance species have been observed at this site over 10 years of monitoring.

1 1. Existence of Significant Natural or Cultural Features, No known significant natural or cultural features would be affected by the proposed disposal actions.

General Criteria (40 CFR 228.5)

1. Minimal Interference with Other Activities. The location of the ocean disposal sites is based upon reasonable distance from the Coos Bay entrance, depth of water, biological conditions, historical use and estimated amount and type of dredged material. Disposal activities are not expected to result in more than minimal interference with the typical marine activities such as navigation and commercial and recreational fishing.

2. Minimize Changes in Water Quality. The material to be disposed consists of clean sand, rock and fine sand. Based on previous testing, the fine sediments dredged from RM 12-15 is the only material which may contain contaminants. As described in the EIS, sediment test results indicate this material is suitable for ocean disposal. Periodic testing and evaluation of material proposed for disposal would occur as necessary to insure acceptability.

3. Interim Sites Which Do Not Meet Criteria. Site F expansion

(double currently approved site), has been given interim EPA approval to alleviate the mounding problem. This interim site expansion has been evaluated and meets MPRSA criteria.

4. Size of Sites. The size of the existing EPA designated Sites E and F have proven to be inadequate for disposal requirements. Expanding Site F to the proposed size along with current use of site E would more than adequately accommodate disposal of initial channel deepening plus current and additional maintenance dredging of RM 0 to 12. Site H is adequately sized to handle current and anticipated material from RM 12 to 15. The rock disposal site is sized to handle the even distribution of rock excavated by the channel deepening work. With the exception of the rock site, annual bathymetric surveys will be conducted to monitor site capacities.

5. Sites Off the Continental Shelf. Such sites were eliminated during site evaluation for the 1986 site designation EIS. Conditions have not changed to offer any environmental advantage to the use of a site off the continental shelf. Transportation costs, sampling and testing costs, and post-disposal monitoring costs associated with disposal at a continental shelf site would greatly increase over present costs. In addition, there is greater uncertainty over impacts associated with continental shelf disposal, compared to disposal at existing sites which are known low impact areas. Therefore, disposal at a site off the continental shelf is not considered necessary or practical.

DETERMINATION OF ENVIRONMENTAL ACCEPTABILITY OF DREDGED MATERIAL FOR OCEAN DISPOSAL

As described in the channel deepening EIS, the sediments contain no contaminants of concern in excess levels, and sediments below RM 12 have been excluded from the requirements of further biological and chemical testing as provided in 40 CFR 227.13 (b). Additional chemical testing has shown fine-grained sediments from RM 12-15 to be acceptable for ocean disposal. The sediments are also similar to bottom materials at the proposed ocean disposal sites.

NEED FOR OCEAN DISPOSAL

Ocean Disposal is a necessary component of the maintenance of the Coos Bay navigation channel as inbay and upland sites are limited or have restrictive conditions. the quantity of material dredged from Coos Bay on an annual basis, even without channel deepening, can only be accommodated through ocean disposal.

IMPACT OF THE PROPOSED DISPOSAL ON ESTHETIC, RECREATIONAL AND ECONOMIC VALUES

The proposed ocean disposal would not have significant impacts on esthetic, recreational or economic values of the areas. Short-term increases in turbidity would occur; however, because the dredged material is primarily sand and rock, and is relatively free of contaminants, the proposed action is not expected to adversely affect water quality or related recreational or economic values.

IMPACT OF THE PROPOSED DISPOSAL ON OTHER USES OF THE OCEAN

No significant impacts on other known uses of the ocean such as commercial or recreational fishing in open ocean, coastal areas, and estuarine areas; commercial and recreational navigation; actual or anticipated exploitation of living marine resources; actual or anticipated exploitation of non-living resources, including sand and gravel and other mineral deposits, oil and gas explorations, or structural development; and scientific research and study are anticipated.

FINDINGS

The material to be dredged has been evaluated according to the criteria in 40 CFR 227 and determined to be suitable for ocean disposal. The ocean disposal sites have been evaluated using the criteria specified in 40 CFR 228.5 and 228.6 and have been determined to be suitable for the disposal of material dredged from the Coos Bay navigation channel.

On the basis of this evaluation, I find the proposed action acceptable under the provisions of section 103 of the Marine Protection, Research and Sanctuaries Act of 1972.

CHARLES A. W. HINES
Colonel, Corps of Engineers
District Engineer

Date:

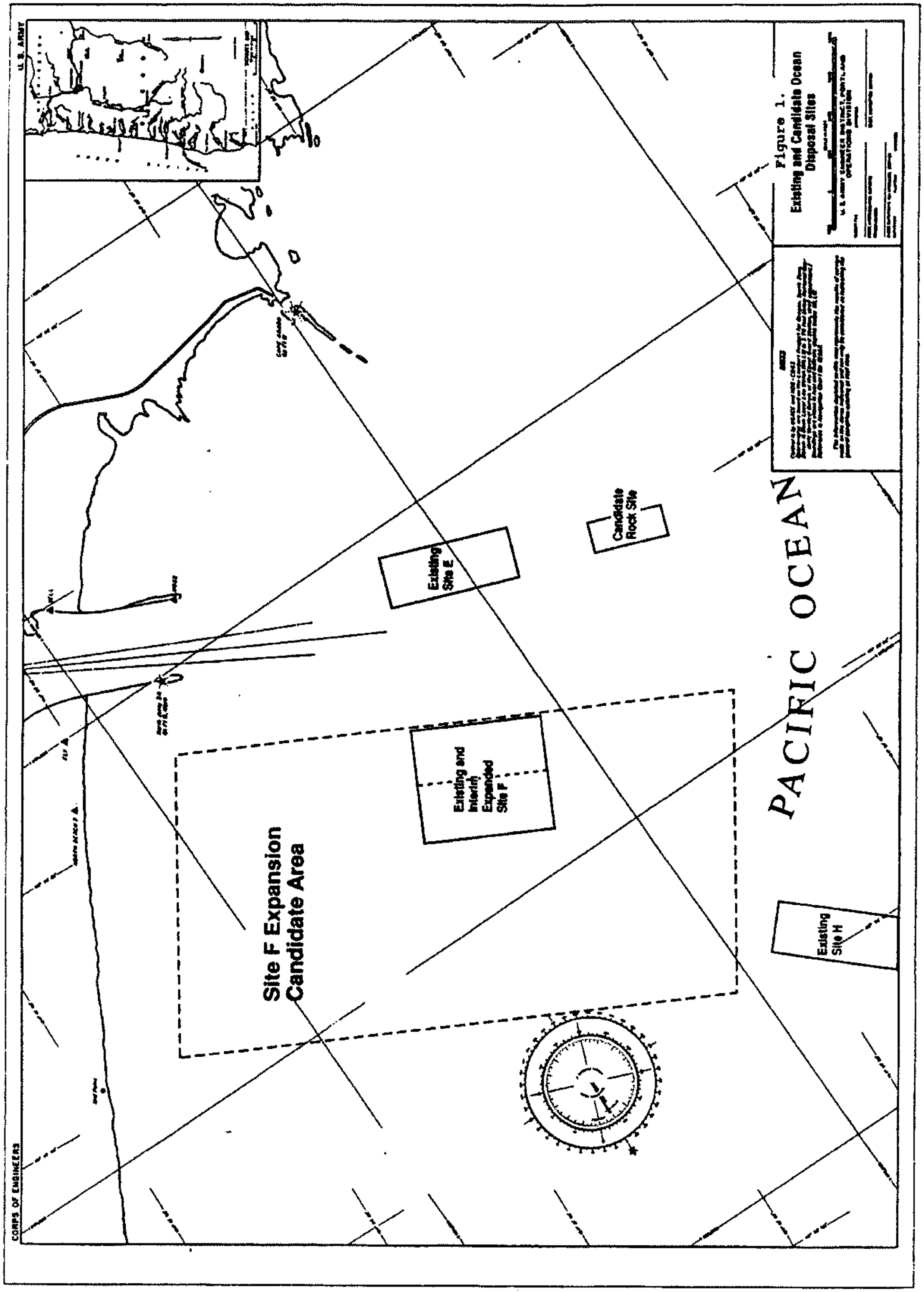

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EXHIBIT 5

CZM CONSISTENCY DETERMINATION

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COASTAL ZONE MANAGEMENT ACT
CONSISTENCY DETERMINATION
NAVIGATION CHANNEL DEEPENING
COOS BAY ENTRANCE TO RIVER MILE 15
COOS BAY, OREGON

INTRODUCTION.

The proposed Federal action addressed in this consistency determination is the deepening of the Coos Bay Federal navigation channel by 2 feet with disposal at three ocean disposal sites. This determination of project consistency with Oregon's Coastal Zone Management Plan is based upon applicable sections of the Statewide Planning Goals and Guidelines and the Coos Bay Estuary Management Plan (CBEMP).

STATEWIDE PLANNING GOAL 19 OCEAN RESOURCES COOS BAY ESTUARY MANAGEMENT PLAN

Goal 19 requires that agencies determine the impact of proposed projects or actions. Paragraph 2.g of Goal 19 specifically addresses dredged material disposal. It states that agencies shall "provide for suitable sites and practices for the open sea discharge of dredged material which do not substantially interfere with or detract from the use of the continential shelf for fishing, navigation, or recreation, or from the long-term protection of renewable resources". Decisions to take an action, such as designating an ocean disposal site, are to be preceded by an inventory based on sound information, an understanding of the resources and potential impacts. In addition, there should be a contingency plan and emergency procedures to be followed in the event that the operation results in conditions which threaten to damage the environment.

Ocean disposal sites for dredged material are designated following guidelines prepared by the EPA (Ocean Dumping Regulations). Site selection is to be based on studies and an evaluation of the potential impacts (40 CFR Part 228.4 (e)). This meets the requirements of State Goal 19 for decisions to be based on an inventory and a sound understanding of impacts.

The five general and eleven specific criteria for the designation of a site presented in 40 CFR 228.5 and 228.6, outline the type of studies to be conducted and the resources to be considered. According to 40 CFR Part 228.5 (a), ocean disposal will only be allowed at sites "selected to minimize the interference of disposal activities with other activities in the marine environment, particularly avoiding areas of existing fisheries or shell fisheries, and regions of heavy commercial or recreational navigation". Monitoring is to be conducted at the ocean disposal site. If adverse effects are observed, then use of the site may be modified or terminated. The requirements of the ocean dumping regulations are broad enough to meet the need of Goal 19.

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Policy 4: Resource Capability Consistency and Impact Assessment.

a. Action. The proposed work involves the deepening of the Coos Bay Federal navigation channel from the entrance to RM 15. Approximately 1.3 million cubic yards (cy) of sedimentary material, consisting predominantly of clean sand, would be placed in ocean disposal Sites F (expanded), and H, and at a new rock disposal site (see attached map). Material would be removed by hopper or clamshell dredge and barge. Area F will be used for the disposal of material dredged below RM 12. Disposal Site H will be used for material dredged between RM 12 and 15. An estimated 90,000 cubic yards of rock material would be placed at the rock disposal site. Dredging would occur between April 1 and January 15.

b. Resources Affected. Aquatic habitats within the Coos Bay area include algal communities, eelgrass beds, and tidal marshes. The greatest variety of algal species is found near the mouth of the estuary. In quieter waters of the inner bay, algae attach to piling and outcroppings. Eelgrass is associated with lower intertidal and shallow subtidal flats. Both eelgrass and attached algae are used as sites for herring spawning. Tidal marshes vary from low silt to bulrush and sedge dominated marshes.

Coos Bay supports a variety of fish species. Anadromous species present include chinook and coho salmon, steelhead, shad, striped bass, and sea run cutthroat trout. These species are all dependent upon the bay or tributaries for spawning and/or rearing activities. Marine and estuarine species include

sculpin, various species of flat fish, ocean perch, and rockfish. Gaper, cockle, butter, macoma, and littleneck clams are present in the area. The two major crab species harvested are Dungeness and red rock crabs.

Coastal birds and waterfowl present in lower Coos Bay include pelagic cormorant, Canada goose, mallard, grebe, common loon, and American wigeon. These birds feed on marine seaweeds and fish as well as invertebrates found in the tidal flats and eelgrass beds. Migratory waterfowl use the bay as a resting place, feeding area, and wintering ground. Shorebirds present include western sandpiper, common egret, killdeer, and great blue heron. Raptors in the vicinity of the project include the marsh hawk, red-tailed hawk, and bald eagle.

Angler use of the estuary is extensive. A sport fishery exists for coho and chinook salmon. Striped bass fishing is also popular.

c. Expected Extent of Impacts. Some additional short-term turbidity would occur during dredging activities; however, given the clean nature of the material to be dredged, the resulting turbidity is not expected to be significant.

Dredging that would take place within the authorized navigation channel would have no direct impacts to estuarine vegetation. Adult fish species would be expected to avoid the dredging and disposal area during the work period and , therefore, would not be adversely affected. Most impacts would be to benthic invertebrates within the dredge and disposal areas. Communities which have recolonized the channel area would be removed. Turbidity, although short-term, could interfere with the survival and settling of the larvae of all benthic invertebrates within and adjacent to the dredged and disposal areas during the work period.

Potential impacts to the estuarine resources would be minimized to the extent possible. Disposal of the material at the ocean disposal sites would minimize impacts to anadromous fish and crab populations.

Policy 5: Estuarine Fill and Removal.

a. Deepening the existing Federal navigation channel is proposed expressly for improving navigation conditions. No estuarine disposal is proposed for this action. No additional channel maintenance disposal would occur in the estuary.

b. The navigation channel is an established and significant part of the Coos Bay estuary.

c. The Feasibility Report/EIS for the navigation improvements has discussed the social and economic basis for the proposed deepening. The proposed improvements would increase economic benefit to the region and maintain the Port of Coos Bay's competitive position with other West Coast ports.

d. This section applies to disposal or fill actions. As stated in 5a, no additional estuarine fill would occur for the deepening or subsequent channel maintenance.

e. Adverse impacts to the estuary will be minimized through ocean disposal, timing of dredging activities, and other specific actions to minimize impacts.

f. The proposed action is consistent with the objectives of the Statewide Estuarine Resources Goal 16 and with other requirements of State and Federal law.

COOS BAY ESTUARY MANAGEMENT PLAN
APPLICABLE MANAGEMENT SEGMENTS

The Coos Bay Federal navigation channel, including the segment proposed for turning basin expansion near RM 12, is classified as a "Development Aquatic" segment. The specific management unit is identified as "OODA" in the management plan which includes the deep draft channel and associated turning basins.

This segment is managed for navigation and and other water-dependent uses, consistent with the need to minimize damage to the estuarine system. Activities allowed within this segment include new and maintenance dredging. The proposed channel deepening with ocean disposal complies with the allowable activities in this segment.

STATEMENT OF CONSISTENCY

Based on the above evaluation, we have determined that proposed deepening of the Coos Bay Federal navigation channel (between the entrance and RM 15) complies with the policies and conditions as specified in the appropriate local plans and ordinances. The action is, therefore, consistent with the State of Oregon's Coastal Zone Management Program to the maximum extent practicable.

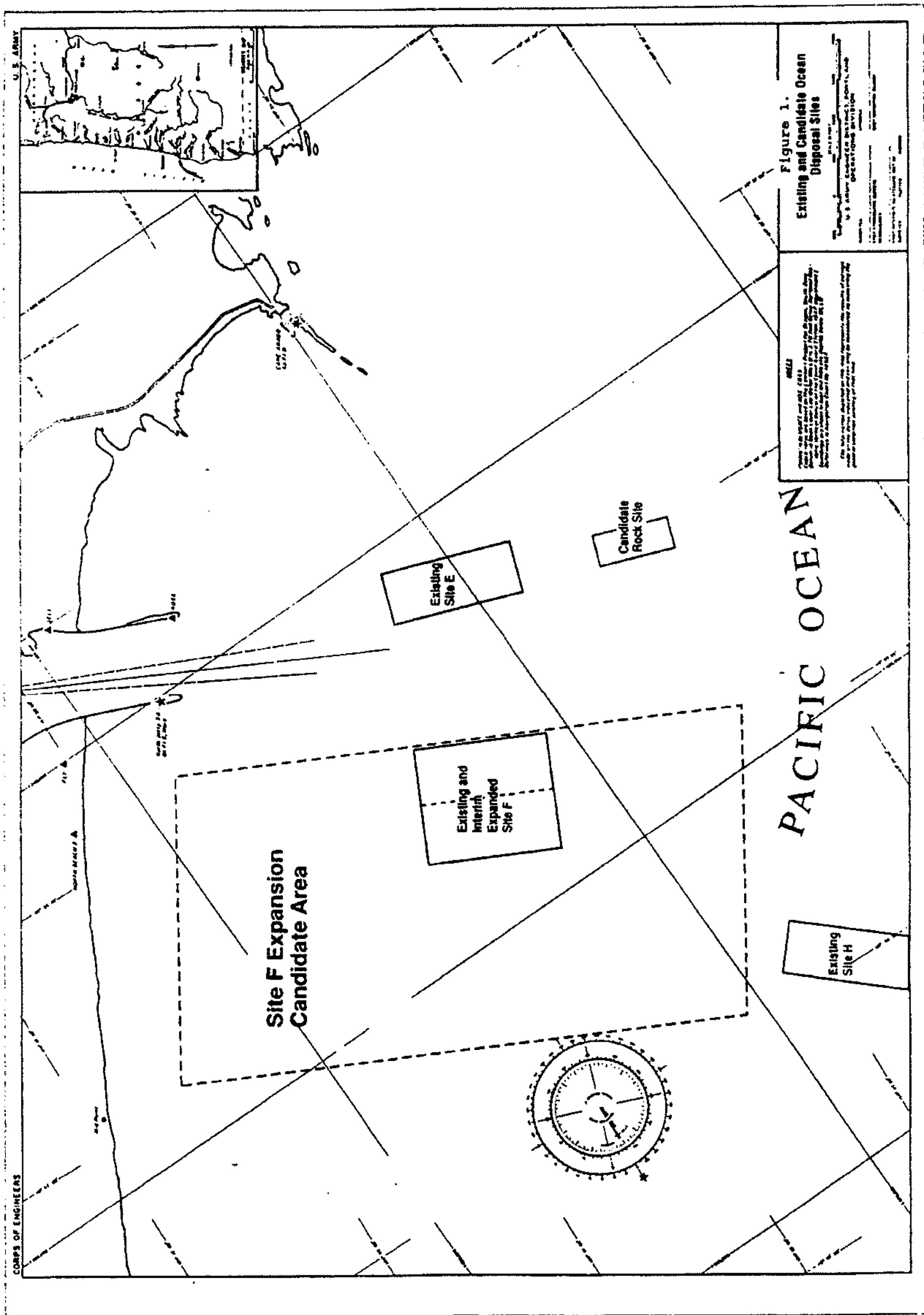

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EXHIBIT 6

FISH AND WILDLIFE COORDINATION ACT REPORT

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United States Department of the Interior

FISH AND WILDLIFE SERVICE
Portland Field Station
2600 S.E. 98th Avenue, Suite 100
Portland, Oregon 97266

July 27, 1990

Colonel Charles E. Cowan, Jr., District Engineer
Portland District, Corps of Engineers
P. O. Box 2946
Portland, Oregon 97208

Dear Colonel Cowan:

This letter expresses the position of the Fish and Wildlife Service on the impacts to fish and wildlife resources resulting from the proposed channel deepening at Coos Bay, Oregon. This statement and the attached detailed report constitute our Fish and Wildlife Coordination Act Report as required under Section 2(b) of the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C. 661 et seq.), and is consistent with the intent of the National Environmental Policy Act. This report is intended for inclusion with the Corps of Engineers' feasibility report on this project.

This report has been coordinated with and has the concurrence of the Oregon Department of Fish and Wildlife as indicated in the attached letter from Ms. Patricia Snow dated July 19, 1990. This report was also reviewed by the National Marine Fisheries Service whose comments have been considered in preparation of the report.

The proposed project involves the deepening and widening of the authorized 45-foot entrance channel and 35-foot-deep draft navigation channel in Coos Bay, Oregon between river mile (RM) 0 and 15. Project alternatives include a 1-2-3-4-or 5-foot deepening executed in either single or multiple phases to a maximum depth of 50 and 40 feet, respectively. Up to 559,000 cubic yards of rock would be removed from the channel between river miles (RM) 1 and 5. Rock material would be pre-drilled and blasted to loosen it prior to dredging. Depending on the alternative selected, between 700,000 and 5,000,000 cubic yards of sandy material would be removed from the entire channel over the life of the project. All material removed would be placed offshore in approved ocean disposal sites.

The proposed channel deepening would have varying impacts on fish and wildlife resources, the severity of which directly relates to the amount and location of material removed. Vegetative, planktonic, benthic, epibenthic, shellfish, and fish species would all be impacted to some degree by the channel dredging. Birds, fish and marine mammals would be negatively effected by the proposed blasting. The project could cause changes in salinity, water quality (contaminants), turbidity, marsh and eelgrass vegetation, and the availability of prey species. Of these changes, the extension of the salt wedge has the greatest potential to change the ecological balance of the Bay. Disposal at the approved offshore sites would have some impacts on benthos and shellfish near the disposal site but these effects are expected to be temporary. There is some concern, however, that offshore disposal is, to some degree, increasing the amount of shell debris and other sediment accumulating on the

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beaches to the north and south of the Coos Bay jetties. This material may be adversely impacting razor clam beds. On the other hand, there may be an opportunity to enhance snowy plover habitat with the disposal of clean materials on the North Spit beaches.

To minimize adverse impacts of the proposed project, the Fish and Wildlife Service recommends that:

1. The project be conducted in multiple phases, i.e., 1 foot deepening every 5 years until authorized depth is achieved. A monitoring study should be initiated to determine increases in salinity related to channel deepening. If salinity increases significantly with dredging, the benefits of completing the dredging must be re-examined.

2. Due to the potential for serious adverse impacts to species in or near the channel, blasting not be considered unless absolutely necessary. If mechanical removal of rock is not possible, then blasting should occur only during the period from January 1 to March 15. Use of bubble curtains, divers to check for fish kills, micro-second delays between blasts, and acoustic surveys should be incorporated as blasting permit conditions.

3. Additional contaminant studies be conducted at the Port of Coos Bay's docks if the channel is widened in this area.

4. Dredged material (clean sand) be used to enhance snowy plover nesting habitat on the North Spit.

5. Any unavoidable habitat losses be mitigated in-kind within the estuary.

6. No dredging occur near identified contaminant sites.

7. Dredging occur only within specified in-water work periods set by the Oregon Department of Fish and Wildlife.

8. Thorough fish and wildlife studies be conducted on the proposed new disposal sites prior to final selection of a site.

9. All shell and rock debris be disposed of far enough offshore to prevent its return to the ocean beaches. Monitoring of the disposal sites and the beaches would be necessary.

Detailed information regarding fish and wildlife resources, project impacts, and our recommended actions are contained in the attached report. Please notify us of your decision regarding our recommendations, and of any changes in the project plans which may require further evaluation by the Fish and Wildlife Service.

Sincerely,

for Russell D. Peterson
Field Supervisor

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NEIL GOLDSCHMIDT
GOVERNOR

Department of Fish and Wildlife

2501 SW FIRST AVENUE, PO BOX 59, PORTLAND, OREGON 97207 PHONE (503) 229-5400

July 19, 1990

Russell D. Peterson
U.S. Fish and Wildlife Service
2600 S.E. 98th Avenue, Suite 100
Portland, Oregon 97266

RE: Draft Coordination Act Report - Coos Bay Channel Deepening

Dear Mr. Peterson:

Thank you for opportunity to comment on the draft Coordination Act Report for the proposed channel deepening project in Coos Bay, Oregon. We concur with the findings in the Coordination Report. We would also like USFWS to include several additional recommendations which are outlined below.

In general the Department opposes the summer time period used by the Corps for its maintenance and construction activities. This is the period when the greatest number of marine species are in the estuary and the greatest negative effects from dredging can occur.

The proposed project would extend, deepen, and widen the existing channel which could result in extension of the salt water wedge further up the estuary. Extension of the salt wedge would change the ecology of the bay affecting all species. In particular, extension of the salt wedge could negatively effect spawning of shad and striped bass.

The Department is very concerned about the extent of inwater blasting that is anticipated for the project. The proposal indicates that blasting could take place every day for four months. This clearly is not the method the Department prefers. If there is no other alternative to blasting, the Department requests that the following conditions be met:

1. Bubble screens be used to prevent fish from moving in to the blast area;
2. Adhere to the Department's timing recommendations (October 1 to January 15);
3. A diver be sent down immediately after each blast to check for damages. If fish are being killed, immediately halt the project.

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The Department is concerned that the ocean dump sites are not far enough out in the ocean. Our district biologists have indicated that sediments disposed offshore are visually affecting beach sediments and may be affecting razor clam success.

Thank you for the opportunity to comment on the draft Coordination Report. Please feel free to call me at 229-5400 ext. 442 if you have any questions regarding our comments.

Sincerely,

Patricia Snow

Patricia Snow
Waterway Alterations Coordinator
Habitat Conservation Division

c John Johnson, ODFW
  Jill Zarnowitz, ODFW

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IMPACTS ON FISH AND WILDLIFE RESOURCES OF THE PROPOSED CHANNEL DEEPENING PROJECT AT COOS BAY, OREGON

Kathleen A. Larson
July 27, 1990

Prepared for the Portland District
U.S. Army Corps of Engineers
by the
Portland Ecological Services Field Station
U.S. Fish and Wildlife Service

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PREFACE

This is the Fish and Wildlife Service's detailed report on fish and wildlife resources affected by the proposed channel deepening project at Coos Bay, Oregon. The project study has been authorized by a resolution from the U.S. Senate Committee on Environment and Public Works passed November 2, 1983. Our analysis of project impacts is based on: 1) project information and engineering data provided as of June 29, 1990; 2) an appraisal of existing resources; and 3) a project life of 50 years.

It should be noted that the proposed project may be subject to permits over which the Fish and Wildlife Service has review responsibilities. Accordingly, our comments do not preclude an additional and separate evaluation by the Service, pursuant to the Fish and Wildlife Coordination Act (16 U.S.C. 661, et seq.), if eventual project development requires a permit from the Corps of Engineers, U.S. Army (Section 10 of the River and Harbor Act of 1899). All such permits are subject to separate review by the Service under existing statutes, executive order, memorandum of agreement, and other authorities. In review of permit applications, the Fish and Wildlife Service may concur, with or without stipulations, or object to the proposed work, depending on specific construction practices which may impact fish and wildlife resources.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

DESCRIPTION OF THE AREA

Coos Bay is located in southwestern Oregon along the Oregon coast about 170 miles southwest of Portland, Oregon. The Coos, South Fork Coos, and Millicoma Rivers are the major tributaries which empty into the bay, the latter two via the Coos River. The bay and estuary extend inland to about mile 31 of the Coos River and mile 30 of the South Fork Coos River. Tides range from -3.0 feet below mean lower low water to 10.5 feet above sea level.

The Coos Bay Estuary encompasses about 10,500 acres, including that portion of the estuary known as South Slough (Figure 1). Coos Bay, via the Coos and Millicoma Rivers, drains about 820 square miles of mostly forested lands, much of which has been logged at one time or another. Soils overlay slopes that are moderately unstable. Certain timber harvesting practices have led to severe erosion. This material eventually ends up in the navigation channels in the estuary, from which it is dredged annually and shipped either to the ocean or placed on upland.

The climate surrounding Coos Bay consists of warm summers and wet, cool winters. Precipitation averages about 62 inches annually.

DESCRIPTION OF THE PROJECT

The proposed project involves the deepening and widening of the authorized deep draft navigation channel in Coos Bay, Oregon. The existing channel is maintained at a depth of 45 feet between river mile (RM) 0-1, and to 35 feet between RM 1-15. Project alternative a 1-2-3-4- or 5-foot deepening of the entrance and navigation channels to a maximum depth of 50 and 40 feet, respectively. This project would be executed in either a single phase or in multiple phases. Multiple phase construction would involve deepening the channel by 1 foot every 5 years until the desired depth is attained. Total construction time could be 20 years if a 5-foot depth is pursued in multiple phases.

Up to 559,000 cubic yards of rock would be removed from the channel between RM 1 and 5. This material would first be blasted to loosen it for removal by clamshell dredge. Blasting is scheduled to occur daily over a 4-month period (January through April) and would extend through two dredging seasons. Depending on the alternative selected, between 700,000 and 5,000,000 cubic yards of sandy material would be removed from the channel over the life of the project. Most of the material between RM 5 and 12 is medium grained sand, but between RM 12 and 15 it is fine grained silty sand.

All the material removed from the channel would be placed offshore in approved sites. The rock material would require placement at a new disposal site (Figure 2). This disposal area is situated on a sandy bottom adjacent to a natural rocky area in water depths of 150-200 feet deep. Dimensions of this site would be 14,000 by 3,600 feet.

In addition to the need for designating the offshore rock disposal site, the further expansion of existing Site F will also be necessary. This site was expanded under Section 103 authority in 1989. Areas 1 and 2 (Figure 2) are the currently designated F sites, while Area 3 is the proposed expansion site which would extend the existing site 1,400 feet northward. Between 425,000 and 1.5 million cubic yards of dredged material could be placed here. This site is designed to accept only clean materials. Area H (Figure 2) would be the site for disposal of the fine-grained sandy silts from RM 12-15. Chemical analyses of these materials do not show contaminant levels in excess of approved standards.

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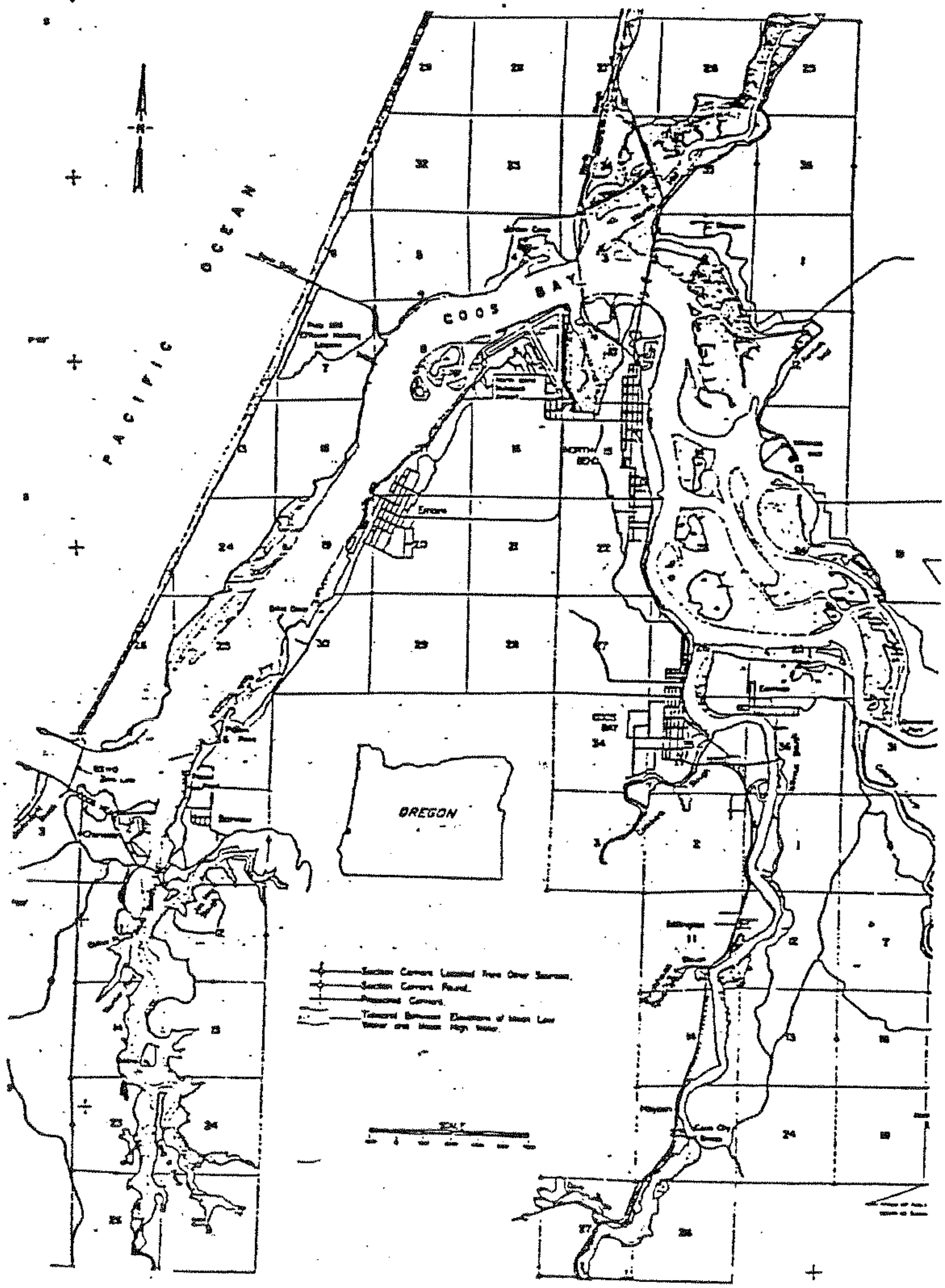

Figure 1. General Location Map for Coos Bay, Oregon

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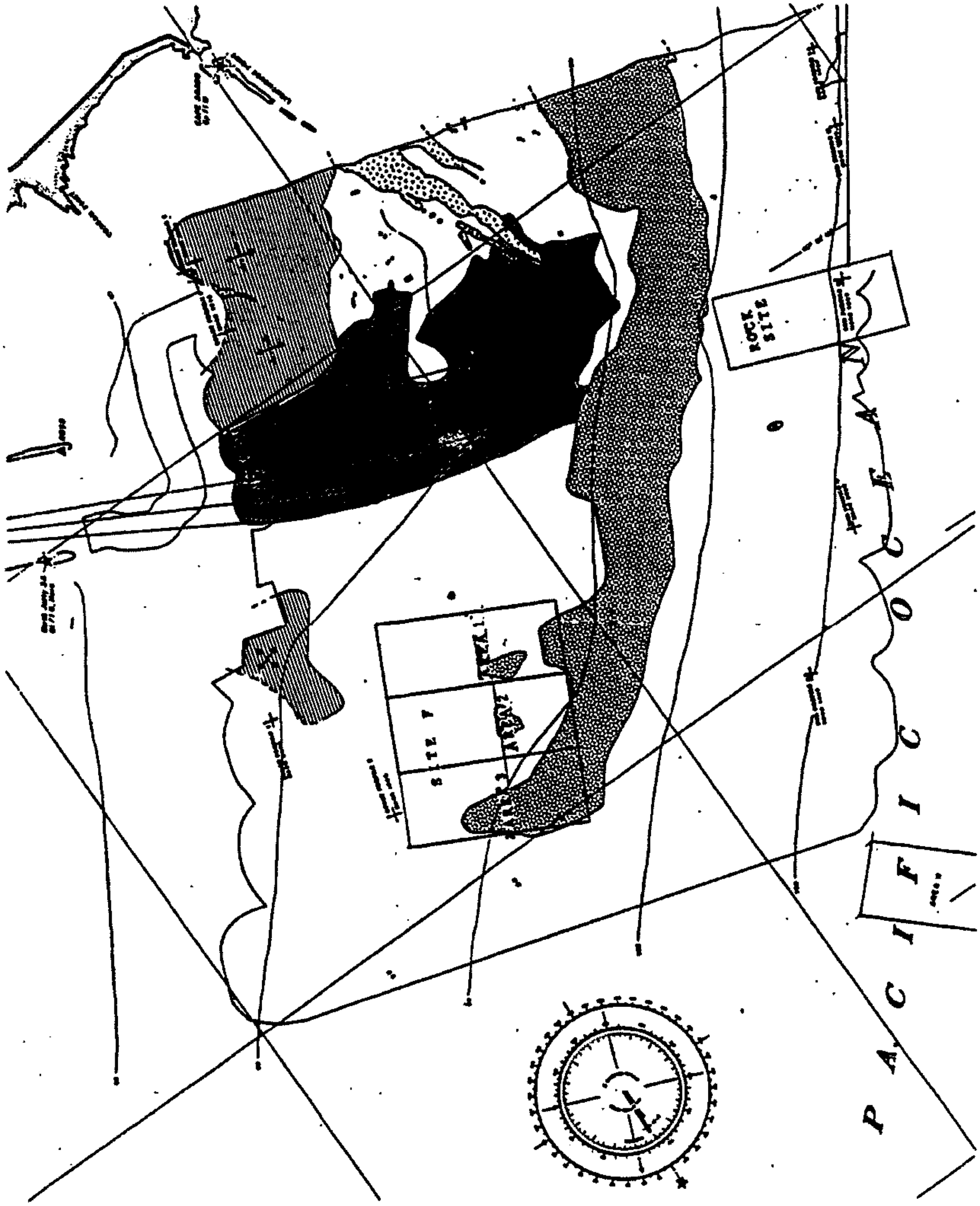

Figure 2. Offshore Disposal Sites, Coos Bay, Oregon

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BIOLOGICAL RESOURCES EVALUATION

FISH

Without the Project

Coos Bay Estuary supports a rich diversity of biological resources. The mid-range salinity of the bay's water provides the right proportion of saline and fresh water to sustain an immense array of plankton. In addition to phytoplankton, every major group of animals in the estuary spends a certain portion of its existence either as a larvae or an adult in planktonic form. Collectively, plankton makes up over 90 percent of the biomass found in the estuary.

Plankton forms the base of the food chain in the estuary. Planktonic production is greatest at salinities of 15 to 25 parts per thousand. Thus, plankton production is high in the vicinity of Empire to North Bend but low near Coos Bay and Isthmus Slough.

A plant community of significance in Coos Bay is the eelgrass community. Eelgrass thrives in shallow, clear waters of high salinity free of heavy wave action. Eelgrass is a source of food and/or cover for epifaunal species such as polychaetes, nematodes, copepods, and amphipods. The substrate associated with the eelgrass beds supports polychaetes, amphipods, pelecypods, and clams. Dungeness crab are commonly found in these beds as well. Eelgrass beds are often found in conjunction with algal beds (Figure 3), and in Coos Bay, extend from South Slough upstream to Catching Slough near Coos River.

Benthic sampling conducted by the National Marine Fisheries Service (NMFS) in May, 1989 has provided some recent data on the organisms associated with the substrate near the navigation channel. Sampling stations are shown in Figure 4.

The NMFS study identified a total of 121 invertebrate taxa. The lower estuary (RM 2 to 5) was the area with the highest invertebrate densities. Stations 1, 4, 5, and 5b (Figure 4) had a mean invertebrate density of 10,441/m^2 while the remaining 16 stations had a mean density of only 661/m^2. The dominant species were the polychaetes, Polygordius sp., Mediomastus californiensis, Heteropodarke heteromorpha and Glycera tenuis and the cumacean Eudorellopsis sp. However, there were few numbers of Dungeness crab, oysters, clams, ghost shrimp, or mud shrimp in these samples. This may have been due to the short duration of the sampling (2 days) or to the location and timing (seasonality) of the samples.

Benthic samples were also collected in December, 1989 (Jones, 1990) from the main channel and the side slopes. Those sampling stations between RM 2 and 4 were dominated by juvenile molluscs of the family Mytilidae (most likely the pea pod borer), and polychaete worms (Polygordius sp., Kefersteinia cirrata, and Chone dunneri). At RM 8, the samples consisted of low densities of polychaetes such as Ophelia sp., Heteropodarke heteromorpha, and Glycera tenuis. Densities of invertebrates increased in those samples taken in the upper estuary (upstream of the Highway 101 bridge) with oligochaetes, polychaetes (Polydora sp., Streblosoma benedicti, Mediomastus californiensis, etc.) and cumaceans dominating the samples.

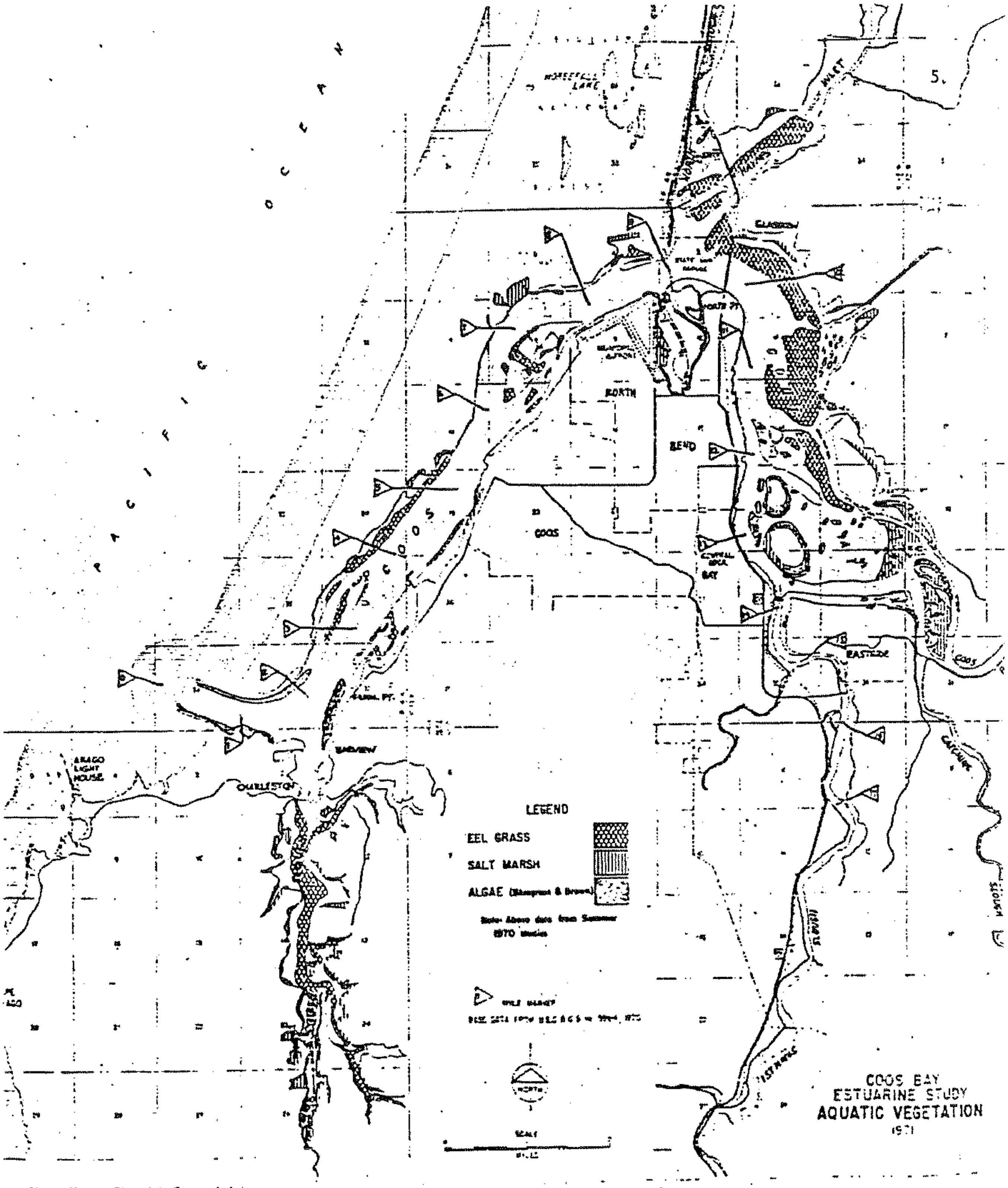

Figure 3. Distribution of Eelgrass Beds in Coos Bay

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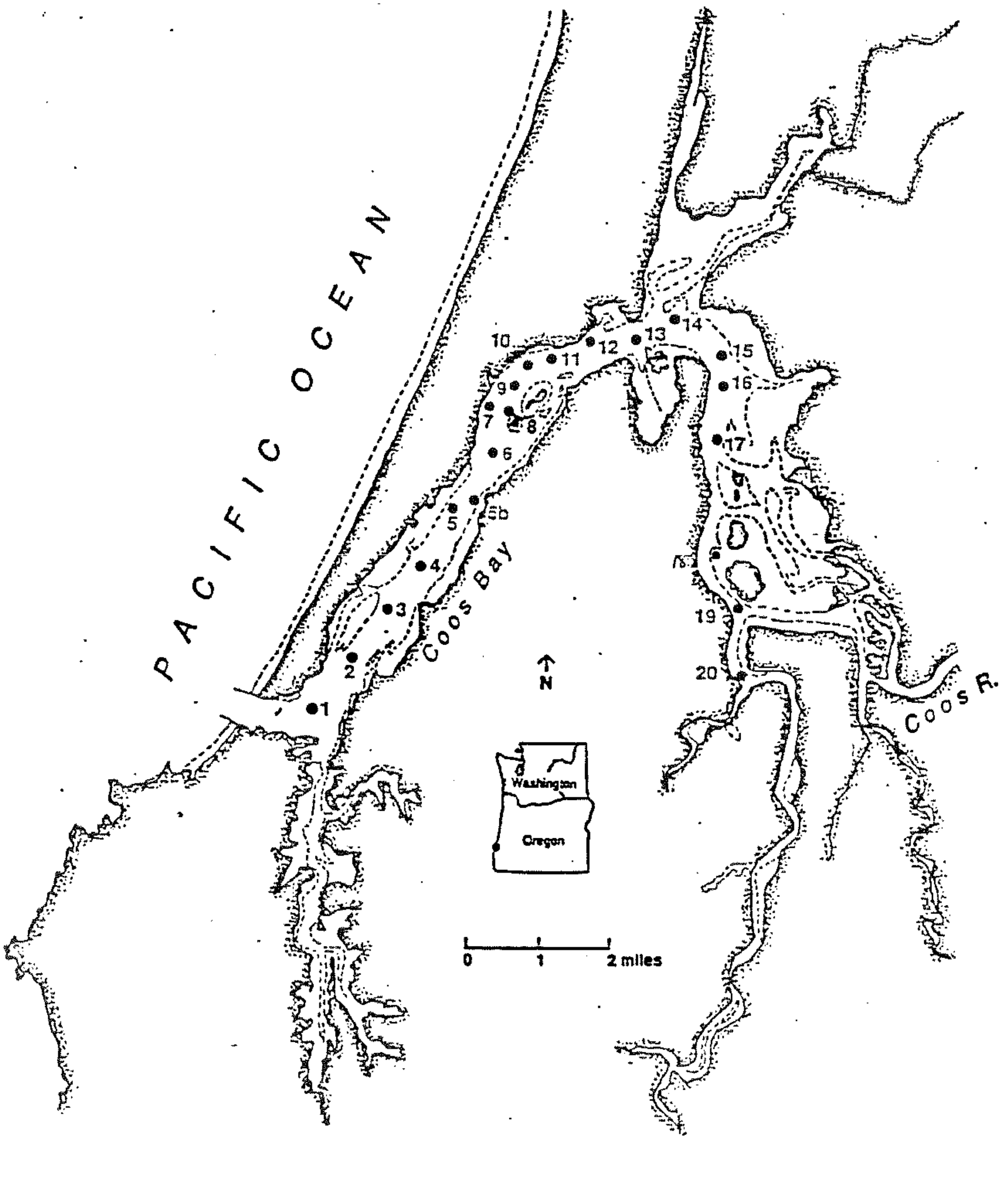

Figure 4. Benthic Invertebrate Sampling Stations Along the Coos Bay, Oregon Navigation Channel (from Miller et al., 1990).

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Sediment samples from the navigation channel were collected by the Corps of Engineers in May of 1989 and analyzed for organic contaminants including pesticides, PAHs and PCBs. Test results indicated that organics, metals, ammonia, and oil and grease concentrations were below the method detection limits. The Port of Coos Bay tested the sediments around its commercial docks (RM 12-14) and found evidence of heavy metal contamination in these soils which are adjacent to the navigation channel. Test results are provided in Table 1.

Another study was done by the Corps of Engineers from July 11 to August 14, 1989 (Moehl and Barton, 1989). Sampling of dredged material from the navigation channel between RM 1+25 and 10+10 demonstrated the presence of razor, macoma, gaper, littleneck, cockle, and softshell clams. Crangon shrimp, Olivella spp., sand dollars, anemone, and miscellaneous worms such as Nephtys spp. were also present. Dungeness crab, particularly young of the year, were also found in the samples. Fish species which occurred in the dredge samples included sand lance (most abundant species), saddleback gunnels, juvenile flatfish, and staghorn sculpin. The river mile and bottom composition at which each of these species occurred is presented in Table 2. Young of the year Dungeness crab were generally found in rocky substrate while sub-adult and adult crabs appeared to prefer substrate consisting of wood, small hash, and sand.

In a study done in December 1989 and April 1990 (Jones, 1990), samples were taken in-channel to determine the presence of demersal fish. Results showed the sand lance, sand dab, American shad and staghorn sculpin to be the most abundant of the fish captured.

Trawl samples near the town of North Bend contained few to no fish. The substrate at this trawl site consisted of fine sand with little debris. Most of the other trawls were over substrate consisting of silty material and debris.

Other fish associated with the Coos Bay Estuary include Pacific herring, northern anchovies, smelt, starry flounder, English sole, sturgeon, striped bass, salmon and steelhead trout. Pacific herring use the bay as a spawning and nursery ground. Herring eggs attach to rocks, pilings, and vegetation and can usually be found during January, February, and March. A mixture of mature and immature herring can be found in the estuary during spring and summer. Northern anchovies are plentiful from April through September. Several varieties of smelt (top, longfin, white bait, and silver) inhabit the top-most layers of the water i.e. the plankton. These fish also move in over the mudflats on the incoming tide.

Sand dab, sole, starry flounder, black rockfish, kelp greenling, and a variety of perch species are found in tremendous numbers in Coos Bay during various aspects of their life cycles. The young of these species are found in the shallow water areas and tideflats feeding on the abundant supply of amphipods and isopods in the substrate or in the water column. As they mature, these fish move into the deeper waters of the bay and then into the ocean where they are taken in the commercial and sport fisheries.

Striped bass are present in Coos Bay all year round. They spawn in the Coos River from the forks upstream to Dellwood, and in the Millicoma River from the forks upstream to Alleghany. The nursery area is the entire bay and the tidewater section of the Coos River system. The spawning population is estimated at 3,000 fish.

Table 1. Concentration of Metals in Coos Bay Sediment 1/

(values in parts per million ppm)

Parameter	D-1&2	E-1&2	E-4	F-1&2	H-1	H3&4	I-1&2	J-1&2	K-1&2	K-3&4
As	6.5	5.8	4.1	4.1	3.9	5.7	4.6	8.6	10	8.1
Cd	0.47	<0.31	0.32	0.47	0.53	<0.31	.58	.73	.64	.59
Cr	80.2	75.3	70.1	612*	73.5	72.3	870*	94.6	91.2	91.6
Cu	82.8*	96.9*	49.1	72.1*	58.8*	76.3*	632*	68.3*	69.7*	68.8*
Pb	13	12	9.2	12	9.2	9.5	11	11	2.2	15
Hg	<0.10	<0.12	0.10	0.30	<0.11	<0.12	<0.12	<0.14	<0.14	<0.14
Zn	40.40	36.40	34.0	37.30	40.30	30.11	42.50	41.80	39.20	35.20
TOC	34600	32600	23500	20700	29200	33100	31700	44300	54500	42400

Note: * Indicates compound exceeded USACE Portland District Tier II Bulk Chemical Concern Level

1/ From U.S. Army Corps of Engineers, 1990

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Table 2. Species Location and Abundance in the Coos Bay Navigation Channel (from Moehl and Barton, 1989).

SPECIES	ENTRAINMENT THROUGHOUT COOS BAY CHANNEL: average/cy	range	distribution (R.M.)	REACH OF CHANNEL WITH HIGHEST SPECIES ABUNDANCE: location (R.M.)	average/cy	average debris composition	debris composition *
SAND LANCE	0.928	0-26/CY	1-9	1-2	5.33	44% SHELL 56% WOOD	90% SHELL 8% ROCK, WOOD &
SADDLEBACK GUNNEL	0.005	0-0.53/CY	2,3,6,8 & 9	2-3	0.10	50% ROCKS 27% WOOD, 23% SHELL	95% ROCK 5% SHELL
JUVENILE FLATFISH	0.005	0-0.13/CY	1-10	2-3	0.03	50% ROCKS 27% WOOD, 23% SHELL	50% WOOD 50% SHELL
STAGHORN SCULPIN	0.004	0-0.24/CY	2-9	2-3	0.03	50% ROCKS 27% WOOD, 23% SHELL	90% SHELL 10% WOOD
RAZOR CLAM	<0.001	0-0.040/CY	3 & 6	6-7	0.002	85% WOOD, 1% ROCK 12% SHELL, 2% MUD	70% WOOD 30% SHELL
COCKLE	0.001	0-0.15/CY	3,4,8,9,& 10	10-10.2	0.07	59% SHELL 34% WOOD, 7% MUD	100% WOOD
MACOMA	0.021	0-1.5/CY	2-6	3-4	0.08	52% SHELL, 29% WOOD 19% ROCK	90% SHELL 8% ROCK, WOOD &
GAPER CLAM	0.001	0-0.096/CY	2-3	2-3	0.03	50% ROCKS 27% WOOD, 23% SHELL	95% ROCK 5% SHELL
[illegible]DOCK	0.001	0-0.095/CY	2-3.	2-3	0.01	50% ROCKS 27% WOOD, 23% SHELL	95% ROCK 5% SHELL
LITTLENECK CLAM	<0.001	0-0.34/CY	10-10.2	10-10.2	0.02	59% SHELL 34% WOOD, 7% MUD	100% WOOD
SOFTSHELL CLAM	0.005	0-1.3/CY	3,9, & 10	10-10.2	0.47	59% SHELL 34% WOOD, 7% MUD	98% SHELL 2% WOOD
PEA POD BORER	0.001	0-0.27/CY	2-3	2-3	0.01	50% ROCKS 27% WOOD, 23% SHELL	70% ROCK 30% SHELL
CRANGON	0.010	0-0.25/CY	1-10	2-3	0.03	50% ROCKS 27% WOOD, 23% SHELL	50% WOOD 50% SHELL
YOY DUNGENESS CRABS	0.17	0-20.8/CY	1-10	4-5	1.33	76% WOOD 28% SHELL, 16% ROCK	100% ROCK
1+ DUNGENESS CRABS	0.01	0-0.73/CY	3-10	10-10.2	0.13	59% SHELL 34% WOOD, 7% MUD	50% WOOD 50% SHELL

* Composition of sample with highest entrainment rate.

Fall and spring chinook, coho, and chum salmon and winter and summer steelhead and searun cutthroat trout are present in Coos Bay during most of the year. These species use the bay as a feeding and nursery area as well as an adult migration route. Time periods when each of the above species is likely to be present are shown in Table 3.

Table 3. Periods of Use by Adult Salmonids in Coos Bay, Oregon

Species	Time Period
Chinook Salmon	July through November
Coho Salmon	July through December
Chum Salmon	October through November
Steelhead Trout	November through February
Searun Cutthroat Trout	July through October

Juvenile salmon, especially chinook salmon, utilize the bay as a nursery throughout the year. Emigration of young salmon occurs over a wide spectrum: chinook salmon - May through July; coho salmon - April through June; chum salmon - March through May; steelhead trout - April through June; and searun cutthroat trout - April through June. Emigration of yearling coho salmon and steelhead and cutthroat also occurs during early fall freshets.

Adult returns to Coos Bay are presented in Table 4.

Table 4. Estimated Number of Adult Salmonids Returning to Coos Bay or Its Tributaries.1/

Species	Number Returning			
	Wild	STEP	Private Hatchery	Totals
Chum	100		18	118
Coho	8,900	1,000	270,000	279,900
Spring chinook			25,500	25,000
Fall chinook	4,300	1,000	3,000	8,300
Winter steelhead	6,000	4,600		10,600
Searun cutthroat trout	4,000 2/			4,000

1/ From U.S. Department of the Interior, 1987
2/ 5-year average 1966-70, no estimates since

Green and white sturgeon are also found in Coos Bay. Spawning occurs in the early spring in areas with a fast current and over sandy, coarse sediment. Sturgeon are bottom feeders and are generally associated with the deeper waters of the estuary.

With the Project

Changes in hydrology, temperature, and water circulation patterns, increases in salinity, and possible losses of intertidal habitat caused by the proposed channel deepening would affect bay productivity. These changes would first impact plankton which forms the basis of the food chain. Adverse effects on plankton would, therefore, have negative impacts on fish and wildlife abundance in the bay. Benthic organisms such as worms, amphipods, clams, and crabs would be adversely impacted by changes in salinity, losses of saltmarshes and algal beds, reductions in intertidal habitat, and long-term changes in turbidity and erosion patterns associated with operation and maintenance activities. Any benthic organisms in the deeper portions of the proposed channel alignment would be eliminated either initially or through maintenance dredging. The same would be true for those organisms on the side slopes of the channel.

In some portions of the channel the substrate consists of shell debris and soft rubble-rock. This material's removal would have a detrimental effect on crab and clam use of the area, particularly juveniles. Blasting to break up rock for removal by dredge would cause immediate increased turbidity which could have long-term impacts on intertidal areas, including tideflats and eelgrass beds. Any permanent changes in hydrology or physical or chemical modifications in the bay would negatively impact wetland quality and quantity. Salinity increases would reduce marsh vegetation but would encourage eelgrass production.

Dredging in or around contaminated sites could re-introduce contaminants into the water column. This then offers the opportunity for contaminants to become magnified throughout the food chain.

Hydrological changes could affect fish distribution and fish populations throughout the estuary. Dredging itself would have only a small influence on fish numbers. Reductions or changes in benthic or planktonic prey species would most influence fish use of the estuary. Blasting would cause immediate mortality to those benthic, shellfish, crustacean and fish species within the blast zone. Increased salinity could mean a change in fish distribution as well with more marine species becoming established further upstream in the estuary. Such an "invasion" could mean the displacement of brackish water species. There is already some concern (Johnson, personal communication) that increased salinity in the bay has interfered with shad and striped bass spawning success in the Coos River.

WILDLIFE

Without the Project

About 250 species of birds are resident or regular visitors to the Coos Bay area. Coos Bay is an important resting and feeding area and wintering ground for migratory birds of the Pacific Flyway.

Water-associated birds found in the Coos Bay Estuary include: waterfowl - black brant, American wigeon, pintail, canvasback, mallard, bufflehead, scaup, and white-winged surf, and common scoter; shorebirds - western sandpiper, least sandpiper, black-bellied plover, and sanderling; seabirds - gulls, terns, and murres; and marshbirds - great blue heron, common egret, and American bittern. Some of these birds depend on a variety of habitat types for resting, feeding, or nesting while others are found solely in one habitat type. Herons, bitterns, and egrets, while common, cannot be considered abundant. On the other hand, ducks, sanderlings, and sandpipers are present seasonally in great numbers.

Marsh birds commonly found in the area include five species of swallows, the song sparrow, long-billed marsh wren, and the sora and Virginia rail. Most of these birds use the marshes primarily for feeding although the marsh wren, rail, and occasionally the song sparrow also nest in them.

Raptors are also present in the bay area. Marsh hawks and red-tailed hawks have been seen using the marshes, although the red-tailed hawk is usually on food forays, flying back and forth between the mudflats and the higher marsh areas. Marsh hawks nest in marshes building nests directly on the ground.

Small mammals using the marshes and tide flats include the vagrant shrew, deer mouse, western red-backed mouse, black rat, and Trowbridge shrew. The vagrant shrew and deer mouse are the most abundant, with the latter found primarily in the high marsh and the former in the more tidally-influenced portions of the marsh.

Aquatic mammals associated with the saltmarshes include raccoon, muskrat, beaver, mink, and river otter. Deer, fox, and coyote have been observed in the South Slough marshes and deer, beaver, muskrat, raccoon, and bobcat have been sighted in Henderson Marsh on the North Spit. By far, however, the raccoon is the most commonly found mammal in all types of marsh habitat. Raccoons are opportunistic, feeding on fruits, fish, invertebrates, bird eggs, and small mammals. Mice feed on fruits, seeds, and insect larvae while shrews eat insects, insect larvae, snails, and worms. For most of the large mammals, the marshes are only part of their home range, but for species such as the vagrant shrew and muskrat, the marshes are their home range.

Marine mammals associated with the estuary include harbor seals, and California and Steller sea lions. The spoil islands in the lower bay are used as hauling grounds by adult and juvenile seals. The sea lions are occasionally seen at the bay entrance; their hauling grounds are located on the rocks and shoals south of the entrance. Killer whales, elephant seals, and harbor porpoises are occasional visitors to the estuary.

With the Project

Changes in hydrology, salinity, water temperature, or turbidity due to dredging would affect changes in planktonic and benthic populations as well as overall habitat viability and function. Increased salinity could have serious negative impacts on saltmarsh vegetation although it would encourage eelgrass production. Turbidity and temperature changes would influence benthic populations, shellfish productivity, and fish distribution, all of which would negatively impact wildlife species that depend on this habitat or these populations for food and cover. The blasting of rock in the lower bay would disturb birds and marine mammals. Greater river traffic and increased maintenance dredging activities would also have adverse impacts on wildlife use of the bay. Increased disposal activity could temporarily affect sea lions and seabirds, but overall offshore disposal impacts would be negligible.

THREATENED AND ENDANGERED SPECIES

In accordance with Section 7 of the Endangered Species Act of 1973 (16 U.S.C. 1531, et seq.), the Corps of Engineers is required to assure that its actions have taken into consideration impacts to Federally listed or proposed threatened or endangered species for all Federally funded, constructed, permitted, or licensed projects within its jurisdiction.

We have determined that listed species may be present within the project area (Attachment A). You may consider the attached list as a response pursuant to Section 7(c) and you may begin a biological assessment if you determine this action to be a "construction project" (Attachment B).

The Corp's responsibilities pursuant to Section 7(a) and (c) of the Act are described in Attachment B. We have also included a list of candidate species for your assistance. These species are presently being reviewed for consideration to propose and list as endangered or threatened. Candidate species have no protection under the Endangered Species Act and are included for your consideration as it is possible the candidates could become formal proposals and be listed during the construction period.

DISCUSSION

The proposed project could affect both fish and wildlife resources, depending on the harm done to estuarine habitat and food chain populations. Increasing the depth of the entrance and navigation channels by 1 to 5 feet would disturb and displace benthic populations, both in the channel and on the side slopes. Turbidity levels would increase during construction and would fluctuate during maintenance dredging, although long-term impacts would not be serious. Another concern is the possibility of salinity intrusion beyond that which is now experienced with present dredging activities. Increased salinities would have a detrimental impact on plankton and benthos as well as on the marsh habitat in the lower bay. Increased salinities would benefit eelgrass production, but, at this point, it is not possible to pinpoint the loss of marsh habitat and the increase in eelgrass.

Removal of rock and channel debris could seriously impact the availability of habitat for juvenile and adult crabs which utilize this type of in-channel substrate. Shrimp and clams also depend on the channel area for food and cover. Adult fish use of the estuary would probably not be disturbed to any great degree as a direct result of dredging, except in cases where contaminants might be reintroduced into the water column. However, indirectly the channel deepening could lead to salinity increases and losses of fish, particularly shad and striped bass. Sturgeon eggs would also be susceptible to salinity changes. Juvenile fish use could be impaired if shallow water areas are affected by the dredging or blasting.

Blasting in the lower estuary would affect a variety of species. The most direct impacts in terms of mortalities would be to benthic, crustacean, and fish species in or near the channel. Waterfowl, colonial nesting birds (including brown pelicans), and marine mammals could be affected indirectly by the blasting. In some cases, the blasting may increase the food supply in the immediate area by increasing the numbers of fish at the surface. However, this "benefit" would be offset by the disturbance to marine mammals and birds, including the brown pelican, which could occur during blasting. Because of the potential for great damage to fish and wildlife resources, blasting should be considered only as a last resort after all other means of rock removal have been eliminated. If blasting is pursued, it must be limited to a time period and duration of least impact to fish and wildlife resources using the area. The Oregon Department of Fish and Wildlife's (ODFW) recommended in-water blasting period is October 1 to January 15. Since this work period could impact anadromous fish, crabs, and brown pelicans, we would prefer to limit the blasting period to the winter months, i.e., January 1 to March 15. The blasting permit should specify use of bubble curtains, micro second delays between blasts, acoustic surveys to check for fish in the area, and divers to check on fish kills. If blasting occurs between May and November, (as recommended by ODFW) it could disturb brown pelicans, making it necessary to initiate formal Section 7 consultation proceedings prior to project construction. A detailed mitigation plan for the brown pelican would also have to be developed.

Disposal at an offshore site would have impacts to benthic and shellfish populations near the disposal site. Clams and crabs would most likely be impacted, since they are not as mobile as fish. Although long-term losses to these species are not expected to occur, thorough fish and wildlife studies of the proposed new disposal sites must be conducted prior to final selection of the new sites. There is some concern that material from the present offshore disposal sites may be washing up on the beaches north and south of the jetties and adversely impacting razor clam beds. Consequently, all shell and rock debris should be placed far enough offshore to prevent its return to the beaches. Of course, timing and location of the disposal is crucial to insuring that the material remains in place. Monitoring studies of the disposal sites and the beaches would also be necessary.

There is an opportunity for enhancing snowy plover habitat with disposal of clean materials on the North Spit beaches. Snowy plovers nest on disposal "mounds." Of course, disposal of contaminated materials must occur only on approved upland sites and every consideration must be given to preventing leakage from these areas.

RECOMMENDATIONS

To assure that fish and wildlife resources are protected, the Fish and Wildlife Service recommends that:

1. The project be conducted in multiple phases, i.e., 1 foot deepening every 5 years until authorized depth is achieved. A monitoring study should be initiated to determine increases in salinity related to channel deepening. If salinity increases significantly with dredging, the benefits of completing the dredging must be re-examined.

2. Due to the potential for serious adverse impacts to species in or near the channel, blasting not be considered unless absolutely necessary. If mechanical removal of rock is not possible, then blasting should occur only during the period from January 1 to March 15. Use of bubble curtains, divers to check for fish kills, micro-second delays between blasts, and acoustic surveys should be incorporated as blasting permit conditions.

3. Additional contaminant studies be conducted at the Port of Coos Bay's docks if the channel is widened in this area.

4. Dredged material (clean sand) be used to enhance snowy plover nesting habitat on the North Spit.

5. Any unavoidable habitat losses be mitigated in-kind within the estuary.

6. No dredging occur near identified contaminant sites.

7. Dredging occur only within specified in-water work periods set by the Oregon Department of Fish and Wildlife.

8. Thorough fish and wildlife studies be conducted on the proposed new disposal sites prior to final selection of a site.

9. All shell and rock debris be disposed of far enough offshore to prevent its return to the ocean beaches. Monitoring of the disposal sites and the beaches would be necessary.

We appreciate the opportunity to provide comments on the project. Please notify us of any changes in the project plans so that appropriate revisions can be made to this report.

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REFERENCES

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ATTACHMENT A

LISTED AND PROPOSED ENDANGERED AND THREATENED SPECIES AND CANDIDATE SPECIES THAT MAY OCCUR IN THE AREA OF THE PROPOSED CORPS OF ENGINEERS COOS BAY CHANNEL IMPROVEMENT PROJECT COOS BAY, OREGON*

1-7-90-I-152

LISTED SPECIES 1/

Peregrine Falcon (Migratory)	Falco peregrinus	(E)
Bald Eagle (Resident and Migratory)	Haliaeetus leucocephalus	(T)
Brown Pelican	Pelicanus occidentalis	(E)

PROPOSED SPECIES

None

CANDIDATE 2/

Western Snowy Plover	Charadrius alexandrinus nivosus	(2)

* The Corps of Engineers should consult with the National Marine Fisheries Service regarding threatened and endangered marine mammals.

(E) - Endangered (T) - Threatened (CH) -Critical Habitat

(1) - Category 1: Taxa for which the Fish and Wildlife Service has sufficient biological information to support a proposal to list as endangered or threatened.

(2) - Category 2: Taxa for which existing information indicates may warrant listing, but for which substantial biological information to support a proposed rule is lacking.

1/ U. S. Department of Interior, Fish and Wildlife Service, Jan 1989, Endangered and Threatened Wildlife and Plants, 50 CFR 17.11 and 17.12.

2/ Federal Register Vol. 50, No. 181, Sept. 18, 1985 Proposed Rules.

CTCLUSI Exhibit C

DEPARTMENT OF THE ARMY
PORTLAND DISTRICT, CORPS OF ENGINEERS
P O BOX 2946
PORTLAND, OREGON 97208-2946

Reply to
Attention of:

October 29, 1990

Planning Division

Mr. Russell D. Peterson
U.S. Fish and Wildlife Service
2600 SE. 98th, Suite 100
Portland, Oregon 97266

Dear Mr. Peterson:

We have reviewed your Coordination Act Report for the Coos Bay Channel Deepening Project and have the following responses to your recommendations.

Recommendation 1: The project be constructed in multiple phases, i.e., 1-foot deepening every five years until authorized depth is achieved. A monitoring study should be initiated to determine increases in salinity related to channel deepening. If salinity increases significantly with dredging, the benefits of completing the dredging must be re-examined.

Response: The selected plan is currently for a 2-foot deepening. Phased construction was evaluated for deeper depths but a deeper channel is not economically feasible at this time. Our evaluation of the existing salinity information leads us to believe that there will not be a significant change in salinity by deepening the channel 2 feet.

Recommendation 2: Due to the potential for serious adverse impacts to species in or near the channel, blasting will not be considered unless absolutely necessary. If mechanical removal of rock is not possible, then blasting should occur only during the period from January 1 to March 15. Use of bubble curtains, divers to check for fish kills, micro-second delays between blasts, and acoustic surveys should be incorporated as blasting permit conditions.

Response: Removal of rock in the channel will be accomplished primarily by mechanical means. It is currently estimated that none of the rock will have to be removed by blasting. In the event blasting will have to occur, in-water work periods will be those coordinated with your agency, Oregon Department of Fish and Wildlife and National Marine Fisheries Service; November to January 15 for river mile 2-4 and January to 15 March for 4-6 first then 0-2.

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Recommendation 3: Additional contaminant studies be conducted at the Port of Coos Bay's docks if the channel is widened in this area.

Response: Currently there are no plans to widen the channel at the Port docks. Widening will only occur near the railroad bridge at river mile 8.5 to 9.5.

Recommendation 4: Dredged material (clean sand) be used to enhance snowy plover nesting habitat on the North Spit.

Response: The project currently does not include any upland disposal, however; if a plan can be developed that can utilize some of the material for this purpose without increasing project cost, it will be considered and implemented.

Recommendation 5: Any unavoidable habitat losses be mitigated in-kind within the estuary.

Response: Project construction will not result in a loss of habitat.

Recommendation 6: No dredging will occur near identified contaminant sites.

Response: Dredging will be confined to the main navigation channel except between river mile 8.5 and 9.5. Sediment testing has not indicated any contaminated sites in the project area.

Recommendation 7: Dredging occur only within specified in-water work periods set by the Oregon Department of Fish and Wildlife.

Response: Concur

Recommendation 8: Thorough fish and wildlife studies be conducted on the proposed new disposal sites prior to final selection of a site.

Response: Additional studies of expanded Site F and the rock disposal site are planned in the Preconstruction Engineering and Design (PED) phase of the study. Results from these studies will be used to verify that the selected site is adequate. We have no evidence that additional studies will uncover a changed condition from earlier studies performed.

Recommendation 9: All shell and rock debris be disposed of far enough offshore to prevent its return to the ocean beaches. Monitoring of the disposal sites and the beaches would be necessary.

Response: All three proposed disposal sites are located far enough offshore to prevent the material from washing up on shore.

Thank you for your comments on the project. If you have any further questions, please contact Mr. Joe Johnson (326-7119) or Mr. Kim Larson (326-6483) of my staff.

Sincerely,

Lauren J. Aimonetto
Chief, Planning Division

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EXHIBIT 7

ENDANGERED SPECIES COORDINATION LETTERS
AND BIOLOGICAL ASSESSMENTS

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UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Northwest Region
7600 Sand Point Way NE BIN C15700
Seattle, Washington 98115

APR 16 1990

F/NWR3:1514-04 js

Mr. Richard N. Duncan
Chief, Fish and Wildlife Branch
Department of the Army
Portland District, Corps of Engineers
P.O. Box 2946
Portland, Oregon 97208

Dear Mr. Duncan:

This is to advise you that the northern sea lion, Eumetopias jubatus, was listed as threatened under the Endangered Species Act (ESA) on April 5, 1990 (see enclosed Federal Register notice, 55 FR 12645). In addition, NMFS is conducting a status review of sockeye salmon (Oncorhynchus nerka) populations in the Snake River basin to determine if any populations should be proposed for listing under the ESA. The Snake River sockeye salmon therefore are to be considered as candidate species for ESA Section 7 consultations as described in 50 CFR 402.12(d).

We have revised our list of endangered/threatened species that may occur off Oregon and Washington and a copy is enclosed. Consultations should be initiated (or reinitiated if prior consultations were conducted) on activities that may affect northern sea lions.

You recently submitted two letters dated March 29, 1990 and March 30, 1990 regarding two ESA Section 7 biological assessments: one for a Coos Bay channel deepening and offshore disposal project; and one for a bank protection project at the mouth of the Coquille River. Because northern sea lions do occur in the area of both projects, we will need to receive revised assessments that include this recently listed species. In addition, the biological assessments do not include the most current information available on gray whales. The gray whale assessments for each project should include the applicable information and analyses described in my March 28, 1990 letter to you regarding the Tillamook Bay project.

We will reinitiate our consultation responsibilities under Section 7 of the ESA for these two projects upon receipt of revised biological assessments. If you have any questions concerning this consultation, please contact Joe Scordino at (206) 526-6140.

Sincerely,

Thomas E. Kruse
for Rolland A. Schmitten
Regional Director

Enclosure
cc: F/PR2 - Pat Montanio
F/NWR5 - Merritt Tuttle

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April 9, 1990

**ENDANGERED AND/OR THREATENED SPECIES
UNDER THE JURISDICTION OF
NATIONAL MARINE FISHERIES SERVICE
THAT MAY OCCUR OFF WASHINGTON AND OREGON**

MARINE MAMMALS

Gray Whale	Eschrichtius robustus
Humpback Whale	Megaptera novaeangliae
Blue Whale	Balaenoptera musculus
Fin Whale	Balaenoptera physalus
Sei Whale	Balaenoptera borealis
Right Whale	Balaena glacialis
Sperm Whale	Physeter macrocephalus
Northern Sea Lion	Eumetopias jubatus

MARINE TURTLES

Leatherback Sea Turtle — Dermochelys coriacea

FISH

Sacramento River Winter-Run Chinook Salmon — Oncorhynchus tshawytscha

Candidate Species

Salmon River Basin Sockeye Salmon — Oncorhynchus nerka

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United States Department of the Interior

FISH AND WILDLIFE SERVICE
Portland Field Office
727 NE 24th Avenue
Portland, OR 97232

April 9, 1990

Re: 1-7-90-SP-122

Mr. Richard M. Duncan
Chief, Fish and Wildlife Branch
Portland District, Corps of Engineers
P. O. Box 2946
Portland, Oregon 97208

Dear Mr. Duncan:

This is in response to your letter of March 29, 1990 in which you requested an update of a species list (1-7-87-SP-88) that was provided by this office for the proposed channel deepening and offshore disposal at Coos Bay, Oregon. Since there has not been a change in project or species concerns, the species list provided to you in 1987 remains valid.

Sincerely,

Russell D. Peterson
Field Supervisor

cc:

KL\mm\SE

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DEPARTMENT OF THE ARMY
PORTLAND DISTRICT, CORPS OF ENGINEERS
P. O. BOX 2946
PORTLAND, OREGON 97208-2946

Reply to
Attention of:

March 29, 1990

Planning Division

Mr. Russell D. Peterson
Field Supervisor
U.S. Fish and Wildlife Service
727 NE. 24th Avenue
Portland, Oregon 97232

Dear Mr. Peterson:

We request a list of threatened, endangered and candidate species for the proposed channel deepening and offshore disposal project at Coos Bay, Oregon. A list was included in your April 27, 1987, Planning Aid Letter for this project, though given the lapse of time, we would like to verify the accuracy of this list. The case number for this list is 1-7-87-SP-88.

The proposed project involves the expansion of the existing deep draft navigation channel in Coos Bay, Oregon. The current channel is authorized and maintained to a depth of 45 feet between river mile (RM) 0-1, and 35 feet between RM 1-15. The proposed expansion calls for the deepening of the existing channel by a minimum of 1-foot, or up to a maximum of 5 feet. Construction may be carried out in either a single phase, or in multiple phases. Multiple phase construction would involve deepening the channel by 1-foot every five years, until the desired depth is attained. It is anticipated that as much as 559,000 cy of rock would be removed from the channel between RM 1 and 5. In general, medium grained sand will be removed between RM 5-12, and fine grained silty sand between RM 12-15. Between 32,000 cy and 2,000,000 cy of sandy material would be removed from throughout the channel. The rock material in the lower channel would be drilled and blasted to loosen it for removal by a clam shell dredge. Due to the nature of the work, rock excavation would be carried out during the first year of construction, rather than in phases.

All of the material removed from the channel will be placed offshore. The rock material would require placement at a new disposal site (Figure 1). The proposed location of this site was selected based on biological productivity information which indicates that fewer organisms will be impacted by disposal here. This disposal area is situated on a sandy bottom adjacent to a natural rocky area in waters 150 ft to 200 ft deep. Dimensions of this site would be 14,000 ft X 3,599 ft.

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In addition to the need for designating the offshore rock disposal site, the further expansion of existing site F will also be necessary. This site was expanded under section 103 authority in late summer 1989 (We received a concurrence letter from your office dated September 5, 1989, with regard to our biological assessment for that expansion). Area 1 and 2 (Figure 1) comprise the currently designated site F, while area 3 is the proposed expansion site. This expansion would extend the existing site 1,400 ft to the north. The total dimensions of the new site would be 3,600 ft X 4,200 ft. Between 425,000 and 1,500,000 cy of material could be placed at this site with the various alternatives. This material would consist of clean sand with a medium grain size of 0.2mm to 0.3mm. These sediments contain no contaminants of concern in excess levels and are excluded from the requirements for further biological and chemical testing as provided in CFR 227.13(b). The fine grained material which will be encountered above RM 12 will be placed at offshore site H. No further expansion of this site will be necessary. Chemical analysis of these materials does not reveal contaminants of concern in excess levels.

If you have any questions, or need further information concerning this project please contact Chris Moehl or Geoff Dorsey of my staff at 326-6485.

Sincerely,

Richard N. Duncan
Chief, Fish and Wildlife
Branch

Enclosure

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USFWS INITIAL ESA LIST

~~Attachment A~~

LISTED AND PROPOSED ENDANGERED AND THREATENED SPECIES AND CANDIDATE SPECIES THAT MAY OCCUR IN THE AREA OF THE PROPOSED CORPS OF ENGINEERS COOS BAY CHANNEL IMPROVEMENT PROJECT COOS BAY, OREGON

1-7-87-SP-88

LISTED SPECIES[1/]

Bald eagle (Resident and Migratory)	(Haliaeetus leucocephalus	T
Peregrine falcon .(Migratory)	(Falco peregrinus)	E
Brown pelican (Migratory)	(Pelicanus occidentalis)	E

PROPOSED

None

CANDIDATE[2/]

Western snowy plover (Charadrius alexandrinus nivosus) (2)

(E) - Endangered (T) - Threatened (CH) - Critical Habitat

(1) - Category 1: Taxa for which the Fish and Wildlife Service has sufficient biological information to support a proposal to list as endangered or threatened.
(2) - Category 2: Taxa for which existing information indicates may warrant listing, but for which substantial biological information to support a proposed rule is lacking.

1/ U. S. Department of Interior, Fish and Wildlife Service, Jan 1986, Endangered and Threatened Wildlife and Plants, 50 CFR 17.11 and 17.12.

2/ Federal Register Vol. 50, No. 181, Sept. 18, 1985 Proposed Rules

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June 22, 1990

Planning Division

Mr. Russell D. Peterson
Field Supervisor
U.S. Fish and Wildlife Service
2600 SE. 98th Avenue, Suite 100
Portland, Oregon 97266

Dear Mr. Peterson:

This letter constitutes an addendum to our biological assessment for the proposed Coos Bay Channel Deepening Project in Coos Bay, Oregon. Our original biological assessment, which was forwarded to you on May 1, 1990, did not address the possible impacts to listed species due to the blasting of rock in the navigation channel.

As recommended by Patty Snow (ODFW), blasting would occur between January 1 and April 30. As much as six months of blasting may be required; if this is the case, the operation would be done over two blasting seasons. A mechanical method of rock removal, which may eliminate the need for blasting either partially or wholly, is currently being explored.

Bald eagles, peregrine falcons and snowy plovers do not utilize the navigation channel directly, therefore, we feel that blasting will have "no effect" on these species. Brown pelicans will not be in the area during the blasting season, hence, this species will also not be effected.

If you need additional information concerning this project, please contact Chris Moehl of my staff at 326-6485.

Sincerely,

Richard N. Duncan
Chief, Fish and Wildlife Branch

PL-File

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CF:
CENPP-EN-GG (Griffiths)
CENPP-EN-GG (Amundson)
CENPP-PL-EF (Johnson)
CENPP-PL-RE (Stevens)

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May 1, 1990

Planning Division

Mr. Russell D. Peterson
Field Supervisor
U.S. Fish and Wildlife Service
727 NE. 24th Avenue
Portland, Oregon 97232

Dear Mr. Peterson:

Pursuant to the requirements of the Endangered Species Act of 1973, we are forwarding a biological assessment for bald eagles, peregrine falcons, brown pelicans and western snowy plovers for the proposed channel deepening and off shore disposal project at Coos Bay, Oregon. This assessment is in response to your 1987 species list (1-7-87-SP-88) and your update letter of April 9, 1990.

We have concluded that this project will have "no effect" on any of the listed species.

Should you require any additional information, please contact Chris Moehl of my staff at 326-6485.

Sincerely,

Richard N. Duncan
Chief, Fish and Wildlife
Branch

Enclosure

CF: PL-F MOEHL

CTCLUSI Exhibit C

BALD EAGLE, PEREGRINE FALCON,
BROWN PELICAN
AND
WESTERN SNOWY PLOVER
BIOLOGICAL ASSESSMENT
FOR
COOS BAY CHANNEL DEEPENING
AND OFFSHORE DISPOSAL PROJECT

PROJECT DESCRIPTION

The proposed project involves the expansion of the deep draft navigation channel in Coos Bay, Oregon, with offshore disposal of all dredged material. The current channel is authorized and maintained to a depth of 45 feet between river mile (RM) 0-1, and 35 feet between RM 1-15. The proposed expansion calls for the deepening of the existing channel by a minimum of 1-foot, or up to a maximum of 5 feet. Construction may be carried out in either a single phase, or in multiple phases. Multiple phase construction would involve deepening the channel by 1-foot every five years, until the desired depth is attained. It is anticipated that as much as 559,000 cy of rock would be removed from the channel between RM 1 and 5. In general, medium grained sand will be removed between RM 0-12, and fine grained silty sand between RM 12-15. Between 32,000 cy and 2,000,000 cy of sandy material would be removed from throughout the channel. The rock material in the lower channel would be drilled and blasted to loosen it for removal by a clam shell dredge. Due to the nature of the work, rock excavation would be carried out during the first year of construction, rather than in phases.

All of the material removed from the channel will be placed offshore. The rock material would require placement at a new disposal site (Figure 1). The proposed location of this site was selected based on biological productivity information which indicates that fewer organisms will be impacted by disposal here. This disposal area is situated on a sandy bottom adjacent to a natural rocky area in waters 150 ft to 200 ft deep. Dimensions of this site would be 14,000 ft X 3,599 ft.

In addition to the need for designating the offshore rock disposal site, the further expansion of existing site F will also be necessary. This site was expanded under section 103 authority in late summer 1989 (We received a concurrence letter from your office dated September 5, 1989, with regard to our biological assessment for that expansion). Area 1 and 2 (Figure 1) comprise the currently designated site F, while area 3 is the proposed expansion site. This expansion would extend the existing site 1,400 ft to the north. The total dimensions of the new site would be 3,600 ft X 4,200 ft. Between 425,000 and 1,500,000 cy of material could be placed at this site with the various

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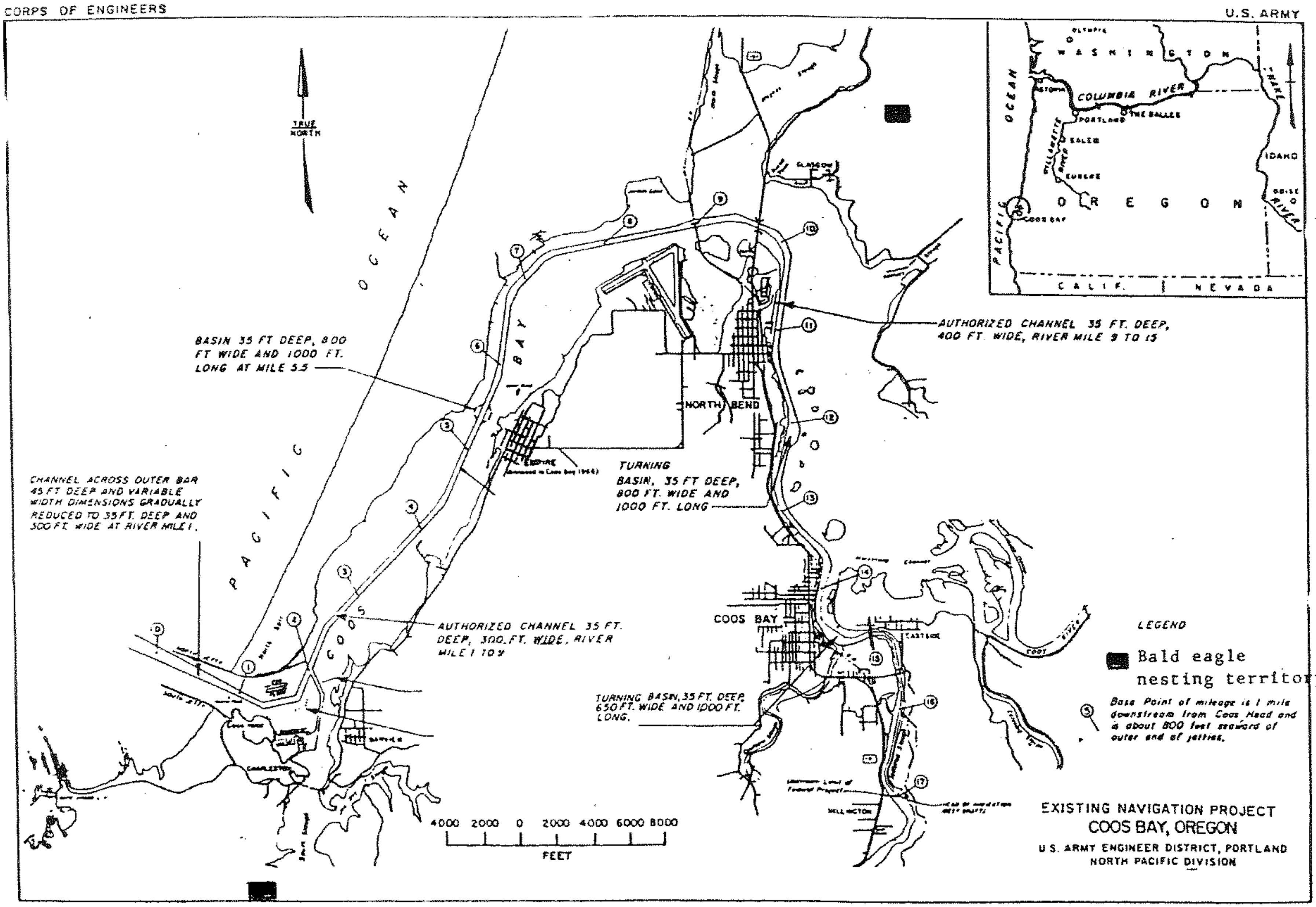

Figure 2.

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alternatives. This material would consist of clean sand with a medium grain size of 0.2mm to 0.3mm. These sediments contain no contaminants of concern in excess levels and are excluded from the requirements for further biological and chemical testing as provided in CFR 227.13(b). The fine grained material which will be encountered above RM 12 will be placed at offshore site H. No further expansion of this site will be necessary. Chemical analysis of these materials does not reveal contaminants of concern in excess levels.

BALD EAGLES

There are two pairs of bald eagles nesting in the vicinity of the Coos Bay navigation channel (Figure 2). One pair nests south of Charleston approximately 2 miles from the navigation channel. This pair is known to have been nesting here since 1986 and have successfully produced two young each year through 1989. Bald eagles are frequently observed foraging and perching at various locations in South Slough, in particular, north of Valino Island, at Collver Point, and on the north side of Brown's Cove. They are occasionally observed flying northward over Charleston, and along the bay off Fossil Point. Bald eagles have also been observed perching on a gravel bar at Pigeon Point.

The presence of eagles in the lower part of the Coos Bay estuary suggests that activities such as regular ship and fishing boat traffic, as well as activities associated with the town of Charleston do not preclude the use of this area by bald eagles. A variety of fish and waterfowl species are available for foraging eagles in the lower bay and south slough.

The other local pair of bald eagles nest at Mettman Ridge, northeast of Glasgow, approximately 1.5-2.5 miles from the northern section of the navigation channel. This pair is known to have been nesting here since 1976. History of nesting success is as follows: 1976-1 (1 young fledged), 1977-2, 1978-2, 1979-F (nesting failure), 1980-F, 1981-F, 1982-F, 1983-1, 1984-F, 1985-2 1986-Of (no eggs observed), 1987-F, 1988-F, 1989-F. Likely foraging areas for this pair include Haynes and North Sloughs, as well as the northern section of Coos Bay. Prey items available in these sloughs include a variety of fish and waterfowl species.

During the construction of the last 5-foot channel deepening project in Coos Bay (1976-79), the Mettman Ridge pair did not appear to be adversely effected by the dredging operation, as breeding success for this pair was consistent between 1976-78. The reason(s) for the high rate of breeding failure which has been experienced by this pair since 1979 is unknown. These failures could possibly be attributed to the loss of perching habitat and/or chemical contamination of their food supply. Much of this pair's territory was logged during the late 1970's and early 1980's; this action may have resulted in a loss of key perch trees. Chemical analysis of sediments from throughout the Coos Bay navigation channel do not indicate that high levels of contaminants occur here. Dredging activities are not expected to have a deleterious effect on local water quality, and ultimately on bald eagles.

Migrant bald eagles also occur at the Coos Bay estuary, particularly in the fall and winter. Concentrations of wintering waterfowl, as well as fish are likely prey items for these eagles. The majority of the dredging in the navigation channel at Coos Bay would occur between April and October, hence migrant bald eagles are not expected to present during construction activities. In the event that dredging should occur while bald eagles are present, it is not expected that these activities would be disruptive to either bald eagles or their prey resources.

We conclude that the construction activities, offshore disposal, and ultimate expansion of the navigation channel at Coos Bay, will have "no effect" on resident or migrant bald eagles.

PEREGRINE FALCONS

Specific information regarding use of the Coos Bay estuary by migrant Peregrine falcons is limited to the vicinity of the North Spit. Personnel from BLM logged 320 hours of observation on 79 trips to North Spit between September 25, 1985 and May 15, 1986. They observed 18 peregrines during their survey for an approximate rate of 18 hours/sighting. CH2M Hill also conducted surveys at the northeast panhandle of the North Spit, where they averaged 31.8 hours/sighting (CH2M Hill Northwest, Inc. 1986). Fall sightings were made primarily on the beach at the northern portion of the spit where shorebird prey were abundant. Winter sightings (Nov. 12, 1985 - Feb. 15, 1986) included two on the southern beach near the North Jetty and four within the forested, stabilized dune habitat of the interior spit. Ten peregrine sightings were recorded by BLM personnel and eight by CH2M Hill personnel in winter. Fewer sightings occurred in spring with BLM recording two peregrines and CH2M Hill personnel one.

The ocean beach, forested, stabilized dune, and effluent lagoon appeared to be the most important peregrine habitat on North Spit. Shorebirds were abundant on the ocean beach habitat and apparently were the primary attraction for peregrines. The forested, stabilized dune habitat provides an excellent vantage point for peregrines of the interior of North Spit. The effluent lagoon provides foraging habitat for peregrines. Sightings of peregrines by Ruediger (1986) and CH2M Hill Northwest, Inc.

(1986) well exceeded that of previous observers (Wilson-Jacobs 1983, 4 sightings.) on North Spit. This appears to be more a function of effort, rather than reflecting a definite increase in peregrine numbers.

Although information with regard to peregrine sightings in other areas of the estuary is not available, it is likely that migrant peregrine falcons occur throughout the Coos Bay estuary, particularly in the fall and winter. Large concentrations of wintering shorebirds and waterfowl occur in the broad intertidal areas of the upper bay and associated sloughs; as such, peregrine falcons should be attracted to these areas.

The dredging of the navigation channel is not expected to effect the distribution of peregrine prey species in the intertidal areas of the bay. Additionally, most of the dredging activities will be conducted between April and October, hence, construction activities should not effect peregrine falcons. Chemical analysis of sediments from the navigation channel do not reveal the presence of pesticides, PCB's or other environmental contaminants at levels which may be deleterious to peregrine falcons.

We conclude this project will have "no effect" on peregrine falcons.

BROWN PELICANS

Brown pelicans are typically found along the southern Oregon coast between June and November; their movement into Oregon waters occurs post breeding and is an annual event. Initial concentrations typically occur at estuaries along the southern Oregon coast, with a gradual movement northward as summer progresses. In recent years they have been observed in Coos Bay during the Christmas bird count, with a high of 54 counted here in 1987. The majority of birds (73-85%) are immatures.

Brown pelicans are known to forage and loaf in the Coos Bay navigation channel and adjacent areas. Foraging by brown pelicans occurs in the bay, between the jetties, and in adjacent nearshore areas. Small fish, such as northern anchovies and Pacific herring, are common prey items for this species. The north jetty at Coos Bay, particularly near the base, is a common loafing area for brown pelicans. Loafing also occurs on sandbars, beaches, offshore rocks, headlands, pilings and channel markers.

During July and August 1989, Corps of Engineers biologists aboard the hopper dredge Yaquina routinely observed brown pelicans foraging and loafing within 50 yards of the dredge. They appeared to be undisturbed by the dredging activities, and may have been feeding on fish which were displaced by the dredge. Pacific sand lance, which normally occur on the bottom of the channel, are entrained by the dredge and discharged through the overflow ports near the surface. It is possible that dredging may increase the availability of fish, especially Pacific sand lance, which may be preyed upon by pelicans. Pelagic fish species such as the northern anchovy and Pacific herring are rarely entrained by dredges, hence, construction actions are not expected to have an impact on prey species for brown pelicans.

Chemical analysis of sediments from the Coos Bay navigation channel do not reveal the presence of pesticides, PCB's or other environmental contaminants at levels which may be deleterious to brown pelicans.

We conclude that the dredging and offshore disposal of material at Coos Bay will have "no effect" on brown pelicans.

WESTERN SNOWY PLOVERS

The open sand dune habitat of the Coos Bay North Spit supports one of the largest breeding populations of western snowy plovers on the Oregon coast. An initial survey of nesting snowy plovers in coastal Oregon during 1972 indicated that North Spit supported 18% (39/216) of the breeding population (Jacobs 1982). Subsequent breeding surveys have indicated that the North Spit has supported a maximum of 45% of the coastal breeding population (Table 1). During the 1990 wintering survey, 38% (19/50) of the Oregon coastal population was observed at North Spit (Table 2).

The ocean beach, and the dredge disposal areas are the most important snowy plover breeding sites at North Spit. Beach nesting is influenced by the availability of suitable habitat, including the amount of beach above high tide, and by the level of human recreational use. Beach availability varies annually and is influenced by the number, intensity, and duration of winter storm events. The disposal sites on the North Spit are more secure from storm events, but are subject to invasion by European beachgrass and other plants, as well as recreational vehicle use. The south disposal area is more difficult to access than the north disposal area, hence, the south disposal area is generally used more heavily by wintering and breeding snowy plovers. BLM has placed a fence around the north disposal site in an effort to protect nesting plovers from recreational vehicle traffic.

Western snowy plovers have been experiencing low overall productivity along the Oregon Coast. The lack of breeding success has been attributed to high egg predation, particularly by avian predators. In an effort to increase plover productivity, The Nature Conservancy and ODFW will be placing

Table 1. Number of western snowy plovers wintering and breeding on Coos Bay North Spit.

Year	Winter	Breeding	Percent of Coastal Breeding Population
1978	--	3[a]	3[a]
1979	--	45	45
1980	--	26	32
1981	--	47	33
1982	30[b]	37 (20)[c]	45 (24)[c]
1983	12	9	17
1984	0	6	13
1985	9	10	21
1986	18	15	20
1987	10	20	32
1988	0	18	34
1989	2[d]	24	41
1990	19[e]		

--Area not surveyed.
[a] North spit south disposal area not surveyed.
[b] All birds located on North Spit south disposal area.
[c] Parenthetical number is average observed during breeding season (Jacobs 1982).
[d] Dredge spoils not surveyed.
[e] All birds located on disposal areas.

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Table 2. ANNUAL SNOWY PLOVER WINTER SEASON COASTAL SURVEYS[a]

Area	Number of Snowy Plovers[b]								
	1990	1989	1988	1987	1986	1985	1984[d]	1982-1983	Mean
Columbia R.-Necanicum R.	-	0	0	0	0	1	0	0	0.3
Nehalem Spit	-	-	-	0	0	0	-	2	0.5
Bayocean Spit	0	39	18	10	13	11	10	10	13.9
Netarts Spit	-	0	-	0	0	0	0	0	0.0
Sand Lake Spits	-	0	0	0	0	0	0	7	1.0
Nestucca Spit	-	0	0	0	0	0	0	0	0.0
Neskowin Beach	-	0	-		-	-	-	-	0.0
Siletz Spit	0	-	0	0	0	-	-	-	0.0
South Beach, Newport [c1]	0	-	0	0	-	0	0	0	0.0
Alsea Spit	0	0	0	0	0	0	0	0	0.0
Heceta Head-Sutton Spit	2	5	0	17	10	24	5	28	11.4
Sutton Cr.- N. Jetty Siuslaw	0	0	0	0	1	0	-	-	0.2
Suislaw R.- Siltcoos Spit[c2]	13?	3	0	0	0	0	0	0	2.0
Siltcoos Spits	0	4	0	0	0	11	0	0	1.9
Siltcoos Spit- Tahkenitch Spit	1?	0	0	3	13	1	0	0	2.3
Tahkenitch Spits	0	0	0	0	0	0	0	0	0.0
Tahkenitch Spit- Threemile Cr.	0	0	0	0	0	0	0	0	0.0
Threemile Cr.- Umpqua R.[c3]	0	1	0	0	0	0	0	0	0.1
Umpqua River- Tenmile Spit	1	5	9	-	0	0	12	5	4.6
Tenmile Spits	0	0	0	-	0	0	0	4	0.6
Tenmile Spit- Horsfall Beach	0	0	0	-	0	0	3	0	0.4
Horsfall Beach- Coos Bay & Spoils	19e	2[f]	0	10	18	9	0	12	8.8
Whiskey Run-Coquille R.	0	-	0	-	0	0	0	0	0.0
Bandon State Park-New R.	14	20	23	4	17	8	10	13	13.6
New River-Floras Lake	0	1	0	2	0	0	3	0	0.8
Euchre Creek-Greggs Creek	0	1	0	-	0	1	0	2	0.6
Myers Creek-Pistol River	0	0	-	-	-	0	0	0	0.0
TOTAL	50	81	50	46	72	66	43	78	61.4

a All surveys in Jan., except 3 Dec. 1982-3 Feb. 1983 and 20 Jan.- 2 Feb. 1984.
b If more than one survey conducted, the highest number observed was recorded.
c Other beach segments where plovers were found during winter (Nov.-Feb.) outside survey period and/or during winter 1978-1981.
1. South Beach, Newport 1980 (1), 1983 (1).
2. Suislaw R. - Siltcoos Spit 1978 (12), 1979 (6), 1980 (4).
3. Threemile Cr. - Umpqua R. 1979 (10), 1980 (1).
d Adverse weather conditions prevailed for most of survey.
e Coos Bay dredge spoils recorded all plovers.
f Coos Bay dredge spoils not surveyed.
(-) Area not surveyed.

Source: Charlie Bruce, ODFW, 1990.

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predator exclosures around individual nests at the south disposal site during the 1990 nesting season.

Snowy plover habitat would be enhanced by upland disposal of dredged material at North Spit, however, upland disposal is not anticipated as it is more economical to use a hopper dredge and dispose of material offshore. Disposal actions offshore would not impact snowy plover habitat.

We conclude that the proposed Coos Bay navigation channel deepening and offshore disposal projects will have "no effect" on western snowy plovers.

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United States Department of the Interior

FISH AND WILDLIFE SERVICE
Portland Field Station
2600 S.E. 98th Avenue, Suite 100
Portland, Oregon 97266

RECEIVED
JUL 6 1990
REG & RES BR

July 3, 1990

Re: 1-7-90-I-152

Mr. Richard Duncan
Chief, Fish & Wildlife Branch
Portland District, Corps of Engineers
P. O. Box 2946
Portland, Oregon 97208-2946

Dear Mr. Duncan:

This is in response to your letter dated June 22, 1990 that was received by us on June 26, 1990, transmitting an addendum to your biological assessment of May 1, 1990. The addendum and original assessment address the impacts of the proposed channel deepening at Coos Bay, Oregon on bald eagles, peregrine falcons, brown pelicans, and western snowy plovers.

We have reviewed the biological assessment and the addendum and concur with your determination of no effect on bald eagles, brown pelicans, peregrine falcons, and western snowy plovers.

To further conserve western snowy plover, we recommend coordination with the Oregon Department of Fish and Wildlife and the Service in the implementation of measures to enhance breeding habitat.

The requirements established under Section 7(a)(2) and 7(c) of the Endangered Species Act of 1973, as amended, have been met, thereby concluding the consultation process.

We appreciate your concern for listed species.

Sincerely,

Roger E. Confenstrasse
for Russell D. Peterson
Field Supervisor

cc:
R1-FWE, SE
ODFW (Nongame)
ONHP

printed on unbleached, recycled paper

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December 4, 1990

Planning Division

Mr. Rolland Schmitten
Regional Director
National Marine Fisheries Service
7600 Sand Point Way, NE.
BIN C15700
Seattle, Washington 98115

Dear Mr. Schmitten:

Pursuant to the requirements of the Endangered Species Act of 1973, we are forwarding a biological assessment for threatened and endangered species which could potentially be impacted by dredging and disposal operations associated with the Coos Bay Channel Deepening Project.

We have concluded that this project will have "no effect" on any of the listed species.

Should you require any additional information, please contact Geoff Dorsey of my staff at (503) 326-6482.

Sincerely,

Robert E. Willis
Chief, Fish and Wildlife
Branch

PL File

WILLIS
CENPP-PL-F

DORSEY
CENPP-PL-F
6482/Cameron
5 Dec 90

Enclosure

CF:
Joe Johnson, PL-C
Steve Stevens, PL-R

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BIOLOGICAL ASSESSMENT

FOR

GRAY, HUMPBACK, BLUE, FIN, SEI, RIGHT, AND SPERM WHALES;

LEATHERBACK SEA TURTLES;

NORTHERN (STELLER) SEA LIONS;

AND

SACRAMENTO RIVER WINTER-RUN CHINOOK SALMON

COOS BAY CHANNEL DEEPENING PROJECT

COOS BAY, OREGON

PROJECT DESCRIPTION

The proposed project involves the deepening of the existing deep draft navigation channel at Coos Bay, Oregon. The current channel is authorized and maintained to a depth of 45 feet between river mile (RM) 0-1, and 35 feet between RM 1-15. The proposed project calls for a two foot deepening of the existing with advance maintenance dredging of 5 feet between RM 0-1, 2 feet between RM 1-10, and 3 feet from RM 10-15.

Dredging activities between RM 10-15 would be carried out by clamshell dredge. Excavation of 673,000 cy of material would take an estimated 2 months of effort. Silty clay in this reach of the project is not suitable for hopper dredging.

Excavation of 803,000 cy of material between RM 1-10 will occur by hopper dredge. Again, approximately 2 months of effort will be required to excavate this material. The entrance channel (RM 0-1) would entail removal of 199,000 cy via hopper dredge. Less than two weeks would be required to remove material from the entrance channel.

It is anticipated that approximately 88,000 cy of rock would be removed from the channel. Harder sandstone rock would be removed between RM 1+12 and 3+02 (20,500 cy) with softer rock removed between RM3+06 and 5+30 (67,700 cy). Rock would be removed via a barge-mounted backhoe. Excavation of rock from the Coos Bay Navigation Channel during the previous channel deepening (1977-79) was accomplished in this manner. Blasting could be required should hard points be encountered. It is estimated that this effort would take four months.

The rock material which would be excavated from the channel would require placement at an offshore site (Figure 1). The location of this site was selected based on biological productivity information which indicates that fewer organisms will be impacted by disposal here. This disposal area would be situated on a sandy bottom adjacent to a natural rocky area in

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waters 150 ft to 200 ft deep.

In addition to the need for designating the offshore rock disposal site, further expansion of existing site F will also be necessary (Figure 1). This site was expanded under section 103 authority in late summer 1989 (We received a concurrence letter from your office on September 13, 1989 with regard to our biological assessment for that expansion). This expansion would extend the existing site 1,400 ft to the north. The total dimensions of the new site would be 3,600 ft X 4,200 ft. Between 425,000 and 1,500,000 cy of material could be placed at this site with the various alternatives. This material would consist of clean sand with a medium grain size of 0.2mm to 0.3mm. These sediments contain no contaminants of concern in excess levels and are excluded from the requirements for further biological and chemical testing as provided in CFR 227.13(b). The fine grained material which will be encountered above RM 12 will be placed at offshore site H. No further expansion of this Site H will be necessary. Chemical analysis of these materials does not reveal contaminants of concern in excess levels.

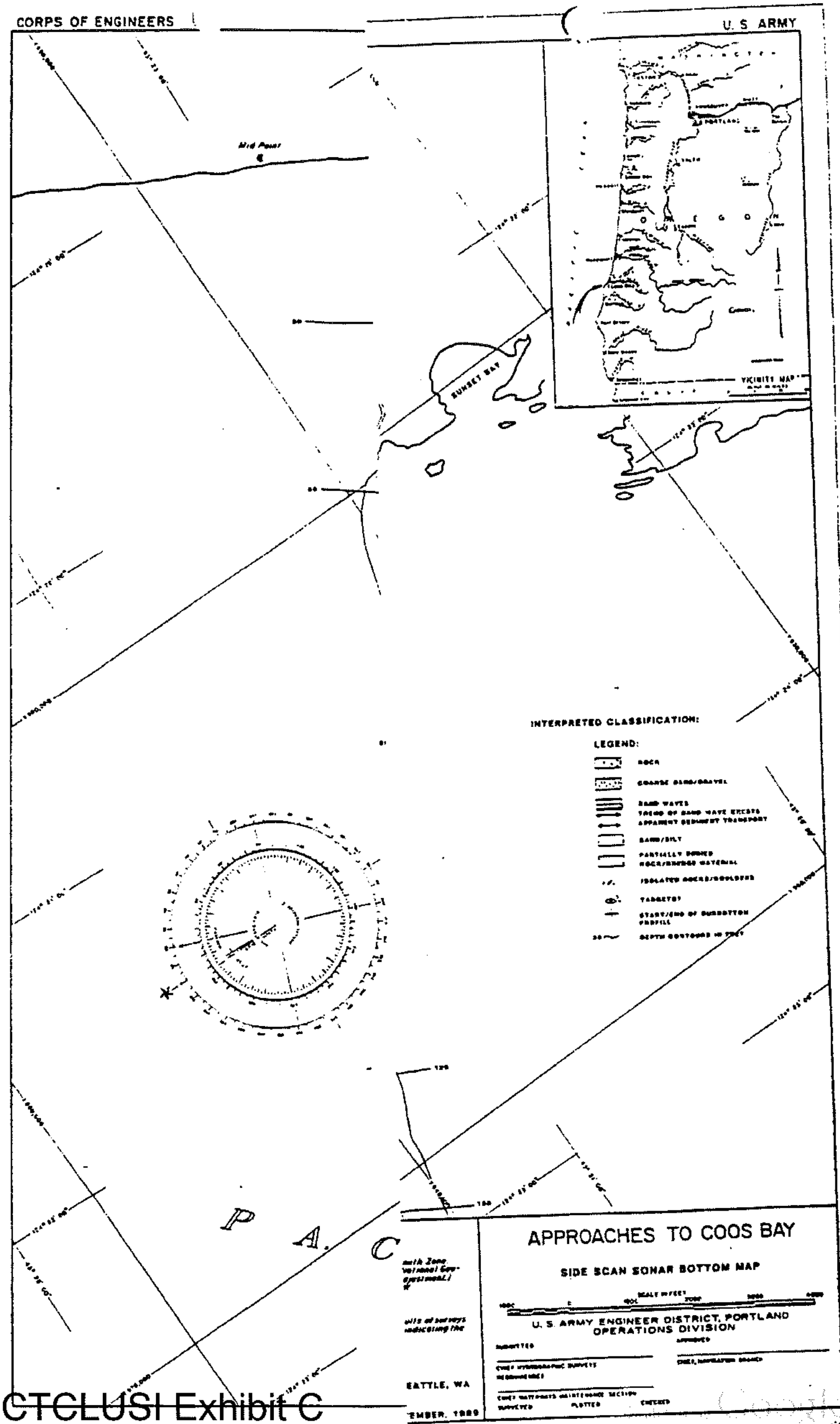
GRAY WHALES

Coastal waters of Oregon serve as a migrational corridor for gray whales moving to and from their breeding, calving, and assembly areas along Baja California, Mexico and their primary foraging areas in the northern Bering and southern Chukchi Seas (Darling 1984).

Southward migration occurs off Oregon between early December and mid-February, with pregnant females being the first to pass southward. (Herzing and Mate 1984). Southbound whales typically occur off Oregon in water less than 90 meters deep, with the majority of migrants occurring in water 40-60 m deep, located between 1.6 and 3.2 km offshore (Herzing and Mate 1984).

The northbound migration is comprised of two groups of whales migrating in two phases. The first phase begins migration between mid-February and April and consists of whales without calves. The second group consists largely of whales with calves, with migration beginning between late April and May (Herzing and Mate 1984). Generally, whales comprising the first phase tend to migrate further offshore, with immatures showing a preference for migration closer to shore (Herzing and Mate 1984). Northward cow/calf migration typically occurs close to shore. Herzing and Mate (1984) observed that 90% of the whales migrating during the later phase, traveled within 800 m of the shore; during the final three weeks of migration, 90% traveled within 100 m of shore.

A portion of the eastern Pacific population of gray whales does not migrate to the northern seas; these whales spend summer offshore of California, Oregon, Washington and British Columbia. Mate estimated a summering population of 75 whales off the coast



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of Oregon in 1979 (Darling 1984). Current population estimates by Mate indicate an increase to 100-200 summering whales (B. Mate, pers. convers., 1990). Information regarding summering grey whale distribution off Oregon is patchy. It appears that most summering gray whales occur between Winchester Bay (Umpqua River) and Cascade Head, near Lincoln City (B. Mate, pers. comm., 1990). These summering gray whales occur in scattered, small groups or as individuals. There was reportedly a cow/calf pair summering off Coos Bay in 1990 (Jan Hodder, OIMB, pers. comm. 7-90). Three small groups have been reported elsewhere in Oregon during 1990 (Beverly Lund, pers. comm. 7-90); these include approximately 6 individuals between Boiler Bay and Yaquina Head, a group between the south Jetty of Yaquina Bay and Seal Rock, and a group at Gold Haven near Sea Lion Caves.

There are occasional reports of gray whales occurring in coastal estuaries including the Columbia River, Tillamook Bay, Yaquina Bay, Siuslaw River, and Coos Bay (B. Mate, pers. comm., 1990). Apparently it is not uncommon for gray whales to occur between the Highway 101 bridge and the jetties at Yaquina Bay; these observations include north and south bound migrants and summering gray whales. Summering gray whales have been observed in the mouth of the Siuslaw River between the jetties by Corps personnel and other observers have recorded them as far upriver as Mapleton on the Siuslaw. Operators of the charter boat Siggi-G out of Garibaldi reported a gray whale near buoy six, Tillamook Bay entrance channel, in late spring 1990; it is not known whether this represented a migrant or summering gray whale. A whale, species unknown, was observed just north of Tillamook Bay in June 1989 less than one-half mile offshore.

The most recent study of summering whales off Oregon was conducted by Sumich (1984). Summer sightings were defined as those which occurred between 1 June and 15 September. Sumich reported over 1200 gray whale sightings during a 1977-1980 study off coastal Oregon. A 100 km section of coastline from the Siuslaw River to Government Point just north of Depoe Bay, appeared to be relatively important to gray whales. In 1977, 60% of the 460 observations occurred within this 100 km section. Sumich reported a maximum observed occurrence of 0.2-0.3 whales/km over the 100 km study area during the 1977 and 1978 studies. It was not determined whether whales were more numerous along this section, or simply easier to detect. Whale distribution within the 100 km section varied between 1977 and 1978; in 1977 whales were most commonly observed in the southern half of the study area, in contrast to 1978 when whales were more frequently observed in the northern half of the study area. Sumich noted that site specific use also varied daily; thus, a period of maximum occurrence was undetectable. Additionally, weather, sea state, observer effort, the presence or absence of strategic observation points, and the unreliability of aerial counts due to the predominant occurrence of gray whales in surf and foam lines (which makes them difficult to detect) also contribute to the large variation in observed abundance. Because of these factors, Sumich considered his abundance estimate of 0.2-0.3 whales/km to be conservative.

Sumich (1984) noted that the primary activity of summer gray whales off the Oregon coast appears to be feeding. Benthic infauna, primarily gammarid amphipods and polychaete worms are the principal food items of gray whales (Rice et al 1984). Migrating whales feed, to some extent, on benthic organisms at the mouths of rivers and estuaries (Nerini 1984). Pelagic foraging by grey whales is thought to be rare (Nerini 1984), though Sumich (1984), suggests that offshore sightings may be an indication of pelagic feeding.

Sumich noted that nearshore locations with silty sediments appear to be foraging areas for gray whales; presumably because of high amphipod populations in silty sediments (D. Hancock, USACE pers. comm., 1985). Gray whales also frequented surf or foam lines. A pod of whales summering near Boiler Bay, OR (1990), was reported to have been feeding in kelp beds (Beverly Lund, pers. comm. 1990).

Sumich (1984) postulates that whales which summer off Oregon may gain energetic benefit by shortening their migration. He further noted that the whales off Oregon consisted predominantly of immature or small mature individuals. Mate has also indicated that the majority of whales summering off Oregon appear to be immature (Beverly Lund pers. comm. 1990). Grey whales that summer off British Columbia have been documented to return to within 150 km of an established location, with some individuals reportedly having returned for up to 8 consecutive years (Darling 1984). As such, Darling argues that these whales are not cutting their migration short, but that they are intentionally seeking out and utilizing available "pockets" of habitat. Although a through investigation of the age structure of these whales has not been made, Darling (1984) believes that these populations may also be composed primarily of young individuals.

DISCUSSION

The Coos Bay channel deepening and offshore disposal projects are not expected to have an impact on gray whales. The ocean disposal areas are south of the locations where most summering gray whales are observed. Additionally, due to the location offshore, depth of the disposal sites and timing of material placement; migrating gray whales are not expected to be impacted by the offshore disposal. Material to be dredged does not contain contaminants at levels of concern and is suitable for inwater placement, therefore contaminants would not pose a hazard to gray whales. Dredging operations in the estuary are very localized in nature. Should summering gray whales occur in the estuary, avoidance of the immediate dredging area would be expected. Loss of foraging opportunities for gray whales is considered negligible as summering and/or migrant gray whales are infrequent users of the estuary. Rock removal by mechanical means should have no impact on gray whales except for possible avoidance of the immediate work area, should whales occur during that action. Blasting operations, should they be required, could be more detrimental. However, blasting is unlikely to occur and conservation measures would have to be employed if blasting is used to minimize fish and wildlife resource impacts.

CONCLUSION:

Based upon the aforementioned information and the nature of the project we have concluded that the project will have "no effect" on gray whales. Further coordination with state and federal agencies would be required if blasting is employed, to include endangered species consultations.

LITERATURE CITED

Sumich, J.L. 1984. Grey whales along the Oregon Coast in summer, 1977-1980. The Murrelet. 65:33-40.

HUMPBACK, RIGHT, FIN, BLUE, SEI, AND SPERM WHALES

These species may occur in the project area but information on numbers, distribution, and feeding habits is lacking other than in a general sense. Occurrence of blue whales off the Oregon coast is primarily in May-June and August-October (Rice 1974 in Maser et al. 1981). Blue whales typically occur offshore as individuals or in small groups. Blue whales winter well south of Oregon as do fin whales (Maser et al. 1981). Fin whales do range off the Oregon Coast during summer. Whaling records indicate that fin whales were primarily harvested off Oregon from May-September (Maser et al. 1981). Sei whales also winter south of Oregon. Based upon information from central California, Sei whales probably occur in southward migration off the Oregon coast in late summer - early fall (Maser et al. 1981). Based upon catch records, humpbacks primarily occur off the Oregon coast between April and October with peak numbers occurring during June, July, and August (Maser et al. 1981). Sperm whales occur as migrants and some may summer off the Oregon coast (Maser et al. 1981). Strandings have occurred along the Oregon coast. Right whales may occur off the Oregon coast during winter; summer distribution is in cool waters north of 50 degrees north latitude (Maser et al. 1981).

CONCLUSION

Given the nature of the project, including the channel dredging, low potential for rock blasting, lack of a contaminant problem, offshore disposal, and whale use/occurrence in the project area, we feel this project will have "no effect" on these whale species.

LITERATURE CITED

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NORTHERN (STELLER) SEA LION

Northern sea lions breed along the west coast of north America from San Miguel in California's Channel Islands, to the U.S.S.R.'s Kurile Islands and the Okshotsk Sea in the western north Pacific Ocean. There is no evidence to indicate that there are separate populations throughout this range (NMFS 1990). The northern sea lion subpopulation which occurs off California has been declining since the 1920's, with a more rapid rate of decline since 1960 (Gentry and Winthrow 1986). The Alaskan population has undergone a 60% decline since 1985 (ODFW 1990), prompting the emergency listing of the species throughout it's range.

Northern sea lions are year-round residents along the Oregon coast. The subpopulation off Oregon is second in size to the Alaskan subpopulation (Brown 1988). Northern sea lions are known to haul out at a minimum of ten sites off Oregon; two of these sites, Rogue and Orford Reefs, are rookeries. Other important haulout sites include Ecola State Park, Sea Lion Caves, Columbia River South Jetty, Three Arch Rock, Cape Arago, and Seal Rock. The south jetty of the Columbia River and Three Arch Rock appeared to be used primarily during the winter (Brown 1988). Seasonal shifts in the use of haul out sites is common among northern sea lions. Northern sea lion numbers appear to be lower off Oregon in the winter than summer, though it is not known where these animals may be migrating to or wintering.

In contrast to the Alaska and California subpopulations, statewide population counts for Oregon have remained fairly stable. In 1984 and 1985, year-round counts ranged from 769 to 2352. During this survey, peak counts (2352) were made on May 21 & 23, 1984 with haulout attendance greatest at Ecola State Park, Sea Lion Caves, Orford Reef and Rogue Reef (Brown 1988). Peak attendance at the two Oregon rookeries occurs during May, June and July. Sea lions begin to leave the rookeries in August. Males are the first to leave, followed by females within a few months (Gentry and Winthrow 1978). The number of sea lions using Orford Reef has declined since 1986. It is not certain, but the decline may be related to disturbance arising from a rapidly growing sea urchin fishery in the area (ODFW 1990).

Northern sea lions forage at river mouths and nearshore areas along the coast. Roffe and Mate (1984) studied the feeding habits of pinnipeds, including northern sea lions in the Rogue River estuary, Oregon in 1984. It was determined that the sea lions fed most heavily on Pacific lamprey. A variety of environmental correlations were studied with respect to feeding, and it was determined that the factor which most affected feeding habits was proximity to the mouth of the river. Although sea lions have been accused of damaging the commercial salmon fishery in several locations along the West Coast, studies have shown that sea lions generally consume less of these fish than thought, and in fact, that salmon comprise a relatively small proportion of their diet (Gentry and Winthrow 1978). Roffe and Mate (1984) determined that, of observed surface feeding, only 2% was on salmon. The main food items for northern sea lions in the Rogue River estuary appeared to be lamprey (26.8%) and non-salmonid fishes (32.4%) (Roffe and Mate 1984).

DISCUSSION

The nearest haulout area to the Coos Bay estuary and offshore disposal sites for northern sea lions is Cape Arago, which is immediately south of the project area. Northern sea lions using Cape Arago appear to frequent the area primarily from April through September (Brown 1988). No pups were recorded during his study at this location. Peak numbers recorded were 110 animals in July 1984.

Foraging by this species would be expected to occur in the project vicinity although the extent of foraging activities at the immediate project site is unknown. Northern sea lions would be expected to avoid dredging operations, but dredging actions affect only limited areas of the channel at any point in time and are not expected to preclude sea lion use of the estuary. It is unlikely that northern sea lions would be impacted by disposal operations which are intermittent in nature and confined to a limited area. We would anticipate some potential for avoidance of the immediate disposal area. As material to be disposed is not contaminated, we anticipate no impacts from contaminants on northern sea lions.

CONCLUSION:

The project may result in some localized avoidance around the immediate dredging and disposal areas by northern sea lions. However, the project should have "no affect" on the status of the population nor should the survival of individuals be affected by the proposed action.

LITERATURE CITED

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Oregon Department of Fish and Wildlife (ODFW), 1990. Northern (Steller) Sea Lion Garners Concern. Wild Flyer, vol. 1, no. 2, June 1990.

LEATHERBACK SEA TURTLE

Leatherback sea turtles occurrence off the Oregon Coast is associated with the appearance of albacore. Albacore occurrence, and very likely that of leatherback sea turtles, is strongly associated with the warm waters of the Japanese Current which tends to approach the Oregon Coast in late summer. Typically, warm water associated with the Japanese Current does not closely approach the Oregon Coast (i.e. 1-5 miles), generally occurring 30-60+ miles offshore. During El Nino events, warm water may occur much closer to the Oregon coast than usual.

Leatherback sea turtles generally occur well offshore from the project location with only occasional individuals occurring in nearshore, colder waters. It is expected that leatherback sea turtles would only be casual visitors to the project area.

CONCLUSION

Given the nature of the project, including the channel dredging, low potential for rock blasting, lack of contaminant levels of concern, offshore disposal, and leatherback sea turtle use/occurrence in the project area, we feel this project will have "no effect" on this species.

SACRAMENTO RIVER WINTER RUN CHINOOK SALMON

The Sacramento River winter-run chinook salmon is not expected to occur in significant numbers in the vicinity of the project. This species is thought to primarily occur offshore in deep water from Fort Bragg to Monterey, California (ECOS INC. 1990). Coded wire tag recovery information compiled by the Alaska Fisheries Science Center, National Marine Fisheries Service, indicates that tagged chinook salmon released in the Sacramento River drainage have been recovered from foreign and joint venture trawl fisheries off Oregon. These tagging programs involve fall chinook salmon and not winter run chinook salmon, though. It does serve as an indication that Sacramento River winter run chinook salmon may occur off the Oregon coast.

In addition to Sacramento River winter run chinook salmon, five salmonid species are listed as candidates for Federal classification as threatened and/or endangered species. Species proposed for listing are Salmon River Basin sockeye salmon, Snake River fall, summer, and spring chinook salmon, and lower Columbia River coho salmon.

Miller et al. (1983) noted that the largest catches of adult coho salmon of Columbia River origin in the ocean fishery have been off northern California to southern Oregon. They also indicated that spring chinook salmon of Columbia River origin apparently migrate north for rearing. Discussions with John Williams, NMFS, Seattle, indicate that available information indicates that Snake River chinook and sockeye stocks migrate north for rearing. Information is preliminary and not complete, however.

CONCLUSION

The limited extent of habitat affected by disposal operations, intermittent nature of disposal events, and lack of contaminants associated with disposal materials indicate that the project will have "no affect" on Sacramento River winter run chinook salmon or on the candidate stocks. Most fish from runs of concern, except lower Columbia River coho stocks, are probably absent from the area.

Literature Cited

ECOS INC., 1990. Draft Biological Data Report: Winter Run Chinook Salmon for the Sacramento River Bank Protection Project. U.S. Army Corps of Engineers, Sacramento Dist. 38 pp.

Miller, D. R., J. G. Williams, and C. W. Sims. 1983. Distribution, abundance and growth of juvenile salmonids off the coast of Oregon and Washington. Fisheries Research 2(1983):1-7.

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Northwest Region
7600 Sand Point Way N.E.
BIN C 15700, Building 1
Seattle, Washington 98115

JAN 22 1991

F/NWR3: 1514-04-020 jbn

Robert E. Willis, Chief
Fish & Wildlife Branch
U.S. Army Corps of Engineers
Portland District
P.O. Box 2946
Portland, OR 97208-2946

Dear Mr. Willis:

This is in response to your December 4, 1990 letter and Biological Assessment (BA) regarding endangered/threatened species in the area of the proposed Coos Bay Channel Deepening Project. We have reviewed the assessment and our National Marine Mammal Laboratory had a few comments to offer which we have enclosed for your information. These comments, however, do not affect our response to your request for concurrence.

We concur with your determination that populations of endangered/threatened species under our purview are not likely to be adversely affected by the proposed action based upon the information provided in your assessment and that, 1) the dredging and disposal are scheduled to occur predominantly during the summer and fall months, a time frame when the presence of migratory gray whales is at a minimum, 2) the potential for blasting is low and further coordination with state and federal agencies including reinitiation of consultation will occur if blasting is required, and 3) that sediments for disposal do not contain environmentally detrimental contaminants. We understand that dredge material disposal may occur as early as May, i.e., the end of the northward migration, and as late as December, i.e., the beginning of the southward migration. Accordingly care should be exercised during disposal to ensure that gray whales are not present in the area of activity. Should this information be incorrect, or change, the Corps should contact this office immediately.

This concludes consultation responsibilities under Section 7 of the ESA. However, consultation should be reinitiated if new information reveals impacts of the identified activities that may adversely affect listed species, the identified activity is subsequently modified, or a new species is listed or critical habitat is determined that may be affected by the identified activity. If you have any new information or questions concerning this consultation, please contact Brent Norberg at 526-6140.

Sincerely,

Thomas E. Kruse
for Rolland A. Schmitten
Regional Director

Enclosure

cc: Nancy Foster - F/PR

CTCLUSI Exhibit C

DEPARTMENT OF THE ARMY
PORTLAND DISTRICT, CORPS OF ENGINEERS
P. O. BOX 2946
PORTLAND, OREGON 97208-2946

Reply to
Attention of:

March 29, 1990

Planning Division

Mr. Rolland Schmitten
Regional Director
National Marine Fisheries Service
7600 Sand Point Way, NE.
BIN C15700
Seattle, Washington 98115

Dear Mr. Schmitten:

Pursuant to the requirements of the Endangered Species Act of 1973, we are forwarding a project description and biological assessment for the proposed Coos Bay, Oregon channel deepening and offshore disposal project. This assessment is in response to your general listing for species in the State of Oregon including: gray, humpback, blue, fin, sei, right, and sperm whales; leatherback sea turtles; and Sacramento River winter-run chinook salmon.

We have concluded that this project will have "no effect" on any of the listed species.

Should you require further information, or an assessment of additional species, please contact Chris Moehl or Geoff Dorsey of my staff at (503) 326-6485.

Sincerely,

Richard N. Duncan
Chief, Fish and Wildlife
Branch

Enclosure

CF: PL-F FILE COPY (MOEHL) NMFCBLET

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BIOLOGICAL ASSESSMENT

FOR

GRAY, HUMPBACK, BLUE, FIN, SEI, RIGHT, AND SPERM WHALES;

LEATHERBACK SEA TURTLES;

AND

SACRAMENTO RIVER WINTER-RUN CHINOOK SALMON

AT

COOS BAY, OREGON

PROJECT DESCRIPTION

The proposed project involves the expansion of the existing deep draft navigation channel in Coos Bay, Oregon. The current channel is authorized and maintained to a depth of 45 feet between river mile (RM) 0-1, and 35 feet between RM 1-15. The proposed expansion calls for the deepening of the existing channel by a minimum of 1 foot, or up to a maximum of 5 feet. Construction may be carried out in either a single phase, or in multiple phases. Multiple phase construction would involve deepening the channel by 1 foot every five years, until the desired depth is attained. It is anticipated that as much as 559,000 cy of rock would be removed from the channel between RM 1 and 5. In general, medium grained sand will be removed between RM 5-12, and fine grained silty sand between RM 12-15. Between 32,000 cy and 2,000,000 cy of sandy material would be removed from throughout the channel. The rock material in the lower channel would be drilled and blasted to loosen it for removal by a clam shell dredge. Due to the nature of the work, rock excavation would be carried out during the first year of construction, rather than in phases.

The rock material which would be excavated from the channel would require placement at an offshore site (Figure 1). The location of this site was selected based on biological productivity information which indicates that fewer organisms will be impacted by disposal here. This disposal area would be situated on a sandy bottom adjacent to a natural rocky area in waters 150 ft to 200 ft deep. Dimensions of this site would be 14,000 ft X 3,599 ft.

In addition to the need for designating the offshore rock disposal site, further expansion of existing site F will also be necessary. This site was expanded under section 103 authority in late summer 1989 (We received a concurrence letter from your office on September 13, 1989 with regard to our biological

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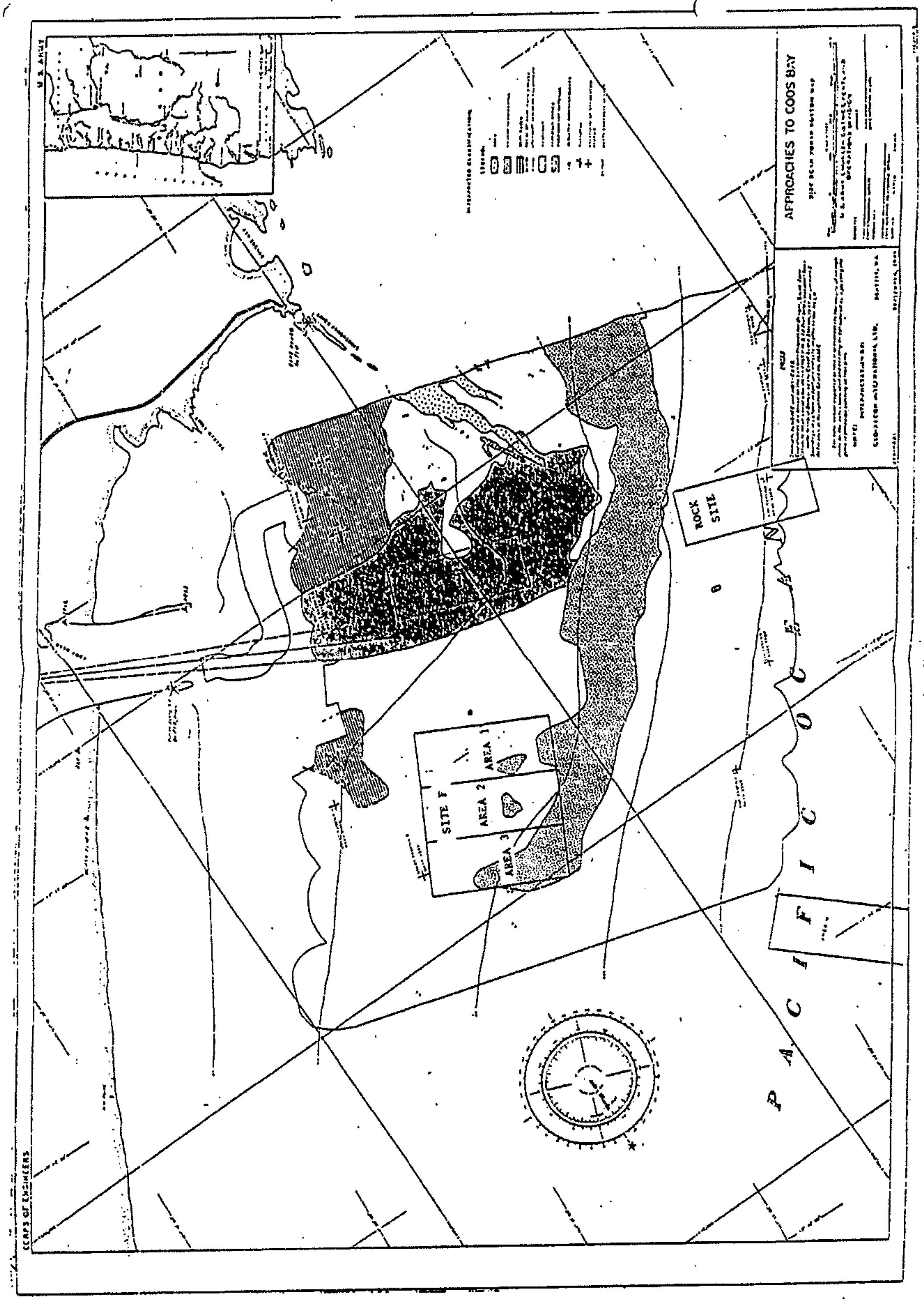

CTCLUSI Exhibit C

assessment for that expansion). Area 1 and 2 (Figure 1) comprise the currently designated site F, while area 3 is the proposed expansion site. This expansion would extend the existing site 1,400 ft to the north. The total dimensions of the new site would be 3,600 ft X 4,200 ft. Between 425,000 and 1,500,000 cy of material could be placed at this site with the various alternatives. This material would consist of clean sand with a medium grain size of 0.2mm to 0.3mm. These sediments contain no contaminants of concern in excess levels and are excluded from the requirements for further biological and chemical testing as provided in CFR 227.13(b). The fine grained material which will be encountered above RM 12 will be placed at offshore site H. No further expansion of this site will be necessary. Chemical analysis of these materials does not reveal contaminants of concern in excess levels.

GRAY WHALES

Coastal waters of Oregon serve as a migrational corridor for gray whales moving to and from their breeding, calving, and assembly areas off mainland Mexico-Baja California and their primary foraging areas in the Arctic (Sumich, 1984). Southward migration occurs in November-December with northbound migrants present from February-April. Recently, it has become apparent that summer occurrence of gray whales off the west coast of North America is more common than previously assumed (Sumich, 1984).

Gray whales summer along the Oregon Coast (Sumich, 1984). Over 1200 gray whale sightings were reported during a 1977-1980 study of gray whale occurrence off coastal Oregon by Sumich (1984). A 100 km section of coastline from the Siuslaw River to Government Point just north of Depoe Bay, appeared to be relatively important to gray whales as 60 percent of the 460 observations in 1977 occurred in that portion of the coastline (Sumich, 1984). The author noted that it was not determined if whales were more numerous or just easier to detect along that section of coast than along other portions of the Oregon coast. Sumich (1984) concentrated 1978 study efforts in the 100 km section from Siuslaw River to Government Point because of the higher incidence of sightings. His 1978 data indicated that gray whales were most commonly observed in the northern half of his study area, approximately Alsea River to Government Point, which contrasted with 1977 results. Sumich (1984) reported a maximum observed occurrence of 0.2-0.3 whales/km of coastline for the 100 km study area for the 1977 and 1978 study years.

Most sightings of gray whales occurred within 500 m offshore (Sumich, 1984). Gray whales frequented surf or foam lines. Nearshore areas with silty sediments appear to be foraging areas for gray whales; presumably because of high amphipod populations in these sediments (D. Hancock, USACE pers. comm., 1985). Confirmation of foraging areas, prey populations, foraging

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substrate, and foraging strategy are necessary. Present tentative conclusions are based on foraging ecology of gray whales in their summer grounds in the Arctic and observed behavior and site use off Oregon. Sightings also occurred at distances 5-80 km offshore in water depths of 50- 2700 m (Sumich, 1984); number of sightings was only 14 comprising 27 whales, however.

Site specific use by gray whales varied both daily and annually (Sumich, 1984); thus, the period of maximum occurrence was undetectable. Additionally, weather, sea state, observer effort, the presence or absence of strategic observation points, and the unreliability of aerial counts due to the predominant occurrence of gray whales in surf and foam lines also contribute to the large variation in observed abundance. Because of these factors, Sumich considered his abundance estimate of 0.2-0.3 whales/km as conservative.

Sumich (1984) states that the primary activity of summer gray whales off the Oregon coast appears to be feeding. It is not known what the prey item(s) are. Benthic infauna, primarily gammarid amphipods, are the principal food items of gray whales in the Arctic. He speculated that the offshore sightings (14 occurrences) may indicate pelagic foraging by the species.

Sumich (1984) also determined size of gray whales whenever possible. His results indicated that calves and yearlings comprised a significantly greater proportion of the Oregon coast population than would be expected from a random sample of the population as a whole. His analysis of length data on gray whales larger than yearlings led to the conclusion that summer gray whales on the Oregon coast are predominantly immature or atypically small mature animals. These animals may be shortening their migration due to insufficient energy reserves.

Advantages to gray whales discontinuing their migration and foraging along the Oregon coast may lie in the energetic savings associated with such behavior (Sumich, 1984). He concluded that the shallow, inshore waters of the Oregon coast should be considered as supplementary summer feeding grounds. As a complete count of gray whales which summer off Oregon is unavailable, the proportion of the population which is present remains an unknown. However, it seems reasonable that only a small proportion of the population does exhibit this tendency to shorten their migration.

CONCLUSION

The Coos Bay channel deepening and offshore disposal projects are not expected to have an impact on gray whales. The ocean disposal areas are south of the locations where summering gray whales are observed and are not expected to have an impact on these whales. Additionally, due to the location offshore, depth of the disposal sites and timing of material placement; migrating gray whales are not expected to be impacted by the offshore disposal. The in-bay dredging and blasting operations are thought to be sufficiently distant from summering and/or migrating whales that these activities will also not have an impact on this species. Based upon the aforementioned information and the nature of the project we have concluded that the project will have "no effect" on gray whales.

LITERATURE CITED

Sumich, J.L. 1984. Grey whales along the Oregon Coast in summer, 1977-1980. The Murrelet. 65:33-40.

HUMPBACK, RIGHT, FIN, BLUE, SEI, AND SPERM WHALES

These species may occur in the project area but information on numbers, distribution, and feeding habits is lacking other than in a general sense. Occurrence of blue whales off the Oregon coast is primarily in May-June and August-October (Rice 1974 in Maser et al. 1981). Blue whales typically occur offshore as individuals or in small groups. Blue whales winter well south of Oregon as do fin whales (Maser et al. 1981). Fin whales do range off the Oregon Coast during summer. Whaling records indicate that fin whales were primarily harvested off Oregon from May-September (Maser et al. 1981). Sei whales also winter south of Oregon. Based upon information from central California, Sei whales probably occur in southward migration off the Oregon coast in late summer - early fall (Maser et al. 1981). Based upon catch records, humpbacks primarily occur off the Oregon coast between April and October with peak numbers occurring during June, July, and August (Maser et al. 1981). Sperm whales occur as migrants and some may summer off the Oregon coast (Maser et al. 1981). Strandings have occurred along the Oregon coast. Right whales may occur off the Oregon coast during winter; summer distribution is in cool waters north of 50 degrees north latitude (Maser et al. 1981).

CONCLUSION

Given the nature of the project, including the channel dredging, rock blasting and offshore disposal, and the whale use/occurrence in the project area, we feel this project will have "no effect" on these whale species.

LITERATURE CITED

Maser, C., B.R. Mate, J.F. Franklin, and C.T. Dyrness. 1981. Natural history of Oregon coast mammals. PNW Forest and Range Exper. Stat., USDA, USFS, Gen. Tech. Rep. PNW-133.

Rice, D.W. 1974. Whales and whale research in the eastern North Pacific. In The whale problem: A status report, p. 170-194. W.G. Scheville, ed. Harvard Univ. Press, Cambridge.

LEATHERBACK SEA TURTLE

Leatherback sea turtles occurrence off the Oregon Coast is associated with the appearance of albacore. Albacore occurrence, and very likely that of leatherback sea turtles, is strongly associated with the warm waters of the Japanese Current which tends to approach the Oregon Coast in late summer. Typically, warm water associated with the Japanese Current does not closely approach the Oregon Coast (i.e. 1-5 miles), generally occurring 30- 60+ miles offshore. During El Nino events, warm water may occur much closer to the Oregon coast than usual.

Leatherback sea turtles generally occur well offshore from the project location with only occasional individuals occurring in nearshore, colder waters. It is expected that leatherback sea turtles would only be casual visitors to the project area.

Given the nature of the project, including the channel dredging, rock blasting and offshore disposal, and the leatherback sea turtle use/occurrence in the project area, we feel this project will have "no effect" on this species.

SACRAMENTO RIVER WINTER RUN CHINOOK SALMON

The Sacramento River winter-run chinook salmon is not expected to occur in the vicinity of the project. This species is thought to occur offshore in the deep water from Fort Bragg to Montery California (ECOS INC. 1990). Therefore, this project will have "no effect" on this species.

LITERATURE CITED

ECOS INC., 1990. Draft Biological Data Report: Winter Run Chinook Salmon for the Sacramento River Bank Protection Project. U.S. Army Corps of Engineers, Sacramento Dist. 38 pp.

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Alaska Fisheries Science Center
7600 Sand Point Way N.E., Bin C15700
Seattle, Washington 98115-0070

MEMORANDUM FOR: F/NWR - Rolland A. Schmitten

FROM: F/AKC - William Aron WA

SUBJECT: Comments on Environmental Assessment -Coos Bay Channel Deepening Project

We have reviewed the information regarding the possible effects of dredging activities in Coos Bay, Oregon, on gray whales and Steller sea lions. We concur with the opinion of no effect on Steller sea lions and that localized disturbance may occur but in our opinion the activity will not jeopardize the species or deleteriously affect critical habitat.

Regarding gray whales, what time of year will dumping occur? The dates of operation are not given. Gray whales migrate through the dumping area from early December and mid-February and again from mid-February through May. The majority of the migrants occur in water 40-60 m deep. The dumping to take place in water 46-62 m deep. Hence we suggest that dumping not be allowed during the southward or northward migrations or when summering animals are present.

The author states that dredging materials do not contain contaminants at levels of concern. Since the report does not give stated levels and since we don't know what levels may impact marine mammals, this statement is not valid (p. 5 under discussion section).

If blasting is deemed necessary, they should review literature on noise effects on marine mammals and fish. This is not adequately addressed in this report. Approval to blast should not be part of the whole package without additional investigations and a knowledge of the timing of these blasting operations and potential effects on wildlife.

Literature cited section is not complete.

We have no additional comments.

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August 16, 1993

Planning and Engineering Division

Mr. Russell D. Peterson
Field Supervisor
U. S. Fish and Wildlife Service
2600 SE. 98th, Suite 100
Portland, Oregon 97266

Dear Mr. Peterson:

Pursuant to the requirements of the Endangered Species Act of 1973, as amended, we are providing a biological assessment for marbled murrelets for the Coos Bay, Oregon Navigation Improvements (channel deepening) Project. We had previously submitted (June 22, 1990; reference 1-7-90-I-152) a biological assessment for bald eagles, brown pelicans, western snowy plovers and peregrine falcons to your office. Subsequent to that listing, marbled murrelets were listed. A concurrence letter confirming our determination in the biological assessments for those species submitted in our June 22, 1990, correspondence was received on July 3, 1990.

There have been some project-related changes during the interim also. The most significant change has been the substantial enlargement of Site F to accommodate initial and operations and maintenance dredged material from the Coos Bay Navigation Channel. We are also not considering blasting to remove rock from the navigation channel. An updated project description is provided with the biological assessment for marbled murrelets. A draft Feasibility Report and Environmental Impact Statement concerning the project will be published in the near future.

We have determined that the proposed actions will have no effect on the continued existence of marbled murrelets nor will the modifications in the project change our determination that other listed species will incur no effect from the project.

Please contact Mr. Geoff Dorsey (326-6481) of my staff should you have any questions or require clarification regarding this project.

Sincerely,

Robert E. Willis
Chief, Resources Protection and
Fish and Wildlife Section

Enclosure

Copies Furnished:
CENPP-PM (Laura Hicks)
CENPP-PE-RPE (Steve Stevens)

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BIOLOGICAL ASSESSMENT

FOR

MARBLED MURRELETS

COOS BAY, OREGON NAVIGATION IMPROVEMENT PROJECT

PROJECT DESCRIPTION

The proposed Coos Bay, Oregon Navigation Improvement (channel deepening) Project is located at Coos Bay, Coos County, in southwestern Oregon. The existing project at Coos Bay consists of a north and south jetty, a 45-foot deep by 700-foot wide entrance channel beginning at the entrance bar which transitions to a 35-foot deep by 300-foot wide lower channel from River Mile (RM) 1 to RM 9, and then a 35-foot deep by 400-foot wide upper channel to RM 15 plus one anchorage and two turning basins (Figure 1). The anchorage is located at RM 6. The turning basins are located at RM 12 and RM 14.7.

The proposed action is to deepen the channel two feet from the entrance to RM 15 and widen the turning basin at RM 12 by 100 feet. The alignment for the deepening will be the same as the currently authorized project. Work will be conducted during in-water work periods coordinated with the USFWS and ODFW. Rock removal from RM 0-5 will occur from 1 May - 31 January. Common excavation of material from RM 0-12 would occur from 1 May - 31 August; removal of common material from RM 12-15 would occur from 1 July - 31 January. Rock removal will be by mechanical means; further coordination will occur if conventional blasting is used for rock removal. Construction efforts will be initiated in May 1995.

Disposal of material will occur at approved ocean disposal sites (Figure 2). Current ocean disposal Sites E, F and H were designated by EPA in 1986 and have been used for disposal of sand material dredged from the channel for 10 years (includes interim use period). Dispersion of dredged material at Sites E and F has been less than predicted, hence added disposal capacity at Coos Bay is currently being sought. Investigations concerning expansion of ocean disposal Site F and designation of a rock disposal site were initiated in 1988 by the Corps and the Environmental Protection Agency. Designation of the expanded and rock disposal sites by EPA is anticipated to occur in 1994 under the authority of Section 102 of the Marine Protection, Research, and Sanctuaries Act. Monitoring, according to a plan developed and coordinated with EPA, is conducted at all dredged material disposal sites.

Rock disposal (90,000 cys) at the Section 103 rock disposal site will constitute a one-time use. Fine grain sediments

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rock disposal sites by EPA is anticipated to occur in 1994 under the authority of Section 102 of the Marine Protection, Research, and Sanctuaries Act. Monitoring, according to a plan developed and coordinated with EPA, is conducted at all dredged material disposal sites.

Rock disposal (90,000 cys) at the Section 103 rock disposal site will constitute a one-time use. Fine grain sediments (584,500 cys) from above RM 12 will be disposed of in Site H; no site expansion for H is required. Sandy sediments will comprise approximately 681,100 cys of the dredged material and will be disposed of at expanded Site F.

Coarser, sandy sediments, characterize channel sediments from RM 0-10. A transition to finer grain sediments occurs at RM 10 corresponding to a major bend in the estuary. Organic content of sediments ranges from 0.4 to 14.5 percent volatile solids with the higher percentage associated with the upstream most, finer grained sediments.

Contaminants exhibit an affinity for fine grain sediments containing organic material. Coarse, sandy sediments with low organic content generally do not contain contaminants. Thus, the most likely sediments to harbor contaminants are located above RM 10 where fine grain materials occur. Five gravity core samples collected in 1989 from the channel above RM 10 analyzed by Battelle's Pacific NW Marine Sciences Laboratory indicated that contaminants were either undetected or else occurred at low levels typical of uncontaminated coastal and estuarine sediments. Concurrent tests (1989) by the International Port of Coos Bay for adjacent dock facilities indicated the existence of higher contamination levels for sediments from RM's 12-14. Subsequent biological testing demonstrated that material associated with dock facilities was suitable for ocean disposal. Sediment samples were also obtained in 1993 from the turning basin extension at RM 12 as the area slated for extension has not been dredged previously.

Four box core samples and two gravity core samples were collected on April 28, 1993 from the area to be dredged to widen the turning basin at Coos Bay River Mile 12.0. These sediment samples are considered to be representative of the material to be dredged. Physical analyses were conducted on all samples while bulk chemical analyses were conducted on material collected by the gravity cores. The two gravity core samples were sub-sampled along their entire length for the chemical and physical analyses.

Chemical analyses included metals, pesticides/PCBs, TOC, AVS, PAHs and butyltin. All chemical analyses are considered acceptable. No element or chemical exceeded USACE, Portland District's established "levels of concern", where established. No USACE, Portland District "levels of concern" have been established for butyltin. All levels except one (DDT) are also below EPA, Region 10's screening levels (SL) for disposal in 404 waters, including the butyltin. Sample CBCD-GC-2 contained 4,4'-DDT at 10 ppb which exceeds EPA's total DDT SL of 6.9 ppb (Portland District's "level of concern" is 15-20 ppb total DDT). Sample CBCD-GC-1 contains <6.0 ppb 4,4'-DDT, the method detection limit for this sample.

The material to be dredged to widen the turning basin is considered to be suitable for ocean disposal without further testing. Because of the hydrophobic nature and low concentration of the contaminates present in the sediments, water quality standards should not be exceeded because of the dredging activities. In addition, dredging, disposal and subsequent dispersal of the dredged material at the ocean dredged material disposal site would reduce the concentrations still further. Fine grained material from the Federal navigation channel including the present turning basin at RM 12.0 has been deposited at ODMDS H since 1985. Based upon extensive evaluation of the sediment and the benthic community at Site H, from past disposal, no unacceptable adverse environmental impacts are anticipated by the proposed widening of the turning basin due to sediment contamination.

GRAY WHALES

Coastal waters of Oregon serve as a migrational corridor for gray whales moving to and from their breeding, calving, and assembly areas along Baja California, Mexico and their primary foraging areas in the northern Bering and southern Chukchi Seas (Darling 1984).

Southward migration occurs off Oregon between early December and mid-February, with pregnant females being the first to pass southward. (Herzing and Mate 1984). Southbound whales typically occur off Oregon in water less than 90 meters deep, with the majority of migrants occurring in water 40-60 m deep, located between 1.6 and 3.2 km offshore (Herzing and Mate 1984).

The northbound migration is comprised of two groups of whales migrating in two phases. The first phase begins migration between mid-February and April and consists of whales without calves. The second group consists largely of whales with calves, with migration beginning between late April and May (Herzing and Mate 1984). Generally, whales comprising the first phase tend to migrate further offshore, with immatures showing a preference for migration closer to shore (Herzing and Mate 1984). Northward cow/calf migration typically occurs close to shore. Herzing and Mate (1984) observed that 90% of the whales migrating during the later phase, traveled within 800 m of the shore; during the final three weeks of migration, 90% traveled within 100 m of shore. In contrast to previous observers, Green et. al. (1992) observed that most gray whales occurred further offshore of Oregon. They reported a mean distance of 9.2 km (SD = 4.2 km) for migrant gray whales off the Oregon coastline. They reported that only 16 percent of the whales they observed passed within 5 km of shore off Oregon.

A portion of the eastern Pacific population of gray whales does not migrate to the northern seas; these whales spend summer offshore of California, Oregon, Washington and British Columbia. Mate estimated a summering population of 75 whales off the coast of Oregon in 1979 (Darling 1984). Current population estimates by Mate indicate an increase to 100-200 summering whales (B. Mate, pers. comm., 1990). Information regarding summering gray whale distribution off Oregon is patchy. It appears that most summering gray whales occur between Winchester Bay (Umpqua River) and Cascade Head, near Lincoln City (B. Mate, pers. comm., 1990). These summering gray whales occur in scattered, small groups or as individuals. There was reportedly a cow/calf pair summering off Coos Bay in 1990 (Jan Hodder, OIMB, pers. comm. 7-90). Three small groups have been reported elsewhere in Oregon during 1990 (Beverly Lund, pers. comm. 7-90); these include approximately 6 individuals between Boiler Bay and Yaquina Head, a group between the south Jetty of Yaquina Bay and Seal Rock, and a group at Gold Haven near Sea Lion Caves. Green et. al. (1992) reported that 13 percent of gray whales observed during their surveys of the Oregon and Washington coast occurred during summer. Their observations indicated that summering gray whales typically occurred within 1 km of the coast or in bays. Thirty-one percent of summering whales observed by Green et. al. (1992) were in the vicinity of Yaquina Head near Newport, Oregon.

There are occasional reports of gray whales occurring in coastal estuaries including the Columbia River, Tillamook Bay, Yaquina Bay, Siuslaw River, and Coos Bay (B. Mate, pers. comm., 1990). Apparently it is not uncommon for gray whales to occur between the Highway 101 bridge and the jetties at Yaquina Bay; these observations include north and south bound migrants and summering gray whales. Summering gray whales have been observed in the mouth of the Siuslaw River between the jetties by Corps personnel and other observers have recorded them as far upriver as Mapleton on the Siuslaw. Operators of the charter boat Siggi-G out of Garibaldi reported a gray whale near buoy six, Tillamook Bay entrance channel, in late spring 1990; it is not known whether this represented a migrant or summering gray whale. A whale, species unknown, was observed just north of Tillamook Bay in June 1989 less than one-half mile offshore.

A study of summering whales off Oregon was conducted by Sumich (1984). Summer sightings were defined as those which occurred between 1 June and 15 September. Sumich reported over

1200 gray whale sightings during a 1977-1980 study off coastal Oregon. A 100 km section of coastline from the Siuslaw River to Government Point just north of Depoe Bay, appeared to be relatively important to gray whales. In 1977, 60% of the 460 observations occurred within this 100 km section.
Sumich reported a maximum observed occurrence of 0.2-0.3 whales/km over the 100 km study area during the 1977 and 1978 studies. It was not determined whether whales were more numerous along this section, or simply easier to detect. Whale distribution within the 100 km section varied between 1977 and 1978; in 1977 whales were most commonly observed in the southern half of the study area, in contrast to 1978 when whales were more frequently observed in the northern half of the study area. Sumich noted that site specific use also varied daily; thus, a period of maximum occurrence was undetectable. Additionally, weather, sea state, observer effort, the presence or absence of strategic observation points, and the unreliability of aerial counts due to the predominant occurrence of gray whales in surf and foam lines (which makes them difficult to detect) also contribute to the large variation in observed abundance. Because of these factors, Sumich considered his abundance estimate of 0.2-0.3 whales/km to be conservative.

Sumich (1984) noted that the primary activity of summer gray whales off the Oregon coast appears to be feeding. Benthic infauna, primarily gammarid amphipods and polychaete worms are the principal food items of gray whales (Rice et al 1984). Migrating whales feed, to some extent, on benthic organisms at the mouths of rivers and estuaries (Nerini 1984). Pelagic foraging by gray whales is thought to be rare (Nerini 1984), though Sumich (1984), suggests that offshore sightings may be an indication of pelagic feeding.

Sumich noted that nearshore locations with silty sediments appear to be foraging areas for gray whales; presumably because of high amphipod populations in silty sediments (D. Hancock, USACE pers. comm., 1985). Gray whales also frequented surf or foam lines. A pod of whales summering near Boiler Bay, OR (1990), was reported to have been feeding in kelp beds (Beverly Lund, pers. comm. 1990).

Sumich (1984) postulates that whales which summer off Oregon may gain energetic benefit by shortening their migration. He further noted that the whales off Oregon consisted predominantly of immature or small mature individuals. Mate has also indicated that the majority of whales summering off Oregon appear to be immature (Beverly Lund pers. comm. 1990). Gray whales that summer off British Columbia have been documented to return to within 150 km of an established location, with some individuals reportedly having returned for up to 8 consecutive years (Darling 1984). As such, Darling argues that these whales are not cutting their migration short, but that they are intentionally seeking out and utilizing available "pockets" of habitat. Although a through investigation of the age structure of these whales has not been made, Darling (1984) believes that these populations may also be composed primarily of young individuals.

DISCUSSION

Disposal operations associated with this project will occur within the designated offshore disposal sites. Rock disposal operations offshore will occur during the Phase B northward and southward migration for gray whales. Coarser, sandy sediments from RM 0-12 will be placed in offshore Site F from 1 May to 31 August which encompasses the northward Phase B migration period. The fine-grain sediments from RM 12-15 will be placed in Site H from 1 July - 31 January. Fine-grain sediment disposal would encompass most of the southward migration period.

Should disposal operations occur when whales are present, it is unlikely that gray whales would be impacted as disposal operations are intermittent in nature, of a limited quantity per load and are confined to a limited area within the offshore disposal locations.

Although DDT has been identified in a portion of the sediments to be disposed of in the ocean, the low concentration of this contaminant in the sediments, the dilution that this material would incur from dredging, disposal, and subsequent dispersal in the ocean and the hydrophobic nature of DDT, combine to minimize the potential for impacts. We anticipate no impacts from contaminants on migrant or summering gray whales.

CONCLUSION

We conclude that dredging and disposal operations associated with the Coos Bay, Oregon Navigation Improvements Projects will have "no effect" on gray whales.

LITERATURE CITED

Darling, J. D. 1984. Gray whales off Vancouver Island, British Columbia. Pages 267-287 in M. L. Jones, S.L. Swartz, & S. Leatherwood, eds. The gray whale, "Eschrichtius robustus." Academic Press, Inc., Orlando, FL. 600pp.

Green, G. A., J. J. Brueggeman, C. E. Bowlby, R. A. Grotefendt, M. L. Bonnell and K. T. Balcomb, III. 1991. Cetacean distribution and abundance off Oregon and Washington, 1989-1990. Final Report prepared by Ebasco Environmental, Bellevue, WA, and Ecological Consulting, Inc., Portland, OR for the Minerals Management Service, Pacific OCS Region, OCS Study MMS 91-0093. 100pp.

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Rice, D. W., A. A. Wolman, & H. W. Braham. 1984. The gray whale, 'Eschrichtius robustus'. Mar. Fish Rev. 46(4):7-14.

Sumich, J. L. 1984. Gray whales along the Oregon Coast in summer, 1977-1980. The Murrelet. 65:33-40.

HUMPBACK, RIGHT, FIN, BLUE, SEI, AND SPERM WHALES

These species may occur in the project area but information on numbers, distribution, and feeding habits is lacking other than in a general sense. Occurrence of blue whales off the Oregon coast is primarily in May-June and August-October (Rice 1974 in Maser et al. 1981). Blue whales typically occur offshore as individuals or in small groups. Blue whales winter well south of Oregon as do fin whales (Maser et al. 1981).

Fin whales do range off the Oregon Coast during summer. Whaling records indicate that fin whales were primarily harvested off Oregon from May-September (Maser et al. 1981).

Green et al. (1989), based upon entries (1911-1925) in the logbooks of W. Lagen, U. of Washington Library, noted that fin whales were harvested in Oregon waters in the vicinity of Heceta Head and Yaquina Bay where oceanic banks occur and at the mouth of the Columbia River. Green et al. (1991) reported observing thirteen groups totaling 27 fin whales off the Oregon coast between June and January; all but 5 observations (Nov. 1989-2; January 1990-3) occurred in either June or July of 1989 and 1990. They observed fin whale groups in slope waters 85-90 km west of Newport, Oregon on three separate occasions and considered this an indication of site-specific preference. This area is referred to as the Newport Valley and has high topographical relief. They noted that other authors had observed site fidelity by this species.

Sei whales also winter south of Oregon. Based upon information from central California, Sei whales probably occur in southward migration off the Oregon coast in late summer - early fall (Maser et al. 1981).

Based upon catch records, humpbacks primarily occur off the Oregon coast between April and October with peak numbers occurring during June, July, and August (Maser et al. 1981). Green et al. (1991) observed 36 groups comprising 68 humpback whales off the Oregon and Washington coasts between May and November. They observed this species to be most abundant between May and September. Observations by Green et al. (1991) indicated that humpback whales first occurred off the Oregon coast in May and were off Washington by July. They were only observed in Washington during August shipboard surveys and were more common in Washington during September than Oregon. They noted that by late November, humpbacks were only observed off Oregon. The largest concentration of humpbacks they observed were 35 animals near Heceta Bank in June 1990. They noted that humpback whales were particularly concentrated in Oregon along the southern edge of Heceta Bank. They found this species to primarily occur on the continental shelf and slope.

Sperm whales occur as migrants and some may summer off the Oregon coast (Maser et al. 1981). Strandings have occurred along the Oregon coast. Green et al. (1989), citing Watkins (1977) indicated that sperm whales are pelagic occurring in water greater than 1000 m in depth. Leatherwood and Reeves (1982; more likely Leatherwood et al. 1982) cited in Green et al. (1989) observed a preference for continental shelf margins and sea mounts where upwelling occurs. Mate (1981), cited by Green et al. (1989) reported sperm whales commonly observed off Oregon between March and September.

Right whales may occur off the Oregon coast during winter; summer distribution is in cool waters north of 50 degrees north latitude (Maser et al. 1981). Green et al. (1989), citing

Fiscus and Niggol (1965) reported an observation of right whales off Tillamook Head in April 1959.

DISCUSSION

Discussions with Bruce Mate and other observers have indicated that these species of whales are rather infrequent visitors to the vicinity of coastal jetties, entrance channels and bays. A review of the literature indicates that these species would be more prevalent at offshore locations more distant and of different physical characteristics than the Coos Bay ocean dredged material disposal locations.

CONCLUSION

Given the nature of the project and whale use/occurrence in the project area, we have determined that there will be no effect to these whale species from dredging and disposal actions associated with the Coos Bay, Oregon Navigation Improvements Project.

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NORTHERN (STELLER) SEA LION

Northern sea lions breed along the west coast of north America from San Miguel in California's Channel Islands, to the U.S.S.R.'s Kurile Islands and the Okshotsk Sea in the western north Pacific Ocean. There is no evidence to indicate that there are separate populations throughout this range (NMFS 1990). The northern sea lion subpopulation which occurs off California has been declining since the 1920's, with a more rapid rate of decline since 1960 (Gentry and Withrow 1986). The Alaskan population has undergone an 60% decline since 1985 (ODFW 1990), prompting the emergency listing of the species throughout it's range.

Northern sea lions are year-round residents along the Oregon coast. The subpopulation off Oregon is second in size to the Alaskan subpopulation (Brown 1988). Northern sea lions are known to haul out at a minimum of ten sites off Oregon; two of these sites, Rogue and Orford Reefs, are rookeries. Other important haulout sites include Ecola State Park, Sea Lion Caves, Columbia River South Jetty, Three Arch Rock, Cape Arago, and Seal Rock. The south jetty of the Columbia River and Three Arch Rock appeared to be used primarily during the winter (Brown 1988).

In contrast to the Alaska and California subpopulations, statewide population counts for Oregon have remained fairly stable. In 1984 and 1985, year-round counts ranged from 769 to 2352. During this survey, peak counts (2352) were made on May 21 & 23, 1984 with haulout attendance greatest at Ecola State Park, Sea Lion Caves, Orford Reef and Rogue Reef (Brown 1988). Peak attendance at the two Oregon rookeries occurs during May, June and July. Sea lions begin to leave the rookeries in August. The number of sea lions using Orford Reef has declined since 1986. It is not certain, but the decline may be related to a rapidly growing sea urchin fishery in the area (ODFW 1990). Seasonal shifts in the use of haul out sites is common among northern sea lions. Northern sea lion numbers appear to be lower off Oregon in the winter than summer, though it is not known where these animals may be migrating to or wintering. Northern sea lions forage at river mouths and nearshore areas along the coast. Roffe and Mate (1984) studied the feeding habits of pinnipeds, including northern sea lions in the Rogue River estuary, Oregon in 1984. It was determined that the sea lions fed most heavily on Pacific lamprey. A variety of environmental correlations were studied with respect to feeding, and it was determined that the factor which most affected feeding habits was proximity to the mouth of the river. Although sea lions have been accused of damaging the commercial salmon fishery in several locations along the West Coast, studies have shown that sea lions generally consume less of these fish than thought, and in fact, that salmon comprise a relatively small proportion of their diet. Roffe and Mate (1984) determined that, of observed surface feeding, only 2% was on salmon. The main food items for northern sea lions in the Rogue River estuary appeared to be lamprey (26.8%) and non-salmonid fishes (32.4%) (Roffe and Mate 1984).

DISCUSSION

Foraging by this species would be expected to occur in the Coos Bay estuary although the extent of foraging activities in the immediate project area is unknown. Robin Brown (ODFW, pers. comm. 1993) indicated that presence of northern sea lions in the Coos Bay estuary occurs but is limited in scope. He indicated that the nature of the project was unlikely to impact the species.

It is unlikely that northern sea lions would be impacted by disposal operations as they are intermittent in nature and confined to a limited area. We would anticipate some potential for avoidance of the immediate disposal area.

Although DDT has been identified in a portion of the sediments to be disposed of in the ocean, the low concentration of this contaminant in the sediments, the dilution that this material would incur from dredging, disposal, and subsequent dispersal in the ocean and the hydrophobic nature of DDT, combine to minimize the potential for impacts. We anticipate no impacts from contaminants on northern sea lions.

Dredging actions are also limited spatially. Some avoidance of the immediate area around the dredge by northern sea lions would be expected. The avoidance area associated with a dredge would represent a very minor fraction of the potential habitat available to this species.

CONCLUSION:

The project may result in some localized avoidance around the immediate dredging and disposal areas by northern sea lions. However, the project should have "no affect" on the status of the population nor should the survival of individuals be affected by the proposed action.

LITERATURE CITED

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LEATHERBACK, LOGGERHEAD AND GREEN SEA TURTLES

Very little information has been published in peer-reviewed journals for sea turtles in the eastern North Pacific. Three ESA listed species of sea turtles (*Dermochelys coriacea*, *Caretta caretta* and *Chelonia mydas agassizi*) have been recorded off the Oregon coast (S. Eckert pers. comm. 1992). Of the three, leatherbacks (*D. coriacea*) are the most common visitors to Oregon waters. This species is very thermal tolerant and can maintain a body temperature of 64° F in 41° F water (S. Eckert 1992). Because of their thermal tolerance, leatherbacks may be found off the Oregon coast all times of the year (S. Eckert, pers. comm. 1992). Of the forty sightings reported off Oregon and Washington, 65% were leatherback, 17.5% loggerhead, 7.5% green; 10% were unidentified (S. Eckert[1]).

Leatherbacks are the most pelagic of the sea turtles, exhibiting the most extensive range of any living reptile (Pritchard and Trebbau 1984). Incidental capture in fisheries and sightings indicate that leatherbacks are found as far north as Alaska. Documented encounters continue southward from Alaska through British Columbia, Washington, Oregon, and south to Mexico (K. Eckert 1991). Of the documented sightings off the Oregon coast, none were reported closer than approximately 15 nautical miles from the mouth of the Columbia River (S. Eckert[1]).

Of the documented sightings off Oregon and Washington, loggerhead sea turtles (*Caretta caretta*) were second to leatherbacks. In the eastern Pacific, loggerheads are reported as far north as Washington, and south to Chile, with most records being of juveniles off California (K. Eckert 1991).

Green sea turtles (*Chelonia mydas agassizi*) were the least abundant of the documented sightings (S. Eckert[1]). As with loggerhead sea turtles, their occurrence off Oregon and Washington is thought to be associated with warmer than normal water temperatures (K. Eckert 1991, S. Eckert, pers. comm. 1992).

DISCUSSION

Leatherback, loggerhead, and green sea turtles are expected to be very infrequent visitors in the area of the Coos Bay, Oregon Navigation Improvements Project. Although all three species have been documented off the Oregon and Washington coasts, none appear to be regular inhabitants. Most sightings occurred off the slope, and the majority of sightings off California are also over the slope. Although there are stranding records for these sea turtles, this near-shore presence can not be considered typical of healthy animals.

CONCLUSION

Due to the very infrequent occurrence of sea turtles in near-shore waters, intermittent nature of disposal operations, and the lack of contaminants associated with disposal materials, indicates that the Coos Bay, Oregon Navigation Improvements Project will have "no effect" on leatherback, loggerhead, and green sea turtles.

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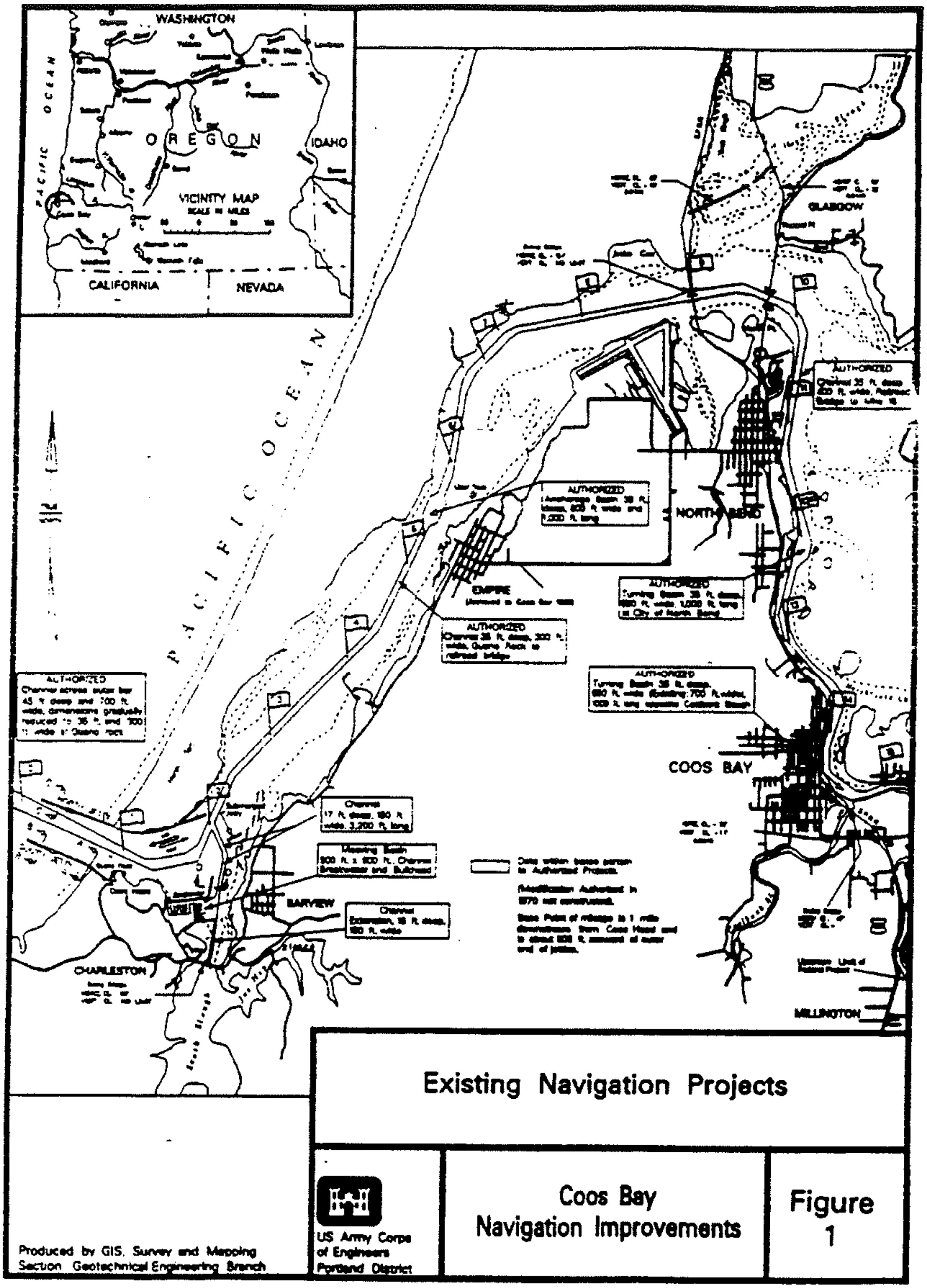

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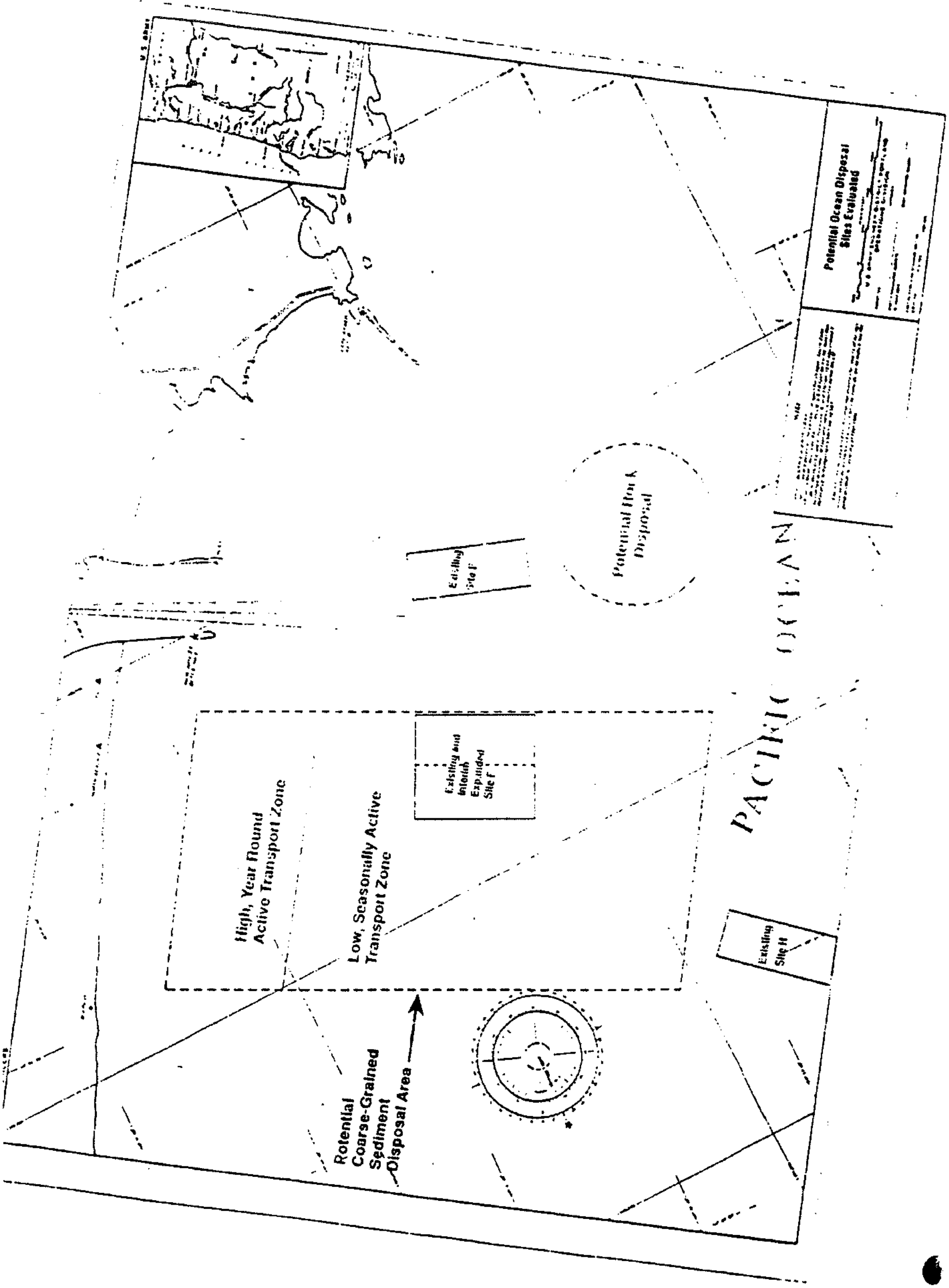

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August 16, 1993

Planning and Engineering Division

Mr. James Lecky
National Marine Fisheries Service
Protected Species Management Branch
501 West Ocean Boulevard Suite 4200
Long Beach, California 90802

Dear Mr. Lecky:

Pursuant to the requirements of the Endangered Species Act of 1973, as amended, we have made a determination that the Coos Bay, Oregon Navigation Improvements (channel deepening) will have no effect on Sacramento River winter run chinook salmon. We previously provided your Seattle office (December 4, 1990), with a biological assessment for this species. We received a letter from your Seattle office on January 22, 1991, (ref. F/NWR3: 1514-04-020 jbn) concurring with our determination of no effect to listed species.

The National Marine Fisheries Service (NMFS) concurrence letter requested renotification should project related actions or information change. There have been changes during the interim in disposal site boundaries. Site F will be substantially enlarged from the proposal set forth in our previous biological assessment. Our information and findings relative to the Sacramento River Winter Run Chinook Salmon have not changed, however. We are resubmitting the biological assessment of December 4, 1990 , plus providing your office a copy of the January 22, 1991 concurrence letter from your Seattle office. To further assist your review, an updated project description follows.

The proposed Coos Bay, Oregon Navigation Improvement (channel deepening) Project is located at Coos Bay, Coos County, in southwestern Oregon. The existing project at Coos Bay consists of a north and south jetty, a 45-foot deep by 700-foot wide entrance channel beginning at the entrance bar which transitions to a 35-foot deep by 300-foot wide lower channel from River Mile (RM) 1 to RM 9, and then a 35-foot deep by 400-foot wide upper channel to RM 15 plus one anchorage and two turning basins (Figure 1). The anchorage is located at RM 6. The turning basins are located at RM 12 and RM 14.7.

The proposed action is to deepen the channel two feet from the entrance to RM 15 and widen the turning basin at RM 12 by 100 feet. The alignment for the deepening will be the same as the currently authorized project. Work will be conducted during in-water work periods coordinated with the U. S. Fish & Wildlife Service and Oregon Department of Fish & Wildlife. Rock removal from RM 0-5 will occur from 1 May - 31 January. Common excavation of material from RM 0-12 would occur from 1 May - 31 August; removal of common material from RM 12-15 would occur from 1 July - 31 January. Rock removal will be by mechanical means; further coordination will occur if conventional blasting is used for rock removal. Construction efforts will be initiated in May 1995.

Disposal of material will occur at approved ocean disposal sites (Figure 2). Current ocean disposal Sites E, F and H were designated by EPA in 1986 and have been used for disposal of sand material dredged from the channel for 10 years (includes interim use period). Dispersion of dredged material at Sites E and F has been less than predicted, hence added disposal capacity at Coos Bay is currently being sought. Investigations concerning expansion of

CF: CENPP-PE-RPE (Steve Stevens)

in 1988 by the U. S. Army Corps of Engineers and the Environmental Protection Agency (EPA). Designation of the expanded and rock disposal sites by the Environmental Protection Agency is anticipated to occur in 1994 under the authority of Section 102 of the Marine Protection, Research, and Sanctuaries Act. Monitoring, according to a plan developed and coordinated with EPA, is conducted at all dredged material disposal sites.

Rock disposal (90,000 cys) at the Section 103 rock disposal site will constitute a one-time use. Fine grain sediments (584,500 cys) from above RM 12 will be disposed of in Site H; no site expansion for H is required. Sandy sediments will comprise approximately 681,100 cys of the dredged material and will be disposed of at expanded Site F.

Coarser, sandy sediments, characterize channel sediments from RM 0-10. A transition to finer grain sediments occurs at RM 10 corresponding to a major bend in the estuary. Organic content of sediments ranges from 0.4 to 14.5 percent volatile solids with the higher percentage associated with the upstream most, finer grained sediments.

Contaminants exhibit an affinity for fine grain sediments containing organic material. Coarse, sandy sediments with low organic content generally do not contain contaminants. Thus, the most likely sediments to harbor contaminants are located above RM 10 where fine grain materials occur. Five gravity core samples collected in 1989 from the channel above RM 10 analyzed by Battelle's Pacific NW Marine Sciences Laboratory indicated that contaminants were either undetected or else occurred at low levels typical of uncontaminated coastal and estuarine sediments. Concurrent tests (1989) by the International Port of Coos Bay for adjacent dock facilities indicated the existence of higher contamination levels for sediments from RM's 12-14. Subsequent biological testing demonstrated that material associated with dock facilities was suitable for ocean disposal. Sediment samples were also obtained in 1993 from the turning basin extension at RM 12 as the area slated for extension has not been dredged previously.

Four box core samples and two gravity core samples were collected on April 28, 1993, from the area to be dredged to widen the turning basin at Coos Bay River Mile 12.0. These sediment samples are considered to be representative of the material to be dredged. Physical analyses were conducted on all samples while bulk chemical analyses were conducted on material collected by the gravity cores. The two gravity core samples were sub-sampled along their entire length for the chemical and physical analyses.

Chemical analyses included metals, pesticides/PCBs, TOC, AVS, PAHs and butyltin. All chemical analyses are considered acceptable. No element or chemical exceeded USACE, Portland District's established "levels of concern", where established. No USACE, Portland District "levels of concern" have been established for butyltin. All levels except one (DDT) are also below EPA, Region 10's screening levels (SL) for disposal in 404 waters, including the butyltin. Sample CBCD-GC-2 contained 4,4'-DDT at 10 ppb which exceeds EPA's total DDT SL of 6.9 ppb (Portland District's "level of concern" is 15-20 ppb total DDT). Sample CBCD-GC-1 contains <6.0 ppb 4,4'-DDT, the method detection limit for this sample.

The material to be dredged to widen the turning basin is considered to be suitable for ocean disposal without further testing. Because of the hydrophobic nature and low concentration of the contaminates present in the sediments, water quality standards should not be exceeded because of the dredging activities. In addition, dredging, disposal and subsequent dispersal of the dredged material at the ocean dredged material disposal site would reduce the concentrations still further. Fine grained material from the Federal navigation channel including the present turning basin at RM 12.0 has been deposited at ODMDS H since 1985. Based upon extensive evaluation of the sediment and the benthic community at Site H, from past disposal, no unacceptable adverse environmental impacts are anticipated by the proposed widening of the turning basin due to sediment contamination.

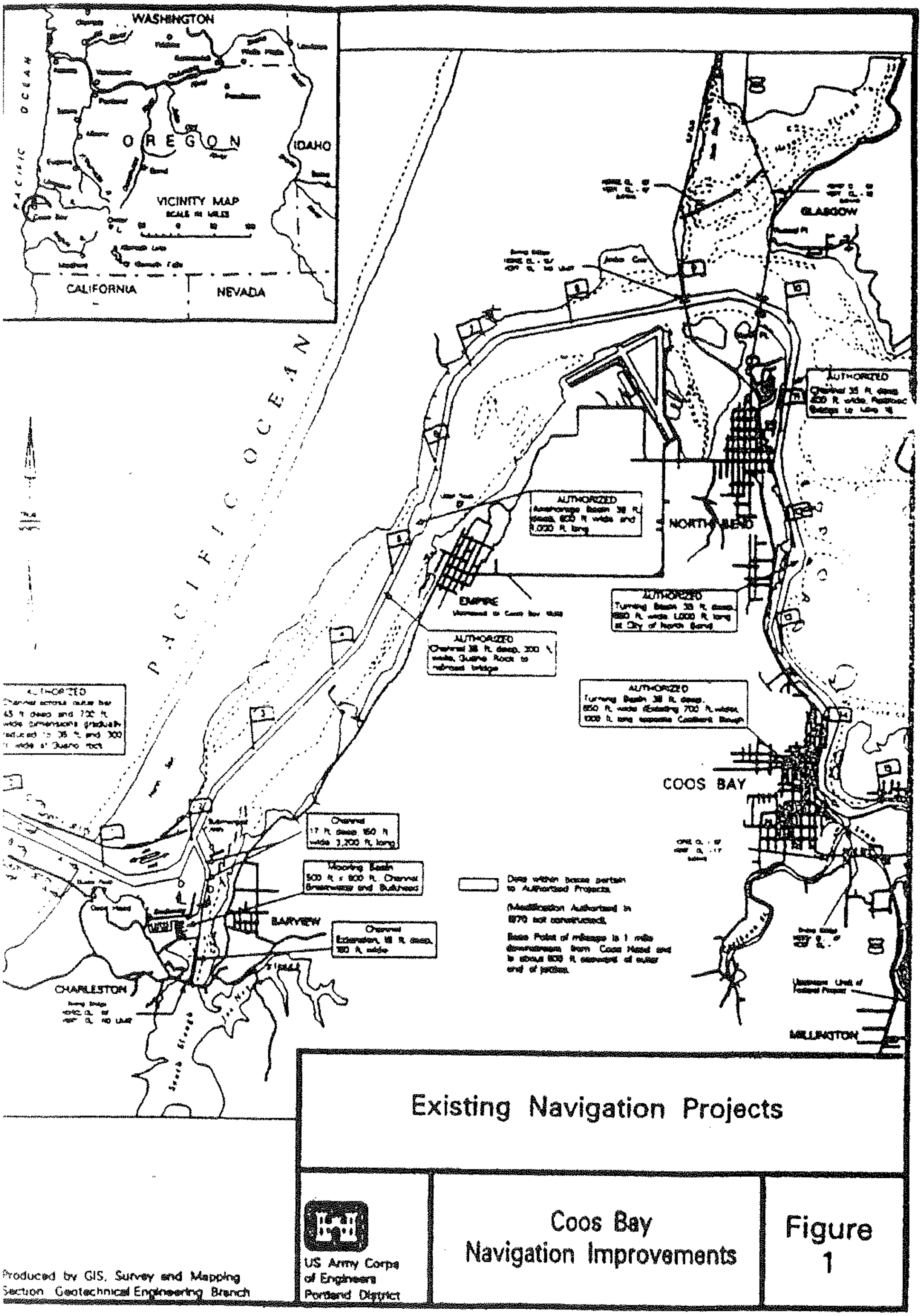
We have determined that the proposed action should have no effect on the continued existence of the Sacramento River Winter Run Chinook Salmon.

Should you require any additional information, please contact Mr. Geoff Dorsey of my staff at (503) 326-6481.

Sincerely,

Robert E. Willis
Chief, Resources Protection and
Fish and Wildlife Section

Copies Furnished:
CENPP-PM (Laura Hicks)
CENPP-PE-RPE (Steve Stevens)



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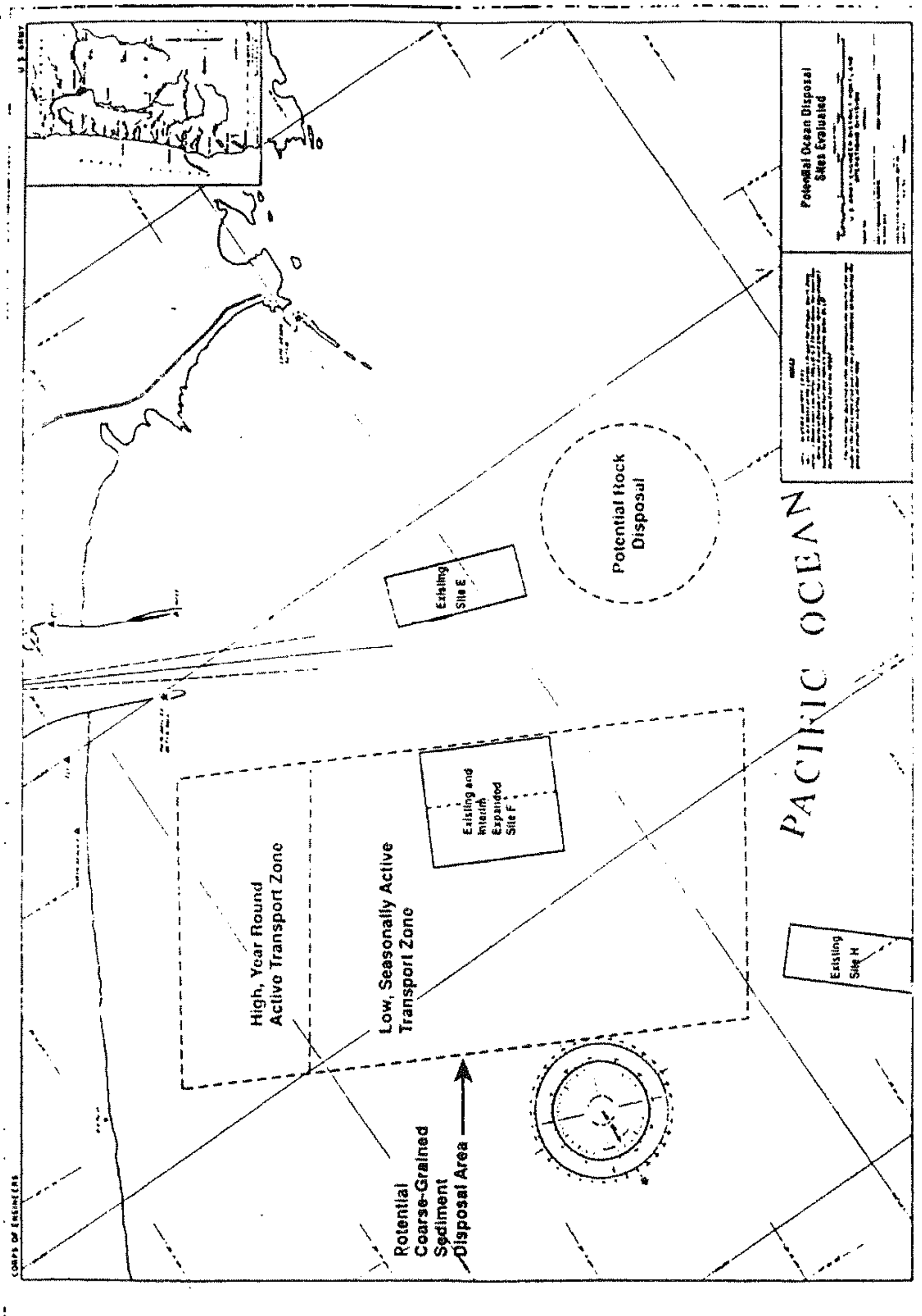

FIGURE 2

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December 4, 1990

Planning Division

Mr. Rolland Schmitten
Regional Director
National Marine Fisheries Service
7600 Sand Point Way, NE.
BIN C15700
Seattle, Washington 98115

Dear Mr. Schmitten:

Pursuant to the requirements of the Endangered Species Act of 1973, we are forwarding a biological assessment for threatened and endangered species which could potentially be impacted by dredging and disposal operations associated with the Coos Bay Channel Deepening Project.

We have concluded that this project will have "no effect" on any of the listed species.

Should you require any additional information, please contact Geoff Dorsey of my staff at (503) 326-6482.

Sincerely,

Robert E. Willis
Chief, Fish and Wildlife
Branch

PL File

WILLIS
CENPP-PL-F

DORSEY
CENPP-PL-F
6482/Cameron
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Enclosure

CF:
Joe Johnson, PL-C
Steve Stevens, PL-R

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SACRAMENTO RIVER WINTER RUN CHINOOK SALMON

The Sacramento River winter-run chinook salmon is not expected to occur in significant numbers in the vicinity of the project. This species is thought to primarily occur offshore in deep water from Fort Bragg to Monterey, California (ECOS INC. 1990). Coded wire tag recovery information compiled by the Alaska Fisheries Science Center, National Marine Fisheries Service, indicates that tagged chinook salmon released in the Sacramento River drainage have been recovered from foreign and joint venture trawl fisheries off Oregon. These tagging programs involve fall chinook salmon and not winter run chinook salmon, though. It does serve as an indication that Sacramento River winter run chinook salmon may occur off the Oregon coast.

In addition to Sacramento River winter run chinook salmon, five salmonid species are listed as candidates for Federal classification as threatened and/or endangered species. Species proposed for listing are Salmon River Basin sockeye salmon, Snake River fall, summer, and spring chinook salmon, and lower Columbia River coho salmon.

Miller et al. (1983) noted that the largest catches of adult coho salmon of Columbia River origin in the ocean fishery have been off northern California to southern Oregon. They also indicated that spring chinook salmon of Columbia River origin apparently migrate north for rearing. Discussions with John Williams, NMFS, Seattle, indicate that available information indicates that Snake River chinook and sockeye stocks migrate north for rearing. Information is preliminary and not complete, however.

CONCLUSION

The limited extent of habitat affected by disposal operations, intermittent nature of disposal events, and lack of contaminants associated with disposal materials indicate that the project will have "no affect" on Sacramento River winter run chinook salmon or on the candidate stocks. Most fish from runs of concern, except lower Columbia River coho stocks, are probably absent from the area.

Literature Cited

ECOS INC., 1990. Draft Biological Data Report: Winter Run Chinook Salmon for the Sacramento River Bank Protection Project. U.S. Army Corps of Engineers, Sacramento Dist. 38 pp.

Miller, D. R., J. G. Williams, and C. W. Sims. 1983. Distribution, abundance and growth of juvenile salmonids off the coast of Oregon and Washington. Fisheries Research 2(1983):1-7.

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Northwest Region
7600 Sand Point Way N.E.
BIN C 15700, Building 1
Seattle, Washington 98115

JAN 22 1991

F/NWR3: 1514-04-020 jbn

Robert E. Willis, Chief
Fish & Wildlife Branch
U.S. Army Corps of Engineers
Portland District
P.O. Box 2946
Portland, OR 97208-2946

Dear Mr. Willis:

This is in response to your December 4, 1990 letter and Biological Assessment (BA) regarding endangered/threatened species in the area of the proposed Coos Bay Channel Deepening Project. We have reviewed the assessment and our National Marine Mammal Laboratory had a few comments to offer which we have enclosed for your information. These comments, however, do not affect our response to your request for concurrence.

We concur with your determination that populations of endangered/threatened species under our purview are not likely to be adversely affected by the proposed action based upon the information provided in your assessment and that, 1) the dredging and disposal are scheduled to occur predominantly during the summer and fall months, a time frame when the presence of migratory gray whales is at a minimum, 2) the potential for blasting is low and further coordination with state and federal agencies including reinitiation of consultation will occur if blasting is required, and 3) that sediments for disposal do not contain environmentally detrimental contaminants. We understand that dredge material disposal may occur as early as May, i.e., the end of the northward migration, and as late as December, i.e., the beginning of the southward migration. Accordingly care should be exercised during disposal to ensure that gray whales are not present in the area of activity. Should this information be incorrect, or change, the Corps should contact this office immediately.

This concludes consultation responsibilities under Section 7 of the ESA. However, consultation should be reinitiated if new information reveals impacts of the identified activities that may adversely affect listed species, the identified activity is subsequently modified, or a new species is listed or critical habitat is determined that may be affected by the identified activity. If you have any new information or questions concerning this consultation, please contact Brent Norberg at 526-6140.

Sincerely,

Thomas E. Kruse
for Rolland A. Schmitten
Regional Director

Enclosure

cc: Nancy Foster - F/PR

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UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Northwest Region
Fisheries Management Division
7600 Sand Point Way N.E.
Seattle, Washington 98115

SEP 21 1993 F/NWO3:1514-04-020

Robert E. Willis, Chief
Resource Protection and
Fish and Wildlife Section
U.S. Army Corps of Engineers
Portland District
P.O. Box 2946
Portland, OR 97208-2946

Dear Mr. Willis:

This is in response to your August 16, 1993 letter requesting review of an Endangered Species Act (ESA) Biological Assessment for the proposed Coos Bay, Oregon, channel deepening project. We have reviewed your Biological Assessment which considers cetaceans, northern sea lions and sea turtles. We concur with your determination that populations of threatened/endangered whales, northern sea lions and sea turtles are not likely to be adversely affected by the proposed actions.

This concludes consultation responsibilities under Section 7 of the ESA with regard to listed marine mammals and sea turtles. However, consultation should be reinitiated if new information reveals impacts of the identified activities that may adversely affect listed species, the activity is subsequently modified, or a new species is listed or critical habitat determined that may be affected by the identified activity.

Sincerely,

Rolland A. Schmitten
Regional Director

cc: F/NWO3 - Elizabeth Garr

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UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Southwest Region
501 West Ocean Boulevard, Suite 4200
Long Beach, California 90802-4213
TEL (310) 980-4000; FAX (310) 980-4018

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F/SW031:RCW

Mr. Robert E. Willis
Chief, Resources Protection and
Fish and Wildlife Section
U.S. Army Corps of Engineers
Portland District
P.O. Box 2946
Portland, Oregon 97208-2946

Dear Mr. Willis:

Thank you for your letter requesting concurrence that the Coos Bay, Oregon Navigation Improvements project will not adversely affect the threatened Sacramento River winter-run chinook salmon.

Based on the available information, including your August 16, 1993, letter describing the project and its potential impacts, the proposed project is unlikely to adversely affect the winter-run chinook salmon. This concludes the section 7 consultation process for the Coos Bay, Oregon Navigation Improvements project. If new information becomes available indicating that the winter-run chinook salmon may be adversely impacted by the project, or if the project is further modified, then further consultation will be required.

If you have any questions concerning these comments, please contact Mr. Craig Wingert at (310) 980-4021.

Sincerely,

Gary Matlock, Ph.D.
Acting Regional Director

January 4, 1994

Planning and Engineering Division

Mr. Russell D. Peterson
Field Supervisor
U.S. Fish and Wildlife Service
2600 SE. 98th, Suite 100
Portland, Oregon 97266

Dear Mr. Peterson:

Pursuant to the requirements of the Endangered Species Act of 1973, as amended, we are providing a biological assessment for marbled murrelets relative to the Coos Bay Channel Deepening Project. We have concluded that this project is not likely to adversely effect marbled murrelets.

Please contact Geoff Dorsey (326-6481) of my staff should you have any questions or require clarification regarding this project.

Sincerely,

Robert E. Willis
Chief, Resource Protection and
Fish and Wildlife Section

cf: Steve Stevens CENPP-PE-RPE
Laura Hicks CENPP-PM
Eric Braun CENPP-OP-NW
John Kranda CENPP-PE-PF

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BIOLOGICAL ASSESSMENT

FOR

MARBLED MURRELETS

COOS BAY, OREGON NAVIGATION IMPROVEMENT PROJECT

PROJECT DESCRIPTION

The proposed Coos Bay, Oregon Navigation Improvement (channel deepening) Project is located at Coos Bay, Coos County, in southwestern Oregon. The existing project at Coos Bay consists of a north and south jetty, a 45-foot deep by 700-foot wide entrance channel beginning at the entrance bar which transitions to a 35-foot deep by 300-foot wide lower channel from River Mile (RM) 1 to RM 9, and then a 35-foot deep by 400-foot wide upper channel to RM 15 plus one anchorage and two turning basins (Figure 1). The anchorage is located at RM 6. The turning basins are located at RM 12 and RM 14.7.

The proposed action is to deepen the channel two feet from the entrance to RM 15 and widen the turning basin at RM 12 by 100 feet. The alignment for the deepening will be the same as the currently authorized project. Work will be conducted during in-water work periods coordinated with the USFWS and ODFW. Rock removal from RM 0-5 will occur from 1 May - 31 January. Common excavation of material from RM 0-12 would occur from 1 May - 31 August; removal of common material from RM 12-15 would occur from 1 July - 31 January. Rock removal will be by mechanical means; further coordination will occur if conventional blasting is used for rock removal. Construction efforts will be initiated in May 1995.

Disposal of material will occur at approved ocean disposal sites (Figure 2). Current ocean disposal Sites E, F and H were designated by EPA in 1986 and have been used for disposal of sand material dredged from the channel for 10 years (includes interim use period). Dispersion of dredged material at Sites E and F has been less than predicted, hence added disposal capacity at Coos Bay is currently being sought. Investigations concerning expansion of ocean disposal Site F and designation of a rock disposal site were initiated in 1988 by the Corps and the Environmental Protection Agency. Designation of the expanded and rock disposal sites by EPA is anticipated to occur in 1994 under the authority of Section 102 of the Marine Protection, Research, and Sanctuaries Act. Monitoring, according to a plan developed and coordinated with EPA, is conducted at all dredged material disposal sites.

Rock disposal (90,000 cys) at the Section 103 rock disposal site will constitute a one-time use. Fine grain sediments (584,500 cys) from above RM 12 will be disposed of in Site H; no site expansion for H is required. Sandy sediments will comprise approximately 834,608 cys of the dredged material (new work and O&M) and will be placed at expanded Site F.

Coarser, sandy sediments, characterize channel sediments from RM 0-10. A transition to finer grain sediments occurs at RM 10 corresponding to a major bend in the estuary. Organic content of sediments ranges from 0.4 to 14.5 percent volatile solids with the higher percentage associated with the upstream most, finer grained sediments.

Contaminants exhibit an affinity for fine grain sediments containing organic material. Coarse, sandy sediments with low organic content generally do not contain contaminants. Thus, the most likely sediments to harbor contaminants are located above RM 10 where fine grain materials occur. Five gravity core samples collected in 1989 from the channel above RM 10 and analyzed by Battelle's Pacific NW Marine Sciences Laboratory indicated that contaminants were either undetected or else occurred at low levels typical of uncontaminated coastal and estuarine sediments. Concurrent tests (1989) by the International Port of Coos Bay for adjacent dock facilities indicated the existence of higher contamination levels for sediments from RM's 12-14. Subsequent biological testing demonstrated that material associated with dock facilities was suitable for ocean disposal. Sediment samples were also obtained in 1993 from the turning basin extension at RM 12 as the area slated for extension has not been dredged previously.

Four box core samples and two gravity core samples were collected on April 28, 1993 from the area to be dredged to widen the turning basin at Coos Bay River Mile 12.0. These sediment samples are considered to be representative of the material to be dredged. Physical analyses were conducted on all samples while bulk chemical analyses were conducted on material collected by the gravity cores. The two gravity core samples were sub-sampled along their entire length for the chemical and physical analyses.

Chemical analyses included metals, pesticides/PCBs, TOC, AVS, PAHs and butyltin. All chemical analyses are considered acceptable. No element or chemical exceeded USACE, Portland District's established "levels of concern", where established. No USACE, Portland District "levels of concern" have been established for butyltin. All levels except one (DDT) are also below EPA, Region 10's screening levels (SL) for disposal in 404 waters, including the butyltin. Sample CBCD-GC-2 contained 4,4'-

[redacted]

DDT at 10 ppb which exceeds EPA's total DDT SL of 6.9 ppb (Portland District's "level of concern" is 15-20 ppb total DDT). Sample CBCD-GC-1 contains <6.0 ppb 4,4'-DDT, the method detection limit for this sample.

The material to be dredged to widen the turning basin is considered to be suitable for ocean disposal without further testing. Because of the hydrophobic nature and low concentration of the contaminates present in the sediments, water quality standards should not be exceeded because of the dredging activities. In addition, dredging, disposal and subsequent dispersal of the dredged material at the ocean dredged material disposal site would reduce the concentrations still further. Fine grained material from the Federal navigation channel including the present turning basin at RM 12.0 has been deposited at ODMDS H since 1985. Based upon extensive evaluation of the sediment and the benthic community at Site H, from past disposal, no unacceptable adverse environmental impacts are anticipated by the proposed widening of the turning basin due to sediment contamination.

Marbled Murrelet

The marbled murrelet is a near-shore marine bird that is most frequently observed within 1.5 miles of shore (Marshall 1988). Marbled murrelets reportedly forage just beyond the breaker-line and along the sides of river mouths where greater upwelling and less turbulence occurs. Sealy (1975a in Marshall 1988) reported that murrelets foraged within 500 meters of shore. Murrelets forage within the water column; prey items include invertebrates and small fish such as anchovy, herring and Pacific sand lance (Marshall 1988).

Currently, the largest concentrations of marbled murrelets in Oregon are thought to occur off the central coast (Marshall 1988) between Depoe Bay and Coos Bay. Lincoln and Lane Counties, which comprise a large block of the central Oregon coast, were historic centers of abundance for marbled murrelets in Oregon (Fed. Reg. 1991). Initial results from Strong (1992) indicate that abundance of murrelets is relatively higher on the central Oregon coast than the northern Oregon coast. Strong (1992) also reported that murrelet occurrence was patchy and that use of specific concentration locations was not consistent. Briggs et al (1992) reported sightings of marbled murrelets off the central-northern Oregon coast (Cape Arago to Tillamook Head) during June 1989. These sightings occurred in waters less than 10-m in depth and with temperatures of 12.5-13.6° C and were comparable in depth and temperatures to areas where murrelets were observed off the Washington coast. They observed 71 murrelets at 25 locations from the California-Oregon border to Cascade Head, Oregon during their September 1990 survey; again the murrelets were in shallow waters with an average temperature of 11° C. It should be noted that surveys by Briggs et al (1992) were not designed for murrelets and that the nearshore ocean zone frequented by this species was covered rapidly during their surveys. Nevertheless, their information does provide some information on murrelet occurrence.

Marbled murrelets nest in old growth/mature coniferous forests (Fed. Reg. 1991). The low incidence of marbled murrelets at coastal locations is probably related to the loss of old growth coniferous forest from harvest and/or fire on near-coastal lands (Fed. Reg. 1991). Marbled murrelet populations now typically occur offshore of forested locations which provide suitable nesting habitat. Detection of marbled murrelets was greater in old growth stands (California) greater than 500 acres in size than for stands of 100 acres; few detections were recorded for stands less than 60 acres in size (Paton and Ralph 1988 and Ralph et al. 1990 in Fed. Reg. 1991). Thus, size of remnant stands may also influence presence of marbled murrelets on adjacent coastal waters.

Discussion:

The primary concern with regard to coastal dredging projects is the potential impact to murrelet prey resources. Sand lance, a prey species of marbled murrelets occur in Coos Bay. The Pacific sand lance is common to abundant in the marine portions of Oregon estuaries from the Columbia River to Coos Bay (Emmett et al. 1991). The species is considered abundant in Tillamook Bay by Emmett et al. (1991). Sand lance are neritic (nearshore) species generally occurring in waters <100 m in depth (Trumble 1973 in Emmett et al. 1991). Clean, unconsolidated sand is required by adults and juveniles for escape and resting habitat; this species burrows into the substrate (Emmett et al. 1991). Escape and resting habitat must also contain sufficient oxygen, thus these areas typically occur in areas with high bottom current velocities (Emmett et al. 1991). Areas with high bottom current velocities, high substrate oxygen levels and clean, unconsolidated sand typically occur in the mouths of estuaries (Emmett et al. 1991).

This species, which uses a resting and predator avoidance strategy of burrowing in unconsolidated sandy substrates, is quite susceptible to entrainment by hopper dredges during dredging operations. The entrainment rate reported by Moehl and Barton (1989) for Coos Bay was 930 sand lance/1000 cy of dredged material.

We have analyzed potential entrainment numbers for sand lance associated with new work and O&M dredging that will occur with project construction. We have also estimated habitat availability for sand lance in the Coos Bay estuary below RM 9.0

in comparison to habitat acreage potentially impacted by project dredging. This analysis is based upon yardage removed, an estimate of acres of bottom substrate impacted and potential habitat acreage available to this species in Coos Bay below river mile 9.0. Moehl and Barton (1989) did not record sand lance upstream of RM 9.0.

We estimated acreage of channel area for the four reaches below RM 9.0 where dredging associated with the channel deepening project would occur (Table 1). Reaches 1, 2 and 4 below RM 9.0 would be dredged; dredging actions included both new work and O&M materials. The first reach extends from RM 0-50+00 to 0+00+30 and encompasses 81 acres (700 feet x 5,030 feet). Total dredging volume associated with project construction in reach one is 155,602 cys; O&M = 60,988 cys and new work = 94,614 cys. Reach two encompasses 50 acres and extends from RM 0+00+30 to 0+40+00. Total project-related dredging volume for reach two is 201,917 cys. No dredging was required in reach three (RM 0+40+00 to 1+00+00 which encompasses 10 acres. Reach four extends from RM 1+00+00 to 9+00+00 and encompasses 320 acres. An estimated 477,089 cy of material will be removed from this reach. There are 461 acres within the channel configuration in these four reaches.

Only common material (i.e. sand) yardage is used in estimating acres impacted by the project; rock removal was not considered as it did not represent suitable substrate for sand lance and the method of removal (backhoe) was not considered a problem.

We have based our estimate of sand lance habitat impacted by dredging associated with the Project on:
1) a review of the typical shoaling areas for these reaches in The Oregon Coast Maintenance Program (USACE 1991);
2) the footprint (acres) of the navigation channel by reach;
and 3) the amount of dredged material (new work and O&M) forecast for each reach below RM 9.0.

We selected a range of acreage impacted for each reach we considered most representative of project impacts (Table 1). Shoaling patterns are not uniform across the channel, instead they are scattered along the channel configuration. Channel deepening will not require a uniform depth reduction along the length of the navigation channel. Deepening actions should occur primarily where the present shoals are located with some expansion to account for the increased depth.

Table 1. Acreage by reach and estimated acres of impacted by Coos Bay Channel Deepening Project.

Reach (acres)	Minimum Acres	Percent of Channel	Maximum Acres	Percent of Channel
1 (81)	24	30	32	40
2 (50)	31	63	42	84
3 (10)	0	0	0	0
4 (320)	74	23	99	31
Total (461)	129	28	173	38

We estimate that dredging actions will impact 129-173 acres of habitat potentially suitable for sand lance within the Navigation Channel (Table 1). There are approximately 461 acres within the Navigation Channel below RM 9.0. Thus, dredging actions associated with channel deepening, including removal of typical O&M material, will impact 28-38 percent of the channel area.

The total yardage (sand) to be removed from the entrance to RM 9.0 is 834,608 cy. The average hopper dredge entrainment rate for Coos Bay reported by Moehl and Barton (1989) of 930 sand lance/1000 cy of dredged material would yield an estimated entrainment level of 776,185 sand lance for the Coos Bay Channel Deepening Project. This number has to be put into some perspective in order to assess potential impacts to marbled murrelets.

To attain some perspective on potential impacts, we have compared the estimated acreage impacted (of potentially suitable habitat for sand lance) within the channnel with the acreage estimate for the lower Coos Bay estuary (i.e. entrance channel to RM 9.0 excluding Charleston Channel, South Slough, islands and intertidal habitat) as represented on the 1970 USGS quads for the area. Total estuarine acreage in the lower estuary was 2,918 acres. The impacted acreage within the channel represents 4-6 percent of this estuarine acreage. If only 50 percent of this estuarine acreage was suitable for sand lance, only 9-12 percent of the habitat base would potentially be impacted. Habitat for sand lance also occurs in the nearshore ocean waters off Coos Bay. The extent of habitat availability and population levels for sand lance in the nearshore environment are unknown.

Thus, we can identify a potential for a minor reduction in the sand lance population based upon entrainment levels and habitat impacts. It seems unlikely that a potential reduction of this magnitude will have an impact on marbled murrelets.

The literature review indicates the species occurs in the nearshore environment more so than in bays. None of the information reviewed to date indicates that concentrations of murrelets occur within Coos Bay proper. Varoujean and Williams (1987) reported marbled murrelets to the immediate north and south of Coos Bay entrance in surveys conducted from April-June 1986 and May-June 1987. The peak number of marbled murrelets recorded by Varoujean and Williams within three km of Coos Bay entrance was 15 in 1986 and 19 in 1987.

Their surveys from Coos Bay entrance to points greater than three km from the entrance recorded highs of 37 (1986) and 60 (1987) marbled murrelets. Their launch location for survey and capture efforts off Coos Bay was Charleston; they did not mention in their report any observations within Coos Bay. One murrelet was captured by Varoujean and Williams (1987) 1.0 km west of the Coos Head lighthouse; this would place the bird in the entrance.

They observed large numbers of murrelets offshore near tidal plumes. They stated that these observations may be biased because their sampling intensity was highest near mouths of estuaries. Varoujean and Williams also observed murrelets near boundaries of rip currents offshore of sandy beaches.

Neither Jim Collins or Dan Van Dyke, Oregon Department of Fish and Wildlife (pers. comm. 1993), were aware of marbled murrelets concentrating within the project area. Christmas Bird Count information provided by Dan Van Dyke, ODFW for the period 1972 and 1974-1992 indicated that marbled murrelets had been observed during seven years of that period; the maximum number being observed was 16 murrelets in 1991. The count area includes Coos Bay, Coos Bay North Spit and south of the entrance to Cape Arago. These observations are indications that Coos Bay proper is not a major foraging area for the species.

The 1991 Federal Register, Volume 56, No. 119, page 28363, stated that: "Concentrations of murrelets offshore were almost always adjacent to old-growth forests on-shore." We interpret the information from the Federal Register to mean that marbled murrelets are currently limited by nesting habitat, not by foraging resources. Our analysis of the listing proposal indicates that it is the U.S. Fish and Wildlife Service's opinion that forested habitat for nesting is limiting (reference Summary of Factors Affecting the Species). Forage resources are not documented as limiting in the Federal Register - Summary of Factors Affecting the Species.

Disposal operations would cause some temporary water column turbidity. However due to the intermittent and confined nature of the operation, and lack of contaminants associated with disposal materials, we do not anticipate these activities will affect foraging by marbled murrelets or their prey resources.

Although DDT has been identified in a portion of the sediments to be disposed of in the ocean, the low concentration of this contaminant in the sediments, the dilution that this material would incur from dredging, disposal, and subsequent dispersal in the ocean and the hydrophobic nature of DDT, combine to minimize the potential for impacts.

Further, the majority of the disposal site acreage is located more than one mile offshore and would appear to be beyond the normal foraging areas for marbled murrelets. Thus, the potential to disrupt foraging activities of marbled murrelets would appear very limited in scope.

Conclusion:

Channel deepening actions will impact sand lance, via physical disruption of 4-12 percent of the available habitat in the lower estuary and entrainment of an estimated 776,185 individuals. Thus, the action may constitute a minor impact to a potential prey population for marbled murrelets. No known foraging concentrations of this species occurs within Coos Bay; typically this species forages in nearshore ocean waters.

The proposed dredge material disposal operation will not modify known marbled murrelet habitat, nor is it expected to result in any substantial disturbance to this species. Materials which are to be disposed of are not contaminated to a level that is unacceptable for ocean disposal. Therefore, we anticipate no impacts from contaminants due to the disposal operation.

We conclude that the proposed Coos Bay, Oregon Navigation Improvements (channel deepening) Project is not likely to adversely effect marbled murrelets.

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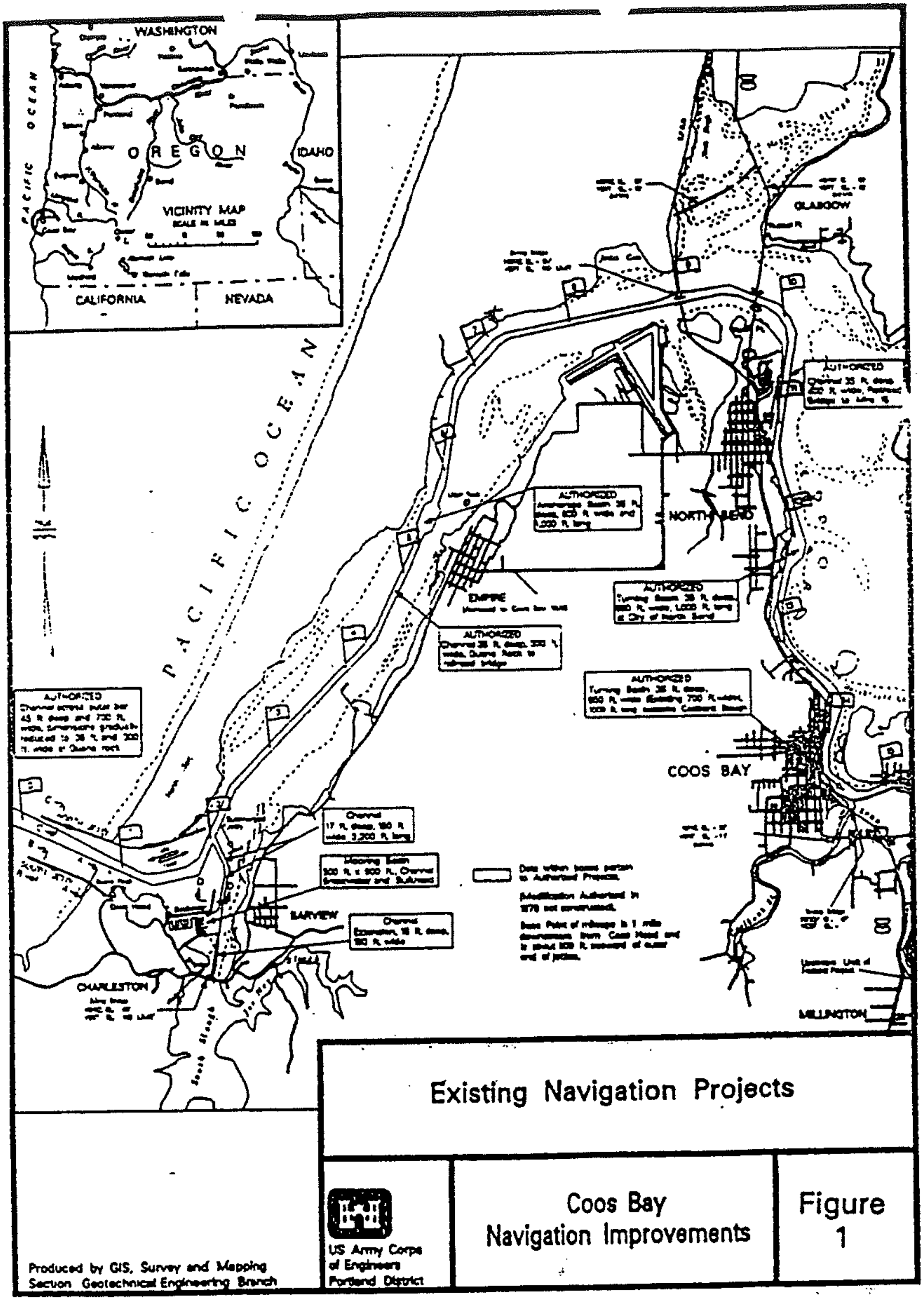

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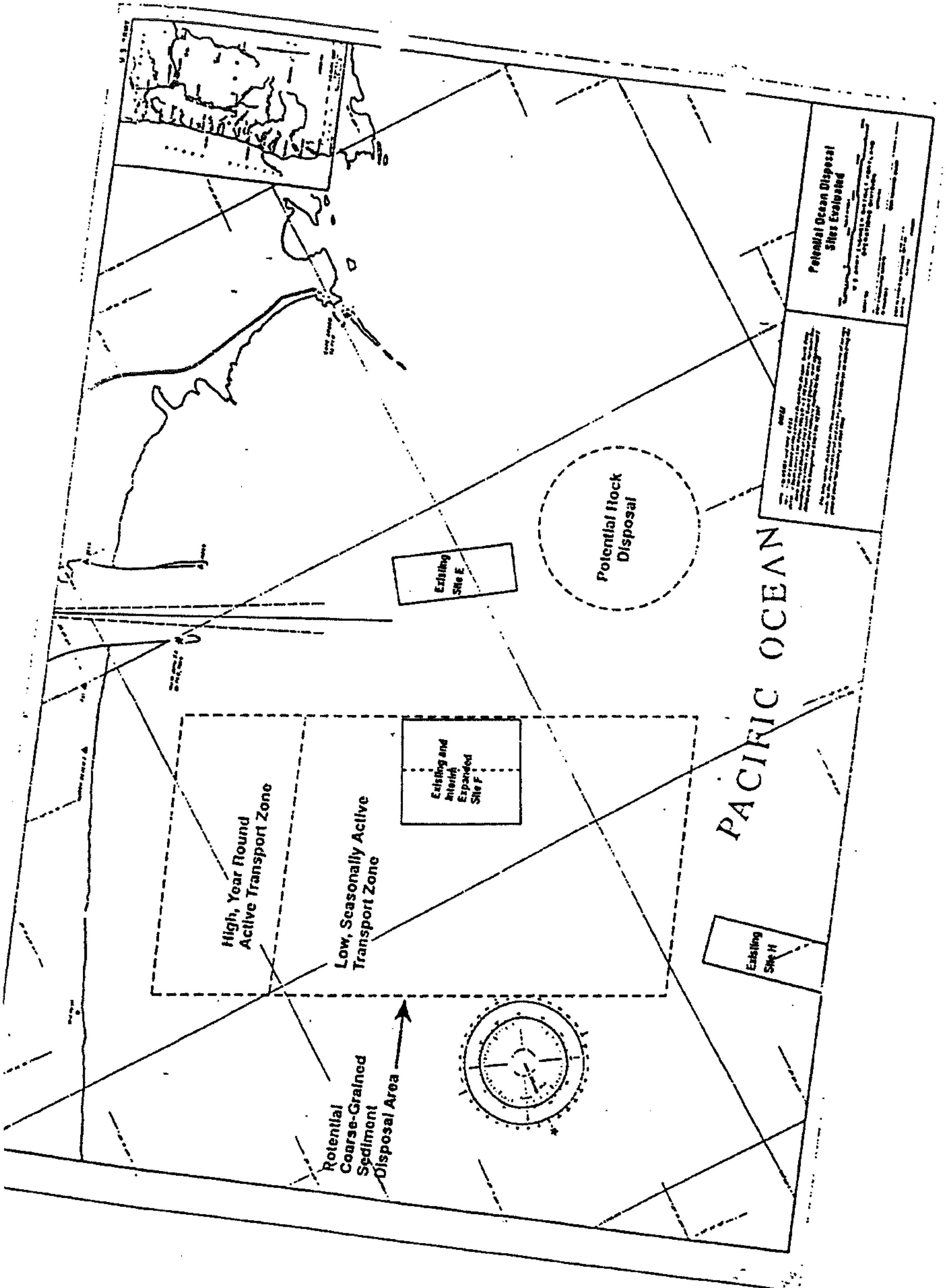

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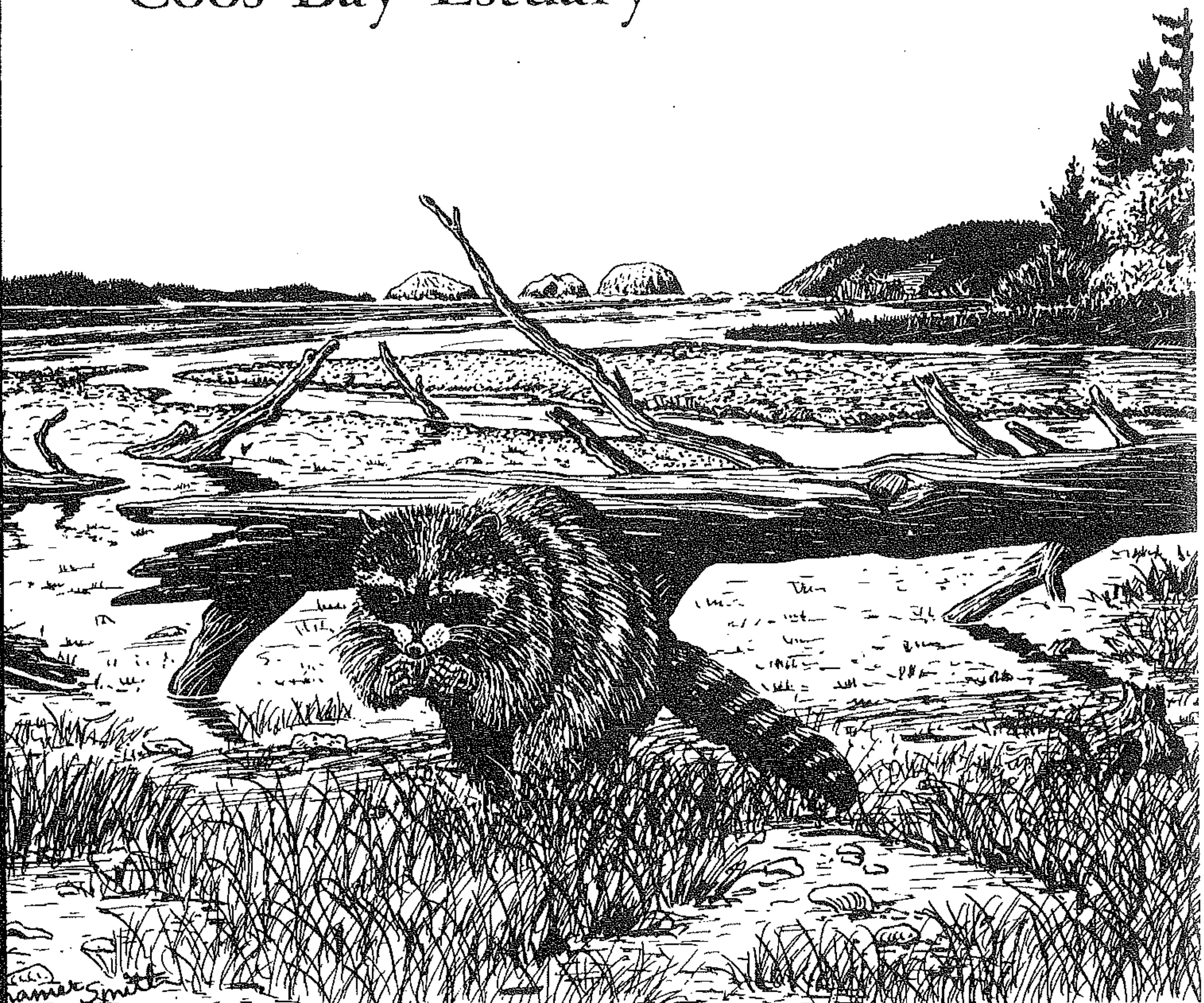
Natural Resources of Coos Bay Estuary



ESTUARY INVENTORY REPORT

Vol. 2, No. 6

Prepared by

RESEARCH AND DEVELOPMENT SECTION
Oregon Department of Fish and Wildlife

for

Oregon Land Conservation and Development Commission

OREGON Fish & Wildlife

1979

FINAL REPORT

ESTUARY INVENTORY PROJECT
OREGON

PROJECT TITLE:	Technical assistance to local planning staffs in fulfilling the requirements of the LCDC estuarine resources goal.
JOB TITLE:	Natural resources of Coos Bay estuary
PROJECT PERIOD:	February 1978 - June 1979

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The preparation of this document was financed in part by funds from the Oregon Land Conservation and Development Department and the Office of Coastal Zone Management, National Oceanic and Atmospheric Administration, U.S. Department of Commerce, and by the Oregon Department of Fish and Wildlife.

CONTENTS

LIST OF TABLES

LIST OF FIGURES

PREFACE

This report is one of a series prepared by the Oregon Department of Fish and Wildlife (ODFW) which summarizes the physical and biological data for selected Oregon estuaries. The reports are intended to assist coastal planners and resource managers in Oregon fulfilling the inventory and comprehensive plan requirements of the Land Conservation and Development Commission's Estuarine Resources Goal (LCDC 1977).

A focal point of these reports is a habitat classification system for Oregon estuaries. The organization and terminology of this system are explained in volume 1 of the report series entitled "Habitat Classification and Inventory Methods for the Management of Oregon Estuaries."

Each estuary report includes some general management and research recommendations. In many cases ODFW has emphasized particular estuarine habitats or features that should be protected in local comprehensive plans. Such protection could be achieved by appropriate management unit designations or by specific restrictions placed on activities within a given management unit. In some instances ODFW has identified those tideflats or vegetated habitats in the estuary that should be considered "major tracts", which must be included in a natural management unit as required by the Estuarine Resources Goal (LCDC 1977). However, the reports have not suggested specific boundaries for the management units in the estuary. Instead, they provide planners and resource managers with available physical and biological information which can be combined with social and economic data to make specific planning and management decisions.

INTRODUCTION

Coos Bay, the estuary of the Coos River, is the site of a unique set of dynamic interactions involving its tributaries, the basin through which they flow, and the ocean (Fig. 1). In historic times man has altered conditions of the estuary more rapidly than expected in nature. Future actions will continue to modify the bay, and only carefully made decisions will insure that Coos Bay continues its history as a biologically productive multiple-use estuary.

Coos Bay has been classified as a deep-draft development estuary by LCDC (1977). Under Statewide Planning Goal 16 (LCDC 1977) the local comprehensive plan will designate estuarine areas as distinct water use management units. In a deep-draft development estuary such management units must include natural, conservation, and development units.

This report is a summary of available information for Coos Bay. It addresses the bay as a system, identifying processes occurring throughout the bay, and as a set of subsystems, smaller geographic areas which are functionally or physiographically distinct. Recommendations are made concerning certain areas or processes. The report is intended to provide information useful to planners, biologists, and citizens during the designation of management units and use policies.

THE COOS BAY ESTUARINE SYSTEM

Physical Characteristics

Dimensions

Several authors have used different methods in estimating the surface area of Coos Bay (Table 1).

Table 1. Reported surface areas of Coos Bay (Percy et al. 1974).

Reference	Surface area (acres)	Measured at	Tidelands Acres	Tidelands Percentage	Submerged Acres	Submerged Percentage
Johnson 1972	10,973	HW				
"	8,242	MSL				
"	5,810	LW				
Marriage 1958	9,543	area affected by by tidal action	4,569	48		
Oregon Division of State Lands (DSL) 1973	12,380	MHW	6,200	50	6,180	50

DSL (1973) estimates that 6,200 acres (50% of the surface area) is submersible land (between high water and mean low water) and 6,180 acres (50%) is submerged land (below MLW). Using these figures, Coos Bay, although larger, compares closely to Tillamook Bay in ratio of submersible to submerged land (Table 2).

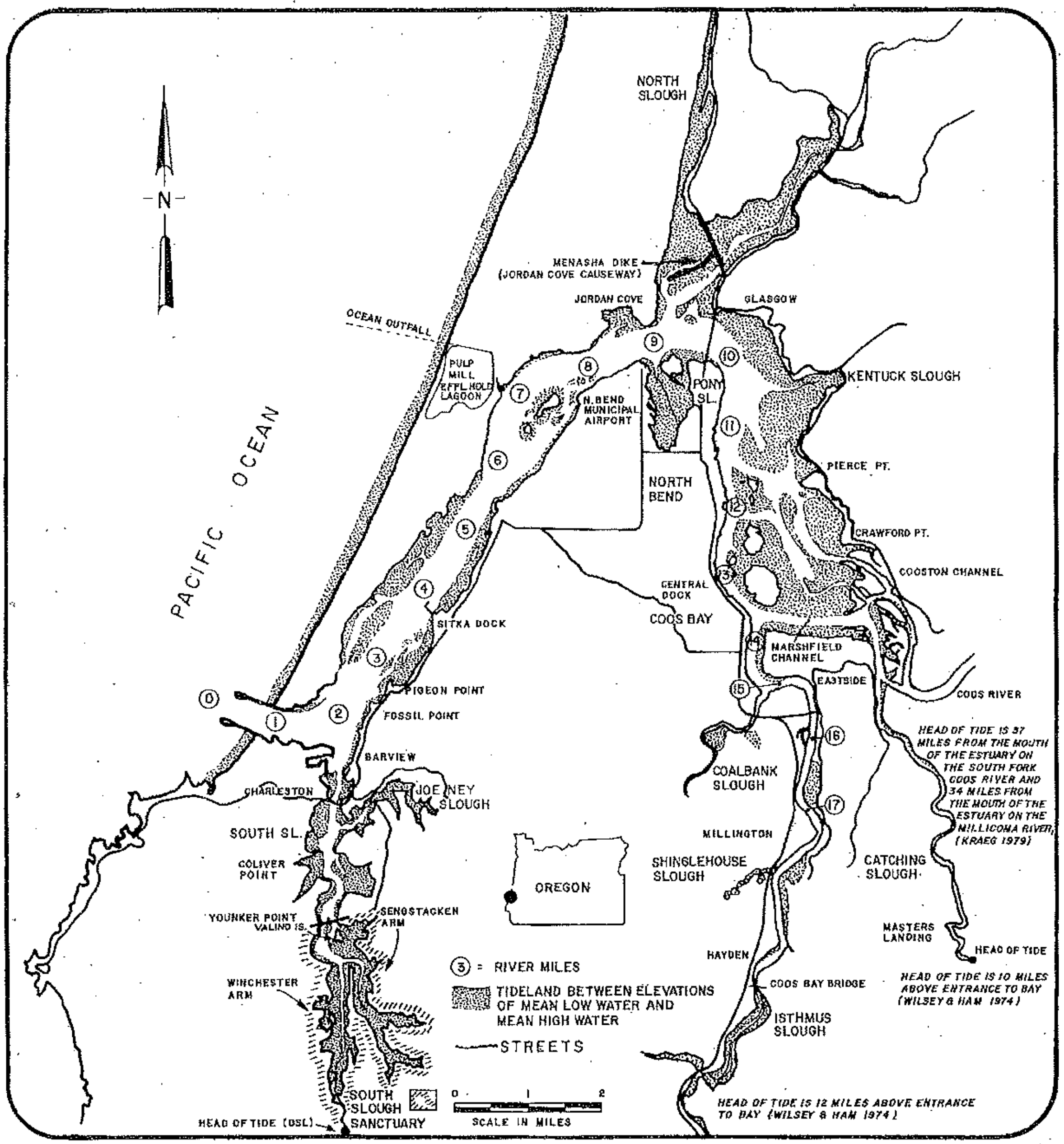

Fig. 1. Coos Bay estuary (base map from DSL 1973).

Table 2. Ratios of tideland (MHW to MLW) to submerged land (below MLW) (estimated from DSL 1973).

Sand Lake	3.0	Nehalem	0.87
Siletz	1.9	Alsea	0.84
Netarts	1.9	Coquille	0.64
Salmon River	1.6	Yaquina	0.53
Nestucca	1.4	Siuslaw	0.57
Necanicum	1.2	Columbia	0.35
Tillamook	1.0	Rogue	0.31
Coos Bay	1.0	Umpqua	0.25
		Chetco	0.13

Even the most extensive estimate of surface area (12,380 acres) covers only the area to mean high water. Much tidal marsh extends above this level and is therefore excluded in all available estimates. By including only the high marshes, at least 1,000 acres could be safely added to that estimate (Hoffnagle and Olson 1974).

Tributaries

About 30 tributaries enter Coos Bay from its 605 mi^2 drainage basin (Fig. 2) (Percy et al. 1974). The major tributary is the Coos River which is formed by the confluence of the Millicoma River and the South Fork Coos River. Head of tide extends up the South Fork Coos River approximately 32 miles from the mouth of the estuary and 34 miles from the mouth of the estuary up the Millicoma River (Kreag 1979). Other streams which contribute a much smaller amount of fresh water to the estuary enter through Catching, Isthmus, Pony, South, North, and Kentuck sloughs and Haynes Inlet. Gradients of the principal tributaries are slight for several miles allowing tidal effects to extend a considerable distance [Oregon State Water Resources Board (OSWRB) 1963]. Head of tide has been recorded for some of these slough systems, and in others the extent of salt water intrusion is limited by a tidegate, which acts as the effective head of tide under most conditions of flow. Information available on drainage areas of tributaries and location of heads of tide is summarized in Table 3.

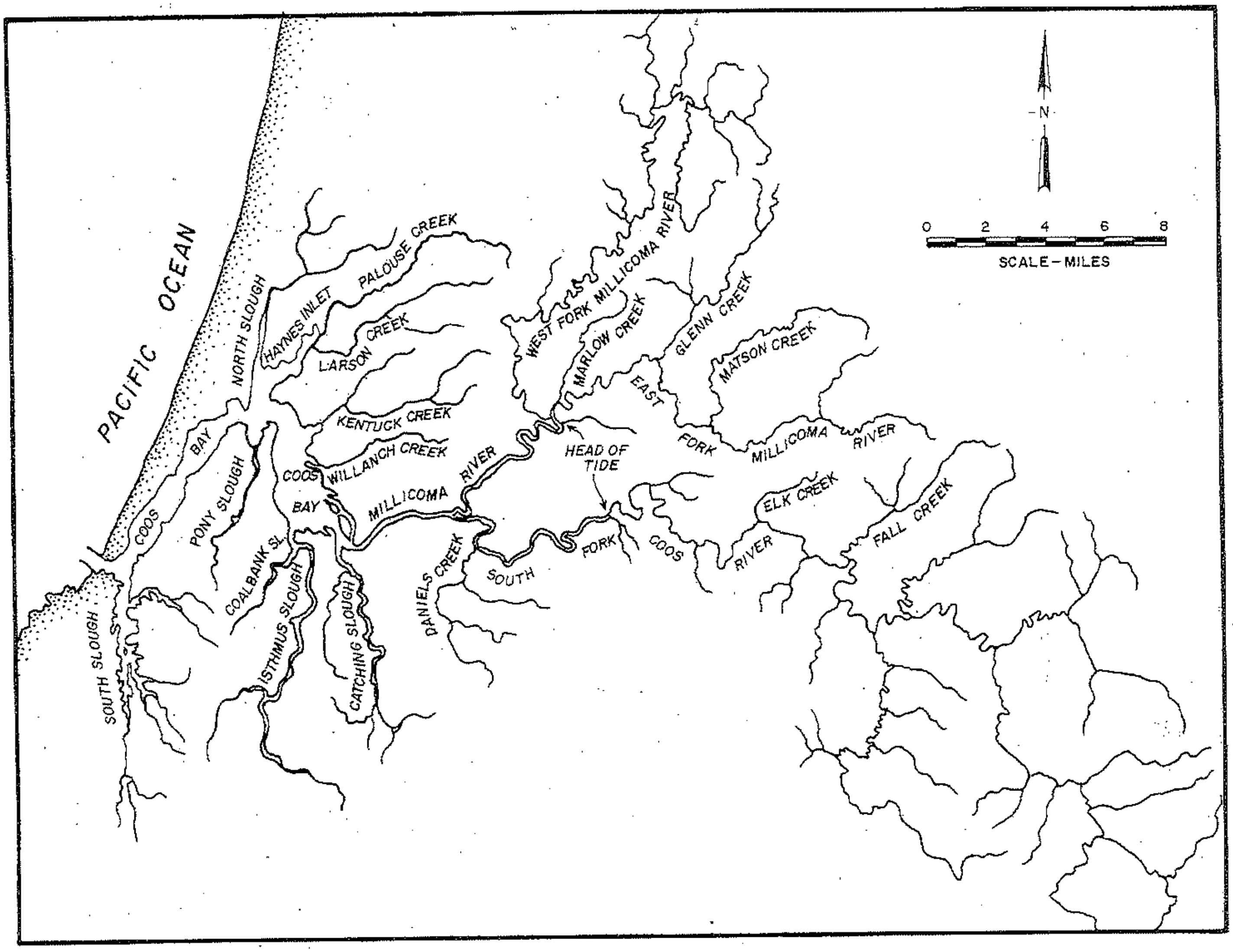

Fig. 2. Coos Bay drainage basin (USDI 1971).

Table 3. Drainage area and head of tide for Coos Bay tributaries.

Tributary	Drainage area (mi^2)	Head of tide (miles from entrance of tributary to main bay)
Coos River	415[a]	
Catching Sl.		10 mi[c]
Coalbank Sl.	6.2[a]	
Haynes Inlet	11[a]	
Isthmus SL		12 mi[c]
Kentuck	17[a]	
North	12.8[a]	
Willarch	7.8[a]	
South Sl.	26[b]	

[a] *OSWRB 1963*
[b] *Stevens, Thompson and Runyon, Inc. (STR) 1974*
[c] *Wilsey & Ham 1974*

Physiography

The physiography of Coos Bay is complex. From its mouth the narrow lower portion of the bay runs southwest to northeast to about river mile (RM) 9, measured from the mouth of the estuary. The main channel then swings to the south and the bay widens into an area of broad tidal flats. Sloughs branch off near the estuary mouth and at several locations in the upper bay. The Coos River enters the upper bay in its southeast corner about 17 mi from the mouth of the estuary. Johnson (1972) states the width at the mouth is 2,060 feet, and the average width of the bay at low tide is 1,200 feet.

Currently the U. S. Army Corps of Engineers (USACE) maintains a dredged ship channel from the entrance to RM 15 (Isthmus Slough). The channel is 45 ft deep and 700 ft wide at the entrance bar and decreases to 35 ft deep and 300 ft wide at RM 1. These dimensions continue to RM 9. From there the channel is 35 ft deep, 400 ft wide to RM 15. Two wide turning basins and an anchorage basin are located at North Bend, near the mouth of Coalbank Slough, and at RM 5.5 respectively. Shallower channels are also dredged by the USACE in the Coos River, the South Fork Coos River, the Millicoma River, and in South Slough connecting Charleston boat basin to the Coos Bay channel. Private concerns maintain a channel in Isthmus Slough to RM 17 (USACE 1976).

The physiography of the Coos estuary has been significantly altered by man. Prior to alterations, the channel across the bar at the entrance to Coos Bay was 10 ft deep and 200 ft wide (USACE 1975). The channel wound to the north with a depth of about 11 ft and width of 200 ft to the town of North Bend, then gradually decreased in width to 50 ft and in depth to 6 ft at Marshfield. Shoals were numerous.

Extensive filling and diking in the main bays, sloughs, and tributaries have changed the form and consequently the function of the estuary. Channel shifts and areas of accelerated erosion and deposition have been noted

(Dicken et al. 1961; Aagard et al. 1971). Other major alterations include the North and South jetties, the Charleston breakwater, and the Charleston small boat basin.

Bottom topography

Coos Bay shares several features with other drowned river valley estuaries. It has a "V"-shaped cross section, a relatively shallow and gently-sloping bottom, and a fairly uniform increase in depth toward the mouth (Baker 1978 [citing Schubel 1971]). NOS charts provide soundings in the navigable portions of the estuary (NOS 1978). Soundings of the bay following completion of the USACE Deep-Draft Navigation Project are available from the Portland District Engineer.

Bottom topography of South Slough can be determined from soundings made in 1977 (USACE 1977). Topography of most other shallow portions of the bay is less well known. Contours showing tidal levels such as MLLW and ELW are generally unavailable.

Water discharge

Fresh water inflow into the Coos estuary is measured only on the West Fork of the Millicoma River. Estimates of total fresh water flow at the mouth are made from extrapolations of these data. Estimated average annual discharge at the mouth of Coos Bay is 2.2 million acre-feet of fresh water (Percy et al. 1974). Using this figure as an average, a yearly maximum of 3,044,000 ac-ft and minimum of 1,560,000 ac-ft may be estimated from data presented in Percy et al. (1974) for the mouth.

Records from 1933-63 show that January is the wettest month at North Bend, averaging 9.9 in of precipitation, and July is the driest with an average 0.38 in (USACE 1975). According to USACE (1975) freshwater inflow may vary from 100,000 cubic feet per second (cfs) in winter to 100 cfs in summer. Arneson (1976) measured an even lower inflow of 35.3 cfs during September of 1973.

Runoff follows the pattern of precipitation. Soils provide a minimum of water retention, and snowfall is light so that a significant snow pack does not form (OSWRB 1963). Figure 3 suggests a one month lag in discharge response to precipitation.

Range of tide

The USACE (1978) states that mean tidal range is 6.7 ft above mean lower low water (MLLW) at the entrance to Coos Bay and 6.9 ft above MLLW at the city of Coos Bay. Predicted extreme range is 10.5 ft above MLLW. Extreme low water (ELW) is predicted to be -3.0 ft below MLLW.

Tidal range predictions are made by the National Oceanic and Atmospheric Administration (NOAA) and are based on data taken over 40 years ago (Arneson 1976). Arneson found that measured ranges at the entrance were slightly greater than predicted ranges for all seasons, although the error was usually

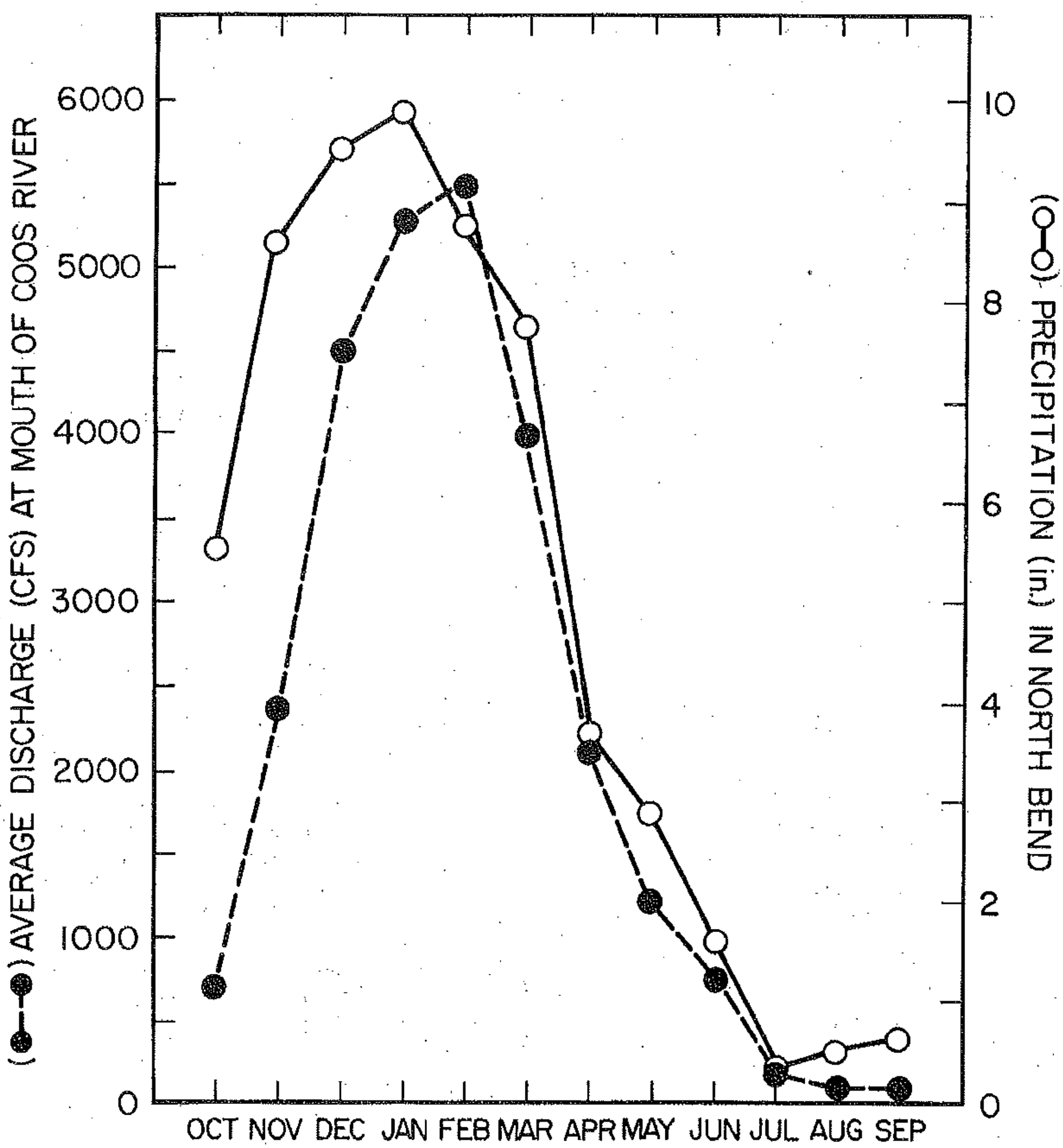

Fig. 3. Precipitation in North Bend (USACE 1975) and average monthly discharge of Coos River at the mouth (OSWRB 1963).

less than 15% . At the city of Coos Bay, Arneson (1976) consistently measured higher tidal ranges than those predicted by NOAA. He states that unusually high ranges may be attributed to river flow.

Arneson (1976) hypothesizes that tidal ranges greater than predicted mainly resulted from fill placed in the bay. Large fills have been placed on the tidelands of the upper bay, near the airport, and at Eastside since the predictions were made. Although the channel was deepened concurrently, the resulting cross-section may be more hydraulically efficient so that dampening of the tidal wave is less (Arneson 1976). The effect of further channel deepening has not been assessed.

Tidal prism

Johnson (1972) based his calculation of the tidal prism of Coos Bay (1.86×10^9 ft^3) on a mean tide range of 5.2 ft multiplied by a mean surface area between high and low water of 10,973 acres. The accuracy of these figures may be questionable. Compared to values for other Oregon estuaries shown in Table 4, Coos Bay is most similar to Tillamook Bay in volume of saltwater exchange.

Table 4. Coos Bay tidal prism compared with selected Oregon estuaries.[a]

Estuary	Tidal prism (ft^3)	Ratio of other estuaries to Coos Bay
Coos Bay	1.86×10^9*	1.0
Tillamook	2.49×10^9	1.3
Umpqua	1.18×10^9*	0.6
Yaquina	8.35×10^9*	0.45
Alsea	5×10^8*	0.3
Nehalem	4.28×10^8*	0.2
Siletz	3.5×10^8	0.2
Netarts	3.3×10^8	0.2
Siuslaw	2.76×10^8	0.2
Nestucca	1.8×10^8*	0.1
Coquille	1.32×10^8	0.07
Sand Lake	8.2×10^7	0.4

[a] *Values indicated by * are from Johnson (1972). All other estimates are calculated by Starr (1979) from DSL (1973).*

Time of tide

Both the high and low tides occur progressively later upbay from the mouth. Lag time at some locations seems to vary with seasonal changes in river flow (Arneson 1976). Arneson's study shows that lag times are variable and difficult to predict for different locations in the estuary.

Arneson (1976) compared his tidal measurements to predictions made by NOAA. For the mouth he discovered actual tides to be within 20 minutes of predications 80% of the time and to generally be earlier than predicted. At Coos Bay tides occurred considerably earlier than predicted. Only 25% of measured tides were within 20 minutes of NOAA predictions.

Arneson suggests the earlier tides at Coos Bay could be attributed to increases in mean channel depth that have occurred subsequent to the tidal predictions. Shallow wave theory predicts that the tidal wave should move faster at increased depth. Measurements have not been made since completion of channel deepening associated with the Deep-Draft Navigation Project. This further depth increase could allow the tidal wave to travel even faster.

Tidal circulation

The USACE (1975) states that the average tidal current at Coos Bay is 2.0 knots (3.4 ft per sec) and that flood currents of 3.5 knots (5.9 fps) have been reported. Arneson (1976) mentions that ebb currents as high as 5.0 knots (8.4 fps) have been measured, although maximum ebb measured during his study was 2.4 knots (4.0 fps).

Arneson (1976) studied the relationships of flow and velocity to maximum and minimum tidal heights to determine the character of the tidal wave. His data (Table 5) reveal that the wave is neither a true standing nor progressive wave. The tide resembles a cooscillating wave in which the tidal wave is reflected at the head of the estuary and the resulting tidal motion is the sum of the incident and reflected waves. However, studies of tidal ranges and lag times of high and low water as one progresses up the mouth show that the cooscillation theory does not strictly define Coos Bay. The complex geometry of the bay and the fact that one may consider tributaries both as sources and as inertial forces contributes to this complexity (Arneson 1976). The response of the tidal phenomena to further changes in estuarine geometry is difficult to predict.

Mixing

Burt and McAllister (1959) used a salinity gradient approach to describe mixing in Coos Bay. They classified the bay as well mixed for all months except November, when the estuary was partly mixed. They also specified a secondary classification of partly mixed for January, March, and June. Arneson (1976) applied the salinity gradient approach and the approach developed by Simmons (Dyer 1973), which uses a ratio of river flow to tidal prism, to data which he collected in 1973 and 1974. Results are shown in Fig. 4.

Both the flow ratio and salinity gradient methods classify the entire estuary as one mixing type. Arneson (1976) used salinity profiles to depict conditions along the main channel of the bay (Fig. 4). He finds a consistent change in mixing patterns occurring between RM 14 and 15 in Marshfield Channel, not far from the entrance of Coos River into the wide, shallow tidal flat area of the bay. It also appears that RM 8-9 is a zone of change. This may also be related to shape changes that occur there.

Table 5. Flow and velocity phase results (Arneson 1976).

Date	Tide	Phase lag following low or high water[a] Entrance (RM 1.06) Flow	Entrance (RM 1.06) Velocity	Coos River (RM 15) Flow	Coos River (RM 15) Velocity	Isthmus Slough (RM 14.22) Flow	Isthmus Slough (RM 14.22) Velocity	Range (m)
Sept. 12, 1973 (Summer)	Flood	78°	78°	148°	126°	156°	129°	1.79
	Ebb	87°	81°	100°	130°	--	--	-1.82
Dec. 18, 1973 (Fall)	Flood	--	--	--	--	--	--	1.33
	Ebb	81°	87°	--	--	90°	49°	-2.15
Mar. 22, 1974 (Winter)	Flood	--	--	113°	95°	128°	--	1.71
	Ebb	84°	78°	124°	156°	92°	112°	-1.89
June 11, 1974 (Spring)	Flood	114°	127°	168°	122°	--	--	1.71
	Ebb	88°	90°	168°	162°	88°	74°	-1.07

[a] *360° = 1 tidal cycle of 12.42 hours*

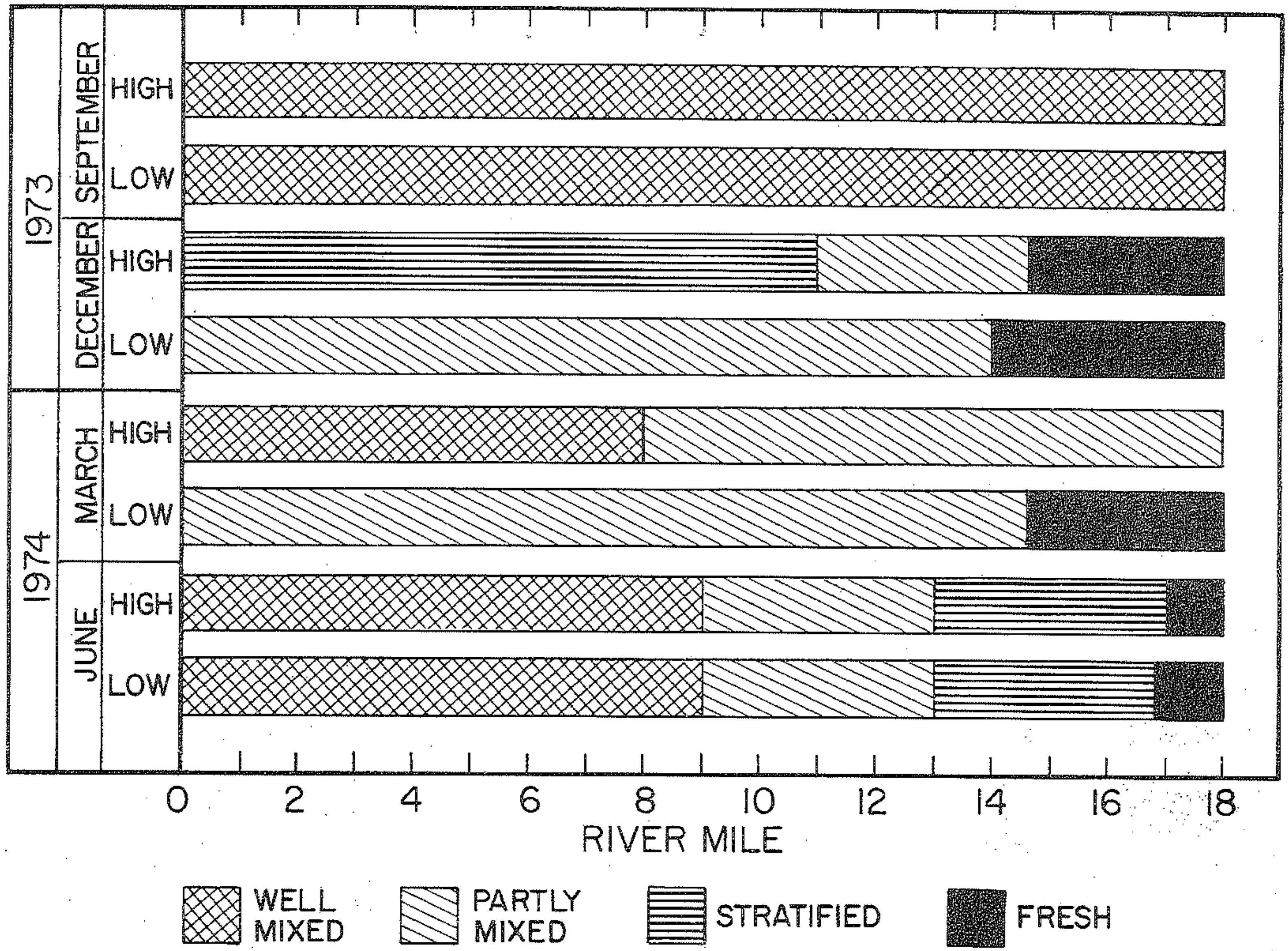

Fig. 4. Coos Bay mixing characteristics (Arneson 1976).

Flushing

Using the modified tidal prism method Arneson (1976) calculated flushing times for several points in the estuary (Table 6). His calculations for a point 27 miles from the mouth of the estuary ranged from 13.4 days at a time of high river flow and tidal range to 48.5 days at low flow and low tidal range. Although these estimates are based on only a few measurements, they demonstrate that flushing takes a number of days even under optimum flow.

Table 6. Calculated flushing rates using the modified tidal prism method (Arneson 1976).

Date	Tidal Range (ft)	Flow (cfs)	Flushing time (days)		
			RM 7.6	RM 17.3	RM 27.0
Sept. 13, 1973	7.9	28	9.7	22.9	40.3
Dec. 19, 1973	5.9	3,814	6.2	11.8	13.4
Mar. 23, 1974	7.2	1,074	8.2	14.4	15.9
June 12, 1974	3.3	431	19.0	41.3	48.5

Temperature

The temperature of Coos Bay undergoes both seasonal and diurnal fluctuations. Fresh water inflow and tidal currents are the main factors affecting temperature distribution in the estuary (Arneson 1976). Coastal upwelling causes offshore surface temperatures to be coldest during summer (Bourke et al. 1971). River temperatures are coldest in winter and warmest during summer and fall (Arneson 1976). DEQ (1978) data show that temperatures in the estuary have reached extremes of 35.6°F and 73.4°F. Seasonal temperature fluctuations are greater upbay than near the mouth of the estuary, reflecting that fluctuations in tributary temperatures are more extreme than those of the ocean.

Arneson (1976) plotted temperature vs RM for the data he collected in 1973 and 1974 (Figs. 5 and 6). His data show large longitudinal variations in September and June when entering fresh water was warmest. June data also show vertical gradients because a greater amount of fresh water was entering at that time. High tide profiles each show a significant increase at RM 8, which Arneson attributes to solar heating of the shallow water over the large tideflats of the upper bay.

In December and March the ocean and entering fresh water were nearly the same temperature so profiles were almost identical. DEQ (1978) data show that fresh water temperatures may be much colder than ocean temperatures. Different profiles would be expected under those conditions.

In summer, low streamflows and poor circulation cause high temperatures in some areas of the bay (STR 1974). High temperatures physiologically stress aquatic life. STR (1974) list high temperature as a water quality problem in Coos River, Millicoma River, North Slough, Catching Slough, and Isthmus Slough.

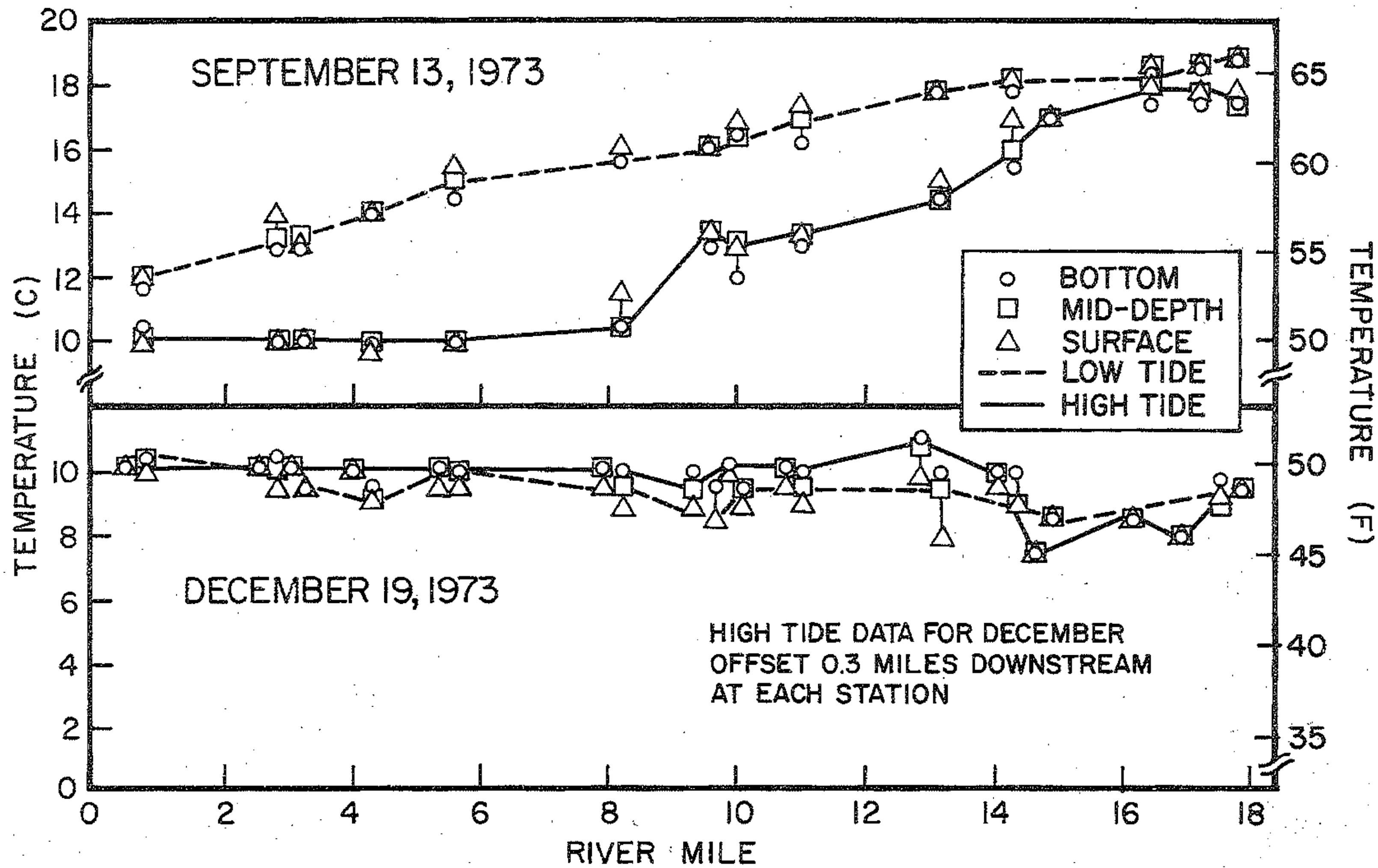

Fig. 5. Temperature vs. river mile, Coos Bay, September 13 and December 19, 1973 (Arneson 1976).

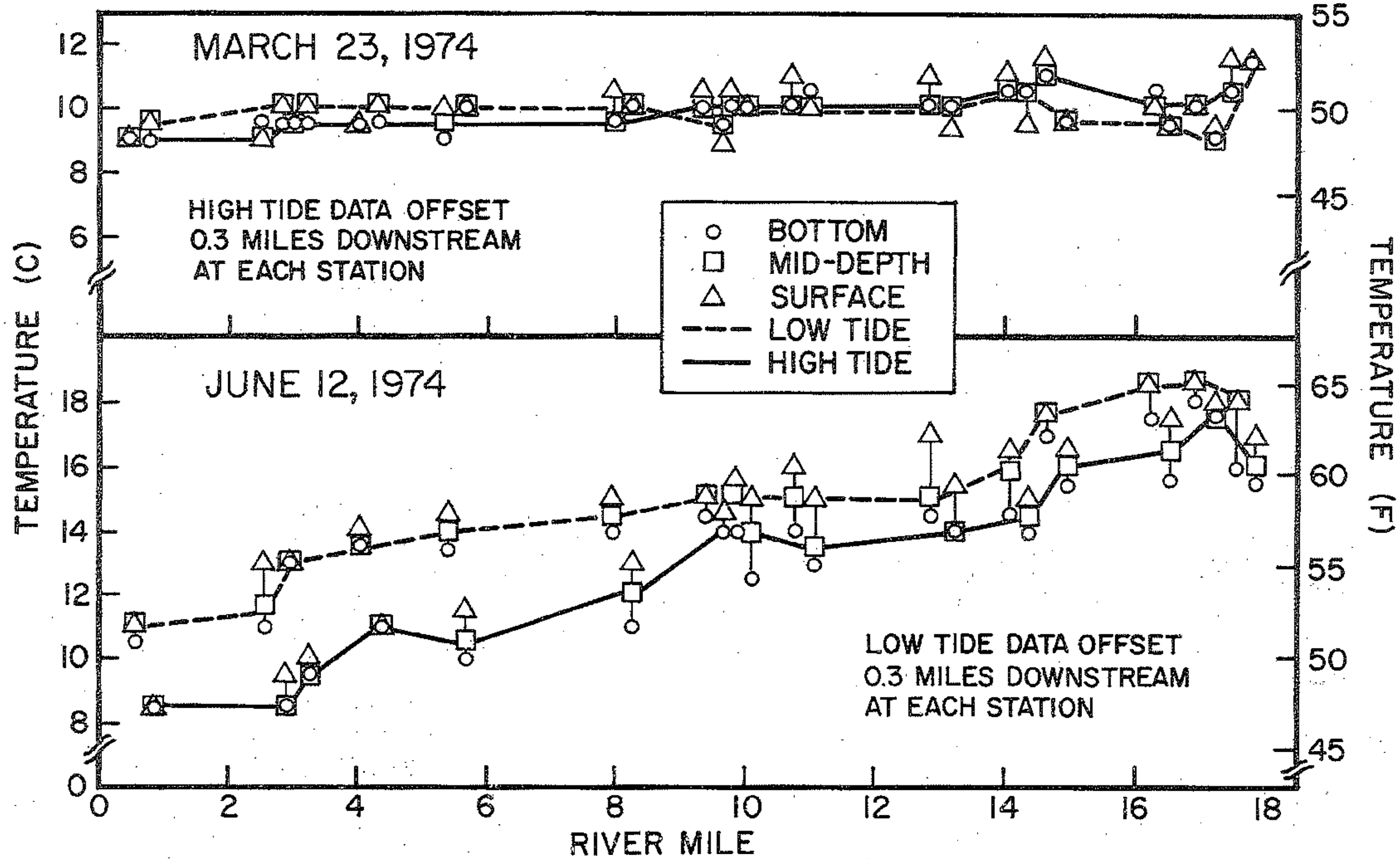

Fig. 6. Temperature vs. river mile, Coos Bay, March 23 and June 12, 1974 (Arneson 1976).

Dissolved oxygen

Dissolved oxygen (DO) is measured by DEQ as part of their regular water quality monitoring program. Others who have measured DO in conjunction with specific projects include Arneson (1976), STR (1974), and Slotta et al. (1973).

DEQ data show DO levels below the 6 mg/l standard occasionally at various locations in the bay (DEQ 1978). Measurements below standards were more frequent above RM 13 and in Isthmus Slough. STR (1974) data generally concur. Arneson (1976) sampled seasonally in 1973 and 1974. His limited data show that DO concentrations were slightly higher in December and March than in June and September. Lowest levels were recorded from Isthmus Slough. DO concentrations below the standard can kill resident fish and invertebrates and prevent migrants from utilizing the area.

Arneson (1976) mentions that DO depressions during fall have been attributed to low fresh water inflow and waste loading caused by offshore upwelling of low DO water and input of organic material, such as seafood industry waste water and bark from stored logs.

Arneson (1976) also noted supersaturation in the Coos River and in Catching Slough during June which he attributes to photosynthetic activity. Arneson attributed supersaturation observed near the mouth in December to reaeration aided by wave action.

Turbidity

Arneson (1976) found, with only a few exceptions, that low tide turbidity levels were higher than high tide levels. He interpreted this to mean that the primary cause of turbidity in Coos Bay is the sediment carried in by fresh water entering the bay. High tide turbidities increase from the mouth upstream during all seasons although this increase is very slight during times of low runoff.

USACE (1975) states the average turbidity in the bay ranges from 20 to 49 Jackson Turbidity Units. Slotta et al. (1973) found that below RM 12 dredging does not significantly increase turbidities. Above RM 12 post-dredging levels of 500 JTU have been recorded. North Slough and the area near Empire Mill are mentioned by the USACE (1975) as areas of high turbidity. Discharge of industrial waste water is listed as a probable cause of these high turbidities by STR (1974). USACE (1975) states that highest turbidity levels measured by STR in 1972 were 2,400 JTU during high tide at the site of log-dumping operations at the Empire Mill. The clearest waters were found at the entrance and near North Bend (USACE 1975).

DEQ standards specify that no more than a 10% cumulative increase in natural turbidities is allowed except for certain DEQ approved limited duration activities (OAR 340-41-325).

Coliform

DEQ has measured fecal coliform counts which exceed standards for commercial shellfish growing areas occasionally below RM 8.75 in the bay and frequently above this point. Counts exceeding general standards are frequent above RM 11.5. With a few exceptions, coliform counts in South Slough have been within shellfish area standards. STR (1974) has measured counts above the standard upbay of Jordon Point in the main bay, in North Slough, Isthmus Slough, and Catching Slough. The bay has been closed to commercial shellfish harvest above Sitka Dock by the State Health Division (Osis and Demory 1976).

Major causes of high coliform counts include improper disinfection of sewage plant effluents, inadequate subsurface disposal systems, and livestock (STR 1974).

Sediments

Coos Bay is an aggrading system--more sediment enters the bay than is removed by natural forces (USACE 1975). Prior to the channel deepening for the Deep-Draft Navigation Project, an annual average of 1.65 million yd^3 of material was removed from Coos Bay by the USACE (1976) to maintain navigation channels.

Sediments entering the bay include

1. materials, primarily silts, derived from erosion of the drainage basins of tributary streams;

2. marine sands carried into the bay by littoral drift;

3. dune sands which are blown into the bay even though the dunes have been partially stabilized by vegetation;

4. sands from wind erosion of the sandstone cliffs of the lower bay and South Slough.

The material from the entrance to RM 12 is predominantly fine sand. No shift to smaller grain size has been observed in that section following dredging. From RM 12 to RM 15 channel, sediments are primarily silts, clays, and organic fines, and the composition shifts to smaller grain sizes after dredging. Above RM 15 sediments are silty (USACE 1975).

Sedimentation is controlled by hydrology. Arneson (1976) has applied the concept of realms of deposition used by Kulm and Byrne (1976) for Yaquina Bay to the Coos. He hypothesizes a marine and a transition realm extends to RM 12 and a fluviatile realm exists above RM 12. Percy et al. (1974) estimate an average of 72,000 tons of sediment enters the bay from its drainage basin annually.

Known areas of sediment deposition in Coos Bay include the entrance to Charleston Channel, the area adjacent to disposal islands west of the North Bend Airport, Jordan Cove, east of the upper Coos Bay Channel, and at the mouths of Pony Slough, North Slough, and Haynes Inlet (USACE 1976).

In the lower portions of Coos Bay, material removed from the channel is deposited in in-bay disposal sites. During recent years the amount of material has been constant and shoaling has recurred at the same sites. USACE (1976) hypothesizes that a semi-closed sediment transport system has been operating from RM 2 to RM 12. Sediments originating upstream of RM 15 were thought to have been trapped between RM 12 and RM 15 where the channel was dredged by the Corps. Sediments from the ocean were thought to accumulate mainly below RM 2. Below RM 2 and RM 12 sediments were thought to result from redistribution of existing sediments in a cycle of removal of material from the channel, disposal of dredged material adjacent to the channel, and gradual infilling of the channel (USACE 1976). Effects of channel deepening on this sytem are unknown.

Most studies of the sediment chemistry of Coos Bay have been related to dredging and disposal of dredged material (STR 1972; Slotta et al. 1973; Arneson 1976). STR (1972) determined that sediments below RM 10 met standards for inwater disposal, whereas all materials above RM 10 failed to meet those standards. Above RM 10 volatile solids increased (Arneson 1976). USACE (1975) found the area above RM 12 in the estuary exceeded EPA standards for grease and oil, volatile solids, nitrogen, and phosphorus.

Biological Characteristics

The biology of Coos Bay has been the subject of numerous studies, including those by individual students and classes at Oregon Institute of Marine Biology (OIMB), by OSU students and faculty, and by ODFW personnel. Most of the studies are descriptive in nature. Quantitative studies of productivity and population dynamics are generally lacking.

Phytoplankton

The USACE (1975) has summarized work done by several authors on the summer phytoplankton of Coos Bay (Kilburn 1961; Ednoff 1970; Ide 1970; McGowan and Lyons 1973). Diatoms are the principal members of Coos Bay's planktonic flora. There appears to be a continuum of species from the ocean to the upper bay containing two species assemblages and a transition zone. The transition zone lies between RM 5 and 9 and is an area of high species diversity and productivity (McGowan and Lyons 1973). *Chaetoceros, Skeletonema,* and *Thalassiosira* predominate in the lower bay, while *Melosira* and *Skeletonema* are found in the upper bay.

OIMB is currently taking quantitative measurements of phytoplankton in South Slough. Preliminary results indicate definite seasonal and tidal changes in species composition.

Macroalgae

The algal flora of Coos Bay is not well described. Most of the existing information is derived from qualitative studies by Sanborn and Doty (1944) and OIMB (1970). The USACE (1975) states that attached algae are probably found throughout the bay on solid substrates and that very few marine algae are restricted to the bay environment and not found in other locations along the Pacific Coast.

The greatest variety of algal species is found near the mouth of the estuary where hard substrates providing significant attachment sites and moderate wave action support a flora similar to that of the protected outer coast (Sanborn and Doty 1944). Along the main channel there is a change from a strictly marine to a brackish water flora.

Small subtidal kelp (*Nereocystis leutkeana*) beds are located in the lower sections of the estuary, and free-floating, seasonally occurring mats of green algae sometimes cover large areas of the upper bay (Ednoff 1970).

Productivity studies of the algae of Coos Bay have not been done.

Seagrasses

Two seagrasses occur in Coos Bay--eelgrass (*Zostera marina*) and ditchgrass (*Ruppia* sp.) (USACE 1975). Approximately 1,400 acres of lower intertidal and shallow subtidal tideflats are covered by eelgrass meadows (Akins and Jefferson 1973). Large contiguous beds of eelgrass occur in the lower and upper bay, in North and South Sloughs, and in Haynes Inlet. George M. Baldwin and Associates et al. (1977) state that the eelgrass meadows of the upper bay are among the largest in the state. In the lower reaches of the estuary eelgrass often occurs in pure stands, whereas in upper, less saline, areas it is often accompanied by ditchgrass.

Tidal marsh

Tidal marsh generally occurs from lower high tide inland to the line of non-aquatic vegetation and includes both salt marsh and tidally influenced fresh marsh. The U.S. Department of the Interior (USDI 1971) states that marsh vegetation in Coos Bay developed where broad, low gradient flats of soft sediment were not too strongly stressed by waves or currents. Large present day marshes are located at the mouth of Coos River and in the slough systems--North Slough, Pony Slough, Kentuck Inlet, Isthmus Slough, and Coalbank Slough. Fringing marshes have developed along the shoreline of the main channel near Empire, around the spoil islands of the lower and upper bay, and along the undisturbed shorelines of South Slough.

Using a classification adapted from Jefferson (1975) and estimating an error of less than 10%, Hoffnagle and Olson (1974) calculated the marsh acreage of Coos Bay (Table 7). Akins and Jefferson (1973) have given a figure of 2,738 ac. of marsh for Coos Bay.

Table 7. Area of Coos Bay marshes (Hoffnagle and Olson 1974).

Marsh type	Area (acres)
Low silt marsh	71.6
Low sand marsh	289.1
Immature high marsh	1000.5
Mature high marsh	97.5
Sedge marsh	353.5
Bullrush and sedge marsh	149.8
Surge plain	285.0
Total undiked marsh	1951.9
Total diked marsh	2942.9

Prior to human alterations of the estuary and its drainage basin, vast marshes occupied the upper bay and slough systems. Hoffnagle ad Olson (1974) estimate that 90% of the salt marshes of this estuary have been diked or filled to accomodate expansion of industry or residential areas and for agriculture and for dredged material disposal sites. Eilers (1974) indicates that of the 14 estuaries examined, Coos Bay marshes have been the most severely disturbed by human activities.

Marsh species and types present in Coos Bay resemble those found in other Oregon estuaries to the north and in the Coquille to the south. Akins and Jefferson (1973) noted that south of the Coquille there is a distinct change in vegetation and marsh types.

Hoffnagle et al. (1976) studied six marsh sites in Coos Bay. The group estimated those marshes produced over 1,050,000 gm/acre/year of plant material and considered this figure to be an underestimate. Their data suggest higher marshes are more productive than lower marshes. Bullrush and sedge were found to be particulary productive species. Productivity alone may be insufficient evidence to judge the importance of a marsh. The palatability of marsh plants to consumer organisms and the importance of the plant to detritus production are examples of other considerations (Hoffnagle et al. 1976).

According to Hoffnagle and Olson (1974), "The salt marsh and bacterial and clinging forms associated with its detritus comprise a base of production for the Coos Bay Estuary, providing food and habitat for commerical fish, bivalves, crab, birds, and mammals, and life in Coos Bay in general." The marsh serves as a buffer between shorelands and estuarine waters, preventing or minimizing erosion, flooding, and pollution. Jefferson (1974) indicates that flooding poses a greater potential hazard to shorelands because vast areas of Coos Bay marshes have been diked. Areas constructed on filled marsh are the most susceptible to flooding.

Zooplankton

McGowan and Lyons (1973) directed a short sampling program during the summer of 1973. Their data show a decreasing number of zooplankton taxa along the axis of Coos Bay with increasing distance from the ocean. The lower bay appeared to have a species assemblage which included neritic zooplankters carried in by tidal action and resident species which maintained reproductive populations. Peak zooplankton numbers occurred near Empire in an area of high chorophyll values. Different species were found in the upper bay and in Coos River.

Quantitative information on Coos Bay zooplankton is sparse, and seasonal species distributions are unknown.

Invertebrates

A wide variety of ecological niches are available to invertebrates in the Coos Bay estuary. Differing substrates provide a range of attachment sites and sediments in which to burrow from the solid rock of Fossil Point to the silty, highly organic mud of Isthmus Slough. In addition to substrate variations, differing salinities, temperatures, dissolved oxygen, and other physical factors provide even more variation in conditions.

Subtidal invertebrate populations of the dredged ship channel have been studied by Parr (1974), Slotta et al. (1974), and Jefferts (1977). Jefferts (1977) found the channel infauna of the lower portions of the estuary to be more diverse than that of the upper bay channel. Species of the upper bay, such as the polychaete *Streblospio benedicti*, are generally widespread and opportunistic. Parr (1974) hypothesizes that the fauna of the upper channel are adapted to dredging and that the "weed" species occurring there require frequent disturbance to maintain their competitive advantage.

A qualitative overview of the intertidal macroinvertebrates in Coos Bay was conducted by OIMB in 1970. Many other workers have concentrated on certain taxa or on limited geographic areas of the bay. Distribution of *Corophium*, an important crustacean in the diet of salmonids and other fishes, is shown in Fig. 7. ODFW has surveyed intertidal clam and shrimp distribution in some areas and is completing surveys in other areas (Gaumer 1978) (Fig. 8-15). Hartmann and Reish (1950 described the annelid fauna of the bay with notes on distribution, and Queen (1930) studied the decapod crustaceans of the bay.

Commercially and recreationally harvested invertebrates include several species of clams, the Dungeness and red rock crabs, oysters, bay mussels, ghost shrimp, kelp worms, and mud shrimp.

Clams. Principal species of clams harvested in Coos Bay are gapers (*Tresus capax*), cockles (*Clinocardium nuttallii*), butter clams (*Saxidomus giganteus*), littlenecks (*Protothaca staminea*), softshell clams (*Mya arenaria*), and razor clams (*Siliqua patula*). Of these, all but the softshell clams are restricted in distribution to areas below the railroad bridge (RM 9). These clam species are all filter feeders. Salinity, substrate, and water circulation probably play significant roles in limiting distribution (USACE 1975).

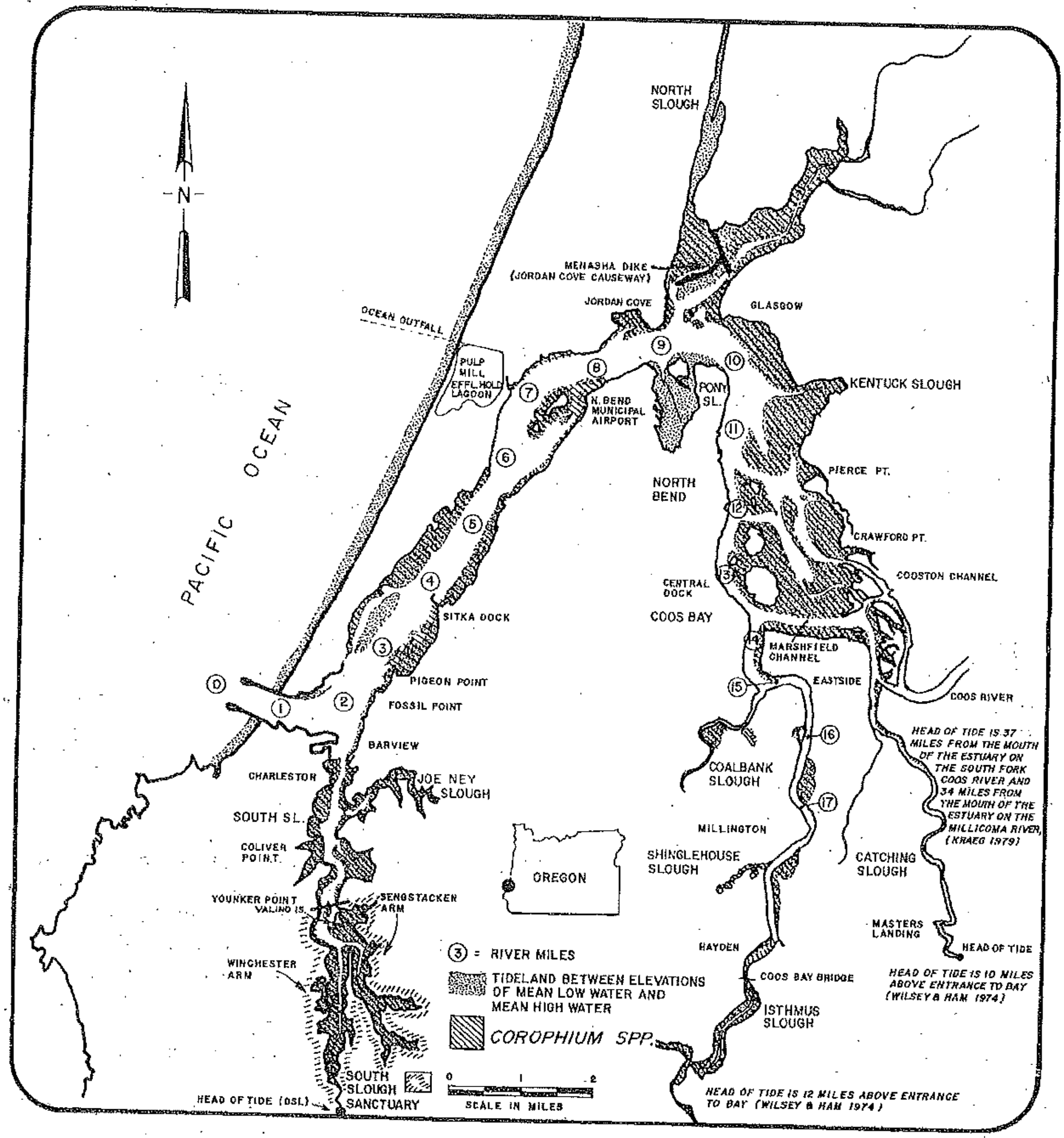

Fig. 7. *Corophium* distribution in Coos Bay (Coos Bay Planning Department 1979).

Fig

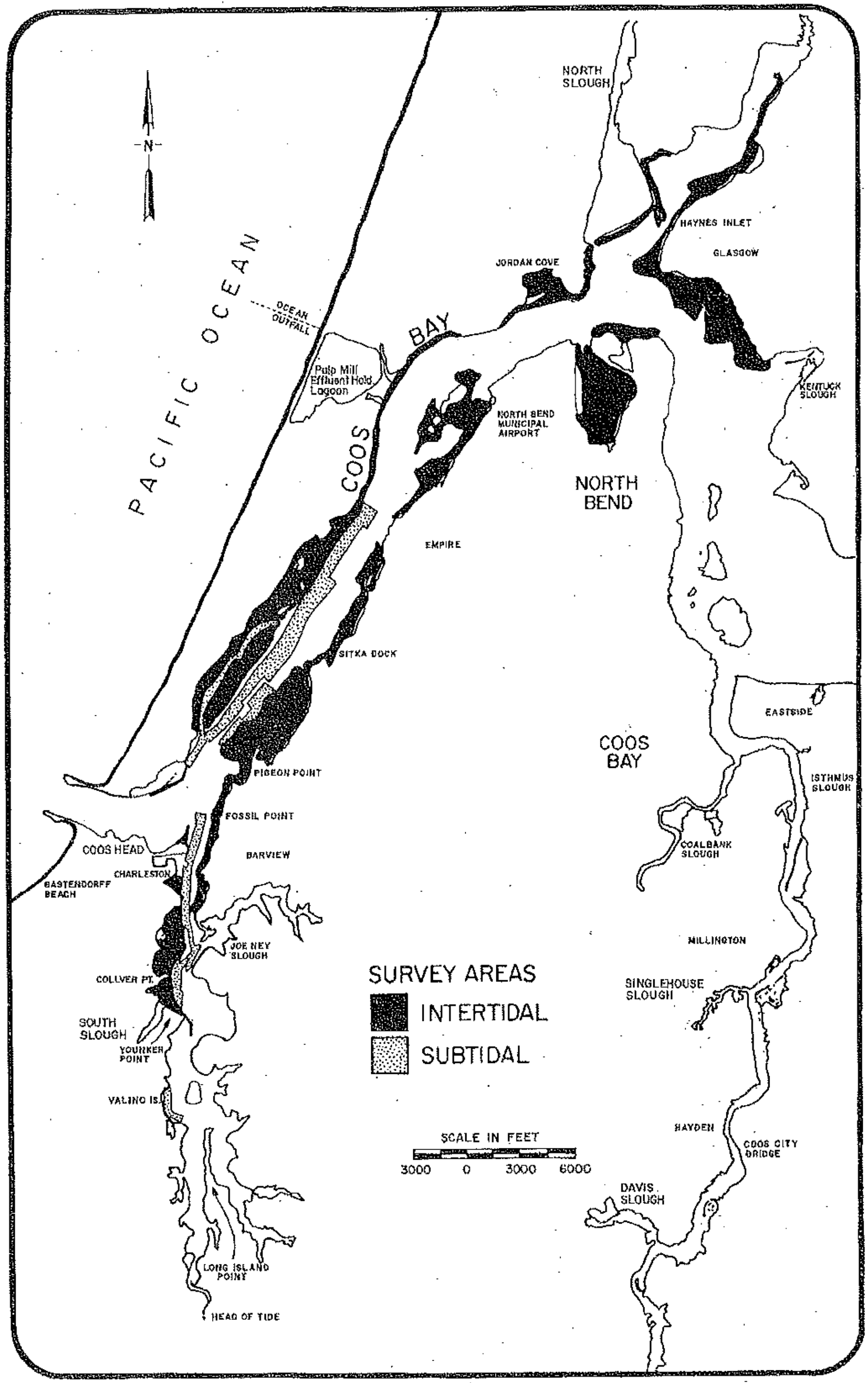

Fig. 8. Areas surveyed for clam and shrimp distribution (Gaumer 1978).

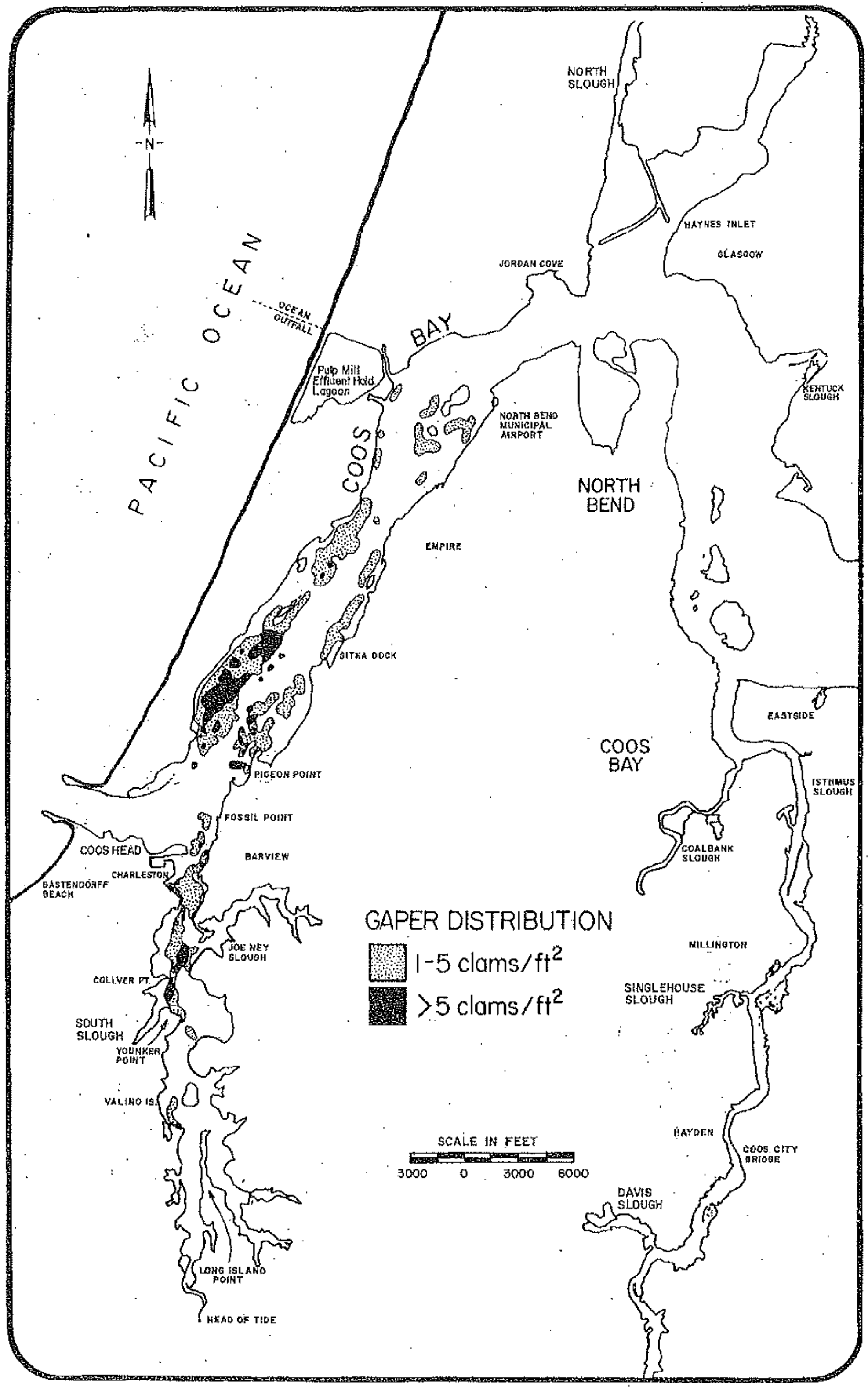

Fig. 9. Gaper distribution in Coos Bay (Gaumer 1978).

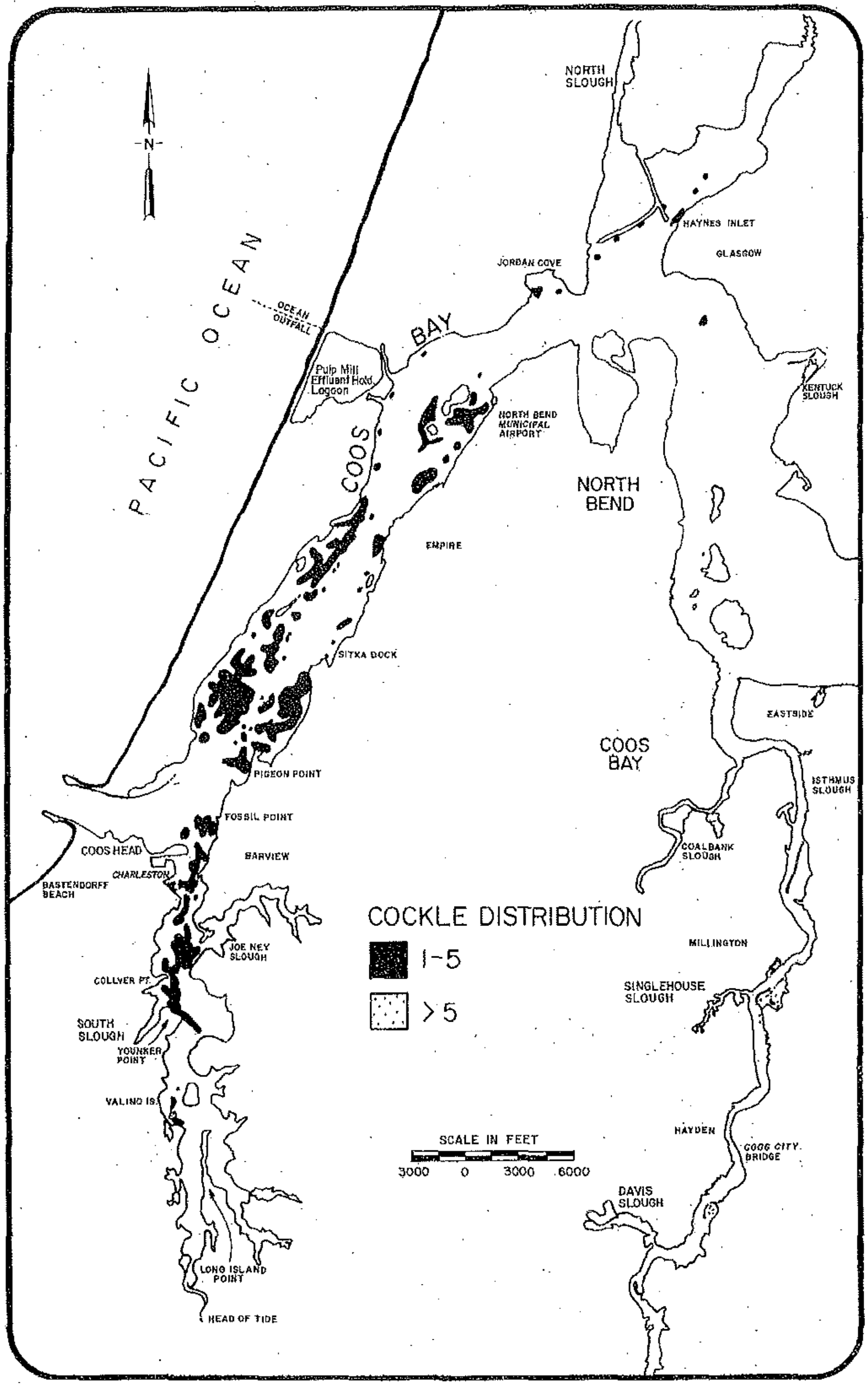

Fig. 10. Cockle distribution in Coos Bay (Gaumer 1978).

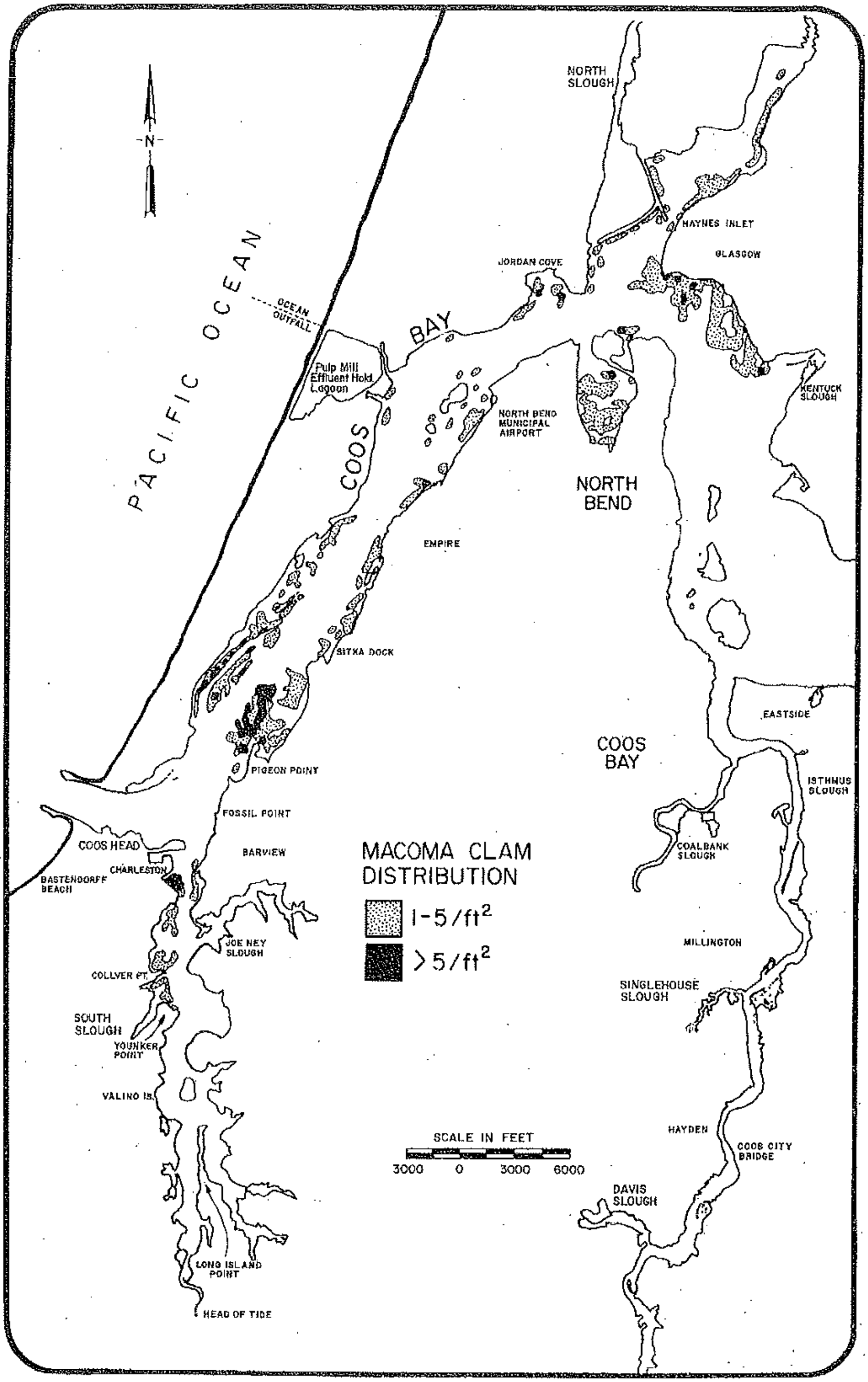

Fig. 11. *Macoma* (*Macoma irus, M. nasuta and M. balthica*) distribution in Coos Bay (Gaumer 1978).

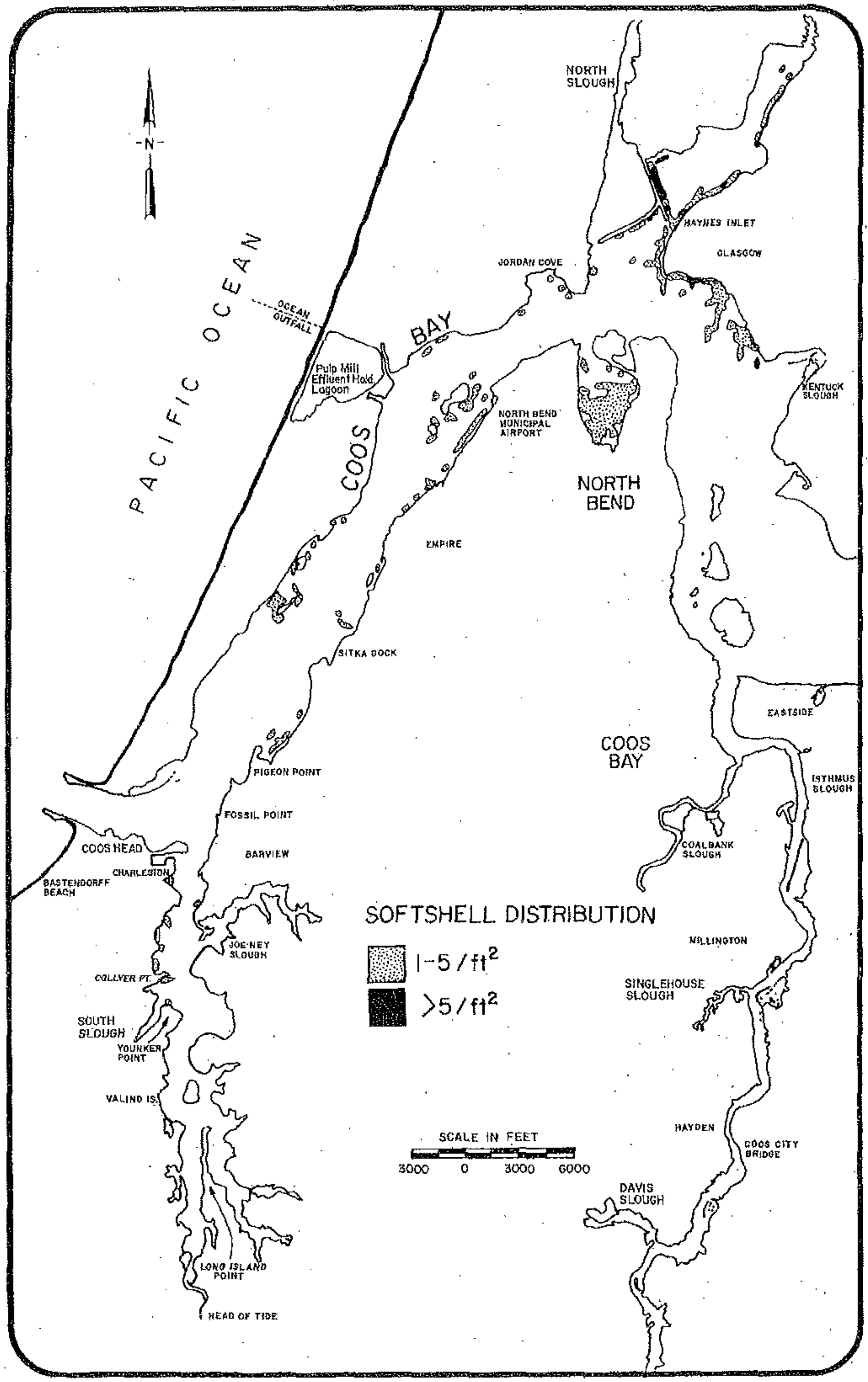

Fig. 12. Softshell distribution in Coos Bay (Gaumer 1978).

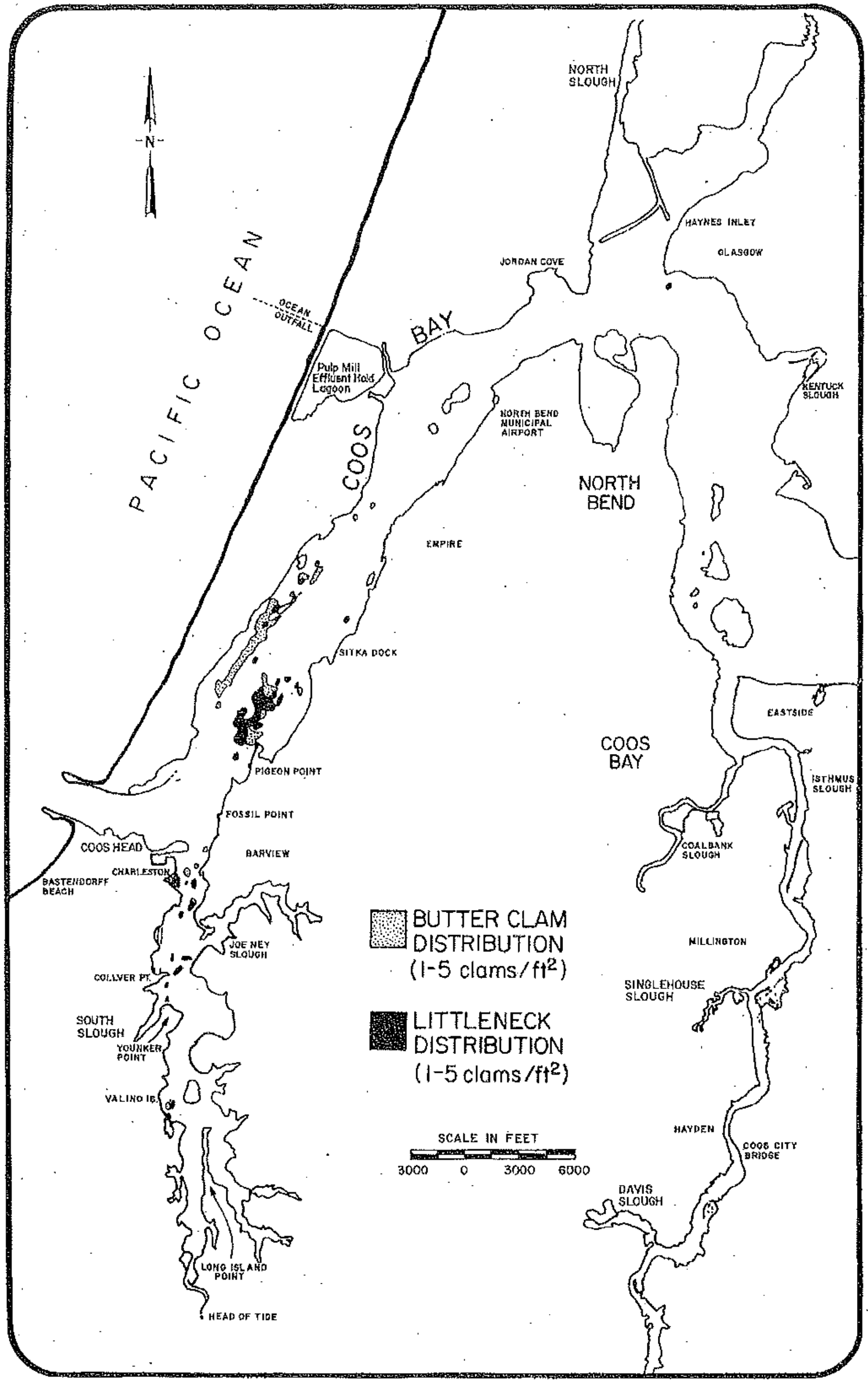

Fig. 13. Butter clam and littleneck distribution in Coos Bay (Gaumer 1978).

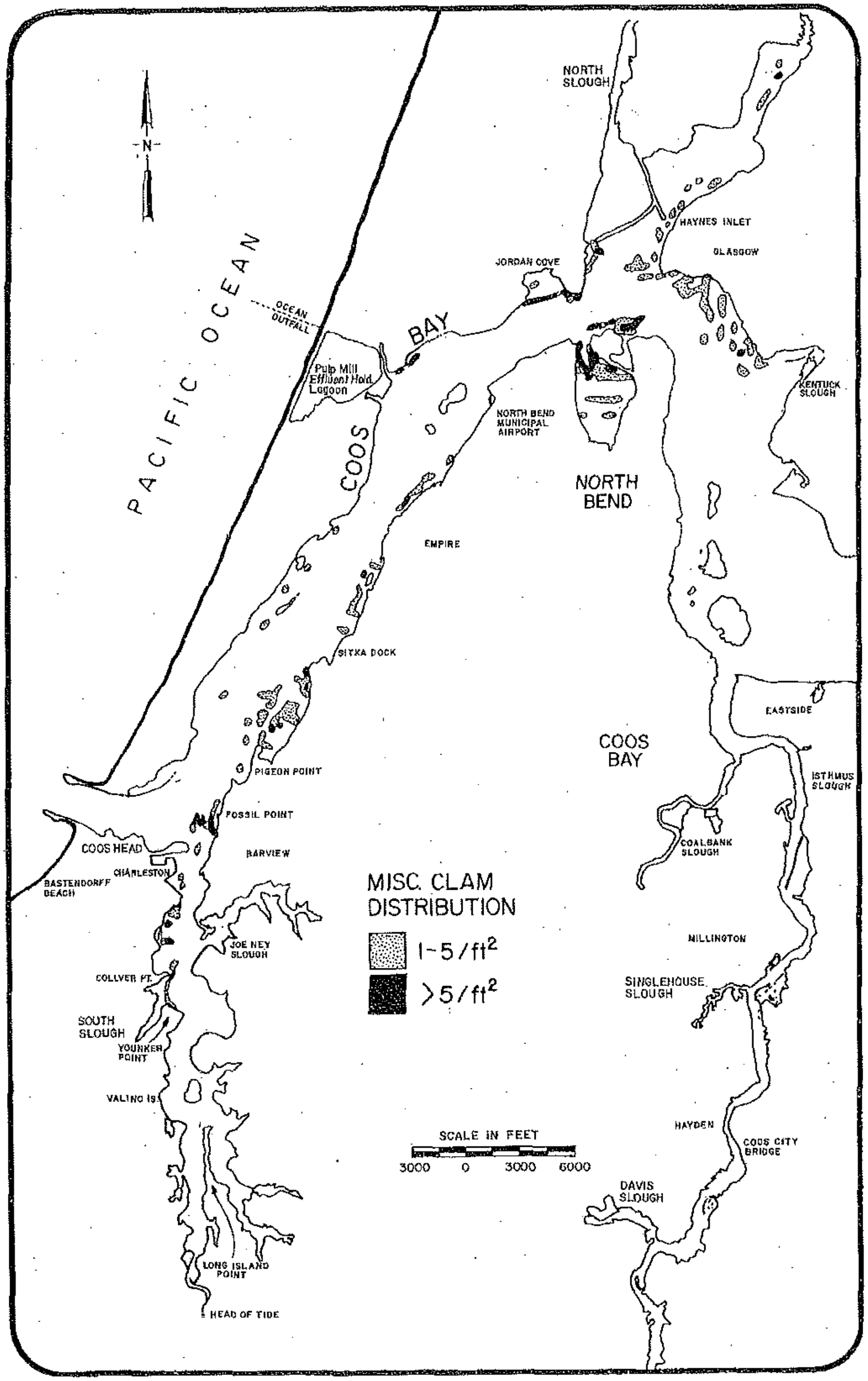

Fig. 14. Miscellaneous clam (California softshell, bodega, paddock, jackknife and rockclams) distribution in Coos Bay (Gaumer 1978).

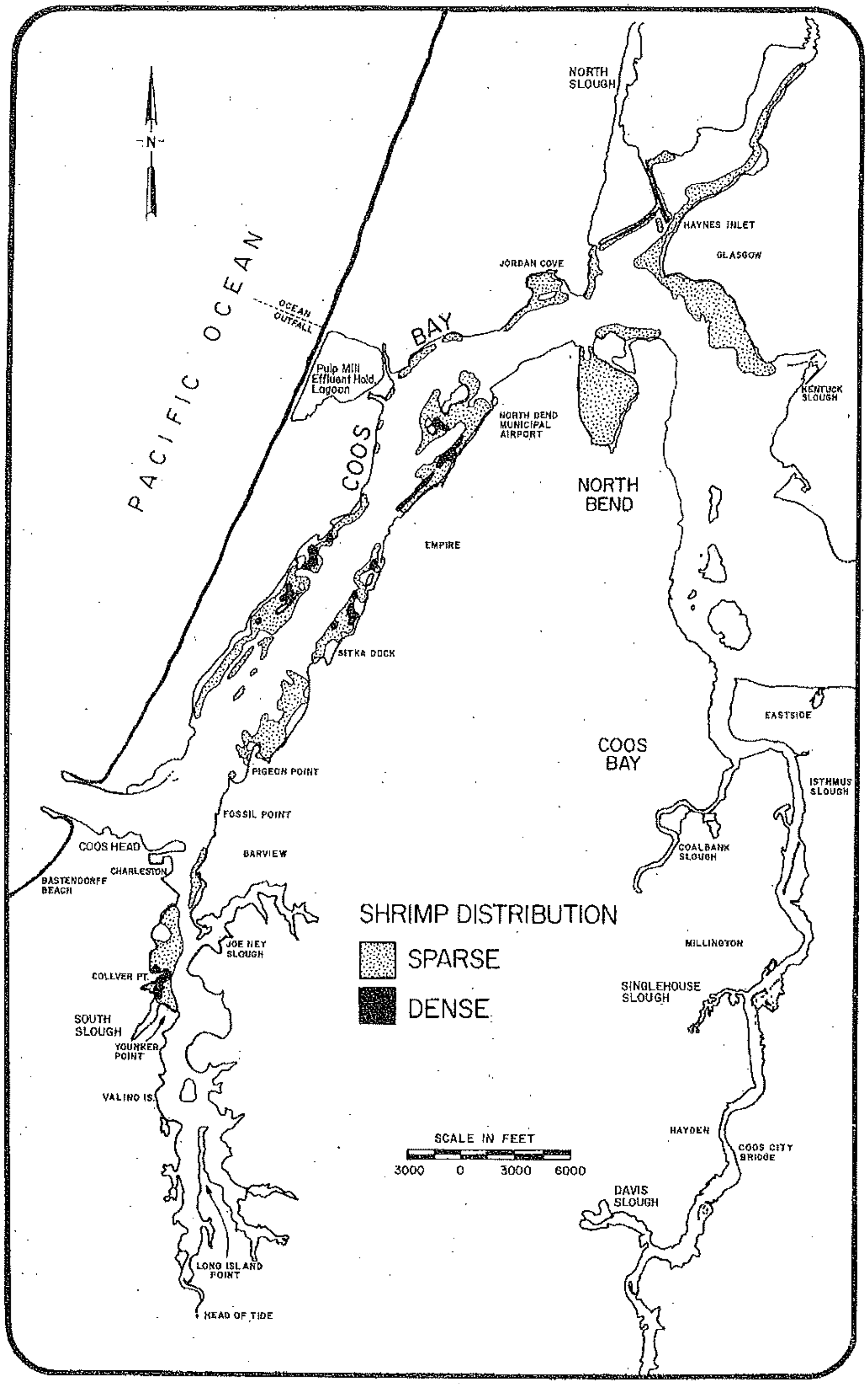

Fig. 15. Shrimp distribution in Coos Bay (Gaumer 1978).

Preliminary ODFW studies indicate that Coos Bay has extensive subtidal clam beds, including large beds of gapers and cockles (Gaumer and Lukus 1976). Principal beds are in the lower bay and lower South Slough. In 1976 one subtidal bed was investigated by ODFW to determine the feasibility of a commercial clam fishery (Gaumer and Halstead 1976). The 48-acre bed off Pigeon Point contained approximately 26.4 million clams, principally gapers and Irus clams (*Macoma inquinata*). Mean size of butter, cockle, littleneck and gaper clams was larger for each species than in a similar study in Yaquina Bay (Gaumer and Halstead 1976). A commercial harvest of 55,482 lb of gapers was taken from the Coos Bay site in 1975-76.

A 1971 estuarine resource use survey (Gaumer et al. 1973) showed that the greatest numbers of clams were taken from tideflats adjacent to North Spit and Pigeon Point and the flats just south of Charleston bridge. Menasha Dike, which separates North Slough from the main bay ranked second. Of the areas surveyed, the Menasha Dike above the railroad bridge was the principal site of softshell clam harvest. Some resource use information on major recreational clam species is contained in Table 8.

Table 8. Clam catch by tideflat users, 1971 (Gaumer et al 1973).

Clam species	Number taken	% of invertebrate tideflat catch	Primary digging area	Secondary digging area
Gaper	107,907	35.3	North Spit	Pigeon Point
Cockle	53,250	17.5	Charleston Flat	North Spit
Butter	53,288	17.4	Pigeon Point	North Spit
Softshell	45,101	14.8	Menasha Dike	North Bend
Native littleneck	15,482	5.1	Pigeon Point	Boat Basin

Razor clams maintain a fluctuating population on a wave-washed sand spit immediately north of the Charleston breakwater where they are taken recreationally (USACE 1978).

Crabs. Both Dungeness (*Cancer magister*) and red rock (*C. productus*) crabs are taken recreationally in Coos Bay. In 1971 crabs accounted for over 80% of the recreational boat fishing catch with Dungeness crabs alone accounting for 76.7% of the catch (Gaumer, Demory, and Osis 1973). Dungeness crabs are also fished commercially within Coos Bay. In-bay crab landings fluctuate, as do those of the ocean, but an average of 11,441 lb were landed from Coos Bay in 1971-74 (personal communication, Darrel Demory, ODFW, May 8, 1979). Of the 31,000 lb landed from Oregon bays in 1977, Demory (personal communication) estimates that 15,000-18,000 lb were from Coos Bay.

Both species of crabs are found subtidally throughout the bay (USACE 1975). Waldron (1958) states that Dungeness crabs have a preference for sandy or muddy bottoms, although they may be found on almost any bottom. Gaumer et al. (1973) found the lower bay to be the primary site of recreational crab fishing.

Fish Commission of Oregon studies (Waldron 1958) have shown that while crabs do move between bays and the ocean, and from bay to bay, 84% of the crabs tagged in bays were recovered within four miles of the tagging site.

The importance of the estuary as rearing ground for crabs is not understood (USACE 1975). Large numbers of crab larvae (megalops) are found in Coos Bay in late spring and early summer and are also found offshore at that time of year (Waldron 1958). Samll (0.8-2 in) Dungeness crabs are found abundantly in the upper reaches of the estuary. Hunter (1973) has shown that small Dungeness crabs seem to be more tolerant of low salinities than are large individuals.

Several other crab species inhabit the bay including the freshwater crab (*Rhithropanopeus harrissi*) of the upper bay and the shore crabs (*Pachygrapsus crassipes* and *Hemigrapsus nusus*) of rocky intertidal areas.

Oysters. While native oysters (*Ostrea lurida*) no longer inhabit Coos Bay, Pacific oysters (*Crassostrea gigas*) are grown commercially in the bay. All existing Coos Bay oyster leases are in South Slouth (Fig. 16). In 1976, 144.08 acres of oyster ground were leased in Coos Bay. About 40% (57 ac.) were actually in production at that time. Osis and Demory (1976) listed a potential ground acreage of 525 ac and indicated that siltation problems account for much of the land remaining unused. Excessive fresh water and heavy siltation sometimes cause oyster mortality in Coos Bay during winter.

The potential oyster culture area of Coos Bay extends upstream from the mouth to the lower reaches of Haynes and North Sloughs, but high bacterial counts have forced closure of commercial areas above Sitka Dock. Jambor and Rilette (1977) note the area open to oyster harvest is only about one-half of the useable oyster tideland.

According to Jambor and Rilette (1977), DEQ officials state that because high bacterial counts in Coos Bay are mainly caused by dairy and wild animal stocks, little improvement is expected. Purification of shellfish grown in polluted waters (depuration) may be one way to increase acreage in Coos Bay used for commercial oyster culture (ODFW 1976; Jambor and Rilette 1977). However, other factors such as existing clam beds and navigation rights may limit expansion of oyster culture.

Other invertebrates. Other invertebrates taken by recreationists in Coos Bay include ghost shrimp (*Callianassa californiensis*), and mud shrimp (*Upogebia pugettensis*), kelp worms (*Nereis* spp.) (Fig. 15) (Gaumer et al. 1973), and lug worms (*Abarenicola pacifica*) (personal communication, Reese Bender, ODFW, March 10, 1979). These organisms are frequently used as bait. The shrimp are primarily taken from tideflats of the lower bay while the worms are harvested in greatest abundance from Menasha Dike (Gaumer et al. 1973).

Fish

At least 66 species of fish are known to use the Coos Bay estuary (Cummings and Schwartz 1971). Fish distribution has been studied during summer months (Cummings and Schwartz 1971; Ednoff 1970) and seining efforts by ODFW in 1977 and 1978 have added further information regarding seasonal use of the bay (personal communication, Reese Bender and Bill Mullarkey, ODFW, April 4, 1979)

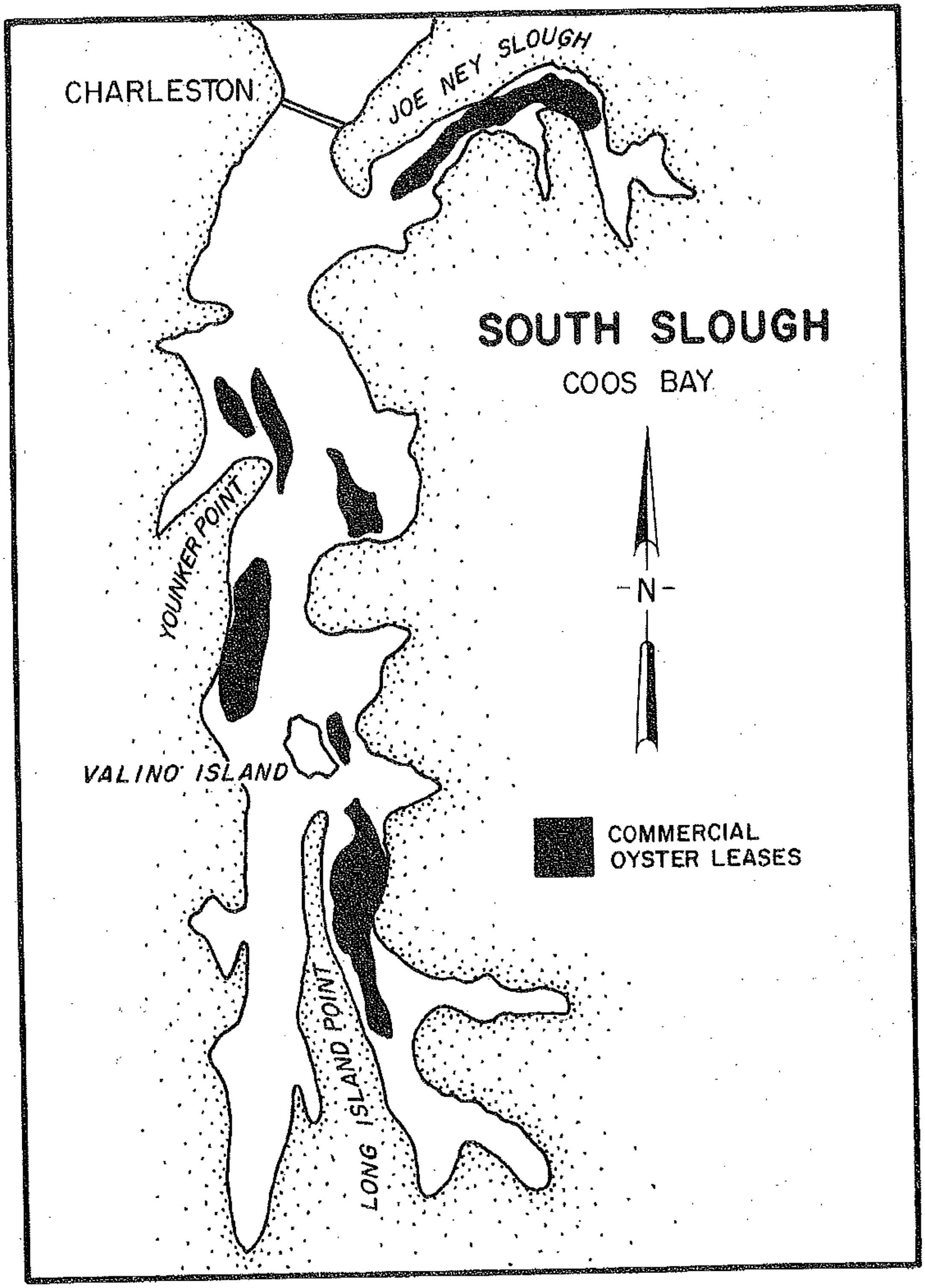

Fig. 16. Commercial oyster leases in Coos Bay (Jambor and Rilette 1977).

(Table 9), but documentation of the use of specific areas and habitats by fish species is lacking.

The greatest variety of species is found in the lower parts of the estuary (Cummings and Schwartz 1971), while the greatest numbers of fish, captured during the same sampling program, were taken near the mouth of the Joe Ney Slough and just west of Jordan Point (Hostick 1975). One might expect those species requiring high salinities to reach the upper most extent of their ranges in the bay during summer and those species requiring low salinities to extend further downbay during periods of high runoff.

The Coos system supports stocks of fall chinook salmon, coho salmon, steelhead, and searun cutthroat trout. Chum salmon are seen occasionally. Records show that a sizeable population of fall chinook salmon once inhabited the Coos system (Cleaver 1951). Gillnet catches declined from an average of 200,000 lb between 1923 and 1930 to 36,000 lb between 1930 and 1940. After the building of splash dams on the South Fork Coos River in 1941, the population declined substantially (personal communication, Al McGie, ODFW, January 17, 1979). Since removal of the dams in 1957, the population has recovered so that now approximately 5,000 chinook spawn in Coos River and its tributaries (personal communication, Bill Mullarkey, ODFW, April 14, 1979). Based on historic records, a spawning population of at least 12,000 chinook is possible when the recovery of spawning grounds and reaccumulation of spawning gravel is complete (personal communication, Mullarkey). Information on salmonids is summarized in Table 10.

In 1978 anglers caught 1,145 chinook and 24,000 coho salmon in the ocean sport fishery offshore from Coos Bay. In late summer chinook and coho are caught from the jetties. A boat fishery develops in late August in the upper bay and river and continues through the fall. In 1977, a year of drought, 604 salmon over 24 inches were caught in the Coos and Millicoma rivers, and Bender (pers. comm.) estimates another 600 jacks may have been caught. A cutthroat fishery of unknown catch also occurs in the river.

Three private hatcheries have obtained permits from ODFW for salmon release/ recapture operations (Table 11). ODFW has begun an evaluation of the private hatchery programs in Coos Bay to determine the periods and areas of residence and food habits of hatchery and wild salmonids.

Coos Bay also supports a large population of striped bass. Commercial fishing for bass has been closed in Coos Bay since 1975, but prior to the 60s, the striped bass fishery on the Coos was surpassed on the West Coast only by that of the Sacramento River in California (Hutchison 1962). Currently an active sport fishery occurs on a population of unknown size. Stripers are taken throughout the year at various places in the bay. Upriver migration of striped bass occurs in several runs from May until July. After spawning the fish move back into the bay to feed, seeking the deeper holes and channel. Although a few may go to the ocean, most of the fish probably stay in the bay all year (personal communication, Al McGie, ODFW, July 10, 1979). Young fish appear to stay upriver until the end of their first year of life.

Table 9. Distribution of fish species by subsystem (Cummings and Schwartz 1971; Hostick 1975, and Mullarkey and Bender 1979).

Species	Subsystem[a]								
	Marine (RM 0-3)	Lower Bay (RM 3-9)	Upper Bay (RM 9-17)	Riverine (RM 17-30)	South Slough	North Slough	Haynes Inlet	Isthmus Slough	Catching Slough
Leopard shark (*Triakis semifasciata*)	X								
Longnose lacetfish (*Alepisaurus richardsoni*)	X								
White seabass (*Cynoscion nobilis*)	X								
Pomfret (*Brama rayi*)	X								
Redtail surfperch (*Amphistichus rhodoferus*)	X								
Wolf-eel (*Anarrhichthys ocellatus*)	X								
Copper rockfish (*Sebastodes caurinus*)	X								
Rock greenling (*Hexagrammos superciliosus*)	X								
Tidepool sculpin (*Oligottus maculosus*)	X	X							
Mosshead sculpin (*Clinocottus globiceps*)	X								
Fluffy sculpin (*Oligottus snyderi*)	X								
Tubenose poacher (*Pallasina barbata*)	X								
Longnose skate (*Raja rhina*)	X	X							
Whitebait smelt (*Allosmerus elongatus*)	X	X							

Table 9. Continued.

Species	Subsystem[a]								
	Marine (RM 0-3)	Lower Bay (RM 3-9)	Upper Bay (RM 9-17)	Riverine (RM 17-30)	South Slough	North Slough	Haynes Inlet	Isthmus Slough	Catching Slough
Eulachon (*Thaleichthys pacificus*)	X	X							
Penpoint gunnel (*Apodichthys flaridus*)	X	X							
Pacific sandlance (*Ammodytes hexapteros*)	X	X							
Bocaccio (*Sebastodes paucispinis*)	X	X		X					
Cabezon (*Scorpaenichthys marmoratus*)	X	X		X					
Tubesnout (*Aulorhynchus flaudius*)	X	X		X					
Spiny dogfish (*Squalus acanthias*)	X	X	X						
White sturgeon (*Acipenser transmontanus*)	X	X	X						
Northern anchovy (*Engraulis mordax*)	X	X	X	XXF					
Longfin smelt (*Spirinchus dilatus*)	X	X	X						
Pacific tomcod (*Microgadus proximus*)	X	X	X						
Surf smelt (*Hypomesus pretiosus*)	X	X	X	F					
Striped seaperch (*Embiotoca lateralis*)	X	X	X	XX					
Walleye surfperch (*Hyperprosopon argenteum*)	X	X	X	XXF					
White seaperch (*Phanerodon furcatus*)	X	X	X	XX					

Table 9. Continued.

Species	Marine (RM 0-3)	Lower Bay (RM 3-9)	Upper Bay (RM 9-17)	Riverine (RM 17-30)	South Slough	North Slough	Haynes Inlet	Isthmus Slough	Catching Slough
	Subsystem[a]								
Pile Perch (*Rhacochilus vacca*)	X	X	X	XX					
High cockscomb (*Anoplarchus purpurescens*)	X	X	X						
Arrow goby (*Clevelandia ios*)	X	X	X						
Pacific pompano (*Palometa simillima*)	X	X	X						
Black rockfish (*Sebastodes melanops*)	X	X	X	XX					
Kelp greenline (*Hexagrammos decagrammus*)	X	X	X	XX					
Lingcod (*Ophiodon elongatus*)	X	X	X	XX					
Padded sculpin (*Artedius fenestralis*)	X	X	X						
Buffalo sculpin (*Enophys biason*)	X	X	X						
Sand sole (*Psettichthys melanostichus*)	X	X	X						
Pacific lamprey (*Lompetra tridentata*)	X	X	X	X					
Green sturgeon (*Acipenser medirostris*)	X	X	X	X					
American shad (*Alosa sapidissima*)	X	X	X	X	XF	X		X	XX
Pacific herring (*Clupea harengus pallasi*)	X	X	X	X	X			X	
Chum salmon (*Oncorhynchus keta*)	X	X	X	X					

Table 9. Continued.

Species	Subsystem[a]								
	Marine (RM 0-3)	Lower Bay (RM 3-9)	Upper Bay (RM 9-17)	Riverine (RM 17-30)	South Slough	North Slough	Haynes Inlet	Isthmus Slough	Catching Slough
Coho salmon *(Oncorhynchus kisutch)*	X	X	X	X	F				
Chinook salmon *(Oncorhynchus tsawytcha)*	X	X	X	XF	XF				
Cutthroat trout *(Salmo clarki)*	X	X	X	XF					
Rainbow trout *(Salmo gairdneri)*	X	X	X	X					
Topsmelt *(Atherinops affinis)*	X	X	X	X	XX		X	XX	
Bay pipefish *(Syngnathus griseolineatus)*	X	X	X	X	X		X		
Striped bass *(Roccus saxatilis)*	X	X	X	X					
Shiner perch *(Cymatogaster aggregata)*	X	X	X	XE	XXE	X	X	XX	X
Silver surfperch *(Hyperprosopon ellipticum)*	X	X	X	XE	XXF			XX	
Snake prickleback *(Lumpenus sagitta)*	X	X	X	X	XX			X	
Saddleback gunnel *(Pholis ornata)*	X	X	X	X					
Pacific staghorn sculpin *(Leptoccotus armatus)*	X	X	X	XF	XXF	X	X	XX	XX
Speckled sanddab *(Citharichthys stigmaeus)*	X	X	X	X	XX				
English sole *(Parophrys retulus)*	X	X	X	X	XX				
Starry flounder *(Platichthys stellatus)*	X	X	X	XF	XF	X	X	X	XX

Table 9. Continued.

Species	Subsystem[a]								
	Marine (RM 0-3)	Lower Bay (RM 3-9)	Upper Bay (RM 9-17)	Riverine (RM 17-30)	South Slough	North Slough	Haynes Inlet	Isthmus Slough	Catching Slough
Bay goby (*Lepidogobius lepidus*)		X	X						
Threespine stickleback (*Gasterosteus aculeatys*)		X	X	XF			X	XX	XX
Prickly sculpin (*Cottus asper*)		X	X	X					
Redside shiner (*Richardsonius balteatus*)				X	F				
Speckled dace (*Rhinichthys osculus*)				X					
Largescale sucker (*Catostomus machrochelius*)				X					

[a] *Pony Slough not included in sources used.*
X= species present according to summer sampling by Cummings and Schwartz (1971).
F= species present in ODFW 1977 seine samples. Applies only to South Slough and Riverine because data from other areas was combined by authors.

Table 10. Salmonid use of Coos Bay (Thompson etal 1972; Bender and Mullarkey 1979).

Species	Estimated population	Time of spawning migration	Spawning peak	Juvenile use of estuary	State releases
Fall chinook salmon	5,000	Sept.-Jan.	Nov.	Feb.-Oct.	--
Coho salmon	8,300	Oct.-Feb.	Dec.	Mar.-Jun.	--
Chum salmon	incidental				
Steelhead	5,000	Nov.-Apr.	Jan.-Mar.	Mar.-Jun.	100,000
Cutthroat trout	3,500	Aug.-Jan.	unknwon	entire yr.	10,000

Table 11. Private hatchery permits for Coos Bay (Cummings 1977).

Hatchery	Total permit	Permits by species		
		Chinook	Coho	Chum
Weyerhaeuser	40,000,000	10,000,000	10,000,000	20,000,000
Anadromous	10,000,000	5,000,000	5,000,000	
Calvin Heckard				5,000,000

Shad are fished commercially in Coos Bay from April 20 to June 21. A five-year (1973-77) average of 19,310 lbs of shad was taken from Coos Bay. Sport fishermen take shad from the South Coos River and Millicoma River from mid April through June by trolling from boats.

Shad tagged in the Coos River have been recovered from the Umpqua and Coquille rivers, but evidence suggests each of these rivers supports its own population of shad (Mullen 1974). Mullen (1974) estimated from tagging studies a population of over 50,762 shad in the Coos River system. However, shad too small to be caught in the gillnets were not included in the estimate.

Shad enter the bay from the ocean in the spring months and start to appear in the commercial gill net fishery when it opens in April. Spawning usually occurs in May and June in upper tidal areas of the Coos and Millicoma rivers. Juvenile shad rear in the Coos and Millicoma rivers throughout the summer. Shad begin to appear in seine hauls in lower Coos Bay during August (pers. comm., Bender). Most of the juveniles enter the ocean in the fall.

In 1978 a conservative estimate of 145 tons of herring spawned in Coos Bay between 0.6 and 13.7 miles from the mouth (Miller and McRae 1978). Spawning occurs from January through April, and herring remain in the bay through summer (pers. comm., Bender). Three areas heavily used during the 1978 spawn were Fossil Point (eelgrass, algae, rocks), lower North Spit (eelgrass), and the Ford Dock near Jordan Cove (pilings) (Miller and McRae 1978). Jackson (1979) observed heavy spawns on lower North Spit, south of Clam Island in 1979. It is possible that timing of the herring spawn is influenced by freshwater runoff so that spawning occurs farther downbay during high runoff periods (Miller and McRae 1978).

Shiner perch, redtail surfperch, striped seaperch, black rockfish, and kelp greenling are among the other fish inhabiting the bay in large numbers which are taken by sport anglers (Gaumer et al. 1973).

Distribution maps for major species have been prepared by the Coos County Planning Department.

Mammals

Resident marine mammals in the estuary are limited to the harbor seal (*Phoca vitulina*) and the harbor porpoise (*Phocoena phocoena*) (personal communication, Mike Graybill, OIMB, March 15, 1979). Approximately 120 harbor seals haul out in the Pigen Point area of Coos Bay. They use the bay for feeding, primarily on bait fish such as herring and eulachon, and have been sighted in both the upper and lower bay. There is evidence that lower North Spit serves as a pupping area (pers. comm., Graybill). Harbor porpoises live in the lower estuary where they are seen frequently from RM 1 to 3.

Non-resident marine mammals occasionally sighted in the bay include California sea lions (*Zalophus californianus*), Stellar sea lions (*Eumetopias jubata*), and rarely California gray whales (*Eschrichtius gibbosu*) and killer whales (*Orciniis orca*).

River otters are common in the Coos and Millicoma rivers (pers. comm., Bender) and have been seen in the Crawford Point area (pers. comm., Graybill) and in South Slough (Magwire 1976a). The population size is unknown.

A variety of mammals are found in Coos Bay salt marshes. Raccoon, bobcat, muskrat, mink, weasel, fox, coyote, black-tailed deer (Magwire 1976a), and striped skunk (Pinto 1972) are found in the salt marshes, and beaver are found in areas of inflowing fresh water (Magwire 1976a). The marsh is only part of the range of animals, and their abundance depends primarily on how remote and undisturbed the community is (Magwire 1976a).

The major small mammals of the marshes are vagrant shrews and deer mice. The deer mouse is most abundant in the high marsh and tends to remain close to the terrestrial environment, while the shrew uses lower marshes and is often near logs or debris. Other species of mice, shrews, voles, and the black rat use the marshes in lesser numbers. These small mammals serve as primary and secondary consumers in the terrestrial food chain (Magwire 1976a).

Birds

Although a thorough study of the use of the estuary by bird populations has not been published, observations by individuals and groups provide information on seasonal use and abundance of bird species at Coos Bay. USACE (1975) abstracted a list of birds using the bay from information published by U.S. Department of the Interior (1971). Magwire (1976a) has summarized observations by Wampole (1959), Fawver and Wampole (1971), McGie (1976), and Richer (1976). Table 12 presents a compilation of this information. In addition, a census of birds of the greater Coos Bay area is made each December by the local chapter of the National Audubon Society.

Table 12. Bird use of Coos Bay estuary (key on p. 46).

Species	Subsystems: Marine & Lower Bay	Subsystems: Upper Bay	Subsystems: Riverine	Habitats: Channel	Habitats: Unconsolidated Shores & Flats	Habitats: Rocky Shores	Habitats: Tidal Marsh	Coos Head W	Coos Head S	Fossil Point to Pigeon Point W	Fossil Point to Pigeon Point S	Empire W	Empire S	Pony Slough W	Pony Slough S	Haynes Inlet W	Haynes Inlet S	Metcalf *Salicornia* Marsh W	Metcalf *Salicornia* Marsh S
Arctic loon (*Gavia arctica*)	FWSp			U				O	U	C	U	U						C	
Red-throated loon (*G. stellata*)	FWSP			U				O	O			O				O	O	O	
Red-necked grebe (*Podiceps grisegena*)	FWSp			U						O		C		O					
Brown pelican (*Pelecanus occidentalis*)	F			U				O	O										
Brandt's cormorant (*Phalacrocorax penicillatus*)	Res			C															
Pelagic cormorant (*P. pelagicus*)	Res			C				A	A	O	O	O				O	O		
Black brant (*Branta nigricans*)	Sp			A[1]	A[1]			O		A	A	R				A		U	
Harlequin duck (*Histrionicus histrionicus*)	FWSp			R		R		O	R					R		R			
Oldsquaw (*Clangula hyemalis*)	W			R				O	R										
Common scoter (*Oidemia nigra*)	W			U								R							
Surf scoter (*Melanitta perspicillata*)	FWSp			A				A	U	A	C	A	A	U	U			A	A
Red-breasted merganser (*Mergus serrator*)	FWSp			U				O	O	U		C	U	U		U			
Surfbird (*Aphriza virgata*)	FWSp					C		C	O										
Ruddy turnstone (*Arenaria interpres*)	M					U							R						

Table 12 continued.

Species	Subsystems: Marine & Lower Bay	Subsystems: Upper Bay	Subsystems: Riverine	Habitats: Channel	Habitats: Unconsolidated Shores & Flats	Habitats: Rocky Shores	Habitats: Tidal Marsh	Coos Head W	Coos Head S	Fossil Point to Pigeon Point W	Fossil Point to Pigeon Point S	Empire W	Empire S	Pony Slough W	Pony Slough S	Haynes Inlet W	Haynes Inlet S	Metcalf *Salicornia* Marsh W	Metcalf *Salicornia* Marsh S
Red phalarope (*Phalaropus fulicarius*)	M			R															
Northern phalarope (*Lobipes lobatus*)	M			C										R					
Glaucous-winged gull (*Larus glaucescens*)	FWSp			C								C				O			
Herring gull (*L. argentatus*)	FW			U				O				A	A	C					
California gull (*L.californicus*)	FW			U										R					
Mew gull (*L. canus*)	FWSp			C				C	U			C	O	C	O				
Heerman's gull (*L. heermanni*)	SF			C				O	U								O		
Bonaparte's gull (*L. philadephia*)	M			C				C	U				O		O		O		
Blacklegged kittiwake (*Rissa tridactyla*)	FWSp			R				O	O										
Caspian tern (*Hydroprogne caspia*)	M			U					R						R				
Common Murre (*Uria aalge*)	Res			A				U	A			O	U		U				
Marbled Murrelet (*Brachyramphus marmoratum*)	Res			R						C		C		C		U		C	C
Horned grebe (*Podiceps auritus*)	FWSp	FWSp		C															
American wigeon (*Mareca americana*)	W	W		A	A		A							A		A			

Table 12 continued.

	Subsystems				Habitats			Subsystems or Specific Areas											
Species	Marine & Lower Bay	Upper Bay	Riverine	Channel	Unconsolidated Shores & Flats	Rocky Shores	Tidal Marsh	Coos Head		Fossil Point to Pigeon Point		Empire		Pony Slough		Haynes Inlet		Metcalf *Salicornia* Marsh	
								W	S	W	S	W	S	W	S	W	S	W	S
Black-bellied plover (*Squatarola squatarola*)	FWSp	FWSp			C		C	R						C	U			R	
Semi-palamated plover (*Charadrius semipalmatus*)	M	M			C							U		U	U				
Snowy plover (*C. alexandrinus*)	Res	Res			R														
Whimbrel (*Numenius phaeopus*)	F	F			U														
Spotted sandpiper (*Actitus macularia*)	F	F				U			O						U				
Dunlin (*Erolia alpina*)	WSp	WSp			A			O	O	C	O	C	C	A	A			O	O
Sanderling (*Crocethia alba*)	FWSp	FWSp			C							C	C	O					
Baird's sandpiper (*Erolia bairdii*)	F			F	R														
Western sandpiper (*Ereunetes mauri*)	FWSp	FWSp			A														
Least sandpiper (*Erolia minutilla*)	FWSp	FWSp			A														
Willet (*Catoptrophorus semipalmatus*)	M	M			U		U												
Western gull (*Larus occidentalis*)	Res	Res		A						C		C		U		C	U	C	C
Common tern (*Sterna hirundo*)	M	M		U					R						R				
Pigeon guillemot (*Cepphus columba*)	S	S		C				U	A		U		U		U				C

Table 12 continued.

Species	Subsystems				Habitats			Subsystems or Specific Areas											
	Marine & Lower Bay	Upper Bay	Riverine	Channel	Unconsolidated Shores & Flats	Rocky Shores	Tidal Marsh	Coos Head		Fossil Point to Pigeon Point		Empire		Pony Slough		Haynes Inlet		Metcalf *Salicornia* Marsh	
								W	S	W	S	W	S	W	S	W	S	W	S
Common loon (*Gavia immer*)	FWSp	FWSp	FWSp	C				A	C	C	O	C	O	C	O	C	O	C	
Pied-billed grebe (*Podiceps dominicus*)	W	W	W	R				O	R					O		O	O	U	
Western grebe (*Aechmophorus occidentalis*)	FWSp	FWSp	FWSp	C															
Double-crested cormorant (*Phalacrocorax auritus*)	FWSp	FWSp	FWSp	C				C	U	A		U		C		O	O	U	
Common goldeneye (*Bucephala clangula*)	W	W	W	C			U	O				U		R		U		R	
Bufflehead (*B. albeola*)	W	W	W	C				O		C		U		C		C		C	
Marsh hawk (*Circus cyaneus*)	Res	Res	Res				U		O					O					
Bald eagle (*Haliaeetus leucocephalus*)	Res	Res	Res				R	R	R							R			
Red-tailed hawk (*Buteo jamaicensis*)	FWSp	FWSp	FWSp				U												
Great Blue heron (*Ardea herodias*)	Res	Res	Res		U		C	U	U	U	U	U		C	C	C	C	C	C
Green heron (*Butorides virescens*)	Res	Res	Res		U		U								O				
American coot (*Fulica americana*)	FWSp	FWSp	FWSp	A			A	U	O	C	C	C	C	A		A		O	
Killdeer (*Charadrius vociferus*)	Res	Res	Res		C			U	U	U		C	C	C	C	U			
Belted kingfisher (*Megaceryle alcyon*)	Res	Res	Res	C								U	U	C	C			C	C

Table 12 continued.

Species	Subsystems: Marine & Lower Bay	Upper Bay	Riverine	Habitats: Channel	Unconsolidated Shores & Flats	Rocky Shores	Tidal Marsh	Subsystems or Specific Areas: Coos Head W	Coos Head S	Fossil Point to Pigeon Point W	Fossil Point to Pigeon Point S	Empire W	Empire S	Pony Slough W	Pony Slough S	Haynes Inlet W	Haynes Inlet S	Metcalf *Salicornia* Marsh W	Metcalf *Salicornia* Marsh S
Whistling swan (*Olor columbianus*)		W					R							R					
Canada goose (*Branta canadensis*)		M					R	O											
Pintail (*Anas acuta*)		FW		A										A	C	A			
Gadwall (*A. strepera*)		FW					U							A					
Shoveler (*Spatula clypeata*)		FW		U	U									C					
Green-winged teal (*Anas carolinensis*)		FW		C	C									A	C	A	O		
Redhead (*Aythya americana*)		W		C										O					
Canvasback (*A. valisineria*)		W		C										A		C			
Blue-winged teal (*Anas discors*)		M		R															
Snowy egret (*Leucophoyx thula*)		W					R							R					
Virginia rail (*Rallus limicola*)		SpSF					U												
Long-billed curlew (*Numenius americanus*)		M			R		R							U					
Marbled godwit (*Limosa fedoa*)		FW			U									O					
Greater yellowlegs (*Totanus melanoleucus*)		FWSp			U									C	O				

Table 12 continued.

Species	Subsystems: Marine & Lower Bay	Upper Bay	Riverine	Channel	Habitats: Unconsolidated Shores & Flats	Rocky Shores	Tidal Marsh	Subsystems or Specific Areas: Coos Head		Fossil Point to Pigeon Point		Empire		Pony Slough		Haynes Inlet		Metcalf *Salicornia* Marsh	
								W	S	W	S	W	S	W	S	W	S	W	S
Lesser Yellowlegs (*Totanus flavipes*)		M(F)			R														
Short-billed dowitcher (*Limnodromus griseus*)		M			U									C	C		O		
Long-billed dowitcher (*L. scolopaceus*)		M(F)			R														
Pectoral Sandpiper (*Erolia melanotos*)		M(F)					R							R					
Knot (*Calidris canutus*)		M			U		U												
American bittern (*Botaurus lentiginosus*)		Res	Res				R												
Common egret (*Casmerodius albus*)		FWSp	FWSp				C							U					
Black-crowned night heron (*Nycticorax nycticorax*)		FWSp	FWSp		U														
Sora rail (*Porzana carolina*)		SpS	SpS				R												
Common snipe (*Capella gallinago*)		Res	Res		U		U							U					
Ring-billed gull (*Larus delawarensis*)		FWSp (Res)	FWSp (Res)		C							C	C	C	C	U	U		
Mallard (*Anas platrhynchos*)			FW	A	C		C							A	C	A			
Ring-necked duck (*Aythya collaris*)			W	R										R					
Common merganser (*Mergus merganser*)			Res	U												R			

Table 12 continued.

Species	Marine & Lower Bay	Upper Bay	Riverine	Channel	Unconsolidated Shores & Flats	Rocky Shores	Tidal Marsh	Coos Head		Fossil Point to Pigeon Point		Empire		Pony Slough		Haynes Inlet		Metcalf *Salicornia* Marsh	
	Subsystems			Habitats				Subsystems or Specific Areas											
								W	S	W	S	W	S	W	S	W	S	W	S

Key (Subsystems and Habitats):

Seasonal Use:

- F Fall
- W Winter
- Sp Spring
- S Summer
- M Migrant
- Res Resident
- (Res) Some residents

Abundance:

- A = Abundant ≥ 50/day/observer
- C = Common 10-49/day/observer
- U = Uncommon 0-9/day/observer
- R = Rare ≤ 5/day/observer (includes very rarely sighted species)

Key (Subsystems or Specific Areas):

Seasonal Use:

- W = Oct. - Mar.
- S = Apr. - Sept.

Abundance:

- A = Abundant ≥ 50/day/observer
- C = Common 1-50/day/observer
- U = Uncommon Not seen each day
- O = Occasional
- R = Rare Not seen every year

1 *Eelgrass beds*

Table 12 continued.

Species noted by Magwire 1976 but not by USACE 1975	C H		F Pt, P Pt		Emp		P Sl		H I		MM	
	W	S	W	S	W	S	W	S	W	S	W	S
Yellow-billed loon *(Garia adamsii)*		R										
Eared grebe *(Podiceps caspicus)*		O	C		O		O	O	C	O	C	
Emperor goose *(Anser albifrons)*											R	
White-fronted goose *(Philacte canagica)*							R					
European wigeon *(Mareca penelope)*							R					
Hooded merganser *(Lophodytes cucullatus)*									R			
Turkey vulture *(Cathartes aura)*	O	U						O				
Osprey *(Pandron haliaetus)*		O						O	O			
Black oystercatcher *(Haematopus bachmani)*	U	O										
Wandering tattler *(Heteroscelus incanun)*	U	O										
Rock sandpiper *(Erolia ptilocnemis)*		O										
Forster's tern *(Sterna forsteri)*		R										
Common crow *(Corvus brachyrhychos)*					C	C	C	C	C	C	C	C

Coos Bay is located in the Pacific Flyway for migratory waterfowl. USDI (1971) lists marshes, tideflats, and open water as prime bird habitats with some birds relying entirely on one habitat type and others using a variety of habitats.

Ducks, geese, loons, gulls, murres, and terns use the open water for resting but are commonly found near food sources in shallow water (USDI 1971). Thompson, Smith, and Lauman (1972) state mallard, pintail, wigeon, and coot are the most abundant waterfowl of the area. Surf and white-winged scoters are also found in large numbers. Waterfowl are abundant in November through March with peak populations occurring in December. USDI (1971) states that Coos Bay has 575,000 waterfowl-use days annually and 1,350 hunter-use days. The protected Pony Slough and Haynes Inlet areas receive particularly heavy use by waterfowl.

COOS ESTUARINE SUBSYSTEMS

The Coos Bay estuary can be divided into marine, bay, riverine and slough subsystems based on sediments, habitats, and geographic location (Fig. 17). Physical and biological characteristics of each subsystem are a result of the relative influence of ocean water, river water, and currents. Although the subsystems do not function independently, a separate discussion of each of the subsystems is used in considering management options.

Marine Subsystem

The marine subsystem is defined as the area between the mouth of the Coos Bay estuary and RM 2.5 (Fig. 17). The vigorous wave action it experiences helps to create and maintain the unique habitats found in this subsystem.

Alterations to the marine subsystem have been numerous. The natural channel across the Coos Bay bar averaged 10 ft in depth and 200 ft in width. The first alteration was a half-tide jetty just upbay from Fossil Pt. constructed in 1880 (USACE 1973). The North Jetty was constructed in the 1890s and reconstructed in the late 1920s, when the South Jetty was built (Lizarraga-Arciniega and Komer 1975). The entrance channel has recently been dredged to 45 ft deep and 700 ft wide at the outer bar and gradually decreases to 35 ft deep and 300 ft wide at RM 1. Previously, the depth was maintained at 40 ft over the entrance bar and 30 ft at RM 1 (USACE 1975).

The entrance channel is exposed to high waves generated by local coastal storms and swells from Pacific Ocean storms (USACE 1973). Waves up to 27 ft occur during major storms (USACE 1973). Mean tidal range at the bar is 6.7 ft with predicted extremes of 10.5 ft above MLLW and 3 ft below MLLW.

During 1973-74, high tide salinities at the mouth ranged from 30.5 ppt at the surface in December to 33.9 ppt at both surface and bottom in June (Arneson 1976). Even during periods of high runoff, high tide salinity at the mouth is similar to that of the ocean. Low tide extremes of 13.0 ppt at the surface in December and 3.33 ppt in September demonstrate the dilution effect of high runoff (Arneson 1976). Vertical salinity profiles from 1973-74 show the mouth was well mixed in June and September, stratified at high tide and partially

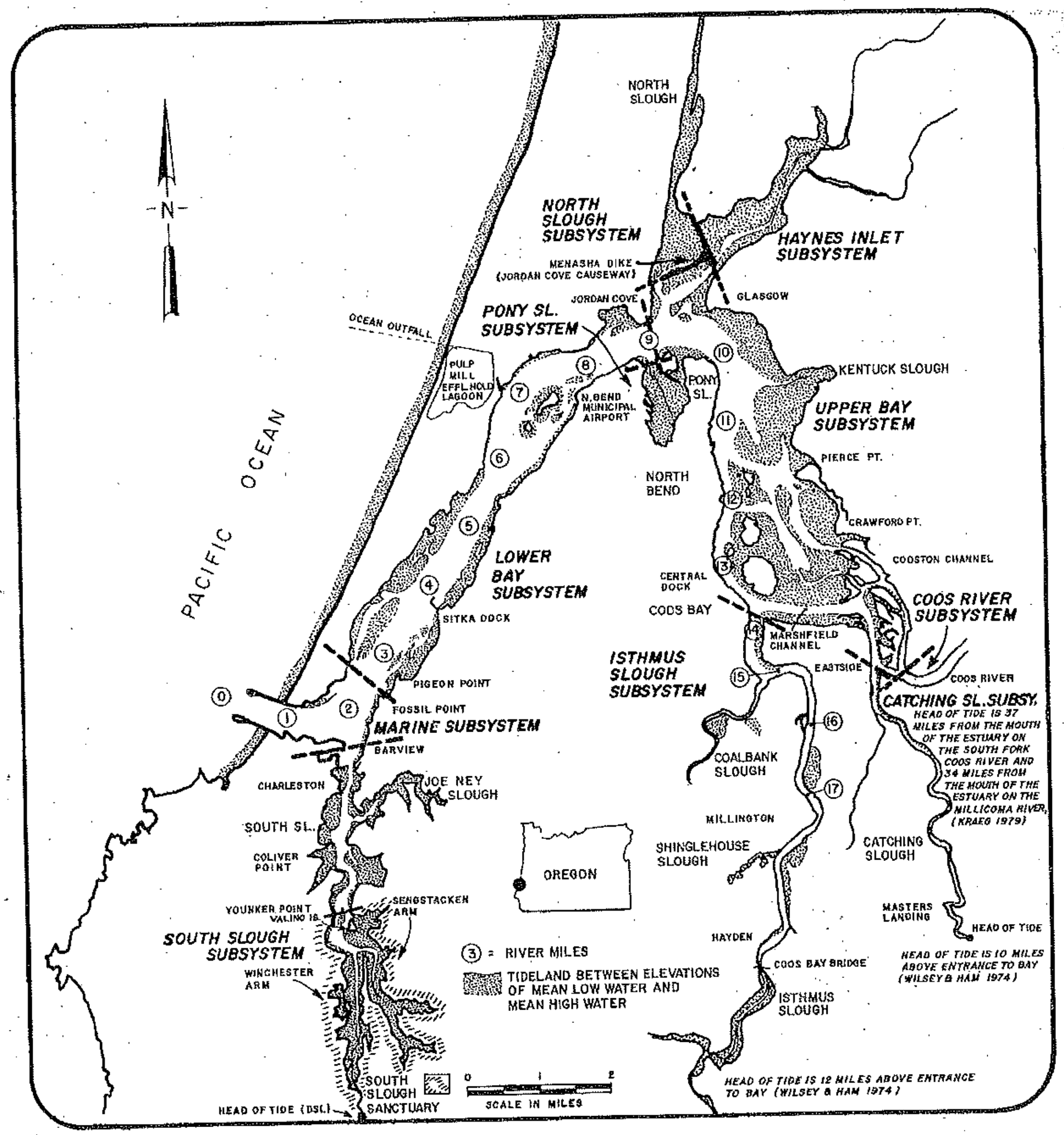

Fig. 17. Coos Bay estuarine subsystems.

mixed at low tide in December, and well mixed at high tide and partially mixed at low tide in March (Arneson 1976).

In general, the water quality of the marine subsystem is good. Temperature generally is similar at high tide to that of offshore waters and may be somewhat influenced by the temperature of the inflowing river waters at low tide (Arneson 1976). Low dissolved oxygen has occasionally been measured by DEQ near the mouth, and a DO depression was also observed by Arneson (1976) during his fall low tide measurements. Waste water from seafood processing which is discharged subtidally into the marine subsystems and upwelling of offshore waters low in dissolved oxygen may be contributing factors to low DO near the mouth (Arneson 1976).

Dredging records show that most of the materials removed from the entrance are clean sands, probably of marine origin (USACE 1975). Dredged material from this area is normally disposed at sea. Spoil from the Charleston area to about RM 10 is disposed in the estuary. The shorelines to the north and south of the entrance advanced following construction of the jetties, probably as an adjustment to a new equilibrium in an area that is experiencing no net north-south sand transport along the beaches (Lizarraga-Arciniega and Komar 1975).

Habitats and species

The marine subsystem has an exceptional diversity of habitats, including sand, cobble, boulder, and bedrock shores; sand and sand-mud flats; algal beds on unconsolidated bottoms and on bedrock; eelgrass; and subtidal unconsolidated bottom (Fig. 18).

Habitats of the north shore of the marine subsystem include the artificial boulder shores of the jetty, a narrow cobble shore, sandy shores and flats, and a flat of sand-mud substrate (Fig. 18). Little is known of the biology of this area. Seining studies have shown large numbers of Pacific herring, surfsmelt, whitebait smelt, shiner perch, and silver surfperch in the area (Hostick 1975). Feeder coho salmon have been found using the sandy area just inside the jetty. This area is just below a very productive portion of the lower bay subsystem and the salmon may be feeding on material carried in the water column as it ebbs from the productive flats (personal communication, Bill Mullarkey, ODFW, May 15, 1979).

The south shore habitats of the marine subsystem include jetty boulders, bedrock shores below the cliffs of Coos Head, small sandy shores, the boulders of the Charleston breakwater, and a transient sand bar west of the Charleston channel (Fig. 18).

The area north of the Charleston breakwater is inhabited primarily by a few species of molluscs and annelids. The sand bar west of the Charleston channel contains the only in-bay population of razor clams on the southern Oregon coast. This clam bed is heavily used by recreational diggers (USACE 1978). USACE has proposed an extension of the Charleston breakwater near the sand spit to stabilize the Charleston channel. The Corps Environmental Impact Statement for this project (USACE 1978) states the clam population will survive the planned modification.

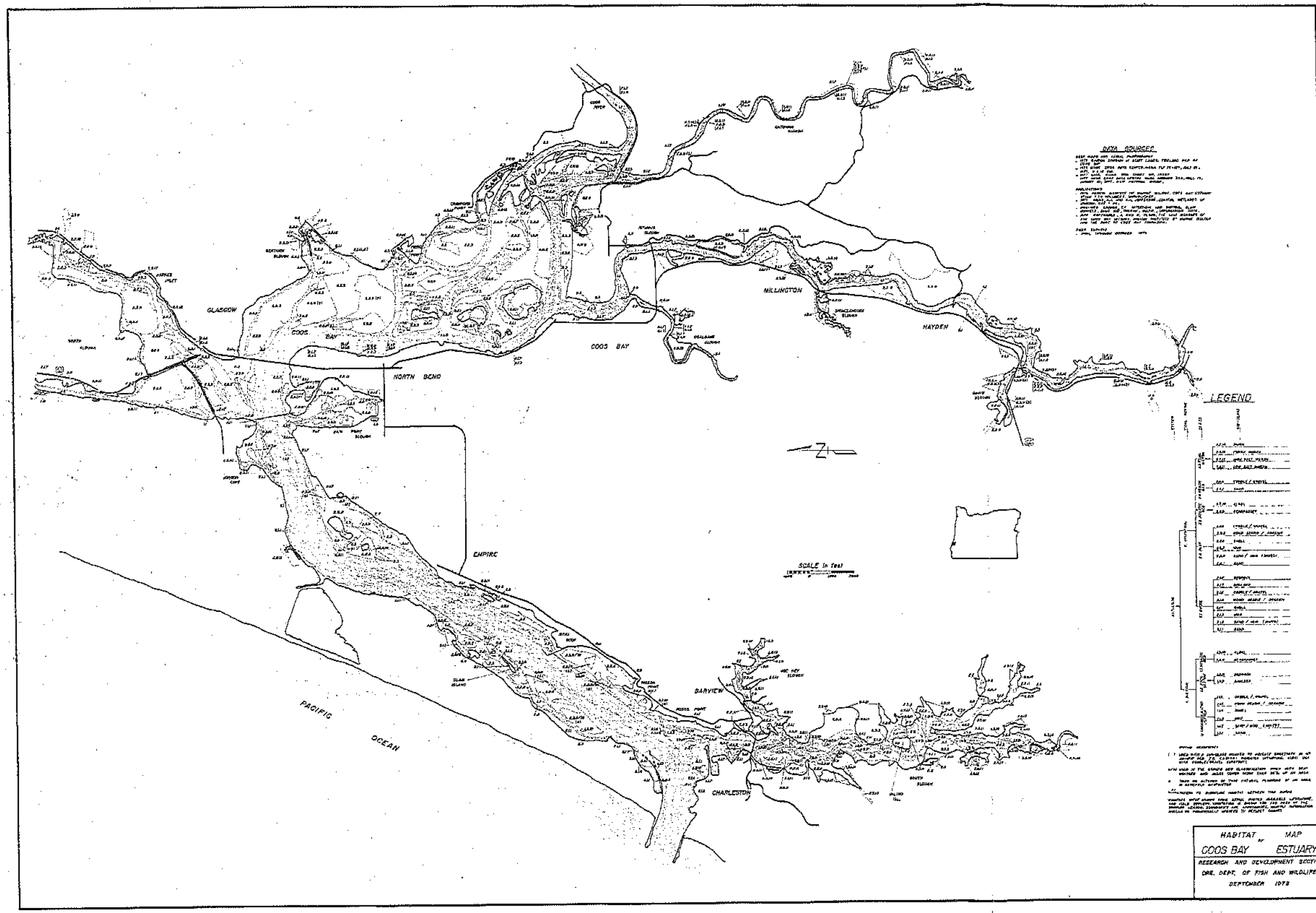

Fig. 18. Habitat map of Coos Bay.

The eastern shore of the marine subsystems has the largest naturally occurring rock habitat in the estuary. This high salinity, protected bedrock is unique to the Coos Bay marine subsystem and is rare in other Oregon estuaries. Over 40 species of plants and 100 species of animals inhabit this area in a community that resembles typical protected outer coast algal and invertebrate communities (Rosenkeetter et al. 1970). Green, brown, and red algae are well represented in the flora of Fossil Pt. (Sanborn and Doty 1944). Sponges, sea anemones, hydroids, and ribbon worms are found in this area (USACE 1975). Certain groups of annelids (sabellids, serpulids, syllids, and phyllodocids), grazing gastropods, carnivorous snails, and nudibranchs are also common.

Small kelp (*Nereocystis leutkeana*) beds occur in the tidal area just north of Coos Head, north of Charleston breakwater, and southward of Fossil Pt.

During the summer sampling, certain fishes were found only in the marine subsystem (Table 9) (Hostick 1975). These fish are commonly associated with open coastal waters. The apparent restriction of these species to the marine subsystem may be due to physiological tolerances or preference for rocky habitat. Almost all other species recorded in the estuary occur in the marine subsystem at some time during the year as residents or migrants (Cummings and Schwartz 1971).

A substantial percentage of the 1978 Pacific herring spawn in Coos Bay occurred on the rocks, algae, and eelgrass of the Fossil Pt. area (Miller and McRae 1978).

The South Jetty is a popular area for sport angling and offers the most varied species to shore fishermen (Gaumer et al. 1973). Redtail surfperch, striped seaperch, Pacific tomcod, starry flounder, and kelp greenling were the most frequently taken fish (Gaumer et al. 1973). A small fishery for chinook and coho salmon occurs from the jetties in late summer. Black rockfish, Pacific tomcod, coho salmon, and Dungeness crab are taken in large numbers in the marine subsystem by boat anglers.

Within Coos Bay, brown pelican, harlequin duck, oldsquaw, surfbird, and blacklegged kittiewake, yellow-billed loon, black oystercatcher, wandering tattler, rock sandpiper, and Forster's tern have been observed only in the marine subsystem (Table 12). Common murres and pigeon guillemots are most abundant in the bay at Coos Head (pers. comm., McGie). Bald eagle and osprey are occasionally sighted (pers. comm., McGie). Pelagic cormorant are abundant at Coos Head, and a nesting population of 12 to 15 pairs occurs on the cliffs there (Graybill 1978). Belted kingfisher and rough winged swallows also nest along the cliffs at Coos Head.

Recommendations

The marine subsystem of Coos Bay contains unique habitats not found in other sybsystems of the estuary and infrequently occurring in other Oregon estuaries. Fossil Pt. is the only naturally occurring rock in the bay exposed to vigorous wave action. Within the area are a biologically significant algal bed and subtidal kelp bed. It provides habitat for diverse invertebrates and fishes and an important spawning site for herring. It is also a valuable scenic and open-space resource. Only those low intensity uses which will not substantially alter these existing habitats and species should be permitted.

The cliffs of Coos Head, which provide nesting areas for pelagic cormorants, kingfishers, and swallows, and the tidal sand flat west of Charleston channel, whch has the only in-bay population of razor clams on the south coast, should be protected in order to maintain the diversity of habitats within Coos Bay and among Oregon estuaries.

Use policies of the marine subsystem should strive to protect water quality. It may be appropriate to restrict discharge of effluent at low tide during times of low river flow or high water temperature.

Lower Bay Subsystem

The lower bay subsystem extends along the main channel from RM 2.5 to the railroad bridge at RM 9 (Fig. 17). Although still under considerable oceanic influence, it is not as strongly affected by wave action as is the marine subsystem.

Salinity extremes recorded by DEQ in this subsystem were 34.0 ppt and 10.7 ppt at a station 1/4 mile north of Pigeon Point, compared to 34.2 ppt and 3.7 ppt at a station 1/4 mile west of the railroad bridge. During 1973-74 surface salinity from RM 2.9 to RM 8.3 at one time differed as little as 0.3 ppt at high tide during periods of low flow to as much as 14.4 ppt at high tide during periods of high flow (Arneson 1976). Surface salinity changed from 24.7 ppt to 11.5 ppt between high and low tides during high flow at RM 2.9 (Arneson 1976).

Salinity gradients indicated the lower bay was well mixed at times of low flow. During high flow the subsystem was stratified at high tide and partly mixed at low tide. During intermediate flows (March), it was partially mixed at low tide and well mixed at high tide.

Dissolved oxygen levels measured at DEQ monitoring stations in the lower bay have been above the minimum standards required for estuarine waters during the 70s (DEQ 1978). However, one sample taken near a log dump in Empire showed very low DO and high turbidity (STR 1974, USACE 1975).

Coliform counts exceeding standards for commercial shellfish harvest and even exceeding general health standards have frequently been measured at DEQ Station 6, 1/4 mile west of the railroad bridge (DEQ 1978). Counts exceeding standards at other DEQ stations in the lower bay are infrequent. Two sewage treatment plants discharge waste from the east side of the lower bay near Empire and near Pony Slough.

Pollutants discharged in the lower bay may not be rapidly flushed through the estuary. Flushing times ranged from 6.2 days in December to 19 days in June 7.6 miles from the mouth (Arneson 1976).

The sediments of the lower bay are predominantly marine sands (Arneson 1976) and probably include sands blown into the bay from the dunes.

Habitats and species

Subtidal habitats of the lower bay include the unconsolidated bottom of the dredged ship channel and adjacent area and aquatic beds in shallower areas (Fig. 18). The substrate is primarily sand (USACE 1975, Jefferts 1977). Shell and wood mixed with sand have also been reported at RM 7, 8, and 9 (Jefferts 1977).

The major alteration to the subtidal lower bay is channel dredging and associated in-bay spoil disposal. Disposal sites for the recently completed deep draft dredging project were adjacent to the channel at about RM 3, between RM 4 and 5, just below RM 6, and between RM 8 and 9.

Biological information on the subtidal lower bay is incomplete. Jefferts (1977) has examined infauna of the dredged ship channel, and ODFW has surveyed clam populations of some subtidal areas (Gaumer 1978).

Surveys west of the channel between RM 4 and 6 show scattered distributions of gaper and cockle clams and densities of 1-5 clams/ft^2 (Figs. 9 and 10) (Gaumer 1978). Butter clams were found in only a few locations in the survey area (Fig. 13) (Gaumer 1978). A 48 ac subtidal area off Pigeon Point was thoroughly surveyed to evaluate its potential for commercial clam harvest (Gaumer 1976). Population estimates for that bed were 5,648,700 gapers, 202,200 cockles, 843,000 littlenecks, and 809,200 butters (Gaumer and Halstead 1976). The bed produced a commercial gaper harvest of 11,931 lb in 1977 and 27,505 lb in 1978.

The infauna of the lower bay dredged channel has numerous species representing many groups of animals (Jefferts 1977). The fauna is more diverse and less likely to be composed of cosmopolitan species than the upper reaches of the dredged channel. Both numbers of species and numbers of individuals were found to decrease with depth in the sediment. Jefferts (1977) concluded that dredging has a relatively minor influence on the fauna of the lower reaches of the estuary, which primarily reflect the coarse sediment type rather than the effects of mechanical disturbance.

The intertidal habitats of the west side of the lower bay include large aquatic beds, sand-mud flats, sand shores, and small marshes (Fig. 18). Between RM 2.5 and 6, flats prevail. From RM 6 to RM 8 there is a narrow sand shore, and between RM 8 and 9 lies Jordan Cove with its flats, aquatic beds, and fringe of marsh.

The southwestern portions of the lower bay has been altered through the disposition of dredge spoils which form "Clam Island" and which have raised some of the shoreline above tidal level. The eelgrass beds are quite extensive and the flats are probably the most productive clamming areas in the bay. Gaper clams occur in densities of greater than 5/ft^2 over much of the area (Fig. 9) (Gaumer 1978). Cockles, butter clams, and native littlenecks are also widely distributed over the flats but occur in lesser density than the gapers (Figs. 10 and 13). Softshell clams are not found in the southernmost flat but occur from Clam Island northward (Fig. 12) (Gaumer 1978).

The southern flat was by far the most prolific site for recreational gaper harvest during a 1971 ODFW survey (Gaumer et al. 1973). Substantial numbers of cockles and butter clams were also taken there.

Above RM 6 the narrow sandy shore drops off quickly into the subtidal zone. Current through this portion of the bay is swift and scours the shores so that attached vegetation is absent. Five pile dikes were placed along this shore to retard erosion and prevent further curvature of the ship channel (USACE 1973). While this area appears barren in comparison to the flats to the south, it is an important feeding area for Englis sole, topsmelt, surfsmelt, herring, northern anchovy, and coho and chinook salmon (pers. comm., Mullarkey). Many of these fish feed on material in the water column from productive areas adjacent. Gut content analysis of salmon seined in sandy areas during August 1978 showed larval fishes were the main diet during the period sampled (pers. comm., Bender).

Jordan Cove lies between RM 8 and 9. Recreationally important clams are scarce, but ghost shrimp occur in moderate density over the entire area of flats and aquatic beds (Fig. 15). Softshell clams are sparsely distributed around the edges of the flats, and smaller species of clams are scattered across the cove (Gaumer 1978).

Just west of the railraod bridge at Jordan Point is a sandy area where ODFW repeatedly seines large numbers of fish (pers. comm., Bender and Mullarkey). The site was highest in numbers of individuals and second in numbers of species taken during seining efforts in 1970 (Hostick 1975).

Below Sitka Dock on the east side of the lower bay, there are broad algal and eelgrass beds on a sand-mud substrate with three large areas of cobble, where dredeged materials have been deposited. The cobbles form a habitat that is unique in the bay and may add niches for colonization by marine life. A high density of marine species, primarily rockfish, have been consistently found there in recent ODFW surveys (pers. comm., Bender).

Gaper clams are much less dense here than on the west side of the bay (Gaumer 1978), but the area provided recreational diggers with the second highest number of gapers taken in 1971 (Gaumer 1973). Butter clams are found among the cobbles of the spoil site (Gaumer 1978), and the Pigeon Point flat was by far the most productive butter clam area in 1971 (Gaumer 1973). Pigeon Point was also the prime site for the harvest of littleneck clams (Gaumer 1973). Ghost shrimp are also common in the area (Gaumer 1978).

The large eelgrass beds of the Pigeon Point area are of particular significance in providing food for migratory black brant. Harbor seals use one of the spoils disposal sites as a haul out area (pers. comm., Graybill). A historic seal haul out area is also located on the western shore of the lower bay just below the Ore-Aqua salmon ranching facility.

The tideflat habitats near Sitka Dock were significantly degraded by waste discharge from the Coos Head Pulp Mill which operated until 1971. Biological productivity has been increasing since closure of the mill (George M. Baldwin and Associates et al. 1977). A dense eelgrass meadow has become established southwest of the mill site, and gaper, tellen (*Tellina* sp.), cockle, *Macoma* spp., and softshell clams occur there (George M. Baldwin and Associates et al. 1977). Studies of the recovery of the flat have not been undertaken. The area is under private ownership and is not available to the public for recreation.

North of Sitka Dock, ghost shrimp, tellens, *Macoma* spp., and softshells inhabit the sand-mud flats and eelgrass beds. Flats there provided the greatest number of ghost shrimp to diggers of the areas surveyed in 1971 but were used much less heavily than the Pigeon Point flats (Gaumer 1973). Limited access and the clam distribution may influence the use pattern.

The narrow north shore of Empire, which is affected by storage of logs at the Cape Arago Lumber Company Mill, gradually widens into the broad complex of flats, aquatic beds, and small marshes southwest of North Bend Municipal Airport (Fig. 18). Qualitative studies show that the area is inhabited by softshell clams, tellens, *Macoma* spp., and polychaete worms (Figs. 12, 14, and 11). A quantitative study of the area has recently been completed and will be available through LCDC (Gonor 1979).

Several fish species are found in the lower bay nad marine subsystems (Table 9). Other species, such as English sole are most abundant in the lower bay, although they may be found further upbay. Sampling during the summer of 1970 showed that juvenile chinook salmon and lingcod were most common at lower bay sites (Hostick 1975; Cummings and Schwartz 1971).

Most of the fish species of Coos Bay use the flats of the lower bay at some time during the year (Cummings and Schwartz 1971). Habitat has considerable bearing on types of fish present. Vegetated areas appear to exhibit greater species diversity and are preferred by surfperch, pipefish, snake prickleback, gunnel species, and starry flounder (pers. comm., Mullarkey). Many of the species are found in greatest numbers over the sandy substrates (pers. comm., Mullarkey).

The aquatic beds adjacent to the North Spit, the Roseburg Lumber Co. dock, and the aquatic beds of Jordan Cove on the west side of the lower bay and the aquatic beds to the north and south of Sitka Dock are prime herring spawning areas (Jackson 1979; Miller and McRae 1978).

A salmon release-recapture facility (Oregon Aqua Foods) is located at about RM 5.5 on the west side of the bay. Another facility, Anadromous Inc., is located at Jordan Pt. at the extreme eastern border of the lower and upper bay subsystems (Fig. 17).

The lower bay was by far the most popular boat angling area in surveys conducted in 1971 (Gaumer et al. 1973). Dungeness crabs represented 80% of the catch. Black rockfish, red rock crab, perch species, and kelp greenling were also taken in large numbers (Gaumer et al. 1973).

Most of the bird species of Coos Bay may be found in the lower bay, and several species have their prime distributions in the lower bay and marine subsystems (Table 12). The more abundant of these birds include Brandt's cormorants, pelagic cormorants, black brant, surf scoters, northern phallaropes, western gulls, glaucous-winged gulls, mew gulls, Heerman's gulls, Bonaparte's gulls, and common murres. A variety of migrant and wintering shorebirds feed on the exposed intertidal mud flats.

Recommendations

The lower bay between RM 2.5 and RM 5 is an area of exceptional natural productivity and a prime aesthetic and recreational resource. The tideflats, eelgrass, and algal beds along the western shore of this region should be considered as major tracts, which require inclusion in a natural designation as described by the LCDC Estuarine Resources Goal (1977).

Although the sandy shore between RM 6 and 8 on the western side of the bay appears unproductive because it does not have attached vegetation, it is a valuable habitat for certain species of fish. Any development occurring there should preserve the sandy substrate and water quality of the area. Use of pilings may be appropriate in the area unless subsequent reduction in current velocity changes the quality of the substrate.

Sitka Dock at about RM 3.8 is located along the eastern shore of the productive lower bay. The adjacent area was formerly degraded by waste discharges, but some evidence suggests that the nearby tidal flats are recovering. Upland uses near the Sitka Dock area are primarily residential. The location of the dock within a prime natural and recreational resource area makes the area unsuitable for industrial development, but water-dependent recreational development would appear to be appropriate.

A public boat ramp, fish processing plant, oil company docks, and a mill are located on the eastern shore at Empire. These developments contribute to degradation of the habitats. Habitat restoration or further development for water-dependent uses, preferably constructed on pilings, are possibilities for this area.

The large flats southwest of the North Bend Airport and the Jordan Cove area should be considered major tracts and protected accordingly (LCDC 1977).

In-bay spoiling of material dredged from the channel between RM 3 and RM 10 should be discontinued. This activity reduces the tidal prism and further increases filling of the estuary, which is already accelerated from upstream activities. Habitat is irreversibly lost, even with mitigation. Suitable areas should be located for upland or offshore spoil disposal.

Upper Bay Subsystem

In the upper bay subsystem Coos Bay broadens into a complex of wide shallow tidal flats adjacent to the main dredged ship channel (Fig. 18). It extends from the railroad bridge at RM 9 to the southeastern corner of Bull Island at RM 17 (Fig. 17).

Massive alterations have occurred in the upper bay. The dredged ship channel runs along the west side of the bay, and industrial activity for the Port of Coos Bay is centered there. The channel between RM 9 and the mouth of Isthmus Slough is 35 ft deep and 400 ft wide. A turning basin 35 ft deep, 800 ft wide, and 1000 ft long is at RM 12. Filling of tidelands has occurred along the western shore, south of Marshfield Channel at Eastside, and on the major tideflats, where dredged materials form several spoil islands. Much of the filling has occurred to dispose dredged material and to provide sites for industrial development. The upper bay also receives industrial wastes and is a site of log storage and handling.

The upper bay receives freshwater inflow from Coos River, Catching, Isthmus, Kentuck, and North sloughs, and Haynes and Willanch inlets. Measurements at the mouth of Kentuck Slough indicate salinity extremes of 33.7 ppt and 3.0 ppt, while extremes measured at the mouth of Marshfield Channel were 33.7 ppt and 0.5 ppt (DEQ 1978). The organisms of the upper bay are exposed to low salinity during freshets, but the water is saline during low flows.

Extreme tidal currents of 4 ft/s have been measured at North Bend, and mean currents are about 1 ft/s (Aagard et al. 1971). Mean seaward velocity of river dishcarge passing a cross section between North Bend and Pierce Pt. is less than 0.1 ft/s at times of low runoff and 3-4 ft/s during peak runoff. Seaward ebbs of 6-8 ft/s during periods of high runoff have been predicted (Aagard 1971).

Wave development over the tideflats of the upper bay is limited by the short fetch and shallow water. Before recent channel deepening, phase changes indicated high dampening of the tidal wave in the upper bay as tidal energy was spent in turbulent mixing over the wide tideflats (Blanton 1964). Mixing in the main bay was probably sufficient so that stagnation causing anoxic conditions did not occur in the main bay (Aagard et al. 1971). The effect of recent channel deepening on tidal circulation has not been evaluated.

Sediments of the upper bay main channel are sandy from RM 9 to RM 10.5, shell from RM 10.5 to RM 12, and mud from RM 12 to RM 15 (USACE 1975). The main channel adjacent to Coos Bay is the area of most active deposition of river sediments (Aagard et al. 1971). Prior to channel deepening, RM 12-15 have been dredged every three years with an average of 450,000 yd^3 of sediment removed annually (USACE 1976). Sediments removed from the main channel above RM 12 do not pass EPA pollution standards for in-water disposal of materials. The sediments of the upper bay tidal flats are primarily silty with some areas of sand near the spoils islands. Wood debris overlies the sediments in many areas (Ednoff 1970).

During the past century the Coos River has changed its course through the upper bay (Aagard et al. 1971). Formerly the main flow of the river was east of Bull Island. At the northern end of Bull Island, it bifurcated into the East Channel and the main Marshfield Channel. At that time, Catching Slough had a large tidal prism and strong tidal flushing.

Splash damming, log transportation, and dredging have increased the size of the channel to the south of Bull Island (the Cutoff) so that it now carries the main flow of the river. As recently as 1970 the channel northwest of Bull Island has been deepening and eroding the tip of the island. From 1944 to 1970 the Cooston and East channels have been stable with minimal channel migration and sedimentation (Aagard et al. 1971). The tendency for channel migration does exist, and changes in hydrographic conditions, such as major dredging projects, may have unpredicted effects on shifting river channels.

Elutriate tests of core and water samples indicate that the main ship channel above RM 12 is polluted (USACE 1976). Coliform counts at DEQ stations in the upper bay during the 70s have frequently been higher than general standards for estuarine waters. In the main shipping channel, the frequency of violations increased from the station at the mouth of Kentuck Slough to the station at the mouth of Marshfield Channel (DEQ 1978). Dissolved oxygen less than the 6 ppm standard for estuarine waters was also measured with increasing frequency (DEQ 1978). STR (1974) attributed coliform problems to the presence of municipal sewage treatment plants and DO problems to municipal sewage treatment plants, industrial wastes, and log storage.

Habitats and species

Subtidal areas of the upper bay include the deep draft dredged ship channel; the shallowly dredged Marchfield, Cooston, and East channels; and the smaller channels draining the tidal flats (Fig. 18). Most of the information available on the upper bay subtidal concerns the dredged ship channel. The ship channel presents an altered environment for colonization by estuarine species. Maintenance dredging, propellor wash, and anchor drag frequently resuspend sediments so that little attached vegetation can grow (Parr 1974).

The benthic fauna of the dredged channel represents a community that has become adapted to the stresses of frequent sediment disruption (Parr 1974). Patches of substrate missed during dredging may be important to re-establishment of benthic organisms (Slotta et al. 1974).

Streblospio benedicti, an annelid, is the dominant organism in the upper bay subtidal area (Parr 1974; Jefferts 1977). Species most frequently encountered by Parr (1974) were

Annelids:

Streblospio benedicti
Pseudopolydora kempi
Polydora ligni
Eteone lighti
Capitella (capitata) ovincola
Notomastus (Clistomastus) tenuis
Glycinde armigera

Pycnogonids:

Achelia nudiuscula
Achelia chelata

Bivalves:

Macoma inconspicua
Clinocardium nuttallii
Mya arenaria
Modiolus sp.

Amphipods:

Corophium salmonis
Corophium spinicorne
Anisogammarus ramellus

These taxa are frequently reported in the literature to be associated with polluted environments (Parr 1974). Jefferts (1977) postulated that in the upper reaches of the estuary, the high water, organic content of the sediment, and the reduced grain size have a deleterious effect on faunal diversity and depth of distribution of organisms in the sediment.

Distribution of fish and of mobile invertebrates, such as crabs, in the dredged channel has not been adequately studied. Seining near the channel in 1970 revealed that shiner perch, silver surfperch, American shad, and English sole use the area in addition to a number of less freqeuntly captured species. More silver surfperch were captured per haul at this location than in other seining sites on the estuary.

Anglers catch pile perch, striped seaperch, and white seaperch from the Coos Bay waterfront (Gaumer et al. 1973). Thirty-eight species of fish have been recorded using the upper bay during the summer (Cummings and Schwartz 1971). Many of the fish probably feed over the tidal flats and congregate in the channels at low tide.

The intertidal area of the upper bay is composed of broad, shallow tidal flats, eelgrass beds, and tidal marshes (Fig. 18). George M. Baldwin and Associates et al. (1977) calculated that tidal flats composed predominantly of mud occupied about 4.5 mi^2. Sand occurs near the spoil islands, and wood debris is common on the southern portion of the flats. A huge eelgrass-tide-flat complex stretches from the Jordan Cove causeway south to the Marshfield Channel. The northern two-thirds of this area is an extensive eelgrass meadow, the largest in Coos Bay and one of the largest in Oregon (George M. Baldwin and Associates et al. 1977). Development has altered intertidal habitats along the shoreline of Coos Bay and North Bend. Studies of invertebrate distribution and abundance have not been conducted.

At least 10 species of annelids, 10 species of molluscs, and 13 species of crustaceans have been recorded from the muddy upper bay tidal flats (USACE 1975). The sea hare (*Aglaja diomeda*) has been recorded in the bay only from upper bay eelgrass beds, and the distribution of the freshwater crab is the upper bay and riverine areas.

The only clam taken recreationally which inhabits the upper bay in large numbers is the softshell, although small cockles have also been reported there. Lugworms and ghost shrimp are the other upper bay invertebrates sought by recreationists. McConnaughey et al. (1971) divided the tidal flats and eel-grass beds into four smaller subunits in their study. Biomass results of the most common species are summarized in Table 13. Animals were the most diverse and abundant within the dense eelgrass beds. Softshells and Dungeness crabs were found in much greater concentrations in the dense eelgrass, but certain invertebrates, such as the ghost shrimp and the false mya (*Cryptomya californica*) preferred sandier substrates and areas of less eelgrass.

Log storage over the flats and channels of th upper bay is common. Log storage areas have been mapped by the Coos County Planning Department. A DEQ study (Zegers 1978) of the impact of logs grounding on tideflats at low tide included sampling sites in the Cooston Channel of the upper bay. There was a large reduction in the number of total organisms (including annelids, arthropods, and molluscs) per unit area in grounding areas compared to adjacent control sites.

It is possible to cultivate oysters (*Crassotrea gigas*) in the upper bay, but commercial harvest there is prohibited because of poor water quality.

The upper bay tidal flats are an important feeding area for shad and striped bass (Cummings and Schwartz 1971). Adult shad may spend several weeks there, and bass can be found there most of the year. Juvenile salmonids also use the area for feeding. Among the most numerous fish found in the upper bay were shiner perch, silver surfperch, shad, topsmelt, starry flounder, and English sole (Hostick 1975).

Table 13. Average sample composition (g/m^2) of most common macrofaunal invertebrates in upper bay tidal flats and eelgrass beds (McConnaughey et al. 1971)

Organism	Subunit I	Subunit II	Subunit III	Subunit IV
Mya arenaria	3.02	0.97	17.28	39.20
Tellina salmonea	1.69	3.95	2.02	2.27
Macoma baltica	0.71	1.95	0.91	0.61
Others	0.77	0.07	4.51	0.65
Clam Total	6.19	6.94	24.72	42.73
Nereis brandti	1.25	2.89	1.60	5.42
Heteromastus f.	2.26	2.48	1.88	2.49
Eteone lighti	0.53	1.04	1.62	1.08
Others	0.87	0.66	1.04	1.91
Worm Total	4.91	7.07	6.14	10.90
Corophium s.	0.71	2.62	2.05	3.53
Anisogammarus c.	0.24	0.00	0.05	0.32
Haustorius sp.	0.01	0.01	0.03	0.01
Others	0.10	0.00	0.00	0.05
Amphipod Total	1.06	2.63	2.13	3.91
Cancer magister	0.00	0.00	0.00	1.55
Callianassa c.	0.34	0.00	1.56	0.00
Tectibranch (?)	0.07	0.16	0.01	0.49
Biomass Total	12.97	16.75	34.72	59.85
Number of Samples	38	16	9	11

I. Near spoil islands, sandy substrate, high elevation
II. Mud without eelgrass
III. Areas with sparse to medium density eelgrass
IV. Areas with dense eelgrass covering.

The upper bay has not been studied as a discrete unit with regard to bird use. Western grebes, pintails, canvasbacks, buffleheads, killdeer, snipe, sandpipers, sanderlings, dunlins, herring gulls, and Bonaparte's gulls were among the more abundant birds sighted in the area during the 1977 and 1978 Audubon Christmas Bird Counts. Graybill (1978) noted a particularly large population of sandpipers on the flats of the upper bay.

In general, the upper bay intertidal area is inhabited by fewer species than either the lower bay or marine subsystems. Jefferts (1977) states "The number of species present in a community is roughly inversely proportional to the degree of environmental uncertainty." The physiological stresses of salinity and temperature fluctuations in the upper bay as well as the presence of pollution and mechanical disturbance tend to produce a community that is physically controlled. Although fewer species are present in such a community, individuals may be numerous, occur in high biomass, and be important to the overall estuarine food chain. For example, *Corophium spinicorne*, the dominant upper bay amphipod, is abundant and is important in the diet of juvenile salmonids during their seaward migration (personal communication, Paul Reimers, ODFW, March 18, 1979).

Present marshes of the upper bay subsystem are located along the eastern side of the bay at the mouths of Kentuck Slough and Willanch Inlet, on the Coos River delta islands and adjacent shores, on the northeastern portion of the Eastside peninsula, and on the spoil islands east of the main ship channel (Fig. 18). Acreage of upper bay undiked marshes was estimated by Hoffnagle and Olson (1974):

Low sand marsh	46.3
Low silt marsh	3.8
Sedge march	22.1
Immature high marsh	416.4
Mature high marsh	44.8

Most of the marsh area of Kentuck and Willanch inlets has been lost through diking (Johannessen 1961, Hoffnagle and Olson 1974). Original diking along the upper portion of Kentuck Inlet was extended and a bridge and tidegate installed. Marsh rapidly invaded the tideflat below this diking (Johannessen 1961). The diked area is currently used for a golf course. In Willanch Inlet about 100 acres have been diked and are used for agriculture, leaving only about 6 acres as marsh (Hoffnagle and Olson 1974).

Extensive marshes currently exist in the Coos River delta and on the shore across the East Channel. Marshland there has increased since the 1800s (Johannessen 1961), probably because of increased siltation (Hoffnagle et al. 1976). The marshes are primarily immature high marsh with *Deschampsia caespitosa, Carex lyngbyei,* and *Triglochin maritima* the dominant plants (Hoffnagle et al. 1976).

The marsh along the shore east of the delta islands was studied by Hoffnagle et al. (1976). The site showed rapid increase in biomass from April to a maximum in June. This site was second in net primary productivity of six marshes studied in Coos Bay with a productivity of 1007.85 g/m^2/yr.

Invertebrates of the Bull Island study site included the sea anemone (*Nematostella* sp.), polychaetes, crustaceans, and molluscs. The number of species reported was intermediate between a site in lower South Slough and one in North Slough (Hall 1976). Fish taken from the site include shiner perch, Pacific staghorn sculpin, starry flounder, gunnel, bay pipefish, and coho salmon. The most common birds noted were the great blue heron, barn swallow, long-billed marsh wren, and song sparrow (Magwire 1976).

In the vicinity of Eastside, diking began before 1980 (Johannessen 1961). About half of the mature high marsh remaining in Coos Bay is in Eastside (Hoffnagle and Olson 1974). Low sand marshes have colonized the edges of these islands (Hoffnagle and Olson 1974).

Losses of marshland in the upper bay have been extensive. Large areas of Kentuck and Willanch Inlets, at Graveyard Pt., on the Eastside peninsula, and near sea level in the cities of Coos Bay and North Bend have been diked or filled for agriculture, industry, and dredge spoil disposal.

Recommendations

The marshes of the Coos River delta islands constitute major tracts of salt marsh, which should be included in a natural management unit as required by the Estuarine Resources Goal (LCDC 1977).

The entire eastern side of the upper bay from Jordan Point to Bull Island and west to the shipping channel is a vast complex of flats, marshes, and eelgrass beds, providing valuable habitat and a rich source of organic material for the entire estuary. George M. Baldwin and Associates et al. (1977) note "the condition of this area is critical for the overall production of the Coos Bay Estuary. Because of its biological importance, the area as a whole should be considered environmentally sensitive." The area should be managed as a single ecological unit. It definitely encompasses major tracts of tideflat and seagrass as discussed in the LCDC Estuarine Resources Goal (1977) and should be managed accordingly.

The tidal flats of the upper bay are feeding grounds for fish, including the anadromous salmonids, striped bass, and American shad. Productivity of these flats should be maintained and increased through restoration of their surface area, including removal of stored logs which ground on the flats.

Habitats along the main channel adjacent to the cities of Coos Bay and North Bend have been altered. Water-dependent uses in these areas are appropriate. Unnecessary pilings should be removed and water quality should be considered in future development. The Cooston Channel is a main artery for the passage of fish between the river and ocean. It should remain unobstructed.

South Slough Subsystem

South Slough enters the main body of Coos Bay near Coos Head, less than 2 mi from the estuary mouth (Fig. 17). It may have once been a separate estuary with its own opening to the ocean. The slough has a drainage basin of 26 mi^2 (STR 1974). Because of its proximity to the ocean, South Slough receives more marine influence than the other slough subsystems. Its north-south orientation makes it particularly susceptible to strong north-northwest winds.

The slough bifurcates into the western Winchester arm and the eastern Sengstacken arm. Major tributaries include Joe Ney and Day creeks from the east; John B. and Talbot creeks, which flow into the Sengstacken arm; and Winchester Creek, which flows into the Winchester arm.

The upper reaches of South Slough (Fig. 17) have been set aside as a research sanctuary to preserve an unaltered site for studies to improve our ability to properly manage estuarine systems. The South Slough Sanctuary was the first of its kind in the nation.

Fresh water inflow into the slough has not been measured directly. Freshwater runoff from the South Slough drainage basin has been estimated from the precipitation and runoff measured in two nearby drainage basins (Harris et al. 1979). Monthly average values ranged from 6 cfs in August to 232 cfs in February. Monthly extremes of 1 cfs and 445 cfs were estimated. Further calculations yielded a representative tidal prism of 3.3×10^8 ft^3 and implied that mixing is thorough and flushing of fresh water is rapid (Harris et al. 1979). Salinity gradients for stations at the mouth of the slough and at Younker Pt. also show the lower slough is well mixed throughout the year (Arneson 1976).

A breakwater separates South Slough from the main body of Coos Bay. A project to extend the jetty to provide additional protection to boats moored in the Charleston boat marina is currently underway. A 10-ft deep, 50-ft wide channel is maintained between the main bay channel and the Charleston Bridge. The Charleston Small Boat Basin is also dredged to dimensions of 500 ft x 900 ft in lower South Slough (USACE 1978). Studies of bottom topography have been conducted by USACE (1978) and a mathematical model, verified by field measurements, of tidal elevations, current velocities, and circulation in South Slough under calm wind and wave conditions has been constructed (USACE 1978). Bathymetric charts are on file at the offices of the South Slough Estuarine Sanctuary. Although DEQ maintains 11 water quality stations in South Slough, most of them are in the lower portion of the slough. Stations have recently been established farther up the slough in conjunction with the South Slough Estuarine Sanctuary, so comparisons should soon be possible.

At the entrance to South Slough, DEQ (1978) has measured salinity extremes of 35.3 ppt and 14.6 ppt. Extremes 0.3 miles south of Collver Pt. were 33.3 ppt and 6.3 ppt. The data suggest that highly saline water extends far into the slough at periods of low flow and that water at the head is fresh at times of high flow.

Dissolved oxygen at the stations monitored by DEQ is generally above minimum standards for estuarine waters (DEQ 1978). Arneson's data (1976) show slight depressions in DO at Younker Pt. in March and at the Charleston Bridge in December relative to surrounding stations.

Several coliform measurements greater than 70 mpn have been taken by DEQ (1978) within the Charleston Small Boat Basin and at the Joe Ney Slough Bridge. Recent work by Plotnick (1979) suggests that improper disposal of sewage from boats may be a problem in the boat basin. Septic tank leakage from dwellings not yet hooked up to the Charleston sanitary district sewage disposal system are another source of coliform. Sampling for coliform in the upper reaches of the slough has only recently begun. Counts in the Sengstacken arm are within standards for shellfish harvest, while those in the Winchester arm often exceed those standards. Livestock waste may elevate coliform counts in the upper reaches of the slough (personal communication, Delane Munson, Manager of South Slough Sanctuary, February 15, 1979).

An examination of the sediment characteristics of volatile solids, Kjeldahl nitrogen, grease and oil, and total sulfides showed that, although the outer boat basin is more exposed to flushing action, it is more highly polluted than the inner basin (Slotta and Noble 1977).

South Slough is an area of sediment deposition. Sediment movement is generally seaward and deposition occurs where movement is obstructed, such as at Valino Island and in regions of large cross sectional area (Baker 1978).

Strong winds may be a factor in sediment resuspension in South Slough as wave bases disturb the bottom (Baker 1978).

Baker (1978) found that most of the sediments of South Slough are a mixture of medium to fine sand eroded from the terrace shorelands and coarse to medium silt from fluvial input. Silty sands are the dominant sediment type over tideflats and in the channels toward the head of the slough. The uppermost reaches are generally silt. Organic content of slough sediments ranged from 0.00 ppt in channel sands to 19.77 ppt in tideflat silts (Baker 1978).

Drainage from Joe Ney Sanitary Landfill was reported to have been increasing sedimentation in South Slough, but recent measures seem to have alleviated the problem (pers. comm., Munson). Logging activities have occurred in the drainage basin which may have obscured the effects of the landfill.

Habitats and Species

The habitats of South Slough show the most variation of any slough subsystem within Coos Bay (Fig. 18). The marine influence, the coarse sediments found in the lower portions of the slough, and the relatively undisturbed nature of the upper portion provide habitats for more species of invertebrates and fish than are found in the other slough subsystems.

South Slough has a irregular shoreline, which leads to a high shoreline to surface area ratio. The area has many diverse habitats. Below the Charleston Bridge are flats of mixed substrate, intertidal and subtidal eelgrass beds, riprapped shores, sandy shores, and only a small amount of marsh. Between the bridge and Valino Island are, in addition to most of the above habitats, a small amount of bedrock shore, sandy bars, and much larger marshes. Above Valino Island the substrate becomes more silty and marshes are more prominent. Eelgrass in the channels extends far up the slough.

Because of the proximity to the ocean and its varied habitats, the number of species inhabiting South Slough is high. Ednoff (1970) recorded more total species from the mud in South Slough than in any other portion of the bay. Polychaetes and molluscs were most diverse in South Slough, but crustaceans were most diverse in the lower bay.

A rich intertidal infauna was also found by Jefferts (1977), who recorded 26 polychaetes, 10 bivalves, 4 harpacticoid copepods, and 7 amphipods. Jefferts' uppermost South Slough station had the lowest diversity of any station sampled. This station was in a backwater with a high concentration of volatile solids, a high water content in the substrate, and was dominated by a few opportunistic species. In these respects, it resembled stations in the upper bay, although the faunal assemblage was different.

Most clambeds used by recreational diggers in South Slough are north of Valino Island. Gaper, butter, cockle, littleneck, and softshell clams are taken from the tide flats. Four South Slough sites provided a total of 22.6% of the marine animals taken by tideflat users in Coos Bay in a 1971 survey (Gaumer et al. 1973). While the clam bed just south of the Charleston Bridge provided the greatest number of clams of the South Slough flats surveyed, the flat just south of the existing boat basin (the Charleston Triangle) had the highest catch per unit effort (Gaumer 1973). Clam resources of this flat have been surveyed in greater detail (Gaumer 1978). Estimates of the populations of recreationally harvested clams occurring there are 1,333,000 gapers, 348,000 cockles, 289,000 native littlenecks, 119,000 butters, and 50,000 softshells. Estimate of the total clam population was 10,078,000 (Gaumer 1978).

Of major significance is the use of South Slough for commercial oyster culture. The only oyster leases in Coos Bay are on South Slough. Leases are scattered on Joe Ney Slough and South Slough proper, except for the Winchester arm (Fig. 16). Oysters can be grown in areas throughout the estuary, but health restrictions due to poor water quality prohibit commercial oyster leases in most of the estuary.

Many of the 995 acres of undiked tidal marsh in South Slough are fringing marshes at scattered points along the slough's edges, especially in inlets and coves (Hoffnagle and Olson 1974). The largest expanses of marsh are found at the heads of various inlets and on the flats just south of the Charleston Bridge and just south of Valino Island. Low sandy marsh and immature high marsh are the major marsh types of the slough (Hoffnagle and Olson 1974).

Several areas in South Slough are reverting to marsh following the breaching of dikes or as a result of tidegate failure. Regions at the head of the Winchester arm are inundated only during high water or very high tides as a result of tidal damming of streams. These areas are termed "surge plain marshes" by Hoffnagle and Olson (1974).

The only area of bullrushes in South Slough is along part of the north bank of Joe Ney Slough (Hoffnagle and Olson 1974). At the head of Joe Ney Slough is a large, tidegated freshwater marsh with dense stands of cattail (*Typha latifolia*) (Hoffnagle and Olson 1974). Studies of this marsh site as a potential mitigation site for alterations in other portions of the estuary have been conducted and results will be available from LCDC (Gonor et al. 1979).

Two South Slough marshes of differing character were studied in detail by Hoffnagle et al. (1976). The marsh site at the upper end of the slough was vegetated primarily by *Carex lyngbyie* and *Distichlus spicata*. Its net primary productivity was estimated at 764.81 $g/m^2/yr$. A low sandy marsh in the Henry Metcalf Estuarine Preserve just south of the Charleston bridge was the other study site (Hoffnagle et al. 1976). The marine influence experienced by this marsh is probably responsible for the diversity of species observed there. Bird observations near the Metcalf marsh are summarized in Table 12.

As in other portions of the bay, the habitats of South Slough have been altered by human use. The lower slough has been a site of rapid change accompanying a growing fishing industry. The construction of the Charleston Breakwater, dredging of the channel and of the small boat basin, and filling of adjacent tidelands have all occurred within the past 25 years. In the middle and upper slough, oyster culture has added a habitat to the intertidal area. Although there have been splash dams and dikes in the upper slough, recent developments have been few.

Recommendations

While generally one would choose to concentrate development in the lower South Slough, certain features of the area deserve special attention. Of 6,200 acres of submersible land in Coos Bay, 6% of the clams harvested were from the 11.5 ac area frequently referred to as the "Charleston Triangle". Because of the density of clam populations at this site and its recreational value, it should be protected. The flats south of Charleston Bridge on the west bank also receive heavy recreational use.

Generally, the diversity of organisms present in lower South Slough and the recreational capacity of the area suggest maintaining as much diversity of habitats and uses as possible. On the east side of the lower slough is the Barview State Wayside, an areas used by recreationists. The site should be maintained for these uses.

The values of South Slough marshes accrue primarily because of the long involuted shore and many fringing marshes. Development should be planned to leave the marshes undisturbed. Although individual marshes are small, the total marsh area makes a significant contribution to the primary productivity of the estuary. The low sandy marsh just south of the Charleston Bridge on the Metcalf Preserve is the closest marsh to the mouth of the bay and is a unique habitat as a marsh under marine influence.

South Slough is the only area within Coos Bay where legal commercial oyster harvest currently takes place. That use must be carefully protected. Oyster land and water quality should be protected for oyster growth. Proper sewage disposal and management of upland uses to minimize sedimentation are particularly important for oyster production.

There are several sites in South Slough appropriate for restoration, including formerly diked areas in the upper slough and in Joe Ney Slough. Habitat improvements should be considered on the east side of the channel from north of Peterson's Seafoods to the mouth of Joe Ney Slough, where discharge of sewage and industrial pollutants has occurred.

The use of Sough Slough Sanctuary an an unaltered site for research presupposes that it will remain undeveloped and its habitats and water quality will be protected. South Slough is very directly influenced by marine waters that enter through the mouth of the bay and slough and flow through the extensive development in the Charleston area. It is imperative that existing uses and new development north of the sanctuary not degrade the water quality of the sanctuary. Approval of new development north of the South Slough should be contingent upon evidence that the development will not adversely impact the water quality of the sanctuary.

Pony Slough Subsystem

Pony Slough branches south from the main bay between RM 8 and 9. Formerly a triangular embayment, its shape has been altered by filling. Presently a narrow mouth gradually opens into a wide tidal flat which is divided by a channel. The slough is about 1 mile long and the widest point is slightly more than 1/2 mile.

Hydrological studies of Pony Slough are limited. Freshwater discharge from Pony Creek is controlled at dams on Upper and Lower Pony reservoirs. Since 1975, USCS has monitored water discharge below the lower reservoir. Records for Water Year 1976 show a total freshwater discharge of 3,010 ac-ft. Flow ranged from a minimum of 0.08 cfs in May, June, July, and September and to a maximum of 26 cfs in December (USGS 1977). Summer mean flow was between 0.27 and 1.42 cfs, and the winter mean was between 4.33 and 13.6 cfs. Water discharge doesn't necessarily coincide with precipitation because of the controlling dams.

Information regarding salinity is limited to a single set of samples taken during August 1970. These measurements showed salinities in the main channel were 30.6 ppt at the mouth and 27.9 ppt at the Virginia Blvd. Bridge on an incoming tide and 23.4 ppt at the mouth and 5.5 ppt at the bridge on the outgoing tide (Horstmann et al. 1970). This demonstrates that considerable variation can occur over one tidal cycle. Interstitial salinities fluctuate less, and standing water on the marsh may become hypersaline because of evaporation (Horstmann et al. 1970).

The sediments of Pony Slough tidal flats are mostly mud and mixed sand-mud near the channels and marsh edges (Horstmann et al. 1970). A reducing layer at depths varying from 0.2 to 11.8 in was present over most of the slough area sampled.

Water quality of Pony Slough has not been examined. Domestic waste and waste water from an adjacent car wash enter the slough. In the spring of 1970, a large accidental discharge of raw sewage entered the slough from a nearby waste treatment plant (Horstmann et al. 1970). The effects of this discharge have not been studied.

Pony Slough has a long history of human alteration. Filling for the Southern Pacific Railroad began in 1917 in the northeastern section of the slough. During World War II, 240 ac. were filled for the North Bend Municipal Airport. In 1958 filling for Pony Village shoping center began, and in 1960 filling occurred north of Virginia Street in North Bend. The southeastern portion of the slough is bordered by residences, the southern side by commercial enterprises, and the North Bend Municipal Airport lies along the western border (Fig. 17). A public boat launch is located near the mouth on the western side. Several waste outfalls empty into the slough.

Habitats and Species

Habitats of Pony Slough include subtidal areas with unconsolidated bottoms and eelgrass and intertidal mud flats, sand-mud flats, eelgrass beds, algal beds and marshes (Fig. 18).

Benthic diatoms were ubiquitous on Pony Slough tideflats and are probably a major source of productivity (Horstmann et al. 1970). Mats of green algae (*Chaetomorpha cannabinna* and *Rhizoclonium* spp.) covered large areas of the tidal flats. Blue-green algae were noted on the eastern edges of the mud flats, and brown algae (*Fucus* sp.) was present on hard substrates and in the marshes.

Dense eelgrass is distributed along the intertidal area near the slough entrance and through part of the main channel. The various types of plant communities in Pony Slough show that the area remains an important producer of organic material for Coos Bay despite extensive alterations by filling. Fringes of high marsh also occur on the east and west margins of the slough and an expanse of low sand marsh occurs on the west side (Hoffnagle and Olson 1974). Most of the marsh vegetation lies between 5.5 and 7.5 ft above MLLW (MacDonald 1967).

The plant community of the low marsh at Pony Slough is composed primarily of *Salicornia virginica* and *Distichlis spicata* (Hoffnagle et al. 1976). *Deschampsia caespitosa* and *Spergularia marina* were also noted (Hoffnagle et al. 1976). These plants evidence a change in species composition since Johannessen studied the marsh 1961. He recorded *Scirpus validus* as a significant member of the flora and did not record any *Distichlis spicata* (Johannessen 1961).

The Pony Slough marsh increases in biomass from April to July (Hoffnagle et al. 1976). Net primary productivity was lower than that of North and South slough marshes probably because of the perennial *Saliconria virginica*, which has high biomass but a low rate of production. The marshes of Pony Slough were the lowest in elevation of the marshes studied by Hoffnagle et al. (1976). Dead standing shoots disappeared quickly probably because of the frequency of inundation. *Salicornia*, although lower in productivity, is an important detritus source, and its woody perennial form stabilizes soil (Hoffnagle et al. 1976).

The Pony Slough mud flat is populated primarily by burrowing mudflat organisms (Hoffnagle et al. 1970). *Corophium spinicorne*, an important amphipod in the diet of juvenile salmonids, is widely distributed over Pony Slough tideflats. Lugworms, ghost shrimp, and clams (*Mya arenaria, Cryptomya californica*) also occur, often in very high densities (Horstmann et al. 1970). Dungeness crabs are found in lower intertidal and subtidal areas. Tideflat users harvest softshell clams and ghost shrimp at Pony Point to the west of the entrance to Pony Slough, but this accounted for only a small percentage of tideflat use on Coos Bay (Gaumer et al. 1973).

Most sampling for fishes in Pony Slough has been by otter trawl because the soft muddy substrate makes beach seining difficult. However, ODFW has seined in the lower slough for the past three years. Eleven species occur in Pony Slough (Rousseau 1972). The slough is an important striped bass feeding area. Adult striped bass feed over much of the tideflats at high tide and move in and out of the slough with the tides. Pony Slough is a popular bass angling area from May through September.

Over 100 species of birds use Pony Slough. The slough harbors the largest concentrations of wintering birds in the estuary (Rousseau 1972). Peak numbers of 7,000-9,000 wigeon and other waterfowl and shorebirds have been noted (Rousseau 1972). Thornburgh (1979) conducted weekly surveys from June 1978 to June 1979 (Table 14).

The protection from southerly winter storms offered by the sheltered Pony Slough is probably a major reason for its heavy use by waterfowl. ODFW manages Pony Slough as a refuge, where hunting is prohibted.

Table 14. Peak counts of birds occurring in Pony Slough between June 1978 and March 1979 in numbers greater than 100 per observation period (Thornburgh 1979).

	Number	Time of observed peak
Dabbling Ducks		
American Wigeon	3,526	Nov.
Pintail	1,943	Jan.
Green-winged Teal	872	Dec.
Gadwall	330	Jan.
Shoveler	209	Jan.
Diving Ducks		
Canvasback	648	Dec.
Plovers		
Killdeer	204	Jan.
Semipalmated Plover	177	July
Black-bellied Plover	151	Mar.
Medium-sized Waders		
Dowitch	220	Sept.
Sandpipers		
Dunlin	2,808	Nov.
Western Sandpiper	1,577	Sept.

Recommendations

Pony Slough is a very important striped bass feeding area in Coos Bay. It is an area of high plant and animal productivity and a critical waterfowl and shorebird habitat, which harbors the largest concentrations of wintering birds in the estuary. The entire slough should be managed as a single unit. Most of Pony Slough is a major tract of intertidal land as described in the LCDC Estuarine Resources Goal (1977) and should be managed accordingly.

In its present condition Pony Slough provides valuable and scenic open space and natural resources to the urban North Bend area and could be used in satisfying state land use Planning Goal 5 (LCDC 1977).

North Slough Subsystem

North Slough extends approximately 3 mi north from the main body of Coos Bay at RM 9 (Jefferson 1975). The slough has a watershed of 8,190 ac (OSWRB 1963). Freshwater inflow from North Creek has not been measured. Although there is a tidegate at the slough's north end, near Highway 101, it may be too high in elevation to provide good flood drainage relief (OSWRB 1963). Upland plants are found adjacent to the channel before the slough crosses under Highway 101 (Hoffnagle and Olson 1974). The lands to the east of the highway are tidegated and diked but may be of sufficient elevation to be unaffected by salt water (Hoffnagle and Olson 1974).

The hydrography of North Slough has not been studied. The Jordan Cove Causeway separates the slough from full exposure to the main bay. The dike system undoubtedly reduces tidal circulation in the slough and may be accelerating sediment deposition. The Southern Pacific railroad bed parallels the western perimeter and acts as a dike, separating the slough from the dunes and forming a barrier between salt and fresh water marshy areas.

Sediments of North Slough are fine silts and broken shells (STR 1974). Sand from the dunes is also carried into the slough by the wind. These sands sometimes clog the channel at the tidegate (OSWRB 1963). Derelict logs occur on both sides of the slough and wood chips are found under the mud surface near the mouth (Baker et al. 1970).

Water quality samples are limited to a single set of samples taken in the summer of 1971 (STR 1974). Results showed high temperatures, high coliform counts, and excessive turbidity. Temperature problems were thought to occur because of low summer stream flows and incomplete mixing. Livestock and log storage were possible sources of turbidity, and livestock waste was thought to account for the high coliform counts. Log storage no longer takes place in North Slough. A municipal water treatment plant is located on North Slough, but wastes are not discharged into the slough from this plant.

The invertebrates of North Slough tidal flats include the molluscs *Mya arenaria*, *Crytpomya californica*, *Tellina salmonea*, *T. Buttoni*, *Macoma nasuta*, and *M. balthica* (Baker et al. 1970). Softshell clams and *T. salmonea* are widely distributed in the lower, broader regions of the slough. *C. californica*, *Macoma nasuta* and *T. Buttoni* are found near the causeway. *Macoma balthica* is found in the narrower portion of this area. The softshell clam is the only mollusc taken by recreational diggers in this area. The Jordan Cove Causeway yielded by far the most softshell clams to recreationists in Coos Bay of areas surveyed in 1971 (Gaumer et al. 1973).

Other invertebrates with wide distributions on North Slough flats include spionid worms, (*Eteone* spp.), ribbon worms (*Paranemertes* spp. and *Cerebratulus* spp.), lugworms, bamboo worms (*Heteromastes* spp.), amphipods (*Corophium* spp.), crangonid shrimp (*Crago* spp.) (USACE 1975), and Dungeness crab (Baker et al. 1970). Ghost shrimp are found only near the causeway, and shore crab (*Hemigrapsus oregonensis*) are associated with the riprap shores. Ghost shrimp and lugworms are collected from North Slough flats by recreationists.

American shad, shiner perch, staghorn sculpin, and starry flounder were found during 1970 sampling in the slough (Cummings and Schwartz 1971). Boat and shore angling for striped bass occurs in the slough May through September. There is an upstream fishery for coho salmon which spawn in North Creek (pers. comm., Bender and Mullarkey).

Large numbers of dunlin have been observed on North Slough tideflats, and North Slough has been identified as a great blue heron feeding area (McMahon 1974). North Slough is a major feeding and resting area for redheads and other ducks.

Of particular significance in North Slough are the marshes. Large, intact, diverse marshes occur there (Akins and Jefferson 1974). Jefferson (1975) described the marshes of North Slough as the "most complete and diverse mosaic of salt marsh plant communities in all stages of succession and with ecotones to freshwater, forest, and sand dunes."

Marsh acreage mapped by Hoffnagle and Olson (1974) included 7 ac. of immature high marsh, 138.5 ac. of sedge marsh, 18 ac. of bullrush-sedge marsh and 23 ac. of low sand marsh. Of six sites studied on Coos Bay, the site on North Slough, which was an almost pure stand of *Scirpus validus*, had the highest standing crop and net primary productivity (Hoffnagle et al. 1976). The plant *Cordelanthus maritima*, which is rare in Oregon, is found within the immature high marsh of North Slough (Hoffnagle and Olson 1974). *Cotula coronopifolia*, an introduced species which thrives in areas of wood and bark accumulation, is quite common (Hoffnagle et al. 1976).

Shiner perch and staghorn sculpin were found adjacent to North Slough marshes. Harpacticoid copepods, insect larvae, small bivalves and *Corophium* spp. were major items in their diet (Hoffnagle et al. 1976).

In addition to barn swallows, long-billed marsh wrens, and song sparrows, the uncommon Virginia rail has been sighted in North Slough marshes and nesting areas for this bird were observed there by Magwire (1976b).

Recommendations

The marshes of North Slough represent major tracts as described in the LCDC Estuarine Resources Goal (1977) and should be protected (Jefferson 1975). Because these diverse marshes have remained relatively unaltered, they could serve as valuable research natural areas for baseline studies of natural processes in undisturbed ecosystems. They are particularly well suited to studies of dune encroachment, impacts of drift logs, and recovery from log storage (Jefferson 1975).

North Slough includes suitable sites for habitat restoration. Removal of derelict logs would increase the surface area available for estuarine production.

Placement of culverts beneath the Jordan Cove Causeway would increase tidal circulation to North Slough and might reverse the accelerated sediment accretion.

Haynes Inlet Subsystem

Haynes Inlet extends about 2-1/2 mi northeast from its entrance into Coos Bay just east of North Slough (Fig. 17). It has a watershed of 7,120 ac (OSWRB 1963), which is drained by Larson and Palouse creeks.

Haynes Inlet was once broad at its mouth, gradually narrowing to a system of narrow, meandering channels at its head. Larson and Palouse creeks once contained large tidal marshes and had substantial tidal prisms. Currently the mouth has been greatly restricted by the Highway 101 causeway. Marshlands on both major creeks have been diked for agricultural use, and stream flows are controlled by tidegates, which reduce the total tital prism of the inlet.

Hydrological studies of freshwater inflow and tidal circulation have not been made. Data on the water quality of Haynes Inlet is lacking, and only minimal biological information is available.

Habitats of Haynes Inlet include subtidal channels with unconsolidated bottoms; intertidal flats of sand, mud, and sand-mud mixed; eelgrass beds; low marsh; high marsh; and sand shores (Fig. 18).

In a brief qualitative survey, invertebrates of the Haynes Inlet mudflats were similar to those recorded in North Slough included (Rischen and Danielson 1970). Additional species not recorded in North Slough included several species of amphipods and the nudibranch *Hermissenda crassicornis*. The California papershell, *Lyonsia californica*, has not been recorded elsewhere in Coos Bay. An oyster farm operated there before construction of the Highway 101 Causeway. The presence of shells suggest that cockles once inhabited the sea.

Fish seined in Haynes Inlet include threespined stickleback, shiner perch, topsmelt, bay pipefish, staghorn sculpin, and starry flounder, all species with wide distributions in Coos Bay (Hostick 1975) (Table 9). Bender (pers. comm.) noted that large numbers of anchovies occur near the mouth of the inlet in September and October. Boat angling for striped bass is popular in Haynes Inlet in May through September. Shiner perch, pile perch, and striped seaperch are also taken there by shore anglers. Larson and Palouse creeks are both productive coho and steelhead streams (pers. comm., Bender). Larson Creek is used to chart coho population trends in coastal streams. It has the highest number of spawning coho of the 3 creeks surveyed by ODFW in the Coos system. A sport fishery for coho develops in October and continues until the end of steelhead season (pers. comm., Bender).

Haynes Inlet is heavily used by waterfowl. The most abundant winter species include black brant, American wigeon, ruddy duck, American coot, pintail, greenwinged teal, and mallard (Magwire 1976b). Few species appear to use the area in summer, but great blue heron are common (Magwire 1976b) and use the inlet as a feeding area (McMahon 1974).

Several hundred acres of salt marsh have been diked for agricultural use in Haynes Inlet (Hoffnagle and Olson 1974). About 150 acres of marsh remain, including immature high marsh, sedge marsh, bullrush-sedge marsh, and one of the few areas of low silty marsh mapped in Coos Bay (Hoffnagle and Olson 1974).

The watershed of Haynes Inlet has a fairly high level of both agriculture and logging (Wilsey and Ham 1974). Other human uses of the slough and adjacent uplands include a small mill and log dump, residences, light commercial use near the mouth, and a boat launch and wayside (Wilsey and Ham 1974).

Recommendations

Haynes Inlet was classified as an area of moderate marine biological value and high terrestrial biological value by Wilsey and Ham (1974). Of particular significance are the salt marshes of the upper end of the inlet, which are listed by Jefferson (1975) as an area that should be protected for primary production in Coos Bay.

The Highway 101 causeway has changed tidal circulation within Haynes Inlet and may be contributing to accelerated accretion. It may be advisable to increase ciruclation with the main bay through a system of culverts. Leaking tidegates, especially the one controlling the entrance to Larson Creek, have necessitated recent diking to protect agricultural land from salt water intrusion. Dike material should be obtained from upland sources rather than from the adjacent channel to protect water quality and bottom characteristics, which are important for anadromous fish using these streams.

Isthmus Slough Subsystem

Isthmus Slough is a very long, narrow body of water which enters the upper southwest corner of Coos Bay at about RM 13.8 (Fig. 17). Head of tide is about 12 mi up the slough (Wilsey and Ham 1974). The drainage area of Isthmus Slough is 32 mi^2 (Arneson 1976), and major tributaries include Coalbank Slough, Shinglehouse Slough, Davis Slough, and Noble Creek.

In Isthmus Slough the deep draft navigation channel extends to RM 15 at a depth of 35 ft and width of 400 ft. Near the mouth of Coalbank Slough a turning basin has recently been enlarged to 700 ft by 1,000 ft. Major shipping activities occur in this area of the bay. A shallower channel 22 ft deep and 150 ft wide extends from RM 15 to Millington at RM 17. It is privately maintained and used primarily for log transport (USACE 1976).

Freshwater flow has been calculated for Isthmus Slough using drainage basin area and precipitation averages (Arneson 1976). In 1973-74 minimum flow was estimated at 1.4 cfs in September 1973 and maximum flow at 304 cfs. Extreme salinities of 30.6 ppt and 4.7 ppt have been measured at the Eastside Bridge over the slough. Salinities at the Coos City Bridge measured 30.2 ppt and 0.3 ppt (DEQ 1978). Downstream from Eastside a minimum salinity of 0.2 ppt has been measured, which probably indicates the influence of fresh water from Coos River.

Salinity profiles show Isthmus Slough to be well mixed at essentially all times of the year (Arneson 1976). In December, when some portions of the estuary were stratified, Isthmus Slough was well mixed at high tide and essentially fresh water at low tide (Arneson 1976). The well mixed condition of the slough may be attributed to limited freshwater inflow (Arneson 1976), even though diking has greatly reduced the tidal prism in the slough (Aagard 1971). Water temperatures as low as 46.4^{o}F have been recorded in Isthmus Slough, while maximum temperatures of 73.4^{o}F have occurred at upstream stations (DEQ 1978).

Isthmus Slough receives heavy industrial use for shipping, waste disposal, and log handling and storage. These uses combined with minimal flushing (Arneson 1976) and low freshwater inflow cause dissolved oxygen to be lowest in

Isthmus Slough of the stations measured in Coos Bay (DEQ 1978). DEQ data show that DO improved from 1974 to 1978, but measurements less than the minimum standards for estuarine waters still occur(DEQ 1978). USACE (1976) reports Isthmus and Coalbank sloughs are moderately to heavily polluted according to EPA standards.

High coliform counts have been recorded in Isthmus Slough. Of the stations measured by DEQ, the most frequent and severe violations occurred in Coalbank Slough and downbay from Coalbank (DEQ 1978). At the upper stations coliform less frequently exceeded standards for general health but was often over the maximum for commercial shellfish harvesting areas.

Sediments of Isthmus Slough are river-born silts (Arneson 1976). Although winter freshets do aid flushing, the slow currents of the slough and general lack of fresh water inflow contribute to the deposition of fine material (Arneson 1978). Wood chips and bark also occur in the substrate of much of the slough. Anerobic sediments are found in most areas (Thompson 1971).

Habitats and Species

The habitats of Isthmus Slough are predominantly the unconsolidated bottom in the channel, muddy shores which are sometimes covered by eelgrass beds, and marshes (Fig. 18). Log rafts are often stored and ground along the tidal flats. Consequently, the exact location of aquatic beds and marshes is subject to change as vegetation is removed and reestablishes itself.

A survey of organisms of Isthmus Slough, primarily those of the tidal flats, was conducted by Thompson (1971). Algae noted in the slough include the green (*Enteromorpha tubulosa*), reds (*Gracilaria* spp., *Antithamnion* spp., *Platythamnion* spp., *Polysiphonia* spp., and *Gigartina* spp.), and the brown (*Fucus* spp.). *Ruppia* is found in increasing abundance in aquatic beds toward the southern end of the slough in less saline water.

Invertebrates primarily include crustacean arthropods and polychaete worms. Only six molluscs are recorded from Isthmus Slough. The softshell clam is the only species taken recreationally. Historical notes show softshells were once more abundant than at present (Thompson 1971).

The arthropods found in the slough are the shrimp *Crago franciscorum* and the crabs *Cancer magister, Rhithropanopeus harrisii,* and *Hemigrapsis oregonensis* (Thompson 1971). At least eight species of amphipods and isopods are also found. The amphipods were primarily in channels under algae, and in eelgrass beds. *Anisogammarus confervicolus* became less dense with increased temperature and decreased salinity. *Corophium* spp. were found farther into freshwater than *Anisogammarus*.

The most abundant polychaete worms were the nereids, *Nereis brandti* and *N. limnicola*. *Heteromastis filiformis* and *Capitella (Capitata) ovincola* were found in reducing layers, and ampharetids and spionids were found throughout the slough. Many of the annelids found have been termed pollution indicators.

At least 11 species of fish have been seined from Isthmus Slough (Table 9).

Adult coho salmon have been seined in Coalbank Slough, and a spawning run of coho occurs in tributaries of Isthmus Slough and in Davis Slough (pers. comm., Mullarkey and Bender).

Historically Isthmus Slough has been used by striped bass which tend to seek out deep holes and channels (pers. comm., Bender). Isthmus Slough was a prime striped bass fishing area until low DO and chemical wastes apparently prevented all use of the slough by striped bass. Conditions have improved somewhat and bass are again showing up. Several age classes of stripped bass have been found south of Davis Slough which have not recently been seen in other portions of Coos Bay (pers. comm., Mullarkey and Bender). It is possible this area is critical to the bass at certain stages of their life cycle (pers. comm., Bender). In February and March striped bass fishing is popular from the banks of Isthmus Slough.

Many of the marshes in Isthmus Slough have been eliminated by diking, filling, and log storage. In Coalbank Slough alone, marshes occupied 597 ac. in 1892, and now only 57.0 ac. remain (Hoffnagle and Olson 1974). The major marshes of Isthmus Slough occur along its banks and in Coalbank, Shinglehouse, and Davis sloughs. Marshes of Coalbank Slough include a 25 ac. marsh separated from the channel by a dike with culverts and a 35 ac. marsh partially bordered by an old dike. These marshes have characteristics of sedge marshes and immature high marshes, but *Carex lyngbyei* is the dominant species present (Hoffnagle and Olson 1974).

Along the main channel of Isthmus Slough south of the mouth of Coalbank Slough lies the estuary's largest expanse of low silty marsh, which is returning to its former state after being diked (Hoffnagle and Olson 1974). Sedge and immature high marshes occur along the main Isthmus Slough channel south of the silty marsh, and bullrush-sedge marsh occurs at the south end of Isthmus Slough (Hoffnagle and Olson 1974). Sedge marshes occur in Shinglehouse Slough, and Davis Slough has marshes of bullrush and sedge. Total undiked marsh acreage of Isthmus Slough and its tributaries is 431.8 ac., which contains 62.8 ac. of sedge marsh, 64.6 ac. of low silt marsh, 219.0 ac. of immature high marsh, and 85.4 ac. of bullrush and sedge marsh.

Recommendations

Hoffnagle and Olson (1974) estimated that 90% of the total acreage of Coos Bay marshes have been lost to filling or other causes since 1892. It is therefore critical that remaining marsh lands be protected from filling and diking in order to maintain habitat diversity in the estuary, as well as the flow of organic material to and from marsh communities. Significant tracts of salt marsh remain in Coalbank and Shinglehouse sloughs and should be preserved for primary production (Jefferson 1975).

Much of Isthmus Slough can be considered degraded habitat, and restoration measures should be undertaken to restore water quality and biological production. The acreage of tide flats impacted by grounding log rafts should be minimized. Log rafts should be removed from intertidal areas wherever feasible. The inventory of logs stored in the slough at any given time and the length of residence of stored logs should not exceed the minimum levels required to keep pace with mill production. All unused pilings, derelict logs, and wood debris should be removed. Breaching of several partially diked areas of Isthmus Slough should improve circulation, water quality, and the flow of materials between these areas and the other portion of the subsystem. The 35-ac. marsh in Coalbank Slough and the low silty marsh east of the channel just south of Eastside should also be considered for restoration through dike removal.

Increased circulation to the 25-ac. Coalbank Slough marsh should be considered to improve the exchange of organic materials with the remainder of the estuary.

Davis Slough and the section of Isthmus Slough above it should remain free of log storage or other uses which would further degrade water quality in the subsystem. Log storage has been gradually phased out in upper Isthmus and Davis sloughs, and during the same period water quality has improved significantly. This recovery and the poor circulation in these upper reaches suggest the area may be particularly important in maintaining the water quality of Isthmus Slough.

Catching Slough Subsystem

Catching Slough enters the main body of Coos Bay just west of the mouth of Coos River (Fig. 17). It is fed by several small streams and is about 10 mi long from its mouth to its head (Wilsey and Ham 1974).

In the late 1800s, Catching Slough was an area of vast tidal marshes and a large tidal prism. Strong tidal flushing was responsible for maintaining depths of 18 to 20 ft at the confluence of the Catching Slough channel and the Marshfield Channel. By the 1940s diking of Catching Slough for agricultural purposes had decreased tidal transport and velocity through Marshfield Channel (Aagard 1971).

Little is known of the physical or biological processes of Catching Slough. Freshwater inflow is unmeasured, but STR (1974) state that because of low summer flow, tidal circulation during summer in Catching Slough is a simple exchange of water from the main bay.

In a single series of summer water quality samples, high temperatures, probably resulting from low summer flows, were noted (STR 1974). Fecal coliform increased from the mouth toward the head of the slough (STR 1974) and could be expected to be greater at times of high runoff.

Habitats of Catch Slough include the subtidal channel, narrow muddy shores, eelgrass or ditchgrass beds, fringing tidal marshes, and rip-rapped shores (Fig. 18). Typically these habitats occur in narrow bands zoned from lowest to highest as listed. The tidal marshes are the only Catching Slough habitat that have been studied.

Tidal marshes of Catching Slough once totalled 1,600 ac., but through extensive alterations for agricultural use, only fringing marshes of bullrush and sedge totalling less than 50 ac. remain (Hoffnagle and Olson 1974).

Distribution of invertebrates in Catching Slough has not been studied. Large numbers of juvenile American shad have been seined from Catching Slough

(Hostick 1974). Coho salmon and steelhead spawn in the upper reaches of the slough (pers. comm., Mullarkey and Bender). Other fish seined from the slough include species with wide distributions in the upper bay and sloughs, such as shiner perch, staghorn sculpin, threespine stickleback, starry flounder, and bay pipefish (Cummings and Schwartz 1971). Water in the upper part of the slough apparently is sufficiently fresh to maintain significant numbers of largescale suckers. Recent gill netting surveys by ODFW have shown the area is also used by striped bass.

Recommendations

Materials needed for dike repair should be obtained from upland sources rather than by dredging in the slough. Dredging can convert productive intertidal areas into less productive subtidal habitats and degrade surrounding habitats. Consideration should be given to restoring a portion of the large amount of diked tidal land to estuarine production. Derelict pilings previously used for log storage should also be removed.

Catching Slough supports good runs of coho salmon in Catching, Selander, and Wilson creeks. Recent sampling suggests the slough may also be an important area for 5- and 6-year-old striped bass. Isthmus Slough is the only other area where concentrations of this age group of striped bass have been found, but Isthmus Slough may be unsuitable for the fish during the summer due to low DO. Water quality in Catching Slough should be maintained and improved for fish and other organisms dependent upon the area. Catch Slough has good potential for recreational fishing, and public use may be improved with increased access.

Coos Riverine Subsystems

There are several riverine subsystems in the Coos Bay estuary, including the Coos and the South Fork Coos rivers and Millicoma river, which enters the Coos River. Tidewater extends more than 11 mi upstream from the boundary of the upper bay subsystem (Fig. 17) on the South Fork Coos and 10.6 mi upstream on the Millicoma River (Wilsey and Ham 1974).

The riverine subsystems provide important fish habitats. Shad are entirely dependent on the area during the first 6-12 months of life and part of their second year. Coho and steelhead can be found in the spring enroute to their spawning grounds. The Coos system is a major freshwater rearing area for chinook, especially during their first year. Juvenile cutthroat also rear in the system, and adults return in late summer to spawn. The lower portions are also used by starry flounder and staghorn sculpin. Prickly sculpin and shiner perch occur in the upper portions. Other species found in the riverine subsystems include red-sided shiners and largescale suckers. Shiner perch and largescale suckers are important forage fish for striped bass (pers. comm., Bender).

This section of the estuary is a popular fishing area for shad (May-July), striped bass (year-round), cutthroat (August-October), coho and chinook (September-November), and steelhead (November-March). Commercial shad fishing takes place on the lower Millicoma, South Fork Coos, and throughout the Coos River.

Recommendations

Generally there is little specific information on other biological and physical characteristics of the riverine subsystems. The habitat map (Fig. 18) does not depict habitats far beyond the upper bay subsystem. However, the Coos riverine subsystems are similar to the tidewater areas of other coastal rivers, and many of the same general considerations should be made in developing management strategies.

The Coos Bay riverine subsystems should be managed as units to prevent the piecemeal destruction of shoreland habitats. Riprap, bulkheads, and docks can destroy riparian vegetation, which is important for fish and terrestrial animals. Docks can reduce the productivity of aquatic plants by shading. Riparian vegetation should be protected as suggested in the implementation of the LCDC Coastal Shorelands Goal (LCDC 1977). New homes and other structures should be placed a sufficient distance from the shore so that bank stabilization measures are not required. This will also help reduce flooding and erosion caused by encroachment into the floodway fringe. Non-structural solutions to erosion and flooding are also encouraged in the LCDC Coastal Shorelands Goal. Bank stabilization should only be allowed as part of an overall stream corridor management plan.

Dredging during July and August will have the least detrimental impact on the riverine fisheries. Spawning and larval development of shad and striped bass occur in the spring (April-June). After September, the tidewater sections are used extensively for sport fishing.

Pollutants discharged into the riverine sections of estuaries can be particularly detrimental to estuarine water quality since flushing times are extremely long much of the year, and all material from the upper estuary may affect the rest of the system downstream. Adequate waste treatment facilities are needed to prevent pollution of the riverine subsystem. Particular care must be excercised to prevent oxygen depletion and high water temperatures, which can stress fish, and to maintain minimum stream flows. Logging and other activities which cause erosion within the riverine subsystems and in the upper watershed should be carefully regulated to prevent rapid filling, which has occurred in many Oregon estuaries as a result of these activities.

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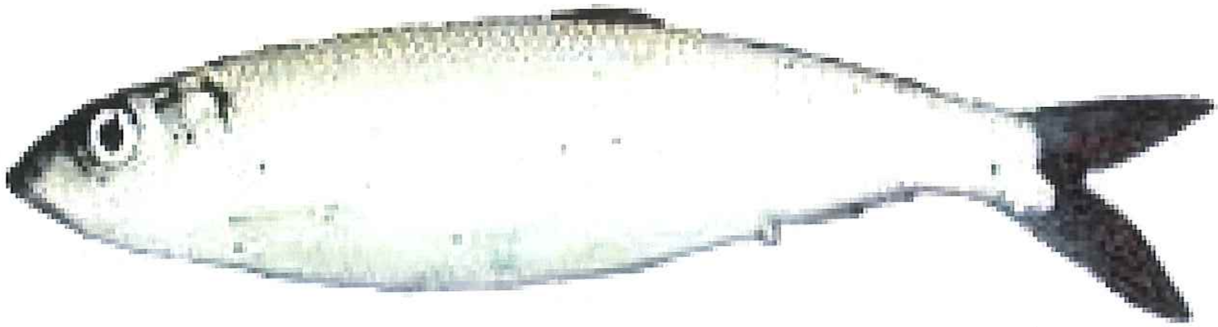


Pacific herring *(Celpea pallasi) are one of the most important prey species in the Northern Pacific. Herring grow to lengths of 10 to 12 inches and may live longer than 9 years. Herring are an essential link in the ocean's food chain, and as such, the large-scale commercial exploitation of herring in British Columbia and Southeast Alaska should be limited until their importance to the species that prey upon them is completely understood.*

Herring occasionally spawn in most all of Oregon's bays but spawn consistently in Coos Bay, Umpqua Bay and Yaquina Bay from February through early April but most consistently during March. They also spawn at this time in the kelp forest and in the shallow rocky areas along the Oregon Coast during periods of neap tides. The females attach their eggs to underwater objects such as eelgrass and seaweed while the males broadcast their sperm into the water. The eggs hatch fourteen days later. Herring are *not only available during the spawning period but enter many of Oregon's bays throughout the year. The popularity of jigging for herring is evident by the number of anglers that jig for off of the port docks at Newport in Yaquina Bay. The population of herring and other forage fish is dependent on the ocean currents. The upwelling of cold nutrient rich water associated with the California Current stimulates the growth of phytoplankton and is the biological engine that drives the ocean's food chain. The population of herring and other forage fish increase dramatically when the upwelling persist over an extended period of time as evidenced by the appearance of large schools of forage fish in Oregon's deepwater bays. The most productive fishing for herring occurs during the spawning period fishing from docks or boats using herring jigs.*

Herring jigs consist of multiple small jigs attached to a leader. They can be purchased at local tackle shops. Use lightweight spinning tackle with 10 pound test monofilament for the main line. Use a sinker of sufficient weight to keep the jigs from tangling as they're jigged up and down. When jigging for herring do not land the first herring hooked. Use the hooked herring to attract other herring to the jigs. It takes several hours to fill a 25 pound limit during the spawning period.

Herring are primarily used as bait. Live herring is the first choice of anglers followed by fresh dead and frozen. To preserve herring for bait freeze them individually in a salt brine solution; however, as a food fish herring are delicious. To preserve herring as a food fish pickle or smoke them. Once smoked, herring can be vacuum packed, frozen or canned.

Herring are so easily caught during the spawning period they provide parents with the opportunity to introduce their children to a positive fishing experience. As always, children on docks or in boats should wear life jackets and be under constant supervision.

Return to Oregon's Other Fish Species.

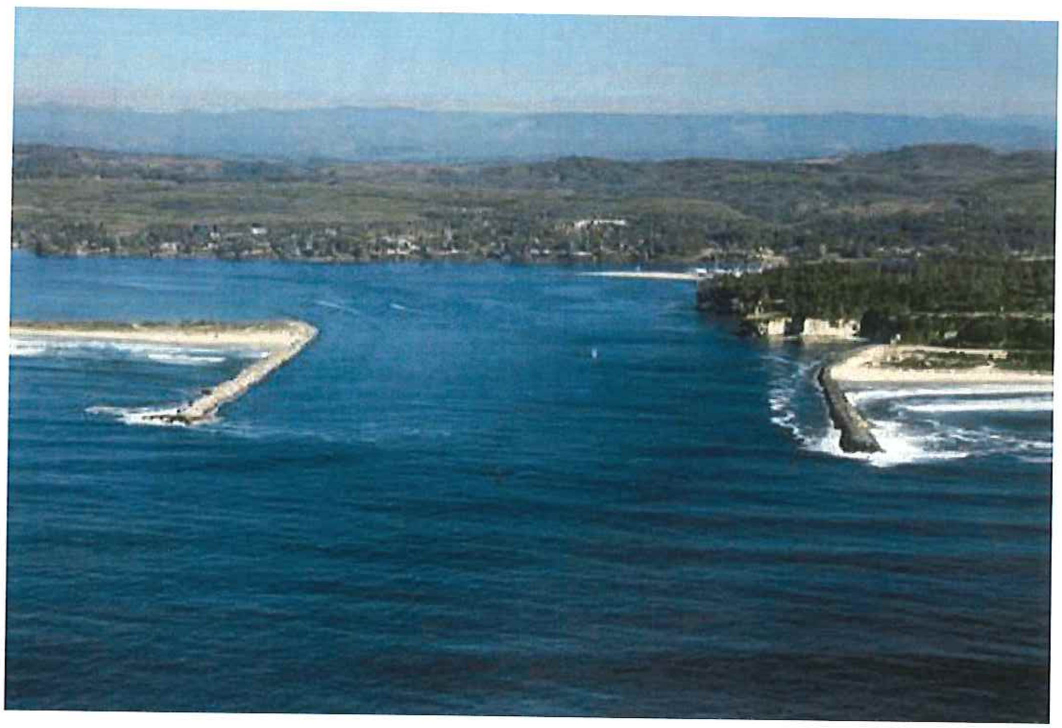
Mile By Mile Map of the Oregon Coast Trail from North Bend to Bandon

234.0 Coos Bay

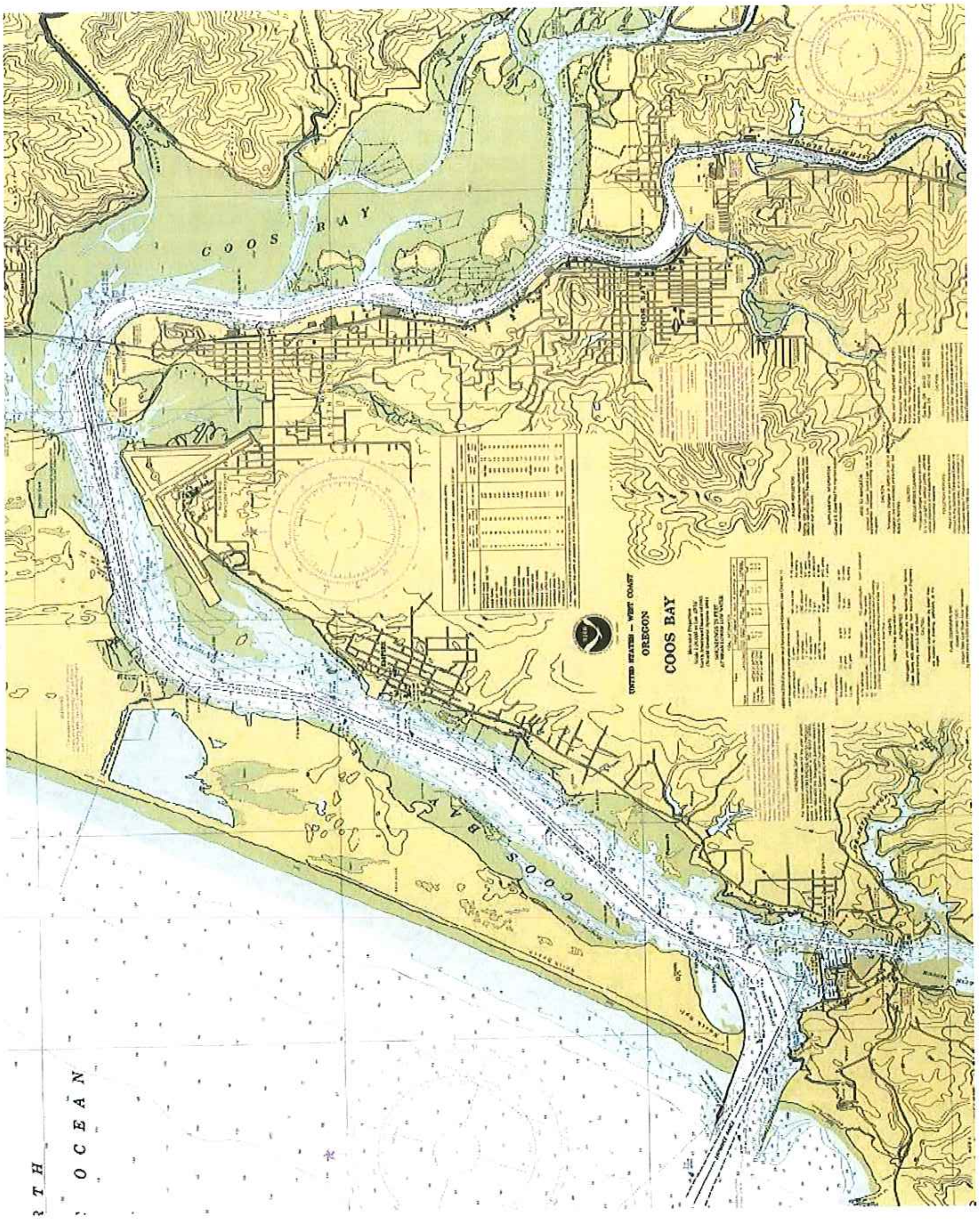
Coos Bay, Oregon's largest bay is an anomaly that is dominated by saltwater. The bay receives comparatively little water from the rivers flowing into it. The Conde McCullough Bridge is the dividing line between West Coos Bay and East Coos Bay. **The Conde McCullough Bridge** was named in honor of the engineer who was a leading innovator in early bridge design of **Oregon's coastal list of bridges**.

The Estuary Reserve at South Slough in Coos Bay is an attraction that will provide visitors with insight to the functional values associated with estuaries. A large percentage of all marine species depend on the ecological productivity of estuaries for their survival. Information compiled from scientific studies at the **South Slough Estuary Reserve** should be used to restore the functional values to Oregon's other bays and estuaries.

To view the Oregon State Marine Board website on boating hazards when crossing the bar at Coos Bay. The website describes the dangerous tidal conditions affecting safe boating when entering or departing Coos Bay as listed on the Web Page for the **Oregon State Marine Board**; then click on the tab, "water levels/navigation charts" listed under the column, "safety & Education" to view the navigational advisories of interest for boaters and Coos Bay.



The bar at the entrance to Coos Bay is usually safe to cross but the boater should be prepared to deal with fog and the waves generated by the prevailing afternoon winds. The last 300 yards of the north jetty is submerged as is the last 100 yards of the south jetty. The submerged jetties are subject to breakers most of the time. A submerged jetty extends 500 yards off the east shore of West Coos Bay 0.8 of a mile NE of Coos Head. The jetty extends in a SW direction from the east shore at a location from just above Fossil Point towards Coos Head. A light with a seasonal fog signal marks the north jetty. A lighted whistle buoy is 1.8 miles WNW of the entrance.



The following underlined areas describe some of the dangerous tidal conditions affecting safe boating when entering or departing Coos Bay. Click on [Coos Bay] to view the Oregon State Marine Board website The website describes the dangerous tidal conditions affecting safe boating when entering or departing Coos Bay.

Sand spit, South Slough. As you leave the Charleston Boat Basin, the South Slough sand spit is on your left. It extends north, parallel to the channel from South Slough buoy #4, approximately 450 yards toward South Slough light #2. Presently, nun buoy #2T marks the north end of the sand spit. Do not cross this area.

Submerged jetty. When you proceed out from the Charleston Boat Basin in the South Slough channel, and are directly between South Slough light #4 and can buoy #5, directly ahead will be South Slough light #1, marking the end of the submerged jetty. This jetty is visible only at low water. When departing the Charleston Boat Basin, stay to the left of light #1 at all times.

Sand spit, north beach. This area is dangerous because of shoal waters and submerged jetties. Occasionally on a strong ebb there will be breakers in this area. Avoid this area because of the possibility of going aground or striking submerged jetties and pilings. Note, too, that inbound and outbound tugs with tows, freighters, and so forth, pass close aboard this area and cannot stop for obstructions in the channel—including small vessels.

South jetty, Guano Rock area. This is a very dangerous area because of shoals that extend out from the south jetty to the entrance channel. Breakers are frequently experienced from Guano Rock lighted whistle buoy #4 extending out to just past the end of the south jetty. Exercise care in this area at all times, especially on ebb tides.

North jetty, submerged. The north jetty extends approximately 200 yards to the west. The outward end of the jetty is submerged from the visible end of the jetty out toward buoy #3. Never cross this area. There are breakers in this area most of the time. When departing the bar northbound, be sure to pass buoy #3 before turning to the north.

Area north of buoy #5. This area can be very dangerous when there are any large swells on the bar or during ebb tide. Freak breakers are common in this area. Many boats do transit this area on occasion, but it is strongly recommended that you never cross here.

Rough Bar Advisory Sign is positioned eight feet above the water on jetty just north of the Charleston Boat Basin. This is a two-part sign, facing toward the Charleston Boat Basin and toward South Slough light #2. The Charleston Coast Guard station records weather and bar conditions; you may obtain this information by phoning (541) 888-102 or (541) 888-3267 before boating in Coos Bay.

Good fishing for salmon extends over a wide area outside of Coos Bay and the area with the hot bite varies throughout the season as the salmon migrate offshore. Fishing for rockfish is excellent from Baltimore Rock to Gregory Point southward through the rocky structure associated with Sunset Bay and from Rocky Point to Simpson Reef. Fishing is excellent for Rockfish and Chinook salmon along Whiskey Run Reef located southwest of Cape Arago. Feeder salmon enter lower Coos Bay during the summer usually in July feeding from Charleston to Fossil Point north to Jordan Cove.

Fishing in Coos Bay:

Chinook salmon Information Report 2003-02 Fall Chinook Salmon in the South Fork Coos River: Spawner Escapement, Run Reconstruction and Survey Calibration, 1998 - 2000

Chinook salmon: Good fishing for salmon extends over a wide area outside of Coos Bay and the area with the hot bite varies throughout the season as the salmon migrate offshore. Fishing for rockfish is excellent from Baltimore Rock to Gregory Point southward through the rocky structure associated with Sunset Bay and from Rocky Point to Simpson Reef. Fishing is excellent for Rockfish and Chinook salmon along Whiskey Run Reef located southwest of Cape Arago. Feeder salmon enter lower Coos Bay during the summer usually in July feeding from Charleston to Fossil Point north to Jordan Cove.

Large numbers of Chinook Salmon begin returning to Coos Bay during the last half of August before peaking in September and running into October before declining in November. The most productive fishing occurs early in the run by trolling a plug cut herring with the incoming tide from the jetty jaws to the Empire Boat ramp.

Troll a plug cut herring, spinner or spinner bait combinations with the incoming tide through high slack tide in the deepwater channel from the Empire Boat ramp to the Conde McCullough Bridge. Back troll or back bounce with the outgoing tide mini mooching or trolling a plug cut herring, a bait wrapped Flatfish lure or a spinner bait combination seaward from the Empire Boat ramp or the Conde McCullough Bridge.

The most productive fishing in east bay occurs in the Marshfield Channel trolling a plug cut herring, spinners, spinner bait combinations or bait wrapped Flatfish lures with the incoming or outgoing tide with from the mouth of Isthmus Slough upriver to the Chandler Bridge. Local fishermen concentrate fishing from the mouth of Catching Slough upriver to the Chandler Bridge.

Fish the 4.8 mile tidal reach of the Coos River from the confluence of the Millicoma and the South Fork of the Coos Rivers to the Chandler Bridge trolling with the incoming tide through high slack tide or back trolling or back bouncing with the outgoing tide using a plug cut herring, bait wrapped Flatfish lures, spinners or spinner bait combinations. Drift with the tidal current back bouncing a walnut sized gob of salmon eggs and sand shrimp combination or drift with the tidal current using a free sliding bobber to fish a walnut sized gob of salmon eggs and sand shrimp suspended just off of the bottom. Anchor above the up current side of the deeper holes during the outgoing tide and fish on the bottom with bait wrapped Flatfish lures; bait sweetened Spin-N-Glos, wobblers or a walnut sized gob of salmon eggs and sand shrimp combination.

Fish in the approximately 9.7 mile tidal reach of the Millicoma River to the community of Allegheny or the South Fork of the Coos River to the community of Dellwood. Drift with the tidal current using a bobber rig baited with sand shrimp and/or salmon eggs. Anchor up current from the deeper holes and fish on the bottom salmon eggs topped with sand shrimp, bait sweetened Spin-N-Glos or an assortment of wobblers. Troll with bait wrapped Flatfish lures, rainbow colored spinners or spinner bait combinations.

Isthmus Slough Step Program at the Noble Creek Fish Hatchery for Fall run Chinook Salmon. ODFW sponsors a terminal fishery for fin clipped Fall returning Chinook salmon returning to Isthmus Slough. Each fall ODFW releases 650 thousand presmolt Chinook salmon into Isthmus Slough. The 3 - 5 year old Fall run Chinook salmon return each Fall to Isthmus Slough from the last week of August or the first week of September, peaking in September into October before declining in November.

Coho salmon return in last week of August or early September peaking in late September info October before rapidly declining in November. A small number of Coho are taken nearly every month by anglers fishing for other species. Fish for feeder Coho salmon or migrating salmon by trolling plug cut herring, hoochies or streamer flies behind a wire spreader or diver in the upper half of the water column with the incoming tide from the jetty jaws to the Jordan Cove.

Coos Bay Coho caught by the new design spinner patented by the Happy Hooker Tackle Company

Steelhead in the Coos/Millicoma, Coquille, and Tenmile Lakers Basins - ODFW is anticipating a slightly above average run of winter steelhead in the Coos, Coquille and Tenmile Lakes basins. The winter steelhead season in the Coos and Coquille basins typically begins around Thanksgiving, and in some years steelhead can be available into April. This year a few steelhead have already shown up in the Coos Basin in late October. The peak harvest occurs from late December to late February. Steelhead usually arrive a month later in Tenmile Creek, often not making the first appearance until late-December.

These three basins are popular with winter steelhead anglers. Strong hatchery programs usually mean there are plenty of marked fish available for anglers to take home if they wish. In all three basins, only adipose fin-marked fish may be retained.

In all three basins from Dec. 1, 2013 through April 30, 2014, steelhead anglers will be allowed to harvest 1 additional adipose fin-clipped steelhead for a total aggregate of 3 adult fish harvested daily. Unmarked steelhead are naturally produced, and must be released unharmed.

Most of the rivers open to steelhead fishing in the Coos-Coquille-Tenmile basins are open through April 30.

The hatchery programs in the Coos, Coquille and Tenmile use local stocks of fish for broodstock. Unmarked, wild steelhead are incorporated into the egg-take each year in an effort to keep the genetics, behavior and other characteristics of the hatchery stock as close as possible to those of the wild population. One possible benefit of using localized broodstock is a longer run, with fish returning from late November through spring.

Hatchery steelhead for the Coquille River Basin are reared at Bandon Hatchery. There are no facilities in the Coos and Tenmile basins to rear winter steelhead to smolts. Subsequently, steelhead smolts for these two basins are reared at Cole Rivers Hatchery in the upper Rogue, and transported back for acclimation and release. ODFW is evaluating and adjusting acclimation and release sites in order to increase survival and contribution to sport fisheries by returning adult steelhead. Source ODFW. Check the ODFW fishing regulations for changes to the fishing current regulations.

Fishing Techniques

Novice anglers are encouraged to try drift-fishing roe and yarn or a corky on a leader about 20 to 24 inches under a three-way swivel. On the third eye of the swivel attach a short dropper (4-6 inches) of line, weighted to bounce slowly along the bottom. Adjust the amount of weight to allow the bait to drift at a natural rate, ticking the bottom periodically. Cast slightly upstream so that the bait is on the bottom by the time it is straight out from the angler. Bobber and jig combinations can also be a good method for the novice angler; if the bobber-to-bait length is adjusted accordingly it will keep the hook away from bottom snags. Long, straight runs with a uniform depth are good places to try this gear type. Sand shrimp are often added to the drift-fishing rig or on the jig to further tempt steelhead to bite.

During steelhead season, don't discount periods when the rivers are low and clear. By scaling-down your bait or lure size, and toning-down the colors, steelhead can be enticed to bite in clear water. For the bobber and jig anglers, a small black jig often works when a neon-colored or pink jig will spook fish.

Flyfishing for steelhead is becoming more popular in the Coos, Coquille, and Tenmile basins. Drifting an egg fly pattern under a strike indicator is a very effective and simple technique to catch steelhead in the area rivers. Fly anglers can also catch steelhead by swinging flies through short to medium runs that have prime steelhead holding water.

Another tip is to try fishing in the late afternoon/evening hours. Many steelhead anglers are out early in the morning and quit by mid-day. After the fish have had a chance to settle-down, and with most anglers off the river, you can have sections of river almost to yourself.

Cutthroat Trout: "The Oregon Coast Coastal Cutthroat Trout Species Management Unit (SMU) includes all populations of cutthroat trout inhabiting ocean tributary streams from the Necanicum River south to the Sixes River. The Oregon Coast Coastal Cutthroat Trout SMU passed all six interim criteria and its conservation risk classification for this Status Report is "not at risk." *Oregon Native Fish Status Report – Volume II*

Striped bass enter Coos Bay from the middle of March before spawning upriver in June. The larger mature striped bass enter the bay followed by schools of smaller striped bass feeding heavily on spawning herring. The larger striped bass move upriver to the tidal portion of the Millicoma River and the South Fork of the Coos River, but fishing is only allowed in the Coos River. The most productive fishing occurs in the Coos River drifting with the tidal current back bouncing a plug cut herring, strip bait cut from shad or by casting broken back rainbow colored Rapala type lures into schools of striped bass. After spawning in June the stripers move down river into the bay feeding heavily before returning to the ocean in the middle of September.

The twilight of evening on a high incoming tide is the best time of day and tide to fish for striped bass in the estuaries. The best fishing in the bay occurs from late March to May and from late July to the middle of September. Fish for stripers as they migrate up into West Coos Bay from the South Slough up the bay into North Slough, Pony Slough and into the Haynes and Kentuck Inlets of East Coos Bay. Most anglers concentrate their efforts at the entrance to or in the shallow water of the Haynes and Kentuck Inlets of East Coos Bay and in Isthmus Slough as the stripers migrate up river to spawn.

Black rockfish, blue rockfish **and** **copper rockfish** are year-round residents of the lower bay. **Brown rockfish** are occasionally caught in the jetty channel.

Click on **Distinguishing the new species of Blue rockfish**, the **Deacon rockfish**, from Black and Blue rockfish is significant to meet the retention requirements while fishing for Deacon, Blue and Black rockfish.

The most productive fishing for black, blue and copper rockfish occurs after sunset in the jetty channel along the north and south jetties and in the small kelp beds along the shore at Coos Head during the incoming tide. Fish along the east shore from Barview to Sitka Dock and over the submerged jetty at Fossil Point and submerged portion of the North Jetty near Hungry Man Cove (near the east end of clam digging area 1). Bass are also caught among pier structure associated with the Ports of Charleston and Empire and at the base of the Southern Pacific Rail Road trestle located west of the Highway 101 bridge and along the riprap of the North Bend Airport.

Ocean Perch: **Striped seaperch, Pileperch, white seaperch, walleye surfperch, redtail surfperch and silver surfperch** enter the bay in the spring during April with the greatest number occurring during the summer months of June and July. Schools of perch move onto the tidal flats feeding heavily on intertidal animals upstream from the entrance to the bay into the South Slough up through West Coos Bay and into East Coos Bay. The fishing ranges from fair to excellent through fall depending on the tides and the weather conditions. Striped seaperch are most commonly caught perch caught followed by pileperch, white seaperch, walleye surfperch, retail surfperch and silver surfperch. Coos Bay offers the most productive fishing for pileperch and white seaperch for any of Oregon's bays. Fish along the channels that drain the tidal flats associated with South Slough, West Coos Bay up through the Jordan Cove and along the riprap associated the North Bend Airport.

The area around Buoy 12 is a local perch hotspot. Fish among the structure associated with docks of the Port of Charleston, the Empire Boat Basin, North Bend and the Port of Coos Bay. Fishing can be excellent in the channel that drains the tidal flats of North Slough, Pony Point Slough. Fish around the railroad trestle at Pony Point and in the deepwater channel off Russell Point that drains the tidal flats associated with Haynes and Kentucky Inlets. Fish along the deepwater channel that drains the tidal flats of North Point and among the pilings under the docks associated with North Bend and Coos Bay.

Kelp greenling, rock greenling and whitespotted greenling enter the bay with the tide throughout the year. The overall catch rate for greenling rates 3rd behind Yaquina and Tillamook Bays. The best fishing occurs in the lower bay from May through August along the submerged structure of the jetties, among the pier structure associated with the Port of Charleston and up the bay past Pigeon Point. The best fishing occurs on the eastside of west Coos Bay but declining numbers further up the bay to Menasha Dike (Transpacific Parkway).

Lingcod fishing is the best from January through April with February and March being the most productive. Fishing during the spawning period is excellent along either ocean side or the bayside of the north or south jetties and inside the bay to the Charleston Bridge.

Cabezon are found all year among the jetty rocks, especially the submerged jetty in addition to the sections of the north and south jetties. Cabezon move into shallow water during March to spawn. The spawning period is the best time to fish for cabezon. Fishing is slow the rest of the year.

Pacific herring enter the bay to spawn in February, March and into April.

White sturgeon enter Coos Bay from January through July but the best fishing occurs in February declines in March and picks up from April through July before declining in August. The sturgeon fishery of Coos Bay ranks 4th overall when compared to the sturgeon fishery of Oregon's other bays. Mud and/or sand shrimp are the most productive bait followed by herring and shad. Shad are most productive bait during their annual spawning run. Fish for shad and use them as bait in Coos and Millicoma Rivers during their annual spawning run from May into June. Fish for sturgeon during the outgoing tide in the deeper holes associated with the channel that drains the North Slough from the Transpacific Parkway Bridge to the railroad trestle bridge. The most productive fishing in the East Bay is associated with the Dolphins just upstream from the Conde McCullough Bridge and in the deeper

Empire Public Fishing Pier is located in the community of Empire at the Empire boat ramp. Crabbing and fishing from the pier is fair at best on an incoming high tide.

Coos Bay Jetties – The north jetty is accessible from the Trans Pacific Parkway via Horsfall Beach by 4-wheel drive vehicle. The south jetty is accessible from the Coos Head road. The fishing for bass, sea trout, cabezon, lingcod and salmon from both jetties is excellent. Fish for bass on an incoming tide from the south jetty after sunset, but be careful south jetty is subject to large breaking waves especially near Coos Head. As always the angler should avoid the jetties during periods of heavy swells, and should never venture onto the jetty alone.

Bank fishing access in Coos Bay limited; however, fish for bass, sea trout, cabezon, lingcod and salmon from the south jetty at Coos Head or from the north jetty but one must be cautious because of the serious threat posed to one's safety by long ocean swells. Point Adams on the Charleston Spit offers the best fishing from shore in Coos Bay for all fish species. Fish for perch, sturgeon and striped bass for the end of the riprap seawall associated with the airport. Fish for perch and striped bass from the west side of the bridge on the Trans Pacific Parkway or from shore along the west shore of West Coos Bay or the west shore of the North Slough. Fish for sturgeon by parking on the turnouts along the Coos River Road paralleling the lower tidal reach of the Coos and Millicoma Rivers. Fish for sturgeon on the South Fork of the Coos River in the hole just upstream from the Myrtle Tree County Boat Launch or downstream off of Landrith Road.

Coos Bay boat launches in West Coos Bay on the south shore are located at the **Charleston Boat Basin** in Charleston. The **BLM operates a boat launch** on the east shore of West Coos Bay that is accessed via the Trans Pacific Parkway but is closed at times because of sedimentation. The **Empire crabbing dock and Boat Ramp** a no use fee boat launch and is located in the community of Empire where the Cape Arago Hwy turns south to Barview and the community of Charleston. Launch at or the Port of Charleston, Empire Boat Launch or the BLM operated boat launch to access lower Coos Bay or the ocean.

The East Coos Bay Boat Launches are located at the **North shore boat launch Conde McCullough** is located in the community of Glasgow via the North Bay Drive. **The California Street Boat Launch** is located in North Bend and the **Eastside Boat Ramp** is located across the Isthmus Slough from downtown Coos Bay via Hwy 101 exit Hwy 101 over the Chandler Bridge on Newport Ln, Hwy 241. to where it becomes 6th Avenue to D Street. Turn left onto D Street to the Eastside Boat Launch. The Eastside Boat Ramp is the boat ramp fishermen use to launch to fish the upper East Coos Bay for salmon. To access the **primitive boat launch at Catching Slough** turn right from 6th Avenue onto D Street, Hwy 241 the Coos River Hwy. Cross Catching Slough on the bridge crossing Catching Slough and immediately turn right from the Coos River Hwy onto Catching Slough Road and right again into the parking area for the Catching Slough Boat Ramp.

Launch at Shinglehouse Slough Boat Ramp or **the Green Acres Boat Ramp** to fish the Chinook Salmon returning to Noble Creek fish hatchery. To access Isthmus Slough Launch at the Oregon Department of Transportation boat launch at Shinglehouse Slough in the community of Hayden on Isthmus Slough. Turn right into the driveway of the boat launch once you have crossed over the Hwy 101 Bridge over Shinglehouse Slough. Be sure to slow your vehicle down to make the turn into the driveway of the improved boat ramp. The Green Acres Boat ramp is a primitive boat ramp operated by ODFW. Call 800-720-6339 for additional information. To access exit Hwy 101 onto Hwy 42 to Coquille. Slow down to make the turn into the parking area for Green Acres. Use caution to observe the traffic exiting from Coquille on Hwy 42 onto Hwy 101 north.

To access the upper tidal reach of the Coos River launch at **Doris Place boat ramp** located at milepost 7.2 on the Coos River Hwy.

To access Millicoma River, launch at the **Rooke Higgins County Park and Boat Launch** located at milepost 10.0 on the Coos River Hwy. The **Stonehouse Bridge Boat Launch** is located 8.8 miles up the Coos River Hwy on the W. Fork Millicoma Rd from the Rooke Higgins Boat Launch. The Stonehouse Bridge Boat Launch a no use fee boat launch is operated by ODFW. For additional information call 800-720-6339. To access the **Myrtle Tree County Boat Ramp** located 8.2 miles from Hwy 101 on the South Coos River Ln. exit Hwy 101 onto Newport Ln. to the Coos River Hwy 241. Turn right onto the Coos River Hwy 241 to the turnoff from the Coos River Hwy to S. Coos River Ln. Turn left onto the S. Coos River Ln. Travel 4.7 miles to the Myrtle Tree County Boat Launch. The no use fee boat launch is operated by Coos County. For additional information call 541-396-3121.

Coos Bay Crabbing: Oregon's largest bay is a salt water dominated bay that holds crabs longer than any other of Oregon's Bays......... Recreational crabbing in the ocean now is open from December 1st of the current year thru October 15 of the following year. Recreational crabbing in the bays is open all year.

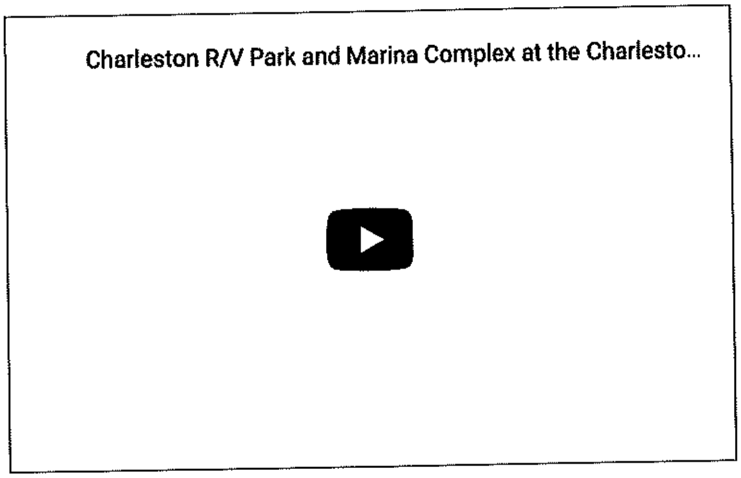
Crabbing like all other salt water related activity in the bays is dependent on the tides. The most productive crabbing tides occur during the series of Neap tides followed by the minor tidal exchange of Spring tides. The most productive crabbing in Oregon's bays occurs in the larger salt water dominated bays during the incoming tide, periods of slack tide and during periods between the low high tide and high low tide of the daily tidal cycle.

Crabbing productivity usually declines over a series of Spring tides. Crabbing is not as productive during the high velocity tidal current generated during the major tidal exchange of spring tides or during the outgoing tide. The crabs bury themselves in the sand to escape the increased current velocity of the outgoing tide. ...... Remember crabbing in the bays is best during periods of neap tides.

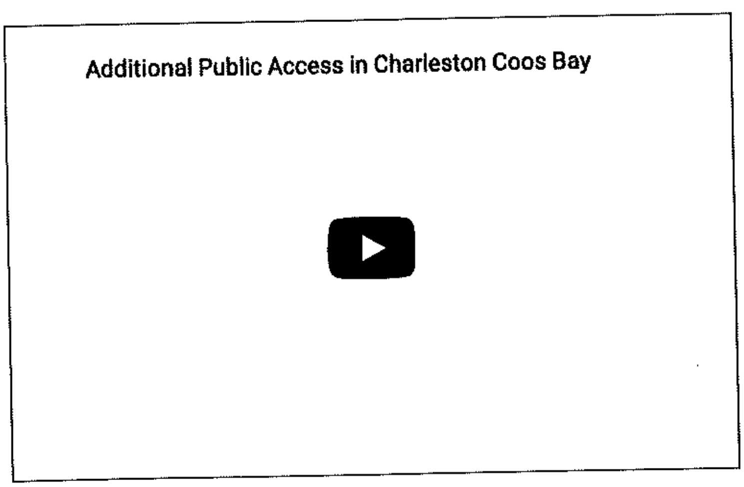
Warning this Spring the rough boating conditions have sunk 4 recreational boats. The weather has had a negative impact on the ability of crabbers to crab in the lower bay but. A word of caution while boating in the Coos Bay during the outgoing tide in combination with or without strong southerly winds associated weather fronts moving through the area: the resulting swells and wind chop can sink a boat in the blink of an eye.

The Bites On is located at 750 Newmark Avenue Empire OR 97420 at 541-888-4015 the Bites On has the fishing, crabbing and clam digging in stock to satisfy your immediate needs; or you can rent crab rings and purchase rockfish carcass for 2.50 or mackerel at 4.99 a bag. When crabbing is productive crabbing with mackerel is worth the cost. Some salmon are being taken in the bay. Call the Bite's On for up to the minute information.

Charleston is ground zero for launching your crabbing or clam digging adventures in Coos Bay. We suggest staying at the Charleston R/v Park or at one of the many motels in the area. Park host Susan Smith will do everything possible to make you stay in the area a pleasant one.



The best crabbing docks have been the B/C and D/E docks in Charleston. The best baits for crabbing are fish, chicken or turkey legs. The best time to crab in the bays is good during the incoming tide but best at slacks tide and during periods of neap tides with minimal movement of water between the high low tide and low high tide.



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Crabbers Mike and Elli from New Jersey score crabbing at Winchester and Coos Bay.

Mike contacted me earlier inquiring where he could purchase several Crab Max crab traps. His next email described his success crabbing at Winchester and Coos bay. That's great!, I responding. Did you crab from A Dock? How many crab were you and Ellie catch? By chance did you take any photos and if you did can you share them with us?

We love to see success; that is what crabbing is all about.

Hi Bill!

Mike passed this on to me. We had a great time with the CrabMax. We bought two and also used two big collapsible box traps. We live in an RV so space is an issue. This is one of the reasons I like the crab max.

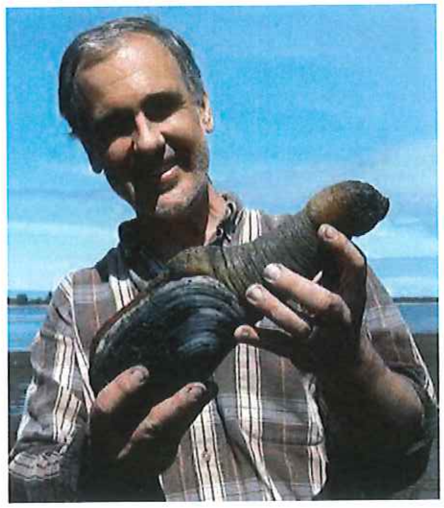
We crabbed at the A dock in Winchester Bay and caught 10 keepers in two days. Just so you know, probably seven of them were in the crabmax not the pot. We went further down the coast to Charleston OR for a few days. We caught six the first day and 20 the next!!! Again almost all were in the crabmax including one that was over 7 inches across. It did not matter what bait we used, chicken, fish or even "special sauced chicken". the crabmax out performed the other pots. And it was easier. So light and easy to haul up. When I pull a pot they are heavy and I feel like I am almost going to fall off the dock, but not with the crabmax. My only regret is that we did not get two more. But we will!

Thank you for a wonderful product!

Ellie (and Mike)

Dgging Clams in Coos Bay is based on ODFW Seacor studies.

Information Report: 2014-09 Status of Oregon bay clam fisheries, stock assessment, and research using **Seacor methods of research.**



"Geoduck clams actually exist in Coos Bay.", exclaimed clam digger John. We thank clam digger John for sharing his Geoduck clam with us, however very few have ever been dug from Coos Bay. The`re are reports of a few Geoduck clams taken from Clam Island. I found one while filming the video clip for cockles in South Slough, but I was not prepared to dig it and I was never able to return to the spot with the proper equipment. I dig not want to fail in any attempt to dig the clam so I left it alone.

Digging clams in Coos Bay produces all the clam species of interest to recreational clam diggers (razor clams, Geoduck clams, gaper clams, butter clams, Manila clams, softshell clams and cockles.

Coos Bay offers the most productive clam digging found in any of Oregon's bays. The gaper, cockle and butter clam beds extend from the South Slough to the Airport. Littleneck clams are found in association with butter clams in South Slough, Bar View, Pigeon Point and Strawberry Island. Softshell clams are found in Pony Slough, North Slough, and Haynes Inlet and along the east shore of East Coos Bay. Piddocks clams are found at Pigeon Point. Razor clams are dug from the sandy beach at Bastendorff Beach, the North Spit and inside the North Spit at the Training Jetty. At times a limited number of razor clams are dug from the sandy beach from the Charleston Sand Spit that separates the Charleston Boat Basin from the jetty channel.

Clam digging access points along the east shore of west Coos Bay are: at the parking area at the Empire Boat Launch, the Fulton St. sewage plant plus several public easements along the Cape Arago Hwy. Charleston clam digging access points: Turn onto Boat Basin Road then right onto Kingfisher Rd. and park next to the bay. Turn left onto Roosevelt and park at the end of the street. Dig for Empire and butter clams on Clam Island. All species of bay clams are dug on the North Spit accessible by 4x4's via the Trans Pacific Pkwy. Access beyond the end of the paved road is by 4x4 vehicles equipped to deal with deep sand.

North Spit Area Clam Digging: Access to the North Spit is by boat or via the Trans Pacific Parkway. Razor clams are located on the Oceanside near the tip of the North Spit and in the sandy substrate of the tidal flat at the Training Jetty just inside the North Spit. All species of "Bay Clams" are accessible from shore of the North Spit associated with Clam Island and Strawberry Island. Butter and Gaper clams dominate the tidal flats associated with Clam Island and Strawberry Island. Cockles and steamer clams (littleneck and Manila clams) are found in the tidal flats associated with Strawberry Island. The following video was sponsored by the World Newspaper of the CDAO initial clam clinics in Coos Bay for gaper clams on the North Spit.

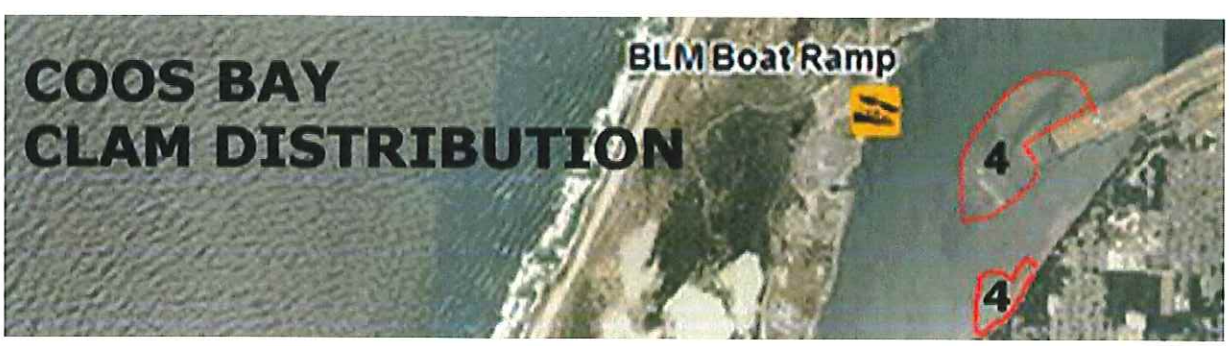
Coos Bay clam digging: offers the most productive clam digging found in any of Oregon's bays. The average size of the gaper clams located in the Charleston Triangle and in the tidal flat located between the Cape Arago HWY and Randolph St. range from mostly small to medium but the clams are plentiful as are cockles and butter clams.

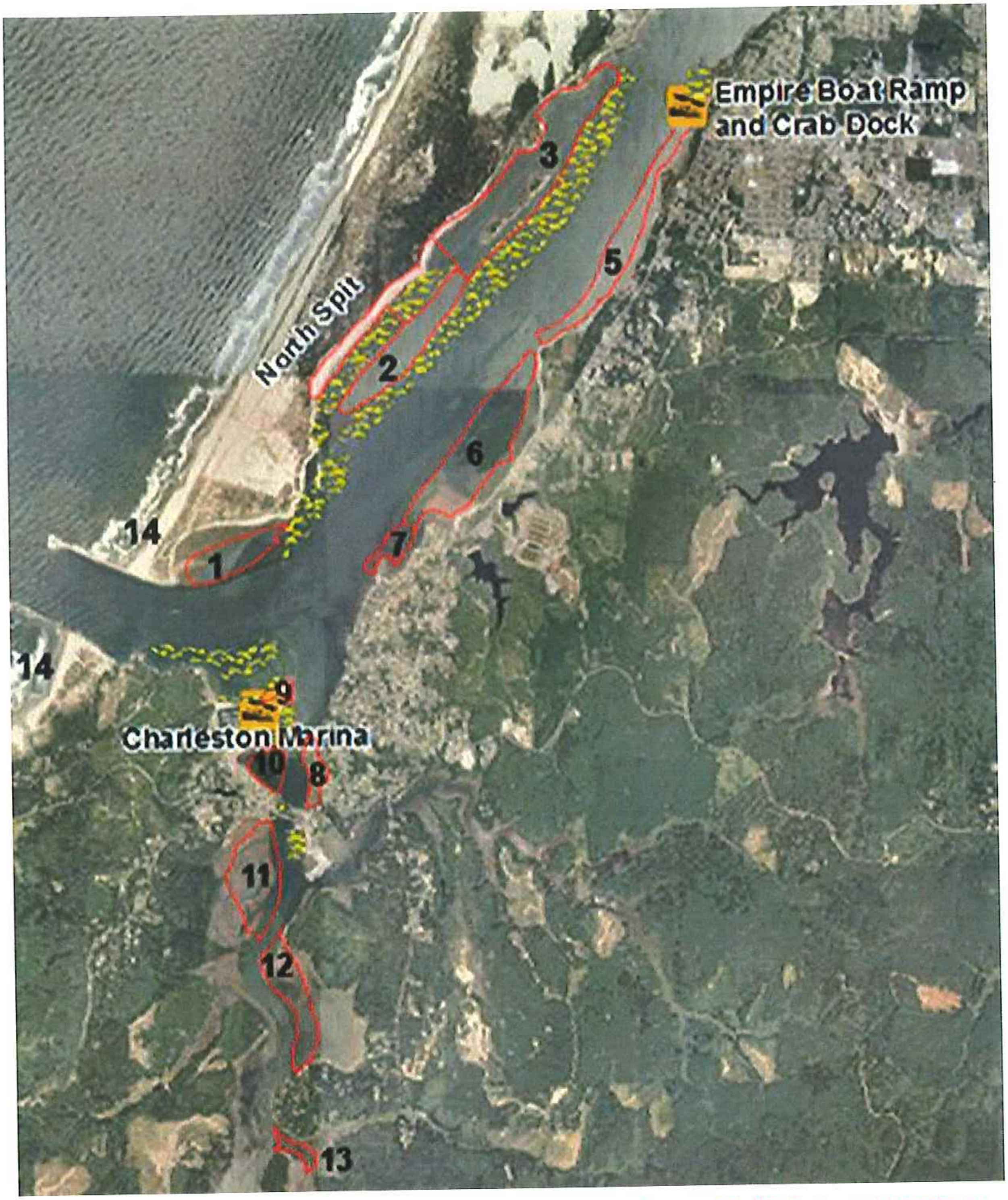
Bill demonstrates raking cockles in South Slough at Crown Point across the channel from Kelly's Point.

The harvest of empire/gaper clams has been good at the North Spit and Clam Island. The best harvest areas for the average clam digger without 4 wheel drive trucks are from the Empire/Charleston tidal flats along Cape Arago Highway, and within Charleston, north and south of the Charleston Bridge. Butter, gaper, and cockle clams are abundant in these areas as listed on the SEACOR maps below.

ODFW Crab and Clam Distribution Maps for Coos Bay

Click on the image of the map of the crabbing and clam digging areas at the bottom of the page to enlarge it. If the image is still too small use the zoom feature on your browser to enlarge the image of the map.





Click on the following link to view the SEACOR maps of Coos Bay. **Seacor Shellfish Areas Coos Bay** to link to ODFW's maps of the shellfish Location of clam beds on map listed below:

1. Training Jetty sandy tidal flat contains large gaper clams and razor clams. The larger gaper clams found in sandy areas of the tidal flats are located at depths up to 39 inches. Gaper clams at this depth in sand substrate are too deep to be dug successfully with a shovel. Use the digging methods described in this book to successfully dig gaper clams from these depths. Razor clams are common to the area. Boat access to the Training Jetty is at entrance to Hungryman's Cove.
2. Clam Island emerges at a +2.0 or lower tide and is only accessible by boat. Hungryman's Cove is a

small channel that separates the shoreline of the North Spit with the island. It features the highest densities of gaper and butter clams in Coos Bay. Cockles and some native littleneck clams are also found. Shoreline flats boast excellent gaper and butter clamming.
3. Strawberry Island tidal flats are located just north of Clam Island. Gaper and butter clams dominate the area followed by cockles and steamer clams. Clam Digging from the tidal flats associated witht the Caper Arago Highway is excellent for all species of Bay Clams.
4. Airport: digging for gapers and cockles is productive west of the runway. Boat access only.
5. Empire: the tide flats adjoining Empire are good for gaper and butter clamming. Parking and access is at a city parking area opposite of Fulton Ave .Sediments are soft and easy to dig in, however holes dug for gapers may cave in easily, choose good low tides.
6. Pigeon point: this expansive clam bed is productive and easily accessed. A good clamming area for butter, gaper and Piddocks clams. Access to the tidal flats is adjacent to the county easement area opposite of Grinnel road.
7. Fossil point area has good beds of large butter and gaper clams, however digging can be a little more difficult as the substrates include shell, and cobble. Access to the tidal flats is from the parking area at Beacon lane.
8. Barview: butter clams are the dominate clam species dug followed by gaper, cockles and steamer clams.
Charleston Clam Digging: is productive but the gaper clams are often small sized when compared to gaper clam taken from other tidal flats in Coos Bay
9. Point Adams large cockles can be raked along the sandy beach. Gapers occasionally recruit to the beach southwest of the point. Access is at the end of Boat Basin road.
10. Charleston Triangle Gapers and butters are abundant. Easily accessed from parking areas South of docks.
11. Charleston Flat Gapers and butters can be dug throughout the areas South of the South Slough bridge. Cockles can be raked toward the South end of this area. Access is at the Charleston visitor center, or turn south from the Arago Hwy onto Roosevelt and park at the end of the street. The parking area is the access point to the gaper, butter, cockle and steamer clams located on the large tidal flat just south of the Charleston Flat.
12. Indian Point: boat access only for cockle, gaper and butter clams.
13. Valino Island: boat access only for cockle, gaper and butter clams.
14. Ocean Beach razor clams at the North Spit and Bastendorff Beach.
15. Upper Coos Bay or East Bay (not shown) are the tidal areas up bay of the Railroad Bridge, North Slough and Haynes Slough are soft and muddy. Softshell clams can be found throughout, finding firm walking substrate is challenging. Areas around transpacific highway and North slough are occasionally used but the tidal flats are extremely muddy.

Internet Links of Interest:

Oregon's bar closure website. Check the **NOAA Bar Observations website** for updated closures and restrictions.

Check the **NOAA Bar Observations website** for updated closures and restrictions for local bar observations of Oregon's Bays.

NOAA Tidal Projections Charleston Coos Bay

Tbone Tidal Projections Charleston, Coos Bay

Click on the Marine Forecast from **Florence to Cape Blanco** to view the marine forecast featuring Small Craft Warning.

Click the following link to view the **Marine Forecast for the NWS Medford Zone:** Coastal waters from Cape Blanco OR to Pt. St. George CA out 10 nm (PZZ356).

The following **NOAA link** for detailed information for the Oregon Coast is a great source for planning your razor clam digging adventures. Click on the following link to see a detailed hourly forecast for weather and surf conditions on the southern Oregon Coast.

NOAA Coastal Forecast for Curry County

LONG OCEAN SWELLS: Click on to view the **Oregon Surf Report**. Use the **Stonewall Bank buoy** or the **St Georges buoy** in place or the **Port Orford buoy** to view the height of the long ocean swells in

Southern Oregon Beaches. Use the Port Orford buoy station 46015. to view the height of the long ocean swells. National Buoy Data Center **observation reports** for buoys off the Oregon Coast. Click on **National Buoy Data Center** to view the observations from buoys off the Oregon Coast.

Recommended website: Click on the following link to see a detailed hourly forecast for **weather and surf conditions** on the southern Oregon Coast. Then click your coastal zone of interest to view the detail information compiled on the Marine Digital Point Forecast Matrix Interface.

The local weather forecast for the greater **Coos Bay area** changes hourly.

Email us with any suggestion how we can improve the information we provide at **crabbinginfo@yahoo.com**

Waterfowl hunting in Coos Bay is allowed except in the following areas. That part of Coos Bay described as follows is closed to waterfowl hunting: Beginning on Russell Point at the north end of Hwy 101 Bridge across Coos Bay in Coos Co; west approximately 3/4 of a mi on Parallel 43°26´ to the Southern Pacific Railway to a point due north of the northeast point of the North Bend airport; south to the northeast point of the North Bend airport; southerly on the west bank of Pony Slough to the Charleston-North Bend Hwy; east on the Charleston-North Bend Hwy to the east bank of Pony Slough; northerly on the east bank of Pony Slough and Coos Bay to the south end of the Hwy 101 Bridge; northerly on the Hwy 101 Bridge to the point of beginning.

Mile by Mile Directions to Cape Arago

The Cape Arago Highway OR 540 begins at the intersection of Sheridan Ave a divided road and Virginia Ave in North Bend where Sheridan Ave carries the northbound traffic of US 101. The Cape Arago Highway travels west along Virginia Ave, turning south onto Broadway St, then west again on Newmark Ave where it enters the city of Coos Bay and the community of Empire. At the western edge of the community of Empire Newmark Ave becomes Empire Blvd and turns southwest where Empire Blvd becomes the Cape Arago Highway. Cape Arago Highway passes through the towns of Barview, Oregon and Charleston. For its remaining length, the highway skirts the coastline to Cape Arago State Park, where it ends, becoming Cape Arago Road.

235.4 North Bend junction of Highway101 and the coast route OR 540 to Charleston and the ocean beaches associated with the Cape Arago Highway and the Seven Devils Road.

Highway 101 continues south from North Bend paralleling the west shore of East Coos Bay through the City of Coos Bay rejoining the coast route at the junction of the Seven Devils Road north of Bandon.

Mingus Pond a small pond located in **Mingus County Park** at N 10th St. and Cedar Ave downtown Coos Bay. Mingus Pond is stocked with catchable rainbow trout and contains largemouth bass.

Coos Bay Boardwalk A unique opportunity to bank fish for chinook salmon in downtown Coos Bay.

Students from Blossom Gulch Elementary School raise and release young chinook smolts into Blossom Gulch that flows under the streets of Coos Bay. Adult salmon returning to the Gulch congregate at the tide gate where the piped stream flows into the bay.

Fall chinook salmon, late August through October. An occasional passing coho salmon, headed further up the bay.

Use large bobbers with bait (salmon roe clusters and/or sand shrimp) or cast large spinners to catch these fish. You'll need a large landing net to land them.

Downtown restaurants, shops, motels and grocery stores are nearby. The Coos Bay Area Visitor's Center is across the street from the Boardwalk, and has public restrooms.

The Boardwalk is in downtown Coos Bay, at the foot of Anderson and Central Avenues, next to the northbound lane of Hwy 101.

1.0 Cape Arago Highway is the route to the crabbing and clam digging opportunities of West Coos Bay and ocean beaches continues along the east shore of West Coos Bay and through the communities of North Bend, Empire and **Charleston to the junction of the Seven Devils Road. The Cape Arago Highway ends 14.0 miles at Cape Arago.** The route along the ocean beach continues along the Seven Devils Road.

2.4 John Topits City Park From Hwy 101 through North Bend and Coos Bay, take Newmark Ave west 1.5 miles. The middle lake entrance to John Topits Park is a few blocks past the entrance for Southwestern Oregon Community

Empire Lakes

The Empire Lakes (lower and middle lakes), within the city limits of Coos Bay, offer great fishing without even leaving town. An extensive forested trail system around and between the lakes will help you forget you're in the middle of the city.

Rainbow trout are stocked regularly from March to early June. Bluegill and yellow perch are also available. In the late springtime, small bluegill and yellow perch can keep young anglers busy. Try fishing a tiny crappie jig tipped with a piece of night crawler, under the smallest bobber you can find. Each lake has a boat ramp, but boating is restricted to small boats with electric motors or boats, kayaks, canoes and pontoon boats -- electric motors only. Boaters troll spinners or spoons, or fly cast to rising trout.

5.5 to 6.2 Cape Arago Highway is the location of access to the tidal flats associated with Coos Bay. Dig for clams in this section of the bay or pump for mud or sand shrimp. The lower bay offers excellent clam digging for gaper clams, cockles, butter clams and littleneck clams. Look for the large yellow beach access signs. Parking is extremely limited. The competition is keen for the few convenient parking places during clam tides.

6.7 Cape Arago Highway is another location for access to the tidal flats associated with Coos Bay. Dig for clams in this section of the bay or pump for mud or sand shrimp.

8.0 Port of Charleston is home to restaurants that serve excellent seafood. Dig for clams in this section of the bay or pump for mud or sand shrimp. Launch your boat and fish and crab in the bay or fish on the inshore reefs just outside the bar.

The Oregon Shorebird Festival**:** One of the longest running bird festivals in Oregon is celebrated in late August or early September. The Coos Bay area offers some of the mostdynamic birding in the State. The festival is headquartered at the Oregon Institute of Marine Biology in the small fishing community of Charleston, OR.

Charleston Marine Life Center at the Oregon institute of Marine Biology Located on the edge of the harbor in Charleston, OR, the Oregon Institute of Marine Biology's Charleston Marine Life Center is an exciting place for discovery. Aquaria highlighting different coastal ecosystems, a tidepool touch tank, whale and sea lion skeletons, underwater video from deep reefs and undersea volcanoes, and a variety of specimens reveal the hidden and remarkable diversity of life off Oregon, from the coast to the deep sea. To access the Oregon Institute of Marine Biology in Charleston Turn north from Cape Arago Hwy onto Boat

Basin Rd. The Oregon Marine Institute of Marine Biology is located .4 tenths of a mile on the west side of the street.

Oregon Institute of Marine Biology: Five exhibit galleries focus on coastal ecosystems, deep-water habitats, fisheries, marine mammals, and ongoing marine research. From the CMLC's windows, you can look out over the harbor as fishing boats unload their catch, and watch seals, sea lions and birds a few feet away. Find out about on-going marine biology research, check out a working ROV (Remotely Operated Vehicle), explore collections and zoom in with microscopes.

8.5 Seven Devils northern junction south is the access route to the beaches south of Cape Arago and to the South Slough Estuary Reserve at Coos Bay. The Seven Devils are named after seven hairpin turns that have been the cause of numerous automobile accidents. Travel on Seven Devils Road north of the Seven Devils Wayside is not recommended for RV's and travel trailers because the road is narrow, windy and not paved. Visitors driving RV's and pulling travel trailers should detour around the gravel road portion of Seven Devils Road via the West Beaver Hill Road to the East Humphrey Road and rejoining the Seven Devils Road to access Whiskey Run Beach, Merchants Beach, Sacchi Beach and Agate Beach. Public access to Sacchi Beach and Agate Beach is restricted by private property.

9.0 Coos Head is the location of the south jetty of Coos Bay. The south jetty at Coos Head can also be accessed through Bastendorff Beach. Fish for bass, sea trout, cabezon, lingcod and salmon from the south jetty at Coos Head. Be careful when fishing on the south jetty as the south jetty is subject to large breaking waves especially near Coos Head. The shore line of Coos Head managed by the BLM while the upland area of Coos Head is the property of the Confederated Tribes of Coos, Lower Umpqua, and Siuslaw Indians and is currently closed to access by nontribal peoples.

10.3 Bastendorff Beach is located just south of the entrance to Coos Bay and north of Yoakum Point. Access is gained via the Cape Arago Highway and is listed by ODFW as a location to dig for razor clams. It is also an excellent location to fish for redtail surfperch and striped bass.

10.7 Yoakum Point is located between Bastendorff Beach and Lighthouse Beach. Public access is limited by private property. Visitors have to park along the Cape Arago Highway and walk in.

11.2 Gregory Point is the location of the Cape Arago lighthouse and was the location of the Cape Arago lifesaving station. Three lighthouses have been built on Gregory Point. The first was built in 1866, the last in 1934. The lifesaving station was part of the tragic drama of cowardice and courage displayed at its worst and its best by the rescuers connected to the sinking of the steam driven ship Tacoma that ran aground off Umpqua Bay during a howling winter storm in January of 1883. Access to Gregory Point and to the lighthouse is restricted through the Coast Guard Station. Visitors have to park on Cape Arago Highway and walk in. Refer to the Oregon Sport Fishing Regulation restricting the taking of shellfish or marine invertebrates within the Gregory Point Subtidal Research Reserve.

11.2 Lighthouse Beach is located between Gregory Point and Yoakum Point. Public access is limited by private property.

11.7 Sunset Bay is located west of Coos Bay on the Cape Arago Highway. The fishing from the rocky shore is renowned for its excellence. There is good to excellent fishing for all shallow water rockfish species, sea trout, lingcod, cabezon, striped seaperch and pileperch including an occasionally white seaperch. Refer to the Oregon Sport Fishing Regulation restricting the taking of shellfish or marine invertebrates within the Cape Arago Intertidal Research Reserve. The best fishing is from the point on the north side of the bay.

Kayakers honing their skills in the stormy surf at Sunset Bay.

The point is accessible during an outgoing tide. Remember to keep an eye on the tide giving you plenty of time to leave the rocks before being trapped by the incoming tide. Use caution when fishing on the rocky shore at Sunset Bay or Cape Arago because the rocky shore is subject to the sudden onset of large breaking waves. The south shore of Sunset Bay isespecially dangerous.

There is a small boat launch located at the far end of the parking lot that will accommodate small open boats. There are some anglers who fish in the ocean outside of Sunset Bay consistently, but do so only when the ocean is flat dead calm.

The Sunset Bay State Park is a full service park with several volley ball courts and a golf course. The winter storms draw kayak enthusiast who practices their sport in the waves.

12.0 Cape Arago Highway is the location of the trailhead that leads to the rocky cove just south of Sunset Bay. There is excellent fishing for rockfish in the cove.

12.4 Shore Acres State Park is the former home of timber baron Louis Simpson who built two homes on the site. One of the homes burned and the other slid into the ocean leaving 7 acres of formal floral gardens. During the winter holidays the park is aglow with more than 200,000 lights to celebrate the season. The park offers winter visitors a surf and ocean spay show as storm driven waves smash into the shore in spectacular fashion. Shell Island offers a springtime visitor a view of the largest sea lion colony on the Oregon Coast. The sea lions arrive each spring to give birth to their pups. There is ample parking for all vehicles. The beach trail is located behind the garden. The fishing is good to excellent for the fish species common to the rocky shore: bass, perch, cabezon, sea trout and lingcod.

14.0 Cape Arago State Park consists of three coves located at the end of the Cape Arago Highway. There is ample parking for all vehicles. The trails to the rocky shore below the north cove, middle cove and south cove are located behind the parking area. The fishing is good to excellent for the fish species common to the rocky shore: bass, perch, cabezon, sea trout and lingcod. South cove is a sheltered cove located on the lee side of Cape Arago and offers boaters anchorage during the summer months.

Hwy 101 Mile by Mile continuation from Coos Bay to Bandon

238.1 Charleston junction to the ocean beaches on Highway 101 and Commercial Ave in the City of Coos Bay is the junction to Charleston and the ocean beaches associated with the Cape Arago Highway and the Seven Devils Road.

239.5 Coos River junction on Highway 101 in the City of Coos Bay is the junction to the **Coos River**, the **South Fork of the Coos River** and the **Millicoma River** and the community of Alleghany.

244.2 Junction of Hwy 101 and State Hwy 42 to Coquille and Powers. Power's Pond a 23.4 acre lake is located at the **Powers County Park**. The pond is stocked with catchable rainbow trout. The 1 acre Sru Lake and **primitive campground** is located 21 miles south of Powers. The area is home to, "Big Foot", sightings (Ha!). ODFW stocks the lake with rainbow trout. Hwy 101 continues south to Bandon.

257.4 Seven Devils southern junction west from Highway 101 is the access route to the beaches south of Cape Arago and to the South Slough Estuary Reserve at Coos Bay. The route south continues on Highway 101 to Bullards Beach and the coastal community of Bandon on Coquille Bay.

Turn west from Highway 101 onto the Seven Devils Road and travel north to access Whiskey Run Beach, Merchants Beach, Sacchi Beach and Agate Beach and the **South Slough Estuary Reserve** at Coos Bay. The Seven Devils Road continues north and joins the Cape Arago Highway just west of the community of Charleston located on Coos Bay. The route along the east shore of West Coos Bay continues through the communities of Charleston and Empire to North Bend where it rejoins Highway 101.

3.9 Whiskey Run Beach off of Seven Devils Road allows beach access by motor vehicles and is listed by ODFW as a location to dig for razor clams and is an excellent location to fish for redtail surfperch and the occasional striped bass. As shown in the video clip Whiskey Run Beach is a great beach to beachcomb, Wind surf, fly kites or enjoy the beach with family and friends.

4.5 Merchants Beach is the location of the Seven Devils State Wayside and is an excellent beach to fish for redtail surfperch and the occasional striped bass. The Seven Devils State Wayside is a day use park with restrooms, picnic tables and ample parking for all vehicles.

5.0 Agate Beach is an excellent beach to fish for redtail surfperch and the occasional striped bass. Access to Sacchi Beach and Agate Beach from the Seven Devils Road is restricted by private property. Access to these beaches is by foot from the Seven Devils Wayside at Merchants Beach.

5.3 Sacchi Beach is an excellent beach to fish for redtail surfperch and the ocasional striped bass. perch and the occasional striped bass following the years when the striped bass spawn successfully in the Smith River.

8.0 South Slough Estuary Reserver The **South Slough Estuary Reserve** mission statement states, "To improve the understanding and stewardship of Pacific Northwest estuaries and coastal watersheds." This entry under development.

Click **HERE** to return to Mile by Mile. Click **HERE** to return to the top of page.