FINAL

ENVIRONMENTAL IMPACT STATEMENT

SUMMARY

1. Major Conclusions and Findings. The National Economic Development (NED), Least Environmentally Damaging (LED) and Recommended (REC) plans consist of widening and deepening the Grays Harbor Navigation Channel from Cosmopolis, Washington, to the Pacific Ocean and replacing the railroad bridge over the Chehalis River in Aberdeen, Washington. Proposed channel dimensions would be similar for all plans and would improve navigation efficiency and safety for water transportation. Mitigation of adverse effects to shallow, subtidal habitat and the Dungeness crab resource is an integral part of each plan.

The NED plan consists of dredging the channel reaches and disposing of the dredged material in a manner formulated mainly for cost efficiency. Hopper and clamshell dredges would be used. Most of the material to be dredged would be discharged at disposal sites within the harbor mouth and at an ocean disposal site 2-1/2 miles from the harbor mouth. An upland site in South Aberdeen and confined disposal at the Port of Grays Harbor Slip No. 1 will be utilized for discharge of dredged material determined to be unacceptable for open-water disposal based on bioassay tests. Major unavoidable environmental impacts associated with the NED plan include possible recirculation of fines and siltation on vegetated mudflats, possible burial of subtidal populations of razor clams, burial of benthos at disposal sites, possible burial of crabbing grounds at 2.5 mile site, and removal of channel benthos by dredging, and permanent loss of 20 acres of subtidal and intertidal area due to filling of Slip No. 1. Without mitigation, environmental impacts of the NED plan would include loss of 4 acres of inner harbor juvenile salmonid feeding and rearing area, an estimated reduction of 1.81 to 4.25 percent to the annual Westport Dungeness crab harvest (which ranges from 500,000 to 3,000,000 crabs per year) during initial construction and an estimated increase in the maintenance dredging related reduction of the local crab harvest from the existing .73 percent to a new 2.23 percent per year for the life of the project.

The LED plan consists of dredging and disposal in a manner with the least environmental impacts. Clamshell dredges would perform the majority of the work with only the Entrance and Outer Bar reaches being dredged by hopper dredge. The material to be dredged would be discharged at an acceptable ocean disposal site approximately 8 miles from the mouth of the harbor, with the material unacceptable for open-water disposal to be discharged at the South Aberdeen upland disposal site and at Slip No. 1. Unavoidable impacts associated with the NED plan include removal of channel benthos by dredging, burial of benthos at disposal sites, and permanent loss of 20 acres of subtidal and intertidal area due to filling Slip No. 1. Without mitigation, environmental impacts associated with the LED plan would include loss of 4 acres of inner harbor juvenile salmonid feeding and rearing area and an estimated reduction of .87 to

2.04 percent to the annual Westport Dungeness crab harvest (500,000 to 3,000,000) during initial construction and an estimated increase in the maintenance dredging related reduction to the annual local crab harvest from the existing .73 percent to a new 1.45 percent for the life of the project.

The REC plan consists of dredging and disposal in a manner which considers both economic and environmental factors. Hopper and clamshell dredges would be used. Dredged material is proposed for disposal at two ocean disposal sites located in the shipping lanes approximately 3-1/2 miles from the mouth of the harbor, at deep water estuarine disposal areas (Point Chehalis and South Jetty) located near the mouth of the estuary, at the Slip No. 1 subtidal disposal site and at the South Aberdeen upland disposal site. Open water disposal of the finer grain size material will occur at South Jetty and in the ocean. Therefore, resuspension of fines and subsequent increased siltation within the estuary would be minimal under this plan. Disposal of dredged material at 3.5 miles from the estuary would avoid adverse impacts to razor clam populations. Unavoidable impacts associated with the REC plan include removal of channel benthos by dredging, burial of benthos at disposal sites, and permanent loss of 20 acres of subtidal and intertidal area due to filling Slip No. 1. Under the REC plan, the total first cost of the recommended plan would be $79,200,000 which has a benefit-to-cost ratio of 1.4 to 1.0. Without mitigation, environmental impacts associated with the REC plan would include loss of 4 acres of inner harbor juvenile salmonid feeding and rearing area, an estimated reduction of 1.45 to 3.40 percent to the annual Westport Dungeness crab harvest during initial construction and, after construction, an estimated maintenance dredging-related increased reduction from the existing .73 percent to a new 1.93 percent to the annual local crab harvest for the life of the project.

Major impacts associated with each of the project plans are expected to be compensated or avoided by the proposed mitigation plan. The mitigation for each of the plans would consist of replacement of 4 acres of juvenile salmonid feeding and rearing area and dredge or equipment modifications to reduce crab mortality.

2. Resolutions During Feasibility Planning. Questions concerning the environmental impacts which would be associated with the widening and deepening of the navigation channel prompted several studies of the physical, chemical, and biological environment of the harbor. The major issues involved impacts on water quality, fish distribution, fish and crab entrainment during dredging, and location of dredged material disposal sites. Based on the study reports, long-term water quality impacts associated with the project will be minimal, dredging schedules have been established to avoid periods of maximum concentrations of juvenile salmonids in the innermost reaches of the harbor, and few, if any, juvenile salmonids will be entrained by the dredges. In addition, crab entrainment and indirect impacts have been reduced through scheduling,

whenever possible, the dredging to avoid months of maximum crab abundance in various channel reaches and by avoiding disposal of silts in the harbor mouth during months of maximum crab larvae abundance. In-harbor, open-water disposal sites have been selected for their capacity (approximately 2 million cubic yards (c.y.) per year for each site), for the scouring action present at these sites, and for cost effectiveness. Dredged material discharged at these sites is also expected to partially replace the material presently scoured away from South Jetty by tidal action, therefore partially alleviating the ongoing undermining of the jetty. This scouring will sweep the dredged material disposed at these sites from the harbor. The ocean disposal sites have been tentatively located in the shipping lanes 3-1/2 miles from Grays Harbor for purposes of estimating the costs of the proposed project. Several studies indicate that little material discharged at these sites will return to either the harbor or the ocean beaches. However, the biological impacts associated with using these sites will not be thoroughly evaluated until proposed continuation of planning and engineering (CP&E) phase studies associated with the project have been completed. Chemical and bioassay tests performed on the Grays Harbor sediments indicate a chemical bioaccumulation potential from the low concentrations of contaminants associated with some of the sediments to be dredged from the Hoquiam and Cow Point channel reaches. Therefore, two confined disposal sites will be used for disposal of approximately 1.84 million c.y. of dredged material. One site is located in South Aberdeen on a Weyerhaeuser Company log storage area and the other site is Slip No. 1 which is owned by Port of Grays Harbor.

Pursuant to Section 404(r) of the Clean Water Act, upon submittal of a 404(b)(1) evaluation with this environmental impact statement and approval by Congress, no further action by the Corps of Engineers to meet the requirements of Sections 301, 402, or 404 of the Clean Water Act will be necessary.

3. Relationship to Environmental Requirements. The relationship of the Grays Harbor Navigation Channel Improvements Project to environmental requirements is summarized in table EIS i-1.

TABLE EIS i-1

RELATIONSHIP OF ALTERNATIVE PLANS TO ENVIRONMENTAL PROTECTION STATUTES AND OTHER ENVIRONMENTAL REQUIREMENTS,
GRAYS HARBOR, AND CHEHALIS AND HOQUIAM RIVERS, WASHINGTON
CHANNEL IMPROVEMENTS FOR NAVIGATION

FEDERAL STATUTES	No Action	NED Alt. 2a	LED Alt. 2b	REC Alt. 2c
Archeological and Historic Preservation Act, as amended, 16 USC 469 et seq.	Full	Partial1/	Partial1/	Partial1/
Clean Air Act, as amended, 42 USC 1857h-7 et seq.	Full	Full	Full	Full
Clean Water Act, as amended (Federal Water Pollution Control Act), 33 USC 1251 et seq.	Full	Partial3/	Partial3/	Partial3/
Coastal Zone Management Act, as amended, 16 USC 1451 et seq.	Full	Partial1/	Partial1/	Partial1/
Endangered Species Act, as amended, 16 USC 1531 et seq.	Full	Full	Full	Full
Estuary Protection Act 16 USC 1221 et seq.	Full	Full	Full	Full
Federal Water Project Recreation Act, as amended, 16 USC 460-1(12) et seq.	Full	Full	Full	Full
Water Resources Act, 1976, Section 150	Partial1/	Partial1/	Partial1/	Partial1/
Fish and Wildlife Coordination Act, as amended, USC 661 et seq.	Full	Partial1/	Partial1/	Partial1/

TABLE EIS i-1 (con.)

FEDERAL STATUTES	No Action	NED Alt. 2a	LED Alt. 2b	REC Alt. 2c
Land and Water Conservation Fund Act, as amended, 16 USC 4601-4601-11 et seq.	Full	Full	Full	Full
Marine Protection, Research and Sanctuaries Act, 33 USC 1401 et seq.	Full	Partial 2/	Partial 2/	Partial 2/
National Environmental Policy Act, as amended, 42 USC 4321 et seq.	Full	Partial 2/	Partial 2/	Partial 2/
Rivers and Harbors Act, 33 USC 403 et seq., 33 USC 401	Full	Partial 1/	Partial 1/	Partial 1/
Watershed Protection and Flood Prevention Act, 16 USC et seq.	N/A	N/A	N/A	N/A
National Historic Preservation Act, 16 USC 407a et seq.	Full	Full	Full	Full
Wild and Scenic Rivers Act, as amended, 16 USC 1271 et seq.	N/A	N/A	N/A	N/A
Executive Orders, Memoranda:				
Flood Plain Management, 11988	Full	Full	Full	Full
Protection of Wetlands, 11990	Full	Full	Full	Full
Environmental Effects Abroad of Major Federal Actions, 12114	N/A	N/A	N/A	N/A
Executive Memorandum Analysis of Impacts on Prime and Unique Farmlands in EIS, CEQ Memorandum, 30 August 1976	N/A	N/A	N/A	N/A

TABLE EIS i-1 (con.)

STATE AND LOCAL POLICIES	No Action	Alt. 2a	Alt. 2b	Alt. 2c
Washington State Constitution				
Article XV. Harbors and Tide Waters	Full	Partial1/	Partial1/	Partial1/
Article XVII. Tidelands	Full	Full	Full	Full
Multiple Use Concept in Management and Administration of State Owned Lands (RCW 79.68.060)	Full	Full	Full	Full
State Environmental Policy Act of 1971 (RCW 43.21)	Full	Partial1/	Partial1/	Partial1/
Water Resources Act of 1971 (RCW 90.54)	N/A	N/A	N/A	N/A
Shoreline Management Act of 1971 (RCW 90.58) and Grays Harbor County Shoreline Management Program	Full	Partial1/	Partial1/	Partial1/
Water Pollution Control Act (RCW 90.48)	Full	Partial1/	Partial1/	Partial1/
Permits Required:				
Shoreline Substantial Development Permit	No	No	No	No
Shoreline Conditional Use Permit	No	No	No	No
Washington Department of Natural Resources Lease of Tidelands	No	No	No	No

TABLE EIS i-1 (con.)

STATE AND LOCAL POLICIES	No Action	Alt. 2a	Alt. 2b	Alt. 2c
Washington Departments of Game and Fisheries Hydraulic Project Approval	No	No	No	No
Washington Department of Ecology Water Quality Certification	No	Alt. 2a-2c: Exemption pursuant to Section 404(r) of the Clean Water Act is being sought during congressional authorization.		

NOTES: The compliance categories used in this table were assigned based on the following definitions:

a. Full Compliance - All the requirements of the statute, executive order, and related regulations have been met.

b. Partial Compliance - Some requirements of the statute, executive order, or other policy and related regulations remain to be met.

c. Noncompliance - None of the requirements of the statute, executive order, or other policy and related regulations have been met.

d. Not Applicable (N/A) - Statute, executive order, or other policy not applicable.

1/Full compliance with completion of the final EIS.
2/Full compliance upon completion of CP&E studies.
3/Full compliance with congressional authorization.

FINAL
ENVIRONMENTAL IMPACT STATEMENT

GRAYS HARBOR, AND CHEHALIS AND HOQUIAM RIVERS, WASHINGTON
CHANNEL IMPROVEMENTS FOR NAVIGATION

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ENVIRONMENTAL IMPACT STATEMENT

GRAYS HARBOR, AND CHEHALIS AND HOQUIAM RIVERS, WASHINGTON
CHANNEL IMPROVEMENTS FOR NAVIGATION

SECTION 1. NEED FOR AND OBJECTIVES OF ACTION

1.01 Study Authority. This environmental impact statement (EIS) is submitted in partial response to resolutions of the committee on Public Works of the U.S. Senate dated 21 October and 30 December 1957 and a resolution of the Committee on Public Works of the U.S. House of Representatives adopted 16 July 1958. Refer to the feasibility report paragraph 1.01 for further detail.

1.02 Public Concerns and Planning Objectives. The Grays Harbor region (figure EIS 1-1) has long been economically dependent on logging and export of forest products. It is a major west coast port for transportation of wood products to foreign nations. The present authorized 30-foot-deep waterway and the horizontal clearance of the Union Pacific Railroad (UPRR) bridge at Aberdeen are inadequate to accommodate the present and future deep-draft vessels with drafts up to 37 feet and beams in excess of 100 feet. The current channel limits the larger vessels to leaving Grays Harbor only during favorable tide and weather conditions and then with partial or "light" loads up to maximum sail drafts of about 32 feet. Accordingly, smaller vessels with greater transportation costs are being used.

The planning objective for this study was to improve the efficiency and safety of deep-draft water transportation.

In formulating a plan to achieve the above objective, a wide range of alternatives were considered and the resultant effects of each proposed alternative were evaluated in terms of economic, environmental, and social factors. The criteria used in the evaluation are detailed in section 2 of the feasibility report.

1.03 Background. In July 1976, Seattle District, U.S. Army Corps of Engineers, completed a feasibility report and revised draft EIS for a navigation channel improvement project at Grays Harbor, Washington. The proposed action consisted of widening and deepening the existing authorized navigation channel in Grays Harbor. Initial construction would have involved widening and deepening the existing channel, disposal of approximately 19.3 million cubic yards (c.y.) of material, and operation and maintenance of the channel for 50 years. Dredged material would have been discharged at a 60-foot contour site in the ocean, at a South Jetty site, and at confined disposal sites upriver of Aberdeen. Also included in the previously proposed plan was replacement of the UPRR bridge across the Chehalis River at Aberdeen.

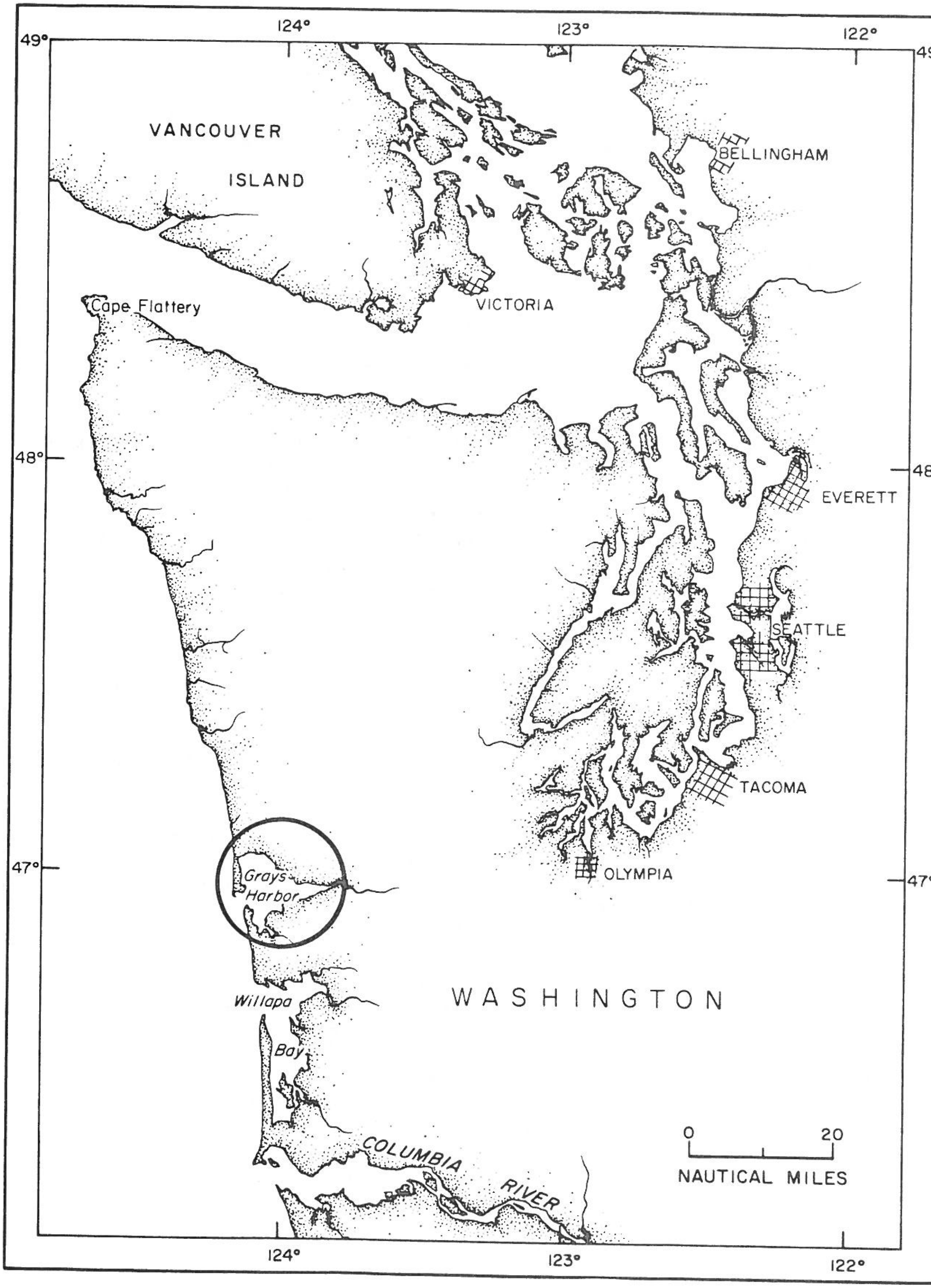


Figure EIS 1-1 location of Grays Harbor

By letter dated 15 March 1979 the President, Office of Management and Budget returned the documents to the Secretary of the Army requesting that additional studies be undertaken to resolve concerns relating to economic evaluation, design criteria, and environmental impacts. Subsequently, the feasibility report and EIS were returned to Seattle District for revision. Prior to initiating the additional studies, Seattle District prepared a plan of study (POS). A major component of the POS was an interagency scoping effort of environmental studies deemed necessary to evaluate a recommendation for construction of the project. This scoping effort is described in section 5 of the EIS.

The environmental studies provided important additional information needed for an accurate evaluation of the environmental consequences associated with the proposed project. These studies are listed in section 4 of this EIS.

1.04 Grays Harbor Navigation Channel.

a. History. Navigation improvements were initially authorized by the Rivers and Harbors Act of 3 June 1896 to prevent the continuous shifting of the entrance channel, bar, and bottom which deterred regular entry of ships into Grays Harbor. Settlement of the area set the pattern for the present economy and the need for improvements to facilitate shipping (U.S. Army Corps of Engineers, 1976b). The entrance bar and channel were stabilized in the early 1900's by the construction of a jetty system and dredged channels. Subsequent reconstructions, improvements, and expansions have culminated in the extensive jetty, groin, and dredged channel system present today.

b. Existing Project. The Grays Harbor navigation channel is presently maintained at -30 feet mean lower low water (MLLW) by annual dredging of bottom material shoals in various areas from Cosmopolis through South reach. The Entrance reach and bar are self maintaining as a result of the jetty system. Dredged material from Grays Harbor is currently discharged at the existing Washington Department of Natural Resources (DNR) designated Point Chehalis open-water disposal site (see plate 7).

c. Proposed Project. The Federal responsibilities of the proposed navigation channel improvement project would include initial widening and deepening and maintenance of the existing channel from Cosmopolis, Washington, to the Pacific Ocean. Disposal of dredged material would occur in the harbor mouth, in the ocean, and at confined disposal areas in the inner harbor. The UPRR bridge in Aberdeen would be replaced with a 250-foot-horizontal channel clearance bridge and would be cost shared between the bridge owner and the Federal government. The local sponsor, the Port of Grays Harbor, would provide all lands required for channel enlargement, dredged material disposal, utility relocations, and in addition, would dredge port vessel berthing areas to depths commensurate with the enlarged channel (see appendix D for Federal and non-Federal dredging requirements). Mitigation required for this project is replacement of 4 acres of shallow subtidal habitat and equipment modification to reduce crab mortality associated with dredging.

SECTION 2. ALTERNATIVES

2.01 Preliminary Alternatives Eliminated from Study. Several alternatives have been considered to meet the need for navigation improvements in Grays Harbor. Possible solutions that have been eliminated from further study are listed below. Reference paragraph 3.02 in the feasibility report for a detailed discussion of these preliminary alternatives.

- o Lightering
- o Waterfront Renewal
- o Development of Other Grays Harbor Sites
- o Development of Other West Coast Ports

2.02 Final Alternatives. The final array of alternatives considered in detailed planning are described in the following sections. Tables EIS 2-1 and EIS 2-2 summarize the engineering features of the alternative plans. Included in this text are the no-action alternative and three variations to the channel improvements alternative (the National Economic Development (NED), Least Environmentally Damaging (LED), and Recommended (REC) plans). The impacts of each alternative are summarized in paragraph 2.04 and a detailed description of impacts is presented in EIS section 4.

a. Alternative 1: Continue Existing Conditions (No Action). Under the no-action plan the project area would be maintained under the following existing conditions:

o Channel depth maintained at present authorized depth of -30 feet MLLW.

o Larger ships would continue to sail with partial loads.

o The UPRR bridge at Aberdeen would not be replaced and larger ships would still be unable to transport goods upstream of the bridge.

With these existing conditions and the trend continuing toward larger ships, vessels will not be used efficiently and, thus, higher shipping costs will result under the no-action plan. Shippers will likely seek other, more efficient deep-draft ports. The no-action plan is not recommended because it is not responsive to the planning objective.

With the present channel conditions and anticipated slow growth for industrial and commercial development, important biological parameters

TABLE EIS 2-1

ALTERNATIVES 2a-2c
EXISTING AND PROPOSED CHANNEL DIMENSIONS AND
AREA DISTURBED BY DREDGE, AND PROPOSED DREDGING QUANTITIES

Reach	Length (miles)	(Existing) and Proposed Channel Dimensions (feet)	Proposed Channel1/ Initial Cut Vol. & (Maintenance) (1,000 c.y.)	(Existing) and Proposed Turning Basin1/ Size (feet) and *Proposed (Dredge Quantity (1,000 c.y.))*	Proposed Area Disturbed by Dredge: Bottom Channel (Acres)	Proposed Area Disturbed by Dredge: Channel Side Slopes (Acres)	Proposed Area Disturbed by Dredge: Shallow Subtidal (Acres)
South Aberdeen	2.3	(200 x 30) 250 x 36	1,300 (100)	(550 x 1,000 x 30) 750 x 750 x 30 *150*	88	17	2
Aberdeen	1.5	(200 x 30) 250 x 36	550 (50)	(600 x 1,000 x 30)	60	25	--
Cow Point	1.0	(350 x 30) 350 x 38	700 (200)	1,000 x 1,000 x 38 *300*	40	11	2
Hoquiam	3.2	(350 x 30) 350 x 38	2,150 (100)	750 x 750 x 30 *150*	125	25	--
Moon Island	2.8	(350 x 30) 350 x 38	1,900 (200)		120	20	--
Cross-Over	3.4	(350 x 30) 400 x 38	2,900 (450)		165	20	--
South	3.5	(350 x 30) 400 x 38	3,400 (450)		170	35	--
Entrance Channel	4.0	(350 x 30) 1,000 x 46-38	200 (0)		20	2	--
Outer Bar	2.6	(600 x 30) 1,000 x 46	4,000 (800)		290	50	--
Totals	24.3		17,100 (2,350)	*600*	1,078	205	4

Proposed Total Area Disturbed by Dredge (Acres)	1,287
Existing Area Disturbed by Dredge (Acres)	724
Proposed Net Area Disturbed by Dredge (Acres)	563

1/Includes quantities for 2-foot construction contract overdredge and 2-foot advanced maintenance.

TABLE EIS 2-2

ENGINEERING FEATURES OF ALTERNATIVES 1 and 2a-2c

Feature	Alternative 1 (No Action)	Alternative 2c (REC Plan)	Alternative 2a (NED Plan)	Alternative 2b (LED Plan)
Present Navigation Channel	Continue maintenance dredging to existing authorized dimensions.	Widen and deepen entire channel to Cosmopolis, construct turning basin at South Aberdeen and Hoquiam, and widen and deepen at Cow Point.	Same as REC	Same as REC
Wetland and Shallow Subtidal Habitat (-10' to + 10' MLLW) Removal/Burial	None	Removal of 2 acres at South Aberdeen; Removal of 2 acres at Cow Point; Burial of 20 acres at Slip No. 1.	Same as REC	Same as REC
Presently Undisturbed Habitat Converted to New Disturbed Channel Habitat	None	563 acres.	Same as REC	Same as REC
Open Water Sites For Dredge Material Disposal	Point Chehalis	9.9 mil. c.y. to open water at South Jetty/Point Chehalis and 5.36 mil. c.y. to sites 3-1/2 miles from the harbor mouth.	10.71 mil. c.y. to open water at Point Chehalis/South Jetty, 4.55 mil. c.y. to ocean (2-1/2 miles from harbor mouth).	16.1 mil. c.y. to ocean (8 miles from harbor mouth).
Upland Disposal of Dredged Material	None	1.84 mil. c.y. at confined disposal areas.	Same as REC	Same as REC
Union Pacific Railroad Bridge	No change	Replace and increase horizontal clearance.	Replace and increase horizontal clearance.	Replace and increase horizontal clearance.
Shipping	Increased shipping costs.	Increased safety, reduced cost, increased commodity movement.	Increased safety, reduced cost, increased commodity movement.	Increased safety, reduced cost, increased commodity movement.
Land Use	Continued current growth trends.	Potential for increased growth.	Potential for increased growth.	Potential for increased growth.
Employment and Economic Growth	Employment trend remains same, possible decrease.	Temporary increase during construction.	Temporary increase during construction.	Temporary increase during construction.
Noise	No significant change; could increase or decrease.	Temporary increase due to construction; same as No Action.	Temporary increase due to construction; same as No Action.	Temporary increase due to construction; same as No Action.
Net Benefits to Public Consumer	No change; possible decrease.	Increase	Increase	Will not increase.

and resources such as commercial crab fishery, recreational clamming, salmon migration, benthic invertebrates, wetlands, water quality, and endangered species would not be expected to suffer substantial increases in impacts above and beyond the existing operation and maintenance (O&M) impacts.

b. Alternative 2a: National Economic Development (NED) Plan.

(1) Engineering Features. The authorized Federal channel for the Grays Harbor waterway would be widened and deepened to dimensions which are summarized in table EIS 2-1 and in table 3-2 of the feasibility report. The benefit-to-cost ratio for the alternative 2a, including initial and maintenance dredging, would be 1.5 to 1.0.

(a) Initial Construction. Project construction would take 2 years or less. Three turning basins are proposed: at Cow Point, South Aberdeen, and Hoquiam reaches. The existing Cosmopolis and Aberdeen turning basins would be deauthorized. In addition, the 125-foot horizontal clearance UPRR bridge at Aberdeen would be replaced by a bridge with a 250-foot-horizontal channel clearance. Dredging would be performed with hopper and clamshell dredges. Five sites would be used for disposal of 17.1 million c.y. of dredged material:

- Fifty-one-acre upland site in South Aberdeen (1,200,000 c.y.).
- Two new Point Chehalis open-water disposal sites in the Grays Harbor estuary (5,280,000 c.y.).
- South Jetty, an open-water disposal site at the mouth of Grays Harbor (5,430,000 c.y.).
- Sixty-foot contour in the ocean located approximately 2.5 miles west from the mouth of Grays Harbor (4,550,000 c.y.).
- Slip No. 1 at Port of Grays Harbor would be diked and filled (640,000 c.y.).

Disposal sites are located on plate 7 and detailed on plates 3, 4 and 6.

Material to be discharged at the South Aberdeen and Slip No. 1 confined sites would be the sediments from Cow Point and Hoquiam reaches that have been determined to be unacceptable for open-water disposal based on recent biological tests (reference appendix A). Dredged material destined for the confined sites would be clamshell dredged and would be rehandled from barges by hydraulic pump out into the disposal sites. Effluent would be contained until it is determined acceptable by water quality standards and guidelines for discharge.

(b) Operation and Maintenance. Channel depths would be maintained by using a hopper dredge for the outer reaches (outer bar upstream to, and including, one third of Moon Island) and using a clamshell dredge for reaches upstream of South reach to dredge approximately

2.35 million c.y. per year. The sandy outer bar material would be discharged in the ocean at a 2.5-mile disposal site and all other dredged material would be discharged at the new Point Chehalis and South Jetty sites. The rationale for the O&M plan is based on the proposed CP&E study (see feasibility report, paragraph 4.33) which involves determining the distribution of contaminants in the inner estuary navigation channel, assisting Federal and state regulatory agencies in identifying contaminant sources to the estuary, and assisting in the development of feasible plans to reduce or eliminate the source of the problem contaminants. Sufficient information exists regarding the contaminant sources to suggest that reduction or elimination of these sources would be feasible.

(2) Environmental Features. This alternative has incorporated the use of clamshell dredges which is the most cost-effective dredge for construction of reaches upstream of Moon Island. The clamshell would reduce Dungeness crab entrainment and possible resuspension of contaminants at the dredging site more effectively than hopper dredging. Cost effectiveness dictates that hopper dredging be used from the Moon Island reach to and including the Outer Bar reach.

Of the plans considered in detail, the NED plan would have the greatest adverse environmental impacts. Under this plan, 62.6 percent (10,710,000 c.y.) of 17.1 million c.y. of dredged material is proposed for estuarine open-water disposal which includes the largest percentage of fines for any plan. In addition, the crab fishermen have expressed objections to the use of the 2.5 mile disposal site because it is located within their crab fishing grounds. Resource agencies and concerned citizens have expressed lack of support for and serious objections to the NED plan.

Table EIS 2-3 shows the percentage of sand, silty sand, sandy silt, silt, and gravel that would be discharged at each disposal site under alternatives 2a-2c. Table EIS 2-4 summarizes the months during which dredging would occur for alternatives 2a-2c and the composition of material to be dredged from each reach.

(3) Mitigation and Monitoring. The NED plan would have the greatest environmental impacts of any of the three alternative improvement plans. Although planning has reduced some project impacts as described for the REC plan (EIS 4.02), the type of dredges to be used and the disposal locations and associated activities have been scheduled more for cost efficiency than for environmental considerations. In addition, the NED plan presents greater unavoidable impacts than the REC plan.

The significant adverse impacts associated with the NED plan include potential impacts on outmigrating juvenile salmonids through water quality degradation and potential impacts to outer harbor biological resources associated with the disposal of the majority of the dredged material at in-harbor, open-water disposal sites. Mitigation to reduce the impacts to the Dungeness crab resource and fishery and to juvenile salmonid habitat would be included in the NED plan and would be refined

TABLE EIS 2-3

PERCENT COMPOSITION OF MATERIAL TO BE DISCHARGED[1/]
AT DISPOSAL SITES DURING INITIAL CONSTRUCTION

NED	Point Chehalis	S. Jetty	Ocean (2-1/2 mile)	Upland S. Aberdeen (51 acres)	Confined Slip No. 1 (20 acres)
Total yardage (c.y.)	5,280,000	5,430,000 *80,000	4,550,000	1,200,000	640,000 *160,000
Type of Material (Percent)					
Sand	51	52	88		
Silty sand	18	18	0		
Sandy silt	27	27	12	71	100
Silt	0	3	0	29	
Gravel	4	0	0		

LED	Point Chehalis	S. Jetty	Ocean (8-mile)	Upland (S. Aberdeen)	Confined (Slip No. 1)
Total yardage (c.y.)	0	0	14,260,000[2/] *80,000	1,200,000	640,000 *160,000
Type of Material (Percent)					
Sand			61		
Silty sand			13		
Sandy silt			24	71	100
Silt			1	29	
Gravel			1		

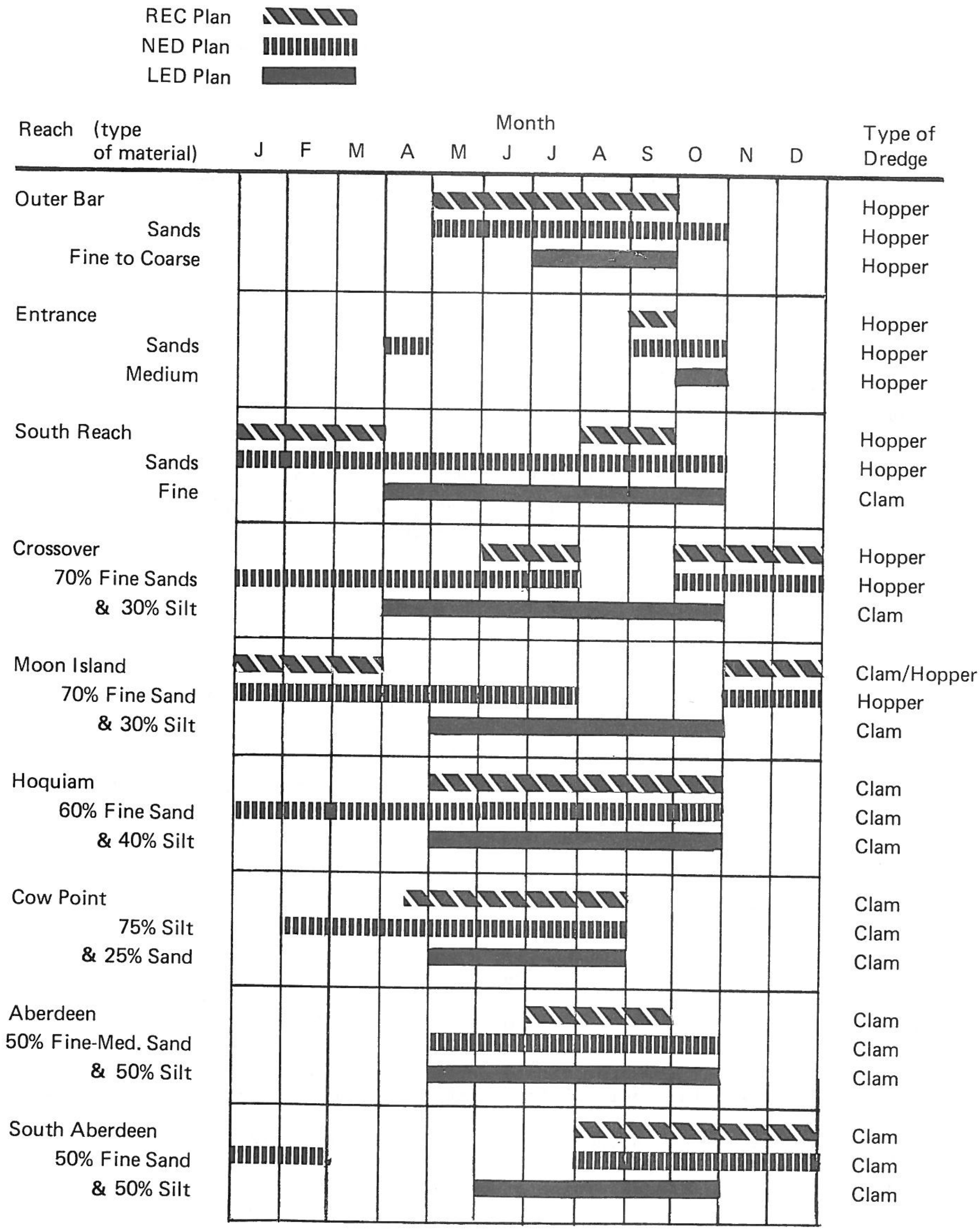
REC	Point Chehalis	S. Jetty	Ocean (3-1/2 mile)	Upland (S. Aberdeen)	Confined (Slip No. 1)
Total yardage (c.y.)	4,300,000	5,600,000 *80,000	5,360,000	1,200,000	640,000 *160,000
Type of Material (Percent)					
Sand	73	44	74		
Silty sand	22	17	0		
Sandy silt	0	39	23	71	100
Silt	0	0	3	29	
Gravel	5	0	0		

1/Refer to plate 10 for approximate percentages of sand and silt in each reach and table A-1 (appendix A) for quantity of material from each reach to be discharged.

2/This total does not include 1 million c.y. of redredged material which are included in NED and REC plans.

*Dredged material from deepening of berthing areas (non-Federal dredging).

TABLE EIS 2-4
DREDGING SCHEDULE FOR REC PLAN & DREDGING WINDOW FOR LED & NED



through Continuation of Planning and Engineering (CP&E) studies as discussed in paragraph 4.03g. The mitigation for loss to crabs would be similar to that discussed for the REC Plan.

Mitigation to replace the 4 acres of shallow subtidal juvenile salmonid feeding and rearing habitat, and to insure that adequate water quality for fish is maintained during project construction, would be the same as described in paragraph 4.03g for the REC plan. In addition, monitoring at the ocean disposal site and chemical analysis of channel sediments would be required as discussed for the REC Plan.

Effluent holding, settling, and monitoring would occur at Slip No. 1 and South Aberdeen confined disposal sites prior to discharge.

c. Alternative 2b: Least Environmentally Damaging (LED) Plan.

(1) Engineering Features.

(a) Initial Construction. The channel design and bridge replacement design of this plan are the same as those described under the NED plan. The major engineering differences between this plan and the NED plan are (1) the location of disposal sites, (2) the dredging schedule, and (3) dredge types to be used. This LED plan proposes disposal of the majority of the dredged material in the ocean at a site to be located within 8 miles of Grays Harbor. Studies during CP&E may show that there is a more suitable nearshore ocean disposal site that is environmentally acceptable. However, based on the minimal data to date, the 8 mile disposal site has been chosen from an array of potential sites as the LED site. Material unacceptable for open-water disposal would be placed in confined disposal sites (South Aberdeen and Slip No. 1). Dredge material destined for the confined sites would be clamshell dredged and would be rehandled from barges by hydraulic pump out into the disposal sites. Effluent would be contained until it is determined acceptable by water quality standards and guidelines for discharge.

Project construction for alternative 2b would take 3 years or less. Table EIS 2-4 summarizes the months during which dredging would occur. Under this plan, clamshell dredges would be used in all reaches upstream of the Entrance reach (South reach - South Aberdeen reach) for construction dredging.

(b) Operation and Maintenance. The O&M for the LED plan includes using the hopper dredge for the Outer Bar reach and clamshell for all other reaches. All maintenance dredged material (2.35 million c.y./year) would be discharged in the ocean at a disposal site located about 8 miles from the harbor mouth. The rationale for the O&M plan is based on the proposed CP&E study (see feasibility report, paragraph 4.33) which involves determining the distribution of contaminants in the inner estuary navigation channel, assisting Federal and state regulatory agencies in identifying contaminant sources to the estuary, and assisting in the development of feasible plans to reduce or eliminate the source of the problem contaminants. Sufficient information exists regarding the contaminant sources to suggest that reduction or elimination or these sources would be feasible.

The benefit-to-cost ratio for initial and maintenance dredging is 0.90 to 1.0.

(2) Environmental Features. The LED construction and O&M plan has been designed to lessen, where practicable, the impacts on the environment. Of major concern in the design and planning of this alternative was the general biological importance of the estuary, the migration of salmonids, the overall abundance and movement (migration) of Dungeness crabs into and out of the estuary, water quality, the nearshore ocean salmon and crab fisheries, and the distribution of razor clams on nearby ocean beaches. The clamshell dredge was chosen to perform dredging upstream of South reach to lessen impacts to fish, crabs, and water quality. Approximately 14.26 million c.y. of dredged material would be discharged at an open ocean site within 8 miles of Grays Harbor (see EIS 2.03) to avoid any adverse impacts associated with discharging dredged material in the estuary. Approximately 1.84 million c.y. of dredged material would be discharged at two confined disposal sites (South Aberdeen and Slip No. 1) to avoid discharge of contaminanted material in open water.

(3) Mitigation and Monitoring. The LED plan would have the least environmental impacts of the three alternative channel improvement plans. Planning and resource agency coordination for the LED plan have reduced overall project impacts below those described for the Recommended Plan (paragraph 2.02d(3)). Use of clamshell dredges with ocean disposal, as well as dredging schedule modifications, would offer crabs and fish the most protection from adverse environmental conditions and entrainment. Further impact reductions could possibly be achieved after evaluation of CP&E studies.

The mitigation for this plan would be similar to, but substantially less than, the mitigation discussed for these impacts for the Recommended Plan since a hopper dredge would only be used in the Entrance and Outer Bar reaches under the LED plan.

Mitigation to replace the 4 acres of shallow subtidal habitat lost, and insurance that adequate water quality for fish would be maintained during project construction, would be the same as described in paragraph 2.02d(3) for the Recommended Plan. In addition, monitoring at the ocean disposal site and chemical analysis of channel sediments would be required as discussed for the Recommended Plan.

Effluent holding, settling, and monitoring would occur at Slip No. 1 and South Aberdeen disposal sites prior to discharge.

d. Alternative 2c: Recommended (REC) Plan. The recommended channel improvement plan takes into consideration both cost efficiency and environmental concerns. Rationale for plan selection and primary features of the REC plan are presented in the following paragraphs.

The recommended channel improvements plan for Grays Harbor involves widening and deepening the existing Federal channel. The widening and deepening of the channel has been selected as the best alternative to meet the need for improved efficiency and safety of deep-draft transportation in Grays Harbor.

The REC plan for channel improvements is responsive to environmental issues not addressed in the NED plan. The REC plan has substantially reduced the unavoidable losses in the estuary and crab losses that would be incurred under the NED plan. This has been accomplished through modification of dredge type, dredge schedule, type of material to be discharged and disposal locations proposed for REC plan. In addition, this plan represents a substantial reduction in cost over the LED while still maintaining an acceptable level of environmental protection.

(1) Engineering Features.

(a) Initial Construction. The authorized Federal channel for Grays Harbor would be widened and deepened to the same dimensions as the NED and LED plan in a 2-year construction period. Dimensions for the channel are summarized in table EIS 2-1 and plate 1.

Turning basins would be constructed at Hoquiam, Cow Point, and South Aberdeen (Elliott Slough) as shown on plates 1 and 6. Refer to table EIS 2-1 for turning basin dimensions. The Hoquiam turning basin has been added to provide turning space for empty vessels in the vicinity of downstream shipping facilities, thus reducing upstream traffic and shipping costs. The existing turning basins at Aberdeen and Cosmopolis would be deauthorized. In addition, the 125-foot-horizontal clearance UPRR bridge in Aberdeen would be replaced by a bridge with a 250-foot-horizontal channel clearance.

Approximately 15.26 million c.y. of dredged material would be discharged in five designated open-water disposal sites: two at Point Chehalis, one at the South Jetty, and two in the ocean at a radius of 3-1/2 miles from the harbor mouth. The two ocean sites are each located in towboat lanes 3-1/2 miles from the Grays Harbor entrance at the 100-foot contour (MLLW). One site, due west of the harbor, would be used for disposal of silty material while the second site, southwest of the harbor, would be used primarily for disposal of sands. The second ocean disposal site has been chosen due to the close proximity to the Outer Bar reach. Plate 7 shows the proposed ocean disposal sites. Federal and state resource agencies have agreed that potentially acceptable ocean sites exist within 8 miles from the entrance to Grays Harbor. The 3-1/2-mile disposal site has been proposed in the recommended plan because: (1) it is the nearest silt site for disposal of like on like material; (2) alternative site selection was needed for purposes of cost analysis; and (3) there is a reasonable expectation that a site at this proximity to the harbor would be found environmentally acceptable during CP&E studies. Biological, physical, and chemical tests would be conducted at a number of potential ocean disposal sites between 2.5 and 8 miles of the harbor during the CP&E phase of this project to determine the most acceptable ocean disposal locations.

The South Jetty site consists of one 900-foot-radius disposal site while the Point Chehalis disposal areas would be composed of two 900-foot-radius sites (plate 3). The center of the Point Chehalis sites would be located 1/4-mile and 6/10-mile southwest of the existing Point Chehalis site. The volume capacity of South Jetty and Point Chehalis disposal areas has been estimated using the formula $\pi r^2(1ft)$ where $r =$ 900 feet. Therefore, approximately 100,000 c.y. would cover a 900-foot-radius site approximately 1-foot deep. This approximation of the volume capacity does not take into consideration the scouring action or the spreading of the material after discharge, thus the new Point Chehalis and South Jetty sites are expected to have a greater capacity than estimated by the formula.

A final decision on the location of the open-water disposal sites would be based on an evaluation of the results of CP&E phase studies.

During initial construction, up to 1.84 million c.y. of material considered unacceptable for open-water disposal would be placed in confined disposal sites. The two selected disposal sites are a 51-acre site in South Aberdeen (plate 7) and a 20-acre site (Slip No. 1) located at the Port of Grays Harbor docks immediately upstream of terminal 2 (plate 6). Confined disposal would be necessary for the discharge of sediments found to be unacceptable for open-water disposal based on results of recent biological tests (see appendix A).

The South Aberdeen site is presently at an elevation of about +16 feet (MLLW). Placement of 1.2 million c.y. of dredged material would increase the elevation of this site after initial consolidation by about 14 feet, to an elevation of about +30 feet (MLLW). Containment dikes would be partially constructed of native materials excavated from within the disposal area, but to attain sufficient stability, the majority of the dike construction material would be clean gravels imported from local sources. Final dike elevation would be 20 feet above the existing ground elevation. Prior to disposal, the site would be lined with impervious material to avoid leaching of potentially harmful substances back to Grays Harbor. The sediment would be clamshell dredged into barges and rehandled from the barges into the site by hydraulic pump. Return flow from the site back to Gray Harbor would be managed and monitored to minimize return of fine sediments back to the harbor and insure acceptable water quality. Specific yardage to be dredged and placed in the site from individual channel reaches is shown in table EIS 2-3.

At Slip No. 1 a dike would be constructed to elevation +18 feet (MLLW) across the entrance. The dike would be built in stages over a 1- to 2-year period. The interior of the disposal area would be lined with an impervious material to prevent potential leaching of potentially harmful substances back to the harbor. Dredged material would be rehandled from barges by hydraulic pump-out into the disposal site. Water returning from the disposal area back to the harbor would be managed and monitored to minimize return of fine material to the harbor and insure acceptable water quality. About 640,000 c.y. of dredged channel material and 160,000 c.y. of dredged berth material would be placed in the site to a final elevation of +10 feet (MLLW). Fry Creek would be diverted to an open channel along the western edge of the disposal area and a tide gate would be installed where the stream enters the harbor. Readers are referred to table EIS 2-3 for information on specific locations of dredged material to be placed in the site. Technical design of the disposal arèa is detailed in appendix D.

In addition to channel dredging, berthing areas would be dredged to depths commensurate with channel depths. Berthing areas are located in the following reaches: Hoquiam, Cow Point, and South Aberdeen. The total quantity to be dredged from berthing areas during initial construction is 240,000 c.y. Berthing dredged material from the Hoquiam and Cow Point reaches (160,000 c.y.) would be discharged at the Slip No. 1 confined disposal site. Berthing material from the South Aberdeen reach (80,000 c.y.) would be disposed of at the South Jetty disposal site.

(b) Operation and Maintenance. O&M for the Recommended Plan over the 50-year project life includes hopper dredging the outer reaches (Outer Bar to and possibly including the western end of Moon Island reach) and clamshell dredging all other reaches. However, a hopper dredge may be used for all O&M should it prove to be more cost efficient. Clamshell and hopper dredges are currently used for O&M of the existing project. Although the proposed O&M (2.35 million c.y.) is an 88 percent volume increase above the existing project, two-thirds of the increased dredged material would be dredged from the outer bar. In addition to Federal O&M dredging, the Grays Harbor berthing areas (Hoquiam, Cow Point, South Aberdeen) would be maintained at new channel depths. Present berthing O&M quantity is 370,000 c.y. each year. This quantity would be increased to 430,000 c.y. per year and would be expected to be discharged at Point Chehalis.

Coarser dredged material would be discharged at the new Point Chehalis sites with finer material discharged at South Jetty. The sandy outer bar material would be discharged at one of the 3.5-mile ocean disposal sites.

The proposed frequency of O&M dredging is the same as the existing O&M (see table 3-2 in the feasibility report). Inner harbor reaches (Moon Island upstream) would be dredged biannually and the outer harbor reaches are expected to require some annual dredging.

The rationale for the O&M plan is based on the proposed CP&E study (see feasibility report, paragraph 4.33) which involves determinin the distribution of contaminants in the inner estuary navigation channel, assisting Federal and state regulatory agencies in identifying contaminant sources to the estuary, and assisting in the development of feasible plans to reduce or eliminate the source of the problem contaminants. Sufficient information exists regarding the contaminant sources to suggest that reduction or elimination of these sources would be feasible.

The benefit-to-cost ratio for the REC plan is 1.4 to 1.0.

(2) Environmental Features. Dredging equipment, timing of dredging, and disposal sites have been carefully chosen to minimize potential environmental impacts of dredging and disposal in Grays Harbor as much as possible given project economic criteria. Clamshell dredging would be used for the reaches from Moon Island upstream and hopper dredging would be used for other reaches. However, hopper dredging may be used for the western one third of Moon Island should it prove to be more economical. Refer to table EIS 2-4 for dredging schedule. The use of clamshell dredging would minimize the entrainment and mortality rates of crabs and fish in those reaches since the entrainment rate for clamshell is 95 percent less than the hopper dredge rates (Armstrong et al., 1981). Clamshell dredging also reduces the potential for resuspension of contaminants (more so than hopper dredging) and other water quality problems associated with the silty material in the inner harbor. Hopper dredges have been selected for Outer Bar through Crossover reaches work due to cost efficiency and logistics. The hopper dredge is the most effective method of dredging for Outer Bar, Entrance, and South reaches due to the combination of greater depths at these locations and sea conditions across the bar to the ocean. It is not practicable to dredge the outer harbor (Outer bar, Entrance reach, South reach) in the winter due to inclement weather conditions. However, to the maximum extent practicable, the dredging activities in each reach have been scheduled for times of the year when the reach is least densely populated by crabs. Scheduling to avoid impacts to crabs has been based on the conclusions and recommendations of Armstrong et al, (1982) contract report. Dredging the Outer Bar and Entrance reach during the summer months would be essential to the logistics and feasibility of the project. Inner harbor dredging is scheduled to avoid large concentrations of juvenile salmonids migrating out of the harbor. In order to minimize the impacts to the estuary, the vast majority of the clean silty inner harbor sediments would be discharged in the ocean.

Three open-water harbor disposal areas have been proposed for combined disposal of 9.9 million c.y. of dredged material during initial construction. One site is located at the end of the South Jetty and would be used as the harbor disposal site for the cleaner silty material; the other two harbor sites are the new Point Chehalis sites, to be used primarily for disposal of sands (see plate 3 and 4 for location of disposal sites). Gravels from Cow Point would also be discharged at Point Chehalis.

Model studies, current measurements, analysis of historical bathymetry changes, and recent drifter studies conducted by the Corps of Engineers indicate that material discharged at South Jetty and new Point Chehalis would be effectively flushed out to the ocean, thus reducing the potential for recirculation of silts into the estuary. Table EIS 2-3 summarizes the quantities and percent composition of material to be discharged at each disposal site. During the proposed O&M, impacts to important resources in most of Grays Harbor may not be substantially greater than those of the existing O&M, except for increased impacts to Dungeness crabs due to the need for maintenance dredging the Outer Bar each year. This impact would be mitigated through dredge equipment modification.

The results of the biological testing of Grays Harbor sediments (refer to appendix A for details) indicated that contaminant bioaccumulation in marine organisms may result if some of the sediments from Cow Point and Hoquiam reaches are discharged in open water. Due to these results, approximately 70 percent of the material from Hoquiam and Cow Point reaches would be discharged at two confined disposal sites to avoid discharging contaminated material in open water.

(3) Mitigation and Monitoring. Impacts associated with the construction of this project under the REC plan have been reduced substantially through planning and coordination with various state and Federal resource agencies. Channel widening would occur on the deeper side of the channel to the maximum extent possible to avoid impact to shallow water fish rearing and feeding areas and to reduce the total amount of dredging required. Dredging in the outer harbor has been scheduled, where practicable, to avoid periods of maximum Dungeness crab abundance. No eelgrass beds or salt marshes would be destroyed through dredging operations. The project has been reduced in size from previously planned dimensions to the minimum channel dimensions allowable for safe navigation. No wetland sites would be used for dredged material disposal under the REC plan. Finally, the inner and outer harbor dredging schedules, equipment to be used, and disposal sites for each channel reach under the REC plan were chosen after considering the environmental impacts and economic costs of various options.

Adverse environmental impacts associated with the REC plan include the loss of 4 acres of shallow subtidal inner harbor habitat. Loss of the important juvenile salmonid feeding and rearing area would be mitigated by purchasing approximately 4 acres of diked marsh in the inner harbor and transforming this area into shallow subtidal and intertidal habitat.

Impacts to Dungeness crabs are expected to be be avoided by physical modification of dredges operating in Grays Harbor to entrain fewer crabs. This modification would take the form of lighting, plow-type structures, electricity or other modifications on the hopper dredge drag arms to scare or push crabs away as the dredge passes. These approaches to reduce crab entrainment would be evaluated during CP&E phase studies for this project.

While the dredging equipment and schedules have been selected to reduce environmental impacts where feasible, water quality in the inner harbor may be degraded during project construction. A water quality monitoring program would be required to insure that adequate water quality for fish survival is maintained during construction in accordance with the Washington State Water Quality Guidelines for Dredging in Inner Grays Harbor and Lower Chehalis River. Effluent holding, settling, and monitoring would occur at Slip No. 1 and South Aberdeen confined disposal sites prior to discharge.

Two other monitoring programs would be required in conjunction with project construction and maintenance. Monitoring would occur at the ocean disposal sites during both construction and project maintenance disposal activities. This monitoring is described in appendix A, paragraph 4.5b along with the ocean disposal site studies which are proposed for the CP&E phase of this project. Monitoring would also be required to insure that the level of contaminant concentrations in the sediments to be dredged over the 50-year life of the project do not change substantially. This sediment chemical analysis should occur periodically (every 5 years) or whenever there is reason to believe new contaminants may be present in significant concentrations.

2.03 Evaluation of Alternative Disposal Sites. Several disposal alternatives have been investigated by the Corps of Engineers. Each disposal site has been evaluated for its value as habitat for fish and wildlife resources as well as for the cost of utilizing it for dredged material disposal. See table EIS 2-5 for a summary of the evaluation. The eight potential ocean disposal sites would be evaluated during CP&E to determine one or two acceptable sites. The cost by reach for using recommended sites is detailed in plate 10.

a. Potential Confined Disposal Sites. Approximately 536 acres of land near Junction City (see plate 7) were investigated as potential disposal areas. This area was found to be a tidally influenced wetland habitat which would be seriously impacted if used as a disposal area for dredged material. Due to the significant, adverse impacts and to the substantially high mitigation costs that would result with use, this area is not proposed as a disposal area in the Recommended Plan.

b. Recommended Confined Disposal Sites. The South Aberdeen site has been used by its present owner, Weyerhaeuser Corporation, for log storage for many years. Due to this usage, the site provides no significant habitat value for any important species of aquatic or terrestrial fish or wildlife.

Elevation increases would tend to make the site drain better and thus the land would be overall "drier" than as it is presently. Within one year of the disposal operation, the Weyerhaeuser Company would once again be able to use the area for log storage and handling and the site would be essentially similar to its present condition with respect to habitat values. No significant potential for long-term resource impacts is envisioned. During construction, disposal pond water would cover

TABLE EIS 2-5

DESCRIPTION OF THE ALTERNATIVE DISPOSAL SITES

Site Location	Type	Size (Ac)	Volume Capacity	Transport Method	Depth	Habitat	Relative Cost for Use
Point Chehalis (two new sites)	open water	120	2 million c.y./year	barge or hopper	50-80 feet below MLLW	subtidal, sandy	low
South Jetty	open water	60	2 million c.y./year	barge or hopper	50-80 feet below MLLW	subtidal, cobble sand, sandy silt	low
Upland in South Aberdeen	confined	51	1.5 million c.y.	clamshell	Above MHHW	upland, log storage	low
Junction City (several sites)	confined	208	3.5 million c.y.	pipeline	Above MHHW	wetlands (marsh and swamp)	Very high due high mitigation cost of filling wetlands.
Slip No. 1, Port of Grays Harbor	confined	20	1 million c.y.	clamshell	Avg. 10 feet below MLLW	subtidal	low
Ocean	open water	160 (ea)	N.A.	barge or hopper		Deepwater sand, silt, or gravel depending on site selected.	Medium to high depending on distance.
Sites 2.5A (2-1/2 miles)					-60 feet below MLLW		
3.5A (3-1/2 miles)					-100 feet MLLW		
3.5B (3-1/2 miles)					-100 feet MLLW		
5.0A (5.0 miles)					-130 feet MLLW		
5.0B (5.0 miles)					-120 feet MLLW		
8.0A (8.0 miles)					-150 feet MLLW		

most of the site; however, on the disposal area margins and at the dredged material inflow point, there may be exposed dredged material which would provide some feeding habitat for gulls and shore birds. There may also be some revegetation by saline tolerant plants during the dewatering period following disposal and prior to reinitiation of log storage and handling operations.

Slip No. 1 is a 20-acre aquatic area which serves as a moorage slip in support of Port of Grays Harbor operations. Maximum depth of the area is about -30 feet and the average depth is -10 feet. About 1-1/2 acres of the area are intertidal. Fry Creek enters the disposal area at its northeastern end through a tide-gated culvert. This small stream historically has supported anadromous fish runs; however, it is culverted in numerous places and visual observation does not indicate that spawning areas are available in the existing streambed. The stream flows through the highly developed portions of the town of Aberdeen. Slip No. 1 has been periodically maintenance dredged for many years and all structures adjacent to the slip are placed on fill material. Thus, both the aquatic habitat, its underlying substrate, and surrounding upland areas are highly altered lands having relatively low habitat value for natural resources. Aquatic species which presently inhabit the area are of the type described in section 3.03b(2)(b). The tidelands and subtidal lands of Slip No. 1 would be irrevocably converted to uplands. Filling of the area would destroy habitat used by several species. Over 20 acres of open water used by water birds for resting and shelter from storms would be lost. Benthic invertebrates present at the site would be smothered. The slip was designated for fill by dredged material disposal in the Grays Harbor Long-Range Maintenance Dredging Program, a program developed by Federal, state and local agencies for the existing Grays Harbor project (U.S. Army Corps of Engineers, 1980). Impacts to Fry Creek are not considered significant because the character of the stream would be essentially unaffected. Additional information on the water quality effects of disposal area operation can be found in appendix A.

c. Estuarine Open-Water Sites. The South Jetty site and the two Point Chehalis sites consist of subtidal estuarine habitats below -50 feet MLLW. These areas support benthos already adapted to a disturbed environment (due to dredged material disposal, wave action, currents, and ship traffic). The loss at these areas would be a burial and destruction of fauna and habitat in the immediate 120-acre Point Chehalis disposal site area and approximately 60 acres at the South Jetty site. These areas would be disturbed annually by disposal of maintenance dredged material. Recreational and commercial fishing for rockfish does occur at the South Jetty site which is a rockfish and crab habitat composed of a cobble and shell substrate. Annual disposal of fine material at the South Jetty site may change the substrate to a habitat unsuitable for rockfish and crabs. Point Chehalis and South Jetty sites have been chosen as disposal sites because current measurements indicate that material would be effectively carried out of the estuary, thus reducing the likelihood that material may be recirculated onto harbor mudflats, eelgrass beds, and oyster beds. Also, disposal of material is desirable at these sites to stem the undercutting of the South Jetty as a result of tidal scouring action.

d. Ocean Sites. Potential ocean disposal areas for the Grays Harbor project include sites in the near shore sands which occur between 0-130 feet water depth (sites 2.5 A and B and 3.5 A and B, and 5B), the midshelf silt deposit which is greater than 130 feet water depth (site 5A), the relict gravels which are in deep water west by northwest of the estuary mouth (site 8A), and one beach site (1A). See plate 7 for the location of these potential ocean sites. All sites are approximately located in the navigation lanes in order to avoid direct impacts to crab fisheries, except for site 1A which is located south of South Jetty to prevent additional scouring of the beach. Site 8A is reported by state resource agencies as an area of low fishery activity (too shallow for shrimpers and draggers, too far out for sports fisheries, and of inappropriate substrate (gravel) for crab fisheries). Detailed studies to be performed during the Continuation of Planning & Engineering (CP&E) phase of the project would allow a more complete evaluation of these sites and will permit selection and formal designation of an ocean disposal site(s) for the Grays Harbor project.

2.04 Comparative Impacts of Alternatives. Comparative engineering features and environmental impacts of the channel improvement plans and the no action plan are shown in table EIS 2-2 and table EIS 2-6, respectively.

TABLE EIS 2-6

COMPARATIVE IMPACTS OF PROJECT ALTERNATIVES WITHOUT MITIGATION

Resource	Alternative 1 (No Action)	Alternative 2c (REC Plan)	Alternative 2a (NED Plan)	Alternative 2b (LED Plan)
Water Quality	Continued temporary decrease during O&M disposal of dredged material.	Short term temporary decrease during construction and at disposal site.	Greater increases in turbidity/suspended solids at Point Chehalis.	Same as REC Plan
Air Quality	Continue existing trends.	Same as No Action	Same as No Action	Same as No Action
Sediment Quality	None	None	None	None
Wetlands	None	None	Possible recirculation of silts and siltation of eelgrass beds.	None
Intertidal and Shallow Subtidal	None	Loss of 2 acres at south Aberdeen 2 acres at Cow Point, and 20 acres at Slip No. 1.	Same as REC Plan	Same as REC Plan
Aquatic Invertebrates	Continued temporary decrease at Point Chehalis and in channel during O&M.	Removal of in channel and disposal site benthos, permanent change in community structure at dredged areas and disposal sites. Convert 563 acres of undisturbed habitat to disturbed habitat. Loss of 20 acres of benthic community at Slip No. 1.	Same as REC Plan	Same as REC Plan
Crab Fishery	None	Substantial impacts to crab population.	Severe impacts on crab population.	Least impact on crab population.
Anadromous Fish	None	Minimal impact.	Probable impact during salmon outmigration.	Minimal impact.
Unavoidable Adverse Impacts	Continued yearly disturbance of channel benthos due to O&M.	Removal and destruction of channel and disposal site benthos. Loss of benthos at Slip No. 1.	Smother benthos at disposal sites. Removal and destruction of channel benthos. Potential for recirculation and subsequent siltation on eelgrass beds, oyster beds, and mudflats, and increased recirculation of silts in estuary. Impact to crab fishery and razor clam resource.	Same as REC Plan

SECTION 3. AFFECTED ENVIRONMENT

3.01 Project Area. Grays Harbor estuary is located at the mouth of the Chehalis River on the southwestern Pacific Ocean coastline of Washington, approximately 110 miles south of the entrance to the Strait of Juan de Fuca and 45 miles north of the Columbia River. The estuary lies within Grays Harbor County (figure EIS 3-1). Moving landward, the estuary can be divided into two major areas: the outer harbor extending from the Pacific Ocean east to Point New and the inner harbor extending east from Point New to Cosmopolis (Plate 1). The navigation channel is divided into eight reaches (figure EIS 3-1).

Grays Harbor is characterized by expansive mudflats, which are bare during low tides, and intervening channels that have been formed by the ebbtide discharge and the many rivers and creeks entering into the estuary. The most important of these channels is the North Channel, used for shipping, extending from the deep water near the estuary mouth to Cow Point. The principal rivers entering Grays Harbor are the Chehalis, Humptulips, Hoquiam, Wishkah, Johns, and Elk. Except for the Chehalis and the lower reaches of the Hoquiam, the tributary rivers are not important for navigation.

The land surrounding Grays Harbor is covered by heavy forests which provide for the bulk of the region's economic subsistence through timber harvest and export. Pacific County and the western portions of Lewis, Jefferson, Mason, and Clallam Counties are considered tributary to Grays Harbor in socioeconomic and environmental characteristics due, in part, to the region's heavy dependence on forest resources that historically have been shipped out of the Port of Grays Harbor. Grays Harbor County contains a population of approximately 66,300 (1980 census); the entire area totals 5,000 square miles. Commercial and recreational fishing, fish processing, tourism, and boating are other important contributors to the region's economy.

The city-ports of Aberdeen, Hoquiam, and Cosmopolis, all located at the head of the estuary, are the major urban centers for the region. Dredged channels provide deep-draft access to port and industrial facilities. Public and private marinas exist throughout the harbor; Westport Marina at Westport serves as the base for one of the Pacific Northwest's largest commercial and recreational fishing fleets.

The economy of Grays Harbor and its tributary area has been historically dependent on the forest products industries and related waterborne commerce with most vessel traffic engaged in transportation of wood products (logs, lumber, wood chips, and pulp). Over the past 10 years, waterborne commerce in the estuary has shown a steady increase in both number and size of vessels with drafts exceeding 30 feet trading at the port. Tourism and recreational activities are also becoming increasingly important, albeit seasonal, aspects of the county's economy.

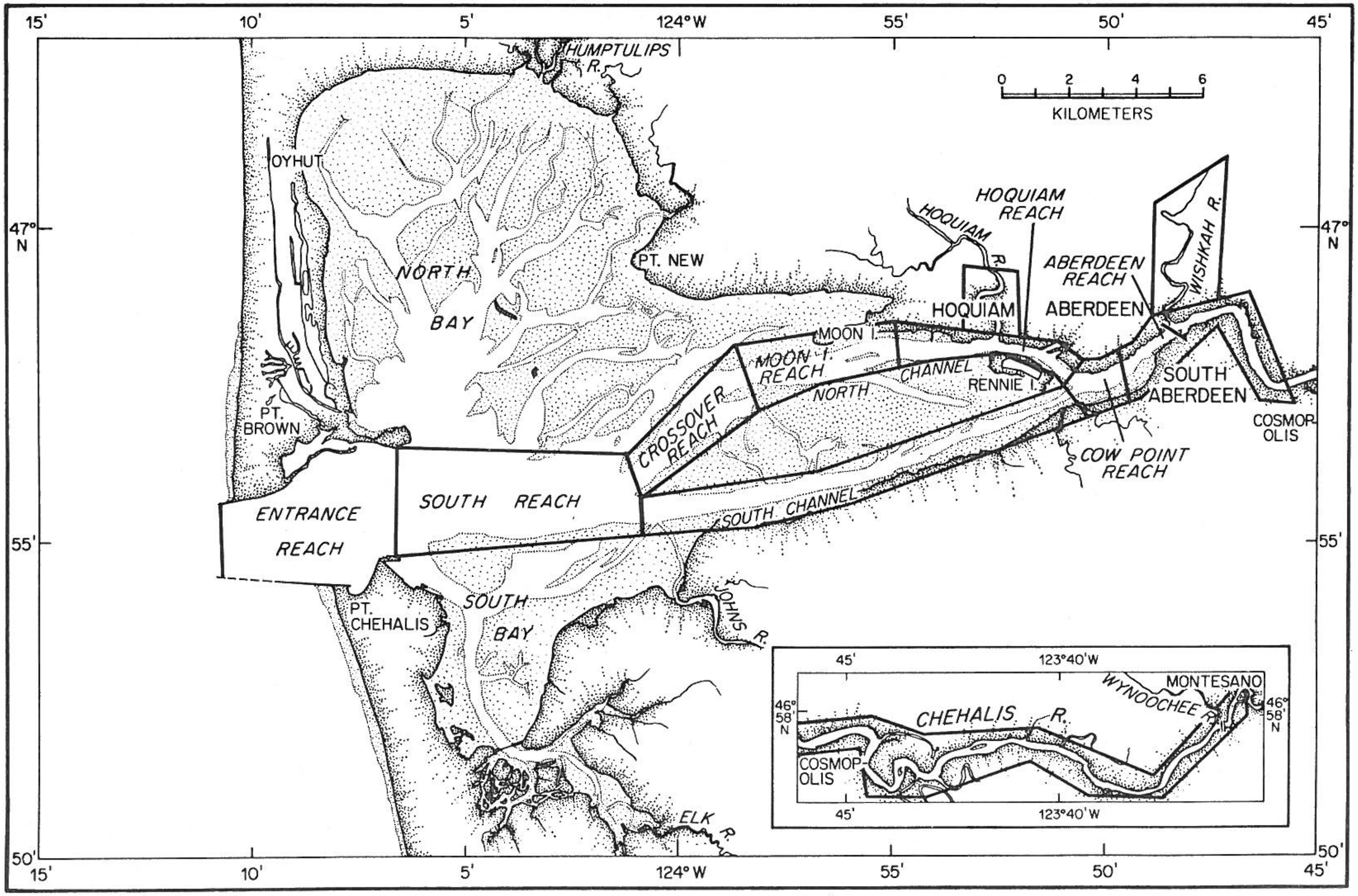


Figure EIS 3-1. Subdivisions of Grays Harbor

3.02 Environmental Conditions. This section describes, in general, the major characteristics of the study area environment. Aspects of the environment that are of special issue to or significantly affected by the project are discussed in detail in the Significant Resources, EIS 3.03.

a. Physical Features and Conditions.

(1) Climate and Weather. At approximately 47 degrees north and 124 degrees west, Grays Harbor lies in a temperate coastal zone influenced by a maritime climate. Summers are cool and dry, and winters are cool and rainy. Rainfall is a major feature of the climate with annual rainfall of approximately 70 to 90 inches a year. Temperatures are mild, rarely freezing, and not often above 75^{o} F.

(2) Air Quality. Grays Harbor County meets Primary Ambient Air Quality Standards. The National Ambient Air Quality Standard (40 CFR 50) and Washington State Ambient Air Quality Standard for high volume suspended particulates are 75 micrograms per cubic meter (ug/m^3) and 60 ug/m^3 (annual geometric mean), respectively. Typical values for suspended particulates in the outer Grays Harbor average 35 ug/m^3, well below the national and state standard. Pollutants are largely from vehicular and marine traffic: mainly carbon monoxide, oxides of nitrogen, and unburned hydrocarbons. There is measurable, although low-level, air pollution from industrial sources on the inner part of the Grays Harbor estuary. Localized air pollution problems occur as a result of high winds that hold emission plumes close to the ground near the source. The major air pollution source within the Aberdeen-Cosmpolis area is sulfur dioxide emission from sulfite pulpmills. Suspended particulate concentrations in the city of Aberdeen show an annual geometric mean of 40 ug/m^3, also below the National Ambient Air Quality Standard, 1981 (Department of Ecology, 1981).

(3) Noise. Ambient noise levels in the harbor vicinity have been measured to be 50 to 60 decibels (db) (A) during the daytime and 4 to 50 db (A) at night which are not considered to be high levels by Environmental Protection Agency (EPA).

(4) Physiography. The Grays Harbor area is a drowned coastal valley sheltered from ocean attack by bay bars and is surrounded on three sides by low hills. Prior to construction of the jetties, the harbor mouth was constricted by two sandspits formed by coastal processes in recent geologic time. Jetty construction has stabilized the entrance to about 6,500 feet wide and caused scour of the bar from about -15 feet MLLW to greater than -35 feet MLLW.

(5) Geology. Reference feasibility report, paragraph 4.08.

(6) Littoral Processes. Reference feasibility report, paragraphs 4.03-4.05.

(7) Estuarine Sedimentation. Grays Harbor acts as a trap for both river and ocean transported sediments. Studies of heavy mineral distribution in Grays Harbor sediments and adjacent beaches and rivers confirm that marine sediments of Columbia River origin are transported to the mouth of the estuary by littoral currents and eventually some are transported into the estuary via tidal currents and wave action along the North Jetty. Fine grained and sandy material is also carried out of the estuary, generally along the toe of the South Jetty during ebb flows. The estuary also receives river transported sediments in its northern, southern, and eastern parts. A general sediment regime of Grays Harbor estuary (Phipps, et al., 1974) is provided in figure EIS 3-2. Phipps grain size analysis indicates that the sediments become finer grained toward the head of the estuary and all the silty sands and muddy silts lie in the mixed or fluvial sediment provinces.

(8) River Sources. A review of the existing literature on discharge of sediments from the Chehalis River showed that the Wynoochee and Satsop Rivers subbasins are discharging suspended sediments at high rates compared to other river subbasins in the Pacific Northwest (Kehoe, 1982). Refer to Table EIS 3-1 below for river contributions to the estuary. The primary land use activity throughout the basin is forestry.

TABLE EIS 3-1

CHEHALIS RIVER BASIN
SUSPENDED SEDIMENT DISCHARGE
LEVELS FROM MAJOR TRIBUTARIES
(IN TONS)(FROM GLANCEY, 1969)

Tributary	Land Area (sq. mi.)	Annual Suspended Sediment Discharge Level (tons/sq. mi./yr.)	Total Annual Discharge (tons/yr.)
Chehalis River Above Porter	1,294	100	129,400
Cloquallum Creek	65	136	8,840
Satsop River (All Forks)	299	787	235,313
Wynoochee River	155	1,070	165,850
Total	1,813	298	539,403

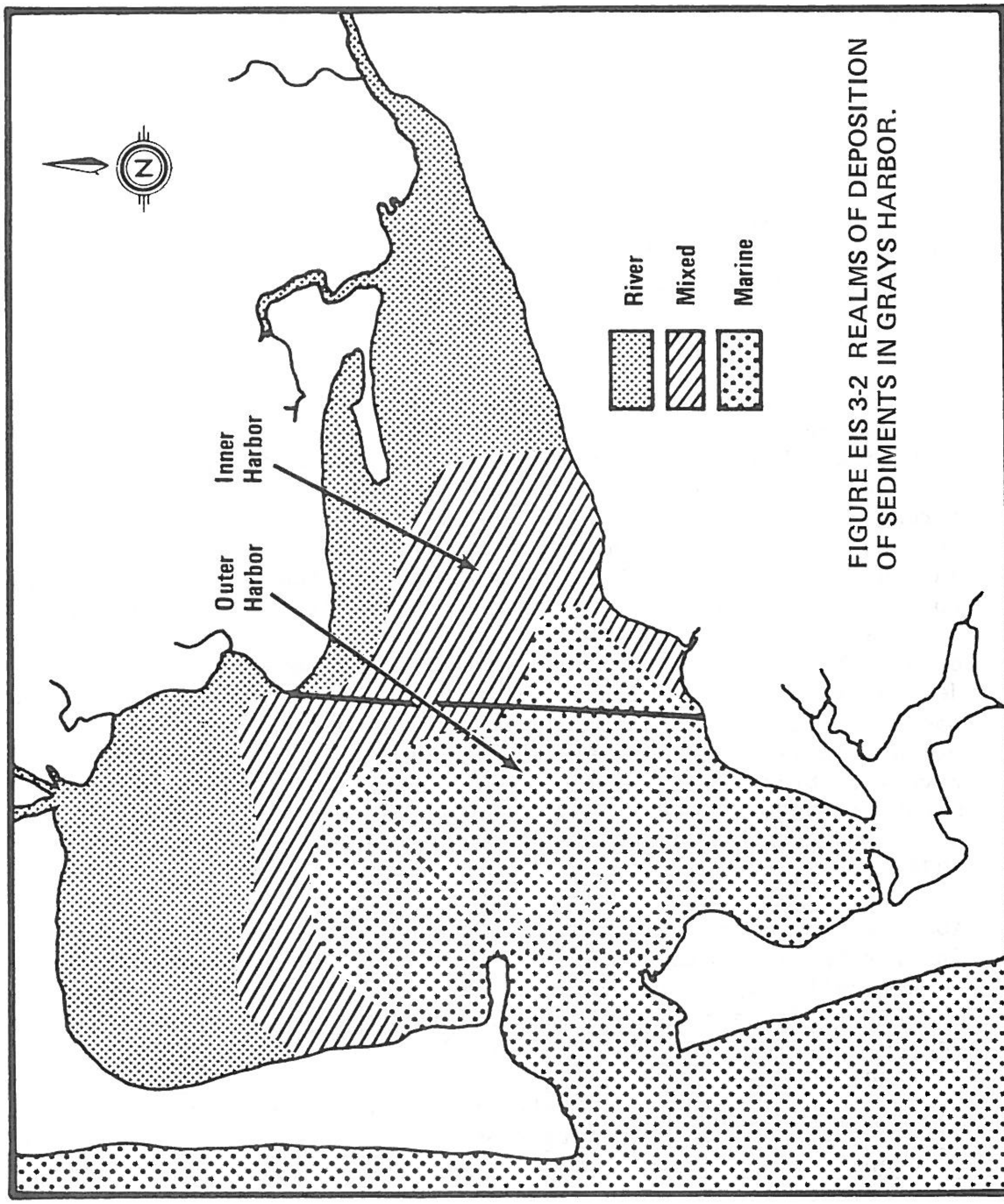


FIGURE EIS 3-2 REALMS OF DEPOSITION OF SEDIMENTS IN GRAYS HARBOR.

(9) Water Conditions

(a) Hydrology. The Grays Harbor watershed measures about 2,550 square miles and includes the Chehalis, Hoquiam, Wishkah, Humptulips, Johns, and Elk River basins. The Chehalis is the largest river system, contributing 80 percent of the total freshwater flow into the Grays Harbor estuary.

(b) Physical Oceanography. Reference feasibility report, paragraph 4.06.

(c) Water Quality. Dredging and discharge of Grays Harbor sediments has the potential to affect water quality and is discussed in detail in Significant Resources, EIS 3.03a.

b. Biological Features.

(1) Terrestrial Ecology. The terrestrial ecological resources of the area include numerous plant and animal species in a diverse array of habitats ranging from man-created, rocky shore marine communities near Westport to thick forests surrounding the estuary. Dense conifer forests, classified as coastal Sitka spruce (*Picea sitchensis*) and western hemlock (*Tsuga heterophylla*) zones by Franklin and Dyrness (1973), surround the estuary. Logging and natural flood plain conditions along lower river courses have encouraged stands of rapidly growing decidiuous trees such as red alder (*Alnus rubra*) and willow (*Salix* spp.) to become established. The canopy of trees and dense underbrush associated with deciduous forests provides habitat for various mammalian and avian species. Terrestrial vegetation in the immediate area of the proposed project falls into four general categories: red alder association, riverside brush and trees, riverside forbs and grasses, and freshwater marshlands (Smith et al., 1976). Over 50 species of mammals, utilizing six different habitat types, are found in Grays Harbor (Mudd and Smith, 1976, and Kalinowski et al., 1981).

About 15 mammal species are found in the Grays Harbor proximity, including fur bearing mammals such as beaver (Castor Canadensis), the most economically important fur bearer of the region; raccoon (*Procyon lotor*); muskrat (*Ondatra zibethica*); mink (*Mustela vison*); river otter (*Lutra canadensis*); red fox (*Vulpes vulpes*); coyote (*Canis latrans*); and longtail and shorttail weasel (*Mustela frenata* and *M. erminia*, respectively). Important game mammals are blacktail deer (*Odocoileus hemionus columbianus*), black bear (*Ursus americanus*), and Roosevelt elk (*Cervus canadensis roosevelti*i). Diked salt-marsh habitats in Grays Harbor are very productive for small mammals. These higher elevations, former salt-marsh areas, are normally located next to riparian wooded swamp habitats. These habitats are the chief furbearer and game habitats, especially the riparian wooded swamp, photo EIS 3-1.

Photo EIS 3-1. Typical view of Grays Harbor swamplands.

(2) Marine Ecology. Marine habitats include open ocean and estuarine environments. Grays Harbor is a typical estuary supporting many important habitats. A detailed discussion on marine ecology is included in Significant Resources, EIS 3.03b(1) and (2).

(3) Avian Fauna. Grays Harbor is composed of diverse and productive habitats that support numerous species of birds. Grays Harbor habitat diversity has attracted approximately 325 species of birds, roughly 80 percent of all species found in Washington State, and is a major stopover ground for migrating species (Herman, 1981). Avian fauna are discussed under Significant Resources, EIS 3.03b(2)(b)4.

(4) Threatened and Endangered Species. There are several birds and marine mammal species found in Grays Harbor that are classified as "threatened or endangered" by the Endangered Species Act of 1973. They are discussed in Significant Resources, EIS 3.03b(3).

c. Historic and Prehistoric Features. A review of the National Register of Historic Places (Federal Register, 18 March 1980, and monthly supplements through Vol. 7, No. 144, 27 July 1982), the Washington State Register of Historic Places, and archeological records at the University of Washington, Department of Anthropology, indicate that no known historic or archeological sites of cultural significance are located within, or will be impacted by, the proposed dredging or disposal areas. See paragraph 4.03d for complete discussion.

d. Socioeconomic Features of the Project Area. See EIS 3.01 of this report.

e. Treaty Fishing Rights. There are no Indian usual and accustomed fishing grounds (a judicially determined treaty right) within the project area, including the Chehalis River and Grays Harbor estuary.

3.03 Significant Resources. The resources discussed in this section include those aspects of the Grays Harbor environment that are of special importance to the Recommended (REC) Plan. These resources are of public interest and may potentially be impacted but will not necessarily be adversely affected due to the project.

a. Physical Features.

(1) Water Quality. Figure EIS 3-2 shows the dividing line in Grays Harbor between the outer harbor waters classified as "A" (excellent) and the inner harbor classified as "B" (good) by Washington Department of Ecology (WDE) criteria. These WDE water quality criteria include consideration of dissolved oxygen (DO) levels, temperature, pH, and turbidity of the water.

The first comprehensive water quality investigation in Grays Harbor conducted by the predecessor agency to WDE in the late 1930's showed DO concentrations often lower than minimum levels required for fish survival. Ericksen and Townsend (1940) observed large numbers of distressed and dead fish, shrimp, and other aquatic animals in 1937, 1938, and 1939. Past and present industrial discharges have had a major impact on water quality in the inner harbor. Wastes often accumulate as a result of low river inflows and limited flushing which, in concert with heavy sedimentation from the Chehalis River, contribute to low DO levels in the inner harbor. Additional organic waste discharges would likely further reduce water quality. However, there are indications that the historic trend of degrading water has been reversed as water quality in the estuary has improved in the last 10 years due recent improvement in industrial waste treatment (Loehr and Collias, 1981).

(a) Toxicants. Grays Harbor studies in 1974 and 1975 (Grays Harbor College, 1976) indicated the presence of toxicants and pollutants in the water and harbor sediment. Therefore, further comprehensive sediment sampling and elutriate testing for contaminants in Grays Harbor was performed in 1980 and 1981 by the Seattle District. The results of this comprehensive testing program indicated that contaminant concentrations in the sediments increase toward the inner harbor as the sediments become finer. Contaminant concentrations were generally found to be higher in the proposed channel areas adjacent to the presently maintained channel (see table A-2a and 2b, appendix A). Of the priority pollutants tested, only nine contaminants were found to be present in water elutriates of Grays Harbor sediment to be dredged and four (copper, zinc, PCB's and BHC) exceeded existing EPA criteria. The effects of these contaminants were evaluated during biological tests of the sediment (see

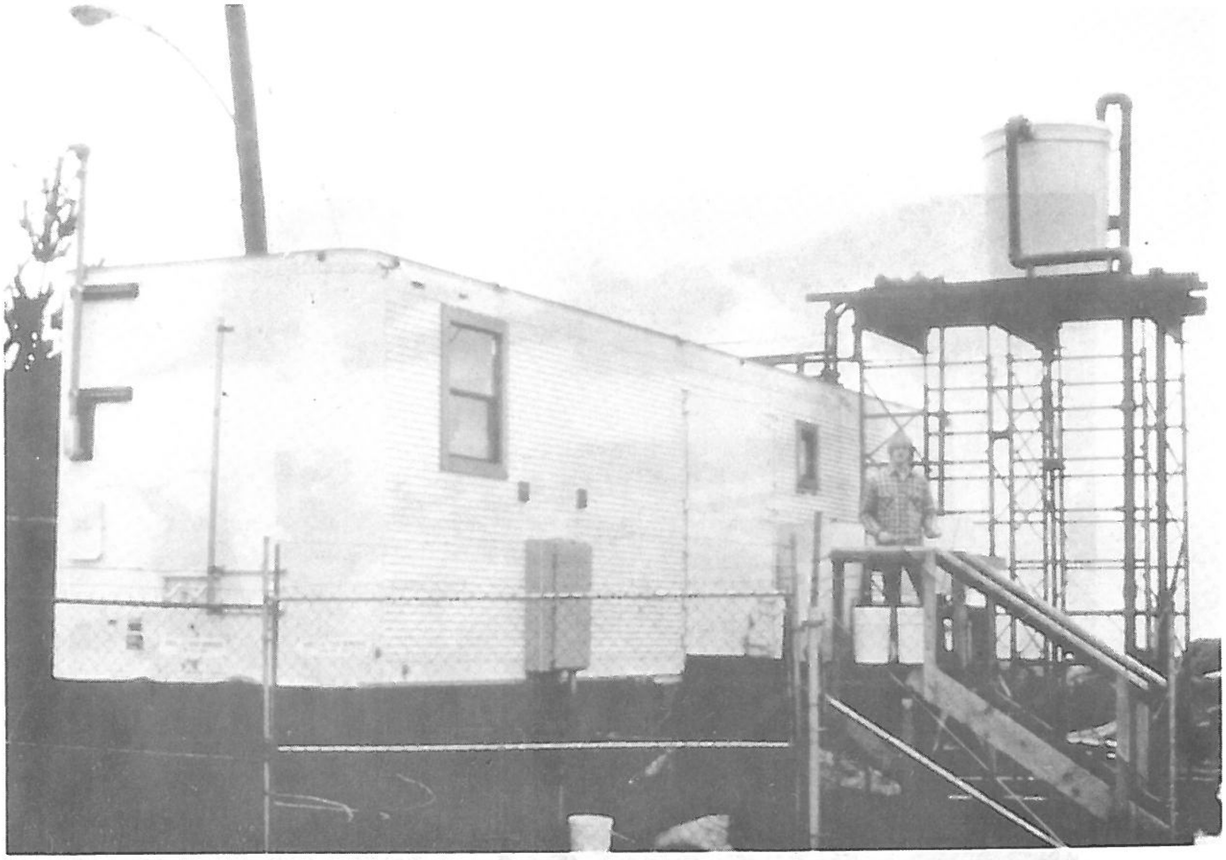


Photo EIS 3-2. Bioassay laboratory used to perform biological testing.

appendix A, exhibit 2). (See photo EIS 3-2 for picture of laboratory facility.) Test results indicate that some of the sediments in Hoquiam and Cow Point reaches could result in contaminant bioaccumulation in tissues of marine organisms if these sediments were discharged in open water. Consequently, these sediments are proposed for confined disposal. Details and results of this recent two phase water and sediment sampling program are included in appendix A, paragraphs 3.5b(1) and (2).

(b) Human Health. Klebsiella, a bacterium isolated from pulp and papermill wastes in Grays Harbor, is a member of the fecal coliform group of bacteria and is considered to be a low risk pathogen. Existing data suggest that the disturbance of sediment contaminated by Klebsiella should not present a serious threat to human health due to several factors. These factors are: (1) the low chance of direct human contact with highly contaminated sediments; (2) the high probability of reduced growth rates and reduced survival of Klebsiella in low nutrient, cold, saline water; and (3) low probability of encountering one of the few Klebsiella which are pathogenic (Storm, 1981). The presence of fecal coliform bacteria in Grays Harbor sediments has been identified. Recent monitoring efforts during maintenance dredging has shown that the redistribution of these bacteria into sensitive areas (e.g. shellfish harvest areas) is minimal. Coordination of dredging schedules with resource agencies would insure that shellfish harvest areas are protected in the event of a bacterial outbreak.

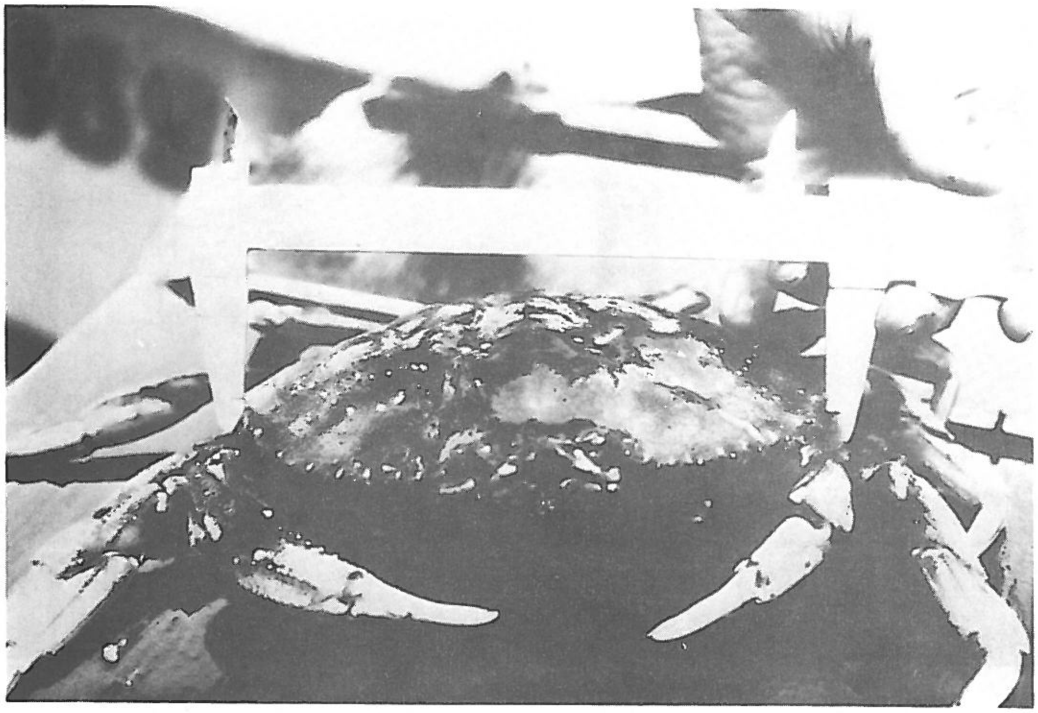


Photo EIS 3-3. Cancer magister, legal size.

b. Biological Features.

(1) Open Ocean Features.

(a) Flora. In the study area (defined as within 8 miles of the harbor entrance, see EIS 2.03c on ocean disposal of dredged material), phytoplankton, mainly diatoms and microflaggelates, constitute the bulk of the flora. Phytoplankton is the foundation of most of the food chains in the study area. In an analysis of stomach contents of 11 species of finfish at the Columbia River ocean disposal site, Durkin and Lipovsky (1977) found that phytoplankton were the primary diet of anchovies and that anchovies were, in turn, eaten by nine of the other fish species. Two surf zone diatom species provide the main food for large razor clam populations which extend from the Columbia River northward at least 63 miles (Lewin, et al., 1978).

(b) Fauna. The fauna within the study area can be divided into three interacting communities: benthic, pelagic, and demersal.

1. Benthic Community. The benthic community consists of those organisms living in the sediment or near the sediment water interface, i.e., marine worms, crustaceans, and molluscs. This community depends on the continued descent of organic materials from the overlying waters for nourishment. The Dungeness crab (Cancer magister), photo EIS 3-3, is an economically important benthic species. Some of the best crabbing grounds are located off the coast of Grays Harbor. The potential impacts to crabs are great and are discussed in section 4, EIS 4.03b(2)(b).

2. Pelagic Community. The pelagic community consists of those organisms drifting (plankton) or swimming (nekton) in ocean waters. The planktonic fauna consists of zooplankton which feed on phytoplankton.

The primary pelagic commercial fishing in Washington occurs off the coast of Grays Harbor. The main catch consists of coho (*Oncorhynchus kisutch*) and chinook (*O. tshawytshca*) salmon. Some important pelagic marine fish inhabiting coastal waters in the proximity of the Grays Harbor entrance include the Pacific herring (*Clupea harengus pallasi*), northern anchovy (*Engraulis mordax*), Pacific sardine (*Sardinops sagax*), surf smelt (*Hypomesus pretiosus*), shiner perch (*Cymatogaster aggregata*), striped seaperch (*Embiotoca lateralis*), pile perch (*Rhacochilus vacca*), and the redtail surfperch (*Amphistichus rhodoterus*).

Occasionally the albacore tuna (*Thunnus alalunga*) and jack mackerel (*Trachurus symmetricus*) are found when warm, southern currents invade the Pacific Northwest.

Approximately thirty species of ocean-feeding birds are found off the Washington coast. Some of the most abundant ocean-feeding birds are sooty shearwater, common murre, rhinocerous auklet, and marbled murrelet; all but the shearwater breed along the coastline of Washington. The shearwater is present during spring and fall migrations. Other species regularly observed in off-shore waters include black-footed albatross, northern fulmar, pink-footed shearwater, fork-tailed and Leach's storm-petrels, red phalarope; parasitic and pomarine jaegers, Sabine's gull, pigeon guillemot, tufted puffin, and ancient murrelet. Most of these species travel widely over the open ocean, stopping where small fish or zooplankton are abundant. The common murre, rhinocerous auklet, marbled murrelet, pigeon guillemot, and ancient murrelet populations are present in reduced numbers throughout the winter and often utilize Grays Harbor for food and shelter during adverse weather.

The list of marine mammal fauna reported for the project area is extensive. Table EIS 3-2 lists the marine mammal species, their relative occurrence, and their legal status (if threatened or endangered) as reported in Volume 43, Federal Register No. 238, 11 December 1978. Endangered species are addressed in EIS 3.03b(3). Larrison (1976) considers the harbor porpoise to be the most abundant marine mammal along the Pacific Northwest coast; it is most often found in coastal and estuarine waters (Eaton, 1975; and Isakson and Reichard, 1976). Other common species include the Northern or Steller sea lion, the California sea lion, and the Harbor seal which, according to Isakson and Reichard (1976), has been identified as inhabiting 15 critical resting and breeding sites within Grays Harbor.

3. Demersal Community. This community consists of those organisms found near the bottom of the ocean which interact between the benthic and pelagic communities. The primary demersal fish found in nearshore and offshore waters in Grays Harbor are the commercially important rockfish and groundfish. These occur primarily on the outer continental shelf and frequently on the continental slope (Smith et al,

1980). Some common fish are rockfish (Sebastus sp.), lingcod (Ophiodon elongatus), Pacific cod (Gadus microgadus), English sole (Parophrys vetulus), Pacific sand dab (Citharichthys sordidus), rex sole (Glypotcephalus zachirus), juvenile Petrole sole (Eopsetta jordani), sand sole (Psettichthys melanostictus), and starry flounder (Platichthys stellatus).

(2) Estuarine Features. Wetland habitats play an important role in the estuarine environment. They make a substantial contribution to the food base of the estuary. A second important wetland function is provision of marine habitat. Wetlands provide habitat for Dungeness crabs and juvenile salmonids, functioning as nursery and feeding areas and as a transition zone for salmonids' physiological adaptation from fresh to saltwater. A third important function of wetlands is the prevention or reduction of siltation and erosion.

TABLE EIS 3-2

MARINE MAMMALS THAT OCCUR
WITHIN THE GRAYS HARBOR STUDY AREA
(from Smith et al., 1980)1/

	Endangered Species Status
Order: Cetacea	
Black or Pacific right whale2/	Yes
Minke whale	No
Sei whale	Yes
Finback or Fin whale	Yes
Humpback whale2/	Yes
Gray whale	Yes
Pacific striped or white-sided dolphin	No
False killer whale2/	No
Killer whale	No
Harbor porpoise	No
Sea Otter	No
Northern fur seal	No
California sea lion	No
Northern or Steller sea lion	No
Harbor seal	No
Northern elephant seal	No

1/Compiled from Eaton (1975), Larrison (1976), Pike and MacAskie (1969), and Northwest Fisheries Center, Marine Mammals Division (1975).

2/Uncommon occurrence in this area.

In addition, wetlands facilitate the absorption of organic and mineral nutrients and the assimilation and concentration of toxic substances, including heavy metals and chlorinated hydrocarbons, from surrounding waters.

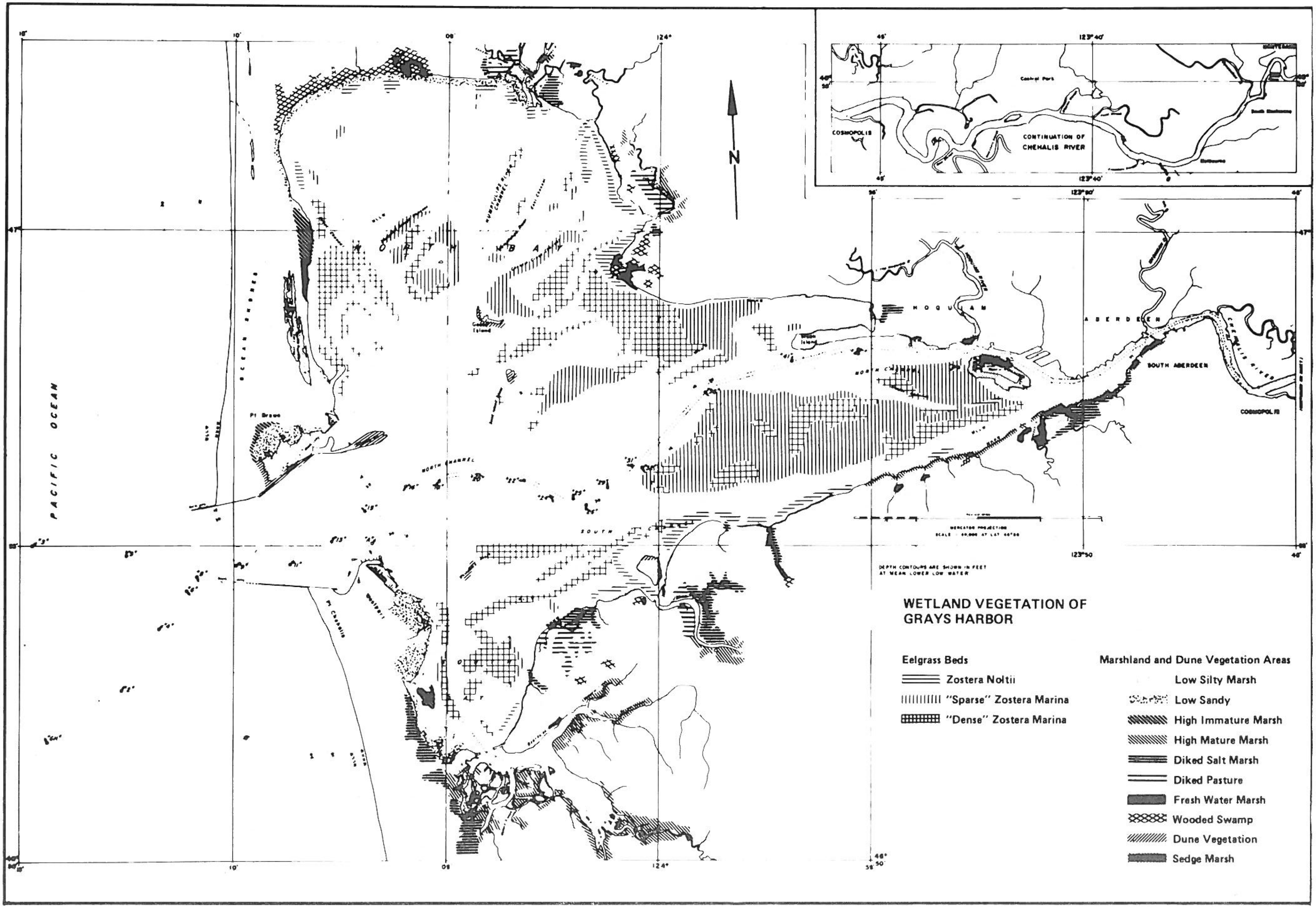
Shallow intertidal flats and associated eelgrass, algae, and salt-marsh communities exist throughout and along the margins of the Grays Harbor estuary (see Fig. 3-3) and account for most of the estuary's primary productivity (Thom, 1981). Table EIS 3-3 shows the estimated acreage of these intertidal habitats. Food energy is produced by plant photosynthesis which captures, converts, and stores energy from sunlight. Understanding this transfer provides a means of ascertaining the importance of surficially unrelated biologic communities. Primary consumers which feed on plants or organic detritus in turn provide food for higher life forms. Several food chain pathways found in Grays Harbor ecosystems have demonstrated the extent and persistence of interdependent relationships throughout the flora and fauna of this estuary.

TABLE EIS 3-3

ESTIMATED EXTENT OF INTERTIDAL HABITATS IN GRAYS HARBOR
(From Grays Harbor LRMDP EISS)1/

	Hectares	Acres
Entire Harbor to Extreme High Water (EHW)	22,140	54,708
Intertidal from MLLW to EHW	13,600	33,605
Salt Marshes:		
Low Marshes	919	2,271
High Marshes	514	1,270
Sedge Marsh	81	200
Diked Salt Marsh	441	1,090
Total Salt Marsh	1,955	4,831
Eelgrass Beds	4,740	11,712
Tidal Flats not Vegetated with Vascular Plants (includes areas with benthic macroalgae and diatoms)	6,905	17,062

1/Grays Harbor Long-Range Maintenance Dredging Project, Environmental Impact Statement Supplement No. 2.


WETLAND VEGETATION OF
GRAYS HARBOR
Eelgrass Beds
Zostera Noltii
"Sparse" Zostera Marina
"Dense" Zostera Marina
Marshland and Dune Vegetation Areas
Low Silty Marsh
Low Sandy
High Immature Marsh
High Mature Marsh
Diked Salt Marsh
Diked Pasture
Fresh Water Marsh
Wooded Swamp
Dune Vegetation
Sedge Marsh
PACIFIC OCEAN
HOQUIAM
ABERDEEN
SOUTH ABERDEEN
COSMOPOLIS
CONTINUATION OF
CHEHALIS RIVER
NORTH CHANNEL
SOUTH CHANNEL
Pt Brown
Pt Chehalis
N
124°
123°50'
123°40'

ure EIS 3-3.

(a) Estuarine Vegetation. The higher intertidal areas of Grays Harbor support salt-tolerant vegetation. Many plant species are capable of living in this environment and often grow in very dense, productive stands.

The estuarine vegetation also provides feeding and rearing habitat for fishes, including salmonids, English sole, herring, and smelt, and a nursery habitat for immature Dungeness crab (Simenstad and Eggers, 1981). In addition, the vegetated areas of the estuary are important habitats for some birds using the Pacific flyway; for resident waterfowl, shore birds, and upland birds; and small mammals.

1. Phytoplankton. Although phytoplankton are the least productive plant group in the estuary, they are considered important primary producers which are the supply of food for zooplankton. Phytoplankton productivity is greater in the outer harbor than in the inner harbor (Thom, 1981). Table EIS 3-3 compares primary production of several types of aquatic flora.

TABLE EIS 3-4

ORGANIC CARBON CONTRIBUTIONS (x 10^6kgC/yr)
OF VARIOUS SOURCES WITHIN THE ESTUARY
(From Thom, 1981)

Source	Inner Harbor1/	Outer Harbor2/	Entire Estuary
Marsh Phanerograms	3.36	12.6	16.0
Zostera spp.	49.02	76.78	125.8
Benthic Algae	24.68	46.6	71.3
Phytoplankton	2.34	6.6	8.9
Total for Plant Sources	73.40	142.6	222.0

1/Includes areas Cosmopolis through Bowerman Basin.
2/Includes the area west of Bowerman Basin through harbor entrance.

2. Eelgrass. Two species of eelgrass, Zostera marina and Z. noltii, cover approximately 11,680 acres of mudflat in Grays Harbor. Z. marina occurs from the -3- to the +6-foot MLLW elevations, while Z. noltii occurs at higher elevations (+3- to +6-foot tidal levels). The locations (indicated on figure 3-3) and densities of the eelgrass beds in Grays Harbor have been previously described (Smith et al. 1976; Smith et al., 1977; Miller, 1977).

Eelgrass is an important primary producer in the Pacific Northwest (Phillips, 1974), and along with salt-marsh plants, is the base of many food chains in estuaries (e.g., primary food source for black brants). Additionally, eelgrass beds serve as an important habitat for several species of invertebrates and fish.

3. Macroalgae. Twenty-three taxa of macroalgae were identified in Grays Harbor estuary (Thom, 1981), with their distribution limited by availability of hard, stable substrata (e.g., logs, roots, boulders) for attachment. The most widespread species were Enteromorpha intestinalis and Fucus distichus spp. edentatus. Productivity rates varied among the major algal species and are listed in Thom (1981).

4. Salt Marsh. Undiked salt marsh, photo EIS 3-4, presently covers approximately 3,740 acres of Grays Harbor. Salt marshes are important for their contribution to the food web and for the habitat they provide for many invertebrates and vertebrates. They have been shown to absorb pollutants, stabilize the substrate, and moderate water temperatures (Akins and Jefferson, 1973). Arrowgrass (Triglochin maritimum) is common in the lowest marshes, while saltgrass (Distichlus spicata) and pickleweed (Salicornia virginica) dominate higher marsh areas. Other important marsh plants are Deschampsia caespitosa, Scirpus americanus, and Carex lingbyei. In the uppermost intertidal areas which are flooded only by extremely high waters, the diversity of plant species increases. Detailed descriptions of the salt marshes of Grays Harbor are provided in Smith et al., 1976 and Armstrong, et al. 1979.

(b) Estuarine Fauna.

1. Benthic Communities. The most comprehensive surveys of invertebrates published to date are the Grays Harbor Dredging Effects Study (GHDES) (U.S. Army Corps of Engineers, 1976b) and Albright and Bouthillette, 1982. The distributions and life histories of the economically important species in Grays Harbor, and species which are found associated with them, are the best known. Additional information can be found in Smith et al. (1980).

o Oysters. Pacific oysters (Crassostrea gigas) are cultivated in outer Grays Harbor, principally near Whitcomb Flats, and in North and South Bays. The inner harbor is closed to oyster harvest and marketing due to high coliform bacteria levels.

Photo EIS 3-4. Typical salt-marsh and mudflat habitat in Grays Harbor.

o Clams. Nine species of clams, including the native littleneck clam (Protothaca staminea), Washington butter clam (Saxidomus giganteus), and softshell clam (Mya arenaria), are found in Grays Harbor. The razor clam is the most important sport fishery on the ocean beaches immediately north and south of Grays Harbor.

o Crabs. Dungeness crabs (Cancer magister) are abundant in Grays Harbor, though most are smaller than the legal size limit (6 inches carapace width). Grays Harbor appears to function as a nursery area for juvenile crabs. These juveniles eventually migrate to the ocean. The habitat of this commercially important species ranges from Cow Point, even during periods of very low salinity, throughout the harbor to the Pacific Ocean. Smaller crabs appeared more abundant in the eastern half of the estuary, especially around Rennie Island. Utilization of tidal flats at high tide is common, with the heaviest use found in tidal channels and depressions in the flats. The main channels are heavily utilized during low tides (Tegelberg et al., 1976 and Armstrong et al., 1981). Productive crabbing grounds lie off the coast of Washington, with the major commercial crabbing occurring from 1 December through 1 June (Stevens, 1981).

o Other Benthic Invertebrates. The distribution and abundance of the great majority of invertebrates in Grays Harbor is rather poorly known. Most of the species reported as occurring in Grays Harbor are not of direct value to man but are indirectly important in the food chain as food organisms for, or competitors or predators of, the commercially or recreationally important fish and invertebrates in Grays Harbor.

The three most frequently encountered amphipods within Grays Harbor are Corophium salmonis, Anisogammarus confervicolous, and an Eohaustorious species. C. salmonis appears to be the most numerous benthic macro-organism found in the inner harbor and midharbor flats and intertidal areas, with maximum densities of over 6,100 individuals per square foot having been measured (Albright and Bouthillette, 1982). A. confervicolous is important in the high intertidal areas of the inner harbor and Eohaustorious is the most numerous in the outer harbor. A cumacean, Leptochelia savignyei, was the numerically dominant organism in parts of the outer harbor. Another cumacean, a Diastylis species, is found at Whitcomb Flats and is the most numerous organism in both the North and South Channels (Albright and Bouthillette, 1982).

Capitellid polychaete worms were also present throughout the harbor. Heteromastus filiformis was the most numerous of this kind in the inner harbor. Populations of burrowing shrimp, primarily ghost shrimp (Callianassa californiensis) or mud shrimp (Upogebia pugettensis), occur in the bays and flats of the harbor, while free-swimming shrimp (various spp.) inhabit deeper marine waters offshore. A small commercial fishery exists in Grays Harbor that harvests ghost shrimp for use as bait. Gray shrimp (Crangon sp.) are also abundant within the estuary. See Albright and Bouthillette, 1982, for greater detail.

2. Fish. Grays Harbor is utilized by at least 54 species of fishes both resident and anadromous during various stages of their life histories (Bengston et al., 1976).

o Resident Fish. Large and diverse populations of resident fishes inhabit the estuary, many of which are economically important. The English sole (Parophrys vetulus) and starry flounder (Platichthys stellatus), commerically important species, use the estuary as a nursery for their first year of life. English sole and starry flounder are present in all areas of the estuary (Bengston et al., 1976 and Simenstad and Eggers, 1981).

Table EIS 3-5 summarizes the residence times and life history stages of numerically abundant baitfish in Grays Harbor. Table EIS 3-6 indicates occurrence and relative abundance of baitfish at five sampling sites in Grays Harbor.

Several species of resident fish that are not commercially important are found in great numbers in Grays Harbor. Sculpin, perch, prickleback, and stickleback species are quite abundant. These species provide forage for birds, mammals, and larger fish.

TABLE EIS 3-5

SUMMARY OF RESIDENCE TIMES OF PROMINENT TAXA AND LIFE HISTORY STAGES OF BAITFISH IN GRAYS HARBOR, WASHINGTON, MARCH-OCTOBER 1980 (From Simenstad, 1981)

Species	Life History Stage	Maximum Residence Times (weeks)	Remarks
Northern anchovy, *Engraulis mordax*	adult	6	Maximum residence during two periods (mid-June to early August, late August to early October); longest residence at Westport.
	juvenile	11	Maximum sustained residence from mid-July to early October; longest residence at Cow Point and Moon Island.
Pacific herring, *Clupea harengus pallasi*	juvenile	15	Maximum sustained residence from early July to early October; longest residence at Cow Point and Moon Island.
Longfin smelt, *Spirinchus thaleichtys*	juvenile	9	Maximum residence during two periods (early May to mid-July, early August to early October); longest residence at Moon Island.

o Anadromous Fish. There are six species of salmonids in the estuary that use various habitats in Grays Harbor for feeding before emigrating to the ocean. The species are chum (*Onchorhyncus keta*), coho (*O. kisutch*), and chinook (*O. tshawytscha*) salmon, and Dolly Varden (*Salvelinus malma*); steelhead (*Salmo gairdneri*); and cutthroat (*S. clarkii*) trout. Other anadromous fish include smelt (*Spirinchus thaleichthys*), American shad (*Alosa sapidissima*), and sturgeon (*Acipenser transmontanus*). Distribution, abundance, and feeding behavior will be discussed below. Distribution of the species is strongly influenced by bottom type, estuary depth, salinity, season, and food organism availability.

TABLE EIS 3-6

OCCURRENCE AND RELATIVE ABUNDANCE OF BAITFISH SPECIES
AT FIVE PURSE SEINE SAMPLING SITES IN GRAYS HARBOR, WASHINGTON,
MARCH-OCTOBER 1980

Circles represent rare occurrences; +'s, common occurrences; and X's, commonly occurring in high abundances; see text for definition of these terms. (From Simenstad, 1981).

Species/Life History Stage	Sampling Site				
	Cosmopolis	Cow Point	Moon Island	Stearn's Bluff	Westport
Alosa sapidissima, American shad					
juvenile		o	o	o	
adult	+	+	o		
Clupea harengus pallasi, Pacific herring					
juvenile	+	X	X	X	X
larvae	o	o	o		
Engraulis mordax, northern anchovy					
adult		+	X		X
juvenile	o	+	X	X	
larvae	o	+	X	o	
Osmeridae, smelts					
larvae	o	o	o		
Hypomesus pretiosus, surf smelt					
adult/juvenile	o	o	+	X	X
larvae	o	o	o		
Spirinchus thaleichthys, longfin smelt					
adult	o	+	+	o	
juvenile, larvae	+	+	+		
Allosmerus elongatus, whitebait smelt					
adult			o		
juvenile			o		
Ammodytes hexapterus, Pacific sand lance					
juvenile			o	X	o
larvae			o		

Figure EIS 3-5 summarizes the residence periods of salmonids in Grays Harbor. Chum and coho salmon have been reported to migrate through the estuary as rapidly as 2-4 weeks. Generally juvenile chum salmonids migrated through the estuary between March and mid-May, coho between mid-April and late June, chinook between early April and the end of October, and steelhead between mid-May and late July (Simenstad and Eggers, 1981). Simenstad and Eggers (1981) indicate that the chinook maintained a residual population that continued to grow and reside in the estuary through late summer and early fall.

Fish utilize distinctly divergent prey spectra in Grays Harbor and their diets are typically associated with the predominant epibenthic or neritic habitats in which they are found. Fishes occupying near shore habitats feed predominantly upon epibenthic crustaceans, primarily harpacticoid copepods, cumaceans, and various species of gammarid amphipods. Salmonids in neritic habitats tend to be somewhat larger and feed upon more pelagic prey such as larval fish (particularly the larvae of northern anchovy) and adult (drift) insects. As a general rule, juvenile salmonids feed upon epibenthic crustaceans upon their initial entry into estuaries and, when larger or after some growth, convert to neritic zooplankton during their residency in the estuary (Simenstad and Eggers, 1981).

3. Marine Mammals. Intertidal flats are used by the harbor seals as haulout areas and pupping grounds. During the summer months, as many as 1,400 harbor seals have been observed in the harbor (Smith and Mudd, 1976). See table EIS 3-2 for a list of other occasional cetaceans in Grays Harbor.

4. Avian Fauna.

o Shorebirds. The Grays Harbor area is an important migratory stopover for approximately 24 species of shorebirds (see photo EIS 3-5). The western sandpiper is by far the most abundant species (Herman and Bulger, 1981). During the winter months in Grays Harbor, the dunlin is the most abundant shorebird, with a population of as many as 100,000 birds. Other common shore birds, primarily during migration periods, include least sandpiper, red knot, short-billed dowitcher, and great blue heron. During mid-April of 1981, a peak number of shorebirds in Grays Harbor was estimated at approximately 1,000,000 birds (Herman and Bulger, 1981), with as many as 50 percent of the shorebirds utilizing the Bowerman basin area (see Figure EIS 3-5). The number of birds in Grays Harbor shorebird population decreased rapidly in late April to approximately 75,000 birds.

The Caspian tern deserves special mention as a nesting species in Grays Harbor. Breeding colonies of these terns east of the Cascade Mountains have been nearly eliminated. The only viable Caspian tern colonies in Washington are in Grays Harbor. Nearly 5,000 Caspian terns nest on Whitcomb and Sand Islands.

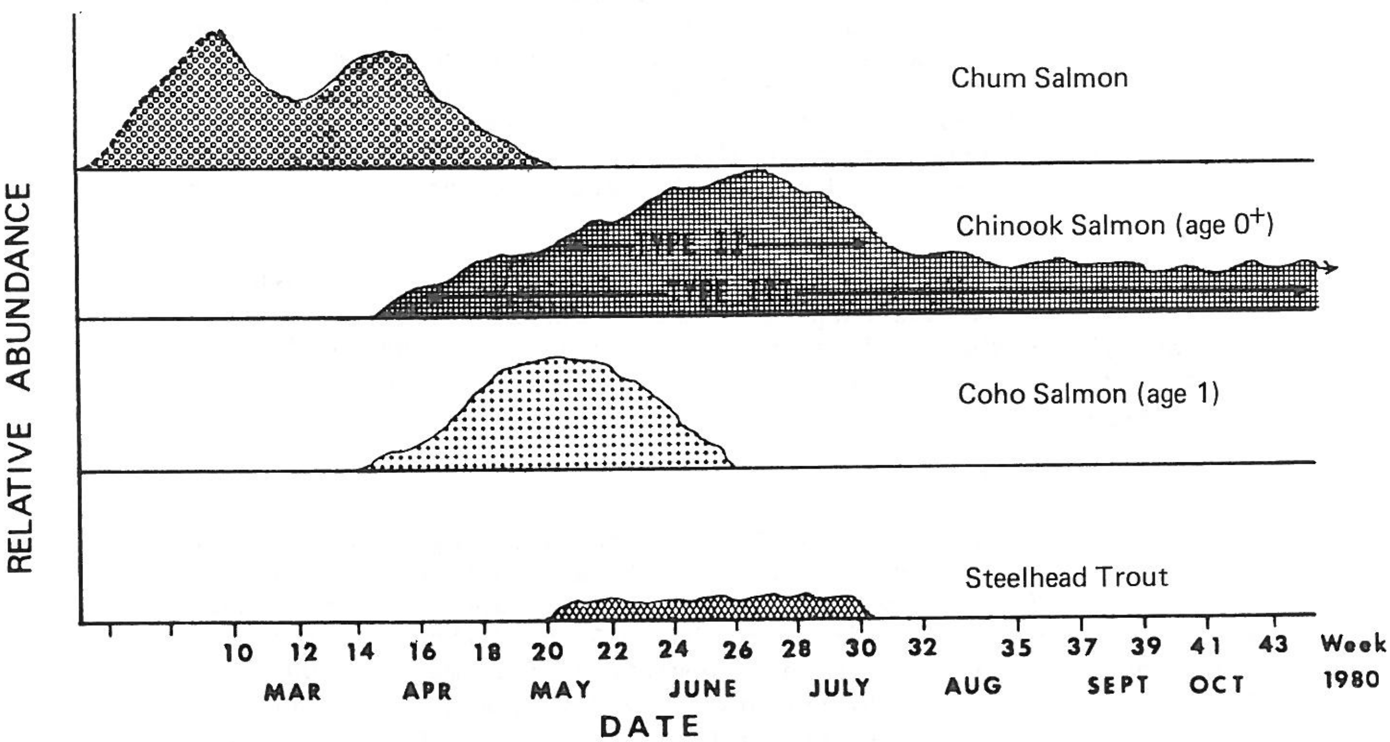


Figure EIS 3-4 Outmigration periods of chum, chinook and coho salmon, and steelhead trout in Grays Harbor, Washington, March - October 1980((from Siminstad 1981).

Type II - migrates out of Grays Harbor

Type III - portion of the population that remains within the estuary through October

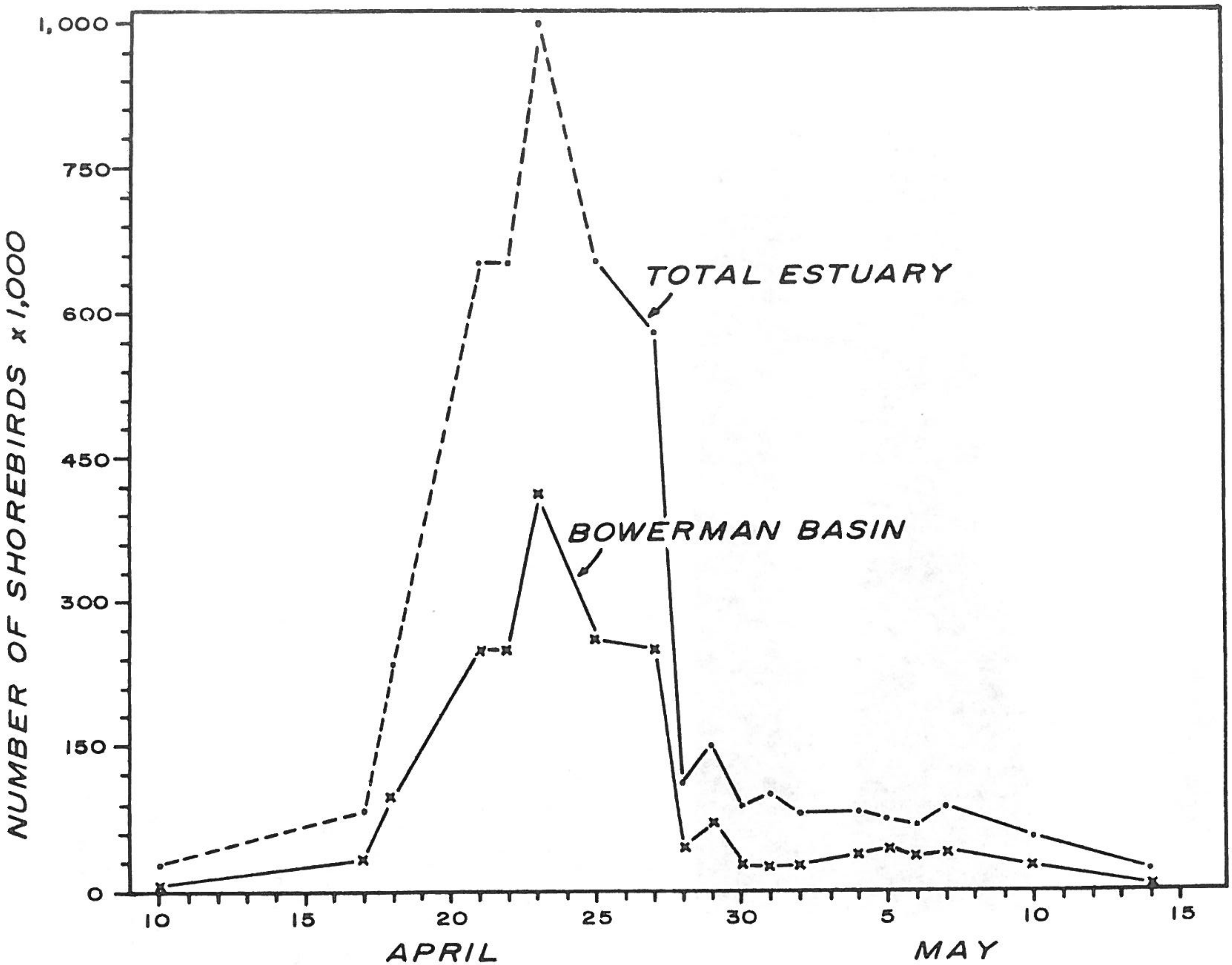


Figure EIS 3-5. Timing and magnitude of the shorebird migration at Grays Harbor, Washington, spring 1981. Dashed line represents extrapolation. (From Herman & Bulger, 1981)

Photo EIS 3-5. Large numbers of shorebirds at Bowerman Basin.

o Waterfowl. Grays Harbor is also important for other aquatic birds, including western grebes, pelagic and double-crested cormorants, rhinocerous auklets, common murres, several species of gulls and terns, and many species of waterfowl. Populations of waterfowl, dependent upon Grays Harbor during migration, reach a peak in the fall of about 45,000 birds (Smith & Mudd, 1976). The most abundant duck utilizing Grays Harbor is the American wigeon, although pintail, mallard, bufflehead, greater and lesser scaups, canvasback, green-winged teal, white-winged and surf scoters, and ruddy duck are also quite numerous in the harbor. Black brant is the most abundant goose, reaching peak numbers of about 2,000 in April (Smith & Mudd, 1976). Brant feed on the extensive eelgrass beds of Grays Harbor, which are also important for scaups and goldeneyes. Grays Harbor is second in importance to Padilla Bay as a wintering area for black brant in Washington.

o Terrestrial Species. The Grays Harbor area supports typical western Washington terrestrial avian fauna. Of special interest are the birds of prey which make use of the wetland habitats, primarily salt marshes and exposed mudflats. The rarest of terrestrial species is the peregrine falcon which prey upon the abundant shorebirds, primarily dunlin during the winter. Bald eagles, rough-legged hawks, marsh hawks, short-eared owls, and snowy owls also utilize the harbor's resources in the winter.

(3) Threatened and Endangered Species. Four species classified as "endangered" by the Endangered Species Act of 1973 are known to occur at Grays Harbor: the brown pelican (*Pelecanus occidentalis californianus*), the Aleutian Canada goose (*Branta canadensis leucopareia*), the gray whale (*Eschrichtius robustus*), and the American subspecies of the peregrine falcon (*Falco peregrinus anatum*). Until recently, most peregrine sightings in Grays Harbor region had been confirmed as the Peale's subspecies (*F. p. pealei*), which is not considered "endangered." Recent sightings in Grays Harbor (19 October 1979 and 27 September 1980) confirm the presence of the endangered American subspecies (Dr. Steven G. Herman, Evergreen State College, personal communication with Ken Brunner, Seattle District, on 6 October 1980).

The northern race of the bald eagle (*Haliaeetus leucocephalus alascanus*) has been included as a threatened species on the Federal list of endangered and threatened species of wildlife and plants in the State of Washington since March 1978 (Federal Register, February 1978) and is regularly sighted in Grays Harbor.

In addition to the species already mentioned, there are six species of whales and one species of turtle that are on the endangered species list and also have been known to occasionally inhabit offshore coastal waters of Washington (Brunner, 1981). Near shore sightings of these animals are very rare in the Grays Harbor area.

One common marine mammal off the pacific coast, the conspicuous gray whale which most frequently migrates within a few kilometers of shore, occasionally strays into the inner areas of Grays Harbor (Eaton, 1975; Rice and Wolman, 1971). The peak of the northward migration here is between early March and early May. The southward migration peaks in late December but may last until early February (Pike and MacAskie, 1969 and Mate, 1979). The humpback whale, although uncommon in occurrence and pelagic in nature, is seen occasionally in the study area in fall and spring while migrating between winter and summer grounds. Humpbacks have been observed entering estuarine waters (Eaton, 1975) while feeding on herring and anchovies, but they mainly feed offshore on euphausids (crustaceans).

SECTION 4. ENVIRONMENTAL EFFECTS OF FINAL ALTERNATIVES

4.01. Introduction. This section discusses and analyzes impacts expected to occur to the Grays Harbor environment due to the widening and deepening of the present navigation channel.

An environmental task force (described in section 5) defined specific studies required for an analysis of the environmental impacts of navigation channel modifications. Twenty reports were written, most of which were contracted by the Seattle District, Corps of Engineers, and were used in the evaluation of impacts provided in this EIS. Final reports from these environmental studies are available from the Seattle District. The studies are listed in table EIS-4-1.

4.02 Continue Existing Conditions (No Action). Should the no-action plan be implemented, the existing Seattle District operation and maintenance (O&M) dredging program would continue to maintain the present federally authorized -30-foot mean lower low water (MLLW) navigation channel. Maintenance dredging and disposal would continue to disturb, remove, and partially destroy resident benthic communities in the channel. Dungeness crab mortality associated with the present maintenance dredging program would continue to reduce the Westport crab harvest below the potential harvest in the absence of dredging by an estimated .73 percent per year (2,900-17,500 fewer crabs harvested per year). Opportunistic invertebrate species (organisms with high reproduction rates, short generation times, and great dispersal ability) reside in frequently disturbed areas and would continue to recolonize disturbed areas (McCauley et al., 1977) in Grays Harbor after the annual dredging.

Juvenile salmonids are presently protected in the inner harbor by restricting maintenance dredging in the shallows above -15 feet MLLW during spring migration. Some fish may be entrained by the dredge although salmonid entrainment is very low or nonexistent (Simenstad & Eggers, 1981) with hopper and clamshell dredges. Therefore, minimal impacts to juvenile salmon would continue.

Water quality in Grays Harbor has been improving in recent years (Loehr and Collias, 1981) but is impacted annually by maintenance dredging. Short-term, nonlethal changes in turbidity and dissolved oxygen have been documented near operating dredges in the inner harbor. Water quality is presently monitored when dredging in the inner harbor if the Chehalis River flow falls below 2,500 cubic feet per second (c.f.s.) This monitoring insures that fish and invertebrates in Grays Harbor are protected from depletion of dissolved oxygen in the water.

Water quality and biological impacts to the ocean from the no-action plan would be negligible.

TABLE EIS 4-1

GRAYS HARBOR AND CHEHALIS RIVER IMPROVEMENTS
TO NAVIGATION ENVIRONMENTAL STUDIES

Report	Authors	Affiliation
Wetland Habitat Mapping	Nelson, Kalinowski & Lynam	Wash. Dept. of Game
Preliminary Ocean Disposal Study	Smith, Messmer, Phipps, Samuelson & Schermer	Grays Harbor College
Water Quality & Circulation	Loehr & Collias	Dept. of Oceanography, Univ. of Wash.
Fish Abundance, Distribution & Feeding	Simenstad & Eggers	Fisheries Research Inst., Univ. of Wash.
Dungeness Crab Mortality	Stevens	Wash. Dept. Fisheries & College of Fisheries, Univ. of Wash.
Crab Feeding & Shrimp Distribution & Abundance in Grays Harbor	Armstrong, Stevens & Hoeman	College of Fisheries, Univ. of Wash. & Wash. Dept. of Fisheries
Benthic Invertebrate Distribution, Composition & Abundance	Albright & Bouthillette	Wash. Dept. of Game
Dredging Modifications to Reduce Crab Mortality	Juhnke	Seattle District, Corps of Engineers
Corophium salmonis Population & Productivity	Albright & Armstrong	Wash. Dept. of Game & Univ. of Wash.
Primary Productivity of Aquatic Plants	Thom	Seattle District, Corps of Engineers
Wildlife Distribution	Kalinowski, Martin & Cooper	Wash. Dept. of Game
Cultural Resources Evaluation	Maas	Seattle District, Corps of Engineers
Endangered Species Evaluation	Brunner	Seattle District, Corps of Engineers
Upstream Sedimentation Sources	Kehoe	Seattle District, Corps of Engineers
Bioassay, Bioaccumulation Studies	Pierson, Tornberg, Nichols & Nakatani	Fisheries Research Inst., Univ. of Wash.
Klebsiella sp. Micro-Organism Study	Storm	Seattle District, Corps of Engineers
Sediment Chemistry Study	A.M. Test, Inc.	A.M. Test, Inc.
Distribution & Abundance of Salmonid Food Organisms in Grays Harbor	Cordell & Simenstad	Fisheries Research Inst., Univ. of Wash.
Distribution & Abundance of Shorebirds & Waterfowl in Grays Harbor During Spring Migration	Herman & Bulger	Evergreen State College
Technical Support Report, Tidal Hydraulics & Oceanography	Schuldt & Lucas	Seattle District, COE

See author's names in bibliography for complete report citations.

Continuation of the present annual maintenance dredging would have no measureable impact on terrestrial flora and fauna, wetlands, threatened and endangered species or historic and prehistoric structures or objects. This no-action alternative would not conflict with any existing plans, policies, or controls.

In summary, environmental impacts associated with the no-action plan would continue as outlined in table EIS 2-6. Under the no-action plan, Grays Harbor will continue to present hazardous navigation conditions for larger, deeper draft ships.

4.03 Alternative 2c: Recommended Plan.

a. Physical Impacts and Their Significance.

(1) Air Quality, Noise Levels, Climate, and Soil Conditions. There would be no significant impacts to the following parameters from project construction according to the recommended (REC) plan: air quality, noise levels, climate, and soil conditions. Impacts associated with this plan are summarized in table EIS 2-6.

(2) Estuarine Ecology.

(a) Dredged Material Disposal. Should this plan be implemented, estuarine disposal of dredged material would occur at the South Jetty, at two new Point Chehalis sites, and at two confined disposal sites, Slip No. 1 and South Aberdeen log storage site. Table EIS 2-3 indicates the amount and type of material to be deposited at each site. Coarser material will be placed at both Point Chehalis sites and fines will be discharged at South Jetty.

The South Aberdeen upland disposal site, which is presently a log storage area, will be used for disposal of 1.2 million c.y. Disposal of material on this site is expected to permanently raise the site elevation after initial consolidation by approximately 14 feet. Since this site will eventually be returned to use as a log storage area, the elevation change is not expected to be significant.

The Slip No. 1 disposal site, which is presently used for ship moorage, is composed of a subtidal and intertidal habitat at an average depth of -10 feet MLLW. This site would be diked and filled to an elevation, after initial consolidation of +10 feet MLLW. This area would eventually be physically changed to an upland industrial development site as a result of further site preparation by the Port of Grays Harbor. However, the site would not be used for initial dredge disposal were it not for the need to confine contaminated material. Therefore, no land enhancement benefits are claimed. Reference paragraphs 2.03d(1) and 2.03(b) for greater detail regarding design, construction, and impacts.

(b) Estuarine Sedimentation. Dredged material discharged at the new Point Chehalis and South Jetty sites would be expected to move seaward and sedimentation in the estuary should not be greatly influenced by dredged material disposal. The majority of silts and sands deposited at South Jetty and Point Chehalis would be expected to be carried by the predominant ebb current seaward of the bar and enter the winter northbound littoral system. A small quantity may be carried into the estuary along the north jetty. Coarse sand material disposal at Point Chehalis would initially undergo spreading in all directions but is expected to remain in the deep thalweg off Point Chehalis. Ultimately the net flow would transport this material to the sea. Information on the movement of silt material is less well known. From bottom photographs and sediment sampling of the old disposal areas, it is evident that silts do not accumulate in this area. In addition, current data indicates the net movement would be seaward. Flood currents are also of sufficient strength to transport silts deposited at the sites although the extent and volume of landward movement is not known. The clean silts have been designated for South Jetty (the seaward most estuarine disposal site) and ocean disposal to minimize the risk of fines being redistributed to the inner estuary.

(c) Water Quality. Short-term impacts would occur due to temporary increases in turbidity, release of small concentrations of contaminants, and minor reduction of dissolved oxygen concentrations in the areas being dredged and at the disposal areas. Initial and operation and maintenance (O&M) dredging associated with this project would be conducted in accordance with the Washington Department of Ecology (WDE) Water Quality Guidelines for Dredging in Inner Grays Harbor and Lower Chehalis River to insure that the aquatic resources of Grays Harbor would be protected from substantial impacts due to the above changes in water quality.

Some of the contaminants present in the dredged sediment would be released into the water column and diluted over a period of time at the disposal sites (reference elutriate chemical testing summarized in appendix A). Bioassay and bioaccumulation tests conducted with sediments to be dredged during project construction have indicated that fish and marine invertebrates exposed to some of the sediments from Hoquiam and Cow Point reaches may bioaccumulate contaminants of concern if these sediments were discharged in open water. Confined disposal of these sediments should avoid this potential contaminant effect (see exhibit 2 of appendix A).

Long-term water quality impacts associated with the new channel dimensions have been addressed by Loehr and Collias (1981). This study indicated that no long-term water quality impacts were expected. Minor changes in circulation, residence time, and salt wedge intrusion have been predicted. In addition, there would be a greater annual impact from O&M dredging to the harbor water quality because the present average annual dredging quantities would be increased by an estimated 88 percent. The vast majority of this increased dredging would occur in the outer harbor (two-thirds of it will be sand from the outer bar), therefore water quality impacts are not expected to be significant.

(3) Ocean Ecology. Ocean disposal of the dredged material to be derived from construction of the Grays Harbor Navigation Improvement Project and subsequent maintenance dredging will require selection and formal designation of an ocean disposal site(s) within 8 miles of the mouth of Grays Harbor. The Corps of Engineers will examine several potential disposal areas, located between 2.5 and 8 miles from the estuary mouth, in a detailed study during the Continuation of Planning and Engineering (CP&E) phase of the project. The detailed studies will serve as the basis for site selection and designation and a more complete impact analysis. The REC plan proposes disposal at two ocean sites, each located approximately 3.5 miles from the estuary. These sites were proposed primarily for purposes of estimating the cost of the REC plan. Additionally, 3.5 miles is the distance from the mouth of the estuary where some silts can be found in the bottom sediments, suggesting that some of the discharged silts may be incorporated into the midshelf silt deposit and not be returned to shore. Actual disposal sites will not be selected until the CP&E phase. The potential disposal areas include sites in the nearshore sands (which occur between 0-130 feet water depth), the midshelf silt deposit (130+ feet water depth), and the relict gravels (deepwater west by northwest of the estuary mouth). The REC plan disposal sites (both 3.5 miles from the estuary) are located in the transition zone between the nearshore sands and the midshelf silts. Impacts of dredging on the outer bar are similar to those discussed in EIS 4.03a(2)(c) and 4.03b(2) and are not addressed below.

(a) Water Column Impacts.

1. Surface Water. Dredged material discharged from a bottom dump hopper dredge or barge would descend through the water column as a dense mass moving faster than the settling velocities of the individual sediment particles. The pycnocline (density discontinuity) during the proposed dumping period (May-October) is expected to be weak due to waves and wind-induced upwelling. As a result, the sediment mass is expected to reach the bottom without "collapsing" (breaking up). However, as the dense mass moves through the water column, currents would entrain water along the edges of the mass and sediment would spin off and slow down to settling velocity. The bulk of the discharge would impact the bottom as one mass. Sediment remaining in the water column would increase turbidity and levels of suspended solids. Coarser sediment (sands) would settle faster than finer sediment (silts) and is not expected to contribute turbidity to the surface waters above the normal range of ambient conditions. However, silts would remain in the water column to be distributed primarily south and away from land by the prevailing surface currents. Silts would be incorporated into the neuston (top 4-8 inches) layer and may be concentrated at the pycnocline. Upwelling during the proposed dumping period would contribute to the continued suspension of silts in the surface waters.

2. Bottom Water. Shear stresses on the falling dredged material mass would suspend and slow down some of the sediment particles near the edge of the sediment mass. Impact with the bottom would also

suspend sediments. Currents in the bottom water during the proposed dumping period would be weak and highly variable to the north and towards land. Coarser particles would settle rapidly to the bottom and would likely stay put until stronger winter bottom currents and storm waves moved the sediment northward and onshore. Silts would stay in suspension for a longer period of time, primarily moving northward and towards land as part of the nepheloid (near bottom) layer. Once near land, waves and upwelling would move the silts to the surface water where they would move offshore and south. Long-term destination of these silts would be to settle out in deeper waters as part of the midshelf silt deposit. Only the finer particle sizes (silts) would result in increased, and possibly persistent, turbidity and suspended solids above the normal range of ambient conditions, primarily near the bottom. Continued use of the disposal site for discharge of maintenance dredged material would not significantly impact the pelagic environment due to the coarse nature of the sediments (sands).

3. Pelagic Chemical Impacts. Current and wave energy at the ocean disposal site, combined with relatively low levels of total organic carbon, volatile solids, and chemical oxygen demand in the proposed dredged sediments indicate that chemically induced changes in water column dissolved oxygen would not be measurable. Some of the contaminants present in the dredged sediment would be released into the water column and diluted over a period of time (reference elutriate chemical testing summarized in appendix A).

(b) Sediment Impacts.

1. Mounding. Long-term changes in bathymetry at the disposal site are not anticipated as the bottom currents are expected to incorporate the discharged sediment into normal sediment circulation patterns. Short-term changes (1 to 3 years) may result in minor, localized variations in near bottom currents and in erosion, deposition and transport rates of sediment. The small quantity of maintenance dredged sands that would be discharged at the disposal site is not expected to produce persistent mounding.

2. Grain Size Changes. Increased amounts of silts above present conditions would occur in the disposal area and to the north of the site. These finer sediments would likely take several years to be completely removed from the predominantly sandy environment. Silts deposited in the mouth of the estuary (South Jetty disposal site) would be flushed into the nearshore ocean environment by tidal action. These silts would be incorporated into normal sediment circulation patterns along the coast.

3. Benthic Impacts. The proposed ocean discharge would increase organic carbon, volatile solids, and sulfides in the sediment of the disposal area. Increased concentrations of organic compounds would likely stimulate bacterial action resulting in localized pH decreases accompanied by release of hydrogen sulfide and contaminants

(especially heavy metals) to the interstitial and nepheloid waters. These releases would likely be slow and temporary (lasting at most until winter storms disperse the primary sediment mound) and would be rapidly diluted.

b. Biological Impacts and Their Significance. The primary impact of this project involves habitat disruption and benthic population reductions. Both temporary and permanent impacts would occur. Some resident species would be displaced and killed. The following subsections discuss the significance of these impacts to significant resources in various habitats.

(1) Terrestrial Ecology. For impact discussion, reference paragraph 2.03b.

(2) Estuarine Ecology.

(a) Vegetation. The REC plan calls for disposal of some of the inner harbor silty sediments at the ocean and the South Jetty disposal sites while the new Point Chehalis site would be used primarily for disposal of sands. These locations have been selected to minimize return of silty sediments to the harbor. In addition, the use of clamshell dredges in the inner harbor would minimize the release of contaminants near the dredge from the sediments more effectively than hopper dredges.

The potential impact on estuarine vegetation associated with the REC plan is a temporary, highly localized decrease in water quality. Minor increases in turbidity and contaminant concentrations and decreases in dissolved oxygen concentrations in the water would be associated with both dredging and disposal activites. However, these temporary water quality changes are not expected to have measurable impacts on the productivity of the estuarine vegetation.

Thom (1981) found that with dredged material disposal occurring completely within the estuary (at Point Chehalis), reduction in phytoplankton and eelgrass productivity due to recirculation of finer material would be 1 - 2%. The recommended plan will avoid this impact by discharging finer sediments in the ocean and at South Jetty. Lands vegetated by marsh angiosperms will not be removed or otherwise measurably affected by dredging or disposal operations. Four acres of shallow subtidal containing benthic algae (i.e., diatoms, macroalgae) would be dredged and removed in the Cow Point (2 acres) and South Aberdeen (2 acres) reaches. This removal would reduce total estuarine benthic algal productivity by an insignificant amount (see Thom, 1981). The permanent burial of 20 acres of subtidal and intertidal area at Slip No. 1 in Aberdeen is expected to have minimal impact on benthic algal productivity in Grays Harbor.

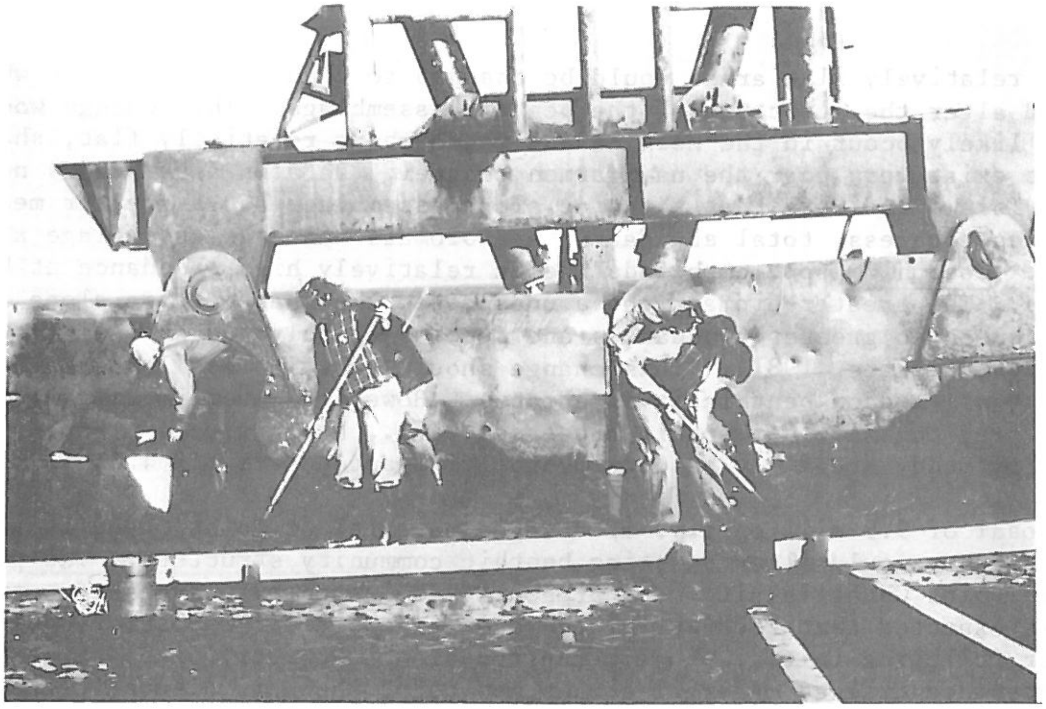


Photo EIS 4-1. Sampling for Cancer magister on a clamshell disposal barge.

(b) Benthic Invertebrate Communities. Recent studies in Grays Harbor have focused on the impact of the widening and deepening project on infauna (Albright and Bouthillette 1982), epibenthos (Albright and Bouthillette 1982, Cordell and Simenstad 1981, Simenstad and Eggers 1981, Armstrong et al., 1981), and Dungeness crab (Armstrong et al., 1981). See photo EIS 4-1 for crab sampling. Benthic invertebrate communities are affected by removal, burial, and changes in water and sediment characteristics.

Channel dredging and dredged material disposal would be confined to depths greater than -15 feet relative to MLLW, with the exception of 4 acres of shallow subtidal habitat near the South Aberdeen and Cow Point turning basins (see table EIS 2-1) and 20 acres of subtidal and intertidal habitat at Slip No. 1.

Within the harbor, the proposed dredging would disturb an additional 563 acres below MLLW beyond that presently affected by existing maintenance dredging. Benthic infauna and epibenthic organisms would be removed in areas to be dredged. Recolonization should occur in these areas shortly after dredging (Albright and Bouthillette, 1982). Initial recolonists would be opportunistic species (e.g., oligochaete and polychaete worms) followed in succession by longer-lived organisms (e.g., bivalve molluscs). Eventually, benthic assemblage structures (i.e., species abundances, biomass, diversity) would reach an equilibrium condition. Periodic disturbance of the assemblages by maintenance dredging would be restricted to shoaling areas. These areas are expected to occur in approximately the same locations as in the present channel.

Some relatively flat areas would be changed to channel side slopes which would alter the structure of the benthic assemblage. This change would most likely occur in the Moon Island reach where relatively flat, shallow areas exist very near the navigation channel. Data on assemblages near Moon Island indicate that the side slope assemblage has a greater mean species richness, total abundance, and biomass than the assemblage at MLLW. Corophium spp. amphipods are in relatively high abundance at both sites. The greater biomass and abundance on the channel side slope is attributed to greater abundances and species of polychaetes (Albright and Bouthillette, 1981). This change should benefit most larger predators that feed on benthic invertebrates. However, juvenile salmonids that prey on small epibenthic crustacea (e.g., harpacticoid copepods) in shallow muddy areas may be detrimentally impacted (see EIS 4.03b(2)(c).

Disposal of 9.9 million c.y. of dredged material at Point Chehalis and South Jetty would alter existing benthic community structure. The proposed Point Chehalis sites are presently dominated by polychaetes, and it is expected that recovery of the area to a similar condition would occur following initial project construction. However, disposal of maintenance dredged material at the new Point Chehalis disposal sites, especially that from the inner harbor, may result in a permanently altered community structure.

A well-developed coarse substrate assemblage dominated by barnacles presently exists at the South Jetty site. Disposal of finer grained sediments may change this assemblage to a soft bottom community probably similar to that at the existing Point Chehalis site. The depth of the site would be decreased. Rockfish are commonly caught by commercial and sport fishermen in this area, and alteration of benthic conditions would probably result in a decline in this fishery. Scouring is intense at this site, and it is expected that the site would recover to preproject con ditions at some time in the future. However, disposal of maintenance dredged material at this site may permanently alter the bottom conditions in a portion of the disposal site.

Turbidity, siltation, and any toxic effects associated with dredging would extend, to a limited degree into areas beyond the navigation channel. Some dredged material disposed at Point Chehalis and South Jetty may be carried back into the harbor. As with primary producers, this is expected to have a small and unquantified impact on benthic invertebrate assemblage structure. Species recolonizing the dredged material would be those tolerant of sediments of various grain sizes and containing low levels of some contaminants.

The filling of Slip No. 1 would result in a permanent loss of 20 acres of subtidal and intertidal habitat. The composition of the benthic habitat is similar to that in the navigation channel.

Confinement, during initial dredging, of the contaminated sediments found in Hoquiam and Cow Point reaches and the reduction or elimination of certain contaminant sources to the estuary during CP&E is expected to reduce the overall contaminant burden to the estuarine community in inner Grays Harbor, therefore maintenance materials would be acceptable for open-water disposal.

The REC plan proposes to avoid the entrainment of crabs through modification of dredging equipment. The basis for recommendation of this mitigation is contained in EIS 4.03g below. Dredging under the REC plan is scheduled to avoid times of high crab densities in various reaches and has avoided disposal of silty materials in the harbor mouth when larval crabs are present in the water column. Burial of crabs by dredged material disposed at Point Chehalis, South Jetty, and at the ocean site would result in some reductions in numbers of larger crabs. Crab fishing does occur near South Jetty, and disposal of dredged material may reduce crab catch in the immediate vicinity of the disposal site during the times when disposal is taking place.

Losses to the crab population due to reduction in the reproductive population may also be important. However, estimates of this impact are difficult to make in view of the possible corresponding decrease in cannibalism and intraspecific competition. Other indirect impacts that may affect crab populations include temporary removal of food sources from dredged and disposal areas, alteration of intraspecific competition, and cannibilistic interactions due to size selective mortality during dredging, potential alteration of a minimal amount of habitat due to the recirculation of some sediments back into the harbor, and water quality impacts on larvae and adults. The bioassay tests described in exhibit 2 of appendix A address the water quality impacts, but these other indirect impacts are unquantifiable and are not expected to be substantial.

(c) Fish. Studies assessing the impact of the dredging project on fish utilizing the estuary were primarily concerned with fish entrainment by dredges (Armstrong et al., 1981) and degradation of the habitats of juvenile salmonids and baitfish (Simenstad and Eggers, 1981).

Eleven species of fish were entrained in hopper dredges working in the South reach, Crossover reach, North Channel, and Cow Point reach (Armstrong et al., 1981) (table EIS 4-2). Using the summer entrainment rates for each species as a worst case estimate (Stevens (1981) recorded lower rates for fish in winter) for the entire year, approximate entrainment levels for hopper dredging quantities were calculated (table EIS 4-2). No fish were entrained by clamshell dredges during a previous study (Stevens, 1981) although Pacific sand lance have been taken up by clamshell dredges in other dredging projects. The recommended plan has scheduled dredging to avoid times of high fish densities in the upstream reaches. Modification of hopper dredges to avoid crab entrainment should beneficially affect the entrainment of fish; however, the extent of the

TABLE EIS 4-2

ENTRAINMENT OF FISH BY HOPPER DREDGES
UNDER THE REC, NED, and LED PLANS1/

Based on entrainment rates in Armstrong, et al., 1981)

Fish Species	Number of Fish Entrained REC Plan	NED Plan	LED Plan
Staghorn sculpin	410,000	440,000	331,000
Pacific sanddab	282,000	282,000	274,000
Pacific tomcod	23,000	23,000	0
Snake prickleback	23,000	23,000	0
Saddleback gunnel	18,000	18,000	18,000
English sole	126,000	126,000	126,000
Northern anchovy	64,800	64,800	64,800
Sand sole	10,800	10,800	10,800
Speckled sanddab	10,800	10,800	10,800
Lingcod	7,200	7,200	7,200
Pacific sandfish	7,200	7,200	7,200

1/Entrainment rates reported in this table do not take into account the changes in fish entrainment that may result from dredge modifications to avoid crab entrainment.

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change in entrainment is unknown. Additionally, water quality impacts would be minimized by the use of clamshell dredges in these reaches. Habitat degradation may be divided into the major categories of decreased water quality and loss of feeding and rearing habitat. Data from trawl samples taken near the working dredge suggest that some fish species (i.e., buffalo sculpin, longfin smelt, Pacific herring, starry flounder, and shiner perch) were actively avoiding the dredge (Armstrong et al., 1981). Avoidance of areas by juvenile salmonids or other fish of increased turbidity around dredges in Grays Harbor was not documented by Simenstad and Eggers (1981). However, they stated that release of substantial amounts of contaminants from sediments could produce an avoidance reaction in the region of the plume created by dredging. Such an effect would only last as long as the plume was present. Most outmigrating juvenile salmonids utilize the estuary from February through July. Under the REC plan, dredges would be working in several areas of the channel simultaneously throughout the year. The plume areas around the dredges would probably be avoided by outmigrating salmonids. This prolonged activity could effectively eliminate a minor portion of shallow sublittoral or neritic rearing habitat normally utilized by juvenile salmonids. Strict avoidance reaction caused by dredges should not measureably alter salmonid populations and migration patterns through the estuary. Impacts of contaminants which may be released through dredging or disposal activities on juvenile fish are not expected to be significant based on bioassay experiments and the confined disposal of the more contaminated sediments.

With the exception of the 20 acres of subtidal and intertidal area that would be lost by filling of Slip 1, an estimated .89 percent of the total sublittoral area of Grays Harbor would be disturbed during the project channel dredging and disposal (with little overall loss in total estuarine bottom surface area). A total of 4 acres of shallow subtidal habitat in the inner harbor would be changed to deeper, and less valuable, subtidal habitat due to project channel dredging. Salmonids may utilize alternative areas if they are available (i.e., if the habitat area is not now limiting fish production). The proposed mitigation of the lost 4 acres should allow replacement of this lost habitat. The loss of habitat values associated with Slip 1 is not considered sufficient to warrant habitat mitigation. Simenstad and Eggers (1981) concluded that, due to their specialized utilization of benthic areas, English sole may be impacted somewhat more than salmonids. This issue would be further investigated during CP&E. Baitfish populations should not be affected.

Disposing dredged material at the Point Chehalis and South Jetty disposal sites will result in a loss of rockfish habitat. O&M dredged material disposal will impact this habitat for the life of the project. Rockfish represent an important sport and commercial resource in this reach which may be temporarily displaced from this habitat due to dredged material disposal.

(d) Avian Fauna. Impacts of the REC plan to shorebirds would be negligible. A very small part of the 4 acres of shallow subtidal habitat which would be lost in the inner harbor is low intertidal. Therefore, shorebirds would have slightly less feeding habitat available in the inner harbor. This loss should be compensated by the proposed mitigation.

A temporary increase in turbidity from dredging and disposal operations may make capture of prey by fish-eating species of water birds (such as grebes, mergansers, and Caspian terns) difficult. However, these birds, and the fish they feed upon, are highly mobile and might be expected to avoid turbid areas. Thus, impacts to waterfowl from turbidity are expected to be minimal under the REC plan.

(e) Marine Mammals. The impacts to marine mammals with the recommended project construction plan would be minimal. The physical dredging of Grays Harbor should not directly impact any marine mammals in the harbor. No seal haul-out areas would be impacted. The transport of dredged material to the harbor and ocean disposal sites would occur every few hours and would be concentrated in a narrow corridor (the navigation channel and towboat lanes) and is not expected to affect marine mammals in either the harbor or the ocean. The food sources of marine mammals living in or passing by Grays Harbor would not be substantially reduced by the REC plan.

(3) Ocean Ecology. Though continental shelf areas are known to be highly productive for marine fisheries, ocean disposal of dredged

material is not likely to affect as many critical ecological processes as would occur with disposal in the estuarine environment. This is primarily due to the high energy dilution potential of the shell zone and the consequently relatively transitory effects to the pelagic environment. Long-term impacts to the benthos would occur at the ocean disposal site which would receive maintenance dredged material from the outer bar. Impacts of dredging on the outer bar would be similar to those discussed in EIS 4.03b(2)(b).

(a) Flora.

1. Phytoplankton. Increased turbidity would result in reduced light penetration and reduced productivity of phytoplankton in the euphotic zone. Phytoplankton in the path of the dredged material mass or settling sediment would be removed from the euphotic zone and lost (flocculated). The release of nutrients and growth inhibitory or stimulatory substances from the dredged material may occur, but it would be in concentrations insufficient to produce persistent effects. All of the above impacts are not expected to be measurable at the edge of the disposal area. Duration of the impacts would be short term (minutes to hours).

2. Other Primary Producers. Benthic primary producers are absent at or near the proposed ocean disposal sites due to the lack of stable substrata. Consequently, the proposed discharge would not impact other primary producers.

(b) Invertebrate Fauna.

1. Zooplankton. Increased suspended solids in the water column as a result of the proposed discharge would interact with zooplankton in several ways. The suspended solids would dilute the concentration of food particles in the water for filter feeders. Flocculation of phytoplankton would also reduce food availability. Microscale changes in the distribution of pelagic, near-bottom larvae may result from mounding-induced current changes. All of the above impacts are expected to be measurable only at or near the actual discharge site. The meroplankton (including pelagic larvae of fish and shellfish) are known to be acutely sensitive to dissolved oxygen changes and increased levels of contaminants in the water. Results of biological tests suggest that toxic effects to meroplankton would not occur during disposal.

2. Benthic Epifauna. Some epifauna in the disposal area would be buried and lost as a result of the discharge. Increased suspended solids near the bottom would displace the more mobile species as they avoid the site. Organisms not avoiding the discharge and plume would be temporarily stressed. Burial of benthic infauna would reduce food supply of some marine organisms. Suspended solids would dilute the food value of the nepheloid layer to filter feeders. These physical effects would be limited to the discharge site and primary plume of the

dredged material. Chemical effects of sediment contaminants on benthic epifauna were addressed by the biological tests. Sediments that could result in adverse contaminant effects would not be discharged in open water. Chemicals released into the water column may result in an avoidance response from crab and shrimp species and/or possible impairment of normal feeding behavior (due to chemical interferences). The extent of this latter impact is unknown.

3. Benthic Infauna. Infauna at the discharge site would be buried by the dredged material. More mobile species near the edge of the discharge mound should be able to survive the burial as long as they are tolerant of the increase in fine particles. Recolonization of the sediment at the disposal site would occur first by those species that are tolerant of silts and later (as silts are winnowed from the site) by most of the species present at the site prior to disposal. Silts moving along the bottom would suffocate those organisms near the disposal site that are less tolerant of finer particle sizes. Suspended sediment would dilute the food value of the nepheloid layer to filter-feeding infauna. Sediment mounding would increase structuring of the benthic environment. This structuring, along with increased fines and organic enrichment, may likely result in temporarily increased infaunal biomass and species diversity after recolonization of the sediment has occurred. However, overall organism abundance is expected to decrease. The above effects are limited in extent to the areas within or near the disposal site. Continued use of the site for disposal of maintenance dredged material would result in some persistent changes to the infauna. Adverse effects of sediment contaminants on the benthic infauna were addressed by biological tests and would be avoided by confined disposal of the more contaminated sediment.

(c) Fish.

1. Pelagic Fish. The proposed discharge would add suspended solids and turbidity to the water column, affecting pelagic fish, including migrating salmonids (both juvenile and adult). Most individuals are expected to avoid the turbid plume. Those that do not avoid the plume would be temporarily stressed and may suffer sublethal respiratory impairment due to sediment effects on the gills. Since the severity of these effects is primarily a function of sediment particle angularity rather than overall suspended sediment levels, and since the Grays Harbor sediments are predominantly well rounded (low angularity), persistent or lethal effects to pelagic fish are not anticipated. Physical interference with feeding behavior may also occur. All of the above impacts would be temporary and limited to the disposal area and primary discharge plume. Effects of sediment contaminants on anadromous fish would be insignificant due to confined disposal of the more contaminated sediments.

2. Demersal Fish. As with pelagic fish, most fish species and individuals are expected to avoid the disposal area and surrounding

water with high concentrations of suspended solids. Though temporary physical stress is likely, mortality resulting from sediment impacts to respiratory surfaces is not expected. Loss of benthic organisms would reduce the availability of food at and near the disposal site. Grain size induced changes in benthic community composition may either increase or decrease the value of the recolonized disposal area to certain species of bottom feeding fish. Disposal sites receiving maintenance dredged sands would be of lower value to demersal fish in the long term. Chemical releases from the sediment mound may cause an avoidance of the disposal area by certain fish species for a short period of time (not to exceed 1 year). Contaminant effects of the proposed discharge on demersal species of fish would not be expected from the relatively cleaner sediment proposed for open-water discharge.

(d) Avian Fauna. Direct impact to birds from disposal of dredged material at the ocean sites is expected to be minimal. Birds are expected to avoid feeding in the plume created by disposal activities since their visibility and feeding success in this area would probably be reduced. These impacts would be temporary and would occur in a relatively small area of the ocean near Grays Harbor.

(e) Marine Mammals. Marine mammals would experience the same minimal impacts described above for birds.

c. Threatened and Endangered Species. Three biological assessments (BA) have been prepared on the threatened and endangered species known to occur in the Grays Harbor area. These assessments covered: (1) seven endangered whale species and the endangered Pacific leatherback sea turtle observed near Grays Harbor, (2) the peregrine falcon subspecies and bald eagle, and (3) the brown pelican. Each of these assessments concluded that no adverse impacts to these species would result from the proposed dredging and disposal under the REC plan.

The above BA's, which are on file at Seattle District, Corps of Engineers, were mailed to the responsible Federal agencies as required by Section 7 of the Endangered Species Act of 1973, as amended. The National Marine Fisheries Service (NMFS) has concurred with the above conclusions regarding the whales and sea turtle and the U.S. Fish and Wildlife Service (FWS) has concurred with the above conclusions regarding the peregrine falcon, bald eagle, and brown pelican.

d. Historic and Prehistoric Impacts and Their Significance. A review of the National Register of Historic Places (Federal Register, 18 March 1980, and monthly supplements through Vol. 7, No. 144, 27 July 1982), the Washington State Register of Historic Places, and archaeological records at the University of Washington, Department of Anthropology, indicate that no known historic or archaeological sites of cultural significance are located within, or will be impacted by, the propsed dredging or disposal areas. Some aspects of this project have been coordinated previously with State Office of Archaeology and

Historic Preservation. Since disposal sites were changed, further coordination with this office was required. It is our determination that there will be no effect to cultural resources due to the project. A letter of concurrence was received from the Office of Archaeology and Historic Preservation (see appendix B, part 4)during public review of the draft document.

(1) Confined Disposal Sites. A cultural resources reconnaissance of several alternative disposal areas (see plate 7 - Junction City sites) was conducted by Seattle District archaeologists in October 1980. The reconnaissance investigation found no indication of prehistoric occupation or historic use. Only the South Aberdeen site and Slip No. 1 are proposed for confined use. Slip No. 1 was constructed in 1926. It has been in continuous use since that time. The State Historic Preservation Officer has previously indicated that the wooden terminal structure located at Slip No. 1 does not have significant historic value. Reconnaissance investigations indicate that human activities have altered or destroyed any significant prehistoric resources that may have existed at the site. It was concluded that no property of national historic significance would be impacted by use of the slip for disposal.

(2) In Harbor Sites. Twenty-four sediment core samples were taken from the navigation channel and examined for the presence of cultural resources by a Seattle District staff archaeologist. In addition, 25 sediment cores from the inner harbor were carefully examined for cultural resources by AM Test Laboratories in Seattle during the chemical analysis of Grays Harbor sediments (AM Test, 1981). No material of cultural resource significance was found in any of the examined sediment cores.

e. Socioeconomic Impacts and Their Significance.

(1) Economy. A wider and deeper channel would allow Grays Harbor to at least retain its current share of the timber export market, possibly increase its share, and definitely be in a more competitive position to attract new commerce, possibly unrelated to forest products. New commerce may not be immediately forthcoming, because attracting a major water-related industry is a gradual and competitive process.

(2) Navigation. Hopper dredge and barge operations are anticipated to result in minor interferences with small craft navigation, especially in the vicinity of the bar and estuary mouth during peak recreational and commercial fishing periods. Disposal of dredged material in the ocean would not result in additional shoaling on the outer bar due to the fact that sediment transport in the ocean is energy limited. However, disposal in the estuary mouth is expected to require redredging of some of the material as it settles in the bar crossing. Redredging is less costly than taking the material directly to the ocean, and as long as the bar crossing is maintained regularly, adverse effects to navigation due to shoaling on the bar would not occur.

(3) Fisheries. As mentioned above, most of the potential ocean disposal sites are located in the navigation lanes to avoid direct impact to bottom fisheries (primarily crabbing done in shallow water). Additionally, the existence of energy limited sediment transport suggests that the discharge would not result in additional loss of crab pots due to dredged material shoaling. However, it is possible that the sediment mound and fine grain size would sufficiently change erosion conditions such that pots near the site are impacted. This effect would be more probable in shallower water (where currents are higher, sediment mounding is more likely and pots are more numerous). Additionally, avoidance of chemicals released from the dredged material may temporarily reduce the catch of pots located near the disposal area. Avoidance of the disposal mound would not be expected to persist through one winter season. Chemical avoidance will be evaluated during CP&E.

f. Relationship of Recommended Plan to Existing Plans, Policies, and Controls.

(1) Existing Land Use. Existing land use in the project area consists mainly of industrial facilities, log storage areas, and shipping terminals on the north shore of Grays Harbor from the Hoquiam reach upstream to Cosmopolis (channel reaches are identified in plate 1). The Bowerman Airport is located at the eastern end of Moon Island reach. The remainder of the channel is flanked by intertidal and subtidal vegetated and unvegetated mudflats from the Cow Point reach to the harbor mouth. The Westport boat basin is located on the south side of the channel near Point Chehalis and the channel is flanked by the North and South Jetties as the navigation channel joins the ocean.

Land use in the project area is controlled primarily by city and county zoning ordinances. Wetland areas near Junction City and on the southern shore of Grays Harbor by Cow Point may become more valuable after the navigation channel improvements are completed due to their proximity to the wider and deeper navigation channel. In this case, they would be under increased pressure for development. Disposal of sediments in the Point Chehalis area and along the South Jetty would not change present land use patterns near the mouth of Grays Harbor. The disposal of dredged material on the South Aberdeen upland site would temporarily alter the use of the land from a log storage site to a dredged material disposal site. Within 1 year, the South Aberdeen site would essentially be returned to its present use and condition. The Slip No. 1 site would permanently be altered from a relatively low habitat value subtidal/intertidal area to an upland site which would eventually become available for industrial development.

(2) Coastal Zone Management Act. The National Coastal Zone Management Act (Public Law 91-583: 86 Stat. 1280) was passed by the United States Congress in 1972 and in June 1976 the state Coastal Zone Management Program (CZMP) was approved to receive funding. The Washington State Shoreline Management Act (SMA) of 1971, as passed by the State

Legislature, provides "for the management of Washington's shorelines by planning and fostering all reasonable and appropriate uses." The SMA is implemented through Shoreline Master Programs (SMP) for large municipalities and the counties. The project would be consistent with all applicable Grays Harbor SMP's and so satisfies consistency with state and national coastal zone management requirements.

(3) Grays Harbor Estuary Management Plan. During the fall of 1975, the Grays Harbor Regional Planning Commission initiated a program designated to produce a draft Grays Harbor Estuary Management Plan (GHEMP). Funding for the development of the GHEMP was provided from the Office of Coastal Zone Management under the auspices of Section 306 of the Coastal Zone Management Act. A preliminary draft of the GHEMP, dated November 1978, was made available for review. Dredging the navigation channel and disposing of this material in the proposed open-water harbor disposal sites are permitted activities under the GHEMP; and the Grays Harbor Channel Improvements for Navigation would be in compliance with GHEMP.

(4) Department of Natural Resources Policy on Open-Water Disposal of Dredged Material. Sites throughout the marine waters of Washington have been designated as open-water disposal areas. If dredged material cannot be constructively utilized (i.e., creation of artificial islands, landfill), and it is approved by all of the various regulatory agencies for open-water disposal, it may be deposited in the Department of Natural Resources (DNR) managed sites. The proposed South Jetty and Point Chehalis disposal sites are expected to be approved by DNR and the DNR-chaired Interagency Open-Water Disposal Site Selection Committee. Assuming these sites would be approved, the project is consistent with DNR dredged material disposal policies.

(5) Grays Harbor Long-Range Maintenance Dredging Program. Based on an initial request by then Washington State Governor Daniel J. Evans, representatives of Federal, state and local agencies met between 1973-1976 to develop a long-range maintenance dredging program that would adequately meet the economic requirements of the Grays Harbor area while maintaining the valuable natural resources of the estuary. Implementation of the program was addressed in a final supplement to the existing project O&M EIS (U.S. Army Corps of Engineers, 1980). Dredging and disposal methods and constraints were specified in the resultant program. Slip No. 1 is identified as an area for placement of maintenance dredged material and eventual port development. Ocean disposal of dredged material is identified as the biologically preferred, though not proposed, disposal alternative. The channel improvement recommended plan is consistent with the intent and purpose of the long-range program.

(6) Clean Water Act of 1977, Section 404(b)(1). In compliance with the Clean Water Act, Public Law 92-500, as amended, a Section 404(b)(1) evaluation of the impacts of disposal of dredged material at Point Chehalis and South Jetty associated with the REC plan has been

completed and is attached as appendix A. Pursuant to Section 404(r) of the Clean Water Act, upon submittal of this EIS with its complete 404(b)(1) evaluation to Congress and its approval by Congress, no further action to meet the requirements of the Clean Water Act will be necessary. Thus, State Water Quality Certification per Section 401 would not be required.

(7) The Marine Protection, Research and Sanctuaries Act (MPRSA) of 1972 (Public Law 92-532). Commonly called the Ocean Dumping Act, the MPRSA and implementing Environmental Protection Agency regulations (40 CFR Parts 220-229) govern the disposal of dredged material in the territorial seas of the United States. Primary requirements of the act and regulations relate to determining acceptability of the dredged material for disposal in the ocean and to locating and formally designating an ocean disposal site. Most of the dredged material to be derived from the Grays Harbor Improvements to Navigation project was identified during the feasibility stage of project study as acceptable for open water disposal by conducting biological tests. Material unacceptable for open-water disposal will not be discharged into the ocean. The acceptability assumes that CP&E evaluation of the carcinogenic potential of the material will indicate no significant effects (see paragraph 4.1c(3) of appendix A, most of the material with carcinogenic compounds is presently proposed for confined disposal). Description of the biological testing is contained in appendix A. Studies to locate a suitable ocean disposal site will be conducted during the CP&E phase of project study. Potential disposal sites to be studied are shown in plate 7. An EIS supplement will be prepared during CP&E to complete formal designation of the ocean disposal site. Consequently, compliance with the MPRSA will be completed during CP&E.

(8) Water Resources Development Act (WRDA) of 1976 (Public Law 94-587). In accordance with the requirements set forth in Section 150 of the WRDA of 1976, a determination was made regarding the feasibility of establishing wetland areas by using dredged material. Several wetlands establishment sites were evaluated and biological studies were begun at one site during 1981. All studies were terminated when the local sponsor withdrew the site and offered no alternate sites. The establishment of wetlands with dredged material in Grays Harbor will be evaluated further during CP&E studies or by the Grays Harbor operation and maintenance program if suitable sites become available.

(9) Executive Order 11988, Flood-Plain Management. Executive Order 11988 defines acceptable management of areas located within flood plains. The plan for improvement lies entirely within the area of tidal influence. Riverine effects do not influence the base flood elevation. Four acres of shallow subtidal habitat in the inner harbor would be changed to deeper subtidal habitat (channel side slope) and mitigated by purchasing nearby diked uplands adjacent to the harbor and converting them to intertidal or shallow subtidal. Slip No. 1, 20 acres of subtidal/intertidal habitat, will be diked and filled to an elevation

after initial consolidation of +10 MLLW. Fry Creek, a culverted and tide gated creek that empties into Slip No. 1, has historically had flooding problems. A pumping station currently exists near the tide gates. In order to avoid the flood aggravation of Fry Creek, the creek would be diverted around the fill area in an open channel. New tide gates and pumphouse would be installed at the end of the channel. Impacts on the flood plain from the project dredging and disposal activities would be negligible.

During the planning process for the proposed project, Federal, state, and local agencies; organizations; and the public have been kept informed of the proposed action, including the dredged material disposal plan, through a series of interagency meetings, workshops, news releases, and public newsletters. Environmental effects of the proposed action are presented in this EIS. This process satisfies the requirements for the decision making process of Executive Order 11988.

(10) Executive Order 11990, Protection of Wetlands. The intent of Executive Order 11990 is to protect wetlands because of their high value to biological productivity. Although plans for improvement would cause removal of 4 acres of shallow subtidal habitat along the waterways, which may be considered wetlands by some, this would be mitigated by construction of similar shallow subtidal habitat. Therefore, based on previous analysis made in accordance with section 2a of this Executive Order, it is determined that no practicable alternative to the proposed alteration exists, and that the REC plan includes all practicable measures to minimize losses to wetlands as a result of construction. The project would be in compliance with Executive Order 11990.

g. Mitigation of Adverse Effects.

(1) Recommended Plan Mitigation. Mitigation actions for two significant, adverse impacts of the navigation channel improvement project have been included as part of the REC Plan. First, REC plan includes replacement of 4 acres of shallow, subtidal habitat that would be lost due to initial channel widening in the Cow Point and South Aberdeen reaches. Replacement would be accomplished by purchasing a diked area along the bank of the Chehalis River (at about River Mile 1.8) and restoring this area to subtidal and intertidal habitat of use to migrating juvenile salmonid fish. Second, the REC plan includes modification of hopper dredges to avoid entrainment of Dungeness crabs. Detailed investigation of dredge modifications and their success in avoiding crab entrainment would occur during the CP&E phase of the project (see paragraph 4.33 of the feasibility report). Through the continued use of dredge modifications for future maintenance dredging, the net impact of the channel improvement project may be beneficial by reducing or eliminating the crab entrainment presently associated with maintenance of the existing channel.

(2) Basis for Crab Mitigation. The REC plan proposed to avoid the entrainment of crabs through modification of dredges. The basis for this mitigation proposal is contained in the following impact analysis. This analysis represents an evaluation of project impacts without mitigation. Dredge entrainment during initial construction of the REC plan could result in a reduction to the Dungeness crab harvest in Westport by an estimated 1.45 to 3.40 percent (project net impact) per year if proposed mitigation was not implemented. Although this is a 2-year construction project, impact would be realized over a 4-year period with the most significant impact occurring in the second year after initiation of project construction. Present maintenance dredging reduces the Westport crab fishery catch by an estimated 0.73 percent per year. Proposed maintenance dredging would result in an estimated additional annual 1.20 percent impact for life of project. Including the outer bar, approximately 1 million crabs (of various age classes) would be killed during initial widening and deepening each year.

Use of dredge entrainment rates (number of crabs per cubic yard dredged) for various channel reaches and seasons and the population estimates presented by Armstrong et al. (1981) were used to derive the above estimates of potential crab mortality that might be caused by initial and maintenance dredging operations. The crab mortality estimates were calculated using the following formula:

$$L = (V)(E)(M)(0.87)$$

where,

L = number of crabs lost (a sum of the impacts for each channel reach and season),

V = volume of material dredged by hopper dredge (varies by channel reach and season),

E = entrainment rate for hopper dredge (varies by channel reach and season), and

M = proportion of entrained crabs that are killed (varies by the size of the entrained crabs).

Armstrong et al., calculated that there would be a 26 percent (on the average) reduction in entrainment if all dredging occurred at night. Since approximately one-half of dredging would occur at night, L was calculated using the constant of 0.87 (i.e., 0.5 x 0.26 = 0.13; 1.00 - 0.13 = 0.87).

The potential reduction in total number of adult crabs available to the fishery was estimated using the formula:

$F = L \times P_A \times P_M$

where,

F = reduction in total number of crabs available to the fishery (a sum of the impact to each age class),

P_A = proportion of the killed crabs belonging to each age class,

P_M = the proportion of each age class that would reach the fishery (i.e., not die naturally).

Based on Armstrong et al., (1981) the following values were used:

Age Class	P_A	P_M
0+	0.25	0.20
1+	0.50	0.50
2+ and older	0.25	0.80

The percentage of the Grays Harbor population that would be expected to reach the fishery without the project was estimated by multiplying population estimates for each age class for the summer season by estimated survival (P_M). The summer population estimate was used because most hopper dredging in the reaches which contained the greatest number of crabs would occur largely in the summer (over 70% of crabs entrained during initial construction and 100% of those entrained during maintenance dredging would be entrained during the summer). According to Armstrong et al. (1981), the best estimate for the summer population of crabs calculated for Grays Harbor estuary is 29,700,000. The population is composed of three age classes where 19,765,140 are 0+, 3 % or 891,000 are adults, and 9,044,000 are 1+ to 2+ (juveniles). Based on the summer population and given the above natural mortality for each age class, the estimate for total number of adult crabs available to the fishery from the estuary is 9,188,000 ((0.2 x 19,765,140) + (0.5 x 9,044,000) + (0.8 x 891,000)). As stated previously, approximately 1 million crabs per year would be killed during the initial project (2 years of initial construction dredging). This represents a loss of 517,000 crabs per year (F) to the total number available to the fishery. The project impact to the total crabs available to the fishery is determined by dividing F by 9,188,000. This would result in an initial project construction loss of 5.63 percent per year to the total number of crabs available to the fishery. However, as explained below, this annual impact is spread over three years due to the year classes of entrained crabs.

Grays Harbor estuary may contribute as much as 80 % of the local (Westport landings) offshore crab fishery (Armstrong et al, 1981). The actual catch landed in Westport ranges from an estimated low of 500,000 to a normal high of 3,000,000 crabs per year. Therefore, the Grays Harbor estuary may contribute as many as 400,000 to 2,400,000 crabs per year to the crab fishery landed at Westport. By allowing for the year classes of entrained crabs (which spreads the impact to the fishery of 1 year over 3 years), we estimate that initial construction could impact the annual crab catch by an estimated 1.45 to 3.40 percent and annual maintenance dredging by an estimated 1.20 percent per year for the life of the project (50 years). Table EIS 4-3 shows how initial dredging for two years affects the impact to the fishery for the first 2 years of postconstruction maintenance dredging. Similarly, the value of this impact can be estimated by assuming an average price of crabs ($1/pound or $2/crab) and multiplying by the Westport catch range and by the percent impact to the catch. Table EIS 4-3 shows that the value of this impact has been estimated to vary between $12,000 and $163,200 per year for the 2 years of construction and first 2 years of maintenance dredging. Value impact of future maintenance dredging is estimated to vary between $9,600 and $57,200 per year, in addition to the impacts of existing maintenance work.

The above analysis does not address several key points that need to be mentioned here:

- Reproductive and related impacts to the crab resource have not been quantified.

- The mitigation proposed for the REC plan should result in avoidance of direct impacts to the crab resource.

- Impacts to the crab fishing catch and value described above do not take into account the all-male crab fishery, primarily due to the substantially higher number of male crabs entrained by the dredge (Armstrong et al., 1981) and the difficulty in addressing reproductive losses.

- Trawl data compiled by Armstrong et al. (1981) has been corrected for known sampling inefficiencies in order to arrive at total estuary population estimates. However, entrainment data could not be modified by any known sampling inefficiencies. Consequently, entrainment estimates for smaller crabs could be substantially underestimated.

h. Adverse Environmental Effects Which Cannot Be Avoided.

(1) Dredging. Dredging associated with this project would remove and destroy sessile and motile species of macroinvertebrates along the navigation channel. Some of these invertebrates are important food sources for sport and commercial fish species in Grays Harbor and others, such as the Dungeness crab, are important commercial species. Impacts to the Dungeness crabs in Grays Harbor would be mitigated through either dredging equipment or scheduling modifications to be determined during CP&E studies. Four acres of shallow subtidal fish feeding and rearing

TABLE EIS 4-3

SUMMARY OF PROJECT IMPACTS TO CRAB FISHERY OVER 5 YEARS

Impact		O&M Existing	Initial		O&M Proposed		
		0	1	2	3	4	5 1/
Available to Fishery (Crabs x 10^3)	Net 2/	0	173	390	315	166	137
	Total 3/	84	257	474	398	250	220
Catch at Westport 4/ (Crabs x 10^3)	Net 2/	0	6.0-36.3	13.6-81.6	10.9-65.5	5.8-34.8	4.8-28.6
	Total 3/	2.9-17.5	9.0-53.8	16.5-99.1	13.8-83.0	8.7-52.3	7.7-46.1
Value at Westport 5/ ($ x 10^3)	Net 2/	0	12.0-72.6	27.2-163.2	21.8-131.0	11.6-69.6	9.6-57.2
	Total 3/	5.8-35.0	18.0-107.6	33.0-198.2	27.6-166.0	17.4-104.6	15.4-92.2

1/Represents the typical impacts due to O&M for life of project.
2/Total minus existing maintenance dredging, net project impact.
3/Includes existing O&M.
4/Expressed as range based on catch range 500,000 to 3 million x percent impact to catch.
5/Expressed as range loss to fishery based on average $2/crab x impact on catch.

area in the inner harbor would be changed to deeper subtidal habitat through dredging but would be mitigated by converting nearby uplands to intertidal or shallow subtidal habitat.

Some minor, temporary decreases in water quality would occur in the areas immediately surrounding the dredging.

The REC plan attempts to minimize the impacts to crabs, fish, and water quality through careful scheduling of the dredging period and equipment to be used in each reach.

(2) Disposal. The material to be disposed from dredging activities would temporarily affect benthic invertebrates at the open-water disposal sites. Some organisms would be eliminated, but with time, recolonization of the dredged material with invertebrates would occur. Commercial fishing in the disposal areas would be temporarily interrupted by disposal activities. Some minor, temporary decreases in water quality would occur at and near the disposal sites. Filling Slip No. 1 will result in a permanent loss of 20 acres of subtidal and intertidal habitat.

i. Irreversible and Irretrievable Commitments to Resources. The capital and labor necessary to dredge the channel would be committed irreversibly and irretrievably. This includes the capital and labor associated with dredging and disposal activities, administration, personnel, operations, maintenance, and petroleum products used. In addition, intertidal lands to be dredged, subtidal lands to be filled, and materials used will be irreversibly committed. Restoration of the substrate and reuse of discharged dredged material would not be possible.

j. The Relationship Between Local Short-Term Uses of Man's Environment and the Maintenance and Enhancement of Long-Term Productivity. The REC plan would enhance commercial and industrial shipping opportunities in the local area by providing more efficient means of transporting goods. Several acres of intertidal and shallow subtidal area would be removed but would be mitigated.

Dredging and dredging-related activities may have a substantial impact on the crab population which could impact the overall commercial crab fishery in the Grays Harbor area. Residents' income of some areas of Grays Harbor are dependent on the commercial crab fishery yearly catch. Therefore, mitigation of this impact is proposed. The full extent of project mitigation needed to avoid impacts to the fishery, would be established during CP&E studies.

Removal and confinement of contaminated sediments in the inner estuary, coupled with reduction or elimination of certain contaminant sources to the estuary, may result in a long-term benefit to inner-harbor productivity through reduction of sediment contaminant burdens. Potential plans for contamination clean-up would be investigated during CP&E. In the long term, Slip No. 1, which would be filled to an elevation +10 feet MLLW, would eventually be available for industrial development.

Expansion of local industrial development is not predicted as a result of the implementation of the recommended plan. Long-term, indirect project effects to local resources are not expected to occur.

4.04 Alternative 2a: National Economic Development Plan. The NED plan would be the same as the REC plan in terms of channel dimensions, dredging quantities, the characteristics of the dredged material, railroad bridge construction, the acres of shallow subtidal habitat lost, and the type of mitigation recommended. For these reasons, socioeconomic, cultural, and many other types of impacts would be the same as those discussed for the REC plan (EIS 4.03).

The major engineering differences between the NED and REC plan include the location of disposal sites and drainage schedule. Under the NED plan, all material destined for open-water disposal, with the exception of that from the outer bar and Aberdeen reaches (which would be discharged at an ocean disposal site about 2-1/2 miles from the harbor mouth), would be discharged within the harbor at the Point Chehalis and South Jetty sites. In addition, Slip No. 1 and a South Aberdeen upland log storage site would be used for confined disposal of 1.84 million c.y. of contaminated dredged material from Hoquiam and Cow Point reaches.

The dredging schedule under the NED plan would be generally established for cost efficiency in overall project dredging rather than for environmental protection. Therefore, some impacts to the large concentrations of outmigrating juvenile salmonids might be expected during inner harbor dredging. These impacts could be from direct entrainment by the dredge or from water quality degradations associated with dredging. Dungeness crabs and marine fish entrained and killed by project construction could be greater than under the NED plan and would require greater mitigation efforts. Direct dredging related impacts to smaller invertebrates in the sediments would be similar to those associated with the REC plan.

Water quality impacts during dredging will be similar to those associated with the REC plan. Water quality in the mouth of the harbor would be temporarily degraded by the disposal of the majority of the inner harbor silts at the harbor entrance. Turbidity and contaminant concentrations in the water column would temporarily increase and dissolved oxygen concentrations would decrease. While the materials to be discharged at these open-water harbor sites would ultimately be swept from the harbor, some recirculation and sedimentation on eelgrass beds, oyster beds, and various benthic organisms (such as larval Dungeness crabs) would be likely to occur. The severity of these impacts has not been quantified.

Ocean impacts associated with the NED plan would probably be less than those expected with the REC plan since less material would be disposed directly in the ocean. However, the use of a nearshore site could potentially result in direct, adverse impacts to the clam resource and the crab fishery. Since the material discharged in the harbor mouth would be scoured from the disposal areas, it would reach the ocean as a thin sheet and cause minimal environmental impacts.

Ocean disposal of dredged material under the NED plan would be substantially reduced in quantity (especially the siltier material). As a result, the potential for direct water quality and chemical impacts to the ocean environment is also reduced. However, the disposal of the dredged material in the mouth of the estuary and closer to shore would result in increased potential for resuspension of fines in the estuary. A high potential for shoaling of crab pots and avoidance-induced reduction in catch would exist due to the proximity of areas with high density fishery activity. Confined disposal site impacts will be similar to those described for the REC plan.

4.05 Alternative 2b: Least Environmentaly Damaging (LED) Plan. The LED plan would be the same as the REC plan in terms of channel dimensions, dredging quantities, the characteristics of the dredged material, railroad bridge construction, the acres of shallow subtidal habitat lost, and the types of mitigation recommended. For these reasons, socioeconomic, cultural, and many other types of impacts would be the same as those discussed for the REC plan (EIS 4.03).

The major difference between the LED and REC plan include dredging equipment to be used, the location of disposal sites, and the dredging schedule. Under the LED plan, clamshell dredging would occur in all reaches upstream of and including the South reach. Use of clamshell dredges in these reaches would substantially reduce the number of Dungeness crabs and marine fish entrained and killed by project construction with an unmodified hopper dredge. Based on the work by Armstrong, et al. (1981) in assessing crab entrainment by dredges operating in Grays Harbor, approximately 3,500-49,000 crabs would be killed by project construction, which represents a .87-2.04 percent loss to the fishery in each year without mitigation. This estimate is about 40 percent less than the number of crabs which would probably be killed by project construction under the REC plan without mitigation.

Direct-dredging related impacts to smaller invertebrates in the sediments and juvenile salmonids will be similar to those associated with the REC plan.

Water quality impacts during dredging will be slightly less with the LED plan than the REC plan since clamshell dredges will be used more under the LED plan.

Under the LED plan, all dredged material suitable for open-water disposal would be discharged at two ocean disposal sites located about 8 miles of the harbor mouth. Disposal at these sites would minimize biological and commercial fishing impacts in the ocean and minimize return of sediments to Grays Harbor. Therefore, secondary impacts to primary producers, invertebrates, and fish in Grays Harbor associated with dredged material disposal would be negligible.

Though ocean impacts associated with the LED plan would increase over those expected under the REC plan because more material would be discharged into the ocean, the additional sediment would be mainly sandy material which would cause minimal impacts and the ocean impacts are, for the most part, less severe than those that could occur in the estuary.

Under the LED plan, increased quantities of dredged material would be discharged into the ocean in order to avoid impacts to the estuarine environment. As a result, direct impacts to the water column would be increased and benthic changes within the discharge site would be more pronounced. The LED ocean disposal site(s) would be located outside of high density pelagic and benthic fishery areas. Confined disposal site impacts will be similar to those described for the REC plan.

SECTION 5. PUBLIC INVOLVEMENT

5.01 Public Involvement Program. The public involvement concerning this project which occurred prior to 1976 is described in section 9 of the revised draft (RD) Widening and Deepening EIS, 1976. Newsletters were mailed to interested agencies and individuals and meetings and public workshops were conducted over the period 1979-1982 to discuss the channel improvement project. See section 5 of the feasibility report for a more complete discussion of the study public involvement program.

a. Coordination with Governmental and Public Environmental Agencies. By letter of 15 June 1979, the Seattle District invited representatives from the U.S. Environmental Protection Agency (EPA); Fish and Wildlife Service (FWS); National Marine Fishery Service (NMFS); and Washington State Departments of Ecology (WDE), Game (WDG), Fisheries (WDF), Natural Resources (DNR) to participate in a task force effort to define the scope and cost of environmental studies necessary to determine the impacts of the proposed navigation improvement project in Grays Harbor. Additionally, the Port of Grays Harbor (the local sponsor), Washington Environmental Council (WEC), Friends of the Earth (FOE), and the Institute for Marine Studies of the University of Washington were invited to participate in the scoping process.

The task force broadly examined a list of suggested environmental studies for Grays Harbor that had been compiled from various sources and with varying applicability to the channel improvement project. From the onset, the task force was reminded by Corps representatives that studies scoped must be project related and should concentrate on those areas and resources that may be affected by the project.

The task force identified three primary areas of concern: water quality, fisheries, and wetlands/wildlife. Subcommittees were established to meet and develop specific study scopes on these areas which could be impacted by the project.

These study scopes were discussed at numerous task force subcommittee meetings and ultimately a reduced list of proposed studies (table EIS 4-1) was presented to the entire task force on 26-27 September 1979. The task force agreed that the results of the proposed studies would form the base from which the state, Federal, and public agencies could determine if the proposed project was environmentally acceptable. The environmental studies began in September 1979 and the results of all these studies were distributed to agencies listed above. Several meetings between agency representatives, Seattle District personnel, and environmental studies contractors were held during 1980 and 1981. These meetings were held to keep agency representatives aware of preliminary study findings and also to allow the representatives to give suggestions or comments to the contractors. Additionally, Seattle District personnel met numerous times with resource agency personnel to discuss potential ocean disposal areas, bioassay techniques, and the approach to the results of the chemical testing of sediments from Grays Harbor. During the task force meetings and task force coordination, resource agencies have: (a) expressed acceptance of the least environmentally damaging (LED) plan, and (b) expressed objections to the national economic development (NED) plan due to unacceptable adverse impacts. Seattle District COE developed a recommended (REC) plan which addressed some of the concerns that agencies had with the NED plan. This REC plan has been generally accepted by the resource agencies.

The task force representatives were also invited to a 1-2 December 1981 meeting at which the REC plan, results of the environmental studies, additional studies being considered for the continuation of planning and engineering (CP&E) phase of this project, and possible mitigation measures were discussed in detail. Comments received from task force members during and after this meeting were considered as all the items listed above were being finalized for inclusion in this feasibility report/EIS. Written comments on the REC plan requested at the meeting indicate that the agencies generally concur with the project as proposed, though a few specific concerns remain. Some of these concerns are addressed in the EIS. The biological testing was completed as part of project feasibility, and the results were provided for review to a task force meeting in August 1982. Other concerns such as using additional clamshell dredging to reduce crab mortality, the precise location of ocean disposal sites, sediment recirculation related to open water harbor disposal and effective reduction of problem contaminants in inner harbor sediments will be evaluated during CP&E.

b. Fish and Wildlife Coordination Act Report. In accordance with the Fish and Wildlife Coordination Act (FWCA) of 1958 (Public Law 85-624), as amended, a final FWCA report on this project, dated August 1982, was prepared by the Olympia, Washington, field office of the FWS and provided to the Corps. The FWCA report is contained in appendix B, Part 3. The recommendations made by the FWS in the FWCA report are addressed in section 5.03 of the feasibility report.

5.02 Coordination of Draft Report. On 3 June 1982 over 450 copies of the draft Feasibility Report/Environmental Impact Statement were distributed to all concerned Federal, State and local agencies, and interested organizations and private citizens for review with a comment period allowed through 26 July 1982. As noted in the widely distributed June 1982 newsletter, the draft report was available at nine public libraries, eight of which were located throughout the Grays Harbor area and the ninth in Seattle. Also a number of copies were available at the port of Grays Harbor office in Aberdeen. The newsletter contained excerpts from the report including the Executive Summary and EIS Abstract.

5.03 Public Views and Responses. Letters providing comments on the draft EIS report were received with only one organization (Friends of the Earth) expressing strong opposition to the recommended plan. A number of concerns were expressed by others over dredge disposal site, sediment movements, and project impacts on crab populations and the crab fishery. The Seattle District has been asked to address these concerns during CP&E. Letters of project support were also received. All letters resulting from the public draft report review are contained in appendix B, part 4 along with abstracted comments and District responses.

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