US Army Corps
of Engineers
Portland District

Coos County, Oregon
Englewood Diking District

Libby Dike
Draft Definite Project Report
And
Environmental Assessment

Flood Damage
Reduction Study

DEPARTMENT OF THE ARMY
PORTLAND DISTRICT, CORPS OF ENGINEERS
P. O. BOX 2946
PORTLAND, OREGON 97208

Planning Division (PL-NR-EQ)

Dear Reviewer:

Enclosed for your review and comment is the draft Libby Dike Definite Project Report (DPR) and Environmental Assessment, which has been prepared in accordance with the National Environmental Policy Act (NEPA). The proposed action involves purchasing all flood prone lands and improvements below elevation 10 feet, and restoring approximately 60 acres of pastureland to natural salt marsh and mudflat.

Copies of the report are being sent to interested Federal, State, and local agencies, public libraries, private organizations, and members of the general public.

Comments on the report should be sent to the above address, attention NPPPL-AP, and should be received by this office no later than April 20, 1987. Questions or requests for additional information regarding the DPR should be directed to Mr. Chuck Mason, Advance Planning Branch, (503) 221-6478. Questions regarding the Environmental Assessment should be directed to Ms. Judy Struznik, Natural Resources Branch, (503) 221-6094.

Sincerely,

William K. Abee
for A. J. Heineman
Chief, Planning Division

Enclosure

COALBANK SLOUGH
COOS COUNTY, OREGON

ENGLEWOOD DIKING DISTRICT

FLOOD DAMAGE REDUCTION STUDY
MARCH 1987

SYLLABUS

In January 1983, Libby Dike was overtopped by a combination of high tides and storm runoff. As a result, Englewood Diking District was inundated for three days, experiencing significant damage. This event dramatized the deteriorated condition of a levee which may be over 100 years old. During the study, various alternatives were evaluated, but the sponsor's funding constraints and economic optimization indicated that conventional structural solutions did not maximize net benefits. The recommended alternative, which is the National Economic Development (NED) Plan, employs permanent floodplain evacuation to reduce flood damages and provide benefits from a new use-fishery enhancement. The floodplain, which was reclaimed estuary, will revert to its natural character and best use, that of nurturing the indigenous fishery, especially salmon. In addition, a small hatchery pond can complement the fishery and provide substantial benefits. The total first cost is $1,714,500 of which 25% or $428,600 will be the local obligation. This translates to a 8.4 to 1 benefit to cost ratio. This plan, which has strong local support, is consistent with current formulation and cost-sharing policy. Finally, this study proves that an NED plan can also be the most environmentally sensitive solution.

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LIBBY DIKE

SECTION 205 STUDY

DEFINITE PROJECT REPORT

INTRODUCTION

1. General. This definite project report (DPR) on flood damage reduction for Englewood Diking District (Libby Dike) is submitted in accordance with provisions of ER 1105-2-10, dated 1 July 1982.

2. Authority. The study described in this DPR was conducted under the authority of section 205 of the 1948 Flood Control Act, as amended. This program is applied to small flood control projects not specifically authorized by Congress. By letter dated August 15, 1983, Coos County, OR, officials acknowledged responsibility for sponsorship and requested that Portland District, Corps of Engineers, study a flood problem in an area southeast of the Coos Bay city limits (Exhibit 1). In August 1984, Englewood Diking District was established from 79 acres of lowlands along Coalbank Slough (Exhibit 2). Only 74 acres of the diking district are subject to flooding; therefore, the additional 5 acres will not be discussed in this report.

3. Study Purpose and Scope. This DPR contains a summary of study area problems and needs and an evaluation of alternative solutions to flooding in this area along Coalbank Slough. Information included in this report will be the basis for plans and specifications and for land acquisition and construction authority. Technical discussions of geotechnical evaluation, design, alternative economics, and the U.S. Fish and Wildlife Coordination Act Report are contained in the appendices.

4. Prior Studies and Reports. An initial appraisal was completed on 16 November 1983 which contained the recommendation that a detailed study of flood control alternatives be made. A fact sheet which served as a reconnaissance report was transmitted on 24 August 1984.

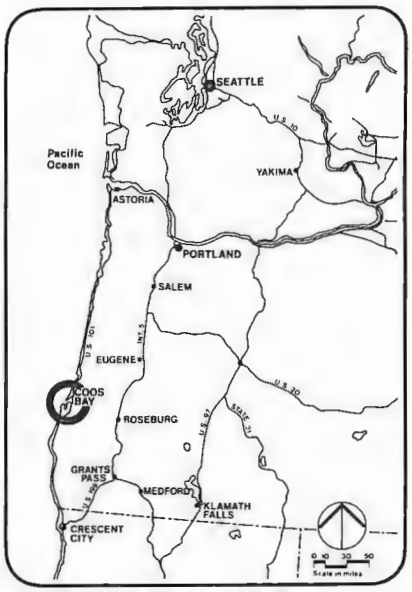
5. Project Location. The study area is located at the southeastern city limits of Coos Bay, in Coos County, Oregon. The area lies behind an existing dike (Libby) which forms the left bank of Coalbank Slough.

6. Public Involvement. Public and agency input during this study was provided through informal discussions and information meetings with the public and with local officials. Comments will be received after review of this report including the Environmental Assessment and Coordination Act Report. Further details are discussed later in this report.

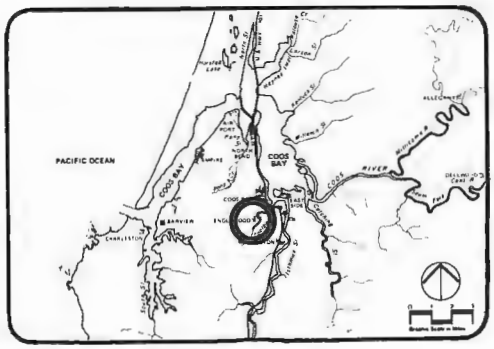
CHARACTERISTICS AND RESOURCES

7. Area Description. The existing levee (approximately 5,500 feet long) is thought to have been built in the late 1800s by private interests and is still privately owned and maintained. The 5,500 foot long levee protects approximately 11 acres of residential land containing 12 occupied homes and several farm buildings; 56 acres of pastureland, and 7 acres of undeveloped land. The remaining 5 acres within the diking district are above flood levels. These acreage estimates are based on land affected by the 500-year frequency flood at 10.0 feet, National Geodetic Vertical Datum (NGVD). See Figure 1. Most of the bottomland behind the levee and east of Southeast Boulevard ranges in elevation from - 0.8 feet NGVD to 1.0 feet NGVD. Approximately 10 acres west of Southwest Boulevard averages about 2.2 feet NGVD in elevation. Three tideboxes have been installed to control flooding from high tides.

8. Geology and Soils. In general, embankment materials consist of medium-stiff silty clay underlain by soft clayey silt with numerous included coal and wood chip fragments. The levee foundation consists of 1.5 feet to 6.5 feet of topsoil and fill underlain by at least 40 feet of very soft clayey silts and silty clays. Underlying weathered bedrock was encountered in at least one boring at about elevation - 20.5 feet NGVD. The weathered material consists of medium-stiff, interbedded sands, silts and clays. Existing levee crest elevations average about 7.5 feet NGVD and average crest width is 3.0 feet. Embankment slopes are .7 foot vertical and 1.0 feet horizontal. The presence of very soft, deep, slow draining tidal flat deposits throughout most



REGIONAL MAP



AREA MAP

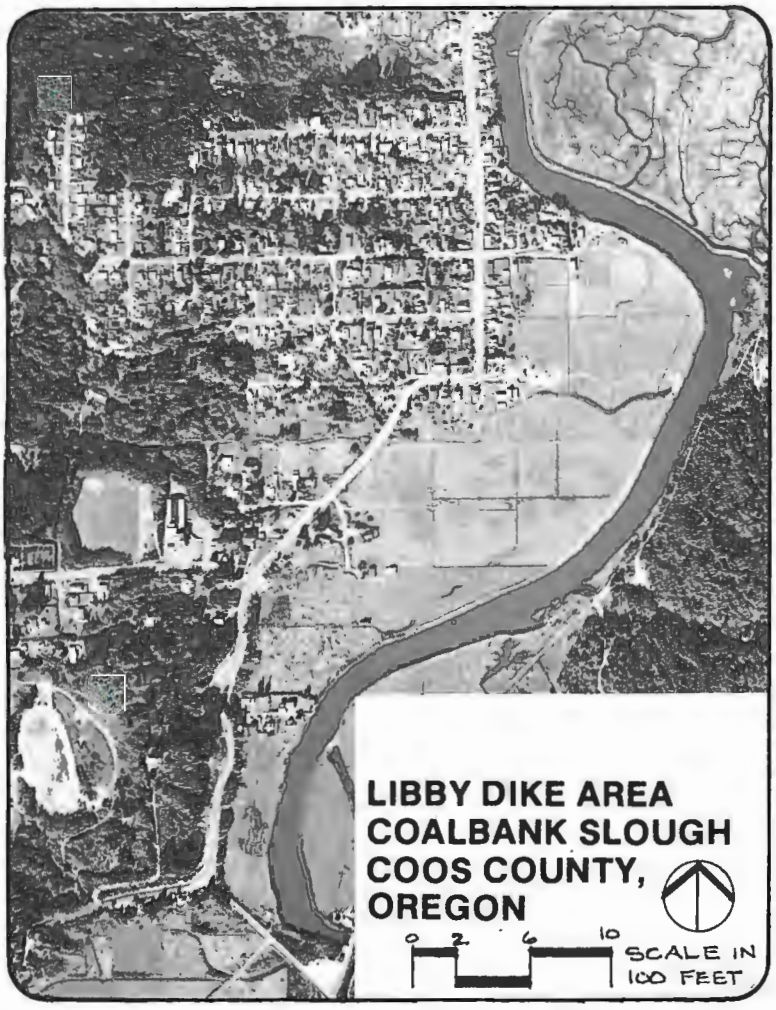


Figure 1. Study Area.

of the study area is indicated. Surface conditions consist of a 1.5 foot layer of grass and silty clay topsoil over the softer flood plain deposits. Based upon soil analyses, foundation conditions are extremely poor due to low bearing capacity. A more detailed geologic and soil analysis is described in Appendix A.

9. Climate. The study area experiences cool, dry summers and mild, wet winters. The Pacific Ocean influences both precipitation and temperature. Based upon records at North Bend, 7 miles north of Coalbank Slough, the average annual precipitation for the study area is 61.20 inches. About 60% of this amount, or 37 inches, occurs during the 4-month period from November through February. The greatest 24-hour precipitation on record was 5.16 inches (3 Feb 1937). The yearly average depth of snow, sleet and hail is 0.6 inches with the maximum monthly and daily amount of 6.5 inches. Temperatures range from a maximum of 94° Fahrenheit(F) to a minimum of 17° F, with an average annual temperature of 52.5°F. The yearly average relative humidity ranges from 93 percent at 4:30 a.m. to 76 percent at 4:30 p.m..

10. Flood elevations. Flood frequency profiles for Coalbank Slough (at Libby Dike) have almost a flat slope with estimated peak elevations for the 10-,50-,100-,and 500-year frequency floods of 8.4, 9.1, 9.4, and 10.0 feet, NGVD, respectively. Inflow hydrographs were developed for the 2-,5-,10-,50-,100, and 500-year storm events. Although the tributary drainage area is small (less than 1 square mile), considerable flooding would be expected from interior drainage. Even with levee improvements, ponding from storms equal to or greater than the 5-year event would exceed 3.4 feet, would overtop Southwest Blvd. and other low-lying roads, and would prevent access to several homes. Winter storms combined with high tides occasionally overtop the existing levee at 7 feet, NGVD, temporarily flooding much of the land behind the levee. The levee is rated " hazardous" at 4 feet, NGVD. When the levee is overtopped, traffic along Southwest Boulevard is curtailed. The last major winter storm occurred in January 1983 and caused extensive damage estimated by the Coos County Office of Emergency Management at $226,000. The maximum flood elevation behind the levee was 6.6 feet, NGVD which is less than a 5-year frequency flood. Events greater than normal tidal conditions threaten a complete breach of the levee.

Figure 2. Photographs of 1983 Flooding.

11. Fish and Wildlife Resources. Nearly all the study area is classified as palustrine emergent diked wetland according to the U.S. Fish and Wildlife Service National Wetlands Inventory. Prior to existing levee construction, the area was an estuarine salt marsh directly connected to Coalbank Slough and and the Coos Bay estuary. Several species of sport and commercial fish inhabit Coalbank Slough, including striped bass and starry flounder. Top smelt, shiner perch and Dungeness crab are also present. Remnant runs of coho salmon, steelhead, and searun cutthroat trout utilize Coalbank Slough and its upper tributary streams. These runs are being supplemented, while the Oregon Department of Fish and Wildlife is coordinating the establishment of a fall Chinook fishery through the Salmon and Trout Enhancement Program (STEP). Several species of birds and small mammals have been observed in the study area. Most prevalent of these are mallard ducks, wigeon, blackbirds, killdeer, gulls, muskrat and raccoon. Bald eagles (Federally classified as threatened) are winter residents in the area. A biological assessment addressing the effects of construction activities and potential disturbance from increased human use of the area is included in the attached Enviornmental Assessment.

12. Cultural Resources. A cultural resource investigation was conducted and the conclusion was reached by the State Historic Preservation Officer that no significant cultural resources would be affected by proposed actions.

PLANNING PROCESS

13. Problems and Opportunities. The Libby Dike area experiences frequent minor flooding from interior drainage and less frequent but severe flooding from overtopping of the existing dike. Soil foundation conditions are very poor for new levee construction. Libby Dike is in an economically depressed area where local ability to cost share is limited. No significant environmental constraints are present. Although the study area has been diked for many years, the resultant development probably has not deteriorated the environmental quality of the site's natural resources. The agricultural use of this area and minimal structural development have not dictated any single land use and, therefore, provide an opportunity for a wide range of future activities, including reestablishment of a natural setting. Other nearby

diked areas previously used for agricultural purposes have successfully reverted to a natural estuary when the levee was breached.

14. Planning Objectives. The major objective of the selected plan is to eliminate or reduce flood damage to improved properties in the study area. The optimum plan maximizes the difference between plan benefits and costs, hereinafter referred to as the National Economic Development (N.E.D.) Plan. Current guidance from ER 1105-2-20 recommends flood protection in rural areas be evaluated at different levels based upon the effects on health, safety, and life. This analysis was done during the initial phase of this study and resulted in the recommendation that protection from a 100-year flood event be sought. Later discussion explains how the NED Plan was identifed.

15. Hydrology. Analysis of flood protection alternatives involved two elements: flooding from Coalbank Slough and interior drainage. Flooding from the slough occurs as water overtops the levee and inundates the area behind the levee. Coos Bay tides affect the study area. Coalbank Slough hydrographs for 2- and 10-year floods were used for interior drainage analyses. The existing flood protection system includes gravity flow tideboxes. Any proposed levee project would also include tideboxes (due to the high cost of the other alternative - pumping). An interior drainage analysis was made for the 2-,5-,10-,50-,100-,and 500-year storm events.

16. Technical Criteria. The following data were used for development and analysis of alternative plans:

a. 100-year frequency flood - el. 9.4 feet, NGVD

b. For levees - design freeboard: 3.0 feet. Phased construction required because of poor foundation conditions.

- settlement anticipated: 2.5 feet ultimately; 1.5 feet in the first 2-3 years, 1.0 foot afterward.

- phase I construction (initial) to el. 9.4 feet NGVD (1V to 3H slopes) with 2 berms to el. 6.5 feet NGVD.

- phase II construction (year 2-3) to el. 13.4 feet with 12-foot gravel road (1V to 3H slopes) landward of existing levee shoulder.

Figure 3. Coalbank Slough Looking Downstream.

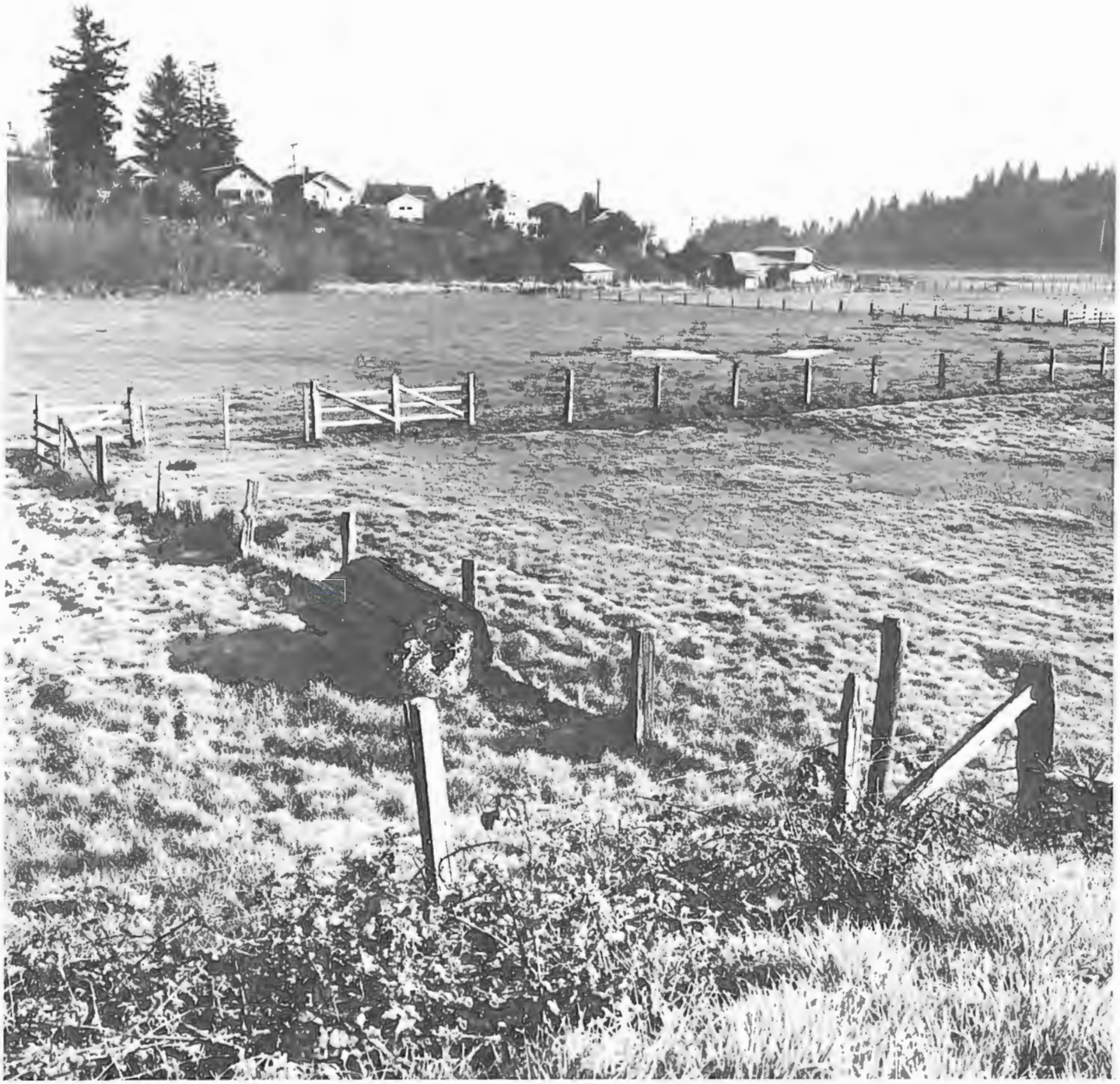


Figure 4. Englewood Diking District - Pastureland.

c. Permanent floodplain evacuation costs include land acquisition, improvement, removal, or relocation of utilities all to above el. 7.0 feet, and raising of a portion of Southwest Blvd. and Illinois Avenue to El. 8 feet, NGVD.

- settlement anticipated: 1.0 feet in first year.

17. Utilities. Three tideboxes and miscellaneous field drain pipe would be removed during construction of levee improvements. Utilities (including a sanitary sewer) would be relocated if Southwest Boulevard and Illinois Avenue are raised.

18. Environmental Aspects. The following environmental aspects were considered while evaluating alternatives and determining the best plan:

a. An interdisciplinary team was used to plan and design different options.

b. Levee rehabilitation would occur landward from the existing levee shoulder except at tidebox locations where bank protection on the outside of the levee will be place to prevent erosion.

c. For the setback levee alternative, all levee construction would be landward of the existing levee shoulder, which would be breached in several places to allow tidal fluctuations outside the shorter levee.

d. For the permanent floodplain evacuation alternative, all improvements below el. 7.0, NGVD would be removed to return the area to a more natural environment. The existing levee would be breached in several places to allow tidal fluctuations to restore the floodplain to a salt marsh or mudflat.

e. Material excavated during levee breaching may be mounded to create islands for wildlife use.

f. A baseline study would be initiated if a permanent floodplain evacuation alternative is implemented. This will serve as a basis for developing a fishery program and could serve as a basis for future impact analysis. If a post-construction monitoring study is required, it would be the responsibility of other agencies.

19. Socioeconomic Criteria. The following criteria were considered during alternative evaluation:

Figure 5. No Federal Action - Alternative 1.

a. General public acceptance of alternative plans (determined by coordination with interested Federal and non-Federal agencies, groups and individuals through public meetings and notices) was a major factor in plan selection.

b. Costs and benefits for all alternatives were based on January 1987 price levels, an interest rate of 8-7/8 percent, and a project life of 50 years.

c. The benefits and costs for all alternatives were expressed in equal terms with the plan maximizing net benefits being the selected plan.

d. Public health, safety, and well-being (prevention of loss of life) were considered for each alternative.

e. Environmental impacts of the alternatives are analyzed in the Environmental Assessment and in Appendix D (coordination with the U.S. Fish and Wildlife Service).

f. Efforts have been made to minimize adverse social effects.

20. Alternatives Considered. Four alternatives have been analyzed for this study and are described as follows. Alternative 1. No Federal Action. A storm in January 1983, combined with high tides, overtopped the existing levee along Coalbank Slough. At one point during the flood, the leveee was overtopped along nearly its entire length. Damage to the levee crest and face resulting from that flood and overtopping was only superficially repaired following the flood. The diking district has not had the funds necessary to adequately repair the levee to a "safe" condition. Under the no-action scenario, the Libby dike would continue to deteriorate as it has for many years. Periodic flooding would continue, causing flood damages both from overtopping of the existing levee and from internal drainage problems. Damages would continue from traffic interruptions and delays, road cleanup, emergency costs, and temporary evacuation costs. Emergency actions similar to January 1983 and minimal remedial repairs would continue to provide some level of protection. The Flood Insurance Administration (FIA) insures nine of the local residents, structures, and contents against flooding; therefore, as long as some flood protection is available, and flood insurance can be obtained, the availability of inexpensive housing will continue to encourage occupation of the floodplain (see Figure 5).

Figure 6. Levee Rehabilitation - Alternative 2.

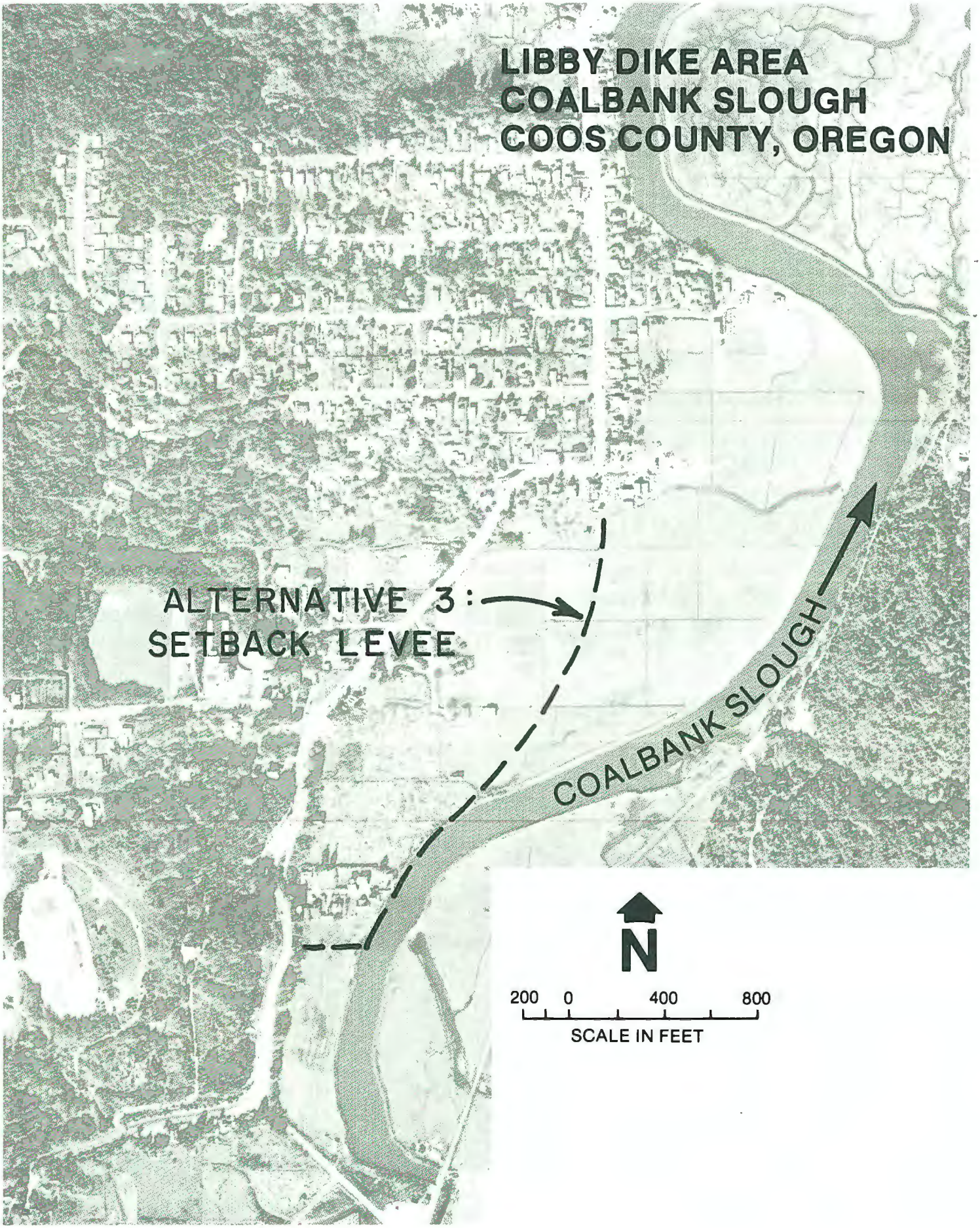


Figure 7. Setback Levee - Alternative 3.

Figure 8. Permanent Floodplain Evacuation - Alternative 4.

Alternative 2. Levee Rehabilitation. Rehabilitation of the existing levee would provide the entire study area with flood protection from levee over-topping resulting from a 100-year event. Relocation or removal of one residence in the levee right-of-way would be required. This alternative would provide jobs for some workers who may otherwise be unemployed. Internal drainage problems would not be addressed by this plan. No fishery enhancement is envisioned with this structural plan (see Figure 6).

Alternative 3. Setback Levee. This alternative would provide a new levee landward from the existing levee along Coalbank Slough, providing protection within part of the study area from levee over-topping resulting from a 100-year event, thus reducing flood damages. However, no protection from internal drainage problems would be provided. The relocation or removal of 4 residences from the flood plain would be required. This alternative would provide jobs for some workers who may otherwise be unemployed and would result in 37 acres of land between the existing and the proposed setback levee to revert back to a saltmarsh or mudflat environment. This would provide habitat for fall chinook salmon and would thus increase fish runs for commercial and recreation use (see Figure 7).

Alternative 4. Permanent Floodplain Evacuation. All residences would be removed from the 500-year floodplain and Southwest Boulevard and Illinois Avenue would be raised to el.7, NGVD. Some flood insurance costs would be avoided. Emergency aid and temporary evacuation costs would also be eliminated. This alternative would permit the creation of an 8-acre freshwater salmon pond and conversion of 60 acres of pasture to salt marsh and mudflat as habitat for juvenile fall chinook and other species. These measures would increase fall chinook runs substantially for both commercial and recreational fishing in the area. This alternative would provide jobs for some workers who may otherwise be unemployed (see Figure 8).

21. Selecting a Plan. The alternative of "No Federal Action" was analyzed as a base condition to which all other alternatives were compared. The results of the comparison are summarized in Table 1 and the benefit/cost analyses are discussed in detail in Appendix C. If the other alternative plans were not cost effective, the "No Federal Action" plan would have been recommended. The

ALTERNATIVE IMPACT COMPARISON

TABLE 1

	Alternatives			
	1 No Fed. Action	2 Rehab. Levee	3 Setback Levee	4 Evac./ Reloc.
National Economic Development				
Area Protected From Flood Damages	0 acres	63 acres	33 acres	74 acres*
Level of Protection	<2-Year	100-Year	100-Year	500-Year*
Average Annual Benefits		$60,100	$82,600	$1,220,400
Average Annual Costs	Damages $66,500	$85,600	$75,200	$144,500
Net Benefits		-$25,400	$7,400	$1,075,900
BCR		.70 to 1	1.10 to 1	8.44 to 1**
Environmental Quality				
Wetlands	NI	AI(Neg)	AI(Neg)	AI(Pos)
Rare and Endangered Species	NI	NI	AI(Pos)	AI(Pos)
National Parks and Wilderness	NI	NI	NI	NI
Cultural Resources	NI	NI	NI	NI
Water Quality	NI	NI	NI	AI
Flood Plain Management	NI	NI	AI	AI(Pos)
Prime and Unique Farmland	NI	NI	NI	NI
Relocated Residences	0	1	4	12
Local Support	None	None	None	To Be Determined During Review

NI - No Impacts

AI - Acceptable Impacts

* Due to Landuse Change

** 6.65 to 1 w/o Rec. Fishing

economics of the structural solutions of levee rehabilitation (Alt. 2) and setback levee (Alt. 3) were below and at unity respectively, thus indicating marginal projects. In addition to the local sponsor not being able to provide their cost sharing contribution, they did not support the concept of protecting only part of the diking district. Therefore, alternative 3, and similar variations, were not acceptable to the local sponsor for economic and social reasons. This led to the analysis of the non-structural alternative of permanent floodplain evacuation (Alt. 4). This alternative not only maximizes net benefits, but also has local support. The local sponsors perceive this plan as their best choice for eliminating their damages from flooding. Because sponsorship requirements are divided between the local diking district and the sponsor of the fishery, the cost of the local share is less than for the structural solutions. The local property owners will also be able to sell their land and improvements at "fair market value..." which otherwise might not be possible given Coos Bay's depressed economy and lack of buyers. Therefore, the permanent floodplain evacuation plan not only maximizes net benefits, but also is acceptable to the local sponsor. The permanent floodplain evacuation alternative was not optimized because it would have been unacceptable to both sponsors. The configuration of the diking district, which contains the damageable property is determined by the adjacent topography. The 500-year floodplain is delineated by the abutting hillsides. However, the elevation of the 10-year event is only 1.6 feet lower than the 500-year event. Most damageable property lies within this band. Public Law 91-646 contains provisions for acquisition of "unecomonic remnants" of property within the floodplain. This is also the option that property owners within that band have selected. Therefore, an alternative which would have retained small, unusable pieces of property was unacceptable to the property owners. In addition, the new use of the floodplain for fishery enhancement would not have been practical with a piecemeal floodplain.

22. There are several public laws that enable the implementation of fish and wildlife enhancement and non-structural alternatives. The Fish and Wildlife Coordination Act of 1958 (PL. 85-624) states in Section 2 that fish and wildlife enhancement shall be included in plans where expected benefits exceed the costs. In addition, it also provided that fish and wildlife conservation receive equal consideration with other project purposes. The Water Resources Development Act of 1974 (PL. 93-251) requires in Section 73 that consideration

be given to non-structural solutions in flood damage reduction studies. Finally, the Water Resources Development Act of 1986 (PL. 99-662) provides cost-sharing requirements for implementation of non-structural flood damage reduction and fish and wildlife enhancement purposes. The acknowledgement and provision for implementation of these purposes is an implied sanction for their existence and use.

SELECTED PLAN

23. Plan Features. The plan which demonstrates the maximum net benefits, the National Economic Development (NED) plan, is Alternative 4 - the permanent floodplain evacuation plan. This is a nonstructural solution to a local flood damage problem. Benefits for a permanent evacuation plan are not calculated in the usual manner of structural flood damage reduction plans. Current policy indicates that benefits are to be obtained from both reduced Federal subsidies from flooding and the new use of the floodplain, i.e. fishery enhancement. Without the project, floodplain residents suffer flood damages, usually heavily subsidized by the Flood Insurance Program. With the "project," subsidies will be eliminated and there will be a change in land use. In this case, the floodplain will be cleared, the existing levee breached, and the area east of Southwest Boulevard will be allowed to return to a salt marsh and mudflat habitat. The floodplain area west of Southwest Boulevard is ideally suited as a freshwater impoundment for increasing anadromous fish production in the estuary.

24. The selected plan will eliminate all damages from 500-year and more frequent floods through permanent evacuation of residents and removal of improvements. The one exception is for short sections of Southwest Boulevard and Illinois Avenue which would be raised only to El. 7 feet, removing them from damage due to daily tidal fluctuation. A freshwater pond would be created west of Southwest Boulevard. After removal of damageable property, the existing levee would be breached in several locations, allowing the area east of Southwest Boulevard to return to its pre-levee environment (as a salt-marsh or mudflat). The economic analysis included additional benefits from the salt marsh-mudflat for indigenous fish. However, the semi-saline environment of the marsh is also an essential element of the proposed salmon

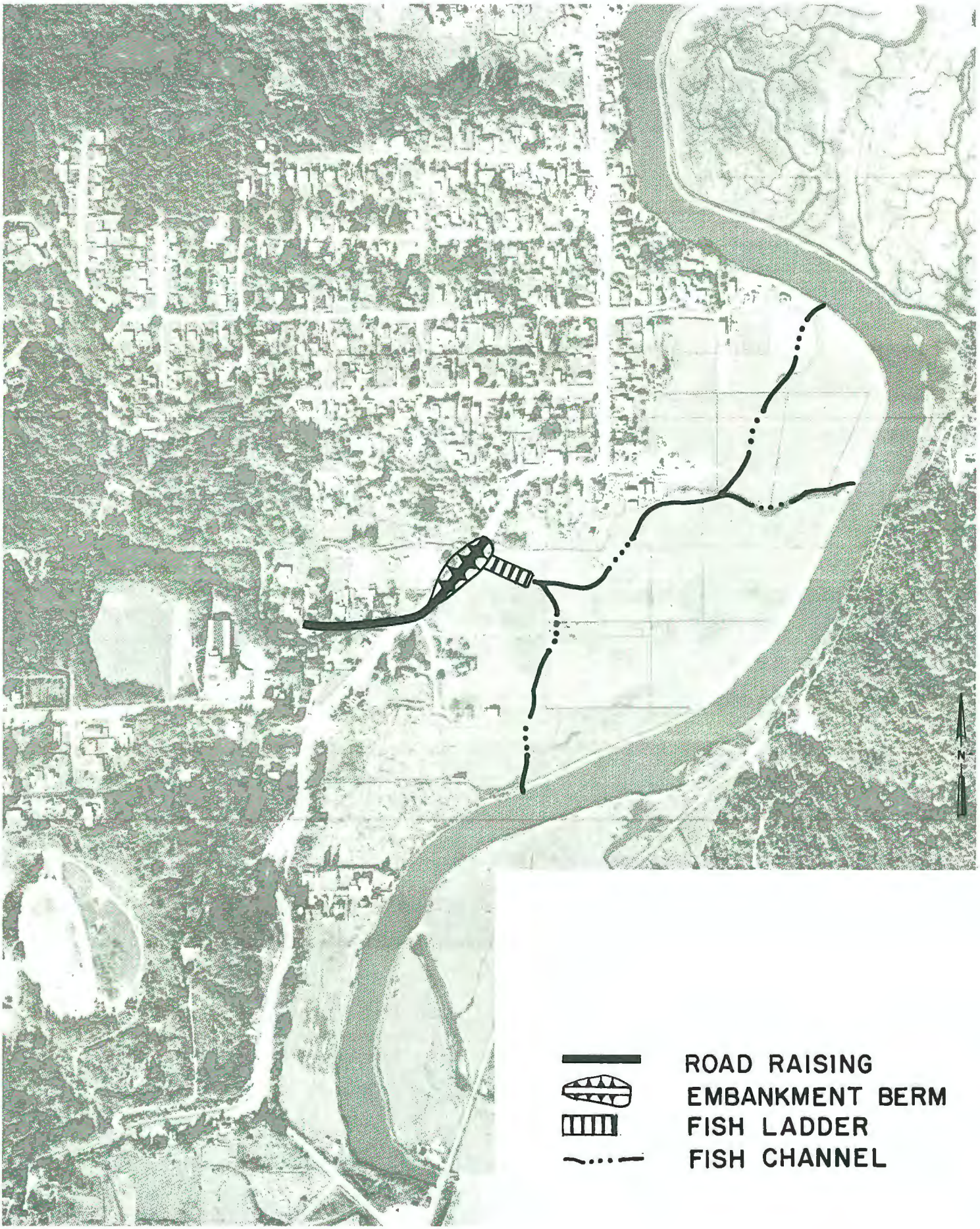


Figure 9. Plan Features.

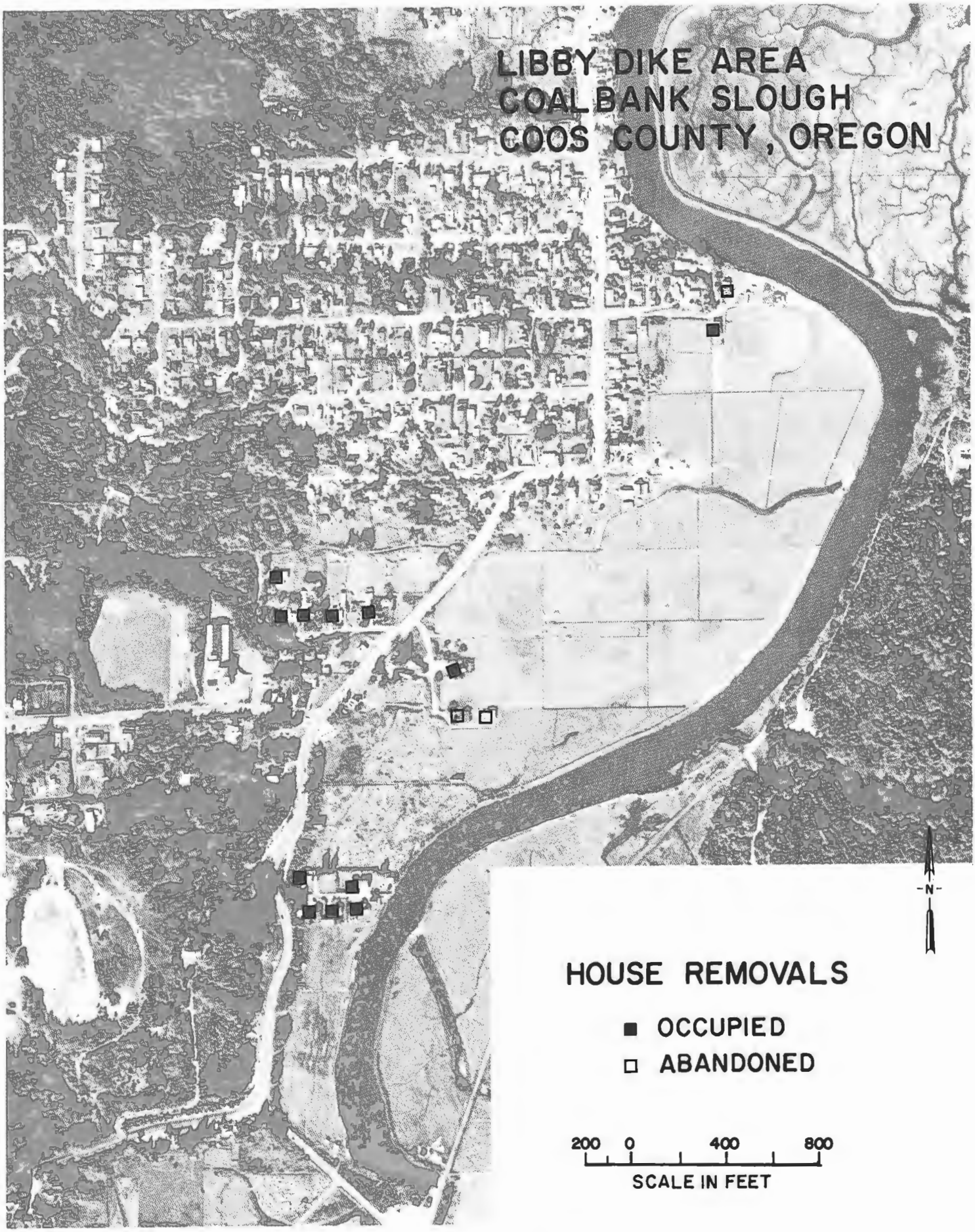


Figure 10. House Removals.

rearing program. The salmon smolts will use the salt marsh-mudflat as a transition from the fresh water rearing pond to the higher saline water in Coos Bay. Without this transition zone, survival of the smolts will be reduced and the number of adults returning will be much less than with the marsh. This position is also supported by the U.S. Fish and Wildlife Service in their 10 March 1986 supplemental letter (Appendix D). The pond west of Southwest Boulevard would provide an ideal environment to increase the fall Chinook salmon fishery and would be constructed in coordination with the State's Salmon and Trout Enhancement Project (STEP). Returning salmon would be trapped by a fishladder/catchment structure located alongside Southwest Blvd. Increased fish production would result for both commercial and recreation fisheries. However, benefits with and without recreation fishing are calculated from U.S. Fish and Wildlife Service estimates to demonstrate the cost effectiveness of the selected plan without relying on recreation-use.

25. Plan Accomplishments. Flood damages except to the roads would be eliminated from all floods through the 500-year frequency level. Employment during construction of currently unemployed workers would benefit the depressed Coos Bay labor market. Only salmon benefits and costs have been analyzed. But many other commercially or recreationally valuable species may benefit from breaching of the existing levee and restoration of the 60-acre pastureland back to salt marsh and mudflats. A monitoring program would be initiated by other agencies upon project approval to permit a comprehensive analysis of wetland restoration benefits.

26. Evacuation of the Floodplain. All flood-prone land below elev. 10, NGVD would be purchased. Twelve current residences and other improvements including abandoned residences, outbuildings, and fences would be removed from within the 500-year flood plain. In addition, unimproved property within the flood plain would also be acquired. Utilities that could be damaged by tidal fluctuations would be relocated. After home owners receive fair market value for their residence, they would have the option of purchasing the structure back at salvage value. They would then be responsible for removing the structure from the flood plain within a specified period.

27. Road Raising. With the breaching of the levee, lower portions of Southwest Boulevard and Illinois Avenue would be subject to flooding. However, the majority of damages could be eliminated by raising the roadways above the influence of daily tidal fluctuations - elev. 7 feet, NGVD. For further discussion, see page C-22.

28. Baseline Studies. In order to insure that rearing habitat is immediately available in the project area, baseline studies of the physical and biological features are necessary. This will verify that conditions are suitable for establishing the lower elevation marsh of the type necessary for successful rearing of juvenile salmonids. As an example, since the area has been used as a pasture for a number of years, soil samples will be needed to insure that water quality problems will not occur when the area is flooded. The results of this and other baseline studies will be used to design corrective measures that should be undertaken prior to levee breaching. As a consequence, fish benefits will not be delayed. These studies, which could be considered as biological plans and specifications, are more detailed than required for this DPR, and therefore have not yet been accomplished. The most desirable sampling period is the spring through summer when the biological system is most active. A post-construction monitoring plan should also be conducted to verify the predicted benefits, but this latter cost is beyond the scope or authority of this Section 205 program. Post-construction monitoring could be an ideal research and development program.

29. Levee Breaching. Once the area east of Southwest Boulevard is cleared of improvements and the roadway is raised, the existing levee along Coalbank Slough would be breached in several locations. This will result in the previously levee-protected area assuming the habitat of a salt marsh or mudflat and being subject to tidal action or flooding. Final details of the floodplain inundation will depend upon the results of the baseline studies conducted during plan and specifications stage.

30. Freshwater Impoundment. Little Creek flows through the study area from west to east after leaving the hills to the west. The stream is spring-fed, with water of sufficient quantity and quality to support fishery production. The watershed, for the most part, is very heavily vegetated and appears to be

in near-pristine condition. Study of streamside conditions at an Oregon Department of Fish and Wildlife (ODFW)-operated salmon hatchery on Priorli Creek, 8 miles east of Coalbank Slough, indicates that a small impoundment and hatchboxes can be used to raise fall chinook salmon from egg to pre-smolt size for very little initial and annual cost. The 8-acre area west of Southwest Boulevard below elev. 10, NGVD, has been studied and, with a freshwater impoundment in place, could be used to raise 1,000,000 fall chinook to pre-smolt size in a 3-month period each year. The 60-acre restored salt marsh and mudflat would be the rearing place for an additional 35,000 chinook salmon fry from areas upstream from Libby Dike. The State of Oregon has initiated the STEP program in several locations. Initial results are very promising.

31. Fishery production and resultant benefits are directly dependent upon the size of the freshwater rearing pond west of Southwest Boulevard. Coalbank Slough and the Coos Bay estuary will essentially support any level of fish production from that pond. Benefits have been calculated using an 8-acre rearing pond that corresponds to a water surface elevation of 5 feet. This size of pool would result from using the entire evacuated floodplain and allowing a small buffer around the pool perimeter. A larger pool could be created if the water surface elevation was raised; however, this would impact 10 residences that are adjacent to the floodplain. The acquisition of 10 additional residences that are not subject now to flooding is unacceptable to the local sponsor. Since "Principles and Guidelines" states that all alternatives including the NED plan should be formulated in consideration of four criteria - including acceptability, the 8-acre freshwater pond is considered the maximum size that Englewood Diking District would support. Therefore, this pool size is also the optimum plan for benefits.

32. Operation and Maintenance. The State sponsor will be responsible for physically operating and maintaining the completed project.

33. Construction Schedule. Plans and specifications (P&S) will require about six months for preparation. If approval and funding is received by 1 April 1987, P&S could be completed by the end of fiscal year (FY 87). If authority for construction was received by 1 January 1988, land acquisition, structure removal, and initial road raising could be completed by 31 December 1988.

Minor road work and fish facilities would be completed by the end of FY 89. In-water work will be compatible with Oregon Department of Fish and Wildlife criteria.

34. Environmental Effects of the Plan. Evacuation of the floodplain, removal of all improvements from the affected area, and creation of a freshwater impoundment west of Southwest Boulevard would have a dramatic environmental impact on the area. The new ponding area would provide increased freshwater marsh habitat for fish and wildlife. Breaching the levee would result in 60 acres of mainly pastureland reverting from a palustrine emergent diked wetland to an intertidal salt marsh/mudflat. Material from the levee breachings could be used to create bird nesting islands. Creation of a new salt marsh/mudflat environment would result in vegetation changes beneficial for detrital material contribution to the marsh and to Coalbank Slough. An increase in the number of waterfowl, shorebirds, invertebrates, and fish species such as shiner and top smelt, steelhead (in addition to salmon), searun cutthroat trout, striped bass, English sole, starry flounder, and also Dungeness crab would result. Turbidity in Coalbank Slough would be increased temporarily as a result of road raising, drainage channel preparation, and levee breaching. Bald eagles, officially listed as an endangered species and winter residents in the area of the project, would benefit from salt marsh/mudflat restoration.

35. Sponsorship. The initial request to study this project was received in August 1983 (Exhibit 1). The Englewood Diking District was then formed in August 1984 to serve as a project sponsor (Exhibit 2). Initial study focussed on levee rehabilitation, but the NED plan is identified as permanent flood plain evacuation. This alternative would have two distinct phases: 1) removal of damagable property from floods, and 2) the new land use of the evacuated floodplain for fishery enhancement. Both of these two phases have a different sponsor: the Englewood Diking District with the support of Coos-Curry Council of Governments, and the State of Oregon, Division of State Lands (DSL), respectively. Both of these sponsors have expressed an interest in providing in-kind services to fulfill their share of project costs. Their letters of intent to sponsor the project are included as Exhibits 3 and 4, respectively.

36. Other Plan Effects. Implementation of the selected plan would result in significantly reduced flood damages within the affected area. The region's depressed economy would be bolstered by short-term employment of otherwise under- or unemployed construction workers.

DIVISION OF RESPONSIBILITY

37. Federal Costs. This study was initiated before study cost-sharing was implemented. Therefore, the Federal Government assumes all costs for preparation of the initial appraisal ($7,500), reconnaissance ($60,200), and this DPR ($228,200). Upon initiation of plans and specifications, project cost-sharing will begin at a ratio of 75% Federal and 25% local. Both flood damage reduction and fishery enhancement are shared at the same ratio. Total cost for project construction is estimated at $1,714,500. The Federal share (75%) is $1,285,900. A further analysis of investment costs by allocation are detailed in Table 2, and page C-30.

38. Non-Federal Costs. The project sponsors assume 25% of project costs which totals $428,600; $91,300 associated with flood damage reduction, and $337,300 for fishery development. In addition to the items listed in the letters of intent (Exhibits 3 and 4), the local residents have agreed in concept to sell their land and improvements within the floodplain, and the State agrees to operate and maintain the fishery facilities. A summary of sponsorship costs is shown in Table 3. Current cost-sharing guidance for permanent flood plain evacuation does not require a 5% upfront cash contribution from the sponsor. As a result, sponsorship obligations are proposed to be fulfilled through in-kind services. However, traditional local sponsorship (A-B-C's) is still required as detailed in the local cooperation agreement. The cost of providing lands, easements, and rights-of-way, in addition to improvements, utility relocations, severance, and relocation assistance (PL. 91-646 costs) totals $1,141,900. Because cost for this traditional sponsorship far exceeds the 25% local requirement ($428,600), the excess cost of $713,300 will be reimbursed to the local sponsor after construction completion. Although this reimbursement will help the local sponsor to afford the project, the need for excessive up-front financing may create a temporary hardship.

TABLE 2
ESTIMATED INVESTMENT COSTS

Feature	Flood Damage Reduction Costs	Fishery Development Costs	Joint Costs
Base Course	7,400		
Leveling Course	2,500		
CMP Culvert & Acces.	32,000		
Road Relocations	25,000		
Utility Relocations	15,000		
Sewage Relocations	75,000		
Demolitions	70,800		
Baseline Studies		150,000	
Fishladder & Pond		75,000	
Levee Breach		10,000	
Mobilization & Demob.			10,000
Embankment			21,000
Residential Lots			150,000
Pastureland			65,000
Timberland			8,000
Public Streets			0
Land Salvage			(14,800)
Improvements			295,000
Improvement Salvage			(15,700)
Severance			37,000
PL 91-646 Costs			194,000
Acquisition & Admin.			118,000
Subtotal	227,700	235,000	867,500
Contingencies	45,500	47,000	136,200
Engr. & Design	34,200	35,300	4,700
Superv. & Admin.	27,300	28,200	3,700
Inter. During Const.	5,000	5,100	12,100
First Cost Subtotal	339,700	350,600	1,024,200
TOTAL FIRST COSTS:		1,714,500	
FIRST COSTS LESS RELOCATION ASSISTANCE (see p. C-22)		1,520,500	

TABLE 3
COST SHARING OBLIGATIONS

Total project investment cost	$1,714,500
Flood damage reduction cost	$ 365,300
Fishery development cost	$1,349,200
Flood damage reduction sponsorship	$ 91,300
Fishery development sponsorship	$ 337,300
Federal portion	$1,285,900

ECONOMICS OF THE SELECTED PLAN

39. Methodology. The economic methodology for this study is based upon comparing the estimated annual benefits to the estimated annual costs over the 50-year economic life at an interest rate of 8-7/8 percent. Costs are based on a 1986 price level. Because the two project purposes of flood damage reduction and fishery enhancement have common or joint costs, a cost allocation procedure has been used to equitably distribute the costs. The separable cost remaining benefits (SCRB) method is mandated by Corps guidance for this analysis. A detailed economic discussion is contained in Appendix C.

40. Average Annual Benefits. Average annual damages were determined by the damage-frequency integration method (ER 1105-2-40). The measure of flood control benefits for structural alternatives is the difference in damages which would occur, on an annual basis, with the project as compared to without the project. The levee rehabilitation and setback levee were analyzed at 100-year level of protection. Only partial benefits were received from the freeboard range above the 100-year flood elevation. The permanent floodplain evacuation alternative removed most damagable improvements below elev. 10 feet, NGVD. This corresponds to a 500-year level of protection. However, net benefits for raising Southwest Boulevard maximized at elev. 7 feet, NGVD. For permanent floodplain evacuation, benefits accrue from both reductions in externalized costs of the floodplain insurance program and the new floodplain use - fishery enhancement. Benefits from the new fishery are not credited to the project until year-4 due to the 1-year delay for facility construction and 3-year rearing delay for anadromous fish. Therefore, total equivalent average annual benefits are $1,220,400. The fishery benefits are further classified between commercial and recreational as discussed in Appendix C. As a means of determining the benefit sensitivity to the recreation fishery, an equivalent average annual benefit excluding the recreational fishery is $961,700.

41. Estimated Investment Cost. The total estimated investiment cost of the selected plan is $1,714,500. Total Federal investment is $1,285,900, while State investment is $337,300 and local costs are $91,300. A summary of estimated investment costs and cost sharing obligations is given in Tables 2 and 3, respectively.

42. Inflation Adjustment. Because of a low rate of inflation today, and the short construction time of this project, an inflation factor was determined insignificant.

43. Annual Operation, Maintenance, and Replacement Costs. The only operation, maintenance, and replacement (OM&R) costs associated with the selected plan are for fishery facilities. These total $7,700 on an average annual basis and are a non-Federal responsibility.

44. Average Annual Costs. Combining the amortized estimated investment cost and the OM&R cost results in an average annual cost of $144,600. The PL 91-646 costs - relocation assistance - are not included because they are considered a social cost, and not required for project justification.

45. Benefit to Cost Ratio. The average annual benefits compared to the average annual costs result in an overall ratio of 8.44:1. Even if benefits for the recreation fishery were deducted,the ratio would still remain 6.65:1.

LOCAL COOPERATION AND AGENCY COORDINATION

46. Public Involvement. During this study, several informal meetings were held with residents of the diking district. A formal public meeting was conducted on 18 November 1985 in Coos Bay to discuss the problems and alternative solutions. This meeting was advertised in advance and open to the general public. In addition, results of the meeting were described in the local newspaper the next day. At a diking district meeting in December 1986, the members voted to support, in concept, the purchase of their flood-prone property. The Draft DPR and Environmental Assessment will be available for public review.

47. Agency Coordination. In addition to the formal public meeting mentioned above, agency representatives were invited to participate in a workshop to discuss the creation of a new fishery in the evacuated flood plain. The workshop, held on 1-2 July 1986 was attended by 18 representatives from Federal, State, and local resource agencies. Their comments were helpful in formulating the need for baseline and monitoring studies. Other typical

coordination included: Fish and Wildlife Coordination Act Report (Appendix D), Planning Aid Letter with Endangered and Threatened Species List (Exhibit 5), and State Historic Preservation Officer Clearance (Exhibit 6). The Draft DPR and Environmental Assessment will also be available for agency review.

CONCLUSION

48. Discussion. This project offers an opportunity to not only eliminate most flood damages within the study area, but also to supplement the natural fishery and environment. The depressed economy of Coos Bay and the deteriorated levee system which is over 100 years old have overtaxed the capability of the diking district to provide needed repairs. This project would allow the residents to sell their flood-prone property at a fair market value and relocate in a safer environment. At the same time, the floodplain would be converted to a new use - fish and wildlife enhancement - which has been successful nearby and is more conducive to this setting. This plan is supported by the local residents and State resource agencies. The formulation of this project is consistent with current cost-sharing requirements and serves as an example of how sponsorship obligations can be fulfilled with creative formulation and in-kind services.

49. Recommendation. To be completed after review.

FINDING OF NO SIGNIFICANT IMPACT

LIBBY DIKE-COALBANK SLOUGH

COOS COUNTY, OREGON

Libby Dike is located at the southeastern limits of the city of Coos Bay and forms the left bank of Coalbank Slough. The proposed action is to purchase all flood prone lands and improvements below 10 feet National Geodetic Vertical Datum, and to provide relocation assistance to the occupants at government expense. The 60-acre pastureland adjacent to the dike would then revert to a salt marsh/mudflat. A detailed description of the proposed action is included in the attached Environmental Assessment. I have reviewed the Environmental Assessment and have determined that the proposed action would not significantly affect the quality of the human environment and that an Environmental Impact Statement is not required.

Date: _____

GARY R. LORD
Colonel, Corps of Engineers
District Engineer

ENVIRONMENTAL ASSESSMENT
LIBBY DIKE-COALBANK SLOUGH
COOS COUNTY, OREGON

1. Introduction

Libby Dike is located at the southeastern limits of the city of Coos Bay, in Coos County, Oregon. The dike forms the left bank of Coalbank Slough three miles upstream from its confluence with Isthmus Slough. That confluence is approximately one mile south of the bay. The dike is thought to have been constructed in the late 1800s by private interests, and is privately owned and maintained. It is approximately 5,500 feet long and protects an estimated 11 acres of residential land (12 residences), 56 acres of pasture land, and 7 acres of undeveloped land. An additional 5 acres of land in the diking district are above flood levels.

In January of 1983, a winter storm with wind velocities up to 60 miles per hour passed over southwestern Oregon. This storm produced five separate episodes of overtopping of Libby Dike due to storm-enhanced high tides. During at least one of these episodes, the levee was subjected to overtopping along nearly the entire length. The cumulative effect of the 1983 storm event, and those occurring in subsequent years, is that the dike is now in a weakened condition and not capable of providing the same level of flood protection as it did prior to 1983. Because of the reduced cross-sectional area, this weakened condition makes the structure prone to a complete breach from future storm events.

2. Proposed Action and Alternatives

The proposed Federal action involves the purchase of all flood-prone lands and improvements below 10 feet National Geodetic Vertical Datum (NGVD), and to provide relocation assistance to the occupants and their farm operations at government expense (Figure 10). Libby Dike would then be breached to restore approximately 60 acres to natural salt marsh and mudflat. A 480-foot section of Southwest Boulevard and a 600-foot section of Illinois Avenue would be raised to elevation 7 feet NGVD to prevent major flooding of the roadways.

The proposed raising would consist of constructing new embankment over the existing roadways of Southwest Boulevard and Illinois Avenue. The existing foundation soils are highly susceptible to failure due to lateral spreading; therefore, the levee embankment is designed to minimize this risk. The Southwest Boulevard raise section would consist of a 36-foot-wide levee constructed to El. 8.0 (NGVD), with side slopes 1V to 3H. The levee would be reinforced with 20-foot-wide berms on both sides of the levee, constructed to El. 5.0 (NGVD) with 1V to 3H slopes to the toe of the berms. The Illinois Avenue raise would consist of a 15-foot-wide levee embankment constructed to El. 8.0 (NGVD) with side slopes 1V to 3H. The top section consists of an 8-inch base course material and 2-inch leveling course material. Typical levee sections are shown on Plate 2. Approximately 3,500 cubic yards (cy) of embankment material, 500 cy of base course material, and 150 cy of leveling course material would be required.

The following structural alternatives to the proposed action were considered and subsequently eliminated because they were not as cost effective as the proposed action:

1) Rehabilitate the Existing Dike. This alternative would involve upgrading the top width and sideslopes of the existing dike to Corps standards. The dike would be raised to elevation 13.1 NGVD, providing 100-year flood protection for the adjacent land. This alternative would alter approximately 11 acres of the adjacent wetland (1 evacuation).

2) Construct a Short Dike. This alternative would involve the placement of a dike, approximately 2,200 feet in length, along a new alignment protecting 33 acres and 8 of the 12 residences (4 evacuations). The new short dike would cover approximately 4 acres of wetland now being used as pasture. The remaining 37 acres of flood plain outside the new dike would retain the current level of protection provided by the existing dike.

The no action alternative was considered and subsequently eliminated because the proposed action was cost effective and supported by the sponsors.

3. Affected Environment

Based upon soil information, vegetation, and visible hydrology, nearly all of the proposed project area is classified as a palustrine emergent diked wetland. The contribution of this wetland to the productivity of Coos Bay Estuary, however, has been greatly reduced by the presence of the levee, which restricts the movement of the tide and the input of organic material to the estuary. Soils in the project area as mapped by the Soil Conservation Service are Langois silty clay loam and Langlois peaty silty clay loam. Both of these soils have poor drainage characteristics. Common wetland plants occupying the area are buttercup (Ranunculus spp.) and reed canary grass (Phalaris arundanacea). The project area between the levee and Southwest Boulevard is pastureland (approximately 60 acres) and is subject to heavy grazing and haying. Land west of Southwest Boulevard is generally ungrazed and is dominated by a heavy growth of reed canary grass. This plant would probably also dominate the pastureland east of Southwest Boulevard if left ungrazed.

No fish surveys have been made in the one or two shallow channels existing behind the levee. However, Oregon Department of Fish and Wildlife (ODFW) gillnet surveys in 1979 revealed that several commercial and sport fish, including striped bass and starry flounder, inhabit Coalbank Slough. Top smelt, shiner perch (important prey species) and Dungeness crab were also present. Remnant runs of coho salmon, steelhead, and searun cutthroat trout utilize Coalbank Slough and its upper tributary streams. These runs are also being supplemented along with attempts to establish a fall chinook fishery through the Salmon Trout Enhancement Program (STEP) which is coordinated by ODFW.

Wildlife expected to use the ditches running through the site include raccoon, mink, gulls, and several species of waterfowl and shorebirds. Rodents are common and provide food for northern harrier and other raptors that may frequent the area. Bald eagles, Federally classified as threatened, are winter residents within the area. The project area, although a wetland, drains rapidly due to the internal drainage ditches. Despite these drainage features, however, it is considered of moderate value to fish and wildlife because of the increasing scarcity of wetlands along the Oregon coast.

The proposed project area lies within the boundaries of three county zoning districts (Figure 10) which are described in the Coos Bay Estuary Management Plan (CBEMP). This local land use plan was acknowledged by the Land Conservation and Development Commission (LCDC) in June 1984. The zoning districts are as follows:

1) Conservation Aquatic - includes the aquatic area of Coalbank Slough. The management objectives for this portion of the zoning district are to restrict intensive uses and protect the area's resource productivity.

2) Rural Shorelands - includes the 60-acre pastureland which is bordered by Coalbank Slough to the east and Southwest Boulevard to the west. According to the CBEMP, this district shall be maintained for agricultural uses. This district also contains two "low" priority mitigation sites, both located within the 60-acre pasture.

3) Exclusive Farm Use - includes the proposed project area west of Southwest Boulevard, which is occupied by 5 of the 12 residences.

4. Environmental Effects

Breaching the levee is expected to result in about 60 acres of pastureland reverting to a salt marsh/mudflat (Figure 11), with vegetation consisting of Lyngbye's sedge (Carex lyngbei), pickleweed (Salicornia virginia), and arrow grass (Triglochin maritima). Lyngbye's sedge, one of the highest primary producers of energy into marsh systems, is likely to cover 2 to 5 acres of restored marsh. Other marsh plants would also contribute detrital material. The 60-acre salt marsh/mudflat and the rest of Coalbank Slough would receive most of this detrital input. There would be secondary beneficial effects to Coalbank Slough resulting from slowing the flow in the presently constricted channel by allowing water to disperse over the previously leveed area. This would allow the sifting mix of bottom sediments in Coalbank Slough to settle and become covered with finer sediments that are more biologically productive.

The 60-acre salt marsh/mudflat portion of the restored area and the improved bottom sediments in Coalbank Slough would support large numbers of

invertebrates. The tube dwelling amphipod Corophium, a major food source for salmon rearing in the estuary, are very abundant in Coalbank Slough. These invertebrates would be fed upon by bait fish (shiners and top smelt) and juvenile sport and commercial fishes, including salmon, steelhead, searun cutthroat trout, striped bass, English sole, starry flounder, and Dungeness crab. All these economically important species would benefit.

Salt marshes provide high quality habitat to a variety of wildlife species, especially waterfowl and shorebirds. An increase in use of the restored marsh and mudflat would be expected by these groups of birds. The proposed project would have no adverse effect on the bald eagle.

Raising Southwest Boulevard and Illinois Avenue to 7 feet NGVD would back water up Little Creek, creating an 8-surface-acre freshwater impoundment west of Southwest Boulevard (Figure 11). Most of the impoundment would be open water with aquatic and semi-aquatic vegetation prevalent around the edges. Cattail (Typha spp.) and bulrush (Scirpus spp.) would likely become the dominant edge vegetation.

The freshwater marsh created by the impoundment would provide habitat for a variety of wildlife. Waterfowl would be expected to nest in the area, and the surrounding riparian habitat would support a variety of passerine (song) birds. The impoundment, in combination with STEP, could also provide a rearing area for juvenile fall chinook salmon.

Raccoons, mink, and striped bass can be expected to prey upon juvenile and adult salmonids. Losses from this predation, however, are not expected to be significant enough to decrease the benefits to salmonids which would be obtained as a result of this project.

5. Consultation Requirements

a. Clean Water Act of 1977 (33 U.S.C. 1344): Inwater activities associated with this project, such as raising Southwest Boulevard and Illinois Avenue, and breaching the existing levee, will require an evaluation in accordance with Section 404(b) of this Act. Because sufficient design

information is not available at this time, the evaluation will be prepared after all project details have been resolved from the baseline studies. The proposed inwater work will not be performed until certification as required under Section 401 of this Act has been obtained from the Oregon Department of Environmental Quality.

b. Coastal Zone Management Act of 1973, as amended: The Coos Bay Estuary Management Plan, acknowledged by LCDC in 1984, has been evaluated. Three county zoning districts are included in the proposed project area: Conservation Aquatic, Rural Shorelands, and Exclusive Farm Use. All three districts would allow restoration of the project area. It has been determined, therefore, that the proposed project is consistent with the CBEMP to the maximum extent practicable.

c. Endangered Species Act of 1973, as amended: The U.S. Fish and Wildlife Service (FWS) has been consulted. In a letter dated January 4, 1985, the FWS listed the bald eagle as a winter resident within the proposed project area. A biological assessment has been prepared by a Corps biologist and has concluded that the proposed action would have no adverse effect on wintering bald eagles.

d. Fish and Wildlife Coordination Act: A Fish and Wildlife Coordination Act Report, dated August 1985, was received for this project and used in the preparation of this environmental assessment. A letter report dated March 10, 1986, provides additional information concerning this project.

e. Marine Protection, Research and Sanctuaries Act of 1972, as amended: Not applicable to this project.

f. Cultural Resources Acts: Field inspection by a staff archeologist has been conducted; no significant cultural resources were documented. The State Historic Preservation Officer has been consulted and has concurred with the findings of the investigation (see attached letter). A review of the latest published version of the National Register of Historic Places and addenda shows that the area to be affected does not contain any registered properties or properties determined to be eligible for nomination to the National Register. Therefore, it has been determined that no significant cultural resources will be affected by the proposed action.

g. Executive Order 11988, Flood Plain Management, 24 May 1977: The proposed action would change the land use of the area adjacent to Coalbank Slough from pastureland to salt marsh/mudflat, and would create an 8-surface-acre freshwater impoundment west of Southwest Boulevard. No new development would be encouraged within the area as a result of the proposed action.

h. Executive Order 11990, Protection of Wetlands, 24 May 1977: The 60 acre pastureland behind the dike is classified as a palustrine emergent diked wetland. Contribution of this wetland to the overall productivity of the Coos Bay Estuary has been reduced because of the presence of the dike. The proposed project would increase the value and productivity of the wetland area by allowing the pastureland to revert to a salt marsh/mudflat. This would result in an increase in the number of invertebrates (food source for fish) present and an increase in use of the area by waterfowl and shorebirds.

i. Analysis of Impacts on Prime and Unique Farmlands, CEQ Memorandum 1976: No prime or unique farmlands would be affected by the proposed project.

j. Clean Air Act of 1973, as amended: This Environmental Assessment along with the Definite Project Report are being provided to the Environmental Protection Agency for their review in accordance with Section 309 of this Act.

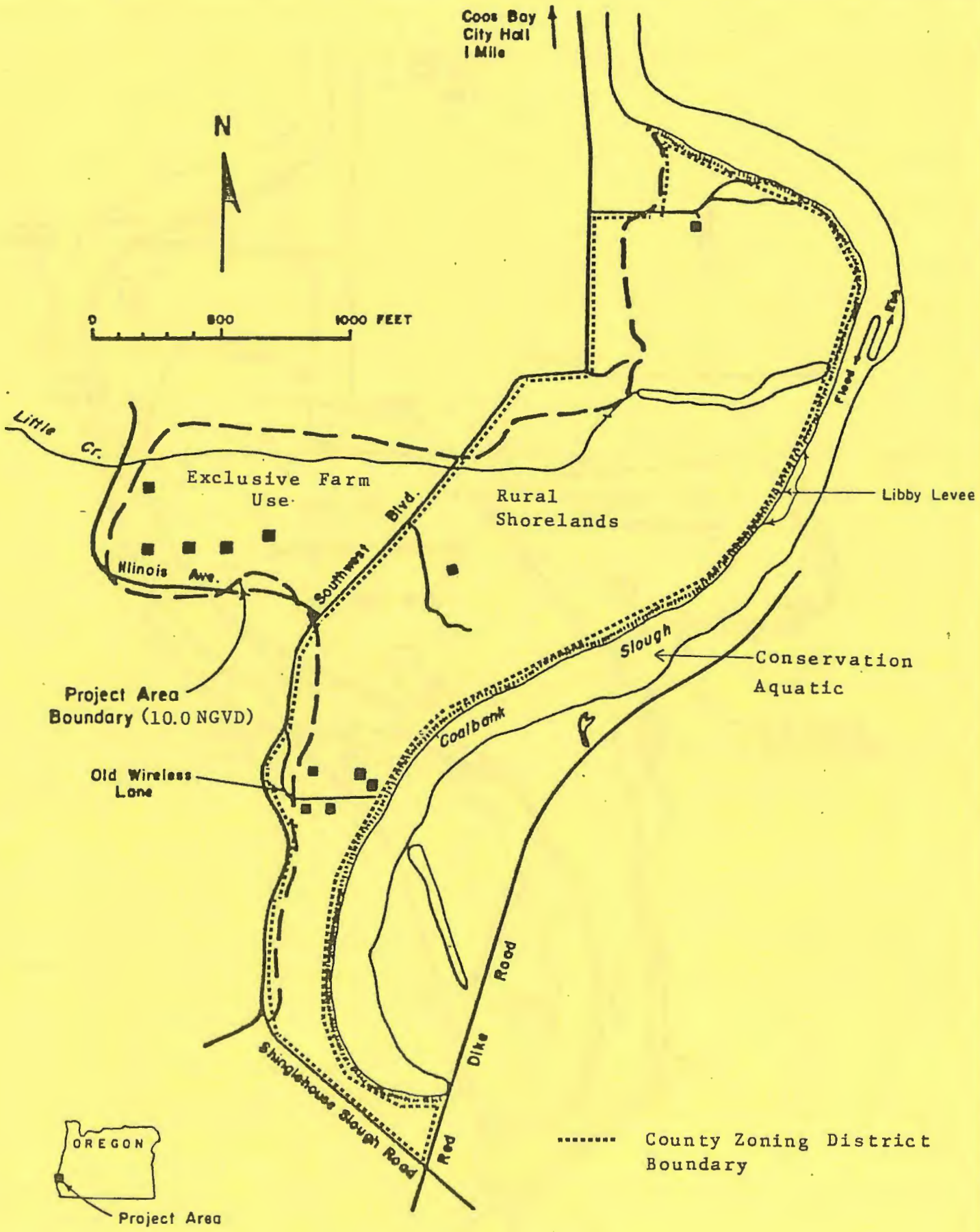


Figure 11. Libby Dike Land Use.

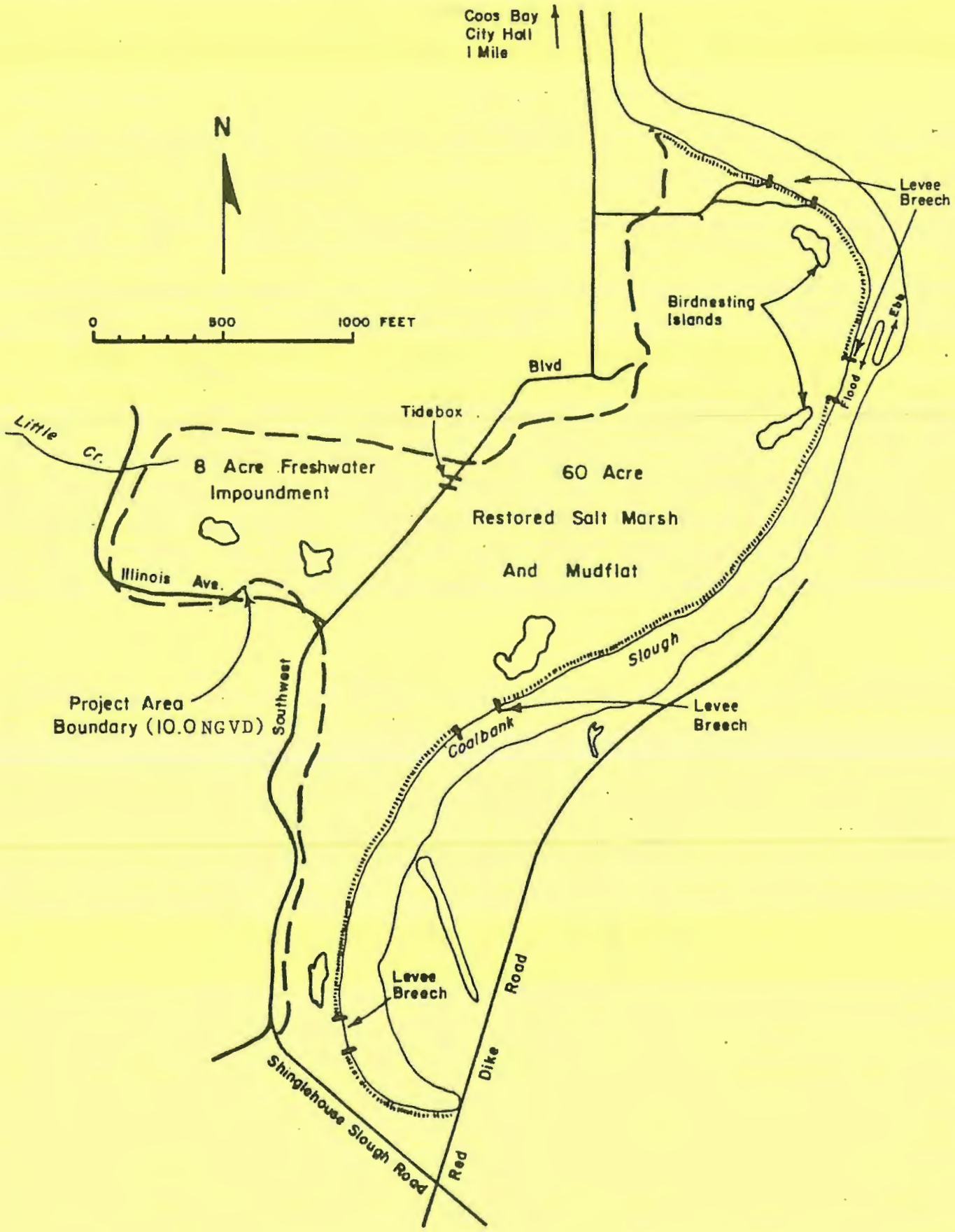
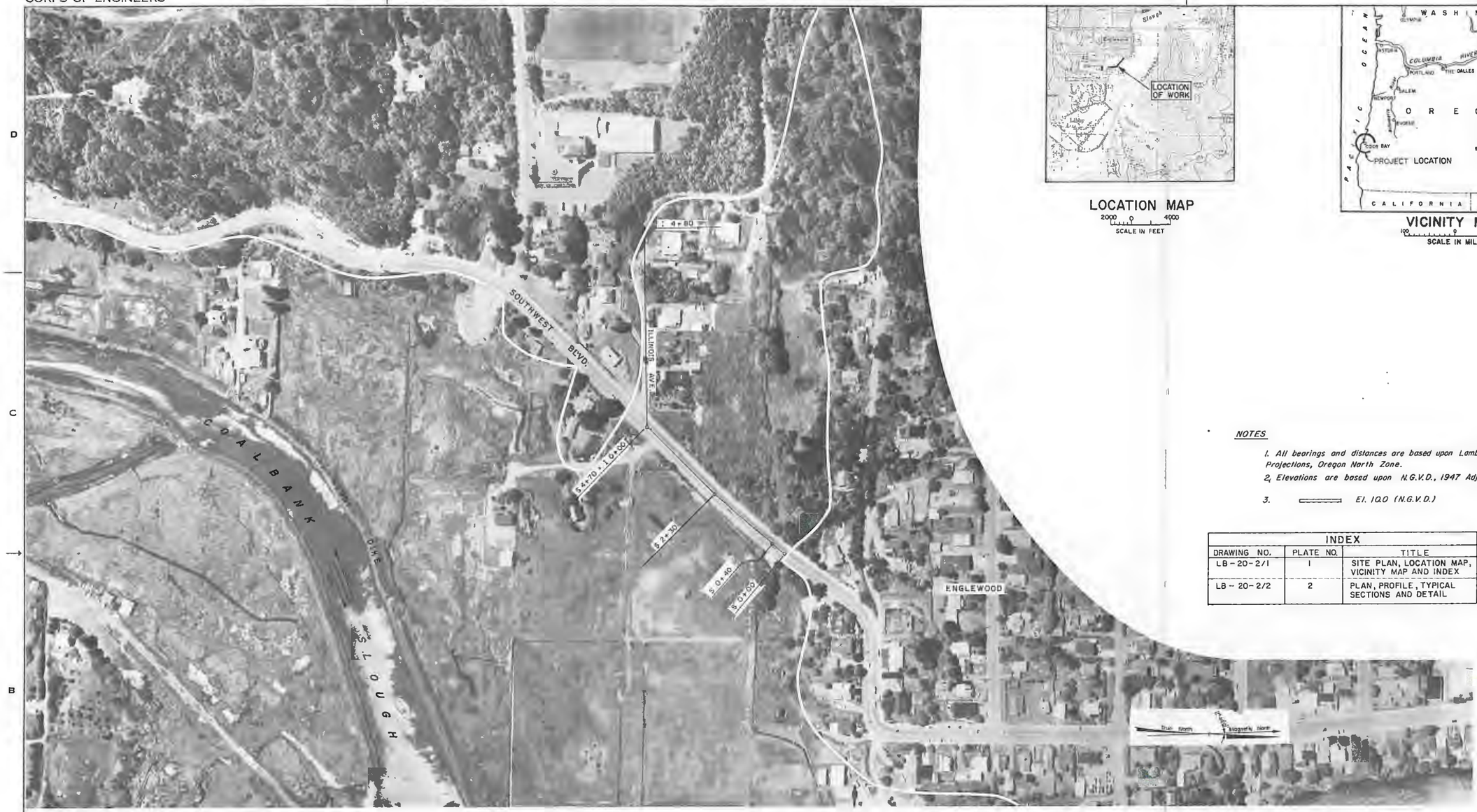


Figure 12. Proposed Fishery Habitat.



SITE PLAN
100 0 100 200 300
SCALE IN FEET

LOCATION MAP
2000 0 4000
SCALE IN FEET

VICINITY MAP
100 0 100
SCALE IN MILES

NOTES

1. All bearings and distances are based upon Lambert Projections, Oregon North Zone.
2. Elevations are based upon N.G.V.D., 1947 Adj..
3. ═══ El. 10.0 (N.G.V.D.)

INDEX

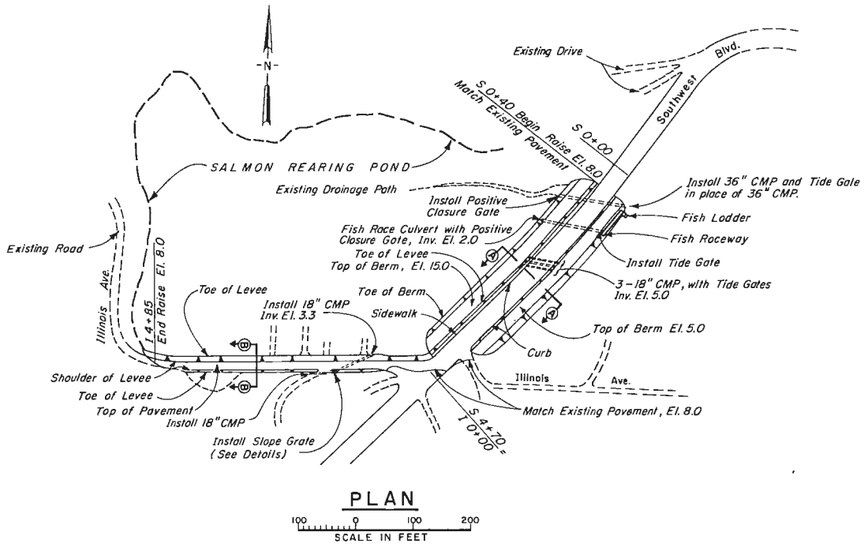
DRAWING NO.	PLATE NO.	TITLE
LB-20-2/1	1	SITE PLAN, LOCATION MAP, VICINITY MAP AND INDEX
LB-20-2/2	2	PLAN, PROFILE, TYPICAL SECTIONS AND DETAIL

U. S. ARMY ENGINEER DISTRICT, PORTLAND

COOS BAY, OREGON
LIBBY DIKE
PROPOSED IMPROVEMENTS, FLOOD PROTECTION

SITE PLAN, LOCATION MAP, VICINITY MAP AND INDEX

SURVEYED:	DESIGNED: EJP	DRAWN:	CHECKED:
DATE:	SHEET:	LB-20-2/1	PLATE: 1



PLAN

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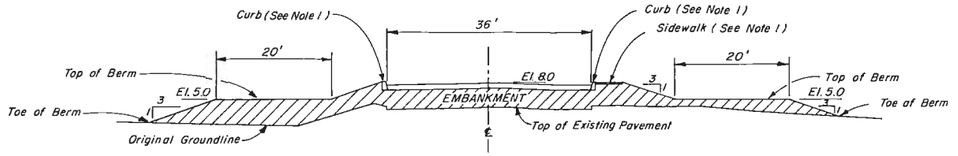
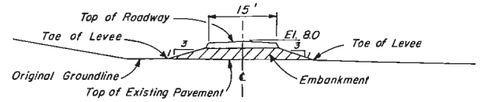
SCALE IN FEET



SOUTHWEST BLVD. SECTION (A)

NOTES:

1. Curbs and sidewalk are to be constructed one year after construction of levee embankment.



ILLINOIS AVE. SECTION (B)

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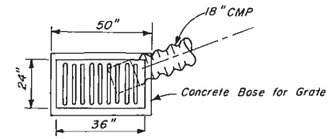

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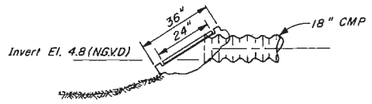
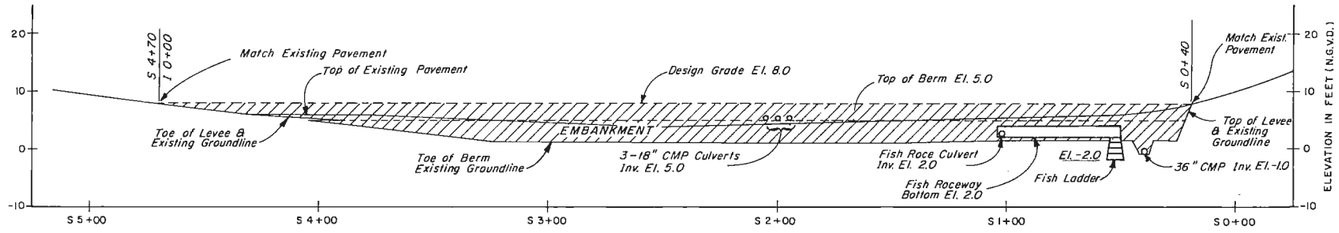


PROFILE

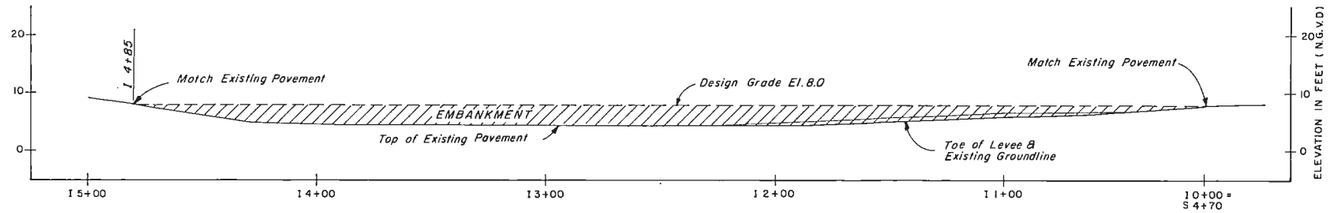
SLOPE GRATE DETAIL

N.T.S.



SOUTHWEST BLVD. PROFILE

10 0 20 40 60 80 100
HORZ. SCALE IN FEET



ILLINOIS AVE. PROFILE

10 0 20 40 60 80 100
HORZ. SCALE IN FEET

REVISION	DATE	DESCRIPTION	BY

U. S. ARMY ENGINEER DISTRICT, PORTLAND

COOS BAY, OREGON

LIBBY DIKE

PROPOSED IMPROVEMENTS, FLOOD PROTECTION

PLAN, PROFILE, TYPICAL SECTIONS AND DETAIL

SUPERVISED:	DESIGNED: EJP	DRAWN:	CHECKED: JDT
DATE:	SHEET:	LB-20-2/2	PLATE 2

APPENDICES

APPENDIX A
GEOTECHNICAL EVALUATION

1. SCOPE. This appendix examines the existing flood protection system, describes existing embankment and foundation conditions along the selected plan alignment, and includes design and construction comments related to the proposed levee improvements for alternatives 2 and 3.

2. GENERAL. Cornforth Consultants, Inc. was retained to perform foundations investigations and engineering studies related to design and construction of proposed levee improvements. These investigations included explorations, laboratory testing, and design analysis and evaluations of levee embankment and foundation features. The above engineering studies were supplemented by some in-house field reconnaissance and design work.

3. GENERAL TOPOGRAPHIC FEATURES. The study area borders the west bank of Coalbank Slough near the southeast limits of the City of Coos Bay in Coos County, Oregon. Coalbank Slough joins with Isthmus Slough approximately 1.5 miles downstream from the project site. Isthmus Slough is a tributary of Coos Bay. The existing levee system, about 5,500 feet in length, protects approximately 56 acres of pastureland and 11 acres of residential lands. The pastured area is relatively flat, varying in elevation from 0.5 to 2.5 feet NGVD. An abrupt hillside rising several tens of feet above the flood plain level forms the west boundary of the study area. A vicinity map and project plan are shown on Figure 1, of the main report.

4. EXISTING FLOOD PROTECTION SYSTEM. The existing levee system is not considered adequate to provide protection for over a two-year flood frequency. During periods of intense winter storms, and storm-enhanced high tides, the existing levee embankment is subject to overtopping, resulting in inundation of the protected area. There is visual evidence of minor embankment reconstruction attempts, probably at breached or weakened locations. In 1983, the levee system was overtopped and local interests requested emergency assistance from the Corps of Engineers.

5. PROPOSED LEVEE IMPROVEMENT PLAN. Although the proposed plan calls for permanent floodplain evacuation, soil explorations were undertaken for the structural alternatives, and those findings will be used for structural components for this non-structural solution. Referenced borings and soil profiles are available for review in the back-up files.

6. EXPLORATIONS. The levee foundation investigation included eight Standard Penetration flight auger borings. Two additional angle auger borings were drilled into the levee embankment. Representative samples were obtained for soil classification, shear and consolidation tests. Location of explorations are shown on Figure A-1. One bulk sample from a potential borrow source for levee embankment was also obtained during field investigations.

7. LABORATORY TESTING. Numerous tests were performed on levee and foundation materials for soils classification. Natural moisture contents were determined on almost all samples. Other classification included Atterberg Limit and material gradation determination, and unit weight and visual classification of representative portions of all thin wall tube samples. Five unconfined compressive strength tests were performed on thin wall tube samples from various depth in borings B-1, B-3, B-6, B-7, and B-8. Torvane undrained strength determinations were performed on all thin wall tube samples. Two odometer consolidation tests were run on thin wall tube materials representing the siltier shallow materials and the materials with more clay at the 15 to 20-foot depth. A triaxial consolidation test was conducted on an undisturbed sample of clayey silt from boring B-3 to further define time-rate response to loading. Classification and compaction testing was performed on the bulk borrow sample obtained at a source west of the project site. One permeability test was conducted on borrow material remolded to about 92 to 94 percent of Standard Proctor maximum dry density. All laboratory testing was performed at the Corps of Engineers North Pacific Division Laboratory in Troutdale, Oregon, under the direction of test specifications provided by geotechnical engineer from Cornforth Consultants, Inc.

8. EXISTING LEVEE EMBANKMENT AND FOUNDATION CONDITIONS. The existing levee embankment is believed to have been constructed in the late 1800s with dredged materials from Coalbank Slough. In general, embankment materials consist of medium stiff silty clay underlain by soft clayey silt with numerous

coal and woodchip fragments included. The levee foundation consists of 1.5 to 6.5 feet of topsoil and fill underlain by at least 40 feet of very soft clayey silts and silty clays. The underlying weathered bedrock was encountered in boring B-1 at about elevation -20.5 feet NGVD. The weathered material consists of medium stiff, interbedded sand, silts and clay. Existing levee crest elevations average about 7.5 feet NGVD and average crest width is 3.0 feet. Embankment slopes are approximately 1 foot vertical (V) on 1.5 feet horizontal (H).

9. EXISTING DRAINAGE STRUCTURES. Three tideboxes are installed in the levee system protecting the improvement area. Two of these structures consist of wood boxes and flapgates and the other is a corrugated metal pipe with flapgate. These tideboxes are in poor condition and subject to leakage.

10. DETAILED LEVEE AND FOUNDATION CONDITIONS. Detailed description of existing conditions along the existing levee alignment for segment intervals are given below.

Station P10+00 to P12+84. This segment starts at a hillside tie near the upstream limit of the project and extends across a gently sloped pastureland to a tie with the existing levee at Coalbank Slough. Residential units, located landward of centerline, are supported on a 3- to 4-foot high fill. Log of boring B-8, located 21 feet right of station 12+13, indicate fill materials are soft silty clay. Fill materials are underlain by 16 feet of very soft clayey silt and, then, by 21.5 feet of very soft silty clay. Traces of fine-to-medium grained sand were encountered in the silty clay below El. -25 feet NGVD. Elevations across the pastureland vary from 1.7 to 2.0 feet NGVD.

Station P12+84 to P15+50. This segment follows the existing levee embankment downstream along the Slough to the end of landside fill area. Two residential units are supported on the 3- to 4-foot high fill. Fill materials are similar to fill materials in the prior levee segment. Levee embankment materials consist of medium stiff silty clay underlain by soft clayey silt. Log of boring B-10 indicates levee foundation materials consist of about 18 feet of very soft clayey silt underlain by 21.5 feet of very soft silty clay.

Existing levee crest elevations are approximatley 7.5 feet NGVD. The average crest width is less than 2 feet. Elevations on the landside fill are about 4.5 feet NGVD. Levee embankment slopes are approximately 1V on 1.5H.

Station P15+50 to P19+50. This segment continues downstream along the Slough and existing levee embankment. Levee embankment materials consist of medium stiff silty clay underlain by soft clayey silt. Logs of boring B-7 and B-10 indicate levee foundation materials consist 1.5 to 5.0 feet of soft silty clay (topsoil fill) underlain by 15 to 18 feet of very soft clayey silt and, then, by 21.5 feet of very soft silty clay. Existing levee crest elevations are approximately 7.0 feet NGVD. The average crest width is 7 feet. Elevations landward of the levee embankment vary from 1.5 to 2.0 feet NGVD. Levee embankment slopes are approximately 1V on 1.5H.

Station P19+50 to P21+50. This segment extends downstream along the existing levee embankment past an existing tidebox at Station P20+71. Levee embankment consists of medium stiff silty clay underlain by soft clayey silt. Log of boring B-7 indicates levee foundation materials consist of 5.0 to 6.5 feet of soft silty clay (topsoil fill) underlain by 13 to 15 feet of very soft clayey silt and, then, 21.5 feet of silty clay. Existing levee crest elevations are approximately 7.0 feet NGVD. The average crest width is 6 feet. Levee embankment slopes are approximately 1V on 2.5H. A drainage ditch and tidebox ponding area border the landward toe of the levee embankment.

Station P21+50 to P29+00. This segment continues downstream along the existing levee embankment past a tidebox at Station P27+85. Logs of boring B-5 indicates levee embankment materials consist of medium stiff silty clay with numerous included shell fragments near the embankment-foundation contact. Logs of boring B-6 indicates foundation materials consist of 18.5 feet of very soft clayey silt with some included sand partings, wood chips, and shells underlain by 21.5 feet of very soft silty clay with occasional included wood chips and shells. Existing levee crest elevations are approximately 7 feet NGVD. The average crest width is 6 feet. Landward embankment slopes vary from 1V on 2H to 1V on 5H. Elevations landward of the levee embankment vary from 1.0 to 2.0 feet NGVD.

Station P29+00 to P39+61. This segment extends downstream along the Slough past an existing tidebox at Station P38+07. Levee embankment materials consist of medium stiff silt with some included wood chips and sawdust underlain by soft clayey silt with included organics. Log of borings B-3 and B-4 indicates the levee foundation materials consist of 6 to 15 feet of very soft clayey silt with occassional wood chips and shells underlain by 26 to 34 feet of very soft silty clay with occassional included wood fragments and shells. Existing levee crest elevations vary from 6.7 to 7.8 feet NGVD. The average crest width is 4 feet. Levee embankment slopes vary from 1V on 1.5H to 1V on 5H. Ground elevation landward of the levee embankment varies from 1.0 to 2.0 feet NGVD.

Station P39+61 to P45+30. This segment continues along the existing levee embankment to a point where the breadth of levee embankment increases. Log of boring B-9 indicates levee embankment materials consist of medium stiff silty clay with some sawdust and wood chips underlain by soft clayey silt with included organics. Logs of B-2 and B-3 indicate levee foundation materials consist of 10 to 16 feet of very soft clayey silt underlain by 24 to 30 feet of very soft sily clay. Existing levee crest elevations vary from 6.0 to 8.4 feet NGVD. Average crest width is 5 feet. Levee embankment slopes are approximately 1V on 2.5H. Elevations landward of the levee embankment vary from 1.0 to 2.0 feet NGVD.

Station P45+30 to P50+85. This segment extends downstream along the slough to a tie with the hillside. Levee embankment materials consist of medium stiff silty clay underlain by soft clayey silt. Log of borings B-1 and B-2 indicate levee foundation materials consist of 7 to 15 feet of very soft clayey silt underlain by 16 to 24 feet of very soft silty clay. Weathered bedrock (Coaledo Formation) was encountered in boring B-1 at about elevation -20 NGVD. The weathered materials consist of medium stiff silty clay with fine-to-medium grained interbedded sand. Soft silty clay fill material, 3 to 4 feet in height, is located landward of the levee embankment between Station P48+50 and P50+85. Existing levee crest elevations vary from 7.0 to 8.0 feet NGVD. The average crest width is 5 feet. Levee embankment slopes are 1V on 1.5H or steeper. Ground elevations landward of the levee embankment vary from 1.0 to 2.0 feet NGVD.

11. LEVEE FOUNDATION COMMENTS. The very soft clayey silts and silty clays beneath the ground surface are weak and highly compressible. These soil properties are undesirable and represent poor foundation conditions for construction of levee improvements. Allowances of 2.5 feet for settlement are warranted for new embankment construction. Because of the softness of the foundation soils, staged construction of embankments is also warranted to prevent failure due to lateral spreading.

12. LEVEE EMBANKMENT DESIGN COMMENTS. A design water at El. 9.4 feet NGVD was used for embankment design. Minimum factors of safety obtained from stability analysis computations for steady seepage and end of construction conditions exceeded minimum values listed in EM 1110-2-1913, Design and Construction of Levees. End of construction was determined to be the most critical design condition with the critical limitation being height of new embankment construction. Staged construction of embankments is necesssary to meet the recommended minimum factor of safety.

12.1. Level Crest Grade. The design crest grade (El. 13.4) includes freeboard and an allowance for settlement. This elevation contains provisions for settlement of 1.0 foot--settlement of 1.5 feet is estimated to have occurred in earlier construction. Levee freeboard provided when ultimate settlement has occurred will be 3.0 feet.

12.2. Levee Embankment Slopes. Embankment slopes were set taking into consideration river, foundation and material placement conditions, and these factors supplemented by experience gained in the design, construction, and performance of levee embankments on the Lower Columbia River.

13. LATERAL SPREADING AND FOUNDATION STABILITY.

13.1. General. In general, foundation soils consist of an upper 20 foot zone of clayey silt (MH) underlain by 20 feet or more of silty clay (CH). The natural moisture contents of materials in both of these foundation zones generally range from 90 to 110 percent with a few determinations outside this range. The liquid limits of the foundation soils were near natural moisture contents. Plasticity chart material plots are on or close to the

A-line. Materials in the upper 20 foot zone exhibit undrained shear strengths averaging about 200 p.s.f. Foundation soils are very compressible exhibiting a compression index of 0.56 and 0.40 for two tests. Time rate consolidation results indicate relatively impermeable materials exhibiting coefficients of consolidation on the order of 75 ft^2/yr as measured in the triaxial consolidation test.

13.2. Lateral Spreading. Constructing a 12-foot high embankment (crest El. 13.4) was judged to be highly risky and susceptible to foundation failure due to lateral spreading. To minimize this risk, staged embankment construction is recommended for levee construction with the maximum initial embankment height being limited to 7.5 feet or to elevation 9.0 feet NGVD. The initial embankment height was determined using a factor of safety of 2 against bearing capacity failure.

13.3. Staged Construction. Embankment construction is recommended to be completed in two phases for both the new cross-levee and the reinforced levee sections. The second phase of construction will not be started until the initial embankment is left in place a sufficient amount of time to allow foundation materials to consolidate and increase in strength. Based on time rate consolidation results, a period of three years is required before the start of the second phase.

14. SETTLEMENT AND BEARING CAPACITY ANALYSES.

14.1. Embankment Construction, Phase I. Construction sequence for this phase consists of placing a 5-foot high berm-base embankment to El. +6.5 NGVD and then, completing the crest portion of the section to El.9.4 NGVD. This placement sequence provides a factor of safety against bearing capacity failure equal to 2 for support on a foundation strength of 200 p.s.f. Time rate analysis results for the above embankment loading indicate a consolidation period of approximately 3 years is necessary before the Phase 2 embankment construction could be started . Analyses results after the 3-year waiting period are tabulated below.

Feature	Location/Remarks
Settlement - 5 Feet High Embankment	0.5 to 0.75 Feet
Settlement - 7.5 Feet High Embankment	1.0 to 1.5 Feet
Increase in Foundation Strength	200 to 325 p.s.f.

14.2. Embankment Construction, Phase 2. Construction under this phase would consist of raising the crest portion of the Phase 1 embankment to El. 13.4 feet NGVD. The calculated factor of safety against bearing capacity failure at the end of Phase 2 construction is 1.88. This calculation is based on a Phase 1 improvement of the foundation strength to 325 p.s.f. A foundation strength of 345 p.s.f. is required to increase factor of safety to 2. Estimated additional long term settlement following Phase 2 construction are tabulated below.

Feature	Location/Remarks
Embankment Crest	1.0 to 1.5 Feet
Landside Berm	0.50 Feet

15. FOUNDATION AND MATERIAL SENSITIVITY. The unconfined compression stress-strain test curve indicate silt and clay materials in the foundation exhibit some sensitivity. Sensitive soils are subject to loss of strength due to remolding and disturbance. The actual in-place field material strengths could be higher than laboratory strength determinations if sample disturbance occurred during explorations or prior to laboratory testing. On the other hand, significant ground disturbance during construction could cause foundation materials to become softer and weaker.

16. STAGED CONSTRUCTION MONITORING. Since settlement estimates and foundation strength increases are based on analytical results using laboratory test data, foundation conditions during and following embankment construction will be monitored. Installation of settlement plates and piezometers are recommended for the foundation monitoring. In additon to the above monitoring it is recommended field vane shear testing be performed to develop undrained

shear strength versus depth profiles for at least two locations. Actual field measurement data would be used to schedule construction of Phase 2 improvements.

17. TIDEBOX CONSTRUCTION COMMENTS.

17.1. General. The new tideboxes at Stations P10+71 and P27+85 consist of 24-inch corrugated metal pipes with flapgates. The new tidebox at Station P38+07 would consist of two 42-inch CMP's with a gatewell located in riverward of the levee crest. Invert elevations at inlet and outlet ends of the tidebox barrels would be -3.5 feet NGVD. Installation of the tidebox barrels and gatewell structure would be completed in an unwatered condition. Stage embankment construction and special foundation preparation would be required due to the soft foundation conditions and anticipated embankment settlements.

17.2. Foundation Preparation. Tidebox barrels and the gatewell floor slab would be founded on a firm surface formed by overexcavating approximately 5 feet below foundation grade, covering the excavated surface with filter fabric and replacing the excavated materials with compacted backfill. The estimated allowable bearing pressure on which the filter fabric is placed is 500 pounds per square foot. The allowable bearing pressure is incresed to a minimum of 800 pounds per square foot due to the foundation preparation.

17.3. Dewatering. A system utilizing the existing levee embankment as a temporary cofferdam and pumping from sumps in the excavation area would be considered adequate for dewatering during tidebox construction. Siltation into sumps during pumping would be controlled by zoned filter materials.

17.4. Construction, Phase 1. Foundation preparation and construction of the embankment to El. +9.0 feet NGVD would be completed during Phase 1. The concrete gatewell structure at Station P38+07 would not be started during this phase of construction. A temporary interior drainage plan would be required until Phase 2 construction is started. The temporary drainage system would consist of leaving the existing tideboxes in place and installing new tidebox barrels with flapgates. Discharges from the new barrels would be

directed to the existing tideboxes. The invert grade of the new installations would be chambered beneath the maximum embankment height to allow for estimated embankment settlement during the Phase 1 surcharge period. Settlement plates would be installed to monitor tidebox barrel movements.

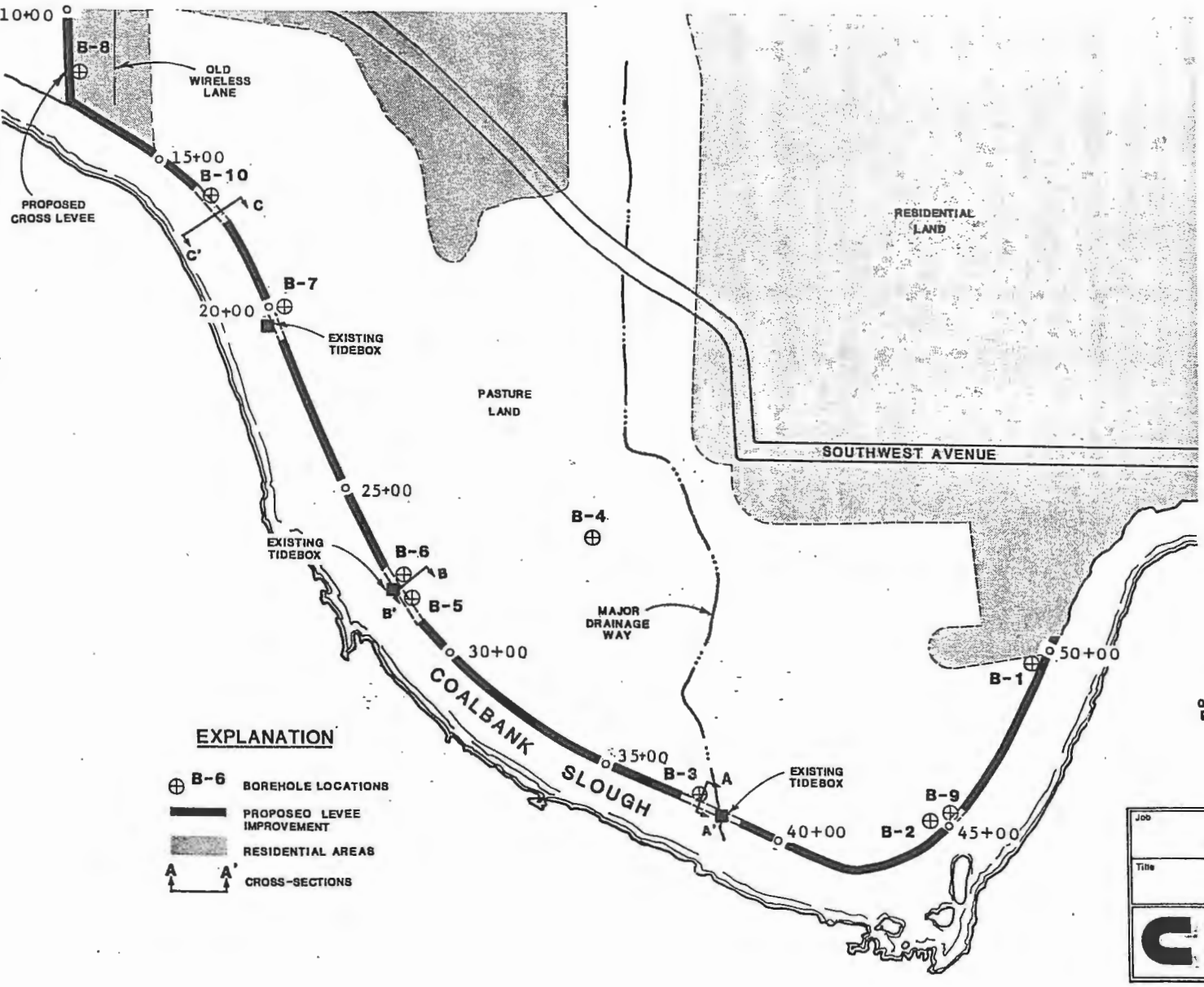
17.5. Construction, Phase 2. This phase of construction would include excavation of Phase 1 embankment to allow for gatewell construction and grade adjustment of tidebox barrels, embankment placement to El. 13.4 feet NGVD and removal of existing tideboxes. Grades along the completed tidebox structures will be chambered to allow for long-term settlement.

18. CONSTRUCTION EQUIPMENT RESTRICTIONS. Construction equipment size and use would be controlled to minimize disturbance of soft foundation material in the construction area. Control measures would include limitations on trafficking and restrictions on the use of very heavy equipment. Lightweight equipment will be used for embankment compaction. Embankment compaction with viboratory equipment would not be allowed. Embankment placement and compaction would be completed during dry summer months to provide the best ground surface conditions for operation of equipment.

19. SOURCES OF BORROW MATERIALS.

19.1. Levee Embankment. On-site clayey materials are not suitable for use as new embankment because of their high moisture content and soft excavated consistency. Several potential borrow sites are located in the hillsides above Coalbank Slough floodplain within 1.5 to 2.0 miles of the project. Visual inspections and laboratory tests on a bulk sample obtained from a site 1.7 miles west of the project indicate these sites are acceptable sources for embankment materials. The material classification of the material tested is sandy silty clay.

19.2. Rock and Drainage Materials. Riprap and drainage materials are available from local suppliers.


10+00
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C
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RESIDENTIAL LAND
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EXISTING TIDEBOX
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MAJOR DRAINAGE WAY
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COALBANK SLOUGH
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B-9
B-2
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EXPLANATION
B-6 BOREHOLE LOCATIONS
PROPOSED LEVEE IMPROVEMENT
RESIDENTIAL AREAS
A A' CROSS-SECTIONS
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Job
LIBBY DIKE
COOS BAY, OR
Title
SITE PLAN M
Comforth Consultants Inc.
Plaza 217, Suite C
7440 S.W. Hunzaker Rd.
Tigard, Oregon 97223
Date
Job
F

APPENDIX B

DESIGN

1. SCOPE. This appendix discusses the design and relocation requirements of the proposed flood protection project at Libby Dike in Coos County, Oregon. Design discussion includes the following alternatives: Permanent Floodplain Evacuation (Alternative 4), Levee Rehabilitation Design (Alternative 2), and Setback Levee Design (Alternative 3).

2. PERMANENT FLOODPLAIN EVACUATION (ALTERNATIVE 4).

a. General. The Permanent Floodplain Evacuation Plan includes: a two-phase construction plan of raising Southwest Boulevard and Illinois Avenue (see Plate 2), removal of existing residences within the floodplain, construction of a salmon rearing pond and facilities area, and drainage features.

b. Existing Roadways (Southwest Boulevard and Illinois Avenue). The existing roadways have slopes that vary between 1 Vertical (V) on 20 Horizontal (H) and 1V on 5H landward, and 1V on 3H and 1V on 10H riverward. The Southwest Boulevard roadway has a minimum elevation of 3.4 (NGVD), a maximum elevation of 35 (NGVD), averages elevation (El.) 5.9 (NGVD) through the section to be raised, and has an average top width of 36 feet. The existing roadway consists of approximately 3 inches of asphalt with a 10-inch base. Both sides of the roadway are curbed and the west side of the roadway has a 3-foot-wide sidewalk. Illinois Avenue has a minimum elevation of 4.0 (NGVD), a maximum elevation of 12.0 (NGVD), averages El. 4.5 (NGVD), and has an average top width of 15 feet. The existing roadway consists of approximately 3 inches of asphalt with a 10-inch base. Historical and geotechnical information is given in Appendix A, "Geotechnical Features."

c. Raising Southwest Boulevard and Illinois Avenue Design Criteria.

(1) General. The proposed raising of Southwest Boulevard and Illinois Avenue to a levee section will protect the surrounding area from the

daily tidal fluctuations and flooding from Coalbank Slough. The Permanent Floodplain Evacuation Design will consist of raising approximately 430 linear feet of Southwest Boulevard and 485 linear feet of Illinois Avenue to El. 8.0 (NGVD). Anticipated settlement of 1 foot would lower the roads to an ultimate elevation of 7.0 (NGVD). Other related work will consist of constructing new curbs, sidewalks, and fish facilities. All related design was based on preliminary surveys completed in April 1985.

(2) Levee Embankment Design. The proposed raising would consist of constructing new embankment over the existing roadways of Southwest Boulevard and Illinois Avenue. This embankment would also serve as a barrier to retain a pond. The existing foundation soils are highly susceptible to failure due to lateral spreading, therefore, the levee embankment is designed to minimize this risk. The Southwest Boulevard raise section would consist of a 36-foot-wide levee constructed to El. 8.0 (NGVD), with side slopes 1V to 3H. The levee would be reinforced with 20-foot-wide berms on both sides of the levee, constructed to El. 5.0 (NGVD) with 1V on 3H slopes to the toe of the berms. The Illinois Avenue raise would consist of a 15-foot-wide levee embankment constructed to El. 8.0 (NGVD) with side slopes 1V on 3H. The top section consists of an 8-inch base course and 2-inch leveling course. Typical levee sections are shown on Plate 2. See Appendix, "Geotechnical Features," paragraph 12, for levee embankment design comments.

(3) Alignment. The alignment of Southwest Boulevard raise follows the centerline of the existing roadway beginning at Station S0+40 and ending at Station S4+70. The alignment of the Illinois Avenue raise follows the centerline of the existing Illinois Avenue, beginning at Station I0+00 (Station S4+70) and ending approximately at Station I4+85.

(4) Elevations. In the construction of the Southwest Boulevard and Illinois Avenue raise, the levee will be constructed to El. 8.0 (NGVD) with typical cross sections as shown on Plate 2. During the 1-year period after initial construction, the levee is estimated to settle 1 foot to El. 7.0 (NGVD). The estimated total ultimate settlement of 1 foot has been estimated from soil analysis.

(5) Source of Materials. Visual inspection and laboratory testing of a potential borrow source 1.7 miles west of the site indicate the materials would be satisfactory for new embankment construction. Other suitable borrow sites within 1.5 miles are also available. Drainage materials are available from local suppliers.

d. Fish Facilities. Fish facilities would not be completed until 1 year after construction of the roadway raises. The fish facilities would be created east of Southwest Boulevard alongside the newly created salmon rearing pond and would consist of a fish ladder, raceway, and control outlet structure. The existing waterway riverward of Southwest Boulevard will be improved to provide fish access to the ladder.

e. Drainage Features.

(1) Hydrology. Interior drainage would be used to create an 8-acre salmon rearing pond located immediately behind Southwest Boulevard and Illinois Avenue (see Plate 1) to El. 5 (NGVD). The salmon rearing pond elevation would be controlled by a 36-inch-diameter CMP with a positive closure gate and tidal gate. Three 18-inch-diameter CMP's with tidal gates, located at invert
El. 5.0, would drain overflows above El. 5.0 (NGVD) underneath Southwest Boulevard. The culvert supplying the fish race facility will be equipped with a positive closure gate and tidal gate.

(2) Special Drainage Features. The existing catch basins located on Southwest Boulevard would be raised to the corresponding raised height of Southwest Boulevard.

f. Rights-of-Way. The local sponsor is responsible for obtaining all required rights-of-way for the proposed raising of Southwest Boulevard.

g. Relocations. All required relocations will be the responsibility of the local sponsor. Twenty structures, which include 12 residences, will have to be evacuated and demolished. A sanitary sewer system would have to be relocated above El. 7.0 (NGVD). This includes relocation of 2,200 linear feet

of 8-inch A.C. pipe, 700 linear feet of 10-inch A.C. pipe, and 14 manholes. The top of the levee embankment sections would consist of a 3-inch asphalt surface. One year after construction of the levee embankment, curbs will be constructed on both sides of Southwest Boulevard. The curbs run from Station SO+40 to Station S4+60. A replacement for the existing sidewalk will be constructed on the west side of Southwest Boulevard beginning approximately at Station SO+40 and ending approximately at Station S4+60. Utilities to be relocated include waterlines, storm drainage culverts, and power poles.

h. Construction Schedule. Construction is scheduled between mid-June to mid-September and between the same period 1 year later for construction of the curbs, sidewalks, and fish facilities.

3. LEVEE REHABILITATION (ALTERNATIVE 2) AND SETBACK LEVEE DESIGN (ALTERNATIVE 3).

a. Existing Dike. The existing dike was constructed in the late 1800s by private interests. Slopes vary between 1V on 1H and 1V on 5H riverward, and between 1V on 1.5H and 1V on 6H landward. The dike has a minimum elevation (El.) of 6.5 (NGVD), a maximum elevation of 9.9 (NGVD), averages about El. 7.6 (NGVD), and has an average top width of 5 feet. Historical and geotechnical information is given in Appendix A, "Geotechnical Features."

b. General. The proposed levee improvements at Libby Dike would protect the surrounded area from the 100-year-frequency flood. The Levee Rehabilitation Design would consist of reinforcing approximately 3,800 linear feet of existing dike and constructing approximately 300 linear feet of new cross-levee. The Setback Levee Design would consist of constructing approximately 300 linear feet of new cross-levee, reinforcing approximately 600 linear feet of existing dike and constructing 1,500 linear feet of new levee. The new levee would curve away and landward from the existing dike to a hillside tie located approximately 850 feet from Libby Dike. Other levee related work would consist of constructing three tide boxes, removing three existing tide boxes, constructing new drainage ditches, and emergency and maintenance access. All levee related design was based on preliminary surveys completed in April 1985.

c. Levee Design Criteria.

(1) Levee Embankment Design. The proposed levee improvements for Alternative 2 would consist of constructing a new reinforced cross-levee embankment on the south end of the project and reinforcement of the existing dike with an improved levee section. The existing dike is not adequate to provide protection from the 100-year-frequency flood, but would provide a suitable support on the riverward side of the improved levee. The proposed improvement for Alternative 3 would consist of constructing a new reinforced cross-levee embankment on the south end of the project, reinforcement of the existing dike with an improved levee section, and a new reinforced setback levee embankment landward of the existing dike. Existing foundation soils are highly susceptible to failure due to lateral spreading, therefore, to minimize this risk, the levee (Alternative 2 or Alternative 3) would be constructed in two phases.

During Phase I, the cross-levee, setback levee, and improved levee embankment sections would load the existing ground foundation and would allow the foundation materials to consolidate and increase in strength obtaining the required bearing capacity. Phase I section for the cross-levee would consist of a 29-foot-wide levee constructed to El. 9.4 (NGVD), with side slopes 1V on 3H. The cross-levee would be reinforced with two 22-foot-wide berms, constructed to El. 6.5 (NGVD) on both sides of the levee centerline, with 1V on 2H slopes to the toe of the berm. Phase I section for the improved levee would consist of a 39-foot-wide levee constructed to El. 9.4 (NGVD), with side slopes 1V on 3H landward and the riverward side sloped to the landward shoulder of the existing dike. The improved levee would be reinforced with a 39-foot-wide berm, constructed landward of the levee to El. 6.5 (NGVD) with a 1V on 2H slope to the toe of the berm. The improved levee section was modified in certain areas to eliminate encroachment on nearby buildings. The Phase I section for the setback levee would consist of a 29-foot-wide levee constructed to El. 9.4 (NGVD), with side slopes 1V on 3H. The setback levee would be reinforced with two 22-foot-wide berms, constructed to El. 6.5 (NGVD) on both sides of the levee centerline, with 1V on 2H slopes to the toe of the berm. Before initiation of Phase II, 1.5 feet of settlement is anticipated.

During Phase II, initiated 2 to 3 years following Phase I, the levee sections would be constructed to provide 100-year protection. The levee sections would consist of a 12-foot-wide crest, constructed to El. 13.4 with side slopes 1V on 3H. The entire levee would feature a 12-foot-wide gravel surfaced road on its crest. See Appendix A, "Geotechnical Features," paragraph 12, for levee embankment design comments. Settlement would eventually lower the crest to El. 12.4 (NGVD).

(2) Alignment.

(a) Levee Rehabilitation Alignment (Alternative 2). Alignment for Alternative 2 of the cross-levee begins with a cross-levee at a hillside near Southwest Boulevard and extends to Coalbank Slough where it transitions to the improved levee. Alignment of the improved levee will follow the existing dike for approximately 3,800 feet. The improved levee would be raised from the landward shoulder of the existing dike, and widened on the landward side, leaving the riverside undisturbed except during Phase II, for construction of channels through the old dike at tide box locations. The levee would be aligned around the existing tide box locations to utilize the existing dike as a temporary cofferdam.

(b) Setback Levee Alignment (Alternative 3). Alignment for Alternative 3 would begin with a cross-levee at a hillside near Southwest Boulevard and extend approximately 300 feet to Coalbank Slough where it would transition to the improved levee. Alignment of the improved levee would follow the existing dike for approximately 600 feet, then curve away from the existing dike for approximately 1,500 feet to tie into a hillside near Southwest Boulevard.

(3) Elevations. In the construction of Phase I, the levee sections would be built to El. 9.4 (NGVD). This elevation represents the 100-year-frequency flood level with no freeboard. During the 2- to 3-year period between Phase I and Phase II, the levee is estimated to settle 1.5 feet to El. 7.9 (NGVD). In the construction of Phase II, the levee sections would be constructed to El. 13.4 (NGVD). This elevation comprises a design height of 9.4 (NGVD), which represents the 100-year-frequency flood level, and includes 3 feet of freeboard and an allowance for settlement of 1 foot. Freeboard is provided in

accordance with EM 1110-2-1601 to ensure that the desired degree of protection will not be reduced by unaccounted factors. The freeboard is estimated to be 3.0 feet when the ultimate settlement has occurred. The estimated total ultimate settlement of 2.5 feet from Phase I through Phase II has been established by soil analysis and is discussed in paragraph 14 of Appendix A, "Geotechnical Features."

(4) Source of Materials. Visual inspection and laboratory testing of a potential borrow source 1.7 miles west of the site indicate the materials would be satisfactory for new embankment construction. Other suitable borrow sites within 1.5 miles are also available. Riprap and drainage materials are available from local suppliers.

(5) Levee Access. Access to the existing dike would be near the north and south ends of the levees. It would be proposed to furnish access to the improved levee at three locations. This access would be for maintenance and emergency use. All points of access will be established by way of Southwest Boulevard and will require ramp construction. Primary design considerations were safety and vehicle maneuverability. A vehicle turnaround would be included on the cross-levee section.

d. Drainage Features.

(1) Hydrology. Due to the existing poor foundation soils and the settlement that would result, a temporary interior drainage plan would be utilized until Phase II construction was completed. The temporary plan for Alternative 2 would leave the existing tide boxes in place and new tide box barrels with flap gates would be installed in the reinforced levee improvement section directly behind the existing tide boxes. This would also permit the existing dike to be used as a cofferdam during Phase I and Phase II construction. Discharges from the new barrels would be directed to the existing tide boxes. Under the temporary plan for Alternative 3, new tide box barrels with gates would be installed in the setback levee at three locations. Existing drainage ditches filled in by the levee embankment would be relocated and replaced with in-kind ditches.

Hydrologic and interior drainage analysis concluded levee improvements would prevent flooding from Coalbank Slough, however, flooding from interior drainage could be expected. The analysis, based on three 36-inch-diameter CMP's, concluded that ponding would result from storms equal to or greater than the 5-year event. The ponding would exceed El. 3.4 (NGVD) which would overtop Southwest Boulevard. The interior drainage plan contained in the design of flood protection at Libby Dike would utilize two 24-inch-diameter and two 42-inch-diameter CMP's.

(2) Tide Boxes. In both Alternative 2 and Alternative 3, three new tide boxes to replace existing tide box structures would be constructed during Phase I. Two tide boxes would be constructed of 24-inch-diameter CMP, and a third tide box with 42-inch-diameter double barrel CMP pipe would also be constructed. Each tide box would have flap gates on the riverside of the levee. No pumps would be installed. Embankment design at the tide box locations would vary from the improved levee sections. Phase I section at the tide box locations would consist of a 39-foot-wide levee constructed to El. 9.4 (NGVD) with side slopes 1V on 3H riverward and 1V on 3H landward to El. 7.0 (NGVD). The levee would be reinforced with a berm, landward of the levee, sloped from El. 7.0 (NGVD) 1V on 20H to El. 5.0 (NGVD). Class II riprap at a thickness of 24 inches would be required around the pipe inlets and outlets for erosion control. Trash racks would be required to prevent the tide boxes from clogging. Invert pipe elevations at the inlet and outlet for the new tide boxes would change from existing elevations, and pipes would be cambered to allow for settlement. During Phase II, the tide box barrels would be realigned if required and recambered to allow for anticipated settlement after Phase II. Tide box sections would be constructed to provide 100-year protection. The sections would consist of a 12-foot-wide crest, constructed to El. 13.4 with side slopes 1V on 3H. Due to the poor foundation soils, and the settlement that would result between Phases I and II, a concrete box gatewell is required and would be installed during Phase II. Installation of the tide box barrels and gatewell structure would be completed in an unwatered condition. The existing dike at the tide box locations would serve as a temporary cofferdam during Phases I and II.

Proposed tide box construction would be as follows:

Existing Feature	Proposed Feature
24" diameter CMP (to be removed - Phase II)	24" diameter CMP
1.5' x 1.5' wooden tide box (to be removed - Phase II)	24" diameter CMP
7.5' x 2' wooden tide box (to be removed - Phase II)	2-42" diameter CMP with double gatewell

(3) Design of Drainage Ditches. Where the new improved levee requires filling existing drainage ditches, a channel would be constructed to present capacity to allow flow to the tide boxes. No drainage ditch will be established at the new cross-levee. This area would drain into a new catch basin.

(4) Special Drainage Features. A storm sewage system would be developed for approximately 300 feet of an improved levee section. This system would be required to eliminate encroachment on a house and buildings in this area, and to provide drainage at the toe of the new cross levee. The system would eliminate potential ponding in the area and would transfer drainage to a nearby tide box. Junction boxes would be located at three catch basins and at an existing 4-inch tile drain for storm sewage system clean out. The catch basins would provide drainage of the cross levee and the improved levee.

e. Rights-of-Way. The local sponsor is responsible for obtaining all required rights-of-way for the new and improved levees.

f. Relocations. All required relocations would be the responsibility of the local sponsor. A comprehensive survey of needed relocations was not made. Below is a listing of known relocations.

(1) Fences. Fences that run perpendicular into the improved levee and setback levee would be relocated and are located at various sections.

(2) Interference with Buildings. The following buildings would have to be relocated or dismantled: a wood house, garage and shed, wooden shed, wooden building, and a wood shed.

g. Construction Schedule. Phase I construction would be scheduled between mid-June to mid-September and Phase II between the same period 2 to 3 years after completion of Phase I.

PROJECT COST ESTIMATE

LIBBY DIKE

PERMANENT FLOODPLAIN EVACUATION/RELOCATION
(ALTERNATIVE 4)

Line Item	Estimated Quantity	Unit	Estimated Cost
Mobilization & Demob.	Job	L.S.	$ 10,000
Embankment	3,500	C.Y.	21,000
Base Course (1 1/2" minus)	500	C.Y.	7,400
Leveling Course (3/4" minus)	150	C.Y.	2,500
CMP Culverts & Accessories	Job	L.S.	32,000
Fish Facilities	Job	L.S.	75,000
Relocations			
Roads (curbs, sidewalk, A.C. pavement)	Job	L.S.	25,000
Utilities (waterlines, culverts, power poles)	Job	L.S.	15,000
Sanitary Sewer	Job	L.S.	75,000
Demolitions (20 structures)	Job	L.S.	70,800
Direct Costs			$333,700
Contingencies (20%)			66,300
Subtotal			$400,000
E&D			50,000
S&I			40,000
Total*			$490,000

*Costs do not include: 1) Land Acquisition and Improvements; 2) Severance; 3) Administration; 4) Baseline Study; and 5) Breaching of Libby Dike.

PROJECT COST SUMMARY

LIBBY DIKE

LEVEE REHABILITATION (ALTERNATIVE 2)

	Federal	Non-Federal	Total
Phase I	$565,000	$90,000	$655,000
Phase II	270,000	--	270,000
Project Cost	$835,000	$90,000	$925,000

Total Project Cost $925,000

PROJECT COST ESTIMATE

LIBBY DIKE - PHASE I

LEVEE REHABILITATION (ALTERNATIVE 2)

Line Item	Estimated Quantity	Unit	Estimated Federal Cost	Estimated Non-Federal Cost
Mobilization & Demob.	Job	L.S.	$ 20,000	
Clearing & Stripping	9.9	Ac.	17,000	
Sand Filter	11,520	C.Y.	69,000	
Embankment	70,400	C.Y.	211,200	
Excavation (ditches)	2,200	C.Y.	10,000	
Tide Box, Station 20+71	Job	L.S.	13,100	
Tide Box, Station 27+85	Job	L.S.	13,100	
Tide Box, Station 38+10	Job	L.S.	54,800	
Drainage Pipe & Accessories	Job	L.S.	4,900	
Relocations				
Fences	1,200	L.F.		7,000
Buildings	5	L.S.		15,000
Lands, Easements & R-O-W	11.5	Ac.		28,000
Direct Costs			$413,100	$50,000
Contingencies (15%)			61,900	
Subtotal			$475,000	
E&D			47,000	$40,000
S&I			43,000	
Project Cost			$565,000	$90,000
Total Project Cost (Phase I)			$655,000	

PROJECT COST ESTIMATE

LIBBY DIKE - PHASE II

LEVEE REHABILITATION (ALTERNATIVE 2)

Line Item	Estimated Quantity	Unit	Estimated Federal Cost
Mobilization & Demob.	Job	L.S.	$ 15,000
Embankment	22,300	C.Y.	89,200
Tide Box, Station 20+71	Job	L.S.	1,900
Tide Box, Station 27+85	Job	L.S.	1,900
Tide Box, Station 38+10	Job	L.S.	51,000
Dike Excavation, Remove Existing Tide Boxes	Job	L.S.	5,000
Gravel Road Surfacing	6,300	S.Y.	25,200
Seeding	8.7	Ac.	8,700
Direct Costs			$197,900
Contingencies (15%)			29,100
Subtotal			$227,000
E&D			23,000
S&I			20,000
Total Project Cost (Phase II)			$270,000

PROJECT COST SUMMARY

LIBBY DIKE

SETBACK LEVEE (ALTERNATIVE 3)

	Federal	Non-Federal	Total
Phase I	$398,000	$213,000	$611,000
Phase II	213,000	--	213,000
Project Cost	$611,000	$213,000	$824,000
Total Project Cost	$824,000		

PROJECT COST ESTIMATE

LIBBY DIKE - PHASE I

SETBACK LEVEE (ALTERNATIVE 3)

Line Item	Estimated Quantity	Unit	Estimated Federal Cost	Estimated Non-Federal Cost
Mobilization & Demob.	Job	L.S.	$ 20,000	
Clearing & Stripping	6.1	Ac.	10,400	
Sand Filter	5,300	C.Y.	31,800	
Embankment	40,300	C.Y.	141,100	
Excavation (ditches)	300	C.Y.	1,400	
Tide Boxes (three)	Job	L.S.	81,000	
Drainage Pipe & Accessories	Job	L.S.	4,900	
Relocations				
Fences	1,200	L.F.		7,000
Buildings	4	L.S.		55,000
Lands, Easements & R-O-W	41.3	Ac.		78,000
Direct Costs			$290,600	$140,000
Contingencies (15%)			43,400	
Subtotal			$334,000	
E&D			34,000	73,000
S&I			30,000	
Project Cost			$398,000	$213,000
Total Project Cost (Phase I)			$611,000	

PROJECT COST ESTIMATE

LIBBY DIKE - PHASE II

SETBACK LEVEE (ALTERNATIVE 3)

Line Item	Estimated Quantity	Unit	Estimated Federal Cost
Mobilization & Demob.	Job	L.S.	$ 15,000
Embankment	15,400	C.Y.	61,600
Tide Boxes, (three)	Job	L.S.	54,800
Dike Excavation, Remove Existing Tide Boxes	Job	L.S.	5,000
Gravel Road Surfacing	3,500	S.Y.	14,000
Seeding	5.0	Ac.	5,000
Direct Costs			$155,400
Contingencies (15%)			23,600
Subtotal			$179,000
E&D			18,000
S&I			16,000
Total Project Cost (Phase II)			$213,000

APPENDIX C
ALTERNATIVE ECONOMICS

DESCRIPTION

Libby Dike is located near the southeastern limits of the City of Coos Bay, in Coos County, Oregon. The levee forms the left bank of Coalbank Slough three miles upstream from its confluence with Isthmus Slough. Coalbank Slough is part of the Coos Bay estuary. It is located 5 miles from the Pacific Ocean and is subject to tidal influences.

Libby Dike was constructed before 1920 by private interests and is privately owned and maintained. It is about 5,550 feet long and protects approximately 74 acres, including 11.0 acres of residential lands and 15 residences (3 of which are unoccupied), 56.0 acres of pastureland, 4.0 acres of timbered wetlands, and 3.0 acres of city and county streets. An additional 5 acres are contained within the diking district, but are above el. 10.0 feet and are not subject to flooding.

There are a total of fifteen residential structures located in the flood plain. Two of these residences are in such poor condition that they are uninhabitable, a third structure is being remodeled and is not currently occupied. Most of the residences susceptible to flooding lie east of Southwest Boulevard. A few others lie within a 10-acre section on the west side which extends from Illinois Avenue on the south, past 15th street on the west, and 400 feet south of Montana Avenue on the North.

Southwest Boulevard is a major arterial highway with an average daily traffic count of 4,766 vehicles.

PROBLEM STATEMENT

Problems and opportunities addressed in this report include flood damages, fishery enhancement, and employment of otherwise unemployed workers.

During a January 1983 storm, Libby Dike was overtopped and serious flooding resulted. This storm event left the dike in weakened condition. Now winter storms combined with high tides occasionally overtop the levee at 7 feet, National Geodetic Vertical Datum (NGVD) and temporarily flood much of the land behind the levee. The levee is rated "hazardous" above 4 feet, NGVD. When the levee is overtopped, a section of Southwest Boulevard is temporarily flooded, curtailing traffic flow.

During floods equal to or larger than the 2-year event, ponding from interior drainage takes place. Any event greater than normal tidal conditions threatens a complete breach of the dike. At the request of local officials, the Corps is studying alternatives to improve flood protection and/or to reduce flood losses.

In addition, fisheries production in the area is well below carrying capacity, when compared to historic fish production levels. Increases in fish production would provide for substantial increases in National Economic Development by increasing fish catches for the commercial and recreation fisheries. These fisheries are highly important to the economy of the region and the nation.

Finally, Federal action at Libby Dike will provide temporary employment in an area that has recently suffered from high unemployment due mostly to reductions in the demand for lumber and wood products. Unemployment averaged 11.5% in Coos County during the first seven months of 1986.

The economic analysis begins with a base study that includes discussions of population, employment, manufacturing, trade, tourism, and the local tax base. This is followed by a description of the alternative measures, and discussions about general assumptions and methodologies. Fishery impacts are discussed, including development of values for commercial and recreational fisheries, and impacts of the various measures on fishing are described. Finally, benefits and costs for each alternative are summarized and the conclusions of the report are presented.

BASE STUDY--COOS COUNTY

General. Coos County is located on the southern Oregon coast. It was established in December of 1853 and originally included what has now become Curry County. Coos County covers 1,629 square miles and had a population of 60,150 in 1985. Forest products, tourism, and fishing dominate the Coos County economy. Boating, dairy farming, myrtlewood manufacturing, ship repair, module fabrication, and agriculture specialty products such as cranberries also play an important role.

Coos Bay itself is an international port. It is Oregon's second largest port and one of the world's largest shipping ports for forest products. Although the International Port of Coos Bay is the point of departure for wood products from all over the northwest, it is not a general cargo port. This is due to its limited tributary area, particularly compared to points on the Columbia and Willamette Rivers, which are more accessible to the population centers of the Northwest and the direct land transportation routes to interior areas.

Population. The largest city in the county is Coos Bay (population 14,695) with 24 percent of the county's total population based on 1985 figures. Other incorporated cities are North Bend (9,135), Coquille (4,220), Myrtle Point (2,700), Bandon (2,330), Lakeside (1,420), and Powers (775). The unincorporated areas of Coos County account for 41 percent of the population.

During the 1970's the population of Oregon's southern coast grew at a moderate pace. According to US census figures, Coos County gained 7,500 residents during that period for an average annual growth rate of 1.1 percent. Between 1980 and 1985 the county lost an estimated 4,000 residents, for an average loss of 1.2 percent per year. The average growth rate for the years 1970 to 1985 was .4 percent. Table one presents a comparison of changes in population between Coos County and the State of Oregon.

Table One

Population Change 1970-1985

Year	Oregon (Thousands)	Coos Co.
1970	2,091.4	56,515
1980	2,633.2	64,047
1981	2,660.7	63,300
1982	2,665.2	61,750
1983	2,635.0	61,450
1984	2,660.0	61,000
1985	2,675.8	60,150

The Office of Business Economics, Economic Research Service (OBERS) which is now called the Bureau of Economic Analysis, U.S. Department of Commerce, projects that southwest Oregon will have a population growth rate of 1.15 percent from 1985 to 2030.

Employment. In every year from 1960 to the present, the unemployment rate in Coos County has exceeded that of the state and of the nation. The seasonal fluctuations also are greater in the county than for Oregon and the US. These two conditions are due to the county's low economic growth rate, declining employment in lumber and wood products, and the seasonality of the county's basic industries. (For Review, Coos County Oregon: Economic Survey and Analysis, US Army Corps of Engineers, Portland District, 1979.) In September 1985 the unemployment rate in Coos County was 15.6 percent, while Oregon had a rate of 9.5 percent.

Employment trends have tended to follow those of population. During the 1970's employment grew at an annual rate of 1.56 percent in Coos County. From 1980 to 1985, employment fell at the rate of 1.5 percent per year. OBERS projects that employment in the southwest region of Oregon will grow 1.02 percent per year between 1985 and 2030.

Manufacturing. Table two lists Coos County Manufacturers by number of employees and Standard Industrial Classification (SIC) Code.

Table Two
Coos County Manufactures
Employing 20 or More Persons

Manufacturing Company	Location	Emp.	SIC Code
Ashford Marine	Coos Bay	45	3731
Bandon Fisheries	Bandon	50	2092
Bayview Manufacturing Company	North Bend	40	2499
Bohemia, Inc.	Lakeside	200	2421
Carlson and Eads, Inc.	Coquille	20	2411
Coos Bay Fabrication & Machine	North Bend	25	3599
Coos Head Timber Co.	Coos Bay	300	2421
Coquille Valley Dairy Coop	Bandon	22	2021
D & H Logging	Coos Bay	27	2411
Eureka Fisheries, Inc.	Coos Bay	20	2091
Forest Protection Products Co.	Coos Bay	20	3079
Georgia-Pacific Corp.	Coquille	300	2436
Hallmark Fisheries	Charleston	412	2092
House of Myrtlewood, The	Coos Bay	30	2499
Industrial Services, Inc.	North Bend	20	3535
Johnson Rock Products, Inc.	North Bend	30	2951
Koontz Machine & Welding	Coos Bay	23	3599
McCarthy Brothers, Inc.	Coos Bay	20	2411
Mid-Coast Marine	Coos Bay	48	3731
Moore Mill & Lumber Company	Bandon	170	2421
Murphy Company, The	Myrtle Point	20	2436
ORCA Pacific Products	Charleston	124	2092
Quiet Valley Veneer, Inc.	Norway	39	2436
Riverside Forest Products	Myrtle Point	22	2435
Rogge Lumber, Inc.	Bandon	130	2421
Roseburg Lumber Company	Coquille	350	2436
Sixes River Logging Company	Coos Bay	30	2411
Southwestern Oregon Publishing	Coos Bay	72	2711
Squirrel Logging Company	Coquille	20	2411
Tap Fisheries, Inc.	Charleston	100	2092
Three Sons Loggers, Inc.	Coquille	83	2411
Tidewater Veneer	Bandon	34	2436
Westbrook Wood Products	Coos Bay	250	2411
Westbrook Wood Products	Coquille	150	2436
Weyerhaeuser Co. Cont. Div.	North Bend	180	2631
Weyerhaeuser Co., Inc.	North Bend	1300	2436

Source: "Oregon Directory of Manufactures 1985-1986," State of Oregon, Economic Development Department, June 1985.

As this table demonstrates, lumber dominates the manufacturing sector of the Coos County economy. Also important are the food and kindred products, paper, and printing and publishing industries.

Forest Products. The forest products industry is Coos County's largest, although its importance has been declining since the late 1950's. From 1959 to 1979, the overall loss in wood products employment was 26 percent. In the recession from 1979 to 1982, one half of all jobs lost in the county were lost in the wood products industry. Employment in the timber industry has continued to decline since that time.

Vast forested slopes are a dominant part of Coos County's resource base. The county contains about 868,000 acres of forest land. Commercial forest lands represent more than 80 percent of the county's total land area. Table three lists land ownership as a percentage of the commercial land in Coos County.

Table Three
Ownership of Commercial Land

Forest Industry	40.0%
US Bureau of Land Man.	18.0%
US Forest Service	7.5%
Other Public	9.0%
Private	25.5%

Tourism. The recreational resources of Coos County include the Coos Bay estuary and ocean beaches, as well as numerous rivers, streams, mountains and forests. Within the county are more than 10,000 acres of recreational lands of the Oregon Dunes National Recreation Area. These areas have been enhanced by tourist facilities for camping and picnicking, fishing, hiking, golfing, and boating.

These natural resources and facilities have yielded a modest tourist industry which is aided by the county's location on the major north-south highway, US 101. The remoteness from the principle population areas of the state has been

one of the limiting factors in the industry. Because of the difficulties in assessing a diversified industry such as tourism, there are widely divergent estimates of the impact of tourism on the local communities. One estimate makes tourism the second leading industry in the county, while others claim that it only makes up a small sector of the Coos County economy.

Tax Base. The Coos County 1985-86 budget anticipates revenues and expenses of $29,669,653. The tax system consists of many different funds that are established to meet the needs and requirements of the services which the county provides. Once created these funds generate their own required revenues through various methods such as fees, permits, rents, loans, and transfers. The largest fund is the General Fund, through which 38 percent of the county's revenues are generated and expended. This fund receives some external aid from the state and Federal governments.

The revenue generate by the local property tax is dispersed amongst the General Fund, the Bonded Debt, and the Library Fund.

Table four displays a summary of the adopted 1985-86 Coos County Budget. This summary lists the various funds and their adopted revenues and expenditures. As the General Fund is dependent upon external aid, a breakdown of how the revenue is generated for that fund is supplied within table four. Note, that there is not a breakdown of the expenditures of the General fund. The expenditures of this fund are spent in many areas. However, in broad terms, the revenue is spent on the legal and court systems, medical programs, protection and corrective institutes, and various government departments.

Table Four

Coos County Budget Summary

1985-86 Budget (Adopted)

FUND	REVENUE & EXPENDITURES
* General Fund	$11,274,402
Dog Control Fund	$ 97,955
Road Fund	$ 2,769,420
Bonded Debt	$ 1,437,785
F.P.S. Title XIX	$ 47,403
County School	$ 366,788
Coos County Fair	$ 220,200
Law Library	$ 110,726
Marine	$ 68,957
Footpath and Bicycle	$ 55,447
Jail Construction Fund	$ 8,750,624
Short Term Borrowing	$ 1,020,000
South	$ 134,487
Crime Victim Asst.	$ 30,200
Federal Revenue Sharing	$ 306,748
Capital Improvement	$ 13,000
Solid Waste Power Gen. Fund	$ 1,880,000
Liquor Enforcement	$ 20,050
Library Funds	$ 893,413
911 Fund	$ 171,245
TOTAL	$29,669,553

* General Fund Revenue Sources	
Working Capital	$ 1,124,333
Local	$ 1,398,280
State	$ 1,877,998
Federal	$ 3,193,421
Transfers and Others	$ 1,338,748
Total General Fund	$ 9,932,780
Taxes to Balance Budget	$ 1,341,622
TOTAL	$11,274,402

ALTERNATIVE MEASURES

General. The alternative measures that address the problems and opportunities in the Libby Dike area are as follows:

(1) No action.
(2) Evacuation of improvements in the floodplain.
(3) Rehabilitation of the existing levee.
(4) Construction of a set back levee with evacuation outside the levee.

These alternatives are described in the following sections.

No Action. Under the no action scenario, the Libby levee would continue to deteriorate. Periodic flooding would occur, causing flood damages both from overtopping of the existing levee and from internal drainage problems. Under this plan, the Federal Insurance Administration (FIA) subsidized insurance program would incur increased costs. In addition, damages would continue for traffic interruptions and delays, road clean-up, emergency costs, and temporary evacuation costs.

Evacuation of Improvements in the Floodplain. Under the floodplain evacuation alternative all residences would be removed from the floodplain and Southwest Boulevard and Illinois Avenue would be raised to 7 feet, NGVD. Some flood insurance costs (which are subsidized by the general public through the FIA's flood insurance program) would be avoided. Emergency aid and temporary evacuation costs would also be eliminated by this measure.

In addition, this alternative would allow the creation of an 8-acre freshwater salmon rearing pond and a 50-acre restored salt marsh which would provide habitat for juvenile fall chinook. These measures would enhance fall chinook runs in the area substantially for both commercial and recreation fishing. Finally, construction of this alternative would provide jobs for some workers who would otherwise be unemployed.

Levee Rehabilitation Alternative. Rehabilitation of the existing levee would provide the residents of the study area with flood protection from overtopping of the existing levee. Removal of one residence in the levee right-of-way would be required. This alternative would also provide jobs for some workers who would otherwise be unemployed. Internal drainage problems would not be addressed by this plan; in addition, no fishery enhancement is envisioned in the rehabilitation plan.

Set Back Levee Alternative. This alternative would provide a new levee inside the existing levee, giving the residents within part of the study area protection from levee failure, and thus reducing flood damages. However, no protection from internal drainage problems would be provided. The removal of 4 residences from the flood plain would be required. This alternative would allow development of a 32-acre restored salt marsh which would provide habitat for fall chinook and thus enhance fish runs for commercial and recreation fishing. This alternative would provide jobs for some workers who would otherwise be unemployed.

GENERAL ASSUMPTIONS

Benefits attributable to the proposed alternative measures have been analyzed at a January 1987 price level and an interest rate of 8-7/8 percent. A 50-year project life has been assumed. No growth is anticipated in the study area and none has been included in this analysis.

Based on the judgement of Corps engineers, the existing levee is rated as "hazardous" above elevation 4.0. In accordance with current guidance, flood damages are measured as one-half of the potential damages which would occur between safe-height (elevation. 4.0) and the top of the levee (elevation. 7.0). This guidance is also applied to alternatives which require phased construction, where initial stages of development provide reduced protection.

Profiles were developed by Corps hydrologists representing the 10-, 50-, 100-, and 500-year flood elevations. The 1-, 2-, and 5-year flood heights were extrapolated from these data. Analysis of interior drainage was done separately using peak pond elevations for each levee construction and rehabilitation alternative.

Real estate values were provided from individual appraisals by a qualified Corps real estate appraisal specialist. Relocation costs were also obtained from this source. No benefits were claimed for periodic inundation of agricultural land due to levee failure because the water in this location is only marginally brackish and, in any case, the few animals using this pastureland would likely be on alternate feed during the winter months when the threat from storms is most serious.

METHODOLOGY

The following is a brief discussion of the methodologies employed in this flood damage evaluation.

Residential Losses. Residential losses include physical damages to dwellings, contents, and grounds. These losses were calculated based on information dated 1985, developed by the FIA, which gives average percent of damage for a given depth of inundation. Damages attributed to internal drainage problems were deducted from total estimated losses for levee improvement alternatives, since these alternatives do not address internal drainage problems.

Utilities. Residences within the city limits are on municipal sewage systems which sustain no flood damages. All residences are on city water lines which are sealed and not subject to contamination.

Emergency Aid. Emergency aid includes all activities (Federal, local, and volunteer) connected with rescue operations, flood preparation, emergency medical and health protection measures, and extra police protection. For the purpose of projecting emergency costs for probable floods encompassed in this survey, a figure of 1.0 percent of total damages has been used. This figure is based on a Portland District Corps of Engineers report entitled "Potential Flood Damages Willamette River System", printed in July 1974.

Evacuation Costs. Evacuation costs include costs which are incurred by people who must reside away from their homes due to loss of access and/or flooding. An estimate of $30 per day per family unit has been used in this report. This figure is based on the cost of renting and traveling to alternative living

quarters. Typical length of temporary evacuation is assumed to be 15 days, including time spent in post flood clean-up.

Road Clean-up. Road clean-up costs affect 625 feet of Southwest Boulevard, 875 feet of Illinois Street, 500 feet of Wireless Street, and 250 feet of California Street. Flood damages to roads in the flood areas are estimated to be equal to the cost of debris removal and sweeping. Based on discussions with the assistant city engineer, this amounts to a cost of $2,058 per mile. No damages are claimed until the depth of water on the road exceeds one foot.

Traffic Interruptions and Rerouting. During flood situations, traffic interruptions would occur for one hour preceeding and one hour following high tides. According to the city engineer, traffic counts on Southwest Boulevard averaged 4,766 vehicles per day in 1985. During a single day, one-sixth of this number would experience delays. Rerouting would be via Shinglehouse Slough Road and U.S. Highway 101, a distance of 5.9 miles. Rerouting is assumed to cost $.20 per vehicle mile. Delay time is valued at the minimum wage of $3.35 per hour, assuming one person per vehicle and 12 additional minutes per trip (5.9 miles @ 30 mph).

Employment of Unemployed Workers. Based on current guidelines, Corps projects constructed in Coos County qualify for benefits due to employment of currently unemployed workers. These benefits are determined based on total construction costs. Engineering judgement indicates labor costs would be 30% of construction costs, with 90% of that figure going for skilled labor and 10% going to unskilled labor. It was assumed that all labor would be hired locally. Standard percentages from Principles and Guidelines are applied to skilled and unskilled labor, as no local hire rule applies to this project. Some measures require phased construction, therefore, some employment benefits accrue after initial construction. Where this occurs, benefits are discounted for the appropriate period using the project interest rate.

FISHERY VALUES

General. As stated previously, two of the proposed alternatives provide for enhancement of the fall Chinook fishery in the area, for both commercial and

recreational fishing. Thus, an estimate of values associated with the commercial and recreational salmon fisheries is required.

Commercial Fishery. A 1985 ex-vessel price for chinook Salmon of $2.48 per pound was adopted as the appropriate measure of average commercial value for this report. An ex-vessel price is the price paid to the fisherman at the dock for his catch. An average fish size of 9.4 pounds was also used. It is assumed that the fish enhancement programs proposed in this report will be too small to affect overall market prices. This assumption seems reasonable in light of the fact that the Pacific coast salmon fishery, which includes Oregon, Washington, California, western Canada, and southeastern Alaska, produces seven to nine million adult fish annually. The ex-vessel price and average fish size were provided from a study published by the Pacific Fishery Management Council in March 1986 entitled Review of 1985 Ocean Salmon Fisheries. This report contains a variety of statistics related to fisheries along the Oregon coast and is applicable to the Coos Bay study area.

The average value per chinook salmon of $23.31 ($2.48 per pound x 9.4 pounds) was adjusted to reflect marginal value by eliminating the incremental increase in operating costs associated with catching these additional fish. This amounted to a 9 percent reduction in average value. The net increase in income to fishermen would, therefore, be $21.21 per fish.

Marginal value is the appropriate measure of value for fish enhancement because it is the net increase in value related to the additional fish produced. The 9 percent reduction used in this report was estimated by Phillip A. Meyer for the National Marine Fisheries Service (NMFS) in a report entitled "Net Economic Values for Salmon and Steelhead from the Columbia River System" published in June 1982. During this study, it was determined that due to chronic excess capacity in the commercial fishing fleet, additional fish could be harvested with only a small (9 percent) incremental change in variable costs.

Recreation Fishery. The marginal value of recreation associated with catching ocean salmon for sport is estimated to be $26.49 per fish under the without project condition, stated in 1984 dollars. This value relates to the average ocean sport catch for Coos Bay between 1980 and 1985, which is 22,484 salmon,

including both chinook and coho. Total consumer surplus under without project conditions is estimated to be $1,167,784. These values were estimated based on information contained in a report by John B. Loomis entitled "Examination of the Variation in Empirical Estimates of Site Specific Marginal Values for Recreation Fisheries" written in 1986.

The model Loomis presents is a varying parameter travel cost demand model that takes a variety of factors into account in estimating marginal fish values. These factors include site location, availability of substitutes, and size of the angler population. Values developed for Oregon using this method are based on information provided from a 1977 survey of recreational fishermen conducted by the Oregon Department of Fish and Wildlife.

The Loomis model has two advantages: first, it provides marginal values, which are a more appropriate measure of recreation fishermen's net willingness-to-pay (i.e. consumer surplus) for improvements in fish catch than average values used in previous reports, and second, it provides site specific values, which are highly desirable, since demand theory suggests that values will differ between recreation sites due to differences in site characteristics. The values presented in this report are applicable to ocean salmon fishing off the Coos Bay estuary. One disadvantage of the Loomis methodology is that specific recreation values for chinook salmon are not available at this time; thus, the values presented are averages for all salmon species. Since chinook has the highest value among salmon species, the use of average values understates the true recreational value associated with these measures.

No differentiation in values is made for fish caught in the ocean, in estuaries, in coastal streams, or in sloughs. Typically, over 95 percent of all salmon caught in the area are taken in the ocean. The recreational fish value and the consumer surplus value have been updated from 1984 to January 1987 dollars using the annual rate of change in the transportation component of the consumer price index for all urban consumers (CPI-U) experienced over the period October 1984 to October 1985. This amounts to an annual increase of 2 percent for a total increase of 4 percent over the two year period. The 1987 marginal recreation fish and consumer surplus values for salmon are

$27.55 and $1,214,495, respectively, under the without project condition. Because construction will take one year and it takes a chinook salmon three years to reach adult size, benefits for the fish enhancement program are assumed to began accruing 4 years after the development of the project and continue for 50 years from that point in time. It should be noted that the value of returning jack salmon is not estimated in the report; therefore, the benefits may be understated to some extent.

Two of the alternatives considered provide for enhancement of the fall Chinook fishery. These are the floodplain evacuation alternative and the set back levee alternative. Fishery benefits for these enhancement measures are discussed below. It should be noted that while benefits are estimated for fall chinook only, restoration of the salt marsh will provide habitat for many other types of fish and wildlife as well. Fishery benefits were based upon U.S. Fish and Wildlife Service estimates contained in their Coordination Act Report (Appendix D) and updated by their 10 March 1986 letter.

Fishery Benefits for Floodplain Evacuation. Under the floodplain evacuation alternative, an 8-acre rearing pond will be constructed for the production of chinook salmon fry. In addition, this alternative will restore 50 acres of salt marsh which will provide habitat for chinook salmon fry during their initial stages of development. The additional 10-acre mudflat restoration has not been used in benefit calculation. According to the US Fish and Wildlife Service, one million chinook fry will be reared in the 8-acre pond each year with supplemental feeding. These fry will move out of the pond and into the marsh within 3 months. An additional 35,000 chinook salmon fry from areas upstream from Libby Dike will also rear in the restored marsh. Thus this alternative will provide for a total of 1,035,000 additional chinook salmon fry.

Assuming an adult escapement ratio of 1.8 percent (US Fish and Wildlife Service), this alternative will result in an additional 18,630 spawning fall Chinook. Based on a catch to escapement ratio of 4 to 1 (also US Fish and Wildlife Service), approximately 74,520 additional fall chinook will be caught. Assuming an 80 percent commercial catch and a 20 percent sport catch (based on historical record), 59,616 additional fall chinook will be taken in the commercial fishery and 14,904 additional fall chinook will be caught by sport fishermen.

Based on the information contained in the Loomis report, the 1986 marginal value of salmon for recreation fishing under these conditions is estimated to be $24.19. Total consumer surplus will rise to $1,578,060, an increase of $363,565. Applying the commercial value of $21.21 per fish, developed previously, the annual value of the commercial catch will be $1,264,455.

The total annual value of the enhanced fishery for fall chinook under this alternative is estimated to be $1,628,020. This value must be discounted for 4 years because the fish facilities will be constructed one year after the flood control measures take effect and salmon fry take three years to mature and return. The total average annual value of the fishery enhancement for the floodplain evacuation plan is $1,158,499 after discounting.

Fishery Benefits for the Set Back Levee. Under the set back levee alternative, 32-acres of salt marsh will be restored. No rearing pond will be constructed. The marsh will provide habitat for an additional 17,500 Chinook salmon fry from upstream of Libby Dike. Based on the assumptions used previously, this alternative will result in 315 additional spawning fall Chinook and 1,260 additional Chinook caught, including 1,008 additional commercial and 252 additional sport fish.

The annual commercial value will continue to be $21.21 per Chinook salmon, so this alternative will result in an increase in the value of commercial fish harvested of $21,380. The marginal recreation value will be $26.42, with consumer surplus rising to $1,174,505, an increase of $6,722 over the without project condition. The total annual value of the enhanced fishery for the set back levee alternative is $28,102. The average annual benefits are $19,997 after discounting for four years at the project interest rate.

BENEFIT ANALYSIS - WITHOUT PROJECT CONDITION

The following section is devoted to a discussion of the benefit analysis as it applies to the without-project condition. Libby Dike was constructed before 1920 by private interests and is privately owned and maintained. It is about 5,550 feet long and protects approximately 74 acres, including 11.0 acres of residential lands and 15 residences (3 of which are unoccupied), 56.0 acres of pastureland, 4.0 acres of timbered wetlands, and 3.0 acres of city and county streets. Based on discussions with the city planner, no new development is

anticipated in the flood plain, nor is any change in land use or economic activity forecast.

The study area is subjected to high water stages on Coalbank Slough which is influenced by tidal fluctuations and wave climate during storms. If no action is taken the levee will continue to deteriorate and will often be overtopped. The top of the levee is 7.0 feet, NGVD and the safe height elevation is 4.0 feet, NGVD. The one-year flood event is 7.4 feet, NGVD. The levee currently offers protection only from normal high tides.

Most of the residences susceptible to flooding lie east of Southwest Boulevard, except for a 10-acre section on the west side which extends from Illinois Avenue on the south, past 15th street on the west, and 400 feet south of Montana Avenue on the North. Most of the area behind the levee that lies east of Southwest Boulevard ranges in elevation from -0.8 feet, NGVD to 1 foot, NGVD. The 10 acres that lie west of Southwest Boulevard average about 2.2 feet, NGVD. Residences first floor heights average 7.0 feet, NGVD; the average ground elevation of the residences is 4.4 feet. Data developed by Corps hydrologists for Libby Dike flooding problems are presented in table five.

Table Five

Hydrological Data for Libby Dike

Flood	Frequency	Stage (NGVD)
<2-Year	.950	7.4 Feet
2-Year	.500	7.8 Feet
5-Year	.200	8.1 Feet
10-Year	.100	8.4 Feet
50-Year	.020	9.1 Feet
100-Year	.010	9.4 Feet
500-Year	.002	10.0 Feet

All land and property value estimates were obtained from a professional Corps real estate appraisal based on field inspection. Values, stated at a January 1987 price level, are displayed in table six.

Table Six

Land and Improvement Values

at Libby Dike

Land:	
11.0 Acres Residential Land	$150,000
56.0 Acres Pastureland	$ 65,000
4.0 Acres Timbered Wetlands	$ 8,000
3.0 City & County Streets	Nil
Improvements:	
Fifteen Residential Dwellings (3 vacant) plus Appurtenances	$295,000
Total Lands and Improvements:	$518,000

Value of contents is assumed to be 25% of the value of occupied structures. Total damages for the without-project condition, including damages to structures, contents, and grounds, as well as damages due to emergency aid, temporary evacuation, traffic interruptions and rerouting, and road clean-up, are listed by flood event in table seven.

Table Seven

Total Damages by Flood Event

Without-Project Condition

Flood Event	Total Damages
less than 2-Year	$ 60,734
2-Year	$ 67,862
5-Year	$ 74,279
10-Year	$ 80,465
50-Year	$ 88,852
100-Year	$ 93,927
500-Year	$100,597

Average annual real estate damages under the without-project condition are $58,411. This includes $40,265 in damages to structures, $15,798 in damages to contents, and $2,348 in damages to grounds. Average annual damages for other categories under the without-project condition are listed in table eight.

Table Eight
Average Annual Damages
Other Damage Categories

Emergency Aid	$ 703
Evacuation	$ 5,119
Traffic Interruption	$ 504
Traffic Rerouting	$ 888
Road Clean-up	$ 831
Total	$ 8,045

Total average annual damages under the without-project condition are $66,456.

BENEFIT ANALYSIS - WITH-PROJECT CONDITION

Floodplain Evacuation Alternative. Under this alternative all flood-prone lands and improvements (below 10 feet, NGVD) would be purchased at fair market value and/ or relocated at government expense. The existing levee would be breached and the flood plain would be restored to a natural salt marsh. Short sections of Southwest Boulevard and Illinois Avenue would be raised to elevation 7 feet, NGVD. This would remove these roads from daily tidal influence, however, they would remain below the level of a flood event with the frequency of less than two years. In addition, a freshwater pond comprising 8 surface acres would be created and used to provide a rearing area for fall chinook salmon. Lands east of Southwest Boulevard would become a salt marsh, providing 50 surface acres of intertidal coastal wetland that would support juvenile fall chinook salmon as well as many other types of fish and wildlife.

Project Benefits. Benefits for the floodplain evacuation alternative are the externalized costs of flooding eliminated by the project. Externalized costs are the costs of flood plain occupancy borne by the taxpayers or public entities outside the flood plain. These include subsidies to flood plain insurance, losses to public utilities, and losses of other public services. The Federal flood insurance subsidy computations are shown in table nine.

Table Nine

Federal Flood Insurance Subsidy Computations

Average Annual Real Estate Damages	$58,411
Plus:	
Annual Agent's Fees	$ 262
Administrative Charges	$ 871
Less:	
Annual Insurance Premiums	$ 1,749
Annual Uninsurable Damages	$ 2,348
Expected Annual Deductible	$ 4,394
Equals:	
Average Annual Insurance Subsidy	$51,053

No insurance costs were calculated for two residences in the flood plain because they are not occupied and their value is nil. Insurance cost estimates for the other structures are based on the most current FIA pre- firm insurance premium rates which apply to structures built prior to 1974. These rates are $.45 per hundred for structures without basements, $.50 per hundred for structures with basements, and $.55 per hundred for contents. Deductibles are $500 for structures and $500 for contents. Damages to grounds are not insurable. Annual insurance agent's fees are 15% of the cost of the premium. Administrative charges are $67.00 per premium based on most current FIA information.

Benefits also accrue from elimination of emergency aid of $703, and temporary evacuation costs of $5,119 annually. No benefits will be realized for reductions in road clean-up or traffic interruptions and rerouting because Southwest Boulevard will remain below the level of the 1-year flood event. Enhanced fish production provides annual benefits of $1,158,499, including $899,786 in commercial fishing benefits and $258,713 in recreation fishing benefits (see fish enhancement, page C-12).

In addition, based on current guidelines, Coos County qualifies for benefits due to employment of currently unemployed workers. These benefits are determined based on total construction costs of $592,440. Average annual benefits for employment of currently unemployed workers is $5,029. Average annual benefits for this alternative are $1,220,403. Average annual benefits without recreation fishing are $961,690.

Project Costs. Construction of this project is expected to require three months. Costs of the floodplain evacuation alternative are displayed in table ten.

Table Ten
Project Costs
Floodplain Evacuation Alternative

Construction Costs	
Direct Costs	$ 493,700*
Contingencies (@ 20%)	$ 98,740
Engineering and Design (@ 12.5%)	$ 74,100
Supervision and Administration (@ 10%)	$ 59,244
Interest During Construction (@ 8-7/8%)	$ 10,788
Total Construction Costs	$ 736,527
Real Estate Costs	$ 803,000
Less Salvage Value of the Land (74 ac. @ $200 per)	$ (14,800)
Less Salvage Value of Residences	$ (15,700)
Net Real Estate Costs	$ 772,500
Interest During Construction (@8-7/8%)	$ 11,483
Total Real Estate Costs	$ 783,983
Total Costs for Floodplain Evacuation	$1,520,510

* Direct costs from p. B-11 ($333,700) plus baseline studies and levee breaching ($160,000) equal $493,700.

Real estate costs include costs for land, improvements, severance, contingencies, and administrative costs. Costs associated with PL 91-646 relocation benefits have not been included as NED costs since they are not required for the project but are rather a social cost. Salvage value of land and residences is subtracted from the total real estate costs. Operations and maintenance costs are expected to be $7,690, including $7,190 for operations and maintenance of the fish pond and $500 for maintenance costs related to the evacuation. Average annual costs for this alternative are $144,536 compared to average annual benefits of $1,220,403. Based on an interest rate of 8-7/8% and a project life of 50 years, the benefit-to-cost ratio for the floodplain evacuation alternative is 8.44-to-1. The benefit- to-cost ratio without recreational fishing is 6.65-to-1.

It should be noted that the floodplain evacuation alternative was also reviewed with the highway raising measure deleted, to determine if this option would provide an increase in net benefits. Under this plan, the highway would not be protected, saving both the actual construction costs and a portion of the interest that would accrue during construction (IDC). The highway would be inundated by tides twice a day, rendering it useless in a short time. Loss of the highway would cause the rerouting of 4,766 vehicles per day for an additional 5.9 miles. At a total cost of $.20 per mile, this amounts to an increase in transportation costs of over $2,059,000 annually. In addition, drivers would experience delays totaling $1,166,000 annually, based on the assumption that there is one person per car, that time is valued at the minimum wage of $3.35 per hour, and that the average traveling time for this alternative route is 12 minutes (5.9 miles @ 30 mph).

Thus, the total transportation cost (dis-benefit) for eliminating the road is over $3,225,000. In addition, unemployment reduction benefits amounting to $903 would be lost if the highway is not raised. This compares to an average annual cost savings of $11,629, which includes the amortized values of both the actual construction costs and IDC. Based on the foregoing discussion it is clear that elimination of the highway raising measure from the floodplain evacuation alternative would provide a significant reduction in national economic development (NED) and it should therefore not be pursued.

Levee Rehabilitation Alternative. Under this alternative 3,800 linear feet of the existing levee would be enlarged and rehabilitated. In addition, 300 linear feet of new levee would be constructed. Three new tide boxes would be constructed and three existing tide boxes would be removed. New drainage ditches would be constructed as would emergency and maintenance access.

The rehabilitated levee would protect 14 of 15 residences and 63 acres of land. One residence in the levee right-of-way would be relocated. This alternative would be constructed in stages due to foundation soil conditions which are highly susceptible to failure due to lateral spreading. The first stage (phase I) would provide a levee 9.4 feet in height including freeboard. This levee would settle to 7.5 feet within three years. The phase I levee would provide freeboard flood protection up to approximately a 10 year flood event in the first year, however, protection would be reduced in the second and third years. It would be constructed during the 3 summer months.

The second stage (phase II) would be constructed 3 years after the first stage in order to allow foundation soils to consolidate. Initially, it would bring the total height of the levee to 13.4 feet. The phase II levee would gradually settle one foot to 12.4 feet, and ultimately provide 100-year flood protection for all land and improvements in the flood plain.

Project Benefits. Project benefits for the levee rehabilitation alternative are the reductions in flood damages that result from construction of the project, plus employment benefits which result from the employment of workers who would otherwise be unemployed.

Under this alternative, residual damages amounting to $3,394 would occur annually due to internal drainage problems which would not be addressed by the construction of a levee. The effects of the internal drainage problem have been accounted for separately in the damage reduction analysis. Hydrological data for internal drainage under the levee rehabilitation alternative are presented in table eleven.

Table Eleven

Hydrological Data for Interior Drainage

Levee Rehabilitation Alternative

Flood	Frequency	Stage (NGVD)
2-Year	.500	3.2 Feet
5-Year	.200	3.6 Feet
10-Year	.100	3.9 Feet
50-Year	.020	4.6 Feet
100-Year	.010	4.9 Feet
500-Year	.002	5.2 Feet

Annual damages and damage reductions are presented for the levee rehabilitation alternative by category in table twelve.

Table Twelve

Average Annual Damages and Damage Reductions

Levee Rehabilitation Alternative

Category	W/O Damages	Residual Damages	Internal Drainage	Damage Reductions
Structures	$40,265	$ 5,860	$ 1,471	$32,934
Contents	$15,798	$ 2,266	$ 743	$12,789
Grounds	$ 2,348	$ 322	$ 0	$ 2,026
Total Improvements	$58,411	$ 8,448	$ 2,214	$47,749
Emergency Aid	$ 703	$ 107	$ 0	$ 596
Evacuations	$ 5,119	$ 756	$ 1,136	$ 3,227
Road Clean Up	$ 831	$ 123	$ 44	$ 664
Traffic Rerouting	$ 888	$ 131	$ 0	$ 757
Traffic Interruptions	$ 504	$ 75	$ 0	$ 429
Total	$66,456	$ 9,640	$ 3,394	$53,422

In addition, benefits accrue due to employment of currently unemployed workers. These benefits are determined based on total construction costs of $565,000 for phase I and $270,000 for phase II. Phase II benefits will accrue 3 years into the future and are discounted for that period at the project interest rate. The average annual benefit for employment of currently unemployed workers is $6,629. No fishery enhancement is anticipated under this alternative. Average annual benefits for this alternative are $60,051.

Project Costs. Initial construction of this project is expected to require three months, with additional work being accomplished after three years. Costs of the levee rehabilitation alternative are listed in table thirteen.

Table Thirteen
Project Costs
Levee Rehabilitation Alternative

Construction Costs		
Phase I		$ 565,000
Phase II		$ 270,000
Total Construction		$ 835,000
Real Estate Costs (Land and Improvements)	$ 90,000	
Less Salvage Value of Residence	$ (500)	
Net Real Estate Costs		$ 89,500
Interest During Construction		$ 9,729
Total Costs		$ 934,229

Real estate costs include costs for land, improvements, severance, contingencies, and administrative costs. Costs associated with PL 91-646 relocation benefits have not been included as NED costs since they are not

required for the project but are rather a social cost. Salvage value of one residence is subtracted from the total real estate costs. Operations and maintenance costs for this project are $1,500 annually. Total average annual costs for this alternative are $85,611 compared to benefits of $60,051. Based on an interest rate of 8-7/8% and a project life of 50 years, the benefit-to-cost ratio for the levee rehabilitation alternative is .70 to 1.

Set Back Levee Alternative. Under this alternative, 1,700 linear feet of new levee would be constructed. In addition, 600 linear feet of the existing levee would be rehabilitated. Two new tide boxes would be constructed, as would new emergency and maintenance access. The new levee would protect 11 of 15 residences. Four residences and one large shed-type structure in the levee right-of-way would be removed or relocated. This alternative would be constructed in stages due to foundation soil conditions which are highly susceptible to failure due to lateral spreading. The first stage (phase I) would provide a levee 9.4 feet in height including freeboard. This levee would settle to 7.5 feet within three years. The phase I levee would provide freeboard flood protection up to approximately a 10 year flood event in the first year, however, protection would be reduced in the second and third years. It would be constructed during the 3 summer months.

The second stage (phase II) would be constructed 3 years after the first stage in order to allow foundation soils to consolidate. Initially, it would bring the total height of the levee to 13.4 feet. The phase II levee would gradually settle one foot to 12.4 feet, and ultimately provide 100- year flood protection for all land and improvements in the flood plain.

Project Benefits. Project benefits for the set back levee alternative are the reductions in flood damages that result from construction of the project, employment benefits which result from the employment of workers that would otherwise be unemployed, and fishery enhancement benefits.

Under this alternative, residual damages amounting to $333 would occur annually due to internal drainage problems. Hydrologic data for internal drainage under this alternative are presented in table seventeen. Damages due to internal drainage are less under this alternative because more homes are

removed or relocated from the flood plain. Hydrological data for interior drainage are presented in table fourteen.

Table Fourteen
Hydrological Data for Interior Drainage
Set Back Levee Alternative

Flood	Frequency	Stage (NGVD)
2-Year	.500	3.3 Feet
5-Year	.200	3.7 Feet
10-Year	.100	4.1 Feet
50-Year	.020	4.8 Feet
100-Year	.010	5.0 Feet
500-Year	.002	5.3 Feet

Annual damages and damage reductions for the set back levee alternative are presented by category in table fifteen.

Table Fifteen
Average Annual Damages and Damage Reductions
Levee Rehabilitation Alternative

Category	W/O Damages	Residual Damages	Internal Drainage	Damage Reductions
Structures	$40,265	$ 4,565	$ 69	$35,631
Contents	$15,798	$ 1,892	$ 19	$13,887
Grounds	$ 2,348	$ 280	$ 0	$ 2,068
Total Improvements	$58,411	$ 6,737	$ 88	$51,586
Emergency Aid	$ 703	$ 107	$ 0	$ 596
Evacuations	$ 5,119	$ 756	$ 591	$ 3,772
Road Clean Up	$ 831	$ 123	$ 38	$ 670
Traffic Rerouting	$ 888	$ 131	$ 0	$ 757
Traffic Interruptions	$ 504	$ 75	$ 0	$ 429
Totals	$66,456	$ 7,929	$ 717	$57,810

In addition, benefits would accrue due to employment of currently unemployed workers. These benefits are determined based on total construction costs of $398,000 for phase I and $213,000 for phase II. Because phase II benefits will accrue 3 years into the future they are discounted for that period of time at the project interest rate. Total benefits are then amortized over the life of the project. Average annual benefits for employment of currently unemployed workers are $4,821 under this alternative.

Enhanced fish production provides annual benefits of $19,997, including $15,214 in commercial fishing benefits and $4,783 in recreation fishing benefits (see fish enhancement, page C-13). Average annual benefits for this alternative are $82,628. Average annual benefits without recreation fishing are $77,845.

Project Costs. Construction of this project is expected to require three months for phase I, and an additional three months for phase II three years hence. Costs of the set back levee alternative are given in table sixteen.

Table Sixteen
Project Costs
Set Back Levee Alternative

Construction Costs	
Phase I	$398,000
Phase II	$213,000
Total Construction	$611,000
Real Estate Costs (Land and Improvements)	$213,000
Less Residual Value of the Land (34.0 ac. @ $200 per)	$ (6,800)
Less Salvage Value of Residence	$ (2,400)
Net Real Estate Costs	$203,800
Interest During Construction	$ 8,946
Total Costs	$823,746

Real estate costs include costs for land, improvements, severance, contingencies, and administrative costs. Costs associated with PL 91-646 relocation benefits have not been included as NED costs since they are not required for the project but are rather a social cost. Salvage value of lnd and residences is subtracted from the total real estate costs. Operations and maintenance costs for this project are $1,000 annually. Total average annual costs for this alternative are $75,164 compared to benefits of $82,628. Based on an interest rate of 8-7/8% and a project life of 50 years, the benefit-to-cost ratio for the set back levee alternative is 1.10 to 1. The benefit-to-cost ratio for this alternative without recreational fishing is 1.04-to-1.

CONCLUSIONS

Identification of the National Economic Development (NED) plan is determined based on the principle of maximum net economic benefits. Average annual benefits, costs, and net benefits for each of the three alternatives are presented in table seventeen, as are benefit-to-cost ratios.

Table Seventeen
Average Annual Benefits, Costs,
Net Benefits, and B/C Ratios

Alternative	Benefits	Costs	Net Benefits	B/C Ratios
#2 Rehabilitation	$ 60,051	$ 85,611	$ (25,560)	.70-to-1
#3 Set Back Levee	$ 82,628	$ 75,164	$ 7,482	1.10-to-1
#4 Evacuate Floodplain	$1,220,403	$ 144,536	$1,075,867	8.44-to-1

Based on the information contained is this report, the NED plan is the floodplain evacuation alternative with $1,075,867 in net benefits. This is a non-structural plan that not only maximizes net economic benefits, but also provides an unusual opportunity to enhance the economically important commercial and recreational fall chinook fishery of the region.

COST ALLOCATION

Introduction

As described in the main report, the NED plan was formulated with flood control and fishery enhancement as major objectives. This allocation of costs is made to equitably distribute the project costs among the two purposes. This allocation uses the basic principles of the separable costs remaining benefits (SCRB) method. This is the preferred method of allocation for use by Federal agencies and is mandated by Corps guidance.

Using the SCRB method, the maximum amount that can be allocated to any purpose is limited to the lesser of the benefits for the purpose or the cost of the most efficient alternative means of achieving the benefit. The reasoning is that if costs are allocated in an amount exceeding benefits, then the purpose in question would not be economically justified. This same logic applies to using alternative cost as a limit. If allocated costs exceed alternative costs, then the alternative would be more economically attractive than the selected plan. The minimum amount that can be allocated to a purpose is the separable cost. By definition, separable costs are the cost of including a purpose in a multiple purpose plan.

Between these maximum and minimum limits, costs will be allocated among purposes in a manner that each purpose shares equitably in the advantages of the multiple use development.

For planning purposes, the allocation procedure requires construction of a percentage that is used to allocate joint costs (total cost less separable cost) between purposes. During the final design stage a detailed re- analysis will be done to identify separable, joint, and alternative project costs. The

allocation percentage defined during this design phase will be used for allocating joint costs through the construction period. When the project is put into service a final allocation will be conducted based on actual construction cost records. At this point it is possible the allocation percentage could change. After approval of the final allocation, the percentage becomes firm.

Allocation Procedure

The allocation procedure requires accounting detail to accurately identify costs, and interest during construction must be determined for each cost category. The basic procedure can be simplified and described. Generally the steps for allocation of annual costs are as follows:

1. Determine benefit of each purpose. This information is provided from the economic analysis.

2. Determine alternative costs of each purpose. Each part of the alternative must represent the least cost means of providing the same benefits as the selected plan.

3. Determine separable costs. This is done by comparing the cost of the multiple purpose plan against the cost of the multiple purpose plan with one purpose removed. The difference is the separable cost of the purpose being tested.

4. Subtract separable costs from the lesser of either the benefits or alternative cost of each purpose. This will leave a remainder entitled "remaining benefits" for each purpose. It is the proportionate relationship of these remainders for each purpose that are used as the allocation percentages.

5. Multiply the allocation percentages for each purpose by the total joint cost.

6. Add each purpose's allocated joint cost to the separable cost to determine cost allocated to each purpose.

Benefits

The annual benefits of the NED plan are $1,220,403. These are comprised of flood damage reductions of $59,339 annually and fishery enhancement benefits of $1,161,064 annually.

Separable Costs

The separable cost for each project purpose is the difference between the cost of the multiple purpose project and the cost of the project with that purpose omitted. Equivalent average annual costs of the NED plan, excluding O & M costs, are $154,361. Of these, separable costs for flood control are $30,584 and separable costs for fishery enhancement are $31,563.

Joint Costs

With separable costs to flood control of $30,584 and separable costs to fishery enhancement of $31,563, remaining NED plan equivalent average annual costs of $92,214 are considered joint costs.

Alternative Projects

In the SCRB method, the costs allocated to any one purpose will not be more than the benefits of that purpose or the cost of the most economical single purpose alternative.

Single Purpose Alternatives

Because the flood control and fishery enhancement components of this study are so closely related, no single purpose alternative plans were developed for this analysis.

Summary

The total cost allocation for flood control is $32,889, the total cost allocation for fishery enhancement is $121,472. Distribution of costs is shown in table eighteen. The allocation process is shown on table nineteen.

Table Eighteen
Libby Dike Cost Distribution

Cost Category	Total Cost	Average Annual Cost
Separable Flood Control Costs		
Base Course	$7,400	$666
Leveling Course	$2,500	$225
CMP Culverts & Accessories	$32,000	$2,881
Road Relocations	$25,000	$2,251
Utility Relocations	$15,000	$1,350
Sewer Relocations	$75,000	$6,752
Demolitions	$70,800	$6,374
Contingencies (@ 20%)	$45,540	$4,100
Engineering & Design (@ 12.5%)	$34,155	$3,075
Supervision & Admin (@ 10%)	$27,324	$2,460
Interest During Construction (@ 8-7/8%)	$4,983	$449
Total Flood Control Costs	$339,702	$30,584
Fisheries Costs		
Baseline Studies	$150,000	$13,505
Fish Ladder and Pond	$75,000	$6,752
Levee Breach	$10,000	$900
Contingencies (@ 20%)	$47,000	$4,232
Engineering & Design (@ 12.5%)	$35,250	$3,174
Supervision & Admin (@ 10%)	$28,200	$2,539
Interest During Construction (@ 8-7/8%)	$5,122	$461
Total Fisheries Costs	$350,572	$31,563
Joint Costs		
Mobilization & Demobilization	$10,000	$900
Embankment	$21,000	$1,891
Residential Lots	$150,000	$13,505
Pastureland	$65,000	$5,852
Timbered Wetland	$8,000	$720
City & County Streets	$0	$0
Savage Value of the Land	($14,800)	($1,332)
Purchase of Improvements	$295,000	$26,560
Salvage Value of Improvements	($15,700)	($1,414)
Severence	$37,000	$3,331
PL 91-646 Costs	$194,000	$17,466
Acqusitions & Administration	$118,000	$10,624
Contingencies (@ 20%, Real Estate 25%)	$136,200	$12,262
Engineering & Design (@ 12.5%)	$4,650	$419
Supervision & Admin (@ 10%)	$3,720	$335
Interest During Construction (@ 8-7/8%)	$12,166	$1,095
Total Joint Costs	$1,024,236	$92,214
Total All Costs	$1,714,510	$154,361
Total less PL 91-646 costs	$1,520,510	$136,895

Note: Annual O & M costs of $7,690 are not included in this table.

Table Nineteen

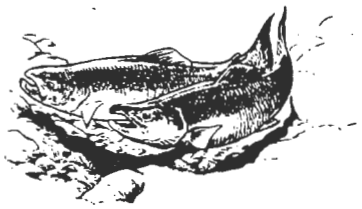
Cost Allocation of NED Plan

Allocation of Annual Costs	Flood Control	Fishery Enhancement
1. Average Annual Benefits	$ 59,339	$1,161,064
2. Alternative Costs	N.A.	N.A.
3. Limited Benefits	$ 59,339	$1,161,064
4. Separable Costs	$ 30,584	$ 31,563
5. Remaining Benefits		
a. Amount	$ 28,755	$1,129,501
b. Percent	2.5%	97.5%
6. Allocated Joint Costs	$ 2,305	$ 89,909
7. Total Allocated Costs*	$ 32,889	$ 121,472

* The difference between $154,361 ($32,889 + $121,472) and $144,536 (p. C-22) is the cost associated with relocations assistance, PL 91-646.

UNITED STATES DEPARTMENT OF THE INTERIOR

FISH AND WILDLIFE SERVICE



IMPACTS OF THE LIBBY LEVEE FLOOD CONTROL PROJECT ON FISH AND WILDLIFE RESOURCES, COOS BAY, OREGON

FISH AND WILDLIFE COORDINATION ACT REPORT

REGION ONE

AUGUST 1985

APPENDIX D

United States Department of the Interior

FISH AND WILDLIFE SERVICE

Division of Ecological Services
Portland Field Office
727 N. E. 24th Avenue
Portland, Oregon 97232

Reference DS:mm

August 15, 1985

Colonel Gary R. Lord, District Engineer
Portland District, Corps of Engineers
P. O. Box 2946
Portland, Oregon 97208

Dear Colonel Lord:

This expresses the Fish and Wildlife Service's position on the proposed Libby Levee Flood Control Project based upon impacts it would have on fish and wildlife resources. This statement and the attached detailed report constitute our Fish and Wildlife Coordination Act Report as required under Section 2(b) of the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C. 661 et seq.), and is consistent with the intent of the National Environmental Policy Act. This report is intended for inclusion with your Feasibility Report, authorized by Section 205 of the 1948 Flood Control Act, as amended.

This report was coordinated with and has the concurrence of the Oregon Department of Fish and Wildlife and the National Marine Fisheries Service as indicated by their attached letters, both dated August 15, 1985. The U.S. Environmental Protection Agency has also reviewed the report and concurs with the report's recommendations in their attached letter dated June 26, 1985.

The project would reduce or eliminate economic losses due to flooding on approximately 10 acres of residential lands (with 13 residences), 52 acres of pasture land, and 8 acres of undeveloped land.

Alternatives evaluated include: 1) No Action; 2) Construct Short Levee-No Action Outside Levee; 3) Rehabilitate Existing Levee; 4) Evacuate Flood Plain; and 5) Construct Short Levee-Evacuate Flood Plain Outside Levee. The Evacuate Flood Plain Alternative would eliminate flooding problems and create jobs, and is by far the most desirable from a fish and wildlife resource and economic standpoint. We believe this alternative would also be favored by the local project sponsors. Fishery values based on improved habitat for fall chinook salmon would result in a National Economic Development benefit cost ratio estimated to be at least 4.79 to 1 and likely up to 19.15 to 1.

To minimize the potential adverse impacts of the proposed project alternatives on fish and wildlife resources and to maximize potential environmental and economic benefits, we recommend, in order of preference, that:

1. The Corps of Engineers, in cooperation with project sponsors, other local interests, and resource agencies, implement the Evacuate Flood Plain Alternative as by far the most environmental and economically beneficial solution to the flooding problems behind Libby Levee.

2. As a much less desirable second choice, the Construct Short Levee-Evacuate Flood Plain Outside Levee Alternative be implemented.

3. If the Construct Short Levee-No Action Outside Levee Alternative is implemented:

    a. Riparian vegetation (herbs and shrubs) and grass and forb species be planted or seeded and allowed to establish on the levee.

    b. The borrow ditch be equal to or greater in surface area than the area of wetlands destroyed by levee construction. The borrow ditch should be shallow on one side (approximately 6:1 slope) and have irregular banks with small points and bays.

    c. Vegetation along the borrow ditch and on the levee be protected by fencing.

    d. Items a, b, and c above be coordinated with the Oregon Department of Fish and Wildlife and the U.S. Fish and Wildlife Service.

4. If the Rehabilitate Existing Levee Alternative is implemented, the same recommendations described under (3) apply with the following exception. The borrow ditch shallow edge should be located next to the inside of the levee with a deep drop off located on the other side to prevent cattle from crossing to the levee. If monitoring shows cattle still cross to the levee, fencing should be constructed.

Detailed information regarding fish and wildlife resources, project impacts, and our recommended actions is contained in the attached report. Please notify us of your decisions regarding our recommendations, and of any changes in project plans which may require further evaluation.

Sincerely,

Russell D. Peterson

Russell D. Peterson
Field Supervisor

VICTOR ATIYEH
GOVERNOR

Department of Fish and Wildlife

506 S.W. MILL STREET, P.O. BOX 3503, PORTLAND, OREGON 97208

August 15, 1985

Mr. Russell D. Peterson, Field Supervisor
U.S. Fish and Wildlife Service
Division of Ecological Services
Portland Field Office
727 N.E. 24th Avenue
Portland, Oregon 97232

Dear Mr. Peterson:

The Oregon Department of Fish and Wildlife has completed its review of your agency's Draft Coordination Act Report on the Libby Levee Flood Control Project.

Our Department concurs with the report's identification of expected environmental impacts associated with possible project alternatives.

Thank you for the opportunity to review your report. If we could be of further help, please call.

Sincerely,

Michael C. Weland, Chief
Environmental Management Section

wbs

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE

ENVIRONMENTAL & TECHNICAL SERVICES DIVISION
847 NE 19th AVENUE, SUITE 350
PORTLAND, OREGON 97232-2279
(503) 230-5400

August 15, 1985 F/NWR5

Mr. Russell D. Peterson
Field Supervisor
Fish & Wildlife Service, ES
727 N.E. 24th Ave.
Portland, OR 97232

Dear Mr. Peterson:

We have reviewed the August 1985 Draft Coordination Act Report titled Impacts of the Libby Levee Flood Control Project on Fish and Wildlife Resources - Coos Bay, Oregon. We are in general agreement with the contents of this report.

The Evacuate Flood Plain alternative provides an innovative solution to flood control because it simultaneously provides restoration and potential enhancement of public trust aquatic resources of Coos Bay. The Corps of Engineers, as the Federal Government's principal water resource development agency, has the experience, construction expertise and capability to work with fisheries management agencies on habitat restoration projects. The Evacuate Flood Plain alternative appears to be an excellent multiple use project because it has flood protection, fisheries and recreation benefits.

Our staff economist has reviewed the economic analysis in the report. Estimating benefits of the Evacuate Flood Plain alternative at 25 percent of calculated average annual benefits is prudent and reasonable. This still produces a 4.79:1 benefit:cost ratio. Because markup to processing figures and benefits at the processing level often are subject to criticism, these could be eliminated from the report. Benefit:cost would still be very high.

The estimate of 6,500 returning chinook spawners is based on extrapolating the carrying capacity of juveniles in the Sixes River Estuary and the average spawning escapement rates on the Elk River. Given the absence of comparable data for Coos Bay, this seems to be a reasonable method to approximate the number of returning adult chinook salmon which may result from restoring 50 acres of mudflat habitat.

Sincerely yours,

for

Dale R. Evans
Division Chief

U.S. ENVIRONMENTAL PROTECTION AGENCY
REGION X
1200 SIXTH AVENUE
SEATTLE, WASHINGTON 98101

JUN 26 1985

REPLY TO ATTN OF: M/S 423

Mr. Russell D. Peterson
Field Supervisor
U.S. Fish and Wildlife Service
Division of Ecological Services
727 N.E. 24th Avenue
Portland, Oregon 97232

RE: Draft Coordination Act Request on the Impacts of Libby Levee Flood Control Project

Dear Mr. Peterson:

We have reviewed the referenced document and concur in the findings and support the recommendations of the U.S. Fish and Wildlife Service.

In addition to the substantial economic and wildlife benefits, the restoration of approximately 60 acres of natural salt marsh and mudflat will have water quality benefits in Coalbank Slough. This project provides a rare opportunity to use public funds to meet a variety of legitimate public needs.

Please let us know if we can be of assistance in regard to promoting the implementation of the preferred alternatives. If you have any questions, please contact Mr. Gary Voerman of my staff at FTS 399-8513.

Sincerely,

Carl Kassebaum

Acting Chief
Water Resources Assessment Section

cc: NMFS
ODFW
ODSL
COE-Portland

IMPACTS OF THE LIBBY LEVEE FLOOD CONTROL PROJECT ON FISH AND WILDLIFE RESOURCES COOS BAY, OREGON

David M. Sill

August 1985

Prepared for the Portland District
U. S. Army Corps of Engineers
by the
Portland Ecological Services Field Office
U. S. Fish and Wildlife Service

PREFACE

This is the Fish and Wildlife Service's detailed report on fish and wildlife resources affected by proposed alternatives to eliminate flooding behind Libby Levee, Coos Bay, Oregon. The project is being studied under Section 205 of the 1948 Flood Control Act as amended (flood control projects not specifically authorized by Congress). Our analysis of project impacts on fish and wildlife is based on: 1) project information and engineering data received prior to August 1, 1985; 2) an appraisal of existing resources; and 3) a project life of 50 years.

The fish and wildlife data contained in this report were developed in cooperation with the Oregon Department of Fish and Wildlife and University of Oregon Institute of Marine Biology, Charleston, Oregon. Fish and wildlife population figures, improvement costs, and economic values are estimates based on factual data.

It should be noted that the proposed project may be subject to permits over which the Fish and Wildlife Service (FWS) has review responsibilities. Acordingly, our comments do not preclude an additional and separate evaluation by the FWS, pursuant to the Fish and Wildlife Coordination Act (16 U.S.C. 611, et seq.), if eventual project development requires a permit from the Corps of Engineers, U.S. Army (Section 10 of the River and Harbor Act of 1899 and Section 404 of P.L. 92-500). All such permits are subject to separate review by the FWS under existing statutes, executive order, memorandum of agreement, and other authorities. In review of permit applications, the FWS may concur, with or without stipulations, or object to the proposed work, depending on specific construction practices which may impact fish and wildlife resources.

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DESCRIPTION OF THE PROJECT AREA

Libby Levee is located at the southeastern limits of the city of Coos Bay, in Coos County, Oregon. The levee forms the left bank of Coalbank Slough 3 miles upstream from its confluence with Isthmus Slough. That confluence is about 1 mile south of Coos Bay. The levee is thought to have been constructed before 1920 by private interests and is privately owned and maintained. It is about 5,550 feet long and protects approximately 10 acres of residential land (with 13 residences), 52 acres of pasture land, and 8 acres of undeveloped land. These estimates are based on land protected by the levee up to the 500-year flood line at approximately 10 feet mean sea level (msl) (Figure 1 and Photo 1). Most of the bottomland behind the levee and east of Southwest (S.W.) Boulevard ranges in elevation from -0.8 feet msl to 1 foot msl. Approximately 10 acres west of S.W. Boulevard averages about 2.2 feet msl in elevation.

Winter storms combined with high tides occasionally overtop the levee (at 7 feet msl) and temporarily flood much of the land behind the levee. The levee is rated "hazardous" at 4 feet msl. When the levee is overtopped, a section of S.W. Boulevard is temporarily flooded, curtailing traffic flow.

Soils in the project area are a Langlois silty clay loam and Langlois peaty silty clay loam. Both of these soils are very poorly drained and place severe restrictions for developing sanitary facilities, building sites, and recreation facilities. They also provide poor construction materials due to the high water table and frequent and long duration of flooding. However, due to the present condition of the existing levee and drainage ditches, and when the tide gates work as designed, the flooding is rapidly dissipated from most of the project area. Aerial photographs taken during the growing season show standing water in some portions of the project area and places where standing water has recently disappeared.

The soils are listed as hydric soils on the Soil Conservation Service's (SCS) List of Soils with Actual or High Potential for Hydric Conditions (SCS, 1983). According to the U.S. Fish and Wildlife Service's (FWS) wetland classification system, a wetland site must either be occupied by predominately wetland plants, have an undrained hydric soil, or in the absence of soil, have surface water for some portion of the growing season (Cowardin et al.,1979).

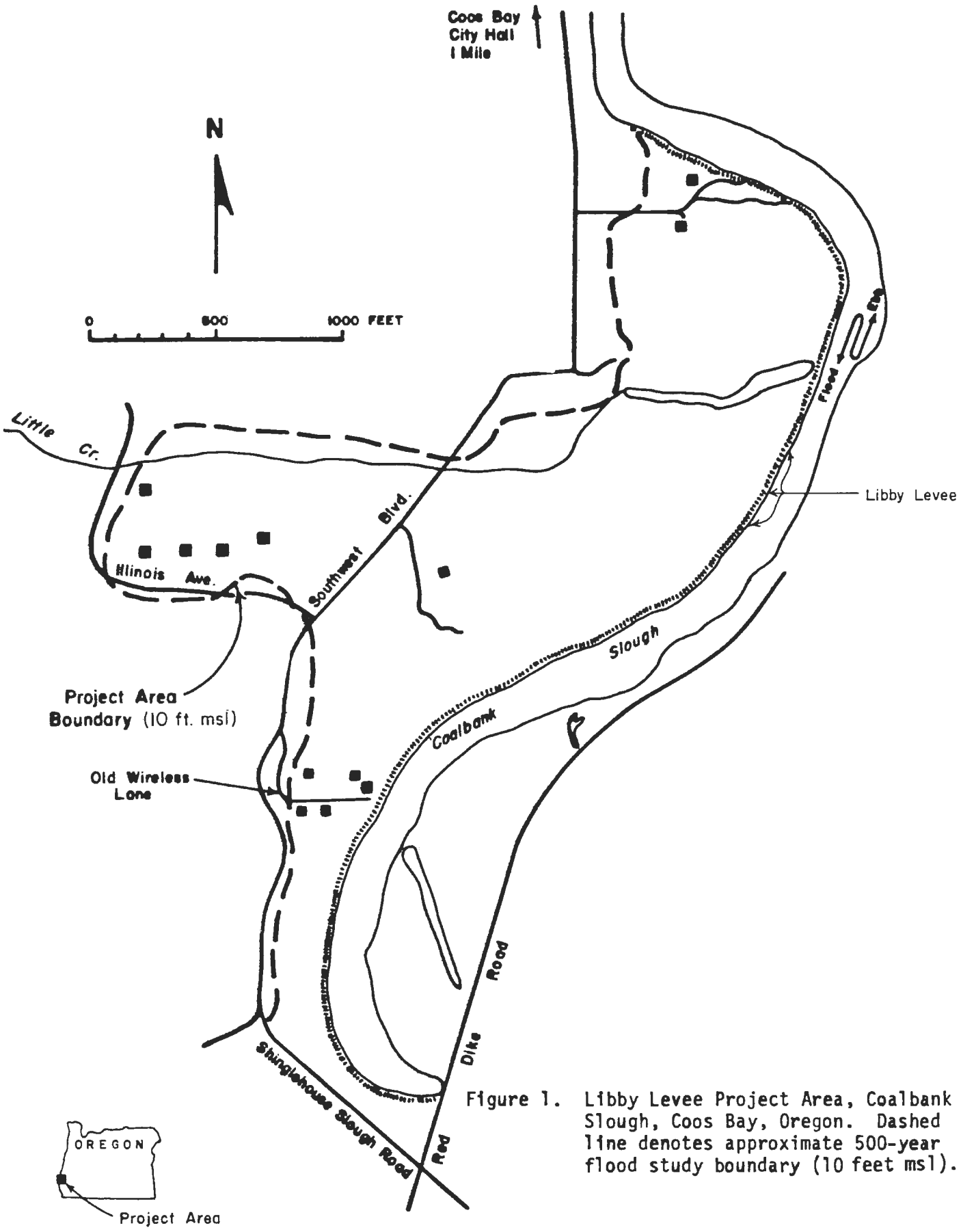

Figure 1. Libby Levee Project Area, Coalbank Slough, Coos Bay, Oregon. Dashed line denotes approximate 500-year flood study boundary (10 feet msl).

Photo 1. Aerial view of Coalbank Slough, Coos Bay, Oregon. Libby Levee Project Area lies west (left) of Coalbank Slough. The paved road in project area is S. W. Boulevard.

Nearly all of the project area is a palustrine emergent diked wetland. Prior to levee construction, it was an estuarine salt marsh directly connected to Coalbank Slough and the Coos Bay Estuary. The contribution of this wetland area to the productivity of the Coos Bay Estuary has been greatly reduced by the presence of the levee which restricts the movement of tides and input of organic material (detritus) to the estuary.

FISH AND WILDLIFE RESOURCES

FISH

No fish surveys were made in the one or two shallow channels behind the levee, but they reportedly contain three spine stickleback (Harris, 1985). Oregon Department of Fish and Wildlife (ODFW) gillnet surveys in 1979 revealed that several commercial and sport fish, including striped bass and starry flounder, inhabit Coalbank Slough. Top smelt and shiner perch (important prey species) and Dungeness crab were also present. English sole, although not found in gillnet surveys, probably inhabit the slough. Remnant runs of coho salmon, steelhead, and searun cutthroat trout utilize Coalbank Slough and its upper tributary streams. These runs are being supplemented along with attempts to establish a fall chinook fishery through the Salmon Trout Enhancement Program (STEP) coordinated by ODFW.

WILDLIFE

Color infrared aerial photography taken on June 30, 1980 at a scale of 1:12,000 was stereoscopically analyzed by Ben Harrison, Assistant National Wetlands Inventory Coordinator, FWS, to determine wetland boundaries and wetland classification. Wetland delineations were determined based on vegetation, soils data, visible hydrology, and on-site photographs in accordance with the FWS wetland classification system. Water regimes for the emergent plants range from temporarily flooded to seasonally flooded. The project area also contains several excavated ditches and one small slough.

Common wetland plants occupying the project area are buttercup (Ranunculus spp.) and canarygrass (Phalaris arundanacea). Both are listed as wetland plants on the FWS National Wetland Plant Species Data Base. Also, the SCS states that the study area soils have good potential for wetland plants and wetland wildlife. The SCS notes that potential native plants for this site are Sitka spruce (Picea sitchensis), willows (Salix spp.), black cottonwood (Populus trichocarpa), rush (Juncus spp.), sedge

(*Carex* spp.), and bentgrass (*Agrostis* spp.). All of these plants are also listed on the National Wetland Plant Species Data Base as wetland plants.

Vegetation on the project area east of S.W. Boulevard is closely cropped by heavy grazing and haying. Land west of S.W. Boulevard is dominated by a heavy growth of reed canarygrass even though it is grazed by horses during the summer. This wetland plant probably would invade and eventually become the dominant plant east of S.W. Boulevard if left ungrazed (Photos 2 and 3).

During field inspections of the project area in 1984 and 1985, mallards, wigeon, cinnamon teal, blackbirds, and a small rodent were observed. At any one time from 6 to 15 waterfowl could be observed on the area. Other birds known to occur in the project area include the black-shouldered kite, American kestrel, northern harrier, American bittern, green-backed heron, turkey vulture, ring-necked pheasant, killdeer, and blue heron (Harris, 1985).

Other wildlife that use the area are muskrat, raccoon, mink, gulls, and several species of waterfowl and shorebirds (Ibid, 1985). Rodents are common and provide food for marsh hawks and other raptors that may frequent the area. A few pairs of mallards probably nest on the area. The project area, although a wetland, drains rapidly due to internal drainage ditches and is heavily grazed and hayed. However, because of the increasing scarcity of wetlands along the Oregon coast, it is considered of moderate value to wildlife despite the heavy grazing, haying, and drainage features.

THREATENED AND ENDANGERED SPECIES

Under the Endangered Species Act of 1973 (16 U.S.C. 1531, et.seq.), Federal agencies are required to assure that their actions have taken into consideration impacts their projects would have on Federally listed threatened and endangered species.

The Service's letter of January 4, 1985 indicated that bald eagles, Federally classified as threatened, are winter residents in the project area as described in the Corps' letter of November 29, 1984. Accordingly, a biological assessment should be conducted to address the following concerns:

1. The level of use of the project area by bald eagles.

2. The effect of the project on the bald eagles' food supply or foraging areas.

Photo 2. Reed canarygrass (a wetland plant) is the predominant vegetation west of S.W. Boulevard.

Photo 3. Heavily grazed and hayed pasture east of S.W. Boulevard. Libby Levee is in background near top of photo.

3. The effect of construction activities that may result in habitat loss or disturbance of eagles and/or their avoidance of the area.

4. The impacts to bald eagles that may result from increased human use of the project area.

If the Corps has any additional questions regarding endangered species or its responsibilities under the Endangered Species Act, please contact:

U.S. Fish and Wildlife Service
Endangered Species Office
2625 Parkmont Lane S.W., B-2
Olympia, WA 98502
Phone: (206) 753-9444

While the Corps must carry out the above described responsibilities, the following discussion may help in understanding probable impacts of the proposed alternatives on endangered species.

It is likely only the Evacuate Flood Plain and Construct Short Levee-Evacuate Flood Plain Alternative might significantly impact bald eagles and perhaps attract peregrine falcons (Federally classified as endangered) to the project vicinity. Under these alternatives a new source of salmon carcasses could become available for bald eagles. Waterfowl and shorebirds attracted to the marsh could provide an increase in the prey base for both bald eagles and peregrine falcons. In essence, these two alternatives likely would benefit the bald eagle and peregrine falcon. Because of the larger amount of wetlands and salmon carcasses, the Evaluate Flood Plain Alternative would have more favorable impacts than the Short Levee-Evacuate Flood Plain Alternative.

ANALYSIS OF PROJECT ALTERNATIVES

NO ACTION ALTERNATIVE

Description

Under this alternative periodic flooding would continue as previously described under Description of the Project Area. Private landowners would continue to maintain the existing levee as they have in the past.

Effects on Fish and Wildlife

Fish and wildlife use would continue as previously described under Fish and Wildlife Resources. Opportunity to restore most of the area to tidal salt marsh at some future date would be retained.

CONSTRUCT SHORT LEVEE - NO ACTION OUTSIDE LEVEE ALTERNATIVE

Description

This alternative involves constructing approximately 2,250 feet of new levee to protect 29 acres and 10 of the 13 residences. About 15 of the 29 acres would be subjected to slightly more ponding due to local runoff until removed by tideboxes. An undetermined amount of borrow ditch would be created by excavating material for levee cover. The new short levee would cover approximately 4 acres of wetland now being used as pasture. The remaining 32 acres of flood plain outside the new short levee would retain the current level of protection provided by the existing levee. Private landowners would continue to maintain the existing levee outside the short levee as they have in the past (Figure 2).

Effects on Fish and Wildlife

The new short levee would destroy about 4 acres of palustrine emergent diked wetland. There would be slightly increased ponding behind the new levee and in the borrow ditches created. Overall this alternative, with proper borrow ditch design and riparian habitat developed on and along the levee as mitigation, would likely result in little short term net change in fish and wildlife resources. However, opportunity to restore approximately 15 acres of former tidelands behind the new short levee would be lost, resulting in continued reduced levels of fish and wildlife resources.

REHABILITATE EXISTING LEVEE ALTERNATIVE

Description

Under this alternative nearly all of the existing levee would be enlarged and rehabilitated. It would be approximately 4,000 feet long and protect 10 of the 13 residences. An undetermined amount of borrow ditch would be created by excavating material for levee cover. Approximately 60 acres would be protected behind the levee. The levee would cover approximately 6 acres of wetland now being used as pasture (Figure 3).

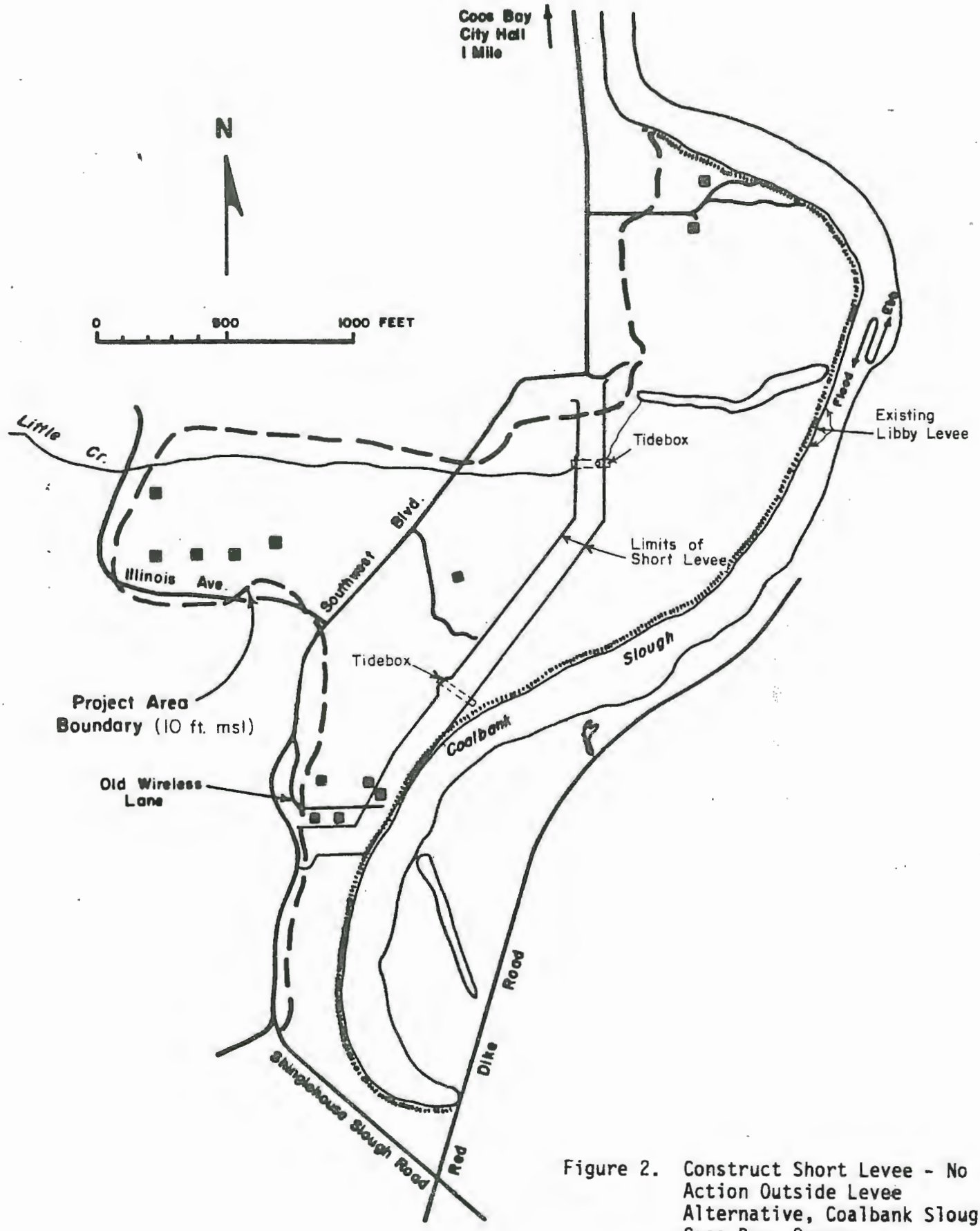

Figure 2. Construct Short Levee - No Action Outside Levee Alternative, Coalbank Slough, Coos Bay, Oregon.

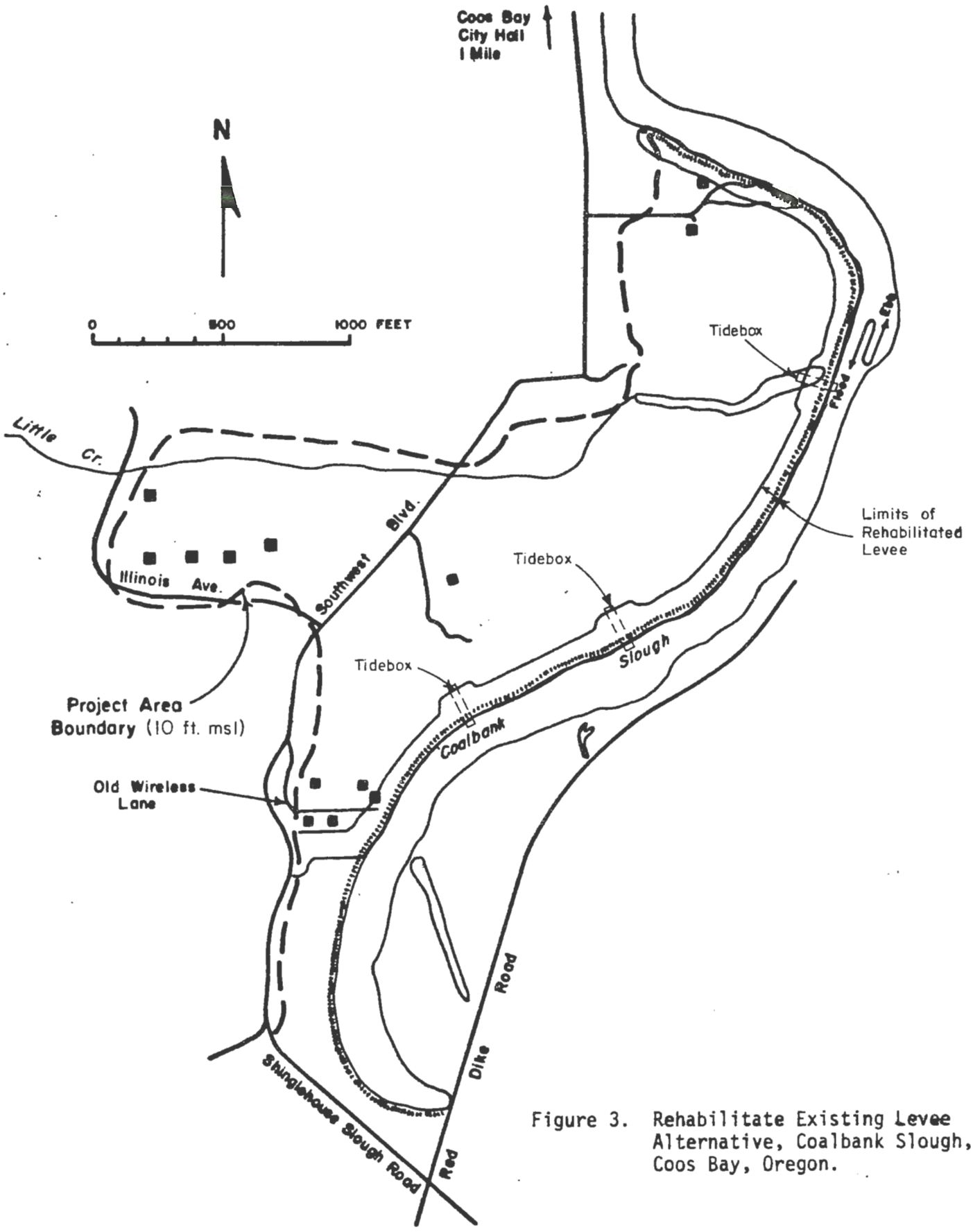

Figure 3. Rehabilitate Existing Levee Alternative, Coalbank Slough, Coos Bay, Oregon.

Effects on Fish and Wildlife

The rehabilitated levee would destroy approximately 6 acres of palustrine emergent diked wetland. The amount and duration of standing water behind the new levee could be expected to decrease (since it would never be overtopped) compared to the No Action Alternative. However, since standing water presently (Without the Project) dissipates rapidly, adverse effects on fish and wildlife would be minimal. If properly designed, the borrow ditch and riparian habitat developed on and along the levee as mitigation would result in little short term net change in fish and wildlife resources. Opportunity to restore approximately 60 acres of former tidelands behind the reconstructed levee would be lost, resulting in continued reduced levels of fish and wildlife resources.

EVACUATE FLOOD PLAIN ALTERNATIVE

Description

Under this alternative all flood-prone lands and improvements (below 10 feet msl) would be purchased at fair market value, and the occupants and their farm operations relocated at government expense (Corps of Engineers, 1984). Loss of county tax revenue would be offset by government in lieu of tax payments (Shivley, 1985; Wise, 1985).

The existing levee would deteriorate over perhaps a 10-year period or be breached to restore approximately 60 acres to natural salt marsh and mudflat. Material removed from breaching the levee could be used to create bird nesting islands. A 480-foot section of S.W. Boulevard and a 600-foot section of Illinois Avenue would be raised to elevation 10 feet msl to prevent flooding of the roadways and to back water up Little Creek, creating an 8 surface acre freshwater impoundment (Photo 4). Bird nesting islands could also be created in this impoundment. Figure 4 shows a schematic illustration of this alternative.

East of S.W. Boulevard

Recent elevation mapping shows that approximately 60 acres of land in the project area east of S.W. Boulevard ranges in elevation from -.8 to 1.5 feet msl. However, most of the land ranges between -.4 to 1 foot msl (City of Coos Bay, 1985). These elevations closely match those found at Pony Slough about 4.5 miles downstream in Coos Bay (City of North Bend, 1985). Based primarily on the close similarity in elevations, breaching the

Photo 4. Under the Evacuate Flood Plain Alternative, S.W. Boulevard would be raised to 10 feet msl. This would form an 8 surface acre freshwater impoundment to the west (leftside of photo). Seasonal road flooding and creek clean out would be eliminated.

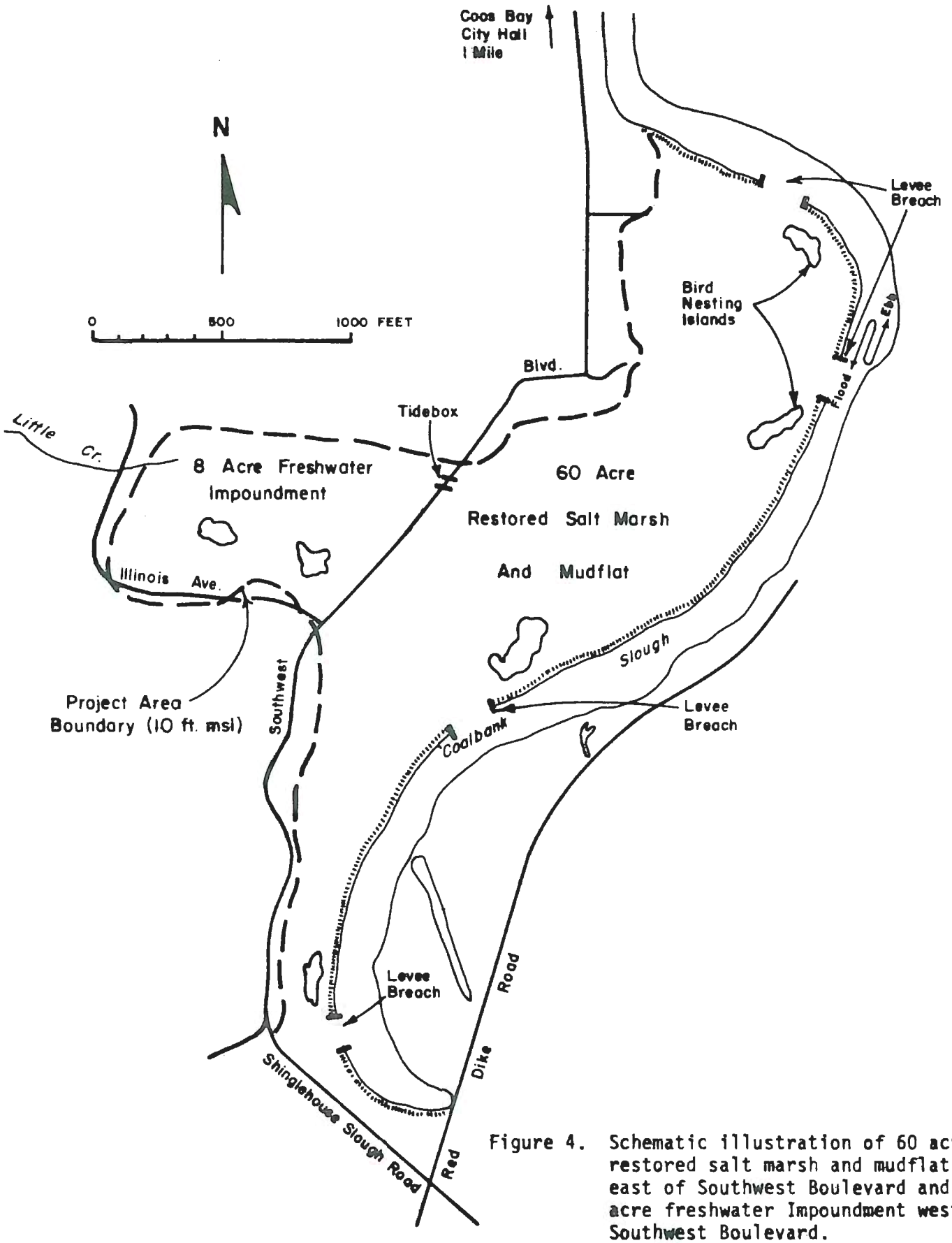

Figure 4. Schematic illustration of 60 acre restored salt marsh and mudflat east of Southwest Boulevard and 8 acre freshwater Impoundment west of Southwest Boulevard.

levee would result in about 50 acres reverting to periodically flooded mudflat with a 10 acre edge of semi-aquatic vegetation consisting of Lyngbye's sedge (Carex lyngbyei) at the higher elevations and pickleweed (Salicornia virginica), arrow grass (Triglochin maritima), and brass buttons (Cotula cornopifolia) (Bierly, 1985) (Photos 5 and 6). This vegetative response is also similar to what has occurred at a previously leveed area on Isthmus Slough located at the same distance from the ocean as the project site. This area, about 1 mile east of the project site, has been restored by breeching a levee and was recently donated to Ducks Unlimited. However, there are no elevation measurements available at this marsh to compare with the project site.

There would be secondary beneficial effects to Coalbank Slough resulting from slowing the flow in the presently constricted channel by allowing water to disperse over the previously leveed area. This would allow the sifting mix of bottom sediments in Coalbank Slough to settle and become covered with finer sediments that are more biologically productive.

West of S.W. Boulevard (Impoundment)

The 8 surface acre impoundment would develop into a freshwater pond. Most of the pond would be open water with aquatic and semi-aquatic vegetation prevalent around the edges. Cattail (Typha spp.) and bulrush (Scirpus spp.) would likely invade and become the dominant edge vegetation.

Effects on Fish and Wildlife

East of S.W. Boulevard

Fish: Intertidal coastal wetlands similar to what would be restored behind Libby Levee are considered to be one of the most productive fish and wildlife habitats in the world. Odum (1959) and many others (Gooselink, et al, 1973; Kline, 1978; Seliskar and Gallagher, 1983) have documented the value of salt marshes to ocean productivity and related commercial and sport fishery industries (Figure 5). Over 90 percent of Coos Bay salt marshes have been lost (Hoffnagle and Olson, 1974).

The Lyngbye's sedge which is likely to cover 2 to 5 acres of restored marsh, is one of the highest primary producers of energy into marsh systems. Net primary production is estimated at 1,850 grams per square meter annually ($g/m^2/yr$) compared for example to Baltic rush which averages 450 $g/m^2/yr$ (Kibby et al, 1980). Other marsh plants would also contribute detrital material. The 50-acre mudflat and the rest of Coalbank Slough would receive most of this detrital input.

Photo 5. Pony Slough at low tide. The restored salt marsh at Libby Levee would look similar.

Photo 6. Pony Slough at high tide. The restored salt marsh at Libby Levee would look similar.

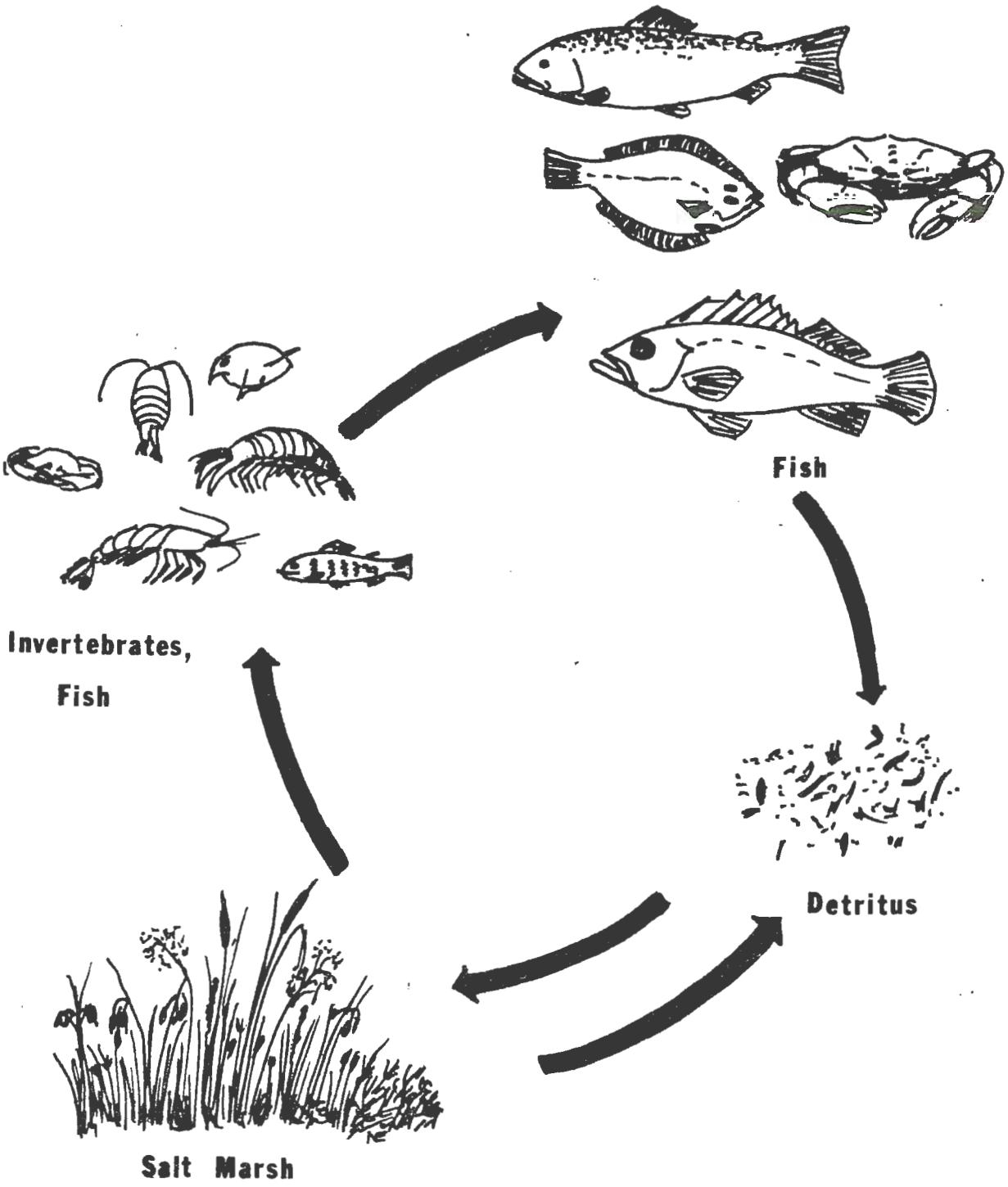

Figure 5. General Salt Marsh Food Web Showing Importance to Sport and Commercial Fisheries.

The 50-acre mudflat portion of the restored area and the improved bottom sediments in Coalbank Slough would in turn support large numbers of invertebrates. The tube dwelling amphipod Corophium, a major food source for salmon rearing in the estuary, are very abundant in Coalbank Slough. These invertebrates in turn would be fed upon by bait fish (shiners and top smelt) and juvenile sport and commercial fishes, including salmon (especially fall chinook), steelhead, searun cutthroat trout, striped bass, English sole, starry flounder, and Dungeness crab. All these economically important species would benefit.

The most significant fish increase could result from developing a fall chinook run in Coalbank Slough. The greatest potential for increasing fall chinook production in Coos Bay is in the Coalbank Slough drainage (Rumreich, 1985). This could be done by restoring the salt marsh behind Libby Levee in combination with the ODFW's Salmon and Trout Enhancement Program (STEP). The STEP effort (almost entirely implemented by voluntary labor) would primarily consist of producing juvenile chinook by placing hatch boxes with eggs in tributaries to Coalbank Slough. The standard hatch box can produce approximately 15,000 juvenile salmon. Fish habitat improvements in the Coalbank Slough tributaries would also be implemented, possibly including riparian vegetation plantings, fencing to protect existing streamside vegetation, and gabions to develop pools. Much of the upper Coalbank Slough watershed was logged many years ago and generally is revegetating so fishery habitat along tributaries is gradually improving.

Fall chinook juveniles characteristically spend approximately 3 months in spring and early summer acclimating to salt water and rearing in the estuarine environment. The restored marsh and improved habitat in Coalbank Slough located at the outlet of tributaries where downstream migrating fry would first encounter brackish water, would provide rearing habitat critical to their survival. Chinook fry would enter Coalbank Slough as early as March and remain until late July. The restored habitat would provide the young salmon a rearing area where they would grow before moving into the lower Coos Bay where predators are more abundant and size is critical to survival.

The young salmon would move out of the Coalbank Slough area in late July ~~bec~~ause water temperatures will become quite warm. Chinook are one of the most temperature tolerant species of all the salmonids. They can stand water temperatures up to 73°F while other salmonids can only tolerate temperatures up to about 65°F. In warm saltwater areas a disease caused by Vibrio spp. can cause substantial mortality in salmonid populations. However, the chinook rearing in Coalbank Slough should move into

the cooler areas of the bay before temperatures increase the chance of disease. Water exchanges due to tides should also reduce infection caused by Vibrio spp.

The restored marsh and mudflat would be expected to function similarly to the estuary at the mouth of the Sixes River, 50 miles south of Coos Bay, in terms of supporting juvenile fall chinook. Invertebrate production providing the food base for juvenile salmon would likely be similar to that produced in the Sixes River Estuary (Bottom, 1985). Extensive studies of the 20-acre Sixes River estuary indicate that it supports an approximate optimum carrying capacity of about 100,000 juvenile chinook, or about 5,000 fish per acre, for 3 months prior to outmigration (Rumreich and Miller, 1984).

The 60-acre restored marsh and mudflat (providing approximately 50 surface acres of water) could support approximately 250,000 juvenile fall chinook (50 x 5,000). Fall chinook return rates on the Elk River (a coastal stream 70 miles south of Coos Bay) indicate spawning escapement ranges from 1.2 to 4 percent or an average of 2.6 percent, which is generally representative of fall chinook in Oregon coastal streams (McGie, 1984). Similar returns could be expected at Coalbank Slough, yielding 6,500 spawners (.026 x 250,000).

Wildlife: Salt marshes provide high quality habitat to a great variety of wildlife species, especially waterfowl and shorebirds. A large increase in use of the restored marsh and mudflat would be expected by these groups of birds.

Investigators from the Oregon Institute of Marine Biology have been censusing bird use on mudflats, marshes, and other estuarine habitats in Coos Bay for several years. Expected waterfowl and shorebird use is shown in Table 1 (Varoujean, 1985). These figures are based on bird counts in the Coos Bay area on habitat similar to that which would be created by restoring the salt marsh and mudflat behind Libby Levee.

Table 1. Estimated Waterfowl, Wading Bird, and Shorebird Use in Restored Salt Marsh, Coalbank Slough, Coos Bay, Oregon

Bird Group	Numbers of Birds
	Foraging
Waterfowl	25 pairs (nesting)
	<50 to 350 (foraging and feeding)
Herons and Egrets	<5 to 20 (foraging and feeding)
Plovers and sandpipers	<100 to 500 (foraging and feeding)

West of S.W. Boulevard (Impoundment)

Fish: The 8 surface acre freshwater impoundment in combination with the STEP could also provide a rearing area for juvenile fall chinook salmon. To accomplish this, hatch boxes containing fall chinook salmon eggs would be placed in Little Creek which enters the upstream end of the impoundment. As the eggs hatch in early spring, the fry would move down Little Creek to the impoundment to rear. Natural feed for the fry in the impoundment would consist of mysid shrimp (Mysis spp) and a variety of semi-aquatic and aquatic insects.

The fry would move out of the impoundment in mid-June or later depending on water temperatures and conditions. If water temperatures remain tolerable through the summer, they may overwinter and leave the following spring as smolts (Figure 6).

The impoundment could support approximately 2,500 fish per surface acre or a total of 20,000 (8 x 2,500) (Garrison, 1985). Using the same return rate cited earlier yields 520 spawners (.026 x 20,000).

Wildlife: The freshwater marsh created by the impoundment would provide habitat for a variety of wildlife. Several pairs of mallards and perhaps teal, wood ducks, and other waterfowl would be expected to nest in the area. Riparian habitat surrounding the impoundment would support a variety of passerine (song) birds. Muskrat and perhaps mink and beaver could be attracted to the pond.

Economic Analysis

The economic analysis presented is based on a report dealing with potential benefits of marsh restoration at Libby Levee by a professional economist (Adams, 1985). It should be noted that many economically important species other than salmon (striped bass, English sole, starry flounder, and Dungeness crab) would contribute an undetermined value. However, the most significant discernable benefits would come from increased salmon production. Based on potential spawner returns of 7,020 (6,500 + 520) fall chinook, the benefits and costs are displayed in Table 2. This would result in new jobs in the salmon fishing industry, especially in Coos County. The detailed economic analysis, including the basis for Table 2, is presented in Appendix A.

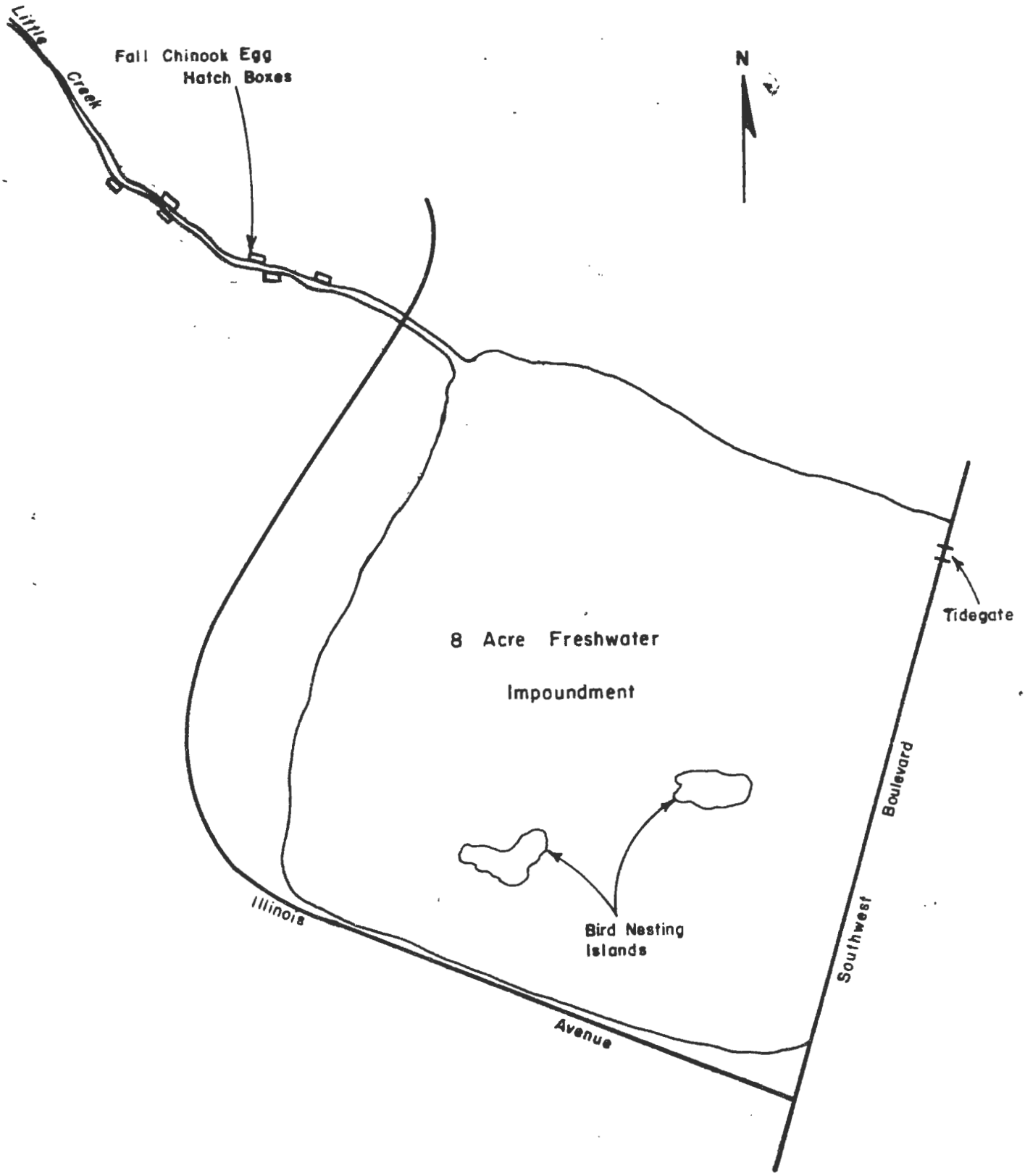

Figure 6. Schematic illustration of 8 acre freshwater Impoundment behind Southwest Boulevard for rearing juvenile Chinook salmon.

Table 2. Summary of Benefits and Costs of the Evacuate Flood Plain Alternative - 1984 Dollars

Benefits and Costs	Fall Chinook
Annual Benefits[1]/	$1,690,160
Annual Costs	88,261
Benefit-Cost Ratio	19.15 to 1

1/ Annual net economic benefits attributable to National Economic Development (NED).

CONSTRUCT SHORT LEVEE-EVACUATE FLOOD PLAIN OUTSIDE LEVEE ALTERNATIVE

Description

This is the same as the Construct Short Levee-No Action Alternative except approximately 32 acres of floodplain outside the new short levee would be allowed to revert to salt marsh and mudflat. About 25 of the 32 acres would be periodically flooded mudflat with an 8-acre edge of semi-aquatic vegetation. Figure 7 shows a schematic illustration of this alternative.

Effects on Fish and Wildlife

The effects on fish and wildlife inside the new levee would be the same as previously described under the Short Levee-No Action Alternative. The area outside the new levee would function in the same manner as described for the 60-acre restored salt marsh and periodically flooded mudflat described under the Evacuate Flood Plain Alternative, but on a smaller scale. Approximately 25 surface acres of water could support approximately 125,000 juvenile fall chinook yielding 3,250 spawners.

Economic Analysis

Benefits would be 46 percent of the Evacuate Flood Plain Alternative based on 3,250 fall chinook spawners. Annual costs based on the Corps' Economic Reconnaissance Study Libby Dike 1984 are used to determine benefit cost ratios which are displayed in Table 3.

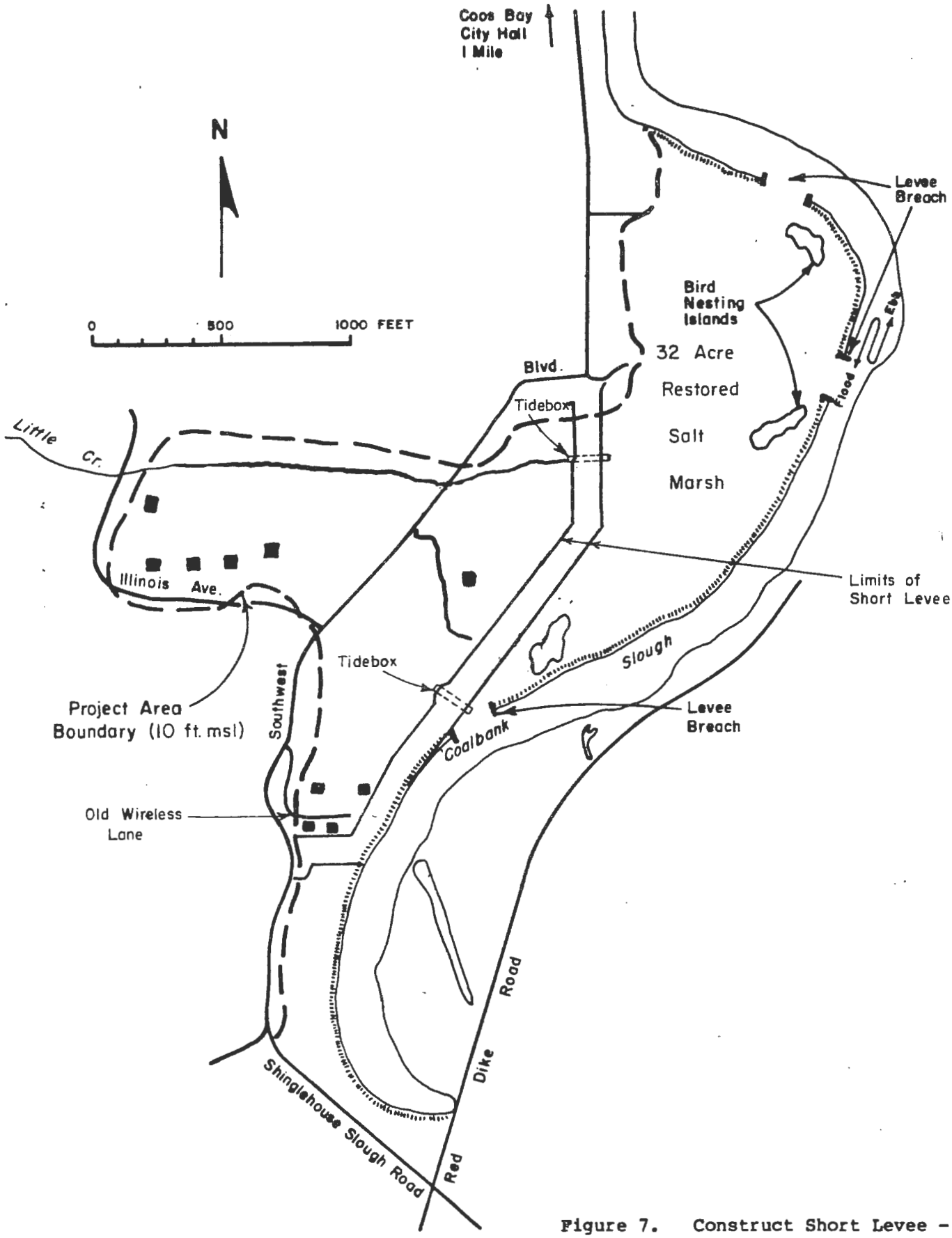

Figure 7. Construct Short Levee - Evacuate Flood Plain Outside Levee Alternative, Coalbank Slough, Coos Bay, Oregon

Table 3. Summary of Benefits and Costs of the Construct Short Levee-Evacuate Flood Plain Alternative - 1984 Dollars

Benefits and Costs	Fall Chinook
Annual Benefits[1]/	$777,474
Annual Costs	
(a)[2]/	66,500
(b)[3]/	58,200
Benefit-Cost Ratios	
(a)[2]/	11.69 to 1
(b)[3]/	13.36 to 1

1/ Annual net economic benefits attributable to National Economic Development (NED).
2/ Based on initial cost of $801,600 (COE, 1984).
3/ Based on initial cost of $701,400 (COE, 1984).

DISCUSSION

The Coos Bay System formerly supported large runs of anadromous fish. It is estimated that historically approximately 35,000 adult fall chinook passed through Coos Bay. Current adult fall chinook runs are estimated to be 7,000. Coalbank Slough and tributaries at the upper end of Coos Bay have great potential for producing improved runs of fall chinook.

Restoring the salt marsh estuary behind Libby Levee at the upper end of Coalbank Slough would be critically important in providing rearing area for downstream migrating fall chinook juveniles. These fish would be naturally produced or emerge from hatch boxes established through the STEP program on small streams feeding into the slough. Other economically important fish species such as coho salmon, steelhead, searun cutthroat trout, striped bass, English sole, and starry flounder would also benefit.

Additionally, there is opportunity to develop an impoundment behind Southwest Boulevard in the Libby Levee project area for rearing fall chinook. All of the former tidelands behind Libby Levee have potential for restoring wildlife resources, especially for waterfowl and shorebirds.

Because of the scarcity of wetland habitat and its high value to fish and wildlife, we have determined that it should be classified as Resource Category 3 according to the Service's Mitigation Policy (Fed. Reg. Vol. 46:15 of January 23, 1981).

The criteria for this category is that habitat to be impacted is of high to medium value for evaluation species and is relatively abundant on a national scale. The mitigation goal is no net loss of habitat value while minimizing loss of inkind habitat value.

Both the Construct Short Levee - No Action Outside Levee and the Rehabilitate Existing Levee Alternatives would require proper borrow ditch design to mitigate wetland losses. Borrow ditches should have a total surface area equal to or greater than the wetland area filled (4 or 6 acres, respectively). One side of the borrow ditch should be shallow (approximately 6:1 slope) and it should have irregular banks with small points and bays to maximize edge effect (Figure 8). To protect the Short Levee from erosive effects of cattle grazing and allow riparian habitat to develop, the levee and borrow ditch should be fenced to exclude cattle. For the Rehabilitate Existing Levee Alternative, the shallow edge should be next to the inside bank of the levee with a deep drop off on the other side to prevent cattle from crossing to the levee. If monitoring shows this does not prevent cattle from grazing on the levee, a fence should be constructed. The New Zealand high tensile electric fence has been proven to be effective for this purpose.

The Evacuate Flood Plain Alternative would be the most desirable from a fish and wildlife and economic standpoint. Implementing this alternative would, of course, depend largely on voluntary willing acceptance and promotion by project sponsors, city and county officials, and the local citizenry. Consideration of the benefits indicate this alternative may be favorable to most if not all parties concerned.

Under this alternative the flooding problem would be eliminated and a salmon fishery would be developed creating new jobs in a traditional Coos County industry. Landowners in the flood area would receive fair market value for their land and they and their farm operations would be relocated at project expense. Government in lieu of tax payments would offset loss of county tax revenues.

Because it is not certain just what the success of salmon production would be, we suggest a conservative estimate of 25 percent of estimated potential benefits attributable to salmon be used as the minimum the Corps can be confident in using to evaluate the Evacuate Flood Plain and Construct Short Levee-Evacuate Flood Plain Outside Levee Alternatives. The actual benefits for these two alternatives will likely be somewhere between 25 and 100 percent of the estimated values. This is without considering benefits to other economically important fish

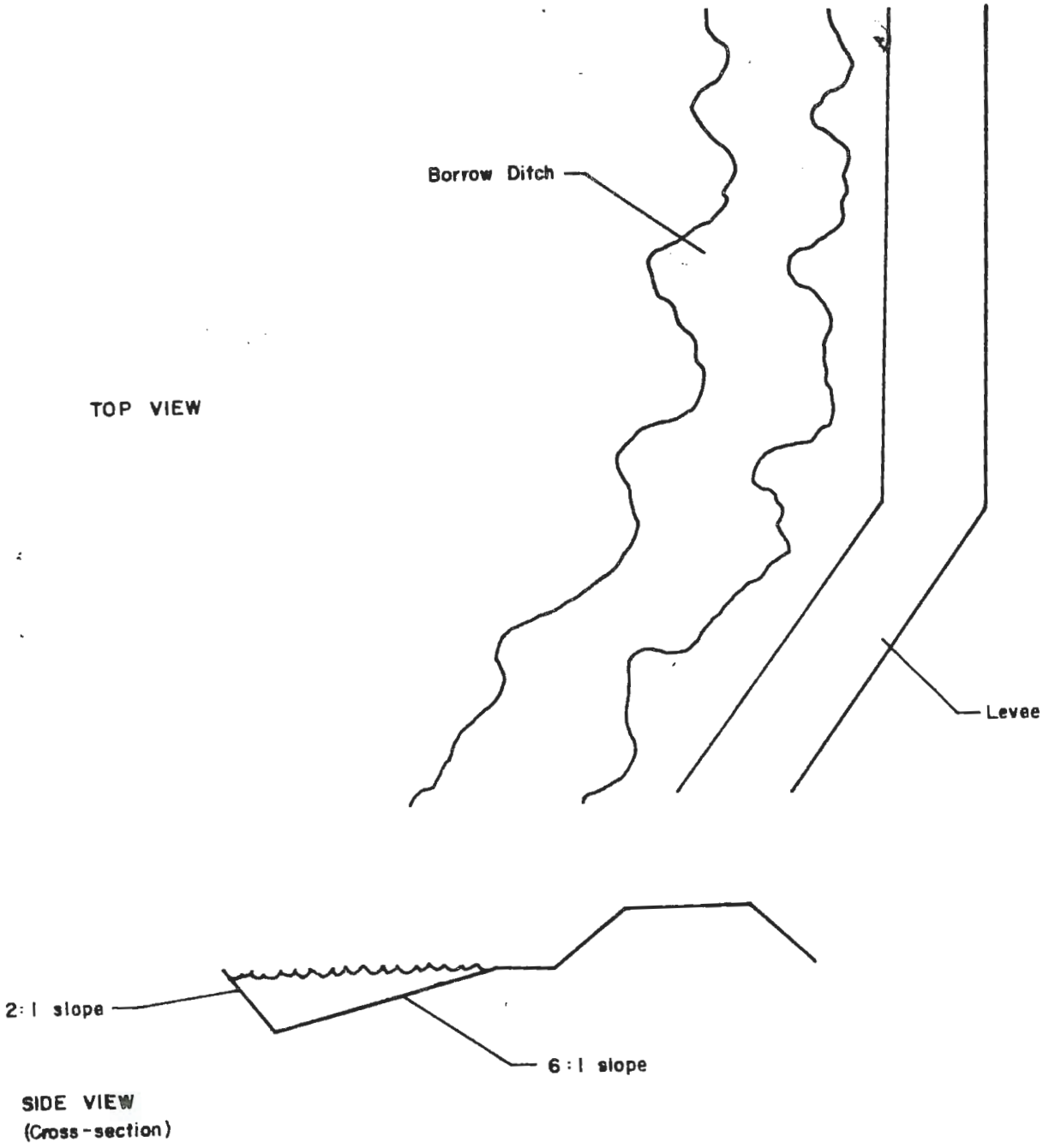

Figure 8. Schematic illustration of a meandering borrow ditch with small points and bays to maximize edge effect.

and wildlife species. A summary of benefits and costs of each alternative is shown in Table 4.

Table 4. Summary of Benefits and Costs for Each Alternative - 1984 Dollars

Alternatives	Annual Benefits	Annual Costs	Benefit/Cost Ratios
No Action	N/A	N/A	N/A
Construct Short Levee - No Action Outside Levee			
(a) 1/	$116,300	$66,500	1.74/1
(b) 2/	115,500	58,200	1.98/1
Rehabilitate Existing Levee	118,100	83,100	1.42/1
Evacuate Flood Plain			
National Economic Development (NED)	1,690,160	88,261	19.15/1
At 25% of benefits	422,540	88,261	4.79/1
Construct Short Levee-Evacuate Flood Plain Outside Levee			
National Economic Development (NED			
(a) 1/	777,474	66,500	11.69/1
At 25% of benefits	194,369	66,500	2.92/1
(b) 2/	777,474	58,200	13.36/1
At 25% of benefits	194,369	58,200	3.34/1

1/ Based on initial cost of $801,600 (COE, 1984).
2/ Based on initial cost of $701,400 (COE, 1984).

Implementation of the Flood Plain Evacuation Alternative would be possible under several existing authorities and/or regulations available to the Corps of Engineers. Since 1934, the Fish and Wildlife Coordination Act, as amended, has provided the basic authority for incorporating fish and wildlife conservation measures in water development projects. Specifically, as part of the consultation process under the Act, Federal water resource agencies are authorized to acquire lands or interests in connection with water projects for mitigation and enhancement of fish and wildlife. Additionally, the Federal Water Project Recreation Act (16 U.S.C. 4601-12 4601.21; 79 Stat. 213) declares the intent of Congress that recreation and fish and wildlife enhancement shall be fully considered purposes of Federal water development projects. Where Federal lands or authorized Federal programs for fish and wildlife conservation are involved (such as anadromous fish or migratory birds), the cost-sharing requirements of the Act are exempted.

Also, Section 73 of Public Law 93-251 expresses Congressional policy that consideration shall be given to nonstructural measures in planning for flood damage prevention or reduction. Consistent with this, Corps policy considers in the planning process all practicable and relevant alternatives applicable to sound flood plain management, including actions intended to modify flood behavior as well as actions intended to modify the ways in which people would otherwise occupy and use flood plain lands and waters (ER 1120-2-117). Similarly, Executive Order 11988 for flood plain management and protection requires that Federal agencies take action to avoid development in the base (100 year) flood plain unless it is the only practicable alternative, and restore and preserve the natural and beneficial values of the base flood plain.

Clearly the Evacuate Flood Plain Alternative could be implemented under several authorities available to the Corps of Engineers, and is consistent with Corps policy to insure that actions avoid or minimize adverse impacts associated with use of the base flood plain; and alternatives are evaluated that avoid use of the flood plain and recognize its natural values (ER 1165-2-26). Also, because of the combined economic values of both flood protection and wetland restoration, this alternative has the highest economic return for the investment of Federal dollars and meets the definition of the National Economic Development (NED) plan as required by current planning guidelines for water resource development.

If the Evacuate Flood Plain Alternative could not be implemented by the Corps of Engineers with adequate support and interest from a local project sponsor, authorization of a specific project could be sought by local citizens and affected landowners through contact with the appropriate Congressional representatives for the area.

RECOMMENDATIONS

To minimize the potential adverse impacts of the proposed project alternatives on fish and wildlife resources and to maximize potential environmental and economic benefits, we recommend, in order of preference, that:

1. The Corps of Engineers, in cooperation with project sponsors, other local interests, and resource agencies, implement the Evacuate Flood Plain Alternative as by far the most environmental and economically beneficial solution to the flooding problems behind Libby Levee.

2. As a much less desirable second choice, the Construct Short Levee-Evacuate Flood Plain Outside Levee Alternative be implemented.

3. If the Construct Short Levee-No Action Outside Levee Alternative is implemented:

    a. Riparian vegetation (herbs and shrubs) and grass and forb species be planted or seeded and allowed to establish on the levee.

    b. The borrow ditch be equal to or greater in surface area than the area of wetlands destroyed by levee construction. The borrow ditch should be shallow on one side (approximately 6:1 slope) and have irregular banks with small points and bays.

    c. Vegetation along the borrow ditch and on the levee be protected by fencing.

    d. Items a, b, and c above be coordinated with the Oregon Department of Fish and Wildlife and the U.S. Fish and Wildlife Service.

4. If the Rehabilitate Existing Levee Alternative is implemented, the same recommendations described under (3) apply with the following exception. The borrow ditch

shallow edge should be located next to the inside of the levee with a deep drop off located on the other side to prevent cattle from crossing to the levee. If monitoring shows cattle still cross to the levee, fencing should be constructed.

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APPENDIX A. POTENTIAL ECONOMIC VALUE OF INCREASED SALMON PRODUCTION DUE TO EVACUATE FLOOD PLAIN ALTERNATIVE, LIBBY LEVEE, COOS BAY, OREGON[1/]

The Evacuate Flood Plain Alternative would provide additional fall chinook salmon available for harvest. This increased harvest, based on spawner returns of 7,020 fall chinook, would provide benefits to the commercial and sport fisheries. The local and regional economies would also benefit from the increase in business related activities associated with the additional salmon production and harvest (Table 1).

Table 1. Increased Salmon Production, Evacuate Flood Plain Alternative

Species	Number of Spawners	----Catch---- Commercial	Sport
Fall Chinook	7,020	33,415 (4.76)	8,705 (1.24)

1/ All references cited are listed in the List of References section of the main report.

COMMERCIAL FISHERY

The commercial fishery benefits attributable to additional salmon stocks are estimated at the ex-vessel and processing levels. Net economic values are calculated for the additional salmon caught and processed by the salmon industry.

Ex-vessel Value

Monetary values for fall chinook salmon are estimated at the ex-vessel level, i.e. the market price paid to the fisherman at dockside. Gross ex-vessel value per salmon is estimated by using the market price per pound and the average pounds per salmon. The average dressed weights per commercially harvested chinook salmon according to the Pacific Fisheries Management Council (PFMC), is 8.5 pounds per fish. The market price per pound is $2.68 (PFMC, 1985).

This type of economic analysis requires benefits to be expressed in net value terms. At the ex-vessel level, net values are

calculated by subtracting the incremental cost of catching salmon from the revenues received from the catch at dockside. Such information is available from a 1982 National Marine Fisheries Service (NMFS) Study, Net Economic Values for Salmon and Steelhead From the Columbia River System. The NMFS study recommendation is used to reduce ex-vessel values by 9 percent to obtain net value estimates.

Processing Value

Additional value is also realized by the salmon industry at the processing level. Data on price markups for salmon processing have been developed for the Oregon salmon industry (Oregon State University, 1978; PFMC, 1983). An ex-vessel to processing value markup of 66 percent developed for Coos County is used since it's specific to the area of analysis.

Net Economic Value

To obtain a final net value, the accrued gross value through processing must also be reduced by its associated costs. Because of the overcapacity in the salmon industry, only the variable costs associated with the processing of salmon stock increments are deducted. The existing capacity in fish processing will be sufficient to handle any additional salmon (NMFS, 1982). The NMFS study recommendation of 48 percent will be used to reduce accrued value through processing. Total net values for fall chinook salmon are displayed in Table 2.

Table 2. Net Economic Value of Commercially Harvested and Processed Chinook Salmon - 1984 dollars

	Values per fish
Average Size (lbs.)	8.5
Market Price (per lb.)	$2.68
Gross Ex-Vessel Value	$22.78
Variable Cost	09 percent
Net Ex-Vessel Value	$20.73
Markup to Processing	66 percent
Processing Value	$37.81
Processing Increment	$15.03
Incremental Cost	48 percent
Net Processing Value	$7.82
Total Net Value	$28.55

SPORT FISHERY

Sport fishing values often exceed actual out of pocket expenditures. Traditional markets may not capture all expenses participants would be willing to pay to fish for the day. Willingness to pay (wtp) values are defined as the user's willingness to pay for the experience in excess of actual out of pocket expenditures. This is the appropriate measure of net economic benefits received by those beneficiaries of the activity (i.e., ocean salmon sport fishing).

This analysis updates (1984 dollars) a recent estimate of willingness to pay for ocean salmon sport fishing in Oregon (NMFS, 1982), and uses $72.00 per day for fall chinook.

The angler-day effort required to catch one fall chinook salmon is 1 day (NMFS, 1982). This 1 to 1 ratio is used to convert the number of angler-days per fish and the angler-day values (wtp) to values per fish. The recommended net value (wtp) per sport caught chinook salmon is $72.00 per fish.

OTHER BENEFITS

It should be noted that many economically important species other than salmon (striped bass, English sole, starry founder, and Dungeness crab, for example) would contribute an undetermined value.

Data presented by the Corps of Engineers (COE) in its 1984 economic analysis report, Economic Study Section 205 Reconnaissance Study Libby Dike, Coos Bay, Oregon, provides average annual benefits for a Relocation/Evacuation Alternative. Transportation benefits claimed by the COE can also be included as a benefit to the Evaluate Flood Plain Alternative. With the anticipated road improvements under this alternative, transportation will no longer be adversely impacted.

Additionally, the City of Coos Bay annually spends approximately $2,500 for flood control work in Little Creek, an area within the anticipated freshwater impoundment (Steele, 1985). The city would no longer be required to make this annual expenditure once this alternative is implemented. Table 3 displays average annual benefits at 1984 dollar levels.

Table 3. Average Annual Benefits - Evaluate Flood Plain Alternative - 1984 Dollars

Residential Structures	$56,700
Residential Contents	46,500
Utilities	800
Roads	500
Evacuation	2,600
Emergency Aid	1,300
Transportation	1,000
City of Coos Bay flood control expenditures	2,500
Total	$111,900

COMMUNITY BENEFITS

Revenues received into a community or region are generally recognized to have positive impacts (benefits) beyond those associated with initial transactions. These secondary impacts are derived from receivers of income that spend a portion of it locally, creating jobs and income for others. They include commercial fishing and processing industries and sport fishing which provides significant revenues for business related activities i.e., motels, restaurants, charter boats and guides, tackle shops, etc.

Increased production of salmon stocks, and subsequent harvest, will provide additional job opportunities in Coos County. Coos County is currently experiencing economic difficulties, with unemployment in the 20 percent range. The county qualifies as an area of substantial and persistent unemployment. Any increase in the number of jobs attributable to the Flood Plain Evacuation Alternative would greatly benefit Coos County.

SUMMARY OF BENEFITS

Benefits can now be estimated for the Evacuate Flood Plain Alternative. Estimated benefits from the previous sections are summarized and displayed in Table 4.

Table 4. Summary of Average Annual Benefits - Evacuate Flood Plain Alternative - 1984 Dollars

Benefits	Fall Chinook
Commercial[1]/	$ 954,000
Sport	626,760
Other	109,400
Total	1,690,160

1/ Includes catching and processing.

ASSOCIATED COSTS

Associated costs include both initial and development costs. The COE preliminary cost estimates for its Evacuation/Relocation Alternative (COE, 1984) apply directly to the Evacuation Flood Plain Alternative. Development costs anticipated to implement the Evacuate Flood Plain Alternative are displayed in Table 5.

Table 5. Estimated Development Costs - Evacuate Flood Plain Alternative[1]/- 1984 Dollars

Raise 480-foot length of S.W. Boulevard (paved) to 10.0 feet MSL		
Compacted Fill	3,500 cy @ 12.00	$42,000
Subbase Aggregate	520 cy @ 16.00	8,400
Base Aggregate	130 cy @ 16.00	2,100
Concrete Sidewalk & Curbs		24,000
Install 3 Catch Basins & Drain Pipe		6,000
Roadbed Preparation		5,000
Asphalt Concrete		13,000
Riprap		15,000
	Subtotal	$115,500
Install Water Control Structure, S.W. Boulevard		
Pipe		$1,500
Bands		300
FB Riser		1,200
Flap Gate		3,000
Installation		8,000
	Subtotal	$14,000
Raise 600-foot length of Illinois Avenue (gravel) to 10.0 feet MSL		
Compacted Fill	2,500 cy @ 12.00	$30,000
Subbase Aggregate	250 cy @ 16.00	4,000
Base Aggregate	125 cy @ 16.00	2,000
Preparation		1,000
	Subtotal	$37,000
Breach Levee and Form Islands	Subtotal	$12,000
	Total	$178,500
Contingencies 10 percent		$17,850
Engineering 10 percent		$17,850
	GRAND TOTAL	$214,200

1/ Weitz, 1985.

Table 6 displays the average annual costs associated with the Evaluate Flood Plain

Table 6. Average Annual Costs of Evacuate Flood Plain for Fall Chinook - 1984 Dollars

Item	Average Annual Costs
Initial Costs[1]/	70,500
Development Costs[2]/	17,761
Total	$88,261

1/ COE, 1984
2/ Development cost from Table 5 ($214,200) multiplied by annual cost (.08292) = $17,761; 50-year project life and 8-1/8 percent discount rate.

SUMMARY OF AVERAGE ANNUAL BENEFITS AND COSTS

The average annual benefits and costs associated with the Evacuate Flood Plain Alternative are summarized and displayed in Table 7.

Table 7. Summary of Average Annual Benefits and Costs of the Evacuate Flood Plain Alternative - 1984 Dollars

Benefits and Costs	Fall Chinook
Annual Benefits[1]/	1,690,160
Annual Costs	88,261
Benefit-Cost Ratio	19.15 to 1

1/ Annual net economic benefits attributable to National Economic Development (NED).

United States Department of the Interior

FISH AND WILDLIFE SERVICE

Portland Field Office
727 N. E. 24th Avenue
Portland, Oregon 97232

Reference DS:mm

March 10, 1986

Colonel Gary R. Lord, District Engineer
Portland District, Corps of Engineers
P. O. Box 2946
Portland, Oregon 97208

Dear Colonel Lord:

This letter provides information needs identified in the scope of work for the Libby Dike-Coalbank Slough Project, Coos Bay, Oregon. We are also providing information pertaining to changes in construction and operation that would affect costs and benefits associated with the evacuate floodplain alternative. It should be noted that this new information was developed in cooperation with Oregon Department of Fish and Wildlife (ODFW) staff, but has not been through the formal concurrence process.

The proposed project would basically consist of evacuating approximately 68 acres of flood-prone lands, including 13 residences. An 8-surface-acre freshwater impoundment (impoundment) would be developed behind a road traversing the upper end of the project. The remaining 60 acres would revert to a restored salt marsh and mudflat (marsh/mudflat). The project is described in detail in our August 1985 Coordination Act Report (CAR). Information requested by the Corps includes the following:

1. How fishery production figures for the impoundment were developed and what assumptions were used to arrive at those figures (i.e. water quantity and quality, food production).

2. How the impoundment will be operated to maximize fishery benefits. The impoundment and marsh/mudflat benefits should be kept separate to facilitate analysis.

3. How the fishery production figures for marsh/mudflat were developed and what assumptions were used.

4. Why fisheries data for the Sixes River were used for the analysis.

5. How wildlife production figures were determined and what assumptions were used.

At the onset we wish to point out that salmon production and other fish and wildlife resource values in both the impoundment and the marsh/mudflat are intended to be developed in concert. Both are interrelated and, when implemented together, offer greater chance for overall success. This is the case because one or the other may be relatively more successful (particularly in producing fall chinook salmon) thus increasing the project's operational flexibility and ability to maximize fishery outputs.

We now believe the impoundment can be managed to produce much larger numbers of fall chinook salmon than at first thought. However, when these fish are released, it is important that they first encounter suitable estuarine habitat in the restored salt marsh and mudflat. The marsh/mudflat may not be as directly responsible for rearing as large a number of fall chinook from sources other than the impoundment. However, it undoubtedly will support many other organisms, including other commercially important fish, and contribute substantial organic input into the entire Coos Bay estuary system. As the following discussion treats the impoundment and marsh/mudflat separately, keep in mind they work in concert to provide flexibility and added insurance for success of the overall restoration effort. We strongly suggest the impoundment and marsh/mudflat be considered as a total package, even though we have analyzed the separate values attributed to each.

8-SURFACE-ACRE FRESHWATER IMPOUNDMENT

FISH PRODUCTION

Estimated fish production figures for the impoundment were developed assuming fall chinook fry released into the impoundment would subsist on natural feed consisting of mysid shrimp and a variety of semi-aquatic and aquatic insects. The density of 2,500 per surface acre used in the CAR was confirmed by Tom Rumreich, ODFW's Salmon and Trout Enhancement Program (STEP) Biologist in Coos Bay. It was slightly lower than the 3,000 figure suggested by Bob Garrison, a salmon expert at the Oregon Department of Fish and Wildlife (ODFW) research lab.

Little Creek, which would be the source of inflow to the impoundment, was assumed to be of sufficient quantity and quality to support fishery production. Further investigation has confirmed this assumption. On February 6, 1986, Tom Rumreich, ODFW, and Dave Sill from this office inspected the Little Creek watershed and interviewed Mrs. Doving, a long-time resident (35 years), occupying property where Little Creek would enter the impoundment.

The watershed is very heavily vegetated and appears to be in near pristine condition. Little Creek was flowing clear at about .75 cubic feet per

second (cfs). Mrs. Doving stated that she obtains drinking water from springs feeding Little Creek. She also said the creek flows year around ranging from about .30 cfs in the summer, to 10.0 cfs for short periods during heavy winter rains, with the normal flow about .75 cfs most of the time. She also stated there were other small springs that would feed into the impoundment of unknown quantity and flow duration. Tom's observation, based on locating salmon hatch boxes and other fish rearing facilities in the area, was that he had no question but that the quantity and quality of water in Little Creek is suitable and probably superior to other similar streams with STEP fish rearing facilities.

We now have information from a STEP fishery facility located on Priorli Creek approximately 8 miles east of Coalbank Slough. The Priorli Creek pond, approximately 1/4 surface acre and averaging about 6 feet deep, is a small version of what the 8-surface-acre freshwater impoundment at Libby Levee would be like. The pond has been used to rear 14,500 fall chinook fry for a 3-month period to pre-smolt size, and 17,000 coho for 6 months to smolt size. Beginning this year, 75,000 fall chinook will be raised to pre-smolt size in the pond (Photo 1).

The cost to feed the fall chinook is very reasonable at $57.50 per 10,000 over a 3-month period. Tom's experience with this facility is that it is important to implement an artificial feeding program for the fall chinook, beginning with precocial feeding in the hatchbox or incubator facility, and continue feeding over the 3-month fry to pre-smolt rearing period.

The first indication of the pond's success in fall chinook rearing was the return this year of approximately 75 jack salmon (premature males) from a 14,500 pre-smolt release. Returns of fall chinook, over a 10 year period at the Elk River Hatchery, show 1.5 to 2.1 (or an average of 1.8) adults return for every jack. This is typical for south coast streams (McGie, 1986). Expected adult return rate would be $\frac{1.8 \times 75}{14,500}$ = .93 percent return, which is well within the return rate estimate used in the CAR (which ranged from 2.6 percent down to 25 percent of this figure, or .65 percent). However, this is the first year jacks were expected to return to the Priorli Creek facility. By experimenting with the timing of pre-smolt releases, and further perfecting operation of the facility, the jack return is expected to be much higher in the near future. For example, coho jack returns at a STEP facility on Catching Slough in Coos Bay have ranged from .5 percent to 5.0 percent (Rumreich, 1986). At the Elk River Hatchery, jack returns for fall chinook smolt releases average 1.5 percent. A jack return for fall chinook pre-smolts over the long run at Priorli Creek would conservatively average 1.0 percent.

Based on the above information, the 8-surface-acre freshwater impoundment at Libby Levee would easily produce 1,000,000 chinook pre-smolts, with annual fish food costs of $5,750. A release of 1,000,000 fall chinook

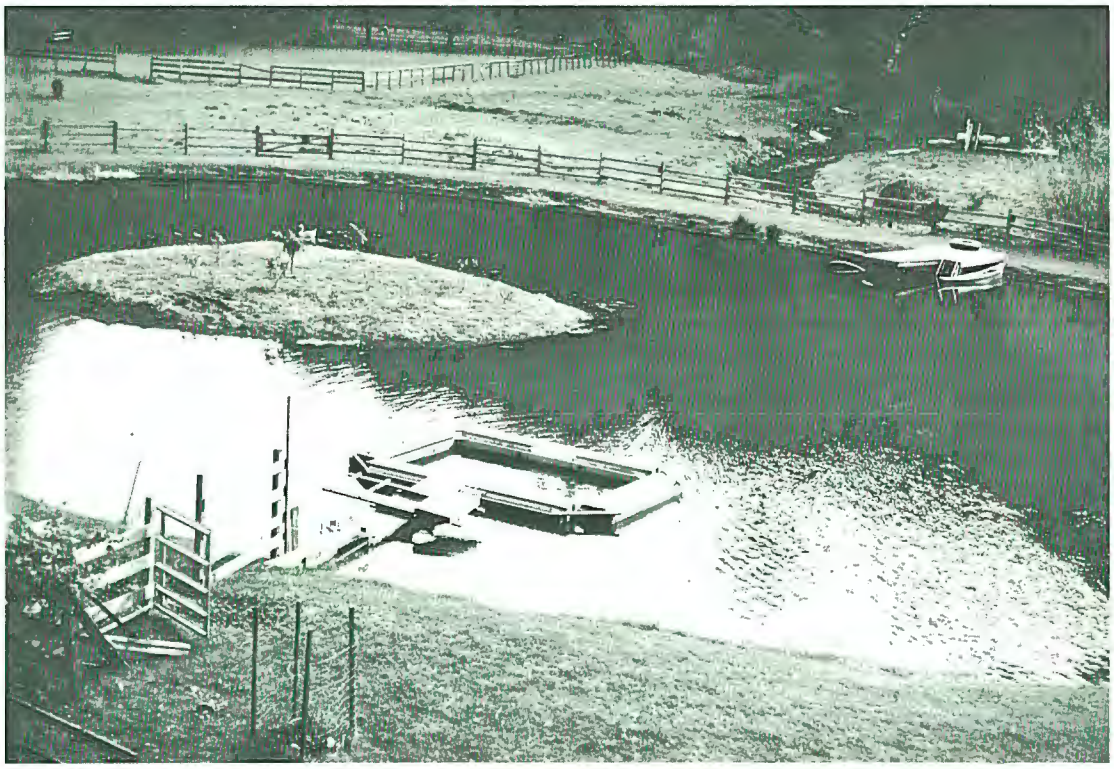

Photo 1. Priorli Creek Pond. Note the fry pen located between the near shoreline and the island. Fry from the incubator facility are acclimated to the pond and feeding program in the fry pen for approximately 30 days prior to release in the pond.

pre-smolts would yield an estimated 10,000 jacks (at 1.0 percent return rate) and an adult spawner return of 18,000 (1.8 x 10,000)-or an average return of 1.8 percent for pre-smolt releases.

WILDLIFE PRODUCTION AND OTHER VALUES

It is clear the impoundment would provide habitat for a variety of wildlife as described in the CAR. Several pairs of waterfowl would nest on islands in the impoundment and around the edge of the pond. At a minimum, at least one or two pairs could be expected to nest on each island, and two or three pairs would nest around the edge of the pond. If three islands were constructed, waterfowl production can be estimated to be about 45 birds to flying stage annually (9 pairs x 5 young to the wing/pair=45). During fall, winter, and early spring the impoundment would be used by flocks of waterfowl (both dabblers and divers), very possibly numbering into the hundreds.

The impoundment would also provide a large amount of organic input into the marsh/mudflat and the Coos Bay Estuary benefitting the entire ecosystem and important commercial and sport fish and wildlife resources therein.

DESIGN AND OPERATION

The basic design and operation of the impoundment was presented in the CAR. Based on the Priorli Creek STEP pond, we suggest the following changes. Rather than placing hatch boxes in Little Creek, it would be more feasible to pipe the water from Little Creek to an incubating facility next to the impoundment similar to one of those located on Priorli Creek or at Dora on an unnamed creek on the East Fork Coquille River. The Dora Creek facility (approximately 20 miles southeast of Coalbank Slough) is capable of hatching and rearing 500,000 fall chinook fry and operates in the following manner. Two 1.25-inch PVC pipes supply 30 gpm through a filter system to two hatchery troughs with a series of egg hatching trays. After the eggs hatch, the fry are held for about 30 days in the trays and then transferred to a fry pen located within the rearing pond for 30 days to acclimate to the pond and further reinforce artificial feeding (Photo 1). After release from the fry pen, they rear in the pond for 60 days to pre-smolt size, averaging about 3.75 to 4.0 inches at time of release. The Libby Levee incubator facility would be about twice the size of the one at Dora (Photos 2 and 3). Several fry pens would be located around the impoundment shoreline and automatic fish feeders would supply feed while the fish are in the impoundment.

To maximize fish production at the Libby Levee impoundment, approximately 3 acres of the bottom should be lowered 6 feet prior to inundation. Estimated cost for dragline excavation is $2,420 per surface acre for 1 foot of depth or $14,520 per acre to lower 6 feet. Material removed should be formed into bird nesting islands. This would provide an area of deep

Photo 2. Salmon egg incubating and hatching facility at Dora, Oregon.

Photo 3. Each incubator/hatchbox with its series of egg trays produces 250,000 fry.

cold water for the fish to retreat to in case of an unexpected, short duration warmwater temperature problem. It also increases fish management flexibility to rear some salmon year round for release as smolts instead of as pre-smolts.

The outlet facility should be a simple spillway built into the roadbed and regulated by splash boards with a rotating self cleaning fish screen at the top. The spillway should empty into a series of concrete steps with a fish trapping facility similar to the one at the Priorli Creek pond (Photos 4 and 5).

An evacuation pipe should be installed to allow lowering water in the impoundment to the bottom of the roadbed as necessary.

60-SURFACE-ACRE RESTORED SALT MARSH AND MUDFLAT

FISH PRODUCTION

Estimated fish production figures for the restored marsh and mudflat were based on the assumption that it would function similarly to the Sixes River Estuary for supporting juvenile fall chinook. Production of the primary food base for juvenile salmon, the invertebrate amphipod Corophium sp., was assumed to be similar to the Sixes River Estuary. On February 4, 1986, mud samples were taken along the west shoreline of Coalbank Slough at the project site. Sample counts are displayed in Table 1 (Fereday, 1986).

Photo 4. Spillway with concrete steps and adult fish trapping facility at Priorli Creek STEP pond.

Photo 5. Fall chinook jack salmon removed from Priorli Creek fish trap.

Table 1. Counts of three most abundant invertebrates from two .02m^2 mud samples at three sites along Coalbank Slough (Fereday, 1986).

	Average number from two .02m^2 samples			Number/m^2			
Invertebrate Species	Upper C.Bank	Mid C.B.	Lower C.Bank	Upper C.Bank	Mid C.Bank	Lower C.Bank	Average
Corophium sp.	137	100	19	6,850	5,000	950	4,266
Neanthes limnicola	16	20	1	800	1,000	50	617
Tharyx sp.	7	13	--	350	650	--	333

The average Corophium sp. counts indicate a winter population of 4,266/m^2. Summer populations would be approximately 10 times the winter population, or about 42,000/m^2 (Bottom, 1986A). The summer population estimate is slightly higher than the range of summer populations found in the Sixes River and is comparable to other west coast estuaries (Table 2).

Table 2. Range in reported densities of Corophium spp. (number/m^2) from selected survey sites during the summer (Bottom, 1986).

Estuary	Region/habitat	Sampling period	Densities	Source
Sixes River, OR	Lower estuary (shallow subtidal)	June-Sept.	8,000-38,000	Bottom, 1982 (et al)
Columbia River,OR	Grays Bay (intertidal)	Entire year	5,000-30,000	Wilson, 1983
	Desdemona Sands (intertidal)	Entire year	0-95,000	
Grays Harbor, WA	Upper bay	March-Sept.	0-50,000	Albright,1982

It is expected Corophium would quickly pioneer into the restored marsh and mudflat and establish population densities comparable to the estimates based on the average of the Coalbank samples (4,200/m^2 winter and 42,000/m^2 summer).

Juvenile fall chinook pre-smolt densities were assumed to approximate those found in the Sixes River at about 5,000 per surface acre. This figure approximates average maximum densities for the Sixes River Estuary and the maximum densities for the Salmon River Estuary, but is high compared to larger estuaries like the Fraser or Columbia (Table 3). Upon further investigation and analysis, we find the average Sixes River densities occur in a permanently flooded part of the lower estuary. In addition, this area is acting more as a nutrient trap as compared to the restored marsh/mudflat which would tend to export nutrients throughout the Coos Bay Estuary. ODFW researchers estimate production figures for the restored marsh/mudflat would be about 500 to 600 returning adults (Bottom, 1986B). This is probably a low estimate since we are recommending lowering about 10 acres of the marsh/mudflat 6 feet to provide a series of deep channels that would be permanently flooded. This would provide an environment more similar to the Sixes River Estuary. Further, we suggest that part of the adult return expected at the impoundment should be attributed to the marsh/mudflat. This is based on the fact that fish released from the impoundment will pass through the marsh/mudflat acclimating to the estuarine environment. They also will linger to feed for a few days in the marsh/mudflat, depending on fluctuating food availability and other factors. We suggest 15 percent, or 2,700 of the estimated 18,000 adult spawner returns attributable to the impoundment, should be credited to the marsh/mudflat.

Other species of fish are expected to inhabit the marsh/mudflat. Fereday, (1986), using ODFW seine data collected in 1980 from Coalbank Slough, estimated the population for several important fish species other than salmon that would be supported by a 50-acre marsh/mudflat available to fish when flooded approximately 30 to 50 percent of the time (Table 4). Ten acres of the 60-acre marsh/mudflat would be high marsh and generally unavailable to fish.

Densities of fish per unit area for selected estuarine surveys. Catch per effort data were converte densities by assuming 100% sampling efficiencies and estimating the total area sampled. For Sixes R densities derived from estimates of total number of juveniles during the period of maximum abundance by the area of the lower estuary (20 acres) (Bottom, 1986)

uary	Region	Period	Species	Density estimates No. per m^2	Density estimates No. per acre	Data so
iver, B.C.	Marsh channels	May (period of peak abundance)	Chinook salmon	.1- .3	400- 1,200	Levy & Northc
k Bay, OR	Mid-upper estuary	Entire year	All species	.02-2.89	80-11,500	Bottom & Fors
iver, OR	Mid estuary	May-October	All species Chinook	2.1 -6.05 .07-1.11	8,000-24,000 280- 4,500	Mullen 1979
iver, OR	Mid estuary	May-October	All species	.20-1.50	800- 6,000	Mullen 1977
ver, OR	Entire estuary	Summer maximum 1967-69 1978-80	Chinook salmon		 7,200-13,450 2,250- 3,000	Bottom et al
River, OR	Young's Bay Baker Bay	June-September	All species	.009-.250	35- 1,000	Bottom et al

Table 4. Average number of fish (other than salmon) based on four ODFW seine sets in Coalbank Slough 1980 (Fereday, 1986).

Species	#fish/seine set	#fish/acre	#fish in 50 acres
Shiner perch	143	2,516	125,800
Staghorn sculpin	32	559	27,950
Starry flounder	6	106	5,300
Shad	3	44	2,200
English sole	1	18	900
Top smelt	1	18	900
Total	186	3,261	163,050

The average number of fish per acre in Table 4 falls within the range of density estimates per acre for the estuaries shown in Table 3.

WILDLIFE PRODUCTION AND OTHER VALUES

Estimated bird use of the marsh/mudflat quoted in the CAR was based on census of similar type habitat in the Coos Bay Estuary conducted by investigators at the Oregon Institute of Marine Biology. Approximately 12 pairs of waterfowl would produce 60 young to flight stage annually (12 x 5 young/pair). Up to 350 waterfowl were estimated to feed and forage. In addition, up to 20 herons and egrets and 500 plovers and sandpipers would use the area for foraging and feeding. Considering the design of several islands and management of the area for fish and wildlife, these estimates are also considered reasonable by the Service's Wildlife Biologist for Oregon Coast Federal Wildlife Refuges (Lowe, 1986).

The many other values of the marsh/mudflat should not be overlooked. For example, several species of clams (including eastern softshell) would seed the intertidal portions of the marsh/mudflat and could be expected to occur in large numbers (Gaumer, 1986). These clams are important food items for waterfowl, shorebirds, and flounders.

Perhaps most importantly the large amount of organic input from the marsh/mudflat through estuarine and terrestrial food chains to the Coos Bay system may ultimately prove to be of most value, although not as readily quantifiable in economic terms as salmon production (Bottom, 1986B).

DESIGN AND OPERATION

The restored marsh/mudflat would function as a natural system described in the CAR, with the following modifications. About 10 acres of bottom should be lowered 6 feet prior to inundation as previously discussed and excavated material fashioned into islands. The islands should vary in height, size,

and configuration to provide habitat variability and increased shoreline. Low flat islands would provide shorebird feeding and resting areas while higher vegetated islands would provide nesting cover for waterfowl and other birds. Island size, height, shape, and distribution would largely depend on the practical capability of the dragline operation. Any deepening should be carefully designed to provide open access to the deeper parts of Coalbank Slough and avoid stranding fish in pools cut off from water circulation.

In our CAR we estimated cost to breach the levee was about $10,000. We believe it may now be possible to breach the levee by using explosives, thus reducing this cost to a few hundred dollars. While we are certain there will be considerable economic benefits from increased fish and wildlife resources far in excess of costs, we highly recommend a monitoring study be conducted. The study should be designed to measure baseline environmental, economic, and social values of fish and wildlife resources and other uses of the land before and after project implementation.

We look forward to working with you and the local community to implement the project as soon as possible.

Sincerely,

Russell D. Peterson

Russell D. Peterson
Field Supervisor

cc:
NMFS
EPA
ODFW, Portland
ODFW, Roseburg
ODFW, Corvallis
ODFW, Charleston

REFERENCES

Bottom, D. 1986A. Oregon Department of Fish and Wildlife Research Laboratory, Corvallis, OR. Personal communication.

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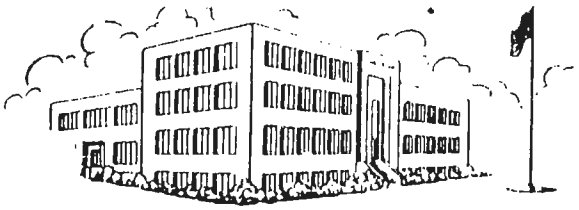
EXHIBITS



COOS COUNTY COURTHOUSE
Coquille, Oregon 97423
Phone: 396-3121

County of Coos
BOARD OF COMMISSIONERS

Jack L. Beebe, Sr.
Robert A. Emmett
Doc Stevenson

August 15, 1983

Mr. Jerry Johnston
Department of the Army
Portland District, Corps of Engineers
P.O. Box 2946
Portland, OR 97208

Dear Mr. Johnston:

We have experienced high storm tidal flooding of residential and commercial structures along or near Coalbank Slough caused by the insufficient height of Libby Dike.

We request that the Corps of Engineers conduct studies to reduce flood damages under Section 205 of the 1948 Flood Control Act.

We understand that preparation of a reconnaissance report is the first step in your process and are also aware of the responsibilities of sponsorship of the proposed project.

Please respond to our request at your earliest convenience.

BOARD OF COMMISSIONERS

Jack L. Beebe
Chairman

Robert A. Emmett
Commissioner

Doc Stevenson
Commissioner

BOC/jm

EXHIBIT 1

COOS COUNTY COURTHOUSE
Coquille, Oregon 97423
Phone: (503) 396-3121
Ext. 224, 225

County of Coos

BOARD OF COMMISSIONERS

Doc Stevenson
Jack L. Beebe, Sr.
Robert A. Emmett

January 7, 1986

Col. Gary R. Lord, District Engineer
Portland District, Corps of Engineers
P.O. Box 2946
Portland, Oregon 97208

RE: LIBBY LEVEE FLOOD CONTROL PROJECT

Dear Col. Lord:

The Board of Commissioners has been concerned for some time about the flooding problems that persist along Coalbank Slough in the vicinity of the Englewood Diking District. The County formed the District in August 1984 as a first step toward solving the flooding problems, but it was recognized then that a coordinated multi-agency effort offered the best hope for a workable solution.

The purpose of this letter is to thank you for the work the Corps has done in developing the Libby Levee Flood Control Project alternatives, and to express Coos County's qualified support for the "Evacuate Flood Plain Alternative." As you know, this alternative would eliminate the flooding problems in the area while substantially improving Coalbank Slough's fishery potential.

However, we must qualify our endorsement of this alternative with the following comments:

1. It is not possible for Coos County to contribute financial support for implementation of the project. Nor is it likely that other local governments in the area will be able to assist in defraying the dollar cost of the project.

2. Coos Bay Mayor Chuck Holbert has expressed concerns that the project's projected costs may be unrealistically low with respect to elevating Southwest Boulevard and utilities in its right-of-way. Mayor Holbert has advised the County that with realistic costs, the project may still prove viable. He has also indicated that the City of Coos Bay might be willing to lift its moratorium on issuance of new Banchroft Bonds to assist financing for the project.

3. The County, City of Coos Bay and Oregon International Port of Coos Bay are united in the belief that 100% of the habitat area created by the project should be considered a mitigation credit against project impacts

that will occur elsewhere on the Coos Bay estuary.

We agree with those who believe this project poses a rare opportunity to accomplish a variety of objectives that generally are in conflict with each other. Coos County hopes the Evacuate Flood Plain Alternative can be implemented.

Sincerely,

BOARD OF COMMISSIONERS

Chairman

Commissioner

Commissioner

BOC/WPG/mos

cc: Mayor Chuck Holbert, City of Coos Bay
Frank Martin, Oregon Int'l. Port of Coos Bay
Kay Harris, Englewood Diking District
Dave Werschkul, Oregon Shores Coastal Conservation Coalition
Glen Hale, DLCD

Englewood Diking District
1860 S.W. Blvd.
Coos Bay, OR. 97420

Colonel Lord, District Engineer
U.S. Army Corp of Engineers
Portland District
P.O. Box 2946
Portland, OR. 97208-2946

Dear Colonel Lord,

RE: Letter of intent for the Floodplain Evacuation of portions of the Englewood Diking District Project;

By board action of 12/29/86 the Englewood Diking District, with support from the Coos-Curry Council of Governments (CCCOG), agrees to act as the Local Sponsor for the proposed Floodplain Evacuation of portions of the Englewood Diking District Project. The Englewood Diking District supports the concept of permanent floodplain evacuation, and is willing to contribute 25% of the costs associated with "Flood Damage Reduction", in either cash contribution; in-kind services; or a combination of the two. We are in agreement with the concept of selling all lands and improvements within the portion of the floodplain to be evacuated for their fair market value. We also agree in concept that fair market value of the subject lands and improvements shall be determined by a qualified, noninterested third party to be jointly agreed upon by both federal and local interests.

Milton Casey
Milton Casey, President
Englewood Diking District

12-30-86
Date

EXHIBIT 3a

COOS-CURRY COUNCIL OF GOVERNMENTS

170 S. SECOND STREET, SUITE 204
COOS BAY, OREGON 97420
267-6500

January 8, 1987

Colonel Lord, District Engineer
U.S. Army Corp of Engineers
Portland District
P.O. Box 2946
Portland, OR 97208-2946

Dear Colonel Lord:

SUBJECT: Letter of intent of the Coos-Curry Council of Governments' participation in the proposed Floodplain Evacuation of portions of the Englewood Diking District Project

By Council action of January 8, 1987, the Coos-Curry Council of Governments, in cooperation with the Englewood Diking District, agrees to act as the local administration/coordination body for the proposed Floodplain Evacuation of portions of the Englewood Diking District Project.

We support the concept of permanent floodplain evacuation, and are willing to assist the Englewood Diking District. Twenty-five percent of the costs associated with flood damage reduction will be provided by either cash contribution, in-kind services, or a combination of the two.

Sincerely,

Sandra Diedrich,
Director

JE:jrd

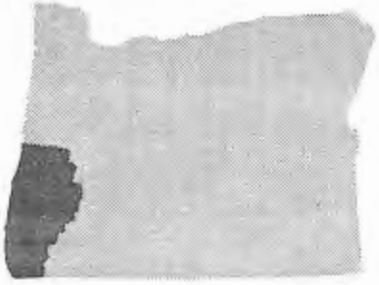


EXHIBIT 36

NEIL GOLDSCHMIDT
GOVERNOR

Division of State Lands

1600 STATE STREET, SALEM, OREGON 97310 PHONE (503) 378-3805

OREGON STATE
LAND BOARD

NEIL GOLDSCHMIDT
Governor

BARBARA ROBERTS
Secretary of State

BILL RUTHERFORD
State Treasurer

February 4, 1987

Colonel Lord, District Engineer
U.S. Army Corp of Engineers
Portland District
P.O. Box 2946
Portland, OR 97208-2946

Dear Colonel Lord:

The state of Oregon acting through the Division of State Lands supports the concept of floodplain evacuation, marsh reestablishment and associated salmon fishery enhancement embodied in the Libby Dike Project. The Division of State Lands is willing to act as state sponsor of the proposed Libby Dike Project pending legislative approval of the 25 percent of the costs associated with marsh reestablishment and anadromous fishery enhancement.

If such approval is obtained, our primary interest would be to help restore lost estuarine resources to the Coos Bay system. We understand that the Division of State Lands would be eventual holder of title to the lands involved and would agree to cooperate with Oregon Department of Fish and Wildlife to operate and maintain the fishery facilities at no cost to the federal government.

Sincerely,

Ed Zajonc
Director

EZ/amg
1060f

cc: Randy Fisher, Oregon Dept. of Fish & Wildlife

EXHIBIT 4

Libby Dike, Coalbank Slough
rd 7-6-84
fm Fred Bell (PL-FW)
beg

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Division of Ecological Services
Portland Field Office
727 N. E. 24th Avenue
Portland, Oregon 97232

Reference DS:sb

July 6, 1984

Colonel Robert L. Friedenwald, District Engineer
Portland District, Corps of Engineers
P. O. Box 2946
Portland, Oregon 97208

Dear Colonel Friedenwald:

This is a planning aid letter evaluating the effects on fish and wildlife resources of two alternative solutions to the flooding behind Libby Levee on Coalbank Slough, 1/2 mile south of the city of Coos Bay, Coos County, Oregon. This letter was prepared under a FY 1984 scope-of-work. Information is of a reconnaissance nature and does not constitute our report under Section 2(b) of the Fish and Wildlife Coordination Act (48 Stat. 401, as amended, 16 U.S.C., 661 et. seq.).

Fish and Wildlife information in this report was developed in cooperation with the Oregon Department of Fish and Wildlife (ODFW) and National Marine Fisheries Service (NMFS). Personnel from the Oregon Institute of Marine Biology were also consulted. Our analysis is based on: 1) a 50-year project life; (2) an appraisal of existing resources; and (3) written material submitted by your agency through May 15, 1984.

DESCRIPTION OF THE AREA

Libby Levee is located near the southeastern limits of the city of Coos Bay, in Coos County, Oregon. The levee forms the left bank of Coalbank Slough 3 miles upstream from its confluence with Isthmus Slough. That confluence is about a mile south of Coos Bay. The levee is thought to have been constructed before 1920 by private interests. The levee is about 5,500 feet long and protects approximately 75 acres of pasture land and 8 acres of residential land.

Recent winter storms combined with high tides overtopped the levee and flooded much of the land behind the levee (figure 1). The levee is now in a weakened condition.

EXHIBIT 5

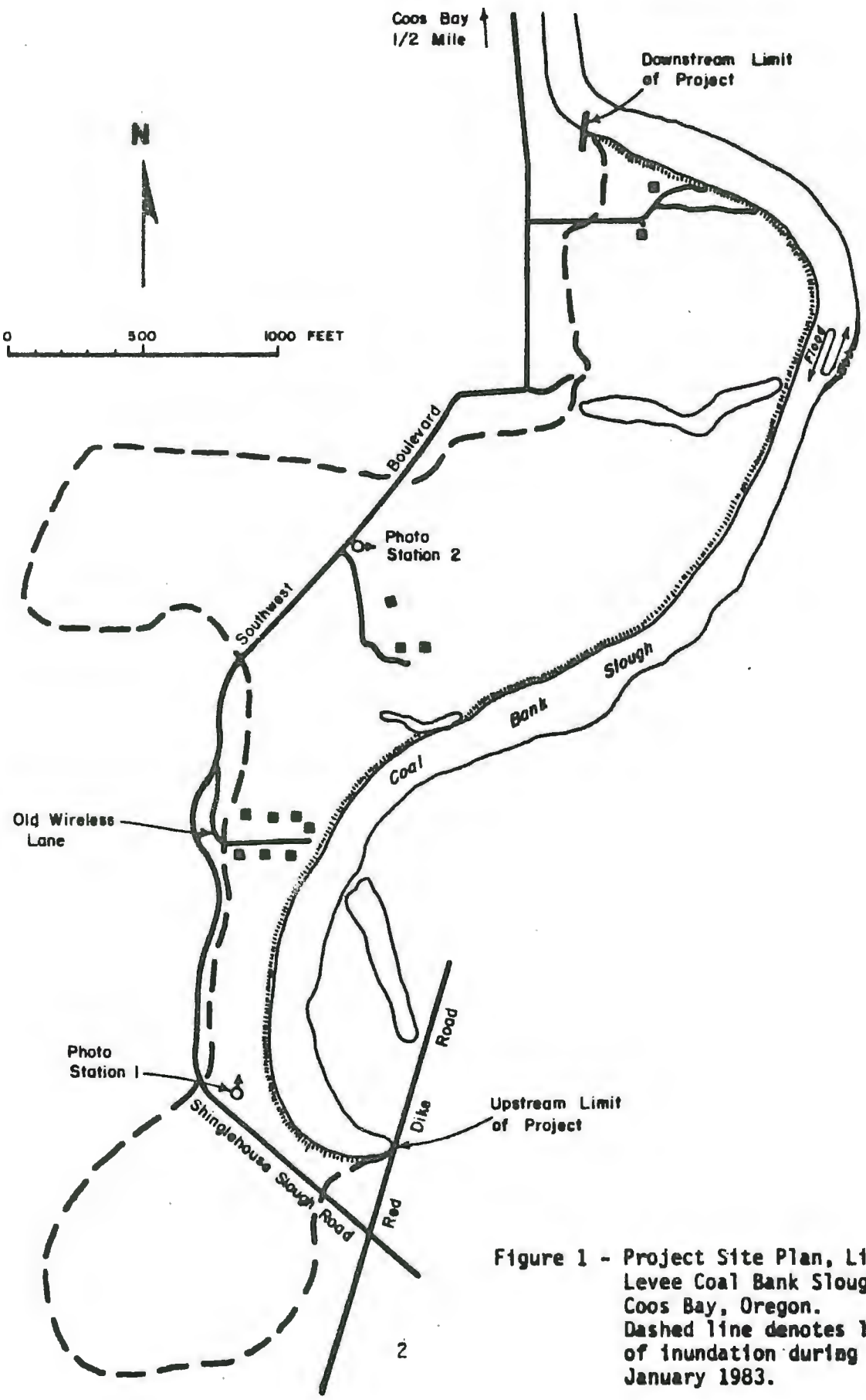


Figure 1 - Project Site Plan, Libby Levee Coal Bank Slough, Coos Bay, Oregon. Dashed line denotes limits of inundation during January 1983.

FISH AND WILDLIFE

The land behind the existing levee is mostly pasture land. Due to recent flooding and above normal rainfall there is some standing water and one or two small shallow creek channels. A variety of grasses and some semiaquatic plants (Juncus spp. and Ranunculus spp.) are the primary vegetation (photos 1 and 2). Primary production, in terms of providing organic material into the estuary system, is very low compared to an unleveed natural salt marsh.

No fish surveys were made in the one or two shallow channels behind the levee. However, ODFW gillnet surveys in 1979 revealed that several commercial and sport fish, including striped bass and starry flounder, inhabit Coalbank Slough. Top smelt and shiner perch (important prey species) and Dungeness crab were also present. English sole, although not found in gillnet surveys, probably inhabit the slough. Remanent runs of coho salmon, steelhead, and searun cutthroat trout utilize Coalbank Slough and its upper tributary streams. These runs are being supplemented along with attempts to establish a fall chinook fishery through the Salmon Trout Enhancement Program (STEP) coordinated by ODFW.

During a field inspection on May 16, 1984 mallard ducks, blackbirds, and a small rodent were observed in the project area. Other wildlife expected to use the area are raccoon, mink, great blue heron, gulls, and several species of waterfowl and shorebirds. Rodents are common and provide food for marsh hawks and perhaps other raptors that may frequent the area. A few pairs of mallards probably nest on the area. Because of heavy grazing and human disturbance, the area is generally of low value to fish and wildlife.

THREATENED AND ENDANGERED SPECIES

To the best of our present knowledge there are no listed or proposed species occuring within the area of the subject project (Attachment A). Should a species become officially listed before completion of the project, the Corps will be required to reevaluate it's responsibilities under the Act.

ALTERNATIVE SOLUTIONS

There are two basic solutions to be evaluated: 1) Reconstruct the existing levee and 2) relocate and/or flood proof existing improvements (perhaps including levees around the high value residential area). The second alternative would include breeching the existing levee to restore about 65 acres of pasture to highly productive natural marsh and mudflat.

Photo 1. Looking North from Shinglehouse Slough Road (photo station 1, figure 1). Libby Levee and Coal Bank Slough are at far right. Protected pasture land covered with Ranunculus sp. (yellow flowers) is in foreground. Houses along Old Wireless Lane are in background.

Photo 2. Looking East from Southwest Boulevard Road (photo station 2, figure 1). Libby Levee and Coal Bank Slough are in background near tree covered hills. Protected pasture is in foreground.

Reconstruct Existing Levee

If the levee were to be reconstructed there would be less standing water and subsequently a general reduction in wildlife value. Since the area has low wildlife values, the losses probably would not be significant. If riparian vegetation were established on or along the levee, it would probably offset any fish and wildlife losses. However, approximately 47 acres behind the levee is designated in the county plan as low priority mitigation lands for salt marsh restoration. Should the levee be reconstructed, the opportunity to restore the area to salt marsh as designated in the county plan would, for all practical purposes, be foregone.

Restore Marsh and Mudflat

Physical Habitat Changes

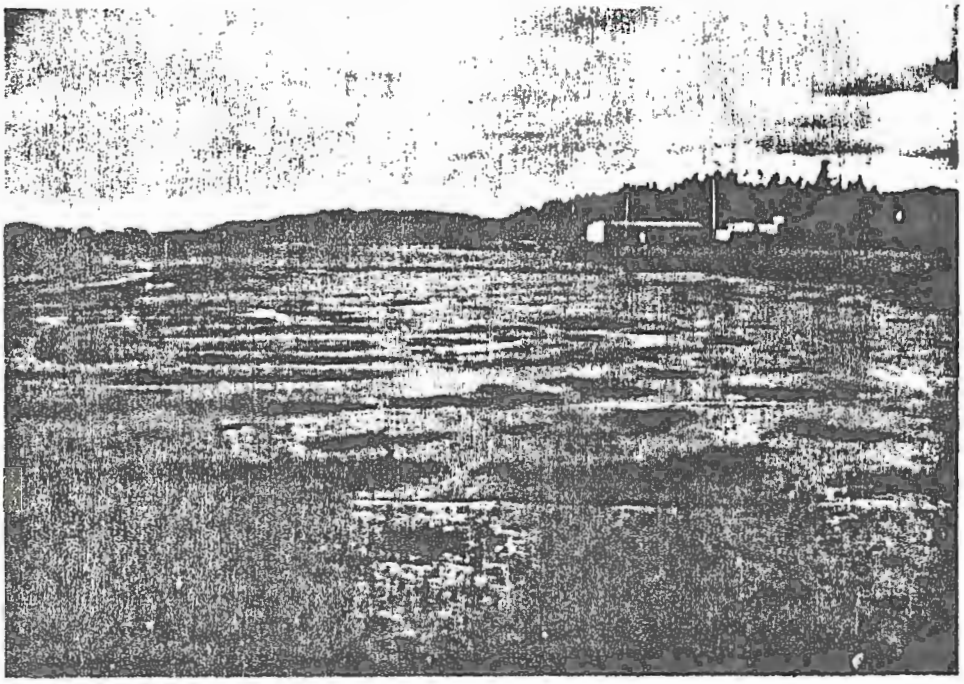
The 65 acres of pasture land that would be returned to marsh and mudflat by breeching the existing levee averages about 1.5 feet above mean sea level (msl Johnson,1984). It appears this land probably would revert to about 50 acres of mudflat with an edge of Lyngbye's sedge (Carex lyngbyei) and other semiaquatic vegetation covering the remaining 15 acres.

There would be secondary beneficial effects to Coalbank Slough resulting from slowing the flow in the presently constricted channel by allowing water to disperse over the previously leveed pasture. The sifting mix of bottom sediments in Coalbank Slough would settle and become covered with finer sediments that are more biologically productive. The resulting physical habitat changes should produce a mudflat with marsh vegetation around the edge, similar to that found at Pony Slough (photos 3 and 4).

Biological Productivity

Intertidal coastal wetlands similar to what would be restored behind Libby Levee are considered one of, if not the most productive fish and wildlife habitats in the world. Odum and many others have documented the value of salt marshes to ocean productivity and related commercial and sport fishery industries (figure 2). Over 90 percent of Coos Bay salt marshes have been lost (Hoffnagle and Olson, 1974).

Photo 3. Pony Slough at low tide



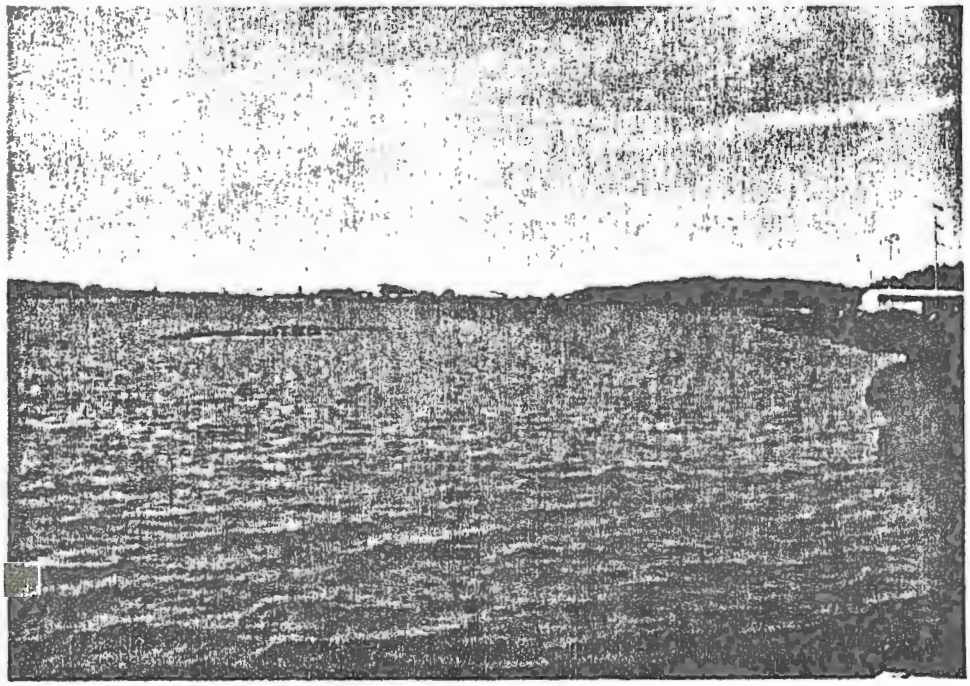
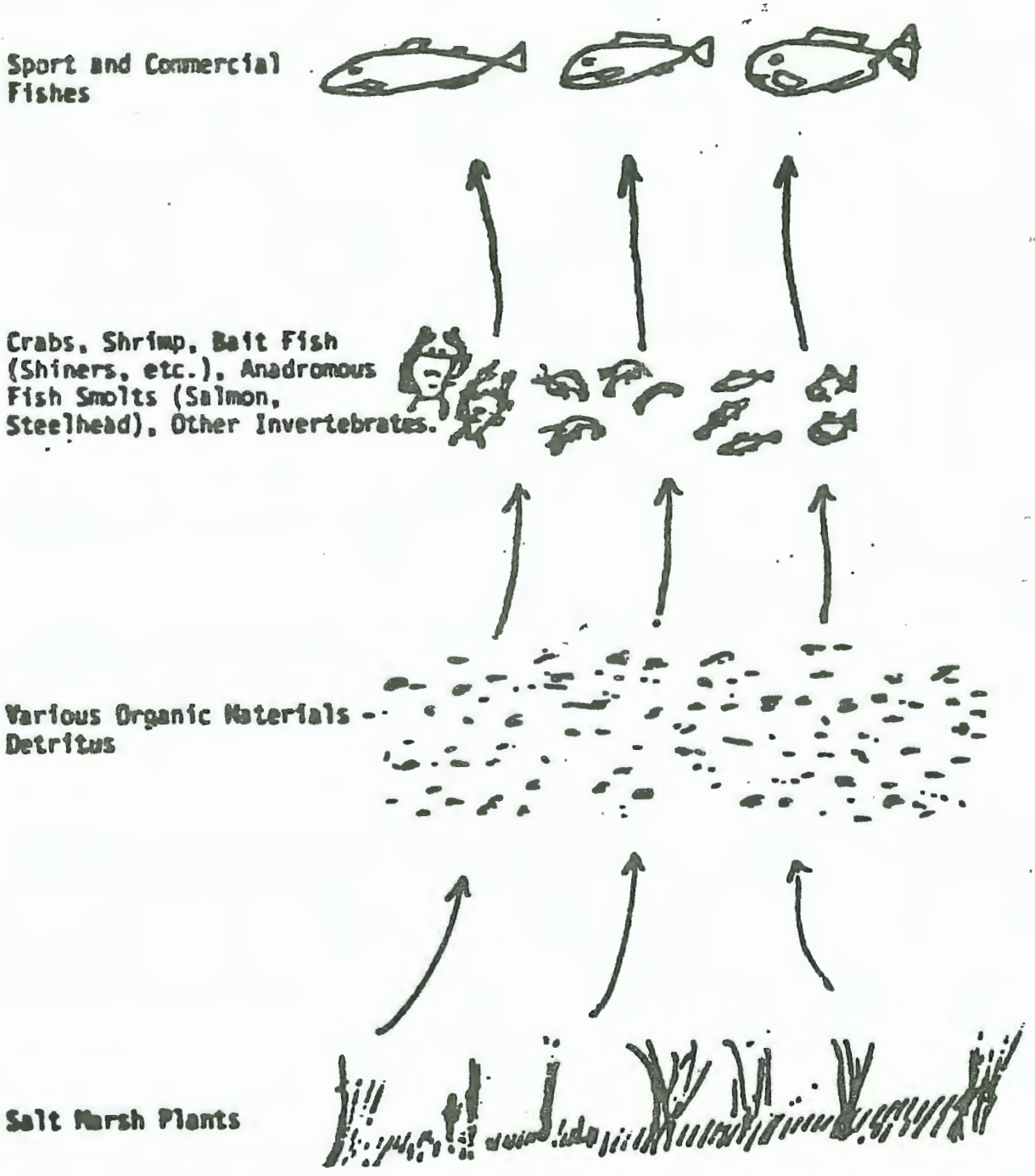


Photo 4. Pony Slough at high tide

Figure 2 General Salt Marsh Food Web Showing Importance to Sport and Commercial Fisheries.



The Lyngbye's sedge which is likely to cover 15 acres of restored marsh, is one of the highest primary producers of energy into marsh systems. Net primary production is estimated at 1,850 grams per square meter annually ($g/m^2/yr$) compared for example to Baltic rush which averages 450 $g/m^2/yr$. (Kibby et. al. 1980). The 50 acre mudflat and the rest of Coalbank Slough would receive most of this detrital input.

The mudflat portion of the restored area and the improved bottom sediments in Coalbank Slough would in turn support large numbers of invertebrates. These in turn would be fed upon by bait fish (shiners and top smelt) and juvenile sport and commercial fishes, including salmon (especially fall chinook), steelhead, searun cutthroat trout, English sole, starry flounder and Dungeness crab.

Salt marshes provide high quality habitat to a great variety of wildlife species, especially waterfowl and shorebirds. A large increase in use of the restored marsh and mudflat would be expected by these groups of birds.

Restoring the 65 acre marsh would provide a new source of salmon carcasses which could attract bald eagles. Waterfowl and shorebirds attracted to the marsh could provide an increase in the prey base for peregrine falcons, which in turn may be attracted to the area. Both the bald eagle and peregrine falcon are endangered species.

Economic Value

The value of restoring the Libby Levee area to salt marsh and mudflat can be estimated, particularily for fall chinook salmon.

Juvenile chinook salmon would be produced through the STEP over the next 5 to 10 years in tributaries to Coalbank Slough. These fish would acclimate to salt water and rear for approximately 3 months during the spring and summer in the restored marsh and improved habitat of Coalbank Slough. The restored marsh, located at the outlet of several small tributaries where downstream migrating fry would first encounter brackish water, would provide rearing habitat critical to their survival. It is believed that the restored marsh and mudflat would function similarly to the estuary at the mouth of the Sixes River, 50 miles south of Coos Bay, in terms of supporting juvenile fall chinook. Extensive studies of the 20-acre Sixes River estuary indicate that it supports an approximate optimum carrying

capacity of about 100,000 juvenile chinook, or about 5,000 fish per acre, for 3 months prior to outmigration (Rumreich and Miller, 1984). The 65 acre restored marsh and mudflat (providing approximately 50 acres of surface water) could support approximately 250,000 juvenile fall chinook (50 x 5,000). Fall chinook return rates on the Elk River indicate spawning escapement ranges from 1.2 to 4 percent or an average of 2.6 percent, which is generally representative of fall chinook in Oregon coastal streams (McGie, 1984). Similar returns could be expected at Coalbank Slough, yielding 6,500 spawners (.026 x 250,000). Each spawner represents 4.76 commercially caught fish with a total value of $140.48, and 1.24 sport caught fish valued at $126.96 for a combined total value of $267.44 per spawner (Tuttle et. al. 1975, updated to January 1, 1984 Consumer Price Index). Total annual economic value represented by an escapement of 6,500 fish is $1,738,360 (6,500 x 267.44). This equates to a value of $34,760 per acre, per year, just considering the benefits of an improved run of fall chinook supported by the restored marsh and improved habitat of Coalbank Slough.

Additional economic values can be attributed to the other previously identified commercial and sport fishes that also would be at least partially dependent upon the restored marsh. Waterfowl (most species are hunted), shorebirds, and other wildlife have economic as well as recreational and esthetic value and are dependent on wetlands. Values can also be attributed to water pollution control, flood retention and other benefits of marsh restoration.

RECOMMENDATIONS

To minimize the potential adverse impacts of the proposed project on fish and wildlife resources and to maximize potential environmental and economic benefits we recommend that:

(1) The alternative of reconstructing the existing levee be dropped in favor of a multi-purpose project alternative with increased benefits; and

(2) The Corps of Engineers develop a multi-purpose project, in cooperation with resource agencies, to flood proof high valued residential improvements, and breech the existing levee to restore about 65 acres of pasture to much higher value natural salt marsh and mudflat.

Please notify us of your proposed actions regarding our recommendations. We would appreciate notification of any changes or refinements in project plans so that we may revise or supplement this report as necessary.

Sincerely yours,

Russell D. Peterson

Russell D. Peterson
Field Supervisor

cc:
ODFW
NMFS
EPA

REFERENCES CITED

Hoffnagle, J. and R. Olson. 1974. The Salt Marsh of Coos Bay Estuary. Port Commission of Coos Bay and Oregon Institue of Marine Biology.

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Kibby, H.V.; J. L. Galligher; and W. D. Sonville. 1980. Field Guide to Evaluate Net Primary Production of Wetlands. U.S. Environmental Research Labratory, Corvallis, OR.

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Tuttle, M. E., J. A. Richards, R. J. Wahle. 1975. Partial Net Economic Values for Salmon and Steelhead for the Columbia River System. U.S. Dept. Commer. Natl. Oceanic Atmos. Admin., Natl. Mar. Fish. Serv., Pro. Rep. (updated Jan 1984 consumer price index).

VICTOR ATIYEH
GOVERNOR

Department of Transportation
STATE HISTORIC PRESERVATION OFFICE
Parks and Recreation Division
525 TRADE STREET S.E., SALEM, OREGON 97310

June 11, 1985

Owen J. Mason
Acting Chief
Natural Resources Branch
Portland District Corp of Engineers
PO Box 2946
Portland, OR 97208

Dear Mr. Mason:

RE: Levee Rehabilitation
Coalbank Slough
Coos County

This letter is in response to the cultural resource survey carried out to assess impact of the above-mentioned project on historic and archeological sites.

After a careful review of the cultural resource survey carried out within the project area, our office can offer the following comments. We feel that no cultural resources of National Register potential have been identified which are likely to be impacted by this project. We therefore feel that Public Law 89-665 and Executive Order 11593 have been complied with and the project may go forward as planned.

Thank you for your cooperation and concern. If you have any questions, please call Leland Gilsen at 378-5023.

Sincerely,

D. W. Powers III
Deputy SHPO

DWP/LG:jn
6602C

Form 734-3122

EXHIBIT 6

ATTACHMENT A

LISTED AND PROPOSED ENDANGERED AND THREATENED SPECIES AND CANDIDATE SPECIES THAT MAY OCCUR WITHIN THE AREA OF THE PROPOSED COALBANK SLOUGH EMERGENCY LEVEE REPAIR (T26S, R13W, S03)
COOS COUNTY, OREGON
1-3-83-SP-262

LISTED:

None

PROPOSED

None

CANDIDATE

None