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COOS COUNTY PLANNING DEPARTMENT

COOS BAY ESTUARY

INVENTORY AND STUDY

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(Copies of these maps are available at the Coos County Planning Department)

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INTRODUCTION

Coos Bay is the largest estuary existing totally within the boundaries of the State of Oregon. It is vitally important to the people of the region as a major shipping port on the West Coast. It is designated as a deep-draft development estuary by the Oregon Department of Land Conservation and Development (LCDC 1977) in order to promote and preserve its use as an industrial port. The environmental resources of Coos Bay are also vitally important to the local people and their economy. The LCDC action (1977) to classify the estuary as a deep-draft port does not intend to preclude the existence of the natural habitats of Coos Bay. Areas of conservation and preservation (Natural Management Units) are also to be designated within the estuary.

The purpose of this paper is to list criteria and establish priorities for determining critical natural and development areas of the estuary and its shorelands. A balanced view of industrial and environmental concerns is intended in the study. Information has been gathered from the existing literature on the Coos Bay estuary, and also to a large extent from interviews with local individuals representing various interests and viewpoints.

Important natural areas and water-dependent use sites as addressed in the Coastal Goals (LCDC 1975) are identified within the Coos Bay estuary. The estuary has also been divided into study units of similar physical, biological, and development characteristics to aid in the eventual establishment of management units in the comprehensive plan. It is hoped that this inventory and study by the Coos County Planning Department will be valuable in the continuing evolution and implementation of the Coos Bay Estuary Comprehensive Plan.

CRITERIA FOR ESTUARINE MANAGEMENT UNITS

The estuarine resources goal of the Statewide Planning Goals and Guidelines (LCDC 1975) states that major tracts of salt marsh, tideflats, and seagrass and algal beds, shall be preserved in natural management units as a minimum inclusion. The preservation and protection of these habitats is important, because they are the sites where many of the beneficial functions of estuaries take place.

Salt Marsh

In Coos County estuary, the area of salt marsh has been greatly reduced over the past hundred years. It has been estimated that over 90% of pre-European settlement salt marsh area has been lost to tidegates, dikes, and fill (Baldwin, et. al. 1977). Most of the land was taken for agriculture, but much was filled for industrial, recreational, and residential use. In any case, little salt marsh remains in Coos Bay estuary, making almost every remaining tract in the estuary a major tract.

Salt marshes have several functions that are critically important to estuaries. They are among the highest yield vegetative producers on earth, higher than intensively managed agricultural land (Hoffnagle and Olson 1974). Some of the marsh plants are eaten directly by insects, birds, and mammals. Most of the vegetation however, dies and decays into organic particles called detritus, which has great significance in the estuarine system. This detritus is the primary source of food for most clams and other filter feeding invertebrates. The salt marsh supplies a continuous source of food, in contrast with the seasonally varying supply of phytoplankton in the water column.

Other benefits from salt marshes are due to its physical structure. The marsh acts as a storage area for flood water and storm tides. Marshes also moderate water temperatures in the estuary. The cool marine waters are warmed in the shallow channels, which enables the rearing and spawning of certain crabs, clams, and fish to occur. The salt marsh can also act as a filter for pollutants, especially domestic sewage (Hoffnagle, et.al. 1976). Nutrients from the sewage are removed and oxidized by bacteria in the marsh, and returned after a period of time in a form useable to estuarine organisms. The salt marsh generally acts as a trap of nutrients and sediments from upland streams. The accretion of sediments in salt marshes impedes the filling of estuary tidelands and channels. Marsh vegetation along channel banks stabilizes shoreland from erosion.

The marsh is a nesting habitat for rails and marsh wrens, a fishing ground for herons, and a hunting area for several birds of prey. The marsh also serves as a habitat for several small mammals including the vagrant shrew and larger mammals such as deer, raccoon, and beaver.

Tideflats

Tideflats are the lands between mean lower low water and mean higher high water by the definition used in LCDC documents (1975). These lands are generally represented by the Tideland map of Coos Bay, (Oregon Division of State Lands (DSL) 1973a). Coos Bay has a total acreage of 12,380, of which 6,300 acres are tideland area (DSL 1973a).

It shows that 15 percent of the original tidelands in the bay have been filled. The substrate of tidelands can vary from rock to sand to a very soft mud. Each of these bottom types supports different kinds of animals underneath and upon its surface.

Tidelands are important as the home for the abundant animal life within the estuary. The bay clams that can be harvested easily exist on the tideflats along with great numbers of burrowing worms, crustaceans, and molluscs. These animals utilize the detritus produced in the salt marshes and also filter algae from the water. The small worms and crustaceans become the diet of larger crabs and fishes that are of direct importance to man. The tidelands, like marshes, also have functions that influence the physical and chemical conditions of estuaries. Sediments absorb organic material from passing water, and microbes decompose it into useable nutrients of ammonia, nitrates and organic phosphates (Odum 1970). Tidelands function to moderate water temperatures and thus provide optimum habitat for spawning and rearing of estuarine organisms. Tidelands also provide food and resting area for shorebirds and some terrestrial mammals.

Eelgrass and Algal Aquatic Beds

Eelgrass and algal beds are vegetative cover on tracts of tideland. which enhance their values for productivity and animal habitat. Eelgrass, Zostera marina, has minor importance as a direct food item. It supports a variety of small animals that live attached to its leaves. Eelgrass serves as specific habitat for several fish species, especially the bay pipefish, and is used by Pacific herring for a spawning ground (Gaumer, Demory and Osis 1973). It has been recognized as the major diet of a few birds, notably the Black Brant (Carl 1963). The major importance of eelgrass is the same as salt marsh, the contribution of organic plant matter to the estuary, which decomposes to useful food particles for filter feeders such as clams. Eelgrass also absorbs nitrogen and phosphorus nutrients from the sediment through its roots and releases them through its leaves back into the estuary system (Thayer, Wolfe, and Williams 1975). Physical functions of eelgrass retard currents and prevent erosion of sediment.

Algal beds are also very important producers of food material for estuarine animal populations. Sea urchins and periwinkles are common animals that feed directly on algae. Ninety percent of the algal production becomes either dissolved or particulate food (Mann 1973). Eelgrass and algal beds occur on a variety of tideland substrates. Their presence enhances the value of tidelands. Coos Bay has large beds of eelgrass on mud-sand sediment and beds of kelp on rocky substrate.

The vegetative production of aquatic beds and marshes in estuaries are the fundamental food supply for the rest of the organisms in the system primarily through detritus food chains. All fisheries, recreational and commercial, depend upon this production to support the species desirable to man.

Other Environmental Criteria

Other environmental resources must be considered in addition to marsh, tideland and aquatic beds. Significant populations of marine organisms such as clam and crustacean beds are to be conserved as estuarine resources (LCDC 1975). Also noted as inventory requirements are specific habitats such as nesting sites, spawning grounds, juvenile rearing areas and adult feeding areas of fish and wildlife species.

The extent of previous habitat alteration and current use influence habitat quality. The potential for aquaculture, commercial harvest, and recreation are also considered to be inventory criteria that determine habitat importance. The accessibility of the habitats on the estuary for these uses is also taken into account to establish the importance of each site.

The entire estuary system operates as an interrelated and interdependent system. Man's activities in the estuary, on the shoreland, and up the rivers have effects upon the quality of estuarine life. It is sometimes arbitrary to place values on individual sites in the estuary, but this must be done to implement land use planning goals.

The criteria for determining the significance of estuarine habitats is the quantity and quality of each habitat. Quantity of habitats can be measured in acreage or productivity. Quality can be attached to specific uses of a habitat, its uniqueness in the bay, and the extent of its degradation. The habitat types of marsh, tidelands, and aquatic beds are listed (LCDC 1975), as primary criteria in determining habitat importance, because they are the most important sources of food production in the estuary. The presence of a clam bed is also a primary criteria for the determination of habitat importance for tide flats. Qualitative data are used as secondary criteria to differentiate among tracts of the same habitat type.

LCDC ESTUARINE RESOURCES GOAL REQUIREMENTS FOR MANAGEMENT UNIT DESIGNATIONS (1975)

Natural At least all major tracts of:

Saltmarsh

Tideflats

Seagrass beds

Algal beds

Conservation Smaller significant habitats:

Fringing marsh

Small tideflats

Fringing aquatic beds

Narrow shores (especially with clams present)

Clam or oyster beds (not classed natural)

Partially altered habitats (e.g. marsh with restricted flushing)

Development

Deep water near shore

Navigation channels

Subtidal inwater dredge disposal sites

Areas of minimal biological productivity (e.g. diked, rip-rapped shores)

Areas of at least significance are considered to be those areas of greatest existing degradation of habitat by human activities or natural factors. Minimal significance is attached to areas of low production of bethnic plants or animals having little potential for restoration or enhancement. Frequently maintained channels are also in the category of minimal biological significance.

CRITERIA FOR COASTAL SHORELANDS MANAGEMENT DESIGNATIONS

The Coastal Shorelands Goal (LCDC 1975) has a set of criteria for placing values upon shorelands, which is different from criteria for estuarine lands. Important habitats for fish and wildlife species remain a primary consideration for protection. Included in shoreland habitats for wildlife protection are bird nesting sites, riparian vegetation, fresh water marshes and seasonally flooded agricultural lands, which serve as resting area for migrating waterfowl. Historical and archeological sites from Indian and pioneer eras of Oregon history are identified as well as significant aesthetic resources.

Water-dependent human activities on shorelands are also given value and priority in planning land use designations. Sites for deep draft moorage, shallow draft marinas, aquaculture and fish processing, and recreational access to the estuary are among coastal shorelands inventory requirements. Criteria from LCDC estuary and shoreland goals (1975) are applied to the existing uses on the estuary toward the end of identifying and protecting sites for water-dependent uses. Water-dependent uses can range from recreational to industrial developments, but the common criterium among water-dependent uses is that they can be carried out only on,

in, or adjacent to water areas, because the use requires access to the water body.

LCDC COASTAL SHORELANDS GOAL REQUIREMENTS FOR COASTAL SHORELANDS USES (1975)

Protection of Natural Values

Major marshes

Significant wildlife habitat

Coastal headlands

Exceptional aesthetic resources

Protection for Water-Dependent Recreational, Commercial, and Industrial Uses in Urban and Urbanizable Land

Deep water close to shore (with supporting land facilities suitable for ship and barge facilities)

Potential for aquaculture

Potential marina sites

Potential for recreational use of water or riparian resources

Appropriate Uses in Rural Areas

Farm use

Forest product propagation

Private and public water-dependent recreation developments

Aquaculture

Commercial and industrial water-dependent uses (water-related uses if county finds need cannot be accommodated in urban and urbanizable areas)

Major and Minor Subdivisions (if county finds need cannot be accommodated upland or in urban or urbanizable areas, and compatible with objectives of protection of riparian habitat)

Single family residences (on existing lots)

The relationship between shorelands and estuarine lands in the coastal goals (LCDC 1975) requires that adjacent land use designations shall be compatible with one another. Shorelands are given higher priority for development uses than estuarine lands. However,

the highest development priority on shorelands is for water-dependent uses. In all cases, the designation of shoreland zones depend upon the management unit of the adjacent estuarine lands.

CRITERIA FOR BEACHES AND DUNES MANAGEMENT DESIGNATIONS

The Beaches and Dunes Goal (LCDC 1975) seeks to protect significant wildlife habitat in dunes such as younger stabilized dunes and wet deflation plains, and also to limit development in hazardous areas such as active foredunes or open dune sand (USDA Soil Conservation Service 1975). Another major concern is to preserve the existing fresh water table in the dune areas. A dilemma exists in planning development in dune areas. The dilemma is the fact that the habitats with soils stable enough for building structures happen to be prime habitat for wildlife, while areas of minimal wildlife significance have unstable soils hazardous for building structures (Table 1). Conditionally stabilized dunes, which have been planted with European beachgrass, and dredge spoil sites are generally the best sites for industrial use in the beaches and dunes area. Beaches and dunes habitats have been identified in Coos County Planning Department's Background Document #1 (1978). Particularly important wildlife habitats on North Spit are identified on the estuary inventory maps that are part of this report.

LCDC BEACHES AND DUNES GOAL REQUIREMENTS FOR COASTAL BEACHES AND DUNES USE (1975)

Beaches and dune land uses shall be based on the capabilities and limitations of these areas to sustain different levels of activity or development. Factors taken into account are to protect areas of critical environmental concern; areas having scenic, scientific, or biological importance; and areas containing significant wildlife habitat (Table 1).

The necessary relationship between the activities on beaches and dunes and the activities on estuarine lands in the coastal goals (LCDC 1975) is that there adjacent land use designations shall be compatible with each other. Beaches and dunes are given higher priority for development use than estuarine lands. However, development is given lower priority in beach and dune areas than on other shorelands. Protection of critical habitats is the highest priority in all of the state coastal goals. However, the Beaches and Dunes Goal broadens the scope of concern with conditions and restrictions upon development in areas with hazards or soils limitations. The following table illustrates the relationships between various types of beach and dune habitat types and the activities for which they are best suited.

TABLE 1 DESCRIPTION OF OREGON COASTAL BEACHES AND DUNES HABITAT TYPES (USDA SOILS CONSERVATION)

Habitat Type	Stability of Soil	Vegetation Cover	Wildlife Use	Physical Hazards	Recreation Potential	Development Potential
Open Dune Sand	Unstable	None	Travel	Buried Trees Quicksand	Excellent Off-road Vehicles	Poor
Active Dune Hummocks	Unstable	Pioneer Species	Bird Variety	Quicksand	Excellent	Poor
Active Foredunes	Unstable	European Beach Grass	Shorebirds Snowy Plover	Visual Barrier	Fair	Poor
Foredunes	Conditionally Stable	Spare Growth Local Species	Shorebirds Snowy Plover	Tsunamis	Fair	Poor
Open Dune Sand Conditionally Stable	Conditionally Stable	Planted European Beach Grass	Few Species	--------	Poor	Fair
Dune Complex	Conditionally Stable	Planted European Beach Grass	Few Species	--------	Poor	Fair
Younger Stabilized Dunes	Stable	Native Grass to Woody Species	Habitat for a great variety of species	Depth of Water Table Permeability of soil;	Wildlife Observation	Good (Conditional)
Older Stabilized Dunes	Stable	Forest Species	Great Variety	Steep Slope; Water Table; Permeability;	Wildlife Observation	Good (Conditional
Older Foredune	Stable	Forest Species	Great Variety	Steep Slope; Water Table; Permeability;	Wildlife Observation	Good (Conditional
Wet Deflation Plains	----------	Grass;Shrub Sedge and Rush	Great Variety	Failing Sewerage	Wildlife Observation	Poor
Wet Interdun)	----------	Varies from Shrub to Open	Great Vari)	Failing Sewerage	Wildlife Observation	Fair (nditional)

SUMMARY

Criteria for the designation of estuarine management units, and shorelands, beaches and dunes land use priorities are taken from LCDC Statewide Planning Goals and Guidelines (1975) and adapted to the inventory of data for Coos Bay Estuary. Land use designations on shorelands shall be compatible with estuarine management units. Development has a higher priority on shorelands than estuarine lands, although the highest development priorities are water-dependent (1st) and water-related uses (2nd) in all development areas.

The map inventory of Coos Bay Estuary (CCPD 1979) presents the data necessary to designate management units and potential land uses in Coos Bay Estuary and shorelands. These maps were prepared using the information outlined in this report as the criteria for the estuary inventory.

ESTUARY RESOURCES INVENTORY

An inventory of estuarine resources, environmental and socio-economic has been prepared for Coos Bay estuary in a map format (See inventory maps of Coos Bay Estuary I-IX; Coos County Planning Department (CCPD 1979). Environmental inventories include estuarine habitats, clam beds, and fish and wildlife habitats in the estuary study area. Socio-economic inventories identify existing land uses and potential water-dependent and water-related uses. Other data which bridge environmental and socio-economic categories are areas of habitat alteration due to human activities and historical, archeological, and aesthetic resources. Basic physical data such as hydrology, hydrography and water quality are addressed in the Coos County Comprehensive Plan Background Document #1 (CCPD 1978). These inventories present several types of data for each site in the estuary.

It is relatively easy to list and collect types of data needed for an inventory of estuary resources, but is more difficult to establish priorities for how all the information can be analyzed to derive land use decisions. The difficulty lies in the fact that there are no established methods to compare environmental with social or economic values. The criteria developed in this paper are derived from LCDC Statewide Planning Goals and Guidelines (1975). Criteria from these Goals are adapted to the existing data base available for Coos Bay estuary.

COOS BAY ESTUARY INVENTORY MAPS

Map I: Clam Beds in the Coos Bay Estuary

The primary source of data on clam beds in Coos Bay estuary is an Oregon Institute of Marine Biology survey of distributions of bottom dwelling invertebrates (USDI 1971). Although this data is almost ten years old, it is the only study to date that has surveyed the entire bay. Additional data on clam beds are from the Oregon Department of Fish and Wildlife clam surveys (Gaumer 1978). The ODFW has made detailed surveys of bay clam distributions in South Slough and the lower bay below Jordan Cove. Their data includes population density information, although their survey has not yet covered the entire bay.

There are three major criteria that determine major clam beds in the estuary. Clam beds with active recreational use or with great potential, if access were improved, are very important. Most recreational clam beds occur below the railroad bridge and in South Slough, although softshell clams are dug along the causeways in Haynes Inlet and North Slough. A second criteria of clam bed importance is its use and potential for commercial clamming or shellfish aquaculture. At this time commercial harvest is closed above Sitka Dock by the State Board of Health. There may be potentially suitable clam beds for commercial harvest in subtidal areas of the lower bay and in South Slough. South Slough at this time is the center of oyster aquaculture. Finally, large beds of productive clam species, such as Tellina and Macoma, that are not necessarily of recreational or commercial importance, do contribute signifantly to the productivity of the estuary. The large tideflats in the upper east bay contain tremendous numbers of these species.

The major limitation of the clam beds map is that subtidal areas of the bay have not been adequately surveyed. It is known that the greatest density of gaper and cockle clams exists beneath the tidelands in some areas (Gaumer 1978). The subtidal beds are thought to be major spawning stocks in Oregon estuaries. Further study will have to be made to identify major subtidal beds in Coos Bay estuary.

Map II; Crustacean Habitats in the Coos Bay Estuary

The source of data for crustacean habitats are the same as for clam beds. Oregon Institute of Marine Biology (USDI 1971) made a general survey that covered the entire bay, while the ODFW (Gaumer 1978) made a more detailed survey of mud and ghost shrimp that covers the lower bay. Information on grey shrimp and dungeness crab was given by ODFW (1979a).

Mud shrimp and ghost shrimp habitats are important areas for commercial and recreational harvest of bait. Corophium aphipod distribution shows important tideland areas for rearing of juvenile salmonids. The distributions of dungeness crab and grey shrimp demonstrate the complexity of the estuarine system. These species

are mobile and migrate according to salinity. Seasonal changes in fresh water flow and daily changes in tidal flow determine the extent of salinity penetration into the estuary. Both species have been collected to the heads of tide in Coos Bay tributaries certain times of the year.

The major limitation of the crustacean habitat map is inadequate data in subtidal areas. Another limitation is the generalized nature of some of its data, which makes the map less applicable to site specific decisions than substrate and aquatic vegetation mapping.

MapIIIa: Estuarine Habitats in Coos Bay (1"=3000')

Map IIIb: Estuarine Habitats in Lower Coos Bay and South Slough (1"-1500')

The source of these maps is the ODFW Habitat map of Coos Bay (1978a), which was based on the Oregon Estuarine Habitat Classification System (ODFW 1978b). This system categorized estuarine lands according to tidal exposure (water regime), physiography (class), and substrate type (subclass). The original habitat map was made from a compilation of existing data, the use of aerial photography, and field surveys by ODFW personnel. The habitat map of the entire bay (IIIa) is reduced in scale from the original source. The map of the lower bay and South Slough is reproduced exactly at the scale presented by ODFW.

The habitat maps can be used to identify all tracts of salt marsh, tideflat, and aquatic beds. Their limitation is that there is no differentiation of major tracts of these habitat types. Criteria for identifying major tracts of estuarine habitat types are discussed earlier in this inventory paper. The habitat maps can become the primary tool for evaluating habitat importance, because it is the most current and accurate presentation of data that covers the entire estuary. As with other inventory maps the least available information is on the subtidal lands of the estuary.

Map IV a; Map IV b: Fish & Wildlife in the Coos Bay Estuary

These maps are a summary of several ODFW maps that identify areas of critical importance for fish and wildlife species. The resulting maps describe important functions of each area to these species. Even though most of these species may be found at almost any site in the entire estuary, the maps were meant to focus on the uses of each area that are of primary importance or are particularly threatened. Some designations are site specific such as bald eagle nests, heron rookeries, and snowy plover habitat. Other uses are more generalized such as shorebird and fish habitat. Nesting sites need to be entirely protected from disturbance. Shorebird and waterfowl habitat can exist adjacent to development as long as their actual area remains unaltered. Juvenile salmonids, herring, and flatfish need particular habitats and high water quality to rear successfully in the estuary, so those environments should be protected and enhanced

for these species. Striped bass seem to be able to thrive in more degraded habitats such as Isthmus Slough. Surf smelt, top smelt, embiotocid perch and many other fish species (Table 2) are more ubiquitous species in the estuary, and occur from the mouth to the head of tide during summer. The preservation of the diversity and abundance of these species is more dependent upon the maintenance of overall environmental quality and estuary production than specific area protection.

More specific data on individual species could not be mapped, but their distributions are included in species lists of fish (Table 2) and birds (Table 3).

The limitation of these maps is that the species are all highly mobile and thus judgement of the importance of particular habitats to them can be subjective. Qualitative information on these maps can be used as justification for differentiating the importance of tracts of the same habitat type in the estuary. This data may also be used to assist in the identification of restoration and mitigation projects such as enhancing striped bass habitat in Isthmus Slough or returning former salmon spawning streams back to production in South Slough.

Map V: Habitat Alteration Caused by Human Activity

The habitat alteration map is a synthesis of data by the estuary planners of the Coos County Planning Department. Each designation is based on separate criteria and implies certain existing environmental conditions. Each area of the estuary is designated with the category of alteration that is thought to have had the greatest influence upon its present condition. Some data are specific, such as filled lands (DSL 1973), diked lands (Hoffnagle and Olson 1974), and dredging (United States Army Corps of Engineers [USACE] 1976). Other designations are based on findings from studies of historic changes in the Coos Bay estuarine environment. Log storage is cited as the major contributing factor to alteration of Isthmus Slough and Coos River. Diking of marshlands for agricultural use has had major impacts in Catching Slough.

Siltation and accretion of sediments have been the major forms of alteration on the East Bay tide flats and also in Pony Slough, North Slough and Haynes Inlet. Siltation in East Bay is attibuted to erosion of uplands in the Coos River drainage basin primarily due to poor logging practices (Dicken, Johannessen and Hanneson 1961). However, siltation in Pony Slough, North Slough, and Haynes Inlet is significantly accelerated by the lack of circulation in them. Their narrow entrances cause poor flushing of suspended sediments, which get trapped inside their basins. The habitat alteration map implies that siltation on East Bay tideflats can be reduced by improving upriver land use practices, while the other three basins with siltation problems may be enhanced by restoration projects which increase circulation between them and the bay.

Table 2 Distribution of Fish Species in Coos Bay Estuary

Common Name (species)	SUBSYSTEM			
	Marine 0-3 Mi	Lower Bay 3-9 Mi	Upper Bay 9-17 Mi	Riverine 17-30 Mi
Leopard Shark (Triakis semifasciata)	x			
Longnose Lancet Fish (Alepisaurus ferox)	x			
White Seabass (Cynoscion noblis)	x			
Pomfret (Bramajaponica)	X			
*Redtail Surfperch (Amphistichus rhodoterus)	x			
Wolf-eel (Anarrhichthys ocellatus)	x			
Copper Rockfish (Sebastes caurinus)	x			
Rock Greenling (Hexagrammos lagocephalus)	x			
Tidepool Sculpin (Oligocottus maculosus)	x			
Mosshead Sculpin (Clinocottus globiceps)	x			
Fluffy Sculpin (Oligocottus snyderi)	x			
Tubenose Poacher (Pallasina barbata)	x			
Longnose skate (Raja rhina)	x	x		
Whitebait smelt (Allosmerus elongatus)	x	x		
Eulachon (Thaleichthys pacificus)	x	x		
Penpoint Gunnel (Apodichthys flavidus)	x	x		
Pacific Sandlance (Ammodytes hexapterus)	x	x		
Bocaccio (Sebastes paucispinis)	x	x		
Cabezon (Scorpaenichthys marmoratus)	x	x		
Tubesnout (Aulorhynchus flavidus)	x	x		
Spiny Dogfish (Squalus acanthias)	x	x	x	
White Sturgeon (Acipenser transmontanus)	x	x	x	
Northern Anchovy (Engraulis mordax)	x	x	x	
Longfin Smelt (Spirinchus thaleichthys)	x	x	x	
Pacific Tomcod (Microgadus proximus)	x	x	x	
Surfsmelt (Hypomesus pretiosus)	x	x	x	
*Striped Seaperch (Embiotoca lateralis)	x	x	x	
*Walleye Surfperch (Hyperprosopon asgenteum)	x	x	x	
*White Seaperch (Phanerodon furcatus)	x	x	x	
*Pile Perch (Rhacochilus vacca)	x	x	x	
High Cockscomb (Anoplarchus purpurescens)	x	x	x	
Arrow Goby (Clevelandia ios)	x	x	x	
Pacific Pompano (Peprilus simillimus)	x	x	x	
Black Rockfish (Sebastes melanops)	x	x	x	
Kelp Greenling (Hexagrammos decagrammus)	x	x	x	
*Lingcod (Ophiodon elongatus)	x	x	x	
Padded Sculpin (Artedius fenestralis)	x	x	x	
Buffalo Sculpin (Enophyrs bison)	x	x	x	

Kelp Greenling (Hexagrammos decagrammus)	x	x	x	
Lingcod (Ophiodon elongatus)	x	x	x	
Padded Sculpin (Artedius fenestralis)	x	x	x	
Buffalo Sculpin (Enophyrs bison)	x	x	x	
Sand Sole (Psettichthys melanostichus)	x	x	x	
Pacific Lamprey (Entosphenus tridentatus)	x	x	x	x
Green Sturgeon (Acipenser medirostris)	x	x	x	x
American Shad (Alosa sapidissima)	x	x	x	x
Pacific Herring (Clupea harengus pallasi)	x	x	x	x
Chum Salmon (Oncorhynchus keta)	x	x	x	x
Coho Salmon (Oncorhynchus kisutch)	x	x	x	x
Chinook Salmon (Oncorhynchus tshawytscha)	x	x	x	x
Cutthroat Trout (Salmo clarki)	x	x	x	x
Rainbow Trout (Salmo gairdneri)	x	x	x	x
Topsmelt (Atherinops affinis)	x	x	x	x
Bay Pipefish (Syngnathus griseolineatus)	x	x	x	x
Striped Bass (Morone saxatilis)	x	x	x	x
*Shiner Perch (Cymatogaster aggregata)	x	x	x	x
*Silver Surfperch (Hyperprosopon ellipticum)	x	x	x	x
Snake Prickleback (Lumpenus sagitta)	x	x	x	x
Saddleback Gunnel (Pholis ornata)	x	x	x	x
Pacific Staghorn Sculpin (Leptocottus armatus)	x	x	x	x
Speckled Sandab (Citharichthys stigmaeus)	x	x	x	x
English Sole (Parophrys vetulus)	x	x	x	x
Starry Flounder (Platichthys stellatus)	x	x	x	x
Bay Goby (Lepidogobius lepidus)		x	x	
Threespine Stickleback (Gasterosteus aculeatus)		x	x	x
Prickly Sculpin (Cottus asper)		x	x	x
Redside Shiner (Richardsonius balteatus)				x
Speckled Dace (Rhinichthys osculus)				x
Largescale Sucker (Catostomus macrocheilus)				x

x=species present according to summer sampling by Cummings and Schwarts (1971)

* Embiotocid Perch

Sources: Cummings and Schwartz 1971
Hostick 1974
Compiled by Cyndi Roye, ODFW, 1979

Table 3. Census of Winter Birds on Coos Bay Estuary.

SPECIES	Sanctuary	Cape Arago	STUDY UNITS (see page 19) 1	2	3	4	5+6	7	8	9	10+11	11+12	TOTAL
Common Loon	x	M	x	x	x	x	x		x		x		193
Arctic Loon	M		x	x									6
Red-throated Loon	x	x	x	M	x		x	x					15
Red-necked Grebe							M						4
Horned Grebe	x	x	x	M	x		x	x					109
Eared Grebe							M						2
Western Grebe	x	x	x	M	x		x	x	x	x	x	x	168
Pied-billed Grebe	x		x		M		x		x		x		14
Double-crested Cormorant	x	M	x	x	x		x	x	x	x	x	x	173
Brandt's Cormorant		x	M					x					4
Pelagic Cormorant		M	x	x	x		x		x				64
Cormorant, Sp.			M						x				26
Great Blue Heron	x	x	x	x	M	x	x	x	x	x	x	x	134
Cattle Egret										M			2
Great Egret				x			x		x	x	x	M	37
Snowy Egret							M						1
Green Heron						x					x		2
Black-crowned Night Heron						x			M				19
American Bittern							M						1
Whistling Swan			x	M		x							45
Black Brant		M			M								10
White-fronted Goose						M							1
Mallard	x			x			M		x		x		76
Gadwall				x			M						390
Pintail	x						M	x			x		219
Green-winged Teal							M	x					46
American Widgeon				x			x	M	M		x		72
*European Widgeon				M						x			3
*Northern Fulmar		M											3
*Shearwater, Sp.		M											2
*Canada Goose										M			1
Northern Shoveler							M						8
Wood Duck							M				x		4
Redhead				x				M					227
Ring-necked Duck							M						7
Canvasback				x			x	M		x		x	291
Greater Scaup			M	x	x			x					124
Lesser Scaup	M			x	x		x						89
Common Goldeneye				M	x		x			x			47
Bufflehead	M		x	x	x		x	x		x			214
*Oldsquaw				M									1
Harlequin Duck		M											2
White-winged Scoter		x	x	M	x		x	x		x			244
Surf Scoter	x	M		x	x	x	x	x	x				345
[illegible]ck Scoter		M	x	x	x								11
Ruddy Duck	x			M	x		x	x					122
Hooded Merganser	x									M	x	x	5
Common Merganser					M				x				3
Red-breasted Merganser	x	x	x	x	x		M						75
Duck, Sp.			M				x						19
White-tailed Kite						x						M	5
Sharp Shinned Hawk	M	x						x	x			x	9
Cooper's Hawk	M							x		x			7
Accipiter, Sp.			M										1
Red-tailed Hawk	M					x	x	x			x	x	11
Rough-legged Hawk												M	12
Buteo, Sp.										M			2
Bald Eagle										M			1
Marsh Hawk						M	x	x				x	6
Merlin			x	x		M							8
American Kestrel	x			x				x		x	x	M	24
*Peregrine Falcon				M									1
Ruffed Grouse	x	x											2
Ring-necked Pheasant							M						1
Virginia Rail	x						x					M	6
American Coot	x		x		M	x	x	x	x	x	x	x	522

SPECIES	Sanctuary	Cape Arago	STUDY UNITS (see page 19) 1	2	3	4	5+6	7	8	9	10+11	11+12	TOTAL
Black Oystercatcher		M	x		x								15
Semipalmated Plover					x								10
Snowy Plover				M									5
Killdeer	x	x	x		x	x		x		x	x	M	481
Black-bellied Plover	x		x	x	x		x	x				M	75
Surfbird		x	x		M								108
Ruddy Turnstone			x		M		x						5
Black Turnstone		x	x		M			x					238
Common Snipe						x			M	x		x	135
Spotted Sandpiper									x			M	6
Lesser Yellowlegs										M			3
Rock Sandpiper		M											17
Least Sandpiper		x		x			x			M	x		358
Dunlin	x			x	x		x	x				M	11,334
Long-billed Dowitcher							M					x	55
Western Sandpiper	x			M	x		x	x		x	x		693
Sanderling	x	x	x	M	x	x	x			x			514
*Whimbrel			M										2
*Marbled Godwit				x				M					13
Sandpiper, Sp.	x		x				M						288
Red Phalarope	x	x	x	x	x	M		x		x			251
Northern Phalarope				x	x						x		3
Glaucous-winged Gull	x	x	x		x	x	x	M	x		x	x	209
Western Gull	x	x	x	M	x	x		x	x				626
Herring Gull	x	x	x	x	x				x	M	x		1,301
Thayer's Gull					x		M		x				5
California Gull		x		x				x					3
Ring-billed Gull				M			x	x	x		x	x	133
Mew Gull		x	x		x		x	M	x		x	x	54
Bonaparte's Gull			x		x		x	x		M		x	109
Black-legged Kittiwake		M											6
Gull, Sp.	x		x		x	x	x		x	x	x	M	2,400
*Sabine's Gull		M											1
*Common Murre		M											43
*Alcid, Sp.				M									3
*Pigeon Guillemot		M											1
*Rhinoceros Auklet		M											2
Cassin's Auklet		M											3
Rock Dove					x				M				44
Mourning Dove	M												1
Barn Owl							M						1
Great-horned Owl	M												1
Snowy Owl				M									1
Short-eared Owl						M							1
Anna's Hummingbird						M	x						4
Hummingbird, Sp.						x			x				2
Belted Kingfisher	M	x	x	x	x		x	x	x	x	x	x	44
Common Flicker	x		x	M			x	x		x		x	106
Red-shafted Flicker	x	x		x	x	x			x		x		86
Pileated Woodpecker	x										x		2
Yellow-bellied Sapsucker	x		x			x			x		x		9
Hairy Woodpecker	M		x			x			x		x		9
Downy Woodpecker		x	x			x			x		x	x	9
Stellar's Jay	M	x	x		x		x		x	x		x	65
Common Raven	x					x			x	x		M	11
Common Crow	M	x	x	x	x	x	x	x	x	x	x	x	728
Black-capped Chickadee		x		M	x	x	x	x	x			x	98
Chestnut-backed Chickadee	x	M	x	x	x		x	x	x			x	114
Common Bushtit						M	x	x	x				135
White-breasted Nuthatch												M	1
Red-breasted Nuthatch	x	x	x	x	x				x			M	54
Brown Creeper						M							1
Wrentit	M	x	x		x	x	x	x	x	x	x	x	204
Winter Wren	x	M	x	x	x	x	x	x	x		x	x	92
Bewick's Wren	x		x	x		x	x	M	x	x		x	20
Long-billed Marsh Wren				M		x		x		x			14

SPECIES	Sanctuary	Cape Arago	STUDY UNITS (see page 19) 1	2	3	4	5+6	7	8	9	10+11	11+12	TOTAL
American Robin	x	M	x	x	x	x	x	x	x	x	x	x	552
Varied Thrush	x	M	x	x	x	x	x	x	x	x	x	x	237
Hermit Thrush	x	x	x	M		x	x	x	x	x	x		65
*Western Bluebird	M												
Golden-crowned Kinglet	x	M	x		x	x		x	x			x	193
Ruby-crowned Kinglet	x	x	x		x	x	x	x	M	x		x	137
Water Pipit							M			x			19
Cedar Waxwing									M				6
Northern Shrike				x		x	x	x				x	5
Loggerhead Shrike									M				1
Starling	x	x	x	x	x	x	x	x	x	x	x	M	8,088
Hutton's Vireo		x									x		4
Yellow-rumped Warbler	x	x	x	x	x	x	x	x			x	x	1,448
Myrtle Warbler							M						5
Audubon's Warbler					x				M				95
Townsend's Warbler					x		x	x	M		x		13
Palm Warbler							M						1
Black and White Warbler									M				1
*Wilson's Warbler					M								1
House Sparrow			M		x		x		x				56
Western Meadowlark			x	M		x	x	x	x			x	42
Red-winged Blackbird				x	x	M							28
Brewer's Blackbird	x				x		x	x		x	x	M	295
*Evening Grossbeak		M											2
Purple Finch			M							x			16
House Finch				x	x	x	M	x	x		x	x	90
Pine Siskin	x	x	x	x	M	x	x	x	x	x		x	739
American Goldfinch			x	x		x	x	M	x			x	79
Red Crossbill	x	M						x					36
Rufous-sided Towhee	M	x	x	x	x	x	x	x	x	x	x	x	62
Slate-colored Junco									x		M		8
Oregon Junco	x	x	x	x	x	x	x	M	x	x	x	x	887
Savannah Sparrow									M				1
White-crowned Sparrow		x	x	x	x	M	x	x	x			x	225
Golden-crowned Sparrow	x	x	x	x		x	M	x	x		x	x	54
Fox Sparrow	x	x	x	x	x	x	x	M	x	x	x	x	239
Lincoln's Sparrow			x		x					x		M	6
Song Sparrow	x	x	x	x	x	x	x	M	x	x	x	x	318
*Lapland Longspur				M									2

x - Species sited in Study Unit.

M - Study Unit in which the largest number of individuals were counted.

SOURCE: Coos Bay Christmas Bird Count
December 17, 1977, Audubon Society-Cape Arago Chapter

* Additional Species counted on the 1978 Christmas Count
December 17, 1978, Audubon Society-Cape Arago Chapter

The remaining two designations, shoreland development and relatively undisturbed habitat, refer to the intensity of use and the long term impact of human activity on estuarine lands. The tidelands along the North Spit below the railroad bridge are relatively undisturbed compared to the tidelands across the bay on the eastern shore. Docks, wharfs, pilings, marinas, storm drains, sewage effluents, seafood processing discharges, and urban runoff are some of the consequences of shoreland development that have altered the estuarine environment. The impact of these is greatest in their immediate location and diminishes with increasing distance from them. The dredged channel is a barrier between the opposite shores. The tidelands of North Spit and South Slough were designated as undisturbed habitat, because the population density in these areas is not as dense as on the developed shoreland of the bay, and because use of these areas is not as intense. South Slough may have some influence from shoreland development such as coliform and organic waste from Charleston area, but it has the most potential of any area in the Coos Bay estuary to remain undisturbed.

This map may be used as additional criteria to identify areas of significant biological value. It also may be used to identify areas of restoration or projects of mitigation. The subjective and broad nature of some of the criteria of alterations on the map make them useful only as secondary tools in designating important tracts of estuarine land.

Map VI: Existing Use Inventory for Coos Bay Estuary

Sources of the existing land use inventory map are aerial photography (U.S.G.S. Eros Data Center 1974) and an existing land use field survey (Coos County Land Use Inventory Team 1978). The existing use map may be used as data for identifying areas suitable for development on the estuary and shorelands. The map is limited by its scale, and so prevents site specific designations. The scale of the map also does not allow commercial uses to be designated, because they are often interspersed among industrial and residential areas.

Map VII: Potential Water-Dependent Uses in the Coos Bay Estuary

This map compiles data and proposals from several different sources. Deep water close to shore with supporting land transport facilities is taken from the Existing Uses Inventory (Map VI), U.S. Army Corps of Engineers channel data (1976), and proposals from industrial interests in the County. The areas include sites on the North Spit, Sitka Dock, North Bend Airport, North Point, Coos Bay-North Bend Waterfront, Eastside dredge spoil sites, and Graveyard Point. The Airport Site is mentioned as a possible deep draft ship docking if its present use is ever replaced by a new airport.

The potential for aquaculture designation includes suitable areas for several types of aquaculture. At the present time only oyster farming and salmon ranching operations are economically and environmentally feasible in Coos Bay. (Jambor & Ritelle, 1977). Oyster farming is currently limited to South Slough, because the upper bay above Sitka Dock is closed to commercial shellfish harvest by the

State Board of Health. The presence of high counts of fecal coliform bacteria due to sewage is the cause of the shellfish closure.

Data from DEQ Estuary and Shellfish Sanitation Program (1979) shows a marked increase of fecal coliform counts above Station 8 (River Mile 11.5), which is in the shipping channel at North Bend, opposite the mouth of the Cooston-Willanch Channel. The average coliform concentration at stations below this point in the estuary have been within acceptable standards for shellfish growing areas over the past three years (Table 4). It may be feasible to re-open tideflats north of Cooston Channel and Willanch Inlet to oyster growing and harvest.

When the shellfish closure is lifted by the State Board of Health, there are proposals for intense oyster culture activities on the tideflats of East Bay, Haynes Inlet, and North Slough (Stanwood 1979). The other alternative for expanding shellfish harvest would be a shellfish depuration (purification) facility in the bay South of Sitka Dock (Furfari 1976).

At present three salmon release-recapture permits are issued for Coos Bay by the Oregon Department of Fish & Wildlife. Weyerhaeuser (Ore-Aqua) on North Spit can release 20 million chum, 10 million coho, and 10 million chinook. Anadromous on Jordan Point can release 5 million coho and 5 million chinook, while a private citizen, Calvin Heckard, can release 5 million chum salmon into Catching Slough (Netbay 1979). If these operations are economically successful there will be more permit applicants in the future.

Other types of aquaculture operations are not now feasible but may become so as the technology or markets develop. Clam culture and seeding is being done on the East Coast, and research is currently being done at Oregon State University to spawn the local bay clams (Breese 1979). Pond culture of anadromous fish is common in Oregon, while in other parts of the world marine species such as sole, sardine, and shrimp are raised in contained environments (Bardach 1979). Pond aquaculture is proposed on North Spit at the site of the Menasha pulp mill effluent holding pond after it is restored (Elfving 1979). There is also future potential for marine polyculture (e.g., raising oyster, clam and mussels together); (Tenore, et al. 1973), and recycling nutrients from waste water treatment into an aquaculture system (Ryther, et al. 1975).

Areas for water dependent recreational uses are primarily major clam beds of the bay clam species, principle sport fishing and hunting areas. The tideflats in the lower bay on North Spit, "crabflats" across the channel from Empire to Barview, and the airport tideflats are very productive for gaper and cockle clams, but the general public has limited access to them. Existing boat launch sites indicate the closest access points to the clam beds for boaters (Oregon State Game Commission 1968). There are proposals for additional boat ramps on North Spit and the Coos River. Important areas for waterfowl hunters are North Slough, Haynes Inlet, and Bull Island Marsh. Included as riparian resources are the Barview State Wayside, the Charleston County Fishing Dock, and the Charleston Triangle. The upper bay has a lack of sites designated

TABLE 4. DEQ FECAL COLIFORM DATA FOR COOS BAY (DEQ 1979).

	STATION	MEAN CONCENTRATIONS OF FECAL COLIFORM* 1978	1977	1976	1975
SOUTH SLOUGH SHELLFISH SANITATION PROGRAM (IBM CODE 14-12)					
1	150 yds. east of flashing light at entrance of South Slough opposite fisherman's coop	(44)** 17.5	(3) 11.7	(3) 23.0	(12) 22.4
2	15 yds.east of 3rd (Southernmost) moorage flot at Charleston Small Boat Basin	(48) 44.5	(3)192.0	(3)119.0	(12) 69.6
4	channel, 50 yds. east of Hallmark Fisheries dock, Charleston	(49) 35.4	(3) 28.7	(3) 15.5	(12)111.0
5	channel, 20 yds.west of Hanson's Landing docks, Charleston	(46) 37.1	(3)373.0	(3) 20.3	(12) 29.1
7	channel, 250 yds,south of Collver Point	(46) 18.3	(3) 41.7	(3) 31.7	(12) 36.0
8	channel, 0.3 miles southwest of Station 7, 50 yds. west of bank	(39) 14.3	(3) 6.7	(3) 17.8	(12) 20.8
11	Joe Ney Road Bridge	(43) 44.8	(3) 36.3	(3) 28.5	(12)120.0
COOS BAY SHELLFISH SANITATION PROGRAM (IBM CODE 14-10)					
1	green light #7,1/4 mile north of Fossil Point	(51) 9.0	(3) 5.3	(3) 5.0	(12) 15.0
2	red light #10,1/4 mile north of Pigeon Point	(51) 10.0	(3) 5.0	(3) 3.2	(12) 26.7
4	red light #16,1/4 mile north of Empire Dock	(51) 25.7	(3) 7.3	(3) 15.0	(12) 63.9
5	green light#23,opposite Henderson Marsh	(50) 21.5	(3) 5.3	(3) 15.3	(12) 22.4
6	black can#27,1/4 mile west of Railroad Bridge	(50) 38.2	(3) 7.3	(3) 84.0	(12) 51.9
7	green light#35,mouth of Kentuck Slough	(50) 58.1	(3) 11.0	(3) 46.3	(12) 85.4
8	red light#36,opposite north Cooston-Willanch channel	(50)107.0	(3) 12.0	(3)114.0	(12) 149.0
9	Coos Bay Yacht Club,opposite mouth of McCurdy Marina	(51)214.	(3) 48.3	(3)563.0	(12) 109.0
10	shipping channel, opposite mouth of Marshfield channel	(48)244.0	(3)450.0	(3) 60.1	(12) 136.0
11	red light,1 mile up Marshfield channel	(47)156.0	(3) 82.0	(3) 90.7	(12) 267.0
13	Coalbank Slough at Hwy.101 Bridge	(50)172.0	(3)247.0	(3)182.0	(12) 261.0
14	Isthmus Slough at Eastside Bridge	(51) 92.3	(3)399.0	(3)102.0	(12) 56.8
15	Isthmus Slough at Coos City Bridge	(49) 68.4	(3)157.0	(3)141.0	(12) 64.3

* Most Probable Number/1000 ml. In marine and estuarine shellfish growing waters the median concentration shall not exceed 70/1000ml (CCPD 1978; ALWO APPENDIX-B).

**Number of Samples

for recreational use of riparian resources. Particularly there is a documented need for such sites in the urban areas of Coos Bay, North Bend, and Eastside (Oregon Department of Transportation 1978). There is substantial boating and bank fishing in Pony Slough, Upper Isthmus Slough, and Coos River for striped bass, shad, and salmon.

Potential marina sites include moorage for sport boats, small commercial trollers, and larger commercial vessels (less than 90'). The site inventory is taken from the "Coastal Acres Exceptions Process" (Coos-Curry Council of Government 1979). That task force ignored potential sites for trawling vessels over 90 feet and also did not look for marina sites above the Highway 101 bridge. The Coos Bay dock site (#18) in the upper bay may be good for future morrage of the largest fishing vessels, while a major small boat basin is proposed in Coalbank Slough (Elfving, 1979).

Map VIII: Shoreland Resources on the Coos Bay Estuary

Shoreland resources are included under the criteria for protection of natural values of shorelands (LCDC 1975). Major marshes, both salt and fresh, are considered in the Estuary and Shorelands Goals as natural resources. The major marshes in Coos Bay are Henderson Marsh, North Slough, Pony Slough, Bull Island, in Eastside, in Coalbank Slough and in Isthmus Slough. Coastal headlands are also considered unique and important natural resources. Coos Head is the only headland on the estuary, and it is a significant aesthetic and biological resource in addition to its uniqueness. Several archeological sites and historical buildings exist on the shorelands of the estuary (Oregon Coastal Conservation and Development Commission 1973). Archeological sites are not precisely identified in order to protect them from disturbance, but their exact locations are recorded in the Oregon Archeological Survey (1979).

Riparian vegetation extends in a band from 10 to 75 feet wide along shorelands of waterways. The riparian floral community is different in species composition from upland vegetation. Species include Sitka spruce, red alder, red cedar, hemlock, big leaf maple, vine maple, and willow (Wilsey and Ham, 1978). The riparian strip is important as a buffer between upland development and the water body. It retards bank erosion and moderates water temperature. It is also significant resting, nesting, and feeding habitat of birds and mammals. In Coos Bay estuary there are significant sections of riparian vegetation in South Slough, Haynes Inlet, East Bay, and Isthmus Slough.

The visual and aesthetic resources of the estuary are also shorelands resources. The criteria of these designations are uninhibited views of natural settings and panoramic views of large expanses of the bay that are available from public highways. The corridors into Coos Bay from the north and south on Highway 101 are important visual resources as well as views of the bay from McCullough Bridge. Some settings of industry and shipping against the natural background of the bay are also of aesthetic importance.

Map IX: Industrial Concerns and Transportation Systems in Coos Bay

The industrial concerns on Coos Bay estuary were presented on a map of water-dependent critical industrial areas to the Coos County Board of Commissioners by a group of Coos County industrialists.

It covers all areas of existing and potential industrial development of any kind, but does not differentiate low intensity uses such as aquaculture from heavy industrial uses of a deep draft port.

Other information on this map includes the deep draft channel, shallow draft channel, airport facilities, railroad lines, major highways, secondary roads, corporate boundaries of cities, private, corporate, and Port property lines in North Spit, and sewage treatment plants. The accessability of transportation systems is a key factor in the siting of industrial facilities.

COOS BAY ESTUARY STUDY UNITS

The Estuary Study Units are estuarine and adjacent shoreland environments within the Coos Bay estuary that exhibit similar existing and potential physical, biological and development characteristics. The boundaries indicated do not necessarily designate an abrubt change in habitat but rather are readily definable landmarks. While not necessarily at the scale of the final management unit designations, it is possible that some management units may include an entire study unit and that some study units might be divided into several management categories.

In the accompanying working papers site-specific economic and environmental concerns are addressed within each study unit.

The following Estuary Study Units address all of the Coos Bay estuary to heads-of-tide:

1. LOWER SOUTH SLOUGH (Charleston, Joe Ney Slough, and South Slough to the Sanctuary boundary at Valino Island)

The South Slough, dominated by marine tidal influence and with a separate watershed from the rest of the estuary, has a wide variety of intertidal and subtidal habitats and a great diversity of marine species. Much of the impact of the intensive fisheries development in Charleston is localized within this study unit.

2. LOWER COOS BAY WEST (North and west of the channel from the North Jetty to the South end of the Port property on North Spit)

The southern intertidal portion of North Spit is characterized by highly productive tideflats influenced by high salinity. Except for potential dredge spoils disposal at the southern tip of North Spit, this study unit is less subjected to existing or proposed development pressures than the rest of the North Spit.

3. LOWER COOS BAY EAST (South and east of the channel from the South Jetty to the mill at Empire)

The extensive tideflats on the east side of the lower bay are also characterized by a range of marine habitat types and a wide diversity of species, but this area has been more obviously impacted by shoreland development than the preceding study unit.

4. MID COOS BAY WEST (North and west of the channel from the southern end of the Port property to the Railroad Bridge)

With the exception of the extensive tideflats of Jordan Cove, this study unit is characterized by a narrow, sandy intertidal area and a deep water channel near the shore.

5. MID COOS BAY EAST (South and east of the channel from the mill at Empire to the Railroad Bridge)

This area is distinguished by limited accessibility to the waterfront, due to steep cliffs in the residential area and the siting of the North Bend Airport.

6. PONY SLOUGH

This 280 acre tract of tideland has a separate watershed and is almost completely surrounded by urban uses. Impact of development is localized.

7. NORTH SLOUGH/HAYNES INLET (North and east from the causeways)

These sloughs are served by separate watersheds, but are similar in the habitats they provide as well as in their restricted flushing capabilities.

8. UPPER COOS BAY WEST (South and west of the channel from the Railroad Bridge to the Chandler Bridge on the Coos River and both sides of the channel in Lower Isthmus Slough to the Eastside Bridge)

This area, which includes most of the Coos Bay/North Bend waterfront as well as the Eastside Peninsula, is predominately comprised of developed and developable land adjacent to a shipping channel.

9. UPPER COOS BAY EAST (North and east of the channel from the Railroad Bridge to Catching Slough)

The east bay is the largest tideland area of Coos Bay, with large tracts of productive mudflats and large salt marsh islands. Upland uses are predominately residential.

10. LOWER ISTHMUS SLOUGH (Eastside Bridge to Davis Slough)

The impacts of log storage are probably most apparent in this study unit, and the primary upland use along the western shore continues to be the wood products industry.

11. UPPER ISTHMUS SLOUGH (Davis Slough to the head-of-tide; Coalbank Slough; Shinglehouse Slough; Davis Slough; Catching Slough)

Though most of these waterways have historically been used for water transport; they are currently less degraded than Lower Isthmus Slough and are productive components of the estuarine system.

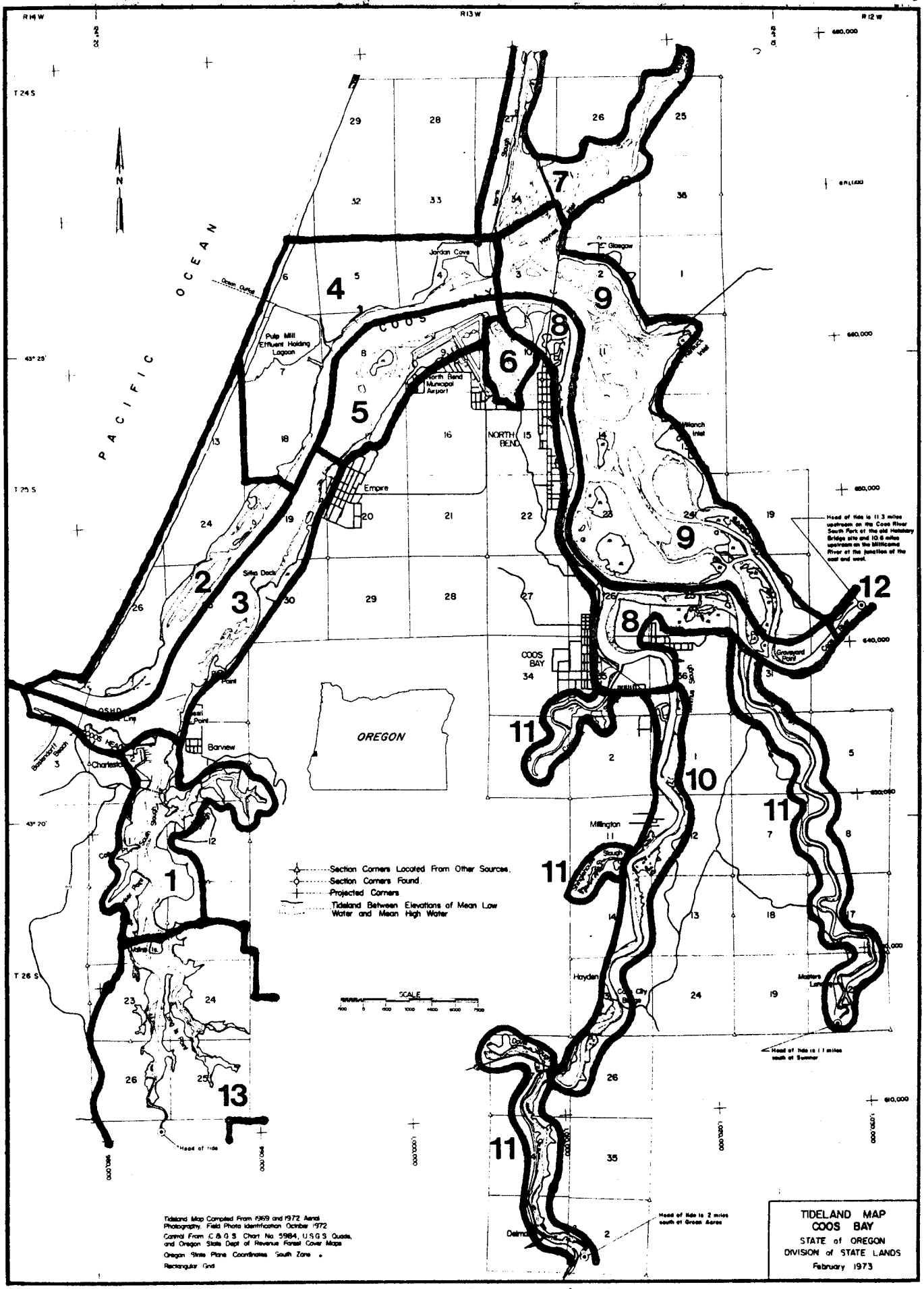
12. COOS AND MILLICOMA RIVER (Chandler Bridge to the heads-of-tide)

The riverine environment is more influenced by freshwater than the sloughs of the bay.

13. SOUTH SLOUGH ESTUARINE SANCTUARY (4,400 acre tract of tidelands and watershed of upper South Slough south of Valino Island)

The estuarine lands and a portion of the watershed of upper South Slough have been recognized on the Federal, State and local levels of

government as the most pristine environment of Coos Bay estuary, and have been set aside for restoration to a natural condition.



COOS BAY ESTUARY STUDY UNITS

COOS COUNTY PLANNING DEPT.
JUNE 1979

THE IMPORTANCE OF THE COOS BAY ESTUARY TO THE ECONOMY OF COOS COUNTY

The importance of the Coos Bay Estuary to the economy of Coos County has several aspects. As one of the largest export ports on the west coast, and as the world's largest volume lumber export port, the Port of Coos Bay provides a valuable service to the region and a multitude of job opportunities for local residents. A large sport and commercial fishing fleet is based in Coos Bay, as well as the fish processing facilities necessary to utilize nearby marine resources. The estuary provides an important habitat for several commercially valuable fish and shellfish, an aspect that may become increasingly more important economically with the development of the bay's aquaculture potential. The estuarine system, in conjunction with the nearby ocean beaches and the Oregon Dunes National Recreation area, forms a base for a growing tourist industry.

While the price and availability of gasoline will certainly be a factor in the continuing health and viability of the tourist oriented sector of the economy, industrial development must recognize and be sensitive to the unique range of visual and recreational resources that can make a visit to Coos Bay an attractive and memorable experience, from clam beds to large ships at anchor.

The 200 mile offshore limit of U.S. jurisdiction has led to increased local concern for an expansion of fish processing capabilities to include hake, or Pacific whiting, and other underutilized species. A successful return of anadromous fish released by local aquaculture facilities must also be considered, as these will be harvested by the releasing facility or landed by local commercial and sport fisherman. The need for increased commercial moorage in the 30'-90' range is currently being studied in the exceptions process for the proposed Coastal Acres marina expansion. A waiting list of vessels requesting moorage space is an indicator of current needs, but fisheries resources and fishing boats are both fairly mobile. Specific moorage and processing needs will likely be dependent upon the timing of the development of similar proposed facilities at other Oregon ports. Boat building and repair is a growing local industry addressing the range of demand from small log handling craft to the larger vessels fishing the North Pacific.

Projected growth of the timber industry on Coos Bay is surrounded by questions, foremost of which is the availability of the supply of raw material. The Baldwin study cites Corps of Engineers projections that anticipate a large decline in log exports, a modest decline in products; timber; plywood; linerboard; pulp and paper moving to foreign and domestic ports and a continued growth in chip exports. (Baldwin 1977a). There seems to be a consensus that timber harvest levels will decline over the next 20-30 years with a replenished resource base again available early in the next century for sustained yield management.

Population projections can be a useful tool in attempts to quantify expected industrial growth requirements. Combining Portland State University Center for Population Research figures for expected growth with Bonneville Power Administration civilian labor force participation rate projections shows a projected 1990 civilian labor force of 35,526 in Coos County. A 6% rate of unemployment would leave a total employment of 33,400, requiring 9860 new jobs by 1990. Using existing urban percentages of total population, plus an assignment of the unincorporated area jobs to cities, it can be determined that 6575 additional jobs will be the upper limit needed for the Coos Bay/North Bend/Eastside area if the growth continues at recent rates. Of these jobs, 2859 can be expected to be in manufacturing and 3716 in non-manufacturing employment sectors. While it is not likely that all of these manufacturing jobs would be in heavy industry (60-70% is a basic relationship, though in the past up to 90% of those engaged in manufacturing in the county have been employed by the forest products industry), this will give use a fairly generous base for the following considerations. One set of standards shows an average of 8 workers per gross acre of heavy industrial land. (De Chiara and Koppelman 1975).

Figures for the Portland area show an average of 10 workers per acre in the lumber and wood products industry, though local industry officials feel more comfortable with a figure of 5 workers per acre, in part a reflection of the large land area demands of log and chip storage. This represents industrial acreage requirements for expected growth, ranging from a low of 286 acres to a high of 572 acres over the next 10 years.

Other factors that must be considered in a determination of industrial growth potential are the possible shift in export log loading from waterside to shoreside for economic reasons, the trend toward relocating saw log storage from water to land and the possible limitation of deep draft activities to the lower bay below the railroad bridge. The latter scenario is a possibility because of a lack of horizontal clearance at the railroad bridge, the lack of space for facilities expansion at most upper bay sites, and the problem of spoils disposal associated with deep draft channel maintenance in the upper bay. Relocating existing upper bay industrial uses would require 56 acres in the next 10-15 years up to a maximum of 146 acres, not including land for administration, customs, equipment storage and repair, employee amenities and parking. (Baldwin 1977a). Though the records show a modest increase in petroleum product arrivals through the Port of Coos Bay, any expansion could conceivably be planned in conjunction with other uses as a means of conserving waterfront land. (Baldwin 1977a).

90% of the tidal wetlands have been removed from the Coos Bay estuary by filling or diking, (Hoffnagle & Olson 1974), thus it is hoped that necessary industrial growth can take place without reducing the effective area of the estuary.

Some general criteria for industrial siting are:

1. Convenient access to a range of transportation facilities.

2. Access to labor force, raw materials supply and market.

3. An adequate amount of suitable land, free from foundation and drainage problems with a sufficient reserve for growth.

4. Adequate and reliable utilities; water; waste disposal, power and fuel.

5. Protection from encroachment of residential and other land uses.

6. Location minimizing impact on neighboring non-industrial land uses. (De Chiara & Koppelman 1975)

Dividing the bay and adjacent shorelands into study units designated on the accompanying map, some of the more site-specific industrial concerns can be looked at.

1. LOWER SOUTH SLOUGH (Charleston/Joe Ney Slough and South Slough to the Sanctuary boundary at Valino Island)

The Port-owned sport and commercial fishing terminal cannot meet current moorage needs, and a boat basin expansion project is currently in the exception process. A breakwater extension and groin are proposed at Charleston to better protect the boat basin and channel. Five large fish processing plants make this a major fish processing center on the coast. Other current uses include some small-scale boat building and at least one oyster farm.

2. LOWER COOS BAY WEST (North and West of the channel from the North Jetty to the south end of the Port property on North Spit)

A jetty staging area is required near the end of the spit for off-loading of rock barges for jetty maintenance. The east side of the end of the spit is seen as an important dredge spoil disposal site, possible filling the eroded area defined by the breakwater. The remainder of this study area is in extensive tidal flats and aquatic vegetation beds and is considered unsuitable for extensive waterfront development in the Baldwin study. (Baldwin 1977a)

3. LOWER COOS BAY EAST (South and East of the channel from the South Jetty to the mill at Empire)

A jetty staging area at the end of North Spit is required for future work on the South jetty. Sitka Dock, currently undeveloped and on the market, is a prime industrial site with deep channel access potential. The narrow shorelands to the north and south of Sitka Dock are addressed in the Baldwin study as being unsuitable for extensive waterfront development. (Baldwin 1977a). The Empire bay front is currently industrial and any further development potential should be explored and maximized, including the possibility of tourist recreational facilities.

4. MID COOS BAY WEST (North and West of the channel from the South end of the Port property to the Railroad Bridge)

The existing Ore-Aqua/Weyerhaeuser aquaculture site might be seen as the initial phase of a comprehensive fisheries development of at least a portion of the port property. North of this site is Port property on undeveloped fill, served by road and adjacent to deep draft channel. Some expansion of the fill to the west, at least to the existing road, might be possible to maximize development at this site. The narrow, sandy intertidal zone is an important habitat for juvenile salmonids and certain flatfish but is perhaps of lesser biological significance than the extensive tidal flats to the south of the Port property or in Jordan Cove.

Proposals for the eventual use of the effluent-holding lagoon include pond aquaculture, restoration to wildlife habitat and dredge spoils disposal.

The land from the port property to Henderson Marsh is held by the Corps of Engineers and Menasha and could be developed in a manner related to and supportive of both existing dock facilities at the Roseburg Lumber site and proposed dock facilities on the Port property with a minimum impact on the adjacent estuarine shore. Henderson Marsh and the adjacent heron rookery to the north should be protected as an important wildlife habitat. The NS5 fill site adjacent to the marsh is currently developed in part as a log storage area for the Menasha pulp mill. The stabilized dunes between the fill site and the Roseburg Lumber site are heavily logged over and probably of minor biological significance, but the terrain could provide serious obstacles to development.

The Roseburg Lumber site, an area of more than 200 acres, has an existing chip facility and deep channel access. The three large buildings not in use and the channel access make this an excellent site for development.

Jordan Cove is identified in the Baldwin study as an area considered unsuitable for extensive water front development because of its physical and biological nature. (Baldwin 1977a). The northwest edge of Jordan Cove was once the site of an important Coos Indian village, according to local descendants of that tribe who feel that the development of North Spit will destroy or prevent access to traditional religious sites. However, with over 200 acres of undeveloped Port property and several hundred acres held by Menasha and Roseburg Lumber that are not in conflict, it seems that realistic development needs can be met without compromising sensitive areas.

The existing Menasha pulp mill site and the existing Anadromous aquaculture site have rail access, though deep channel access might be difficult because of their proximity to the railroad bridge.

5. MID COOS BAY EAST (South and East of the channel from the mill at Empire to the Railroad Bridge)

The cliffs that extend from the mill to the airport preclude industrial development of the waterfront. The existing airport is a major feature of this area and is currently incapable of serving larger jet aircraft because of restricted runway length. If the airport was to be relocated, this would be an excellent site for industrial development.

6. PONY SLOUGH

Though large tracts of wetlands in Pony Slough have been filled for commercial development, the remaining intertidal areas have a high biological importance, especially to the large winter population of migrating birds and waterfowl that find protection here from storms and hunting pressures. The Baldwin study recognizes this area as unsuitable for extensive waterfront development. (Baldwin 1977a). North Bend has, in the past, seen this area as a potential marina site.

7. NORTH SLOUGH/HAYNES INLET (North and East from the causeways)

Most of this area is characterized by poorly flushed tidelands. Any alteration of the North Spit causeway to meet increased traffic demands should include more openings for improved flushing of the slough.

The railroad right-of-way borders North Slough on the west and presently serves some small scale sand mining close to the North Spit causeway. Industrial development along this right-of-way will probably be limited by its proximity to the Oregon Dunes National Recreation Area and by the unstable nature of the encroaching active sand dunes. Any development would have to be sensitive to the visual resources of this entry corridor into the Coos Bay area.

A small existing boatyard on Haynes Inlet is the only existing marine industrial development in this predominately residential area.

8. UPPER COOS BAY WEST (South and West of the channel from the Railroad Bridge to the Chandler Bridge on the Coos River, and both sides of the channel in Lower Isthmus Slough to the Eastside Bridge)

The filled areas at North Point, between the railroad bridge and the highway bridge, have a high industrial potential hindered only be inadequate road access. The small water area in the midst of these fills has marina potential and might also eventually be considered as a dredge spoils disposal site because of degradation by wind-blown sand from the adjacent unstabilized fill.

A portion of the area below and immediately east of the highway bridge is currently being used by a rock products company. The potential for development of the remainder of this site as well

as the narrow strip of land along the bay extending south to the Menasha plywood mill should be explored, including the possibility of increased public recreational access, with a concern for the impact on adjacent residential uses.

The North Bend/Coos Bay waterfront has the fewest conflicts for maximized industrial development with both railroad and deep channel access. With the exception of the Eastside peninsula, much of the area is presently developed, though not in every case by water-dependent or water-related uses, and further development might be limited by the lack of adequate back-up space.

The waterfront at downtown Coos Bay is relatively undeveloped at present, and might provide a suitable moorage location for large commercial fishing boats.

9. UPPER COOS BAY EAST (North and East of the channel from the Railroad Bridge to Catching Slough)

This area is primarily a marine production area with a tradition of log storage on Cooston and Marshfield channels. At least three spoil islands are located in this area, with the two largest not yet at full capacity.

Upland uses along the east side of the bay are predominately residential and Pierce Point, without channel access or adequate road access, would seem to face severe obstacles to future development, especially in light of the apparent local opposition. Currently a small part of Pierce Point is committed to a diverse marine industrial use that includes a boatworks, salvage operation and potential oyster processing site.

The likelihood of an unfavorable economic cost/benefit ratio of a maintained channel to Kentuck Inlet would seem to rule out the further development of this existing site as a major barge-loading facility.

The Baldwin study shows most of this area to be unsuitable for extensive waterfront development. (Baldwin 1977a)

Christianson ranch, a large undeveloped spoils disposal site at Graveyard Point, has access to the Coos River, an existing shallow draft channel. The site has a high potential for low to medium intensity industrial development, but concern must be shown for the impact on adjacent residential areas, public roads, and utilities.

10. LOWER ISTHMUS SLOUGH (Eastside Bridge to Davis Slough)

The maintained 15' channel depth to Millington and the current use of much of the west side of the slough by water-related industry underscore the importance of the waterway for marine transport and storage with industrial development as a favored upland use between the slough and Highway 101.

Development interests should consider the impact on several large existing tracts of salt marsh. Also, because of the Highway 101

route into Coos Bay from the south, development must be aesthetically pleasing or an adverse impact may be felt by local tourist industry.

11. UPPER ISTHMUS SLOUGH (Davis Slough to head of tide); COALBANK SLOUGH; SHINGLEHOUSE SLOUGH; DAVIS SLOUGH; CATCHING SLOUGH

These are not industrially developed at present and are important as natural areas in a diversified estuarine system. Existing upland uses are primarily residential, agricultural and forest.

A proposed 1100 boat marina development on Coalbank Slough will be dependent upon satisfactory solutions to problems presented by the existing highway and railroad bridges.

12. COOS RIVER AND MILLICOMA RIVER (Chandler Bridge to the heads-of-tide)

The maintained channel supports a traditional log transport and storage system.

13. SOUTH SLOUGH ESTUARINE SANCTUARY (4,400 acre tract of tidelands and watershed of upper South Slough south of Valino Island)

Current uses include farming and forestry on privately held land within the Sanctuary, though eventually the commercial use of the Sanctuary might be limited to oystering. As a research tool, the Sanctuary designation could be of benefit to the long-term economic health of the Coos Bay Estuary.

INVENTORY OF IMPORTANT ENVIRONMENTAL AREAS OF THE COOS BAY ESTUARY

Dividing the bay and adjacent shorelands into study units designated on the accompanying map, some of the more site-specific environmental concerns can be discussed:

1. LOWER SOUTH SLOUGH (Charleston, Joe Ney Slough, and South Slough to the Sanctuary boundary at Valino Island)

The South Slough is dominated by marine tidal influence and has a separate watershed from the rest of the estuary. It has a wide variety of intertidal and subtidal habitats and a great diversity of marine species. Much of the impact of the intense fisheries development in Charleston is localized within this study unit. The area south of the Charleston Bridge acts as a buffer between the development of Charleston and the South Slough Estuarine Sanctuary.

The most controversial estuarine area is the Charleston Triangle, the site of the proposedCoastal Acres commercial boat basin project. The major environmental objection to the alteration of that site is its importance as a clam bed to recreational clam diggers. South of the Charleston Bridge are extensive productive tideflats and undredged channels. There are major clam beds on these tideflats with limited public access (CCPD 1978; R-32). Joe Ney Slough is not as pristine as the rest of South Slough due to more intensive shoreland development, although the major oyster aquaculture operation in Coos Bay is located there. Under the present ruling by the State Board of Health, the South Slough has the greatest potential as an oyster growing area in the Coos Bay estuary.

The shorelands of Lower South Slough vary in values from high economic value for water-dependent use sites in Charleston to high natural value of riparian vegetation along shorelands south of the Charleston Bridge. South Slough is rich in water fowl, shorebird, and terrestrial bird species that utilize riparian habitat. A particularly critical habitat is the heron rookery near Collver Point (McMahon 1974). The low density rural residential areas of South Slough are significant habitat for terrestrial wildlife, but also contribute some degradation to the estuarine water quality. The commercial and industrial development in Charleston is located primarily on filled lands, which have minimal biological significance. The Lower South Slough also has high economic and social value for recreation.

Fishing and clamming access are important tourist attractions in Charleston, while across the channel the Barview State Wayside is an important undeveloped recreation site to local residents.

2. LOWER COOS BAY WEST (North and West of the channel from the North Jetty to the south end of the Port property on North Spit)

The lower portion of the North Spit is characterized by highly productive tideflats with predominant influence of high salinity marine waters. The tidelands are adjacent to the deep draft channel.

The tideflats contain major clam beds, but access is limited to boats and 4-wheel drive vehicles. The tideflats contain significant algal and eelgrass beds and are also rearing habitat for juvenile salmonids and flatfish. This area is also important as a potential aquaculture or commercial shellfish harvest site south of the Shellfish Closure line.

The shorelands of the southern end of North Spit are predominantly open dune areas conditionally stabilized by beach grass and wet interdune areas (CCPD:1978; BD-3). The most critical habitat is the younger stabilized dunes at the site of the Old Coast Guard station. These forested dunes contain a heron rookery and are a crucial habitat for North Spit wildlife (USDA Soil Conservation Service 1975). Conditionally stabilized dune areas are not as critical as wildlife habitat and may be suitable for dredge spoils. Wet interdune areas are important wildlife and water fowl habitat. The ocean beaches and foredunes of the lower North Spit are important as nesting area for the snowy plover, which is classified as a threatened species by the Oregon Department of Fish and Wildlife. Also, Indian burial grounds and village sites are located on the bay side of the lower North Spit. Precise location of sites is recorded in the state archeological inventory (Oregon Archeological Survey 1979 (CS-27)).

3. LOWER COOS BAY EAST (South and East of channel from the South Jetty to the mill at Empire)

The tideflats on the east side of the lower bay are also characterized by a range of habitat types and a wide diversity of species. Clam beds south of Sitka Dock are available for commercial harvest of shellfish, while "crabflats" clam beds north of Sitka Dock are productive enough for intense recreational harvest, but have limited accessibility. The sand spit in front of Charleston channel is the site of the only razor clam bed within the estuary. It will be temporarily removed by the construction of the Charleston breakwater extension, but may be repopulated with razor clams as the sand bar accumulates again behind the new breakwater (USACE 1979). The rocky intertidal habitat below Fossil Point in Barview is also a unique habitat with respect to the rest of Coos Bay, and should be considered environmentally sensitive (Baldwin, et al. 1977). It is more similar to rocky habitats found on Cape Arago than within an estuary, because of its exposure to ocean swells.

The most important shoreland natural resource in this study unit is Coos Head. It is an aesthetic resource as well significant bird habitat. Shorelands from Barview to Empire have been altered by residential and commercial development. The new sewerage line from Charleston to the Empire sewage treatment plant should improve estuarine water quality. In the future the east shore of the lower bay may have significant aquaculture potential. A fish release facility has been proposed at Tarheel Reservoir. The lower bay may be a good site for a shellfish purification facility for shellfish grown in polluted areas of the upper bay. The Empire Sewage Treatment Facility may also be a prime site for future aquaculture operations that use recycled nutrients from domestic waste disposal systems.

4. MID COOS BAY WEST (North and West of the channel from the Southern end of the Port property to the Railroad Bridge)

This portion of the estuary along North Spit is a narrow strip of sandy shore adjacent to the deep draft channel, except for Jordan Cove. The sandy tideland is particularly important as a rearing habitat for juvenile flatfish, especially English Sole (Hostick 1975). Jordan Cove is a major tideflat which contains major clam beds and minor tracts of algae and eelgrass. It is also the site of a documented Indian village site and burial ground (Oregon Archeological Survey 1979 (CS-26)).

The shorelands of the upper North Spit are the most important environmental resources of this study unit. Henderson Marsh is one of the most important natural areas in Coos County (Oregon Natural Heritage Program 1977). The major portion of the marsh is a fresh water deflation plain marsh (USDA Soil Conservation Service 1977), and is the home or feeding site of several threatened bird species including bald eagles, ospreys, peregrine falcons, snowy owls, whistling swans and merlins. The southern area of the marsh is affected by tidal flooding and contains some salt marsh plant species, which contribute nutrients to the estuary. An endangered plant species for Oregon, the Salt Marsh Birds Beak (Cordylanthus Maritimus) is found in Henderson Marsh (Oregon Natural Heritage Program 1977). Also associated with Henderson Marsh is a large heron rookery in a grove of Sitka Spruce at the head of the marsh. There are forests of cedar and spruce on younger stabilized dunes in the area , that support a great variety of wildlife. Local Indian tribes claim access to and protection of the habitat of the eagle and the other birds of prey and the traditional gathering places of certain plants used for religious ceremonies. They claim protection through the American Indian Religious Freedom Act (P.L. 95-341, 92 Stat. 469) (Coos, Lower Umpqua, Siuslaw Indian Tribes, Inc. 1979).

The Menasha effluent holding lagoon presently is an area of minimal biological significance. However, as the need for this type of facility diminishes, the pond has significant potential to be restored to wildlife habitat.
Another potential future use of the lagoon might be pond aquaculture operations such as shrimp or pond-reared trout.

Other wet interdune areas besides Henderson Marsh area also important to wildlife. Waterfowl and shorebirds use the wet deflation plain areas south of the pulp mill lagoon during their winter migrations. Open dune sand areas south of the pulp mill lagoon are less important wildlife habitat (USDA Soil Conservation Service 1977).

5. MID COOS BAY EAST (South and East of the channel from the mill at Empire to the Railroad Bridge)

This area is distinguished by limited accessibility to the water front due to steep cliffs in the residential area and the siting of the North Bend Airport.

The major tidelands of this study unit are the extensive tideflats at the west end of the airport runway. These flats contain large beds of softshell clams and have been the site of a commercial bait shrimp operation. Complex circulation patterns and input of organic material from the North Bend sewage treatment plant creates a variety of substrate types from sand to mud and supports significant tracts of eelgrass and red algae (Baldwin, et al. 1977). The channel between the dredge spoil island and the airport runway contains a significant portion of the tidal flow of the bay.

The shoreland environment in the vicinity of Empire and North Bend consists of younger stabilized dunes and open dune sand (CCPD 1979;BD-3). Areas of open sand may present some hazards to building. There are major archeological and historical sites in Empire. A Coos Indian village site and cemetery and Empire pioneer cemetery are located south of the mouth of Chickses Creek (Oregon Archeological Survey 1979). There is also the site of Empire City Fort on the Empire shoreland (CCPD 1978; S-9). There are existing boat ramps at Empire and at the east end of the North Bend Ariport (CCPD 1978; R-26).

6. PONY SLOUGH

This 280 acre tract of tideland is a small portion of the former area of Pony Slough. At one time, the land of North Bend Airport, Pony Village Shopping Center, and North Point were part of the tidelands of Pony Slough. Although circulation has been restricted through its mouth and surrounding development has caused some habitat degradation, the tideland of Pony Slough is still one of the most important waterfowl and shorebird habitats in the Coos Bay estuary. It is designated as a waterfowl refuge from hunting by the Oregon Department of Fish and Wildlife. Major tracts of eelgrass exist in Pony Slough in addition to the 35 acres of low sandy marsh and 16 acres of immature high marsh on the western side (Hoffnagle and Olson 1974). Pony Slough is also an important feeding area for striped bass and juvenile salmonids. Pony Slough represents an important natural area in close proximity to an urban area.

7. NORTH SLOUGH/HAYNES INLET (North and East from the Causeways)

These sloughs are served by separate watersheds, but are similar in the habitats they provide as well as in their restricted flushing capabilities. Both North Slough and Haynes Inlet have productive mud flats with large beds of clams and crustaceans. Softshell clams are taken by recreational clam diggers, expecially in the tideflats beside the causeways. Both areas are important to feeding striped bass and juvenile salmonids and are significant shorebird and waterfowl habitat. Haynes Inlet contains extensive tracts of eelgrass, while North Slough has significant tracts of marsh alongits western shore from the causeway north. These

include 23.0 acres of low sandy marsh, 18.0 acres of diked marsh, 7.0 acres immature high marsh (Hoffnagle and Olson 1974. Hoffnagle and Olson stated that marshes in the North Slough are some of the finest in the Coos Bay system, in terms of both extent and condition. Akins and Jefferson (1974) singled out North Slough as particularly significant: "The North Slough is of particular significance as a visual asset...The marshes and associated dunes constitute one of the most characteristic and scenic landscapes available to the traveler."

North Slough marshes are bordered on the west side by open dunes (CCPD 1978; BD-3), which may present considerable hazards to structural developments. The eastern shoreland along Highway 101 has significant segments of riparian vegetation.

There has been accelerated deposition of sediments in North Slough and Haynes Inlet due to poor circulation. The construction of causeways with inadequate culverting has created the situation. Restorative actions are possible to improve circulation over these tideflats. These tideflats may become prime oyster farming lands if the siltation problem is corrected and if commercial harvest restrictions are removed by the State Board of Health, or if a shellfish depuration (purification) site is designated in the lower bay to remove potential toxins from oysters grown up-bay.

Other critical concerns in this study unit are the continuation of native salmon runs up North Slough and protection of the bald eagle and their nesting site above the southern shoreland of Haynes Inlet.

8. UPPER COOS BAY WEST (South and West of the channel from the Railroad Bridge to the Chandler Bridge on the Coos River and both sides of the channel in Lower Isthmus Slough to the Eastside Bridge)

The estuarine environment of this study unit consists of fringing tideland of minimum biological significance adjacent to the deep draft channel. The ship channel requires frequent maintenance dredging of fine particle sediments which are difficult to dispose. There is one major tract of undiked high salt marsh in Eastside that exists between adjacent diked marshes that are designated for dredge spoils.

The tideland in the midst of the North Point dredge spoils is of less biological significance than Pony Slough. However, restorative actions could connect the two basins to improve sediment flushing and enhance tideland production.

Shoreland resources include North Bend and Coos Bay marine commercial and industrial development and large ship docks. There are several areas of dredge spoil and other vacant land that have high potential for water-dependent development.

9. UPPER COOS BAY (North and East of the channel from the Railroad Bridge to Catching Slough)

The east bay is the largest tideland area of Coos Bay. It is characterized by large tracts of productive mud flats, several vegetated spoils islands, and large salt marsh islands.

One of the largest contiguous tracts of eelgrass in the state exists from the mouth of Kentuck Inlet to the McCullough Bridge to the north and to Willanch Inlet to the south (Baldwin, et al, 1977). There are several minor tracts of salt marsh at the head of Kentuck Inlet, which are remnants of 175 acres that were formerly salt marsh before diking (Hoffnagle and Olson 1974). On Willanch Inlet, 110 acres of salt marsh were lost to diking, leaving the small tracts presently fringing its mouth(Hoffnagle and Olson 1974). The clam beds of these tideflats produce softshell clams and an abundance of other smaller species of importance to estuarine productivity. Bull Island is one of the major salt marshes of the estuary. It is primarily immature high marsh with small portions of low silt marsh, sedge marsh, and high ground. The Bull Island Marsh includes several tracts of marsh from the junction of Coos River to Pierce Point. There are also three spoils islands east of the Coos Bay channel, which have vegetated upland areas and extensive borders of low salt marsh. The Oregon Department of Fish and Wildlife has designated these as important shorebird habitat.

Shorelands are primarily residential and forest land with some slopes between 15-30% (Oregon Department of Geology and Mineral Industries 1975). The riparian habitat along the shoreline is an important wildlife habitat. Bald eagles that nest above Haynes Inlet use the riparian habitat for feeding and resting.

10. LOWER ISTHMUS SLOUGH(Eastside Bridge to Davis Slough)

The estuarine lands of lower Isthmus Slough are essentially a degraded habitat due to the activity of log storage. There are three large tracts of tideland north of Davis Slough, which are used for log storage, that also have small areas of low salt marsh and eelgrass. Water quality is affected, but still supports a variety of fish and shellfish. Striped bass are caught by bank and boat anglers in this slough. There is good angler access.

The west side of Isthmus Slough supports dense residential and intense marine industrial uses. The east shore is steep hillside supporting less dense residential development forest tracts and a large farm at the Coos City Bridge. The contrast of industrial and natural uses in Isthmus Slough provides a visual resource to travelers entering Coos Bay along the north bound highway entrance corridor. This balance and harmony of environments is a powerful expression of the life style of Coos Bay.

11. UPPER ISTHMUS SLOUGH(Davis Slough to the head of tide), COALBANK SLOUGH, SHINGLEHOUSE SLOUGH, DAVIS SLOUGH, CATCHING SLOUGH

Most of these estuarine areas have been used historically for log rafting, but each area has some natural features that are less degraded than lower Isthmus Slough. In upper Isthmus Slough the mud flats produce more abundant Corophium amphipod beds than in lower Isthmus Slough, because logs have not recently been stored upon them (Zegers 1978). Corophium are important in the diet of juvenile salmon that emerge from salmon spawning grounds up Davis Slough. It is also believed that striped bass may spawn

in upper Isthmus Slough, because first year juveniles have been seined there (ODFW 1979).

Davis Slough, Shinglehouse Slough, and upper Isthmus Slough all have significant tracts of undiked marsh contributing nutrients to the estuary. Shinglehouse Slough contains 80 acres of sedge marsh, while across the Isthmus Slough channel is a 180 acre tract of immature high marsh (Hoffnagle and Olson 1974). Along both shores of Isthmus Slough south of Davis Slough are 143 acres of immature marsh and 83 acres of bullrush and sedge marsh (Hoffnagle and Olson 1974). These tracts are among the largest acreages of undiked marsh in the estuary. These marshes help maintain the water quality of Isthmus Slough and are an integral part of the aesthetic appeal of the Slough as an entrance corridor.

Another important environmental aspect of upper Isthmus Slough is the strip of riparian vegetation that exists along the eastern shore. It acts as a temperature, erosional, and visual buffer to the hills behind it that have been recently clearcut. This riparian habitat is important to wildlife that use this waterway.

Coalbank Slough has two large marshes which add significantly to its environmental value. Both are formerly diked marshes, which have been breached. The larger marsh has become channelized and may be classified as a sedge marsh (Hoffnagle and Olson 1974). The smaller tract, 25 acres, has a more restricted tidal flow. Both are remnants of a once much larger marsh. They are important visual resources to the residents of the City of Coos Bay, who live on the hills overlooking Coalbank Slough.

Catching Slough is a channel which has fringing border of mud, eelgrass, and marsh along its entire length. There is salmon spawning activity at its head and striped bass feed along its length. Seven hundred acres of Catching Slough marsh have been lost through diking for agricultural use (Hoffnagle and Olson 1974).

In this study unit most shorelands are separated by dikes from the uplands, many of which are public road beds. Land forms are forested hills and agricultural plains.

12. COOS AND MILLICOMA RIVERS (Chandler Bridge to the heads-of-tide)

There are fringing mud shores bounded by rip-rap and road beds along the Coos River to its head of tide. The estuarine environment is more influenced by fresh water in the Coos River than in the sloughs of the bay. American shad and striped bass use this portion of the estuary for spawning, feeding and rearing. The tidal portion of Coos River is an important area for the rearing of juvenile salmonids. The major portion of the Coos Bay wild stocks of salmonids migrate through the Coos River to spawning grounds. There is a lack of information about the riverine portion of the estuary. Most of its length is not mapped by the Division of State Lands. There is no information about its productivity. Data about plankton production and other food sources for its fish population are needed.

There are large tracts of agricultural land behind dikes along the Coos River. These lands are valuable to migrating waterfowl during the winter and as scenic open spaces for local residents besides

their value as agriclutural resources.

13. SOUTH SLOUGH ESTUARINE SANCTUARY (4,400 acre tract of tidelands and watershed of upper South Slough south of Valino Island)

The estuarine lands and a portion of the watershed of Upper South Slough have been recognized on the Federal, State and local levels of government as the most pristine environment of Coos Bay estuary. It has been set aside for restoration to a natural condition for the purpose of research, education, and low intensity recreation. It is now in the process of being completely purchased through the Oregon Division of State Lands and managed by the South Slough Estuarine Sanctuary Management Commission. Eventually the most intensive use of the estuarine lands may be oyster farming operations, which have traditionally been located there. South Slough Estuarine Sanctuary Management Commission has requested a separate management unit designation other than those covered in natural, conservation, and development categories. Therefore, it has been included in this report as a separate study unit.

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