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DESCRIPTIONS AND INFORMATION SOURCES

FOR

OREGON ESTUARIES

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PREFACE

This report is a second expanded edition of a previous edition entitled "Description and Information Sources for Oregon's Estuaries," March 1973. The study leading to this second edition has been sponsored by the Office of Water Resources Research, United States Department of the Interior administered through the Water Resources Research Institute, Oregon State University.

The first edition was performed as part of a study for the Oregon Study Team of the Pacific Northwest River Basins Commission under contract with two of the member agencies of the study team: the U.S. Army Corps of Engineers and the National Oceanic and Atmospheric Administration. Concepts and recommendations developed under this study are included in the report "General Planning Methodology for Oregon's Estuarine Natural Resources," Pacific Northwest River Basins Commission, P.O. Box 908, Vancouver, WA, 98660. The interested reader can also refer to the technical publications by the principal investigators for more recent research on the environmental management of Oregon's Estuaries.

The support and cooperation of a great number of individuals and organizations is acknowledged. Particular acknowledgment is given to James B. Kennedy who served as Resource Coordinator for a portion of the study. The professional assistance of Larry S. Slotta and Charles K. Sollitt, Department of Civil Engineering, Oregon State University is greatly appreciated.

The appreciable support of the Oregon Coastal Conservation and Development Commission, particularly James F. Ross, Executive Director, and Wilbur Ternyik, Chairman, and of Paul Coyne, President of the Oregon Coastal Ports Federation, in obtaining information and in arranging meetings to exchange ideas with numerous knowledgeable individuals from state agencies, port authorities, coastal towns and counties is gratefully acknowledged.

Considerable help and information was also provided by many other individuals whose assistance is collectively acknowledged here. Mrs. Elisabeth Schafer and Ms. Kathie Zuleger prepared this report through several drafts and numerous revisions.

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INTRODUCTION

Information concerning the physical, chemical, and biological characteristics of Oregon's estuaries and of the natural resources found within them has not been available in complete form from any one agency, group or publication. Partial information can be obtained from many different sources if the planner or decision maker knows whom to ask and where to look.

This report, while not a complete compilation of facts about the natural resources and related features of Oregon's estuaries, provides a summary of much of the known information about the estuaries and gives numerous citations of literature and agencies from which supporting information may be obtained. The report is intended to provide the planner with a "starting point" for assembling the required data concerning most of the Oregon estuaries.

Oregon Estuaries

Oregon's recognized estuaries, reportedly 14 in number [149,155], are shown in Figure A, together with some of the state's smaller estuaries. Also shown are the five basins into which the coastal zone is commonly divided--the North Coast, Mid-Coast, Umpqua River, South Coast, and Rogue River basins. These basins are mentioned periodically herein and are included in Figure A to give a general indication of their boundaries and of the estuaries included within them. Thirteen major Oregon estuaries are described in this report. However, the Columbia River estuary which is the largest estuary, is an interstate estuary of a multi-state drainage basin and has been omitted. Information is organized as individual estuary reports with the same basic format for each. The outline used is presented in the following pages with descriptions and explanations of the information and major references being given as necessary. Definitions are included at the end of this section. References, which are indicated by brackets ([]) are included in alphabetical order at the end of this report.

General Description of Estuary and Drainage Basin

Estuary

Listed in this section are the location, population, centers, dimensions, and major tributaries of each estuary. Also given are addresses and phone numbers of Port Commissions [106] and other organizations having a special interest in the area. Mention is made of any existing physical models⁽¹⁾ or special reports.

(1) Records of physical models were found for Tillamook and Umpqua Bays only.

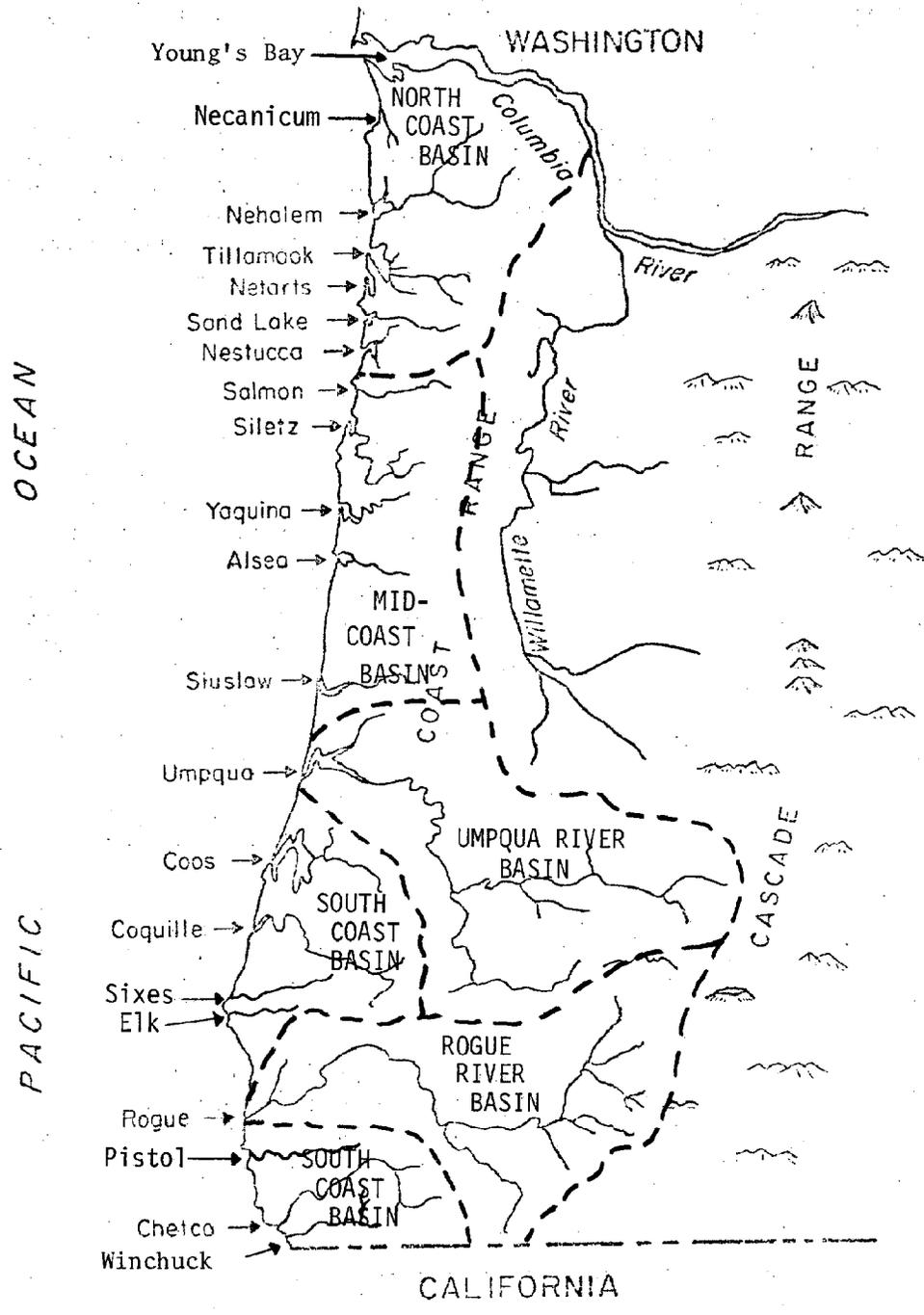


Figure A. Oregon's estuaries and major coastal drainage basins.

For comparison, the estuaries are shown in Table A in order of decreasing estuary size, along with surface areas, percent tidelands, and size of drainage basins as presented in various sources. This information is also given in the individual reports.

Table A. Surface areas, percent tidelands, and drainage areas of Oregon's estuaries [55,59,70].

Estuary	Surface area (acres) measured at			Percent of surface areas which is tidelands		Drainage basin area (sq.mi.)
	HW [55]	MHT [70]		[59]	[70]	
Coos	10,973	---	9,543 ^a	48	--	605
Tillamook	8,861	8,289	8,839 ^a	58	50	540
Umpqua	6,749	6,830	5,712 ^a	27	22	4,560
Yaquina	4,233	3,910	2,853 ^a	61	35	253
Youngs Bay	---	---	2,870 ^b	--	--	122
Nehalem	2,388	2,309	3,766 ^a	32	47	855
Netarts	2,179	2,325	2,406 ^a	--	65	14
Alsea	2,140	2,146	2,227 ^a	--	46	474
Siuslaw	1,458	2,245	1,589 ^a	38	34	773
Siletz	1,086	1,187	1,203 ^a	--	65	373
Nestucca	1,022	1,000	1,149 ^a	--	58	322
Coquille	818	---	703 ^a	--	--	1,058
Rogue	575	---	---	--	--	5,100
Sand Lake	429	528	700 ^a	--	75	17
Sixes	---	---	330 ^d	--	--	129
Elk	---	---	290 ^d	--	--	94
Necanicum	---	---	278 ^c	--	--	87
Pistol	---	---	230 ^d	--	--	106
Salmon River	171	204	438 ^a	57	62	75
Chetco	140	---	---	--	--	359
Winchuck	---	---	130 ^d	--	--	70

^aTidal stage not given -- described as "those areas affected by tidal action." [59]

^bArea calculated by planimeter -- shoreline representing approximate line of mean high water. [116]

^cTidal stage not given -- described as "the estuary covers 278 acres." [66]

^dArea calculated by planimeter from aerial photographs -- Tidal stage not known. [135]

Population centers considered here are those located on or near the estuary (i.e., near water subject to tidal influence or near the head of tidewater.) In cases where the extent of tidal influence was not known, population centers within a reasonable distance from the estuary mouth (assumed to be 1 to 10 miles, depending on the estuary) were included. The centers are given in table form for most estuaries and were taken from three sources--(1) the 1972 Rand McNally and Co. Atlas [111], (2) the Oregon State Water Resources Board (OSWRB) basin report maps [88,89,93,99], and (3) the OSWRB stream mile summaries [94,95,96,97]. The Rand McNally Atlas [111] either provided the 1970 census figures or used the terms "rural" and "no pop," defined in the atlas as follows:

no pop--most of these places are railroad stations, but some are factories, mines, power plants, etc. The "no pop" designation indicates that the place is in the open country and is not associated with any settlement.

rural--open-country localities that have a locally recognized name, although no built-up section exists and the population is scattered over a wide area.

Towns shown on a map or listed in a stream mile summary but for which census figures were not given are described here as "not listed."

Estuary surface areas are from work by Marriage [59], Johnson [55], the Division of State Lands [70], and Department of Water Resources, OSU [87]. Marriage did not specify the tidal stage for which he gave the areas but did state that "only those areas affected by tidal action were included in the acreage measurements." He determined the areas sometime around 1948 from either U.S. Coast and Geodetic Survey (USCGS) bay charts (preferably) or coastal charts, but made no indication as to which type was used for the individual estuaries. In most instances he also gave the number of tideland acres. Johnson apparently used USCGS charts from the late 1960's and early 1970's for determining surface areas and other dimensions presented here, such as distance to farthest estuary shore, inlet dimensions at throat, and average lagoon depth below MSL. The Division of State Lands, the most recent of the three references, obtained MLT and MHT surface areas by planimeter measurements taken from aerial photographs on which estuarine boundaries at those tidal stages had been marked by direct observation. That agency has also compiled a tideland abstract listing the acreage of most Oregon estuary tidelands as well as some ownership and deed information [70]. The State of Oregon Division of State Lands provided most of the maps at the beginning of each section, the others being U.S.G.S. and U.S. Army Corps of Engineers maps.

Major tributaries are described in terms of length, annual fresh water yield, and drainage areas. Some indication is also made of the location of the point for river mile zero as given in the OSWRB stream mile summaries [94,95,96,97] or basin reports maps [88,89,93,99]. In some cases the major tributary has its zero river mile at the estuary mouth, and therefore, the lower section of the river actually is the estuary (or at least its major portion). Yaquina Bay provides an example of this type of stationing. In other cases (e.g., Nestucca Bay) the zero river mile stations of major tributaries are at their points of discharge into the "bay." In instances such as this, an attempt was made to estimate (from the OSWRB maps) the distance along the center of the estuary from its mouth to the zero river mile.

In any case such as the above, where a distance was estimated and is therefore very approximate, it is so designated here by simply describing it as being approximately or about the indicated number of miles. Unless otherwise stated statute miles are used.

The Estuaries of Oregon are now and have been in the past regions of rich resources for the inhabitants of the coast. For this reason those lands adjacent to the estuaries have been used for thousands of years by prehistoric inhabitants as occupation areas. There are state and federal laws which protect these archeological resources on all public lands. Inquiries concerning these laws and archeological sites should be directed to the Museum of Natural History, University of Oregon, Eugene, Oregon [22]. The Museum is by state law the protector of state antiquities and the repository of information concerning antiquities.

This information has not been mentioned in the individual reports.

Drainage Basin

Drainage basin area, annual fresh water yield, composition (percentage of forests, croplands, rangelands, etc.), annual precipitation, air temperature, wind direction, and range of elevation are included in this section. It should be noted that the terms "drainage basin" and "watershed" are used interchangeably.

Areas of the drainage basins are mainly those presented in the OSWRB stream mile summaries [94,95,96,97]. In cases where no area was found, estimates were made from the OSWRB basin reports maps [88,89,93,99].

In 1968, the OSWRB made available information in punch card or printout form from surface water gaging stations for which monthly and water-year runoff records had been compiled. A description of the format used and a listing of the stations from which records would be provided are given in a publication by the agency entitled "Surface Water Gaging Stations, Oregon" [98]. Some of those stations are also noted here in the table of surveillance stations included at the end of each estuary section.

Precipitation records are available for towns on many of the estuaries [92,143]. Wind roses can be obtained for some areas [7]. Also, it has been generalized that along the Oregon coast, winter winds are predominantly from the southwest and summer winds are from the northwest to north [7].

Hydraulic Description of Estuary

Tides and Currents

Information given here includes exposure of the estuary to waves at the mouth [55]; the extent of tidal influence (various references); mean tide range⁽²⁾ and its diurnal range [55]; the extreme tidal range [86]; tidal prism on mean range and its diurnal range [55]; amplification information [43]; and phase difference between tidal elevations and tidal currents [43].

(2) "The mean tide range as listed was taken from the 1971 USC&GS Tide Tables for the station inside the bay or lagoon nearest to the entrance." [55].

Two items of information that can be given for this entire coastal area (and have therefore not been repeated in the individual reports) are that (1) tides are "mixed," meaning two unequal high tides and two unequal low tides daily, and (2) wave roses are available through the U.S. Army Corps of Engineers.

River Discharges

Where possible, observed or estimated flow rates of major tributaries are given. The U.S. Geological Survey (USGS) operates numerous stream gaging stations and annually presents records from them in its publication "Water Resources Data for Oregon, Part I. Surface Water Records" [140].

Salinity and Classification by Mixing

Most salinity information was taken from research conducted by Burt and McAllister during the late 1950's [12,13].

Determination of the extent of salinity intrusion involved up to only nine measurements being made over a two-year period [12]. These were taken along the channel centerline at various distances from the ocean. Concentrations presented here are those from the sampling point showing greatest inland intrusion.

In classifying estuaries on the basis of mixing characteristics, Burt and McAllister used the following distinctions, previously defined by Pritchard⁽³⁾, in terms of salinity change from top to bottom [13]:

two-layered system--20 ppt or over
partly-mixed system--between 4 ppt and 19ppt
well-mixed system--3 ppt or less.

Classification was made for various months from HW measurements taken at the nearest station where mean salinity was 17 ppt (roughly half fresh and half salt water). It should be noted that, as Burt and McAllister pointed out, an estuary will probably change from one type to another as conditions vary throughout the year. Examples of this situation can be seen repeatedly in the individual reports.

Sediments

Given in this section is information and reference material on littoral drift, sediment loads, and analyses of dredge samples.

Littoral drift along the Oregon coast seems, in most cases, to be to the south during the summer and to the north during the winter, with the net drift being to the south [57]. However, proximity to the mouth of the Columbia River may be a significant factor regarding predominant drift direction.

(3) Pritchard, D.W., "Estuarine Circulation Patterns," Proc. Am. Soc. Civil Eng., Vol. 81, Separate 717, pp. 1-11, 1955.

Estimates of sediment loads were made [85] from a map presented by H.W. Anderson in 1954⁽⁴⁾. Conditions of the watersheds have changed considerably since then, and the generalized estimates can no longer be considered to be as reliable as they once may have been.

The U.S. Army Corps of Engineers has analyzed dredge samples to determine organic content, void ratio, and grain size [124]. In most cases, this involved several samples; however, the data given here include only the mean grain size and the extreme values of organic content and void ratio, with some indication of the sampling date and site. More information could be obtained from the Corps records.

The amount of accretion at jetties of some of the estuaries has been given in the Division of State Lands tideland abstract previously mentioned [70]. That information, which is not repeated in the individual reports, is as follows: Nehalem--115 feet S; Siuslaw--320 feet N, 55 feet S; Tillamook--250 feet N, 70 feet S; Umpqua--245 feet N, 12 feet S.

Water Quality

The Department of Environmental Quality (DEQ) operates numerous water surveillance stations and will provide records from them in punch card or printout form showing temperature, pH, salinity, dissolved oxygen (DO), biochemical oxygen demand (BOD), Pearl-Benson Index (PBI), turbidity, total coliforms, and fecal coliforms [67,68]. Initial measurements in some estuaries were made as far back as 1957 (Coos and Umpqua) whereas for others they are only as recent as 1969 (Alsea and Siletz). No attempt was made to review the records and summarize them here; only the number of stations with their locations and periods of records are given.

Temperature or other water quality measurements from stations other than those operated by the DEQ are also mentioned. In most cases, these are USGS stations, the records from which are available in annual USGS publications, "Water Resources Data for Oregon. Part II. Water Quality Records" [141].

Descriptions of some sewage treatment facilities are given, but the information is incomplete because not all of the treatment plants in any given estuarine area are necessarily covered. Industrial outfall information is not easily accessible at this time, but the DEQ is now issuing permits and is in the process of putting the rate and type of discharge at the outfalls on punch cards. By the fall of 1973 the project will possibly be to the point where the information will be readily available [44].

(4) Anderson, H.W., "Suspended Sediment Discharge as Related to Streamflow, Topography, Soil, and Land Use," Transactions, American Geophysical Union, Vol. 35 (2) pp. 268-281, 1954.

Biological Information

In this section, mention is made of as least some of the fish, water-fowl, and big game animals commonly found in each estuarine area. Listings of fish generally include only those which are of either commercial or recreational interest. Estimates of the number of anadromous salmonids spawning in various streams as presented in the Oregon State Game Commission (OSGC) basin environmental investigations are given in the individual reports and compiled for comparison in Table B [75,76,77,78,79]. Also available in these publications are periodicity charts and distribution maps for anadromous fish.

Table B. Estimated numbers of adult anadromous salmonids spawning in the Oregon estuarine stream systems, 1972 [75,76,77,78].

	Stream system	Chinook		Coho	Chum	Steelhead		Sea-run Cutthroat
		spring	fall			winter	summer	
North Coast	Nehalem River ^{1,3}	---	4,000	21,840	200	11,000	---	8,000
	Tillamook (Tillamook, Trask, Wilson, Kilchis, and Miami Rivers) ^{1,3}	6,120	33,705	33,625	9,900	49,575	2,400	18,000
	Netarts			no information				
	Sand Lake			no information				
	Nestucca (Nestucca and Little Nestucca Rivers) ^{1,3}	1,890	20,565	18,580	2,000	37,290	5,600	5,800
	Necanicum ¹	---	---	3,780	100	2,000	--	2,000
	Youngs Bay ¹	---	500	17,200	200	2,800	--	1,000
Mid-Coast	Salmon River ^{1,2,3}	180	2,000	5,700		4,200	250	3,800
	Siletz ^{1,2,3}	775	14,200	26,900		11,500	4,900	32,000
	Yaquina ^{1,2,3}	0	2,100	12,600		2,300	0	7,500
	Alsea ^{1,2,3}	300	20,000	58,000		13,600	200	28,600
	Siuslaw ^{1,2,3}	0	4,500	22,000		13,000	0	50,000
Umpqua	Umpqua ^{3,4}	12,600	5,000	25,000		40,000	12,000	30,000
Rogue	Rogue ¹	45,500	75,000	5,000	50	75,500	51,250	5,300
South Coast	Coos ^{1,2,3}	0	500	8,300		5,000		3,500
	Coquille ^{1,2,3}	50	4,900	23,000		16,100		12,000
	Sixes ¹	---	3,000	300		2,500		3,000
	Elk ¹	---	3,200	800		3,500		2,800
	Pistol ¹	---	500	50		1,200		4,000
	Chetco ¹	---	3,000	500		4,000		2,500
	Winchuck ¹	---	400	50		1,500		1,500

¹ Estimates by OSGC and FCO biologists.

² Numbers indicate spawning escapement. Total run would be computed by adding appropriate sport and commercial harvest data.

³ Estimates include hatchery contributions.

⁴ Estimates by OSGC.

The charts and maps are not presented here, but much of the other information for this section was taken from those references. In the case of the Coquille River, the preliminary report [81] used in preparing a portion of the South Coast Basin investigation [78] was supplied by the OSGC. Similar papers on the other estuaries were not available, although they apparently had been written.

Physical Alterations

Physical modifications such as jetties, channel projects, and landfills are described here. Some dredging records and project (channel) use statistics are also given, and a listing is made of fishways and hatcheries.

All jetty and channel projects are under the jurisdiction of the U.S. Army Corps of Engineers and records of such modifications are open to the public. Information used here was taken from a Corps water resources development report [129] and to a lesser degree from a fairly detailed unpublished 1971 reference entitled "Study and Maintenance Dredging Coastal Harbor Estuaries" [128]. Reports by the Chief of Engineers dating back to 1866 (when the Corps first became responsible for the maintenance of Pacific Coast Harbors) are available as annual publications.

It is presently the duty of the Corps to maintain harbors for use by ocean going vessels. This consists of maintaining or improving channels and maintaining, improving, or constructing jetties and breakwaters. References used here were written up with a description of the "existing project" (i.e., the authorized project) followed by completion dates of the various phases. In some instances, difficulty arose in determining exactly what had and had not been constructed. For that reason, some completion dates may be lacking here, but (as noted in the individual reports) that does not mean the modification has not been completed, but only that records of such were not found. More detailed information could be obtained directly from the Corps in Portland.

Statistics of channel use are from the Corps water resources development report [129]. Dredging records, taken from the Chief of Engineers Annual Report and presented by Johnson [55] for 1959 to 1969 (excluding 1968), list the quantity (in cu yds) removed from each estuary. The dredged amounts presented here are "typical quantities," meaning those that appeared to be close to the average amount removed during the 1959 to 1969 period.

The Oregon Division of State Lands has completed inventories of filled lands in many Oregon estuaries [69] with individual reports being made available as each estuary inventory is completed. The reports give a general description of the estuary and its drainage basin with information on landfills such as location, ownership, construction dates, usage, permit number, and areas. Some of that information is presented in Table C and also in the reports on the Siuslaw, Umpqua, and Sand Lake estuaries. Navigable lengths of some of the estuary tributaries, provided to the Division of State Lands by the Corps of Engineers, are also given in those landfill inventories and have been presented here in the individual estuary reports.

Table C. Information on landfills in Oregon estuaries [69].

estuary	landfill area (acres)			use/ownership	main location
	on submerged lands ¹	on submersible lands ²	total		
Alsea	0	24.75	24.75	marine oriented; heavy emphasis on recreation	east side of Waldport
Nehalem	20.11	7.27	27.38	residential or recreation oriented; generally small fills	Brighton, Wheeler, and Nehalem areas
Nestucca	0.15	0.68	0.83	erosion control on residential property; mainly state owned	Pacific City; Woods area; between miles 1.5 and 2.5
Salmon	0	0.12	0.12	one fill; parking area, boat launch; state owned	north side near mile 1.8
Sand Lake	no landfills; 4.1 acres of diking of which 3.0 acres is on submersible land				
Siuslaw	0.12	40.63	40.75	used mainly by the city of Florence; some marine oriented with heavy emphasis on industry; 36.28 acres are dredge spoils	Florence area
Tillamook	0.57	102.06	102.63	industry oriented; no particular emphasis on navigation	Garibaldi area
Umpqua	8.50	97.54	106.04	80 acres used for marina and harbor at Winchester Bay; remainder mainly marine oriented with heavy emphasis on deep water navigation and industry	Winchester Bay and Reedsport
Yaquina (below Toledo)	55.06	202.06	257.12	are only 3 fills over 5 acres--all marine oriented with heavy emphasis on deep water navigation and industry	Newport and Marine Science Center areas and north side of river between miles 4 and 5

¹submerged lands--those lying below the line of ordinary low water of all navigable waters.

²submersible lands--those lying between the line of ordinary high water and the line of ordinary low water.

(More complete definitions are given in the Inventories of Filled Lands [69].)

Fish ladders on Oregon coastal streams are constructed and operated by the OSGC, Fish Commission of Oregon (FCO), Corps of Engineers at Bonneville Dam, and the National Marine Fisheries Service in Portland, although those of the latter two agencies are located exclusively on the Columbia River. The FCO and OSGC fishways are found on tributaries of various estuaries with the OSGC owning, inspecting, and operating all of theirs [56], and the FCO possibly only inspecting ladders which are not exactly owned by them [45].

Records of constructed fishways mentioned in the individual reports were taken from a FCO publication describing the "Coastal 60-40 Program" [119]. The program, passed into law in May 1961, was administered by the FCO from July 1, 1961 to July 1, 1963 and provided mainly for fishways and stream clearance projects. A more accurate and complete list of ladders is as follows [28,56]:

Youngs Bay		
Barth Falls--Klaskanine River		FCO
Necanicum		
Mail Creek Culvert--Necanicum River		
City of Seaside Dam--South Fork Necanicum River		FCO
Sunset Trout Farm--North Fork Necanicum River		
Nehalem		
Hamlet Falls--North Nehalem River	}	FCO
Water House Falls--North Nehalem River		
Fishhawk Lake--Nehalem River		
Tillamook		
Fall Creek--Wilson River	}	FCO
Fox Creek Culvert--Wilson River		
Killiam Creek--Tillamook River		
Nestucca		
Upton Falls--Little Nestucca River	}	FCO
Stella Falls--Little Nestucca River		
101 Camp Fishway--Nestucca River		
" ? "--Nestucca River		OSGC
Salmon River		
Trout Creek Falls (Rock Cut)--Slick Rock Creek		FCO
Siletz		
Mill Creek Falls--Siletz River	}	FCO
Valsetz Falls--Siletz River		
Cedar Creek Falls--Siletz River		
Sunshine Creek--Siletz River		
Valsetz Lake--Siletz River		
Yaquina		
City of Toledo Dam--Mill Creek	}	FCO
Sloop Creek (Rock Cut)--Yaquina River		
Quarry Falls--Little Elk		
Alsea		
Five Rivers Fishway--Alsea River	}	FCO
Cascade Creek Falls--Alsea River		
Fall Creek Falls--Alsea River		
Henning Dam--South Fork Alsea		
Bohannon Falls Upper--Drift Creek		
Bohannon Falls Lower--Drift Creek		
Scott Creek (Rock Cut)--Alsea River		
Grant Creek 1 (Rock Cut)--Alsea River		
Grant Creek 2 (Rock Cut)--Alsea River		

Siuslaw		
Siuslaw Falls--Siuslaw River		OSGC
Umpqua		
Smith River Falls--Smith River		FCO
South Umpqua Falls--South Umpqua	}	
Winchester Dam--North Umpqua River at Winchester		OSGC
Smith River Falls--Smith River		
Coos		
Vaughn Falls--Millicoma River	}	
Tioga Creek 1--Coos River		FCO
Tioga Creek 2 (Rock Cut)--Coos River		
Air Force Dam--North Creek of North Slough		
Coquille		
Middle Creek Falls--Coquille River	}	
Steelhead Falls--North Fork Coquille River		FCO
LaVern Park Falls--North Fork Coquille River		
Rogue		
Savage Rapids Dam--Rogue River		
Oak St. Div. Dam--Bear Creek		FCO
Bear Creek Div. Dam--Bear Creek		
Frilder Dam--Rogue River		

The OSGC, FCO, and National Marine Fisheries Service operate hatcheries on Oregon Rivers. The National Marine Fisheries Service hatcheries, like its fishways, are on the Columbia River only; therefore, only the FCO and OSGC hatchery locations are given here. Release statistics presented here were taken from the OSGC annual report [80] and from the FCO biennial report [33]. Hatchery names and locations are as follows [54,56]:

Nehalem		
North Nehalem River--1/4 mile downstream from highway 53 bridge		FCO
Tillamook		
Trask River--5 miles east of Tillamook at the mouth of Gold Creek		FCO
Nestucca		
Cedar Creek--Nestucca River		OSGC
Siletz		
Siletz River--North Fork Rock Creek, 4 to 5 miles east of Logsdan		FCO
Alsea		
Alsea River--on Fall Creek at mile 3 or 4, 30 miles from Waldport		FCO
North Fork Alsea--out of town of Alsea		OSGC
Umpqua		
Rock Creek--North Umpqua River out of Idlewild Park		OSGC
Coquille		
Bandon--Bandon		OSGC
Elk		
Elk River Salmon Hatchery--11 to 12 mile NE of Port Orford		
Rogue		
Butte Creek--Butte Falls		OSGC

Estuary Uses

Industrial and Commercial

Listed and described in this section are the types of industries which are of particular economic importance to each estuary area. Foremost among these are lumbering and commercial fishing activities and various aspects of tourism and recreation (such as sport fishing, which is described in the "Recreational" section). Most of the information was provided by the Port Commissions and Chambers of Commerce or taken from the 1972 Directory of Oregon Manufacturers [71] published by the State Economic Development Division.

In connection with the lumber industry, statistics of channel use (taken from Army Corps of Engineers records [129]) and figures for log raft storage are mentioned for many estuaries. Locations of and the area covered by log rafts at Siuslaw estuary were supplied by the Port Commission, but in the other cases, that information would have to be obtained directly from the industries having log rafts. This information should eventually be more readily available through the Division of State Lands since that agency plans to have completed an inventory of log rafts on all navigable waters in Oregon by 1974 or 1975 with eventual zoning and leasing [46].

Statistics of commercial fish landings were made available by the FCO [20,34,118] and the OSGC [75,76,77,78,79] and have generally been presented in terms of annual catch and value to fishermen. Landings given here are divided into two groups--those from the estuary alone and those taken from the entire area (ocean, estuary, streams) and received at a port on the estuary. There is actually little commercial fishing directly from the estuaries and their tributaries, especially since the Columbia River is the only place in Oregon where commercial fresh water salmon fishing is presently permitted [4,20]. However, many ports receive commercially-caught salmon taken in nearby ocean areas. Included among them during 1971 were [34]:

Astoria	
Nehalem	
Tillamook	North Coast Basin
Pacific City (Nestucca)	
Depoe	
Newport (Yaquina)	Mid-Coast Basin
Florence (Siuslaw)	
Winchester Bay (Umpqua)	Umpqua River Basin
Coos	
Bandon (Coquille)	
Port Orford	South Coast Basin
Brookings	
Gold Beach	Rogue River Basin

Statistics of commercial landings received at ports on the estuaries of this report are given in Tables D and E.

Table D. Commercial harvest of food fish in pounds round weight at Oregon estuaries [34].

Receiving port	Chinook	Coho	Green sturgeon	Shad	Striped bass	Smelt	Pinks	Crabs	Clams	Shrimp	Albacore tuna	Groundfish	Oysters	Misc.	Totals
Astoria	162,631	788,509	25,886	--	---	---	110	5,148,741	30,227	1,797,242	11,293,939	10,524,609	---	---	29,750,716
Nehalem Bay	---	524	---	---	---	---	---	---	589	---	---	262	---	---	1,375
Tillamook	18,449	777,671	---	---	---	---	5	987,058	5,948	896,080	118,217	72,689	239,136	---	3,115,941
Netarts Bay	---	---	---	---	---	---	---	21,761	1,598	---	---	---	---	---	23,359
Sand Lake	---	---	---	---	no information	---	---	---	---	---	---	---	---	---	---
Pacific City (Nestucca)	18,347	792,773	---	---	---	---	17	142	---	---	7,924	45,030	---	148	864,381
Salmon River	---	---	---	---	no information	---	---	---	---	---	---	---	---	---	---
Siletz	---	---	---	---	---	---	---	---	---	---	---	---	---	176	176
Newport (Yaquina)	104,876	1,695,469	9,599	---	---	350	1,848	3,624,105	2,039	3,601,879	998,262	2,369,197	39,560	---	12,447,184
Waldport (Alsea)	---	---	---	---	---	---	---	3,914	---	---	---	---	---	6,877	10,791
Florence (Siuslaw)	6,898	133,395	---	8,290	1,242	40	---	134,213	---	---	12,003	2,293	---	---	298,374
Winchester Bay (Umpqua)	2,377	781,611	50	246,968	56,321	5,976	1,580	809,070	7,459	81,330	13,766	4,561,702	---	---	6,592,210
Coos	128,945	2,119,332	---	54,973	8,884	---	929	1,898,998	10,892	1,521,483	376,877	2,688,307	208	---	8,809,929
Randon (Coquille)	48,113	440,728	---	11,607	537	---	1,912	20,328	---	---	660	7,037	---	---	530,922
Port Orford	77,530	260,046	---	---	---	---	1,647	469,500	---	410,672	11	552,890	---	---	1,772,296
Gold Beach	45,052	185,414	---	---	---	---	45	300	---	---	953	5,830	---	---	237,594
Brookings	492,015	1,478,040	---	---	---	---	904	1,072,526	---	766,320	240,004	1,178,134	---	---	5,227,943

1 Total miscellaneous landings consisted of 8,002 shrimp (16%), 39,537 crawfish (78%), and 3,000 eel (6%).

Table E. Estimated fishermen value of food fish landings received at Oregon estuaries, 1971 [34].

Receiving port	Chinook	Coho	Green Sturgeon	Shad	Striped bass	Smelt	Pinks	Crabs	Clams	Shrimp	Albacore tuna	Groundfish	Oysters	Misc. 1	Totals
Astoria	\$ 75,000	\$247,000	---	---	---	---	---	\$1,184,000	\$ 18,000	\$208,000	\$3,086,000	\$865,000	---	---	\$5,683,000
Nehalem Bay	---	---	---	---	---	no information	---	---	---	---	---	---	---	---	---
Tillamook	10,000	243,000	---	---	---	---	---	227,000	1,000	109,000	37,000	6,000	\$270,000	\$1,000	904,000
Netarts Bay	---	---	---	---	---	---	---	5,000	---	---	---	---	---	---	5,000
Sand Lake	---	---	---	---	---	no information	---	---	---	---	---	---	---	---	---
Pacific City (Nestucca)	10,000	248,000	---	---	---	---	---	---	---	---	5,000	4,000	---	---	265,000
Salmon River	---	---	---	---	---	no information	---	---	---	---	---	---	---	---	---
Siletz	---	---	---	---	---	no information	---	---	---	---	---	---	---	---	---
Newport (Yaquina)	63,000	531,000	\$1,000	---	---	---	\$1,000	1,087,000	---	431,000	302,000	195,000	81,000	---	2,682,000
Waldport (Alsea)	---	---	---	---	---	---	---	---	1,000	---	---	---	---	7,000	8,000
Florence (Siuslaw)	4,000	42,000	---	\$ 1,000	---	---	---	40,000	---	---	4,000	---	---	---	91,000
Winchester Bay (Umqua)	15,000	245,000	---	34,000	\$9,000	\$2,000	---	283,000	1,000	10,000	4,000	375,000	---	---	978,000
Coes	66,000	663,000	---	8,000	1,000	---	---	665,000	1,000	197,000	112,000	221,000	---	---	1,934,000
Randon (Comille)	27,000	138,000	---	2,000	---	---	1,000	7,000	---	---	---	1,000	---	---	176,000
Port Orford	40,000	81,000	---	---	---	---	1,000	164,000	---	54,000	---	45,000	---	---	385,000
Gold Beach	23,000	58,000	---	---	---	---	---	---	---	---	---	---	---	---	81,000
Brookings	242,000	463,000	---	---	---	---	---	---	376,000	101,000	71,000	97,000	---	---	1,550,000

1 Total miscellaneous landings consisted of 8,002 shrimp (16%), 39,537 crawfish (78%), and 3,000 eel (6%).

Recreational

The information given in this section is concerned primarily with angling activities, although parks, campgrounds, and boat landings have also been at least partially listed.

The major references were again provided by the OSGC [75,76,77,78,79] and the FCO [38]. One of these, the 1971 Estuarine Resource Use Study conducted by the FCO [38], ⁽⁵⁾ is mentioned in most of the reports and should be explained to some extent. In the study itself, the total number of landings by boat and shore angling, clamming, and scuba diving were recorded for each estuary by species between March and October 1971. Fish such as salmon and trout which are under the jurisdiction of the OSGC were excluded from the study. The information given here lists only the three species most commonly caught (in order of frequency) by boat and shore angling and by clam digging--scuba diving catches were usually omitted since they accounted for a very small percentage of the total catch.

The task of developing and operating public recreation areas at the state level is the responsibility of the Parks and Recreation Section of the Oregon State Highway Division [122], and it was from that agency that a listing of state parks located on the estuaries with a day user and camper attendance figures was obtained [67,68]. Other parks, boat landings, and national forests in each area are also mentioned in this section, although the information is far from complete.

Table of Surveillance Stations

This includes climatological, stream and crest stage gaging, water quality, water temperature, and chemical analysis stations for which references were found. Where available, the following information was included for each station: its name and/or an identifying number (usually USGS); an approximate location; the drainage area at its location; the period of record; and the reference(s) which mentioned the station.

In describing the period of record, the dates may not always be accurate since some refer to the water year and some refer to the calendar year, and the distinction was not always noted. (The water year runs from October first of one year to September 30th of the next, and it is designated by the calendar year in which it ends--records between October 1, 1954 and September 30, 1955 fall in the 1955 water year, and therefore would be considered as dating from 1955, although the records would actually date from 1954.)

In noting the period of record, an asteric (*) denotes it as being periodic while a dash (-) indicates a continuous record. In many instances, the second date given is in parentheses ().

(5) Preliminary data was presented here; publication is scheduled for March 1973.

This indicates that it is not necessarily the last date of record, but merely the last one for which records were found. Those dates not in parentheses denote the final date of record. For example, 1915*1925 would mean that records were kept periodically from 1915 to 1925; 1915-(1968) would mean that records were kept continuously from 1915 through 1968 with 1968 being the most recent record found.

Definitions

anadromous--migrating up rivers from the sea to breed in fresh water.

biochemical oxygen demand (BOD)--a measure of the oxygen necessary to satisfy the requirements of microbes for the aerobic decomposition of organic matter. The amount of oxygen consumed in the test can be used as a direct measure of biodegradable organic matter.

coliform--a group of bacteria with various habitats (e.g., soil, plants, insects, old sewage, intestines of warm-blooded animals, previously-polluted waters), the presence of which reflects the safety of water.

diurnal range--the range between the highest and lowest tides occurring during one tidal day.

diurnal tide--tides having a period or cycle of approximately one tidal day. Such tides exhibit only one high and one low water during a tidal day; the predominant type of tide in the Gulf of Mexico [69].

drainage basin--a part of the surface of the earth that is occupied by a drainage system, which consists of a surface stream or a body of impounded surface water together with all tributary surface streams and bodies of impounded surface water [139].

extreme tidal range--the range between the highest and lowest tides of the year.

fecal coliform--the type of coliform bacteria found in the intestines of warm-blooded animals, the presence of which reflects the safety of water.

fresh water yield--the fresh water contribution in a stream to an estuary.

game fish--fish of major recreational interest (e.g., salmon, bass, trout, shad).

head of high tide--the farthest point up a stream that tidal fluctuations are felt.

high water (HW)--same as high tide; the maximum height reached by each rising tide [127].

higher high water (HHW)--the higher of the two high waters of any tidal day. The single high water occurring daily during periods when the tide is diurnal is considered to be a higher high water [127].

higher low water (HLW)--the higher of two low waters of any tidal day [127].

littoral drift--the material moved in the littoral (shore) zone under the influence of waves and currents [127].

low water (LW)--same as low tide; the minimum height reached by each falling tide [127].

lower high water (LHW)--the lower of the two high waters of any tidal day [127]. 21

lower low water (LLW)--the lower of the two low waters of any tidal day. The single low water occurring daily during periods when the tide is diurnal is considered to be a lower low water [127].

mean high tide (MHT)--same as mean high water [69].

mean high water (MHW)--the average height of the high waters over a 19-year period. All high waters are included in the average where the tide is either semidiurnal or mixed. Where the type of tide is predominantly diurnal, only the higher high-water heights are included in the average on those days when the tide is semidiurnal [69].

mean higher high tide (MHHT)--same as mean higher high water [69].

mean higher high water (MHHW)--the average height of the higher high waters over a 19-year period [69].

mean low tide (MLT)--same as mean low water [69].

mean low water (MLW)--the average height of the low waters over a 19-year period. All low water heights are included in the average where the type of tide is either semidiurnal or mixed. Where the type of tide is predominantly diurnal, only the lower low water heights are included in the average on those days when the tide becomes semidiurnal [69].

mean lower low water (MLLW)--the average height of the lower low waters over a 19-year period [69].

mean sea level (MSL)--the average height of the surface of the sea for all stages of the tide over a 19-year period, usually determined from hourly height readings. A determination of mean sea level that has been adapted as a standard for heights is called a sea level datum [69].

mean tide level (MTL)--a tidal datum midway between mean high water and mean low water. Also called half-tide level [69].

mean tide range--the average range of consecutive high and low tides over a 19-year period.

mixed tides--tides in which the presence of a diurnal wave is conspicuous by a large inequality in either the high or low-water heights, or in both, with two high waters and two low waters occurring each tidal day. Tides along the California (and Oregon) Coast are of the mixed type [69].

non-game fish--those which are of no major recreational interest (e.g., suckers, shiners, sculpin).

non-salmonid game fish--warm-water game fish (e.g., bass, crappie, bluegills).

partly-mixed system--see Introduction.

parts per thousand (ppt)--a unit for expressing the concentration of chemical constituents by weight, usually as grams of constituent per thousand grams of a solution.

Pearl-Benson Index (PBI)--a measure of the lignin content of pulp wastes [136].

salinity intrusion--the farthest point at which salinity can be measured.

salmonid--a fish of the family Salmonidae, which includes salmon, trout, chars, and whitefishes.

sediment load--the quantity of sediment being transported hydraulically.

semidiurnal tides--tides having a period of approximately one-half a tidal day; the type of tide that is predominant throughout the world, with two high waters and two low waters each tidal day. Tides along the Atlantic Coast are of this type [69].

submerged lands--lands lying below the line of ordinary low water [69].

submersible lands--lands lying between the line of ordinary high water and the line of ordinary low water [69].

tidal prism--the total amount of water that flows into a harbor or estuary and out again with movement of the tide, excluding any fresh water flow [127].

tidal prism on mean range--the tidal prism between the extremes of the mean tide range.

tidelands--the land that is covered and uncovered by the daily rise and fall of the tide; the zone between the mean high-water line and the mean low-water line [69].

tidewater--same as head of high tide.

two-layered system--see Introduction.

void ratio--the ratio of the volume of voids (fluids) to the volume of solids.

well-mixed system--see Introduction.

ALSEA BAY

ALSEA BAY

General Description of Estuary and Drainage Basin

Estuary

Alsea Bay lies roughly 130 miles south of the mouth of the Columbia River. Of the estuaries included here, it ranks 7th in size (Table A). The only incorporated town in the area is Waldport, located on the south side of the bay near the mouth. This and other population centers on the estuary are given in Table 1 with their locations and 1970 populations [94,111].

Table 1. Population centers at Alsea Bay¹ [94,111]

name	general location	river mile location	1970 population
Waldport ²	Alsea River; south side	0.7 to 2.7	700
Bayview	Alsea River; north side	2.2	rural
Little Albany	Alsea River	10.6	50
Tidewater	Alsea River; north side	11.7	150
Little Switzerland	Alsea River; north side	12.7	not listed

¹Tidal effects extend approximately to mile 16 of the Alsea River and to mile 5.5 of Drift Creek.

²Incorporated

The estuary measures 7,500 feet at its widest point [60] and covers about 2,170 acres. Surface areas reported by Johnson [55], Marriage [59], and the Division of State Lands [70] are given in Table 2, and cross-sectional areas at MTL at various distances from the mouth are shown in Table 3.

Table 2. Reported surface areas of Alsea Bay [55,59,70].

reference	surface area (acres)	measured at	tidelands		submerged lands	
			acres	percent	acres	percent
[6]	2,140	HW				
[63]	2,227	1				
[117]	2,146 1,168	MHT MLT	979	46	1,168	54

¹Specified by Marriage as the area affected by tidal action.

Alsea Bay

Table 3. Cross-sectional areas of Alsea Bay [43].

point of measurement	distance from mouth (miles) ¹	cross-sectional area (sq ft)
throat	0	8,000
Waldport	1.9	15,000
Oakland	5.7	4,600
Kozy Kove	11.7	2,100

¹Mile values were obtained by conversion from the distances reported in feet.

The estuary consists essentially of the lower reaches of the Alsea River, which is charted as having its zero mile at the mouth of Alsea Bay. The river drains an area of 474 sq mi and is formed at mile 48.7 by the North Fork Alsea River (total length 15.0 miles) and the South Fork Alsea River (total length 17.4 miles). Tributaries to head of high tide at mile 16 include Drift Creek from the north at mile 5.1 and about 21 smaller creeks and sloughs. Drift Creek measures 29.2 miles to its source and has a drainage area of 69 sq mi [88,94].

A good deal of information on Alsea Bay was presented in a 1971 dissertation by A.L. Matson entitled "Zooplankton and Hydrography of Alsea Bay, Oregon, September 1966 to September 1968" [60], and the work is referred to frequently in this chapter.

The Port of Alsea is located at Waldport, and can be contacted at P.O. Box 638, Waldport, Oregon 97394; 563-3564 [106].

Drainage Basin

Alsea Bay has a drainage basin of 474 sq mi [94] which yields an average of 1,500,000 ac-ft of fresh water annually (estimate based on data collected from 1937 to 1963) [88]. A large part of the rugged and mountainous basin is within the Siuslaw National Forest [49]. It consists of 94% (446 sq mi) forests; 3% (14 sq mi) cropland and 3% (14 sq mi) ranges and "other uses" [88].

Precipitation averages 80 to 90 inches annually, with 60 inches per year occurring along the coast and 110 inches per year in the upper watershed. There is a climatological station located on the Alsea River near mile 11.5 from which precipitation records are available through the OSWRB (Table 10) [19,88,92,143]. Elevations range from 0 to 3,000 feet [88].

Alsea Bay

Hydraulic Description of Estuary

Tides and Currents

The bay is described as being fully exposed to waves at the throat [55]. The head of high tide is at mile 16 of the Alsea River and mile 5.5 of Drift Creek [43].

The mean tidal range is 5.8 feet with a diurnal range of 7.7 feet [55]. Goodwin reported a tidal prism on mean range of 5×10^8 cu ft (tidal prism between MLLW and MHHW), and he noted a "choking" of tidal range occurring from the entrance of the estuary to the Oakland Marina Station (5.7 miles from the mouth) [43]. Beyond the marina station, amplification of the tidal range occurred. Goodwin also looked at the phase difference between tidal elevations and tidal currents and found it to be equal to 90 to 100 degrees. A calibrated numerical tidal hydraulic model of the Alsea has been provided by Goodwin [42]. Currents and tidal ranges have been measured (1973) to determine the times of maximum ebb and flood flow [62].

River Discharges

Stream flow records are available from USGS stream gaging stations on the Alsea River and Drift Creek (Table 10) [140]. The Alsea River station is located at river mile 21.0. The one on Drift Creek, no longer operating as of 1970, was located at mile 21.8, where the drainage area is 20.5 sq mi or 27% of the stream's total drainage basin. Streamflow averages and extremes for these two stations are given in Table 4 [140]. The combined average flow rate of the Alsea River and Drift Creek is estimated as 2,070 cfs [86].

Table 4. Flow rates of Alsea Bay tributaries [140].

stream	point of measurement (river mile)	drainage area (sq mi)	complete water years of record	flow rate (cfs)		
				maximum	minimum	mean
Alsea River	21.0	334	1939-1970	41,800 12/64	45 9/65	1,534
Drift Creek	21.8	20.5	1957-1963 1966-1970 (discontinued)	2,500 10/62	3.8 9/58	120

Salinity and Classification by Mixing

Matson measured salinity intrusion to mile 13.8 of the Alsea River [60]. This was in August 1967 at high tide when stream flow was 63 cfs. Measurements by Burt and McAllister in October 1957 and January, March, July 1958 showed intrusion to mile 13.0 (October 8, 1957 at HHW) at a concentration of 0.1 ppt on the surface and at the bottom [12]. Concurrent temperatures were 12.9°C. No salinity was detected at mile 13.7.

Alsea Bay

On the basis of mixing characteristics, Burt and McAllister [13] and Matson [60] have described the estuary as a partly-mixed system. Burt and McAllister collected data at high tide during January, March, April and October; Matson collected data at all tidal stages from September 1966 to September 1968. During that two-year period, Matson also looked at four sites in the estuary (the mouth, 5,000 feet, 2.3 miles, and 4.6+ miles) for long-term layering of waters of different densities and found that the site at mile 4.6+ was the only one where such layering might occur.

Giger [39] provides salinities with depth and length for high and low tides during winter (1968), spring (1968), and summer (1967) conditions. This data show salinity intrusion during the summer to a distance of 13-14 miles from the mouth while winter salinity intrusion extended to 4-5 miles from the mouth. Vertical stratification appears to occur to some degree during all seasons.

Seasonal (1973) measurements of salinity, temperature, turbidity, pH and dissolved oxygen have been taken for high and low tides with depth and length within the estuary [62].

Sediments

Littoral drift in the area varies throughout the year but tends to be northward in the winter and southward in the summer with the net drift to the south [57]. Sediments deposited in the estuary by its tributaries are estimated at 249,000 tons annually [85].

Water Quality Information

The DEQ operates six water surveillance stations at Alsea Bay (listed in Table 10) for which records of measurements taken 5 times between July 1969 and December 1971 are available [67, 68]. There is also a USGS water temperature station at mile 21 of the Alsea River (Table 10) [139]. Temperature ranges recorded at this point and at two sites in the Alsea River monitored by Matson [60] are presented in Table 5.

Table 5. Temperature extremes of the Alsea River [60,139].

point of measurement	period of record	observed temperature extremes (°C)	
		maximum	minimum
mouth	9/66-9/68	16	7
		surface	
mile 5	9/66-9/68	22	4
		surface	
mile 12	1947-1962 (110 spot observations)	25.6	0.6

Alsea Bay

The city of Waldport operates the only sewage treatment plant in the Alsea Bay area. It is located on the east side of town in the "old town" section and serves the Waldport population only. Average daily flow is estimated at 90,000 gallons. Presently a primary treatment facility, it will be secondary on completion of the new addition now in progress [21].

Biological Information

Estimates of the number of adult anadromous Salmonids spawning in the Alsea River system are as follows: spring chinook--300, fall chinook--20,000, coho--58,000, winter steelhead--13,600, summer steelhead--200, and sea-run cutthroat--28,600 [75]. A comparison with other stream systems of the Mid-Coast Basin (Table B) shows that the Alsea River system has the highest estimated numbers of fall chinook, coho, and winter steelhead spawning in its waters.

Species supported in the estuary which are of interest to fishermen include salmon, staghorn sculpin, flounder, perch, crab, shrimp, and cockle, gaper, and softshell clams. The softshells are found primarily two miles upstream from Waldport and are more abundant than the cockle and gaper clams [38,53,155].

In Matson's study conducted from September 1966 to September 1968, he looked at zooplankton in the estuary and found the following species accounting for the greatest percentage of the total number: Acartia clausi (found mainly in the center of the estuary)--40%; Barnacle Nauplii (equally distributed upstream and downstream)--11%; and Pseudocalanus sp (found more downstream)--8.1% [60].

The area around the estuary is considered a big game winter range primarily for black-tailed deer (the most abundant big game), Roosevelt elk (now being transplanted to the Mid Coast Basin by the OSGC), black bear, and cougar [75].

Lint Slough, which discharges into the Alsea River from the south at mile 1.8, is used as an OSGC experimental station for rearing salmon under saline conditions [155].

Physical Alterations

Jetties have not been constructed, but a basin project providing for a protective breakwater, an entrance channel, and a small boat basin at Waldport has been approved [129]. A date for beginning the project had not been given as of 1971 (publication date). A portion of the present channel, located along the south side of the estuary, was excavated in 1948 and met a previously-existing south channel, which ran between the highway 101 bridge and the entrance of Drift Creek, at some point

Alsea Bay

upstream. This channel system measures 1,400 feet at its widest point. A northern channel in the estuary was blocked off in three places sometime before June 1962. The channel to the ocean shifts (the controlling depth is about 6 to 7 feet), limiting navigation [60]. Navigable length of the Alsea River is 13.0 miles; that of Drift Creek is 1.5 miles [69].

The inventory of filled lands in the Alsea River has been completed by the Division of State Lands [69]. Table C shows some of the information from that report.

Under the "Coastal 60-40 Program" the FCO constructed three fishways in the Alsea River system--one on Five Rivers and two on Drift Creek. The Five Rivers Fishway, located 1 mile above the town of Paris (or approximately at mile 18), was completed in 1963. The Drift Creek Fishways were completed in 1964 and are located about 15 miles south of Toledo. In 1963 a spawning channel on Cherry Creek, about one mile below the town of Fisher, was also constructed under the program [119].

There are two hatcheries in the Alsea River system--one operated by the FCO and the other by the OSGC. The FCO Alsea River Salmon Hatchery is between miles 3 and 4 of Fall Creek, or approximately 35 miles from the estuary mouth [54]. Releases from it between July 1, 1968 and June 3, 1969 were to Fall Creek and tributaries of the Coos and Coquille Rivers and consisted of 3,006,149 salmon and steelhead [33]. The OSGC hatchery, located on the North Fork Alsea River near the town of Alsea and a little over 50 miles from the estuary mouth [56], released 900,555 winter steelhead in 1968. During 1970, its releases totaled 1,942,636 and consisted of 967,809 winter steelhead, 678,738 fall chinook, and 296,089 cutthroat trout [80].

Estuary Uses

Industrial and Commercial

Lumber-related activities, tourism, and agriculture are of major economic importance to the area [69,153,155]. Most manufacturers there, listed in Table 6, are involved with logging activities [71,153]. Industrial use of the bay itself is limited to log towing [155]; it is not used for log raft storage, and there are no industries actually on it [102].

Commercial fishing, from the estuary or otherwise, provides a very limited income as indicated by the commercial harvest figures shown in Tables 7 and 8.

Alsea Bay

Table 6. Major Manufacturers at Alsea Bay [71].

Location	Name	Type of Business	Number employed
Waldport	M and W Lumber Co.	logging	60
Waldport	Alsea Veneer	veneer core	20
Waldport	W.H. Meinert Co.	cutting contractor	5
Waldport	McKinley Lumber Co.	railroad spike-hole plugs	3
Waldport	M.R. Kittel Logging	logging	1
Waldport	Waldport Ready Mix	ready mix	
Tidewater	Gerald Smallwood Logging	logging	4
Tidewater	Julian F. Smallwood	logging	4
Alsea	Tidewater Crushing Co.	crushed rock	6

Table 7. Commercial Harvest of Clams, Crabs, and Bait Shrimp from Alsea Bay [75,118].

Species	1969		1970 pounds landed	1971 pounds landed
	pounds landed	fishermen value		
Clams	16	prices vary according to species and market		
Crabs	21,000	\$5,250	3,249	3,316
Bait Shrimp	5,500	7,220 (retail)		

Alsea Bay

Recreational

The main recreational activities in the area are fishing, boating, agate hunting, clamming, and crabbing [153]. Angling data shown in Table 9 indicate that salmon fishing from the estuary is especially popular. In fact, more time and money are spent on this sport there than at any other Mid-Coast Basin estuary [75]. The best time for chinook trolling is during August and September, and the coho run begins in mid September and peaks in October [58]. Sea-run cutthroat can be taken from July to November [58]. Species other than salmon and trout most commonly caught during the FCO study from March to October 1971 include staghorn sculpin, starry flounder, and shiner perch by shore angling; dungeness crab and relatively few staghorn sculpin and redbtail seaperch by boat angling, and ghost shrimp, cockle and softshell clams by clamming [38].

Alsea Bay

Table 8. Commercial Harvest of Food Fish Received at Waldport 1971⁽¹⁾ [34].

Species	Harvest (pounds round weight)	Fishermen value
Crabs	3,914	\$1,000
Miscellaneous ⁽²⁾	6,877	7,000
Totals	10,791	\$8,000

¹Includes 1971 data presented in Table 7.

²Sand shrimp, crawfish, eel

Table 9. Estimated Annual Harvest Data for Sport Fishing At Alsea Bay⁽¹⁾ [75].

Species	area fished	annual harvest (total number)	effort (angler-days)	gross expenditures
Salmon	Estuary	6,900	27,600	\$510,600
	Alsea River	1,730	6,920	128,020
Sea-run cutthroat	Estuary	4,550	10,500	194,250
	Alsea River	650		
Steelhead	Alsea River	6,000	24,000	444,000
Non-salmonid bay fish	Estuary	15,000	5,000	30,000

¹Average of data from past years.

Alsea Bay

Table 10. Surveillance Stations at Alsea Bay.

type of station	name and/or identifying number	approximate location	drainage area (sq.mi)	period of record	references
climatological	Tidewater	Alsea River; mile 11.5	58	1940-(1968)	[88,92,143] ¹
stream gaging	Alsea River near Tidewater; USGS #3065	Alsea River; mile 21	334	1939-(1970)	[88,98,140] ²
	Drift Creek near Salado; USGS #3066	Drift Creek; mile 21.8	20.5	1958-1963 1965-1970	[140]
crest stage gaging	South Fork Weist Creek near Waldport	South Fork Weist Creek; mile 1 (about 6 miles from the estuary mouth)	0.33	1953-(1963)	[88]
DEQ water surveillance	#1	Highway 101 bridge at Waldport (mile 0.9)		7/69-(12/71) (5 measurements)	[67,68]
	#2	channel at mouth of Lint Slough (mile 1.8)		"	"
	#3	channel 50 yards below the mid-channel island (mile 2.9)		"	"
	#4	channel opposite boat docks at Chevron gas outlet (mile 3.9)		"	"
	#5	Alsea River at high tension wire crossing (mile 4.9)		"	"
	#6	Alsea River; 1.25 miles above Highway 34 bridge (mile 9.7)		"	"
water quality	Alsea River near Tidewater; USGS #3065	Alsea River; mile 21	334	1958-1959 (spot observations)	[88]
water quality	Drift Creek above Tidewater			1958-1959 (spot observations)	[88]
water temperature	Alsea River near Tidewater; USGS #3065		334	1947-1962 (110 spot observations)	[88,139]

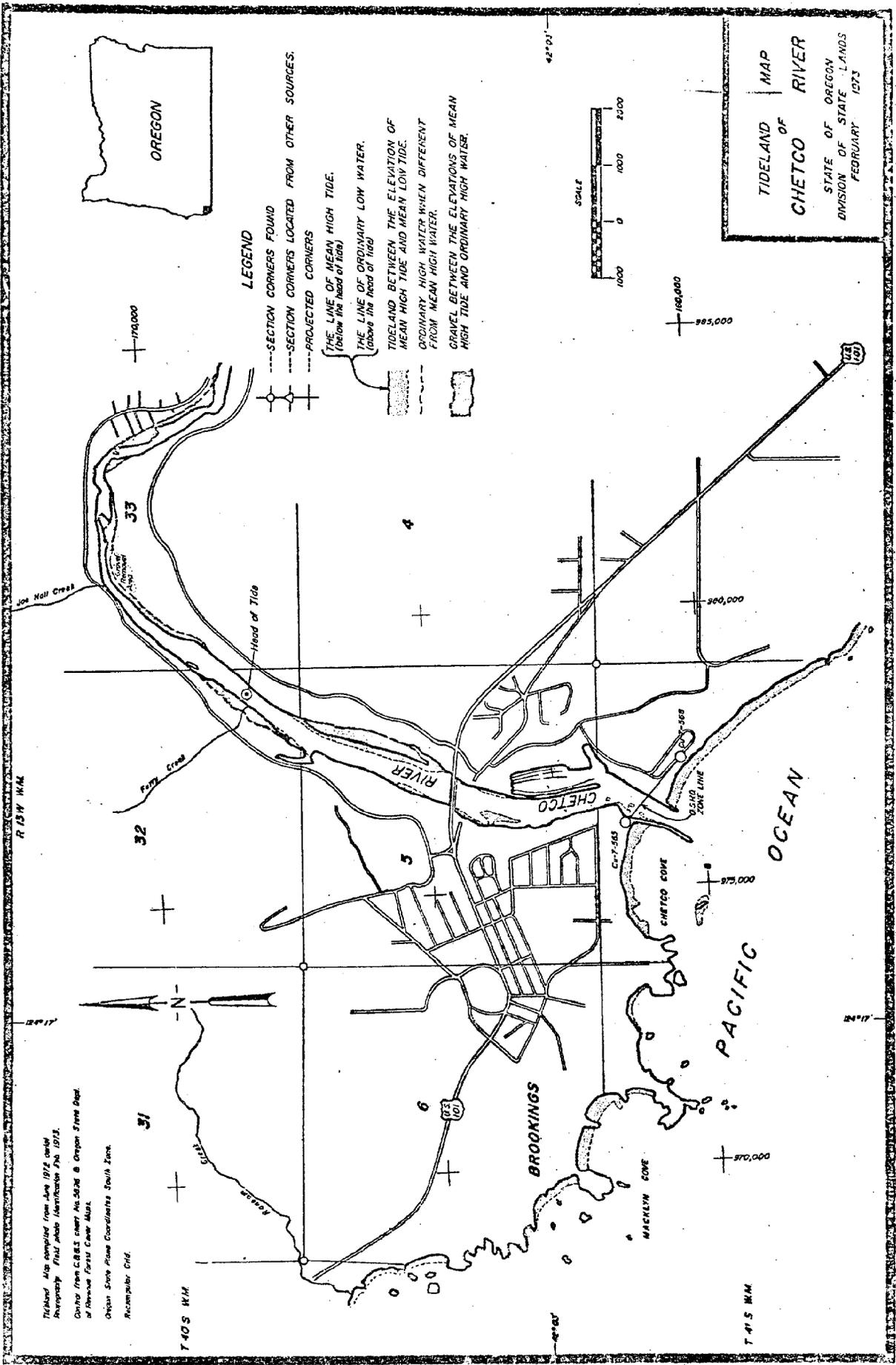
¹Precipitation data available in punch card or printout form through the OSWRB.

²Monthly and water-year runoff records have been compiled and are available in punch card or printout form through the OSWRB.

³Data available in punch card or printout form through the DEQ.

() This is the most recent record date found and is not necessarily the last.

CHETCO BAY



This Map was compiled from June 1972 aerial photography. Field photo identification No. 1973. Control from CBRS sheet No. 5026 & Oregon State Dept. of Revenue Field Control Map. Oregon State Plane Coordinates South Zone. Rectangular Grid.

CHETCO BAY

General Description of Estuary and Drainage Basin

Estuary

The Chetco River discharges into the Pacific Ocean at a point 300 miles south of the Columbia River mouth. The estuary is the smallest of those included here (Table A), and the area around it is sparsely populated. The only two towns near the Chetco River are Brookings and Harbor, both at the mouth. Brookings lies to the north between miles 0 and 1.1. It was incorporated in 1951 and had a 1970 population of 2,720. Harbor, with a 1970 population of 900, lies on the south side of the estuary at mile 0.7 [96,111].

The HW surface area of the estuary, is estimated from the 1954 USGS Cape Ferrelo Quad., is 140 acres [55].

The estuary consists primarily of the lower reaches of the Chetco River, which has a length of 58.0 mi. and drains an area of 359 sq. mi. [96]. One of the larger tributaries to the estuary is the North Fork at mile 5.4 with a length of only about 14 miles and drainage area 40 sq. mi.

The port commission for the area is Port of Brookings, P.O. Box 848, Brookings, Oregon, 97415; telephone number 469-2219 [106]. The Port Commission and Curry County Planning Commission have jurisdiction over planning and regulating land use [81].

Drainage Basin

The 359 sq. mi. drainage basin is comprised mainly of forests, although some of the area around the estuary is used for pasture and hay, rangelands can be found slightly upstream [93]. Much of the inland portion of the basin is within the Siskiyou National Forest. Annual fresh water yield of the Chetco River at its mouth was estimated to average 1,230,000 ac-ft during the period from 1930 to 1961, although there were no complete water years of record. Extremes of the annual average were 1,570,000 ac-ft and 740,000 ac-ft [93].

Annual rainfall in the basin averages from 80 inches along the coast to 120 inches near the headwaters of the Chetco River. Growing season in the basin lasts about 250 days. Monthly precipitation at Brookings, where the elevation is 80 feet, averages from less than an inch (July and August) to almost 13 inches (December and January). The climatological station at Brookings (Table 7) has records dating back to 1912 which are available on punch cards.

Elevations of the Chetco Basin watershed range from sea level to 5,098 feet at Pearsoll Peak in the western region [93]. Average wind direction in the vicinity of the estuary during the period from 1937 to 1942 was as follows: November, December, January, February, and March--northeast; April, May, and June--northwest; July and August--south; September--northwest; and October--north [7].

The Chetco River stream profile appears on page 43.

CHETCO BAY

Hydraulic Description of Estuary

Tides and Currents

The estuary is described as being partially--exposed to waves at the throat. The mean tide range is 5.1 feet with a diurnal range of 6.9 feet [55].

River Discharges

The only stream gaging station in the basin for which records were found is located at mile 10.7 of the Chetco River. Also, there are crest stage gaging stations on Harris and Ransom Creeks near Brookings (both streams discharge directly into the ocean just to the north of the estuary.) More descriptions of these three stations are given in Table 7, and discharge records are included in Table 1. Also shown in Table 1 is information concerning minimum miscellaneous discharge measurements taken periodically since 1926 in the Chetco River below the mouth of the North Fork at mile 5.4. Estimates of the average monthly discharge of the Chetco River at the mouth for 1930 to 1961 have been presented in "South Coast Basin," [93]. These show the high average flow rate occurring in February (4,000 cfs) and the low in September (130 cfs) with a twelve-month mean of 1,700 cfs.

Salinity and Classification by Mixing

No information.

Sediments

Net littoral drift in the area is from north to south [57].

Results of analyses of two dredge samples taken from the Chetco River by the Corps of Engineers in July 1971 showed organic contents ranging from 1.83% to 4.04%, void ratios from 0.577 to 0.769, and mean grain size medium to fine sand [124].

Water Quality Information

At the present time, the DEQ has no water surveillance stations on the Chetco River.

Thermograph records taken at mile 4.4 of the Chetco River on August and September of 1962 (Table 7) show a mean water temperature in August of 66°F and extremes of 73°F and 62°F and September with a mean temperature of 63°F and extremes of 69°F and 58°F [138].

As of 1963, the only sewage treatment plant in the area was a primary facility serving a population of 3,000 and capable of serving 5,000 [93].

CHETCO BAY

Table 1. Flow rates of the Chetco River and nearby coastal tributaries [93,140].

Stream	Point of measurement	Drainage area (sq.mi.)	Period of record	Flow rate (cfs)	
				maximum	minimum
Chetco River (near Brookings)	mile 10.7	271	10/69-(1971)	65,800 (1/16/71)	52 (10/14,15,/70)
Chetco River ⁽¹⁾	below mouth of the North Fork		1926*1952	---	47.70 (9/31)
Ransom Creek ^(2,3) (near Brookings)			1953-1961	300 (1/53)	---
Harris Creek ^(2,3) (near Brookings)			1953-1961	439 (12/54)	

(1) Minimum miscellaneous discharge measurements only.

(2) Annual maximum discharge measured at crest stage gaging stations.

(3) Ransom and Harris Creeks are coastal streams located just north of the Chetco R.

() This is the most recent record date found and is not necessarily the last.

* Period of record is not continuous.

Biological Information

Estimated number of adult anadromous salmonids spawning in the Chetco River are as follows: spring chinook--0; fall chinook--3,000; coho--500; steelhead--4,000; and sea-run cutthroat--2,500 [78]. In comparison with other estuarine stream systems included here (Table B), these numbers are quite low.

Roosevelt elk are present in the watershed, but are not as numerous as in the northern section of the South Coast Basin. According to the preliminary report [70] to "Environmental Investigations. South Coast Basin," [78], the only significant wildlife area in the lower bay is a section where brown pelican feed on anchovies during the summer. Eel grass is not present in the estuary. Following is a check list of fishes, waterfowl, birds, and mammals found in the vicinity of Chetco Bay [81].

CHETCO BAY

Biological Information

Game fish found in the estuary at least during a part of the calendar year (in order of abundance) are: cutthroat trout, winter steelhead, fall chinook, coho, rainbow trout. Game birds found are: American widgeon, green-winged teal, pintail, scaup, ring-necked duck, bufflehead, common golden eye, and red-breasted merganser.

Shore and other birds most commonly found in or near Chetco Bay are: least sandpiper, western sandpiper, western gull, herring gull, California gull, belted kingfisher, double-crested cormorant, and brown pelican.

Medium common mammals found in or near Chetco Bay are: harbor seal, river otter, and the beaver. Uncommon mammals found are: California sea lion, stellers sea lion, mink and black-tailed deer.

Physical Alterations

Modifications to Chetco Bay, summarized in Table 2, were completed in 1957 with further alterations between 1965 and 1970. Studies to determine the feasibility of extending the jetties have been authorized, but funds have not yet been made available as of 1971 [129].

Water borne traffic through the channel project totaled 191,000 tons in 1969, consisting almost entirely of wood chips. Annual use between 1960 and 1969 averaged 99,000 tons [129].

Table 2. U.S. Army Corps of Engineers modifications to Chetco Bay [126,129].

Proposed modification	Location	Demensions			Date and stations ⁽¹⁾
		Depth (feet)	Width (feet)	Length	
North Jetty					1957-Completed 1965-Authorized 1970-Completed
South Jetty					1957-Completed 1962-Repairs completed
Entrance channel	through the bar	7 14	120 120		1965-Authorized 1970-Completed
Small boat basin and barge ship	down stream from Harbor	4			
Protective dike				1,800	1965-Authorized 1970-Completed
Small boat access channel		12	110		1965-Authorized 1970-Completed

(1) Lack of completion date does not necessarily signify that the modification has not been completed.

CHETCO BAY

Estuary Use

Industrial and Commercial

Economy of the basin depends primarily on forestry and the manufacture of wood products, Table 3. Wood products are shipped from the estuary, and use is made of adjacent lands for stockpiling of wood chips. Agriculture, commercial fishing, and recreation are also of importance. Mining does not make a considerable contribution, although there are several claims in the area. Most of the known mineral deposits, located in the headwaters of the Chetco River, are either chromite or gold [34,81].

Table 3. Major manufacturers at Chetco Bay [71].

Location	Name	Type of Business	Number Employed
Brookings	Brookings Plywood Corp.	(2432)	340
"	South Coast Lumber Co.	(2421)	165
"	Agnew Timber Co.	(2432)	100
"	Ferry Creek Rock and Concrete Inc.	(3273)	15
"	Pacific Rock and Paving	(2951)	15
"	Wood Logging Eugene S.	(2411)	15
	21 manufacturers employing 10 or less dealing in (2411).		
Harbor	Brookings Fiberglass Boat Inc.	(3732)	9
"	Kirkpatrick, DR	(2411)	1
"	Driftwood House	(2999)	

() Type of business is given in [71]: "Directory of Oregon Manufacturers, 1972 " Each manufacturer is listed under the number in parentheses.

CHETCO BAY

Estuary Use

Industrial and Commercial

Commercial food fish landings received at Brookings are shown in Table 4 and again in Tables D and E of the introduction. In comparison with landings received at other Oregon Ports, these figures are fairly high. Twenty-two percent of the 1970 commercial salmon catch of the South Coast Basin was received at Bandon. Total catch for the basin (South Coast) consisted of 3,000,000 pounds of coho and 1,200,000 pounds of chinook at a value to fishermen of \$2,500,000 [34,78].

Due to frequent flooding and drainage problems, agricultural use of the tidal areas consists primarily of dairying activities rather than hay and pasture. About 270 acres of the well-drained sandy soils south of Brookings are used for lily bulb production. Although the area used is relatively small, the activity is of considerable economic importance [93].

Table 4. Commercial harvest of food fish received at Brookings, 1971 [34].

Species	Harvest (pounds round weight)	Fisherman value
Coho	1,478,040	\$ 463,000
Groundfish	1,178,134	97,000
Crabs	1,072,526	376,000
Shrimp	766,320	101,000
Albacore tuna	240,004	71,000
Pinks	904	---
TOTALS	5,227,934	\$1,350,000

Recreational

Sport fishing at Chetco Bay is becoming increasingly popular. The Chetco River provides the best salmon and steelhead fishing south of the Rogue River. Chinook enter the river from September to mid-November. Coho are present from late in September through December. Casting from the up-river shores is most popular, although there is some trolling in the tidewater. Chinook fishing offshore generally begins in July; August and September are reportedly the best months for offshore coho fishing. Boats can be chartered at Brookings [58,81]. According to the FCO study from October to March 1971, there was a limited silver and striped perch fishery by shore anglers in the estuary. Boat angling for anchovy proved more successful [38]. Estimated salmon and trout annual harvest data for the area are given in Table 5 [78].

CHETCO BAY

Estuary Uses

Recreational

Table 5. Estimated annual harvest data for recreational fishing at Chetco Bay(1) [78]

Species	Area fished	Annual Harvest (total number)	Effort (anglerdays)	Gross Expenditures
Salmon	ocean	8,000	16,800	\$592,000
	estuary	1,400	3,500	103,000
	Chetco River system	100	400	7,400
Steelhead	Chetco River system	1,200	4,800	88,800
Sea-run Cutthroat	Chetco River system	150	100	1,850

(1) Average of data from past years.

Boating is also an important recreational activity and is directly associated with sport fishing [93]. The Chetco River boat landing is located at mile 0.2 [96]. In addition to fishing, hunting for black-tailed deer, elk, black bear, and waterfowl are also major recreational activities, but not in the immediate vicinity of the estuary.

State parks in the area number three. Two of these, Harris and Azalea Beaches, are located on the coast to the north. Camping is permitted at the former but not at the latter. The third park (Loeb) is situated at mile 5 of the Chetco River. Camping is also permitted there. Attendance figures for 1966, 1968, and 1970 are given in Table 6 [82].

CHETCO BAY

Table 6. State park annual attendance, 1966, 1968, and 1970 [82,83].

Park	1966	1968	1970
Azalea			
day visitors	84,836	72,116	190,568
Harris Beach			
day visitors	545,128	542,732	704,734
Camper nights	61,601	55,273	56,193
Loeb			
day visitors	75,104	78,024	86,946
camper nights	7,930	10,801	13,544

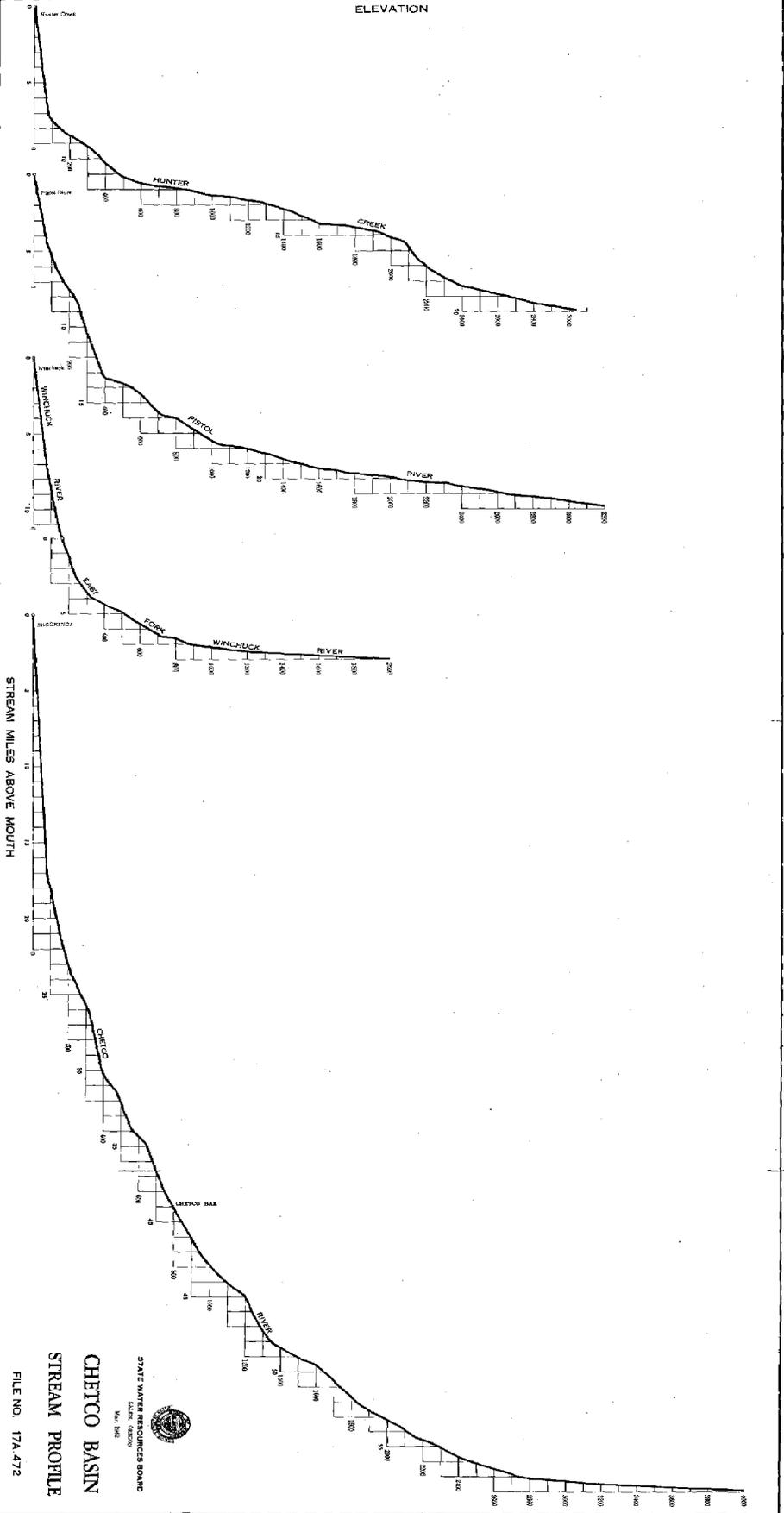
Table 7. Surveillance stations at Chetco Bay.

Type of station	Name and/ or identifying number	Approximate location	Drainage area (sq.mi.)	Period of record	Reference
Climatological	Brookings (formerly Harbor); USWB#1055	elevation--		1912-(1960)	[92,93] ⁽¹⁾
Stream gaging	Chetco River near Brookings	Chetco River; mile 10.7	271	10/69-(1971)	[140]
Crest stage gaging	Harris Creek near Brookings USGS#3788		1.05	1953-(1961)	[93]
	Ransom Creek near Brookings USGS#3789		0.74	1053-(1961)	[93]
Water temperature	Chetco River near Brookings	Chetco River; mile 4.4		August and September 1962	[138]

(1) Data available in punch card or printout form through the OSWRB.

() This is the most recent record date found and is not necessarily the last.

ELEVATION



STREAM MILES ABOVE MOUTH

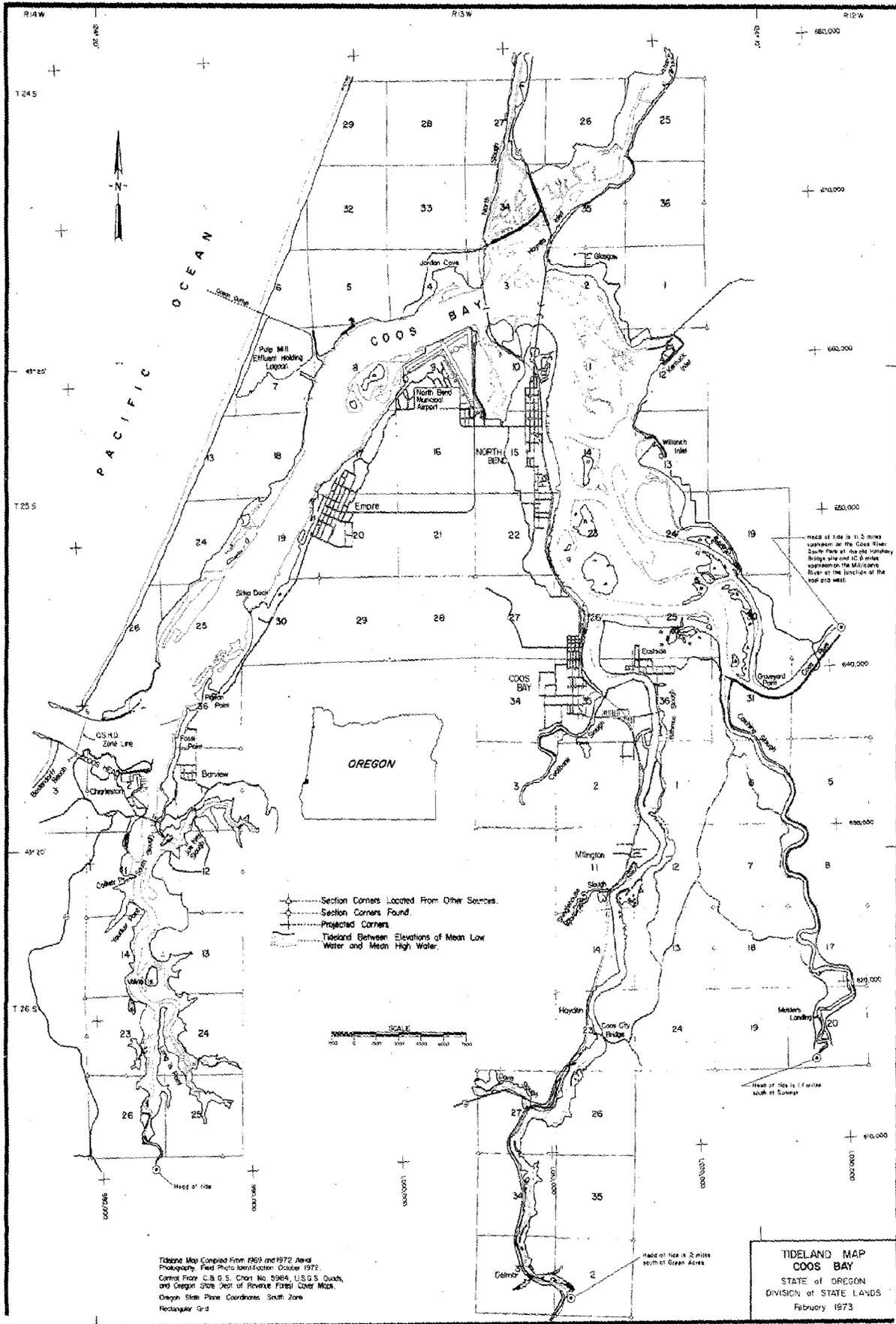
STATE WATER RESOURCES BOARD
 OREGON
 DEPT. OF AGRICULTURE
 DIVISION OF WATER RESOURCES
 1961, 1962

CHETCO BASIN
STREAM PROFILE

FILE NO. 17A-472



COOS BAY



Tidal Map Compiled From 1959 and 1972 Aerial
 Photography, Field Photo Interpretation, October 1972.
 Control From U.S. G.S. Chart No. 596A, U.S.G.S. Quads,
 and Oregon State Dept. of Revenue Forest Cover Maps.
 Oregon State Plane Coordinates, South Zone
 Rectangular Grid

TIDELAND MAP
COOS BAY
 STATE OF OREGON
 DIVISION OF STATE LANDS
 February 1973

- Section Corners Located From Other Sources.
- Section Corners Found.
- Projected Corners.
- Tideland Between Elevations of Mean Low Water and Mean High Water.

SCALE
 0 500 1000 1500 2000 2500 3000

Head of tide is 1/4 mile south of Sunset

Head of tide is 2 miles south of Green Acres

Head of tide is 11.5 miles upstream on the Coos River. South Fork at its old highway bridge site and 10.5 miles upstream on the Millican. Note at the junction of the top and west.

COOS BAY

General Description of Estuary and Drainage Basin

Estuary

Coos Bay, the largest of the estuaries included in this report (Table A), is located about 200 miles south of the mouth of the Columbia River. Most towns in its vicinity lie to the south. Their populations and very approximate locations are given in Table 1.

Table 1. Population centers at Coos Bay¹ [24,96,111].

name	general location	river mile location	approximate distance from estuary mouth (miles)	1970 population
Barview	Coos Bay; south side	--	1.4	1,388
Empire ³	Coos Bay; south side	--	4.5	3,781 (1960)
Glasgow	Coos Bay; north side	--	9.0	400
North Bend ²	Coos Bay; south side	--	9.9	8,553
Cooston	Coos Bay; north side	--	10.5	100
Coos Bay ²	Coos Bay; south side	--	13.3	13,400
Eastside ²	Coos Bay; south side	--	15.4	1,331
Charleston	South Slough; east side	0	2	700
Hauser	North Slough; west side	4.5	13.5	250
Englewood	Coalbank Slough; west side	1.5	14.5	
Libby	Coalbank Slough	2.0 (0.6 mile to the west)	15.0	300
Bunker Hill	Isthmus Slough; west side	0	13	1,549
Millington	Isthmus Slough; west side	2	15	300
Dellwood	South Fork Coos River; north side	9.0	26.5	rural
Allegany	West Fork Millicoma River ⁴ ; north side	0.1	26.3	40

¹Tidal effects extend approximately to mile 9 of the South Fork Coos River and to mile 8.7 of the Millicoma River.

²Incorporated

³Consolidated with Coos Bay in 1965

⁴Also described as being located on the Millicoma River [93,129].

Coos Bay

The estuary is roughly 10,000 acres in size; surface areas reported by Johnson [55] and Marriage [59] are presented in Table 2 with the latter's estimate of the number of tideland acres. Aerial photographs

Table 2. Reported surface areas of Coos Bay [55,59].

reference	surface area (acres)	measured at	tidelands	
			acres	percent
[6]	10,973	HW		
	8,242	MSL		
	5,810	LW		
[63]	9,543	¹	4,569	48

¹Specified by Marriage as the area affected by tidal action.

indicate that these tidelands consist of sand bars in the lower reaches and mainly mud, silt, and marsh-pasture flats in the upper reaches [53]. Other measurements given by Johnson are shown in Table 3 [55].

Table 3. Dimensions of Coos Bay [55].

distance from throat to
farthest estuary shore--13.4 miles

inlet dimensions at throat (at MSL):
width--2,060 feet
average depth--29 feet
cross-sectional area--56,500 sq ft

average lagoon depth below MSL--5 feet

The bay is quite complex with close to 30 tributaries, the major one being the Coos River from the east. The river's point of discharge into the bay 12 miles from the estuary mouth is considered its zero mile. It is formed by the South Fork Coos River and the Millicoma River at mile 5.5; the Millicoma River is formed by the East Fork Millicoma River and the West Fork Millicoma River at mile 8.7. Lengths, drainage areas, and annual fresh water yields of these rivers are shown in Table 4 [93,96].

Coos Bay

Table 4. Lengths, drainage areas, and fresh water yields of Coos Bay tributaries [93,96].

Stream	Length (miles)	Drainage area ⁵ (sq.mi.)	Fresh water annual yield ¹ (ac-ft)		
			maximum	minimum	mean
Coos River	5.5 ²	415	2,200,000	1,130,000	1,590,000
South Fork Coos River	31.3 ³	254	1,280,000	660,000	930,000
Millicoma River	8.7 ⁴	151	880,000	450,000	630,000
East Fork Millicoma River	23.9	79	460,000	230,000	330,000
West Fork Millicoma River	34.9	55	---	---	---

¹Yields were estimated for 1930 to 1961 by correlations from available records (consisting of spot observations with no complete water years of record).

²To the confluence of the South Fork Coos River and Millicoma River

³To the confluence of Williams River and Tioga Creek

⁴To the confluence of the West Fork Millicoma River and the East Fork Millicoma River

⁵Total Coos Bay drainage area is not the sum of these individual drainage areas.

The area port commission is stationed at the city of Coos Bay where there is also a community industrial development corporation. Their addresses and phone numbers are as follows:

Port of Coos Bay
P.O. Box 787
Coos Bay, Oregon 97420
269-1131

Jobs and Industries, Inc.
of Southwestern Oregon
P.O. Box 359
Coos Bay, Oregon 97420
267-7035

Also, located in Charleston is the University of Oregon Institute of Marine Biology (Paul P. Rudy, Director), from which a great deal of information is available.

A comprehensive report on Coos Bay has been prepared by the U.S. Department of the Interior [142].

Drainage Basin

Coos Bay drains a total of about 605 sq mi (estimated from [93-plate 1]) which yields an average of 2,200,000 ac-ft of fresh water annually [93]. The basin consists primarily of forests (88% or 532 sq mi) with some croplands (2% or 12 sq mi) and rangelands (1% or 6 sq mi) [93]. (These areas are approximate since the percentages were given for the Coos Bay drainage basin plus an adjacent coastal zone of about 124 sq mi).

Coos Bay

Average annual precipitation ranges from 50 inches along the coast to 100 inches near the headwaters of the Millicoma River [93]. Records from the North Bend and Allegany climatological stations, listed in Table 12, are available through the OSWRB in punch card or printout form [92,143].

Wind roses from North Bend show 50% of the January winds coming from the southeast at speeds generally between 4 and 15 mph and July winds coming from the north 30% of the time and from the northwest 30% of the time at speeds from 4 to 31 mph [7].

Stream profiles for the Coos Bay river systems appear on page 63

Hydraulic Description of Estuary

Tides and Currents

Coos Bay is described as being fully exposed to waves at the throat [55]. Tidal effects extend as far as Dellwood on the South Fork Coos River (mile 9) and as far as Allegany on the Millicoma River (mile 8.7) [93,96]. Both towns are about 27 miles from the estuary mouth.

The mean tidal range is 5.2 feet with a diurnal range of 7.0 feet and an extreme range of 11.0 feet [86]. Tidal prism on mean range is 1.86×10^9 cu ft with a diurnal range of 2.51×10^9 cu ft [55].

The average tidal current velocity is 2.0 knots (3.4 ft/sec) with maximum ebb currents of up to 7 knots (11.8 ft/sec) and maximum flood currents of up to 3.5 knots (5.9 ft/sec) [7].

Currents and tidal ranges are being measured (summer 1973 through spring 1974) to determine the times of maximum ebb and flood flow [1].

River Discharges

Although stream gaging stations on the estuary tributaries are limited (there is one on the West Fork Millicoma River near Allegany [140]), estimates of the average monthly discharge of the Coos, South Fork Coos, and Millicoma Rivers have been made [93]. These are shown in Table 5.

Records from September 1954 to October 1970 from the stream gaging station on the West Fork Millicoma River at mile 6.8 (Table 12) where the drainage area is 46.5 sq mi show an average discharge at this point

Coos Bay

of 257 cfs and extremes of 8,100 cfs (December 11, 1960) and 1.8 cfs (September 1965 and 1967) [140].

Salinity and Classification by Mixing

Salinity measurements in Coos Bay and the Coos River have been reported by Burt and McAllister for one date during each of the following months: June 1956, October 1957, and January, March, and June

Table 5. Flow rates of Coos Bay tributaries [93].

stream (at mouth)	drainage area (sq mi)	average monthly flow (cfs) ¹		
		high	low	mean
Coos River	415	5,500 February	90 August September	2,200
South Fork Coos River	254	3,300 February	50 August, September	1,300
Millicoma River	151	2,200 February	30 September	870

¹Yields were estimated for the period from 1930 to 1961 by correlations from available records (consisting of spot observations with no complete water years of record).

1958 [12]. Of these five test dates, salinity intrusion was greatest on June 27, 1956 at LHW at the "Coos River High School." (The distance was not given, but it is greater than 17 miles from the ocean.) Salinity was 2.3 ppt on the surface and 3.3 ppt at a depth of 13 feet with a concurrent temperature at both points of 20.9°C. Measurements beyond this were not recorded.

On the basis of salinity change from top to bottom, Burt and McAllister found that the estuary was either well mixed or partly mixed during January, April, and June; during November it was partly mixed; during all other months it was well mixed [13].

Temperature, salinity and current measurements extending over one or more tidal cycles were made by McAlister and Blanton [61] at various times during the three year period 1960-1963. On the basis of these measurements, they concluded that Coos Bay ranges from a well-mixed estuary during periods of low runoff to a partially mixed estuary during periods of maximum runoff.

Coos Bay

Burt and Queen [10] describe tidal overmixing in Coos Bay. During the flood stage of the tide, more dense water tends to flow over less dense water resulting in sinking of surface waters and thus an intense mixing over the water depth toward the end of the flood tide.

Sediments

Seasonal (summer 1973 through Spring of 1979) measurements of salinity, temperature, turbidity, pH and dissolved oxygen are being taken for high and low tides with depth and length within the estuary [1].

Littoral drift is to the south in the summer and to the north in the winter with a net transport to the south [7,57]. Since the completion of the south jetty (described under "Physical Alterations"), entrapment of sand has occurred between this jetty and Yoakim Point located approximately 1 mile to its south [57].

Sediments transported to the estuary from its drainage basin average 72,000 tons annually [85,86].

The Corps of Engineers has analyzed dredge samples which were taken from the estuary once in March 1960 and 12 times between June 1970 and May 1972 [124]. Organic contents of these samples ranged from 0.38% (April 1972--lower Jarvis Range) to 8.77% (October 1971--river mile 14.00); void ratios ranged from 0.570 (December 1970--Upper Jarvis Range) to 3.344 (March 1960--Coos Bay channel, station 51.35); and the mean grain size was generally that of fine sand. Volatile solids greater than ten percent have been reported in the Isthmus slough area [5,142]. Free sulfides have also been measured within some of the sediments of Isthmus slough [5].

Water Quality

The DEQ operates 26 water surveillance stations in this area (Table 12)--15 in the bay and 11 in South Slough [67,68]. Records in punch card or printout form are available from some stations for as far back as May 1957. The total number of sampling dates ranges from five (at a station on South Slough, operating since July 1970) to 70 (at two different stations on Coos Bay, operating since May 1957).

The primary factors affecting the water quality are commercial and domestic waste [155] and ground water seepage from a coal field (the largest in the state) located southeast of the bay and covering 250 sq mi [53]. The only area of the estuary which is reportedly still considered a definite water quality problem is Isthmus Slough [100].

Table 6. Sewage treatment plants at Coos Bay [B,65,117].

	USN station	Coos Bay #2	North Bend	Coos Bay #1	Eastside	Bunker Hill	USAF station
location		3/4 mile south of Empire	1/4 mile west of North Bend Airport	1 mile north of the center of the city of Coos Bay			
area served			North Bend	city of Coos Bay			
number now serving	90	4,925	6,600 ¹	8,370	1,500	1,200	
description	secondary	primary	primary	primary	primary	primary	secondary
average flow (mgd)		0.58 to 0.8	1.74	2.86 (3.4-peak)	0.14	0.20 ¹	
rainy							
dry		0.21	0.59	1.35	0.07	0.12 ¹	

¹Estimated, based on limited data [117].

Coos Bay

A listing of the major waste discharges in the Coos Basin (including receiving water, type of waste, volume, and present treatment) has been given in an interim report on a feasibility study for regionalization of sewerage facilities in the Coos River and Chetco River Basins [117]. According to this study, there are seven sewage treatment plants in the Coos Bay area. Information concerning these facilities is presented in Table 6.

Biological

The numbers of adult anadromous salmonids spawning in the Coos Bay stream system, low in comparison with the other estuarine stream systems included in this report as shown in Table B, are estimated as follows: spring chinook--0, fall chinook--500, coho--8,300, steelhead--5,000, and sea-run cutthroat 3,500 [78].

Sportsmen take salmon, striped bass, shad, perch, staghorn sculpin, crabs, and clams in the bay. The most numerous clams are gaper, which account for 40% of the state's total bay clam landings. These, along with cockle, butter, and littlenecks, are located mainly in the lower reaches of the estuary. Softshell clams (decreasing in number in recent years) are supported in the upper portions of the bay. Pacific oysters are produced in South Slough, but native oysters, which were once common, no longer exist [38,53,155].

Mallard, pintail, widgeon, and coot are the most abundant waterfowl in the Coos Bay area [78]. Canvasback and pintail ducks use it as a migrant or wintering area, and black brant use it for wintering [155].

The vicinity around the estuary is a winter range for black-tailed deer, the most numerous big game animal of the South Coast Basin. Elk winter to the east of the estuary, and the watershed contains one of Oregon's largest Roosevelt elk herds [78].

Physical Alterations

Proposed alterations to the estuary, many of which have been completed, are quite extensive with two jetties, numerous channels, and five basins. An attempt has been made to summarize these modifications, as described in the Army Corps of Engineers report [129], in Table 7. Project use statistics are included under "Estuary Uses".

Army Corps of Engineers records from 1959 through 1969 (excluding 1968) show annual dredging of the entrance channel and periodic dredging

Coos Bay

Table 7. U.S. Army Corps of Engineers Modifications to Coos Bay [128,129].

Proposed Modification	Location	Dimensions			Date and Status (1)
		depth (feet)	width (feet)	length	
COOS BAY PROJECT					
North Jetty	entrance				1929-completed 1940-reconstructed
South Jetty	entrance				1970-repair started 1942-reconstructed
Channel	entrance	40	suitable	1 mi	1962-63-rehabilitated 1952-completed
Channel	entrance to mouth of Isthmus Slough (15 miles from estuary mouth)	30	300	15 mi	1937-"main channel" dredged to a depth of 24 feet 1951-"30-foot channel" completed
Channel (Isthmus Slough)	Mouth of Isthmus Slough to Millington (on Isthmus Slough; 18 miles from estuary mouth)	22	150	3 mi	
Turning Basin	Opposite Coalbank Slough	30	600	1,000 ft	
Turning Basin	At the City of North Bend	30	600	1,000 ft	
Anchorage Basin	Outer part of-mile 3.5	30	600	2,000	
Anchorage Basin	Coos Bay - near mile 7	30	600	2,000	
Connecting Channel	Deep Water in Coos Bay to the Mooring Basin at Charleston (near South Slough)	10	150		1956-completed
Channel Extension	In South Slough to the Highway Bridge	10	150		1970-completed
Mooring Basin	Locality of Charleston	500	900		1956- "Small Boat Basin at Charleston completed
Breakwater	Locality of Charleston				
Bulkhead	Locality of Charleston				
COOS AND MILLICOMA RIVERS PROJECT					
Channel	Coos River Mouth on Coos Bay to Allegany on The Millicoma River	5	50	13.8 ⁽³⁾	1966-channel improvements completed
Channel	To Dellwood on the South Fork Coos River	5	50	15 ⁽³⁾	
Channel	Dellwood to mile 14.7 of the South Fork Coos River	3	50	0.7	

¹Lack of Completion date does not necessarily signify that the modification has not been constructed (The Coos Bay project is described as complete).

²Observed on USCGS chart #5984 (March 18, 1972).

³Includes the 5.5 miles of channel on the Coos River which the 2 presumably have in common.

Coos Bay

of the "river channel" (1969), the "inner channel" (1959, 1962, 1963), and the "30-foot channel" (1961). Amounts dredged ranged from 523,752 cu yds removed from the entrance and river channels in 1969 to 2,729,077 cu yds taken from the entrance channel in 1966 [55].

Dredging (by bucket or clamshell) has been performed by private contractors in Coos and Millicoma Rivers with spoil disposal on high land [50]. In June 1972 the Georgia Pacific Co. (Coos Bay) submitted a request for a permit to do maintenance dredging in 3 areas of Isthmus Slough [31].

During the period of 1920-1970, approximately 1500 acres of tidelands have been filled and 2000 acres diked for agricultural use adjacent to Coos Bay [142]. A map of filled and diked areas is available [142].

Industrial and Commercial

Timber and fish resources are of major economic importance to the area, although agricultural activities involved mainly with dairy products, poultry, cattle, hogs, sheep and lambs, rabbits, and turkeys also provide some income [24,93,100,155].

A listing of manufacturers at Coos Bay, presented in Table 8, indicates that most jobs there are connected in some way with the lumber manufacturing industry [71]. Such jobs, in fact, account for 58% of the Coos County work force [24]. Wood and wood products comprise a large percentage of the traffic using the Coos Bay and River and Millicoma River projects [129], and Coos Bay is the leading lumbershipping port in the U.S. [4]. In 1969 the Coos Bay channel project saw 6,102,000 tons of waterborne traffic--41% (2,500,000 tons) of this was rafted logs; 36% (2,200,000 tons) was wood chips and the remaining 23% (nearly 1,500,000 tons) was lumber, exported logs, petroleum products, and paper and paperboard. Traffic using the project between 1960 and 1969 averaged 4,181,000 tons annually. Traffic on the Coos and Millicoma Rivers averaged 1,589,000 tons for the same time period and totaled 1,257,000 tons (all rafted logs) in 1969 [129]. An estimated 500 acres of the bay and its tributaries are used at some time for log rafts [100]. It has been estimated (1971) that as much as 15 to 20 percent of the surface of Marshfield Channel, Isthmus Slough, and lower Coos River are covered with stored logs [142]. A review and discussion of the ecological impacts of man's activities is provided in a special report by the U.S. Department of the Interior [142]. Lumber shipments from Port of Coos Bay in 1971 totalled 463,976,968 tons lumber and logs, 2,238,136 tons chips, 42,529 tons plywood, and 5,208,092 tons general cargo.

Coos Bay

Table 8. Major Manufacturers at Coos Bay [71,100].

Location	Name	Type of Business	Number employed
Charleston	Peterson Sea Foods Inc.	crab and shrimp packaging	140
	Hallmark Fisheries	crab and shrimp packaging	100
	Fishermens Cooperative Association Inc.	fish, crab, and shrimp packaging	5
North Bend	Weyerhaeuser Co.	lumber and wood products (particleboard, wood chips, plywood)	1,640
	Menasha Paper Co.	corrugating paperboard	160
	Maze Bros. Logging Co.	logging and mill	40
	17 manufacturers employing under 25	dealing mainly in logging, wood products and soft drinks	
Coos Bay	Coos Head Timber Co.	saw and planing mills, plywood	400
	Georgia-Pacific Corp.	plywood	368
	Cape Arago Lumber Co.	wood products	175
	Al Peirce Co.	lumber	115
	Georgia-Pacific Corp.	hardboard	105
	Eureka Fisheries, Inc.	fishery products packaging	69
	The World	newspaper	60
	Sixes River Logging Co.	logging	50
	Georgia-Pacific Corp.	phenolic and urea resins, formaldehyde, chemical specialties	45
	35 manufacturers employing 35 or under	dealing mainly in lumber and wood products	
Eastside	Nelson Log Bronc Co.	steel work boats and tugs; steel fab-saw mill equipment	19

Coos Bay

Commercial fishing from Coos Bay itself, as indicated by the statistics presented in Table 9 is quite limited [20,118]. However, landings received

Table 9. Commercial Harvest of Shad, Striped Bass, Crabs, and Clams at Coos Bay, 1969, 1970, and 1971 [20,118].

Species	1969		1970		1971	
	pounds landed	fishermen value	pounds landed	fishermen value	pounds landed	fishermen value
Shad ⁽¹⁾	32,425	\$4,000	59,865	\$9,000	54,973	\$8,000
Striped Bass ⁽¹⁾	18,337	3,000	13,524	2,000	8,984	1,000
Crabs ⁽²⁾			67,846		24,339	1,000
Clams ⁽²⁾	5,109		4,522		10,893	

¹Source of reference [20]; data for Coos Bay and its tributaries.

²Source of reference [118]; data for Coos Bay.

there from the entire area (Table 10) are extensive [34]. In 1971 Coos Bay was one of the Oregon ports receiving the most commercial fish landings (Tables D and E), and in 1970 it received 57% of the South Coast Basin salmon landings [34,78]. Most of the fish packaging plants there (Table 8) are centered in Charleston [71].

A report covering the ecological features of Coos Bay has been prepared by the U.S. Department of the Interior. The report includes maps of Coos Bay showing aquatic vegetation, benthic shellfish habitat, bristle worm species, and shrimp habitat [142].

Recreational

As can be seen from Table 11, sportsmen spend a great deal of time and money on angling at Coos Bay. Salmon fishing is excellent offshore, where chinook and coho abound from early June to early September. A limited number of fall chinook and coho can also be caught near the head of tidewater from mid September to the beginning of November [58,78]. Most commonly caught species other than salmon and trout, as determined by the FCO Study from March to October 1971, include shiner perch, staghorn sculpin, and red rock crab by shore angling; dungeness crab and relatively few black rock fish and red rock crab by boat angling; and gaper, butter, and cockle clams by clamming [38]. The estuary also

Coos Bay

reportedly provides good shad fishing, particularly in June and July, as well as some of the best striped bass fishing of the South Coast Basin with July to October being the peak period. Striped bass from the bay average 6 pounds [78].

Table 10. Commercial Harvest of Food Fish Received at Coos Bay, 1971⁽¹⁾ [34].

Species	Harvest (pounds round weight)	Fishermen value
Groundfish	2,688,307	\$ 221,000
Coho	2,119,332	663,000
Crabs	1,898,998	665,000
Shrimp	1,521,483	197,000
Albacore Tuna	376,877	112,000
Chinook	128,945	66,000
Shad	54,973	8,000
Clams	10,893	1,000
Striped Bass	8,984	1,000
Pinks	929	—
Oysters	208	—
Totals	8,809,929	\$1,934,000

¹Includes 1971 data presented in Table 9.

Table 11. Estimated Annual Harvest Data for Sport Fishing at Coos Bay (1) [78].

Species	area fished	annual harvest (total number)	effort (angler-days)	gross expenditures
Salmon	Estuary	500	1,250	\$ 37,000
	Ocean	28,400	32,300	2,101,600
Sea-run cutthroat	Streams	150	100	1,850
Steelhead	Streams	1,400	5,600	103,600
Shad	Estuary	6,500	2,990	55,315
Striped bass	Estuary	875	1,660	30,710

¹Average of data from past years.

Coos Bay

Table 12. Surveillance stations at Coos Bay.

type of station	name and/or identifying number	approximate location	drainage area (sq mi)	period of record	references
climatological	Charleston	elevation--10 feet		1938-1940	[93]
	North Bend FAAAP (formerly Marshfield) USGS #6073	elevation--11 feet		1902-1960	[92,93,143] ¹
	Allegany	Millicoma River; mile 9		1940-1960	[92,93,143] ¹
stream gaging	West Fork Millicoma River near Allegany; USGS #3245	West Fork Millicoma River; mile 6.8	46.5	1954-(1970)	[98,140] ²
DEQ water surveillance	#1	Coos Bay; green light #7; 1/4 mile north of Fossil Point		5/57-(5/72) (43 measurements)	[67,68] ³
	#2	Coos Bay; red light #10; 1/4 mile north of Pigeon Point		5/57-(5/72) (70 measurements)	"
	#3	Coos Bay; red light #12; 1/2 mile north of Sitka Dock		5/57-(5/72) (42 measurements)	"
	#4	Coos Bay; red light #16; 1/4 mile north of Empire Dock		4/60-(5/72) (38 measurements)	"
	#5	Coos Bay; green light #23 opposite Henderson Marsh		5/57-(5/72) (70 measurements)	"
	#6	Coos Bay; black can #27; 1/4 mile west of railroad bridge		5/57-(5/72) (41 measurements)	"
	#7	Coos Bay; green light #35; mouth of Kentuck Slough		5/57-(5/72) (70 measurements)	"
	#8	Coos Bay; red light #36; opposite mouth Cooston-Willanch Channel		5/57-(5/72) (42 measurements)	"
	#9	Coos Bay Yacht Club; opposite McCurdy Marina		5/57-(5/72) (42 measurements)	"
	#10	Coos Bay; shipping channel opposite mouth of Marshfield Channel		5/57-(5/72) (42 measurements)	"

Coos Bay

Table 12. Surveillance stations at Coos Bay, cont.

type of station	name and/or identifying number	approximate location	drainage area (sq mi)	period of record	references
DEQ water surveillance	#11	Coos Bay; red light 1 mile up Marshfield Channel		8/57-(5/72) (25 measurements)	[67,68] ³
	#12	Coos Bay; green light #43 opposite downstream from Coalbank Slough		5/57-(5/72) (25 measurements)	"
	#13	Coalbank Slough at Highway 101 bridge		9/66-(5/72) (12 measurements)	"
	#14	Isthmus Slough at Eastside Bridge		5/57-(5/72) (25 measurements)	"
	#15	Isthmus Slough at Coos City Bridge		6/60-(5/72) (21 measurements)	"
	#1	South Slough; 150 yards east of flashing light at entrance; opposite fisherman's coop		4/67-(5/72) (19 measurements)	"
	#2	South Slough; 15 yards east of southern most moorage float at Charleston small boat basin		4/67-(5/72) (20 measurements)	"
	#3	South Slough; 100 yards west of slip on east bank		4/67-(5/72) (19 measurements)	"
	#4	South Slough; channel 50 yards east of Hallmark Fisheries Dock, Charleston		4/67-(5/72) (20 measurements)	"
	#5	South Slough; channel, 20 yards west of Hansen's Landing Docks		4/67-(5/72) (20 measurements)	"
	#6	South Slough; channel, 50 yards west of mouth of Joe Ney Slough		4/67-(5/72) (19 measurements)	"
	#7	South Slough; channel, 250 yards south of Colliver Point		4/67-(5/72) (19 measurements)	"
	#8	South Slough; channel, 0.3 miles southwest of station 7, 50 yards west of bank		4/67-(5/72) (13 measurements)	"

Coos Bay

Table 12. Surveillance stations at Coos Bay, cont.

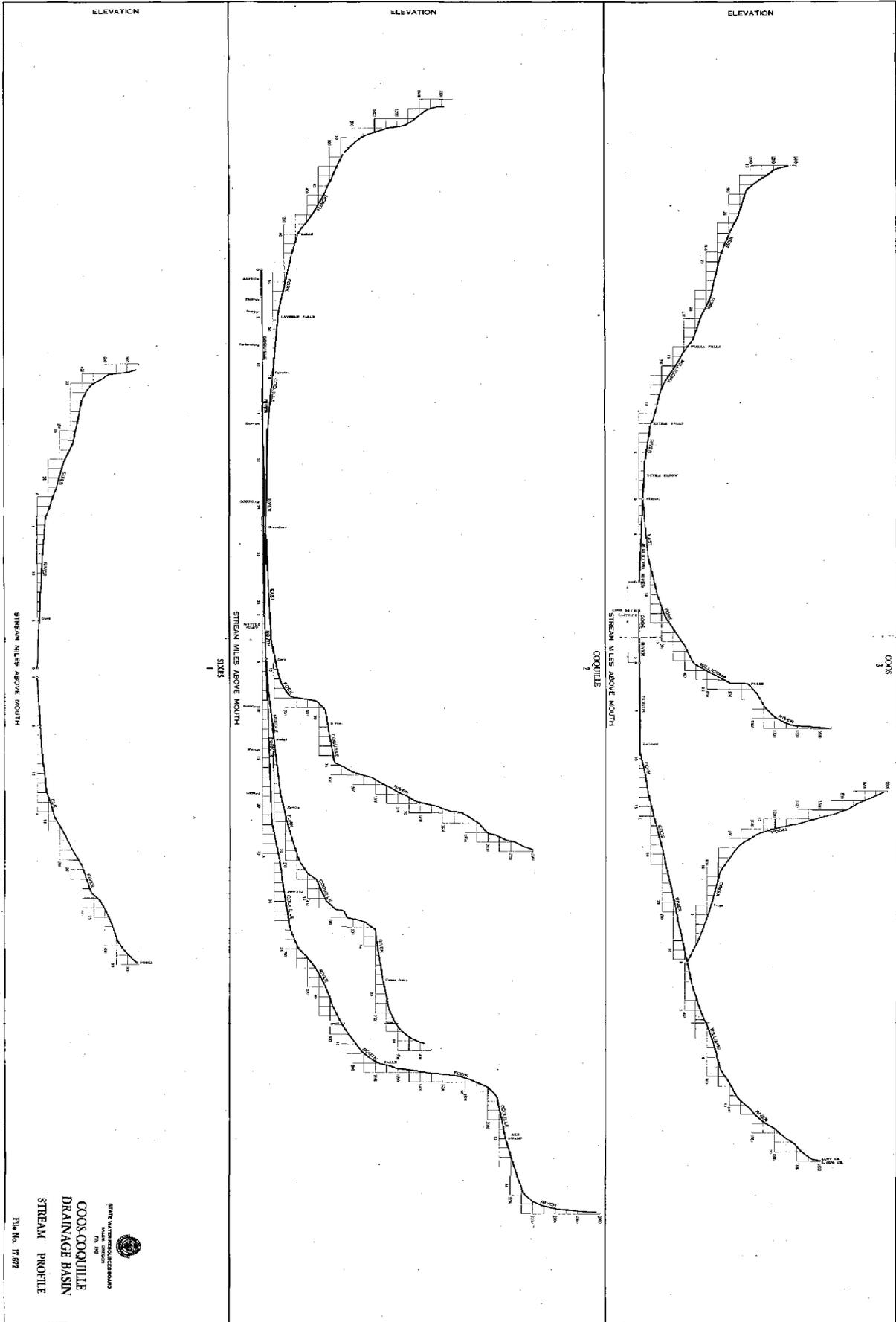
type of station	name and/or identifying number	approximate location	drainage area (sq mi)	period of record	references
DEQ water surveillance	#9	South Slough; channel, 0.3 mile south of station 8		4/67-10/68 (12 measurements)	[67,68] ³
	#10	South Slough; channel, 0.2 mile south of station 9		4/67-10/68 (12 measurements)	"
	#11	South Slough; Joe Ney Road bridge		7/70-5/72 (5 measurements)	"
water quality		Coos River; miles 1.8, 4, and 5.5		1930-1933 (spot observations)	[93]
water temperature	West Fork Millicoma River near Allegany	West Fork Millicoma River; mile 6.8	46.5	10/54-(1968) (4 days monthly)	[141]
chemical analysis	"	"	"	10/63-(9/68)	[141]

¹Precipitation data available in punch card or printout form through the OSWRB.

²Monthly and water-year runoff records have been compiled and are available in punch card or printout form through the OSWRB.

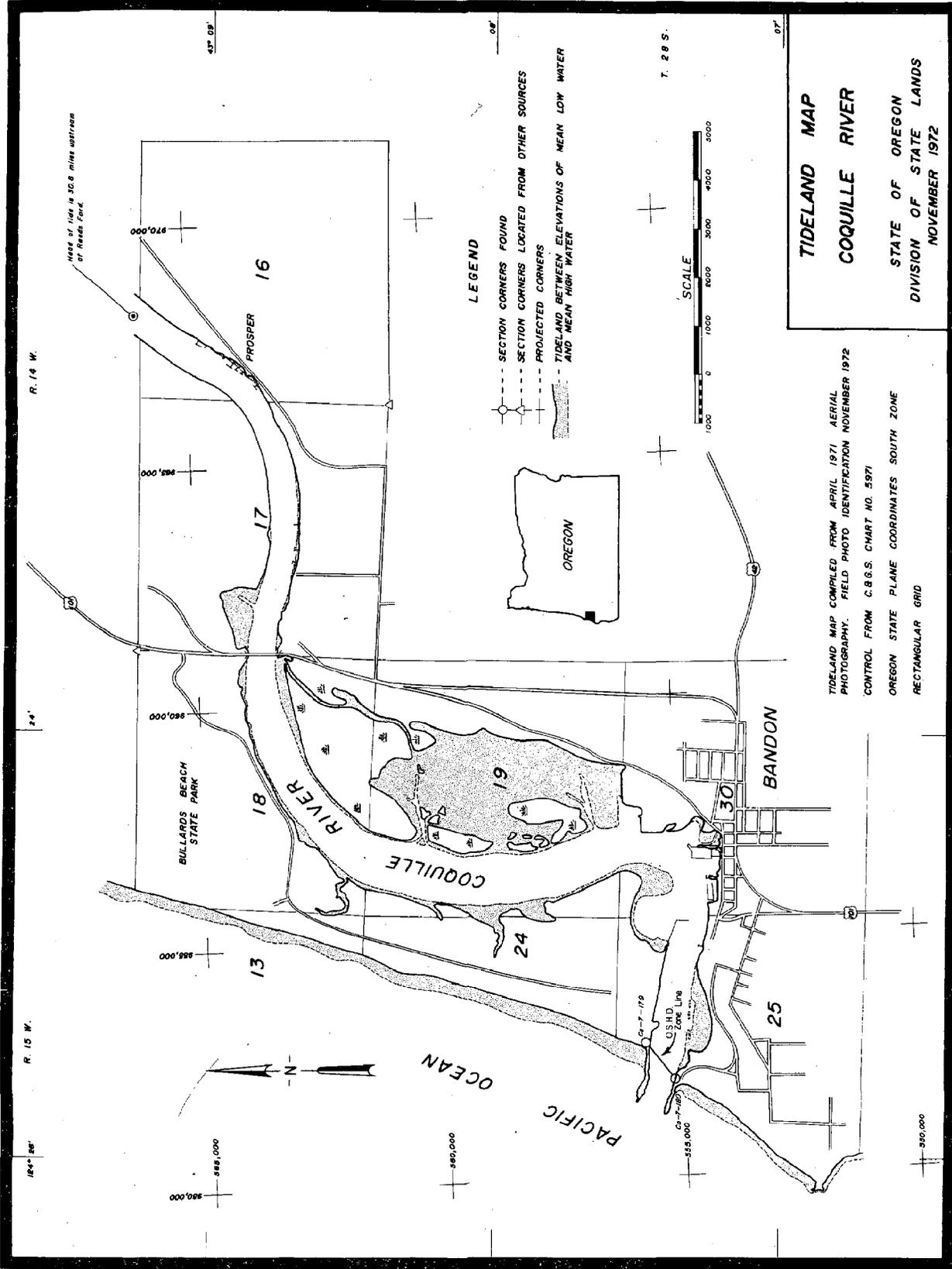
³Data available in punch card or printout form through the DEQ; records are not complete before 1967.

() This is the most recent record date found and not necessarily the last.




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COQUILLE BAY



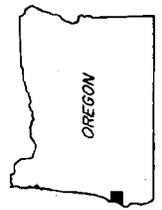
**TIDELAND MAP
COQUILLE RIVER**

STATE OF OREGON
DIVISION OF STATE LANDS
NOVEMBER 1972

TIDELAND MAP COMPILED FROM APRIL 1971 AERIAL PHOTOGRAPHY. FIELD PHOTO IDENTIFICATION NOVEMBER 1972
CONTROL FROM C.B.S.S. CHART NO. 5971
OREGON STATE PLANE COORDINATES SOUTH ZONE
RECTANGULAR GRID

LEGEND

- SECTION CORNERS FOUND
- - - SECTION CORNERS LOCATED FROM OTHER SOURCES
- · · · · PROJECTED CORNERS
- ▨ TIDELAND BETWEEN ELEVATIONS OF MEAN LOW WATER AND MEAN HIGH WATER



Here of line is 30.8 miles upstream of Reed Park.

R. 14 W.

R. 15 W.

T. 28 S.

124° 25'

437' 00"

04'

01'

585,000

585,000

585,000

585,000

570,000

580,000

535,000

550,000

COQUILLE BAY

General Description of Estuary and Drainage Basin

Estuary

Coquille Bay lies approximately 225 miles south of the mouth of the Columbia River. It is a long and narrow estuary and is among the smallest of those included in this report (Table A). Population in the area is centered in the incorporated towns of Bandon, Coquille, and Myrtle Point. Approximate locations and 1970 populations of these and other towns have been summarized in Table 1 [96,111].

Table 1. Population centers at Coquille Bay¹ [96,111].

name	general location	river mile location	approximate distance from estuary mouth (miles)	1970 population
Bandon ²	Coquille River; south side	0.1 to 1.8	0.1 to 1.8	1,832
Prosper	Coquille River; south side	4.5	4.5	rural
Randolph	Coquille River; north side	6	6	rural
Parkersburg	Coquille River; south side	8.0	8.0	rural
Riverton	Coquille River; south side	16.4	16.4	150
Leneve	Coquille River; north side	19.5 (0.5 mile to the north)		
Coquille ³	Coquille River; north side	24.5 to 24.9	24.5 to 24.9	4,437
Johnson	Coquille River; east side	27.7	27.7	no pop
Arago	Coquille River; west side	32.5	32.5	100
Norway	Coquille River; north side	34.7	34.7	150
Myrtle Point ²	South Fork Coquille River; east side	0.7 to 1.7	37 to 38	2,511

¹Tidal effects extend approximately to between miles 36 and 40 of the Coquille River.

²Incorporated

³Incorporated in 1970

The estuary measures roughly 760 acres (an average of the surface area given by Johnson at HW [55] and by Marriage [59] and presented in Table 2). Other dimensions reported by Johnson are given in Table 3 [55].

Coquille Bay

Table 2. Reported surface areas of Coquille Bay [55,59].

reference	surface area (acres)	measured at
[6]	818	HW
	582	MSL
	346	LW
[63]	703	1

¹Specified by Marriage as the area affected by tidal action.

Table 3. Dimensions of Coquille Bay [55].

distance from throat to
farthest estuary shore--2.3 miles

inlet dimensions at throat (at MSL):
width--620 feet
average depth--11.5 feet
cross-sectional area--7,030 sq ft

average lagoon depth below MSL--7feet

The major tributary of Coquille Bay is the Coquille River which has its zero river mile at the mouth of the estuary, at the outer end of the jetties [96]. The main stem of the Coquille River is formed by the South Fork Coquille River and the North Fork Coquille River at a point 36.3 miles from its mouth. Tributaries (creeks and sloughs) of this main stem number about 13 from the north and 20 from the south. The entire Coquille River, from its mouth to the headwaters of the South Fork Coquille River, measures 99 miles, making it the longest river of the South Coast Basin [93]. The Middle Fork Coquille River flows into the South Fork Coquille River at mile 4.7, and the East Fork Coquille River discharges into the North Fork Coquille River at mile 9.1. Tables 4 and 5 give the lengths, drainage areas, and estimated fresh water yields of these major streams [93,96].

Coquille Bay

Table 4. Lengths and drainage areas of Coquille Bay tributaries [96].

stream	length (miles)	drainage area (sq mi)
Coquille River	36.3 ¹	1,058
North Fork Coquille River	53.3	289
South Fork Coquille River	62.8	598
East Fork Coquille River	33.8	135
Middle Fork Coquille River	40.3	310

¹To the confluence of the North Fork Coquille and South Fork Coquille Rivers

Table 5. Fresh water yields of Coquille Bay tributaries [93].

stream	point of measurement	drainage area (sq mi)	complete water years of record	fresh water annual yield ¹ (ac-ft)		
				maximum	minimum	mean
Coquille River	mouth	1,058	none	3,900,000	1,220,000	2,400,000
North Fork Coquille River	near Myrtle Point	276	1930-1946	1,120,000	374,000	720,000
South Fork Coquille River	Powers (near mile 29)	169	1917-1926; 1930-1961	950,600	287,000	573,000
East Fork Coquille River	mouth	135	none	450,000	150,000	290,000
Middle Fork Coquille River	near Myrtle Point	305	1931-1946	1,020,000	257,000	590,000

¹Yields were estimated for the period from 1930 to 1961 by correlations from available records.

Coquille Bay

Port commissions at Bandon and Broadbent serve the area [106]. Their addresses and phone numbers are:

Port of Bandon
P.O. Box 53
Bandon, Oregon
347-2669

Port of Coquille River
P.O. Box 1245
Broadbent, Oregon
572-5937

Drainage Basin

The estuary drainage basin, as shown in Tables 4 and 5, is 1,058 sq mi with an average fresh water yield of 2,400,000 ac-ft/yr, based on an estimated annual average yield of 2,270 ac-ft/sq mi. The area is rough and mountainous, consisting of approximately 88% (931 sq mi) forests, 5% (52 sq mi) cropland, and 6% (63 sq mi) rangeland [49,93].

Annual rainfall varies from 50 inches (at the mouth of the Coquille River) to 110 inches (near the headwaters of the South Fork Coquille River) [93]. Precipitation records from the Bandon and Coquille climatological stations described in Table 14 are available in punch card or printout form through the OSWRB [92,143].

Elevations range from sea level to 5,100 feet [93].

Stream profiles for the Coquille Bay river systems appear on page 63 in the Coos Bay Basin section.

Hydraulic Description of Estuary

Tides and Currents

The estuary is described as being fully exposed to waves at the throat [55]. Tidal effects on the Coquille River extend as far as from 36 to 40 miles (near Myrtle Point) upstream [53,93]. The mean tide range is 5.2 feet with a diurnal range of 7.0 feet [55] and an extreme range of 10.0 feet [86]. Tidal prism on mean range is 1.32×10^8 cu ft with a diurnal range of 1.77×10^8 cu ft [55].

River Discharges

Table 6 lists the mean, maximum, and minimum flow rates of the Coquille River and its major tributaries. These flow rates are either estimated monthly averages as presented in the "South Coast Basin" [93] or one-day

Coquille Bay

extremes recorded at USGS stations and published by that agency [140]. More information on the stream gaging stations is included in Table 14.

Salinity and Classification by Mixing

No information.

Table 6. Flow rates of Coquille Bay tributaries [93,140].

stream	point of measurement	drainage area (sq mi)	period of record	flow rate (cfs)		
				maximum	minimum	mean
Coquille River	mouth	1,058	none ¹	8,250 February	130 September	3,300
North Fork Coquille River	near Myrtle Point	276	1930-1946 ¹	2,450 February	55 September	1,000
	near Fairview (river mile 21.7)	74.0	10/63-(1970) ²	4,660 1/65	2.0 10/67	289
South Fork Coquille River	at Powers (river mile 29)	169	1917*(1961) ¹	1,880 January	32 September	790
			9/16*(1970) ²	48,900 (12/22/64)	12 (9/61)	784
East Fork Coquille River	mouth	135	none ¹	1,050 February	20 August, September	400
Middle Fork Coquille River	near Myrtle Point	305	1931-1946 ¹	2,150 February	25 September	810

¹Average flow rate by month was estimated for the period from 1930 to 1961 by correlations from available records [42].

²Extreme daily flow rates were recorded [27].

() This is the most recent record date found and is not necessarily the last.

* Period of record is not continuous

Sediments

Net transport of sediments in the area of Coquille Bay seems to be to the south with accretion being dominant at the south jetty. Accretion also occurs to some extent to the north where a spit has developed at the end of the Coquille River [57]. Sediments transported to the estuary each year are estimated to average 100,000 tons [85,86].

Dredge samples taken by the Corps of Engineers at the Coquille River entrance once in 1960 and twice in 1970 showed organic contents ranging

Coquille Bay

from 0.44% (August 1970) to 0.60% (November 1970); void ratios ranging from 0.376 (September 1960) to 0.660 (August 1970); and mean grain size either that of fine sand (August, November 1970) or medium sand (September 1960) [124].

Water Quality

The DEQ operates ten water surveillance stations in Coquille Bay (Table 14) [67,68]. Records have been kept since September 1968 with five or six measurements at most of the stations between then and March 1971.

The city of Bandon has a new (1971) sewage treatment plant [103], and the city of Coquille has a primary treatment facility available to industry [25] (Table 7). The only real pollution problem reportedly arises at Moore Mills (at Bandon) where dumping of sawdust and bark into the bay and log storage occur [81].

Table 7. Sewage treatment plants at Coquille Bay [25,101,103].

	City of Bandon	City of Coquille
completion date	1971	
location	Coquille River; south side; mile 0.5; in Bandon	
area served	1/3 of the population	
number served	in 3/4 of the area of Bandon	
description	secondary	primary
average flow (mgd)		
rainy	0.473 (high monthly average)	
dry	1.5 (high for one day)	
overall	0.018 (low for one day)	
overall	0.21	

Biological Information

Estimated numbers of anadromous salmonids spawning in the Coquille River system are as follows: spring chinook--50⁽¹⁾, fall chinook--4,900,

(1) A remnant run found mainly in the South Fork Coquille River.

Coquille Bay

coho--23,000, steelhead--16,100, and sea-run cutthroat--12,000. A comparison with other stream systems can be made from Table B [78]. During June, striped bass and shad spawn in the tidal portion of the Coquille River where brown bullhead (a warm-water game fish) can also be found [78]. Other common species include softshell clams (located in the tidal flats between the mouth and mile 3.5), surf smelt, perch, and dungeness crab [38,53,155].

Waterfowl use of the estuary up to Riverton near river mile 16.3 is estimated at 39,000 waterfowl use days per year, with white winged scoter (coot) being the most abundant [81]. American widgeon, pintails, wood ducks, american merganser, and surf scoters can be found to a lesser degree [78,81].

The most abundant shorebirds include great blue heron, gulls (western, herring, and California), belted kingfisher, and double crested cormorant. The common crow is also frequently found [81].

Some river otter, mink, and beaver inhabit the area around the estuary [81], and black-tailed deer (the most abundant big game animal of the South Coast Basin) use it as a wintering range. A section to the north of the estuary serves as a winter range for elk, and the Coquille watershed contains one of the largest Roosevelt elk herds in Oregon [78].

Physical Alterations

Alterations at Coquille Bay by the Corps of Engineers, described in Table 8, include two jetties and an entrance channel [126,129]. Statistics of project use have been included under "Estuary Uses." Records of dredging activities (also by the Corps of Engineers) between 1959 and 1969 (excluding 1968) show annual dredging of the entrance channel with 62,250 cu yds being a typical quantity removed [55].

Under the "Coastal 60-40 Stream Improvement Program," the Middle Creek Fishway, located 18 miles east of the city of Coquille on the Coquille River, was constructed by the FCO [119]. No completion date was given, but dedication of the fishway took place in 1963.

The OSGC operates a hatchery at Bandon from which a total of 799,771 fish were released in 1970. These consisted of 527,390 cutthroat trout, 241,618 summer steelhead, 24,610 rainbow trout, and 6,153 winter steelhead [80].

Industrial and Commercial

Lumber-related activities are of major economic importance to the area, although commercial and recreational fishing also provide some income.

Coquille Bay

Table 8. U.S. Army Corps of Engineers Modifications to Coquille Bay [126,128,129].

Proposed Modification	Location	Dimensions			Date and Status
		depth (feet)	width (feet)	length	
North Jetty	Entrance			3,450 feet	1908-completed 1942-reconstructed 1951-750-foot extension added to east end 1956-repaired
South Jetty	Entrance			2,700 feet	1908-completed 1954-repaired
Channel	Entrance	13	Suitable	1.3 miles	1933-completed

Major manufacturers in the area, which are listed in Table 9, deal mostly in lumber and wood products. Lumber in coast wise trade accounted for 40% of the 370,000 tons using the Coquille channel project in 1969, and rafted logs accounted for the other 60%. (Traffic through the project between 1960 and 1969 averaged 446,000 tons [129].

Presented in Tables 10 and 11 are commercial fish landing statistics for the Coquille Bay area. In comparison with figures for commercial fishing at other estuaries included in this report (Tables D and E), these are quite low. Shad, striped bass, and crab are the primary species taken from the estuary, while salmon account for most of the landings received from the ocean [20,34,118]. In 1970, Bandon received 9% of the south coast salmon landings or roughly 270,000 pounds coho and 108,000 pounds chinook at a total value to fishermen of \$225,000 [78].

Recreational

Sports fishing for salmon and trout is quite popular (Table 12). Between mid-September and the first good high water in November, both chinook and coho abound, mainly in the lower 20 miles of the Coquille River. Most of the angling is by boat, with some along the shore in the upper reaches [58]. Other commonly-caught species (as determined in the study by the FCO between March and October 1971) include surf smelt, redbtail perch, and relatively few shiner perch by shore angling; dungeness crab by boat fishing; and softshell clams by clamming [38]. Some shad and striped bass are also taken--harvest data are included in Table 12.

Hunting for waterfowl along the first 16 miles of the Coquille River peaks in December and was estimated at 900 hunter days for 1970. There is exceptionally good pigeon hunting at Prosper (approximate river mile 4.5), but the area is now (1972) closed to public access. When open to the public, use averages 2,500 hunter days [81].

Coquille Bay

Table 9. Major Manufacturers at Coquille Bay [2,25,71].

Location	Name	Type of Business	Number Employed
Bandon	Moore Mill and Lumber Co.	lumber	170
	Rogge Lumber Sales Inc.	lumber	90
	9 manufacturers employing less than 20	dealing mainly in logging and food products	
Coquille	Georgia-Pacific Corp.-Coquille Plant	plywood, studs, chips	300
	Georgia-Pacific Corp.	plywood, lumber, and chips	250
	Gold Mountain Logging Co.	logging	30
	11 manufacturers employing 10 or under	dealing mainly in lumber and wood products (mostly logging)	
Norway	Georgia-Pacific Corp.	veneer and chips	85
	Norway Archery	arrow manufacturer	6
Myrtle Point	Leep Logging Corp.	lumber	40
	Doyle Veneer	wood veneer	29
	11 manufacturers employing 10 or under	dealing mainly in lumber and wood products (mostly logging)	

There are boat ramps at the Port Docks in downtown Bandon, Bullards State Park, Rock Point at mile 2, Coquille at mile 24.2, and Arago at mile 32.4. The small boat basin at Bandon takes care of about 100 fishing and pleasure boats [2,96].

The City of Coquille has two parks (one developed and one not), and Bullards Beach State Park borders Coquille Bay and the ocean to the north. Attendance at Bullards Park by day visitors and campers showed a fairly steady increase from 1966 to 1970 with the exceptions of 1968 and 1969 when use by campers and day visitors, respectively, dropped. Figures given in Table 13 are for total park attendance for 1966 and 1970 only with estimates of the percentage of those attending who actually used the estuary portion of the park [82,83].

Coquille Bay

Table 10. Commercial Harvest of Shad, Striped Bass, and Crabs from Coquille Bay [20,118].

Species	1969		1970		1971	
	pounds landed	fishermen value	pounds landed	fishermen value	pounds landed	fishermen value
Shad ⁽¹⁾	13,485	\$2,000	7,430	\$1,000	11,607	\$2,000
Striped Bass ⁽¹⁾	796		395		537	0
Crabs ⁽²⁾			644		0	

¹Source of reference [20]; data for Coquille Bay and its tributaries.

²Source of reference [118]; data for Coquille Bay.

Table 11. Commercial Harvest of Food Fish Received at Bandon, 1971⁽¹⁾ [34].

Species	Harvest (pounds round weight)	Fishermen value
Coho	440,728	\$138,000
Chinook	48,113	27,000
Crabs	20,328	7,000
Shad	11,607	2,000
Groundfish	7,037	1,000
Pinks	1,912	1,000
Albacore Tuna	660	
Striped Bass	537	
Totals	530,922	\$176,000

¹Includes 1971 data presented in Table 10.

Coquille Bay

Table 12. Estimated Annual Harvest Data for Sport Fishing at Coquille Bay⁽¹⁾ [78].

Species	area fished	annual harvest (total number)	effort (angler-days)	gross expenditures
Salmon	Estuary	1,300	3,250	\$ 96,200
	Coquille river system	150	600	11,100
	Ocean	500	600	37,000
Sea-run cutthroat	Coquille river system	400	250	4,625
Steelhead	Coquille river system	3,500	14,000	259,000
Shad	Coquille Bay	250	115	2,127
Striped bass		50	95	1,758

¹Average of data from past years.

Table 13. Bullards Beach State Park Annual Attendance, 1966 and 1970 [82,83].

Park Users	1966 attendance		1970 attendance	
	total park	estuary ⁽¹⁾	total park	estuary ⁽¹⁾
day visitors	222,712	< 1,114	292,312	< 1,462
camper nights	34,265	< 171	50,601	< 253

¹Actual use of the estuary portion of the park estimated to be less than 0.5% of the total attendance.

Coquille Bay

Table 14. Surveillance stations at Coquille Bay.

type of station	name and/or identifying number	approximate location	drainage area (sq mi)	period of record	reference
climatological	Bandon (formerly Coquille R.L.H., Bandon 2E)	Coquille River; mile 0.5		1887-1960	[92,93,143] ¹
	Coquille	Coquille River; mile 25		1942*1954	[92,93] ¹
stream gaging	North Fork Coquille River near Myrtle Point; USGS #3270	North Fork Coquille River; mile 4.30	282	1929-1946	[98] ²
	North Fork Coquille River near Fairview; USGS #3268	North Fork Coquille River; mile 21.7	74	1963-(1970)	[98,140] ²
	South Fork Coquille River at Powers; USGS #3250	South Fork Coquille River; mile 29	169	1916-(1970)	[98,140] ²
	Middle Fork Coquille River near Myrtle Point; USGS #3265	Middle Fork Coquille River; mile 2.2	305	1931-1946	[98] ²
crest stage gaging	Geiger Creek near Bandon; USGS #3271		1.36	1953-(1961)	
DEQ water surveillance	#1	Coquille Bay; channel next to old lighthouse		9/68-(7/70) (5 measurements)	[67,68] ³
	#2	Coquille Bay; next to Coast Guard Station, 40 yards from south shore		9/68-(3/71) (6 measurements)	"
	#3	Coquille Bay; red channel buoy #14		9/68-(3/71) (6 measurements)	"
	#4	Coquille Bay; channel opposite Moore Lumber Mill, Bandon		9/68-(7/70) (5 measurements)	"
	#5	Coquille Bay; channel at Highway 101 bridge		9/68-(3/71) (6 measurements)	"
	#6	Coquille Bay; channel at Riverton Ferry		9/68-(3/71) (5 measurements)	"

Coquille Bay

Table 14. Surveillance stations at Coquille Bay, cont.

type of station	name and/or identifying number	approximate location	drainage area (sq mi)	period of record	reference
DEQ water surveillance	#7	Coquille Bay; channel at Coquille STP outfall (50 yards below highway bridge)		9/68-(3/71) (6 measurements)	[67,68] ³
	#8	Coquille Bay; channel, 1/2 mile below highway bridge		9/68-(7/70) (3 measurements)	"
	#9	Coquille Bay; channel at Rink Creek		9/68-(3/71) (4 measurements)	"
	#10	Coquille Bay; channel, 1 mile upstream from station #9		9/68-(3/71) (4 measurements)	"
water quality	North Fork Coquille River near Myrtle Point	North Fork Coquille River; mile 4.3		1960-(1961)	[93]
water temperature	Ferry Creek at hatchery	Ferry Creek; mile 2 (about 3 miles from the estuary mouth)		1943-1956	[93]

¹ Precipitation data available in punch card or printout form through the OSWRB.

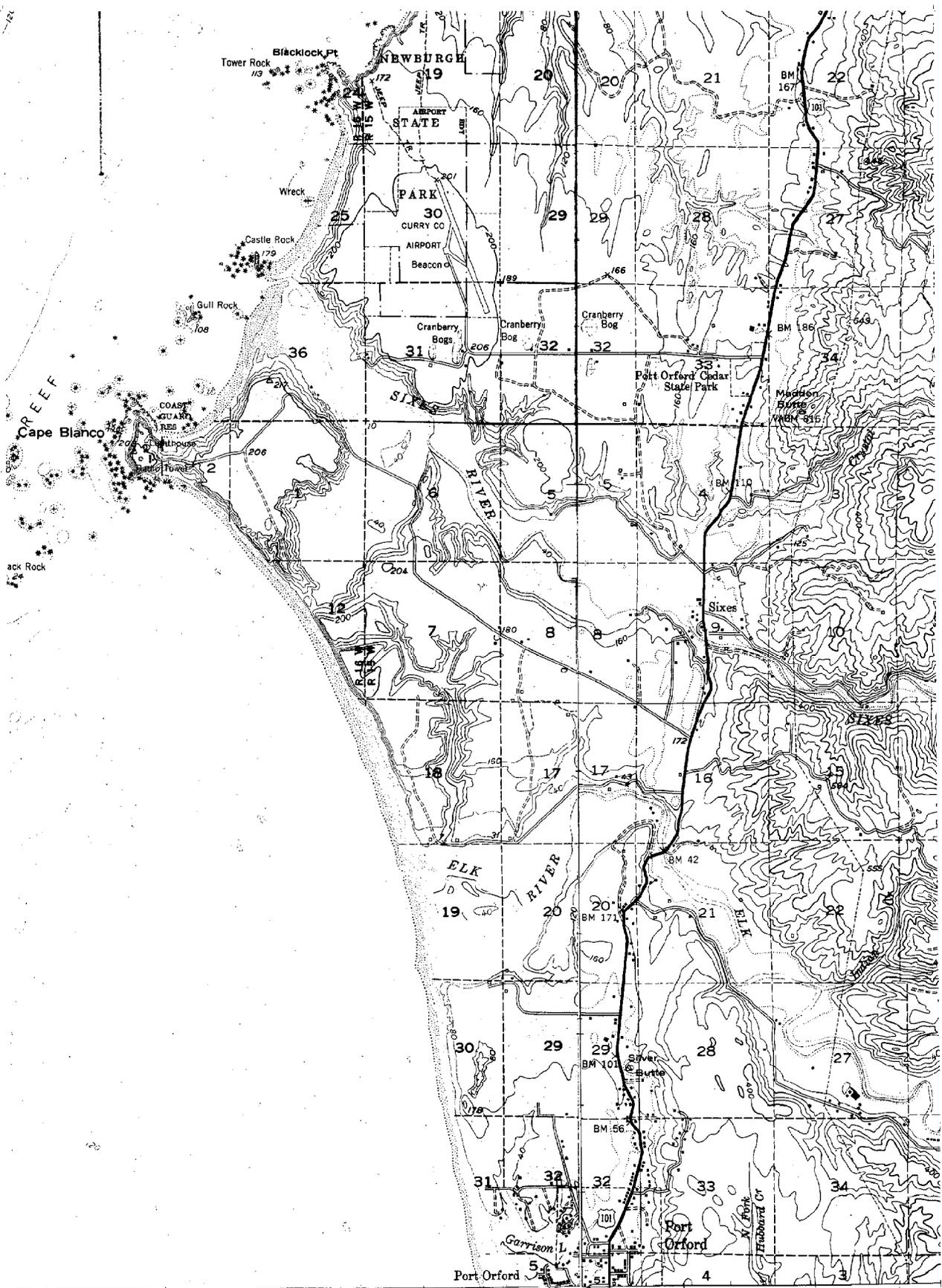
² Monthly and water-year runoff records have been compiled and are available in punch card or printout form through the OSWRB.

³ Data available in punch card or printout form through the DEQ.

() This is the most recent record date found and is not necessarily the last.

* Period of record is not continuous.

ELK RIVER



INTERIOR-GEOLOGICAL SURVEY, WASH. D. C. -1963
 MR 6175
 (FORT ORFORD) 124°30' 375000m. E.
 OPHIR 21 MI.
 GOLD BEACH 33 MI.
 R. 15 W.

ELK RIVER

General Description of Estuary and Drainage Basin

Estuary

The Elk River Estuary lies approximately 237 miles south of the Columbia River mouth. It ranks as one of the smallest in size in terms of surface area. Port Orford is the nearest populated community which is located 1 mile south of the Coast Highway Bridge (U.S. 101) that crosses the Elk River. Census figures for Port Orford appear in Table 1.

Table 1. Population Centers Near
Elk River [9,96,111,134].

Name	General Location	River Mile location	1970 Population
Port Orford	1 mi. south of Elk R. Coast Hwy. Br. (u.S. 101)	not applicable	1,037

The HW surface area of the estuary as estimated from 1973 EROS Data Center aerial photographs is 290 acres [135].

The average annual yield of the Elk River at its mouth was 330,000 ac-ft for the period of 1930-1961. The minimum annual yield was 180,000 ac-ft, and the maximum, 470,000 ac-ft. The Elk River source is at river mile 29.8, elevation 890 feet (river mile 29.8 is the confluence of the North Fork and the South Fork of the Elk River) [93,96].

The Port of Port Orford is located at P.O. Box 227, Port Orford, Oregon, 97465; telephone number 332-3281 [106].

Drainage Basin

The Elk River drains a total basin area of 94 sq. miles. The average yearly freshwater yield of the Elk River is 330,000 ac-ft which equals an average annual precipitation of 66 inches over the basin [93].

The Elk River Basin consists primarily of woodlands (96.1%; 58,766 acres), croplands (3.0%; 1,814 acres), and pasture (1.0%; 180 acres). As of January, 1963 the Elk River had no existing storage ponds or reservoirs, but had 2 potential reservoir sites being studied.

The average annual precipitation ranges from 65 inches at the mouth of the Elk River to 120 inches in the upper reaches [93].

ELK RIVER

General Description of Estuary and Drainage Basin

Estuary

There are two climatological stations in the vicinity of the Elk River Estuary. The Cape Blanco station has precipitation and temperature data from 1952 and the Port Orford station has precipitation and temperature data from 1852 to 1856 and from 1905 to the present. (See Table 7) [93,143].

The Elk River has a length of 29.8 miles to the confluence of the North Fork and South Fork, the North Fork Elk River having an additional length of 5 miles. The elevation drop from the source to the mouth for the Elk River is 890 feet and 2,080 feet for the North Fork. The average gradient for the Elk River is 30 feet per mile and 400 feet per mile for the North Fork [93].

Elk River stream profile appears in page 63 in the Coos Bay Basin section.

Hydraulic Description of Estuary

Tides and Currents

According to the U.S. Geological Survey the average range of the tide is approximately 5 feet [144].

It appears that the mouth of the Elk River Estuary may migrate several hundred yards and change its position periodically due to the sand bar and the coastline characteristics at the mouth. During the summer months the sand bar prevents saline water from entering the estuary except during periods of extremely high tides.

River Discharges

Stream flow records are available from the USGS stream gaging station on the Elk River at river mile 3.2. The station is discontinued, but records are available for data taken between October, 1967 and June, 1970. Spot observations are available for years 1926, 1931-32, 1934-38, and 1949 to 1952 [148].

Table 2. Stream Gaging Data [148].

Stream	Location (river mile)	Drainage area (sq.mi.)	Complete water years of record	Flowrate (cfs)		
				max.	min.	mean
Elk River near Sixes, Ore.	3.2	86.1	Oct., 1967- June, 1970	14,300	48	610

ELK RIVER

Hydraulic Description of Estuary

Salinity and Classification by Mixing

Salinity profiles as a function of depth and distance from the mouth of the river are presented in Table 3. Data was taken on August 22, 1973 during a high tide of +7.5 feet [87].

Table 3. Salinity Values for the Elk River Estuary.* Aug. 22, 1973 [87].

Station	Distance from mouth (mi.)	Salinity %		Depth (ft.)
		top	bottom	
1	0.1	0.2	0.2	1
2	0.2	0.2	0.2	2
3	0.3	0.2	0.2	2
4	1.4	0.2	0.2	3
5	1.6	0.2	0.2	5
6	1.7	0.2	0.2	7
7	1.9	0.2	0.2	5

* The Elk River mouth was almost completely closed off by sand bars and no saline water entered the estuary except for extremely high tides.

Sediments

Cliffs and small embayments characterize the shoreline south of Cape Blanco. The narrow beaches in the area are composed of coarse sands and gravels. From Cape Blanco (through Port Orford) the beach is narrow with mountainous uplands, partially developed with residences.

According to the National Shoreline Study by the U.S. Army Corps of Engineers, (Aug., 1971), the shoreline at Cape Blanco to the north of the estuary is experiencing non-critical erosion. The beaches in the immediate vicinity of the Elk River Estuary are experiencing no erosion [125].

ELK RIVER

Hydraulic Description of Estuary

Sediments

The generalized sediment yield for the Elk River basin is 0.1 to 0.5 ac-ft per sq. mile per year [23].

Water Quality Information

Miscellaneous flow and temperature measurements for the basin were made by the Oregon State Game Commission. Temperature ranges from these sources are presented in Table 4 [78].

Table 4. Temperature Extremes for Elk River Drainage Basin [78].

Point of measurement	Period of record	Observed temperature extreme (F°)		
		max.	min.	type of observation
Elk River river mile 3.5	4-8-69 to 7-22-69	70	51	spot
Elk River below Bald Mtn. Creek	4-8-69 to 7-22-69	69	49	spot
Elk River above Butler Creek	4-8-69 to 7-22-69	69	49	spot
Elk River above Blackberry Cr.	4-8-69 to 7-22-69	69	49	spot
Anvil Creek mouth	4-8-69 to 7-22-69	62	50	spot
Bald Mtn. Creek mouth	4-8-69 to 7-22-69	67	49	spot
Purple Mtn. Creek mouth	4-8-69 to 7-22-69	56	49	spot
Panther Creek mouth	4-8-69 to 7-22-69	67	48	spot
Butler Creek mouth	4-8-69 to 7-22-69	65	47	spot
Blackberry Cr. mouth	4-8-69 to 7-22-69	61	47	spot

DEQ water quality stations are listed in Table 7.

ELK RIVER

Biological Information

Estimates of the number of adult anadromous salmonids in the Elk River system are as follows: spring chinook--none, fall chinook--3,200, coho--800, steelhead--3,500, and sea-run cutthroat--2,800. The Elk River is considered to be one of the most important fall chinook streams on the Oregon Coast [78,93].

Dace, cottids, red-sided shiners, sticklebacks, lamprey, and suckers are the known rough fish species in the stream systems of the South Coast Basin [78].

Low natural summer runoff coupled with extensive streamside logging in the Elk River watershed contribute to warm stream flow conditions during the summer. The Elk River is also affected by siltation and logjams [78].

The Elk River system has 10 streams used by adult anadromous salmonids, 8 of which have minimum flow recommendations established and 1 protected by the State Water Resources Board.

Table 5 refers to the estimated sport harvest in the Elk River system.

Table 5. Estimated Annual Harvest, Angler Days, and Gross Expenditures for Angling in the Elk River System [78].

Fish	Harvest	Angler Days	Gross Expenditures
Salmon*	4,200	16,800	\$310,800
Steelhead	1,200	4,800	88,800
Sea-run Cutthroat	300	200	3,700
TOTALS		21,800	\$403,300

* Includes jack salmon

The Elk River Estuary is small in size, but this estuary, along with the Sixes, Pistol, Chetco, and Winchuck is very important to the survival of salmon and steelhead.

Figure 1 is a periodicity chart showing when adult spawning anadromous fish are present in the Elk River system.

Figure 1. Periodicity Chart for Adult Spawning
Anadromous Fish in the Elk River System [78].

Chinook Salmon *****

Coho Salmon -----

Steelhead and
Cutthroat trout ::::::::::::::

Stream	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	April	May
Elk River	*****	*****	*****	*****	*****			
		-----	-----	-----	-----			
		::::::::::	::::::::::	::::::::::	::::::::::	::::::::::	::::::::::	::::::::::
Anvil Creek	*****	*****	*****	*****	*****			
Bald Mountain Creek	*****	*****	*****	*****	*****			
		-----	-----	-----	-----			
		::::::::::	::::::::::	::::::::::	::::::::::	::::::::::	::::::::::	::::::::::
Butler Creek	*****	*****	*****	*****	*****			
		::::::::::	::::::::::	::::::::::	::::::::::	::::::::::	::::::::::	::::::::::
Elk River, North Fork			::::::::::	::::::::::	::::::::::	::::::::::	::::::::::	::::::::::
Elk River, South Fork			::::::::::	::::::::::	::::::::::	::::::::::	::::::::::	::::::::::
Blackberry Creek			::::::::::	::::::::::	::::::::::	::::::::::	::::::::::	::::::::::
Panther Creek	*****	*****	*****	*****	*****			
		::::::::::	::::::::::	::::::::::	::::::::::	::::::::::	::::::::::	::::::::::
Red Cedar Creek	*****	*****	*****	*****	*****			
		-----	-----	-----	-----			
		::::::::::	::::::::::	::::::::::	::::::::::	::::::::::	::::::::::	::::::::::

ELK RIVER

Biological Information

A general description of big game, upland game, waterfowl, and furbearers of the basin is given in the Sixes River section on Biological Information.

Physical Alterations

The only physical alteration near the estuary is the Oregon Coast Highway Bridge (U.S. 101), at river mile 3.2 [96].

Estuary Uses

Industrial and Commercial

Irrigation, mining, and gravel removal are the basic industrial and commercial uses of the Elk River. The average annual yield of the Elk River is 330,000 ac-ft while the legal annual depletion is 1,000 ac-ft and the estimated actual annual consumption is 900 ac-ft. The Elk River has 1 reservoir right issued for industrial purposes with a total of 32 ac-ft storage capacity and a surface area of 5 acres. Surface water rights include 3.99 cfs consumptive for domestic, irrigation, and industrial purposes.

Chromite, gold, quicksilver, and coal are mined in the watershed [93].

Port Orford manufacturers are listed in Table 6.

Recreation

The principal attraction of the basin is the Pacific Ocean. The large forest areas covering the slopes of the Coast Range which include the Siskiyou National Forest provide excellent hunting.

Parts of the Elk River flow through the northern portions of the Siskiyou National Forest. Several streams in the basin have outstanding aesthetic value and make a significant contribution simply because they maintain attractive flows, have little streamside development, and possess watersheds that have not been excessively logged. The Elk River above Anvil Creek was selected by the Oregon State Game Commission as a stream which should be managed for its aesthetic value [78,93].

ELK RIVER

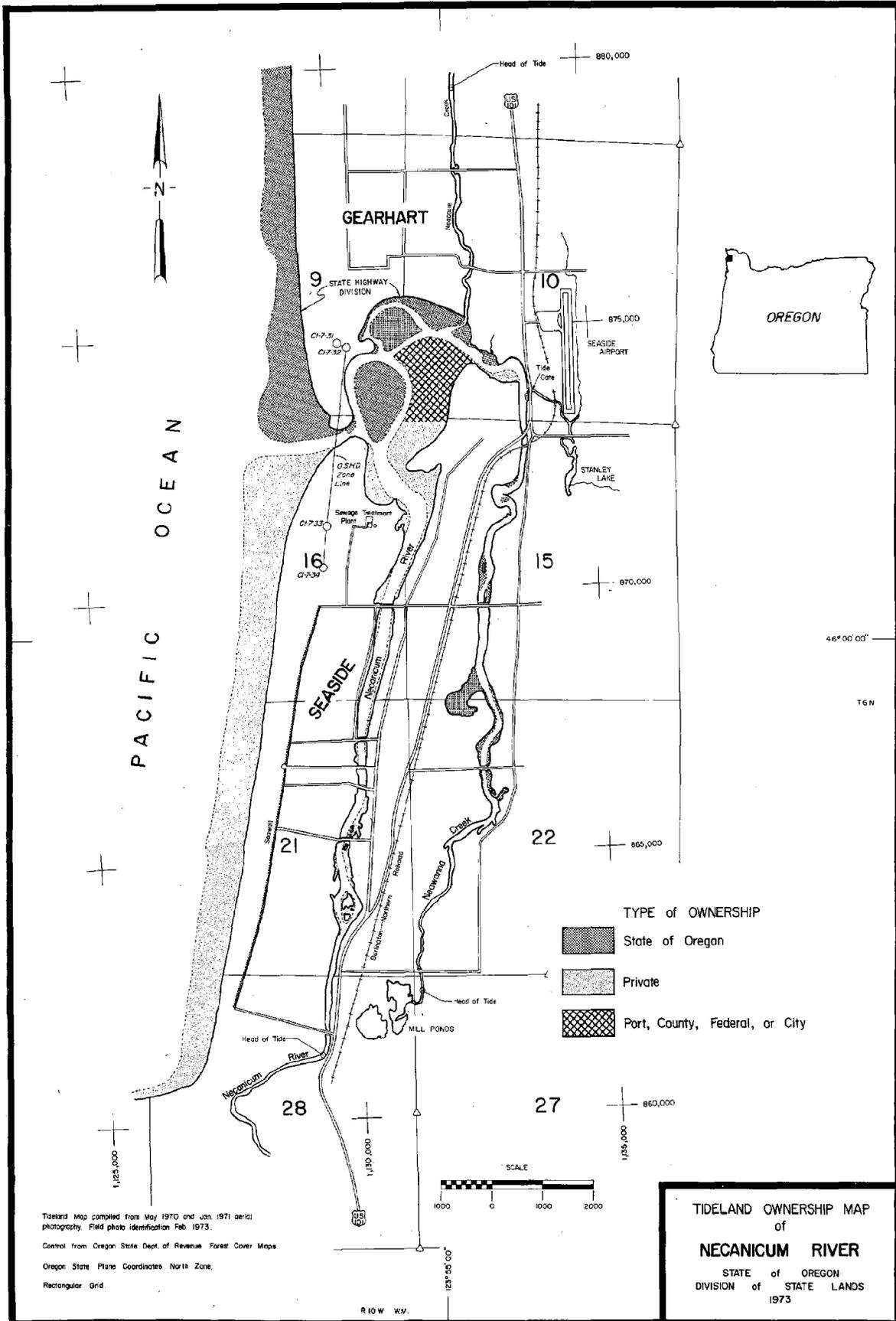
Table 6. Major Manufacturers at Port Orford, Oregon [71].

Location	Name	Type of Business	Number Employed
Port Orford	Cape Fisheries Inc.	Canned and Cured Fish and Seafoods	75
"	Walter and Allen Cram Co.	Logging Camps and Logging Contractors	5
"	Laird Logging Co.	"	100
"	N.B. Marsh Logging Co.	"	not listed
"	Stole and Bens Loggers	"	4
"	Western States Plywood Cooperative	Veneer and Plywood	245
"	Port Orford Press	Newspapers-Publishing, Publishing and Printing	2

Table 7. Surveillance Stations near the Elk River Estuary

Type of	Name and/ or identifying number	Approximate location	Drainage area (sq.mi.)	Period of record	Reference
Climatological	Cape Blanco	T32S, R16W Sec. 2		1952-present	[93]
"	Langlois	T13S, R15W Sec. 35		1891-1904	"
"	Langlois 2 (Formerly Denmark, Willow Creek)	T13S, R15W Sec. 2		1922-present	"
"	Port Orford (Formerly the Heads)	T33S, R15W Sec. 8		1852-1856, 1905-present	"
Water Quality	Elk River 1 mi. above Hwy 101 Bridge	T32S, R15W Sec. 21 river mile 4.5			[152]

NECANICUM RIVER

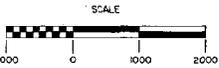


Tideland Map compiled from May 1970 and Jan. 1971 aerial photography. Field photo identification Feb 1973.
 Control from Oregon State Dept. of Revenue Forest Cover Maps
 Oregon State Plane Coordinates North Zone.
 Rectangular Grid.

TIDELAND OWNERSHIP MAP
 of
NECANICUM RIVER
 STATE of OREGON
 DIVISION of STATE LANDS
 1973

TYPE of OWNERSHIP

- State of Oregon
- Private
- Port, County, Federal, or City



R 10 W W.M.

NECANICUM RIVER

General Description of Estuary and Drainage Basin

Estuary

The Necanicum River Estuary lies approximately 16 miles south of the Columbia River mouth. Of the estuaries included herein, it ranks among the smallest in size. Towns located on or near the estuary include Seaside and Gearhart. Locations and 1970 populations are given in Table 1 [95,111,129].

Table 1. Population Centers at Necanicum River
[9,95,111,134]

Name	General Location	River Mile Location	1970 Population
Seaside	Necanicum R., S. Side at mouth	0 to 2.9	4,402
Gearhart	Necanicum R., N. Side	0 to 0.9	820

Tidal reach is approximately 3.0 miles from the mouth of the Necanicum [87].

The estuary measures less than 2,000 feet at its mouth and covers about 278 acres [66]. Maximum depth varies from 9 to 12 feet becoming very shallow at the mouth [87].

The estuary consists of the Necanicum River, Neawanna Creek, and Neacoxie Creek. The Necanicum-Neawanna system drains an area of 87 sq. miles with the source of the Necanicum at river mile 21.2, elevation 1,360 feet.

The mouth of Neawanna Creek enters the estuary from the North bank at river mile 0.2. Neawanna Creek is approximately 7 miles in length with its source at an elevation of 880 feet.

The mouth of Neacoxie Creek enters the estuary from the North bank of river mile 0.2 also. The Neacoxie Creek is less than 4 miles in length with its source at Sunset Lake, elevation approximately 25 feet [95,123,129].

Drainage Basin

The Necanicum River-Neawanna Creek system drains a total area of 87 sq. miles. The average yearly freshwater yield of the system is 220,200 ac-ft with an average annual precipitation of 100 inches. The basin consists primarily of forests (93.6%; 40,500 acres), cropland (1.2%; 500 acres), and rangeland (1.2%; 500 acres).

NECANICUM RIVER

General Description of Estuary and Drainage Basin

Drainage Basin

Frequently flooded areas along the Necanicum average 150 acres. As of June, 1966, the Necanicum River had 4 storage ponds and 1 storage reservoir with no plans for future reservoir sites.

The average annual precipitation ranges from 85 inches at Seaside to over 110 inches at the headwaters of the Necanicum [115].

The Seaside surveillance station has recorded climatological data from 1931 to the present.

The Necanicum River stream profile appears on page 221 in the Tillamook Basin section.

Hydraulic Description of Estuary

Tides and Currents

In an effort to determine the precise elevations of mean high water (MHW) in the Necanicum River Estuary, the Portland District, U.S. Army Corps of Engineers, in cooperation with the National Ocean Survey, in the fall of 1971 installed two temporary tide gauging stations in the Necanicum River at Seaside, one located at the 12th Street Bridge and the other near the City of Seaside Sewage Treatment Plant. A third temporary tide gauging station was installed in the Pacific Ocean near Indian Beach at Ecola State Park. Analyses of continuous measurements of tidal fluctuations at these three stations show the tidal datum plane for those stations as follows in Table 2. The tidal prism is equal to approximately 1,350 ac-ft of water [27].

Table 2. Tidal Fluctuations for the Necanicum Estuary [27].

Datum Plane	Elevation of Datum Plane (feet)		
	Seaside ₁ Sewage Plant	12th St. Bridge	Indian Beach ₂
MHHW	4.9	5.3	4.1
MHW	4.2	4.6	3.4
SLD	0.0	0.0	0.0
MLW			-2.6
MLLW			-3.9

MHHW=Mean Higher High Water MHW=Mean High Water
SLD=Sea Level Datum MLW=Mean Low Water
MLLW=Mean Laver Low Water

¹Two months of observation, Nov. and Dec. 1971

²31 high and low waters, observed from Jan. 27 to Feb. 14 1972

NECANICUM RIVER

Hydraulic Description of Estuary

Tides and Currents

Head of Tide is at about river mile 2.7 in the Necanicum (near the golf course footbridge) and at about river mile 3.8 in Neawanna Creek (400 ft. from the mill ponds) [73,87].

River Discharges

Stream flow records are available from the USGS stream gaging station on the South Fork of the Necanicum River near Seaside, Oregon. The station, no longer operating as of 1968, was located at the Seaside water supply dam on Hollenback road, 1.4 miles upstream from the mouth and 8 miles southeast of Seaside.

The drainage area at the station is 7.99 sq. miles or 9.2% of the drainage area of the total system. Streamflow averages and extremes for the station are given in Table 3 [147].

Table 3. Flowrates for South Fork of Necanicum River [146,147].

Stream	Point of Measurement (river mile)	Drainage area (sq.mi.)	Complete water Years of record	Flowrate (cfs)		
				max.	min.	ave.
S. Fork Necanicum	12.8	7.99	1953-1968	3040	1310	1965

The Portland District, U.S. Army Corps of Engineers, by use of the regional frequency approach, and basin characteristics (mean annual precipitation \approx 100 inches per year, river length = 21 miles, average stream surface slope = 65 feet per mile) arrived at these estimates for peak river discharges for the Necanicum River [27].

FLOOD	PEAK DISCHARGES
2-year frequency	6,000 cfs
5 year frequency	7,900 cfs
10-year frequency	9,000 cfs
25-year frequency	10,300 cfs
50-year frequency	11,200 cfs
100-year frequency	12,000 cfs

Average monthly flows are given in Table 4 from the Oregon State Water Resources Board, 1972.

NECANICUM RIVER

Table 4. Average Monthly Flows for Necanicum River [140].

	Average Monthly Flows (cfs)		
	20%	50%	80%
October	380	197	56
November	982	626	298
December	1286	836	565
January	1228	843	534
February	1153	843	546
March	867	616	415
April	588	401	234
May	255	169	103
June	148	98	59
July	63	42	26
August	30	23	16
September	52	26	14
<hr/>			
Total			

S.M. 0- Correlated with Youngs River at S.M. 9.7 by Area-Preci-.

Area= 70 sq. mi.

Area-Precip.= 417,837 Ac.-Ft. Calculated by SWRB '72]

NECANICUM RIVER

Hydraulic Description of Estuary

Salinity and Classification by Mixing

The open estuary north of the Seaside Sewage Treatment Plant, during periods of flood tide, has a general salinity of that comparable to the adjacent Pacific Ocean, which salinity is only slightly reduced in concentration by fresh-water flows of the river during ebb-tide periods.

South of the Sewage Treatment Plant, the full depth of the river estuary, particularly along the bottom levels, will show evidence of salinity concentrations during the flood tide periods, which may diminish in concentrations, particularly in the upper levels, during ebb-tide periods [27].

These conditions were observed on August 17, 1973 during flood tide of approximately +7.0 feet. Results are given in Table 5 [87].

Table 5. Salinity Values for the Necanicum River Estuary Aug. 17, 1973 [87].

Station	Distance from mouth (mi)	Salinity %		Depth (ft.)
		top	bottom	
1	0.6	26.9	26.9	2
2	0.8	23.3	26.9	4
3	0.9	23.3	26.9	5
4	1.3	22.0	26.9	8
5	1.8	22.0	26.9	9
6	2.1	19.9	26.9	9
7	2.3	19.2	26.2	5
8	2.9	3.0	26.2	4
9	3.0	---	----	2

Sediments

The processes of sedimentation are apparently active in the open estuary area as evidenced by the migration of the outlet channel to and including the year 1968. Such migration of that channel is the direct result of the deposition of sediments during periods of low flow when velocities are insufficient to support the transportation of suspended sediments.

NECANICUM RIVER

Hydraulic Description of Estuary

Sediments

The deposition of these sediments in the channel raises the elevation of the water surface and thus imposes an increased hydraulic gradient with respect to downstream areas. The creation of this gradient and the influence of gravity causes the flow to take the most direct course which, almost invariably, results in a change in the direction of flow and thus, migration of the channel [27].

According to the U.S. Army Corps of Engineers National Shoreline Study, the ocean beaches south of the Necanicum Estuary to Tillamook Head are experiencing non-critical erosion while those north of the estuary are experiencing no erosion [125].

The generalized sediment yield for streams in the area is 0.1 to 0.2 ac-ft per sq. mile per year [23].

Predominant direction of littoral movement is from north to south. In this area, waves approach the coast from the northerly sector 49.25 per cent of the time and from the southerly sector 31.71 per cent of the time.

Water Quality Information

Miscellaneous flow and temperature measurements for the basin were made by the Oregon State Game Commission. Temperature ranges from these sources are presented in Table 6 [77].

Table 6. Temperature Extremes for Necanicum Drainage Basin [77].

Point of Measurement	Period of Record	Observed Temperature Extremes (°F)		
		max.	min.	Type of observation
Necanicum River below Klootchie Cr.	4-7-71 to 8-21-71	67	45	spot
Necanicum River above Bergsrik Cr.	1-7-71 to 8-5-71	65	43	spot
Klootchie Cr. mouth	1-7-71 to 11-16-71	66	43	spot
South Fork Necanicum River mouth	1-7-71 to 11-16-71	64	43	spot
North Fork Necanicum River mouth	3-24-71 to 7-20-71	72	45	spot

NECANICUM RIVER

Water Quality Information

There is one sewage treatment plant in Seaside built and expanded between years 1940 through 1962. It is of the trickling filter type for a design population of 4,000 and a design flow of 1 MGD. The estimated population served in 1967 was 3,600. The Necanicum River is the receiving stream. The Oregon State Sanitary Authority recommended that additions to enlargement or improvement of the existing facility at Seaside be completed by July 1972. The cost of the recommended work, which consisted of interceptors and additional treatment works, was estimated at \$75,000 [84].

DEQ water quality stations are listed in Table 8.

Biological Information

Estimates of the number of adult anadromous salmonids spawning in the Necanicum River system are as follows: spring chinook--none; fall chinook--none; coho--3,780; chum--100; winter steelhead--2,000; summer steelhead--none; and sea-run cutthroat--2,000 [77].

Other fish in the estuary include herring, sculpins, perch and flounder [66].

The Oregon State Game Commission recommends that the Necanicum River be protected against gravel removal above Meyer Creek. It was also determined that a possible reservoir site on the South Fork Necanicum River (T5N-R9W-S29) is thought compatible with fishery resources [77].

Species of wildlife present in the basin are Black-tailed deer, Roosevelt elk, muskrats, minks, raccoons, otters, beavers, opossum, and bobcats. The principal upland game birds are mountain quail, ruffed grouse, and band-tailed pigeons. A few ring-neck pheasants and California quail are also in the area [133].

Due to the combination of high density sand and coastal configuration, the 20 mile long beach from Seaside to the Columbia River entrance is ideal for razor clams [74].

Physical Alterations

At the Necanicum River entrance construction of a sand spit in the open estuary beginning in late 1967, directed estuarine flows to the Gearhart shores, causing erosion of that shoreline as well as erosion of the Pacific shore for a distance of about 4,000 feet immediately north of the entrance.

Sunset Cove, Inc., a land development firm, contracted the sand spit on which the City of Seaside is located during the period between November, 1967, and November 1969 without benefit of legal permit. Some 375,000 cubic yards of sand were relocated from the firm's property and the adjacent public beach area in the direction of the sand spit.

NECANICUM RIVER

Physical Alterations

The original construction also included the riprapping of the western perimeter of the raised area to protect it from storm and ocean erosion. In November, 1969, the protection was extended some 500 feet northward and around the northeast corner of the sandfill site. Later in May, 1970, as the result of high tides, snow-melt streamflow and its natural tendency to meander, the course of the Necanicum River outlet shifted to the south and attacked the northern extremity of the elevated sand spit, necessitating emergency repairs [27].

The U.S. Army Corps of Engineers has completed projects for the protection of public works from flood hazard totalling \$46,600 as of 1971. Also, a survey report was authorized to determine the feasibility of providing a small-boat basin at the south end of the ocean beach at Seaside, near Tillamook Head. Completion of that report has been postponed until it has been determined whether a qualified local sponsor for the project can be found [129].

Records of bank protection, fill, piling, revetment, and sub-surface cable permits issued for the Necanicum River estuary are kept by the U.S. Army Corps of Engineers, Portland District.

There are seven small bridges crossing the Necanicum River Estuary at the City of Seaside [116].

Estuary Uses

Industrial and Commercial

Clatsop County relies heavily on fisheries and an expanding forestry industry for its livelihood. Total timber production in the county was 303 billion board feet in 1970, employing 1,020 persons in the industry with annual wages directly and indirectly related to the timber industry averaging \$35,000,000.

Farmland in the county totals 39,501 acres and is devoted largely to forest products and forage for cattle and other livestock. Increased industrialization and the growing need for housing space will continue to put a stress on the farm economy of Clatsop County, according to the Oregon Department of Geology and Mineral Industries.

Mink raising is favored by the nearby supply of abundant fish meal, and in 1967, 34 farms were raising a total of 34,000 female minks [116].

Table 7 lists major manufacturers in the Necanicum area.

NECANICUM RIVER

Estuary Uses

Recreational

Tourism added \$10 million to the local economy of Clatsop County in 1965 and officials estimate that the industry is expanding at a rate of 30 per cent per year. Attractions include sightseeing, beach activities, fishing, big-game hunting, and boating. Points of interest in the immediate vicinity of Seaside are Ecola State Par, The Lewis and Clart Salt Cairn Historic marker, and the ocean beaches [116].

The estimated angler catch for Necanicum Bay was 9,000 fish in 1970 with an effort of 1,800 angler-days expended as estimated by the Oregon State Game Commission [77].

NECANICUM RIVER

Table 7. Major manufacturers in Necanicum River Estuary
[71].

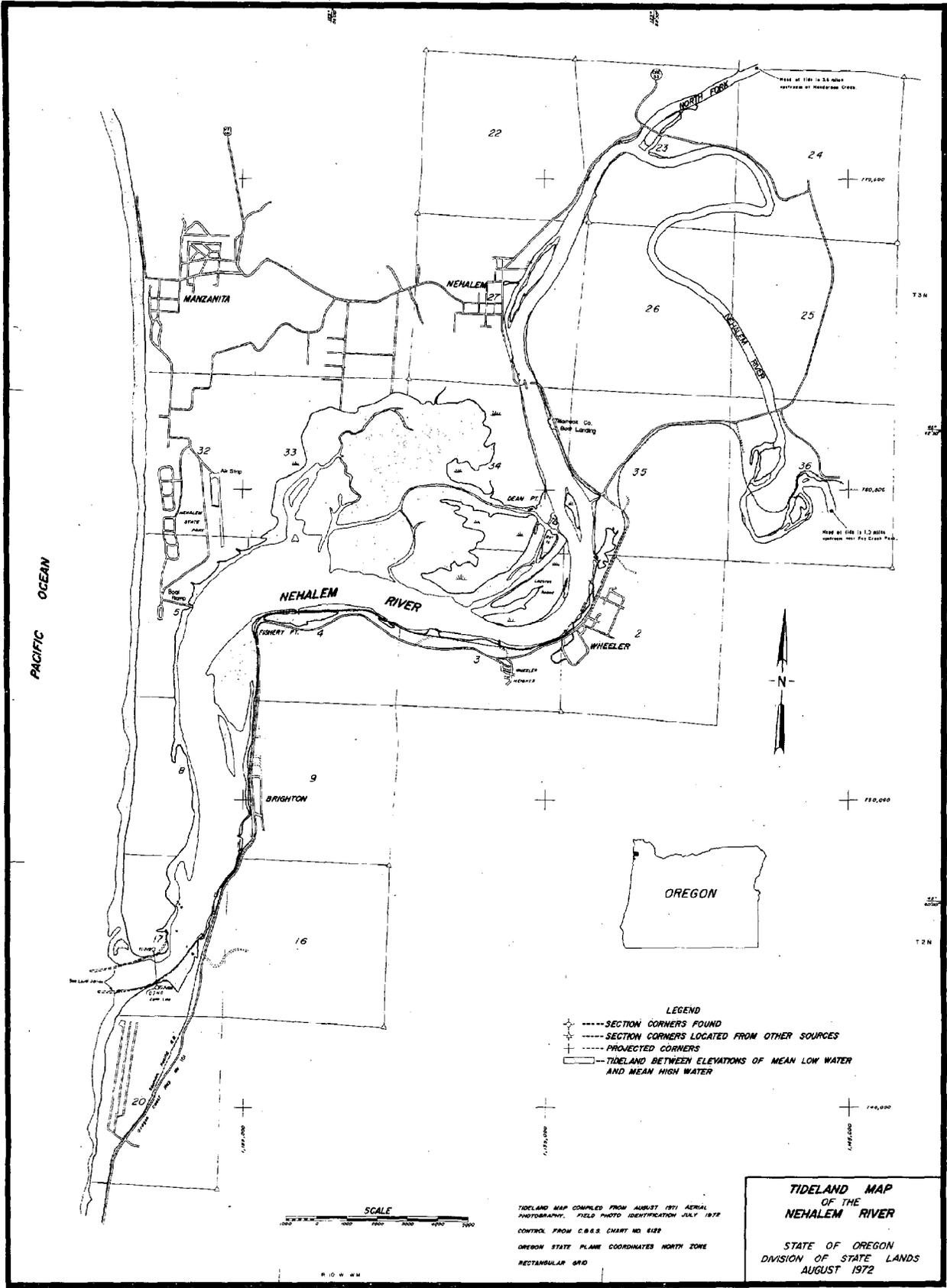
Location	Name	Type of Business	Number Employed
Seaside	Bell Bouy Crab Co.	Canned and Cured Fish and Seafoods	45
"	Harrison's Bakery	Bread and other Bakery products	13
"	Phillips Candies	Candy and other Confectionery products	14
"	Burke Logging Co.	Logging camps and Logging Contractors	5
"	Crown Zellerback Corp.	"	375
"	Kohl Inc.	"	12
"	Olson Logging, Ben	"	12
"	Ordway Logging Co.	"	8
"	Shaw Co.,	"	14
"	Waterhouse Logging Co.	"	20
"	Wilson Logging Co., Ed Q.	"	14
"	Seaside Publishing Co.	Newspapers-Publishing, Publishing and Printing	8
Gearhart	Gilmore, Andy & Lyle	Logging Camps and Logging Contractors	8
"	Wren Logging Co.	"	18

Necanicum River

Table 8. Surveillance Stations at Necanicum

Type of Stat on	Name and/or Identifying	Approximate Location	Drainage area	Period of record	Reference
Climatological	Seaside	Lat 45° 59' Long. 123° 55' El. 10		1931-1971	[143]
Stream Gaging	S. Fork Necanicum USGS #14-299000	Lat 45° 53' Long. 123° 50'	7.99	1953-1963	[140]
Water Quality	Necanicum R. near mouth	River mile 0.1			[152]
"	Necanicum R. near 12th Ave. Bridge	River mile 1.3			"
"	Necanicum R. near Golf Course Rd. Bridge	River mile 2.9			"
"	Necanicum R. near Hwy 101 & Hwy 26	River mile 5.8			"
"	Neawanna Cr. near 12th Ave. Bridge	River mile 1.6			"
"	Neacoxie Cr. near Gearhart	River mile 0.5			"
"	Neacoxie Cr. near Golf Course Rd.	River mile 1.4			"
"	Neacoxie Cr. near Surf Pines Rd.	River mile 3.0			"

NEHALEM BAY



- LEGEND**
- SECTION CORNERS FOUND
 - SECTION CORNERS LOCATED FROM OTHER SOURCES
 - PROJECTED CORNERS
 - TIDELAND BETWEEN ELEVATIONS OF MEAN LOW WATER AND MEAN HIGH WATER

**TIDELAND MAP
OF THE
NEHALEM RIVER**

STATE OF OREGON
DIVISION OF STATE LANDS
AUGUST 1972

TIDELAND MAP COMPILED FROM AUGUST 1971 AERIAL PHOTOGRAPHY, FIELD PHOTO IDENTIFICATION JULY 1972
CONTROL FROM C.B.S. CHART NO. 812
OREGON STATE PLANE COORDINATES NORTH ZONE
RECTANGULAR GRID

SCALE

0 1000 2000 3000 4000

NEHALEM BAY

General Description of Estuary and Drainage Basin

Estuary

Nehalem Bay is located about 40 miles south of the mouth of the Columbia River. Although relatively large in size (Table A), population is sparse. The three incorporated towns in the area--Manzanita, Wheeler, and Nehalem--had a combined 1970 population of less than 900. These and other population centers are given in Table 1 [89,95,111].

Table 1. Population centers at Nehalem Bay¹ [89,95,111].

name	general location	river mile location	approximate distance from estuary mouth (miles)	1970 population
Manzanita ²	coast; 3.5 miles north of the estuary mouth			365
Bayside Garden				120
Jetty	Nehalem Bay; south side	--	0.5	not listed
Brighton	Nehalem Bay; south side	--	1	60
Wheeler Hts.	Nehalem Bay; south side	--	4	70
Wheeler ²	Nehalem Bay; south side	--	4.5	262
Nehalem ²	Nehalem River; west side	1.1 to 1.8	6.1 to 6.8	241
Mohler	Nehalem River; south side	5.7	10.7	70
Foss	Nehalem River; north side	10.9	15.9	not listed
Batterson	Nehalem River; north side	12.8	17.8	no pop
Aldervale	North Fork Nehalem River; southeast side	3.9	11.6	not listed
Salmonberry	Salmonberry River; south side	0.4	27.7	no pop

¹Tidal effects extend approximately to mile 8.6 of the Nehalem River and to mile 4.7 of the North Fork Nehalem River.

²Incorporated

The estuary is about 2,820 acres in size. Reported surface areas [55,59,70] are given in Table 2; and other dimensions are included in Table 3 [55].

Nehalem Bay

Table 2. Reported surface areas of Nehalem Bay [55,59,70].

reference	surface area (acres)	measured at	tidelands		submerged lands	
			acres	percent	acres	percent
[58]	2,388	HW				
	1,669	MSL				
	948	LW				
[59]	3,766	1	1,180	32		
[70]	2,309	MHT	1,078	47	1,231	53
	1,231	MLT				

¹Specified by Marriage as the area affected by tidal action.

Table 3. Dimensions of Nehalem Bay [55].

distance from throat to
farthest estuary shore--6.0 miles

inlet dimensions at throat (at LW):

width--375 feet

average depth--20 feet

cross-sectional area--7,501 sq ft

average lagoon depth below MSL--2 feet

The main tributary of Nehalem Bay is the Nehalem River which discharges into it from the east approximately five miles from the mouth. The river drains an area of 847 sq mi and reaches a total length of 118.6 miles, making it the longest river of the North Coast Basin. The North Fork Nehalem River, which has a length of 24.2 miles, flows into the Nehalem River at mile 2.7. From that point to the ocean, the river and bay have about two tributaries from the north and seven from the south [89,95].

The Port Commission for the area with its address and phone number is [106]:

Port of Nehalem
P.O. Box 125
Nehalem, Oregon 97131
368-5258

Nehalem Bay

Drainage Basin

Nehalem Bay drains an area of roughly 855 sq mi (estimated from [89-chart]) with an average annual fresh water yield of 2,700,000 ac-ft [53,143]. The Nehalem River, draining over 99% of the watershed (847 sq mi), yields an average of 2,662,000 ac-ft of this total with estimated extremes (between 1933 and 1958) of 4,400,000 ac-ft and 1,500,000 ac-ft. Forests cover about 775 sq mi (91%) of the watershed, and streams total over 1,350 miles in length [89].

There are climatological stations, described in Table 7, at Classic Lake and Nehalem; records from the latter are available through the OSWRB in punch card or printout form [32,28]. Precipitation in the watershed averages 85 inches along the coast, 120 inches in the northwestern sections, 50 to 60 inches to the east, and near 150 inches in the south-central portion [89].

Stream profiles for the Nehalem River system appear on page 221 in the Tillamook Basin section.

Hydraulic Description of Estuary

Tides and Currents

The estuary is about 8 miles in length [53] and is described as being fully exposed to waves at the throat [55]. Tidal effects extend to mile 8.6 of the Nehalem River and to mile 4.7 of the North Fork Nehalem River [69]. The mean tide range is 5.9 feet with a diurnal range of 7.8 feet [55] and an extreme range of 15 feet [86]. Tidal prism on mean range is 4.28×10^9 cu ft with a diurnal range of 5.66×10^9 cu ft [55].

River Discharges

There is a stream gaging station on the Nehalem River at mile 13.5 (Table 7). Records from October 1939 to October 1970 show an average discharge at this point of 2,705 cfs with extremes of 43,200 cfs (January 25, 1964) and 34 cfs (August 1967) [140]. The average monthly discharge at the mouth of the Nehalem River from 1933 to 1958 has been presented in graph form in "North Coast Basin" [51]. Estimates from this graph show December with the high average monthly discharge (8,600 cfs) and August with the low (200 cfs). Flow for all 12 months averaged 3,600 cfs.

Salinity and Classification by Mixing

Salinity measurements by Burt and McAllister in the Nehalem River were made once during each of the following months: September 1957

Nehalem Bay

and January, April, and July 1958 [12]. Of these dates, salinity intrusion was greatest on September 11, 1957 at HHW when it reached a point 13.8 miles from the ocean at a concentration of 0.1 ppt on the bottom (10 feet) with a concurrent temperature of 19.4°C. No salinity was detected at the surface. Salinity at a point 12.9 miles from the ocean was found at 1.9 ppt on the surface and 3.2 ppt on the bottom (14 feet) with concurrent temperatures of 19.6°C and 19.7°C, respectively. Measurements beyond 13.8 miles were not reported.

Burt and McAllister have classified Nehalem Bay as a partly-mixed system in January and September and as a two-layered system in April [13].

Sediments

Littoral drift in the area is to the south during the summer and to the north during most of the winter; the net drift is to the north. Material has been deposited to some degree behind the north jetty and more extensively behind the south jetty [57]. Sediments ranging from sand to clay are deposited in the estuary by its rivers and average 116,000 tons annually [85].

Water Quality Information

The DEQ operates five water surveillance stations at Nehalem Bay (Table 7) [67,68]. Records are available dating back to March 1967 with 16 sampling dates at most of the stations between then and March 1972. Data from spot water quality checks made from 1948 to 1958 in various parts of the Nehalem River are also available, as indicated in Table 7 [89,90].

Water temperature records have been kept for at least three points on the Nehalem River (Table 7) [89,90,140]. Those from the station at mile 13.5 near Foss (between February 1947 and September 1962) show the average monthly temperature ranging from 1°C (March) to 26°C (July) [138].

At the present time, there are no sewage treatment plants in the estuary area; however, bids for a pumping plant will be let in the spring of 1973. It is to be located in Nehalem and will initially serve Nehalem and Manzanita and, eventually, Wheeler, Bayside Garden, and some of the surrounding territory [104].

Nehalem Bay

Biological Information

Numbers of adult anadromous salmonids spawning in the Nehalem River are estimated as follows: fall chinook--4,000, coho--21,840, chum--200, winter steelhead--11,000, and sea-run cutthroat--8,000 [77]. Although salmon are reportedly decreasing in number [49], the comparison with other stream systems in Table B shows these figures to be fairly high.

Fish commonly taken by anglers at Nehalem Bay include shiner perch, staghorn sculpin, dungeness crab, starry flounder, and redbait perch [38]. Due to the low salinity, the most abundant clams in the estuary are softshells, found primarily north of the main channel and about 3 miles upstream from the entrance [53,155]. There are some crabs near the estuary mouth [20,53] and experimental plantings of Pacific oysters have been made [89].

The estuary is a feeding, resting, and wintering spot for waterfowl generally found in western Oregon [89], and an area of about 1.5 sq mi on the southeast portion of the estuary is a winter range for black-tailed deer and Roosevelt elk [77].

Physical Alterations

Alterations by the Army Corps of Engineers include two rubble-stone jetties and an entrance channel. The south jetty, constructed partially by the Port of Nehalem, was completed in 1915 with a total length of 4,950 feet. The northern one is 3,850 feet long and was finished in 1918. The channel goes across the ocean bar at the bay entrance and has a depth of 8 feet. It was also completed in 1918 [126,129].

Navigation on the Nehalem River is described as being possible to 8.5 miles above Wheeler or 1.0 mile upstream from Mohler [69], which would be to river mile 7 or 8 [95]. The North Fork Nehalem River has a navigable length of 5.0 miles [69].

The Division of State Lands has completed its inventory of filled lands in the Nehalem River; some of the information from it is given in Table C [69].

The FCO operates the North Nehalem River Salmon hatchery on the North Fork Nehalem River 1/4 mile downstream from the Highway 53 bridge, or approximately at mile 10.4. Between July 1, 1968 and June 3, 1969, salmon and steelhead released into Oregon waters (Nehalem River and Ten Mile Lakes) from the hatchery totaled 1,347,585 [33,54].

Nehalem Bay

Industrial and Commercial

The most important economic resource of the Nehalem basin is timber [89]; lumbering is the main industry [90]. In the area of the estuary itself, most manufacturers, listed in Table 4, deal in lumber and wood products. Tourism is also of major economic importance there, and some of

Table 4. Major Manufacturers at Nehalem Bay [71]

Location	Name	Type of Business	Number Employed
Nehalem	Miami Shingle and Shake Co.	shakes and shingles	17
	Newberg and Scovell	logging contractors	15
	8 manufacturers employing less than 10	dealing mainly in lumber and wood products (mostly logging)	

the land along the Nehalem River and its tributaries is used for agriculture, dairy farming, and cattle raising [69,104].

Commercial fish landings, generally very limited, totaled less than 1,400 pounds of coho, clams, and groundfish in 1971. A breakdown is given in Table 5, and these figures are also included in Table D of the introduction

Table 5. Commercial Harvest of Food Fish Received at Nehalem Bay, 1971 [34].

Species	Harvest (pounds round weight)	Fishermen value
Clams	589	
Coho	524	NOT GIVEN
Ground Fish	262	

Nehalem Bay

for comparison with landings received at other ports. Statistics showing the value of the landings to fishermen, given here in Table E, were not included for Nehalem, probably because they were too limited to be of significant value [34]. For example, 1970 clam landings reported by other sources weighed only 258 pounds with a value to fishermen of \$33 [49,118].

Recreational

Angling and clamming are popular; annual harvest data for non-game bay fish and clams are given in Table 6. Salmon are taken mainly between the "bar" and Foley Creek (river mile 7.5) by trolling. Chinook enter

Table 6. Estimated Annual Harvest Data for Sport Fishing at Nehalem Bay, 1970 [77].

Species	area fished	annual harvest (total number)	effort (angler- or digger-days)
Non-game bay fish	Estuary	12,00	5,000
Clams	Estuary	27,000	900

the river in August and run until late September. From mid-August to mid-October coho are present, and following the first Fall rains, there is usually a nice run of jack salmon (two-year old bucks) [58]. Other species commonly caught in the bay (as determined by the FCO study between March and October 1971) include shiner perch, staghorn sculpin, and dungeness crab by shore angling and dungeness crab and relatively few starry flounder and redbtail perch by boat angling [38].

Nehalem Bay State Park is located on the north side of the estuary. Attendance during 1970, which was the first year of record, was 9,403 camper nights. Of those nights, less than 0.5%, or 47, have been estimated as being spent on the estuary itself [52,82,83].

Nehalem Bay

Table 7. Surveillance stations at Nehalem Bay.

type of station	name and/or identifying number	approximate location	drainage area (sq mi)	period of record	references
climatological	Classic Lake	1 mile north of Nehalem Bay; elevation--60 feet		1922-1926	[89,90]
	Nehalem; USGS #5969	1 mile north of Nehalem Bay		1894*(1967)	[90,92,124,143]
stream gaging	Nehalem River near Foss; USGS #3010	Nehalem River; mile 13.5	667	10/39-(1970)	[89,90,98] ²
DEQ water surveillance	#1	Nehalem Bay; 1/4 mile above Highway 101 bridge next to City of Nehalem; west side of channel		3/67-(3/72) (16 measurements)	[67,68] ³
	#2	Nehalem Bay; channel, 200 yards west of Tye Grill at Wheeler		3/67-(3/72) (16 measurements)	"
	#3	Nehalem Bay; channel, 150 yards west of Paradise Cove		3/67-(3/72) (16 measurements)	"
	#4	Nehalem Bay; channel, 175 yards west of Easton's Moorage		3/67-3/72 (16 measurements)	"
	#5	Nehalem Bay; channel, 250 yards west of cable crossing entry to Nehalem Bay near large yellow house		3/67-3/72 (15 measurements)	"
water quality	Nehalem River from ocean to Nehalem			1948-1958 (spot observations)	[89,90]
	Nehalem River	Nehalem River; mile 9.3			[89,90]
water temperature	Nehalem River from ocean to Nehalem			1948-1958 (spot observations)	[89,90]
		Nehalem River; mile 9.3		8/60-(1971) (monthly)	[89,90]
		Nehalem River near Foss; USGS #3010	Nehalem River; mile 13.5	667	2/47-(9/62)

¹ Precipitation data available in punch card or printout form through the OSWRB.

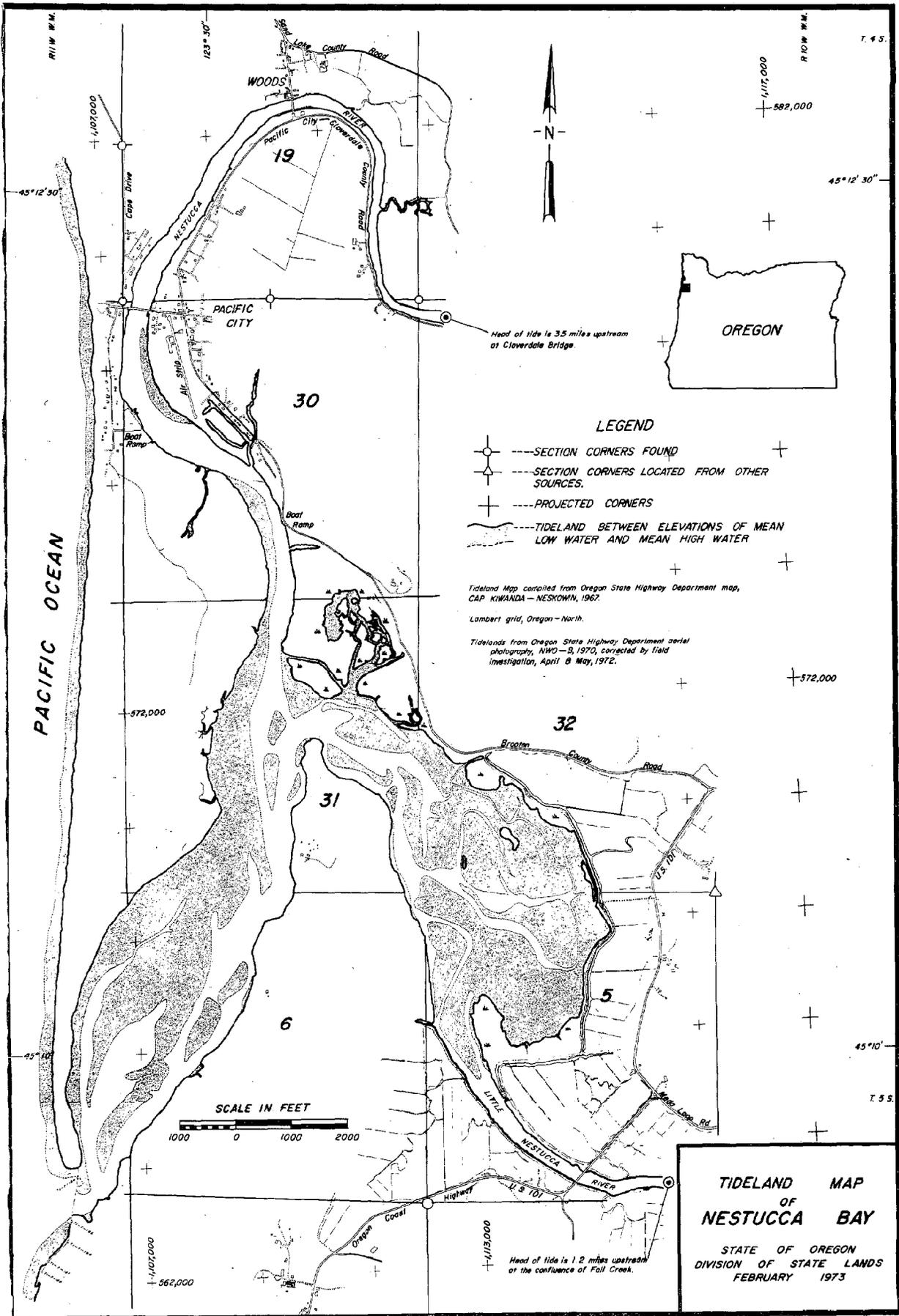
² Monthly and water-year runoff records have been compiled and are available in punch card or printout form through the OSWRB.

³ Data available in punch card or printout form through the DEQ.

() This is the most recent record date found and is not necessarily the last.

* Period of record is not continuous.

NESTUCCA BAY



NESTUCCA BAY

General Description of Estuary and Drainage Basin

Estuary

Nestucca Bay lies approximately 75 miles south of the Columbia River mouth and is the fourth smallest estuary of those included here (Table A). There are no towns on the bay itself, and none in the area are incorporated. Pacific City, with a 1970 population of 400, is the largest. This and other population centers there are listed in Table 1.

Table 1. Population centers at Nestucca Bay¹ [89,95,111].

name	general location	river mile location	approximate distance from estuary mouth (miles)	1970 population
Oreton	2 miles south of Nestucca Bay	--	--	rural
Pacific City	Nestucca River; east side	1.5	3.5	400
Woods	Nestucca River; north side	2.4	4.4	95
Cloverdale	Nestucca River; south side	7.0	9.0	no pop
Meda	Little Nestucca River; south side	2.5 (0.5 mile to the south)	--	rural
Dolph	Little Nestucca River; north side	10.9	13.9	not listed
Hebo	Three Rivers	0.9	12.7	200

¹Tidal effects extend approximately to mile 7.0 of the Nestucca River (the Cloverdale Bridge) and to mile 3.1 of the Little Nestucca River (0.8 mile above the Meda Loop Bridge).

The estuary is approximately 1,060 acres in size--surface areas reported by Johnson [55], Marriage [59], and the Division of State Lands [70] are given in Table 2 which also shows that over 50% of the bay is tidelands, although at one time it was a much larger estuary [53,70,155].

Major tributaries are the Nestucca River from the north and the Little Nestucca River from the south. There are two smaller tributaries discharging into the bay from the east, and Upton Slough empties into the Little Nestucca River just before the latter flows in the bay [89]. The Nestucca and Little Nestucca Rivers have their zero miles at their points of discharge into the bay, or roughly 2 and 3 miles, respectively, from the ocean [95,89-chart]. The Nestucca River is 52.9 miles long, drains 259 sq mi [95], and had an estimated average annual fresh water yield of 1,114,900 ac-ft between 1933 and 1958 [89]. A major tributary of the Nestucca River is Three Rivers, which has a length of 12.7 miles and discharges into the Nestucca River at mile 9.8. The Little Nestucca River is 19.5 miles long and drains 59 sq mi [95].

Nestucca Bay

Table 2. Reported surface areas of Nestucca Bay [55,59,70].

reference	surface area (acres)	measured at	tidelands		submerged lands	
			acres	percent	acres	percent
[6]	1,022	HW				
[63]	1,149	1				
[117]	1,000 422	MHT MLT	578	58	422	42

¹Specified by Marriage as the area affected by tidal action.

Drainage Basin

The estuary has a drainage area of about 322 sq mi (estimated from [89-chart]) consisting of sparsely settled, rough, mountainous, forested land [49]. It yields an average of 1,600,000 ac-ft of fresh water per year [85] and receives average annual precipitation ranging from 85 inches in the coastal areas to 110 inches in the central watershed [89]. There is a climatological station on the Nestucca River near mile 7 (Table 7) for which records are available back to 1940 [89,90,92].

Stream profiles for the Nestucca River system appear on page 221 in the Tillamook Basin section.

Hydraulic Description of Estuary

Tides and Currents

The bay is described as being fully exposed to waves at the throat. It has a mean tide range of 5.8 feet with a diurnal range of 7.6 feet [55].

Tidal effects, as reported by the Division of State Lands, extend to the Cloverdale Bridge (mile 7.0) on the Nestucca River and to 0.8 mile above the Meda Loop Bridge (mile 2.3) on the Little Nestucca River [69,95].

River Discharges

There are stream gaging stations on the Nestucca River at miles 13.5 and 49.3 (Table 7). Between 1964 and 1970 the average discharge at mile 13.5 was 1,042 cfs with extremes of 24,000 cfs (January 28, 1965) and 32 cfs (September 14, 1967). At mile 49.3 river flow between 1960

Nestucca Bay

and 1970 averaged 32.6 cfs with extremes of 876 cfs (December 22, 1964) and 0.87 cfs (July 17, 1968) [140]. Normal flow at the mouth of the Nestucca River is estimated at 1,540 cfs [85].

Salinity and Classification by Mixing

Giger [39] provides salinities with depth and length for high and low tides during winter (1969) and summer (1969) conditions. Salinity intrusion extended to approximately 4-5 miles from the mouth during the summer period. During the winter, saline water was located only within approximately the first two miles from the mouth with very low salinities occurring during low tide periods. Tidal variations of salinity appeared significant during both the winter and summer periods.

Sediments

Littoral drift in the area varies, being mainly to the south during the summer and to the north during the winter. Net movement, as indicated by the formation of a spit pointing south, is probably to the south [57].

The rivers deposit about 54,000 tons of sediments (ranging from sands to clays) into the bay annually, resulting in a definite reduction in the size of the estuary [57,85]. Sand dunes at the mouth shift enough to cause severe flooding of the estuary [69].

Water Quality Information

The DEQ operates six water quality stations in Nestucca Bay. Data is now available for the 1970 through 1971 period (3 measurements) [68]. Locations are given in Table 7.

There are USGS water temperature stations, also listed in Table 7, on the Nestucca River at mile 13.5 and on Cedar Creek near Hebo. (Cedar Creek discharges into Three Rivers near mile 2.) [138,141] Records of the daily temperature range for 1964 to 1968 from the Nestucca River station show extremes of 3°C (December 1964) and 24°C (May 1967). The greatest one-day range at this location during the 1968 water year was 4°C. This occurred on several days during July and August with temperatures as low as 15°C and as high as 21°C [141]. Records from the Cedar Creek station were kept from 1943 to 1962 and show the average temperature for each month. January 1957 had the lowest average temperature (1°C) and July 1949 had the highest (17°C) [138].

There are some water quality problems from increased domestic sewage and from siltation from logging runoff [155].

Nestucca Bay

Biological Information

The Nestucca River provides spawning grounds for relatively high numbers of fall chinook and winter and summer steelhead (Table B). Estimated numbers of these and other anadromous salmonids (coho, chum, spring chinook, and sea-run cutthroat) spawning in the Nestucca and Little Nestucca Rivers are given in Table 3 [77].

Table 3. Estimated numbers of adult anadromous salmonids spawning in the Nestucca and Little Nestucca Rivers [77].

stream	chinook		coho	chum	steelhead		sea-run cutthroat
	spring	fall			winter	summer	
Nestucca River	1,800	19,350	17,500	1,000	36,000	5,500	5,000
Little Nestucca River	90	1,215	1,080	1,000	1,290	100	800
totals	1,890	20,565	18,580	2,000	37,290	5,600	5,800

Due to the low salinity of Nestucca Bay, the only clams supported there are softshell varieties. Salmon, cutthroat trout, flounder, perch, staghorn sculpin, and dungeness crab are taken by sportsmen as described under "Estuary Uses" [38,77,89,155].

The bay is fairly important as a wintering area for water fowl [155].

Physical Alterations

Jetties have not been constructed, and dredging by the Corps of Engineers has not occurred. Navigation is possible to mile 6.0 of the Nestucca River and to mile 1.6 of the Little Nestucca River [69].

The Division of State Lands has completed its inventory of filled lands in the Nestucca River, and some information from the report is given in Table C [69].

The Cedar Creek hatchery, located near Hebo at mile 2 of Three Rivers, is operated by the OSGC. Three Rivers discharges into the Nestucca River at mile 9.8, so the hatchery is about 12 miles from the bay. Releases of anadromous fish from the hatchery during 1970 totaled 712,404 and consisted of 49,604 summer steelhead, 602,164 winter steelhead, and 60,636 spring chinook.

Nestucca Bay

Estuary Uses

Industrial and Commercial

Most of the industry in the basin is connected with processing of timber or with agricultural products [89]. In the estuary area itself, manufacturing companies, listed in Table 4, are small and deal mainly in lumber [71].

Table 4. Major Manufacturers at Nestucca Bay [71].

Location	Name	Type of Business	Number Employed
Pacific City	Kiwanda Fish Co.	canned and frozen seafoods	2
	Pacific City Boat works	dories	1
Cloverdale	Anderson Log Co.	logging	4
	Kimber Log and Lumber Co.	lumber	2
Hebo	Noble and Bittner Plug Co.	plugs and lumber and chips	19
	Wm. H. Balmer Logging Co.	fir/spruce/hemlock	7

There is some farming around the bay and along the Nestucca River where the main crops are hay and pasture for livestock [89], and commercial and sport fishing also provide some income [34]. Although there are no commercial landings from the estuary, those received at Pacific City during 1971 had a value to fishermen of \$265,000 and totaled 864,381 pounds, consisting primarily of coho with some groundfish, chinook, and albacore tuna. A breakdown is given in Table 5, and a comparison with landings received at other ports can be made from Tables D and E [34].

Recreational

Salmon and steelhead and cutthroat trout fishing in the Nestucca and Little Nestucca Rivers is outstanding--some consider the Nestucca as the best fishing stream of the state [58,69]. June and July provide good chinook fishing in the tidewater areas of both rivers with the main fall run beginning around the first of August and lasting through September. Coho enter the Nestucca River just after mid September and usually continue until the beginning of December. Numerous coho and some chinook are taken by deep sea fishing out of Pacific City from late June to the end of summer [58]. Species other than salmon and trout most commonly landed from the bay by sportsmen, as determined in the FCO study between March and October 1971, include staghorn sculpin and shiner perch by shore

Nestucca Bay

angling; dungeness crab and relatively few striped seaperch by boat angling; and softshell clams and relatively few "shrimp" (ghost and/or mud) by clamming [38]. Estimated sports catches are shown in Table 6 [77,89].

The bay is also used as a hunting area for waterfowl [155].

Table 5. Commercial Harvest of Food Fish Received at Pacific City, 1971 [34].

Species	Harvest (pounds round weight)	Fishermen value
Coho	792,773	\$248,000
Groundfish	45,030	4,000
Chinook	18,347	10,000
Albacore Tuna	7,924	3,000
Crabs	142	—
Pinks	17	—
Miscellaneous(1)	148	—
Totals	864,381	\$265,000

(1) Sand shrimp, crawfish, and eel.

Table 6. Estimated Annual Harvest Data for Sport Fishing at Nestucca Bay, 1970 [77].

Species	area fished	annual harvest (total number)	effort (angler- or digger-days)
Non-game bay fish	Estuary	3,000	400
Clams	Estuary	12,000	400

Nestucca Bay

Table 7. Surveillance stations at Nestucca Bay.

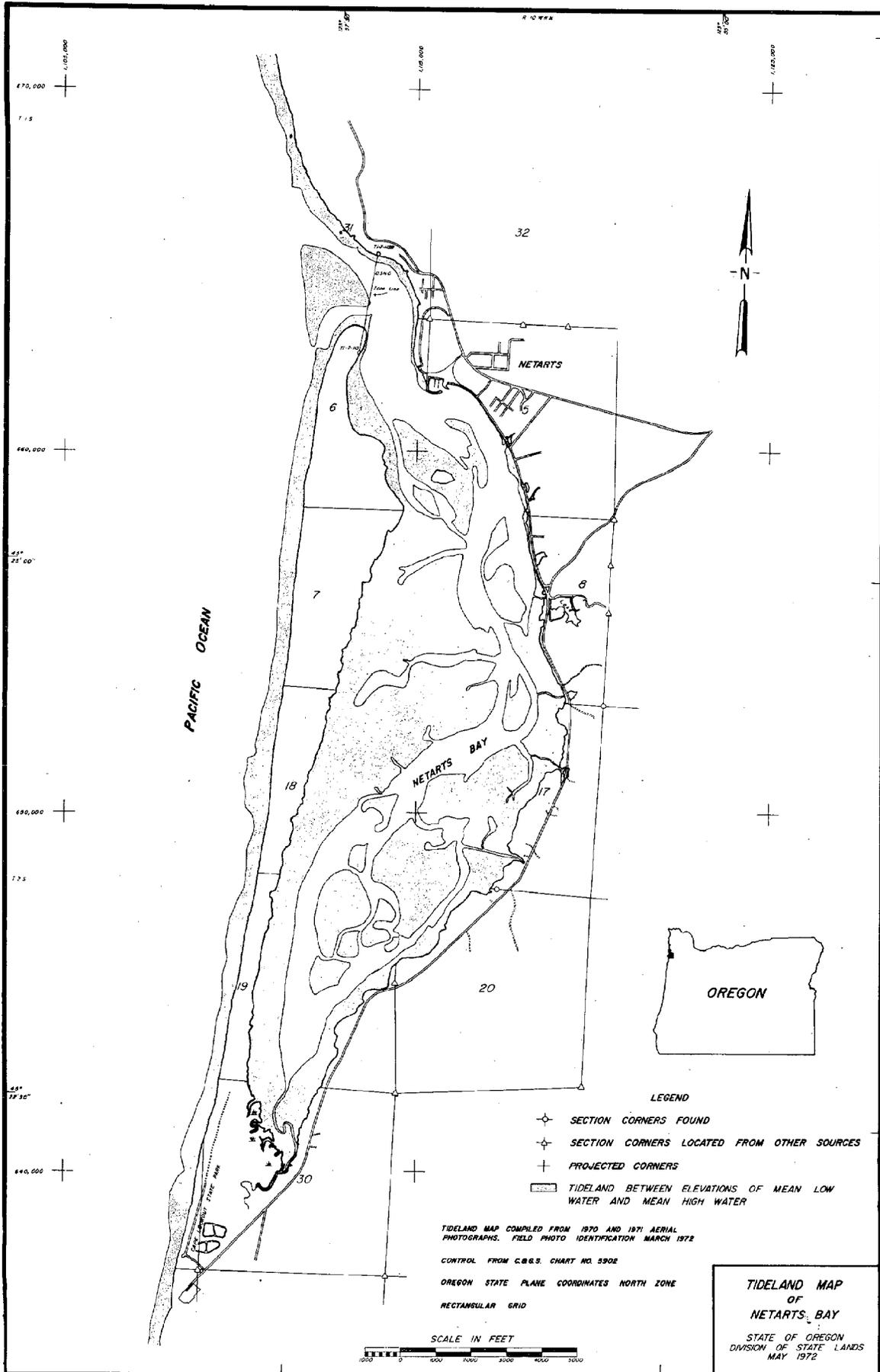
type of station	name and/or identifying number	approximate location	drainage area (sq mi)	period of record	references
climatological	Cloverdale 1 NW; USGS #1682	Nestucca River; mile 7; elevation--20 feet		1940-(1960)	[89,90,92] ¹
stream gaging	Nestucca River near Beaver; USGS #3036	Nestucca River; mile 13.5	180	10/64-(1970)	[98,140] ²
	Nestucca River below Powder Creek near Blaine; USGS #3035	Nestucca River; mile 29	91.2	10/28-9/44	[98] ²
	Nestucca River near Fairdale; USGS #3029	Nestucca River; mile 49.3	6.18	6/60-(1970)	[98,140] ²
DEQ water surveillance.	#1	Nestucca Bay; 1.5 miles upstream from mouth		data not yet available although samplings have been made	[67]
	#2	Nestucca Bay; bay inlet of Little Nestucca River		"	"
	#3	Nestucca Bay; 1.5 miles below Pacific City bridge		"	"
	#4	Nestucca Bay; Pacific City bridge		"	"
	#5	Nestucca Bay; Woods City bridge		"	"
	#6	Nestucca Bay; 2.5 miles upstream from Woods City bridge		"	"
water temperature	Nestucca River near Beaver	Nestucca River; mile 13.5	180	10/64-(9/68)	[141]
	Cedar Creek near Hebo			2/43-(1962)	[138]

¹Precipitation data available in punch card or printout form through the OSWRB.

²Monthly and water-year runoff records have been compiled and are available in punch card or printout form through the OSWRB.

() This is the most recent record date found and is not necessarily the last.

NETARTS BAY



NETARTS BAY

General Description of Estuary and Drainage Basin

Estuary

Netarts Bay is located about 60 miles south of the Columbia River mouth. As the sixth largest of the estuaries included in this report (Table A), it is of relative medium size. The only three towns in the area (with their 1970 populations) are Netarts (900), Wilson Beach (30), and Oceanside (160), none of which are incorporated. Both Netarts and Wilson Beach lie on the north side of the bay--Netarts at the mouth, and Wilson Beach about 1 mile to the east. Oceanside is not actually on the estuary, but a few miles to the north on the coast [89,111]. An area of about 150 acres near Whiskey Creek, a tributary from the east and near the center of the bay, is used as the OSU estuary research area [155].

The estuary covers roughly 2,300 acres. As can be seen from reported surface areas and tidelands acres presented in Table 1, tidelands are fairly extensive, comprising from 65% to 90% of the total area [53,55,59,70], and its only tributaries are 12 small creeks 1 or 2 miles in length [see 89-chart]. Hydrographic Survey map No. 8372 by the U.S. Coast and Geodetic Survey describes the bay in 1957. The meander pattern of channels within the Bay, however, has changed since 1957 [41]. Contours within the bay from aerial photographs have been prepared for August 2, 1970 [41]. The volume for mean high water appears to have decreased by 10 percent from 1957 to 1969[41].

Table 1. Reported surface areas of Netarts Bay [55,59,70].

reference	surface area (acres)	measured at	tidelands		submerged lands	
			acres	percent	acres	percent
[6]	2,179	HW	2,160	90		
[63]	2,406	1				
[117]	2,325 812	MHT MLT	1,513	65	812	35

¹Specified by Marriage as the area affected by tidal action.

Drainage Basin

The bay drains an area of only 14 square miles [89-chart], which yields 42,000 ac-ft of fresh water annually, based on an estimated average annual yield for the North Coast Basin of 3,000 ac-ft/sq mi. Precipitation averages between 100 and 110 inches annually [89].

Netarts Bay

Hydraulic Description of Estuary

Tides and Currents

The bay is partially exposed to waves at the throat. The mean tide range is 5.7 feet with a diurnal range of 7.5 feet [55]. Measurements at the entrance show MHHW at 6.6 feet, MHW at 6.0 feet, MTL at 3.5 feet, MLLW at 0.0 feet, and extreme LW at -3.0 feet [130-#5902].

Waters leaving the mouth of Netarts Bay during the summer move primarily south toward Cape Lookout and along the beach littoral zone (surf zone) [41].

A study of tidal exchanges and mixing within Netarts Bay during the summer of 1969 is provided by Glanzman, Glenne and Burgess [41].

River Discharges

No records of streamflow rates of any of the Netarts Bay tributaries were found.

Salinity and Classification by Mixing

Due to the lack of any major tributaries, the estuary is quite high in salinity. Measurements by Burt and McAllister were taken in the bay at HHW once during January 1958 and once during July 1958 [12]. The sampling made farthest from the mouth was at 5.5 miles (probably the southernmost tip of the bay) on January 5, 1958. At this point, salinity was still easily detected at a concentration of 13.9 ppt on the surface with a concurrent temperature of 6.8°C.

Burt and McAllister also classified Netarts on the basis of mixing characteristics and found it to be a well-mixed system during January and April [13]. Based on summer 1969 measurements, Glanzman, Glenne and Burgess also consider the bay to be vertically well mixed [41].

Sediments

Littoral drift varies, but is predominantly northward during the winter and southward during the summer. As already mentioned, the bay is fairly stable since it has no major tributaries. In fact, sediments transported to it are estimated to average only 2,250 tons annually [57,85].

Netarts Bay

Water Quality Information

The DEQ operates six water surveillance stations in Netarts Bay (Table 5) [67,68]. Records are available for about 34 samplings from each of the stations between May 1960 and March 1972, but with BOD, DO, conductivity, and turbidity information lacking before 1967. Some pollution was occurring from septic tank seepage near the town of Netarts, but correction of the problem had been planned as of 1970 (publication date) [155].

Biological Information

Of the 12 Netarts Bay tributaries, the OSGC reports that eight are used by anadromous fish. Estimates of the actual number of salmonids spawning there were not given [77].

The high salinity provides good conditions for a variety of clams. Gaper, cockle, butter, and some razor clams are located in the northern half of the bay toward the mouth, and remnant populations of geoducks and thinshelled little neck clams are also present. The southern section is apparently low enough in salinity to support some softshells [53,155].

Netarts is the only bay of the North Coast Basin where native oysters can still be found, although as a remnant population only. Pacific oysters are cultivated in the bay, as described under "Estuary Uses." Other species (all of recreational or commercial interest) supported there are salmon, perch, flounder, crab, kelp greenling, and black rockfish [38,89,155].

Waterfowl, including black brant, use the bay as a feeding, resting, and wintering spot [89,155], and an area of about 3 sq mi to the east of the estuary is considered a big game winter range, mainly for black-tailed deer and Roosevelt elk [77].

Physical Alterations

Corps of Engineers records show that jetties have not been constructed and dredging has not taken place [55].

Netarts Bay

Estuary Uses

Industrial and Commercial

Little information on industrial use of the Netarts Bay area was found, except that manufacturing companies are lacking completely [71] and commercial fishing is limited, with landings consisting of Pacific oysters, cultivated on about 300 of the bay's tideland acres [53,89,155], and a few crabs and clams, as shown in Table 2 [34,77,118]. Other species such as salmon, trout, sturgeon, shad, bass, shrimp, and tuna which are received at many of the other ports apparently are not received at Netarts (Tables D and E).

Table 2. Commercial Harvest of Clams, Crabs, and Oysters From Netarts Bay [[34,77,118]

Species	1970		1971	
	pounds landed	fishermen value	pounds landed	fishermen value
Clams	2,210	\$283	1,589	
Crabs	14,280		21,761	\$5,000
Oysters	122	\$119		

Recreational

Recreationally, clam digging at Netarts is very popular. Of the North Coast Basin estuaries, more days are estimated as being spent clamming there than at any other, although the harvest from Tillamook is about nine times as great. The estuary and its tributaries are also popular for salmon and steelhead angling [77]. Other species most commonly taken from the estuary (as determined in the FCO study from March to October 1971) are kelp greenling, black rockfish, and relatively few striped seaperch by shore angling; dungeness crab, relatively few red rock crab, and very few striped seaperch by boat angling; and gaper, cockle, and butter clams by clamming [38]. Estimated annual harvest data for non-game bay fish angling and for clamming in the estuary are shown in Table 3 [77].

Netarts Bay

Cape Lookout, a state park bordering the south side of the estuary, provides facilities for day visitors and for campers. Attendance figures have been dropping since 1967 and are included for 1966, 1967, and 1970 in Table 4 [82,83,52].

Table 3. Estimated Annual Harvest Data for Sport Fishing at Netarts Bay, 1970 [77].

Species	area fished	annual harvest (total number)	effort (angler- or digger-days)
Non-game bay fish	Estuary	5,000	1,000
Clams	Estuary	60,000	20,000

Table 4. Cape Lookout State Park Annual Attendance, 1966, 1967, and 1970 [82,83].

Park Users	1966 attendance		1967 attendance		1970 attendance	
	total park	estuary ⁽¹⁾	total park	estuary ⁽¹⁾	total park	estuary ⁽¹⁾
day visitors	155,388	<777	222,208	<1,111	85,216	<426
camper nights	107,903	<540	114,551	<573	97,096	<485

¹Actual use of the estuary portion of the park estimated to be less than 0.5% of the total attendance [52].

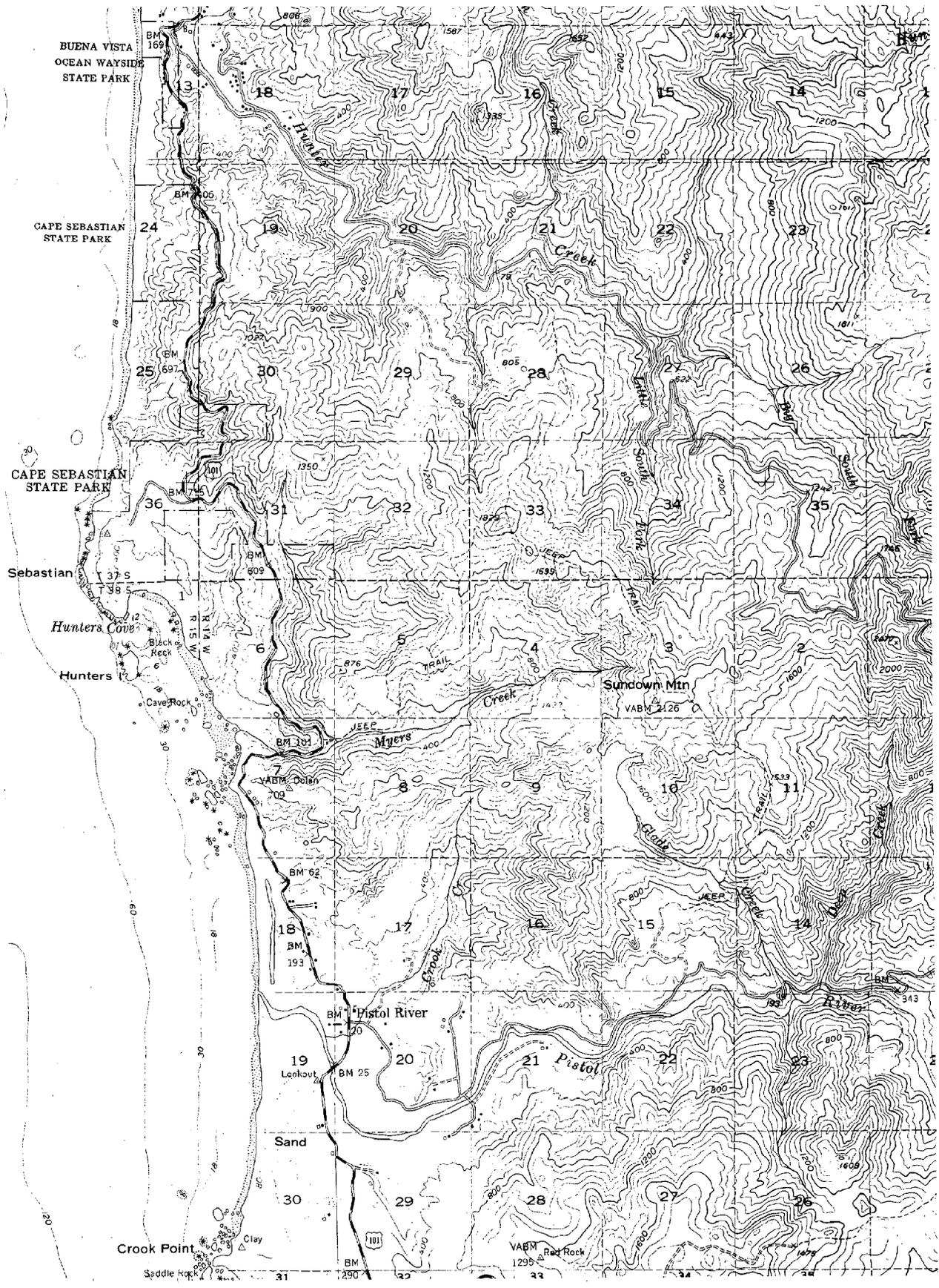
Netarts Bay

Table 5. DEQ water surveillance stations at Netarts Bay¹ [67,68].

identifying number	location	period of record	number of measurements
#1	channel, 0.4 mile northwest of Tillamook County boat launching site	5/60-(3/72)	34
#2	channel, opposite boat ramp mouth at pilings	"	"
#3	channel, 0.4 mile south of Wilson Beach	"	"
#4	channel, 600 yards southwest of sample station #3	"	"
#5	channel, 300 yards west of highway junction (Cape Lookout-Netarts Bay Highway)	"	"
#6	channel, 0.6 mile southwest of sample station #5	"	33

¹Records are not complete before 1967.

PISTOL RIVER



PISTOL RIVER

General Description of Estuary and Drainage Basin

Estuary

The Pistol River Estuary lies 274 miles south of the Columbia River mouth. It ranks as one of the smallest in size in terms of surface area. Population in the area is largely rural, the small town of Pistol River, Oregon being north of the river and just east of the Oregon Coast Highway (U.S. 101) at river mile 1.0. Population figures were not listed for Pistol River, Oregon [9,96,111,134].

The HW surface area of the estuary as estimated from 1973 EROS Data Center aerial photographs is 230 acres [135].

The average annual yield of the Pistol River at its mouth was 360,000 ac-ft for the period of 1930 to 1961. The minimum annual yield was 210,000 ac-ft. The Pistol River source is at river mile 21.8, elevation 3,200 feet [93,96].

Drainage Basin

The Pistol River drains a total basin area of 106 sq. miles. The average yearly freshwater yield is 360,000 ac-ft which equals an average annual precipitation of 64 inches over the basin [93].

The Pistol River Basin consists primarily of woodlands (92.1%; 62,998 acres), cropland (51.0%; 392 acres), and pasture (6.5%; 4,460 acres). As of January, 1963 the Pistol River has no existing storage ponds or reservoirs and no studies for potential reservoir sites.

The average annual precipitation ranges from 80 inches at the mouth of the Pistol River to 115 inches in the upper reaches.

The closest climatological station is the Gold Beach R.S. station, 10 miles to the north of the Pistol River Estuary, which has recorded temperature and precipitation data from 1889-1891, 1903-1913, 1915-1918, and 1927 to the present. (See Table 5) [93,143].

The Pistol River has a length of 21.8 miles. The elevation drop from the source to the mouth is 3,200 feet which produces an average gradient of 147 feet per mile [93].

Pistol River stream profile appears on page 43 in the Chetco River Basin section.

PISTOL RIVER

Hydraulic Description of Estuary

Tides and Currents

According to the U.S. Geological Survey the average range of the tide is approximately 5 feet [144].

It appears that the mouth of the Pistol River Estuary may migrate several hundred yards and change its position periodically due to the sand bar and coastline characteristics at the mouth. During the summer months the sand bar prevents saline water from entering the estuary except during periods of extremely high tide.

River Discharges

Streamflow records are available from the USGS stream gaging station on the Pistol River. The station is discontinued, but spot observations are available for the years 1935, 1938, and 1949-52. Streamflow averages and extremes appear in Table 1 [148].

Table 1. Stream Gaging Data [148].

Stream	Location	Drainage (sq.mi.)	Complete water years of record	Flowrate (cfs)		
				max.	min.	mean
Pistol River	T38S, R14W Sec. 21	---	---	48.0	8.2	17.4

Salinity and Classification by Mixing

Salinity profiles as a function of depth and distance from the mouth of the river are presented in Table 2. Data was taken on August 23, 1973 during a high tide of +4.5 feet [87].

Sediments

Between Port Orford and Brookings, the area is mountainous and rocky, with steep cliffs and sand beaches.

According to the National Shoreline Study by the U.S. Army Corps of Engineers (Aug., 1971), the shoreline north of the Pistol River Estuary to Cape Sebastian is experiencing non-critical erosion, while the shoreline south of the estuary to Crook Point is experiencing no erosion. From Crook Point to within 5 miles of Brookings the shoreline is experiencing non-critical erosion while the remainder of the shoreline to the Chetco River Estuary is experiencing critical erosion [125].

The generalized sediment yield for the Pistol River Basin is 0.1 to 0.2 ac-ft per sq. mile per year [23].

PISTOL RIVER

Table 2. Salinity Values for
the Pistol River Estuary*
Aug. 23, 1973 [87].

Station	Distance from mouth (mi)	Salinity %		Depth (ft.)
		top	bottom	
1	0.1	0.2	0.2	3
2	0.3	0.2	0.2	8
3	0.4	0.2	0.2	8
4	0.7	0.2	0.2	6

* The Pistol River mouth was completely closed off by sand bars through which river flows seeped to the ocean. No saline water entered the estuary except for extremely high tides.

Water Quality Information

Miscellaneous flow and temperature measurements for the basin were made by the Oregon State Game Commission. Temperature ranges from these sources are presented in Table 3 [78].

Table 3. Temperature Extremes for
the Pistol River Drainage Basin [78].

Point of measurement	Period of record	Observed Temperature Extremes (F°)		
		max.	min.	type of observation
Pistol River 1.8 mi. above Crook Creek	4-9-69 to 7-23-69	71	49	spot
Crook Creek 100 yds. above mouth.	4-9-69 to 7-23-69	--	54	spot
Deep Creek 100 yds. above mouth	4-9-69 to 7-23-69	56	50	spot

DEQ water quality stations are listed in Table 5.

PISTOL RIVER

Biological Information

Estimates of the number of adult anadromous salmonids spawning in the Pistol River system are as follows: spring chinook--0, fall chinook--500, coho--50, steelhead--1,200, sea-run cutthroat--4,000.

Dace, cottids, red-sided shiners, sticklebacks, lamprey, and suckers are the known rough fish species in the stream systems of the South Coast Basin [78].

The most important factor limiting fish production in the South Coast Basin is summer water supply. The Pistol River contains extensive porous gravel beds through which summer flows frequently sub-out, resulting in considerable fish loss. Summer flows which substantially sub-out can also be excessively warm [78].

The Pistol River system has 6 streams used by adult anadromous salmonids, 3 of which have minimum flow recommendations established and 1 protected by the State Water Resources Board [78].

Table 4 refers to the estimated sport harvest in the Pistol River system.

Table 4. Estimated Annual Harvest, Angler Days, and Gross Expenditures for Angling in the Pistol River System [78].

Fish	Harvest	Angler days	Gross Expenditures
Salmon*	300	1,200	\$22,200
Steelhead	350	1,400	25,900
Sea-run	475	<u>250</u>	<u>4,625</u>
TOTALS		2,850	\$52,725

* Includes jack salmon

Figure 1 is a periodicity chart showing when adult spawning anadromous fish are present in the Pistol River system.

A general description of big game, upland game, waterfowl, and furbearers of the basin is given in the Sixes River section on Biological Information.

PISTOL RIVER

Figure 1. Periodicity Chart for Adult Spawning Anadromous Fish in the Pistol River System [78].

Chinook Salmon *****
 Coho Salmon -----
 Steelhead and Cutthroat trout ::::::::::::::

Stream	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	April	May
Pistol River	*****	::::::::::::::	::::::::::::::	::::::::::::::	::::::::::::::	::::::::::::::	::::::::::::::	::::::::::::::
Crook Creek		::::::::::::::	::::::::::::::	::::::::::::::	::::::::::::::	::::::::::::::	::::::::::::::	::::::::::::::
Deep Creek		*****	::::::::::::::	::::::::::::::	::::::::::::::	::::::::::::::	::::::::::::::	::::::::::::::

Physical Alterations

The only physical alteration near the estuary is the Oregon Coast Highway Bridge (U.S. 101) at river mile 1.2 [96].

Estuary Uses

Industrial and Commercial

Irrigation and gravel removal are the only industrial and commercial uses for the Pistol River. The average annual yield of the Pistol River is 360,000 ac-ft. The legal annual depletion is 100 ac-ft with the estimated actual annual consumption being 30 ac-ft. Surface water rights include 0.18 cfs for domestic and irrigation purposes.

Chromite, nickel, and quicksilver are mined in the watershed [93].

PISTOL RIVER

Recreation

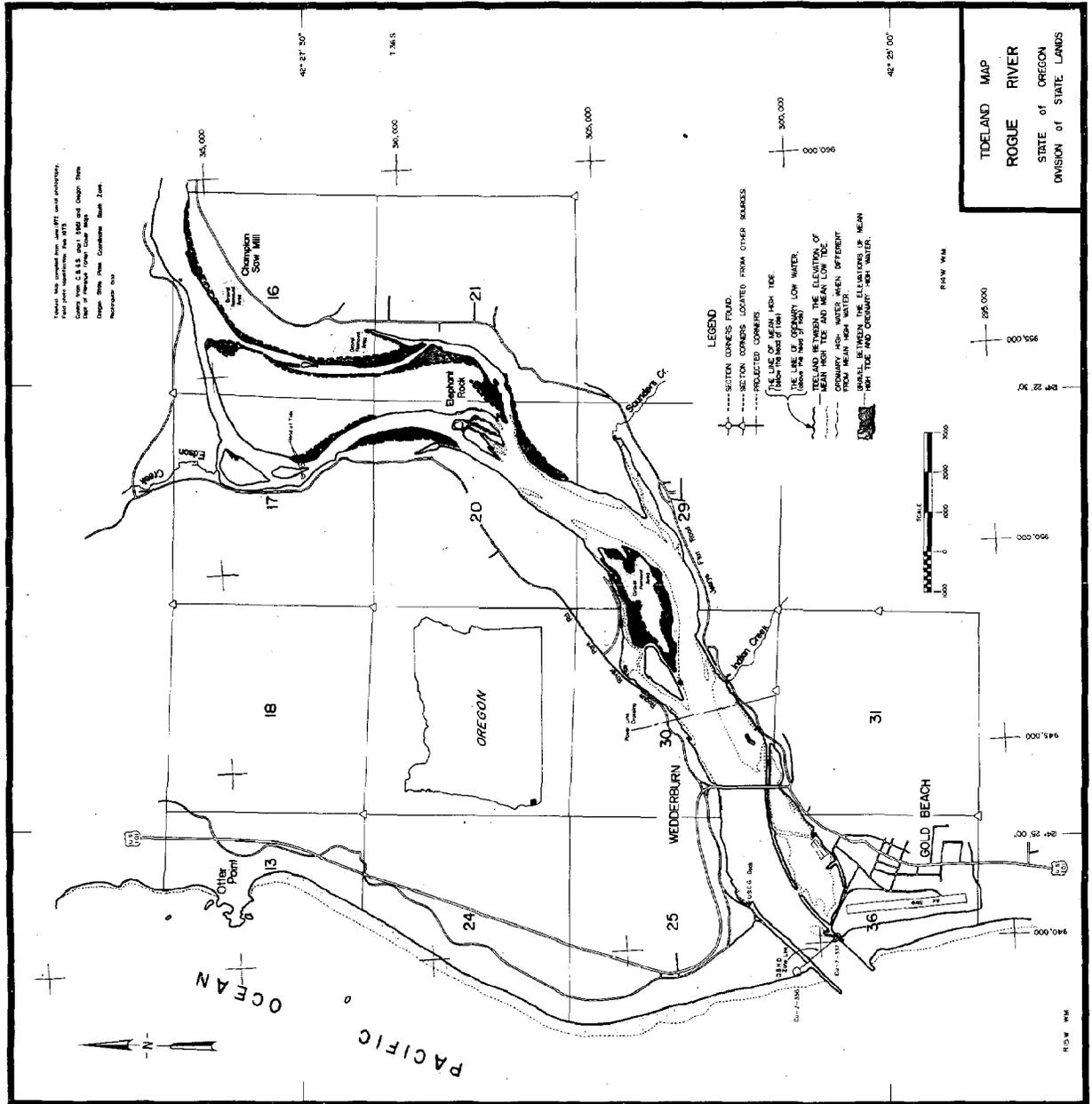
The principal attraction of the basin is the Pacific Ocean which is easily accessible from the Oregon Coast Highway (U.S. 101) at the Pistol River Estuary. A small state park is located south of the estuary between the highway and the ocean beaches.

Parts of the Pistol River flow through the Siskiyou National Forest. Several streams in the basin have outstanding aesthetic value and make a significant contribution simply because they maintain attractive flows, have little stream-side development, and possess watersheds that have not been extensively logged. The Pistol River above Deep Creek was selected by the Oregon State Game Commission as a stream which should be managed for its aesthetic value [78,93].

Table 5. Surveillance Stations near the
Pistol River Estuary

Type of station	Name and/ or identifying number	Approximate location	Drainage area (sq.mi.)	Period of record	Reference
Climatological	Gold Beach R.S. (Formerly Ellensber ; Wedderburn)	T37S, R14W Sec. 6	---	1889- 1891, 1903- 1913, 1915- 1918, 1927- present	[93]
Water Quality	Pistol River 4 mi. above	T38S, R14W Sec. 22 river mile 4.5	---		[152]
Stream Gaging	Pistol River above head of tide 10 mi. south of Gold Beach.	T38S, R14W Sec. 21	---	1935, 1938, and 1949- 1952	[148]

ROGUE RIVER



ROGUE RIVER

General Description of Estuary and Drainage Basin

Estuary

Rogue River Estuary lies 264 miles to the south of the mouth of the Columbia River. Although relatively small in terms of surface area (Table A), it has an extremely large drainage basin, the central section of which is within the Siskiyou National Forest. Population in the vicinity of the estuary is concentrated in the small incorporated town of Gold Beach just to the south of the mouth. Census figures and estimated locations of this and the other four towns to river mile 45 are given in Table 1.

Table 1. Population centers at Rogue River Estuary [111,116].

Name	Approximate location	Population
Gold Beach ⁽¹⁾	Rogue River; mile 0; south side	1,554
Wedderburn	Rogue River; mile 0; north side	250
Agness	Rogue River; mile 27; north side	25
Illahe	Rogue River; north side	rural
Marial	Rogue River; mile 43; north side	not listed

(1) Incorporated.

HW surface area of the estuary, as estimated from the 1954 USGS Gold Beach Quad., is 575 acres [55].

Numerous tributaries discharge into the lower reaches of the Rogue River, the Illinois River being the largest. Monthly runoff records as of 1966 are available on punch cards from a total of 82 surface water gaging stations in the Rogue River watershed [98]. The three of these located nearest the estuary mouth are listed in Table 9. Computed average annual yield of the Rogue River at its mouth for the period from 1933 to 1955 was 5,661,000 ac-ft with extremes of nearly 9,000,000 ac-ft and slightly less than 3,000,000 ac-ft [116]. Annual yield of the Illinois River from 1929 to 1956 averaged 1,986,000 ac-ft with a high yearly mean of slightly over 1,000,000 ac-ft and a low of about 3,500,000 ac-ft [116].

The Port of Gold Beach is located at P.O. Box 1126, Gold Beach, Oregon, 97444; telephone number 247-6269 [106]. The Port Commission, along with the Curry County Planning Commission, is involved with planning and regulating land use of the estuary zone [81].

ROGUE RIVER

General Description of Estuary and Drainage Basin

Drainage Basin

The Rogue River drainage basin covers 5,100 sq. mi. in Jackson, Josephine, Curry, Klamath, Douglas, and Coos Counties of Oregon and Siskiyou and Del Norte Counties of California. Over 75% of the basin is timberland, and 9% is used for agriculture. The average annual growing season at Gold Beach is 280 days. The fresh water yield at the estuary mouth average 5,661,000 ac-ft per year during the period from 1933 to 1955 as perviously described. Precipitation in the coastal section average 120 inches at the highest elevations, 60 inches to the east, and 90 inches along the coast. the central and eastern portions receive from 20 to 60 inches per year [116]. there are numerous climatological stations in the area of which at least 43 have records available on punch cards through the OSWRB. Those situated closest to the estuary are included in Table 9 [92,143]. Average annual temperatures in the western watershed ranges from 40°F to 67°F along the coast and from 32°F to 75°F in the mountains. In the central and eastern portions of the watershed, temperatures average from 17°F to 92°F [116].

Rogue River system stream profiles appear on page 154.

Hydraulic Description of Estuary

Tides and Currents

The estuary is described as being moderately exposed to waves at the throat. The mean tide range is 4.9 feet with a diurnal range of 6.7 feet. Tidal prism on mean range is 1.59×10^8 cu. feet [55].

River Discharges

Several USGS stream gaging stations are in operation on the Rogue River and its tributaries. These are listed in the USGS publication, "Water Resources Data for Oregon, Part I. Surface Water Records" [140]. Information concerning two stations located in the lower reaches of the Rogue and Illinois Rivers is given in Table 9, and the maximum, minimum, and mean flow rates recorded at them are given in Table 2. Average monthly flow at the mouth of the Rogue River during the period from 1933 to 1955, as determined by extrapolation of data to that point, ranged from a high flow rate during January of 16,200 cfs to a low flow rate during September of 1,200. Mean stream flow for the entire period was 7,800 cfs [116].

Salinity and Classification of Mixing

No information.

ROGUE RIVER

Hydraulic Description of Estuary

Table 2. Recorded flow rates of Rogue and Illinois Rivers [140].

Stream	Point of measurement (rivermile)	Drainage area (sq.mi.)	Period of record	Flow rate (cfs)		
				maximum	minimum	mean
Rogue River	mile 29.7	3,939	10/60-(1971)	290,000 (12/23/64)	608 (7/68)	6,386
Illinois River	mile 3.0	988	10/60-(1971)	225,000 (12/22/64)	135 (10/7/70)	4,439

() This is not the last year of record.

Sediments

Net littoral drift in the area is from north to south [57]. Analyses of dredge material taken in January 1962, November 1965, and July and November 1971 are available through the Corps of Engineers. Results shown that (1) organic contents of the sample ranged from 1.19% to 1.94%, both samples having been taken during July 1971, (2) void ratios ranged from 0.297 (November 1965) to 0.838 (July 1971), and (3) the mean grain size varied from fine gravel to fine sand [124].

Water Quality Information

There are presently no DEQ water surveillance stations on the Rogue River, but the USGS operates some water quality and numerous water temperature stations in the watershed. Records are available from various publications by that agency [138,139,141]. Those stations located closest to the estuary are described in Table 9.

Biological Information

The Rogue River Basin stream systems provide spawning grounds for numerous adult anadromous salmonids and is used especially heavily by chinook and steelhead, as indicated in Table B. A partial breakdown, by stream system within the basin, is given in Table 3, and a more complete breakdown is given in "Environmental Investigations, Rogue River Supplement" [116]. The remainder of the information presented in this section was taken from a preliminary report to that publication described in the introduction [81].

ROGUE RIVER

Biological Information

Table 3. Estimated numbers of adult anadromous salmonids spawning in the Rogue River Basin stream systems [123].

Stream system	Chinook		Coho	Chum	Steelhead		Sea-run Cutthroat
	Spring	Fall			Winter	Summer	
Rogue River ⁽¹⁾	44,275	41,850	2,085	50	20,150	36,950	2,400
Illinois River	0	20,000	1,400	0	30,000	0	2,500
Rogue River Basin totals	45,500	75,000	5,000	50	75,500	51,250	5,300

1

Main stem and tributaries other than Lobster Creek, Illinois River, Applegate River, Bear Creek, Little Butte Creek, Big Butte Creek.

Game fish found in the estuary at least during a part of the calendar year (in order of abundance) are: summer steelhead; winter steelhead; fall chinook; spring chinook; sea-run cutthroat, shad, coho, green sturgeon, white sturgeon, and chum salmon. Non-game fish found in the estuary are: anchovy, surf smelt, herring, red-tail surf perch, silver surf perch, spot--fin perch, striped perch, starry flounder, tom cod, and ling cod.

A common waterfowl found in or near the Rogue River Estuary is the American merganser. "Medium" common waterfowl found are: American widgeon, pintail, red-breasted merganser, surf scoter, and white-winged scoters.

Shore and other birds most commonly found in or near Rogue River Estuary are: great blue heron, least sandpiper, western sandpiper, western gull, herring gull, California gull, belted kingfisher, common crow, and double crested cormorant.

Common mammals found in or near Rogue River Estuary are: California sea lion, stellers sea lion, and black-tailed deer. "Medium" common mammals found are: harbor seal, river otter, and beavers. Uncommon mammals found are: mink and muskrats.

Physical Alterations

U.S. Army Corps of Engineers modifications to Rogue River Estuary, described in Table 4, consist of two jetties, a turning basin, and a channel from the entrance to the turning basin.

ROGUE RIVER

Physical Alterations

Table 4. U.S. Army Corps of Engineers to Rogue River [126,129].

Proposed modification	Location	Dimensions			Date and Status ⁽¹⁾
		depth (feet)	width (feet)	length (feet)	
north jetty	entrance				1960-completed 1966-repaired
south jetty Channel	entrance	13	300	from the ocean to a point 1/4 mile down- stream from the Highway 101 bridge	1960-completed
turning basin	north section of the estuary 1/4 mile down- stream from the highway 101 bridge.	13	500	650	

Although the Rogue is one of the estuaries dredged by the U.S. Army Corps of Engineers [50], statistics of such were not found. Waterborne traffic through the project during 1969 totaled 106,000 tons of which over 90% was lumber shipments. Annual use from 1960 to 1969 averaged 67,000 tons. Passenger traffic on the project during 1969 consisted of 113,000 persons, most of whom were on the mail boat to Agness [129].

The OSGC operates the Butte Falls Hatchery located on Butte Creek near Butte Falls in the eastern section of the drainage basin [56]. According to the OSGC Annual Report, releases from the hatchery totaled 371,490 during 1970 and consisted of 152,762 rainbow trout, 98,885 spring chinook, and 119,843 summer steelhead [80].

Fishways in the Rogue River system are all operated by the FCO. Their names and general locations are as follows [28]: Savage Rapids Dam--Rogue River; Oak St. Div. Dam--Bear Creek; Bear Creek Div. Dam--Bear Creek; Frilder Dam--Rogue River.

ROGUE RIVER

Estuary Uses

Industrial and Commercial

The economy of the entire Rogue River Basin is based on timber, agriculture, offshore commercial fishing, minerals, and recreation. The timber industry has been of primary importance since 1940. Before that time, the major emphasis was on agriculture, and prior to that mining ranked as the most important activity. Timberlands account for over 75% of the basin area, and nearly 95% of those lands are commercial. Only 9% of the basin is used for agricultural purposes. Half of that 9% is dry pastureland. About 75% of the farms produce cattle or dairy products [116].

In the lower Rogue River basin, which includes the estuary area, the economy is based on timber and tourism with the center at Gold Beach and Wedderburn [127]. Manufacturers in the area, listed in Table 5, all have addresses in those two towns and are mostly logging camps and logging contractors [71]. In terms of tourism and recreation, the area is one of the most popular for sport fishing in the South Coast district with port facilities and resorts. More descriptions of the angling activities is given in the following section. Commercial fishing also provides some income to the area, as shown in Table 6, and is extensive enough to support a cannery at Wedderburn (Table 5).

Table 5. Major manufacturers at Rogue River Estuary [71].

Location	Name	Type of business	Number employed
Gold Beach	U.S. Plywood	plywood	300
	Chipco	wood chips; box shook; veneer	60
	Laird Logging Co.	contract logging	50
	Tamco Co.	veneer; box shook	36
	23 manufacturers employing 15 or under; 1 are logging camps or logging contractors;		
Wedderburn	Rogue River Cannery Inc.	canned fish and seafood	4

ROGUE RIVER

Estuary Uses

Industrial and Commercial

In the case of the Illinois River basin, agriculture is the economy base. Tourism is important to a lesser degree, and although there is some logging, it is limited due to the relative inaccessibility of most land. Agricultural activities are concerned mainly with raising dairy and beef cattle and various types of crops [116].

Table 6. Commercial harvest of food fish received at Gold Beach, 1971 [34].

Species	Harvest (pounds round weight)	Fishermen value
Coho	185,414	\$58,000
Chinook	45,052	23,000
Ground fish	5,830	---
Albacore tuna	953	---
Crabs	300	---
Pinks	<u>45</u>	<u>---</u>
TOTAL	237,594	\$81,000

Recreational

The Rogue River, particularly popular for its steelhead fishing, is also a good salmon stream. The lower reaches of the river provide good salmon fishing starting in April and continuing through the summer and fall. Late in September Coho enter and are present until December. In the upper reaches around Grants Pass, mid-March marks the first good fishing with the run continuing into June. Chinook and Coho can be caught offshore from mid-July through September [58]. Estimated annual harvest data for sport fishing in the area are given in Table 7.

According to the OSGS study conducted during March and April of 1971, red-tail perch were most commonly taken by shore anglers [28].

Hunting data, as presented in "Environmental Investigations, Rogue River Basin Supplement," for big game, upland game, and waterfowl are given in Table 8 [123]. As indicated in Table 8, a breakdown is given of upland game and waterfowl harvest in that publication. It also provides furbearer trapping data, which includes beaver, otter, mink, muskrat, raccoon, skunk, weasel, gray fox, bobcat, and coyote.

ROGUE RIVER

Table 7. Estimated annual harvest data for Sport Fishing at Rogue River⁽¹⁾ [123].

Species	Area fished	Annual harvest (total number)	Effort (angler-days)	Gross expenditure's
Salmon	Estuary	750	2,700	\$ 55,500
	Rogue River	16,800	47,000	1,243,200
	Illinois River	150	900	11,100
	Ocean (Gold Beach)	4,750	11,500	351,500
Steelhead	Rogue River	32,500	95,000	2,405,000
	Illinois River	3,500	6,900	259,000
	Applegate River	2,000	6,000	148,000
Sea-run Cutthroat		220	190	3,515
Resident Salmonids		1,312,500	525,000	3,150,000
Warm-water Game fish		51,000	17,000	102,000
Shad		100	75	1,390
Sturgeon		35	100	600
Bay fish		<u>14,220</u>	<u>1,580</u>	<u>9,480</u>
TOTALS		1,438,525	713,945	\$7,740,285

(1) Based on recent annual averages.

Table 8. Rogue River hunting data, 1970 [123].

Species	Hunters	Hunter days	Harvest	Gross Expenditures
Big Game				
deer	12,986	88,560	5,043	1,780,056
elk	599	1,952	56	51,924
Upland Game ¹	13,642	64,292	76,474	385,752
Waterfowl ²	1,611	9,061	8,433	72,488
TOTALS		163,865	90,006	2,290,220

¹A breakdown of data for upland game (band-tailed pigeon, mourning dove, quail, grouse, pheasant, and silver gray squirrel) is available [134].

²A breakdown of data for waterfowl (ducks and geese) is available [134].

ROGUE RIVER

Table 9. Surveillance stations at Rogue River Estuary.

Type of station	Name and/ or identifying number	Approximate location	Drainage area (sq.mi.)	Period of record	References
Climatological	Gold Beach Ranger station; U.S. Weather Bureau (USWB) #3356	elevation-- 50 feet		1890*(1967)	[92]
	Agness	elevation-- 200 feet		1914-1922	[92] ⁽¹⁾
	Illahe 1 N; USWB #4133	elevation-- 330 feet		(1967)	[92] ⁽¹⁾
	Illahe 2 N; USWB #4135	elevation-- 488 feet		1963*(1967)	[92] ⁽¹⁾
	Marial 8 NNE; USWB #5217	elevation-- 2,080 feet		1956*(1967)	[92] ⁽¹⁾
Stream gaging	Rogue River near Agness; USGS #3723	Rogue River; mile 29.7	3,939	10/60-(1971)	[140] ⁽²⁾
	Illinois River near Agness; USGS #3782	Illinois River; mile 3.0	988	10/60-(1971)	[140] ⁽²⁾
	Illinois River near Selma; USGS #3780	Illinois River mile 32	665	1957-(1966)	[98]
Water Quality	Rogue River near Agness; USGS #3723	Rogue River; mile 29.7	3,939	10/60-(9/64)	
	Illinois River near Selma; USGS #3780	Illinois River; mile 32		10/61-(9/64)	[139]

(continued)

Table 9. (continued)

Type of station	Name and/ or identifying number	Approximate location	Drainage area (sq.mi.)	Period of record	Reference
Water temperature	Rogue River near Gold Beach	Rogue River; mile 11.2		3-10/60	[138]
	Rogue River near Agness; USGS #3723	Rogue River; mile 29.7	3,939	10/60-(9/70)	[138,141]
	Rogue River at Agness	Rogue River; mile 27.5		10/59-11/60	[138]
	Illinois River near Agness	Illinois River; mile 2.4		11/59-10/60	[138]
	Rogue River at Marial	Rogue River; mile 48.5		5-10/60	[138]
	Illinois River near Selma; USGS #3780	Illinois River; mile 32	665	9/61-(9/62) (spot observations)	

(1) Precipitation data available in punch card or printout form through the OSWRB.

(2) Monthly and water-year runoff records have been compiled and are available in punch card or printout form through the OSWRB.

() This is the most recent record date found and is not necessarily the last.

* Period of record is not continuous.

ROGUE RIVER PROFILE

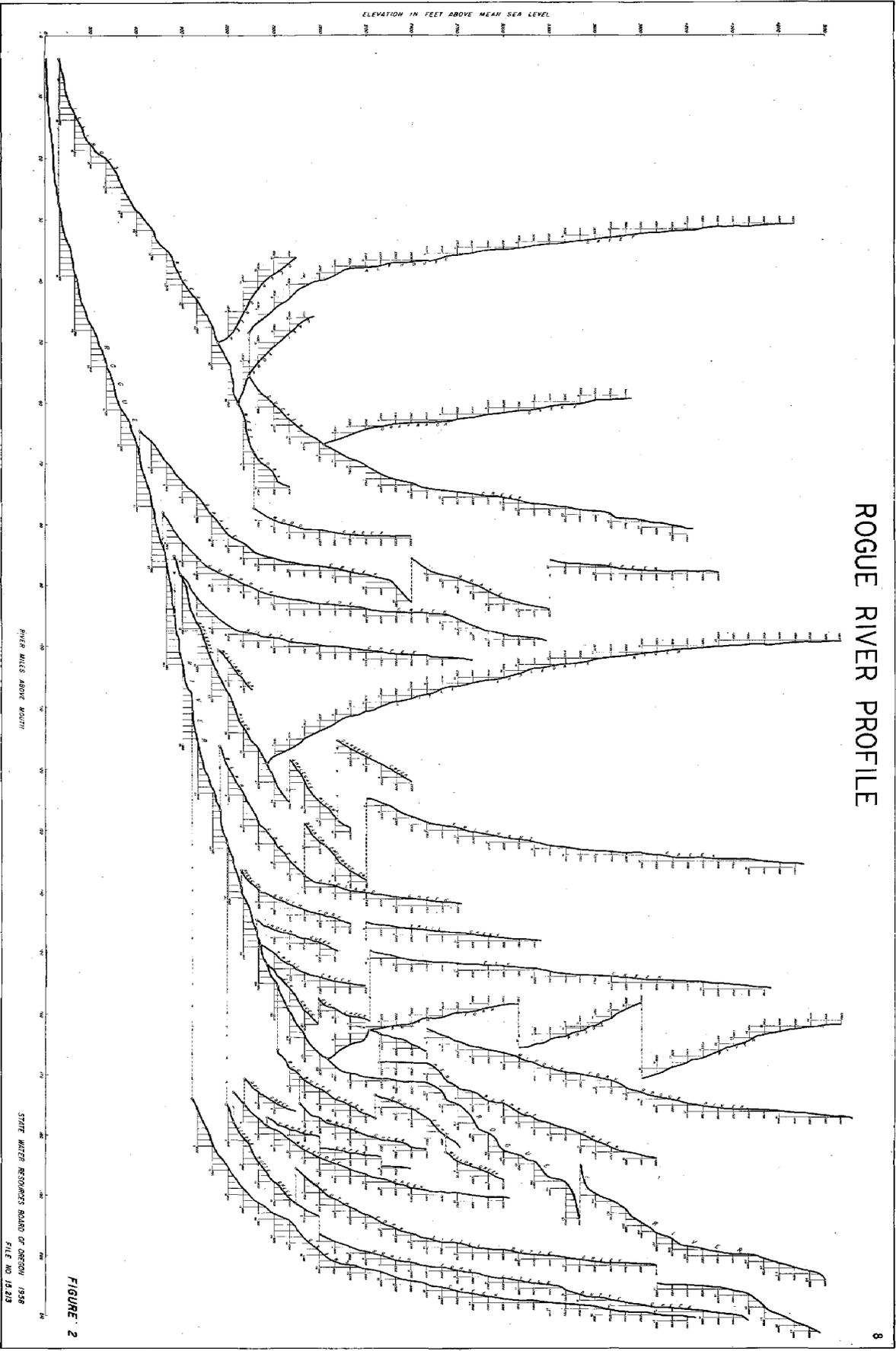
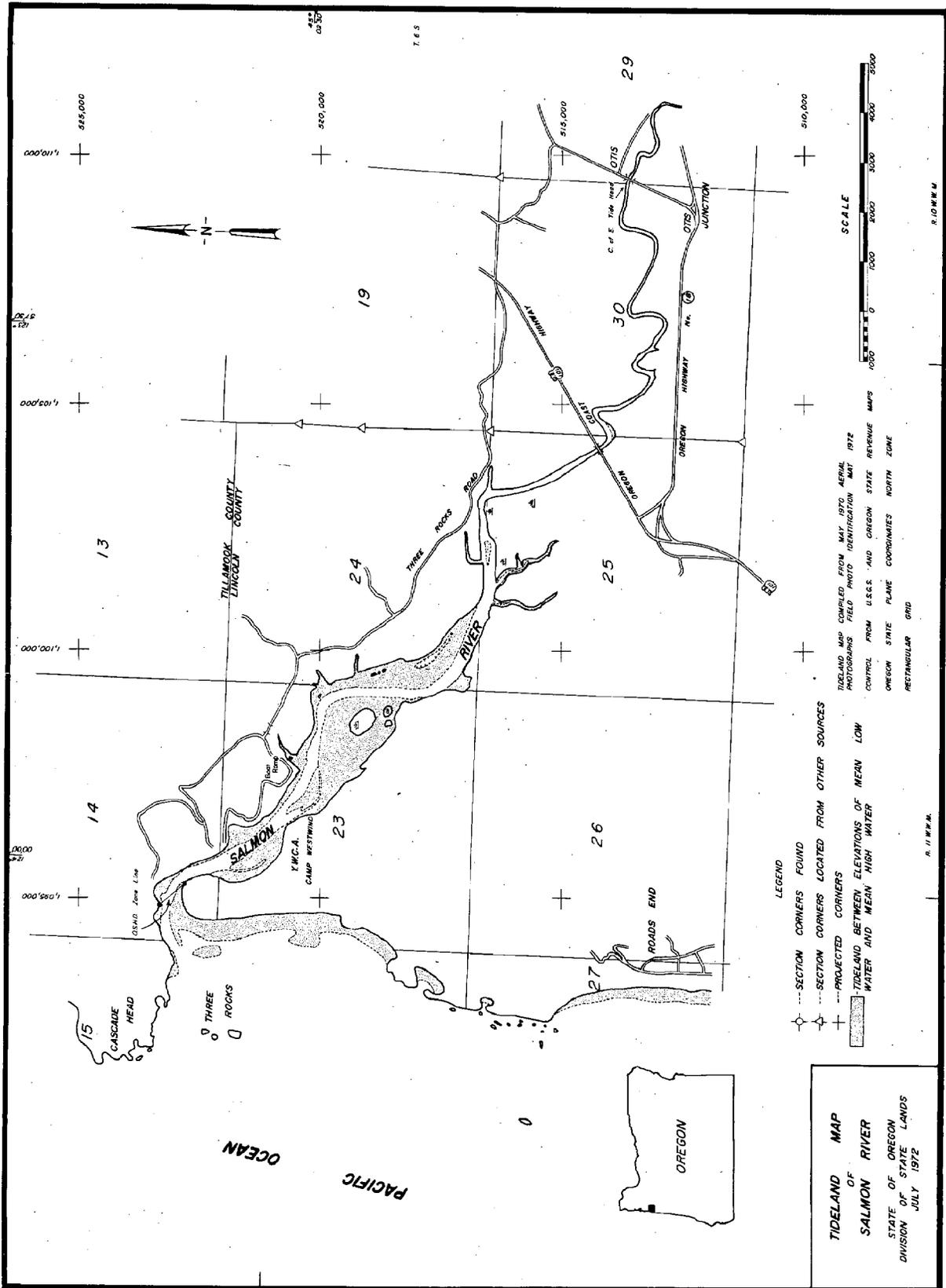


FIGURE 2

STATE WATER RESOURCES BOARD OF OREGON 1938
FILE NO. 13 213

SALMON BAY



TIDELAND MAP
OF
SALMON RIVER
 STATE OF OREGON
 DIVISION OF STATE LANDS
 JULY 1972

LEGEND

- SECTION CORNERS FOUND
- SECTION CORNERS LOCATED FROM OTHER SOURCES
- PROJECTED CORNERS
- TIDELAND BETWEEN ELEVATIONS OF MEAN LOW WATER AND MEAN HIGH WATER

TIDELAND MAP COMPILED FROM MAY 1970 AERIAL PHOTOGRAMMETS FIELD PHOTO IDENTIFICATION MAP 1972 CONTROL FROM U.S.G.S. AND OREGON STATE REVENUE MAPS OREGON STATE PLANE COORDINATES NORTH ZONE RECTANGULAR GRID

R. J. W. W. M.

SALMON BAY

General Description of Estuary and Drainage Basin

Estuary

Salmon Bay, the smallest estuary of those included here (Table A), lies roughly 85 miles south of the mouth of the Columbia River. Population in the area totals less than 100 and is centered in three towns, all on the Salmon River. These (with their 1970 populations) are Three Rocks (30) to the north at mile 0.3, Otis (15) to the south at mile 4.3, and Rose Lodge (20) to the south at mile 9.3 [88,94,111].

A nature conservancy area is located on the south side of Cascade Head and adjoins the estuary to the north [155]. Presently under consideration is the possibility of including Salmon Bay and some of the surrounding area as part of the Siuslaw National Forest. Reports on this were prepared by the U.S. Siuslaw National Forest Service prior to [150] and following [149] a public meeting held for the purpose of discussing this matter.

The estuary is about 270 acres in size; reported surface areas and tideland acres are given in Table 1 [59,70,153]. The tidelands are particularly extensive between the mouth and mile 2 to both the north and south and comprise about 60% of the total area [53,88-map no. 18.6].

Table 1. Reported surface areas of Salmon Bay [55,59,70].

reference	surface area (acres)	measured at	tidelands		submerged lands	
			acres	percent	acres	percent
[55]	171	HW				
[59]	438	¹	250	57		
[70]	204 78	MHT MLT	126	62	78	38

¹Specified by Marriage as the area affected by tidal action.

The estuary is essentially part of the lower reaches of the Salmon River, as its mouth and the zero river mile are at the same point. The river measures 25.3 miles to its source and has about four small tributaries from the north and three from the south to the head of tidewater at mile 4.3 [88-map no. 18.6].

Watershed

Salmon Bay (River) drains an area of 75 sq mi [94], which yields an average of 450,000 ac-ft of fresh water annually [70,85,88]. The

Salmon Bay

watershed, plus an adjacent coastal area to the north of 3 sq mi, is comprised of 94% (73 sq mi) forest; 3% (2 sq mi) rangeland; 2% (2 sq mi) cropland; and 1% (1 sq mi) "other" [88].

Average annual precipitation varies from 90 inches along the coast to 180 inches on the Coast Range Divide [53,88]. There is a climatological station at mile 5 of the Salmon River (Table 4) [88,143].

Elevations range from sea level to 2,900 feet [88].

Hydraulic Description of Estuary

Tides and Currents

The bay is described as being partially exposed to waves at the throat [55], and tidal effects reach mile 4.3 of the Salmon River [69]. The mean tide range is 5.8 feet with a diurnal range of 7.6 feet and an extreme range of 13.0 feet [86].

River Discharges

The only stream gaging station on the Salmon River stream system for which records were found is located at mile 0.1 of Alder Brook, a tributary of the Salmon River at mile 10.7 (Table 4) [140]. Records from 1954 to 1970 show 50 cfs on January 24, 1970 as the maximum flow rate at this point during those 6 years.

Estimates (based on precipitation, runoff, and some spot observations) of the average discharge, by month, of the Salmon River "near tidewater"¹ have been made for 1937 to 1963 [88]. February had the high estimated monthly discharge at 1,169 cfs and August the low at 44 cfs. Mean discharge was 538 cfs. The mean minimum flow at tidewater¹ has been estimated as 18 cfs and observed as 21.7 cfs.

Salinity and Classification by Mixing

No information.

Sediments

Littoral drift varies [57]. Sediments deposited in the estuary by fresh-water drainage are estimated to average 14,000 tons annually [85].

1 The river mile location was not given.

Salmon Bay

Water Quality Information

The DEQ has taken water samples at Salmon Bay. Data is now available for the 1972 year (2 measurements) (Table 4) [67,68].

Biological Information

Estimated numbers of adult anadromous salmonids spawning in the Salmon River system are spring chinook--180; fall chinook--2,000; coho--5,700; summer steelhead--250; winter steelhead--4,200; and sea-run cutthroat--3,800 [75]. Figures for all species mentioned here are low in comparison with those for other stream systems (Table B).

Salmon, flounder, perch, sea-run cutthroat, limpets, staghorn sculpin, dungeness crab, and ghost and mud shrimp are commonly caught by anglers, as described under "Estuary Uses." The estuary is essentially fresh water and it supports a small quantity of soft shell clams [53].

Waterfowl and about 100 species of other birds can be found on or near the estuary [150,155], and the surrounding area is a winter range for black-tailed deer, Roosevelt elk, and cougar, with black-tailed deer being the most abundant. Roosevelt elk are being transplanted into the Mid-Coast Basin by the OSGC and are increasing in number [75].

Physical Alterations

Jetties have not been constructed, nor has dredging by the U.S. Army Corps of Engineers occurred, but in 1948 the Corps did remove rocks just downstream from Three Rocks located near the mouth [129]. Navigable length of the Salmon River is 3.0 miles [69].

An inventory of filled lands in the Salmon River has been completed by the Division of State Lands and some of the information from that report is presented in Table C [69].

In June 1963 the Trout Creek Fishway was completed under the FCO "Coastal 60-40 Program" [119]. It is located on Trout Creek, near mile 1.25, or roughly 11 miles from the estuary mouth. (Trout Creek flows into Slick Rock Creek about 1 mile from the mouth of the latter, and Slick Rock Creek discharges into Salmon River at mile 8.8 [94].)

Estuary Uses

Industrial and Commercial

Forestry, agriculture, fishing, recreation and summer homes are of primary economic importance to the Salmon River area [88]. Commercial

Salmon Bay

fish landings from the ocean or estuary apparently either are not received at Salmon Bay or are not considered extensive enough to report (Tables D and E). The only manufacturers there listed in Table 2, are three small logging operations in Otis and Rose Lodge [71].

Table 2. Major Manufacturers at Salmon Bay [71].

Location	Name	Type of Business	Number Employed
Otis	Jurhs Logging Co.	logging	7
	Ted E. Bray Co.	logging	1
Rose Lodge	Holliday Hauling Co. Inc.	logging	15

Recreational

Species other than salmon and trout most commonly taken by sports fishing, as determined in the FCO study from March to October 1971, are as follows: shore angling--limpets, staghorn sculpin, and starry flounder; boat angling--dungeness crab and starry flounder; and clamming--ghost and/or mud shrimp [38]. Estimated annual harvest data for angling in the area (ocean, estuary, and streams) are shown in Table 3 [75].

Table 3. Estimated Annual Harvest Data For Sport Fishing at Salmon Bay⁽¹⁾ [75].

Species	area fished	annual harvest (total number)	effort (angler-days)	gross expenditures
Salmon	Estuary	550	2,200	\$ 40,700
	Salmon River	310	1,240	22,940
	Ocean	390	520	28,860
Sea-run cutthroat	Estuary	560	2,800	51,800
	Salmon River	105		
Steelhead	Salmon River	2,240	8,960	165,760
Non-salmonid bay fish	Estuary	1,800	600	3,600

¹Average of data from past years.

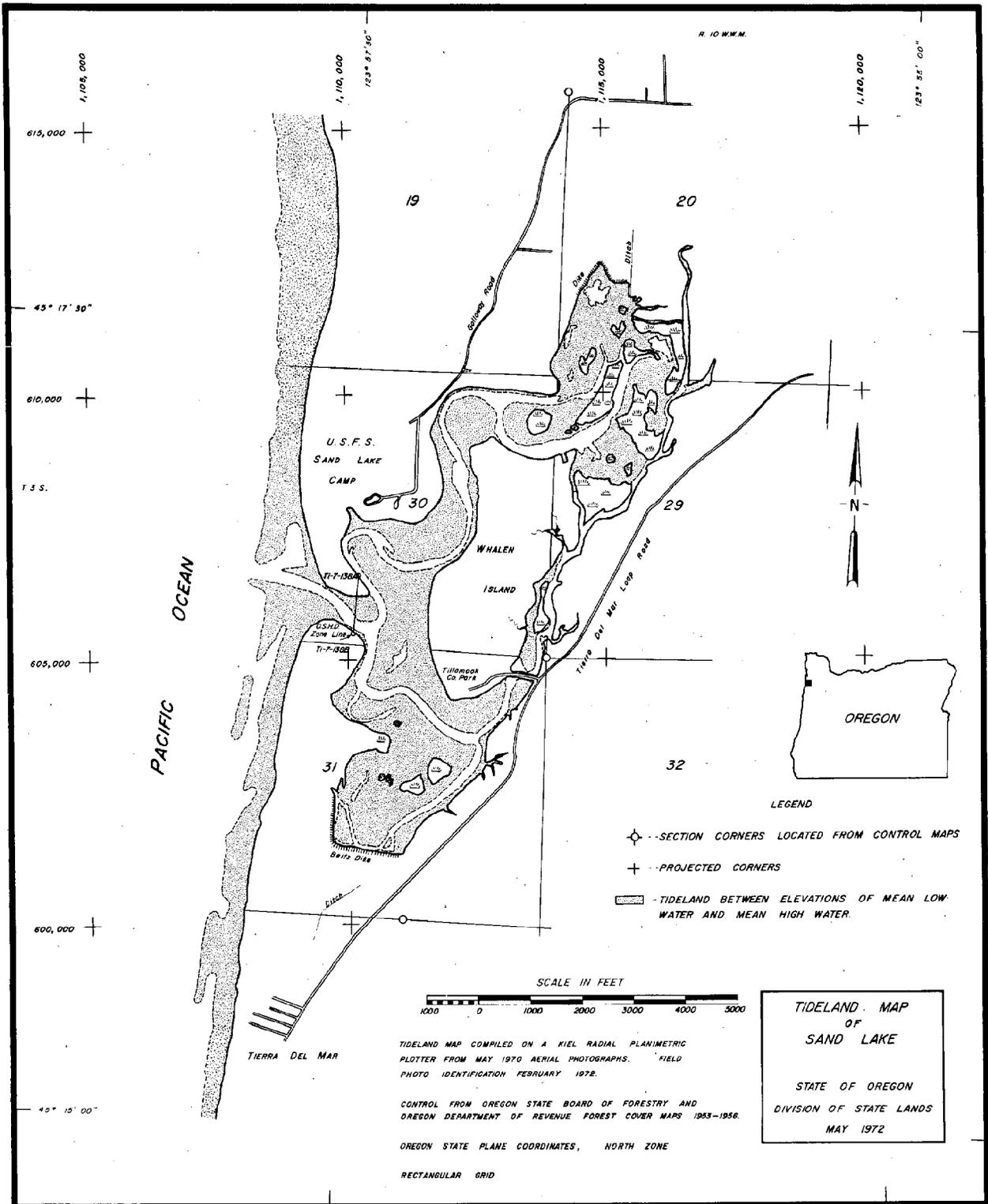
Salmon Bay

Table 4. Surveillance stations at Salmon Bay.

Type of station	Name and/ or identifying number	Approximate location	Drainage area (sq.mi.)	Period of record	References
Climatological	Otis 2 NE	Salmon River; mile 5	150	1948-(1963)	[88,143]
Stream gaging	Alder Brook near Rose Lodge; USGS #8037	Alder Brook, mile 0.1; 10.8 miles from the estuary mouth	1.09	1954-(1970)	[140]
Crest stage	"	"	"	1954-(1963)	[88]
DEQ water surveillance	#1. 1/2 mile below public boat ramp	45° 05' 48" N 124° 00' 00" W			[67,68]
"	#2. 1/4 mile below public boat ramp	45° 02' 29" N 123° 59' 48" W			
"	#3. opposite public boat ramp	45° 02' 22" N 123° 59' 14" W			
"	#4. 1/4 mile above public boat ramp	45° 02' 18" N 123° 59' 05" W			
"	#5. 1/2 mile above public boat ramp	45° 01' 54" N 123° 59' 05" W			
"	#6. 3/4 mile above public boat ramp	45° 01' 49" N 123° 58' 35" W			
"	#7. Hwy 101 Bridge	45° 01' 34" N 123° 58' 05" W			

() This is the most recent record date found and it not necessarily the last.

SAND LAKE



1,105,000
615,000 +
45° 17' 30"
610,000 +
T.S.S.
605,000 +
600,000 +
45° 15' 00"

PACIFIC OCEAN

1,110,000
123° 57' 30"

1,115,000
123° 57' 30"

1,120,000
123° 55' 00"

19

20

U.S.F.S.
SAND LAKE
CAMP

WHALE
ISLAND

Tillamook
Co Park

30

29

31

32

TIERRA DEL MAR



LEGEND

- ⊕ --- SECTION CORNERS LOCATED FROM CONTROL MAPS
- + --- PROJECTED CORNERS
- ▨ --- TIDELAND BETWEEN ELEVATIONS OF MEAN LOW WATER AND MEAN HIGH WATER.

SCALE IN FEET



TIDELAND MAP COMPILED ON A KIEL RADIAL PLANIMETRIC PLOTTER FROM MAY 1970 AERIAL PHOTOGRAPHS. FIELD PHOTO IDENTIFICATION FEBRUARY 1972.

CONTROL FROM OREGON STATE BOARD OF FORESTRY AND OREGON DEPARTMENT OF REVENUE FOREST COVER MAPS 1953-1956.

OREGON STATE PLANE COORDINATES, NORTH ZONE

RECTANGULAR GRID

TIDELAND MAP
OF
SAND LAKE

STATE OF OREGON
DIVISION OF STATE LANDS
MAY 1972

SAND LAKE

General Description of Estuary and Drainage Basin

Estuary

Sand lake, located about 70 miles south of the mouth of the Columbia River, is the second smallest estuary of those included here (Table A). The area is sparsely populated with no towns on the bay itself. Sandlake, described as rural, is located 1 mile northeast of the estuary, and Tierra del Mar with a 1970 population of 40 lies on the coast, about 1 mile south of the estuary mouth [111,89-chart].

Surface area of the estuary is about 550 acres, of which 75% is tidelands (Table 1).

Table 1. Reported surface areas of Sand Lake [55,70,155].

reference	surface area (acres)	measured at	tidelands		submerged lands	
			acres	percent	acres	percent
[2]	700	not specified				
[6]	429	HW				
[117]	528 131	MHT MLT	397	75	131	25

Major tributaries are Sand and Jewel Creeks, which flow into the bay from the north. Gurtis Creek from the east and Reneke Creek from the south are its only other tributaries. None of these streams appear to be longer than 4 or 5 miles [53,89-chart].

Drainage Basin

Sand Lake and its tributaries drain an area of about 17 sq mi [89-chart]. An estimate of the average annual water yield of the North Coast Basin is 3,000 ac-ft/sq mi [89]. Using this figure, the watershed yields 51,000 ac-ft of fresh water annually, an amount somewhat less than the 60,000 ac-ft reported by the Division of State Lands [70].

Yearly precipitation ranges from 95 inches along the coast to 110 inches in the northern watershed [89].

Sand Lake

Hydraulic Description of Estuary

Tides and Currents

The bay is described as being fully exposed to waves at the throat. The mean tide range is 5.7 feet with a diurnal range of 7.5 feet [55]. The channel network in the estuary as observed through aerial photographs is complex [53].

River Discharges

No records from stream gaging stations in this area were found.

Salinity and Classification by Mixing

Salinity is high in concentration [155].

Sediments

Littoral drift varies but tends to be to the south during the summer and to the north during the winter with the net drift being to the south, as indicated by the accumulation of driftwood and sand at the southern third of Sand Lake Beach [57]. An estimated 2,500 tons of sediments are deposited in the estuary by its tributaries annually [85].

Water Quality Information

The DEQ apparently operates no surveillance stations here, and records from other water quality stations were not found.

Biological Information

Of all the streams of the Sand Lake stream system (about 12), seven are reportedly used by anadromous fish, but no estimates of the number of fish using the streams were given [77]. The bay supports bent nose clams (unimportant for food) and ghost shrimp, and it provides excellent fishing for flounder, crabs, and staghorn sculpin [38,155].

Ducks and geese use it as a feeding, resting, and wintering spot [69,89,155].

Sand Lake

Physical Alterations

Jetties have not been constructed, and records show that dredging by the U.S. Army Corps of Engineers has not been performed [55]. Also, as reported in the Division of State Lands inventory of filled lands in Sand Lake, there are no landfills, but three dike-type structures have been built [69]. One is part of the county road leading to Tillamook Park on Whalen Island, another is on the northern shore of the estuary and reportedly is intended for flood control, and the third, located on the southern shore and called "Beltz Dike," is believed to have been built to help extend the limits of grazing lands there. Some further description is given in Table C, and more details can be gotten from the inventory report.

Estuary Uses

Industrial and Commercial

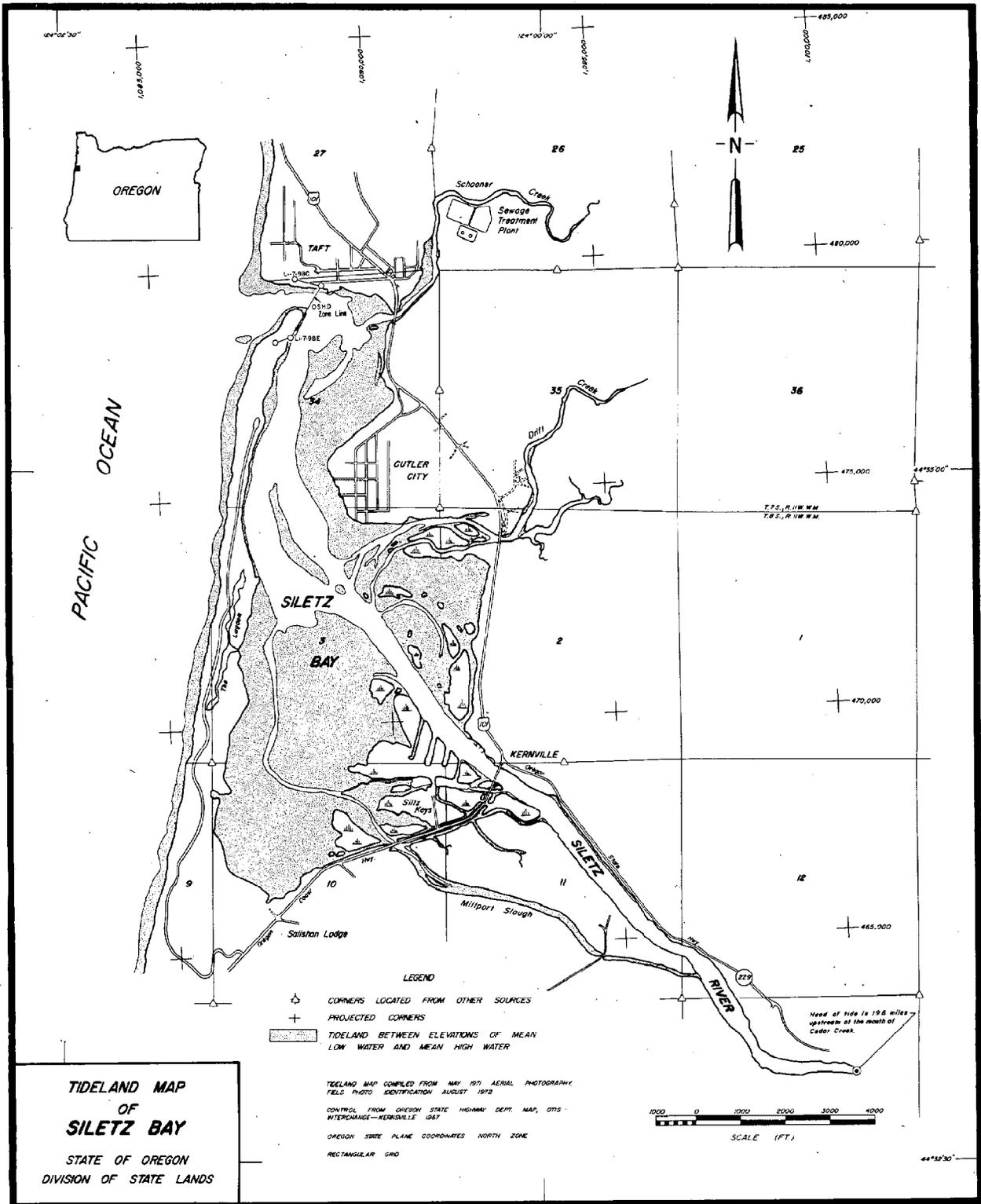
There are no manufacturers or industries at Sand Lake [71,155], nor is there commercial fishing [69]. Agricultural lands in the vicinity are cultivated for the production of hay and pasture, both of which are used for the support of livestock [89],

Recreational

Recreational fishing (for species other than salmon and trout) at Sand Lake, according to statistics from the FCO study, is best for shore anglers [38]. During the period from March to October 1971, they caught mostly staghorn sculpin, starry flounder, and shore crabs. Clammers took mainly ghost shrimp and relatively few mud shrimp, and boat anglers landed a limited number of starry flounder and dungeness crab.

There are two public camp grounds in the area, and they are both used heavily during the spring and summer. One is the USFS Sand Lake Camp on the northern spit, and the other is Tillamook County Park, on Whalen Island located in the northeast corner of the bay. The latter provides a boat ramp [69,150,155].

SILETZ BAY



SILETZ BAY

General Description of Estuary and Drainage Basin

Estuary

Siletz Bay lies roughly 95 miles south of the Columbia River mouth. As the ninth largest of the estuaries included here (Table A), it is relatively small in size.

In 1964, the only towns on the bay (Taft and Cutler City) were consolidated with several others in the coastal zone to the north to form the incorporated city of Lincoln City. These and other population centers in the area are listed in Table 1.

Table 1. Population centers at Siletz Bay¹ [88,95,111].

name	general location	river mile location	approximate distance from estuary mouth (miles)	1970 population
Lincoln City ^{2,3}	coast; north of estuary			4,198
Taft ³	Siletz Bay; north side		0	557 (1960)
Cutler City ³	Siletz Bay; northeast side		1	
Kernville	Siletz River; north side	0.5	2.5	50
Reed Creek	Siletz River; north side	22.0	24.0	not listed
The Maples	Siletz River	26.2	28.2	not listed
Siletz ²	Siletz River	35.3 to 41.3	37.3 to 43.3	596
Gleneden Beach	Sijota Creek; west side	1	4	500

¹Tidal effects extend approximately to mile of the Siletz River.

²Incorporated

³Taft and Cutler City were consolidated with several other towns in 1964 to form Lincoln City.

Surface area of the estuary is about 1,160 acres (Table 2). Cross-sectional areas at MTL at various distances from the mouth are shown in Table 3 [43].

Table 2. Reported surface areas of Siletz Bay [55,59,70].

reference	surface area (acres)	measured at	tidelands		submerged lands	
			acres	percent	acres	percent
[55]	1,086	HW				
[59]	1,203	1				
[71]	1,187 412	MHT MLT	775	65	412	35

¹Specified by Marriage as the area affected by tidal action.

Siletz Bay

Table 3. Cross-sectional areas of Siletz Bay [43].

points of measurement	distance from mouth (miles) ¹	cross-sectional area (sq ft)
Taft	0.19	3,400
Kernville	2.5	5,400
Howard's	10.8	2,200
Strome	18.0	1,100

¹ Mile values were obtained by conversion from distances reported in feet.

The major tributary of Siletz Bay is the Siletz River. Its point of discharge into the bay (about 2 miles from the mouth) is considered its zero mile [94,88-map #15.6]. Length to its source (the confluence of the North Fork Siletz River and Boulder Creek) measures 72.1 miles [95]. It drains an area of 308 sq mi [94] and yields an average of 1,400,000 ac-ft of fresh water annually [88]. Other tributaries discharging directly into the bay are Schooner Creek from the north and about 1 mile from the mouth, Drift Creek from the east and about 1.5 miles from the mouth, and a smaller stream from the south [88-map #18.6]. Schooner Creek drains 15 sq mi and has an average annual fresh water yield of 80,000 ac-ft [88]. Drift Creek has a length of 21.3 miles; drains 41 sq mi [94]; and yields an average of 190,000 ac-ft of fresh water annually [88].

The Siletz Bay Regional Planning Advisory Committee has monthly meetings at which various types of information about the area have been presented [114]. An attempt has been made to summarize some of that material here.

Drainage Basin

Siletz Bay has a drainage area of 373 sq mi [88-map #18.6] which yields an estimated 1,780,000 [117] to 1,800,000 [85] ac-ft of fresh water annually.

Figures given for that portion of the watershed drained by the Siletz River (308 sq mi or 82%) show it to be composed of 94% (289 sq mi) forests; 3% (9 sq mi) cropland; 1% (4 sq mi) rangeland; and 2% (6 sq mi) "other." Precipitation in the watershed averages from 70 inches along the coast to over 180 inches in the headwaters of the Siletz River [88].

Elevations of the Siletz River portion of the watershed range from sea level to 2,850 feet along the Coast Range divide [88].

Siletz Bay

Hydraulic Description of Estuary

Tides and Currents

The bay is described as being fully exposed to waves at the throat [55]. Head of high tide for the Siletz River is 24.2 miles (128,000 feet) from the estuary mouth where the drainage area is 268 sq mi. [43]. The mean tide range is 5.0 feet [55]. Tidal prism on mean range (tidal prism between MLLW and MHHW) is 3.5×10^8 cu ft [43]. Goodwin has found a marked choking of the tidal range taking place through the entrance of the estuary (probably due to channel constrictions) and also found a phase difference of 90 to 100 degrees between tidal elevations and tidal currents [43]. A calibrated numerical tidal hydraulic model of the Siletz has been provided by Goodwin [42].

As a result of the geometry of the entrance, the maximum flood and ebb currents occur at different locations within the estuary. In its first mile (the area between Taft and Cutler City) the flood currents occur along the east side of the bay, while the ebb currents occur along the west side near a sand spit located there [53]. Seasonal (1973) measurements of salinity, temperature, turbidity, pH and dissolved oxygen have been taken for high and low tides with depth and length within the estuary [112].

River Discharges

A stream gaging station located on the Siletz River at mile 42.6 (near the town of Siletz) has been in operation periodically since October 1905 (Table 6). The average recorded discharge for the time up to 1970 was 1,573 cfs with a maximum of 34,600 cfs (November 22, 1909) and a minimum of 48 cfs (September and October 1965 and October 1967). [140]. The normal river flow at the mouth of the Siletz River is estimated at 1,930 cfs [85].

Drift Creek has a computed minimum flow of 22 cfs [88].

Salinity and Classification by Mixing

Burt and McAllister took salinity measurements in the Siletz River once during each of the following months: October 1957, January, April, and July 1958 [12]. Salinity intrusion was greatest on July 25, 1958 at LHW when it reached a point 12.7 mi from the ocean. It was detected at a concentration of 0.4 ppt at the surface and on the bottom (7 feet) with concurrent temperatures of 21.3° C at both points. Measurements beyond this were not reported.

The estuary, as classified by Burt and McAllister on the basis of salinity change from top to bottom, was found to be a two-layered system in January and April and a partly-mixed system in October [13].

Currents and tidal ranges have been measured (1973) to determine the times of maximum ebb and flow [112].

Siletz Bay

Sediments

Littoral drift in the area varies, but it is believed to be to the north [57]. A problem within the estuary has arisen from the large volume of fresh water inflow as it carries an estimated 74,000 tons [85] of sediments to the estuary annually, resulting in a gradual filling [53]. There are delta deposits near the mouth of Drift Creek [53], and a spit with dunes has formed at the mouth of the Siletz River [57]. Four sand bars have formed northeast of Cutler City, as a result of the flow pattern of the ebb and tidal currents as previously described [53].

Analysis of sediments for grain size, porosity and volatile solids along the length of the estuary have been determined for summer and winter (1973) conditions [112].

Of recent concern is the erosion of Salishan Spit located just south of the estuary mouth.

Water Quality Information

There are six DEQ water surveillance stations in Siletz Bay (Table 6) with records from four sampling dates between July 1969 and April 1972 available from most of them [67,68]. The USGS operates water quality stations on the Siletz River--one at mile 34 and another at mile 42.6 where it also has a water temperature station (Table 6) [88,138].

The greatest water quality problem reportedly results from siltation in the streams and in the bay. Effluent and other pollutants discharged into the waters are also of concern [114-8/2/72, J. Fortune].

Biological Information

The Siletz River system provides spawning grounds for more spring chinook and summer steelhead than any other stream system of the Mid-Coast Basin (Table B) [75]. Estimated numbers of these and other salmonids spawning in the river system are as follows [75]: spring chinook--775, fall chinook--14,200, coho--26,900, summer steelhead--4,900, winter steelhead--11,500, and sea-run cutthroat--32,000. These all provide good sport fishing. Other species commonly caught include staghorn sculpin, shiner perch, dungeness crab, starry flounder, and ghost shrimp [38,155].

Some softshell clams can be found along the east side of the estuary between Cutler City and Kernville [155], but most clambeds have been silted in. There is an experimental plant of Manila Littlenecks [114-7/5/72 D. Snow].

Siletz Bay

The estuary is used during migration and wintering by waterfowl [155] with the Millport Slough area (to the southeast of the bay) being used particularly heavily by various species of ducks and occasionally by Canadian Geese. Ruffled grouse are among the game birds found in the estuary area, and blue grouse and mountain quail are found at middle and high altitudes of the watershed. Band-tailed pigeons are quite common, particularly in the vicinities of Millport Slough and the mouth of Drift Creek which they use for watering. The Drift Creek and Schooner Creek areas provide nesting and feed for bald eagles [114-8/2/72; G. Hatten].

The area around the estuary is a winter range for big game such as black-tailed deer, Roosevelt elk, black bear and cougar. Of these, black-tailed deer are the most abundant and can be found at a concentration of 1.8 deer/sq mi in the upper areas. Elk are being transplanted to the Mid-Coast Basin (34 to the Drift Creek area) by the OSGC and are increasing in number, [75,114 -8/2/72 G. Hatten].

Beaver, muskrat, nutria, and raccoon are examples of some of the many fur-bearing animals in the area. Beaver are generally trapped at a rate of 30-40/year [114-8/2/72, G. Hatten].

Physical Alterations

Jetties have not been constructed, but a survey was authorized by Congress in 1964 to consider the possibility of constructing a small-boat basin and jetties near Taft. As of 1971 (publication date), work on the report was in progress [129]. The jetties, in addition to protecting the entrance to the ocean, would probably increase the flushing action of the river and thereby inhibit the silting-in of the bay. Opening up Millport Slough is also expected to result in a decrease of the filling of the bay and this too is apparently being considered [114-7/2/72, D. Snow].

The FCO operates the Siletz River Salmon Hatchery on the North Fork Rock Creek. It lies 4 or 5 miles east of the town of Logsdon, or about 53 miles from the mouth of the Siletz River. Releases (into Rock Creek) between July 1, 1968 and June 3, 1969 consisted of 377,402 coho [33,54,88].

Dams have been constructed at mile 4.3 of the South Fork Siletz River (Valsetz Dam) and at mile 9.7 of Drift Creek [94].

Estuary Uses

Industrial and Commercial

Of economic importance to the watershed are forestry, agriculture, rock and gravel mining, tourism, recreation, and summer homes [88]. Since Siletz Bay is located within the "20 miracle miles" of Oregon's coast where vacationing is popular, tourism, summer homes, and recreation

Siletz Bay

are of particular importance to the population there. Kernville, Cutler City, and Taft are the resort areas on the estuary [88]. Most of the manufacturers there, listed in Table 4, have Lincoln City addresses and deal in lumber and wood products.

Table 4 Major Manufacturers at Siletz Bay [71].

Location	Name	Type of Business	Number Employed
Lincoln City	L. Jepson and Sons	contract logging	50
	Oceanlake Ready-Mix Co.	concrete and crush rock	25
	Fallon Logging Co.	fir/alder/hemlock pulp	22
	10 manufacturers employing less than 15	dealing mainly in lumber and wood-products (mostly logging)	
Gleneden Beach	Gleneden Brick and Tile Work	concrete pipe and building blocks and bricks	5

Farmlands, recently used mainly for stable farming/ranching/dairying activities are now being purchased for recreational development. The farms which are increasing in number are those such as nurseries and tree and berry farms dealing in more specialized products and having higher incomes. Those which have lower incomes are rapidly decreasing in number. For example, the number of county farms grossing less than \$5,000 dropped 50% from 1964 to 1969, while those grossing over \$9,999 nearly doubled during the same time period [114-7/5/72, J. Gurton].

Commercial fishing and clamming formerly provided some income to the area. Now, however, most clam beds have been silted in and commercial fishing is extremely limited, with the commercial salmon fleet once supported there no longer existing [75, 114-7/5/72, D. Snow]. In fact, statistics of commercial landings of salmon and other species received at various bays during 1971 (Tables D and E) show sand shrimp, crawfish, and eel as the only ones received at Siletz with a total catch for the year of 176 pounds at essentially no value to fishermen [34]. Also, of the various species such as clams, crabs, oysters, bait shrimp, and shad harvested directly from estuaries of the Mid-Coast Basin, bait shrimp was the only one taken at Siletz Bay. Such landings have averaged 700 pounds over the past years with a retail value to fishermen of \$920 [75].

Recreational

While commercial fishing at Siletz Bay is limited, sport angling is quite popular. It has good potential, but problems apparently arise from limited

Siletz Bay

angler access and low summer flow rates [88, 114-8/2/72, J. Fortune]. Nevertheless, anglers are relatively successful, as indicated by the annual harvest data shown in Table 5 [75]. The bay and its major tributaries (the Siletz River, Drift Creek, and Schooner Creek) all provide good salmon

Table 5. Estimated Annual Harvest Data For Sport Fishing at Siletz Bay⁽¹⁾ [75].

Species	area fished	annual harvest (total number)	effort (angler-days)	gross expenditures
Salmon	Estuary	4,400	17,600	\$325,600
	Siletz River	1,550	6,200	114,700
	Ocean	40	50	2,960
Sea-run cutthroat	Estuary	3,440	16,000	296,000
	Streams	1,475		
Steelhead	Siletz River	7,155	28,620	529,470
Non-salmonid bay fish	Estuary	24,000	8,000	48,000

¹Average of data from past years.

and trout angling [88,155]. Sea-run cutthroat can generally be caught from July to late fall with the big chinook entering the estuary in August and providing their best fishing in September. Late in September the coho enter and peak in October and November[58]. Species other than salmon and trout which are most frequently caught in the estuary, as determined in the FCO study from March to October 1971, include staghorn sculpin, shiner perch, and dungeness crab by shore angling; dungeness crab, starry flounder, and relatively few staghorn sculpin by boat angling; and ghost shrimp and some mud shrimp by clamming [38].

There are two Siuslaw National Forest camps in the watershed--one on Schooner Creek and the other on North Creek. The one on Schooner Creek is located at a point about 7 miles from the bay where the creek is formed by North Fork and South Fork. North Creek's campsite is near its mouth, which is at mile 10.2 of Drift Creek [114-7/5/72, W. Jones, 83, 26].

Boat landings on the Siletz River number about nine between the mouth and mile 16.5 [88,94].

Hunter days in the Siletz Bay area are estimated at 530 annually [114-8/2/72, G. Hatten].

Siletz Bay

Table 6. Surveillance stations at Siletz Bay.

type of station	name and/or identifying number	approximate location	drainage area (sq mi)	period of record	references
stream gaging	Euchre Creek near Siletz; USGS #3060	Euchre Creek; mile 1; 29 miles from the estuary mouth	13.4	1924	[88]
	Siletz River at Siletz; USGS #3055	Siletz River; mile 42.6	202	1905*(1970)	[88,98] ¹
DEQ water surveillance	#1	adjacent to dock at Taft		7/69-(4/72) (4 measurements)	[67,68] ²
	#2	opposite Cutler City		"	"
	#3	1.5 miles downstream from Highway 101 bridge at Kernville		"	"
	#4	Highway 101 bridge at Kernville		"	"
	#5	Siletz River opposite sunset Landing (4 miles above Highway 101 bridge)		"	"
	#6	Siletz River 2.5 miles above Sunset Landing		8/70-(4/72)	"
water quality	Siletz River 3 miles north of Siletz	Siletz River; mile 34		1960-(1963) (spot observations)	[26]
	Siletz River at Siletz; USGS #3055	Siletz River; mile 42.6	202	1911-1912 1915 (daily spot observations)	[26]
water temperature	"	"	"	1947-(1962) (spot observations)	[88,138]

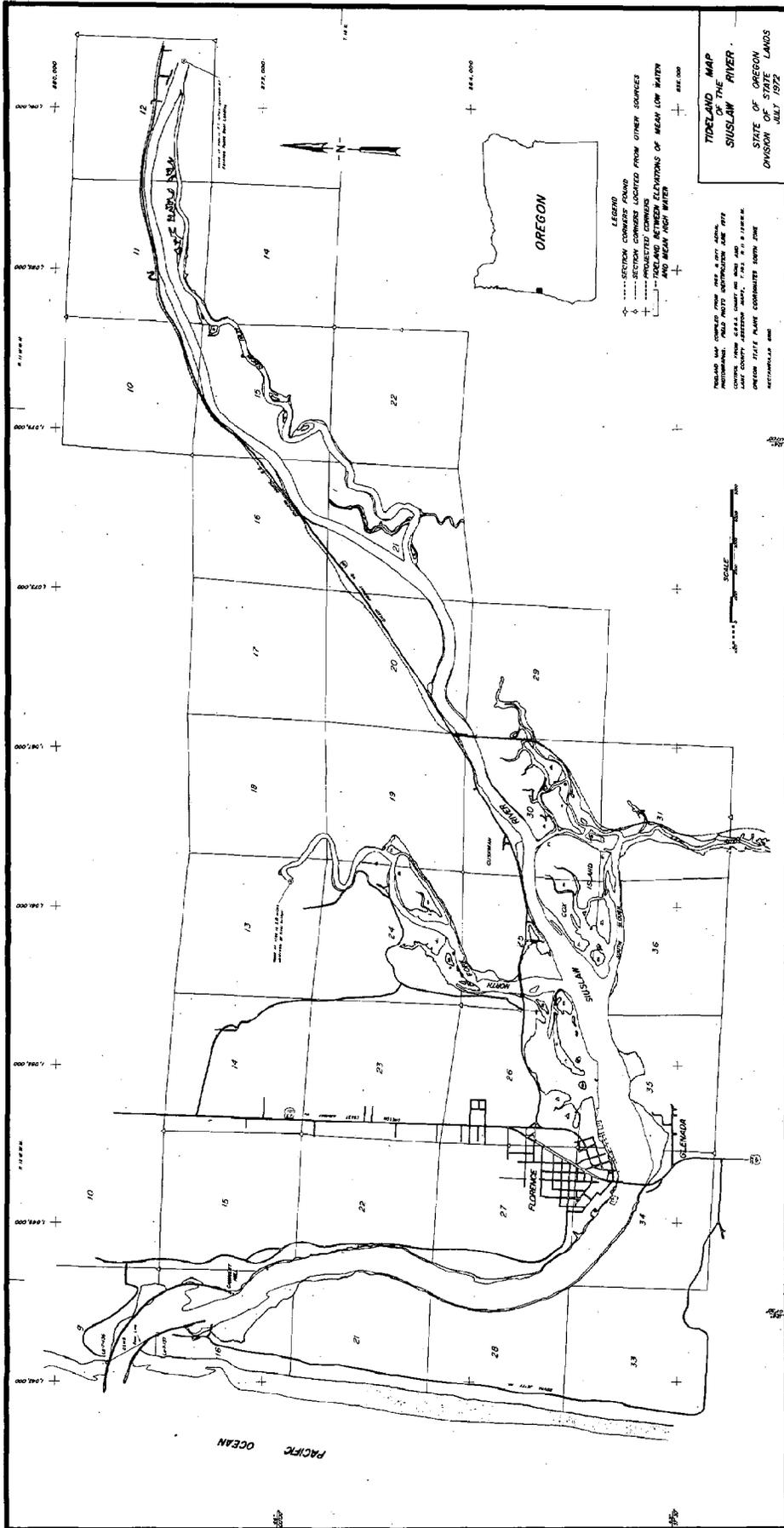
¹ Monthly and water-year runoff records have been compiled and are available in punch card or printout form through the OSWRB.

² Data available in punch card or printout form through the DEQ.

() This is the most recent record date found and is not necessarily the last.

* Period of record is not continuous.

SIUSLAW BAY



SIUSLAW BAY

General Description of Estuary and Drainage Basin

Estuary

Siuslaw Bay is located about 160 miles south of the mouth of the Columbia River. Of the estuaries included here, it ranks eighth in size (Table A). Populated areas, shown in Table 1, lie primarily on the north side of the Siuslaw River.

Table 1. Population centers at Siuslaw Bay¹ [94,111].

name	general location	river mile location	approximate distance from estuary mouth (miles)	1970 population
Florence ²	Siuslaw River; north side	3.5 to 5.4	3.5 to 5.4	2,246
Glenada	Siuslaw River; south side	4.7	4.7	200
Cushman	Siuslaw River; north side	8.2	8.2	no pop
Wendson	Siuslaw River; north side	9.9	9.9	no pop
Beck (Tiernan)	Siuslaw River; north side	14.7	14.7	130
Point Terrace	Siuslaw River; 0.5 mile to the south	16.2	16.2	not listed
Mapleton	Siuslaw River; north side	20.5	20.5	900
Firo	Siuslaw River	23.9	23.9	not listed
Brickerville	Siuslaw River; north side	24.2	24.2	140
Tide	Siuslaw River; north side	26.5	26.5	75
Siuslaw	Siuslaw River; north side	27.8	27.8	no pop
Swisshome	Siuslaw River; north side	28.9	28.9	400
Minerva	North Fork Siuslaw River; east side	16.7	23.0	rural

¹Tidal effects extend approximately to mile 25 of the Siuslaw River and to mile 6.9 of the North Fork Siuslaw River.

²Incorporated

The estuary covers about 1,780 acres. Surface areas reported by Johnson [55], Marriage [59], and the Division of State Lands [70], presented in Table 2, vary from 1,458 acres to 2,245 acres. Tidelands (also given in Table 2) are extensive upstream from Florence and nearly nonexistent in the lower section of the estuary [53]. Other dimensions (distance from throat to farthest estuary shore, throat measurement; and average lagoon depth below MSL) are listed in Table 3.

Siuslaw Bay is narrow and crooked. It consists primarily of the lower reaches of the Siuslaw River, which has its zero river mile at the mouth of the estuary [94]. The river drains 773 sq mi. It has a length of 109.4 miles to its source (the confluence of the North Fork Siuslaw River¹) and

1 There are two North Fork Siuslaw Rivers.

Siuslaw Bay

Table 2. Reported surface areas of Siuslaw Bay [55,59,70].

reference	surface area (acres)	measured at	tidelands		submerged lands	
			acres	percent	acres	percent
[55]	1,458 1,218 978	HW MSL LW				
[59]	1,589	1	597	38		
[70]	2,245 1,489	MHT MLT	756	34	1,489	66

¹Specified by Marriage as the area affected by tidal action.

Table 3. Dimensions of Siuslaw Bay [55].

distance from throat to
farthest estuary shore--6.9 miles

inlet dimensions at throat (at MSL):

width--745 feet

average depth--23 feet

cross-sectional area--8,330 sq ft

average lagoon depth below MSL--7 feet

the South Fork Siuslaw River) and a total length (to the source of the South Fork Siuslaw River) of 117.9 miles. Between its mouth and the head of tidewater at mile 25, its major tributary is the North Fork Siuslaw River⁽¹⁾ at mile 6.3. This North Fork Siuslaw River has a length of 25.8 miles and drains 65 sq mi. Minor tributaries of the Siuslaw to tidewater at mile 25 include approximately 28 from the north (20 named) and 15 from the south (11 named) [94,88-map no. 18.6].

In addition to the port commission at Siuslaw Bay, there is also a community development corporation, both located in Florence. Their addresses and phone numbers are [106]:

Port of Siuslaw
P.O. Box 297
Florence, Oregon 97439
997-2027

Siuslaw Valley Development Corp.
P.O. Box 280
Florence, Oregon 97439
997-3486

¹ There are two North Fork Siuslaw Rivers.

Siuslaw Bay

Drainage Basin

The drainage basin of Siuslaw Bay is the same as that of the Siuslaw River--it covers 773 sq mi and yields an average of 2,300,000 ac-ft of fresh water annually [7,70,85,88]. It consists of 91% (708 sq mi) forests; 4% (28 sq mi) cropland; 1% (6 sq mi) rangeland; and 4% (31 sq mi) "other" [88].

Annual precipitation averages from 40 inches in the eastern watershed to 100 inches in the northwestern section with 80 inches along the coast [88]. Precipitation records from Florence are available through the OSWRB in punch card or printout form (Table 10) [92,143].

Elevations range from sea level to 3,000 feet [88].

Hydraulic Description of Estuary

Tides and Currents

The bay is described as being fully exposed to waves at the throat [55].

Tidewater reaches to between miles 22.5 [69] and 25 [107] of the Siuslaw River and to mile 6.9 of the North Fork Siuslaw River [69].

The mean tide range is 5.2 feet with a diurnal range of 6.9 feet and an extreme range of 11.0 feet [86]. Tidal prism on mean range is 2.76×10^8 cu ft with a diurnal range of 3.66×10^8 cu ft [55].

Currents and tidal ranges have been measured (1973) to determine the times of maximum ebb and flood flow [151].

River Discharges

Normal flow of the Siuslaw River (at the mouth) has been estimated as 3,150 cfs based on precipitation records from 1937 to 1963 [7]. A stream gaging station is located on the Siuslaw River at mile 23.7 near Mapleton (Table 10) where the drainage area is 588 sq mi. The station has been in operation since October 1967, and records through September 1970 show extreme flows of 32,300 cfs (January 27, 1970) and 70 cfs (August 30 and 31, 1970) with an average discharge during the 1969 water year of 2,023 cfs [140].

Salinity and Classification by Mixing

Burt and McAllister have reported salinity measurements taken in the Siuslaw River during October 1957 and January, March, and July 1958 for a total of four sampling dates [12]. Of the four, salinity intrusion

Siuslaw Bay

was greatest on October 7, 1957 at HHW when it reached a point 17.3 miles from the ocean at concentrations of 0.2 ppt on the surface (water temperature-- 14.0°C) and 0.4 ppt on the bottom at a depth of 10 feet (water temperature-- 13.7°C).

On the basis of salinity change from top to bottom, Burt and McAllister classified Siuslaw Bay as a two-layered system in January and May; as a partly-mixed system in March; and as a well-mixed system in October [13].

Giger [39] provides salinity measurements with depth and length for high and low tides during winter (1968) and summer (1967) conditions. Salinity intrusion was shown to approximately 20-22 miles from the ocean during summer conditions and approximately 5-7 miles from the mouth during winter conditions. The system is well mixed during the summer period particularly at high tide.

Seasonal (1973) measurements of salinity, temperature, turbidity, pH and dissolved oxygen have been taken for high and low tides with depth and length within the estuary [151].

Sediments

It is estimated that the Siuslaw River transports some 103,000 tons of sediments to the estuary annually [57,85]. A water temperature station is located on the Siuslaw River at mile 23.7 (near Mapleton) and records of sediment concentrations and sediment loads are kept there (Table 10) [141]. Daily extremes of sediment concentration during the period from August 1967 through September 1968 were 1 mg/l (many times) and 160 mg/l (February 1968). The daily sediment load ranged from 0.36 tons (August 1967) to 4,600 tons (February 1968). A major source of coarse grain sediments in the estuary is the sand dunes to the south. Some material is transported by the wind with a degree of counteraction by the high current velocities which result from the narrow channel; however, all but the main channel in the lower reaches of the estuary has been filled [53].

Analyses of 6 U.S. Army Corps of Engineers dredge samples taken primarily from the entrance channel during the early 1960's and 1970's show the following: (1) organic contents ranging from 0.26% (April 1972) to 0.61% (August 1971); (2) void ratios ranging from 0.551 (August 1971) to 0.809 (August 1962), and (3) mean grain size consistently that of fine sand [124].

Analysis of sediments for grain size, porosity and volatile solids along the length of the estuary have been determined for summer and winter (1973) conditions [151].

Siuslaw Bay

Water Quality Information

The DEQ operates nine water surveillance stations on Siuslaw Bay (Table 10) [67,68]. Records are available in punch card or printout form for as far back as June 1968 with at least seven sampling dates at most of the stations.

The USGS water temperature station located on the Siuslaw River at mile 23.7 (Table 10) recorded an average temperature for November 1967 through August 1968 (10 months) of 12°C and extremes for the period of 26°C (in July 1968) and 3°C (in December 1967 and January 1968) [141].

Florence city water is pumped from the sand dunes [35]. The city operates a secondary treatment sewage plant located in the southwest section of Florence on Rhododendron Drive about 4.5 miles west of Highway 101. Average daily flow from the plant during October 1972 (fairly dry weather) was about 350,000 gallons. The plant serves Florence only (no industries) and is the only sewage treatment plant on the bay [36,121].

Biological Information

The number of adult anadromous salmonids spawning in the Siuslaw River system are estimated as follows: spring chinook--0, fall chinook--4,500, coho--22,000, summer steelhead--0, winter steelhead--13,000, and sea-run cutthroat--50,000 [75]. A comparison with the number of salmonids spawning in other estuarine river systems (Table B) shows these figures to be below average.

Species commonly found in the bay which are of interest to anglers include salmon, redbay seaperch, bay mussels, pile perch, dungeness crab, and softshell clams (found mainly in the tidelands upstream from Florence). Less common (but still fairly abundant) are shiner perch, staghorn sculpin, piddocks, and gaper clams (in a small bed near the mouth of the bay) [38,53,155].

The area around the estuary is a winter range for black-tailed deer, Roosevelt elk, black bear, and cougar. Of these, black-tailed deer are the most abundant [75].

Physical Alterations

Modifications to the estuary by the U.S. Army Corps of Engineers as originally planned included an entrance channel stabilized by two rubble-mound jetties and leading to a river channel which was to extend approximately 7.5 miles up the Siuslaw River. In 1958, expansion of many portions of the project plus a turning basin near Florence were authorized. A summary of the alterations is given in Table 4.

Siuslaw Bay

The Siuslaw River is navigable to mile 19.0, and the North Fork Siuslaw River is navigable by small craft to mile 2.0 (controlling depth 3 feet) [69].

Army Corps of Engineers dredging records for 1959 through 1969 (excluding 1968) show most of their dredging activities taking place in the entrance channel with the 82,300 cu yds removed from there in 1965 being a fairly typical quantity [55]. The maximum amount was 822,080 from the "16-foot channel" in 1969 and the minimum amount was 48,250 cu yds from the entrance channel in 1965.

Private contractors have performed hydraulic dredging on the North Fork Siuslaw River and have spoiled behind berms [50].

The inventory of filled lands in the Siuslaw River taken by the Division of State Lands shows that land fills on submerged or submersible lands are located nearly exclusively in the Florence area [69]. As of June, 1972, these fills totaled 40.75 acres of which 36.28 acres were dredging spoils (Table C). Considerable modification of marshes has occurred in the past through agricultural uses.

Table 4. U.S. Army Corps of Engineers Modifications to Siuslaw Bay [55,126,128,129].

Proposed Modification	Location	Dimensions			Date and Status	(1)
		depth (feet)	width (feet)	Length		
North Jetty	entrance				1917-completed 1958-rehabilitated 1958 ⁽²⁾ -600-foot extension authorized	
South Jetty	Entrance				1917-completed 1962-rehabilitated	
Channel	Entrance	12			1930-completed	
		18	300	1,500 feet	1958 ⁽²⁾ -expansion authorized 1969-deepened	
Channel	Entrance to Florence	12	200	5 miles	1930-completed	
		16	200 (wider at bends)	5	1958 ⁽²⁾ -expansion authorized 1968-dredging completed	
Turning Basin	Opposite Siuslaw dock at Florence	16	400	600 feet	1958 ⁽²⁾ -authorized	
Channel	Florence to Cushman		150	2.5 miles	1930-completed	

¹Lack of completion date does not necessarily signify that the modification has not been constructed.

²Preconstruction planning for the 1958 authorization reportedly underway as of 1971 (publication date) unless otherwise indicated [129].

Siuslaw Bay

Table 5. Major water-related businesses on the Siuslaw River within tidewater (mile 25) [107].

name	distance from mouth ¹ (miles)	type of business	number employed	log raft storage (acres)
U.S. Coast Guard Station, Siuslaw R.	1.9		20	
Siuslaw Pacific Moorage	2.5		4 - 6	
Bay Bridge Marina	4.9		2 - 4	
Port of Siuslaw main dock commercial marina sport boat marina	5.3		8 - 12 1 - 2 1 - 2	
Umpqua River Navigation Riverside Machine Shop T. O. Nordahl	6.9		4 - 8	
The Murphy Company	7.8	veneer mill peeler logs	40 - 60	2
Siuslaw Marina and Boatways	8.1		1 - 3	
Nordahl Tow Boat Co.	8.4		3 - 6	
Cushman Store and Marina	8.5		1 - 2	
Will's Shingle Mill	10.8	shingle mill	2 - 6	0.25 to 0.5
Midway Docks	11.4		1 - 3	
Porters Landing	14.9		1	
C & D Docks	15.4		1 - 2	10 to 15 ²
Davidson Industries, Inc.	16.1	lumber mill	172	
Russels Marina	17.9		1 - 2	
U.S. Plywood Corp.	19.2	plywood mill	150 - 200	2 to 3 ³

¹All located on the north side of the Siuslaw River except Russels Marina on the south.

²Has cut back almost 35% of water storage in the last year; 10 to 15 acres is the present use.

³No storage--only barked peelers put into water prior to use, utilizing 2 to 3 acres.

Siuslaw Bay

Estuary Uses

Industrial and Commercial

Incomes in the Siuslaw Basin are derived primarily from the forests. The estuary is used for log storage, towing, and barging, and numerous forest products are made in the area and shipped from the Port of Siuslaw each year [35,49,129,155].

The 16 major water-related businesses on the Siuslaw River (to Tidewater at mile 25) are listed in Table 5. Of the 16, four deal in forest products and have a combined work force of about 400 as opposed to approximately 60 for the remaining 12. These four industries use from 14.25 to 20.5 acres of the estuary (depending on the time of year) for log storage (also shown in Table 5) [107]. Manufacturers in the area other than those on the Siuslaw River listed in Table 5 are described in Table 6 [71]. Most of these deal in lumber or wood products.

Table 6. Major Manufacturers at Siuslaw Bay not Included in Table 5 [71].

Location	Name	Type of Business	Number Employed
Florence	Siuslaw News and Printing	newspaper and commercial print and magazine printing	10
	10 other manufacturers employing less than 10	dealing mainly in lumber and wood products (mostly logging)	
Mapleton	Lagler Logging Inc.	Contract logging	20
	3 manufacturers, 2 of which employ 1 (the other is not listed)	dealing in logging	

Forest products account for virtually all traffic on the Siuslaw River project. Of the 127,000 tons of traffic using the river during 1969, about 75% was lumber and nearly 25% rafted logs. Annual traffic between 1960 and 1969 averaged 207,000 tons [155], and water shipment of forest products by the Port of Siuslaw is about 125 tons each year [35]. Much of this is sent to the San Francisco Bay area, Los Angeles, and the Hawaiian Islands.

Siuslaw Bay

Commercial fishing from the estuary, mainly for shad and crab, is quite limited (Table 7). Landings from the entire area provide some

Table 7. Commercial Harvest of Shad, Striped Bass, and Crabs From Siuslaw Bay.

Species	1969		1970		1971	
	pounds landed	fishermen value	pounds landed	fishermen value	pounds landed	fishermen value
Shad ⁽¹⁾	10,266	\$1,000	9,520	\$1,000	8,290	\$1,000
Striped Bass ⁽¹⁾			629		1,242	
Crabs	12,000 ⁽²⁾	\$3,000 ⁽²⁾	3,320 ⁽³⁾		3,800 ⁽³⁾	

¹Source of reference [20]; data for the Siuslaw River System.

²Source of reference [75]; data for Siuslaw Bay.

³Source of reference [118]; data for Siuslaw Bay.

income (Table 8), although not as much as at most of the other estuaries included here (Tables D and E) [34].

There are some agricultural activities (dairy and row crop farming) [35], and the area upstream from the estuary is becoming more industrialized [155].

Table 8. Commercial Harvest of Food Fish Received at Florence, 1971⁽¹⁾ [34].

Species	Harvest (pounds round weight)	Fishermen value
Crabs	134,213	\$40,000
Coho	133,395	42,000
Albacore Tuna	12,003	4,000
Shad	8,290	1,000
Chinook	6,898	4,000
Groundfish	2,293	—
Striped Bass	1,242	—
Smelt	40	—
Totals	289,374	\$91,000

¹Includes 1971 data presented in Table 7.

Siuslaw Bay

Table 9. Estimated Annual Harvest Data for Sport Fishing at Siuslaw Bay⁽¹⁾ [75].

Species	area fished	annual harvest (total number)	effort (angler-days)	gross expenditures
Salmon	Estuary	4,600	11,000	340,400
	Siuslaw River	2,000	4,000	148,000
	Ocean	11,000	14,000	814,000
Sea-run cutthroat	Estuary River	14,000	20,000	370,000
		2,000		
Steelhead	River	4,000	12,000	296,000
Shad	Estuary	300	200	3,700
Striped Bass	Estuary	100	600	11,100
Non-salmonid bay fish	Estuary	12,000	10,000	60,000

¹Average of data from past years.

Recreational

Annual harvest data for angling at Siuslaw Bay are given in Table 9.

Trolling for coho, chinook, and sea-run cutthroat in the estuary is popular from mid July through November with the best salmon fishing occurring soon after the first heavy rain in September. During the winter months, casting for steelhead is popular [35,58].

Species other than salmon and trout which are most commonly taken from the estuary (as determined in the FCO study from October to March 1971) are redbait seaperch, bay mussells, and pile perch by shore angling; dungeness crab and relatively few shiner perch and staghorn sculpin by boat angling; and soft shell clams, relatively few piddocks, and a limited number of mussells by clamming [38].

Marinas on the estuary include the Bay-Bridge Marina, Port of Siuslaw, and Siuslaw Pacific Moorage [35].

Siuslaw Bay

Table 10. Surveillance stations at Siuslaw Bay.

type of station	name and/or identifying number	approximate location	drainage area (sq mi)	period of record	references
climatological	Florence 3 NNW	Siuslaw River; mile 10		1909*(1963)	[88,92,143] ¹
	Mapleton	Siuslaw River; mile 21		1924-1929	[88]
stream gaging	Siuslaw River near Mapleton	Siuslaw River; mile 23.7	588	1967-(1970)	[140]
	Siuslaw River above Wildcat Creek near Austa; USGS #3070	Siuslaw River; mile 44.9	267	1931-1941	[98] ²
	North Fork Siuslaw River near Minerva	North Fork Siuslaw River; mile 13.09			[140]
DEQ water surveillance	#1	red channel buoy #16		6/68-(12/71) (7 measurements)	[67,68] ³
	#2	red channel buoy #32		"	"
	#3	channel, 250 yards below Highway 101 bridge-- buoy #47		"	"
	#4	200 yards north and 700 yards east of Highway 101 bridge		"	"
	#5	black channel buoy #55		6/68-(12/71) (6 measurements)	"
	#6	North Fork Siuslaw River bridge		6/68-(12/71) (7 measurements)	"
	#7	main channel near Cushman		"	"
	#8	South Slough inlet next to Siboco		6/68-(12/71) (6 measurements)	"
	#9	Beck station Tiernan; 4 miles above Cushman		6/68-(12/71) (7 measurements)	"
water temperature	Siuslaw River; near Mapleton	Siuslaw River; mile 23.7	588	1967-(1968)	[141] ⁴

¹Precipitation data available in punch card or printout form through the OSWRB.

²Monthly and water-year runoff records have been compiled and are available in punch card or printout form through the OSWRB.

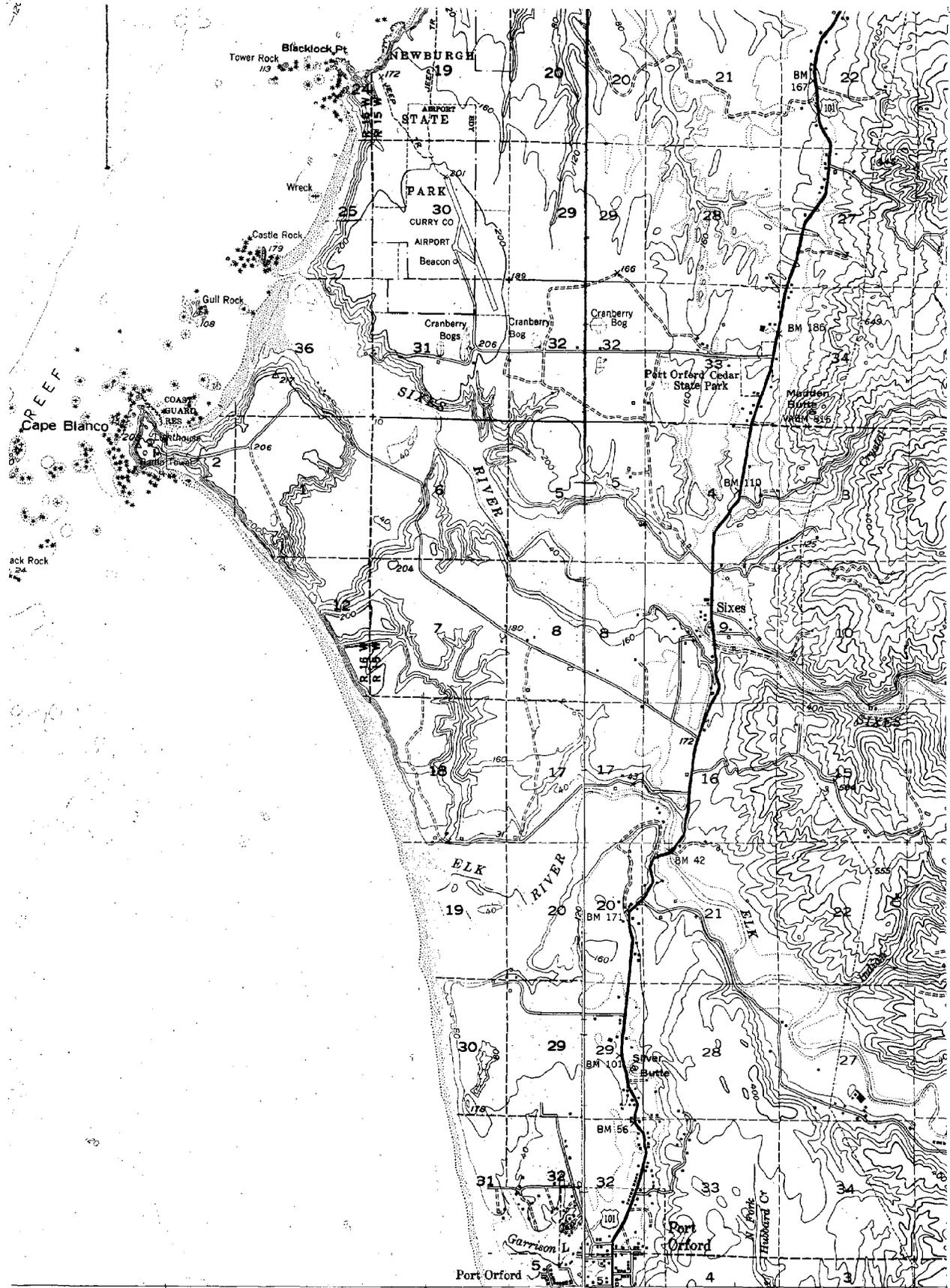
³Data available in punch card or printout form through the DEQ.

⁴Includes sediment records.

() This is the most recent record date found and is not necessarily the last.

* Period of record is not continuous.

SIXES RIVER



INTERIOR-GEOLOGICAL SURVEY, WASH. D. C. -1963 (FORT ORFORD) 124°30' 0" W. OPHIR 21 MI. GOLD BEACH 33 MI. R. 15 W.
 MR 6175 376000m.E.

SIXES RIVER

General Description of Estuary and Drainage Basin

Estuary

The Sixes River Estuary lies 233 miles south of the Columbia River mouth. It ranks as one of the smallest in size in terms of surface area. Population in the area is largely rural, the small town of Sixes being near the river and Port Orford approximately 5 miles to the south. Census figures and locations appear in Table 1.

Table 1. Population Centers at Sixes River [9,96,111,154].

Name	General Location	River Mile Location	1970 Population
Sixes	Sixes River, N. Side	5.3	(not listed)
Port Orford	5 miles south of Sixes, Ore.	not applicable	1,037

The HW surface area of the estuary as estimated from 1973 EROS Data Center aerial photographs is 330 acres [135].

The average annual yield of the Sixes River at its mouth was 440,000 ac-ft for the period of 1930-1961. The minimum annual yield was 240,000 ac-ft, and the maximum, 630,000 ac-ft. The Sixes River source is at river mile 31.4, elevation 880 feet [93,96].

The Port of Port Orford is located at P.O. Box 227, Port Orford, Oregon 97465; telephone number 332-3281 [106].

Drainage Basin

The Sixes River drains a total basin area of 129 sq. miles. The average yearly freshwater yield of the Sixes River is 440,000 ac-ft which equals an average annual yield of 64 inches over the basin [93].

The Sixes River Basin consists primarily of woodlands (92.3%; 76,765 acres), cropland (1.9%; 1,565 acres), and pasture (4.3%; 3,610 acres). As of January, 1963 the Sixes River had one existing storage pond and 3 potential reservoir sites being studied.

The Sixes stream profile appears on page 43 in the Chetco River Basin section.

SIXES RIVER

General Description of Estuary and Drainage Basin

Drainage Basin

The average annual precipitation ranges from 60 inches at the mouth of the Sixes River to 110 inches in the upper reaches [93].

There are four climatological stations in the vicinity. The Cape Blanco station has precipitation and temperature data from 1952, the Langlois stations has precipitation and temperature data from 1891-1904, the Langlois 2 station has precipitation data from 1922, and the Port Orford station has precipitation and temperature data from 1852-1856 and from 1905 to the present [93,143].

The Sixes River has a length of 31.4 miles, the South Fork having a length of 8 miles. The elevation drop from source to mouth is 880 feet for the Sixes River and 1,840 feet for the South Fork. The average gradient for the Sixes River is 28 feet per mile and 230 feet per mile for the South Fork [93].

Hydraulic Description of Estuary

Tides and Currents

According to the U.S. Geological Survey, the average range of the tide is approximately 5 feet [144].

River Discharges

Stream flow records are available from the USGS stream gaging station on the Sixes River at Sixes, Oregon. The station is located at river mile 5.3. The station is discontinued, but records are available for data taken between October 1967 to June 1970. Stream flow averages and extremes appear in Table 2 [148].

Table 2. Stream Gaging Data [148].

Stream	Location (river mile)	Drainage area (sq.mi.)	Complete water years of record	Flowrate (cfs)		
				max.	min.	mean
Sixes River	5.3	116	Oct; 1967 to June, 1970	23,800	18	646

SIXES RIVER

Hydraulic Description of Estuary

Salinity and Classification by Mixing

Salinity profiles as a function of depth and distance from the mouth of the river are presented in Table 3. Data was taken on August 22, 1973 during a high tide of +7.5 feet [87].

Sediments

North of Cape Blanco the shoreline is dominated by marine terraces with low cliffs and narrow, sand beaches. The narrow beaches in the area are composed of coarse sands and gravels. The shoreline between Floras Lake and Cape Blanco displays rocky headlands with steep cliffs.

According to the National Shoreline Study by the U.S. Army Corps of Engineers (Aug., 1971), the beach area at Floras Lake north of the Sixes River Estuary is experiencing non-critical erosion along with the shoreline at Cape Blanco to the south of the estuary. The beaches in the immediate vicinity of the estuary are experiencing no erosion [125].

The generalized sediment yield for streams in the area is 0.1 to 0.5 ac-ft per sq. mile per year [23].

Water Quality Information

Miscellaneous flow and temperature measurements for the basin were made by the Oregon State Game Commission. Temperature ranges from these sources are presented in Table 4 [78].

DEQ water quality stations are listed in Table 7.

Biological Information

Estimates of the number of adult anadromous salmonids spawning in the Sixes River system are as follows: spring chinook--none, fall chinook--3,000, coho--300, steelhead--2,500, sea-run cutthroat--3,000. The Sixes River is considered to be one of the most important fall chinook streams on the Oregon Coast [78,93].

Dace, cottids, red-sided shiners, sticklebacks, lamprey, and suckers are the known rough fish species in the stream systems of the South Coast Basin [78].

The most important factor limiting fish production in the South Coast Basin in summer water supply. The Sixes River system contains extensive porous gravel beds through which summer flows frequently sub-out, resulting in considerable fish loss (Table 5) [78].

Sixes River

Biological Information

Table 3. Salinity Values for Sixes River Estuary. Aug. 22, 1973 [87].

Station	Distance from mouth (mi.)	Salinity %		Depth (ft.)
		top	bottom	
1	0.1	28.5	28.5	2
2	0.2	22.7	26.9	4
3	0.3	18.8	27.2	5
4	0.4	22.1	27.9	6
5	0.5	3.1	27.9	6
6	0.7	2.7	27.2	4
7	0.9	2.8	27.2	3
8	1.0	2.9	27.2	3.5
9	1.3	2.8	19.5	2
10	1.4	1.7	26.0	5
11	1.9	---	----	1

Water temperatures over 70°F commonly accompany low summer flows. Low natural summer runoff coupled with extensive streamside logging in the Sixes basin contribute to warm streamflow conditions during the summer. (See Table 4) [78].

Logging and related road construction are the main causes of siltation. Naturally--occurring landslides and poor land development are other causes. Heavy deposition of silt is more likely to occur on spawning beds and food producing areas when stream flows are low and unable to keep the particles in suspension. The Sixes system is one of five areas in the South Coast Basin considered to be most affected by siltation [78].

Table 4. Temperature Extremes for Sixes Drainage Basin [78].

Point of measurement	Period of record	Observed Temperature Extremes (F°)		type of observation
		max.	min.	
Sixes River river mile 5	4-8-69 to 7-22-69	71	54	spot
Sixes River above Dry Cr.	4-8-69 to 7-22-69	74	52	spot
Sixes River below Middle Fork	4-8-69 to 6-4-69	70	49	spot
Sixes River below North Fork	4-8-69 to 6-4-69	69	45	spot
Sixes River above Hays Cr.	4-8-69 to 5-7-69	49	44	spot
Crystal Cr. mouth	4-8-69 to 7-22-69	67	54	spot
Edson Cr. mouth	4-8-69 to 7-22-69	68	50	spot
Dry Cr. 100 yd. above mouth	4-8-69 to 7-22-69	55	51	spot
Elephant Rock Cr. 100 yd. above mouth	4-8-69 to 5-7-69	58	52	spot
S. Fork Sixes R. 100 yd. above mouth	4-8-69 to 7-22-69	65	47	spot
Otter Cr. 50 yd. above mouth	4-8-69 to 5-7-69	59	51	spot
Mid. Fork Sixes R. below Cold Cr.	4-8-69 to 6-4-69	64	46	spot
Sugar Cr. 200 yd. above mouth	4-8-69 to 5-7-69	52	48	spot
N. Fork Sixes R. river mile 0.7	4-8-69 to 6-4-69	68	45	spot
Hays Cr. 100 yd. above mouth	4-8-69 to	50	44	spot

SIXES RIVER

Biological Information

Table 5. Dry Creek (Sixes River) Fish Salvage Results, 1949-1952 [78].

<u>YEAR</u>	<u>NUMBER OF FISH SALVAGED*</u>
1949	20,125
1950	37,454
1951	47,673
1952	<u>32,330</u>
<u>TOTAL</u>	<u>137,582</u>

* Steelhead, coho, salmon, and fall chinook salmon.

Logjams and natural falls create the only significant barriers to fish passage in the South Coast Basin. The Sixes system is one of five areas in the basin considered to be most adversely affected by logjams [78].

The Sixes River system has 13 streams used by adult anadromous salmonids, 11 of which have minimum flow recommendations established and 1 protected by the State Water Resources Board. It has been recommended that the entire stream of Dry Creek (Sixes R.) above river mile 0.25 should be protected from gravel removal [78].

Table 6 refers to the estimated sport harvest in the Sixes River system.

Many of Oregon's important bottom fish and shellfish, as well as all anadromous salmonids, depend on the estuarine environment during some part of their lives. Due to the geology of the extreme southern Oregon Coast, the estuaries in this region are generally small in size. However, these estuaries, including the Sixes River Estuary, are important for the survival of salmon and steelhead [78].

Figure 1 is a periodicity chart showing when adult spawning anadromous fish are present in the Sixes River System.

Figure 1. Periodicity Chart for Adult Spawning Anadromous Fish in the Sixes River System [78].

Chinook Salmon *****

Coho Salmon -----

Steelhead and Cutthroat trout ::::::::::

Stream	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	April	May
Sixes River	*****	*****	*****	*****	*****			
Dry Creek	*****	*****	*****	*****	*****			
Edson Creek	*****	*****	*****	*****	*****			
Elephant Rock Creek	*****	*****	*****	*****	*****			
Otter Creek	*****	*****	*****	*****	*****			
Sixes River, Mid. Fork	*****	*****	*****	*****	*****			
Sixes River, North Fork	*****	*****	*****	*****	*****			
Sixes River, South Fork	*****	*****	*****	*****	*****			
Sugar Creek								

SIXES RIVER

Biological Information

Table 6. Estimated Annual Harvest, Angler Days, and Gross Expenditures for Angling in the Sixes River System [78].

Fish	Harvest	Angler Days	Gross Expenditures
Salmon *	2,600	10,400	\$192,400
Steelhead	1,200	4,800	88,800
Sea-run Cutthroat	450	<u>250</u>	<u>4,625</u>
TOTAL		15,450	\$285,825

* Includes jack salmon.

Big game create the most hunting opportunities of all wildlife in the basin. In order of abundance, they are: black-tailed deer, Roosevelt elk, black bear, and cougar. Upland game animals include: band-tailed pigeon, ruffed grouse, blue grouse, mourning dove, mountain quail, valley quail, pheasant, and silver-grey squirrel. Waterfowl use of the Sixes area is relatively minor, but can provide some good to excellent shooting at times in certain areas. Species sighted are mallard, pintail, widgeon, coot, ruddy duck, canvasback, green-winged teal, gadwall, readhead, ringnecked duck, scaup, and merganzers.

Furbearers trapped most frequently are beaver, muskrat, river otter, raccoon, and mink. The ring-tailed cat (Bassariscus) and sea otter are the most unique animals in the area and have received full protection by the Game Commission [78].

Physical Alterations

The only physical alteration near the estuary is the Oregon Coast Highway Bridge (U.S. 101) at river mile 5.4 [96].

SIXES RIVER

Estuary Uses

Industrial and Commercial

The only known industrial and commercial uses for the Sixes River are irrigation, mining, and gravel removal. The legal annual depletion is 1,700 ac-ft with the estimated actual annual consumption being 400 ac-ft. The Sixes River has 2 reservoir rights issued for industrial purposes with a total of 464 ac-ft storage capacity and a total surface area of 39 acres. Surface water rights include 3.12 cfs consumptive for domestic, irrigation, and industrial use, while 75 cfs nonconsumptive rights are issued for mining purposes. Chromite, gold, platinum, and coal are mined in the watershed [93].

The only manufacturer in Sixes, Oregon is the Lester T. Smith Lumber Co., a logging contractor which has one employee [71].

Recreation

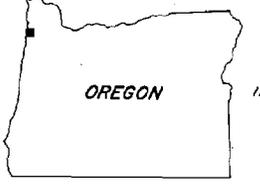
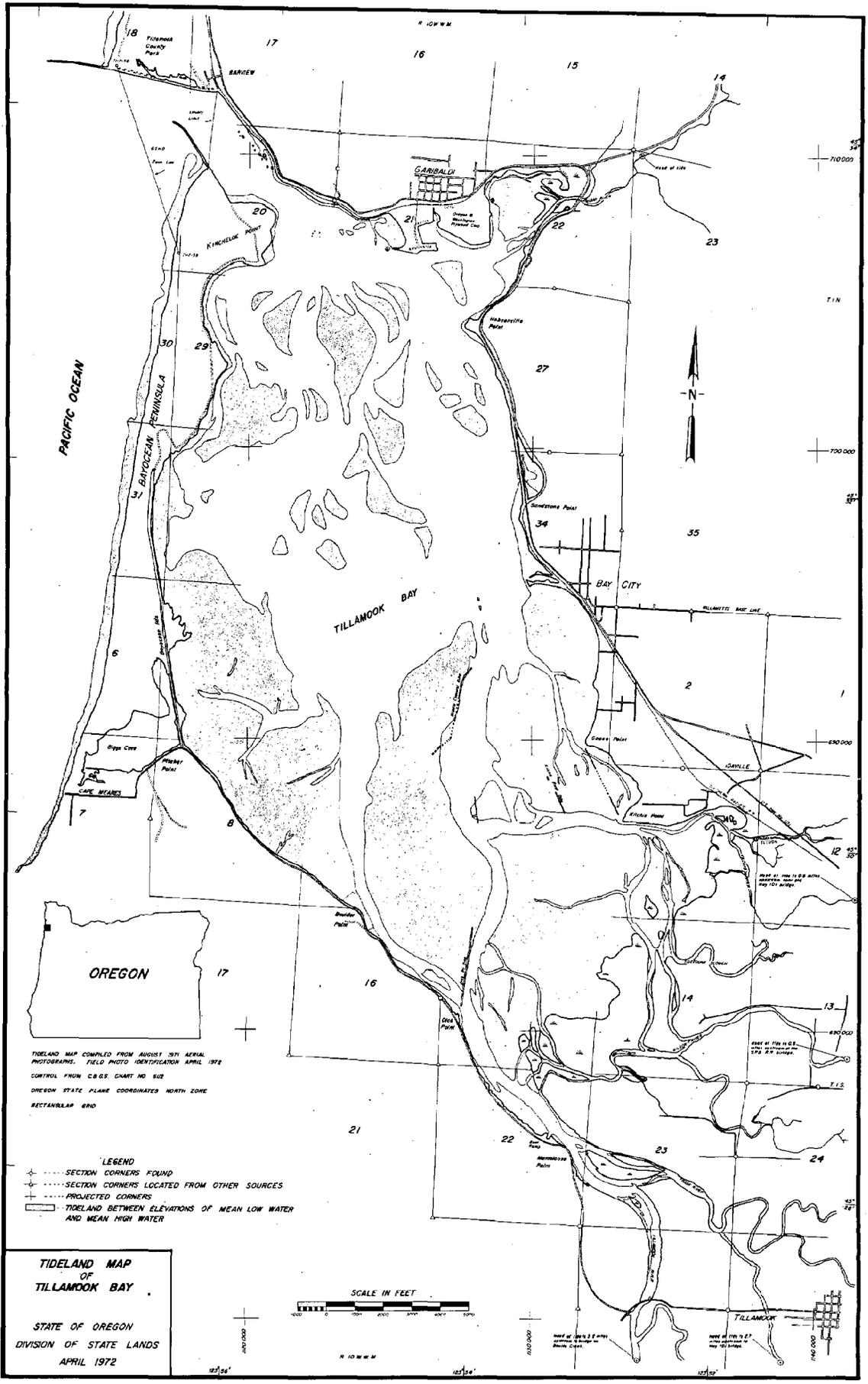
The principal attraction of the basin is the Pacific Ocean, and the 145 miles of shoreline are dotted with state parks, waysides, and tourist facilities. Fishing, boating, and other water-based sports make extensive use of the basin's stream system. The large forest areas covering the slopes of the Coast Range provide excellent hunting.

Parts of the Sixes River flow through the northern portions of the Siskiyou National Forest. Several streams in the basin have outstanding aesthetic values and make a significant contribution simply because they maintain attractive flows, have little stream-side development, and possess watersheds that have not been excessively logged. The entire South Fork of the Sixes River was selected by the Oregon State Game Commission as a stream which should be managed for its aesthetic value [78,93].

Table 7. Surveillance Stations at Sixes River

Type of station	Name and/ or identifying number	Approximate location	Drainage area (sq.mi.)	Period of record	Reference
Climatological	Cape Blanco	T32S, R16W Sec. 2		1952- present	[93]
"	Langlois	T30S, R15W Sec. 35		1891- 1904	"
"	Langlois 2 (Formerly Denmark, Willow Creek)	T13S, R15W Sec. 2		1922- present	"
"	Port Orford (Formerly the heads)	T33S, R15W Sec. 8		1852- 1856, 1905- present	"
Stream Gaging	14327150 At Sixes, Oregon	T32S, R15W Sec. 9	116	Oct., 1967- June, 1970	[148]
Water Quality	Sixes R. 1 mi. above HWY 101 Bridge river mile 7.2	T32S, R15W Sec. 10			[148]

TILLAMOOK BAY



TIDELAND MAP COMPILED FROM AUGUST 1971 AERIAL PHOTOGRAPHING, FIELD PHOTO IDENTIFICATION APRIL 1972
 CONTROL FROM C.B.S. CHART NO. 512
 OREGON STATE PLANE COORDINATES NORTH ZONE
 RECTANGULAR GRID

- LEGEND**
- ⊕ SECTION CORNERS FOUND
 - ⊕ SECTION CORNERS LOCATED FROM OTHER SOURCES
 - ⊕ PROJECTED CORNERS
 - ▭ TIDELAND BETWEEN ELEVATIONS OF MEAN LOW WATER AND MEAN HIGH WATER

TIDELAND MAP OF TILLAMOOK BAY

STATE OF OREGON
 DIVISION OF STATE LANDS
 APRIL 1972



TILLAMOOK BAY

General Description of Estuary and Drainage Basin

Estuary

Tillamook Bay, the second largest of the estuaries included in this report, lies about 50 miles south of the mouth of the Columbia River. Three incorporated towns in the area are Garibaldi, Bay City, and Tillamook. These and other population centers are listed with their 1970 census figures and approximate locations in Table 1. Not included in Table 1 are the U.S. Coast Guard Station to the north of the estuary mouth and the U.S. Naval Air Station about 1 mile southeast of mile 5 of the Trask River.

Table 1. Population centers at Tillamook Bay¹ [95,111,89-map].

name	general location	approximate distance from estuary mouth (miles)	1970 population
Barview	Tillamook Bay; north side at the mouth	0	55
Garibaldi ²	Tillamook Bay; north side	1	1,083
Miami	Tillamook Bay (Miami Cove); north side	3	not listed
Hobsonville	Tillamook Bay; north side (east of Miami Cove)	2	not listed
Bay City ²	Tillamook Bay; east side	4	898
Idaville	Tillamook Bay; 1 mile to the east		250
Juno	Tillamook Bay; 1 mile to the east		no pop
Cape Meares	Tillamook Bay (Briggs Cove); west side	3.5	50
Tillamook ²	Trask River; north side; mile 2	9.5	3,968
South Prairie	Tillamook River; north side; mile 6.9	14.5	not listed
Pleasant Valley	Tillamook River; east side; mile 11.3	18.8	rural

¹Tidal effects extend approximately to mile 1.3 of the Kilchis River, mile 0.4 of the Miami River, mile 7.0 of the Tillamook River, mile 4.2 of the Trask River, and mile 2.4 of the Wilson River.

²Incorporated

Tillamook Bay is about 6 miles long and 2 miles wide. An average of the surface areas reported by Johnson at HW [55], Marriage [59], and the Division of State Lands at MHT [70] is approximately 8,660 acres

Tillamook Bay

of which 50% to 60% is tidelands (Table 2). Other dimensions as given by Johnson are shown in Table 3.

Table 2. Reported surface areas of Tillamook Bay [55,59,70].

reference	surface area (acres)	measured at	tidelands		submerged lands	
			acres	percent	acres	percent
[55]	8,861	HW				
	6,589	MSL				
	4,339	LW				
[59]	8,839	¹	5,147	58		
[70]	8,289	MHT	4,163	50	4,127	50
	4,126	MLT				

¹ Specified by Marriage as the area affected by tidal action.

Table 3. Dimensions of Tillamook Bay [55].

distance from throat to
farthest estuary shore--6.9 miles

inlet dimensions at throat (at MSL):

width--1,485 feet

average depth--16 feet

cross-sectional area--15,700 feet

average lagoon depth below MSL--5 feet

The five major tributaries of the bay are the Miami River from the north, the Kilchis and Wilson Rivers from the east, and the Trask and Tillamook Rivers from the south. About 19 smaller tributaries also discharge directly into the bay. Table 4 presents the lengths, drainage areas, annual fresh water yields, and the approximate distance from the estuary mouth to the zero river mile of each of these five larger rivers [89,95-map].

A good deal of information on Tillamook Bay has been compiled by Thos. J. Murry and Associates in "Development Program for Tillamook Bay, Oregon." [120]. The study is referred to frequently here.

The U.S. Army Corps of Engineers constructed a physical model of Tillamook Bay in 1970 to consider problems developing in connection with the construction of the south jetty [83,115]. This is mentioned in more detail under "Physical Alterations."

Port commissions for the area have their headquarters in Tillamook and Garibaldi and can be contacted at the following addresses and phone numbers:

Tillamook Bay

Port of Tillamook Bay
 P.O. Box 113
 Tillamook, Oregon 97141
 842-2413

Port of Bay City
 P.O. Box 228
 Garibaldi, Oregon 97118
 322-3292
 322-3279

Table 4. Lengths, drainage areas, and fresh water yields of Tillamook Bay tributaries [89,95].

stream	distance from estuary mouth to zero river mile ¹ (miles)	length (miles)	drainage area (sq mi)	average annual fresh water yield ² (ac-ft)
Miami River	3	13.6	36	
Kilchis River	6	13.8 ³	67	
Wilson River	6.5	33.2 ⁴	193	1,071,600
Trask River	7.5	18.2 ⁵	176	839,800
Tillamook River	7.5	18.4	61	292,500

¹Estimated from [89-map]

²Estimated for 1933 to 1958 [89]

³To the confluence of North Fork and South Fork

⁴To the confluence of Devils Lake Fork and South Fork

⁵To the confluence of North Fork and South Fork

Drainage Basin

Tillamook Bay drains an area of 540 sq mi [89-map]. The average annual fresh water yield of three of its major tributaries (Wilson, Trask, and Tillamook Rivers) totals 2,203,000 ac-ft. These three rivers drain a combined area of 430 sq mi or about 80% of the drainage basin [85].

Principal trees in the watershed are douglas fir, hemlock, and spruce [121]. Timberlands, owned primarily by large corporations, lie to the north and south of the estuary. Located to the east is an area of 300,000 acres hit by forest fires in 1933, 1939, and 1945 and known as the "Tillamook Burn" [120,121].

Precipitation ranges from an annual average of 90 inches along the coast to 150 inches in the north central portion of the watershed [89]. There are several climatological stations in the Tillamook Bay area, and precipitation records are available through the OSWRB from at least 2 of them as described in Table 13. Major floods occurred in the Tillamook Bay area in January 1972 and in 1964.

The average air temperature at the city of Tillamook is 51°F with recorded extremes of 0°F and 101°F [89]. Wind roses there show January winds with speeds of 4 to 31 mph coming from the south or from the east about 30% of the time. In July, winds are primarily from the northwest (about 35% of the time) and also have speeds generally from 4 to 31 mph [138].

Tillamook Bay

Stream profiles for the Tillamook Estuary river systems appear on page

Hydraulic Description of Estuary

Tides and Currents

Tillamook Bay is described as being well protected from waves at the throat [55]. Tidal effects extend to the following points on its five major tributaries: Kilchis River--mile 1.3, Miami River--mile 0.4, Tillamook River--mile 7.0, Trask River--mile 4.2, and Wilson River--mile 2.4 [69].

The mean tide range is 5.7 feet with a diurnal range of 7.5 feet [55] and an extreme tidal range of 13.5 feet [86]. Tidal prism on mean range is 1.635×10^9 cu ft with a diurnal range of 2.15×10^8 cu ft [55].

River Discharges

Stream gaging stations are located at mile 11.4 of the Wilson River and at mile 10.4 of the Trask River (Table 13) [140]. Flow rate extremes and means recorded at these two stations are given in Table 5.

Table 5. Flow rates of Tillamook Bay tributaries [140].

stream	point of measurement (river mile)	drainage area (sq mi)	complete water years of record	flow rate (cfs)		
				maximum	minimum	mean
Wilson River	11.4	161	40	32,100 (12/22/64)	34 (9/67)	1,205
Trask River	10.4	145	33	23,000 (12/22/64)	42 (10/52)	959

Salinity and Classification by Mixing

Salinity measurements of the Tillamook River by Burt and McAllister were made once (each month) in October 1957 and January, April, and July 1958 [12]. Maximum intrusion for these four times was on July 23, 1958 when salinity was measured at concentrations of 8.2 ppt (21.9°C) on the surface and 8.6 ppt (21.8°C) on the bottom (12 feet) at a point 13.2 miles from the ocean. Measurements beyond this were not reported.

On the basis of salinity change from top to bottom, Burt and McAllister have classified Tillamook Bay as a two-layered system during January and as a well-mixed system during April and October [13].

Tillamook Bay

Sediments

Net littoral drift in this area is to the north [57].

Since the completion of the north jetty in 1933, material has been deposited behind it, and erosion of the shore along the Bayocean Peninsula (to the south of the estuary mouth) has been a problem. In 1952 this erosion reached a point where the southern portion of the peninsula was breached. Four years later a dike (as described under "Physical Alterations") was constructed to help close this gap. A south jetty, also described later, is now being constructed, and although erosion is continuing, it is expected that accretion along the peninsula will occur as the jetty is completed [57,120,126,129].

Sediments are being deposited in the estuary at an estimated rate of 135,000 tons annually [57], and the estuary is now believed to be about 40% of its original size [53]. Erosion of the drainage basin following major fires as described earlier has contributed to this filling [53]. To help reduce the quantity of sediments being deposited at the river mouths, it has been suggested that a system of multiple-purpose channels and sediment-settling basins be developed [120].

Analyses of dredge samples taken from the bay at a point 1 mile from the mouth in August 1962 show a void ratio of 0.604 and a mean grain size that of fine sand [124].

Water Quality Information

As of May 1972 data from 12 water surveillance stations in Tillamook Bay were available through the DEQ (Table 13) [67,68]. Records have been kept at most of these stations since 1960 but do not generally include DO, BOD, conductivity, turbidity and PBI data until 1966. The DEQ also conducted two comprehensive studies in 1972 and 1973, in addition to routine surveillance, on the levels of coliform bacteria present in the oyster growing regions of Tillamook Bay.

Water temperature records are available for the Wilson River near mile 11.4 [138] and for the Trask River at mile 10.4 [141] (Table 13). Temperatures at the Wilson River station have been reported as adjusted monthly averages and have ranged from 2°C for February to 24°C for July. Records from the Trask River station show daily temperature extremes. Between 1962 and 1968, these ranged from 1°C (January 1963) to 22°C (May of 1967 and 1968). The greatest range of temperature during a single day in 1968 was 4°C (18°C to 22°C).

Sewage treatment plants in the Tillamook Bay area are presently in operation for the cities of Tillamook and Garibaldi, Tillamook Creamery Association, and the Tillamook Airport Industrial Park. Also, a treatment plant to serve Bay City is now under construction. Information about these facilities has been summarized in Table 6 [108,120].

Tillamook Bay

Table 6. Sewage treatment plants at Tillamook Bay [108,120].

	city of Tillamook	city of Garibaldi	Tillamook Creamery Association	Tillamook Airport Industrial Park	city of Bay City
completion date	(updated in 1970)	1958 ¹			now (11/72) under construction
location		boat basin area; southwest of city shops	about 1 mile north of Tillamook city		
area served			handles industrial waste and sewage at the cheese manufacturing plant		
number now serving	4,000	1,250		614	960
number capable of serving	7,000			1,060	2,120
description	secondary treatment		secondary treatment; activated sludge and aerated basin	secondary treatment	14-acre lagoon treatment facility
average flow (mgd)					
rainy	0.4 to 0.6				
dry	0.125 (10/20/72)				

¹Being replaced by an activated sludge sand filtration plant with secondary treatment; to be capable of serving 2,500.

Table 7. Estimated numbers of adult anadromous salmonids spawning in the major tributaries of Tillamook Bay [77].

stream	chinook		coho	chum	steelhead		sea-run cutthroat
	spring	fall			winter	summer	
Miami River	90	540	270	2,850	675	50	2,500
Kilchis River	540	2,970	1,890	4,050	4,000	100	3,000
Wilson River	1,800	9,900	6,300	1,500	33,600	2,000	5,000
Trask River	3,150	17,325	23,275	1,000	11,000	200	5,000
Tillamook River	540	2,970	1,890	500	300	50	2,500
totals	6,120	33,705	33,625	9,900	49,575	2,400	18,000

Tillamook Bay

Biological Information

Estimated numbers of chinook, coho, chum, steelhead, and sea-run cutthroat spawning in the five major tributaries of Tillamook Bay are shown in Table 7 [77]. In comparison with other estuarine rivers and river systems (Table B), these numbers are quite high.

Salmon and perch provide excellent sport fishing there, and clam digging and crabbing are important both recreationally and commercially, as discussed later [38,86,126]. Clams found in the estuary include gaper and cockle in the northern section, softshells near the southern portion, and some butter, littleneck, and razor clams near the mouth [38,53,155]. The bay is also the main oyster producer in the state, but the oysters must be seeded in order to grow [89,120,155].

The estuary is used by widgeon, pintail, canvas back, scaup, and other ducks during fall and winter, and it is the main black brant wintering area of Oregon [89,155].

A much more complete listing of fish, waterfowl, shore birds, and wildlife found in the area, provided by the Bureau of Sports Fisheries and Wildlife, the OSGC, and the FCO, is presented in the T.J. Murray report [120], where it is also stated that, according to OSGC and FCO representatives, there are no endangered species (as defined by Congress in the Endangered Species Act of 1966 and in the Endangered Species Conservation Act of 1969) in the Tillamook Bay area.

Physical Alterations

Proposed alterations to the estuary by the U.S. Army Corps of Engineers include two jetties, a channel through the ocean bar to Miami Cove and then on to Hobsonville, turning basins at Miami Cove and Hobsonville, a small boat basin at Garibaldi, and a dike to close the breach in the Bayocean Peninsula [55,120,126,129]. The north jetty, channel system to Miami Cove, small-boat basin, and dike have all been completed. The south jetty has been partially constructed as has the turning basin at Miami Cove (most of which is described as being inactive) [126]. The channel from Miami Cove to Hobsonville and the turning basin, also described as inactive [126], have apparently not yet been constructed. Dimensions and construction dates are given in Table 8.

U.S. Army Corps of Engineers dredging records from 1959 through 1969 (excluding 1968) show that (1) the entrance bar and inner channel were dredged annually from 1962 through 1966 with an average of 57,232 cu yds being removed; (2) the small boat basin and approach channel were dredged in 1959 with a total of 11,724 cu yds removed; and (3) there was no dredging in 1960, 1961, 1967, and 1969 [55]. The Corps of Engineers was to issue an invitation for bids for dredging about 200,00 cu yds from the lower 5,000 feet of the Trask River and the lower 8,000 feet of the Wilson River with the bid opening on July 31, 1972 and the dredging to be completed 60 days after the bid [120].

Tillamook Bay

Table 8. U.S. Army Corps of Engineers Modifications to Tillamook Bay
[55,120,126,128,129].

Proposed Modification	Location	Dimensions			Date and Status	(1)
		depth (feet)	width (feet)	length		
North Jetty	Entrance			5,700 feet	1933-completed 1965-rehabilitated	
South Jetty	Entrance			8,000 feet ⁽²⁾	1965-authorized 1969-construction started 1971-completed to 4,200 feet 1974-scheduled for completion	
Channel	Entrance	18 ⁽³⁾	Not Specified		1927-completed	
Channel	Entrance to Miami Cove	18 ⁽³⁾	200	3 miles	1927-completed	
Turning Basin	Miami Cove				1968 (publication date)- "most of it inactive"	
Small-boat Basin	Garibaldi	12			1958-completed	
Channel	Miami Cove To Hobsonville	16 ⁽³⁾	200	4,000 feet	1968 (publication date)- "Inactive"	
Turning Basin	Hobsonville				1968 (publication date)- "Inactive"	
Dike	Bayocean Peninsula-Between Pitcher Point and Bayocean			1.4 miles	1956-completed	

¹Lack of completion date does not necessarily signify that the modification has not been constructed.

²Modified to 6,500 feet after scouring at the completed end during the winter of 1971-72.

³The possibility of deepening the entrance channel to 40 feet and the inner channel to 30 feet is being considered.

Tillamook Bay

Navigable lengths of the Tillamook Bay tributaries are as follows: Kilchis River--2 miles, Miami River--0.5 miles, Tillamook River--16.0 miles, Trask River--2.0 miles, and Wilson River--3.0 miles.

Between 1960 and 1969, traffic using the channel system averaged 99,000 tons annually, and until 1967, rafted logs accounted for from 20,000 to 70,000 tons each year. In 1969 traffic reached 250,000 tons and consisted entirely of inbound crushed rock for use in jetty construction [120,129].

Future modifications to the bay as well as plans for continuing (or altering) present projects are being considered. A U.S. Army Corps of Engineers study of the navigation features of Tillamook Bay has been authorized and is ready (July 1972--publication date) for implementation pending decision by the local port authorities as to improvements to be proposed [120]. Examples of projects which are being discussed and questioned include completion of the south jetty, deepening of channels, and a method of reducing sedimentation in the bay.

Concerning the south jetty, there has been some problem, due to the scouring off its completed end, as to the way work on it should proceed. At one time, the possibility of leaving temporary gaps in the jetty to minimize scour and then filling the gaps as a final stage was to be tested through the U.S. Army Corps of Engineers physical model of Tillamook Bay [155]. As of July 1972, however, plans were reportedly to complete the jetty to a final length of 6,500 feet by 1974, and no mention of leaving gaps was made [120].

Also under consideration is a proposal to deepen the entrance channel to 40 feet and the inner channel to 30 feet [55,120,129]. This is discussed in the T.J. Murray report [120]. To help alleviate the problem of sedimentation at the mouths of the tributaries to the bay, it has also been suggested in that report that a system of multiple purpose channels and sediment settling basins be developed.

The Division of State Lands inventory of filled lands in Tillamook Bay has been completed and is now available [69]. Some of the information from it is given in Table C.

The FCO operates the Trask River Salmon Hatchery located near the junction of Gold Creek and the Trask River at a point 5 miles east of the city of Tillamook and near mile 7 of the Trask River [54]. Total releases, all coho and spring chinook, from the hatchery to Oregon waters (the Trask River, coastal tributaries, and Gold Creek) between July 1, 1968 and June 3, 1969 numbered 1,206,463 [33]. A fishway, located on Fall Creek and called the Fall Creek Fishway, was completed in 1964 under the FCO "Coastal 60-40 Program" [119]. The creek is a tributary of the Wilson River at mile 17.2.

Tillamook Bay

Estuary Uses

Industrial and Commercial

Major industries around the bay are those connected with timber, agricultural products, fish and seafoods, and tourism [20,34,89,118,121,155].

A listing of the manufacturers in the area is given in Table 9 [71].

Table 9. Major Manufacturers at Tillamook Bay [71].

Location	Name	Type of Business	Number Employed
Garibaldi	Oregon-Washington Plywood Co.	sanded plywood	280
	Edmunds Fish and Crab Co.	seafoods (canning)	21
	Smith Pacific Shrimp Co.	shrimp (packaging)	24
	7 manufacturers employing less than 20	dealing in lumber and wood products and food (fish, seafoods, and meat).	
Bay City	McRae and Sons Inc.	furniture; brush parts	20
	2 manufacturers employing less than 10	dealing in packaged fish and seafoods	
Tillamook	Tillamook Veneer Co.	plywood	275
	Publishers Paper Co.	lumber	200
	Diamond Lumber Co.	lumber	175
	Tillamook County Creamery Association	cheese, butter, milk and whey, feeds	150
	Crown Zellerbach Corp.	logging	140
	21 other manufacturers employing 20 or under	dealing in a variety of products, the main ones being lumber and wood products	

Tillamook County is a center of lumber production with its greatest income being derived from forest products [121]. About half of its basic industry jobs are provided by independently owned lumber and plywood mills in the Tillamook Bay area [120]. Long-term stabilization of the wood processing industry will reportedly depend on the operations of the major timberland owners in Tillamook County and on developing both more modern facilities and the capability of utilizing smaller trees [120].

Tillamook Bay

The four major wood processing plants in the vicinity of the bay, listed in Table 9, are the Oregon-Washington Plywood Co. (on tidewater at Garibaldi), Publishers Paper Co., Tillamook Division (in the city of Tillamook), Diamond Lumber Co. (southeast of the city of Tillamook in the Tillamook Airport Industrial Park), and the Tillamook Veneer Co. (also in the Tillamook Airport Industrial Park) [71,120]. Crown Zellerbach Corp. and Publishers Paper Co. are the major private timberland owners in the county [120], and the Forest Service and BLM manage extensive acres with the State Forestry Department managing the Tillamook Burn (described earlier) [121].

Commercial fishing activities are centered at the small boat basin at Garibaldi where the commercial fleet is moored with 119 commercial fishing boats having annual moorage and over 200 more delivering to the processing plants, which are also concentrated in that area as indicated in Table 9 [71,120]. With the exception of oysters, commercial harvests directly from the estuary (Table 10) are quite limited; however, landings from the entire area (Table 11) with a total value to fishermen of over \$900,000 during 1971 provide some income [34,77,118]. A comparison with landings received at other estuaries can be made from Tables D and E.

Table 10. Commercial Harvest of Clams, Crabs, and Oysters From Tillamook Bay [77,118].

Species	1969 pounds landed	1970		1971	
		pounds landed	fishermen value	pounds landed	fishermen value
Clams	4,770	7,819	\$ 1,000	5,948	\$1,000
Crabs		47,160		92,465	
Oysters		241,929	\$236,000		

Table 11. Commercial Harvest Food Fish Received at Tillamook, 1971(1) [34].

Species	Harvest (pounds round weight)	Fishermen value
Crabs	987,058	\$227,000
Shrimp	896,080	109,000
Coho	777,671	243,000
Oysters	239,136	270,000
Albacore Tuna	118,217	37,000
Groundfish	72,689	6,000
Chinook	18,449	10,000
Clams	5,948	1,000
Pinks	5	
Miscellaneous(2)	688	1,000
Totals	3,115,941	\$904,000

1Includes 1971 data presented in Table 10.

2Sand shrimp, crawfish, eel. 217

Tillamook Bay

Oysters, which must be seeded for growth to occur, are cultivated in 2,650 acres of Tillamook Bay leased from the FCO. About 85% of the oysters grown in Oregon are seeded and produced there by Hayes Oyster Co., Tillamook Oyster Co., and Olsen Oyster Co. [69,89,120,155].

There are 565 dairy farms in Tillamook County, and the Tillamook County Creamery Association, listed in Table 9, is well known for its dairy products, particularly its cheddar cheese. Located just north of Tillamook on Highway 101, it is reportedly the west's largest cheese plant [89,106,121].

Recreational

Fishing, clamming, and crabbing are some of the major aspects of tourism in the area [121]. Species most commonly caught (excluding salmon and trout), as determined in the FCO study between March and October 1971, include pile perch, kelp greenling, and shiner perch by shore angling; dungeness crab by boat angling; cockle and littleneck clams and relatively few butter clams by clamming; and some black rockfish by scuba diving [38]. Estimates of the recreational harvest of clams and non-game fish are shown in Table 12.

Table 12. Estimated Annual Harvest Data for Sport Fishing at Tillamook Bay [77].

Species	annual harvest (total number)	effort (angler- or digger-days)	Year
Non-game bay fish	24,500	6,000	1970
Clams	540,000	18,000	average of data before 1970

Mid April to mid May is the best time for spring chinook fishing. July and August are good for offshore salmon trolling and September through December provides good coho fishing. Mid September to mid October marks the peak fall chinook fishing. The Wilson and Trask Rivers are the most heavily fished areas, although the Tillamook, Miami, and Kilchis Rivers are also popular [58].

Boat landings on the estuary include the Garibaldi ramp at Garibaldi, the Tillamook Bay County boat launch at the south end of the bay, the Siskeyville Boat Slide on the Wilson River near mile 12, and the Tillamook Marine Park on Hoquarten Slough near Tillamook [91,121]. Various aspects of recreational boating, including (1) an Oregon State Marine Board Survey of Oregon boating facilities (1971), (2) suggestions for further development for boat use; and (3) the 1971 number of small boat round-trip crossings of Tillamook Bay, have been presented in the T.J. Murray reference [120].

Tillamook Bay

The Wilson River Highway Forest Wayside on the Wilson River near mile 20 and the Trask Guard Station (State Forestry) on the Trask River at approximate river mile 18.5 are State Parks in the area. County Parks include Barview Wayside on the north side of the estuary at the mouth, Wilson River Wayside on the Wilson River at various points between miles 10 and 18, Kilchis on the Kilchis River at approximate river mile 7, and Peninsula Park on the Trask River near mile 13.5 [91,121].

Table 13. Surveillance stations at Tillamook Bay.

type of station	name and/or identifying number	approximate location	drainage area (sq mi)	period of record	references
climatological	Bay City	Tillamook Bay; north side; elevation--14 feet		1896-1912	[89,90]
	Tillamook	Trask River; mile 2.5; elevation--33 feet		1886*(1960)	[89,90]
	Tillamook Naval Air Station	Trask River; mile 5.5; elevation--45 feet		1945-1948	[89,90]
	Tillamook 12 E; Tillamook 11 E; Trask; USGS #8504	Trask River; mile 18.5; elevation--320 feet		1909-1912 1940-(1960)	[89,90,92,143]
	Tillamook 1 W; USGS #8494	elevation--10 feet		1889*	[92,143] ¹
stream gaging	Trask River near Tillamook; USGS #3025	Trask River; mile 10.4	145	7/31*(1970)	[89,90,98,140]
	Wilson River near Tillamook; USGS #3015	Wilson River; mile 11.4	161	10/14*(1970)	[89,90,98,140] ²
	North Fork Wilson River near Tillamook; USGS #3020	Wilson River; mile 8.5	19.9	1913-1917	[89,90]
DEQ water surveillance	#1	temp. channel marker 45 yards N, 15 yards E BW "A"		2/60-(4/72) (92 measurements)	[67,68] ³
	#2	temp. channel marker 50 yards N, 15 yds E BW "B"		"	"
	#3	pile--near covered jetty 70 yards S, 10 yards E		2/60-(4/72) (91 measurements)	"
	#4	Dick Pt. Dike near North End 145 yards S, 100 yards E		"	"
	#5	Memaloose Pt. 100 yards N, 0 yards E/W		2/60-(4/72) (92 measurements)	"
	#6	Pitcher Pt. 1/2 mile E, 1/4 mile N		2/60-5/72 (100 measurements)	"

Tillamook Bay

Table 13. Surveillance stations at Tillamook Bay, cont.

type of station	name and/or identifying number	approximate location	drainage area (sq mi)	period of record	references
DEQ water surveillance	#7	opposite Sandstone Pt. 225 yards S, 1.59 miles W		2/60-(5/72) (102 measurements)	[67,68] ³
	#8	flashing green light #17, 0.91 mile S 500 yards W		2/60-(5/72) (127 measurements)	"
	#9	flashing light #19, 30 yards S, 100 yards W		2/60-(4/72) (98 measurements)	"
	#10	Hobsonville Point, 700 yards S, 340 yards E		"	"
	#11	Sandstone Point, 100 yards N, 0.55 mile W		6/62-(5/72) (34 measurements)	"
	#12	Dick Point Dike South End, 30 yards S, 50 yards E		2/72-(4/72) (11 measurements)	"
water quality	Wilson River (mile 6.5)				[89,90]
water temperature	Trask River near Tillamook	Trask River; mile 10.4	145	4/62-(9/68)	[141]
	Wilson River near Tillamook	Wilson River; mile 11.4	161	1/47-(9/62)	[138]
	Wilson River (mile 6.8)			8/60	[89,90]

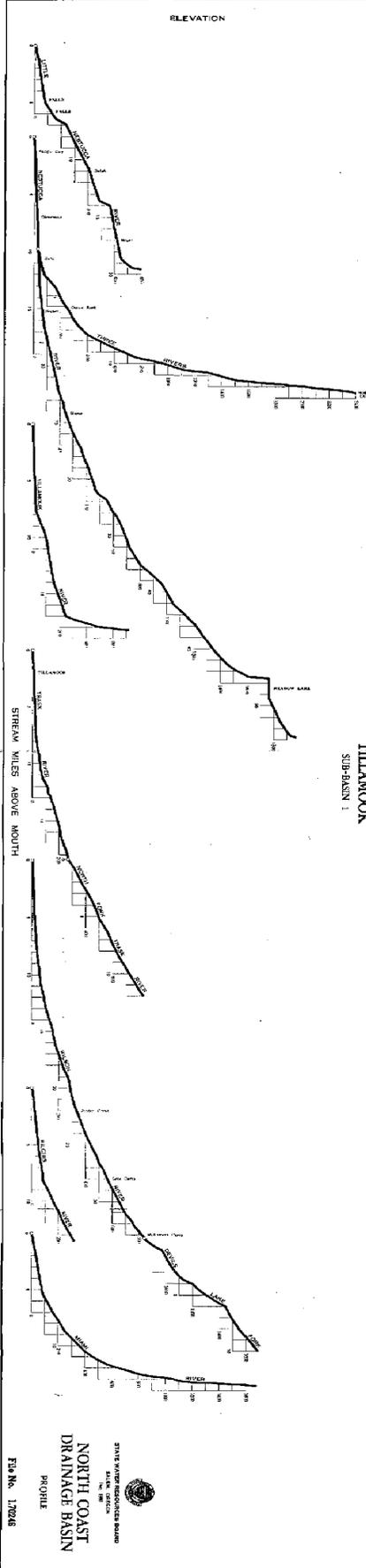
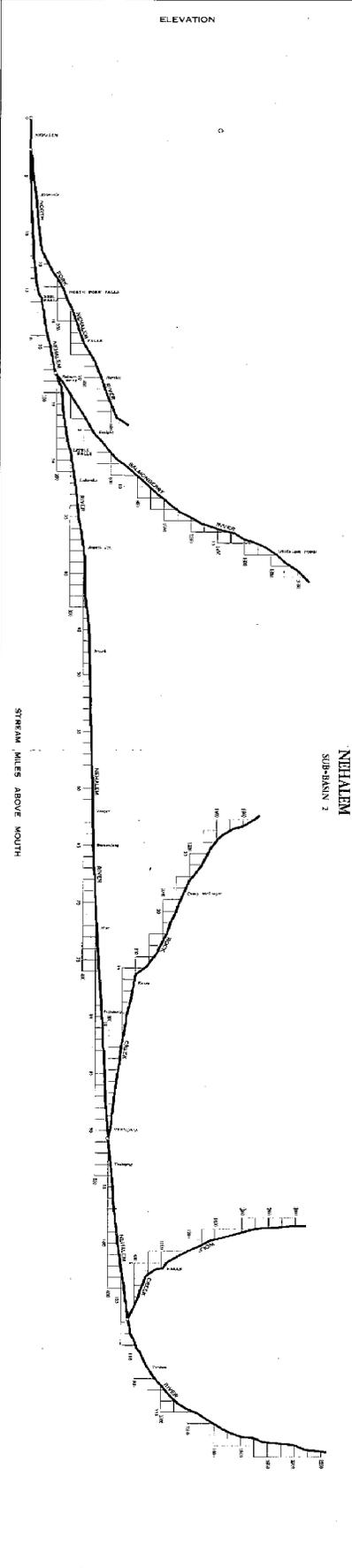
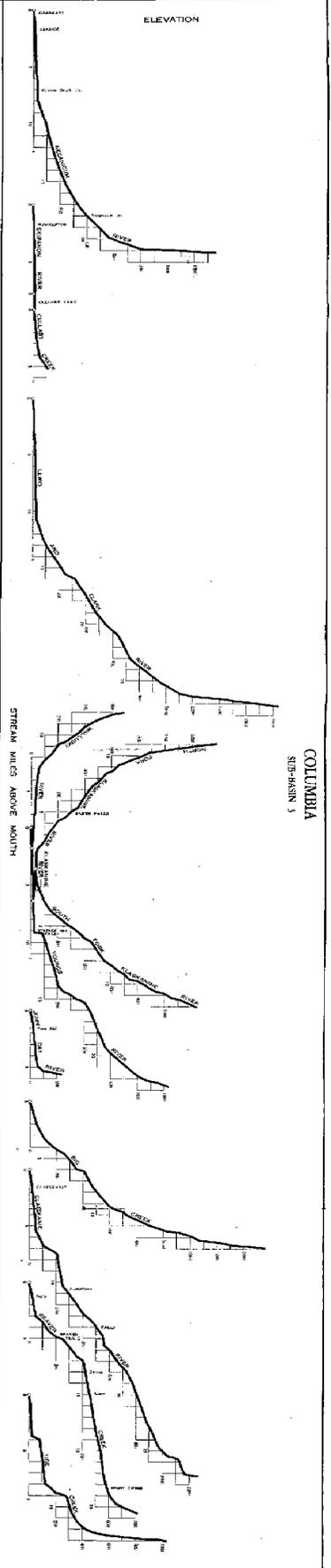
¹Precipitation data available in punch card or printout form through the OSWRB.

²Monthly and water-year runoff records have been compiled and are available in punch card or printout form through the OSWRB.

³Data available in punch card or printout form through the DEQ; records are not complete before 1966.

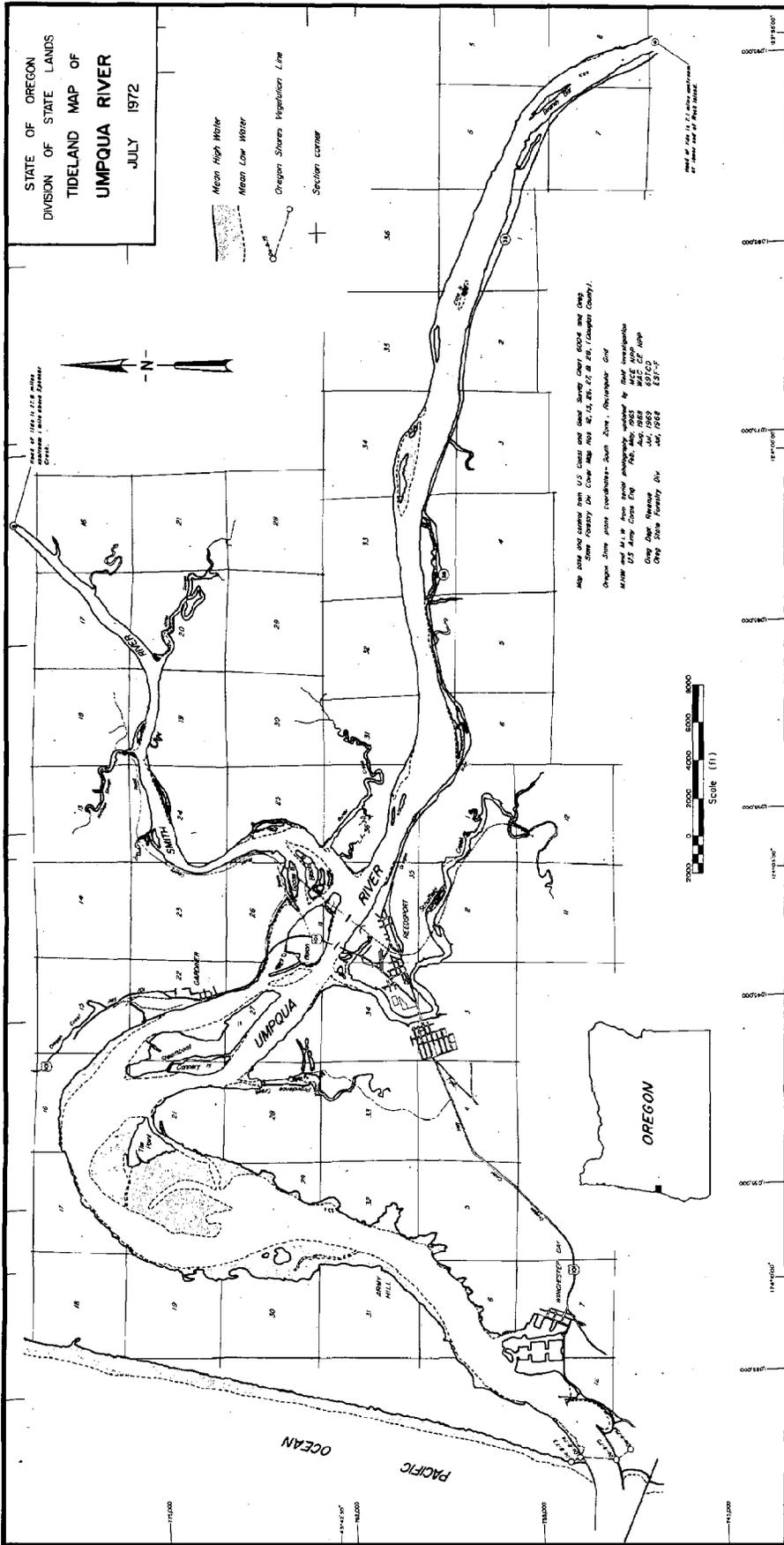
() This is the most recent record date found and is not necessarily the last.

* Period of record is not continuous.



STATE WATER RESOURCES BOARD
NORTH COAST
DRAINAGE BASIN
PROFILE
FIG. NO. 1726G

UMPQUA BAY



UMPQUA BAY

General Description of Estuary and Drainage Basin

Estuary

Located about 180 miles south of the Columbia River mouth, Umpqua Bay ranks third in size of the estuaries included here (Table A). Its largest and only incorporated town is Reedsport. Table 1 lists the locations and 1970 census figures of this and other population centers in the area.

Table 1. Population centers at Umpqua Bay¹ [97,111].

name	general location	river mile location	approximate distance from estuary mouth (miles)	1970 population
Winchester Bay	Umpqua River; south side	1.7	1.7	500
Gardiner	Umpqua River; north side	9.0	9.0	500
Reedsport ²	Umpqua River; south side	10.7 to 12.6	10.7 to 12.6	4,039
Murphys Camp	Umpqua River	26.3	26.3	no winter population
Scottsburg	Umpqua River; north side	27.5	27.5	200
Greenacres	Umpqua River	30.1	30.1	rural
East Gardiner	Smith River	1.3	12.8	30
Frantz	Smith River	2.7	14.2	no pop

¹Tidal effects extend approximately to mile 28 of the Umpqua River.

²Incorporated

Approximate surface area of the estuary is 6,430 acres of which between 20% and 30% is tidelands, as shown in Table 2. These tidelands are found mainly between the mouth and mile 14 (about 1 mile above Reedsport). Other estuary dimensions are given in Tables 3 and 4.

Table 2. Reported surface areas of Umpqua Bay [55,59,71].

reference	surface area (acres)	measured at	tidelands		submerged lands	
			acres	percent	acres	percent
[55]	6,749	HW				
	5,303	MSL				
	3,845	LW				
[59]	5,712	¹	1,548	27		
[71]	6,830	MHT	1,531	22	5,298	78
	5,298	MLT				

¹Specified by Marriage as the area affected by tidal action.

Umpqua Bay

Table 3. Dimensions of Umpqua Bay [55].

distance from throat to
farthest estuary shore--13.5 miles

inlet dimensions at throat (at MSL):
width--1,980 feet
average depth--20 feet
cross-sectional area--33,000 sq ft

average lagoon depth below MSL--15 feet

Table 4. Cross-sectional areas of Umpqua Bay, 1962 [40].

Point of measurement (river mile)	Cross-sectional area (sq ft) ¹
0	22,000
3	30,500
7	14,925
8	28,800
11	5,840

¹ Taken perpendicular to the main channel
for water level at 0 feet above MLLW.

Umpqua Bay, in effect, consists of the lower reaches of the Umpqua River with the estuary mouth and zero river mile being the same point. The major tributary to mile 28 (head of tidewater) is the Smith River at mile 11.5. Mill Creek, at mile 24.2, is the next largest tributary within tidal effects, and there are numerous smaller creeks. Lengths and drainage areas of these three larger streams (the Umpqua and Smith Rivers and Mill Creek) are presented in Table 5.

Table 5. Lengths and drainage areas of Umpqua Bay tributaries [97,99].

stream	length (miles)	drainage area (sq mi)
Umpqua River	111.7 ¹	4,560
Smith River	89.6	347
Mill Creek	22	135

¹ To the confluence of the North Umpqua River and the South Umpqua River

Umpqua Bay

At least two physical models have been made of Umpqua Bay--one through Washington State University [40] and the other by the U.S. Army Corps of Engineers [32]. The Washington State University model, completed some time before August 1962 (publication date), was used

(1) to determine whether a highly distorted small scale model could be made to operate satisfactorily; and (2) to determine the pollution potential of the Umpqua Estuary under certain outfall conditions [40].

The Corps of Engineers model was used in a testing program in 1967 and 1968 at the Hydraulics division of the U.S. Army Engineer Waterways Experiment Station, Vicksburg, Mississippi. The purpose of the program was to

determine the optimum plan for the reduction of shoaling and elimination of cross-currents in the navigation channel at the entrance [32].

These studies have been described in detail in the references cited.

The port commission and industrial development corporation for the area are located in Reedsport and Roseburg with addresses and phone numbers as follows:

Port of Umpqua
Reedsport, Oregon 97467
271-3636

Umpqua Development Corp.
410 S.E. Spruce St.
P.O. Box 1026
Roseburg, Oregon 97470
672-2648

Drainage Basin

The Umpqua River drainage basin covers 4,560 sq mi and yields 6,700,000 ac-ft of fresh water annually with extremes of 12,000,000 ac-ft and 2,750,000 ac-ft [99]. Precipitation records are available from several climatological stations in the basin (Table 13). The average annual rainfall ranges from 25 to 110 inches with 50 to 110 in the Coastal Range, 25 to 50 inches in the "Central Valley" (the area of the confluence of the North and South Umpqua Rivers), and 50 to 75 inches in the Cascade Mountains [99]. Average rainfall along the coast (western Douglas County) is 77 inches, and the average air temperature there is 52°F [58].

Elevations are from sea level to 3,000 feet in the Coast Range and 9,000 feet in the Cascade Range [99].

Hydraulic Description of Estuary

Tides and Currents

The estuary is described as being fully exposed to waves at the throat [55]. Tidal effects extend up the Umpqua River as far as Scottsburg at river mile 27.5 [99,126]. The mean tide range is 5.1 feet, the diurnal range 6.9 feet [55], and the extreme range 11.0 feet [86]. Tidal prism on mean range is 1.18×10^9 cu ft with a diurnal range of 1.595×10^9 cu ft [55].

River Discharges

Records kept between 1905 and 1970 at a stream gaging station (Table 13) located on the Umpqua River at mile 56.8 where the drainage area is 3,683 sq mi (80% of the total basin) show an average discharge of 7,435 cfs and extremes of 265,000 cfs (December 23, 1964) and 640 cfs (July 18, 1926) [140]. The average maximum and minimum daily flows at this same spot, but for the 14-year period between 1953 and 1967, were 125,000 cfs and 900 cfs [7].

There are numerous stream gaging stations in the Umpqua River system, but the only other major tributary for which records will be given here is the Smith River, which has a station located at mile 28.5 where the drainage area is 206 sq mi (Table 13). The station has been in operation since October 1965 and recorded an average discharge between then and 1970 of 685 cfs with extremes of 26,700 cfs (January 3, 1966) and 4.3 cfs (August 26, 1966) [140].

Salinity and Classification by Mixing

In the study by Burt and McAllister, salinity measurements were taken in the Umpqua River in June 1956, October 1957, and January, March, and July 1958 [12]. Of these five times, maximum intrusion was found on October 6, 1957 at HHW when it reached a point 16.7 miles from the ocean at concentrations of 1.3 ppt on the surface and 1.5 ppt on the bottom (5 feet) with a concurrent temperature of 15.8°C at both points. Measurements beyond this were not reported.

More extensive salinity data were taken by R.J. Callaway through the Department of Health, Education, and Welfare, Public Health Service, in 1961 [15,16,17].

Also, the U.S. Army Corps of Engineers measured surface and bottom salinity at miles 1 and 2 of the estuary in verifying its physical model of Umpqua Bay [32]. The measurements were taken during 1966 on March 30-31 and August 3-4. The greatest range in concentration on the surface was found during the March 30-31 period at mile 1 where it ranged from 3 ppt to 26.5 ppt. Fresh-water discharge at that time was 17,000 cfs. The greatest range on the bottom also occurred during March 30-31, but at mile 2, and was from 5 ppt to 30 ppt.

Salinity, velocity and dissolved oxygen data were taken by Callaway [15,16,17], who also observed the intrusion of low dissolved oxygen (<2 ppm) due to upwelling.

The estuary as classified by Burt and McAllister on the basis of mixing was found to be a two-layered system in January and February; a partly-mixed system in March, May, and October; and a well-mixed system in July [13].

Sediments

Net transport of material along the coast near Umpqua Bay seems to be to the south, and there is some erosion south of the south jetty [57]. Movement of sand sediments around the north jetty and into the estuary during high tide has been observed through aerial photographs [53]. Sediments transported to the estuary from its drainage basin are estimated at 564,000 tons annually [85].

Analyses of U.S. Army Corps of Engineers dredge samples taken at numerous points within the estuary from November 1970 to August 1971 show the following: (1) organic contents ranging from 0.91% to 3.27% (both samples were taken in August 1971--the first from the east side between miles 5.30 and 5.50 and the second from the west side at Buoy #9); (2) void ratios ranging from 0.772 (November 1970 at milepost 80-100 at Barretts upper dike) to 0.967 (August 1971 from the west side at Buoy #9); and (3) mean grain size that of fine sand [124].

Water Quality Information

The DEQ operates seven water surveillance stations in the estuary for which records are available in punch card and printout form for about 25 sampling dates since 1957 [67,68]. Locations of these stations are given in Table 13.

Sewage treatment facilities in the area consist of a new plant in Reedsport and a new sanitary district in Gardiner which pumps into the Reedsport plant. Plans are underway for construction of a plant in Winchester Bay. The plant in Reedsport is a secondary treatment facility, located on the south side of the Umpqua River between the Highway 101 bridge (mile 11.0) and the Southern Pacific Railroad bridge (mile 11.3). Operating since September 1970, it serves the cities of Reedsport and Gardiner. Daily flow averaged 725,000 gallons in September 1972 and 707,000 gallons in October 1972 (both fairly dry months); during rainy weather, it peaks at 2,000,000 gallons [63,97,110].

A water quality problem has arisen from logging operations as well as from sand and gravel and agricultural practices in the area. These activities all cause an increase in silt resulting in turbidity and (when high enough in concentration) destruction of eggs in the spawning grounds [155].

Biological Information

Estimated numbers of adult anadromous salmonids spawning in the Umpqua and Smith Rivers and in the entire Umpqua River system are shown in Table 6. In comparison with the other estuarine river systems included in this

Table 6. Estimated numbers of adult anadromous salmonids spawning in the Umpqua River system [79].

stream	chinook		coho	steelhead		sea-run cutthroat
	spring	fall		winter	summer	
Umpqua River	0	2,200	15,000	10,500	0	8,000
Smith River	0	1,000	5,000	10,000	0	10,000
Umpqua River system	12,600	5,000	25,000	40,000	12,000	30,000

report (Table B), the Umpqua has relatively high numbers of spring chinook, steelhead (winter and summer), and sea-run cutthroat [79].

Salmon and trout provide good fishing, as do tomcod, perch, striped bass, and green and white sturgeon (in the upper bay). Dungeness crab and soft shell clams are also commonly taken. The clams are found mainly in the tidal flats near the northern bend of the estuary around mile 6.5 where near optimum conditions for them exist. Gaper clams are frequently taken in Winchester Bay [38,79,155].

Scaup are found in the upper bay, and other ducks use the estuary in the fall during migration. Band-tailed pigeons exist on the tidal flats [79,155].

The entire area around the estuary is considered a winter range for big game, which, in order of abundance, include black-tailed deer, Roosevelt elk, white-tailed deer, black bear, and cougar [79].

Physical Alterations

Completed and proposed alterations to the estuary by the U.S. Army Corps of Engineers consist of three jetties, a main channel to Reedsport with a turning basin there, side channels (with turning basins) to Winchester Bay and Gardiner; a channel in Scholfield Creek and one with a passing basin in the Smith River. These have been summarized in Table 7. As of 1971 (publication date), consideration of the possibility of expanding entrance and river channel dimensions was in the primary phase, meaning a public meeting was to be scheduled [129].

Umpqua Bay

Table 7. U.S. Army Corps of Engineers Modifications to Umpqua Bay
[55,126,129,130--#6004,128].

Proposed Modification	Location	Dimensions			Date and Status	(1)		
		depth (feet)	width (feet)	length				
North Jetty	Entrance			8,000 feet	1940-completed			
South Jetty	Entrance			4,200 feet	1938-extension completed 1963-rehabilitated			
Training Jetty	South Side of Entrance; Mostly inside			5,500 feet	1951-completed			
UMPQUA RIVER PROJECT	Channel	Entrance	26		26 feet	completed		
	Channel	Umpqua River from the Entrance to Reedsport	22	200	11 miles	1941-completed		
	Turning Basin	Reedsport	22	600	1,000 feet	appears completed	(2)	
	Side Channel	From Main Channel to Docks at Winchester Bay	12	100		appears completed	(2)	
	Mooring and Turning Basin	Winchester Bay	12	175	300	appears completed	(2)	
	Side Channel	From Main Channel to Gardiner	22	200		appears at least partially completed	(2)	
	Turning Basin	Gardiner	22	500	800			
	Channel	Scholfield Creek-- from its confluence with the Umpqua River	12	100	2 miles	1971 (publication date)- "Inactive"		
	SMITH RIVER PROJECT	Channel	Smith River Mouth to North Fork	6	100	16 miles	1957-completed	
		Passing Basin	Near North Fork (mile 16)				1957-completed	
		Channel	Smith River From North Fork to Sulphur Springs	4	75	5 miles	1957-completed	

¹Lack of completion date does not necessarily mean that the modification has not been constructed.

²Observed on USCGS chart #6004 (August 15, 1970).

The channel systems have been maintained by the U.S. Army Corps of Engineers and by private contractors. Corps of Engineers records of dredging activities in the entrance channel from 1959 to 1969 (excluding 1968) show the 270,151 cu yds removed in 1964 to be a fairly typical amount [50,55]. Private contractors have performed hydraulic dredging in the Smith River near Otter Slough (mile 4.4) and have spoiled either on high land behind water-tight berm or on the beach as nourishment [50].

Navigation is possible to mile 30.0 of the Umpqua River, mile 20.0 of the Smith River, mile 1.0 of the North Fork Umpqua River, and mile 6.0 of Scholfield Creek [69].

Traffic through the Umpqua River project in 1969 weighed 505,000 tons and consisted of about 50% rafted logs; "less than 50%" sand, gravel, and crushed rock;-and 13% fuel oil and lumber shipments. Between 1960 and 1969 traffic averaged 810,000 tons annually. On the Smith River project rafted logs constituted about 90% of the traffic during 1969 with sand, gravel, and crushed rock accounting for the remaining 10%. Total traffic using the Smith River project during the year (1969) was 302,000 tons, which was considerably lower than the annual average (from 1960 to 1969) of 457,000 tons [129].

"An Inventory of Filled Lands in Umpqua River Estuary, June 1972" has been prepared by the Division of State Lands [69]. According to the report, there are 106.04 acres of landfills on submerged and submersible lands of the estuary. Of that total, 78.73 acres have been used to construct the marina and harbor in Winchester Bay, and most of the remaining acres are all marine oriented. Some information from that report is given in Table C, but more details (e.g., location and ownership of filled lands) can be obtained from the report itself.

A rearing pond (Camp Creek rearing pond) was constructed 21 miles east of Reedsport in 1963 under the FCO "Coastal 60-40 Program" [119].

The OSGC operates the Rock Creek hatchery on the North Umpqua River near the town of Idleyld Park which is almost 148 miles from the estuary mouth [56]. Releases from the hatchery totaled 956,598 during 1970 and consisted of 726,994 rainbow-trout, 182,914 spring chinook, and 46,690 summer steelhead [80].

Estuary Uses

Industrial and Commercial

The economy of the estuary area depends mainly on timber and fish resources, although tourism is also important, as are sand and gravel operations and dairying to some extent. In the Smith and Umpqua River valleys there is some farming and ranching based on cattle and sheep raising [58,99,110].

As can be seen from the listing of the area's manufacturers given in Table 8, paper, plywood, and lumber mills there are numerous [58,71]. Not listed in Table 8 is the Bohemia Lumber Co. operation now (October 1972)

umpqua bay

Table 8. Major Manufacturers at Umpqua Bay [71].

Location	Name	Type of Business	Number Employed
Winchester Bay	Winchester Bay Seafood Co.	seafood and minkfood	300
	Salmon Harbor Seafood Inc.	canning seafood	5
	Sportsmens Cannery	salmon processing	5
Gardiner	International Paper Co.	plywood and lumber/chips	650
	Gardiner Paper Mill	paper products	250
Reedsport	Whitcomb Logging Co.	contract logger	75
	U.S. Plywood	fir veneer	50
	Reedsport Mill Co.	lumber	50
	G and C Logging Co.	logging	28
	12 manufacturers employing less than 10	half deal in lumber and wood products and the remaining 6 in cheese and butter; newspaper and commercial printing; perfume; concrete building blocks; machine shop and welding; pick-up tops and campers	

under construction between Reedsport and Gardiner [110]. Statistics of waterborne traffic through the Umpqua and Smith River projects, presented in more detail under "Physical Alterations," give an indication of the extent of timber-related activities in the area. For example, in 1969 rafted logs accounted for 50% of the 505,000 tons using the Umpqua River Project and 90% of the 302,000 tons using the Smith River project [129].

Commercial fishing in the area is based at Winchester Bay where the major industry is the Winchester Bay Seafood Co., which processes a variety of fish, crab, and shrimp [58,155]. Commercial harvest from the estuary and its tributaries consists mainly of shad and striped bass and some crabs and clams. Statistics are presented in Table 9 [20,118]. Commercial landings from the entire area, shown in Table 10, are high in comparison with landings received at other estuarine ports as shown in Tables D and E.

The Umpqua River Navigation Co. maintains an extensive sand and gravel operation with headquarters in Reedsport [58]. Its floating gravel plant is used to dredge, crush, and process river run gravel. The company has removed over 4,216,000 cu yds of gravel from the Umpqua River since 1949 with an annual average (between 1965 and 1970) of 239,868 cu yds [26].

Umpqua Bay

Table 9. Commercial Harvest of Shad, Striped Bass, Crabs, and Clams at Umpqua Bay, 1969, 1970, and 1971 [20,118].

Species	1969		1970		1971	
	pounds landed	fishermen value	pounds landed	fishermen value	pounds landed	fishermen value
Shad ⁽¹⁾	374,000	\$40,000	394,018	\$52,000	246,968	\$34,000
Striped Bass ⁽¹⁾	19,481	3,000	35,473	6,000	56,321	9,000
Crabs ⁽²⁾			23,049		2,417	700 ⁽³⁾
Clams ⁽²⁾	9,384		10,631		7,459	1,000

¹Source of reference [20]; data for the Umpqua River system.

²Source of reference [118]; data for Umpqua Bay.

³Determined as a percentage of the total value of crab landings given in Table 10.

Table 10. Commercial Harvest of Food Fish Received at Winchester Bay, 1971⁽¹⁾ [34].

Species	Harvest (pounds round weight)	fishermen value
Groundfish	4,561,702	\$375,000
Crabs	809,070	283,000
Coho	781,611	245,000
Shad	246,968	34,000
Shrimp	81,330	10,000
Striped Bass	56,321	9,000
Chinook	26,377	15,000
Albacore Tuna	13,766	4,000
Clams	7,459	1,000
Smelt	5,976	2,000
Pinks	1,580	—
Green Sturgeon	50	—
Totals	6,592,210	\$978,000

¹Includes data presented in Table 9.

Umpqua Bay

A study to determine the extent of replenishment of the removed gravel was completed by CH₂M/Hill in June 1971 [26]. Use of the channel systems for transport of sand, gravel, and rock, as described under "Physical Alterations" has been especially extensive on the Umpqua River [88].

Recreational

As with commercial fishing, Winchester Bay also serves as the center for the sport fishing, having numerous facilities, docks, and marinas for all types of boats. Facilities for salmon angling are provided at Salmon Harbor on the bay where coho and chinook can be caught from June through September. Salmon fishing on the Umpqua River is good from its mouth to the dam at Winchester located at mile 7.0 of the North Umpqua River or 118.7 miles from the ocean. Chinook can be taken from the river from mid March through June, and coho enter it after the fall rains and provide their best angling in the sections near the towns of Scottsburg at mile 27.5 and Umpqua at mile 102.7 [58,97].

Species other than salmon and trout most commonly caught by sportsmen at Umpqua Bay, as determined in the FCO study from March to October 1971, include tomcod, redbtail perch, and shiner perch by shore angling; striped bass (caught mainly in the upper bay), dungeness crab, and relatively few redbtail perch by boat angling; and softshells by clamming [38]. The softshell clams are found mostly in the tidal flats near the northern bend in the estuary (approximate river mile 5) where near optimum conditions for them exist [155]. Additional species commonly taken include green and white sturgeon, shad, and gaper clams. The sturgeon are caught primarily in the upper bay and the gaper clams in Winchester Bay [79,155]. Annual harvest data for some of the above mentioned fish are given in Table 11.

Table 11. Estimated Annual Harvest Data For Sport Fishing at Umpqua Bay⁽¹⁾ [79].

Species	area fished	annual harvest (total number)	effort (angler-days)	gross expenditures
Salmon	Estuary	3,000	7,500	\$ 222,000
	Umpqua River	13,000	52,000	962,000
	Smith River	500	2,000	37,000
	Ocean	57,000	50,000	4,255,000
Steelhead	Umpqua River	8,000	32,000	592,000
	Smith River	1,300	5,200	96,000
Shad	Umpqua Basin	2,750	1,500	27,750
Striped Bass	Umpqua Basin	5,000	12,000	222,000
Sturgeon	Umpqua Basin	600	2,000	12,000
Bay fish	Umpqua Basin	60,000	10,000	60,000

¹Average of data from past years.

Umpqua Bay

The band-tailed pigeons found on the tidal flats reportedly provide excellent shooting [79].

The Umpqua Lighthouse State Park is located 5 miles south of Reedsport near the estuary mouth, and there is another state park (Umpqua Wayside) on the Umpqua River near mile 23. The former has day-use and camping facilities while the latter is for day visitors only. Attendance figures show that, while camper use at Umpqua Lighthouse has been fairly constant since 1966, the number of day visitors has dropped nearly 90%. The situation at Umpqua Wayside has been an increase in use from 1966 to 1968 followed by a rapid decrease. Some attendance figures for the two parks are given in Table 12 [58,82,83]. Windy Cove Park, which is a Douglas County campground, is located at Salmon Harbor [58].

Table 12. Umpqua Lighthouse and Umpqua Wayside Annual Attendance [82,83].

Park Users	Umpqua Lighthouse		Umpqua Wayside		
	1966	1970	1966	1968	1970
day visitors	478,166	48,367	88,632	111,380	38,264
camper nights	24,637	24,690	—	—	—

Umpqua Bay

Table 13. Surveillance stations at Umpqua Bay.

type of station	name and/or identifying number	approximate location	drainage area (sq mi)	period of record	references
climatological	Gardiner; USGS #9940	elevation--15 feet		1889-1914	[92] ¹
	Reedsport; USGS #7082	elevation--94 feet		1937*	[92,99,143] ¹
	Elkton 3 SW; USGS #2633	elevation--114 feet		1937*	[92] ¹
	Elkton 4 S; USGS #2637	elevation--170 feet		1950*1956	[92,99] ¹
	Gunter	Smith River		1940*	[99]
stream gaging	Umpqua River at Scottsburg; USGS #3229	Umpqua River; mile 30	4,095	1966-	[98] ²
	Umpqua River near Elkton; USGS #3210	Umpqua River; mile 56.8	3,683	10/05-(1970)	[98,99,140] ²
	Smith River near Gardiner; USGS #3231	Smith River; mile 28.5	206	1966-(1970)	[98,140] ²
DEQ water surveillance	#1	red buoy #6		5/57-(4/72) (25 measurements)	[67,68] ³
	#2	Double Cove Point		"	"
	#3	4 mile green light		"	"
	#4	red buoy #20		"	"
	#5	Highway 101 bridge		"	"
	#6	1 mile up Smith River		"	"
	#7	1 mile east of railroad bridge		"	"
water quality	Umpqua River near Elkton	Umpqua River; mile 56.8	3,683	12/65-(9/68) (1 sample monthly)	[141]
water temperature	"	"	"	6/47-(1968)	[138,141]

¹ Precipitation data available in punch card or printout form through the OSWRB.

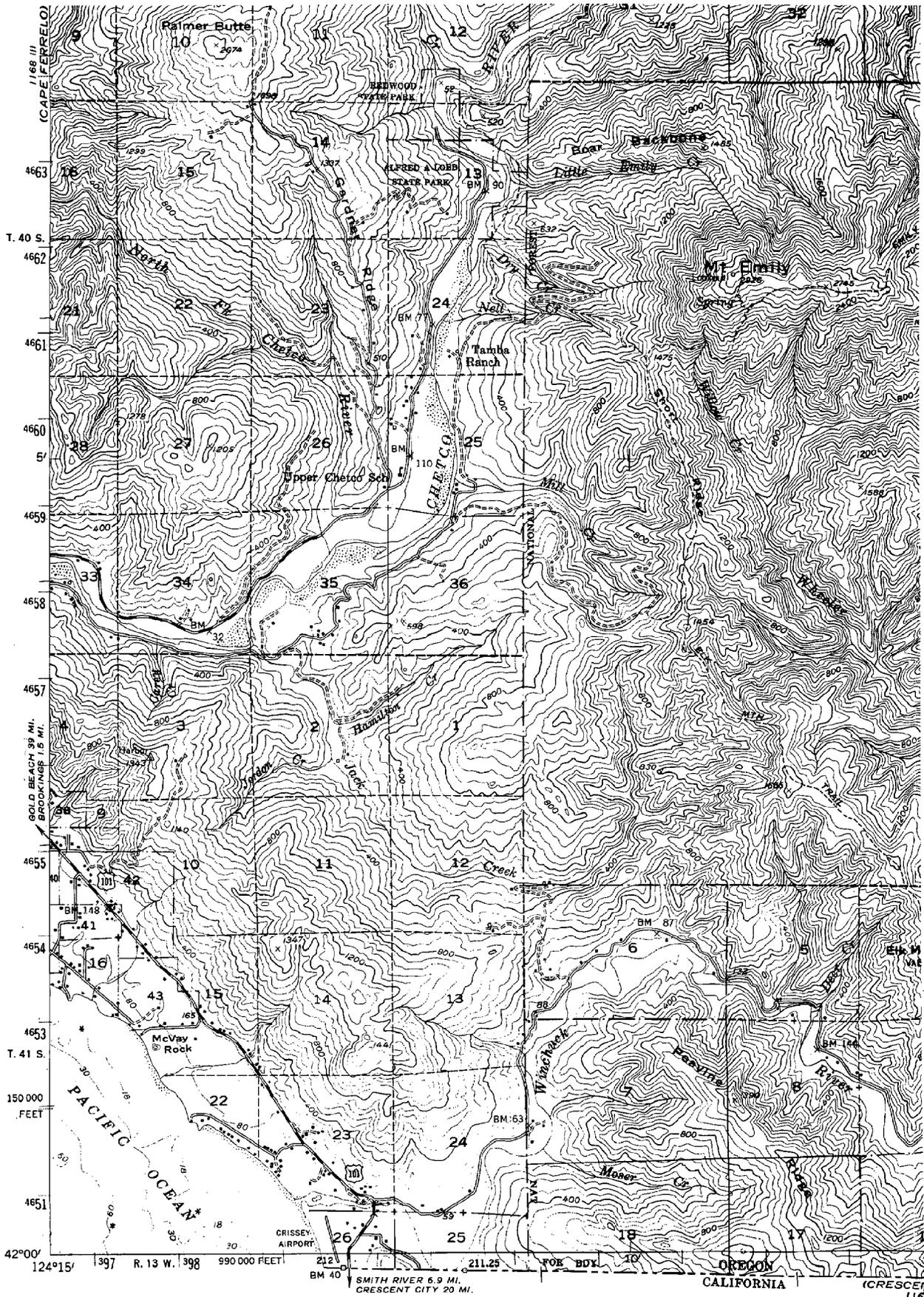
² Monthly and water-year runoff records have been compiled and are available in punch card or printout form through the OSWRB.

³ Data available in punch card or printout form through the DEQ.

() This is the most recent record date found and is not necessarily the last.

* Period of record is not continuous.

WINCHUCK RIVER



WINCHUCK RIVER

General Description of Estuary and Drainage Basin

Estuary

The Winchuck River Estuary lies approximately 294 miles south of the Columbia River mouth and 1/2 mile north of the Oregon-California state line. It is the smallest estuary in terms of surface area of those included in this report. The population in the area is rural, the closest communities being Harbor and Brookings, Oregon which are 2 miles to the north (see Chetco River Estuary for populations of these communities).

The HW surface area of the estuary as estimated from 1973 EROS Data Center aerial photographs is 130 acres [135].

The average annual yield of the Winchuck River is 62,400 ac-ft. Minimum recorded flow was in September, 1934 when 3 cfs was recorded for the Winchuck River above the mouth of the South Fork.

The Winchuck River source is at river mile 8 of the East Fork (approximately 20 river miles from the mouth) at elevation 1,920 feet [93,96].

Average wind direction in the vicinity of Brookings, Oregon during the period from 1937 to 1942 was as follows: November, December, January, February, and March--northeast; April, May, and June--northwest; July and August--south; September--northwest; October--north [7].

Drainage Basin

The Winchuck River drains a total basin area of 70 sq. miles. The Winchuck River Basin consists primarily of woodlands (95.2%; 36,372 acres), cropland (1.4%; 538 acres), and pasture (2.6%; 990 acres). As of January, 1963, the Winchuck River had no existing storage ponds or reservoirs, with 3 possible reservoir sites being studied [93].

The average annual precipitation ranges from 80 inches at the mouth of the Winchuck River to 105 inches in the upper reaches.

The only climatological station near the Winchuck River estuary is the Brookings station which has precipitation and temperature data from 1912 to the present.

The Winchuck River has a length of 12.0 miles, the East Fork having a length of 8.0 miles. The elevation drop from source to mouth is 160 feet for the Winchuck River and 1,760 feet for the East Fork Winchuck River. The average gradient for the Winchuck River is 13 feet per mile and 230 feet per mile for the East Fork [93,96].

Winchuck River stream profile appears on page 43 in the Chetco River Basin section.

WINCHUCK RIVER

Hydraulic Description of Estuary

Tides and Currents

According to the U.S. Geological Survey the average range of the tide is approximately 5 feet [144].

River Discharges

Stream flow records are available from the USGS stream gaging station on the Winchuck River above the South Fork near Harbor. The station is discontinued, but spot observations were taken in 1935, 1936, and 1949-1952. Stream flow averages and extremes appear in Table 1 [148].

Table 1. Stream Gaging Data [148].

Stream	Location	Drainage area (sq.mi.)	Complete water years of record	Flowrate (cfs)		
				max.	min.	mean
Winchuck River	T415, R13W Sec. 24	---	---	13.7	5.4	10.6

Salinity and Classification by Mixing

Salinity profiles as a function of depth and distance from the mouth of the river are presented in Table 2. Data was taken on August 23, 1973 during a high tide of +4.8 feet [87].

Sediments

From Brookings south the coast is flat, with some beach, and the upland is agricultural with many farms to the Oregon-California border.

According to the National Shoreline Study by the U.S. Army Corps of Engineers (Aug., 1971), the shoreline from the Chetco River Estuary to the Oregon-California border is experiencing no erosion [125].

The generalized sediment yield for the Winchuck River basin is 0.1 to 0.2 ac-ft per sq. mile per year [23].

WINCHUCK RIVER

Table 2. Salinity Values for the Winchuck River Estuary. Aug. 23, 1973 [87].

Station	Distance from mouth (mi.)	Salinity %		Depth (ft.)
		top	bottom	
1	0.1	12.3	12.3	1
2	0.2	2.0	10.4	6
3	0.3	2.4	6.6	6
4	0.4	2.4	10.4	6
5	0.5	2.5	9.0	3
6	0.6	3.0	10.4	3.5
7	0.8	4.3	10.4	4.5
8	1.0	6.6	6.6	3
9	1.2	0.2	0.2	0.5

Water Quality Information

Miscellaneous flow and temperature measurements for the basin were made by the Oregon State Game Commission. Temperature ranges from these sources are presented in Table 3 [78].

DEQ water quality stations are listed in Table 5.

Biological Information

Estimates of the number of adult anadromous salmonids spawning in the Winchuck River system are as follows: spring chinook--none, fall chinook--400; coho--50, steelhead--1,500 and sea-run cutthroat--1,500.

Dace, cottids, red-sided shiners, sticklebacks, lamprey, and suckers are the known rough fish species in the stream systems of the South Coast Basin.

WINCHUCK RIVER

Table 3. Temperature Extremes for the
Winchuck River Drainage Basin [78].

Point of measurement	Period of record	Observed Temperature Extremes (F°)		
		max	min.	type of observation
Winchuck River below Moser Cr.	4-10-69 to 7-23-69	70	55	spot
Winchuck River above Bear Cr.	5-8-69 to 7-23-69	70	56	spot
Bear Creek below Bridge Cr.	4-10-69 to 7-23-69	63	49	spot
Wheeler Cr. 100 yds. above mouth	4-10-69 to 7-23-69	68	52	spot
East Fork Winchuck River mouth	4-10-69 to 7-23-69	70	52	spot
East Fork Winchuck River above Fourth of July Creek	4-10-69 to 7-23-69	66	50	spot
Fourth of July Creek mouth	4-10-69 to 7-23-69	67	52	spot

Biological Information

The streams in this basin are noted for their excellent spawning gravel. The Winchuck River system has 6 streams used by adult anadromous salmonids, 5 of which have minimum flow recommendations established and 1 protected by the State Water Resources Board. The entire stream of Bear Creek (Winchuck R.) should be protected from gravel removal [78].

Table 4 refers to the estimated sport harvest in the Winchuck River system.

Figure 1 is a periodicity chart showing when adult spawning anadromous fish are present in the Winchuck River system.

A general description of big game, upland game, waterfowl, and furbearers of the basin is given in the Sixes River section on Biological Information.

WINCHUCK RIVER

Figure 1. Periodicity Chart for Adult Spawning Anadromous Fish in the Winchuck River System [78].

Chinook Salmon *****
 Coho Salmon -----
 Steelhead and Cutthroat trout ::::::::::::::

Stream	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	April	May
Winchuck River	*****	::::::::::::						
Bear Creek	*****	::::::::::::						
Wheeler Creek	*****	::::::::::::						
Winchuck River, East Fork	*****	::::::::::::						
Fourth of July Creek	*****	::::::::::::						

Physical Alterations

The only physical alteration near the estuary is the Oregon Coast Highway Bridge (U.S. 101), at river mile 0.6 [96].

WINCHUCK RIVER

Table 4. Estimated Annual Harvest, Angler Days, and Gross Expenditures for Angling in the Winchuck River System [78].

Fish	Harvest	Angler Days	Gross Expenditures
Salmon *	450	1,800	\$33,300
Steelhead	350	1,400	25,900
Sea-run Cutthroat	200	<u>80</u>	<u>1,480</u>
TOTALS		3,280	\$60,680

* Includes jack salmon.

Estuary Uses

Industrial and Commercial

The only industrial or commercial use of the Winchuck River is for the purpose of irrigation. The average annual yield for the river is 62,400 ac-ft. The maximum legal annual depletion consumptive rights are 120 ac-ft for domestic purposes and 450 ac-ft for irrigation purposes totalling 570 ac-ft. The river has one reservoir right for irrigation purposes with a storage capacity of 1 ac-foot and a surface area of 1 acre. Surface water rights total 1.55 cfs for domestic and irrigation use [42].

The nearest population centers are Harbor and Brookings. Manufacturers for these areas are listed in Table 3 of the Chetco Bay report.

Recreation

The Pacific Ocean is the principal attraction of the basin. Sport fishing at Brookings to the north is becoming increasingly popular. Fishing in the Winchuck River system is also quite common while the forested areas in the upper basin provide excellent hunting.

Parts of the Winchuck River flow through the Siskiyou National Forest in both Oregon and California. Several streams in the basin have outstanding aesthetic value and make a significant contribution simply because they maintain attractive flows, have little streamside development, and possess watersheds which have not been excessively logged. The entire Winchuck River was selected by the Oregon State Game Commission as a stream which should be managed for its aesthetic value [78].

WINCHUCK RIVER

Table 5. Surveillance Stations
near the Winchuck River.

Type of station	Name and/ or identifying number	Approximate location	Drainage area (sq.mi.)	Period of record	Reference
Climatological	Brookings (formerly Harbor)	T145, R13W Sec. 7	---	1912 to present	[93]
Water Quality	Winchuck River 1.3 mi. above Hwy. 101 Bridge	T415, R13W Sec. 24 river mile 2.5	---		[152]
Stream Gaging	Winchuck River above S.Fk. near Harbor	T415, R13W Sec. 24	---	1935, 1936 1949-1952	[148]

YAQUINA BAY

YAQUINA BAY

General Description of Estuary and Drainage Basin

Estuary

Yaquina Bay lies about 115 miles south of the mouth of the Columbia River. Of the estuaries included here, it is fourth in size (Table A). The only incorporated towns on the estuary itself are Newport and Toledo, which are listed in Table 1 with other population centers in the area. There is also a U.S. Coast Guard Station on the north side of the Yaquina River at mile 1.2.

Table 1. Population centers at Yaquina Bay¹ [94,111].

name	general location	river mile location	1970 population
Newport ²	Yaquina River; north side	0.7 to 1.8	5,188
South Beach	Yaquina River; south side	2.5	300
Yaquina	Yaquina River; north side	4.3	50
Winant	Yaquina River; north side	6.8	not listed
Oysterville	Yaquina River; south side	6.8	not listed
Moody	Yaquina River; north side	11.2	rural
Toledo ²	Yaquina River; north side	12.2 to 13.5	2,818
Elk City	Yaquina River; south side	22.2	25
Pioneer	Yaquina River; north side	25.0	not listed
Chitwood	Yaquina River; north side	30.9	rural

¹Tidal effects extend approximately to mile 26 of the Yaquina River.

²Incorporated

Surface areas of Yaquina Bay reported by Johnson [55], Marriage [59], and the Division of State Lands [70] are shown in Table 2. Tidelands

Table 2. Reported surface areas of Yaquina Bay [55,59,70].

reference	surface area (acres)	measured at	tidelands		submerged acres	lands percent
			acres	percent		
[55]	4,233	HW				
	3,239	MSL				
	2,245	LW				
[59]	2,853	1	1,751	61		
[]	3,910	MHT	1,353	35	2,557	65
	2,557	MLT				

¹Specified by Marriage as the area affected by tidal action.

Yaquina Bay

(also given in Table 2) cover between 35% and 61% of the total area and are mostly within three tide flats at Sally's Bend, King's Slough, and the area between Idaho Point and the Marine Science Center [59,69,70]. Other estuary dimensions are given in Tables 3 and 4.

Table 3. Dimensions of Yaquina Bay [55].

distance from throat to
farthest estuary shore--6.7 miles

inlet dimensions at throat (at MSL):
width--1,000 feet
average depth--19.6 feet
cross-sectional area--19,610 sq ft

Table 4. Cross-sectional areas of Yaquina Bay [43].

point of measurement	distance from mouth (miles) ¹	cross-sectional area (sq ft)
Newport	1.9	35,000
river's bend	5.5	20,600
G. P. dock	10.7	8,900
Mill Creek	15.2	3,700
Elk City	22.4	1,200

¹Mile values were obtained by conversion from the distances reported in feet.

The estuary is comprised primarily of its major tributary, the Yaquina River, which has its zero mile at the mouth of the bay. The river drains 253 sq mi and is relatively short with a length of 58.8 miles to its source. From its mouth to the head of high tide at mile 26, it has one major tributary (Elk Creek at mile 22.3) and about 30 smaller creeks and sloughs discharging into it. Elk Creek is 29.7 miles in length and drains 136 sq mi [88-map, 94].

Information concerning land use and ownership at Yaquina Bay has been presented in "Preliminary Land Use Plan for the Yaquina Bay Area" (1969) prepared by the Bureau of Government Research and Service, University of Oregon for the Yaquina Bay Planning Commission [122]. Much of the material from that publication has been included here.

Two port commissions serve the area. The Port of Newport (P.O. Box 921, Newport 97365; 265-7758) is responsible for that section of the estuary from its mouth to just beyond Oneatta Point at mile 5.5. The remaining

Yaquina Bay

navigable portion of the Yaquina River is under the jurisdiction of the Port of Toledo (P.O. Box 370, Toledo; 336-2221 and 336-2552). The Lincoln Development Corporation is located at #2 Dodd Building, 155 East Olive St., Newport 97365; 265-2271.

A relatively large number of scientific studies have been conducted in Yaquina Bay, and reports may be available at the Oregon State University Marine Science Center at Newport.

Drainage Basin

The 253 sq mi drainage basin yields an average of 780,000 ac-ft of fresh water annually [53,85,88]. It consists of 87% (222 sq mi) forests; 4% (9 sq mi) cropland; 2% (4 sq mi) rangeland; and 7% (18 sq mi) "other" [88].

Annual rainfall averages from 60 inches along the coast to 100 to 110 inches in the eastern portions [53,55]. Precipitation records from the Newport climatological station (Table 10) are available through the OSWRB in punch card or printout form [92,143], and wind roses are also available for that area. Winds are primarily from the east and southeast during January and from the west and northwest during June [7].

Elevations range from sea level to 2,300 feet [88].

Hydraulic Description of Estuary

Tides and Currents

The bay is described as being moderately exposed to waves at the throat [88]. Tidal influences extend as far as mile 26 of Yaquina River and "several miles" up Elk Creek [43,88]. The mean tide range is 5.9 feet with a diurnal range of 7.9 feet [55] and an extreme range of 11.5 feet [86]. Tidal prism on mean range is 8.35×10^8 cu ft with a diurnal range of 11.5×10^8 cu ft [55].

In a study by Goodwin, it was found that (1) amplification of the entrance tidal range occurs throughout the estuary and (2) a phase difference of 90 to 100 degrees exists between tidal elevations and tidal currents [43]. A calibrated numerical tidal hydraulic model of the Yaquina has been provided by Goodwin [42].

Currents off Newport are quite variable and reportedly exhibit the characteristics of a large eddy [7].

Yaquina Bay

River Discharges

There are apparently no stream gaging stations on the Yaquina River (at least no records were found), but its normal flow rate has been estimated at 1,078 cfs [86]. Mill Creek, which flows into the Yaquina River from the south at mile 14.9, has a stream gaging station near its mouth where the drainage area is about 4 sq mi (Table 10). Average discharge for the 11-year period from October 1959 to October 1970 was 2.10 cfs with extremes of 609 cfs (January 27, 1965) and 0 (September and October 1961 and September 1962) [140].

Salinity and Classification by Mixing

In the study by Burt and McAllister, salinity measurements were taken in the Yaquina River during October, November, December 1957 and January, February, April, May, July 1958 for a total of 11 test dates [12]. The furthest point from the estuary mouth where salinity was detected was mile 19.8 on October 1 and 27, 1957 and on July 7, 1958 at HHW. Of these three dates, concentration was greatest on October 1, 1957 when it was measured at 3.0 ppt on the surface with a concurrent temperature of 18.2°C.

Burt and McAllister also reported that, on the basis of salinity change from top to bottom, the estuary was a well-mixed system in January, August, October, and November and a partly-mixed system in February, April, and May [13].

Surface and bottom salinity and temperature are provided for two locations over the period January 1963 through August 1970 [37].

A steady state model which used salinity data for a description of mixing was employed by Burt and Marriage to compute potential pollution in the Yaquina [11]. Methods of computing mixing from salinity data were examined by Bella and Grenney [6].

Callaway, et al., [18] observed the longitudinal distribution of salinity, rainfall, and runoff in the Yaquina and demonstrated a rapid decrease in salinity in response to runoff followed by a gradual increase after termination of the runoff input. A more rigorous classification scheme [47] is discussed by Callaway [14] and applied to the Yaquina Estuary above Toledo.

Sediments

Littoral drift in this area is northward in winter and southward in summer with the dominant drift to the north [7]. Drift from both directions either accumulates on the south beach or enters the estuary with the tides; there is little accretion occurring at the north jetty [57]. Sediments deposited in the bay each year by its tributaries total an estimated 30,000 tons [85].

Yaquina Bay

More information on the sediments there is given in a publication by Kulm and Byrne entitled "Sediments of Yaquina Bay, Oregon."⁽¹⁾

Analyses of dredge samples taken from the entrance channel by the U.S. Army Corps of Engineers once in 1958, 1964, and 1970 and twice in 1971 show organic contents ranging from 0.49% (May 1971) to 0.79% (September 1970); void ratios of from 0.5761 (May 1971) to 0.749 (September 1964); and a mean grain size that of fine sand [24].

Water Quality

The DEQ operates 22 water surveillance stations on Yaquina Bay and eight on various sloughs in the area (Table 10) [67,68]. Records from most of the bay stations are available since 1960 with the number of sampling dates ranging from 21 to 93. Turbidity, conductivity, DO, BOD, salinity, PBI, and fecal coliform counts were not always included before 1967. Records from the stations on the sloughs were generally kept from 1967 to 1968 with seven to eleven sampling dates.

A water temperature station is located on Mill Creek near Toledo (Table 10) [138]. Temperatures from November 1959 to September 1969 have been presented as the adjusted average for each month and have ranged from 4°C (January, February, March) to 12°C (August).

The city of Newport operates a secondary sewage treatment plant located on NW 3rd off highway 101 [64]. It presently serves the Newport population; future plans are to include service for the Marine Science Center and some condominiums. Average daily flow at the plant during October 1972 (relatively dry weather) was 900,000 gallons. During rainy weather it ranges from 3 to 5 million gallons.

The city of Toledo also operates a secondary sewage treatment plant [48]. Serving Toledo only, its average flow rate is 750,000 to 800,000 gal/day. It is located at Butler Road and South Fir Street, an area where Georgia Pacific also has a secondary treatment plant [109].

Dissolved oxygen, temperature salinity, and zooplankton populations are provided from January 1963 through August 1970 within Yaquina Bay [37].

The main pollution sources of Yaquina Bay are reportedly at Toledo [29].

1 Kulm, L.D. and Byrne, J.V., "Sediments of Yaquina Bay, Oregon," Estuaries, American Association For the Advancement of Science, 1967.

Yaquina Bay

Biological Information

Estimates of adult anadromous salmonids spawning in the Yaquina River system are as follows: spring chinook--0, fall chinook--2,100, coho--12,600, summer steelhead--0, winter steelhead--2,300, sea-run cutthroat--7,500 [75]. Compared with estimates for other estuarine river systems of Oregon (Table B), these are notably low.

From a list of the fishes of Yaquina Bay, those considered as most abundant include threespine stickleback, striped seaperch, black rockfish, bocaccio, kelp greenling, Ling cod, prickly sculpin, buffalo sculpin, staghorn sculpin, saddleback gunnel, English sole, and starry flounder. Frequently found clams are cockle, softshells, and gaper--the softshells existing mainly in the upper reaches of the bay and the other two in the lower sections. There are some butter and leatherneck clams in the middle reaches and crabs and oysters are also present [38,53,155].

A study was made during 1971 and 1972 in which invertebrates were counted and identified between marker buoy 36 and a point 1.5 miles above marker bouy 47 [154]. Those most often found at given times are as follows:

July-August

1. *Amphisamytha bioculata*
2. *Carophium spinicorne*
3. *Mya arenaria*

August-September

1. *C. spinicorne*
2. *Pseudopolydarna kempfi*
3. *M. arenaria*

December

1. *Macoma*
2. *C. spinicorne*
3. *Balanus amphitrite*

April

1. *Macoma*
2. *C. spinicorne*

The bay is used during migration and wintering by black brant, several species of ducks, and shore birds [155]. The area around it is a big game winter range--most commonly for black-tailed deer, and to a lesser degree for Roosevelt Elk, black bear, and cougar. Roosevelt Elk are now being transplanted to the Mid-Coast Basin by the OSGC and are increasing in number [75].

Yaquina Bay

Zooplankton populations and temperature, salinity and dissolved oxygen were collected from January 1963 to August 1970 at close to weekly intervals within Yaquina Bay. The data permits study of year to year variation of abundance and seasonal cycle over 7 1/2 years and can aid in distribution patterns within the Bay [37].

A much more thorough description of the fish and wildlife of Yaquina Bay is given in a special report published in 1968 by the U.S. Department of the Interior, Fish and Wildlife Service [137].

Physical Alterations

Alterations to Yaquina Bay, Harbor and River by the U.S. Army Corps of Engineers, listed in Table 5, consist of two jetties, channels, and turning and small boat basins. Also, studies were in progress as of 1971 to (1) determine the feasibility of deepening the channel between Yaquina and Toledo and (2) consider a potential small boat basin project on the south side of Yaquina Bay [129].

Corps of Engineers records of dredging the entrance bar, inner channel, and Depot Slough from 1959 to 1969 (excluding 1968) show 247,737 cu yds as being fairly typical of quantities removed [55]. That amount was taken from the entrance bar and inner channel in 1962. Navigable length of the Yaquina River is 23 miles [69].

Annual traffic using the channel system during the period from 1960 to 1969 averaged 586,000 tons (Yaquina River) and 349,000 tons (Yaquina Bay and Harbor). In 1969, traffic through the Yaquina River project totaled 358,000 tons and consisted mainly (67%) of rafted logs, followed by lumber, fuel oil, and wastes. Traffic through the bay and harbor project was 133,000 tons (Mainly lumber, paper and paperboard, and petroleum products) [129].

The Division of State Lands has completed its inventory of filled lands in Yaquina Bay and River and has presented its findings in a main report and a supplement to that report [69]. Some information from those 2 papers is given in Table C of the introduction.

Two fishways were completed in 1962 under the FCO "Coastal 60-40 Program." One is the Sloop Creek Fishway located 3 miles above Elk City, or approximately at mile 25, and the other is the Little Elk Creek Fishway at mile 28.2 [119].

Yaquina Bay

Table 5. U.S. Army Corps of Engineers Modifications to Yaquina Bay [122,128,129].

Proposed Modification	Location	Dimensions			Date and Status	(1)
		depth (feet)	width (feet)	length		
YAQUINA BAY AND HARBOR PROJECT	North Jetty			6,500 feet	1896-completed 1934-repaired 1940-extended 1966-repaired and extended	
	South Jetty			7,600 feet	1896-completed 1934-repaired 1971-extended to the same length as the North Jetty	
	Spur Jetty and 5 groins	Channel Side of South Jetty		800 feet		
	Entrance Channel	Entrance	40	400		1968-dredging completed
	Channel	Bay (to Newport)	30	300		1968-dredging completed
	Turning Basin	Newport	30	900-1,200	1,400 feet	1968-dredging completed
	Small Boat Basin	Newport				1949-completed
	Channel	Newport to Yaquina	18	200	4.5 miles	1968-dredging completed
	Channel	Yaquina to Toledo	10	150	10 miles	1914-completed
	Channel	Depot Creek (2)		200		1914-completed
YAQUINA RIVER PROJECT	Channel	Near Olalla Creek (2)	10	150		1968-completed
	Turning Basin	Near Olalla Creek	10			1968-completed
	2 Levees with Tide gates and Pile Bulkheads	6 miles south-east of Newport; North Bank of the Yaquina River				1948-completed

¹Lack of completion date does not necessarily signify that the modification has not been constructed.

²Depot and Olalla Creeks discharge into the Yaquina River at Toledo.

Yaquina Bay

Estuary Uses

Industrial and Commercial

As a major industrial estuary, Yaquina Bay is a center for lumbering and commercial fishing activities [88,122,155]. Recreation is also important to the area and is actually growing at a faster rate than the forest products industry [122]. Manufacturers in the area are listed in Table 6 [71].

Table 6. Major Manufacturers at Yaquina Bay [71].

Location	Name	Type of Business	Number Employed
Newport	New England Fish Co. of Oregon	processing fresh and frozen fish	100
	Yaquina Bay Fish Co.	fish, salmon, crab, fillet (packaging)	40
	Point Adams Packing Co.	crab, shrimp processing	32
	Newport News-Times	weekly newspaper and commercial printing	20
	14 manufacturers employing less than 10	dealing in a variety of products	
Toledo	Georgia-Pacific Corp.	paperboard mill	595
	Georgia-Pacific Corp.	plywood sheathing and lumber, studs	320
	Cascadia Lumber Co.	lumber	102
	Toledo Shingle Co. Inc.	shingles and shakes	45
	Guy Roberts Lumber Co.	sawmill/planer mill	40
	Toledo Products Inc.	wooden pallets and fish boxes	26
	Newport-News Publishing Co., Inc.	newspaper and job printing	20
	5 manufacturers employing 15 or under	dealing mainly in lumber and wood products	
Eddyville	WOW Lumber Co.	lumber	27
	Three B's Logging Co.	logging	9

Toledo (particularly its south side) is the focal point of the forest industry processing facilities not only for the estuary and county (Lincoln) [122], but for the entire Mid-Coast Basin [88]. Most of the major industries there, included in Table 6, are concerned with forest products. The only lumber mill in the estuary area not in Toledo is located at Eddyville (river mile 36.3) [122]. In addition to the manufacturing of wood products, log storage and lumber shipping are also important [155]. Statistics of use of the Yaquina Bay and River projects (presented under "Physical Alterations") show that much of the traffic using the channel systems

Yaquina Bay

consists of rafted logs, lumber, and wood products [129]. Log rafts are under the jurisdiction of the Port of Toledo; total area of the estuary used for their storage could be determined by contacting the industries listed in Table 6 [105,109].

While Toledo is the center of the forest products industry in the Mid-Coast Basin, Newport is the center for commercial fishing activities-- in 1967 there were 450 commercial fishing boats licensed as being moored at Newport [122], and there are numerous fish processing plants there (Table 6). During 1971 commercial landings from the estuary itself were fairly limited (Table 7), but those from the entire area received at Newport (Table 8) were greater than at any of the other estuaries included

Table 7. Commercial Harvest of Clams, Crabs, and Oysters From Yaquina Bay [75,118].

Species	1969		1970 pounds landed	1971 pounds landed
	pounds landed	fishermen value		
Oysters	47,530	\$56,000		
Crabs	15,000	3,750	29,071	5,906
Clams	1,581		444	1,819

Table 8. Commercial Harvest of Food Fish Received at Newport, 1971⁽¹⁾ [34].

Species	Harvest (pounds round weight)	Fishermen value
Crabs	3,624,105	\$1,087,000
Shrimp	3,601,879	431,000
Groundfish	2,369,197	195,000
Coho	1,695,469	531,000
Albacore Tuna	998,262	302,000
Chinook	104,876	63,000
Oysters	39,560	81,000
Green Sturgeon	9,599	1,000
Clams	2,039	
Pinks	1,848	1,000
Smelt	350	
Totals	12,447,184	\$2,692,000

¹Includes 1971 data presented in Table 7.

Yaquina Bay

here (Tables D and E). In fact, of the entire Oregon coast, the landings received at Newport were exceeded only by those received at Astoria [34].

Recreational

Sport fishing is popular, as indicated by the estimated annual harvest data for salmon, sea-run cutthroat, steelhead, and non-salmonid bay fish presented in Table 9 [75]. Deep sea boats make regular and chartered trips

Table 9. Estimated Annual Harvest Data For Sport Fishing At Yaquina Bay(1) [75].

Species	area fished	annual harvest (total number)	effort (angler-days)	gross expenditures
Salmon	Estuary	2,240	9,000	\$ 165,760
	Yaquina River	560	2,240	41,440
	Ocean	41,600	61,800	3,078,400
Sea-run Cutthroat	Estuary	540	2,700	49,950
	Yaquina River	540		
Steelhead	Yaquina River	200	1,600	14,800
Non-salmonid bay fish	Estuary	77,000	28,750	172,500

1Average of data from past years.

on the ocean from May through September. The best time for chinook and coho angling in the estuary is during August [58].

Clams most commonly taken from the bay, as determined in the FCO study from March to October 1971, are cockle, softshell, and some gaper [38]. Cockle and gaper clams are found in the lower sections and softshells in the upper reaches.

Most of the recreation sites in the area are along the coast. One of these is Yaquina Bay, a state park for day use only located north of the estuary mouth. Statistics for 1966 to 1970 show a steady increase in the number of visitors there from 974,469 to 1,335,905. A county park is located at Elk City, and within tidewater there are six private boat landings and five charter boat services [82,122].

A plan for water access in the Yaquina River Basin entitled "Yaquina River Basin, Master Plan for Angler Access and Associated Recreational Uses" published by the OSGC in November 1968 is described in the paper, "Preliminary Land Use Plan for the Yaquina Bay Area" which was mentioned briefly in the first section of this report [122].

Table 10. Surveillance stations at Yaquina Bay.

type of station	name and/or identifying number	approximate location	drainage area (sq mi)	period of record	references
climato logical	Newport; USGS #6032		136	1237-(1968)	[88,92,143] ¹
	#11	Newport Bridge (Highway 101)		8/60-(3/72) (31 measurements)	[67,68] ^{2,3}
	#12	McLean Point		8/60-(3/72) (32 measurements)	"
	#13	Coquille Point		8/60-(3/72) (30 measurements)	"
	#1	channel #17 (near west bank) 600 yards south, 400 yards west		3/60-(12/69) (60 measurements)	"
	#2	flashing light #17, 100 yards south		3/60-(7/69) (62 measurements)	"
	#3	Weiser Point, 275 yards; #19 marker		3/60-(3/72) (68 measurements)	"
	#4	Oneatta Point, 275 yards north, 400 yards west; #21 marker		3/60-(4/72) (85 measurements)	"
	#5	flashing light #25		3/60-(4/72) (84 measurements)	"
	#6	red channel buoy #26		3/60-(4/72) (89 measurements)	"
	#7	Oregon Oyster Co. plant, 100 yards south, 500 yards east		3/60-(4/72) (87 measurements)	"
	#8	red channel buoy #28		3/60-(4/72) (85 measurements)	"
	#9	flashing light #32		3/60-(4/72) (93 measurements)	"
	#10	red channel buoy #34; 375 yards north		3/60-(9/70) (60 measurements)	"
	#14	red light #42		8/60-(7/69) (23 measurements)	"
	#15	flashing light #47		8/60-(3/72) (31 measurements)	"
	#16	below shingle mill		8/60-(7/69) (23 measurements)	"
	#17	shingle mill		8/60-(3/72) (31 measurements)	"
	#18	mouth of Depot Slough		8/60-(3/72) (30 measurements)	"
	#19	Toledo Bridge		8/60-(1/71) (24 measurements)	"
	#20	Cascadia Mill		8/60-(7/69) (21 measurements)	"
	#21	Hill Creek at mouth		8/60-(3/72) (26 measurements)	"
	#22	Mouth of Otiala Slough		1/67-(3/72) (21 measurements)	"

Yaquina Bay

Table 10. Surveillance stations at Yaquina Bay.

type of station	name and/or identifying number	approximate location	drainage area (sq mi)	period of record	references
DEQ water surveillance	log dump in King Slough, east of Highway 101			1/67-(9/68) (7 measurements)	[67, 68] ²
	Peole's Slough, south side of Yaquina River			2/68-(12/68) (7 measurements)	"
	Flesher's Slough bridge, south side of Yaquina River			1/67-(12/68) (10 measurements)	"
	Boona Slough bridge near flashing light #37			6/67-(12/68) (10 measurements)	"
	Rutes Slough Bridge west of black channel can #41			6/67-(12/68) (10 measurements)	"
	Depot Slough bridge on Yaquina Bay Road			1/67-(12/68) (10 measurements)	"
	Otalla Slough bridge, Firecrest Way Drive			1/67-(12/68) (11 measurements)	"
	Otalla Slough Bridge; Corvallis-Newport Highway			6/67-(12/68) (8 measurements)	"
water quality	Yaquina Bay and Yaquina River to Toledo	Yaquina River; mile 4.2		1953-1955	[88]
water temperature	Mill Creek near Toledo; USGS #3055.36	Mill Creek; mile 2; 17 miles from the estuary mouth	4	11/59-(1955) (spot observations)	[88, 158]

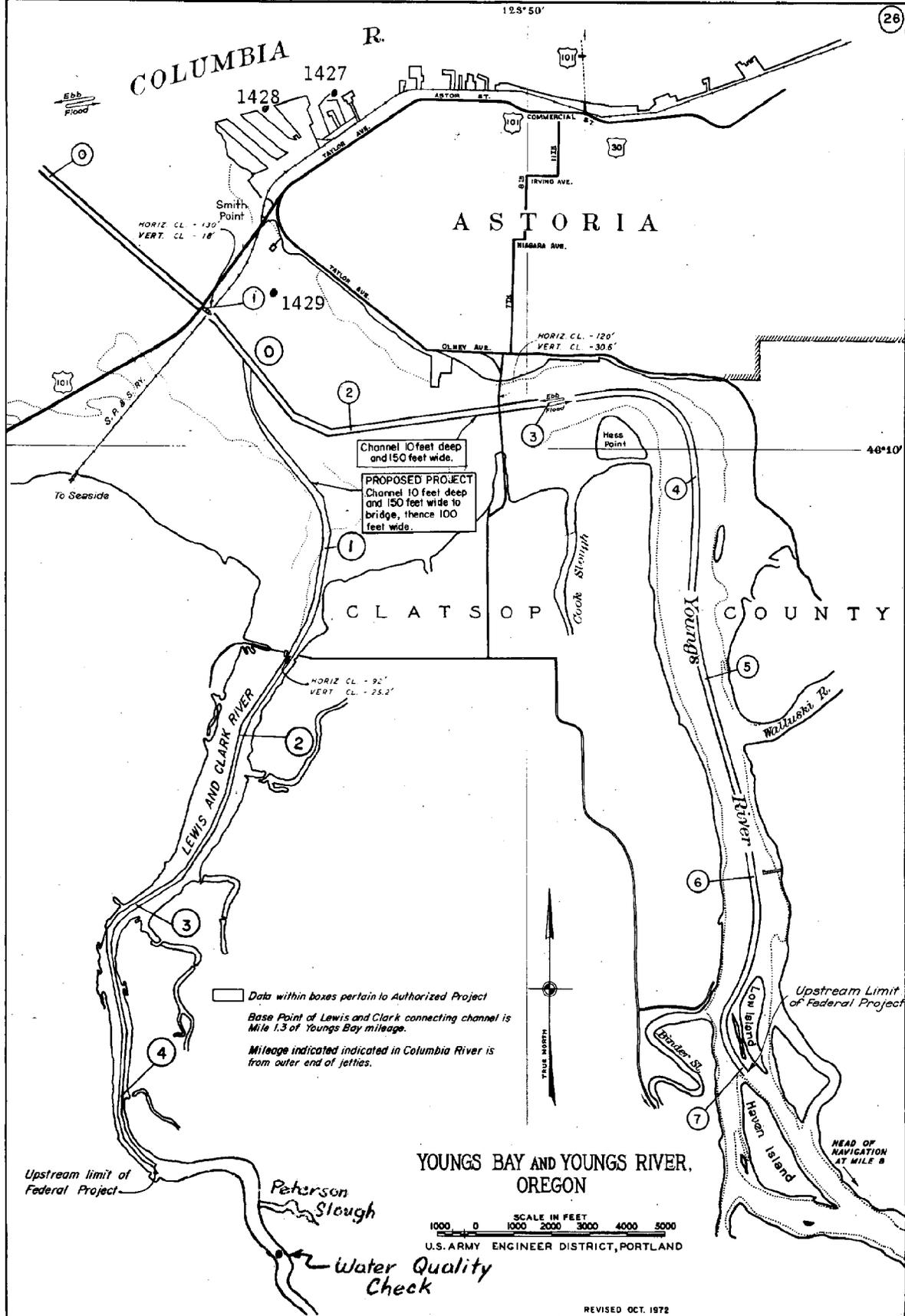
¹Precipitation data available in punch card or printout form through the OSWRB.

²Data available in punch card or printout form through the DEQ

³Records are not complete before 1967.

() This is the most recent record date found and is not necessarily the last.

YOUNG'S BAY



YOUNG'S BAY

General Description of Estuary and Drainage Basin

Estuary

Young's Bay lies approximately 12 miles above the mouth of the Columbia River. Of the estuaries included herein, it ranks 5th in size. Towns located on or near the estuary are Astoria, Miles Crossing, and Warrenton. Locations and 1970 populations are given in Table 1 [9,95, 111,123,129].

Table 1. Population Centers at Youngs Bay
[9,95,111,134].

NAME	GENERAL LOCATION	RIVER MILE LOCATION	1970 POPULATION
Astoria	Columbia R., S. Side Youngs Bay, E. Side	13 to 15 0 to 3	10,244
Miles Crossing	Lewis and Clark R., E. Side	3	(not listed)
Warrenton	Skipanon R., W. Side Lewis and Clark R., W. Side	0 to 4.3 0.4	1,825

Tidal reach is approximately 8 miles in Lewis and Clark River [134].

The estuary measures 12,000 feet at its mouth and covers about 2,870 acres. The width converges to approximately 1,800 feet at the Young's Bay Bridge, river mile 2.9 [116].*

The estuary consists of young's Bay and the lower reaches of the Young's, Lewis and Clark, and Skipanon Rivers. The Young's River drains an area of 122 sq. miles with its source at river mile 22.7; elevation 1,040 feet. Tributaries of the Young's River include the Walluski River (length-12.0 miles; source-700 feet) and the Klaskanine River (length-2.8 miles; North Forth-11.1 miles; source 1,350 feet; South Fork-12.1 miles, source-1,240 feet). The mouth of the Walluski River is located on the East bank of the Young's River at mile 1.7 while the Klaskanine River, also on the East bank, is located at mile 6.5. The Lewis and Clark River drains an area of 62 sq. miles with its source at river mile 27.2, elevation 1,920 feet. The Skipanon drains 16 sq. miles with its source at Cullaby Lake, mile 7.8, elevation 10 feet. The source of Cullaby Lake is another 6.7 miles up Cullaby Creek at elevation 150 feet. (Elevations are water elevations based on mean flow with zero occurring at the mouths of each stream) [124].

The Port of Astoria is located at Astoria and can be contacted at P.O. Box 569, Astoria, Oregon, 97103, telephone number 325-4521 [7].

*Dimensions taken from maps included in [116].

YOUNG'S BAY

General Description of Estuary and Drainage Basin

Drainage Basin

The Young's--Lewins and Clark--Skipanon system drains a total basin area of 200 sq. miles. The average yearly freshwater yields of the Young's River is 403,300 ac-ft, with an average annual precipitation of 92 inches; the Lewis and Clark yields 184,700 ac-ft. with 94 inches; and the Skipanon yields 35,900 ac-ft, with 80 inches. Total average yearly freshwater yield of the system is 623,900 ac-ft [133].

The Young's River Basin consists primarily of forests (76.3%; 67,100 acres), cropland [4.8%; 4,200 acres) and rangeland (0.6%; 500 acres). Lewis and Clark River Basin: forests (79%; 34,600 acres), cropland (8%; 3,500 acres), and rangeland (1.6%; 700 acres). Skipanon River Basin: forests (78.1%; 8,180 acres), cropland (8.6%; 900 acres), and rangeland (0.5%; 50 acres). Frequently flooded areas average 600 acres on the Young's River, 400 acres on the Lewis and Clark River, and 200 acres on the Skipanon River. As of June 1966, the Young's River had 3 existing storage ponds with 5 potential reservoir sites being studied; the Lewis and Clark River had 1 existing storage reservoir with 4 potential reservoir sites being studied, and the Skipanon had 4 storage ponds with no studies for future sites. (Reconnaissance data for these possible reservoir sites may be found in reference [133]).

Average annual precipitation ranges from 75 inches at Young's Bay to over 110 inches at the headwaters of the Lewis and Clark.

There are two climatological stations in the Young's Bay vicinity. The Astoria Experiment Station has recorded data from 1918 to the present and Astoria WSO has recorded data from 1953 to the present [143].

Wind roses from Astoria show annually averaged winds to occur from the northwest, west, southwest, south, and southeast, each 15% of the time at speeds from 4 to 31 mph. Wind roses for July indicate winds from the northwest 40% of the time with speeds for 4 to 31 mph [84].

The Young's Bay river profiles appear on page 221 in the Tillamook Basin section.

Hydraulic Description of Estuary

Tides and Currents

The diurnal range of tides is about 8.6 feet and the extreme tidal variation amounts to about 12 feet (mean lower low water is used as the plane of reference). Tides at the mouth of the Columbia River exhibit the diurnal inequality that is typical of the Pacific Coast of North America.

YOUNG'S BAY

Hydraulic Description of Estuary

River Discharges

Stream flow records are available from USGS stream gaging stations on the Young's River and North Fork of the Klaskanine River (Table 8) [146,147]. The Young's River station, located at approximately river mile 9, was discontinued in 1958. The Klaskanine River station, located at approximately river mile 5, was discontinued in 1955. Stream flow averages and extremes for these two stations are given in Table 2A [146,147].

No records of river stage or flow have been kept for the Lewis and Clark River, but based on records for the nearby Young's River, the maximum average monthly discharge is estimated to exceed 600 cubic feet per second [123]. Average monthly flows for the Young's and Lewis and Clark Rivers are given by Oregon State Water Resources Board, 1972, in Table 2B and 2C.

Table 2A. Stream gaging data [146,147].

Stream	Location (river mile)	Drainage area (sq. mi.)	Complete water years of record	Flowrate (cfs)		
				max.	min.	mean
Youngs R.	9	40.1	31	4750	3.3	178
N. Fork Klaskanine R.	5	14.0	Aug. 1949 Sept. 1955	829	1.5	66.3

Salinity and Classification by Mixing

No information was found for this area.

Sediments

Although quantitative data on the sedimentation rate is lacking, considerable filling of the Lewis and Clark River has been occurring during recent years. The Geological survey reports that a "turbidity maximum" normally develops in the Columbia River estuary (of which Young's Bay and the lower Young's and Lewis and Clark Rivers are part) because of a net circulation pattern in which dense saline water flows landward in the bottom layers and less dense fresher water flows seaward in the surface layers. The turbidity maximum is an area within which concentrations of suspended sediment, including some sand, are substantially higher than they are either downstream toward the mouth of the estuary or upstream in the Columbia River. Sample results taken near Astoria are presented in Table 3.

YOUNG'S BAY

Table 2B. Average Monthly Flows for Youngs River [140]

	Average Monthly Flows (cfs)		
	20%	50%	80%
October	176	91	26
November	456	291	138
December	598	389	262
January	571	392	248
February	536	392	254
March	403	286	193
April	273	186	109
May	119	78	48
June	69	46	27
July	29	20	12
August	14	11	8
September	24	12	7
Total			

S.M. 7- Correlated with S.M. 9.7 by Area-Precipitation

Area = 36 Sq. Mi.

Area-Precip. = 194,210 Ac.-Ft. [Calculated by SWRB '72]

YOUNG'S BAY

Table 2C. Average Monthly Flows for Lewis and Clark River [140]

	Average Monthly Flows		
	(cfs)		
	20%	50%	80%
October	241	125	36
November	624	398	189
December	817	532	359
January	780	536	339
February	733	536	347
March	551	392	264
April	374	255	149
May	162	107	66
June	94	63	37
July	40	27	16
August	19	15	10
September	33	16	9
Total			

S.M. 4- Correlated with Youngs River at S.M. 9.7 by Area-Precip.

Area= 50 sq. mi.

Area-Precip.= 265,530 AC.- Ft. [Calculated by SWRB '72]

YOUNG'S BAY

Hydraulic Description of Estuary

Table 3. Sediment Quality Characteristics.

	Sediment Analysis			EPA Tentative Criteria
	Sample No. *			
	1427	1428	1429	
Particle Size Distribution				
Gravel (6 mesh)	0%	1%	0%	No standard established
Sand	70%	51%	93%	"
Silt & Clay (-200 mesh)	30%	48%	7%	"
Chemical Characteristics (Cone % Dry wt.)				
Volatile Solids	4.5	4.8	2.2	6.0%
Chemical Oxygen Demand (COD)	3.8	2.7	2.0	5.0%
Initial Oxygen Demand (IOD)	0.45	0.49	0.26	No standard established
Oxygen-Reduction Potential	-0.13	-0.11	+0.01	"
Sulfides	0.13	0.25	0.04	"
Total Phosphorus	0.78	0.84	0.74	"
Kjeldahl Nitrogen	0.084	0.118*	0.049	0.10
Oil & Grease	0.061	0.101	0.031	0.15

*Grab sample locations noted on map.

*Exceeds EPA Tentative Criteria [123].

Sediments

According to the U.S. Army Corps of Engineers environmental statement on dredging of the Lewis and Clark connecting channel, the maximum intensifies, abates, and moves back and forth with the tide. It is most fully developed at about the time of peak velocities. The highest sediment concentrations are usually associated with low salinities and develop in the reach where net flow at the bottom is near zero. Maximum deposition often occurs in that area. During moderate river flow, the turbidity maximum develops highest values at about Columbia River mile 9 or 10 (the mouth of Young's Bay being at mile 12) [123].

YOUNG'S BAY

Water Quality Information

Water temperature data was taken at the North Fork Klaskanine River gating station near Olney, Oregon for the period of May 1950 to September 1954. (Table 8) [145]. Also miscellaneous flow and temperature measurements for the basin were made by the Oregon State Game Commission. Temperature ranges for these sources are presented in Table 4 [77,145].

Table 4. Temperature Extremes for Youngs Bay Drainage Basin [77,145].

Point of measurement	Period of record	Observed temperature extremes (F°)		type of observation
		maximum	minimum	
USGS--	May 1950			
N. Fork Klaskanine 4 mi. SE of Olney, Ore.	Sept. 1954	65°	34°	continuous
OSGC--	Jan. 1971			
N. Fork Klaskanine mouth	Aug. 1971	66°	44°	spot
S. Fork Klaskanine mouth	"	67°	44°	"
Youngs R. below Wawa Cr.	"	71°	44°	"
Lewis and Clark R. below Klickitat Cr.	"	70°	44°	"

Table 5 describes water quality characteristics for the Lewis and Clark River obtained at a site 1/2 mile above Peterson Slough at river mile 4.3, as reported by the Oregon State Department of Environmental Quality. Extensive bottom deposits of bark from log storage may create a physical barrier to the development of a healthy community of benthic organisms [123].

As of December 1967, there were two sewerage works projects needed in the Young's Bay area according to the Oregon State Sanitary Authority. Astoria needed a new sewer system and sewage treatment plant. The preliminary engineering study was underway. Schedule completion was July 1972. Warrenton needed sewer extensions, replacement or improvements and a new sewage treatment plant. As of December 1967, the preliminary engineering study and report had been completed. For further information contact the Oregon State Sanitary Authority [84].

DEQ water quality stations are listed in Table 8.

Table 5. Water Quality Characteristics, Lewis and Clark River
1/2 mile upstream of Peterson slough, river mile 4.3. [123].

Analysis	6/3/69	8/19/69	10/7/69	3/10/70	4/11/72
Time	1230	1430	1400	1215	1445
ph (field)	6.6	6.7	6.5	6.6	6.6
temperature	18.0	20.0	11.0	8.5	6.5
Orig. DO	8.2	6.3	9.1	11.4	11.9
Final DO	7.5	5.6	8.3	10.6	10.5
BOD	0.7	0.7	0.8	1.4	1.4
PBI	---	---	---	---	---
Cond.	---	---	---	78	120
MPN (total)	2400	230	230	620	230
ph (lab)	6.8	7.0	6.7	---	6.5
Color	.7	10	25	---	10
Turbidity	29	7	8	---	5
Solids (total)	91	1259	112	---	55
Solids (susp.)	17	20	19	---	---
Alkalinity	14	22	13	---	9
Hardness	20	198	18.7	---	14.8
SO ₄	7.1	7.4	9.7	---	4.59
NH ₃ -N	0.11	0.07	0.06	0.05	0.04
NO ₃ -N	0.24	0.07	0.25	0.21	0.25
PO ₄ -	0.03	0.08	0.05	0.03	0.02
Cl ⁻	8.8	594	22.4	---	12.2
Na	---	---	---	---	6.5
K	---	---	---	---	1.5
Fecal Coliform	---	230	230	---	60
Fecal Strep.	---	245	62	---	---

YOUNG'S BAY

Biological Information

Estimates of the number of adult anadromous salmonids spawning in the young's--Lewis and Clark River systems are as follows: fall chinook--500, coho--17,700, chum--200, winter steelhead--2,800, and sea-run cutthroat--1,000. A breakdown appears in Table 6 [77]. Non-anadromous fish include shad, chub, carp, sculpin, dace, and chisel mouth [123].

Table 6. Adult Anadromous Salmonid Spawning Estimate
[77]

Stream	Chinook		Coho	Chum	Steelhead		Sea-run Cutthroat
	Spring	Fall			Winter	Summer	
Lewis & Clark	---	50	3,000	50	750	---	500
Youngs	---	50	200	50	50	---	200
Klaskanine	---	400	14,000	100	2000	---	300

The Oregon State Game Commission recommends that the Lewis and Clark River be protected from gravel removal above the South Fork. It was also determined that possible reservoir sites in the North Fork of the North Fork of the Klaskanine River (T7N-R8W-S17) and Young's River (T7N-R9W-S27) are thought compatible with fishery resources [77].

Species of wil life present in the region in significant numbers are Black-tail deer, Roosevelt elk, marten, fisher, weasel, striped and spotted skunks, raccoon, opossum, bobcat, cougar, nutria, muskrat, mink, and beaver. Many species of waterfowl frequent the regions, primarily as migrants on the Pacific flyway. The most numerous ducks sighted are pintail and scaup. Upland birds include hummingbirds and wrens.

Three major plankton groups were found in the estuary. The freshwater (0.1‰ salinity or less) plankton were dominated by a copepod Cyclops vernalis, and cladocerans, Daphnia longispina and Bosmina spp. Seasonally abundant species included the cladoc rans Diaphanosoma brachyurum (summer), and Ceriodaphnia quadrangula (summer-fall), juvenile amphipods Corophium salmoinis (winter-spring), the rotifers Brachionis spp (summer), and copepod Diaptomus ashlandi (spring and summer). In brackish waters the copepod Eurytemora hirundoides made up 90-100% of the plankton population. In the waters of the salt intrusion, principal species were Acartia clausi, A. longiremus, and Psuedocalanus minutus; while seasonally abundant species included Oithana similis (fall), Acartia tonsa and Corycaeus affinis (fall), and Evadne nordamanni (summer-fall).

YOUNG'S BAY

Physical Alterations

A channel 10 feet deep and 150 feet wide from the Columbia River to the foot of Haren Island, a distance of about 2 1/2 miles across Young's Bay and 4 miles in Young's River, was authorized by the River and Harbor Act of 30 August 1935 and completed in 1938. Project, as modified under Section 107 of the 1960 River and Harbor Act, amended by Section 310 of the 1965 River and Harbor Act, and approved 7 January 1970, provided for a channel in Lewis and Clark River 10 feet deep and 150 feet wide from Young's Bay Channel to the State Highway 105 Bridge to the end of the project, a distance of about 4 1/2 miles. Total federal cost through June 1970 was: \$9,000 construction; \$50,000 maintenance. Estimated federal cost of the Lewis and Clark channel is \$190,000 [129].

Records of bank protection, dock, launch ramp, log dump, piling, cable, wire, and pipe permits in the estuary are kept by the U.S. Army Corps of Engineers, Portland District.

The Skipanon Waterway at the mouth of the Skipanon River was constructed June 1950 and is 30 feet deep [116].

Bridges over the estuary include the U.S. 101 Bridge, the Spokane, Portland, and Seattle Railroad Bridge (horizontal clearance 130', vertical clearance 18') the Young's Bay Bridge, U.S. 26 (horizontal clearance 120', vertical clearance 30.6') and the Oregon Coast Highway Bridge across the Lewis and Clark River (horizontal clearance 92', vertical clearance 25.2') [116,123].

Estuary Uses

Industrial and Commercial

Lumbering, dairying, stock raising, tourism, boat building, and fishing provide the economic base for the region. Seafood processing is an important industry.

The lowlands beside the navigable reaches of the Lewis and Clark River and Young's River are cleared and in agricultural use. Most other lands in the basin are mountainous and are managed for timber productions. Second-growth timber is the principal natural resource of the basin. Existing commerce consists mainly of rafted logs. Table 7 lists major manufacturers in the Young's Bay area [71,116,123].

Recreational

The main recreational activities in the area are fishing, hunting, sightseeing, picknicing, boating, clam digging, and crabbing.

One of the more popular places of interest in the area is the Fort Clatsop National Memorial. The site of Fort Clatsop was preserved by the Pregon Historical Society and later donated to the people of the United States. The 125-acre Fort Clatsop National Memorial was authorized by Congress in 1958 to commemorate the winter encampment of the Lewis and Clark Expedition following its successful crossing of the North American Continent [116,123,133].

Table 7. Major manufacturers at Youngs Bay. [71]

Location	Name	Type of Business	Number Employed
Astoria	Curtis Olson Logging, Inc.	Logging	6
"	Herman F. Labiske Logging	"	1
"	Johnson Logging & Dairyman, H.B.	"	20
"	Nygaard Logging Co., M.	"	20
"	W & W Logging Co.	"	47
"	Astoria Plywood Corp.	Veneer and Plywood	235
"	Mayflower Farms	Fluid milk	9
"	Barbey Packing Corp.	Canned and cured Fish and Seafoods	50
"	Bumble-Bee Seafoods-Astoria	"	500
"	Union Fishermans Coop. Pkg. Co.	"	115
"	Astoria Fish Factors Inc.	Fresh or Frozen Packaged Fish and Seafood	25
"	Astoria Seafood Co.	"	50
"	Ocean Foods of Astoria Inc.	"	65
"	Coca-Cola Bottling Co.	Bottled and Canned soft drinks and Carborated water	7
"	Van Dusen Beverages	"	8
"	Astorian-Budget Publishing Co.	Newspapers-Publishing, Publishing and Printing	50
"	Astoria Printing Co.	Books-Publishing, Publishing and Printing	42
"	Consolidated Printing and Stationery Inc.	"	5

Table 7. (cont.)

Location	Name	Type of Business	Number Employed
Astoria	Sunset Crushed Rock Co.	Minerals and Earths, Ground or Otherwise treated	6
"	American Can Co.	Metal cans	15
"	Phillips-Drucker Div.	Pumps, Air and Gas Compressors and Pumping Equipment	35
"	Astoria Marine Construction Co.	Shipbuilding and Repairing	23
Warrenton	Pacific Shrimp Inc.	Canned and Cured Fish and Seafoods	17
"	New England Fish Co.	Fresh or Frozen Packaged Fish and Seafoods	45
"	Bioproducts Inc.	Prepared Feed for Animals and Fowls	50
"	Warrenton Lumber Co.	Sawmills and Planing Mills	85
"	Lektro Inc.	Industrial Trucks, Tractors, Trailers, and Stackers	20
"	Carruthers Co., E.H.	Food Products Machinery	16

Table 8. Surveillance Stations at Youngs Bay

Type of Station	Name &/or Identifying number	Approximate Location	Drainage Area	Period of record	References
Cumatological	Astoria Experiment Station	Lat. 46° 09' Long. 123° 49' El. 48		1918-1971	[143]
"	Astoria WSO	Lat. 46° 09' Long. 123° 53' El. 8		1953-1971	"
Water Quality	N. Fork Klaskanine R. near Olney, Ore.	Lat. 46° 04' Long. 123° 42'	14.0	May 1950- Sept. 1954	[145]
Stream Gaging	Youngs R. near Astoria	Lat. 46° 04' Long. 123° 47'	40.1	Aug 1929 Sept. 1958	[147]
"	N. Fork Klaskanine R. near Olney, Ore.	Lat. 46° 04' Long. 123° 42'	14.0	Aug 1949 Sept. 1955	[146]
Water Quality	Skipanon R. near Dam and 8th St.	River mile 2.2			[152]
"	Skipanon R. near Clatsop Sta. Rd.	River mile 4.7			"
"	Skipanon R. near Cullaby L.	River mile 7.4			"
"	Lewis and Clark R. 1/2 mile above Peterson Slough	River mile 4.3			"
"	Lewis and Clark R. below Klickitat Cr.	River mile 7.9			"
"	Youngs R. near Ore. 1 Br.	River mile 9.1			"
"	S. Fork Klaskanine R. near mouth	River mile 0.01			"
Water Quality	N. Fork Klaskanine R. below Fish Hatchery	River mile 0.5			"
"	N. Fork Klaskanine R. above Fish Hatchery	River mile 3.5			"

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