NORTH COAST BASIN

STATE WATER RESOURCES BOARD
SALEM, OREGON
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ON LOAN
from
STATE WATER RESOURCES BOARD
500 Public Service Building
Salem, Oregon 97310

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COVER PICTURE

Coastal scene near Cannon Beach, Oregon. Oregon State Highway Department photo.

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PURPOSE AND INTRODUCTION

The purpose of this report is to set forth in a condensed form the major items considered by the State Water Resources Board in its formulation of an integrated, coordinated program of use and control of the water resources of the North Coast Basin in Oregon.

The board's investigation activities were completed in April 1961. The study was made in conformity with ORS 536.300(1) which states:

> *"The board shall proceed as rapidly as possible to study: existing water resources of this state; means and methods of conserving and augmenting such water resources; existing and contemplated needs and uses of water for domestic, municipal, irrigation, power development, industrial, mining, recreation, wildlife, and fish life uses and for pollution abatement, all of which are declared to be beneficial uses, and all other related subjects, including drainage and reclamation."*

Having completed the study necessary to formulate and implement an integrated, coordinated water resources program, the board proposes to adopt a program for the North Coast Drainage Basin. This program will fulfill the requirements of ORS 536.300(2) which states:

> *"Based upon said studies and after an opportunity to be heard has been given to all other state agencies which may be concerned, the board shall progressively formulate an integrated, coordinated program for the use and control of all the water resources of this state and issue statements thereof."*

The program will be based on the standards outlined in ORS 536.310 and the data obtained in the basin investigation. A summary of basic data and factors examined in the study are contained in the report. Detailed information is available for examination in the files of the board in Salem, Oregon.

Data for study and evaluation were made available through (1) physical field activity, (2) review of available reports and data, (3) extensive personal contact, (4) formal hearings on the basin's water needs and problems (Astoria, January 4, 1961 and Tillamook, January 5, 1961), (5) data supplied by the Department of Agriculture (Soil Conservation Service, Forest Service, and Agricultural Research Service) through a cooperative program with the State Water Resources Board, and (6) submission of data to the board, at its request, by local, state, and federal agencies and other groups.

GENERAL CONCLUSIONS

1. *Population and economic growth in the basin will depend primarily upon further development of natural resources and the degree to which these resources are processed by local industry. Availability of water will continue to be of importance but probably will not be critical.*

2. *Total yields of surface water are sufficient to satisfy current and presently foreseen needs, including recommended minimum flows for fish life.*

3. *Basic data are not adequate to properly determine the amount or distribution of the waters of several of the major independent stream systems of the basin. Reestablishment of recently closed recording stations, the addition of new stations, and detailed ground water studies would be necessary in order to more completely identify the water resources of the basin.*

4. *Natural seasonal distribution of annual yields of surface water does not provide sufficient water for current needs during low flow months on some streams, or for future needs on most streams.*

5. *There are a few streams where rights for fish life limit upstream use of water for consumptive purposes.*

6. *The Clatskanie and Klaskanine Rivers and their tributaries, the Lewis and Clark River, and Tillasqua Creek (Big Creek) have been withdrawn by the Legislature for the protection of fish life.*

7. *Over 90 percent of the average annual basin yield is unappropriated and is subject to the jurisdiction of the State Water Resources Board.*

8. *Use of the waters of certain major streams or sections of these streams, a few lakes and numerous minor streams is limited due to physical characteristics, location, land ownership, or economic potential.*

9. *Known ground water supplies are of limited quantity throughout most of the basin, and are relatively poor in quality.*

10. *The major consumptive water rights are for municipal and irrigation uses. Rights for fish life represent nearly 85 percent of the total for nonconsumptive use.*

11. *Major future water use, quantitatively, is expected to be for industrial, power, and fish life purposes. Much of the industrial use will probably be provided from municipal supplies.*

12. *There is no major out-of-basin diversion at present, but plans for diversion to*

Mid-Willamette Basin cities for municipal use have been proposed. Annual quantities to be diverted under these proposals are a small part of the average annual yield of the streams involved.

13. *Storage relative to out-of-basin diversions could be of benefit to the North Coast Basin by maintaining higher minimum flows through summer releases, but could be detrimental if not coordinated with downstream needs.*

14. *Domestic, livestock, and wildlife uses of water, while important, represent a minor share of existing and contemplated future water use.*

15. *Municipal water rights are the largest group of rights in the basin at present. A substantial share of these rights are held primarily to insure a supply for present and potential industrial water users. Future increases in municipal supplies for other than industrial purposes will probably be limited.*

16. *Shortages of irrigation water occur during the late summer months in some areas.*

17. *Irrigation will probably expand in the future and storage facilities will be needed to provide water in some areas. Economic justification of storage projects for irrigation alone is questionable at this time.*

18. *Potential for power development exists on the Nehalem, Trask, Wilson, and Nestucca Rivers.*

19. *Further studies would be necessary to determine the economic and physical feasibility of potential power projects.*

20. *Conflicts exist between fish life use of water and proposed storage projects.*

21. *There is potential for industrial development in the basin.*

22. *Existing water supplies would have to be developed, in some areas, to make possible major expansion of industries which require large quantities of water.*

23. *Water supplies are adequate for present and anticipated mining needs.*

24. *A major portion of water-based recreation in the basin is associated with ocean beaches.*

25. *Sport fishing is the leading water-based recreation associated with inland streams.*

26. *Commercial fishing is vital to the economy of the basin.*

GENERAL CONCLUSIONS

27. *Data indicating the extent to which commercial fishing is dependent upon spawning areas in the basin is not available.*

28. *Flows in many streams during the summer months fall below recommended minimums for fish life.*

29. *There are no major pollution problems in the basin at present. Increased development and use of recreational areas could create pollution problems.*

30. *Flooding, drainage, and streambank erosion are not major problems.*

31. *Flood control and streambank erosion problems would be decreased by upstream storage, but benefits would justify little of the cost of such projects.*

NORTH COAST BASIN STUDY

CHAPTER 1 THE BASIN

GENERAL

Location and Size

The drainage area of the North Coast Basin is shown on Plate 1 and the location of the basin in the extreme northwestern part of the state is shown on the key map in the upper right hand corner of the plate. This drainage basin covers an area of approximately 2,700 square miles, or 1,730,000 acres, which is about three percent of the area of the State of Oregon.

Basin boundaries consist of the Pacific Ocean on the west, the Columbia River on the north, the Coast Range Divide on the east, and the divide between Neskowin Creek and Salmon River on the south.

The basin measures approximately 85 miles in a north-south direction and nearly 60 miles in an east-west direction across the northern portion. The eastern boundary follows a general southwesterly course, reducing the southern width of the basin to approximately 10 miles.

TABLE 1

AREAS OF COUNTIES LYING WITHIN THE NORTH COAST BASIN

COUNTY	TOTAL AREA Sq. Mi.	*AREA WITHIN NORTH COAST BASIN			
		Sq. Mi.	Acres	% of County	% of Basin
Clatsop	921	921	589,440	100.0	34.0
Columbia	688	543	347,520	78.9	20.1
Polk	739	3	1,920	.4	.1
Tillamook	1,115	1,091	698,240	97.8	40.3
Washington	716	85	54,400	11.9	3.2
Yamhill	709	62	39,680	8.5	2.3
TOTAL	4,888	2,705	1,731,200		100.0

*Determined from SWRB Map No. 1.7014

As shown by Table 1, the North Coast Basin includes all of Clatsop County, 98 percent of Tillamook County, 79 percent of Columbia County and a small portion of Washington, Yamhill, and Polk Counties. Water areas are included in the figures shown in this table.

Sub-basin Divisions

Because of differences in physical characteristics, needs and uses of water, and levels of economic development, the basin has been divided into three sub-basins for individual treatment (Plate 1).

Sub-basin 1, Tillamook, consists of all drainage south of the Nehalem watershed. Sub-basin 2, Nehalem, is composed entirely of the Nehalem River and Bay drainage. The remainder of the basin, all drainage north of the Nehalem watershed including Columbia River drainage, makes up Sub-basin 3, Columbia.

THE BASIN

Stream System

All stream systems of the basin drain into either the Pacific Ocean or the Columbia River. The Pacific Ocean portion constitutes the major share of the basin. This area is drained by the Little Nestucca and Nestucca Rivers emptying into Nestucca Bay; the Tillamook, Trask, Wilson, Kilchis, and Miami Rivers emptying into Tillamook Bay; the Nehalem River emptying into Nehalem Bay; and the Necanicum River flowing directly into the ocean between Seaside and Gearhart. Major streams draining into the Columbia are the Clatskanie River, Big Creek, Youngs River, and Lewis and Clark River. Stream miles of these and other tributaries are shown on Plate 1. None of the drainage areas exceed 200 square miles except the Nehalem River which drains an area of over 700 square miles.

Only a few rivers in the North Coast Basin are more than 30 miles in length. The Nehalem River with a main stem of 118 miles is the longest. Other rivers are the Nestucca, 53 miles; Wilson, 43 miles; Trask, 39 miles; Clatskanie, 28 miles; and Lewis and Clark, 27 miles.

Basin streams total over 4,000 miles in length, of which nearly 3,000 miles are perennial in nature. The extent of perennial and intermittent streams in each sub-basin is given in Table 2, which also lists the areas of the sub-basins.

TABLE 2

SUB-BASIN AREAS AND MILES OF STREAMS

SUB-BASIN	AREA(1)(2) Sq. Mi.	(2)MILES OF STREAMS Perennial	Intermittent	Total
1 Tillamook	958	1,155	265	1,420
2 Nehalem	845	930	425	1,355
3 Columbia	902	855	400	1,255
TOTAL	2,705	2,940	1,090	4,030

(1) Areas include the Columbia River within the boundaries of the State of Oregon and coastal bays within the main shore line.

(2) Determined from SWRB Map No. 1.7014.

A profile of the more important streams in the North Coast Basin is shown on Plate 2. In general, the streams exhibit relatively steep gradients in their headwater sections and very flat gradients in the lower sections. Stream gradients are summarized in the appropriate sub-basin sections of Chapter III.

Climate

The North Coast Basin has a humid climate resulting from the temperature moderating influence of the Pacific Ocean and from intensification of rainfall induced by the Coast Range. Some variation in this pattern is brought about by effects of the Columbia River Gorge along the northern boundary of the basin.

There is a general lack of uniformity in the rainfall distribution pattern throughout the

basin as shown by Plate 3. This plate is based on Weather Bureau data, U. S. Geological Survey data, and Corps of Engineers' isohyetal maps.

Average annual precipitation is lowest, about 40 inches, in the northeast corner of the basin near Rainier and remains below 80 inches along the Columbia River.

The highest precipitation, 150 inches, occurs near the northern boundary of the Tillamook sub-basin, on the headwater areas of the Kilchis and Wilson Rivers. Most of the Tillamook sub-basin has average annual precipitation above 80 inches, with the lowest values occurring along the eastern boundary.

In the Nehalem watershed, the lowest precipitation, 50 inches, also occurs towards the eastern boundary. Average annual values increase in a westerly direction to a high of more than 140 inches over the headwaters of Cook Creek, and then decrease to about 90 inches over the coastal strip.

In general, annual precipitation ranges between 80 and 100 inches all along the coastal portion of the basin, except near the mouth of the Columbia where it decreases to less than 70 inches.

Snowfall varies considerably in the different parts of the basin. It is quite light along the coast with annual averages of 5 inches at Cloverdale and Astoria, and increases eastward up the Columbia River to an average of 14 inches at Clatskanie. Moving southward, there is an average of 32 inches at Vernonia, increasing to approximately 47 inches in the area of Lees Camp. Snow does not often remain on the ground for more than a week at a time in the valley areas but at the highest elevations may remain throughout the colder winter months. However, it does not have an appreciable effect on the pattern of stream runoff in the basin.

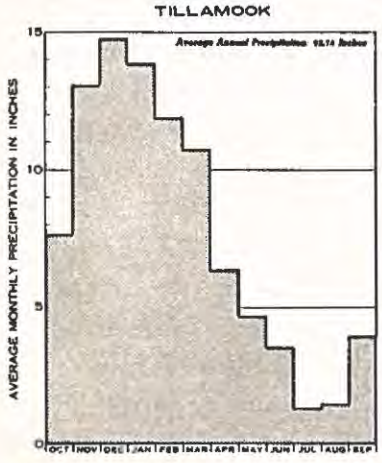


FIGURE 1. Average monthly precipitation at Tillamook, 1889-1929 and 1932-1959.

Monthly distribution of seasonal precipitation is illustrated by Figure 1, which shows this information for the Tillamook station. This pattern is representative of the entire basin although the magnitude of monthly values varies appreciably from area to area.

Most of the precipitation occurs during the fall and winter, with 75 to 85 percent of the annual precipitation occurring during the months of October through March. The lowest precipitation, usually well below two inches, generally occurs during both July and August.

Hailstorms, thunder storms, and severe rainstorms are the exception and fog and cloudiness the rule during the winter. The heavy rainfall of winter generally comes in moderate rains that may continue without interruption for several days.

The highest temperatures recorded at weather bureau stations, 106 degrees Fahrenheit, have occurred at Vernonia and near Lees Camp. The lowest temperature, minus 8° F., was also recorded at Vernonia. Average annual temperatures at various locations along the coast and in the interior valleys are very uniform and range from 49 to 52° F.

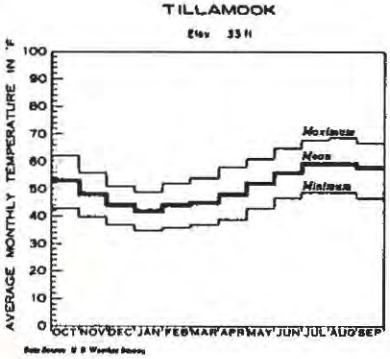


FIGURE 2. Long-term average monthly air temperature at Tillamook.

Monthly temperature averages are shown in Figure 2 for Tillamook and are representative of the pattern throughout the basin. Mean temperatures range between 42 and 59° F. annually with the average minimums ranging from 35 in January to 48° F. in August and the average maximums from 49 to 69° F. for the same months.

The average number of days without killing frosts along the coast and the Columbia River ranges from 182 days at Tillamook to 273 days at Astoria. In the interior portions, the range is from 140 days near Lees Camp to 188 days at Vernonia.

Population

Table 3 shows the population distribution in the basin by counties and sub-basins. The

TABLE 3

COUNTY POPULATION DISTRIBUTION*
BY SUB-BASINS

SUB-BASIN	COUNTY						TOTAL
	Clatsop	Columbia	Polk	Tillamook	Washington	Yamhill	
1 Tillamook	0	0	10	17,050	0	50	17,110
2 Nehalem	600	2,440	0	1,500	490	0	5,030
3 Columbia	26,780	12,990	0	410	0	0	40,180
TOTAL IN BASIN	27,380	15,430	10	18,960	490	50	62,320

* SWRB estimate

total population of the North Coast Basin for 1960 was estimated to be 62,300 (including St. Helens) which is approximately 3.5 percent of the total population of the state. Sixty-four percent of the population of the basin is concentrated in the Columbia sub-basin.

There are 19 incorporated cities in the basin of which 8 have populations above 1,000. Astoria, population 11,220, is the largest and Prescott, population 129, the smallest. Population trends for incorporated cities are shown and discussed in Chapter III in the appropriate sub-basin section.

There are 137 unincorporated communities in the basin but population estimates are known for only 59 of them. These range in size from 600 downward, with the majority being below 150.

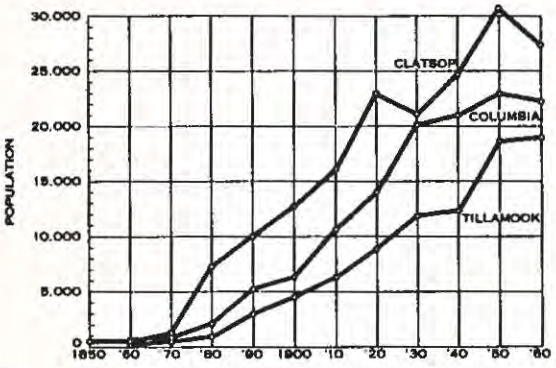


FIGURE 3. County population growth, 1850-1960.

Trends in county populations since 1850 are illustrated in Figure 3. The North Coast Basin was among the earliest settled regions in Oregon and the first white settlement in Oregon was a fur trading post established in 1811 at the present site of Astoria. Population growth was slow until 1870 when a large increase was experienced in Clatsop County due to expansion of the salmon canning and timber industries. A fairly steady growth was experienced in the entire basin until 1930 with the exception of Clatsop County whose population dropped between 1920 and 1930, due to the 1922 Astoria fire. Clatsop County experienced a relatively high growth rate between 1930 and 1950 as a consequence of expansion in fish processing, forest product industries, agriculture, tourist trade, and during the second world war, in ship building and military installations. Its population dropped during the last 10 years due to reduced fishing, logging, and military activities.

The growth of Tillamook County between 1930 and 1940 was restricted by the Tillamook forest fire of 1933 which consumed half of the county's extensive sawtimber resources. Population increased rapidly in the 1940's as a result of the construction of an air base, the greatly expanded logging of burned timber, and an increase in the dairy production. Only a slight growth was experienced during the last 10 years because of a reduction in military establishments and leveling off of salvage logging.

Logging activity in Columbia County reached its peak during the 1920's and, as a consequence, the county's population increased only slightly from 1930 to 1950 and has declined some since then.

ECONOMIC FACTORS

Land Ownership

Table 4 shows the land ownership for the three sub-basins in terms of federal, state,

TABLE 4

LAND OWNERSHIP OR ADMINISTRATION

SUB-BASIN	*AREA IN ACRES				
	Federal	State	Counties and Cities	Private and Others	Total
1 Tillamook	160,800	243,400	7,100	201,800	613,100
2 Nehalem	5,300	210,800	2,700	322,000	540,800
3 Columbia	6,100	134,600	20,100	416,500	577,300
BASIN TOTAL	172,200	588,800	29,900	940,300	1,731,200
PERCENT OF BASIN AREA	10.0	34.0	1.7	54.3	100.0

*Determined from SWRB Map No. 1.707

county and city, and private ownership. Nearly 55 percent, 940,300 acres, of the total basin area is in private ownership. Approximately 34 percent, 588,800 acres, is in state ownership ranking this basin first in terms of percentage of area owned by the state. Only 10 percent, 172,200 acres, is owned or administered by the federal government. Of this federal ownership, the majority, 160,800 acres, is in the Tillamook sub-basin, with only 5,300 acres in the Nehalem sub-basin, and 6,100 acres in the Columbia sub-basin. County and city ownership makes up a little less than two percent of the basin area.

Major areas of federal forest land in the basin are in the southern part of Tillamook County, which contains the northern portion of the Siuslaw National Forest. This is mostly old growth timber having good production capabilities.

The Tillamook forest fires damaged land in both Nehalem and Tillamook sub-basins and much of this area was later acquired by the counties due to tax delinquency. The counties subsequently turned this land over to the state for management purposes and continue to share in the revenue from timber and land sales. Much of this land has been reforested by the State Board of Forestry

The Columbia sub-basin has the highest percentage of private ownership, much of which is controlled by a few large timber companies.

Timber

The importance of timber resources in the North Coast Basin is indicated by the fact that

approximately 1,510,000 acres of the total 1,731,000 acres in the basin are in forest lands. Ninety-nine percent of this is classed as commercial forests which are lands available for and capable of producing marketable timber.

Forest land areas and sawtimber volumes, determined from data supplied by the U. S. Forest Service, are shown by counties in Table 5.

TABLE 5

FOREST AREAS AND SAWTIMBER VOLUMES

COUNTY	TOTAL FOREST AREA	COMMERCIAL FORESTS														NONCOMMERCIAL FORESTS	
		AREA	SAWTIMBER VOLUME	% OF TOTAL SAWTIMBER VOLUME												PRODUCTIVE RESERVED	UNPRODUCTIVE
				Softwoods(1)								Hardwoods(2)					
	Acres	Acres	Million Bd. Ft.	DF	WH	SS	WR	LP	PS	GF	TOTAL	RA	BM	OO	TOTAL	Acres	Acres
Clatsop	472,600	465,600	6,560	25	60	6	3	0	1	*	95	5	*	0	5	3,900	3,100
Columbia	341,600	341,600	2,410	79	1	*	4	0	0	4	89	8	2	1	11	0	0
Tillamook	669,800	666,000	13,840	41	31	18	1	*	0	0	92	8	*	0	8	3,800	0
TOTALS	1,484,000	1,473,200	22,810	41	36	13	2	*	*	*	92	7	*	*	8	7,700	3,100

(1) Softwoods: DF-Douglas fir, WH-western hemlock, SS-sitka spruce, WR-western red cedar, LP-lodgepole pine, PS-Pacific silver fir, GF-grand fir.

(2) Hardwoods: RA-red alder, BM-bigleaf maple, OO-Oregon white oak.

*Less than one percent

Source: U. S. Forest Service

Softwoods are predominant on about 80 percent of the commercial forest lands of the basin, with Douglas fir the major species, followed by western hemlock and sitka spruce. There are minor acreages of other softwoods, including western red cedar, lodgepole pine, Pacific silver fir, and grand fir.

The principal hardwood is red alder. Hardwoods exceed other species on less than 10 percent of the commercial acreages, with the remainder unstocked at this time.

The approximate percentage of total sawtimber volume for various species is Douglas fir 41 percent, western hemlock 36, sitka spruce 13, other softwoods 2 percent, and all hardwoods 8 percent.

Of the 172,000 acres of nonstocked land, 83 percent was destroyed by fire, mostly within the Tillamook Burn area, and the remainder is clear-cut land scattered throughout the three counties.

The three major forest fires occurred in 1933, 1939, and 1945. These fires covered large portions of the northern section of Tillamook sub-basin and some of Nehalem sub-basin. Of the total 355,000 acres of burned area, 255,000 acres are now owned by the state and 150,000 acres of this has been reforested by the State Board of Forestry.

Private companies own most of the remainder and have reforested an estimated 90,000 acres. This brings the total reforested area to about 70 percent of the burned area.

Noncommercial forests comprise only 10,800 acres, or less than one percent of the total forest area of the three counties. Of this, 3,100 acres are classified as rocky, sterile lands not capable of supporting commercial timber stands. The remaining 7,700 acres are reserved commercial forest lands within state parks, federal lighthouse reserves, and federal military reservations.

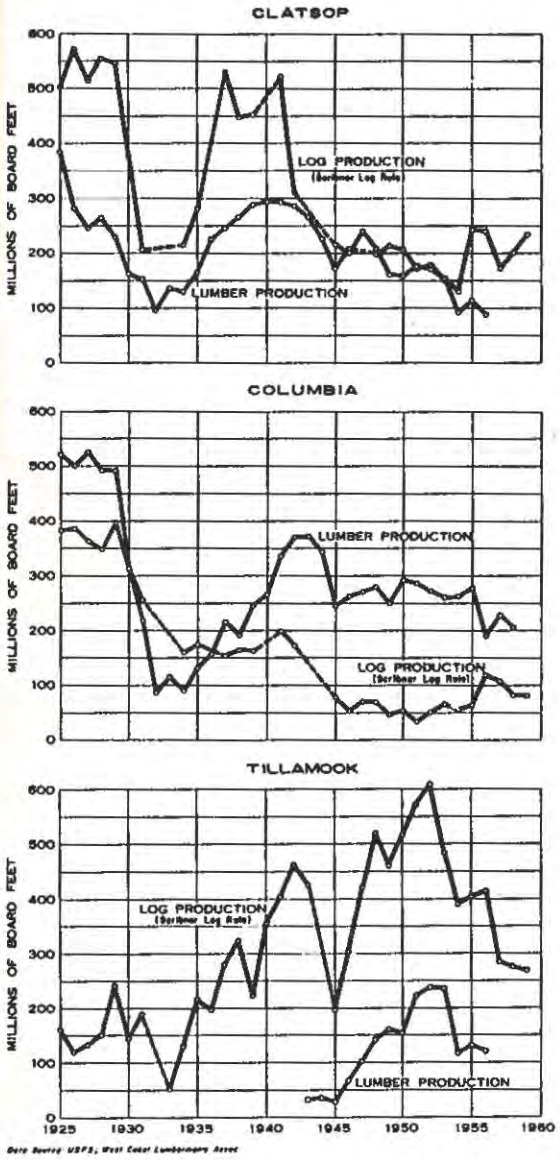


FIGURE 4. Log and lumber production by counties, 1925-1960.

Logging and sawmill operations in Clatsop and Columbia Counties were among the earliest in Oregon. The early operations selectively cut only the large, high-grade timber fronting on the Columbia River. Beginning about 1910, logging railroads began opening up practically all portions of these two counties. By the 1920's, log production had increased to the extent that Clatsop County ranked first and Columbia second in the state.

Annual log and lumber production within the major counties of the basin have varied appreciably over the years. The trend by counties from 1925 through 1959 can be seen in Figure 4.

Peak production in Columbia County was reached in 1927 with 527 million board feet, Scribner rule. A noticeable decline in log production followed as several large timber holdings were cut out. In 1951, only 35 million board feet of logs were cut. By then, some second growth timber had reached sawtimber size and log production has since risen, averaging 90 million board feet in the five-year period, 1955-1959.

Peak production in Clatsop County was reached in 1926 with 572 million board feet. Log production in Clatsop County also dropped sharply in the early 1930's but rose nearly to

the previous high late in the decade. Starting in 1942, log production declined again until it reached its minimum of 132 million board feet in 1954. Since then it has shown a gradual increase averaging 218 million board feet in the five-year period, 1955-1959.

Log production in Tillamook County shows a completely different pattern than that of the Columbia River counties. Timber operations in this county were on a small scale until 1911, when the opening of a railroad between Portland and Tillamook provided a new outlet for both logs and lumber. Log production showed a stready increase until 1933 when the first of the Tillamook fires burned over 245,000 acres in northwestern Oregon, including 149,000 acres of Tillamook County's finest sawtimber.

Since 1933, salvage logging of fire-killed trees in Tillamook County has been more important than harvesting of green timber. Log production increased rapidly until 1952, except for major drops in 1939 and 1945 caused by the second and third Tillamook burns. Peak production in Tillamook County was 610 million board feet in 1952, of which 447 million board feet came from dead timber. Then salvage activity decreased, and log production dropped to 269 million board feet in 1959.

Lumber production in the three counties does not always follow the same pattern as log production. The reason for this is, in part, the large exchange of logs between counties, especially along the Columbia River.

Clatsop County's lumber production followed the same pattern as that for logs until 1945, when importing of logs caused lumber to increase over log production for a number of years.

In Columbia County, the production patterns were similar until the late 1930's when lumber surpassed logs due to a large amount of logs imported from the Willamette Valley and other areas.

Lumber production in Tillamook County follows the same pattern as that for logs but is of much smaller magnitude due to the large amount of logs exported to Willamette Valley mills.

A further discussion of lumber and other wood processing is given under Industry. The basin potential in terms of long-range development of its timber resources is discussed in Chapters II and III.

Agricultural Land

Nearly all agricultural lands of Clatsop and Tillamook Counties, and over 75 percent of

the agricultural land of Columbia County, lie within the basin. Of the total North Coast area of 1,731,000 acres, 203,000 acres, 12 percent, is in farm land. Of this, 178,000 acres are judged by the Soil Conservation Service to be suitable for cultivation, and irrigable.

Table 6 shows acreages by land capability classifications and by sub-basins. This shows

TABLE 6

IRRIGABLE ACREAGE BY LAND CAPABILITY CLASS

SUB-BASIN	ACRES BY LAND CAPABILITY CLASS										TOTAL IRRIGABLE ACRES
	I	II			III			IV			
		e	s	w	e	s	w	e	s	w	
1 Tillamook	6,670	7,150	1,010	5,270	4,320	6,670	3,040	4,460	0	7,570	46,160
2 Nehalem	5,650	800	870	600	1,400	350	6,480	4,000	0	2,300	22,450
3 Columbia	710	1,600	1,170	8,100	27,030	3,000	20,920	23,300	2,920	20,420	109,170
TOTALS	13,030	9,550	3,050	13,970	32,750	10,020	30,440	31,760	2,920	30,290	177,780

e - dominantly subject to wind and/or water erosion
s - limited chiefly by soil conditions
w - subject to excessive wetness or overflow

Source: U. S. Department of Agriculture

a total of approximately 13,000 acres in Class I, which is considered very good cultivable land with no special difficulties. Approximately 64,000 acres are in the lowest category, Class IV, which is considered fairly good land suitable for occasional cultivation but best suited for hay, pasture, or orchard and vineyard. The remaining 100,000 acres are in Classes II and III.

TABLE 7

AGRICULTURAL LAND USE
1959

USE	ACRES	PERCENTAGE OF TOTAL LAND IN FARMS
Cropland harvested	31,661	15.6
Cropland; pasture only	43,503	21.5
Cropland; cultivated, fallow	646	0.3
Cropland; idle or failure	3,654	1.8
TOTAL CROPLAND	79,464	39.2
Woodland; pastured	31,619	15.6
Woodland; not pastured	59,531	29.4
TOTAL WOODLAND	91,150	45.0
Other land; pastured	17,945	8.8
Other land; not pastured	14,100	7.0
TOTAL OTHER LAND	32,045	15.8
TOTAL LAND PASTURED	93,067	45.9
TOTAL LAND IN FARMS	202,659	100.0

Source: U. S. Department of Agriculture

Total land in farms reached a peak in 1940 and has had a general and steady decline since that time. Part of this is due to the fact that some of the lands which were originally converted from forests to farm use are now being put back into forest production. The general trend in cropland acreage has been gradually upward, largely due to increases in acreage devoted to pastures. Currently about 3,100 acres in harvested crops and 6,800 acres in pasture are irrigated.

Use of agricultural land in 1959 is indicated in Table 7. Approximately 39 percent was

cropland, 45 percent woodland, including pastured woodland, and slightly under 16 percent other lands, pastured and not pastured.

Of the 79,500 acres in cropland, only 31,700 acres, 40 percent, were in crops harvested. Of these, nearly 85 percent were hay crops.

The principal agricultural activity of the basin is dairying. The local market for dairy products is enhanced by the manufacture of cheese, for which Tillamook is nationally famous. Although the basin does not have a large share of land in agricultural production, ability to use the land for dairy and beef cattle production and raising of hay and pasture has enabled the area to develop a good agricultural economy.

A unique agricultural activity of this area is the raising of mink. The five major mink producing counties of Oregon include Clatsop, Tillamook, and Columbia Counties in this basin. Marion and Multnomah Counties make up the remainder. As of 1956, Oregon ranked sixth in the nation in mink production, producing approximately four percent of the national annual production of nearly three million pelts.

The U. S. Bureau of Census lists the value of farm products sold in 1954 for the three principal counties of the basin as $11,500,000. Although this is only one-fifth the value added by manufacturing for the same year, farm products are the basis for food processing which, in turn, plays an important role in the total value of manufacturing.

TABLE 8

GROSS AGRICULTURAL INCOME
1959

COMMODITY	GROSS VALUE $1,000	PERCENTAGE OF TOTAL GROSS INCOME
Livestock and livestock products other than poultry, dairy, and mink	2,112	14.4
Poultry and poultry products	583	4.0
Dairy products	8,376	56.9
Mink products	2,125	14.4
TOTAL LIVESTOCK AND LIVESTOCK PRODUCTS	13,196	89.7
Vegetables	44	0.3
Fruits, nuts, and vineyard produce	273	1.9
Horticultural specialities	134	0.9
Field crops	455	3.1
TOTAL CROPS	906	6.2
Forest products	602	4.1
TOTAL GROSS INCOME	14,704	100.0

Source: U. S. Department of Agriculture

Estimated gross agricultural income for the basin for 1959 is shown in Table 8. This amounted to nearly 15 million dollars. Ninety percent of the basin's agricultural income was from livestock and livestock products, of which 57 percent was from dairy products alone. Crops sold amounted to only six percent of the total agricultural income, the remaining four percent being made up by forest products.

Of the total population of the North Coast Basin, over 62,000 people, it is estimated that about 15 percent are engaged in farming. The rural farm population increased

between 1930 and 1940 but the trend since then has been downward. The rural non-farm population remained fairly stable from 1930 to 1940 but has increased substantially since that time.

There are about 1,950 farms in the North Coast Basin. Of these, approximately 45 percent are commercial farms and 55 percent part-time farms. U. S. Department of Agriculture data indicate that the percentage of farm operators working off the farm has risen from 50 percent in 1939 to 61 percent in 1959. Currently, 38 percent work 100 days or more each year off the farm.

Minerals

Data from the State Department of Geology and Mineral Industries indicate that known economic mineral resources of the North Coast Basin include reserves of ferruginous bauxite. These occur as fairly extensive deposits covering an area from the Columbia River, in the vicinity of Rainier, south into the Willamette Basin. This deposit is said to be the largest unmined source of alumina in the United States. The general area in which this mineralization is known to occur is indicated in Plate 4 along with other mineral deposits and active mines.

In the same general area, there are numerous deposits of limonite, an ore of iron. Recent developments in direct reduction have placed this ore in a much more favorable position than formerly. There is a possibility that a small, low-cost steel plant, using low-grade coals from the Vernonia-St. Helens area, might successfully process the iron ore. Other low-grade coal deposits occur on Neahkahnie Mountain north of Nehalem.

Expandable shales of the Keasey formation are found exposed at many places in the area south and west of Vernonia. Two plants are presently quarrying and expanding the material to provide lightweight aggregate for concrete building blocks.

Sand deposits containing considerable concentrations of magnetite, an ore of iron, are located in the bed of the Columbia River near its mouth. Preliminary plans are under way for development of these deposits in the near future. These plans include the location of a plant in the Astoria area which would extract the iron ore for shipment to smelters in other areas. Long-range plans include the possibility of also locating a smelter in the area. Similar deposits are located on the south bank of the Columbia near Hammond.

Deposits of sand and gravel, and rocks suitable for crushed aggregate and large jetty blocks, are found at many places in the basin. In general, there is no shortage of sand and gravel aggregate, but location of deposits with respect to point-of-use is not

always the best. Quarries capable of supplying jetty blocks presently are few in number. As the area develops, the demand for these commodities will increase since they are basic construction materials.

Several deposits of clay suitable for pottery and drain tile are located in the basin. One such deposit currently supports an active operation producing drain tile in the Tillamook area.

Oil and gas exploration has been carried on periodically in the North Coast Basin since 1910. Representative exploratory wells are shown on Plate 4. As of December 1960, a total of 49 wells had been drilled in the basin; 29 in the Columbia sub-basin, 18 in the Nehalem sub-basin, and 2 in the Tillamook sub-basin. These wells range in depth from 85 to 8,500 feet. To date, no oil and very little gas have been found. With the passage of legislation by the 1961 State Legislature permitting offshore drilling, at least two major oil companies are planning exploratory programs there.

Much of the basin has not been examined geologically in sufficient detail to determine whether or not other mineral resources are available.

Nearly all mineral production in the basin is associated with sand, gravel, stone, and shale. Annual production values now total about $600,000 which is about one percent of the state total.

Fish Life

The State of Oregon is well known for its fishing, both stream and coastal. The commercial aspect of fishing is now limited primarily to coastal waters and the Columbia River. No North Coast streams are open commercially, although chum salmon fishing is allowed in Tillamook Bay. All remaining Oregon coastal streams were closed to commercial fishing in 1956.

Commercial fishing is important to the economy of the North Coast Basin, especially in the Astoria area. Due to the number of fish processing plants in and near Astoria, it serves as the focal point for Columbia River fisheries, and much of Oregon's coastal fisheries.

Coastal fishing is generally full time, with set seasons for different species. Many coastal fishermen change from salmon to crab fishing in the winter. Coastal fishing was long dominated by chinook and silver salmon, with salmon leading all other species in value. Since 1935, however, the albacore tuna has become an important part of the Oregon fishing industry and has surpassed coastal salmon in poundage, and rivals it in value.

Figure 5 shows a comparison by poundage for Oregon landings of salmon and tuna from 1937 through 1959. Tuna landings surpassed salmon in 1938 and peaked at over 22 million pounds in 1943, declining to a low of less than one-half million in 1954. There was a sharp increase in 1958, again surpassing the salmon, with the 1959 catch the highest since 1945. Albacore tuna is a very unpredictable species, undergoing extreme fluctuations from year to year in occurrence and abundance. Salmon fishing on coastal waters is generally quite consistent, although it showed a general increase from 1950 to 1956, followed by a sharp decline to 1959.

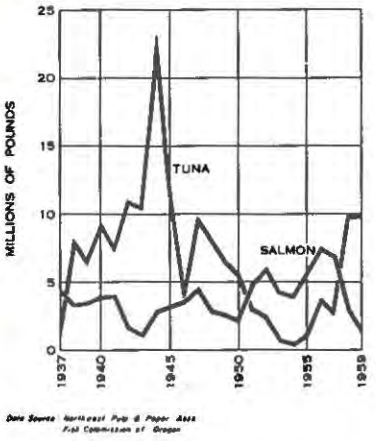


FIGURE 5. Pacific salmon and tuna catch, Oregon landings, 1937-1959.

Tuna packing in the Astoria area accounted for over 80 percent of the total northwest tuna pack in 1957. This includes processing of both local and imported tuna.

Shellfish, rockfish and flatfish are the leaders of other ocean fish caught annually. A substantial market has developed for scrap fish, important to the mink industry.

The salmon fishing season on the Columbia River is generally less than 100 days in length, therefore, providing only part-time work for the fishermen. The seasons vary for different species, with exact dates established each year.

Chinook salmon were being fished commercially on the Columbia as early as 1866 and this fishery reached its all-time peak in 1883, with over 42 million pounds taken.

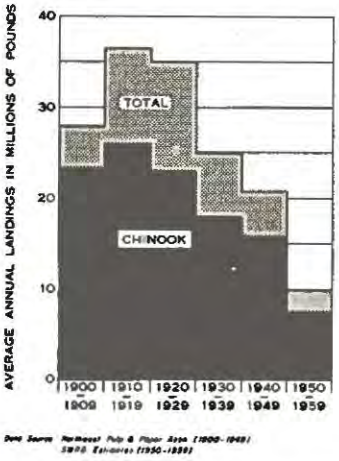


FIGURE 6. Columbia salmonoid catch by decades.

Figure 6 shows the Columbia River catch for chinook salmon and total salmonoid species. The average annual catch in millions of pounds for each decade from 1900 to the present is given. This is total Washington and Oregon catch, and shows the decline beginning in the 1920's. Oregon landings make up 50 to 80 percent of total Columbia catches for salmonids.

Other fish caught commercially on the Columbia include sturgeon, shad, and smelt.

The commercial crab fishery is first in economic importance of the basin's shellfish. Crabs are caught within the three-mile limit of Oregon's coast line and, to a lesser degree, in all the estuaries of the basin and the Columbia River.

Columbia River commercial landings have varied from about 50 percent of the total Oregon catch in 1947 and 1948 to about 25 percent in recent years. Tillamook Bay commercial landings have remained approximately constant at about 10 percent of the total.

Cocktail-size pink shrimp are a newly developed commercial fishery in our offshore waters with almost 2.5 million pounds landed in 1959.

Two species of oysters, the native and exotic Pacific, or Japanese, are found in the basin. The native oyster is found only in Netarts Bay and Pacific oysters are cultivated extensively in Netarts and Tillamook Bays. Experimental plantings of Pacific oysters have been made in Nehalem Bay.

Five species of bay clams are dug by commercial diggers in the bays of the basin, and annual landings during 1950-1959 averaged approximately 66,000 pounds.

A separate species, razor clams, are found between Seaside and Astoria, and commercial landings during the same period averaged 177,000 pounds annually. This constitutes over 95 percent of the total Oregon razor clam harvest.

North Coast Basin fishing is also extremely important to recreation, drawing sportsmen to the area from other states as well as all parts of Oregon. This is discussed more fully under Recreation.

Industry

Major industry in the North Coast Basin is principally related to processing of timber and food. The importance of manufacturing to the economy of the basin is pointed out by the fact that of 12,460 covered employees listed by the Oregon State Department of Employment for the three principal counties, 7,110 are employed in some form of manufacturing. Of this total, 4,240 are in manufacturing of lumber and wood products, including logging, and 1,630 in food and kindred products, with all other manufacturing combined totaling 1,240. Of other categories, only wholesale and retail trade with 2,150 employees have more than 1,000 in covered employment.

A further indication of the importance of lumber and food processing in this basin is given by the fact that the three principal counties represent only 3.9 percent of the state population, while the number of covered employees in lumber and wood products is 5.7 percent of the state total, and those in food and kindred products is 7.7 percent of the state total. Their relative position in the state by number of covered employees for lumber and wood products is Clatsop County 17th, Columbia 21st, and Tillamook 11th.

For food and kindred products, the same rating is Clatsop 5th, Columbia 23rd, and Tillamook 12th. Of the three principal counties, Tillamook leads in lumber and wood products processing with 47 percent of the total employees and Clatsop County leads in the food and kindred products processing with 75 percent of the total.

Industries which are not within the basin boundaries but are included in Columbia County totals include a large paper plant and insulating board company, a green veneer plant, a pole creosoting plant, and a broom handle and dowel factory. These are all located near St. Helens and contribute substantially to the economy of the basin.

Items important to industry within the basin are the availability of raw materials and access to comparatively cheap water transportation, thereby permitting processing of materials from outside of the basin, as well as those readily available.

Table 9 shows waterborne cargo in the North Coast Basin and illustrates the relative magnitude of tonnage handled by various ports or areas. While Youngs Bay and River has the greatest total tonnage, this consists entirely of rafted logs.

TABLE 9

WATERBORNE CARGO
1959

PORT OR AREA	TONNAGE(1)		
	Vessels	Rafted Logs	Total
Astoria	291,374	81,378	372,752
Clatskanie River	0	11,896	11,896
St. Helens	164,508	253,285	417,793
Skipanon Channel (Warrenton vicinity)	28,502	111,826	140,328
Tillamook Bay and Bar	2,601	34,982	37,583
Westport Slough (Westport vicinity)	5,878	3,141	9,019
Youngs Bay and Youngs River(2)	0	964,477	964,477

(1) Short tons

(2) Includes that section of the Port of Astoria with frontage on Youngs Bay

Source: U. S. Army Corps of Engineers

Astoria is one of the leading ports in Oregon. It has a good harbor, and rail and highway freight services.

St. Helens tops Astoria for total tonnages due to its heavy log raft traffic, which serves wood processing industries in the area.

Tillamook has suffered from channel maintenance and bay entrance problems and has made surveys to determine the feasibility of construction of a south jetty to help alleviate this situation.

Recreation

Recreation is important to the North Coast Basin. The basin serves as a principal coastal recreation area for much of the mid and lower Willamette Valley populations, as well as attracting many people from out of state, principally from Washington and California.

One of the prime recreational attractions of the basin is its 95 miles of coastal shoreline and 21 square miles (13,440 acres) of bay area. Besides the developed recreation areas, many beaches are enjoyed by both residents and tourists for sightseeing, fishing, picnicking, swimming, boating, and clamming.

While there are over 1,800 acres of lake, slough, and reservoir areas within the basin, only the coastal lakes are utilized for general recreation. The main recreational use of Columbia River tide marshes and sloughs is for waterfowl hunting.

Developed recreation areas in the basin include forest camps, state parks, county parks, roadside rest areas, and boat landings. These are shown on Plate 5 and a detailed summary of the facilities available at these developments may be obtained from the State Water Resources Board.

There are nine forest camps, most of them located in the Siuslaw National Forest. Due to the comparatively small percentage of national forest land in this basin, the number of forest camps is less than usually found in an area of this size.

There are 14 state parks within the basin, 2 of which, Fort Stevens and Cape Lookout, rank among the largest in the state. The state also owns most of the coastal tidelands which were obtained early in the century to protect coastal areas for public use.

There are 11 county parks within the basin and many of these are undergoing expansion of both area and facilities.

Possibly the fastest growing single recreation activity, at the present time, is boating and the basin now has over 40 public boat landings.

Boating is popular along portions of the Columbia River, including Youngs Bay, within the ocean bays and river mouths, and for short distances out into the ocean along the coast. It is estimated that development of the south jetty for the Port of Tillamook would greatly increase pleasure boating for this area, Oregon's second largest coastal bay. Interest has been shown by Seaside in establishing a small boat harbor and stabilizing the mouth of the Necanicum River.

The North Coast area differs from the total state tourist trade in origin of out-of-state visitors. A study of Seaside by the Oregon Bureau of Municipal Research indicated 71

percent of the out-of-state visitors were from Washington and 7 percent from California, compared to statewide statistics by the Highway Department showing 46 percent from California and 22 percent from Washington.

A study of state parks in the North and Mid-Coast Basins by the Oregon State Highway Department, Parks and Recreation Division, indicates that state parks contribute noticeably to the economy of the surrounding area. Many of the out-of-state visitors surveyed, especially from Washington and California, came specifically because of the state parks. The three parks included in the study were Fort Stevens near Astoria, Cape Lookout near Tillamook, and Honeyman near Florence, the latter being in the Mid-Coast Basin.

Fort Stevens was selected to study the effect of a state park on the economy of an area. Hammond and Warrenton were used as the study area and Miles Crossing as the control area. This study covered the period 1954 to 1958. The study area was found to have an increasing economic trend while both the control area and the county as a whole showed a decreasing economic trend.

Statistics from the three parks study show the average number of persons per party as slightly over five, the average number of days stayed within 25 miles of the park as 2.2, the average amount spent per party within 25 miles of the park as $15.60, and the average amount spent per person within 25 miles, $3.10. The average amount spent per person per day within 25 miles of the park was $1.50.

Besides economic returns from parks, additional dollars are realized from expenditures by fishermen, hunters, and campers not using parks.

Hunting and fishing in the North Coast Basin are regarded as excellent. Fishermen come from a large area to participate in the excellent steelhead trout and salmon fishing available in these waters. There is also trout fishing, as well as surf fishing for rock cod, ling cod, sea bass, and other species. Clamming and crab fishing are popular along the coast.

Duck and goose hunting exists on bays and lakes along the coastal portion and along the Columbia River islands on the northern boundary of the basin. Most big game hunting is for deer and elk. The nature and extent of wildlife trapping and hunting is discussed more fully in Chapter II.

Table 10 shows the estimated salmon and steelhead sports catch for 1958 in the North Coast system by sub-basins and streams. The table does not include the Columbia River catch.

The total catch of salmon and steelhead, 31,460, represented nearly 15 percent of the total for the state. The steelhead catch alone, 16,684, was more than 18 percent of the state total for this species.

TABLE 10

ESTIMATED SALMON AND STEELHEAD SPORT CATCH
1958

	SALMON	STEELHEAD	TOTAL
SUB-BASIN 1, TILLAMOOK			
Beaver Creek	62	112	174
Kilchis River	440	384	824
Little Nestucca River	162	147	309
Miami River	69	240	309
Neskowin Creek	28	41	69
Nestucca River and Bay	3,142	4,407	7,549
Tillamook Bay	2,229	200	2,429
Tillamook River	165	131	296
Trask River	1,260	1,247	2,507
Wilson River	1,708	3,747	5,455
SUB-BASIN 1 TOTALS	9,265	10,656	19,921
SUB-BASIN 2, NEHALEM			
Nehalem River and Bay	5,015	4,597	9,612
Rock Creek	91	131	222
Salmonberry River	9	106	115
SUB-BASIN 2 TOTALS	5,115	4,834	9,949
SUB-BASIN 3, COLUMBIA			
Clatskanie River	50	277	327
Gnat Creek	3	19	22
Klaskanine River	25	231	256
Lewis and Clark River	81	181	262
Necanicum River	234	483	717
Youngs River	3	3	6
SUB-BASIN 3 TOTALS	396	1,194	1,590
BASIN TOTALS	14,776	16,684	31,460
PERCENT OF STATE TOTAL	11.5	18.4	14.4

Source: 1959 Annual Report, Oregon State Game Commission, Fishery Division

Tillamook sub-basin leads the other two with a total catch of 19,921 fish, of which 9,265 were salmon and 10,656 steelhead. The Nestucca River and Bay contributed nearly 38 percent of this total.

Of the other stream systems, Nehalem River and Bay in the Nehalem sub-basin had a total of 5,115 salmon and 4,834 steelhead, making this stream the largest single contributor to the sports catch in the basin.

Transportation

The North Coast Basin is well served by federal, state, and local highways which connect major cities with Portland and other Willamette Valley points. The proposed Interstate Bridge at Astoria will complete U. S. 101 between Oregon and Washington and plug the last gap in the Mexico to Alaska highway. This is expected to have a substantial influence on the economy of the basin. At present, regular passenger ferry service is maintained between Astoria and Megler and between Westport and Puget Island. Secondary roads permit access to most locations within the basin.

Water transportation is important in the northern part of the basin, a 35-foot-deep channel being maintained from the mouth of the Columbia River to Portland. Astoria has the largest seaport in the basin and has facilities to handle ocean-going vessels.

Passenger service is provided by bus to mid-coast and Willamette Valley locations. Regular airline service is limited to Portland-Astoria-Seaside connections. No rail passenger service is available.

Inland freight service is provided by truck and railway.

CHAPTER II WATER SUPPLY, USE, AND CONTROL

GENERAL

Water has played a vital role in the history and development of the North Coast Basin. Early Columbia River explorers found numerous Indian fishing villages located along the river, with salmon being both a chief source of food and an important item of commerce between tribes. Early development of this region by white men was based on the abundance of water-based furbearing animals, followed by development of an economy based primarily on timber, fishing, agriculture, and shipping.

Although the North Coast has one of the highest rainfall averages of any basin within the state, it also has a problem of unequal seasonal distribution of both rainfall and runoff.

SURFACE WATER SUPPLY

Yield

Because the North Coast Basin is a composite of many individual watersheds, it is not within the scope of this report to determine the total yield for the basin. Flow records in the basin are very scarce on most of the major streams with only the Trask, Wilson, Nehalem, and Youngs Rivers having stations with more than six years of record. Plate 6 shows the location of these and other hydrological stations. Operation of recording stations on the Trask and Youngs Rivers has been terminated in the last few years. Due to tidal influences on coastal and Columbia River streams, recording stations cannot be operated near the mouths of these streams. However, to present estimated yields for major streams on a common basis, all flows were adjusted to the stream mouths.

Table 11 shows the area-yield relationship for three streams, each representative of one

TABLE 11

AREA-YIELD RELATIONSHIP FOR REPRESENTATIVE STREAMS

SUB-BASIN	STREAM NAME	DRAINAGE AREA Sq. Miles	AVE. ANNUAL YIELD* Acre Feet	Acre Ft. Per Square Mile
1 Tillamook	Trask River	176	840,000	4,770
2 Nehalem	Nehalem River	830	2,662,000	3,210
3 Columbia	Youngs River	122	403,000	3,300

* Based on adjusted or correlated flows at stream mouths.

of the sub-basins. Trask River, in Tillamook sub-basin, has the highest unit yield, 4,800 acre-feet per square mile, with Nehalem and Youngs Rivers having unit yields of 3,200 and 3,300, respectively. A rough estimate of total basin yield, determined by assuming

a conservative figure of 3,000 acre-feet per square mile, is eight million acre-feet per year.

By comparison, the Upper Willamette Basin's unit yields range from 1,600 to 2,900 acre-feet per square mile, with a basin average of 2,200.

The annual yield for the Trask, Nehalem, and Youngs Rivers for the period 1933 through 1958 is shown in Figure 7.

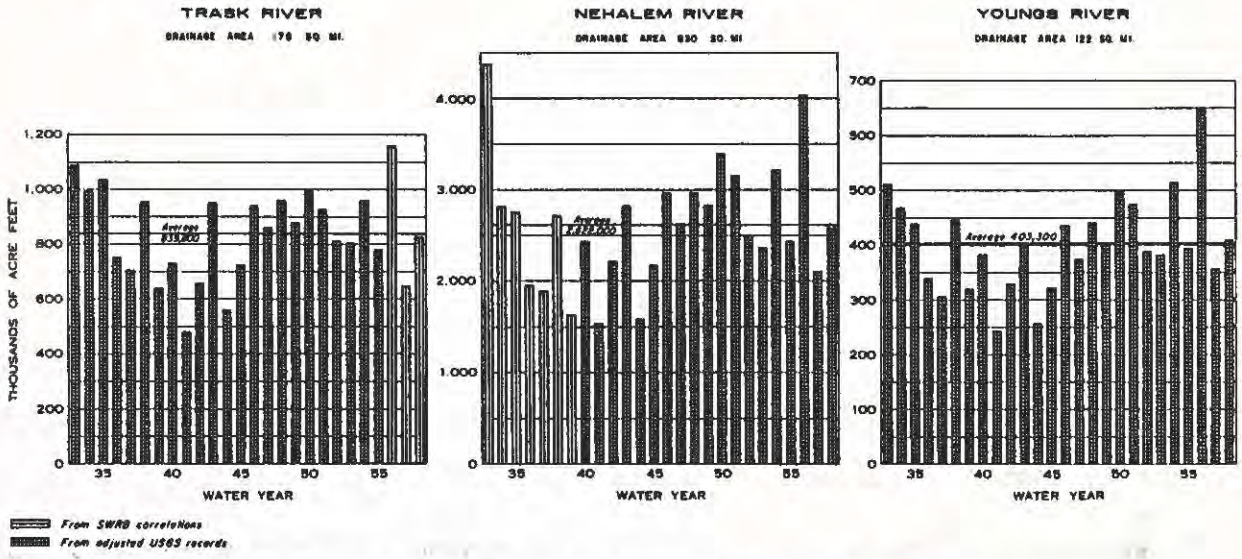


FIGURE 7. Annual yield of representative rivers, 1933-1958.

The Nehalem is the longest river and has the greatest drainage area of any within the basin. Annual yields range from slightly over 1,500,000 acre-feet in 1941 to over 4,300,000 in 1933. The average for the 26-year period is approximately 2,600,000 acre-feet. This would be enough water to cover each acre in the North Coast Basin to a depth of 1.5 feet. The period from 1936 through 1945 was generally below average, and for 1946 through 1948 generally near or above average.

Trask River is the third largest within the Tillamook sub-basin and Youngs River the largest within the Columbia sub-basin. Dry-wet trends are basically the same for these two streams as for the Nehalem.

Distribution

Although rainfall varies considerably in magnitude throughout the basin, the seasonal distribution pattern is quite uniform. This and similar vegetative and soil conditions

result in a fairly uniform seasonal streamflow distribution pattern. A lag exists between rainfall and runoff until late fall rains have primed the soil. Then runoff varies nearly directly with rainfall since snowfall is not significant, there is very little stream regulation, and the soil is fairly tight.

Figure 8 shows average monthly discharge patterns for the Nehalem, Trask, and Youngs Rivers. From these it may be seen that the peak flows occur during December, January,

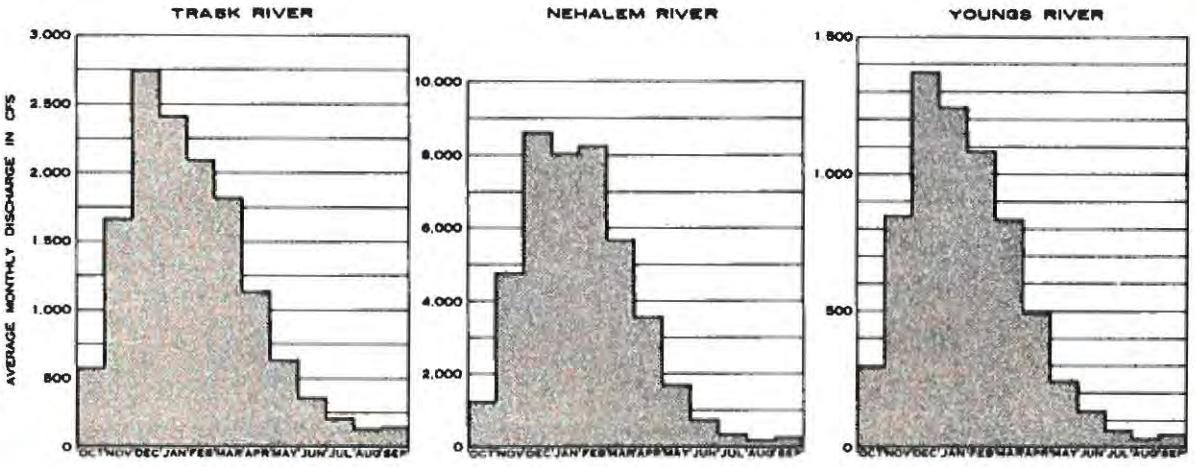


FIGURE 8. Average monthly discharge of representative rivers, 1933-1958.

and February, reflecting the heavy rainfall of those months. The low flow months of July, August, and September reflect low precipitation plus lack of streamflow regulation.

Extremes

Extremes for both maximum and minimum instantaneous discharges and for maximum and minimum annual yields are given in Table 12 for the Trask, Nehalem, and Youngs Rivers.

TABLE 12

EXTREMES OF DISCHARGE AND YIELD
AT SELECTED STATIONS

STATION	YEARS OF RECORD	INSTANTANEOUS DISCHARGE		ANNUAL YIELD		DRAINAGE AREA
		Water Year	cfs	Water Year	Acre-feet	Square Miles
Trask River near Tillamook	1931-1955					143
Minimum		1953	42	1941	407,000	
Maximum		1934	20,000	1933	922,000	
Nehalem River near Foss	1939-1959					667
Minimum		1951	54	1941	1,146,000	
Maximum		1954	39,300	1956	2,996,000	
Youngs River near Astoria	1927-1958					40
Minimum		1951	3	1930	73,900	
Maximum		1949	4,750	1956	212,900	

Source: USGS station records

The maximum instantaneous flow for the Trask River occurred in 1934, following the Tillamook Burn of the previous year.

Depletions

The locations of points of diversion for all water rights within the basin are shown in Plate 7. The rights are shown by their application numbers and are indicative of the distribution of rights throughout the basin. For determination of quantities involved and types of rights, a summary has been prepared listing each right, its location, priority date, purpose, quantity, and stream. A limited number of these summaries are available at cost from the State Water Resources Board.

Surface rights within the basin, as of September 28, 1960, total 555 cubic feet per second (cfs). A summary of these rights by use and by sub-basin is given in Table 13.

TABLE 13

SURFACE WATER RIGHTS SUMMARY

USE	SUB-BASIN Tillamook	Nehalem	Columbia	BASIN
CONSUMPTIVE				
Domestic	32.9	6.2	19.2	58.3
Municipal	69.5	11.8	107.3	188.6
Irrigation	67.0	24.1	28.0	119.1
Industrial	13.6	16.3	5.1	35.0
Recreation	5.6	0	0	5.6
Total Consumptive	188.6	58.4	159.6	406.6
NONCONSUMPTIVE				
Power	16.8	0	5.7	22.5
Mining	0.1	0	0	0.1
Fish	18.5	24.8	82.8	126.1
Total Nonconsumptive	35.4	24.8	88.5	148.7
TOTAL - Consumptive and Nonconsumptive	224.0	83.2	248.1	555.3

Note: All values in cfs

Source: State Engineer and SWRB Summary File No. 1.3018

Nonconsumptive rights make up 148 cfs and consumptive rights 407 cfs. If all consumptive surface rights were used to their maximum legal extent, about 230,000 acre-feet would be diverted each year.

Industries often take their water supply from municipal sources and, therefore, the amount of industrial rights does not indicate the full use for this purpose. Irrigation rights in this basin are unusual in that it is estimated that more acreage is irrigated than is shown by the rights, whereas the reverse is normally true. This is due to irrigation from sloughs and tidal estuaries with such usage generally not covered by irrigation rights.

The largest single group of consumptive rights is for municipal purposes with 189 cfs, followed by irrigation with 119 cfs, applying to nearly 9,000 acres. Two nonconsumptive rights, fish and power, have 126 and 22 cfs, respectively. Total domestic rights are for 58 cfs and industrial rights total 35 cfs.

Columbia sub-basin leads in total rights with 248 cfs, followed closely by Tillamook sub-basin with 224 cfs, while the Nehalem sub-basin has only 83 cfs.

There are a number of recent water right applications listed in Table 14 for the Wilson, Trask, Nehalem, and Nestucca Rivers. These are for both municipal and power purposes. The applications on these rivers range from 2 to 3,700 cfs, the largest being for power on the Nehalem.

TABLE 14

PENDING WATER RIGHTS APPLICATIONS*

STREAM	NUMBER	DATE	USE	QUANTITY
Wilson River Misc.	R 31285	1-4-57	Municipal (Forest Grove)	1,500 ac. ft.
Wilson River Misc.	31286	1-4-57	Municipal (Forest Grove)	2.10 cfs
Wilson River Misc.	R 32304	5-2-58	Municipal (Forest Grove)	1,500 ac. ft.
Wilson River Misc.	32305	5-2-58	Municipal (Forest Grove)	3.00 cfs
Trask River Misc.	R 32420	6-26-58	Municipal (Hillsboro)	12,600 ac. ft.
Trask River Misc.	32421	6-26-58	Municipal (Hillsboro)	38.70 cfs
Nestucca River	R 32769	11-19-58	Municipal (McMinnville)	5,000 ac. ft.
Nestucca River	32770	11-19-58	Municipal (McMinnville)	16.00 cfs
Nestucca River	R 32824	12-24-58	Municipal (McMinnville)	5,000 ac. ft.
Nestucca River Misc.	R 32825	12-24-58	Municipal (McMinnville)	5,000 ac. ft.
Nehalem River	R 33374	9-17-59	Power (Tillamook Co. PUD)	280,000 ac. ft.
Nehalem River	33375	9-17-59	Power (Tillamook Co. PUD)	3,700.00 cfs
Trask River	R 33376	9-17-59	Power (Tillamook Co. PUD)	38,000 ac. ft.
Trask River	33377	9-17-59	Power (Tillamook Co. PUD)	1,300.00 cfs
Trask River	R 33378	9-17-59	Power (Tillamook Co. PUD)	120,000 ac. ft.
Trask River	33379	9-17-59	Power (Tillamook Co. PUD)	2,300.00 cfs

*Recent major surface water applications

It should be noted that all of the municipal water right applications listed in Table 14 are for water from the North Coast Basin to be diverted for use in the Willamette Basin.

GROUND WATER SUPPLY

General

The role of ground water in the North Coast Drainage Basin is becoming more important as industrial activity and population increase. Although the greater part of water currently used is obtained from surface sources, ground water is significant to the economy and future growth of the region. To date, the only ground water study that has been made is a reconnaissance survey of the wells of Columbia County, in the northeast corner of the basin. The ground water concepts and predictions presented in this report are

based on these and other well records, on discussions with local water resources committees, and on an interpretation of the water-bearing qualities of the basin geology.

Geology

A generalized ground water geology map of the basin showing the major rock units and their estimated yield capabilities, a geologic cross section extending from the coast to the crest of the Coast Range, and specific capacities (gallons per minute (gpm) per foot of drawdown) of various water wells, is shown on Plate 8.

Geology determines to a large degree the source, occurrence, quality, quantity, and movement of the ground water available for use. Rocks in this basin consist principally of sedimentary and volcanic units which are relatively impervious. It is unlikely that these two rock types, which cover approximately equal areas, will produce high-capacity wells. The Coast Range extends throughout most of the basin and is bounded on the west by a narrow coastal belt of sand. The principal ground water supplies are in the lowland alluvial deposits situated along the Columbia River and the lower reaches of the main streams. Some fresh water is stored in the thicker beach deposits.

Sedimentary rocks in the basin are mainly medium to fine-grained sandstone, shale, conglomerate, silt, and clay, while volcanic rocks are principally basaltic flows and pyroclastics, such as tuff. Both the sedimentary and volcanic rocks have been deeply weathered. Records of well logs throughout the basin show that rocks underlying the veneer of top soil have usually decomposed to form substantial layers of clay, some 50 feet thick, through which ground water is unlikely to penetrate. The runoff is therefore rapid and the streams are flashy. The alluvium generally consists of fine-grained material, terrace deposits, and beach sand.

Three basic factors to be considered in estimating the usable ground water resources of any region are precipitation, topography, and the porosity of the rocks. Because the Coast Range is characterized by relatively impervious rocks, steep slopes, and narrow valleys; and the coastal belt likewise has relatively impervious rocks forming a narrow band of steep hills, the general ground water potential for the basin is considered poor except for the Tillamook and St. Helens-Deer Island areas.

Yield

Ground water supplies vary from moderate amounts in the alluvial deposits along the Columbia River and the lower, westernmost part of the Coast Range to very small quantities in the Coast Range proper. Steep slopes and the generally well-compacted rocks forming the range make for rapid runoff.

WATER SUPPLY, USE, AND CONTROL

Except for the recent Columbia County well survey, the general lack of ground water data in all but the most populous areas of the basin precludes an adequate evaluation of the water available. The Columbia County survey indicates that the majority of those wells are producing adequate quantities for the purposes for which they are used. This use is predominantly domestic, 60 percent being solely for domestic purposes and 38 percent for domestic use in conjunction with stock and irrigation of lawns and gardens.

Of the 342 replies obtained as to the adequacy of well production from 3,400 ground water questionnaires sent out, 81 percent indicated adequate supplies. The remaining 19 percent experience shortages, principally during the months of July, August, September, and October. It is realized, however, that "adequacy" is a relative term, and that if more water were available, demand would probably be created for it.

The municipal well at St. Helens, the two Tillamook Water Commission wells, and the two Fairview Water District wells near Tillamook have specific capacities ranging from 172.5 to 5.5. This represents productions from 2,760 gpm to 380 gpm. The alluvial plain surrounding Tillamook, through which the Kilchis, Wilson, Trask, and Tillamook Rivers flow, is deemed the most capable of yielding substantial quantities of ground water to wells.

Distribution

Ground water is concentrated in the coarser lowland alluvial deposits along the Columbia River and the fringes of the Coast Range, particularly in the Tillamook area. The sand forming much of the narrow coastal belt is generally too fine grained and too tightly compacted to contain much ground water. The large amount of precipitation falling throughout the Coast Range has caused the sedimentary and volcanic rocks to weather to varying thicknesses of impermeable clay in much of the basin, with resultant rapid runoff. The runoff is aided by the steep slopes characterizing much of the basin.

More specific information is available as the result of the recent well survey made in Columbia County by the County Agent's office. Replies to questionnaires sent to rural box holders throughout the county indicate that the most productive wells are located in the triangular lowland area extending from the vicinity of Scappoose to St. Helens, and northward along the lowlands to Columbia City and Deer Island. The largest concentration of wells is between Scappoose and St. Helens.

Good producing wells are also located in the alluvium along the lower reaches of the larger streams. These wells are most likely to produce inadequate supplies or to go dry during the summer and fall months.

Wells in the slough areas along the Columbia River are high producers. The majority of these wells are for irrigation purposes and generally pump from sumps.

Depletions

The Ground Water Act of 1955 does not require the registration of wells supplying 15,000 or less gallons per day (gpd) for domestic or stock use or for lawns or noncommercial gardens not exceeding one-half acre in area. Wells supplying 5,000 or less gpd for any single industrial or commercial purpose likewise need not be registered.

Ground water rights for the North Coast Basin, as of September 28, 1960, are assigned to 38 wells and total 25 cfs. This amounts to an annual depletion of 11,000 acre-feet. Of the total flow, 14 cfs are for irrigating 1,100 acres, 10 are for municipal, 0.9 are for industrial, and 0.2 are for fish purposes. A summary of the ground water rights for each of the three sub-basins is listed in Table 15.

TABLE 15

REGISTERED* WELLS
As of September 28, 1960

	SUB-BASIN	NO. OF WELLS	RIGHTS IN CFS				MAXIMUM LEGAL ANNUAL DEPLETION** (Acre-Feet)
			Irrigation	Municipal	Industrial	Fish	
1	Tillamook	28	12.0	4.9	0	0	6,030
2	Nehalem	1	0	0.2	0	0	140
3	Columbia	9	1.8	4.9	0.9	0.1	4,710
	TOTALS	38	13.8	10.0	0.9	0.1	10,880

* Includes registered wells for which permits have been granted under the Ground Water Act of 1955.

** Irrigation depletion is based on use of 2½ acre-feet per acre per year.

LEGAL RESTRICTIONS AND LIMITATIONS ON WATER USE

The only restrictions on streams in the North Coast Basin are found within the Columbia sub-basin. By statutory decree of 1949, the following streams were withdrawn from appropriation and from diversion or interruption for any purpose except for protecting fish life therein:

1. *Clatskanie River and its tributaries.*
2. *Klaskanine River and its tributaries.*
3. *Lewis and Clark River.*
4. *Tillasqua Creek (Big Creek) in Clatsop County.*

This withdrawal is not to affect any of the then existing rights to appropriate or use water, or any renewals or extensions thereof, or prevent appropriation and use of such water for domestic, stock, municipal, public park, or recreational purposes.

PRESENT WATER USE AND ASSOCIATED PROBLEMS

General

Water rights are not necessarily an indication of total use. In many cases, actual water use is less than that for which total rights are held. On the other hand, some users do not hold rights. The total abundance of water compared to present water-use rights for the basin in general is illustrated in the Tillamook sub-basin. Tillamook River, one of the smaller rivers in terms of annual flow, has an average annual yield of approximately 292,000 acre-feet, while the sub-basin has consumptive surface rights for only 189 cfs, which if used to the maximum legal extent would amount to 103,000 acre-feet per year.

Domestic

There are 534 domestic rights for surface water within this basin totaling 58 cfs, the majority being for 0.01 cfs. There are no domestic ground water rights because the Ground Water Act of 1955 requires permits only for wells exceeding 15,000 gpd production. Included under domestic rights are those granted for camp sites, parks, and stock-watering purposes.

A quality problem associated with ground water throughout the basin is that of a high iron content and general hardness. Although information is not available relative to domestic ground water use throughout the basin, specific information has been obtained in Columbia County through the Extension Agent. Ground water questionnaires sent to rural residents have provided much valuable information.

It appears that, although the water is often high in iron content, it is still used by many people in the rural areas. There is also quite extensive use of spring water for domestic purposes which has proven much more satisfactory from a quality standpoint.

Domestic supplies, both surface and ground water, are often inadequate in many areas of the basin during the late summer months.

Municipal

Columbia sub-basin holds 17 municipal rights totaling 107 cfs, Tillamook sub-basin 30

rights totaling 70 cfs, and Nehalem sub-basin 11 rights totaling 12 cfs. Warrenton holds rights for 46 cfs and Astoria 68 cfs, of which 26 cfs were granted after September 1960.

Recent applications for municipal rights include 5.1 cfs from the Wilson River system by the City of Forest Grove, 38.7 cfs from the Trask River system by the City of Hillsboro, and 16 cfs from the Nestucca River system by the City of McMinnville (Table 14).

Surface water supplies are generally of good quality with the water being very soft and low in total dissolved solids, although slight acidity is present in some areas.

There is some use of ground water for municipal purposes, although generally on a standby basis for use when surface flows are either extremely low or high and turbid. An exception to this is at St. Helens, which has an underground water collecting system supplying a central well that is utilized year round.

In general, municipalities have adequate supplies of satisfactory quality water after necessary treatment.

Irrigation

There are 362 surface irrigation rights in the basin totaling 119 cfs for slightly under 9,000 acres. Of these, over half, 234 rights for 67 cfs covering 5,700 acres, are in the Tillamook sub-basin. Ground water rights are for 14 cfs and 1,100 acres, the majority of these also being in the Tillamook sub-basin. U. S. Department of Agriculture estimates, based on preliminary agricultural census data for 1959, list about 10,000 acres irrigated within the North Coast Drainage Basin. Field estimates by the USDA indicate that about 3,000 acres are irrigated from tidal estuaries and drainage ditches, most of which do not hold water rights.

All irrigation development within the basin has been accomplished on an individual farm basis. Irrigation practices fluctuate widely depending upon weather conditions, with heavy increases in irrigation pumpage during extremely dry years. Except for high salt content of tidal water, no particular problem in quality of either surface or ground water for irrigation purposes has been noted in the basin. Shortages have been experienced, particularly in the Tillamook River area, during late summer months.

Power

At the present time, there are no significant hydroelectric developments within the basin.

Water rights for power total 23 cfs, of which 16 cfs are on the Nestucca River and its tributaries.

Applications by Tillamook County PUD for 1,300 and 2,300 cfs for Trask River water and 3,700 cfs for Nehalem River water are now pending in the State Engineer's office (Table 14).

Industrial

Nehalem sub-basin has industrial rights totaling 16 cfs, Tillamook 14 cfs, and Columbia 5 cfs. Many industries along the Columbia River operate without water rights and others, throughout the basin, use municipal water supplies. The only industrial ground water right in the basin, slightly under one cfs, is for a lumber company.

Present supplies are generally adequate for industrial needs throughout the basin, although there are some problems in disposal of industrial wastes, as discussed under Pollution Abatement.

Mining

Total mining water rights for the entire basin are less than one-tenth of one cfs.

Present mining activities are associated with a clay deposit southeast of Tillamook, two expandable shale deposits south of Vernonia, and sand and gravel located along the main streams. These, and other mineral deposits, are located on Plate 4.

Recreation

Although water-based recreation is very important in the basin, water rights specifically for this purpose amount to only six cfs, all in the Tillamook sub-basin. Rights have seldom been acquired to protect the use of streams, lakes, or reservoirs for recreational uses.

The area is perhaps most famous for its fine stream and coastal fishing, but also offers boating, water skiing, swimming, and clam digging among its water-based recreational activities.

Lakes, reservoirs, and sloughs within the basin have a combined surface area of under 2,000 acres. Coastal and Columbia bays contain more than 20,000 acres, many of which offer fine boating.

Estimated salmon and steelhead sports catches for principal streams of the basin for 1958 were shown in Table 10.

Fishing activity on the Nehalem main stem in 1958 averaged 164 angler trips per week-end day and 55 angler trips per weekday during the peak of the steelhead season. The Game Commission reports a three-year average of approximately 170,000 angler days resulting in a catch of 65,000 salmon and 16,000 steelhead within the basin.

Deer, elk, and small game populations are based on a minimum water requirement. Waterfowl and furbearing animals require more water for their habitat, and are found in large numbers along the coastal bays and in the Columbia tidal marshlands.

The 1958 deer and elk kill, and number of hunters participating, are shown by counties in Table 16. Tillamook leads in deer kill with 4,642 and Clatsop in elk kill, with 737. Totals show approximately one deer for every two hunters, and one elk for every nine hunters.

TABLE 16

DEER AND ELK KILL
1958

COUNTY	DEER		ELK	
	Number Killed	Number of Hunters	Number Killed	Number of Hunters
Clatsop	1,467	3,981	737	6,547
Columbia	900	2,433	23	205
Tillamook	4,642	8,664	92	1,015
TOTALS	7,009	15,078	852	7,767
PERCENT OF STATE TOTAL	6.0	6.4	12.2	18.3

Source: Oregon State Game Commission

Waterfowl hunters averaged more than three birds per man during the 1958 season, according to the Game Commission.

Recreational facilities available to the public include nine forest camps, all located within the Siuslaw National Forest in Tillamook County. There are, in addition, 14 state parks, 11 county parks, 6 roadside rest areas, and approximately 40 boat landings.

As an indication of consumptive water requirements, the U. S. Forest Service estimates this use on national forest lands within the basin at 22 gallons per man day. On this basis, the 66,500 man days of use of national forests within the basin in 1960 would have required nearly 1,500,000 gallons, over four acre-feet, of water for consumptive purposes.

Wildlife

There are no water rights for wildlife within the basin. Wildlife needs vary according to species and are met from the streams, lakes, bays, sloughs, and marshlands.

Big game species of the basin include black-tailed deer and Roosevelt elk, with a few white-tailed deer occurring in the bottom lands along the lower Columbia River. The

State Game Commission reports production of Oregon's big game as being dependent directly upon the type and condition of the habitat in which they exist. The opening of western Oregon forests by fires such as the Tillamook Burn, and by extensive clear cutting, has contributed to an increase in the western Oregon deer populations.

Ring-necked pheasant, valley and mountain quail, blue and ruffed grouse, fantail pigeons, mourning doves, and brush rabbits represent the small game species of the basin. The majority of waterfowl species normally found in western Oregon occur in the North Coast area, with feeding, resting, and wintering concentrations occurring in the lower Columbia River, Sand Lake, and Youngs, Nehalem, Tillamook, and Netarts Bays. Adjoining farm lands also hold substantial waterfowl populations at various times.

Furbearers of economic importance are mink, beaver, and muskrat. The three most recently completed trapping seasons produced an average of 620 mink, 1,980 beaver, and 3,540 muskrats with an annual pelt value to the basin averaging nearly $27,000.

The principal problem connected with wildlife in the basin, at the present time, is that of animal damage in areas of reforestation, especially within Tillamook burn areas. This damage is generally caused by deer, elk, and rodents, the latter being principally rabbits and mountain beaver.

Damages have run as high as 80 percent of total tree plantings in certain areas in past years. Special hunts held by the Game Commission in cooperation with the Oregon State Board of Forestry have helped reduce damage. This continues to be a problem, however, with a survey conducted in the spring of 1960 showing an overall average for animal damage within the previous year amounting to 24 percent in the Tillamook County portion of the reforested burn area, and 21 percent in the Clatsop County portion. Between 40 and 50 percent of the trees classed as damaged were in the severe damage or dead category.

Fish Life

Surface water rights for fish in the basin total 126 cfs, with 83 in the Columbia subbasin, 25 in Nehalem, and 18 in Tillamook. Anadromous fish species in the basin include spring and fall chinook, silver, blueback, and chum salmon; steelhead, cutthroat, and brown trout; and Columbia River smelt, shad, and white and green sturgeon. Resident fish include cutthroat, rainbow, brown, and eastern brook trout; and largemouth bass, yellow perch, bullhead catfish, black and white crappie, bluegill, and pumpkinseed sunfish.

Plate 9 shows the spawning distribution of spring and fall chinook, silver and chum

salmon, and steelhead trout. Native cutthroat trout are also found in nearly all the tributaries of the coastal rivers of the basin. Only those streams known to be utilized by silver salmon are indicated, although this species generally uses all available feeder streams. Spring chinook are generally found only in larger streams and consequently do not appear within the Columbia sub-basin, while fall chinook utilize some of the smaller streams and are more widely distributed. Steelhead, like silvers and cutthroat, are present in almost all of the smaller tributaries which are accessible. Chum salmon are found principally in the Columbia River and Tillamook Bay tributaries, with smaller numbers present in many other streams.

Estimates of species and races of salmon entering the Columbia River are made by adding commercial landings to the Bonneville Dam counts. It is believed these represent minimum figures because of the difficulties in determining lower tributary spawners. The ten-year average reported for 1950-1959 is: spring chinook, 206,600; summer chinook, 142,000; blueback, 225,500; and summer steelhead, 263,600. Similar data is not available for fall chinook, silvers, chums, and winter steelhead. Incomplete average estimates of fall chinook entering the river during the same ten-year period is 333,000. Average commercial landings have been about 66,000 silvers and 21,000 chums for 1950-1959. In 1956 the population of winter steelhead in the lower Columbia River was estimated at 180,000.

The Fish Commission has reported estimates made of runs of certain fish for specific years and periods of time for Tillamook Bay and the Nehalem River. These were based on tagging studies conducted by the commission, using statistical analyses of tag or mark recoveries.

The silver salmon run into Tillamook Bay during the period August 15 to November 27, 1951, was estimated to be between 13,000 and 70,000 fish. The run in the Nehalem during the periods September 1 to October 14, and November 1 to November 20, 1952, was estimated to be between 45,000 and 111,000.

In 1953 the commission made a tagging study in Tillamook Bay to determine the number of salmon and steelhead available to the commercial fishery, the period of study being August 23 to December 10. These estimates, which with minor exceptions applied to fish returning to their streams of origin were: fall chinook, 15,500; silvers, 22,000; chums, 54,000; and steelhead (incomplete) 8,000.

Ocean sports fishery has increased from an average for the 1949-1954 period of 24,000 fish to a 1955-1958 average of over 90,000. Sport fishing is also enjoyed from docks, jetties, beaches, and boats for ling cod, flounders, surf perch, herring, rockfish, and English sole.

Shellfish in the North Coast Basin are of value for both commercial and sports catch.

Five species of bay clams are dug by sport and commercial diggers in bays of the basin. Annual commercial landings of bay clams along the entire coast during the period 1950-1959 averaged 121,000 pounds. It is estimated that the sports take is equal to, or greater than, the commercial harvest. Approximately 55 percent of these are taken in the North Coast Basin. Average annual commercial landing of razor clams during the same period was 186,000 pounds, with the sports take varying from 288,000 pounds in 1958 to only 72,000 pounds in 1959. Over 95 percent of the razor clam harvest in Oregon is taken principally in the 18-mile stretch of open beach from Seaside to Astoria.

The Research Division of the Oregon Fish Commission conducts fishery investigations in the Columbia River portion of the North Coast Basin. This work is performed using federal funds from the Columbia River Fishery Development Program. Scattered sections of most of the tributary streams for this portion of the Columbia were surveyed during the peak of silver spawning in every year since 1949 to obtain an index of abundance of spawning populations.

A dam and weir provided with upstream and downstream traps was constructed on Gnat Creek in 1954 for further study of natural spawning of salmon and steelhead. The study includes measuring the survival of hatchery-reared fingerlings released into Gnat Creek, determining the effects of varying flows on the production of young fish, and determining the efficiency of reproduction by permitting known numbers of adult spawners to ascend above the weir.

In addition to the Gnat Creek weir, four hatcheries in the North Coast Basin are operated by the Fish Commission. These are located on Big Creek, North Fork Klaskanine River, Foley Creek (a tributary to the Nehalem), and Trask River. The Big Creek and Klaskanine hatcheries have recently been enlarged under the Columbia River Fishery Development Program. Over 61 million salmon and steelhead fingerlings have been released from these four stations during the period 1951 to 1960.

The Oregon Game Commission has made experimental hatchery plants of young steelhead in the Wilson River. In the 1958-59 season, approximately 30 percent of the boat angler catch and 20 percent of the bank angler catch resulted from planted hatchery fish. The commission has provided nine boat launching facilities for angler access areas, either by itself or in cooperation with other public bodies. They own and operate two fish hatcheries, a new one-half million dollar steelhead plant at Gnat Creek, and the older station at Hebo on Cedar Creek, tributary to Three Rivers, which produces trout, steelhead, and salmon.

The Game Commission reports that a major difficulty in the Nehalem and Columbia subbasins has been logging operations, especially during spawning seasons for anadromous

fish. Other problems include periodic fish losses in the Necanicum River at Seaside resulting from domestic and industrial waste in the stream, and occasional losses resulting from a lack of dissolved oxygen during summer low flow periods when water temperatures are high.

Table 17 shows desirable minimum flows to maintain fish life, recommended by the

TABLE 17

DESIRABLE MINIMUM FLOW TO MAINTAIN FISH LIFE

STREAM	LOCATION	FLOW CFS
TILLAMOOK SUB-BASIN		
Crescent Lake	Outlet	4.0
Electric Creek	Mouth	0.2
Fall Creek	Oceanside	1.0
Gurtiss Creek	Sand Lake	1.0
Little Nestucca River	Head of tidewater	23.0
Little Nestucca River	Boyer	1.0
Austin Creek	Mouth	2.0
Bear Creek	Mouth	2.0
Kellow Creek	Mouth	1.5
Louie Creek	Mouth	1.0
Baxter Creek	Mouth	0.3
Sourgrass Creek	Mouth	0.6
Pheasant Creek	Mouth	0.2
South Fork	Mouth	5.0
Squaw Creek	Mouth	1.2
Miami River	Mouth	35.0
Moss Creek	Mouth	1.0
Neskowin Creek	Mouth	4.0
Alder Creek (Butte Cr.)	Mouth	0.5
Hawk Creek	Mouth	0.8
Fall Creek	Mouth	0.4
Jim Creek	Mouth	0.4
Kingston Creek	Mouth	0.2
Lewis Creek	Mouth	0.2
Prospect Creek	Mouth	0.2
Nestucca River	Below Beaver	110.0
Alder Creek	Mouth	1.0
Buck Creek	Mouth	0.4
Rock Creek	Mouth	0.2
Wood Creek	Mouth	0.3
Bay Creek	Mouth	7.0
Bear Creek	Mouth	10.0
Beaver Creek	Mouth	13.0
East Beaver Creek	Mouth	10.0
Bear Creek	Mouth	1.0
West Fork	Mouth	3.0
Tiger Creek	Mouth	0.2
Boulder Creek	Mouth	3.0
Cedar Creek	Mouth	2.0
Clear Creek	Mouth	1.0
Elk Creek	Mouth	14.0
Farland Creek	Mouth	0.6
Farmer Creek	Mouth	3.0
George Creek	Mouth	1.5
Horn Creek	Mouth	1.0
Mina Creek	Mouth	0.8
Moon Creek	Mouth	12.0
East Creek	Mouth	6.0
Sailing Creek	Mouth	0.3
Testament Creek	Mouth	10.0
Three Rivers	Mouth	37.0
Tony Creek	Mouth	3.0
West Creek	Mouth	1.0
Wolf Creek	Mouth	3.0
Tillamook River	Below Bewley Cr.	15.0
Anderson Creek	Mouth	0.4
Fawcett Creek	Mouth	2.0
Killiam Creek	Mouth	1.5
Munson Creek	Mouth	1.5
Simmons Creek	Mouth	2.0

STREAM	LOCATION	FLOW CFS
TILLAMOOK SUB-BASIN		
South Prairie Creek	Mouth	0.3
Trask River	Above Gold Cr.	90.0
Gold Creek	Mouth	3.0
North Fork	Mouth	70.0
South Fork	Mouth	30.0
East Fork	Mouth	16.0
Edwards Creek	Mouth	1.5
Wilson River	Above L.N. Fork	100.0
Bear Creek	Mouth	0.1
Beaver Creek	Mouth	0.1
Cedar Creek	Mouth	10.0
Devils Lake Fork	Mouth	20.0
Devils Lake Fork	Above Elliott Cr.	1.0
Elliott Creek	Mouth	1.0
Elk Creek	Mouth	6.0
Fall Creek	Mouth	3.0
Fox Creek	Mouth	1.5
Little North Fork	Mouth	25.0
North Fork	Mouth	16.0
South Fork	Mouth	7.0
NEHALEM SUB-BASIN		
Jetty Creek	Mouth	2.0
Nehalem River	Mouth	200.0
Beneke Creek	Mouth	5.0
Buster Creek	Mouth	12.0
Cook Creek	Mouth	15.0
Cronia Creek	Mouth	8.0
Fishhawk River	Mouth	5.0
Foley Creek	Mouth	20.0
Humbug Creek	Mouth	5.0
Nehalem River N. Fork	Mouth	35.0
Oak Ranch Creek	Mouth	3.0
Rock Creek	Mouth	25.0
Salmonberry River	Mouth	30.0
Salmonberry R. N. Fk.	Mouth	10.0
Soapstone Creek	Mouth	10.0
COLUMBIA SUB-BASIN		
Arch Cape Creek	Mouth	10.0
Columbia River		
Bear Creek	Head of tidewater	5.0
Beaver Creek	Head of tidewater	5.0
Big Creek	Head of tidewater	30.0
Claskanie River	Head of tidewater	25.0
Fox Creek	Head of tidewater	2.5
Gnat Creek	Head of tidewater	12.0
Klaskanine River		
Klaskanine R. N. Fk.	Mouth	10.0
Klaskanine R. S. Fk.	Mouth	10.0
Lewis and Clark River	Head of tidewater	15.0
Merril Creek	Head of tidewater	2.0
Plympton Creek	Head of tidewater	10.0
Tide Creek	Head of tidewater	2.0
Youngs River	Head of tidewater	15.0
Elk Creek	Near Cannon Beach	12.0
Necanicum River	Mouth	25.0
Necanicum R. S. Fk.	Mouth	5.0

Fish and Game Commissions. These flows are lower limits and are based on the supposition that flows in excess of these minimums will occur during periods of fish migration. These flows are greater in many instances than average low flow season discharges.

Optimum water temperatures for spawning vary with the different species. Spring chinook usually spawn from late August into October at water temperatures between 50 and 60 degrees Fahrenheit. Fall chinook usually spawn from October until December with peak spawning occurring at temperatures between 45 and 50° F. Silver salmon peak spawning occurs in December at water temperatures near 45° F.

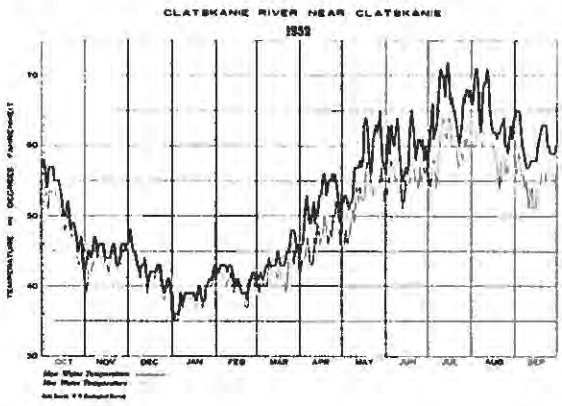


FIGURE 9. Seasonal pattern of water temperature for the Clatskanie River near Clatskanie, 1952.

Figure 9 indicates the seasonal pattern of water temperature variation for the Clatskanie River near Clatskanie during 1952. This shows the highest temperatures, in this case above 70° F., occurring in July and August and lows to 35° F. in January. Continuous records such as this are available for only three streams, all in the Columbia sub-basin. This pattern is probably indicative of all streams in the basin, although the extreme values undoubtedly vary from area to area.

Gravel removal operations also cause problems for fish life. In the lower stretches of the rivers of the Tillamook sub-basin they have reduced spawning areas, destroyed eggs, and caused undue siltation on numerous occasions.

Pollution Abatement

Water quality stations in the North Coast Basin are maintained principally along the Columbia River as shown in Plate 6.

The State Sanitary Authority lists 16 existing public and semi-public sewerage works within the basin. Of these, six discharge raw or untreated sewage into streams or bays. These do not all present pollution problems, however, due to strong tidal action and high flows of the Columbia River. Eight other communities require additions to present facilities or construction of new facilities, and two communities have adequate systems. Present sewerage works include two with lagoons, four with primary treatment, and four with secondary treatment.

The Sanitary Authority reports no major industrial waste disposal problems in the basin at the present time. Minor pollution has, on occasion, been caused in the Nehalem and Tillamook sub-basins by industrial plants, gravel operations, and log pond drainage.

WATER CONTROL

Flood Control

Flood control problems within the basin are usually handled by the Corps of Engineers at the request of local agencies. Flooding occurs principally near the mouths of the major streams. Other areas include a strip from below Seaside to the vicinity of Warrenton, lowlands and islands along the Columbia River which have not been sufficiently diked, and scattered portions along the main streams of the basin where gradients are relatively flat.

A major Corps of Engineers' program includes the lower Columbia River and covers over 45 locations from the Willamette to the mouth of the Columbia. Work on this project is slated to begin in 1961, with initial construction in this basin to be at the mouth of the Clatskanie River. Other authorized projects throughout the basin are discussed in the sub-basin sections.

Also slated for initial construction in 1961 is the Skipanon River Watershed Project. This is sponsored by the Warrenton Dune Soil Conservation District and Clatsop County under the provisions of the Watershed Protection and Flood Prevention Act.

Figure 10 shows generalized locations of areas having water control problems of drainage and erosion in the North Coast Basin. Flood problems are generally within the drainage area, although additional minor problems exist along portions of the major streams.

Shifting sands in the vicinity of Nestucca Bay are clogging the mouth of the Nestucca River, thereby increasing flooding in the area.

Drainage

As listed in Table 6 and shown in Figure 10, a majority of the arable acreages within the North Coast Basin have either drainage or erosion problems. Seventy-five thousand of the total 178,000 arable acres within the basin are classed as lands subject to the presence of excess wetness or to overlow.

Census of Irrigation data for 1950 shows that about 40 percent of the irrigated acreage was artificially drained and, in addition, it was estimated that about 29 percent of

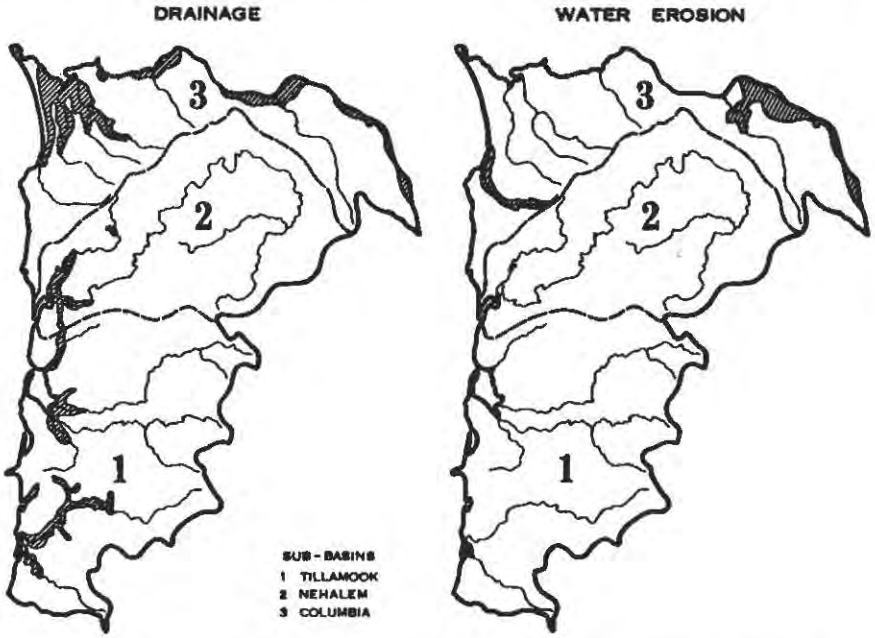


FIGURE 10. Generalized location of land having water control problems of drainage and water erosion.

the irrigated land needed additional drainage. The same census estimated that drainage water was a source for 37 percent of total irrigation within the basin.

Erosion

Table 6 and Figure 10 also point out areas with dominant erosion problems within the basin. These include lands subject to water erosion, which applies mainly to the arable lands within the basin and includes 16,000 acres in Tillamook sub-basin, 6,000 acres in Nehalem sub-basin, and 52,000 acres in Columbia sub-basin. Water erosion or flood erosion problems vary from moderate to severe along inland areas and along the Columbia River. Much of the forest land in the basin is subject to water erosion if improper management techniques are used.

Severe wind erosion is a problem in certain areas along the coast. Much work has been done in stabilization of sand dunes, especially in the Clatsop County portion, with work also presently being carried out in Tillamook County.

POTENTIAL WATER USE AND ASSOCIATED PROBLEMS

Domestic

Future domestic needs in the basin vary considerably between sub-basins. No particular problems are foreseen at this time for Columbia and Nehalem sub-basins, although Columbia sub-basin could possibly experience a substantial increase in population due to overflow from Portland or to a significant increase in industrial activity in that area. The Tillamook sub-basin area faces a possible 50 percent increase in water use for domestic and municipal purposes in the next 20 to 25 years.

Future domestic needs throughout the basin will probably have to be supplied, in most cases, from organized water districts using surface flows. Although there is a significant use of ground water for domestic use in the northern portion of the basin, this is not expected to increase to a very large extent due to the poor quality of this water throughout the area.

Municipal

Substantial increases in demand will require many municipalities to supplement present supplies through storage or from additional sources. Increases in demand may be brought about by industrial development if not by population growth.

The cities of Forest Grove, Hillsboro, and McMinnville, all of which lie outside the basin, have made preliminary investigations of plans for using rivers of the North Coast Basin for municipal supplies. The rivers involved are the Devils Lake Fork of the Wilson, the Middle Fork of the North Fork of the Trask, and the Nestucca above Meadow Lake. These are discussed in more detail in the sub-basin section and associated damsites are shown on Plate 10.

Irrigation

All of the lands classed by the U. S. Department of Agriculture as arable within the North Coast Basin are also classed as potentially irrigable without regard to the present agricultural use of the land or the economics involved. Trends in irrigated land use for the three counties from 1939 through 1959 are shown in Figure 11 which shows a leveling off during the last five years. The USDA reports that because the climate of the North Coast Basin is conducive to the production of grass and legume forage crops for pasture, silage, and hay, these have become the predominant crops. These crops sustain dairy and livestock production, which is a source of over 70 percent of the agricultural income

of the basin. About 85 percent of the land irrigated is in hay and pasture and it is anticipated that future expansion of irrigation will continue to be predominantly for the production of these two crops.

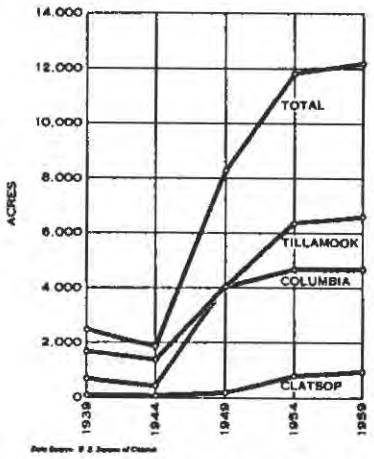


FIGURE 11. Acreage of irrigated land by counties, 1939-1959.

It is believed that irrigated acreage will continue to increase in the future, although this will be limited by physical and economic factors. Part of the land is presently in forests and the economic feasibility of clearing much of this land will be questionable. It is anticipated that most irrigation development will be limited to the 97,500 acres presently in cropland and pasture. In some areas, there would be a further limitation on availability of summer water for irrigation purposes unless storage is provided. From an economic standpoint, expansion of the market for livestock products will probably be the most important factor influencing irrigation development.

IRRIGABLE LAND



FIGURE 12. Generalized location of irrigable land.

The general location of irrigable land within the basin is indicated by Figure 12 which includes presently irrigated lands. According to the USDA, nearly all arable lands in the North Coast Basin are also considered irrigable.

Power

Potential power development within the North Coast Basin is shown in Table 18 which lists the potential as derived by the U. S. Geological Survey for the Nehalem, Trask, Wilson, and Nestucca Rivers. Although there are water rights for small power developments on other streams in the basin and other proposals, as shown in the potential water development projects summary in the Appendix, it is believed the USGS summary is the best estimate available of major potential developments within the basin. North Coast power developments could furnish peaking power to the Northwest Power Pool during the winter when Columbia River flows are low.

With full development of these four streams, total continuous power generation would range from 109,000 kilowatts (KW) to 135,000 KW depending upon the Nehalem River

alternative used. This would result in a total average annual energy production of from 958,000 megawatt hours (MWH) to 1,179,000 MWH. If these plants were operated to provide winter peaking power only, the November through February

TABLE 18

UNDEVELOPED POWER POTENTIAL

STREAM	POWER POTENTIAL CONTINUOUS		WINTER PEAKING			APPROXIMATE RESERVOIR CAPACITY
	KW	MWH	Period	KW	MWH	Ac.-Ft.
Nehalem (1)	72,700	637,000	Nov-Mar	170,000	616,000	1,900,000
Nehalem (2)	50,800	445,000	Nov-Mar	128,000	465,000	1,000,000
Nehalem (3)	76,000	666,000	Nov-Mar	192,000	696,000	38,000
Wilson	28,300	248,000	Nov-Feb	83,000	240,000	250,000
Trask (4)	14,300	125,000	Nov-Mar	41,040	148,000	200,000
Nestucca	16,000	140,000	Nov-Feb	47,000	137,000	190,000

(1) Five dams on Nehalem River
(2) Gravity diversion to Columbia River
(3) Pumped storage diversion to Columbia River
(4) Five dams on Trask River

Source: USGS

power generation would range from 299,000 KW to 363,000 KW, again depending upon the Nehalem River alternative used. The resultant average annual energy production would range from 990,000 MWH to 1,221,000 MWH.

Plate 10 shows the site locations for major projects which have been investigated by public or private agencies in recent years for power development, municipal water supplies, or combination projects including flood control and irrigation.

Industrial

Although there is considerable industrial potential in the basin, there are no major needs for industrial water rights from surface or ground water supplies seen at this time. In the Columbia sub-basin, much industrial water is taken from the Columbia River and it is expected this will continue to be the case in future development due to the relatively unlimited supply. Most of these users do not hold industrial rights.

Both the Cities of Tillamook and Astoria would have to increase their municipal supplies in order to meet any heavy increases in industrial use. This could come under either municipal or industrial water rights and, in the case of Tillamook, would probably have to be developed by means of storage on one of the principal Tillamook Bay tributary streams. Astoria has rights for a considerable increase of water supply, based primarily on potential industrial uses.

Based on its timber resource, the Nehalem sub-basin has considerable potential for industrial development related to wood processing.

Mining

Preliminary plans are under way for the development of sand deposits in the bed of the Columbia River near its mouth and adjacent bays. These deposits contain appreciable quantities of magnetite, an ore of iron. The quantity of water necessary for extracting or smelting operations has not been determined but would probably be obtained from the Astoria system.

There is some possibility of the location of a reduction plant in the lower Columbia area to treat the numerous deposits of limonite, an ore of iron. Metallurgical, as well as tonnage problems, have yet to be overcome. Water requirements for mining and for reducing the ore to pig iron would be modest and much of the water could be salvaged and recycled.

Although unlikely because of present plants nearby, there is the possibility of an aluminum plant being established in the basin for the reduction of ferruginous bauxite. Water requirements for mining would be nominal but a reduction plant would require large quantities of wash and process water.

No appreciable increase in water use is foreseen for the mining and processing of other known mineral deposits.

Recreation

The basin has many areas in which potential development of water-based recreation is a major factor. Tillamook County is considering an increase in area of some of their county parks. Columbia County is working toward establishment of a county park system.

The Oregon Board of Forestry has adopted a multiple-use policy for state forest lands. The Forestry Board feels that other uses may be deemed either commensurate or compatible to the growing of forest products or more to the public interest than the yield of forest products. Long-range development plans include determination of lands for recreation purposes in cooperation with local agencies, including but not limited to the following:

1. *Campground development and use for the general public.*

2. *Summer camp development and use for youth organizations.*

3. Designated and regulated hunter and fisherman camping.

4. Aesthetic value confined to lands abutting public highways and lands abutting lakes, reservoirs, and major streams adaptable to recreational development and use.

5. Boat landings confined to lakes, reservoirs, and major streams.

Due to the fact that much of the state ownership covers areas of either clear-cut lands or the Tillamook Burns, much of the land is not well suited at present for recreational development although organizational camps have been established by various groups. The Forestry Board has listed potential development sites along the Wilson and Trask Rivers which are described in Chapter III.

A Pacific Coast recreation survey for the National Park Service conducted in 1958 recommended several areas for development along the north coast of Oregon.

The U. S. Forest Service estimates that recreational use of national forest lands within the basin is expected to increase about 7 times by 1976 and 20 times by the year 2000. Consumptive water use for recreation is expected to increase at this or a greater rate which would amount to at least 90 acre-feet per year within national forests in the basin by the year 2000.

The University of Oregon, Bureau of Municipal Research, has stated that increases in population, leisure time, personal income, and greater mobility have contributed to the growth of the tourist industry. Expenditures for recreation purposes have increased twice as fast during the past decade as has the gross national product. Forecasts indicate continuation of these trends with the result that any community which possesses natural recreation facilities may expect to benefit economically. A further important trend is the increasing popularity of house trailers and a great interest in participation sports, such as water skiing and boating. This has created a demand for trailer parks, small boat harbors, and developed reservoir areas.

Use of Oregon state parks is shown in Figure 13, illustrating trends for overnight camping and day use for the period 1953 to 1959, with projections to 1969. The low value for present and contemplated future use of Saddle Mountain State Park reflects the trend towards utilization of coastal and stream areas, rather than parks devoted primarily to picnicking and sightseeing. Overnight camping at Oswald West Park is limited by the nature of the physical layout, whereas Cape Lookout has a good potential for expansion for overnight campers which, it is predicted, will cause it to surpass the camping use of Fort Stevens by the year 1962. Day use of Cape Lookout, Oswald West, and Ecola State

Parks was very nearly identical in 1959. Projections indicate doubling the use of

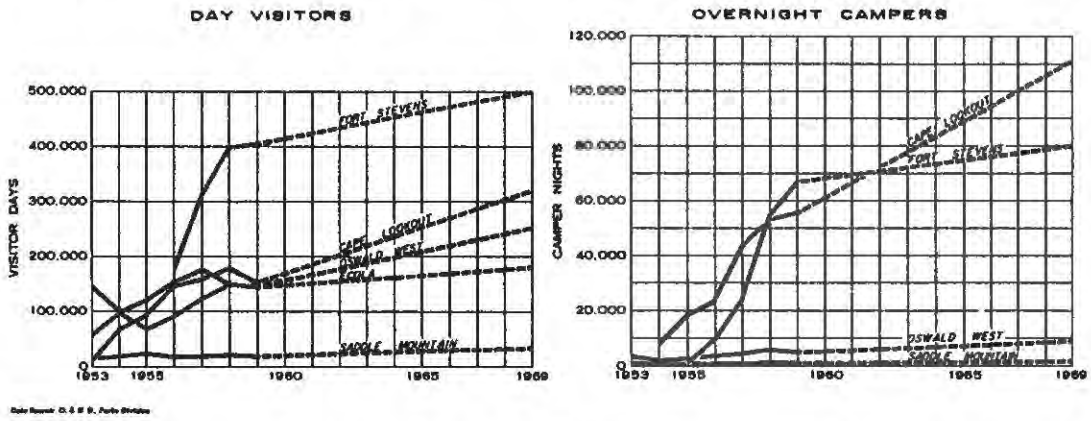


FIGURE 13. Annual use of state parks, day visitors and overnight campers, from 1953 to 1959 projected to 1969.

Cape Lookout by 1969 but only a slight increase in the use of Ecola State Park.

Wildlife

Water quantity or quality problems relative to wildlife are minor in the forest lands. Multiple-use development and improved logging practice on both private and public forest lands will help preserve the wildlife habitat. Waterfowl and furbearing animals utilize excessively wet and poorly drained areas, and further drainage developments could reduce the habitat available for those animals.

Fish Life

Because the North Coast area serves as a principal recreation area for stream and coastal fishing for much of the middle and lower Willamette Valley population areas, fishing pressure will undoubtedly continue to increase rapidly as measured by angler trips per year. The U. S. Forest Service statistical forecast of future angler use of the Siuslaw National Forest and other comparable areas states that the angler use will increase over 4 times by 1975 and over 12 times by the year 2000.

As population increases, new developments increase the probability of stream pollution. Sewage and organic materials lower the dissolved oxygen content, which is an essential factor in fish health. Heavy stream siltation also creates problems, especially during egg incubation times.

The Fish and Game Commissions are active in research pointed towards determining adequate minimum needs relative to flows and temperatures for maximum development of fish life. Table 17 listed their recommended minimum flows for major streams in the North Coast Basin.

The Fish Commission reports that trends in harvesting of salmon, including both river and ocean troll catch, indicate the decline in salmon fishing is related principally to silvers. Average annual Oregon landings for silvers are: 1925-1935, 4.7 million pounds; 1936-1945, 3.5 million pounds; and 1946-1956, 2.4 million pounds. During the same periods, the chinook salmon averages were: 1925-1935, 2.0 million pounds; 1936-1945, 1.5 million pounds; and 1946-1956, 2.2 million pounds.

The commission believes much of the difference is probably due to changes in stream habitat brought about by such activities as logging, road building, gravel removal, irrigation, and pollution. Due to their habit of ascending the smaller, easily modified tributaries to spawn, these activities affect silvers more than chinook. The majority also remain in the smaller streams for one year, making them quite susceptible to effects of siltation, floods, low flows, and high water temperatures. Steelhead are affected in much the same manner as silvers and, in addition, remain in the tributaries up to three years.

Stream surveys have shown an average of one log jam per mile for all coastal streams, and over two per mile on the Nehalem.

Operations creating silt problems, such as logging and gravel removal, not only result in smothering of spawning beds but also kill off some food organisms. This effect may also extend into estuarine areas, causing damage to oyster populations by reducing the "set" of larval oysters.

A large escapement to spawning grounds does not guarantee a large returning run. On the other hand, comparatively small escapements followed by favorable stream conditions can produce large returning runs. Studies in Washington and Oregon have shown significant correlations between low summer flows and the production of yearling silvers and two-year old steelhead, as well as the catch of adult silvers three years later.

Pollution Abatement

Pollution abatement will probably assume an increasing role in the use of water in the basin as populations increase. Although no heavy population increases are forecast for the North Coast Basin, certain areas will face the need for new or larger sewerage systems. According to the State Sanitary Authority, sewage treatment will eventually be needed

at Astoria, Nehalem, Warrenton, and Wheeler. No compliance dates have yet been set for installation of such facilities. There are no special statutes which apply specifically to the control of pollution in the basin.

SUB-BASIN 1 TILLAMOOK

GENERAL

Location and Size

The Tillamook sub-basin includes all of the North Coast Basin south of the Nehalem River watershed (Plate 1). This is the largest of the three sub-basins with an area of 959 square miles, 36 percent of the total area of the North Coast Basin.

Approximately 90 percent of the sub-basin lies in Tillamook County, 6 percent in Yamhill County, 3 percent in Washington County, and less than 1 percent in Polk County.

The western boundary of the sub-basin is the Pacific Ocean and the northern boundary is the divide between the Nehalem River watershed and the headwaters of the Miami, Kilchis, and Wilson Rivers. The eastern boundary and part of the southern boundary is the Coast Range divide. The remainder of the southern boundary is the divide between the drainage areas of the Neskowin and Salmon Rivers.

Stream System

There are seven major stream systems within the Tillamook sub-basin. Each enters the Pacific Ocean by way of a coastal bay; five into Tillamook Bay, and two into Nestucca Bay. Those entering Tillamook Bay are the Miami, Kilchis, Wilson, Trask, and Tillamook Rivers. Those entering Nestucca Bay are the Nestucca and Little Nestucca Rivers.

There are also over 20 smaller named stream systems which empty directly into the Pacific Ocean. The total length of the coast line in this sub-basin is approximately 45 miles.

There are approximately 1,420 miles of streams in the sub-basin, of which 1,160 miles are perennial in nature (Table 2). The eight major streams and their lengths are as follows: Miami, 14 miles; Kilchis, 14 miles; Wilson, 33 miles with the Devils Lake Fork extending an additional 10 miles; Trask, 18 miles with the North Fork extending an additional 12 miles; Tillamook, 18 miles; Nestucca, 53 miles; Three Rivers, 13 miles; and the Little Nestucca, 20 miles.

Profiles of these streams, showing elevation versus stream mile, are shown on Plate 2. The average gradients for these streams vary from 182 feet per mile for Three Rivers to 23 feet per mile for the Kilchis River. Table 19 lists gradients of the major streams in the sub-basin.

TABLE 19

TILLAMOOK SUB-BASIN
STREAM GRADIENTS

STREAM	LENGTH Miles	ELEVATION DROP Feet	AVERAGE GRADIENT Ft/Mile
Little Nestucca River	20	800	40
Nestucca River	53	1,975	37
Three Rivers	13	2,370	182
Tillamook River	18	720	40
Trask River	18	265	15
North Fork Trask River	12	555	46
Wilson River	33	840	25
Devils Lake Fork Wilson River	10	840	84
Kilchis River	14	315	23
Miami River	14	1,680	120

Climate

Average annual precipitation in the Tillamook sub-basin has the widest range of any of the sub-basins, varying from less than 70 inches on portions of the eastern edge of the sub-basin and 80 inches along a portion of the western edge to approximately 150 inches in the central portion near the northern boundary. There is a general lack of uniformity in areal distribution of rainfall within this sub-basin. Monthly distribution, however, is quite uniform with approximately 80 percent of the total precipitation occurring during the six-month period from October through March.

Precipitation averages by months were shown in Figure 1 for the representative station at Tillamook. December and January are the months of highest rainfall while July and August are the lowest. This is the general pattern for the entire North Coast Basin.

The average annual snowfall is 47 inches at Lees Camp and 5 inches at Tillamook.

Temperatures are not extreme in this sub-basin, with Tillamook having a recorded minimum of 0 degrees Fahrenheit and maximum of 101° F., with a mean of 51° F. Temperature variations by month were shown in Figure 2.

The average length of season without killing frost is 140 days near Lees Camp and 182 days at Tillamook.

Population

The Tillamook sub-basin has slightly over one-fourth of the population of the entire North Coast Basin. The 1960 population estimate for this sub-basin is 17,100. Tillamook is the largest city with a 1960 population of 4,240, followed by Garibaldi with 1,160, Bay City with 1,000, and Rockaway with 770.

Population estimates for unincorporated towns with over 100 persons are: Netarts 600; Pacific City 350; Twin Rocks 300; Oceanside 225; Idaville, Beaver, Hebo, and Cloverdale 200 each; and Manhattan Beach 150.

Tillamook County is the only one of the three principal counties to show a steady population increase (Figure 3). Although not entirely within the sub-basin, the change in county population is indicative of that for the sub-basin.

Between 1900 and 1920, the population of Tillamook County doubled. Development of a prosperous and stable dairy industry aided growth. Dairying continued to expand after 1920, but a more important factor in the population increase was the expansion of the lumber industry. This was halted in 1933 by the first Tillamook Burn. Population increase from 1930 to 1940 was slight. By the late 1930's, logging was again well under way with salvage operations on the burn being quite successful. Nearly as many workers were employed in logging in 1939 as in 1929, although less than half as many were working in sawmills.

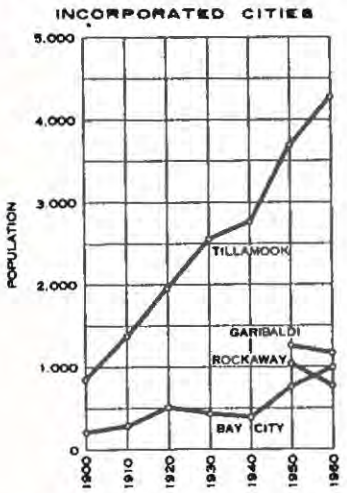


FIGURE 14. Population trend of incorporated cities in Tillamook sub-basin, 1900-1960.

In recent years, the population has continued to increase as a result of the logging of burned timber and an increase in cheese production. The tourist industry, fishing, forest products industries, and agriculture all have had some part in the expanding population.

The trend in population growth of the incorporated cities within this sub-basin is shown in Figure 14.

The City of Tillamook has had the steadiest growth of any of the incorporated cities in the entire basin. It is the only city, other than St. Helens, which has not declined in population during any census period since the turn of the century. The average rate of growth by decades since 1900 has been just under 600, with a lesser rate in the thirties due principally to the fire, and a greater rate during the forties. Bay City has shown a steady increase since 1940, with Rockaway and Garibaldi declining after 1950.

ECONOMIC FACTORS

Land Ownership

Land ownership for the North Coast Basin was summarized in Table 4.

SUB-BASIN INVENTORY - TILLAMOOK

The Tillamook sub-basin contains approximately 960 square miles, of which about 20 square miles are water areas. The state owns about 40 percent of the sub-basin, 26 percent is federally owned, 1 percent is in county and city ownership, and the remaining 33 percent in private or other ownership.

Most of the federally owned land in the sub-basin is in the Siuslaw National Forest, which is the only national forest in the North Coast Basin.

Timber

An estimated 900 square miles, 94 percent of the sub-basin, are in commercial forest lands.

Western hemlock is the predominant species in the western portion of the sub-basin, with Douglas fir being predominant in the central and eastern portions. Some sitka spruce is found in the western portion along with minor amounts of red alder.

The State Board of Forestry estimates the net allowable annual cut for their lands in the Tillamook sub-basin at 28 million board feet. It is expected that this will be decreased to approximately 25 million board feet in 60 years, doubled the following decade, and increased to 83 million board feet at the end of 100 years. This represents approximately 40 percent of the commercial forest land within the Tillamook sub-basin. Most of these lands were acquired following the Tillamook Burns of 1933, 1939, and 1945 and consequently much of the land is currently in the reforestation stage.

TABLE 20

LOG PRODUCTION AND STUMPAGE VALUE
SIUSLAW NATIONAL FOREST WITHIN
THE NORTH COAST BASIN

YEAR	ANNUAL CUT Million BM	STUMPAGE VALUE Thousands of Dollars
1951	16	125
1952	31	409
1953	37	410
1954	28	338
1955	37	704
1956	31	633
1957	46	1,026
1958	40	734
1959	65	958
1960	45	989

Source: USDA, Forest Service

Table 20 shows log production and stumpage values for the Siuslaw National Forest for the years 1951 through 1960. In 1959 there was a cut of 16 million board feet and in 1960, 45 million board feet. This is for an area of approximately 250 square miles.

It is important to note that stumpage value and log production figures cannot be compared directly for any given year since timber sold in one year usually is logged over a period of several years following the sale. Further, stumpage figures are not true indicators of timber value because of a number

of factors that influence the difference between sale price and market value of timber.

For example, timber that is overripe, low grade, or diseased may not have a high stumpage value, but if utilized in pulp and paper production will yield an end product of high value.

On the other hand, high-grade timber that brings premium prices at the mill may have a relatively low sale price on the stump because of high road building and logging costs.

A third situation would be a good grade of timber having a high value both on the stump and at the market.

These and many other factors influence the relationship between stumpage value and true market value of timber, so the values cited in Table 20 should only be used to indicate the relative magnitude of timber sales in national forests.

The estimated allowable annual cut for national forest lands is 50 million board feet, based on a 100-year rotation age.

Agricultural Lands

Agriculture constitutes an important economic resource within this sub-basin. According to statistics furnished by the U. S. Department of Agriculture, this sub-basin is second in total acreage of lands suitable for cultivation, but first in number of acres falling within the classifications of good and very good arable land. There are 46,160 acres classed as land suitable for cultivation, of which slightly more than 20,000 acres are within land Classes I and II.

As is true throughout the North Coast Basin, livestock products account for the major share of the gross agricultural income. Dairy products, in turn, account for approximately 90 percent of the livestock products total. Tillamook County ranks first in the state with respect to both the value of dairy products sold and the amount of milk produced, although it has less land in farms than almost any other county in the state. Other livestock and livestock products include hogs, sheep, chickens, and eggs. Mink farming is also of some importance in this sub-basin.

Agricultural lands lie primarily in the Tillamook Bay area, along the Miami, Tillamook and Nestucca Rivers, and in the vicinity of Sand Lake and Nestucca Bay. Principal crops are hay and pasture which support livestock. Other crops include vegetables and horticultural specialties and small amounts of fruit, nuts, grains, and seeds.

SUB-BASIN INVENTORY - TILLAMOOK

Minerals

Known mineral resources in the entire basin are shown by area on Plate 4.

A clay deposit, aggregate, and deposits of sand and gravel are found within this sub-basin. The clay is used in the manufacture of drain tile and the aggregate and sand and gravel are used for road and building materials. According to the State Department of Geology and Mineral Industries, there are no other known economic mineral resources.

A small quantity of gas was encountered in a 2,532-foot-deep exploratory oil well drilled in 1910 about five miles southeast of Tillamook. No further exploratory oil drilling has been done.

More detailed geological examination would be necessary to determine if other mineral deposits exist in the sub-basin.

Fish Life

All coastal streams within the North Coast Basin are closed to commercial fishing except Tillamook Bay, which has a commercial chum salmon fishery from November 1 through November 30. Other salmonids are caught incidental to the chum salmon fishery, and some ocean fishing is carried on from the area, particularly for Dunganese crabs. These are the most important economically of all the shellfish, and Tillamook Bay landings have remained relatively constant in recent years at 10 percent of the total Oregon landings. Native oysters are found only in Netarts Bay on the entire Oregon coast, and Pacific or Japanese oysters are cultivated extensively in Netarts and Tillamook Bays. A relatively new commercial fishery is for cocktail-size pink shrimp. These are also taken as a sport catch in some of the beach areas of the sub-basin.

Industry

Nearly all industry within the sub-basin is connected with processing of either timber or agricultural products. The major concentration of industry within the sub-basin is located in the vicinity of Tillamook Bay.

Four mills in the immediate Tillamook area, which produce plywood, wood chips, and lumber, require an annual volume of 175 million board feet of logs. Three of these mills regularly employ over 100 persons. There are also many smaller operations in the sub-basin.

Cheese manufacturing, for which Tillamook is famous, is the second largest industry of the sub-basin. There is one cheese plant in Tillamook which regularly employs over 100 persons.

Tillamook is the only seaport in this sub-basin. Its major traffic is in rafted timber. Table 21 lists freight traffic in 1959 for Tillamook Bay and Bar. These figures, however, are for traffic reaching only as far as Hobsonville and do not include internal traffic.

TABLE 21

TILLAMOOK BAY AND BAR FREIGHT TRAFFIC
1959

COMMODITY	COASTWISE		TOTAL
	Receipts	Shipments	
Fish and shellfish products, edible		453	453
Wood and paper	2,148	34,982	37,130
TOTALS	2,148	35,435	37,583

Note: All values are in short tons

Source: U. S. Army, Corps of Engineers

In recent years traffic across the bar has decreased sharply. Part of the reason for this is attributed to rough water conditions at the entrance to the bay channel, which are primarily due to the partially unprotected bay entrance.

The presently existing north jetty offers protection from the north, but winter storms are mostly from the south and regular coastwise water service is hard to provide. Delays to vessels awaiting favorable conditions to enter the bay are costly, and in some cases barges have had to be towed back to Astoria to wait for better conditions.

Protection of Tillamook Bay's entrance channel with a south jetty would be helpful to sport and commercial fishing, shipping, and pleasure boating.

Congress has authorized the Corps of Engineers to study navigation conditions at Tillamook Bay and Bar to determine if improvements at the entrance and in the bay are economically feasible.

Recreation

Recreation makes an important contribution to the economy of the sub-basin, based primarily on the combined factors of excellent fishing and the multiple attractions of the 45 miles of coastline.

The area is readily accessible to the mid and lower Willamette Valley populations.

People also come from throughout the state and out of state to enjoy the fishing, hunting, scenery, and park facilities.

The amount spent by sportsmen is difficult to estimate, but constitutes an appreciable share of the income for many of the restaurants, motels, and stores in the area.

The Parks and Recreation Division of the State Highway Department conducted a study of Fort Stevens, Cape Lookout, and Honeyman State Parks to determine their effects on surrounding areas. This study was discussed in Chapter I and some of the statistics will be repeated here because of the inclusion of Cape Lookout, the largest state park in the sub-basin. The average number of persons per party was five, with an average expenditure of $1.50 per person per day within 25 miles of the parks. The visits averaged slightly over two days in length. According to the Highway Department, of the estimated total annual expenditures of $2,752,000 within 25 miles of the parks, the portion directly attributable to the parks was $1,652,000, or about 60 percent.

Present and projected future use of state parks was indicated by Figure 13 which shows Cape Lookout as having the second highest present usage by both day visitors and overnight campers, and the highest rate of increase predicted for the future.

Transportation

Federal, state, and county roads provide a good transportation system in the sub-basin. Passenger service is provided by bus lines and freight service by trucks and railroads. Three airports serve local and transient light planes.

Water transportation has now been reduced to small shipments of peeler logs from Tillamook Bay to Grays Harbor and the Columbia River plywood mills. The proposed improvement of Tillamook Bay with construction of the south jetty would increase shipping by protecting the entrance to the bay and decreasing rough water conditions over the bar.

SURFACE WATER SUPPLY

Yield

Streamflow records of more than one or two years exist only on the Wilson, Trask, and Nestucca Rivers (Plate 6). The station on the Trask River became inactive in 1955 so the records were extended by direct correlations with the Wilson River. The gage on the Nestucca River was just below Meadow Lake and had a drainage area of only 12 square miles. Therefore, flow records were established for the Nestucca River at its

mouth by a precipitation-runoff correlation. Similar correlations were prepared for the Miami, Kilchis, Tillamook, and Little Nestucca Rivers. All flow records were established for a common base period from 1933 through 1958. In each case, it was necessary to project both gaged and correlated figures to the river mouth since tidal influences prohibit actual gaging near the mouths of rivers.

Annual yields adjusted to the mouth are shown in Figure 15 for the Wilson, Trask,

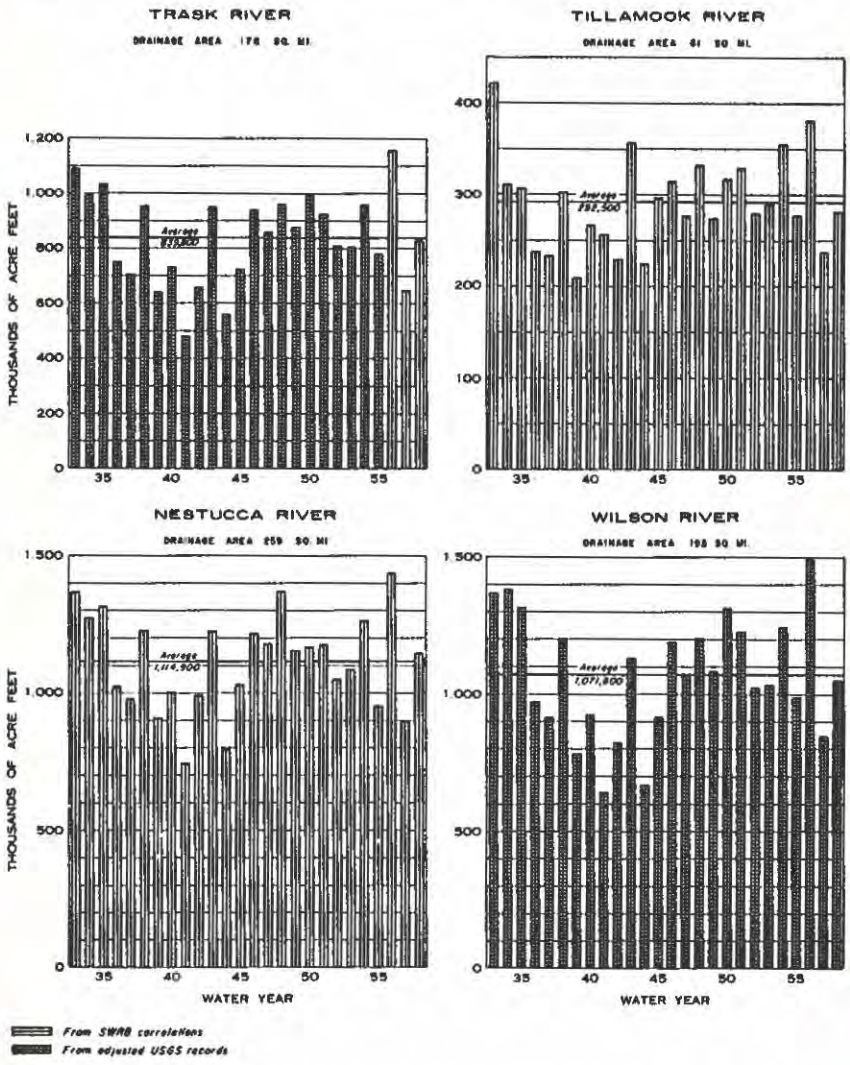


FIGURE 15. Annual yields of major stream systems in Tillamook sub-basin, 1933-1958.

Tillamook, and Nestucca Rivers for the base period which includes the low and high years of record. The largest of these streams, the Nestucca River, has varied in annual yield

from 745,000 acre-feet in 1941 to 1,437,000 acre-feet in 1956. The smallest, the Tillamook River, varied from 209,000 acre-feet in 1939 to 422,000 acre-feet in 1933.

Distribution

Yield distribution by months is shown for the Wilson, Trask, Tillamook, and Nestucca Rivers in Figure 16. Since no flow records were available for the Tillamook or Nestucca

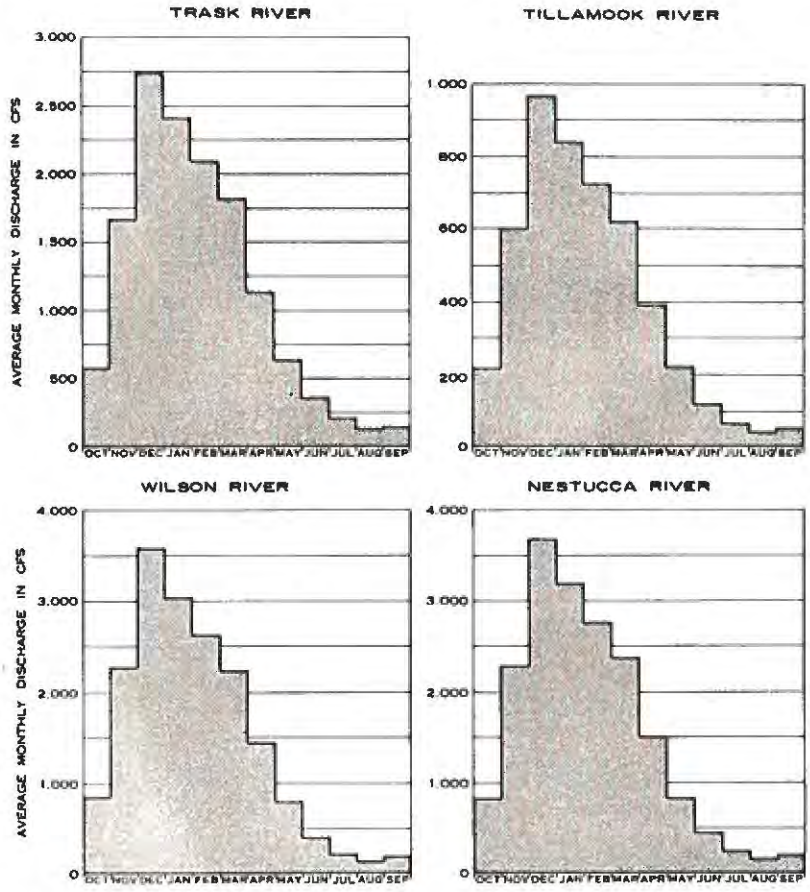


FIGURE 16. Average monthly discharge at the mouth of major streams in the Tillamook sub-basin, 1933-1958.

Rivers, their distribution was assumed to be the average of that for the Wilson and Trask Rivers, based on similarity of vegetation, soil, geology, topography, and precipitation.

Peak flows occur during December, January, and February, reflecting heavy rainfall during those months following saturation of the ground by the late fall rains. Snowfall in the higher areas is not sufficient to materially affect spring runoff and ground water storage is slight, with the result that the streams reach very low flows during July, August, and September.

Extremes

Although some portions of the sub-basin are subject to flooding from long, heavy rains, flash floods from thunder storms are not generally experienced. The highest instantaneous flow of record on the Trask River, 20,000 cubic feet per second (cfs), occurred in December 1933. The minimum flow of record, 42 cfs, occurred in October 1952.

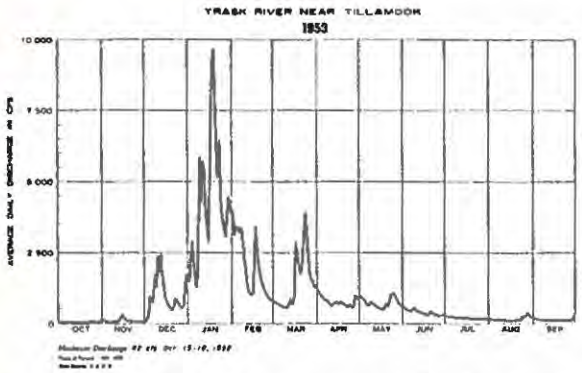


FIGURE 17. Daily discharge pattern of the Trask River near Tillamook for the water year having the minimum instantaneous flow of record, 1953.

The daily pattern of discharge during the water year of minimum instantaneous recorded flow, 1953, for the Trask River is shown in Figure 17. The distribution of flow exhibited by the plot illustrates the peaks in flows that occur in winter, particularly January, and the extremely low flows during late summer and fall. The Trask watershed is representative of much of the Tillamook sub-basin. This is substantiated by similar charts developed for the Wilson and Nestucca Rivers which exhibit nearly identical characteristics during a critical water year.

Depletions

Diversion points for all water rights in the North Coast Basin are located as shown on Plate 7. A detailed summary of these rights listing number, location, use, quantity, stream, and priority date is available from the State Water Resources Board.

The four streams carrying the greatest percentage of the 235 cfs of water rights within the sub-basin are the Wilson, Trask, Tillamook, and Nestucca Rivers. These rights, as well as those on the Miami, Kilchis, and Little Nestucca, are summarized by use and stream in Table 22. Miscellaneous, as used in the table, applies to all remaining tributaries whose rights are combined with those of the parent stream or bay.

Of the total 235 cfs in water rights, 188 cfs are consumptive. The three principal consumptive uses and their rights are municipal 70 cfs; irrigation 66 cfs; and domestic 33 cfs. Other consumptive rights are for recreation and industrial uses. The principal nonconsumptive uses are power 28 cfs, and fish 19 cfs.

If all of the consumptive surface water rights within the sub-basin were used to the maximum legal extent, approximately 103,000 acre-feet would be diverted from the

TABLE 22

SURFACE WATER RIGHTS SUMMARY
SUB-BASIN 1 - TILLAMOOK

USE	STREAM	CFS	TOTAL RIGHTS
Domestic	Neskowin Creek and Misc.	0.1	
	Little Nestucca River and Misc.	1.0	
	Nestucca and Misc.	8.5	
	Sand Lake and Misc.	0.4	
	Netarts Bay and Misc.	0.5	
	Tillamook River and Misc.	0.8	
	Trask River and Misc.	3.3	
	Wilson River and Misc.	6.3	
	Kilchis River and Misc.	0.4	
	Tillamook Bay and Misc.	4.1	
	Misc.	7.6	
	TOTAL		33.0
Municipal	Neskowin Creek and Misc.	2.7	
	Nestucca River and Misc.	5.1	
	Sand Lake and Misc.	2.1	
	Tillamook River and Misc.	37.8	
	Kilchis River and Misc.	0.5	
	Tillamook Bay and Misc.	8.6	
	Misc.	12.8	
	TOTAL		69.6
Irrigation	Neskowin Creek and Misc.	1.3	
	Little Nestucca River and Misc.	3.6	
	Nestucca River and Misc.	24.5	
	Sand Lake and Misc.	4.5	
	Tillamook River and Misc.	10.9	
	Trask River and Misc.	11.6	
	Wilson River and Misc.	5.5	
	Kilchis River and Misc.	2.3	
	Miami River and Misc.	0.7	
	Tillamook Bay and Misc.	1.4	
	Misc.	0.6	
	TOTAL		66.9
Industrial	Little Nestucca River and Misc.	1.0	
	Nestucca River and Misc.	1.1	
	Sand Lake and Misc.	0.2	
	Tillamook River and Misc.	0.3	
	Wilson River and Misc.	0.2	
	Kilchis River and Misc.	2.9	
	Tillamook Bay and Misc.	5.7	
	Misc.	2.2	
	TOTAL		13.6
Recreation	Nestucca River and Misc.	0.1	
	Netarts Bay and Misc.	5.0	
	Misc.	0.5	
	TOTAL		5.6
Power	Nestucca River and Misc.	15.9	
	Wilson River and Misc.	0.8	
	TOTAL		16.7
Fish	Nestucca River and Misc.	14.4	
	Netarts Bay and Misc.	0.2	
	Tillamook River and Misc.	0.1	
	Trask River and Misc.	3.9	
	TOTAL		18.6
	GRAND TOTAL		224.0

streams each year. Although this is far less than the average annual yield of the streams in the sub-basin, shortages do exist due to the low summer flows at the times of heaviest use.

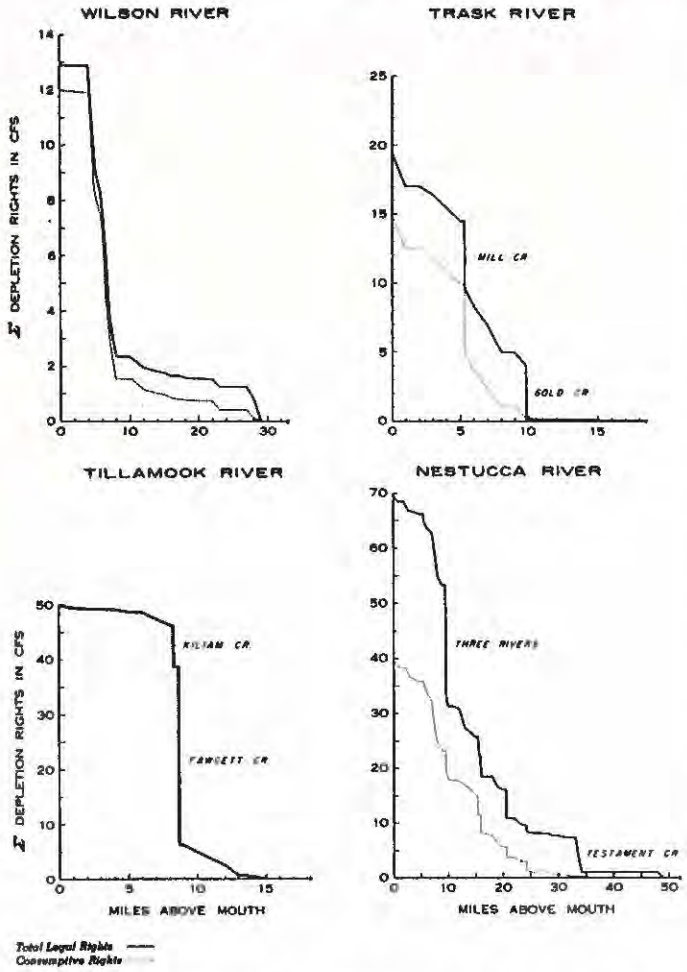


FIGURE 18. Legal depletion rights by stream miles of major streams in Tillamook sub-basin as of September 1960.

Patterns of legal depletion rights by stream miles for the four principal streams are shown in Figure 18. Major depletion potentials exist on the Wilson River between mile 2 and mile 4, totaling six cfs for domestic use on minor tributaries and six cfs for irrigation. Major rights in the Trask River system are on Mill Creek which has total rights for about five cfs, and on Gold Creek, four cfs for fish. In the Tillamook River system, there are municipal rights of 32 cfs on Fawcett Creek and 6 cfs on Killiam Creek. The Nestucca River has rights totaling about 70 cfs, more than any other stream in the sub-basin. From mile 25 downstream to the mouth, a consistently heavy use pattern is seen. Major depletions occur along the main stem and the major tributaries.

While these depletion diagrams show the total of all water rights, they do not indicate the actual water use for the following reasons:

1. *Irrigation use depends upon the pattern of rainfall occurring during the year, the availability of water for irrigation during the year, and the use pattern of each individual irrigator.*

2. *Some irrigation rights may be filed with the knowledge that low flows of the streams have been appropriated and that subsequent rights can be exercised only during high flow periods.*

3. *Not all water diverted for consumptive purposes is consumed.*

4. Water for nonconsumptive purposes, such as power and fish life, becomes available for other uses at downstream locations.

Supplemental rights are not shown on either the depletion diagrams or the water rights summary table.

GROUND WATER SUPPLY

Geology

A generalized ground water geology map of the major rock units, and their estimated yields, is shown on Plate 8. This map also shows a geologic cross section and locations, and specific capacities of various water wells.

The Tillamook sub-basin is predominantly made up of volcanic rocks consisting of basaltic lavas and tuffs which form the backbone of the Coast Range. These rocks are exposed along most of the large streams in eastern Tillamook County, attaining thicknesses of 6,000 to 10,000 feet along the Trask River from the mouth of its canyon to its forks. The rocks are relatively impervious, are often weathered to thick layers of clay, and contain little ground water. The steep slopes and narrow valleys of the region facilitate rapid runoff.

Sedimentary rocks, also relatively impervious and yielding small quantities of ground water, crop out along the western part of the sub-basin. Wells penetrating these rocks of marine deposition to any great depth are likely to tap salty water. The rocks consist mainly of shale, sandstone, and conglomerates, with lesser exposures of siltstone and claystone. Much local gradation and interbedding occurs. Heavy precipitation has caused these rocks to weather to varying thicknesses of clay near the surface, making them more impermeable.

Alluvium of sand, gravel, and terrace deposits make up much of the narrow coastal belt and the lower valleys of the larger streams. Beach sand deposits, where thick enough, store some fresh ground water above the underlying saline water. The Tillamook lowland plain, through which the Kilchis, Wilson, Trask, and Tillamook Rivers flow, makes up the largest single alluvial area in the North Coast Basin. Well records indicate that this alluvium generally consists of layers of clay, sand, and gravel. The sand and gravel units produce good quantities of ground water.

Distribution and Yield

Based on geological factors and available information from well records, the highest

present and potential ground water yield is found in the Tillamook plain. Most of the remainder of the sub-basin is believed to be low in ground water production capability.

Four municipal wells in or near Tillamook have productions ranging from 400 to 1,300 gallons per minute (gpm), with corresponding specific capacities (gpm per foot of drawdown) from 6 to 20.

The apparent lack of domestic use of ground water is believed due to more dependable and better quality surface supplies, especially springs. Known supplies of ground water are moderately hard and fairly high in iron.

Depletions

A summary of ground water rights for the entire North Coast Basin was shown in Table 15. Ground water rights for the sub-basin, on file in the State Engineer's office as of September 28, 1960, total 17 cfs. Of this total, 12 cfs are for the irrigation of 1,000 acres, and 5 cfs are for municipal purposes. The maximum legal annual depletion amounts to 6,000 acre-feet. These figures represent the total capacity of the wells as stated by the owners under the terms of the Ground Water Act of 1955, and are not necessarily the amount of water the wells withdraw.

The majority of these wells are in the Tillamook area. Although no ground water observation wells are known to be in the basin, withdrawal by wells compared to the total amount available is negligible. Available data indicate that the recharge rate is relatively rapid, particularly in the Tillamook area.

Ground water levels range from 13.5 to 58 feet below the ground surface for the four municipal wells cited above. The water table in this area is generally lowest during late summer and early fall, and highest during late winter and early spring.

PRESENT WATER USE AND ASSOCIATED PROBLEMS

Domestic

Domestic surface water rights in this sub-basin total 33 cfs. The largest group of these is on the Nestucca River, 8 cfs, followed by the Wilson River, 6 cfs, and Tillamook Bay and miscellaneous tributaries, 4 cfs. Water districts and private water companies hold domestic rights for 2 cfs in this sub-basin. Most of these latter rights have been taken over by municipal systems in recent years.

SUB-BASIN INVENTORY - TILLAMOOK

Surface water in the Tillamook sub-basin is of good quality while ground water is generally poor, being high in iron content and hard. There is often a deficiency in surface and ground water supplies along the Tillamook River during the summer months. Available information indicates little domestic use of ground water in this sub-basin but from 200 to 300 families use springs.

Municipal

Municipal rights for surface water total 70 cfs and ground water rights for this use 5 cfs. Table 23 shows public water supply data for cities and towns within the sub-basin.

TABLE 23

PUBLIC WATER SUPPLIES
TILLAMOOK SUB-BASIN

SYSTEM	SOURCE	TREATMENT		POPULATION SERVED	MAXIMUM SYSTEM CAPACITY mgd	AVERAGE OUTPUT mgd	WATER RIGHTS CFS	
		Type	Adequate				Surface	Ground
Bay City	Streams	A	Yes	850	-	-	1.00	0
Beaver	Stream	A	Yes	-	-	-	0.33	0
Cape Mears	Stream	A	Yes	-	-	-	0.50	0
Cloverdale	Stream	A	Yes	200	-	-	2.00	0
Fairview	Streams, wells	A	Yes	1,230	1.90	0.70	0.96	2.30
Garibaldi	Streams	A	Yes	1,000	1.00	0.50	4.71	0
Hebo	Spring	A	Yes	50	-	-	0.25	0
Kilchis	Stream	A	Yes	-	-	-	1.00	0
Long Prairie	Stream	A	Yes	200	-	0.01	3.00	0
Neskowin	Spring	A	Yes	-	-	-	3.65	0
Netarts Water Co.	Spring	A	Yes	100	-	-	0.30	0
Netarts Water District	Spring	A	Yes	-	-	-	0.70	0
Oceanside	Spring	A	Yes	300	-	-	-	-
Pacific City	Streams	-	-	-	-	-	2.55	-
Rockaway	Stream	A	Yes	-	-	-	5.74	0
Tillamook	Streams, Well	A	Yes	5,000	5.00	2.50	37.80	2.59
Tillamook County Creamery Association	Stream	A	Yes	280	0.50	0.40	0.05	0
Wilson R. Farmer's Water Company	Stream	A	Yes	-	-	-	2.00	0
Woods	Stream, spring	A	Yes	-	-	-	-	-

Note: A = Chlorination

Source: Oregon State Board of Health
Oregon State Engineer

Tillamook water rights include two on Fawcett Creek, tributary to the Tillamook River, which total nearly 32 cfs.

The Tillamook system serves a population of approximately 5,000 with a maximum system capacity of 5 million gallons per day (gpd) and an average output of 2.5 million gpd. The only treatment required for this system is chlorination.

Garibaldi holds municipal water rights for five cfs from Struby and Electric Creeks,

tributaries to Miami River and Cove in the northern portion of Tillamook Bay. The Garibaldi system serves approximately 1,000 people, with a maximum system capacity of 1 million gpd, two cfs, and an average output of 0.5 million gpd. Chlorination is also the only treatment required in this system.

Bay City serves a population of 850 and has municipal water rights for one cfs from surface flows. Its supplies come from Doty, Patterson, and Vaughn Creeks.

Municipal supplies are generally adequate, although some areas have had problems in the past. Surface water is of good quality while present sources of ground water are fairly high in iron and moderately hard.

Irrigation

Irrigation rights form the second largest group of water rights in this sub-basin. They total 67 cfs for the irrigation of 5,700 acres from surface flows and 12 cfs for the irrigation of 1,000 acres from ground water supplies. Surface irrigation rights for this sub-basin are more than double those of either of the other two sub-basins.

The Nestucca River and its tributaries account for the largest share of these surface irrigation rights with 24 cfs. The Trask River has 12 cfs for irrigation and the Tillamook River has 11 cfs.

There are no known quality problems associated with these rights but shortages often occur during late summer months, principally in the Tillamook River area.

Power

Power rights in the Tillamook sub-basin total 17 cfs, ranking it first in the North Coast Basin. The majority of these rights are located on the Nestucca River and its tributaries, with a total of 16 cfs. The largest of these is a right for 6 cfs on Bible Creek which enters the Nestucca at mile 33. Other streams having power rights are Boulder Creek, with 3.5 cfs, and tributaries of Three Rivers, with 4 cfs. The remainder are on small tributaries.

Industrial

Industrial water rights for surface water in this sub-basin total 13 cfs. As in the other portions of the basin, many industries obtain water from municipal supplies and do not hold individual rights. There are no industries using large amounts of water. Major

water-using industries with rights are dairy foods processing five cfs, manufacturing five cfs, rock and sand and gravel operations two cfs. Other industrial rights are for mills and fish processing operations. The major concentration of water-using industries is in the Tillamook Bay area.

Water supplies are adequate during the winter season but some areas run low during the late summer months, especially along the Tillamook River. Surface supplies show some coloration after heavy rains.

Mining

Mining water rights within the sub-basin total less than one-tenth of one cfs. Existing mining operations are confined to sand and gravel, stones, and clay with water requirements being negligible.

The principal problems associated with sand and gravel operations are disturbance of gravel beds used for fish spawning and turbidity in the streams which is detrimental to some downstream users.

Recreation

The total surface water rights for recreation in the Tillamook sub-basin is less than six cfs, of which five cfs are from Netarts Bay and tributaries. However, the value of water to recreation is not measured by the amount of rights held. Recreation is divided principally between coastal beaches and fresh water streams, lakes, and reservoirs. There are approximately 58 lakes and reservoirs in this sub-basin with a total surface area of 410 acres. There are also four major bays in the sub-basin. These are Tillamook Bay with 8,400 acres of surface area, Netarts Bay with 2,300 acres, Nestucca Bay with 830 acres, and Sand Lake which is actually a cove or bay with 450 acres. Meadow Lake, high in the headwaters of the Nestucca River, is the only major mountain lake in this area. It has an area of 93 acres and is partially man made, having had its natural elevation raised in the early years of this century in order to make it more attractive as a fishing area for a private club.

Other natural lakes in the sub-basin are located within a mile or two of the coast. The largest of these is Lake Lytle.

There are five state parks in the Tillamook sub-basin, including 1,400-acre Cape Lookout, the third largest park in the North Coast Basin. There are nine federal forest camps, located primarily in the Siuslaw National Forest. Additional recreation areas include eight county parks and four roadside rest areas.

In addition, there are approximately 16 boat landings within this sub-basin. The Siuslaw National Forest is located in the southern portion of the sub-basin and has a good stand of old growth timber, providing a unique setting for general sightseeing and recreation purposes.

The Tillamook sub-basin provides many fine streams for sports fishing as well as bay and ocean areas for both sport and commercial fishing. The estimated sport catch of salmon and steelhead in the North Coast Basin was shown in Table 10. It is seen from this table that the Nestucca River and Bay accounted for 7,500 salmon and steelhead or 24 percent of the sport catch for the entire basin in 1958. Other important salmon and steelhead areas in the sub-basin are the Trask and Wilson Rivers and Tillamook Bay. The Tillamook sub-basin salmon and steelhead sport catch in 1958 accounted for 63 percent of that for the North Coast Basin.

The kill of deer and elk in 1958 for the three principal counties in the North Coast Basin was summarized by county in Table 16. The deer kill in Tillamook sub-basin accounts for a major portion of that shown for Tillamook County.

Wildlife

There are no water rights for wildlife within this sub-basin. The streams and coastal areas are widely used by game animals and waterfowl. The larger animals hunted, in the order of their kill, are deer, elk, and bear. Smaller animals hunted or trapped include muskrat, beaver, mink, coyote, bobcat, raccoon, and the majority of the waterfowl species normally found in western Oregon. Beaver are trapped generally along the major streams throughout the sub-basin. Muskrats are generally found close to the coastal areas, inhabiting the eastern portion of Tillamook Bay, Sand Lake, and Lake Lytle. The coastal lakes and bays are also used by waterfowl as feeding, resting, and wintering areas.

The upper portions of the Kilchis, Wilson, and Trask Rivers have been opened by the Tillamook Burns and contribute to the increased western Oregon deer population.

Deer and elk are a problem in the areas which have been recently reforested because they nip the growth buds of the young trees. The State Board of Forestry and the State Game Commission are working together to alleviate this problem. Included in these efforts have been seasons for antlerless hunts.

An indication of the distribution of deer and elk in the area is the annual kill, which was listed by counties in Table 16.

SUB-BASIN INVENTORY - TILLAMOOK

Fish Life

Surface water rights for the propagation of fish in this sub-basin total 19 cfs, which is the least amount in any of the North Coast sub-basins. There are two fish hatcheries in the sub-basin. One is on Cedar Creek, a tributary of Three Rivers, and is operated by the Game Commission which holds a 13 cfs right for the hatchery. The other is maintained on Gold Creek by the Fish Commission which holds a 4 cfs right for the hatchery.

Plate 9, based on information provided jointly by the Fish and Game Commissions, shows spawning distribution of spring and fall chinook salmon, silver salmon, chum salmon, and steelhead trout. Only those streams known to be utilized by silver salmon were marked. However, since this species normally uses all available feeder streams, some additional small tributaries are probably utilized. Spring and fall chinook are found primarily on the main stems of the Miami, Kilchis, Wilson, Trask, Tillamook, Nestucca, and Little Nestucca Rivers. Steelhead are distributed throughout the sub-basin in the major streams and their tributaries. Resident and cutthroat trout are found generally throughout the sub-basin.

Table 17 lists the minimum desirable flows to maintain fish life in the streams of the sub-basin as determined by the Fish and Game Commissions. These flows are all at or near the mouths of the streams. Since they represent desirable minimums, in some in stances they are greater than present low season flows. The minimum flows are based on the supposition that flows will be higher the remainder of the year, especially when migratory fish movements are at a maximum. These concepts of minimum flow are subject to change as conditions change and knowledge increases.

Figure 9 shows a water temperature graph for Clatskanie River for the water year 1952. This pattern is believed to be generally representative of streams throughout the basin. Spot checks taken by Fish and Game personnel on streams within the sub-basin show temperatures during the summer in excess of that desirable for fish life. There were temperatures above 60° F. as late as September, for flows up to 30 cfs.

Pollution Abatement

The State Sanitary Authority operates a recently initiated basic data station within this sub-basin, on the Wilson River one-quarter mile east of Tillamook.

There are five public or semi-public sewerage systems located within the sub-basin. The largest of these is the Tillamook system which has secondary treatment and a designed capacity of 1.3 million gpd. It was designed to serve a population of 5,000

and is presently serving 4,000. This system delivers its effluent into the Trask River.

The Garibaldi system has a designed capacity for 1,200 persons with 0.2 million gpd and is presently serving 1,100 persons. The discharge from this system goes into Tillamook Bay.

The Rockaway system has a 0.4 million gpd capacity for a population of 3,750 and it is presently serving only 1,100 people. Its discharge enters the ocean by way of Clear Lake.

The Tillamook airport system is presently serving 250 people and discharges into the Trask River while the Mt. Hebo system is serving 200 people and is discharging into the Nehalem Bay.

The Tillamook, Rockaway, and Mt. Hebo systems have secondary treatment, Garibaldi has primary treatment, and no treatment is provided by the Tillamook airport system. Other areas dispose of domestic sewage by means of individual septic tanks.

The Tillamook County Creamery Association has the only operation in this area listed by the State Sanitary Authority as having a pollution problem. This problem involves discharge from the cheese plant and steps to correct the situation are being taken at the present time. No major or serious waste disposal problems are present according to the State Sanitary Authority.

WATER CONTROL

Flood Control

Flood problems within this sub-basin are restricted principally to the areas near the mouths of the seven major streams. According to the Tillamook County Advisory Committee and the Soil Conservation Service, Nestucca River flooding is principally due to the congested outlet of the river caused by shifting sand dunes.

The U. S. Department of Agriculture made a study of individual tributaries and presented summaries of pertinent water-related problems within these individual watersheds. Data are not considered precise, but are intended to show the nature and general extent of the problems. These summaries indicate that annual floods inundate about 8,000 acres of croplands in this sub-basin, and have affected numerous farms as well as business buildings, roads, and bridges.

The Corps of Engineers have authorization from Congress for a study of flood control

and water resource developments on the Nehalem, Miami, Wilson, Trask, Kilchis, and Tillamook Rivers, and on the Nestucca River and tributaries. Emergency flood control activities completed include levee repair and revetment work on the Little Nestucca River within the Little Nestucca drainage district.

Other Corps of Engineers' flood control work under special continuing authority includes raising and strengthening the existing levee in the Stillwell Drainage District, Tillamook Bay; revetment work on the Wilson River in the vicinity of Highway 101 in Tillamook, on the Nestucca River at Pacific City, and on the Kilchis River. Also a reconnaissance study is being conducted on possible flood control work on Beaver Creek, tributary to the Tillamook River.

Drainage

Sixteen thousand acres or about 35 percent of the arable land in the sub-basin are subject to the presence of excessive wetness or overflow. These are mostly tidal lands near the mouths of the Wilson, Trask, Tillamook, Nestucca, and Little Nestucca Rivers (Figure 10).

Diked areas with tide gates in this sub-basin total about 8,400 acres. Of this total, 6,900 acres are within organized drainage districts.

Drainage improvements have been made on about 5,400 acres of the imperfectly drained lands in the sub-basin.

Congestion of the lower Nestucca River due to sand dunes has long been a problem in the sub-basin. The restricted outlet of the river has limited farm drainage in that area.

Erosion

There are about 16,000 acres of arable land considered dominantly subject to wind or water erosion or both.

Severe wind erosion is a problem on the Nestucca North Spit and Netarts Spit. Some stabilization has been done at both locations. Streambank erosion is a problem on the lower Kilchis, Wilson, and Trask Rivers and to some extent on the lower Tillamook River and some of the other smaller streams (Figure 10).

Slight water erosion occurs in much of the sub-basin and moderate water erosion occurs in the Coast Range north of the Nestucca River drainage (Figure 10).

POTENTIAL WATER USE AND ASSOCIATED PROBLEMS

Domestic

This sub-basin is faced with a possible 50 percent increase in water use for domestic and municipal purposes in the next 20 to 25 years. Part of this increase will be due to the increasing per capita use of water.

As has been indicated, most of the systems in the county have small streams and creeks as their source of water. Future domestic needs will in many cases have to be supplied through larger streams, possibly with storage facilities being provided to take care of the low summer months. Present storage and distribution facilities are inadequate during extreme low flow periods in some areas and would have to be enlarged to meet growing population needs.

Municipal

Provisions have been made or are being made in many of the municipalities in this sub-basin for increased water supplies with some supplementary water being provided from ground water.

Hillsboro and Forest Grove, located in the Tualatin-Willamette drainage area, are currently considering various proposals for developing future municipal water supplies. A preliminary report covering these proposals has been prepared for these cities and two of the plans involve waters of the North Coast drainage.

One plan calls for a dam on Devils Lake Fork of the Wilson River, with an initial storage capacity of 2,400 acre-feet and possible ultimate development to 12,000 acre-feet.

The other plan involving North Coast water is for an initial storage of 4,000 acre-feet on the Middle Fork of the North Fork of the Trask River and 12,000 acre-feet ultimately. These sites are shown on Plate 10.

A report prepared for the City of McMinnville includes possible development of the Nestucca River above Meadow Lake. Various sites are suggested, including two on the Nestucca main stem and one on Walker Creek, principal tributary above Meadow Lake. The larger of these has a drainage area of 6.3 square miles and would require a storage of 2,400 million gallons or 7,400 acre-feet to meet an assumed demand based on the adverse year of 1939. These sites also appear on Plate 10.

Irrigation

Potentially irrigable lands are located in the western portion of the sub-basin along the major streams and in the area surrounding Tillamook (Figure 12). There are 46,000 acres of potentially irrigable land in the sub-basin.

Most of the water for irrigation is taken from the natural flow of streams with some shortages occurring during the low flow months. Lands along the Tillamook River obtain some irrigation water from wells due to the inadequate supply of the Tillamook River during low flow seasons.

Dairy products account for a major share of the gross agricultural income in this sub-basin. Irrigation of pasture land is desirable since this allows the land to support larger herds.

A substantial increase in irrigated acreage along most streams would require storage in order to provide an adequate water supply.

Power

The power potential in this sub-basin is considered by the U. S. Geological Survey as being the hydroelectric power that could be developed by dams on the Wilson, Trask, and Nestucca Rivers (Table 18).

The USGS considers the Cedar Creek site to be the only large reservoir site on the Wilson River. If operated to provide continuous power, a plant at this site could generate an average of 28,300 kilowatts (KW) with an average annual energy production of 248,000 megawatt hours (MWH). If operated from November through February only, average generation could be 83,000 KW with an average annual energy output of 240,000 MWH.

According to the USGS, development of the Trask River could be accomplished by a combination of five dams. Continuous operation of this combination could result in average power generation of 14,300 KW and average annual energy of 125,000 MWH. November through March operation could result in average generation of 41,000 KW and average annual energy of 148,000 MWH. These five dams would develop the Trask River from mile 13 on the main stem to mile 9 on the North Fork.

Development of the power potential of the Nestucca River could be by means of a moderately high dam about three miles above Blaine. Continuous operation could result in average generation of 16,000 KW and average annual energy production of 140,000 MWH. November through February operation could generate an average of 47,000 KW

with average annual energy production of 137,000 MWH. A dam at Meadow Lake has been considered, but is believed to be of little value.

These sites are located on Plate 10 and physical data is summarized in the Appendix.

The Tillamook County Peoples Utility District has had a reconnaissance study made of hydroelectric development of the Trask River. Two sites on the Trask main stem and one on the North Fork were considered in the study. Proposed dams range from 100 to 170 feet in height, and reservoirs from 22,000 to 120,000 acre-feet in storage capacity. Annual energy for the median year for these sites ranges from 23,000 MWH to 82,000 MWH.

The Tillamook County PUD has made application for water rights for storage and use for power on the Trask River. These applications total 158,000 acre-feet and 3,600 cfs (Table 14).

Any of these developments would interfere with existing highways and create fishery problems.

Further studies would be needed to determine the physical and economic feasibility of power development in this sub-basin.

Industrial

Future industrial expansion for the Tillamook sub-basin is believed dependent in part on improvement of the Tillamook Bay port facilities. Improved port facilities could help increase both the commercial fishing and timber industries through increased utilization of local and imported resources.

Any major increase in industrial water use would require new sources of supply. Such supplies would probably have to come through construction of storage facilities on one of the nearby major streams or development of ground water supplies.

Mining

No undeveloped mineral deposits of economic importance are known to exist in this area. No increased mining activity is anticipated at this time.

Recreation

There are numerous areas in the sub-basin which have high potential for future development of recreation. Tillamook County is considering an extensive increase in the area of its present park at Sand Lake. Figure 13 showed annual use of state parks in the basin, with State Highway Department projections of estimated future use.

In 1959 the day use at Cape Lookout was slightly over 150,000, with a projected increase to 320,000 by 1969. Overnight campers during the same period are expected to increase from 55,000 to 111,000. The rates of increase predicted for this park are the highest in the basin.

Estimates of increased use of the national forest lands in the basin indicate about 7 times greater use by 1970, and 20 times greater by the year 2000. The number of visitors rose from 31,000 to 39,000 during a three-year period from 1957 to 1959. Consumptive water needs are small for recreational use, the total USDA estimate for national forest land use in 1959 amounting to only four acre-feet.

The multiple-use policy approved by the Oregon State Board of Forestry in March of 1960 and stated in Chapter II is applicable to the Tillamook sub-basin.

Due to the fact that much of the state forest land covers areas within the Tillamook Burns of 1933, 1939, and 1945, much of this land is not well suited at present for recreational development. Organization-type camps have been established, however, within the burn areas. It is believed that the Wilson River and its tributaries will present many excellent sites for picnic grounds and limited campground development as the new forest becomes established.

Present areas specifically proposed for picnic or campground development in the near future are located on the Devils Lake Fork of the Wilson River near mile 7 and along the Trask River near the North Fork confluence.

The Wilson River location is a natural meadow on an island of 50-year-old green timber within the Tillamook Burn. The Devils Lake Fork of the Wilson River flows through the area but development would be needed to provide swimming facilities. There are agate beds which are visited by local collectors and other areas presently used by Boy Scout troops. Present use, without any development other than access, indicates that there is a demand for recreation in the area. Topography, available water, and access are favorable for such recommended development as sanitary facilities, tables, fireplaces, and water supply outlets.

The Trask River proposed development consists of three areas along the river of 10, 20,

and 23 acres. All three lie in a two-mile stretch below the Trask North Fork and all would be flooded with construction of the proposed power dams at The Peninsula. However, the State Forester has indicated that the recreational potential would, in such a case, be greatly increased along the shoreline of the artificial lake, and other state forest areas in the vicinity could be developed for recreational use. The three areas presently have old-growth timber stands varying from 60 to 100 years of age. Two of these sites are suitable for extensive development including swimming, picnicking, and camping facilities.

Construction of a south jetty at Tillamook Bay would probably help both fishing and boating. This area is potentially one of the largest bay boating areas in the state. If developed, the area would be available not only for boating within the bay but for passage on a year-round basis for boats going out into the Pacific Ocean.

A 1958 survey for the National Parks Service considered several potential recreation areas along the Pacific Coast. These included the Tillamook Sand Spit, Netarts Spit, Sand Lake, and the Nestucca Spit. Extension of present facilities at Nestucca Spit and Cape Kiwanda was recommended. The State of Oregon is interested in acquiring the Netarts Spit area as a possible addition to the adjacent Cape Lookout State Park. A portion of the Sand Lake area has already been developed by Tillamook County.

Wildlife

Water needs for wildlife will not change materially in the future unless the habitat is changed substantially by new developments.

Fish Life

Potential development of fish life to maximum capacity depends upon determining optimum conditions and the ability to create or maintain necessary flows, temperature, spawning areas, and pollution abatement once such criteria are established. Based upon streamflow, gradients, and other natural conditions, probably the greatest potential for enhancement of fish life in this sub-basin lies with the Nestucca, Trask, and Wilson stream systems.

Several storage facilities for irrigation, power, and other uses have been proposed in this sub-basin. If constructed, these would present serious problems for anadromous fish runs and fish passage facilities would have to be provided if present runs were to be maintained. Conversely, development of storage is the only way by which low streamflows can be increased to the desirable minimums recommended for fish life.

Pollution Abatement

The Oregon State Sanitary Authority indicates that the communities of Bay City, Manhattan Beach, Netarts, Prescott, and Twin Rocks are in need of public sewerage systems at this time. These are beach communities and do not affect streams since they discharge into the ocean. It is likely that increased population will require a higher degree of treatment in the future for the present plants discharging into the Trask River and Tillamook Bay.

Increased development and use of recreational areas will result in an increase in potential pollution problems.

SUB-BASIN 2 NEHALEM

GENERAL

Location and Size

The Nehalem sub-basin (Plate 1) includes the entire drainage of the Nehalem River and Bay. It is the smallest of the three sub-basins, containing 845 square miles or 31 percent of the total area of the North Coast Basin.

Thirty-seven percent of the sub-basin lies in Clatsop County, 30 percent in Columbia County, 26 percent in Tillamook County, and 7 percent in Washington County.

The western edge of the sub-basin bounded by the Pacific Ocean is a short strip of about 3.5 miles corresponding roughly to the north-south extension of Nehalem Bay. The northern boundary of the sub-basin is formed by the divide between the Nehalem drainage and many streams of the Columbia sub-basin. The southeastern boundary of the basin is the Coast Range divide. The southern boundary is the divide between the Nehalem drainage and that of the Wilson, Kilchis, and Miami Rivers.

Stream System

The headwaters of the main stem of the Nehalem River are in the southeastern portion of the sub-basin. They begin flowing in an easterly direction and then form a counter-clockwise spiral to eventually complete the last 25 miles in a generally southwesterly direction, flowing into Nehalem Bay.

Also heading in the same area are the Salmonberry River and the South Fork of Rock Creek. Rock Creek joins the Nehalem near mile 90 and the Salmonberry River joins the Nehalem at mile 22. The Salmonberry River is 19 miles in length and Rock Creek 28 miles. The second longest tributary to the Nehalem is its North Fork, 24 miles, which heads in the northwest part of the sub-basin, joining the main stem at mile 3.

TABLE 24

NEHALEM SUB-BASIN
STREAM GRADIENTS

STREAM	LENGTH Miles	ELEVATION DROP Feet	AVERAGE GRADIENT Ft/Mile
Nehalem River	119	2,240	19
North Fork Nehalem River	24	730	30
Salmonberry River	19	1,890	99
Rock Creek	28	1,125	40
Wolf Creek	8	1,330	166

There are over 1,350 miles of streams in this sub-basin (Table 2), of which 930 or slightly more than two-thirds are perennial in nature.

Profiles of the main stem and the three principal tributaries showing elevations versus stream miles are on Plate 2. Gradients of major streams in the sub-basin are listed in Table 24.

SUB-BASIN INVENTORY - NEHALEM

The main stem of the Nehalem has an overall gradient of 19 feet per mile. Its upper portion from mile 119 to mile 107 has a drop of 124 feet per mile, while the middle section from mile 107 to mile 38 has a drop of 5 feet per mile and the remaining 38 miles have a drop of nearly 11 feet per mile. The Salmonberry River has an average gradient of 99 feet per mile. The average gradient of the Nehalem North Fork is 30 feet per mile and that of Rock Creek is 40 feet per mile.

Climate

At Nehalem Bay the average annual precipitation is approximately 90 inches, increasing to 110 inches in a northeasterly direction and then declining to about 50 inches in the area of Vernonia. It rises to over 60 inches at the northeastern edge of the sub-basin. The highest precipitation in the sub-basin occurs near the center of the southern boundary where the annual precipitation averages over 140 inches (Plate 3).

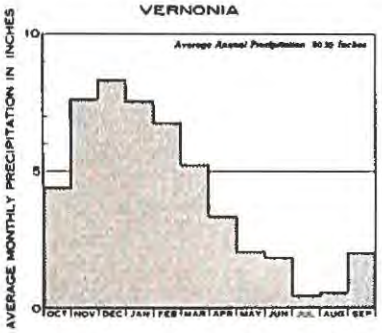


FIGURE 19. Average monthly precipitation at Vernonia, 1889-1900 and 1938-1959.

Average monthly precipitation is shown in Figure 19 for the station at Vernonia. November, December, and January are the peak months, while July and August are the months of least precipitation.

Annual snowfall averages 32 inches at Vernonia. Nehalem is probably comparable to Tillamook, where the annual snowfall averages 5 inches.

There is considerable variation in temperature extremes within the sub-basin with a maximum of 106 degrees Fahrenheit and a minimum of minus 8° F. recorded at Vernonia and a maximum of 101° F. and minimum of 0° F. at Tillamook, which is representative of coastal regions of the sub-basin. The mean annual temperature at Vernonia is 49° F. Temperature variations by months are shown in Figure 20 for Vernonia.

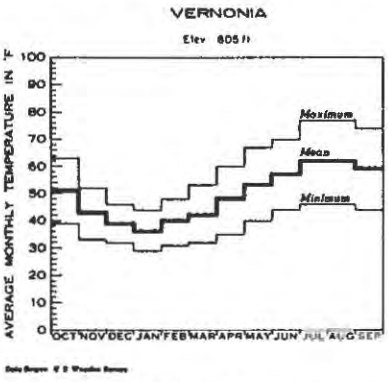


FIGURE 20. Average monthly air temperature at Vernonia, 21 years of record.

The average number of days without killing frost at Vernonia is 188 and at Jewell 166.

Population

The Nehalem sub-basin has less than 10 percent of the total population of the North Coast Basin with a 1960 estimate of 5,640. Vernonia is the only city of over 1,000 population with 1,090 in

1960, followed by Timber with 250, Wheeler 240, Nehalem 230, Bayside Garden 140, and Mist 100.

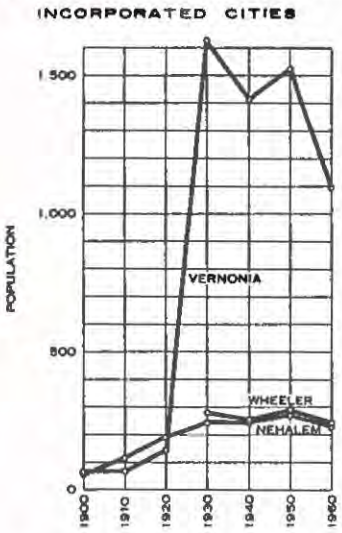


FIGURE 21. Population trend of incorporated cities in Nehalem sub-basin, 1900-1960.

Population trends in the incorporated cities are shown in Figure 21. Wheeler and Nehalem show a leveling off period followed by a slight decline in the 1950's. Vernonia's population jumped during the 1920's due to exploitation of the substantial timber resources in the area. In the period 1950 through 1960, the population dropped considerably due to the closing of a major mill.

ECONOMIC FACTORS

Land Ownership

The Nehalem sub-basin comprises 845 square miles, of which about 500 or 59 percent are owned by private parties, mostly major lumber companies. Three hundred and thirty square miles, or 39 percent, are owned by the State of Oregon, administered principally by the Board of Forestry. The federal government owns only eight square miles or approximately one percent of this sub-basin, and four square miles are under county and municipal ownership.

The principal lands owned by the State of Oregon are forest land acquired from the counties.

Timber

Timber is the most important economic resource within this sub-basin. Approximately 775 square miles are covered by forests. Nearly all of this is of commercial type and is divided principally between state and private ownership.

Western hemlock is predominant in much of the western portion of the sub-basin and along the southern boundary. Douglas fir is the predominant species east and north of the mouth of the Salmonberry River. Minor amounts of sitka spruce are also scattered throughout the western portion of the sub-basin.

Much of the Tillamook burn area in this sub-basin has been reforested and the State Board of Forestry predicts a net allowable annual cut on its lands for the present decade

of about 35 million board feet. This is expected to rise within 50 years to 43 million board feet and at the end of 100 years to slightly over 100 million board feet.

Clatsop, Tillamook, and Washington Counties contain the largest acreages of state forest lands in the state, and the majority within the North Coast Basin are found in the Nehalem and Tillamook sub-basins. Most of these lands in the northern portion of the Nehalem sub-basin were acquired by the state after early day logging in Clatsop County. County officials recognized the need for stabilizing forest ownership and placing them on a sound management basis. Consequently, soon after 1936, Clatsop County began turning tax delinquent forest lands over to the state.

Some land in the southern portion of the Nehalem sub-basin was acquired by the state, following the Tillamook Burns of 1933, 1939, and 1945.

Agricultural Land

Agriculture is an important economic resource in this sub-basin. Of the 178,000 acres of arable land in the entire basin (Table 6), the U. S. Department of Agriculture estimates that 22,000 acres lie in the Nehalem sub-basin which is the least amount of arable land in any of the three sub-basins. Of this total, about 35 percent is considered good to very good cultivable land and the remainder ranges from moderately good cultivable land to land best suited for pasture. All of this land is considered susceptible to irrigation although it is estimated that only a little over 1,000 acres are presently irrigated.

The principal agricultural lands lie along the Nehalem River valley and the principal crops are hay, pasture, and small grains.

Minerals

Known mineral resources in the entire basin are shown on Plate 4.

Shale, coal, sand and gravel, and building stone constitute the principal mineral resources in the sub-basin. Two plants are presently quarrying and expanding the shale for use as a lightweight aggregate for concrete building blocks and for monolithic concrete construction. Low-grade, undeveloped coal deposits occur north of Nehalem and southeast of Vernonia.

Eighteen exploratory oil wells have been drilled in the sub-basin with no oil and very little gas being encountered. The wells are concentrated in the Mist area where they range from 85 to 8,500 feet deep.

SUB-BASIN INVENTORY - NEHALEM

Fish Life

There is no commercial fishing activity within the Nehalem sub-basin other than limited shellfish catches of clams, crabs, and oysters from Nehalem Bay.

Some commercial ocean fishermen use Nehalem Bay as their base of operations and some of the fish caught are landed at Nehalem.

Industry

Nearly all industry within this sub-basin is connected with timber and timber processing. The largest, and to date the only operation employing over 100 persons, is a tree farm at Vernonia. A shingle mill at Wheeler and two lumber companies at Mist are the only other operations within this sub-basin which regularly employ more than 20 persons according to the State Department of Planning and Development.

In 1957 a major mill at Vernonia closed due to an inadequate supply of large old-growth logs for which the mill was set up. This resulted in a drop in community population from 1,520 in 1950 to slightly less than 1,100 in 1960.

Recreation

Recreation within this sub-basin is principally stream fishing and hunting. There are no major developed beach recreation areas.

Clatsop County and the State of Oregon have set aside large wooded areas in the Nehalem sub-basin as forest preserve areas for fishing and camping.

It is difficult to ascertain the economic return of recreation in this sub-basin due to the lack of large county or state parks where surveys are generally conducted.

Transportation

Federal, state, and county roads provide good transportation in the sub-basin, with passenger service furnished by bus line and freight service by truck and rail. There is one airport which serves small planes, but has no regular passenger service. Wheeler has a port on Nehalem Bay which handles primarily small boats and barges.

SURFACE WATER SUPPLY

Yield

Annual yields of the Nehalem River and one of its principal tributaries, Rock Creek, are shown in Figure 22. The Nehalem River is one of the few streams in the North Coast Basin with relatively long-term flow records. These are for the station located at Foss, upstream from tidal influence, which has been in existence since 1940 (Plate 6).

In order to use the common 26-year base period adopted for this study, 7 years of correllations for the Nehalem River were necessary. These were based on precipitation-runoff relationships.

The highest year for the Nehalem River at the mouth, during the base period, had a yield almost three times that of the low year. The high year was 1933 with 4,400,000 acre-feet and the low year, 1941, with 1,500,000 acre-feet.

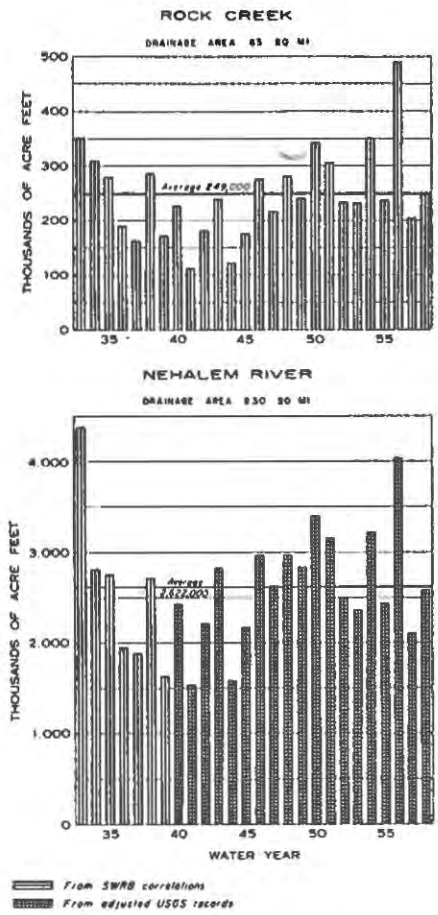


FIGURE 22. Annual yields of representative streams in Nehalem sub-basin, 1933-1958.

Distribution

Figure 23 illustrates the general trend of streamflows on a monthly basis throughout the sub-basin.

Snowfall is not sufficient to have a material affect on spring and summer runoff. Lack of regulation of the streams is reflected in high December,

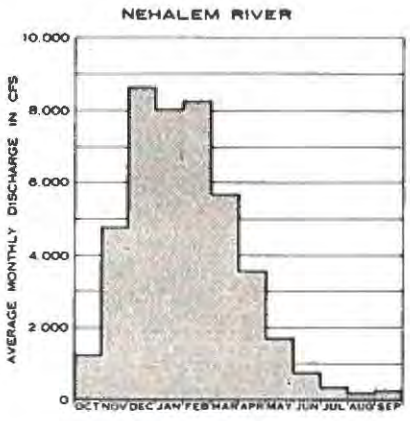


FIGURE 23. Averege monthly discharge at the mouth of the Nehalem River, 1933-1958.

January, and February runoff and very low runoff throughout the summer months.

Extremes

The highest flow of record on the Nehalem River at Foss occurred in December 1956 with 39,300 cubic feet per second (cfs) and the minimum flow occurred in September 1951 with 54 cfs.

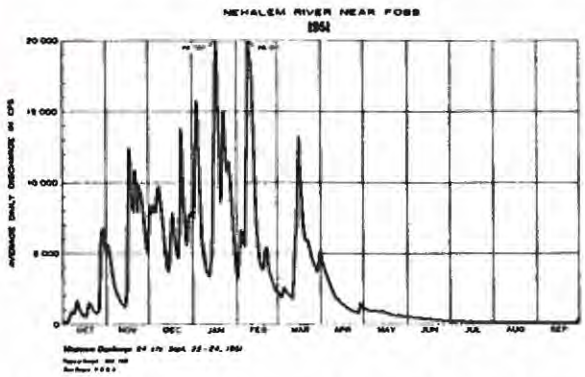


FIGURE 24. Daily discharge pattern of the Nehalem River near Foss for the water year having the minimum instantaneous flow of record, 1951.

The daily pattern of discharge during the water year of minimum instantaneous recorded flow, 1951, for the Nehalem River is shown in Figure 24.

Depletions

Diversion points for all water rights in the North Coast Basin are located as shown on Plate 7. A detailed summary of these rights listing the number, location, use, quantity, stream, and priority date is available at the SWRB office in Salem.

Water rights are distributed quite evenly throughout the Nehalem watershed and also along the main stem and principal tributaries. The largest concentration of rights is within the lower areas of the Nehalem drainage in the general vicinity of Nehalem Bay, lower North Fork, and Foley Creek. Rights for the main stem Nehalem, Rock Creek, Foley Creek, North Fork Nehalem, and Nehalem Bay are summarized by use in Table 25.

Of the total 133 cfs, 58 cfs are consumptive and 75 cfs are nonconsumptive. The principal consumptive use is for irrigation, with rights for 24 cfs and 2,200 acres. Other consumptive rights are 16 cfs for industrial, 6 cfs for domestic, and 12 cfs for municipal uses. Nonconsumptive rights are 50 cfs for power and 25 cfs for fish.

If all the consumptive surface water rights in the sub-basin were used to the maximum legal extent, approximately 30,000 acre-feet would be diverted from the streams each year. Although this is far less than the average annual yield of the streams of the sub-basin, shortages exist due to heavy uses during periods of low summer flows.

TABLE 25

SURFACE WATER RIGHTS SUMMARY
SUB-BASIN 2 - NEHALEM

USE	STREAM	CFS	TOTAL RIGHTS
Domestic	Nehalem River and Misc. North Fork Nehalem R. and Misc. Nehalem Bay and Misc.	3.9 1.3 1.0	
	TOTAL		6.2
Municipal	Nehalem River and Misc. North Fork Nehalem R. and Misc. Nehalem Bay and Misc.	4.5 2.5 4.8	
	TOTAL		11.8
Irrigation	Nehalem River and Misc. North Fork Nehalem R. and Misc. Nehalem Bay and Misc.	20.0 2.2 1.9	
	TOTAL		24.1
Industrial	Nehalem River and Misc. North Fork Nehalem R. and Misc. Nehalem Bay and Misc.	7.4 0.1 8.9	
	TOTAL		16.4
Fish	Nehalem River and Misc. North Fork Nehalem R. and Misc. Nehalem Bay and Misc.	22.5 0.1 2.2	
	TOTAL		24.8
	GRAND TOTAL		83.3

The pattern of legal depletion rights by stream mile for the Nehalem River is shown in Figure 25.

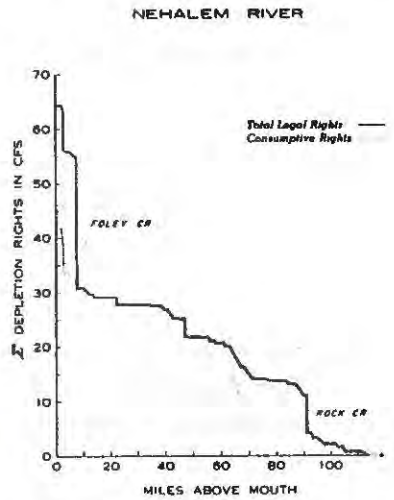


FIGURE 25. Legal depletion rights by stream miles of the Nehalem River as of September 1960.

The largest single right is for 22 cfs for a fish hatchery on Foley Creek.

While this depletion diagram shows the total of all water rights as of September 1960, it does not indicate the actual water use for the following reasons:

1. *Irrigation use depends upon the pattern of rainfall occurring during the year, the availability of water for irrigation during the year, and the use pattern of each individual irrigator.*

2. *Some irrigation rights may be filed with the knowledge that low flows of the*

streams have been appropriated and that subsequent rights can be exercised only during high flow periods.

3. Not all water diverted for consumptive purposes is consumed.

4. Water for nonconsumptive purposes, such as power and fish life, becomes available for other uses at downstream locations.

Supplemental rights do not show on either the depletion diagrams or the water rights summary tables.

GROUND WATER SUPPLY

Geology

A generalized ground water geology map of the basin showing the major rock units and their estimated yield capabilities, a geologic cross section, and locations and specific capacities of various water wells is shown on Plate 8.

Sedimentary rocks made up of shale, sandstone, and conglomerate crop out over the greater part of the sub-basin, extending from east to west borders. These rocks, for the most part tightly compacted and impermeable, weather to varying thicknesses of clay near the surface. Their ground water potential is low.

Volcanic units of basaltic lavas, tuffs, and associated intrusives make up the south, central, and the northeast border areas of the basin. The lavas, particularly the more fragmental, retard runoff and may be regarded as a potential low-to-moderate source of ground water. Little is known as to their overall porosity and permeability qualities. Steep slopes and narrow valleys characteristic of the Coast Range, as well as the tendency of both the sedimentary and volcanic rocks to weather to clay where exposed, preclude them from having more than moderate quantities of ground water.

Alluvial deposits along the lower reaches of the streams entering Nehalem Bay consist of sedimentary debris along the North Fork and the Nehalem Rivers, and volcanic debris east and south of the confluence of Foley Creek with the Nehalem River. Although little information is available regarding the ground water potential of these deposits, it is believed that the sedimentary alluvium yields little water and that moderate quantities may be obtained from the volcanic alluvium.

SUB-BASIN INVENTORY - NEHALEM

Distribution and Yield

Based on geological factors and known well records, the areas of fairly good ground water yield appear limited to the alluvial deposits of the valley lowlands, particularly along the Nehalem River and Foley Creek. Direct precipitation is believed to be the main source of supply throughout the alluvial areas.

The largest known producing well, located in volcanic alluvium east of Wheeler, had a test production of 250 gallons per minute (gpm). The specific capacity (gpm per foot of drawdown) was 12. Most other production records are for wells located in sedimentary rocks, which average only about 8 gpm with specific capacities generally less than 1.

No records are available for wells situated in volcanic areas, but it is probable that these rocks, generally tightly compacted and impermeable, would yield little ground water.

In general, ground water throughout the sub-basin is moderately hard and fairly high in iron content. Shortages exist in some areas during late summer months.

Depletions

Ground water rights for the sub-basin, on file in the State Engineer's office as of September 28, 1960, total only 0.2 cfs. This is for a well for group domestic use near Vernonia. Its maximum legal annual depletion amounts to about 140 acre-feet. This figure represents the total capacity of the well as stated by the owner under the terms of the Ground Water Act of 1955, and is not necessarily the amount of water the well withdraws. A summary of registered wells for the entire North Coast Basin was shown in Table 15.

Existing industrial, municipal, and irrigation needs are supplied by surface sources and depletion by existing wells is negligible.

PRESENT WATER USE AND ASSOCIATED PROBLEMS

Domestic

Domestic water in this sub-basin is obtained from wells, springs, and streams. Total domestic rights for the entire sub-basin are six cfs from surface supply. This is by far the smallest amount for domestic purposes of any of the three sub-basins in the North Coast Basin.

There are many homes having wells in the upper Nehalem valley but most of these wells

yield poor quality water and some have inadequate supply during the summer months. An existing quality problem is principally one of high iron content and hardness.

Surface supplies are of good quality above tidewater and no known shortages exist.

Municipal

Municipal water rights for surface water in this sub-basin total 12 cfs. Ground water rights for municipal purposes total only 0.2 cfs.

Table 26 shows public water supply data for cities and towns within the sub-basin.

TABLE 26

PUBLIC WATER SUPPLIES
NEHALEM SUB-BASIN

SYSTEM	SOURCE	TREATMENT Type	TREATMENT Adequate	POPULATION SERVED	MAXIMUM SYSTEM CAPACITY mgd	AVERAGE OUTPUT mgd	WATER RIGHTS CFS Surface	WATER RIGHTS CFS Ground
Nehalem	Stream	A	Yes	390	-	0.10	2.00	0
Timber	Stream	A	Yes	200	-	-	0.15	0
Vernonia - city	Stream	A,B, C,D	Yes	1,700	0.70	0.24	2.12	0
Vernonia - Riverview	Well, spring	-	Yes	200	-	-	0	0.17
Wheeler	Streams	A	Yes	-	-	-	3.28	0

Note: A = Chlorination
B = Chemical flocculation
C = Sedimentation
D = Filtration

Source: Oregon State Board of Health
Oregon State Engineer

Vernonia is the largest city within the sub-basin and holds municipal water rights for slightly over two cfs for surface water on Rock Creek. Nehalem holds a municipal right for two cfs from Bobs Creek, a small tributary of Nehalem Bay, and Wheeler holds a municipal surface right on Jarvis Creek for three cfs and minor industrial and domestic rights on the West Fork of Coal Creek.

The Vernonia supply serves an estimated population of 1,700 people with a maximum system capacity of 0.7 million gallons per day (gpd). The actual average output of the system is 0.24 million gpd.

Present municipal supplies are adequate in quantity and, in most cases, require only chlorination.

SUB-BASIN INVENTORY - NEHALEM

Irrigation

Irrigation rights form the third largest group of rights within the Nehalem sub-basin. A total of 24 cfs surface water rights exist for the irrigation of 2,200 acres. The U. S. Department of Agriculture estimates that only a little over 1,000 acres are presently being irrigated.

The majority of rights in this sub-basin are from the main stem of the Nehalem River with rights for 14 cfs. The rest of the irrigation rights are distributed along the minor and major tributaries and Nehalem Bay miscellaneous.

There are areas along the lower river that would benefit from irrigation. Such water could be provided from upstream storage.

Power

Power rights in the Nehalem sub-basin total less than one-tenth of one cfs. A former right for 46 cfs on Rock Creek has been canceled and the dam associated with it was removed in 1948 by the Oregon Fish Commission.

Industrial

Industrial rights for the use of surface waters in this sub-basin total 16 cfs. Some industries obtain water through municipal supplies and do not hold individual rights. The two largest amounts of rights are on Rock Creek with 3.4 cfs and Nehalem Bay and miscellaneous with 9 cfs. These rights are used primarily for manufacturing and lumber mills.

The present industrial demand for water is concentrated in the Wheeler area and the supply is adequate. Industrial rights for manufacturing in this area total 8 cfs. There is a 2.9 cfs right on Rock Creek for manufacturing but this is no longer used.

Mining

There are no water rights for mining within this sub-basin. The only active mining operation other than sand and gravel is quarrying and processing expandable shales for building materials. This involves very little use of water. These operations are located at the southeastern edge of the sub-basin.

The principal problems associated with sand and gravel operations are disturbance of gravel beds used for fish spawning, and turbidity in the streams which is detrimental to some downstream users.

Recreation

There are no recreational water rights within this sub-basin.

Fishing, boating, hunting, and camping as well as hiking, horseback riding, and sightseeing are all enjoyed within the Nehalem sub-basin.

There are approximately 33 lakes, ponds, and reservoirs with a total surface area of 125 acres within this sub-basin. The largest of these is a 33-acre millpond just west of the City of Vernonia. The second largest, with a surface area of 15 acres, is Lost Lake at the end of Lost Lake Creek 1.5 miles east of Lukarilla. The third largest, Soapstone Lake, 10 acres in area, is located at the end of Soapstone Creek, tributary to the Nehalem North Fork.

Recreational areas in the North Coast Basin are located on Plate 5 and facilities at these areas are indicated in a summary available through the State Water Resources Board.

The state has two undeveloped parks in this sub-basin. One is on Nehalem Sand Spit and the other is in the central portion of the sub-basin. Portions of Oswald West and Saddle Mountain State Parks also lie in this sub-basin.

Tillamook County has one 12-acre park with camping, fishing, and bathing facilities and rest rooms. This park is located on Roy Creek, tributary to the Nehalem, between Foss and Mohler.

Clatsop County also has a park with facilities for camping, fishing, and bathing. It is located at the confluence of Spruce Run Creek and the main stem of the Nehalem. There are also small roadside private parks and roadside rest and picnic areas provided by the major lumber companies.

There are six public boat landings in this sub-basin with four in Nehalem, one in Wheeler, and one at the county park on Roy Creek.

In 1958 fishing activity on the main stem of the Nehalem River averaged 164 angler trips per week-end day and 55 angler trips per weekday during the peak of the steelhead season.

SUB-BASIN INVENTORY - NEHALEM

Wildlife

There are no water rights for wildlife within this sub-basin. Streams and coastal areas are widely used by game animals and waterfowl. The larger animals hunted are deer, elk, and bear and smaller animals hunted or trapped include muskrat, beaver, mink, coyote, bobcat, and raccoon. Muskrat are found along the lower Nehalem, Nehalem North Fork, Nehalem Bay, and along the Nehalem River from about mile 47 to about mile 70. Beaver are trapped generally along the main streams throughout the sub-basin. Waterfowl use the lower Nehalem River and Nehalem Bay as feeding, resting, and wintering areas.

The southern portion of the Nehalem sub-basin, which was involved in the Tillamook Burn, has been opened by the fires and contributes to the increase in western Oregon deer population.

Deer and elk are a problem in areas which have been recently reforested because they nip the new growth of young trees. The State Board of Forestry and the State Game Commission are working together to alleviate this problem. Included in these efforts have been seasons for antlerless hunts.

An indicator of the distribution of wildlife is the annual kill of deer and elk which was listed by counties in Table 16.

Fish Life

Water rights for propagation of fish in the sub-basin total 25 cfs of which the principal amount is 22 cfs for the fish hatchery operated by the Fish Commission on Foley Creek.

The Nehalem River is one of the four drainage areas in which the Oregon Fish Commission began a study of the angler harvest of chinook and silver salmon in 1947. The purpose of the program has been to collect production and fishing effort statistics to aid in resource management and to supplement commercial catch records.

Overall statistics since 1925 on areas south of the Columbia River have indicated that silver salmon are the anadromous species experiencing the major population decline. This was discussed more fully in Chapter II.

Beginning in 1948, Oregon coastal stream surveys were initiated by the Fish Commission and since that time they have covered 2,500 stream miles in 34 drainages. Ninety-one detailed surveys of 212 stream miles have been made in the Nehalem River drainage. A total of 460 log jams was observed for an average of 2.1 log jams per mile, as

compared to an average of slightly over one log jam per mile for the total survey. About 60 miles or 23 percent of the streams surveyed are above barriers impassable to fish, including natural falls.

Plate 9, based on information provided jointly by the Fish Commission and the Game Commission, shows spawning distribution of spring and fall chinook salmon, silver salmon, chum salmon, and steelhead trout. Only those streams known to be utilized by silver salmon were marked. However, since this species normally uses all available feeder streams, some additional small tributaries are probably utilized. Chum salmon in the Nehalem are found only in the lowest portion of the sub-basin. Spring and fall chinook are found primarily on the main stem of the Nehalem, Rock Creek, and the Salmonberry River. Steelhead are distributed throughout the sub-basin in the Nehalem and major tributaries.

Table 17 listed Nehalem sub-basin streams and their desirable minimum flows for fish life as recommended by the Fish and Game Commissions. The Oregon Game Commission has stated that these are desirable minimum flows and in some instances may be greater than present low season flows. These minimum flows are based on the supposition that natural flows will be higher the remainder of the year especially when migratory fish movements are at a maximum. These concepts of minimum flow are subject to change as conditions change and knowledge increases.

The desirable minimum flow specified for the Nehalem River is 200 cfs at the mouth. It is estimated that this would amount to approximately 150 cfs at Foss where the minimum gaged flow during 20 years of record was 54 cfs. The estimated mean flow at the mouth for August, which is the low flow month, is 200 cfs (Figure 23).

Figure 9 showed a water temperature graph for the Clatskanie River covering the water year 1952. This pattern is believed to be generally representative of streams throughout the basin. Spot checks taken by Fish and Game personnel on streams within the sub-basin show temperatures during the summer in excess of that desirable for fish life. There were temperatures above 60° F. as late as September for flows up to 35 cfs.

Pollution Abatement

The State Sanitary Authority operates one recently initiated basic data station within this sub-basin. This station is located on the Nehalem River at the County Bridge one mile east of Mohler at approximately river mile 6.5 (Plate 6).

There are three public sewerage systems located within the sub-basin. These are at Nehalem, Wheeler, and Vernonia of which only Vernonia, which uses a lagoon system,

has any type of treatment. The Nehalem system serves an estimated population of 200 persons and discharges raw sewage into Nehalem Bay. The Wheeler system serves an estimated population of 250 persons and also discharges raw sewage into Nehalem Bay. The system at Vernonia serves a population of 1,100 compared to a design population of 2,000 and discharges its effluent into the Nehalem River. The Vernonia plant was constructed in 1960.

According to the State Sanitary Authority, there are no major industrial waste disposal problems at the present time. Minor pollution has on occasion been caused in the Nehalem sub-basin by a private plant near Vernonia. The State Sanitary Authority states that primary sewage treatment will eventually be required at Nehalem and Wheeler, but no compliance dates have yet been set for the installation of such facilities.

WATER CONTROL

Flood Control

Most of the arable lands subject to flooding in this sub-basin lie in the lowlands near the mouth of the Nehalem River. Information from USDA field personnel and the Tillamook County Advisory Committee indicates that annual floods inundate about 2,000 acres of cropland and have affected homes and farms and the Nehalem business district.

In 1951 the Corps of Engineers completed rehabilitation of an existing levee and construction of an additional adjoining levee on the Nehalem River in the vicinity of Nehalem. The total cost was $46,000 and annual benefits amount to about $18,000. About 770 acres are protected. Emergency flood control work has also been done by the Corps of Engineers on the Nehalem North Fork near the mouth. The cost of this project was about $24,000.

The Corps of Engineers has Congressional authorization for a study of flood control on the Nehalem, Miami, Kilchis, Wilson, Trask, and Tillamook Rivers.

Drainage

There are about 9,000 acres or less than 15 square miles in this sub-basin considered as lands subject to the presence of excessive wetness or to overflow (Figure 10).

There are only three drainage districts in the sub-basin. These are located in the tidelands near the mouths of the Nehalem and the Nehalem North Fork.

Erosion

There are 6,200 acres, or less than 10 square miles, in this sub-basin considered as arable lands dominantly subject to wind or water erosion or both. Very severe wind erosion has been a problem on the Nehalem Spit, but most of this area has been stabilized.

Some minor bank erosion occurs along the Nehalem valley during high water periods but no serious problems occur in the sub-basin (Figure 10).

POTENTIAL WATER USE AND ASSOCIATED PROBLEMS

Domestic

No major increase in water use for domestic supplies is seen in this sub-basin for the immediate future. Due to poor quality of ground water in both shallow and deep wells, future needs will probably have to be met from surface water supplies in most areas.

Municipal

Due to recent population trends in major municipalities in this sub-basin, no problems relative to quantity are anticipated in the foreseeable future.

Irrigation

Potentially irrigable lands were shown in Figure 12. There are about 22,000 acres of such land within the sub-basin. These consist mainly of lands in the three drainage districts in the lower portion of the sub-basin and narrow tracts of bottom or terrace land adjacent to major streams in the remainder of the sub-basin. The latter are primarily along the Nehalem, Nehalem North Fork, and Rock Creek.

At the present time, nearly all irrigation waters are taken from natural flows of the Nehalem and its tributaries and no major shortages are prevalent at the present level of usage. However, natural flows are not adequate for any substantial expansion of irrigated acreages.

Nearly all the present cropland could be irrigated to good advantage if an adequate supply of summer water were available to permit irrigation water to be pumped from streams and applied to the land by sprinkler systems. If a project involving flood

protection and irrigation could be developed, considerable intensification of agricultural practices would be necessary to take full advantage of and pay for the project.

Power

The power potential in this sub-basin is considered by the U. S. Geological Survey as being the hydroelectric power that could be developed by a combination of five dams at the following locations: Clear Creek, Elsie, Nehalem Falls, and Stonehill on the Nehalem main stem and Gods Valley on the Nehalem North Fork (Table 18). The USGS uses this five-dam development for estimating gross power potential, not as a suggested plan. If operated to provide continuous power, these plants could generate an average of 72,700 kilowatts (KW) with an average annual energy production of 637,000 megawatt hours (MWH). If these operated from November through March only, generation could average 170,000 KW with an average annual energy output of 616,000 MWH.

An alternate plan is diversion of the flow of the Nehalem to the Columbia River utilizing a high-line reservoir and off-peak hour pumping, continuous year-round operation could generate an average of 76,000 KW and produce an average annual energy of 666,000 MWH. If operated from November through March only, generation under this plan could average 192,000 KW with average annual energy production of 696,000 MWH. This plan would require approximately 350,000 MWH of off-peak energy for pumping.

All of the above figures are based on a study period of 1940 through 1954.

The Tillamook County PUD has had a reconnaissance study made of potential hydroelectric development on the Nehalem River. The Tillamook County PUD has made application for water rights for storage and power use on the Nehalem River. These applications total 280,000 acre-feet and 3,700 cfs (Table 14).

Three sites, all on the Nehalem main stem, were considered in this study. Proposed dams range from 70 to 250 feet in height and from 100,000 to 400,000 acre-feet in storage capacity. Annual energy for the median year ranges from 101 to 293 MWH. These sites are located on Plate 10 and physical data is summarized in the Appendix.

Further studies would be needed to determine the physical and economic feasibility of power development in this sub-basin.

Industrial

Based on its timber potential and water flow, the Nehalem sub-basin has potential for

future industrial development provided an increased share of the timber can be processed within the area or local utilization of wood products increased.

Mining

Coal deposits near Vernonia and Nehalem represent a mining potential. Utilization of the Vernonia deposits has been considered in conjunction with development of nearby deposits of limonite. The relatively low grade of the coal deposits has precluded their development up to this time.

Only small amounts of water would be required for such mining developments.

Recreation

Figure 13 showed annual use of state parks in the basin with State Highway Department projections of estimated future use. Portions of Saddle Mountain and Oswald West parks are within this sub-basin.

Saddle Mountain is limited in both present use and expected future use by the preference of most park visitors for areas of more varied recreational interests, this being principally an area for sightseeing and picnicking. Visitor days are expected to increase from 19,000 in 1959 to about 35,000 in 1969, and overnight campers from 800 to 1,700 during this period.

Oswald West is primarily in the Columbia sub-basin but is closely associated with the Nehalem Bay area and the projected increase in use will affect this area. Day use is expected to increase from 146,000 to 250,000 during the 10-year period, and overnight camping use from 4,000 to 8,000.

These increases do not indicate any major problem in water supply for recreational development. Maintenance of proper flows for fish and wildlife needs are considered below.

There are numerous areas in this sub-basin which have potential for future development of recreation.

The multiple-use policy, approved by the Oregon State Board of Forestry in March of 1960 was discussed in Chapter II. The board has specifically proposed development for the Morrison Eddy area on the Nehalem River. This is located just north of the confluence of the Salmonberry River and less than one mile south of the Tillamook-Clatsop County line. This is a 20-acre strip with 3,500 feet of river frontage and presently has

an all-weather gravel road for access. It is covered with a stand of merchantable alder and second-growth Douglas fir. The river has a large eddy at this location with rock and gravel bottoms suitable for swimming in the summer months. This area is now used and probably will continue to be used primarily for camping and picnicking for fishermen, hunters, and family outings. Water supply is available from streams located entirely on state forest lands.

Wildlife

Water needs for wildlife will not change materially in the future unless the habitat is changed substantially by new developments.

Fish Life

Potential development of fish life maximum capacity depends upon determining optimum conditions and the ability to create or maintain necessary flows, temperatures, spawning areas, and pollution abatement once such criteria are established.

Based upon streamflow, gradients, and other natural conditions, probably the greatest potential for enhancement of fish life in the entire North Coast Basin lies with the Nehalem River system.

Several storage facilities for power, irrigation, and other uses have been proposed in this sub-basin. If constructed, these projects would present serious problems for anadromous fish runs and fish passage facilities would have to be provided to maintain present runs. Conversely, development of storage is the only way by which low streamflows can be increased to the desirable minimums recommended for fish life.

Pollution Abatement

The State Sanitary Authority states that primary sewage treatment will eventually be required at Nehalem and Wheeler, although no compliance dates have been set for the installation of such facilities.

There are no special statutes of the Sanitary Authority which apply specifically to the control of pollution in this sub-basin and none are being considered for future adoption at the present time.

Increased development and use of recreational areas will result in an increase in potential pollution problems.

SUB-BASIN 3 COLUMBIA

GENERAL

Location and Size

The Columbia sub-basin (Plate 1) includes that portion of the North Coast Basin north of the Nehalem River watershed. This is the second in size of the three sub-basins, containing 902 square miles, which is 33 percent of the total area of the North Coast Basin.

Sixty-seven percent of the sub-basin lies in Clatsop County, 32 percent in Columbia County, and less than 1 percent in Tillamook County.

The sub-basin is bounded on the north and east by the Columbia River and on the west by the Pacific Ocean. The southern boundary is the divide between the drainages of the Columbia and Nehalem Rivers and the divide between the drainages of the Columbia and Willamette Rivers. The eastern tip of the boundary passes through the City of St. Helens.

Stream System

There are five major streams within this sub-basin of which four, the Clatskanie, Youngs, and Lewis and Clark Rivers, and Big Creek are tributary to the Columbia and the fifth, the Necanicum River, flows into the Pacific Ocean. There are approximately 20 minor tributaries to the Columbia River and a dozen tributary to the Pacific Ocean. There are over 1,250 miles of streams in this sub-basin (Table 2), of which slightly more than two-thirds are perennial in nature.

TABLE 27

COLUMBIA SUB-BASIN
STREAM GRADIENTS

STREAM	LENGTH Miles	ELEVATION DROP Feet	AVERAGE GRADIENT Ft/Mile
Necanicum River	21	1,360	65
Lewis and Clark River	27	1,840	68
North Fork Klaskanine River	11	1,355	122
Klaskanine River	3	20	7
South Fork Klaskanine River	12	1,100	92
Youngs River	23	1,040	45
Big Creek	13	1,760	135
Clatskanie River	27	1,270	47
Beaver Creek	21	820	39

Profiles of 13 of the more important streams are shown in Plate 2. Average stream gradients are listed in Table 27 which shows that gradients vary from 7 feet per mile for the Klaskanine River to 135 feet per mile for Big Creek. All streams tributary to the Columbia River and Pacific Ocean are subject to tidal influences in their lower reaches.

Climate

Astoria has the longest rainfall record of any station in the North Coast Basin, dating back to 1850, but there is little long-term precipitation information available in the remainder of the sub-basin (Plate 3).

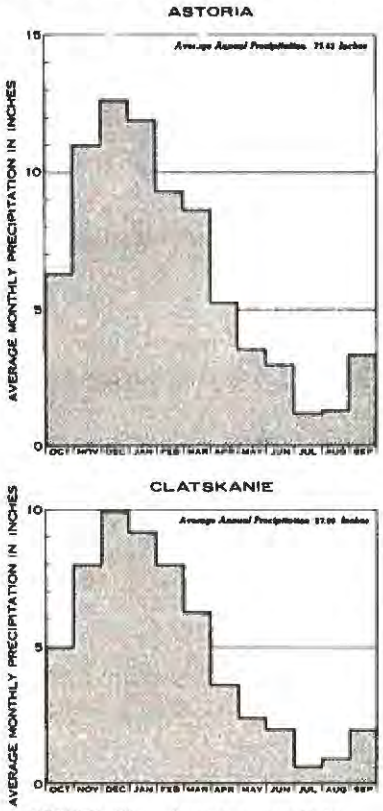


FIGURE 26. Average monthly precipitation at Astoria, 1850-1959, and Clatskanie, 1935-1959.

As indicated on Plate 3, average annual precipitation along the Columbia River varies from less than 50 inches near St. Helens to more than 70 inches near the ocean. Southward towards the Nehalem divide, precipitation increases and reaches a high of more than 120 inches near the southwest corner of the sub-basin.

Average monthly precipitation is shown in Figure 26 for the Astoria and Clatskanie stations. While actual monthly values differ, the pattern is nearly identical at these stations with the highest precipitation usually occurring in December and January and relatively low rainfall during July and August.

Annual snowfall averages 14 inches at Clatskanie and 5 inches at Astoria. These are lowland areas and the snowfall is higher at the upper elevations.

There is little variation in temperature extremes between Astoria and Clatskanie with Astoria having a high of 101 degrees Fahrenheit and a minimum of 10° F., and Clatskanie a high of 103° F. and a minimum of 2° F. Both cities have temperature means of approximately 51° F. Temperature variations by months are shown for Astoria and Clatskanie in Figure 27. Astoria records cover a period of over 100 years, dating back to 1858.

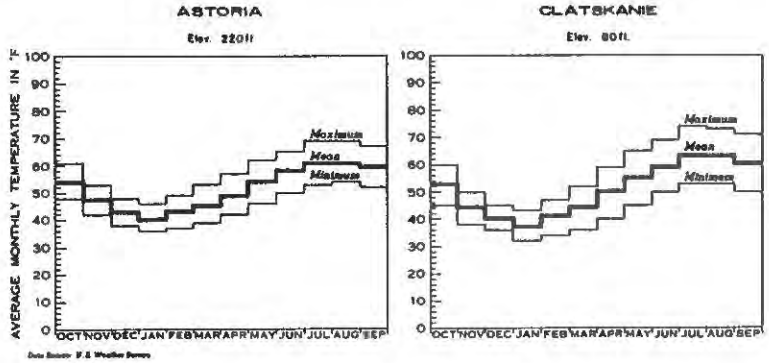


FIGURE 27. Average monthly air temperature at Astoria and Clatskanie.

Average growing seasons vary considerably throughout the sub-basin, with the old Doraville station (1.5 miles west of Fern Hill in Columbia County) having 197 days and Astoria having 273 days.

Population

Columbia sub-basin had an estimated population in 1960 of 40,200 which is slightly over 64 percent of the total basin population. Astoria is the largest city in the North Coast Basin with a 1960 population of 11,240, followed by St. Helens, which is partially within the basin, with 5,020. Other incorporated cities in this sub-basin of more than 1,000 population are Seaside 3,880, Warrenton 1,720, and Rainier 1,150.

Other incorporated cities in the sub-basin and their populations are Clatskanie 800, Gearhart 720, Cannon Beach 500, Hammond 480, Columbia City 420, Manzanita 360, and Prescott 130.

There are also 50 unincorporated towns in the sub-basin, of which one has a population of 500, seven between 100 and 500, 17 have less than 100, and 26 for which no data is available.

The growth of incorporated cities since 1900 is illustrated in Figure 28. In nearly all

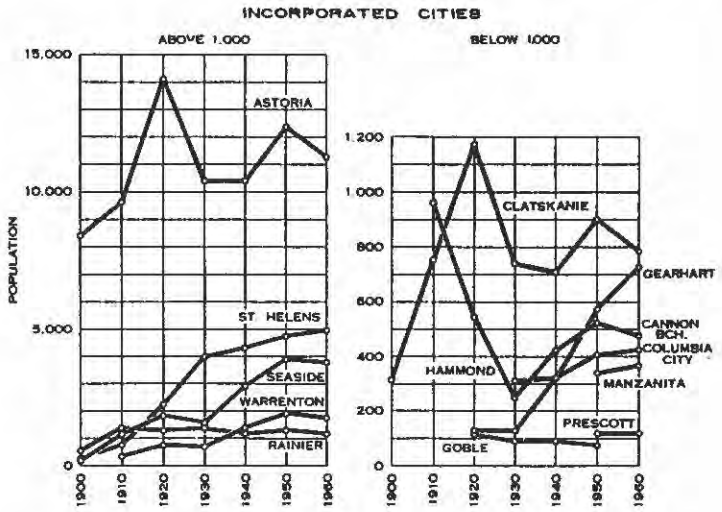


FIGURE 28. Population trend of incorporated cities in Columbia sub-basin, 1900-1960.

cases, a leveling off or even a drop in population is evident during the 1950's. Those cities incorporated before 1900 showed a rapid increase in population at the turn of the century.

Based on early day lumbering and agricultural activities, followed in the 1870's by establishment of a salmon packing industry, Astoria had grown to a population of 14,000 by 1920. A decline in the salmon industry and a serious fire in 1922 resulted in a sharp drop during the twenties. Shipbuilding and a naval installation caused a rise during World War II.

St. Helens' population grew slowly until 1910 and then increased rapidly until 1930 due to lumbering activity. Since then it has experienced a moderate but steady increase.

ECONOMIC FACTORS

Land Ownership

The Columbia sub-basin contains approximately 900 square miles, of which about 115 square miles are water areas. Most of the water area and 95 square miles of land are state owned, with the total state ownership comprising 23 percent of the sub-basin. The federal government controls 10 square miles and the counties and cities own 30 square miles, leaving 650 square miles, slightly more than two-thirds of the sub-basin, in private and other ownership.

Over 90 percent of the land is in commercial forests, with the private ownership made up principally of a few companies with large holdings. The state ownership is mostly lands acquired from Clatsop County in areas where private owners had been unable to meet tax payments after early clear-cut logging had made them temporarily nonproductive.

Federal lands consist primarily of Tongue Point Naval Base, Beaver Military Reservation, and a few sections under the administration of the Bureau of Land Management.

Timber

Lands in commercial timber make up roughly 75 percent of the sub-basin area. Of the approximately 675 square miles in forest land, 575 are estimated to be in private ownership with over 90 percent of the remainder belonging to the state.

Western hemlock exceeds other species throughout much of the western portion of the sub-basin, with Douglas fir predominant east of the Big Creek area. Other softwoods include sitka spruce and western red cedar, with red alder being the most predominant of the hardwoods.

Current yield estimates by sub-basins were made by the Oregon Board of Forestry.

With less than 60,000 acres of cutover lands, portions of which now have young-growth stands, the present cut is approximately 10 million board feet per year, or 170 board feet per acre. By comparison, Clatsop and Columbia County figures, based on log production of 1958 and 1959, are 460 and 240 board feet per acre per year, respectively. Assigning a conservative yearly yield of 300 board feet per acre for the estimated 575 square miles of private commercial forest land in the sub-basin, a current annual production of 100 million board feet is obtained.

Agricultural Land

Agricultural land plays an important role in the economy of this sub-basin. Of the 178,000 acres of arable land in the entire basin (Table 6), the U. S. Department of Agriculture estimates 109,000 lie within the Columbia sub-basin. Of this total, 98,000 acres, about 90 percent, are in Classes III and IV. This designates a range from moderately good cultivable land to land best suited for pasture. This land is also judged to be susceptible to irrigation, although only a few thousand acres are presently being irrigated.

The irrigable lands lie primarily along or near the Columbia River in the western part of the sub-basin, extend deep into the Youngs and Lewis and Clark River valleys in the northwestern portion, and follow Neacoxie Creek and the Necanicum River. Many acres of diked tidelands occur along the Columbia River between Astoria and Brownsmead, between Westport and the Beaver Military Reservation, and between Rainier and St. Helens.

Principal crops are hay and pasture which support livestock. Dairy products lead all others in dollar value, with mink, poultry, and poultry products also being important. Principal crops other than hay and pasture include fruits and nuts, horticultural specialties, and vegetables.

Minerals

The known mineral resources of the entire basin are shown on Plate 4. As indicated in Chapter I, the principal mineral resources of the North Coast Basin are found in this sub-basin. A deposit of ferruginous bauxite lies in a north-south strip across the eastern part of the sub-basin, extending south as far as North Plains, about one mile north of Hillsboro. The State Department of Geology and Mineral Industries, in reference to these deposits, states that "Ferruginous bauxite is an ore of aluminum but there is a distinct possibility that both iron and titanium could be recovered as by-products. The deposits have been extensively sampled and explored and are said to constitute the largest unmined source of alumina in the United States." The deposits average 39 percent alumina,

21 percent iron, 9 percent silica, and 6 percent titania.

Limonite, an ore of iron, also occurs in the same general area. Proven tonnage is small, but there are probably several million tons, ranging in grade from 51 to 58 percent, dry analysis. There is the possibility that small, low-cost reduction plants using low-grade coal from the Vernonia district might successfully convert the ore to pig iron.

Magnetite, likewise an ore of iron, has been found in appreciable concentrations in the sands of the Columbia River near its mouth and adjacent bays. Other possible products of the sands include titanium, zirconium, glass, and abrasives. The 1961 Oregon Legislature passed a law permitting the leasing and mining of the area extending from the low water line north to the state boundary. Present commercial plans include a plant in the Astoria area to extract the iron ore for shipment to smelters elsewhere, and possibly later, to a proposed local smelter.

Two deposits of sand on the south bank of the Columbia near Hammond are also high in magnetite concentrates and have similar potential for other products. These deposits contain about 40 percent magnetite.

A number of active sand and gravel operations are located in the sub-basin.

Low-grade coal deposits occur between Columbia City and Deer Island, and clay, formerly used for pottery and stoneware manufacture, is located near Seaside and Mayger.

Twenty-nine exploratory oil wells have been drilled in the sub-basin. No oil and very little gas were encountered. The drilling was concentrated between Clatskanie and Swede Town, and near Shiloh Basin. The deepest wells are 7,100 feet near Seaside, and 5,700 feet near Swede Town.

Fish Life

This sub-basin is dependent for much of its economy upon the commercial fishery resources of the Columbia River and Pacific Ocean. Because Astoria serves as the focal point for fish processing in Oregon, including the majority of the total catch on the Columbia River and much of Oregon's share of the ocean catch, most of the state's commercial fishermen live in this sub-basin.

Columbia River fishing is mainly for salmonids including spring and fall chinook, silvers, chum, blueback (sockeye), and steelhead.

Columbia River fishing is highly seasonal and many of these fishermen also work at other jobs, such as logging or construction during off seasons.

A general discussion of commercial fishing is given in Chapter I. Because ocean fishing is widely distributed, many home ports are outside the basin but Astoria also receives some of the fish from boats operating out of the Coos Bay and Newport areas with the fish being trucked from the home port.

A whaling industry is scheduled to begin operations in the spring of 1961, principally for providing food required by the mink farms. This operation will be based at Warrenton.

Industry

Industrial activity within this sub-basin is the most varied of the three sub-basins. Ready access to cheap water transportation via the Columbia River, as well as basic resources in fish and forestry, has led to the development of many of the industries in this sub-basin.

Wood processing plants include production of lumber, shakes, plywood, boxes, veneer, and poles and piling. The major concentration of these industries is in the Astoria and St. Helens areas.

There are five major industrial plants just outside the basin, south of St. Helens' city limits. These include a paper mill, an acoustical board products plant, a green veneer plant, a pole creosoting plant, and a broom and mop handle factory. Although outside the basin, these industries contribute substantially to the economy of the North Coast Basin. They employed over 1,000 people in 1952, and logs for their use come from within the basin as well as a substantial volume imported via the Columbia River.

Commercial fishing in the Columbia River and off the coast supports a large fish processing industry in this sub-basin including fresh, frozen and canned fish, and shellfish products and by-products. Included in the fish processed annually at Astoria are many tons of whole frozen tuna from Japan. In 1959 there were 12 plants engaged in fish processing in this sub-basin, employing over 1,000 people in peak seasons. These plants are concentrated in the Seaside, Warrenton, and Astoria areas. Annual canning packs were discussed in Chapter I.

Astoria is one of the leading ports in Oregon in vessel cargo tonnage handled annually. Waterborne cargo for Astoria in 1959 is listed in Table 28. The three leading commodity groups handled in 1959 were wood and paper, 108,000 tons; nonmetallic minerals, 106,000 tons; and vegetable food products and beverages, 103,000 tons. Among

commodities exported to foreign markets are wheat, flour, barley, lumber, canned goods, newsprint, and fish products. Of lesser importance and volume are foreign

TABLE 28

PORT OF ASTORIA
WATERBORNE CARGO
1959

COMMODITY	FOREIGN		DOMESTIC					TOTAL
	Imports	Exports	Coastwise Receipts	Coastwise Shipments	Internal Receipts	Internal Shipments	Local	
Fish and shellfish products, edible	10,595	192	1,466				17,290	29,543
Animals and animal products, inedible	323							323
Vegetable food products and beverages	444	102,403				200		103,047
Vegetable products, inedible except fibers and wood	5	106						111
Textile fibers and manufactures	2							2
Wood and paper	20	1,446		25,256	73,066		8,312	108,100
Nonmetallic minerals	13	220	99,210		5,457	892		105,792
Metals and manufactures except machinery and vehicles		6,478						6,478
Machinery and vehicles		110	144					254
Chemicals and related products		17						17
Miscellaneous	26	12,349	10		1,625	5,075		19,085
TOTALS	11,428	123,321	100,830	25,256	80,148	6,167	25,602	372,752

Note: All values are in short tons

Source: U. S. Army, Corps of Engineers

imports, including fish and shellfish products and manufactured wood products. Coastwise trade to and from Astoria accounts for a large annual volume made up of wheat, lumber, watercraft, petroleum products, chemicals, and rafted logs. More than 200 vessels of 20 steamship lines dock at Astoria during each year.

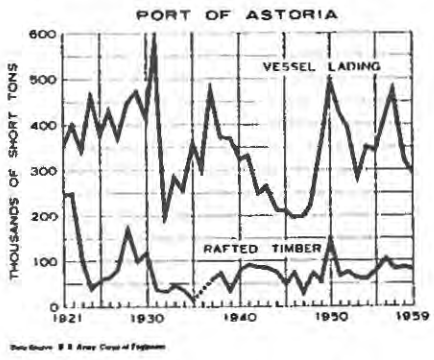


FIGURE 29. Trend in tonnage of waterborne cargo for the Port of Astoria, 1921-1959.

Trends in waterborne cargo for Astoria are shown in Figure 29. Although there have been fluctuations in vessel lading tonnages from year to year, the long-term trend appears to be steady. The same is true of rafted timber tonnages although fluctuations are of smaller magnitude.

St. Helens is also a very important port in this sub-basin. Waterborne cargo for 1959 is shown in Table 29. By far the most important commodity group handled at St. Helens in 1959 was wood and paper with 399,000 tons. Nonmetallic minerals were next with 18,000 tons, and fish and shellfish products and

miscellaneous cargo were far behind. In total tonnage, 418,000 tons in 1959, St. Helens exceeded Astoria. This is due to the large volume of rafted logs handled at

TABLE 29

PORT OF ST. HELENS
WATERBORNE CARGO
1959

COMMODITY	COASTWISE SHIPMENTS	INTERNAL Receipts	INTERNAL Shipments	LOCAL	TOTAL
Fish and shellfish products, edible	70,535			210	210
Wood and paper		174,603	154,250		399,388
Nonmetallic minerals		17,595			17,595
Miscellaneous		600			600
TOTALS	70,535	192,798	154,250	210	417,793

Note: All values are in short tons

Source: U. S. Army, Corps of Engineers

St. Helens, which is a domestic port with no foreign traffic. Rafted logs make up 60 percent of the annual waterborne tonnages along the Oregon Coast. Trends in waterborne cargo for St. Helens are shown in Figure 30. In the 13 years shown, the general trend in both vessel lading and rafted timber tonnages appears to be slightly downward. This period is not long enough, however, to give an indication of a long-term trend.

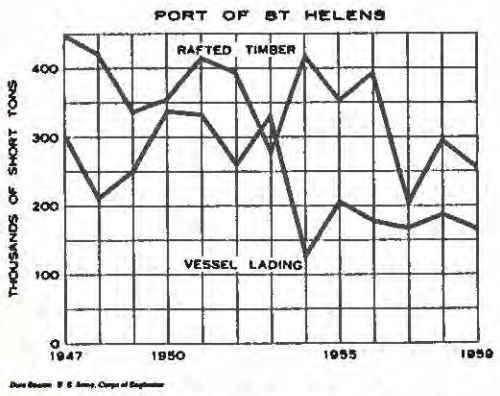


FIGURE 30. Trend in tonnage of waterborne cargo for the Port of St. Helens, 1947-1959.

Shipbuilding and repairing and flour milling are also important industries in the Astoria area.

Recreation

The western portion of Columbia sub-basin receives an important economic assist from visitors attracted by its fine recreation areas, including over 45 miles of coastline. Other portions of the sub-basin also draw revenue from visitors, especially from fishermen and hunters.

The area is readily accessible to the lower Willamette Valley population. People also come from throughout the state and out of state to enjoy the various attractions.

The amount spent by sportsmen is difficult to estimate, but is important to many restaurants, motels, and stores.

The Parks and Recreation Division of the State Highway Department made a study of Fort Stevens, Cape Lookout, and Honeyman State Parks to determine their effects on surrounding areas. This study was discussed in Chapter I and some of the statistics will be repeated here because of the inclusion of Fort Stevens.

The average number of persons per party was five with an average expenditure of $1.50 per person per day within 25 miles of the parks. The visits averaged slightly over two days in length. Of the estimated total annual expenditures of $2,752,000 within 25 miles of the parks, the portion directly attributable to the parks was $1,652,000 or about 62 percent.

Present and projected future use of state parks was indicated by Figure 13, which shows Fort Stevens as having the highest present usage by both day visitors and overnight campers. Ecola Park is also located within the sub-basin, as are large portions of Oswald West and Saddle Mountain Parks.

The impact of the recreation trade on other areas of the coast is emphasized at Seaside, where a normal population of less than 4,000 people expands during the summer season to as many as 20,000.

Transportation

This sub-basin has an excellent system of federal, state, and local highways.

Passenger service is by bus, and freight service is by truck and rail. There are three airports serving local and transient planes, two of which also serve commercial airlines. West Coast Airlines operates the only regular air service in the basin. This service is comprised of two trips daily between Portland, Astoria, and Seaside.

Plans are now under way for the construction of a bridge from Astoria to Megler to replace the ferry service. This bridge will play an important role in the economy of the Astoria area in the future. It will complete the Alaska to Mexico highway, which will probably cause a substantial increase in tourist traffic through the area. The bridge will also open a much larger trading area for Astoria.

Water passenger service was quite important at Astoria in the past, but has decreased in significance due to improvements in highways and rail service. The Oregon State Highway Department presently maintains ferry service between Astoria and Megler, Washington, which is the link between Oregon and Washington for U. S. Highway 101. There is also a privately-owned ferry service which links Westport with Puget Island.

Water transportation is important to the economy of this sub-basin. Astoria is the

leading port in the North Coast Basin, handling over 200 vessels each year as well as large volumes of rafted timber (Figure 29). It is the only port in the North Coast Basin which carries on foreign trade.

St. Helens is another important port, leading in annual tonnages of rafted timber handled (Figure 30). There are several large timber-based industries in the St. Helens area which receive much of their timber via the Columbia River. St. Helens also handles a considerable volume of domestic vessel traffic.

Other ports in this sub-basin include Columbia City, Prescott, and Westport.

SURFACE WATER SUPPLY

Yield

There are no active recording stream gages in the sub-basin. The only station with more than six years of records was located on the Youngs River above the confluence of the Klaskanine River. This station was closed at the end of the 1957-58 water year. Therefore, other streamflows had to be estimated by correlations and all the records were adjusted to the stream mouths.

Adjusted annual yields are shown in Figure 31 for the Youngs, Lewis and Clark, and Clatskanie Rivers and Big Creek for the period 1933 through 1958. This includes both low and high years of record. The largest stream, Youngs River, varied in annual yield from 240,000 acre-feet in 1941 to 640,000 in 1956, and the smallest, Big Creek, from 65,000 acre-feet to 240,000 for the same years. As shown, the average for Youngs River, 403,000 acre-feet, is more than twice the average annual yield of any of the other streams.

Distribution

Yield distribution in terms of average monthly discharge for the Youngs, Lewis and Clark, and Clatskanie Rivers and Big Creek is shown in Figure 32. The Lewis and Clark River had no record and its distribution pattern is assumed the same as that for Youngs River, based on proximity of the watersheds and similarity in vegetation, soil, and precipitation.

Peak flows occur during December, January, and February, reflecting the heavy rainfall of those months following saturation of the ground during the fall rains. Snowfall in the higher areas is not sufficient to materially affect the spring runoffs, and ground

water storage is slight. Therefore, the streams reach very low flows during July,

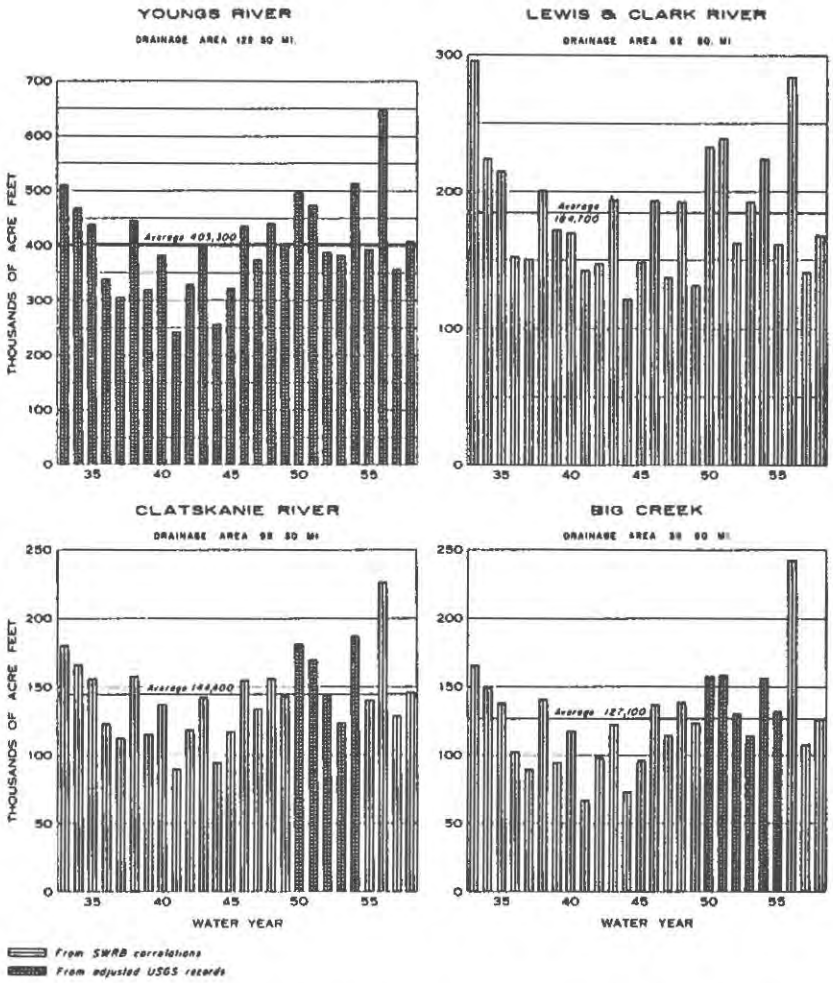


FIGURE 31. Annual yields of major stream systems in Columbia sub-basin, 1933-1958.

August, and September, which also reflects lack of regulation on these streams.

Extremes

Although portions of the sub-basin experience flooding after periods of sustained rainfall there is little of the flash-type flooding created by high intensity storms.

The extremes of discharge and yield for Youngs River were shown in Table 12. The

daily pattern of discharge for the Clatskanie River for 1953, the water year of minimum

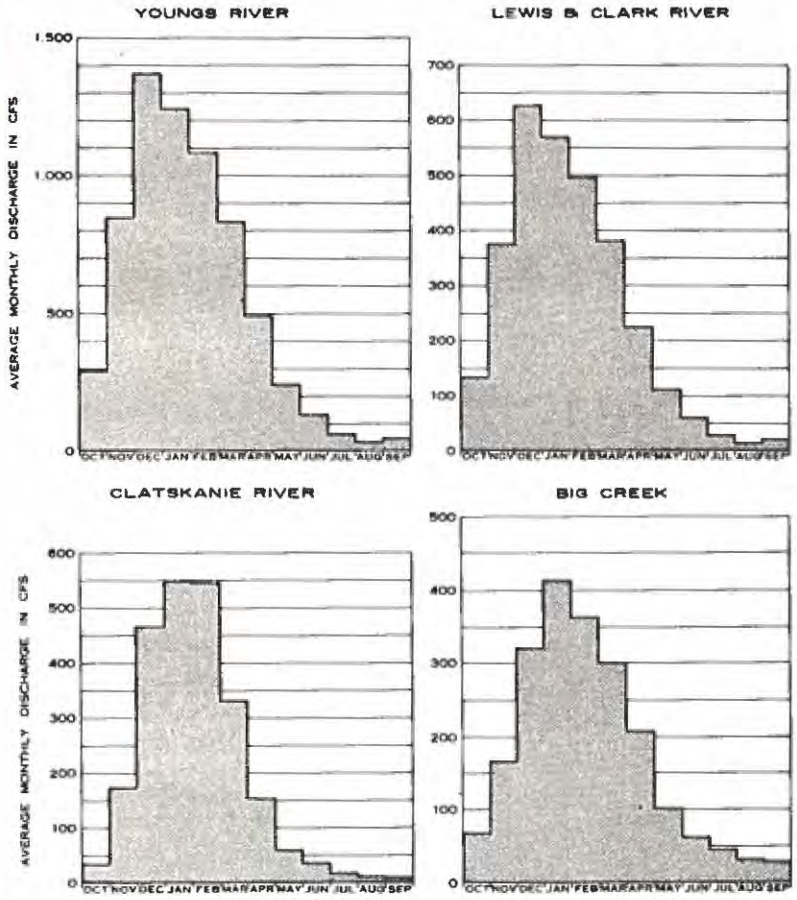


FIGURE 32. Average monthly discharge at the mouth of major streams in Columbia sub-basin, 1933-1958.

instantaneous recorded flow, is shown in Figure 33. This shows a variation of from 3 to 875 cubic feet per second (cfs), and is similar to the discharge pattern of other streams in this area.

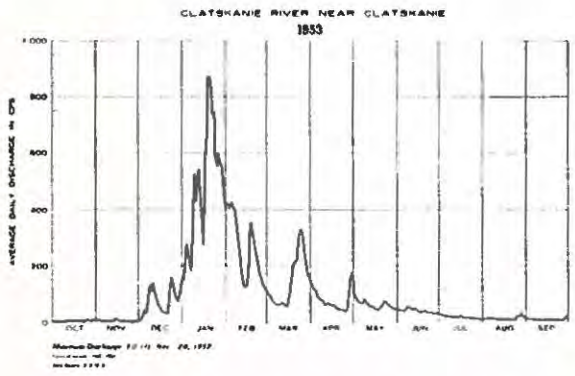


FIGURE 33. Daily discharge pattern of the Clatskanie River near Clatskanie for the water year having the minimum instantaneous flow of record, 1953.

Depletions

Diversion points for all water rights in the North Coast Basin are located as shown on Plate 7. A detailed summary of these rights listing the number, location, use, quantity, stream, and priority date is available at the SWRB office in Salem.

SUB-BASIN INVENTORY - COLUMBIA

Water rights are distributed generally throughout the Columbia sub-basin with no major concentration on any one stream. Youngs River has the largest total of water rights of any stream in the sub-basin, with 79 cfs. Fifty of these are held by the Fish Commission on the North Fork of the Klaskanine, major tributary to Youngs River, for operation of a fish hatchery. Distribution of rights by streams for principal uses is shown in Table 30.

TABLE 30

SURFACE WATER RIGHTS SUMMARY
SUB-BASIN 3 - COLUMBIA

USE	STREAM	CFS	TOTAL RIGHTS
Domestic	Arch Cape Creek and Misc.	0.3	
	Elk Creek and Misc.	1.5	
	Necanicum River and Misc.	0.2	
	Lewis and Clark River and Misc.	0.3	
	Youngs River and Misc.	5.4	
	Big and Little Creeks and Misc.	2.6	
	Westport Slough and Misc.	2.6	
	Clatskanie River and Misc.	0.3	
	Beaver Creek and Misc.	0.3	
	Columbia River and Misc.	2.9	
	Misc.	2.8	
	TOTAL		19.2
Municipal	Elk Creek and Misc.	1.6	
	Necanicum River and Misc.	15.0	
	Lewis and Clark River and Misc.	46.0	
	Youngs River and Misc.	23.0	
	Big and Little Creeks and Misc.	16.0	
	Clatskanie River and Misc.	2.0	
	Beaver Creek and Misc.	0.3	
	Columbia River and Misc.	3.4	
	TOTAL		107.3
Irrigation	Necanicum River and Misc.	1.0	
	Youngs River and Misc.	1.0	
	Big and Little Creeks and Misc.	0.3	
	Westport Slough and Misc.	0.8	
	Clatskanie River and Misc.	0.2	
	Beaver Creek and Misc.	2.2	
	Columbia River and Misc.	17.9	
	Misc.	4.6	
	TOTAL		28.0
Industrial	Arch Cape Creek and Misc.	0.4	
	Lewis and Clark River and Misc.	0.3	
	Westport Slough and Misc.	2.4	
	Clatskanie River and Misc.	0.7	
	Beaver Creek and Misc.	0.8	
	Columbia River and Misc.	0.4	
	TOTAL		5.0
Power	Clatskanie River and Misc.	2.5	
	Columbia River and Misc.	3.1	
	Misc.	0.1	
	TOTAL		5.7
Fish	Necanicum River and Misc.	4.8	
	Youngs River and Misc.	50.0	
	Big and Little Creeks and Misc.	26.0	
	Clatskanie River and Misc.	0.8	
	Columbia River and Misc.	1.2	
	TOTAL		82.8
	GRAND TOTAL		248.0

All surface rights within the sub-basin total 248 cfs, of which 160 cfs are for consumptive

use and 88 nonconsumptive. Of the consumptive rights, by far the largest single category is municipal rights with 107 cfs, followed by irrigation with 28 cfs and domestic with 19 cfs. Irrigation acreages under existing rights total 1,090. Of the nonconsumptive rights, 83 cfs are for fish and 6 cfs for power. No other nonconsumptive rights are held in this sub-basin.

If all of the consumptive surface rights in the sub-basin were used to the maximum legal extent, approximately 98,000 acre-feet would be diverted from the streams each year. Although this is far less than the average annual yield of the streams in the sub-basin, shortages exist due to heavy uses during periods of low summer flows.

The pattern of legal depletion rights by stream miles for Youngs and Lewis and Clark Rivers and Big Creek is shown in Figure 34.

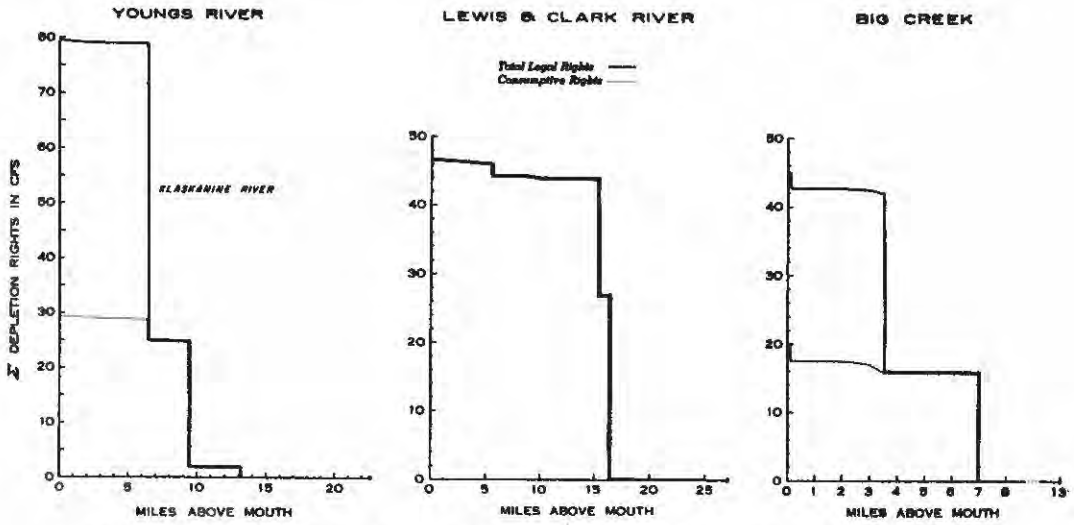


FIGURE 34. Legal depletion rights by stream miles of representative streams in Columbia sub-basin as of September 1960.

Major depletions on the Youngs River are seen to occur at mile 6.5, which indicates a 50 cfs fish hatchery right on the Klaskanine River and 23 cfs for the City of Astoria at mile 9.5. The City of Astoria also has a newly-granted municipal right for 26 cfs from Youngs River at mile 16.6, priority date January 17, 1961. Major depletions on Big Creek are 26 cfs for fish rights at mile 3.5 and 16 cfs for Astoria at mile 7. Warrenton has municipal rights on the Lewis and Clark River totaling 46.0 cfs, which is over 98 percent of the total for the stream.

While these depletion diagrams show the total of all water rights as of September 1960, they do not indicate the actual water use for the following reasons:

1. *Irrigation use depends upon the pattern of rainfall occurring during the*

year, the availability of water for irrigation during the year, and the use pattern of each individual irrigator.

2. Some irrigation rights may be filed with the knowledge that low flows of the streams have been appropriated and that subsequent rights can be exercised only during high flow periods.

3. Not all water diverted for consumptive purposes is consumed.

4. Water for nonconsumptive purposes, such as power and fish life, becomes available for other uses at downstream locations.

Supplemental rights do not show on either the depletion diagrams or the water rights summary tables.

GROUND WATER SUPPLY

Geology

A generalized ground water geology map of the entire North Coast Basin is shown on Plate 8. This map shows the rock units and their yield capabilities, a geologic cross section extending from the coast to the crest of the Coast Range, and the specific capacities (gallons per minute per foot of drawdown) of various wells throughout the basin.

Most of the eastern, the north central, and scattered areas of the western part of the sub-basin are overlaid by volcanic rocks made up of Columbia River basalt flows and associated intrusives. Available data indicate that these rocks are relatively impermeable, although the fragmental flows retard runoff and probably contain some ground water in the more porous interflow zones.

Underlying the volcanics are sedimentary formations, principally of shale, sandstone, and conglomerate. These sediments are exposed throughout the sub-basin, mainly in the western part. They are fine grained, tightly compacted, relatively impermeable, and contain little ground water.

The volcanic and sedimentary rocks together form the Coast Range which rises throughout much of the sub-basin.

Alluvial deposits of varying porosity and permeability make up the lowlands along the Columbia River, the coastal belt, and the main streams. The coarse volcanic alluvium and terrace deposits formed by the Columbia River basalt make good aquifers, whereas

the sedimentary alluvium is generally too fine grained to transmit substantial quantities of water. The most productive alluvium is believed to be that along the Columbia River, in Columbia County.

Distribution and Yield

Ground water distribution in this sub-basin follows the same general pattern as in the Nehalem and Tillamook sub-basins because of similar rock types, topography, and precipitation. Steep slopes, narrow valleys, and relatively impermeable rocks forming the Coast Range produce rapid runoff. The largest known quantities of ground water are in alluvial deposits, particularly those along the Columbia River in the southeastern part of the sub-basin.

Little ground water information is available for the western or Clatsop County part of the sub-basin. If the production rate of 10 and 20 gpm for the two recorded wells at Seaside are indicative of the alluvial deposits extending north to the Columbia River, the potential is quite low. No well data is available for the lowland areas south of Astoria through which the Lewis and Clark, Youngs, and Walluski Rivers flow. Good production has been obtained from two wells in the northeastern part of Clatsop County, which tested at 400 and 170 gpm, with specific capacities (gpm per foot of drawdown) of 100 and 8, respectively. Four of the five other recorded wells in Clatsop County had productions of 30, 20, 10, and 8 gpm; with specific capacities of 1.5, 0.7, 10, and 0.7, respectively.

The recent Columbia County well survey, conducted by the County Agent's office, indicates that a number of wells in that county are withdrawing good quantities of water from the alluvial deposits forming the lowlands along the Columbia River. Some moderate production is also being made by wells in the alluvium of the lower reaches of the main streams. Little ground water is being withdrawn elsewhere in the county.

Of the 3,400 questionnaires mailed to rural route addresses during March 1961, 485 were returned and 447 contained usable information. Of 26 replies stating the results of pump tests, 7 wells produced in the range of 1 to 5 gpm, 9 produced from 6 to 20 gpm, 8 produced from 21 to 100 gpm, and 2 wells produced more than 100 gpm. The largest production, 435 gpm, was from an 89-foot well located near Deer Island. The St. Helens municipal well, a Ranney water collector equivalent to several wells, had a maximum production of 2,760 gpm with a specific capacity of 172 when tested. Of 367 well owners who answered a question on adequacy, 278 or 76 percent stated that their well production was adequate. About 60 percent of these were for domestic use, which does not involve large quantities of water. Of those which were inadequate, 90 percent of the deficiencies occurred during July, August, and September.

The quality of ground water in Columbia County varies, with the iron concentration so excessive in some parts, particularly around Clatskanie, that well water is not used for domestic purposes. Of the 389 replies relative to wells, 36 percent noted iron in their water and a few noted sulfur. "Soft" water was reported at 173 wells; "hard" water at 127 wells. This is probably due mainly to individual taste, as available records indicate moderate hardness and fairly high iron content. Only 8 wells were reported to have unpotable water. Forty-five well owners stated that no treatment was necessary and 51 that treatment was required.

Except for the alluvial areas previously noted, it is believed that most of the sub-basin has little ground water potential.

Depletions

A summary of ground water rights for the entire North Coast Basin was shown in Table 15.

Ground water rights for the sub-basin, on file in the State Engineer's office as of September 28, 1960, total 7.8 cfs. Of this total, 1.8 cfs are for irrigation of 145 acres, 4.9 cfs for municipal, 0.9 cfs for industrial, and 0.2 cfs for fish life purposes. The maximum legal annual depletion for these rights total 4,700 acre-feet. These figures represent the capacity of the wells as stated by the owners under the terms of the Ground Water Act of 1955, and are not necessarily the amount of water the wells withdraw.

Of the nine wells for which permits have been granted, five are for irrigation, two for municipal, and one each for industrial and fish life uses. The irrigation wells are concentrated in the Deer Island area about four miles north of St. Helens and the two municipal wells are located at St. Helens and Columbia City. The lone industrial well is for a lumber company at Wauna. Ground water rights for fish propagation are assigned to the Oregon State Game Commission hatchery well on Gnat Creek. These wells deplete only minor quantities of the ground water available.

LEGAL RESTRICTIONS AND LIMITATIONS ON WATER USE

By Statutory Decree of 1949, the following streams were withdrawn from appropriation and from diversion or interruption for any purpose except protecting fish life therein by the Fish Commission or the Game Commission of Oregon:

1. Clatskanie River and its tributaries.
2. Klaskanine River and its tributaries.

3. Lewis and Clark River.

4. Tillasqua (Big Creek) in Clatsop County.

This withdrawal is not to affect any of the then existing rights to appropriate or use water, or any renewals or extensions thereof, or prevent appropriation and use of such water for domestic, stock, municipal, public park or recreational purposes.

PRESENT WATER USE AND ASSOCIATED PROBLEMS

Domestic

Domestic water rights in this sub-basin total 19 cfs, all for surface water. Many small water companies with domestic rights have become part of a municipal system or are serving small towns as private companies and these districts are discussed under municipal use.

The domestic use in the area is supplied principally from small streams or springs and wells. The quality of the ground water is a serious problem in some areas as discussed above. Supplies of surface and ground water are generally adequate, although some ground water shortages occur during the late summer months.

Municipal

Municipal water rights for surface water in this sub-basin total 107 cfs. Municipal rights for ground water are held by the Cities of St. Helens and Columbia City.

Table 31 shows public water supply data for cities and towns within the sub-basin.

Astoria, the largest city in the North Coast Basin, holds municipal rights for a total of 68 cfs, including a right for 26 cfs granted after September 1960. In addition, it has irrigation rights and supplemental rights of one cfs each on Smith Lake and has a claimed right from the Astoria Reservoir on Bear Creek, dating back before the turn of the century. Rights held by the city include 49 cfs on Youngs River, 16 cfs on Big Creek, and 3 cfs on Bear Creek. Astoria's present source of water is from Bear Creek where, in addition to the large Astoria Reservoir mentioned above, they have Middle Lake and Wickiup Lake connected to their supply system. The maximum system capacity is approximately 5.5 million gallons per day (gpd) and the average use, 2.5 to 3.0 million gpd. The city has an ample water supply and distribution system to meet the present and probable future demand within the city limits for domestic water. However,

It is not in a position to supply any heavy industrial water users and, for this reason, has secured additional water rights. The quality of the water is very good, although Astoria uses lime to counteract corrosiveness caused by slight acidity.

TABLE 31

PUBLIC WATER SUPPLIES
COLUMBIA SUB-BASIN

SYSTEM	SOURCE	TREATMENT Type	TREATMENT Adequate	POPULATION SERVED	MAXIMUM SYSTEM CAPACITY mgd	AVERAGE OUTPUT mgd	WATER RIGHTS CFS Surface	WATER RIGHTS CFS Ground
Arch Cape	Springs	-	No	250	-	-	0.30	0
Astoria	Stream	A	Yes	16,000	-	3.00	69.20	0
Bradwood	Stream	A	Yes	120	-	-	-	-
Brownsmead	Stream	A	Yes	200	0.04	0.02	1.00	0
Cannon Beach	Springs	-	-	1,000	-	-	1.60	0
Clatskanie	Stream	A	Yes	-	0.70	0.50	2.00	0
Columbia City	Well	A	Yes	400	0.10	0.05	0	0.22
Knappa W D	Stream	A	-	-	-	-	-	-
Oklahoma Hill	Springs	-	Yes	-	-	-	-	-
Prescott	Streams	A	Yes	-	-	-	0.10	0
Quincy Water Assn.	Stream	A	Yes	-	-	-	0.17	0
Rainier	Stream	A	Yes	-	-	-	0.96	0
Seaside	Stream	A	Yes	-	3.00	1.50	15.00	0
St. Helens	Well	A	Yes	-	1.50	0.70	0	4.64
Manzanita	Streams	A	Yes	-	-	-	4.30	0
Neah-kah-nie	Springs	-	-	-	-	-	0.17	0
Warrenton	Streams	A,C	No	3,500	2.50	2.00	46.00	0
Wauna	Well	A	Yes	150	0.14	0.04	-	-
Westport (Mill)	Stream	A	Yes	300	0.40	-	-	-
Westport (Wilson)	Stream	A	Yes	-	-	-	-	-
Wickiup W D	Stream	A	Yes	1,200	-	-	2.00	0
Youngs River - Lewis and Clark W D	Stream	A	Yes	4,000	0.30	0.15	2.00	0

Note: A = Chlorination
C = Sedimentation

Source: Oregon State Board of Health
Oregon State Engineer

The City of Warrenton is the second largest holder of municipal water rights within this sub-basin, with a total of 46 cfs from the Lewis and Clark River and tributaries. Seaside holds a total of 15 cfs municipal rights, with 8 on the South Fork of the Necanicum and 7 on the Necanicum main stem. St. Helens has a 5 cfs ground water right and Manzanita holds municipal rights totaling 4 cfs. Clatskanie and Cannon Beach have municipal rights for 2 cfs each.

The St. Helens supply is obtained from a Ranney water collector, or infiltration well. It is designed for a system capacity of 1.5 million gpd and has an average output of 0.7 million gpd. This replaced a former system based on a combination of five springs, a creek, and a well, and provides an adequate supply of good quality water.

Irrigation

Irrigation rights in this sub-basin are for 28 cfs from surface water to irrigate 1,100

acres, and ground water rights for 1.8 cfs and 145 acres. Present use is believed to exceed this considerably. Rough estimates by U. S. Department of Agriculture field personnel show 2,000 acres irrigated from streams, and 2,900 acres from tidal estuaries and drainage ditches.

The Clatsop County Water Resources Committee estimated about 750 acres of irrigation by flooding from tide gates on diked lands within Clatsop County. Low salt content tidewater has been used by the J. J. Astor Branch Experiment Station for irrigation purposes. The water used was obtained downstream from Tongue Point and had an average salinity of two-tenths of one percent, which is about one-fifteenth the salinity of ocean water. Above Tongue Point, Columbia River water is considered fresh.

An annual application of 18 inches of low salt content tidewater has not resulted in appreciable accumulation of salt or adverse effect on crop growth. The 18-inch figure is the average requirement for tidelands, but upland areas require about 24 inches.

According to Mr. Herb Howell, superintendent of the experiment station, most of the farmers using water from small creeks and rivers have filed water rights and to date there have been no conflicts or shortages. Rights for water pumped from sloughs supplied by tidewater have not been considered essential because of the unlimited supply.

The USDA reports that all irrigation development in the basin has been accomplished on an individual farm basis. Irrigation practices fluctuate widely depending upon weather conditions, and according to one power company, the number of acres irrigated by pumping may increase as much as three times during a dry year.

Power

Power rights in the Columbia sub-basin total six cfs. These consist of one for three cfs on Bear Creek, a small tributary of the Columbia River, and another also for three cfs on a small tributary of the Clatskanie River near Clatskanie.

Industrial

Industrial water rights for the use of surface water in this sub-basin total only five cfs. Industrial ground water rights amount to an additional one cfs. As in most areas, many industries obtain water through the city municipal supplies and do not hold individual rights. This sub-basin also has many industries which take water directly from the Columbia River without water rights.

The present industrial demand for water in the sub-basin is concentrated at Astoria,

Warrenton, Clatskanie, Rainier, and St. Helens. Annual industrial use for Astoria and Warrenton totals nearly 1,400 acre-feet. The estimated annual industrial use in St. Helens, Rainier, and Clatskanie totals an additional 80 acre-feet. These are negligible quantities compared to flows of the Columbia River, and this water is satisfactory in quality for most industrial purposes.

Mining

There are no water rights for mining in this sub-basin. Present mining operations are confined to sand and gravel and building stone. The principal problems associated with sand and gravel operations are disturbance of gravel beds used for fish spawning and turbidity in the streams which is detrimental to some downstream users.

Recreation

There are no water rights for recreation in this sub-basin. As is generally true, the value of water to recreation is not measured by the amount of rights held.

There are approximately 122 lakes, reservoirs, and sloughs in this sub-basin with a total surface area of 1,320 acres, the largest being Cullaby Lake with an area of 216 acres. There are two major bays, Youngs and Cathlamet, along the Columbia River. The Columbia River is used extensively for fishing and boating.

There are seven state parks, one roadside rest area, and one county park in this sub-basin.

According to a report by the Clatsop County Duck Hunters Association on behalf of the Clatsop County Water Resources Committee, there are 18 square miles of tidal marshland in the county. These tidal islands, 90 percent covered by high tide, are publicly owned and have no apparent economic value other than offering fine waterfowl hunting for Oregon sportsmen. Clatsop County has 1,100 duck hunters and the area is used by large numbers of migrating waterfowl.

There are 17 public boat landings on various streams along the Columbia and the Pacific Coast within this sub-basin. There are also a few private boat landings.

Wildlife

There are no water rights for wildlife within this sub-basin. The streams, coastal areas, and lands along the Columbia are used by game animals and waterfowl. Large animals

hunted include elk, deer, and bear. Smaller animals include muskrat, beaver, mink, coyote, bobcat, raccoon, and the majority of the waterfowl species normally found in western Oregon.

Waterfowl are numerous from Seaside north along the coast, and along the Columbia River from the mouth to the vicinity of the Beaver Military Reservation. Beaver are distributed generally along the major streams of the Clatsop County portion of the sub-basin, and along some sections of Clatskanie River in Columbia County. Muskrat are found near the coast from Seaside to Hammond, along the lower reaches of the Lewis and Clark and Youngs Rivers, and along the Columbia from the mouth of the John Day River to Blind Slough.

An indication of the distribution of deer and elk in the area is the annual kill, which was listed by counties in Table 16.

Fish Life

Water rights for propagation of fish total 83 cfs for the Columbia sub-basin. This is approximately two-thirds of the total water rights for fish in the North Coast Basin. The Fish Commission holds a 50 cfs right for a fish hatchery on the North Fork of the Klaskanine River, and a 26 cfs right for a fish hatchery on Big Creek. In addition, the Game Commission has recently been granted a permit for 6 cfs on Gnat Creek. There are also small diversion rights and reservoir rights held by private parties for fish culture.

Plate 9, based on information provided jointly by the Fish and Game Commissions, shows spawning distribution in basin streams of spring and fall chinook salmon, silver salmon, chum salmon, and steelhead trout. Because silver salmon normally use all available feeder streams, some additional small tributaries are probably utilized by this species.

Spring chinook are not generally found in this sub-basin due to their preference for larger streams for spawning. Fall chinook are found along short stretches of the Lewis and Clark, Youngs, and Clatskanie Rivers and Big, Bear, Gnat, and Plympton Creeks.

Silvers and steelhead are found along various portions of many of the streams in the western part of the sub-basin, and on the Clatskanie River in the eastern portion. Chum salmon are found only in portions of the Necanicum. Resident and cutthroat trout are found generally throughout the sub-basin.

Table 17 lists the minimum desirable flows to maintain fish life in the streams of the sub-basin, as determined by the Fish and Game Commissions. These are in some

instances greater than present low season flows, and are based on the supposition that flows will be higher the remainder of the year, especially when movements of migratory fish are at a maximum. These concepts of minimum flow are subject to change as conditions change and knowledge increases.

Figure 9 shows a water temperature graph for the Clatskanie River for the 1952 water year. This pattern is believed to be representative of other streams in the sub-basin. This shows temperatures in excess of those desirable for fish life, reaching over 72° F. in July and August and over 60° F. through much of May, June, and September.

Pollution Abatement

There are five active water quality stations in this sub-basin, all located on the Columbia River, maintained through a cooperative program between Washington, Oregon, and the pulp and paper industry.

The State Sanitary Authority lists St. Helens, Rainier, and Seaside as having primary treatment plants, Clatskanie with secondary treatment, and Cannon Beach with lagoon treatment. Systems having no treatment, discharging untreated sewage, include Astoria, Astoria Airport, and Warrenton. Astoria and Warrenton discharge into the Columbia River, and Astoria Airport discharges into Youngs Bay. Prescott has no public sewerage system. Approximate populations served are Astoria 11,000, Astoria Airport 100, Cannon Beach 400, Clatskanie 800, Rainier 1,200, St. Helens 5,000, Seaside 3,000, and Warrenton 100. Design populations for these treatment plants are Clatskanie 1,400, Rainier 2,000, St. Helens 8,000, Cannon Beach (lagoon) 650 to 2,700, and Seaside 3,000.

The State Sanitary Authority lists present needs as including the addition of secondary treatment and extension of sewage collection at Seaside for pollution abatement in the Necanicum River. The city has voted bonds and has plans under way for early construction of the facilities. Sewer extension is needed at Warrenton, which discharges into both the Columbia and Skipanon Rivers, and a fund for this work has been started. Astoria discharges its untreated sewage into Youngs Bay or the Columbia River, and strong tidal action has eliminated the need for any further treatment to date according to the Clatsop County Water Resources Committee. In the Bradwood, Wauna, and Westport areas, there is some sewage drainage into the Columbia and sloughs, but due to many mills being down and decreased population, sewage disposal is not a major problem at this time.

WATER CONTROL

Flood Control

Arable lands subject to flooding in the sub-basin lie principally near the north coastal portion and along the Columbia River.

The coastal portion begins along the Skipanon River south of Seaside and extends north to the Warrenton area. Columbia River areas include low lying lands and islands which have not been protected by flood dikes.

The 1950 Flood Control Act authorized the Corps of Engineers to accomplish work at a number of locations along the lower Columbia River. Levee districts where improvements are authorized include Deer Island, Rainier, John, Beaver, Clatskanie, Magruder, Midland, Woodson, and Clatsop County Nos. 1, 4, and 6 (Tenasillahe Island). In addition, a new levee was authorized for the Clatskanie River area and bank protection was authorized at numerous locations. It is anticipated that necessary work to protect the Rainier Drainage District against the recommended controlled flood flow of 940,000 cfs on the Columbia River will be initiated in 1961. Also, bank protection work at Beaver Drainage District is scheduled for accomplishment in 1961.

A study by the Corps of Engineers of flood problems along the Columbia River also is authorized. That study, when completed, will include consideration of flood problems and possible solutions in the Columbia sub-basin.

The Warrenton Dunes Soil Conservation District and Clatsop County are planning initial construction on the Skipanon River Watershed Project in 1961. Included in this project is a flood gate near the mouth of the river, channel improvement along the river, and a lake level control structure at the outlet of Cullaby Lake. This development will be accomplished under the provisions of the Watershed Protection and Flood Prevention Act.

The USDA made a study of individual tributaries and presented summaries of pertinent water related problems within these individual watersheds. Data are not considered precise, but are intended to show the nature and general extent of the problems. These summaries indicate that annual floods inundate 1,100 acres of cropland in this sub-basin and have caused damage to farms, houses, roads, bridges, and a park and golf course.

Drainage

Due to heavy rainfall and low elevation and poor drainage of much of the better soil in the sub-basin, drainage is a major problem. There are over 49,000 acres, or 45

percent of the arable land in the sub-basin, which are subject to presence of excessive wetness or to overflow. These areas are found in the lowlands along the Columbia, Youngs, Lewis and Clark, and Necanicum Rivers, along the coast from Warrenton to Gearhart, and in the Warrenton and Seaside areas (Figure 10).

There are 32 diking and drainage districts in this sub-basin which include over 30,000 acres.

Since few of the important cultivated crops will yield satisfactorily on poorly-drained soils, drainage is extremely important.

Erosion

Erosion is a problem in several areas in this sub-basin. There are about 52,000 acres, or 48 percent of the arable land in the sub-basin, classed as lands dominantly subject to wind or water erosion, or both.

Lands subject to stream flood erosion are located in the low-lying areas along the Columbia, Youngs, and Necanicum Rivers (Figure 10).

Areas along the coast, including Clatsop Spit and the section from Warrenton to Gearhart known as the Warrenton Dunes area, are subject to very severe wind erosion. However, much has been done to stabilize this area in the past 25 years. Stabilization has been accomplished by a process of planting beach grass, shrubs, and native trees. This procedure along with adequate maintenance has been so successful that it has been used around the world.

POTENTIAL WATER USE AND ASSOCIATED PROBLEMS

Domestic

Future domestic needs in this sub-basin will probably be met by utilization of surface flows rather than ground water reserves due to the high iron content of ground water. There is no major increase in domestic demands seen at this time. The general trend in population is such that any major changes would likely occur in urban areas served by municipal supplies.

Municipal

Population trends in the sub-basin do not indicate rapid growth in the next 20 to 30

years. Therefore, no major increases in water use are expected. Most of the larger cities have adequate supplies for expected increases in population during this period.

Rainier has sufficient water for the present and could triple the storage by adding 10 feet to the dam on Fox Creek. The resident population of Seaside is approximately 3,900 people but in the summer this increases to roughly 20,000 for short periods of time due to the large influx of visitors. Their present water supply is capable of taking care of an anticipated population growth to 7,200. The source of these supplies is the Necanicum and South Fork of the Necanicum Rivers. This present supply is capable of rapid enlargement with comparatively little work.

The City of Astoria presently has an ample water supply to meet expected future demands for domestic water. The city recently obtained a 26 cfs right primarily to assure an adequate supply of water for major water-using industries.

St. Helens is equipped to serve approximately 900 more people than are presently being served and will ultimately need additional supplies.

Irrigation

There are 109,000 acres of potentially irrigable land in this sub-basin. These lands (Figure 12) consist mainly of land within drainage and diking districts and small tracts of bottom or terrace land adjacent to major streams.

At the present time, many of the streams are fully or overappropriated. The Clatskanie and Klaskanine Rivers and their tributaries and the Lewis and Clark River and Big Creek have all been withdrawn for protection of fish life. These withdrawals do not affect existing rights or prevent appropriation and use for domestic, stock, municipal, public park, or recreational purposes.

In Columbia County future expansions in irrigated acreage will probably be slow.

Irrigation of pasture land in Clatsop County will probably continue to expand. Irrigation of pasture land allows this land to support larger herds, and since such land is limited, it is desirable to make it as productive as possible.

Power

The Youngs River has been considered for development of small quantities of power in the past, but no projects are under active consideration at present and little potential exists in the streams of the Columbia sub-basin.

Industrial

Many industries in this sub-basin obtain their water from the Columbia River and for these there are no anticipated problems in the foreseeable future. Astoria has a right for 26 cfs from Youngs River to provide for future municipal and industrial uses. This amounts to about 17 million gpd.

There have, at various times, been inquiries in the Astoria area from prospective industries with water requirements ranging from 6 to 30 million gpd, the latter being the requirements of a pulp mill. It is estimated that the present supply of timber could support a pulp mill using 30 million gpd and that double this supply of timber will eventually be available.

Potential water needs for industrial development of iron ores are either small or unknown at present. The location of a smelter in the Astoria area is a future possibility. This would involve considerable quantities of water which could be obtained from the Columbia or through the Astoria system.

A reduction plant to produce alumina from the bauxite deposits would require large quantities of wash and process water.

Mining

Known mineral deposits and active mining operations in the North Coast Basin are shown on Plate 4.

Mining of deposits in this sub-basin would require minor quantities of water.

Recreation

Figure 13 showed annual use of state parks in the basin, with State Highway Department projections of estimated future use.

Parks included which lie wholly or partially within the sub-basin are Fort Stevens, Ecola, Oswald West, and Saddle Mountain.

Fort Stevens presently leads in both day visitors and overnight campers. The number of day visitors is expected to increase from 404,000 in 1959 to 500,000 in 1969, with a comparable increase in overnight campers from 67,000 to 80,000.

Oswald West is limited in overnight camping by physical restrictions but has a projected increase in day visitors from 146,000 in 1959 to 250,000 by 1969.

Ecola has no overnight camping and a moderate projected increase in day use from 141,000 to 180,000.

Estimates for Saddle Mountain are for increases in day use from 19,000 to 35,000, and for camping from 800 to 1,700. This area is used primarily for sightseeing and picnicking.

Consumptive use of water for parks and camps is relatively small and no problems are anticipated in this regard.

A 1958 survey for the National Parks Service recommended several potential recreation areas along the Pacific Coast. Included in those recommended for development were several areas in the North Coast Basin. These included Clatsop Plains and Manzanita Beach. The Clatsop plains area is located five miles southwest of Astoria and possesses a potentially valuable recreation beach and inland lakes for fresh water bathing and water sports. Manzanita Beach adjoins Nehalem Bay State Park on the north. This area receives heavy public recreation use and would make a desirable addition to Nehalem Bay State Park.

Wildlife

Water needs for wildlife will not change materially in the future unless the habitat is changed substantially by new development.

Fish Life

Construction of storage projects on streams supporting anadromous fish runs would have to include fish passage facilities if these runs are to be sustained.

Potential development of fish life in the sub-basin to maximum capacity depends upon determining optimum conditions and the ability to create or maintain necessary flows, temperatures, spawning areas and pollution abatement once such criteria are established.

Based upon streamflow, gradients, and other natural conditions, the potential for enhancement of fish life in this sub-basin appears limited compared to the potential in the other sub-basins.

Pollution Abatement

The State Sanitary Authority has indicated primary sewage treatment will eventually be required at Astoria and Warrenton. No compliance date has been set.

Prescott is the only city in the sub-basin the Authority lists as in need of a public sewer system at present.

Increased development and use of recreational areas will result in an increase of potential pollution problems.

APPENDIX

AUTHORITY

The authority for the preparation and presentation of this report is set forth in ORS 536.300. The Legislative Assembly recognizes and declares in ORS 536.220 (1) that:

"(a) The maintenance of the present level of the economic and general welfare of the people of this state and the future growth and development of this state for the increased economic and general welfare of the people thereof are in large part dependent upon a proper utilization and control of the water resources of this state, and such use and control is therefore a matter of greatest concern and highest priority.

"(b) A proper utilization and control of the water resources of this state can be achieved only through a coordinated, integrated state water resources policy, through plans and programs for the development of such water resources and through other activities designed to encourage, promote and secure the maximum beneficial use and control of such water resources, all carried out by a single state agency.

"(c) The economic and general welfare of the people of this state have been seriously impaired and are in danger of further impairment by the exercise of some single-purpose power or influence over the water resources of this state or portions thereof by each of a large number of public authorities, and by an equally large number of legislative declarations by statute of single-purpose policies with regard to such water resources, resulting in friction and duplication of activity among such public authorities, in confusion as to what is primary and what is secondary beneficial use or control of such water resources and in a consequent failure to utilize and control such water resources for multiple purposes for the maximum beneficial use and control possible and necessary."

The authority for the report, the study on which it is based, and the actions effected are specifically delegated to the State Water Resources Board in ORS 536.300 (1) and (2) which state:

"(1) The board shall proceed as rapidly as possible to study: existing water resources of this state; means and methods of conserving and augmenting such water resources; existing and contemplated needs and uses of water for domestic, municipal, irrigation, power development, industrial, mining, recreation, wildlife, and fish life uses and for pollution abatement, all of which are declared to be beneficial uses, and all other related subjects, including drainage and reclamation.

"(2) Based upon said studies and after an opportunity to be heard has been given to all other state agencies which may be concerned, the board shall

progressively formulate an integrated, coordinated program for the use and control of all the water resources of this state and issue statements thereof."

Within the limits of existing data and knowledge, the study has taken into full consideration the following declarations of policy under ORS 536.310:

"(1) Existing rights, established duties of water, and relative priorities concerning the use of the waters of this state and the laws governing the same are to be protected and preserved subject to the principle that all of the waters within this state belong to the public for use by the people for beneficial purposes without waste;

"(2) It is in the public interest that integration and coordination of uses of water and augmentation of existing supplies for all beneficial purposes be achieved for the maximum economic development thereof for the benefit of the state as a whole;

"(3) That adequate and safe supplies be preserved and protected for human consumption, while conserving maximum supplies for other beneficial uses;

"(4) Multiple-purpose impoundment structures are to be preferred over single-purpose structures; upstream impoundments are to be preferred over downstream impoundments. The fishery resource of this state is an important economic and recreational asset. In the planning and construction of impoundment structures and milldams and other artificial obstructions, due regard shall be given to means and methods for its protection;

"(5) Competitive exploitation of water resources of this state for single-purpose uses is to be discouraged when other feasible uses are in the general public interest;

"(6) In considering the benefits to be derived from drainage, consideration shall also be given to possible harmful effects upon ground water supplies and protection of wildlife;

"(7) The maintenance of minimum perennial streamflows sufficient to support aquatic life and to minimize pollution shall be fostered and encouraged if existing rights and priorities under existing laws will permit;

"(8) Watershed development policies shall be favored, whenever possible, for the preservation of balanced multiple uses, and project construction and planning with those ends in view shall be encouraged;

"(9) Due regard shall be given in the planning and development of water recreation facilities to safeguard against pollution;

"(10) It is of paramount importance in all cooperative programs that the principle of the sovereignty of this state over all the waters within the state be protected and preserved, and such cooperation by the board shall be designed so as to reinforce and strengthen state control;

"(11) Local development of watershed conservation, when consistent with sound engineering and economic principles, is to be promoted and encouraged; and

"(12) When proposed uses of water are in mutually exclusive conflict or when available supplies of water are insufficient for all who desire to use them, preference shall be given to human consumption purposes over all other uses and for livestock consumption, over any other use, and thereafter other beneficial purposes in such order as may be in the public interest consistent with the principles of this Act under the existing circumstances."

STATUTORY REFERENCES

ORS 538.251

"Tributaries of Columbia River; limitations on appropriation or diversion. Except as provided in subsection (4) of this section, the following waters, all being tributaries of the Columbia River, are withdrawn from appropriation and shall not be diverted or interrupted for any purpose, except for protecting fish life therein by the fish commission or the game commission of Oregon:

"(1) Clatskanie River and its tributaries in Columbia County.

"(2) Klaskanine River and its tributaries in Clatsop County.

"(3) Lewis and Clark River in Clatsop County.

"(4) Sandy River and its tributaries in Multnomah and Clackamas Counties, except:

"(a) Beaver Creek and its tributaries.

"(b) Buck Creek and its tributaries.

"(c) The tributary of the Sandy River in Multnomah County which empties into the Sandy River near the north quarter corner, section 10, township 1 south, range 4 east, Willamette Meridian, and its tributaries, and is locally known as Big Creek.

"(d) All tributaries, but not the main channel, of the Sandy River within Multnomah County and below the point where the stream described in paragraph (c) of this subsection empties into the Sandy River are open for appropriation and storage from December 1 to June 1 of each year. Water stored during this period may be used at any time.

"(5) Scappoose Creek in Columbia County.

"(6) Tillasqua Creek in Clatsop County."

ORS 538.260

"Existing rights not affected; appropriation and use for certain purposes permitted. ORS 538.251 shall not affect any existing rights to appropriate or use water, or any renewals or extensions thereof, or prevent appropriation and use of such water for domestic, stock, municipal, public park or recreational purposes."

POTENTIAL WATER DEVELOPMENT PROJECTS
DAM AND RESERVOIR SITES - NORTH COAST BASIN

MAP INDEX NO.	SITE NAME	STREAM	DR. AREA Sq. Mi.	AVERAGE ANNUAL YIELD Ac.-Ft.	PURPOSE	DAM		RESERVOIR				POWER				LOCATION				SOURCE NO.
						Height Feet	Crest Length Feet	Max. Pool Elev. Ft.-MSL	Max. Pool Area Acres	Usable Storage Ac.-Ft.	Total Storage Ac.-Ft.	Installed Capacity KW	Average Annual Generation 1000 KW	Gross Head Feet	Channel Or Conduit Feet	Twp.	Rng.	Sec.	Str. File	
	ALDER CREEK	Alder Creek			N			5	40		195									14
1	BARK SHANTY	North Fork Trask River	75	348,000	P	200		600	350	25,000	27,000		45,600	180		1S	7W	29	3	7
	BAYS CREEK	Bays Creek	4	18,260	**			320	62		1,490					3S	9W	24		22
	BEAVER CREEK	Beaver Creek	26	113,000	**		800	840	1,189		26,490					3S	9W	18		22
	BEAVER CREEK	Beaver Creek	1	3,050	**		500	160	93		2,640					2S	10W	11		22
	BEAVER CREEK	Beaver Creek	1	3,410	**		100	80	37		177					2S	10W	3		22
	BEAVER CREEK	Beaver Creek	15	16,630	**		1,000	560	356		5,340					7S	7W	19	14	22
	BEWLEY CREEK	Bewley Creek	3	1,330	**		800	80	100		750					2S	10W	24		22
	BIG CREEK	Big Creek	23	87,300	**		950	590	100		2,810					7S	7W	3	7	22
	BIG CREEK	Big Creek			H	60		665	60		1,500					7S	7W	14	9	12
2	BLAINE	Nestucca River		470,000	P	250		650			170,000	15,000	70,000	240		3S	8W	33	28	5
	BUSTER CREEK	Buster Creek	13	40,200	**		1,000	800	629		29,600					5S	6W	19		22
	BUSTER CREEK	Buster Creek	5	13,180	**		900	880	255		5,590					5S	6W	21		22
3	CAMP FIVE	Middle Fk. of N. Fk. Trask R.	9	35,000	P							6,000		950	23,000	1S	6W	27		1
	CAMP McGREGOR	Rock Creek			P-FC-I-R															8
4	CEDAR CREEK	Wilson River	100		P	260		810			250,000	18,000	96,000	260		1N	7W	17	26	5
5	CITY OF FOREST GROVE	Devils Lake Fk. of Wilson R.	5	15,000	M	55		1,635			1,800					1N	5W	6	8	20
	" " " " "	" " " " "	5	15,000	M	60		1,640			2,400					1N	5W	6	8	20
6	CITY OF HILLSBORO	Middle Fk. of N. Fk. Trask R.			M						12,600					1S	6W	35		16
	Middle Fk. of N. Fk. Trask River	" " " " " " "	8	24,300	**		1,200	1,000	218		4,900					1S	6W	35		22
7	CITY OF McMINNVILLE	Nestucca River	6	12,270	M	60	330	1,840			3,000					3S	6W	15	4B	17
	" " "	" "	6	12,270	M	70	370	1,860			5,000					3S	6W	15	4B	17
	" " "	" "	6	12,270	M	80	410	1,860			7,700					3S	6W	15	4B	17
	CITY OF McMINNVILLE	Nestucca River	2	4,480	M	50	285	1,840			1,250					3S	6W	14	50	17
	" " "	" "	2	4,480	M	60	315	1,850			1,950					3S	6W	14	50	17
	" " "	" "	2	4,480	M	70	370	1,860			3,150					3S	6W	14	50	17
	CITY OF McMINNVILLE	Walker Creek	3	6,400	M	60	480	1,870			2,500					3S	6W	13		17
	" " "	" "	3	6,400	M	70	505	1,880			4,000					3S	6W	13		17
	" " "	" "	3	6,490	M	80	540	1,890			6,800					3S	6W	13		17
	WALKER CREEK		3	9,650	**		1,900	1,920	349		10,700					3S	6W	15		22
	CLATSKANIE RIVER	Clatskanie River	72	118,200	**		350	250	168		2,520					7N	4W	35	8	22
	CLATSKANIE RIVER	Clatskanie River	11	20,770	**		700	920	243		5,820					5N	3W	10	21	22
8	CLEAR CREEK	Nehalem River	70	171,000	P-FC-I	111		800	2,300	90,000	114,000		11,600	130		4N	5W	22	100	6
	" "	" "	70	171,000	P-FC-I	138		865		250,000						4N	5W	22	100	6
	ROCKY POINT				P-FC-I-R											4N	5W	22	100	8
	NEHALEM RIVER	" "	71	192,200	**		1,000	800	2,230		83,100					4N	5W	22	100	22
9	CLEAR CREEK	North Fork Trask River	53	257,000	P	210		900	500	40,000	43,000		34,200	200		1S	7W	24	9	7
	North Fk. Trask River	" " " " "	54	260,500	**		550	800	197		7,000					1S	7W	24	9	22
	COOK CREEK	Cook Creek			D-I											2N	5W	1		8
	COOK CREEK	Cook Creek	19	115,500	**		850	480	125		3,940					2N	8W	8		22
	CROOKED CREEK	Crooked Creek	8	13,210	**		950	680	284		6,370					5N	4W	17		22
	CULLABY LAKE	Skipanon River			FC-R	280					600					7N	10W	15	8	14
	" "	" "			FC											7N	10W	15		15
	DEEP CREEK	Deep Creek	21	37,400	**		1,150	560	423		9,000					6N	5W	29		22
	DEER CREEK	Deer Creek	12	21,900	**		450	600	137		2,060					6N	4W	31		22
	DEER CREEK	Deer Creek	5	8,910	**		950	720	411		11,460					5N	4W	7		22
	EAST BEAVER CREEK	East Beaver Creek	10	42,500	**		600	480	62		1,300					3S	9W	15		22
	EAST BEAVER CREEK	East Beaver Creek	6	34,080	**		500	800	82		2,030					3S	9W	1		22
	EAST CREEK	East Creek	5	23,350	**		900	720	81		1,940					3S	8W	15		22
	EAST FOLEY CREEK	East Foley Creek	2	18,780	**		750	460	56		1,340					2N	9W	6		22
	EAST FORK NEHALEM	East Fork Nehalem River			FC															4
	EAST FK. TRASK R.	East Fork Trask River	24	118,200	**		600	800	100		3,510					2S	7W	20		22
	EAST FK. TRASK R.	East Fork Trask River	16	80,000	**		900	1,840	243		12,180					2S	7W	28		22
	ELKHORN CREEK	Elkhorn Creek	7	37,900	**		850	1,600	137		6,570					2S	6W	8		22
10	ELSIE	Nehalem River	498	1,140,000	P	165		560	23,600	1,400,000	1,500,000	25,000	150,000	165		4N	7W	4	38	6
	"	" "	498	1,140,000	P	205		600	23,600	1,200,000	1,500,000		147,200	205		4N	7W	4	38	6
	"	" "	498	1,140,000	P	205		600	23,600	1,200,000	1,500,000		447,000	600	30,000	4N	7W	4	38	6
	"	" "	498	1,140,000	P	205		600	23,600	1,000,000	1,500,000		666,000		9,500	4N	7W	4	38	6
	R-1	" "		1,310,000	P	70		470	4,800		150,000		100,800*			4N	7W	4	38	18
	R-1	" "			P	100		500	9,500		300,000		127,500*			4N	7W	4	38	18
	FALL CREEK	Fall Creek			P						1,500	77,900		560		3S	9W	16		6
	FAWCETT CREEK	Fawcett Creek	2	8,570	**		350	1,200	37		890					2S	8W	19		22
	FISHHAWK CREEK	Fishhawk Creek	23	83,200	**		1,500	560	542		9,430					6N	5W	17		22

POTENTIAL WATER DEVELOPMENT PROJECTS
DAM AND RESERVOIR SITES - NORTH COAST BASIN
(Continued)

MAP INDEX NO.	SITE NAME	STREAM	DR. AREA Sq. Mi.	AVERAGE ANNUAL YIELD Ac.-Ft.	PURPOSE	DAM		RESERVOIR				POWER				LOCATION				SOURCE NO.
						Height Feet	Crest Length Feet	Max. Pool Elev. Ft.-MSL	Max. Pool Area Acres	Usable Storage Ac.-Ft.	Total Storage Ac.-Ft.	Installed Capacity KW	Average Annual Generation 1000 KWH	Gross Head Feet	Channel Or Conduit Feet	Twp.	Rng.	Sec.	Str. Mile	
	FISHHAWK CREEK	Fishhawk Creek	11	26,100	**		450	880	174		4,170					7N	5W	20		22
11	FISHHAWK CREEK	Fishhawk Creek	11	23,650	P			900	600	35,000	45,000					7N	5W	29		6
	F-1	" "			P	200		880	570		35,000					7N	5W	32		18
	FISHHAWK CR.	" "	2	5,810	**		950	800	162		3,740					7N	5W	32		22
	FOLEY CREEK	Foley Creek	4	9,650	**		600	320	125		2,250					2N	10W	23		22
12	GINGER PEAK	Trask River	140	672,000	P	250		345	1,200	100,000	117,000		124,700	250		1S	5W	29	13	7
	"	" "		672,000	P	260		450			300,000	25,000	70,000	260		1S	6W	21	13	5
	T-6	" "		656,000	P	100		320	700		15,000		63,500*			1S	6W	28	14	19
	T-6	" "		656,000	P	150		350	1,150		120,000		81,600*			1S	6W	28	14	18
	TRASK RIVER	" "			P	150		340		100,000	120,000	30,000				1S	6W	27	15	2
	TRASK R. REREGULATING	" "			P						38,000	5,000				1S	6W	35	11	2
13	GODS VALLEY	North Fork Nehalem River	45	220,000	P	160	590	400	1,490		75,000		44,500	340	18,500	4N	9W	27	11	6
	GODS VALLEY	Gods Valley Creek	7	35,800	**		900	430	498		7,760					4N	9W	36		22
	GOLD PEAK	North Fork Gold Creek			P	27	1,600	1,775			400	68,000		1,740	5,300	1S	8W	32		7
	GREEN CREEK	Green Creek	4	4,400	**		550	450	181		2,210					8N	3W	32		22
	HECKARD CREEK	Heckard Creek	1	4,120	**		250	150	44		1,180					7N	10W	24		22
	HELLOFF CREEK	Helloff Creek			P						1,500	130,000		950		3N	9W	11		6
14	HOLLYWOOD	South Fork Trask River	49	231,000	P	200		550	450	30,000	34,000		38,700	200		2S	7W	6	2	7
	T-1	" " " "		236,000	P	100		375	320		92,000		22.8Gx			2S	8W	1		19
	T-1	" " " "		236,000	P	150		425	550		50,000		32.3Gx			2S	8W	1		19
	HORTILL CREEK	Hortill Creek	2	6,000	**		350	200	49		734					7N	9W	30		22
	HUMBUG CREEK	Humbug Creek	5	23,000	**		400	800	125		4,410					5N	8W	22		22
	KEYHOLE	North Fork Trask River	53	277,000	P	110	260	690	130	5,000	7,000		21,100	113		1S	7W	27	7	7
	North Fk. Trask River	" "	59	267,000	**		200	640	50		1,000					1S	7W	27	7	22
	KILCHIS RIVER	Kilchis River	18	217,000	**		600	160	100		2,400					1N	9W	21	8	22
	KILCHIS RIVER	Kilchis River	32	186,700	**		650	320	187		4,450					1N	9W	9	11	22
	KILLIAM CREEK	Killiam Creek	5	2,210	**		500	320	37		890					2N	9W	15		22
	KLASKANINE RIVER	Klaskanine River	7	28,800	**		350	450	37		953					7N	8W	34	3	22
	KLASKANINE RIVER, LOWER	Klaskanine River			X	40		440	42		720					7N	8W	27	6	14
	KLASKANINE R., UPPER	" "			X	40		480	42		904					7N	8W	27	7	14
	KLICKITAT CREEK	Klickitat Creek	1	2,260	**		450	200	27		405					7N	9W	31		22
	LITTLE CLATSKANIE	Little Clatskanie River	3	4,120	**		1,200	840	106		984					5N	3W	2		22
	LITTLE FALLS	Unnamed			P						800	69,000		1,210		4N	7W	30		6
	LITTLE NESTUCCA RIVER	Little Nestucca River	40	152,000	**		500	410	178		2,900					5S	10W	22	9	22
	LITTLE NESTUCCA RIVER	Little Nestucca River	33	116,700	**		850	400	584		21,600					5S	10W	25	8	22
	LOST CREEK	Lost Creek	4	4,480	**		600	450	534		1,900					7N	3W	28		22
	LOST CREEK	Lost Creek			P						9,000	242,000		300		3N	9W	25		6
	LOST LAKE	Lost Lake Creek			P						900	90,000		1,170		4N	7W	17		6
	LOUSIGNOT CREEK	Lousignot Creek	4	8,570	**		800	560	137		2,340					4N	6W	14		22
	MEADOW LAKE	Nestucca River		32,000	P-N							4,000	27,000	870		3S	6W	7	47	5
	MIAMI RIVER	Miami River	11	55,100	**		800	400	187		8,970					2N	9W	29	9	22
	MIDDLE FK. OF N. FK. TRASK RIVER	See City of Hillsboro																		
	MILE 9	Trask River			P	70						13,000	40,000	70						1
	MILE 12.5	Trask River			P	70						13,000	40,000	70						1
	MOON CREEK	Moon Creek	6	27,630	**		700	480	93		3,150					3S	8W	17		22
	N-1	See Elsie																		
15	N-2	Nehalem River	15	1,418,200	P	100		450	3,500		120,000		136,800*			4S	7W	7	35	18
	N-2	" "	23	1,410,800	P	110		500	4,500		400,000		193,600*			4S	7W	7	35	18
	N-4	See Salmonberry																		
	NEACOXIE LAKE	Neacoxie Creek			X				182		380									14
16	Nehalem Falls	Nehalem River	660	1,877,000	P	83		148				18,000	79,900	83		3N	9W	22	15	6
	"	" "	660	1,877,000	P	340		395	3,700	347,000	367,000		377,600	330		3N	9W	22	15	6
	"	" "			P											3N	9W	22		6
	NEHALEM RIVER	See Clear Creek																		
	NESTUCCA RIVER	Nestucca River	48	191,700	**		1,200	800	317		15,200					4S	7W	6	34	22
	NESTUCCA RIVER	Nestucca River	28	103,600	**		500	1,040	106		3,370					3S	7W	27	39	22
	NORTH FK. NEHALEM R.	North Fork Nehalem River	43	217,000	**		450	320	224		4,830					4N	9W	26	12	22
	NORTH FK. NEHALEM R.	North Fork Nehalem River	31	151,200	**		600	400	218		4,445					4N	8W	19	15	22
	NORTH FK. NEHALEM R.	North Fork Nehalem River	16	72,000	**		450	360	243		5,460					4N	8W	16	19	22
	NORTH FK. TRASK RIVER	See Keyhole																		

POTENTIAL WATER DEVELOPMENT PROJECTS
DAM AND RESERVOIR SITES - NORTH COAST BASIN
(Continued)

MAP INDEX NO.	SITE NAME	STREAM	DR. AREA Sq. Mi.	AVERAGE ANNUAL YIELD Ac.-Ft.	PURPOSE	DAM		RESERVOIR				POWER				LOCATION				SOURCE NO.
						Height Feet	Crest Length Feet	Max. Pool Elev. Ft.-MSL	Max. Pool Area Acres	Usable Storage Ac.-Ft.	Total Storage Ac.-Ft.	Install'ed Capacity KW	Average Annual Generation 1000 KWH	Gross Head Feet	Channel Or Conduit Feet	Twp.	Rng.	Sec.	Str. Mile	
	NORTH FK. TRASK RIVER	See Clear Creek																		
	NORTHRUP CREEK	Northrup Creek	7	21,230	**		1,000	640	187		4,210					6S	6W	17		22
	PEBBLE CREEK	Pebble Creek	21	35,350	**		1,000	680	648		14,560					4S	4W	9		22
	ROCK CREEK	Rock Creek	58	140,700	**		2,800	800	2,528		129,800					5S	4W	32	3	22
	ROCK CREEK	Rock Creek	27	95,200	**		1,100	1,280	286		10,120					4S	6W	15	28	22
	ROCK CREEK	Rock Creek			FC											5S	5W	32	12	4
	ROCKY POINT	See Clear Creek																		
	SAGER CREEK	Sager Creek	4	7,510	**		750	560	125		2,470					6S	6W	26		22
17	SALMONBERRY	Nehalem River	573	1,462,000	P	130		395	500			20,000	84,900	100		3S	8W	10	23	6
	"	" "	573	1,462,000	P	200		395	1,900					190		3S	8W	10	23	6
	"	" "	573	1,462,000	P	395		600	31,000	1,420,000	2,500,000					3S	8W	10	23	6
	Alt	" "		1,505,000	P	200		400	1,800		130,000		244,100*			3S	8W	10	23	18
	Alt	" "		1,505,000	P	250		450	4,500		280,000		292,800*			3S	8W	10	23	18
	SKIPANON RIVER	Skipanon River			M	6		37	37		214									14
	SMITHS LAKE	Smiths Lake			I	4	135	24	25		33					8N	10W	20		14
	"	"			M	6		47	47		295									9
	SOUTH FK. KLASKANINE R.	South Fork Klaskanine River	18	72,300	**		425	250	56		1,225					7N	8W	31	4	22
	SOUTH FK. TRASK RIVER	South Fork Trask River	7	3,410	**		550	720	50		1,146					2S	8W	24		22
18	SPRUCE RUN	Nehalem River	548	1,360,000	P	90		395	880	30,000		17,000	72,800	90		4S	8W	34	33	6
	"	" "	548	1,360,000	P	132		437	1,200	115,200				137		4S	8W	34	30	6
	"	" "	548	1,360,000	P	245		600	28,529	1,770,900	2,000,000					4S	8W	34	30	6
	SPRUCE RUN LAKE	Spruce Run Creek			P						1,000	59,000		640		4S	7W	17		6
19	SQUAW CREEK	Nehalem River	398	795,950	P	150		800	13,950	570,000	700,000					6N	6W	33	53	6
20	STONEHILL	Nehalem River	700	2,105,000	P	42		65			3,000		56,100	42		3N	9W	34	12	6
	SUTTON CREEK	Sutton Creek	1	2,900	**		1,200	80	93		530					2S	10W	14		22
21	T-2	North Fork Trask River		378,000	P	120		450	330		22,000		42,500*			1S	7W	30	1	19
	T-2	" " " "		378,000	P	170		700	900		38,000		57,700*			1S	7W	30	1	19
	T-4	See Hollywood																		
	T-6	See Ginger Peak																		
	THREE RIVERS	Three Rivers	28	111,400	**		500	240	218		5,030					4S	9W	30	4	22
	TIDE CREEK	Tide Creek	10	13,900	**		500	320	168		4,030					6N	2W	33	9	22
22	TIDEPORT	Nehalem River	463	1,023,000	P	163		600	19,600	802,000	1,063,000					5N	7W	23	44	6
	TILLAMOOK RIVER	Tillamook River	2	9,050	**		700	240	56		386					2S	10W	35	16	22
23	WAKEFIELD	Nehalem River	647	1,810,000	P	62		205				13,000	57,700	62		3N	8W	17	20	6
	"	" "	647	1,810,000	P	252										3N	8W	17	20	6
	"	" "	647	1,810,000	P	457										3N	8W	17	20	6
	WAKEFIELD, UPPER	" "	644	1,800,000	P	220		395	2,400							3N	8W	16	22	6
	"	" "	644	1,800,000	P	425		600	38,170							1N	8W	16	28	6
	WALKER CREEK	Walker Creek	12	37,500	**		500	640	100		1,980					6N	7W	25		22
	WALKER CREEK	See City of McMinnville																		
	WALLOWA RIVER	Wallowa River	5	15,460	**		1,100	250	137		3,900					8N	8W	31	8	22
	WARRENTON DAM	Lewis and Clark River	22	90,200	**		500	400	112		2,250					6N	9W	20	16	22
	WOLF CREEK	Wolf Creek			FC-I															4
24	YOUNGS RIVER, LOWER	Youngs River	34	138,100	P-M	50	135	125	135		2,900	150		80		7N	9W	27	9	14
	YOUNGS RIVER	" "			**		500	250	597		23,400					7N	9W	27	10	22
25	YOUNGS RIVER, UPPER	Youngs River	22	98,500	M						28,000					6N	9W	12	16	14
	YOUNGS RIVER	" "			**		500	500	238		9,860					6N	9W	12	16	22
	12 RA NO. 29	Nestucca River			P	170						3,400	23,600	170						1
	12 RA NO. 38	Wilson River			P	165						3,300	21,400	165						1
	12 RA NO. 39	Wilson River			P	145						4,200	27,400	145						1
	12 RA NO. 40	Wilson River			P	110						3,600	23,700	110						1
	12 RA NO. 41	Wilson River			P	80						2,800	18,100	80						1

* Includes generation at reregulating dam.

** No purpose proposed.

Purpose: D - Domestic and Stock; M - Municipal and Industrial; I - Irrigation; P - Power; R - Recreation; FC - Flood Control.

NOTE: This table includes dams with conflicting reservoir areas.

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ABBREVIATIONS AND SYMBOLS

ac	acre
ac. ft.	acre-feet
Assoc., Assn.	Association
Ave.	average
Bch.	Beach
BM	board measure
Br.	branch
Can.	canyon
cfs, CFS	cubic feet per second
Ch.	Channel
Co.	County
Cr.	Creek
Dept.	Department
Dom.	domestic
E.	East
elev.	elevation
° F.	degrees Fahrenheit
Fig.	figure
Fk.	Fork
Fls.	Falls
Ft.	feet, foot
Ft./mi.	feet per mile
G.	gulch
gpd	gallons per day
gpm	gallons per minute
Ind.	industrial
Irrig.	irrigation
Is.	Island
Jct.	Junction
KW	kilowatts
KWH	kilowatt hours
L.	Little, Lake
Max.	maximum
mgd	million gallons per day
mi.	mile
Min.	mining, minimum
Misc.	Miscellaneous
Mt.	mount, mountain
Mun.	municipal
msl, MSL	mean sea level
MWH	megawatt hours
N.	North
Neh.	Nehalem
No.	number
OSHD	Oregon State Highway Department
Pt.	Point
ppm	parts per million
PUD	People's Utility District
Q	rate of flow
R	Range
R., Riv.	River
Rec.	recreation
Res.	Reservoir
S.	South
SCS	Soil Conservation Service
Sec.	section
Σ	sigma (a summation)
Sl.	slough
Spr.	Spring
Sq.	square
SWRB	State Water Resources Board
temp.	temperature
T	Township
U. S. A. F. Sta.	United States Air Force Station
U. S. C. G. Sta.	United States Coast Guard Station
USFS	United States Forest Service
USGS	United States Geological Survey
W.	West
WD	Water District
WSP	water supply papers

APPROXIMATE HYDRAULIC EQUIVALENTS

1 acre foot
- = *a volume 1 acre in area and 1 foot in depth*
- = *326,000 gallons*
- = *43,560 cubic feet*
- = *0.5 cubic feet per second for 1 day*

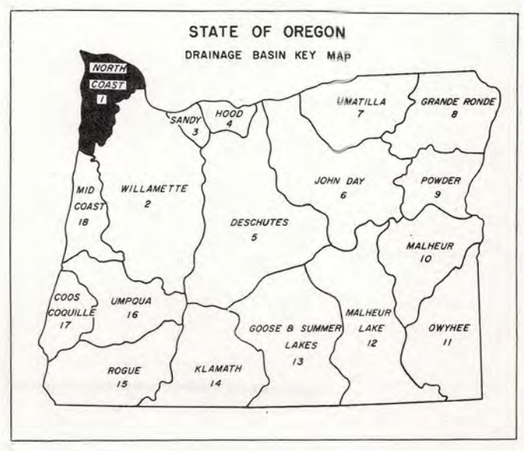
1 cubic foot per second
- *falling 8.8 feet will produce 1 horsepower**
- *falling 11.8 feet will produce 1 kilowatt**
- = *7.5 gallons per second*
- = *450 gallons per minute*
- = *2.0 acre-feet per day*
- = *650,000 gallons per day*

1 inch per day
- = *0.04 cubic feet per second per acre*
- = *27 cubic feet per second per square mile*
- = *19 gallons per minute per acre*

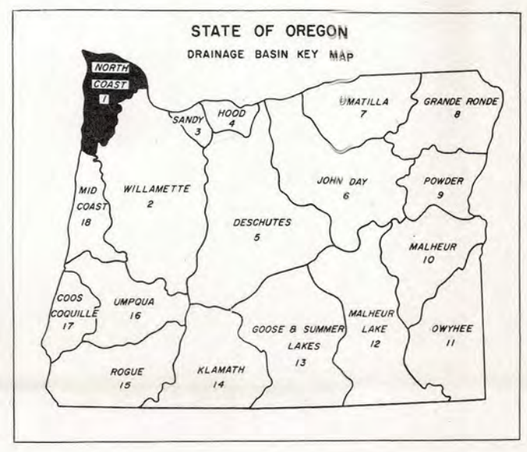
1 inch per hour
- = *1.0 cubic feet per second per acre*
- = *640 cubic feet per second per square mile*
- = *450 gallons per minute per acre*

1 million gallons per day
- = *690 gallons per minute*
- = *1.5 cubic feet per second*
- = *3.0 acre-feet per day*

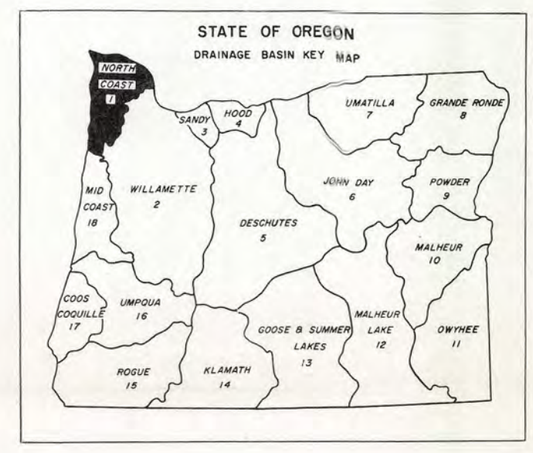
**theoretical for water at standard conditions*



R10W R9W R8W R7W R6W R5W R4W R3W R2W R1W
T9N T8N T7N T6N T5N T4N T3N T2N T1N T1S T2S T3S T4S T5S T6S
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46 15 45 45 45 30 45 15 45 00
WASHINGTON OREGON COLUMBIA
PACIFIC OCEAN
SUB-BASINS
1 TILLAMOOK
2 NEHALEM
3 COLUMBIA
WILLAMETTE BASIN
CLATSOP CO. COLUMBIA CO. TILLAMOOK CO. WASHINGTON CO. YAMHILL CO.
ASTORIA HAMMOND WARRENTON SEASIDE CANNON BEACH TILLAMOOK NEHALEM MANZANITA NEDONNA BEACH ROCKAWAY GEARHART SUNSET BEACH
CATHLAMET KELSO LONGVIEW CLATSKANIE RAINIER ST. HELENS SCAPPOOSE VERNONIA
Columbia R. Willamette R. Nehalem R. Nestucca R. Wilson R. Trask R. Tillamook R. Kilchis R. Miami R. Youngs R. Klaskanine R. Lewis & Clark R. Clatskanie R. Scappoose Cr.
Fort Stevens Fort Canby Fort Columbia Tillamook Rock Cape Falcon Cape Lookout Cape Meares Cape Kiwanda Cape Kiwanda Cape Lookout
Astoria Bridge Megler-Astoria Bridge Longview Bridge
Tillamook Naval Air Station U.S.A.F. Station U.S. Coast Guard Sta. U.S.C.G. Sta. U.S. Military Res.
Tongue Pt. Naval Base Beaver Military Res. Warrenton Res. Seaside Res. Apiary Res. Three Tree Pt. Res.
Camp Rilea McGregor Camp Meriwether
Fort Canby O'Neil L. Fort Dry L. Fort Black L. Fort Stanley L.
Youngs River Falls Nehalem Falls North Fork Falls Little Falls Nestucca Falls
Astoria Golf Course
Cape Falcon Cape Kiwanda Cape Lookout Cape Meares Cape Mears Cape Mears Cape Meares Cape Meares Cape Meares



R10W R9W R8W R7W R6W R5W R4W R3W R2W R1W
T9N T8N T7N T6N T5N T4N T3N T2N T1N T1S T2S T3S T4S T5S T6S
124 00 123 45 123 30 123 15 123 00
46 15 45 45 45 30 45 15 45 00
NORTH PACIFIC OCEAN
WASHINGTON OREGON
COLUMBIA
WILLAMETTE BASIN
CLATSOP CO. TILLAMOOK CO. COLUMBIA CO. WASHINGTON CO. YAMHILL CO. POLK CO.
1 2 3
HOLMAN WAUNA WESTPORT OKLAHOMA TAYLORVILLE HILL ONEIDA FRANKFORT ALTOONA CARLSON LANDING DAHLIA BROOKFIELD U.S. Military Res. SLEEPY HOLLOW SKAMOKAWA ELOCHOMAN RIVER CATHLAMET BROWNSMEAD CLIFTON BRADWOOD KNAPPA SVENSON FERN HILL BURNSIDE ASTORIA HAMMOND Fort Stevens WARRENTON SKIPANON CLATSOP ST. Camp Rilea GLENWOOD SUNSET BEACH CARNAHAN WEST DELMOOR SURF PINES GEARHART SEASIDE NEAWANNA MELVILLE OLNEY LILLEAS BIDDLE KNAPPTON MEGLER MC GOWAN Fort Columbia CHINOOK STRING TOWN IL WACO HOLMAN Fort Canby U.S.C.G. Sta. Peacock Spit Cape Disappointment North Jetty South Jetty Clatsop Spit Jetty Sands Desdemona Sands Pt. Adams Tongue Pt. Tongue Neck Tongue Pt. Naval Base McGregor Is. Grassy Is. Taylor Sands Pt. Green Is. Seal Is. Snag Is. Brush Is. Miller Sands Horsetail Is. Aldrich Pt. Tenasillahe Is. Welch Island Quinns Is. Grassy Is. Goose Is. Wapato Is. Jim Crow Sands Three Trees Pt. Harrington Pt. Hungry Harbor Cliff Pt. Pt. Ellice Portuguese Pt. Grays Pt. Rocky Pt. Brix Bay Miller Pt. Devils Elbow Hitchcock Cr. Crooked Cr. Jim Crow Cr. Skamokawa Cr. Elochoman Slough Brooks Slough Steamboat Slough Hunting Island Wallace Island Tenasillahe Island Cathlamet Channel Abernathy Pt. Oak Pt. Gull Is. Crims Is. Stella Coal Cr. Mill Cr. Abernathy Cr. Germany Cr. Mosquito Cr. Coal Cr. Eagle Cliff Beaver Military Res. Willow Grove Green Pt. Tibbetts Cr. Fisher Is. Is. 60 Locoda Mayger Cooper Pt. Cape Horn Pancake Pt. Sand Island Nassa Oak Pt. Eagle Cliff Downing Barlow Pt. Quincy Inglis Kerry Woodson Marshland Clatskanie Alston Delena Rainier Lindbergh Carrolls Prescott Beaver Spgs. Fern Hill Clatskanie Hts. Swede Town Apiary Res. Goble Kalama Beaver Homes Shiloh Basin Martin Bluff Deer Island Waterview Columbia City St. Helens Longview Kelso Cowlitz River Lewis River Columbia River Kalama River Lake River Multnomah Channel Scappoose Bay Scappoose Creek Merrill Lake Burke Cr. Deer Is. Pt. Swan Is. Martin Is. Able Pt. Hunter Bar Sandy Is. Elder Rocks Neer Cr. Cottle Rock Jack Falls L. Jack Falls Quic Cr. Carrolls Channel Rainier Bridge Dibblee Pt. Log Pond Barlow Pt. Bridge Wallace Is. Aunde Is. Tibbetts Cr. Fisher Is. Is. 60 Gull Is. Crims Is. Stella Coal Cr. Mill Cr. Abernathy Cr. Germany Cr. Mosquito Cr. Coal Cr. Eagle Cliff Beaver Military Res. Willow Grove Green Pt. Tibbetts Cr. Fisher Is. Is. 60 Locoda Mayger Cooper Pt. Cape Horn Pancake Pt. Sand Island Nassa Oak Pt. Eagle Cliff Downing Barlow Pt. Quincy Inglis Kerry Woodson Marshland Clatskanie Alston Delena Rainier Lindbergh Carrolls Prescott Beaver Spgs. Fern Hill Clatskanie Hts. Swede Town Apiary Res. Goble Kalama Beaver Homes Shiloh Basin Martin Bluff Deer Island Waterview Columbia City St. Helens Longview Kelso Cowlitz River Lewis River Columbia River Kalama River Lake River Multnomah Channel Scappoose Bay Scappoose Creek Merrill Lake Burke Cr. Deer Is. Pt. Swan Is. Martin Is. Able Pt. Hunter Bar Sandy Is. Elder Rocks Neer Cr. Cottle Rock Jack Falls L. Jack Falls Quic Cr. Carrolls Channel Rainier Bridge Dibblee Pt. Log Pond Barlow Pt. Bridge Wallace Is. Aunde Is.
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Nehalem Beach Neahkahnie Beach Manzanita Bayside Gardens Mohler Wheeler Wheeler Hts. Brighton Jetty Batterson Foss River Tillamook Bay Tillamook Head Tillamook Rock Bird Pt. Indian Pt. Indian Beach Bald Pt. Ecola Pt. Sea Lion Rock Crescent Beach Chapman Pt. Seal Rock Beach Cannon Beach Haystack Rock Tolovana Park Arch Cape Castle Rock Gull Rock Cape Falcon C. Falcon Rock Short Sand Beach Cape Meares Pyramid Rock Pillar Rock Maxwell Pt. Three Arch Rocks Oceanside Netarts Bay Netarts Wilson Beach U.S. Naval Air Station Trask South Prairie Pleasant Valley Kilchis River Wilson River Tillamook River Trask River Kilchis Tillamook Bay Miami Cr. Garibaldi Kiawhlos Pt. Bayocean Peninsula Hobsonville Pt. Hobsonville Harbor Larson Cove Sandstone Pt. Bay City Tillamook Idaville Goose Pt. Hathaway Slough Biggs Pt. Cape Meares Lake Meares Bay Squaredeal Boulder Pt. McCoys Creek Rock Pt. Dick Pt. Juno Wilson Memaloose Pt. Tillamook Fairview Netarts Bay Netarts Wilson Beach U.S. Naval Air Station Trask South Prairie Pleasant Valley Kilchis River Wilson River Tillamook River Trask River
Nestucca River Nestucca Bay Nestucca Spit Nestucca River Nestucca Bay Nestucca Spit



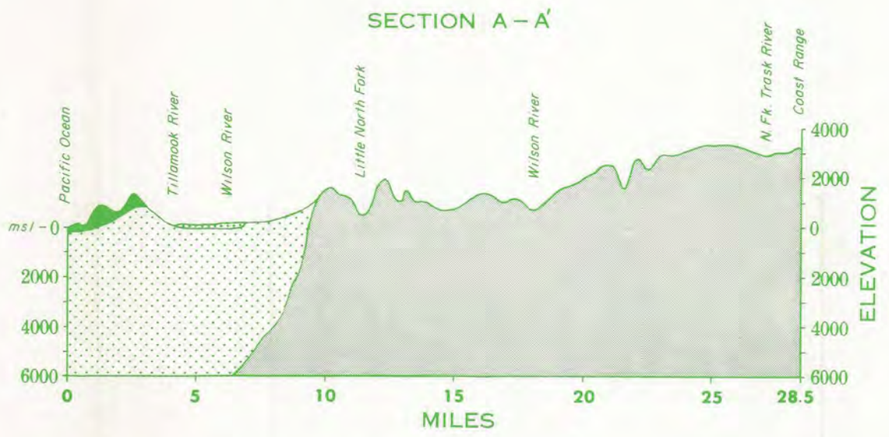
LEGEND

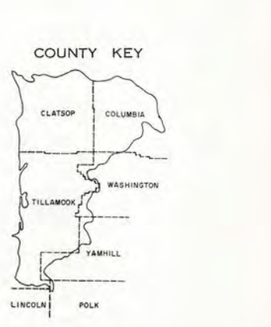
GEOLOGIC UNIT	YIELD CAPABILITY
Alluvium	Medium
Columbia River Basalts	Low
Basaltic Lavas and Tuffs	Very low
Sandstones, Shales, etc.	Very low

● 2 Reported Wells — numbers indicate specific capacity (gpm per foot of drawdown)

Data Source: U. S. Geological Survey
Oregon State Dept. of Geology and Mineral Industries
Oregon State Engineer

SECTION A – A'





SCALE OF MILES
0 1 2 3 4 5 10

SUB-BASINS

1 TILLAMOOK
2 NEHALEM
3 COLUMBIA

Numbers on streams indicate miles above mouth

CITIES & TOWNS

COUNTY SEATS ..... ASTORIA
OTHER INCORPORATED CITIES ..... SEASIDE
UNINCORPORATED TOWNS ..... WESTPORT

Planimetric Control Based on U.S.G.S. Quadrangle Maps

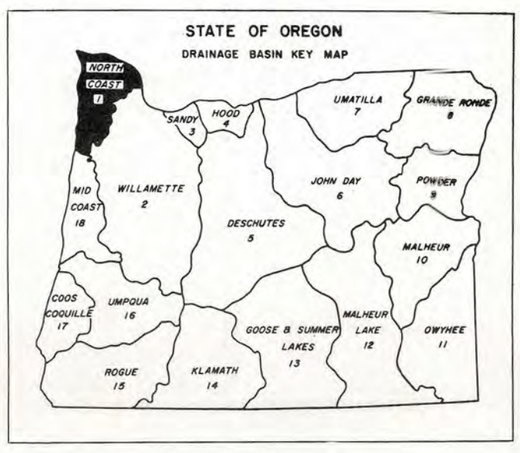
STATE WATER RESOURCES BOARD
SALEM, OREGON
Aug. 1960

NORTH COAST DRAINAGE BASIN

GENERALIZED GROUND WATER GEOLOGY

FILE NO. 1.70146/217

Plate 8



R10W R9W R8W R7W R6W R5W R4W R3W R2W R1W

T9N T8N T7N T6N T5N T4N T3N T2N T1N T1S T2S T3S T4S T5S T6S

NORTH PACIFIC OCEAN

WILLAMETTE BASIN

MID COAST BASIN

1 TILLAMOOK

2 NEHALEM

3 COLUMBIA

LEGEND

999 . . . . . A plain number is the application number for a permit to use water under the provisions of the 1909 water code.

R 999 . . . . . A number preceded by the letter R is the application number for a permit to store water under the provisions of the 1909 water code.

HE 999 . . . . . A number preceded by the letters HE is the application number for a permit to utilize water for the generation of hydroelectric power under the provisions of the Hydroelectric Act of 1931.

GR 999 . . . . . A number preceded by the letters GR indicates the registration of ground water rights established through beneficial use prior to enactment of the 1955 ground water law.

G 999 . . . . . A number preceded by the letter G indicates a ground water filing made under the terms of the 1955 ground water law.

NOTE: The priority of rights established by the provisions of the 1909 water right code cannot be determined by comparing the relative magnitude of numbers. Numbers as placed on the map indicate the approximate physical locations of diversions for the indicated rights. For precise definition of location, reference should be made to the files in the State Engineer's office.
For summary of water rights information, including application, permit, and certificate number; priority date; type of use; and point of diversion by township, range, and section, refer to State Water Resources Board summary number 1.301S. All permits as of Sep. 28, 1960 and all certificates as of Sep. 23, 1960 are included.

COUNTY KEY

SCALE OF MILES

0 1 2 3 4 5 10

SUB-BASINS

1 TILLAMOOK

2 NEHALEM

3 COLUMBIA

Numbers on streams indicate miles above mouth

CITIES & TOWNS

COUNTY SEATS ..... ASTORIA

OTHER INCORPORATED CITIES ..... SEASIDE

UNINCORPORATED TOWNS ..... WESTPORT

Planimetric Control Based on U.S.G.S. Quadrangle Maps

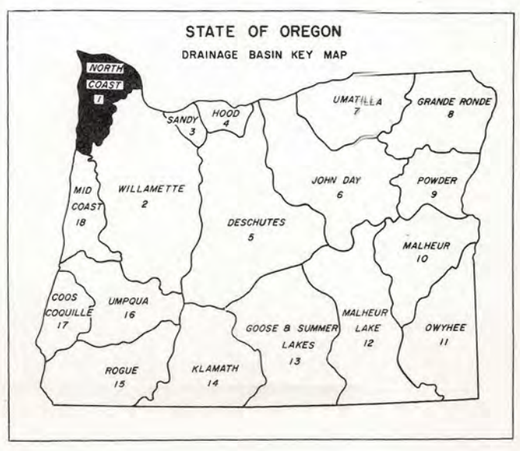
STATE WATER RESOURCES BOARD
SALEM, OREGON
Aug. 1960

NORTH COAST DRAINAGE BASIN

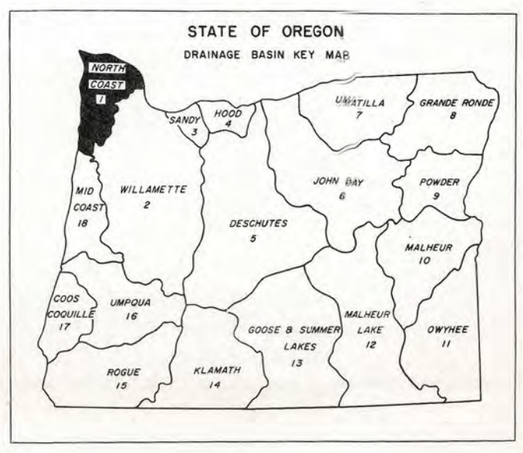
WATER RIGHTS

File No. 1.3016

Plate 7



124 00
123 45
123 30
123 15
123 00
R10W
R9W
R8W
R7W
R6W
R5W
R4W
R3W
R2W
R1W
T9N
T8N
T7N
T6N
T5N
T4N
T3N
T2N
T1N
T1S
T2S
T3S
T4S
T5S
T6S
46 15
45 45
45 30
45 00
COLUMBIA
WILLAMETTE
BASIN
3
2
1
HOLMAN
ILWACO
STRING TOWN
BAKER BAY
Fort Canby
U.S.C.G. Sta.
Cape Disappointment
North Head
Peacock Spit
Sand Island
Hoares Channel
WASHINGTON
OREGON
Fort Columbia
CHINOOK
MC GOWAN
MEGLER
Pt. Ellice
Hungry Harbor
Cliff Pt.
KNAPPTON
Grays Pt.
FRANKFORT
Portuguese Pt.
Rocky Pt.
GRAYS BAY
ONEIDA
Brix Bay
Miller Pt.
Devils Elbow
Harrington Pt.
ALTOONA
CARLSON LANDING
DAHLIA
BROOKFIELD
U.S. Military Res.
Three Tree Pt.
Jim Crow Pt.
Jim Crow Sands
SLEEPY HOLLOW
SKAMOKAWA
Elliott Pt.
Miller Sands
Snag Is.
Horseshoe Ish.
Brush Is.
Grassy Is.
Goose Is.
Woody Is.
Quinns Is.
Welch Island
Aldrich Pt.
BROWNSMEAD
CLIFTON
CATHLAMET
BRADWOOD
Tenasillahe Is.
Huntington Pt.
ELOCHOMAN
Green Is.
Seal Is.
Wendy Is.
North Is.
Marsh Is.
Long Is.
Gretchen St.
Blind Slough
Warren St.
Grassy Is.
Carlson Is.
Russian Is.
Mott Is.
Settler Pt.
Cathlamet Bay
Tongue Pt.
Tongue Pt. Naval Base
Taylor Sands
Dadedmona Sands
Jetty Sands
Clatsop Spit
South Jetty
Pt. Adams
HAMMOND
Fort Stevens
ASTORIA
Tansy Pt.
Smith Pt.
YOUNGS BAY
WARRENTON
Coffenberry Is.
Columbia Beach
SKIPANON
MILES CROSSING
FERN HILL
BURNSIDE
SVENSON
IVY
KNAPPA
Russian Pt.
Settler Pt.
Cathlamet Channel
Wallace Is.
Wallace Slough
Deep River
Skamokawa Cr.
Brooks Slough
Elochoman Slough
Elochoman River
Abernathy Pt.
Gull Is.
Crims Is.
Mosquito Cr.
Germany Cr.
Abernathy Cr.
Mill Cr.
Coal Cr.
Fall Cr.
OAK PT.
STELLA
WILLOW GROVE
EAGLE CLIFF
Beaver Military Res.
LOCOCDA
MAYGER
Green Pt.
Fisher Is.
Cooper Pt.
Cape Horn
Pancake Pt.
Deep River
Columbia River
Puget Island
Little Is.
Crims Is.
Welch Is.
Grassy Is.
Quinns Is.
Aldrich Pt.
Tenasillahe Is.
Elochoman Slough
Elochoman River
Brooks Slough
Skamokawa Cr.
Abernathy Pt.
Gull Is.
Mosquito Cr.
Germany Cr.
Abernathy Cr.
Mill Cr.
Coal Cr.
Fall Cr.



R10W R9W R8W R7W R6W R5W R4W R3W R2W R1W

T9N T8N T7N T6N T5N T4N T3N T2N T1N T1S T2S T3S T4S T5S T6S

124 00 123 45 123 30 123 15 123 00

46 15 46 00 45 45 45 30 45 15 45 00

WILLAMETTE BASIN

MID COAST BASIN

1 2 3

CLATSOP CO. COLUMBIA CO. TILLAMOOK CO. WASHINGTON CO. YAMHILL CO.

LEGEND

- Forest Camp
- State Park
- Roadside Rest Area
- County Park
- Boat Landing

NOTE: Index numbers refer to SWRB summary number 1.107S.

COUNTY KEY

SCALE OF MILES

0 1 2 3 4 5 10

SUB-BASINS

1 TILLAMOOK

2 NEHALEM

3 COLUMBIA

Numbers on streams indicate miles above mouth

CITIES & TOWNS

COUNTY SEATS ..... ASTORIA

OTHER INCORPORATED CITIES ..... SEASIDE

UNINCORPORATED TOWNS ..... WESTPORT

Planimetric Control Based on U.S.G.S. Quadrangle Maps

STATE WATER RESOURCES BOARD
SALEM, OREGON
Aug. 1960

NORTH COAST DRAINAGE BASIN

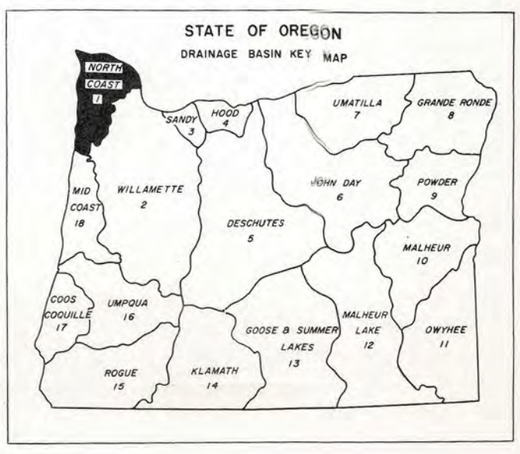
RECREATION AREAS

FILE NO. 1.70146/107

Plate 5

Concentration of magnetite occurs in Columbia River bed.

STATE OF OREGON
DRAINAGE BASIN KEY MAP



LEGEND

EXAMINED SITES

♦ METALS
- 1 Bauxite, ferruginous (alumina)
- 2 Limonite (iron)
- 3 Magnetite (iron)

◊ NONMETALS
- 4 Aggregate
- 5 Clay
- 6 Coal
- 7 Shale, expandable

Note: Sand and Gravel along major streams
Magnetite concentrated in Columbia River bed

Active Operation

Dry hole drilled for oil— numbers indicate depth

GENERALIZED AREAS

Area of ferruginous bauxite

Area of expandable shale

COUNTY KEY

SCALE OF MILES
0 1 2 3 4 5 10

SUB-BASINS
1 TILLAMOOK
2 NEHALEM
3 COLUMBIA

Numbers on streams indicate miles above mouth

CITIES & TOWNS
- COUNTY SEATS ..... ASTORIA
- OTHER INCORPORATED CITIES ..... SEASIDE
- UNINCORPORATED TOWNS ..... WESTPORT

Planimetric Control Based on U.S.G.S. Quadrangle Maps

Data Source: U. S. Geological Survey
Oregon State Dept. of Geology and Mineral Industries

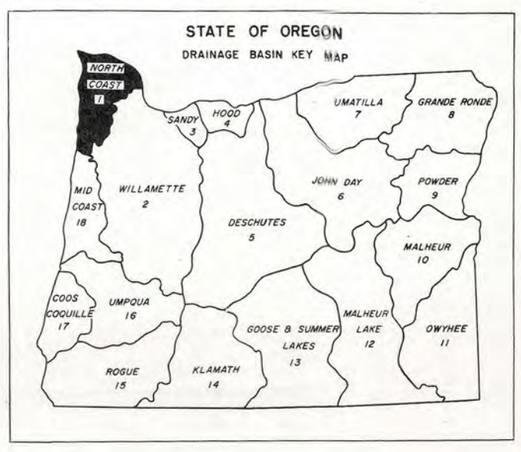
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Aug. 1960

NORTH COAST DRAINAGE BASIN

MINERAL DEPOSITS

FILE NO. 1.70146/504

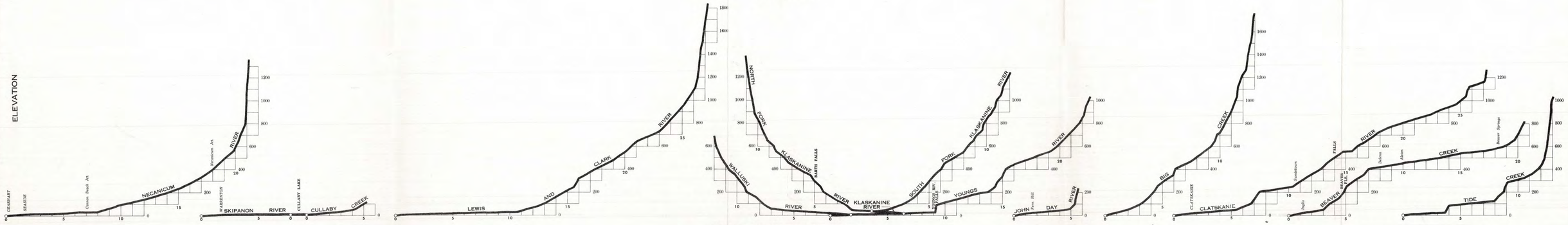
Plate 4



124 00
123 45
123 30
123 15
123 00
45 15
45 00
44 45
44 30
R11W
R10W
R9W
R8W
R7W
R6W
R5W
R4W
R3W
R2W
R1W
T9N
T8N
T7N
T6N
T5N
T4N
T3N
T2N
T1N
T1S
T2S
T3S
T4S
T5S
T6S
OREGON
WASHINGTON
COLUMBIA
SPOKANE
WILLAMETTE
BASIN
1
2
3
70
80
90
100
110
120
130
140
150
60
50
40
HOLMAN
WALLACE
STRING TOWN
CHINOOK
BAKER BAY
Fort Canby
U. S. C. G. Sta.
Cape Disappointment
North Head
North Jetty
Sand Island
Peacock Spit
Clatsop Spit
South Jetty
Desdemona Sands
Pt. Adams
HAMMOND
Fort Stevens
ASTORIA
Tongue Pt.
Tongue Pt. Naval Base
Taylor Sands
Miller Sands
Green Is.
McGregor Is.
Grassy Is.
Tenasillahe Is.
Welch Island
Quinns Is.
Woody Is.
Horseshoe Is.
Snag Is.
Brush Is.
Marsh Is.
Aldrich Pt.
Jim Crow Sands
Jim Crow Pt.
Cliff Pt.
Hungry Harbor
Pt. Ellice
Chinook Pt.
Fort Columbia
MC GOWAN
MEGLER
KNAPPTON
Grays Pt.
FRANKFORT
Portuguese Pt.
Rocky Pt.
Brix Bay
Miller Pt.
ONEIDA
Devils Elbow
Harrington Pt.
ALTOONA
CARLSON LANDING
DAHLIA
BROOKFIELD
U. S. Military Res.
Three Trees
SLEEPY HOLLOW
SKAMOKAWA
ELOCHOMAN
Brentlee Is.
Wigger Is.
CATHLAMET
BRADWOOD
BROWNSMEAD
CLIFTON
IVY
KNAPPA
SVENSON
FERN HILL
BURNSIDE
WARRENTON
SKIPANON
MILES CROSSING
CLATSOP STA.
Camp Rilea
GLENWOOD
SUNSET BEACH
CARNAHAN
WEST
DELMOOR
SURF PINES
MELVILLE
GEARHART
SEAWANNA
SEASIDE
TILLAMOOK HEAD
CANNON BEACH JCT.
NECANICUM JCT.
CANNON BEACH
TOLOVANA PARK
ARCH CAPE
CAPE FALCON
NEAHKAHNIE BEACH
MANZANITA
NEHALEM
BAYSIDE GARDEN
WHEELER
BRIGHTON
JETTY
NEDONNA BEACH
MANHATTAN
ROCKAWAY
TWIN ROCKS
WATSECO
CAMP MAGRUDER
U. S. Coast Guard Sta.
BARVIEW
GARIBALDI
HOBSONVILLE
BAY CITY
TILLAMOOK
IDAVILLE
CAPE MEARES
OCEANSIDE
NETARTS
WILSON BEACH
U. S. Naval Air Station
SOUTH PRAIRIE
NETARTS BAY
CAPE LOOKOUT
CAMP MERIWETHER
SANDLAKE
HEMLOCK
BEAVERY
TIERRA DEL MAR
HEBO
CAPE KIWANDA
WOODS
CLOVERDALE
PACIFIC CITY
NESTUCCA BAY
WINEMA BEACH
KIWANDA BEACH
NESKOWIN
Proposal Rock
OLNEY
LILLEAS
ELSIE
POPE CORNER
HAMLET
LUKARILLA
CAMP OLSON
SALMONBERRY
ENRIGHT
TIMBER
COCHRAN
MCNAMERS CAMP
SO. FORK CAMP
JORDAN CREEK
TRASK
POLPH
BOYER
CLATSOP CO.
TILLAMOOK CO.
WASHINGTON CO.
YAMHILL CO.
COLUMBIA CO.
POLK CO.
OAK PT.
STELLA
EAGLE CLIFF
Beaver Military Res.
LOCODA
MAYGER
WILLOW GROVE
NASSA
WAUNA
WATERFORD
OKLAHOMA HILL
TAYLORVILLE
WESTPORT
LONGVIEW
KELSO
Log Pond
DOWNING
QUINCY
INGLIS
KERRY
WOODSEN
MARSHLAND
CLATSKANIE
ALSTON
DELENA
RAINIER
LINDBERG
CARROLLS
CLATSKANIE HTS.
FERN HILL
SWEDETOWN
PRESCOTT
BEAVER SPRS.
APIARY
GOBLE
KALAMA
BEAVER HOMES
MIST
BIRKENFELD
VESPER
NEHALEM
SHILOH BASIN
MARTIN BLUFF
DEER ISLAND
WATERVIEW
COLUMBIA CITY
ST. HELENS
KEASY
VERNONIA
NEHALEM TREHARNE
CAMP MCGREGOR
PITTSBURG
VINE MAPLE
TIDEPORT
ALDERVALE
SALMONBERRY
ENRIGHT
TIMBER
COCHRAN
MCNAMERS CAMP
SO. FORK CAMP
JORDAN CREEK
TRASK
YAMHILL
BLAINE
VESTUCCA
CASTLE ROCK
ORETOWN
MEDA
HAPPY HOLLOW
TILLAMOOK
FAIRVIEW
PLEASANT VALLEY
Skookum
Meadow Lake
SAND LAKE
Cranberry Marsh
Knowles Sl.
Black L.
Wallace Is.
Anunde Is.
Log Pond
Three Trees
Grassy Is.
Goose
Quinns Is.
Welch Island
Tenasillahe Is.
Aldrich Pt.
Brentlee Is.
Wigger Is.
Hunts Mill Pt.
Cooper Pt.
Cape Horn
Pierce Is.
Gull Is.
Crims Is.
Green Pt.
Fisher Co's Is.
Rocky Pt.
Abernathy Pt.
Mill
Abernathy
Grassy
Mosquito
Coal
Stella Coal
Mill Cr.
Abernathy Cr.
Coal Cr.
Gull R.
Crims Cr.
Green Pt.
Fisher Co's Is.
Rocky Pt.
Cooper Pt.
Cape Horn
Pierce Is.
Wallace Is.
Anunde Is.
Log Pond
Three Trees
Grassy Is.
Goose
Quinns Is.
Welch Island
Tenasillahe Is.
Aldrich Pt.
Brentlee Is.
Wigger Is.
Hunts Mill Pt.
Cooper Pt.
Cape Horn
Pierce Is.
Gull Is.
Crims Is.
Green Pt.
Fisher Co's Is.
Rocky Pt.
Abernathy Pt.
Mill
Abernathy
Grassy
Mosquito
Coal
Stella Coal
Mill Cr.
Abernathy Cr.
Coal Cr.
Gull R.
Crims Cr.
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Rocky Pt.
Cooper Pt.
Cape Horn
Pierce Is.
Gull Is.
Crims Is

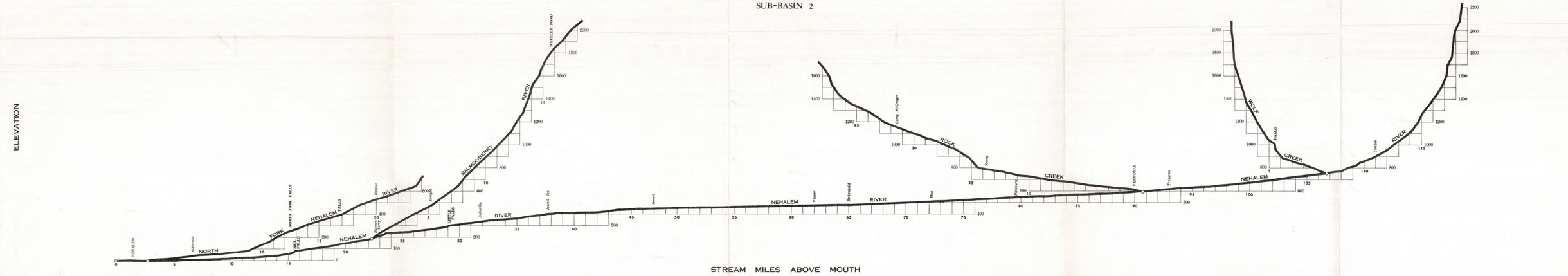
COLUMBIA

SUB-BASIN 3



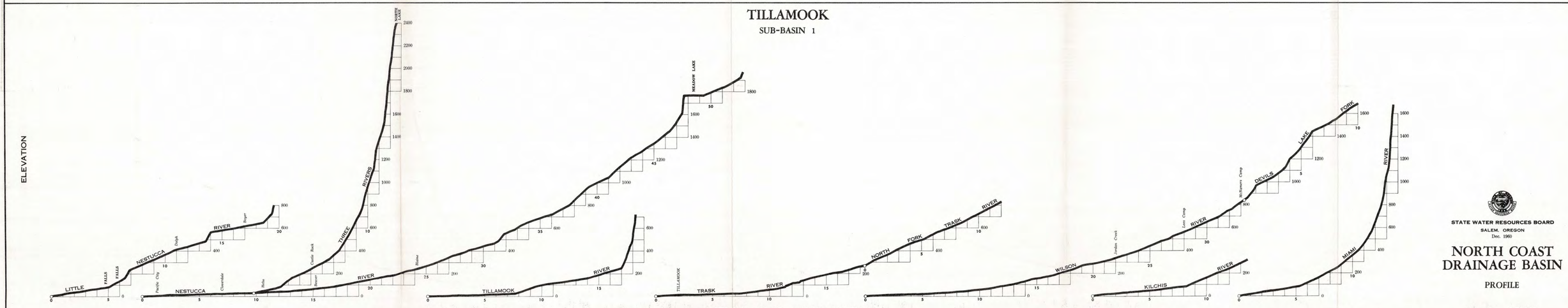
NEHALEM

SUB-BASIN 2



TILLAMOOK

SUB-BASIN 1



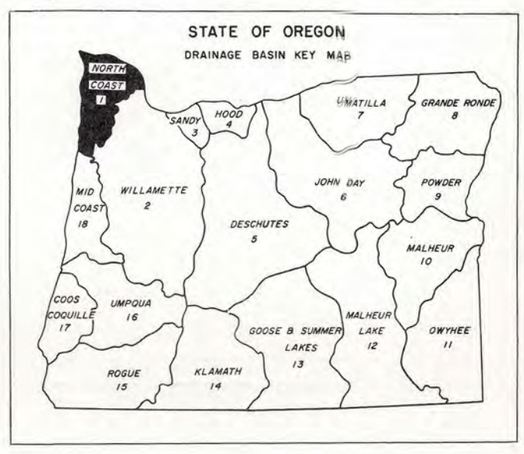
STATE WATER RESOURCES BOARD
SALEM, OREGON
Dec. 1960

NORTH COAST DRAINAGE BASIN

PROFILE

File No. 1.70246

Plate 2



COUNTY KEY

SCALE OF MILES

0 1 2 3 4 5 10

SUB-BASINS

1 TILLAMOOK

2 NEHALEM

3 COLUMBIA

Numbers on streams indicate miles above mouth

CITIES & TOWNS

COUNTY SEATS ..... ASTORIA

OTHER INCORPORATED CITIES ..... SEASIDE

UNINCORPORATED TOWNS ..... WESTPORT

Planimetric Control Based on U.S.G.S. Quadrangle Maps

STATE WATER RESOURCES BOARD
SALEM, OREGON
Aug. 1960

NORTH COAST DRAINAGE BASIN

FILE NO. 1.70146

Plate 1