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USDA Report on
WATER and RELATED LAND RESOURCES

NORTH COAST DRAINAGE BASIN
OREGON

Based on a cooperative Survey by

THE STATE WATER RESOURCES BOARD OF OREGON

and

THE UNITED STATES DEPARTMENT OF AGRICULTURE

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June 1966

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WATER AND RELATED LAND RESOURCES

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THE UNITED STATES DEPARTMENT OF AGRICULTURE

Report Prepared by

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June 1966

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INTRODUCTION

The purpose of this report is (1) to provide information on the past and present uses of water and related land resources, (2) to supply the production data from the use of these resources, (3) to assess the magnitude of water-related problems such as erosion, flooding, and drainage, (4) to indicate the probable direction of future use of water and land for agriculture and forestry in comparison to competing uses, and (5) to outline a general program for water and land resource management as a background for future detailed study and planning.

Anyone interested in land and water resources could benefit from the information in this report. The information could be of value to federal, state, and local agencies for planning and development of their various agricultural programs as they appraise the present and future uses of water for agriculture and forestry as compared to competing uses of water.

This study is a result of a cooperative agreement between the U. S. Department of Agriculture and the State Water Resources Board of Oregon and is conducted under the provisions of Section 6 of the Watershed Protection and Flood Prevention Act (Public Law 566, 83rd Congress, as amended).

Much of the material made available in unpublished form to the State Water Resources Board was incorporated in its North Coast Basin Report published in June 1961. The unpublished information which was given to the State has been refined and updated in some respects; consequently, there may be some minor discrepancies between these data and those given to the State Water Resources Board. Also, some additional information has been obtained since the Board's report was issued. Thus, this material complements that published by the State.

The survey consisted partly of accumulating and evaluating previously recorded data, both published and unpublished, much of which was furnished by other cooperating groups. In addition, the USDA River Basin Survey Staff made limited studies to gather basic information that was not otherwise available including physical characteristics of certain reservoir sites, land and water availability and use, problems and needs for many tributary watersheds, and forest land resources and ownership. These were not detailed surveys; much of the information was obtained through consultation with local, public, and private officials. The basic data used as a foundation for statistical information presented in this report are in the files of the USDA River Basin Survey Staff.

Several agencies and organizations provided helpful assistance in making this survey. The field offices of the Soil Conservation Service furnished much of the basic information concerning reservoir sites and tributary watersheds. The County Extension Service also assisted in the collection of

tributary watershed data. Most of the land status information was obtained from County Assessor's records of the counties concerned. Much information on the forest land was furnished by the Pacific Northwest Forest and Range Experiment Station, the various field offices of the Forest Service, the Bureau of Land Management, and the State Forester of Oregon. Some of the agricultural data were obtained from publications of the Bureau of the Census. Several of the above-mentioned agencies also provided helpful consultation and comment concerning the preparation of this report. In accordance with the cooperative agreement, the State Water Resources Board developed and furnished information concerning existing water rights, major resources and their use, and other pertinent information in addition to furnishing hearing reports and maps.

SUMMARY

GENERAL DESCRIPTION OF THE BASIN

The North Coast Drainage Basin of Oregon, located in the extreme northwestern part of the state, is bounded by the Columbia River on the north, the Pacific Ocean on the west, the Middle Coast Drainage Basin on the south, and the Willamette River Basin on the east. The total area is 1,731,200 acres or about 2.8 percent of Oregon.

The climate is humid because the Pacific Ocean moderates the temperatures and the Coast Range intensifies the precipitation. The annual precipitation of 40 to 150 inches contains only a small amount of snow. Approximately 80 percent of the precipitation falls from October to April and most of it is moderate rain. The prevailing winds are generally from the northwest in the summer and from the southwest and southeast in the winter. The average frost-free season varies from 182 to 273 days along the coast and from 140 to 183 days in the interior sections.

The basin is located on the west slope of the Coast Range which is a large, broad uplift. The rock formations consist of more than 20,000 feet of marine sedimentary formations which are intermixed by formations of volcanic materials. Alluvial sediments in the estuaries at the mouth of the streams and on the flood plains along the streams are the youngest material. The supply of ground water is considered to be very low to moderate in all the rock formations and to be moderate to large in the recent sedimentary deposits.

The soils are derived from rocks of sedimentary and volcanic origin, loess, marine sediments, and alluvium. Rocks of sedimentary and volcanic origin produce soils which are moderately to strongly developed and are on uplands with a forest cover. The loessial soils are moderately developed and, on the flatter slopes, they are well adapted for cropland and respond well to irrigation. The soils from recent marine sediments are very unstable and erodible when the vegetation is removed. The alluvial soils, which are nearly level to moderately sloping and are readily developed for irrigation, support most of the agriculture.

The most significant exploration in the basin was the Lewis and Clark expedition of 1805-06; however, there were explorations in the eighteenth century. The first permanent settlement began in 1811 but settlement was slow because the densely forested Coast Range served as a barrier to trans-

portation. The early agriculture was dairying and the production of livestock, potatoes, and small grain. The first sawmill began operating in 1851 and the logging and forest products industry has grown from that time.

The population of the basin in 1960 was 62,300 or about 3.5 percent of the total for the state. The largest cities are Astoria and Tillamook with populations of 11,200 and 4,260, respectively. The four important industries--forestry, agriculture, fisheries, and recreation--are all involved with the natural resources. The most important contributor to the economy has been the forest industry. The 1940's was an era of rapid economic and population growth with an increase of employment in all industries; however, the 1950's was an era in which a lag occurred in economic and population growth. The management of the natural resources is important in determining the future growth and development of the basin.

The use of the land of the basin is related to its ownership. The land owned by the federal, state, county, and municipal governments is mostly forest land and it is managed for the production of lumber. Fifty-nine percent of the land, or 1,029,400 acres, is owned by private interests and, of this total, 808,200 acres are forest, 81,600 acres are cropland, and 139,600 acres are miscellaneous use.

FOREST LAND MANAGEMENT IN THE BASIN

The forests covering 86 percent of the basin are composed mainly of Douglas-fir, western hemlock, Sitka spruce, and red alder. Fifty-four percent, or 808,200 acres, is privately owned.

The major uses of forest land are commercial timber production, water production, and outdoor recreation. Considerable variation exists in the management of the forest land. National forests and most other public forests are managed under the multiple-use, sustained-yield concept. Forests owned by large timber companies are generally managed for sustained production of forest products.

Fire protection for forested land is primarily the responsibility of the State Forestry Department, but the Federal Government and rural fire districts also have areas of responsibility. The Tillamook Burn is the area with the greatest fire hazard. Because of the rugged terrain and abundant snags, this area was a fire-fighters nightmare during the 1939 and 1945 fires. As a result of a legislative study of the situation, finances were made available to reduce the hazard in the Burn.

Protection from damage by insects, diseases, and animals is the responsibility of the individual landowner. Several kinds of insects, which cause extensive damage, are now at endemic levels. Several tree farms in Clatsop and Columbia Counties have a problem arising from black bears tearing away bark and chewing on the cambium layer of pole-size Douglas-fir trees. Deer damage to fir reproduction is heavy in several areas within the basin.

Approximately 1,477,000 acres are classed as commercial forest land and contain about 23 billion board feet of softwood timber. The basin has an

estimated annual sustained-yield potential of 998 million board feet. The early settlers began the logging and sawmilling but the industry reached a peak in the late 1920's when Clatsop and Columbia Counties vied with each other in leading the State. The production has fluctuated since then and has been in a general downward trend since 1950.

Harvesting practices have evolved from clearcut by drainage to clearcut by scattered units. Cable systems are generally used on steep slopes; tractors are used on flatter slopes. Most timber is transported by trucks. Douglas-fir slash is customarily burned immediately following timber harvest. The clearcut units are reforested the fall or winter following burning. If reforestation is delayed, brush takes over the site.

The problem of rehabilitating the Tillamook Burn has complications which test the ingenuity and patience of a forester. At the beginning of the rehabilitation program, salvage logging operations were active in every drainage. Although the State Board of Forestry became owner of 250,000 burned acres, the State did not own the snags on all the land. The owners of the snags continued to log and this operation hampered rehabilitation projects during the first six years of the program. Since the inauguration of the rehabilitation program, nearly 54 million seedlings have been planted on almost 70,000 acres and more than 100,000 acres have been seeded aerially. Access roads, snag-free firebreaks, and other fire protection measures are being completed as rapidly as possible. The program is costly but soon the project will start yielding returns. The Douglas-fir plantations are now 30 to 35 feet tall.

Approximately 26,200 acres of forest land are grazed. This is predominantly private land in the stream bottoms with low quality, brushy forage.

Few quantitative estimates have been made of water requirements on forest land. The domestic and recreational uses of water are expected to increase; the fire control and wildlife needs are expected to remain stable; and the livestock and industrial uses are expected to decline.

RECREATION IN THE BASIN

There are various recreational opportunities available. The shoreline, a complex of wide, sandy beaches and bluffs or rocky areas, affords easy and active forms of recreation. Recreational attractions of the tidewater area, which extends several miles inland on the major streams, are fishing, clam digging, waterfowl hunting, boating, and water skiing. Because the interior is primarily forested, the recreational opportunities consist of hunting, fishing, sightseeing, and picnicking.

Recreational use data show heavy use in the shoreline area with the majority of users concentrated in the southern and northern extremes. The areas with wide, sandy beaches are the most popular and the popularity is expected to increase.

The public recreational facilities presently available are varied. The state parks on the coast are quite modern, while the campgrounds in the interior are more primitive. Because of the increased demand for recreational

developments such as campgrounds, picnic grounds, boat-launching ramps, and improved hunting and fishing opportunities, all public land managers are making plans to meet future requirements.

The wildlife resource provides a significant portion of the recreational attraction of the basin. Black-tailed deer are the most numerous and popular big game animal but the Roosevelt elk herd has increased during the past few years. Hunting pressure is variable depending on the accessibility of the hunting area; however, the hunting pressure will probably increase. Anadromous fish--steelhead, chinook, and silver or coho salmon--run in all of the major streams. Most of the rivers and lakes contain trout and warm-water fish are found in fresh water lakes near the coast. Clams, Dungeness crabs, and oysters are gathered along the coast and in the bays for commercial and recreational purposes.

AGRICULTURE IN THE BASIN

Agriculture in the basin revolves around the production of forage for livestock. The land base for agriculture consists of 26,200 acres of grazed forest land, 19,650 acres of rangeland, and 81,600 acres of cropland. About 94 percent of the cropland is used to produce pasture, hay, or silage. Forage yields have increased in the past because of added inputs of irrigation, commercial fertilizer, lime, and drainage.

Of the 1,950 farms in the basin, 45 percent are commercial farms and 55 percent are part-time or part-retirement farms. Over half of the farm families had incomes from non-farm sources that exceeded farm income in 1959.

Dairy products accounted for 56 percent of the basin's $11.9 million farm income in 1959, and all livestock products accounted for 88 percent. Although the number of milk cows has decreased in recent years, milk production has increased because of higher production per cow.

Irrigated acreage in the basin varies from year to year depending on moisture conditions, pasture conditions, and forage needs. Of the 12,040 acres developed for irrigation, about 9,900 acres were irrigated in 1964. Forage crops were grown on 89 percent of the irrigated land. Natural streamflow is the water source for 96 percent of the land developed for irrigation.

Opportunities for expanding irrigated acreage are limited from physical, economical, and social standpoints. It is estimated that an additional 52,300 acres could be readily irrigated. Flooding and drainage are problems on some of the irrigable land.

It is anticipated that forage will continue to be the most important crop in the basin. Livestock operations are well established and changing from dairying would entail considerable losses in present investments in specialized equipment. In the long run, the demand and prices for dairy and livestock products and the competitive situation between this and other producing areas will have a bearing on irrigation development in the basin.

WATER-RELATED PROBLEMS, NEEDS, AND OPPORTUNITIES

The management of cultivated, forest, and range lands has a direct impact on the quantity and quality of water. Water resources influence all segments of the economy of the basin.

Average annual precipitation in the North Coast Drainage Basin ranges from about 40 to 150 inches, but less than 10 inches fall during June through September.

Average annual surface water yield after consumptive use is about 9,005,900 acre feet. More than two-thirds of the precipitation runs off in the form of surface water.

Approximately 24,080 acre feet, or only about 6 percent of the surface water yield during the irrigation season, is used to irrigate 12,040 acres of land; however, there are critical water-supply problems in some areas, and future irrigation development would be limited without storage.

There is usually an adequate water supply for livestock and forest-related uses; however, as recreational uses in the forests increase, water-supply problems are expected to increase.

There are two main sources of floodwater in this basin--the rapid runoff from rain and melting snow and the tidal action of the ocean. Floods are most likely to occur during the November through March heavy precipitation period. Evaluated agricultural flood damages consists primarily of crop and property losses; however, land damage from erosion, leaching, scour, and deposition is significant but very difficult to evaluate and it is probably inadequately appraised.

Irrigation is a major consumptive use of water in the basin. It has been developed by individuals. Water is applied almost exclusively by sprinklers because it is the easiest method to manage under existing conditions.

Approximately 75,250 acres, or about 42 percent, of the arable land have soils with a major drainage problem.

Careful management of forest and range resources can result in maximum economic and social benefits without impairment of soil and watershed values; however, improper management of these resources can produce or intensify flood, erosion, and water quality and quantity problems.

There is potential for development of the water resources of the basin to serve all needs better. Ground water, surface water, and stored water can all be used to help meet the increasing water requirements of the area. There are many potential water storage sites, both large and small, that could be developed for multiple purpose use to aid in the future development and growth of the area. Seventy-one of these sites are pointed out in this report.

OPPORTUNITIES FOR WATERSHED PROTECTION AND FLOOD PREVENTION PROJECTS

The USDA River Basin Survey Staff made a study of the potential for P. L. 566 projects in the North Coast Drainage Basin to provide information as a guide to long-range coordination and planning. The basin was divided into 26 tributary watersheds and a reconnaissance survey and report were made on each. It was concluded that four projects appear to be feasible; however, a more detailed study might prove that nine more projects are feasible. In addition, eight other watersheds have sub-areas that might prove feasible but more study is required for determination.

The watersheds with best possibilities for projects are those with a high potential for agricultural and/or urban development with localized flooding, drainage, and water-supply problems that cannot be solved by individual action.

GENERAL DESCRIPTION OF THE BASIN

PHYSICAL FEATURES

Location and Size

The North Coast Drainage Basin of Oregon is located in the extreme northwestern part of the state (map 1). It includes all of the coastal drainages from Cascade Head to the Columbia River and all of the drainages of the Columbia River from the city of St. Helens to the mouth of the river. The basin is bounded by the Pacific Ocean on the west, the Middle Coast Drainage Basin on the south, the Middle and Lower Willamette River Basins on the east, and the Columbia River on the north. It has a total area of 1,731,200 acres which is about 2.8 percent of the total area of Oregon. The basin includes all of Clatsop County, major portions of Tillamook and Columbia Counties, and minor portions of three counties--Yamhill, Washington, and Polk.

For the purpose of this report, the North Coast Drainage Basin has been divided into three subbasins. Subbasin 1, the Tillamook Subbasin, is the largest of the three and its 613,120 acres are located in the southern section of the basin. The major streams are the Neskowin Creek, the Nestucca and Little Nestucca Rivers which enter Nestucca Bay, and the Miami, Kilchis, Wilson, Trask, and Tillamook Rivers which enter Tillamook Bay. Subbasin 2, the Nehalem Subbasin, includes the entire drainage of the Nehalem River and Bay. It, the smallest of the three subbasins, contains 540,800 acres. Subbasin 3, the Columbia Subbasin, is the northern portion of the basin and it covers 577,280 acres. The major streams are the Necanicum River, which drains into the Pacific Ocean; and the Clatskanie River, Big Creek, Youngs River, and Lewis and Clark River, which drain into the Columbia River.

Climate

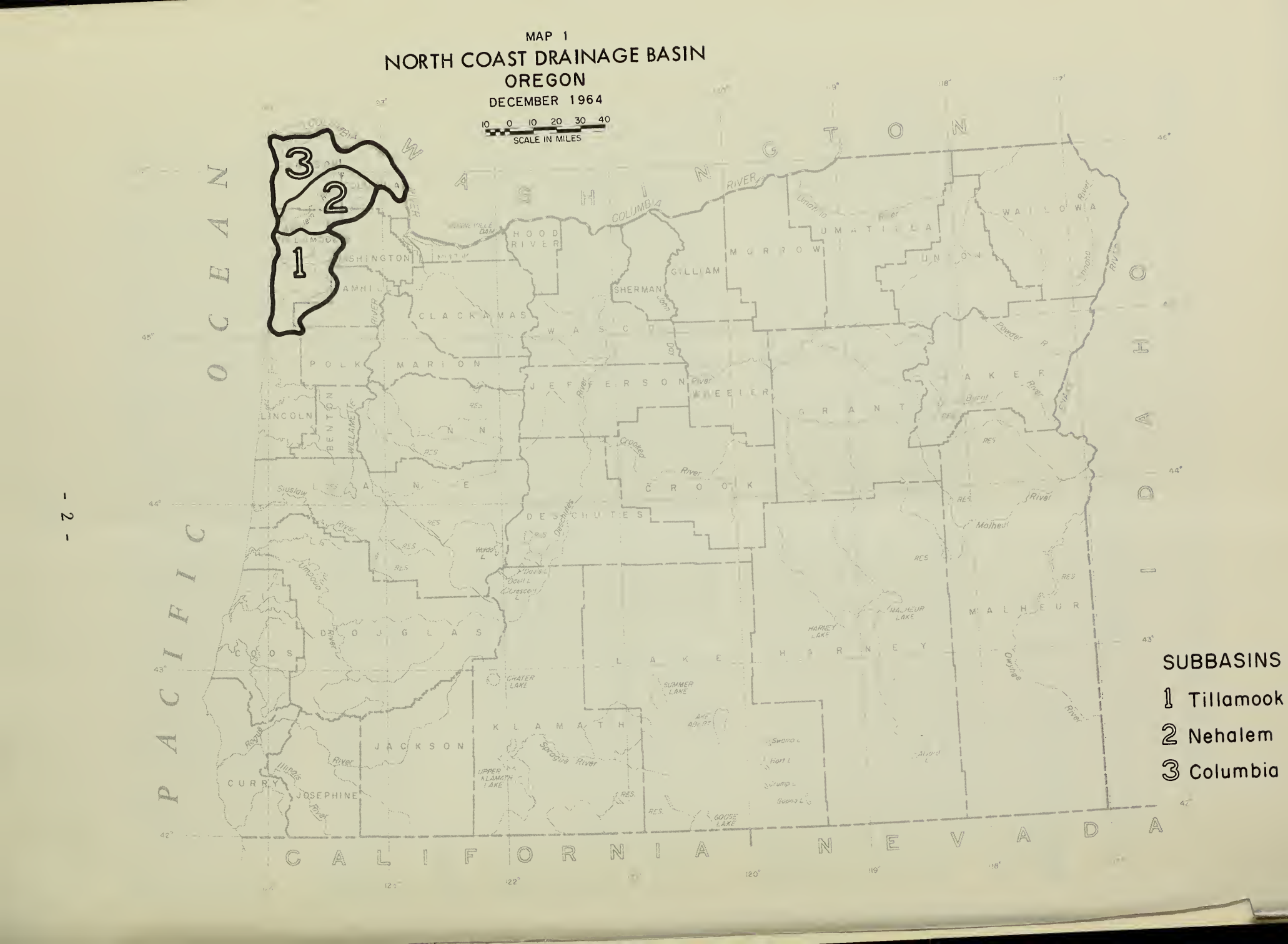
The climate of the North Coast Drainage Basin is humid because of the temperature-moderating influence of the Pacific Ocean and intensification of rainfall induced by the Coast Range. Along the northern boundary of the basin, a variation in the rainfall pattern is caused by the Columbia River Gorge.

Map 2 illustrates the lack of uniformity in the rainfall distribution pattern throughout the basin. The annual precipitation ranges from 80 to 110 inches along the main coastal area and decreases to 70 inches at the mouth of the Columbia River. Average annual precipitation is lowest, about 40 inches, in the northeastern portion of the basin near Rainier and does not exceed 80 inches along the Columbia River. The highest precipitation, 150 inches, occurs on the headwaters of the Kilchis and Wilson River watersheds. The snowfall varies considerably in the different portions of the

MAP 1

NORTH COAST DRAINAGE BASIN
OREGON

DECEMBER 1964



SUBBASINS

1 Tillamook

2 Nehalem

3 Columbia

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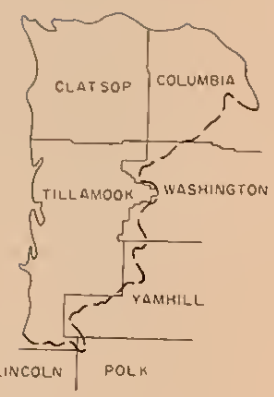
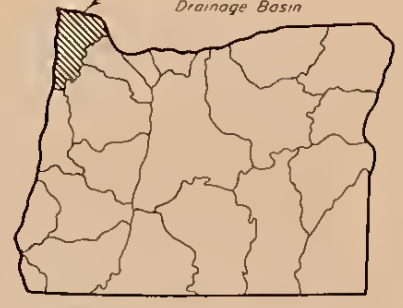
SUBBASINS

1 TILLAMOOK
2 NEHALEM
3 COLUMBIA



COUNTY LOCATION



DRAINAGE BASIN LOCATION

LEGEND

- 90 — Average Annual Precipitation in Inches
- Drainage Basin Boundary
- Subbasin Boundary
- C — Watershed Boundary and Letters

Source S.W.R.B. North Coast Basin Report, June 1961

MAP 2

AVERAGE ANNUAL PRECIPITATION

NORTH COAST DRAINAGE BASIN

OREGON

SEPTEMBER 1964

5 0 5 10 15
SCALE IN MILES

7-E-11751-N

basin. Along the coast at Astoria and Cloverdale, it averages 5 inches. At Vernonia, annual snowfall averages 32 inches and in the area of Lees Camp on the Wilson River it averages approximately 4 feet. Snow in the lower elevations normally remains on the ground no more than a day or two but at higher elevations may remain throughout the colder winter months. Winter snow accumulations do not materially affect the streamflow pattern in the basin. Approximately 80 percent of the annual precipitation occurs from October through March in moderate rains that may continue without interruption for several days. Summer precipitation is limited generally to occasional light rainstorms, relatively rare thunderstorms, and coastal fog.

The prevailing winds are generally from the northwest during summer and from the southeast and southwest during winter. Continuous wind velocities of from 15 to 25 miles per hour are common along the coast and at times during the winter months reach gale velocities. The wind velocities are more moderate in the inland valleys, but strong winds caused by daily temperature variations are common in narrow canyons and on upper mountain slopes during the summer. Occasional short periods of strong easterly winds may occur at any time of the year.

High relative humidities are common all year except during the easterly wind periods. Temperatures in the basin range from a high of 106° F. to minus 8° F.; these were both recorded at Vernonia. Average annual temperatures at various locations along the coast and in the interior valleys are very uniform and range from 49° F. to 52° F.

The average frost-free season along the coast varies from 273 days at Astoria to 182 days at Tillamook. In the interior portions, the range is from 188 days at Vernonia to 140 days at Glenora. The average frost-free season in most of the agricultural area is around 180 days.

Geology

The North Coast Drainage Basin is located on the west slope of the Coast Range. The rock formations making up the Coast Range consist of more than 20,000 feet of marine sedimentary formations and intermixed volcanic material. The generalized geologic map (map 3) illustrates the topography and structure, and it locates the area where each of the rock units crops out on the surface. The topography, structure, and rock formations are described in the narrative.

Topography and Structure. The coast line, forming the west edge of the basin, alternates between rugged headlands of volcanic rock and broad, sandy beaches. The east boundary, corresponding to the summit of the passes, is east of the center of the range because of the more vigorous headward erosion of the coastal streams. Elevations along the summit vary from 600 feet to 3,461 feet, averaging about 1,500 feet. Well known peaks include the following: Wickiup Mt., 3,423 feet; Saddle Mt. in Clatsop County, 3,283 feet; Saddle Mt. in Washington County, 3,461 feet; Trask Mt., 3,423 feet; Mt. Hebo, 3,067 feet; Larch Mt., 3,449 feet; Hembre Ridge, 3,409 feet; Nicolai Mt., 3,020 feet; Sugarloaf Mt., 2,858 feet; Onion Peak, 3,064 feet; and Grindstone Mt., 3,012 feet. Most of the present topography was excavated by the streams to form a dendritic and radial pattern. A mature topography with irregular ridges and short steep slopes exists in the area of the basin south of Seaside

and the southern portion of the upper Nehalem drainage. In the northern portion of the basin, the topography is mature and approaching old age being characterized by broad, shallow valleys, low mountainous or hilly relief, and streams of low gradient. The Nehalem watershed features a stream which has eroded headward beyond the summit of the Coast Range and captured and reversed the drainage of a large area.

The Coast Range is a geanticline or large, broad uplift and the North Coast Drainage Basin is located on the west slope. The uplift was created by a regional upwarping of the rock formations in late Cenozoic time. In early Miocene time, it was eroded to a surface of gently rolling relief. The uplift, which resumed in the Pliocene and Pleistocene Epochs and which was accompanied by minor faulting and much gentle folding, elevated the Coast Range to its present level. Pleistocene changes of sea level have resulted in stranded terraces along the coast and the Columbia River and drowned stream mouths, broad alluvial flats, and numerous islands in the Columbia River.

Volcanic Formations. The oldest rocks in the basin, the Tillamook volcanics, are equivalent to the Siletz River volcanics of the Middle Coast Drainage Basin. This lower Eocene series forms the basement complex of at least the southern two-thirds of the basin and is exposed in all of the drainages from Beaver Creek in the south to the Nehalem River in south Clatsop County. It consists of a great thickness of dark gray to greenish-gray submarine lava flows, flow breccias, pyroclastic rocks and debris, and tuffaceous sedimentary rocks.

The upper Eocene Goble volcanics interfinger and interbed with sedimentary formations. These volcanic rocks are dark gray to black porphyritic basalt flows, pyroclastic rocks, and include related intrusive rocks. This formation crops out at Cascade Head south of Neskowin, along the Nestucca River, in the middle Nehalem River and Rock Creek area, and along the Columbia River near Goble and Prescott.

Numerous hills or peaks are prominent throughout the basin. These are igneous bodies which have intruded the softer sedimentary rocks and have persisted at their higher elevation because they are more resistant to erosion.

The volcanic rocks are relatively impervious and the water yield capacity is considered to be very low.

Sedimentary Formations. Many sedimentary formations occur in the basin. The middle Eocene Tyee formation crops out in only a small area along the upper Little Nestucca River near Dolph. It is composed of bluish-gray to gray, rhythmetically bedded, highly micaceous arkosic sandstone. Upper Eocene sedimentary rocks surround the area of Tillamook volcanics and interfinger and interbed the Goble volcanics near the Columbia River. The Nestucca and Cowlitz formations are brackish water and marine tuffaceous siltstone and claystone, sandstone, and intercalated volcanic material.

A bewildering array of marine sandstone, mudstone, conglomerates, and volcanic ash beds was deposited unconformably upon the older sedimentary and volcanic rocks in most of the northern portion of the basin and along the

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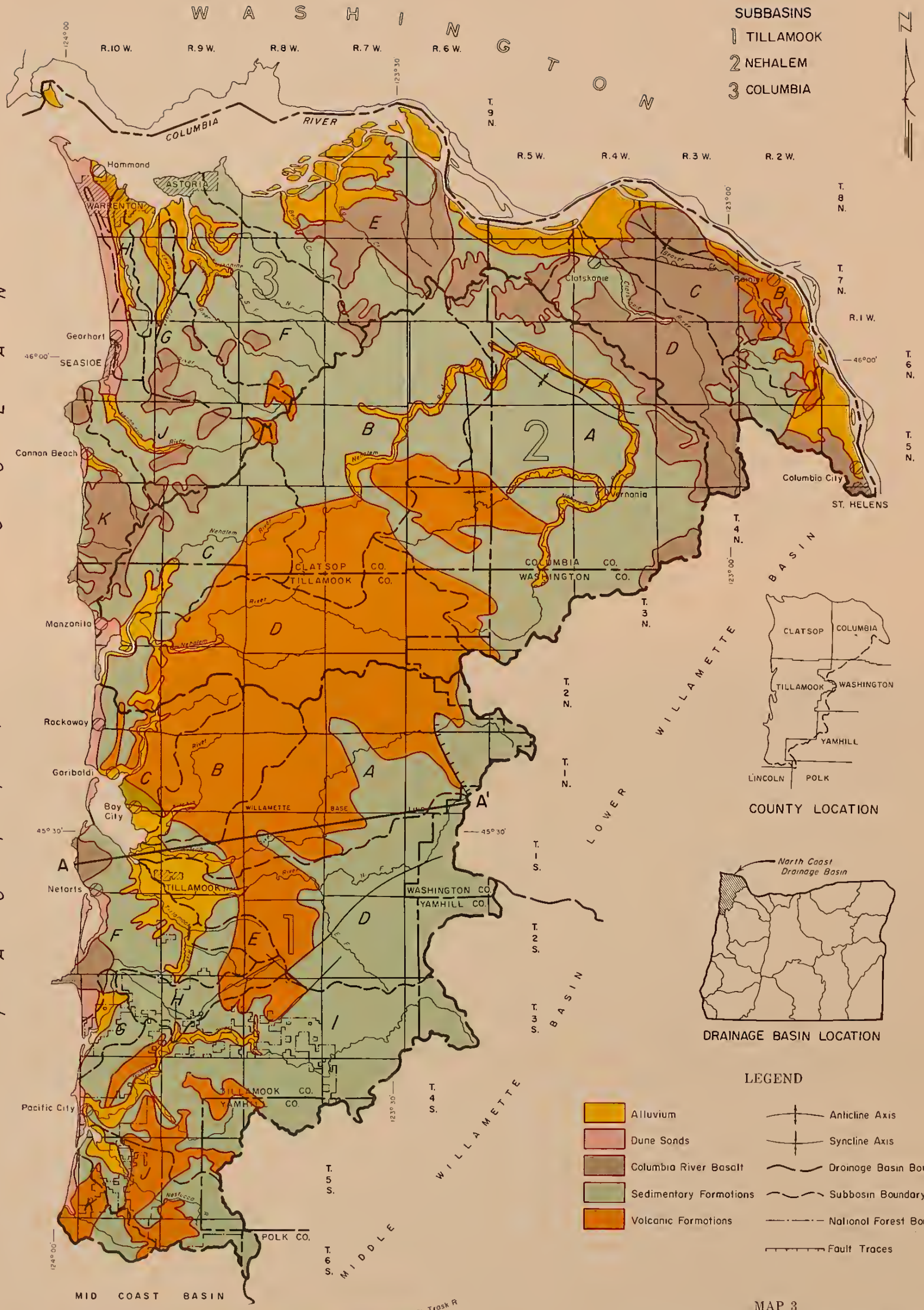


MAP 3

GENERALIZED GEOLOGIC MAP
NORTH COAST DRAINAGE BASIN
OREGON

DECEMBER 1964

5 0 5 10 15
SCALE IN MILES

7-E-17751-N

coastal section of the south portion. These formations, Keasey, Gries Ranch, Pittsburg Bluff, Yaquina, Scappoose, and Astoria, vary in age from upper Eocene to middle Miocene.

The water yield capacity of the sedimentary rocks is considered to be very low.

Columbia River Basalt. The middle Miocene Columbia River basalt formation flowed out over most of the northern portion of the basin when the area was at low relief. This extensive basaltic extrusion grades westward and southward into submarine breccias and interfingers with the marine strata of the Astoria formation. Most of this rock has been eroded away except for a large area along the northern and northeastern section of the basin. Prominent points, such as Tillamook Head, Cape Falcon, Cape Meares, and Cape Lookout, are composed of this basalt. The water yield capacity of this rock is considered to be low to moderate.

On the hills in northern Columbia County, a thick, structureless, light brown loess was deposited on the Columbia River basalt in depths of 25 to 100 feet. This loess, known as Portland Hills silt, is middle Pleistocene in age and probably originated from the glacial outwash plains near the Columbia River.

Superficial Deposits. Pleistocene and Recent terrace deposits, dune sands, and alluvium exist along the coast and on the valley bottoms. It is possible that a large quantity of ground water is stored in the dunes, and that a moderate supply is stored in the alluvial sediments.

Soils

Six general groups of soils occur in the North Coast Drainage Basin. Difference in kinds of soil is determined by the following factors of soil formation: geologic, source and kind of parent and underlying material; physiographic, kind and shape of landform; meteorologic, temperature and precipitation conditions; organic, dead and living animal and plant life; and time, relative age and development of the soils. The area of each of these groups of soils is delineated on the generalized soil map (map 4). The narrative contains a general description of each group. Table 1 lists the soil series in each group and describes some of the prominent characteristics and qualities.

Soils Derived from Sedimentary Rock. About 55 percent of the basin is mantled by soils formed in material from sedimentary rock. The parent rock is micaceous and arkosic sandstone and sandy siltstone, mudstone and shale, and tuffaceous sandstone and siltstone. The topography is mountainous with a dendritic pattern of maturely dissected drainages.

These soils have moderately to strongly developed, moderately fine to fine textured profiles. Some have cobbles or pebbles intermixed in all or a portion of the profile, and some have a high slump potential. Depth varies from shallow to very deep with most varying from moderately shallow to deep. The slopes are smooth to uneven, of variable length, and nearly level to very steep, varying from 0 to 75 percent gradient. The largest areas of these

soils are producing forests and smaller areas are growing forage crops.

Soils Derived from Igneous Materials. In the mountainous upland areas, colluvial/residual soils have formed from igneous materials including basalt, gabbro, diorite, and syenite rocks, consolidated tuffs, and interbedded tuffaceous sandstone. These soils occupy about 33 percent of the basin. Erosion has shaped these areas into typical mountain topography with maturely dissected drainages and a few relatively wide ridgetops.

Profile development varies from moderate to strong. Some soils have cobbles or pebbles intermixed throughout the profile and some possess a high slump potential. Depth varies from shallow to very deep with the majority of soils moderately shallow to deep. The slopes are smooth to uneven, of variable length, and gently sloping to extremely steep, varying from 3 to 90 percent gradient. The largest acreage of these soils is producing forest and smaller acreages, used as cropland, are growing forage crops.

Soils Derived from Loess on Uplands. A deposit of light brown, massive, sandy, and silty loess in depths as great as 100 feet mantles the area that is a northwestern extension of the Portland Hills into Columbia County. This homogeneous, structureless silt is composed predominately of quartz and other minerals that indicate that it is not weathered basalt. It is believed that the surface of the loess conforms rather closely to that of pre-existing topography of the underlying rock. The origin of the loess was the glacial outwash plains adjacent to the Columbia River.

These soils have moderately developed, moderately fine to fine textured profiles. The topography is rolling, gently to strongly sloping, convex slopes, varying from 5 to 30 percent gradient. These soils possess very deep profiles; however, Cascade, Delena, and Kinton have effective depths varying from 24 to 60 inches caused by weakly to strongly developed fragipans. Forest is the predominate vegetation on these soils, however, small areas are used for cropland and rangeland. On the flatter slopes, they are well adapted for cropland and respond well to irrigation.

Soils Derived from Marine Sediments. Great quantities of uniform sized, mostly quartz sand were deposited in dunes along the coast in depths of 100 to 200 feet, rising to elevations as high as 250 feet above sea level. The oldest of the sediments are semi-consolidated, and the youngest are loose, nonvegetated dune lands which the ocean winds constantly move eastward. Intermittent areas of peat, thin lenses of silt and clay, and cemented layers and hardpan occur in places.

The topography is undulating and dune-like with long parallel ridges and smooth slopes. The slopes vary from nearly level to strongly sloping. These soils are suited for urban and recreational use and, to a lesser degree, agricultural and forestry use. Being very unstable and erodible when the vegetation is removed, these soils require careful treatment when used for any purpose (photos 1 and 2).

Soils Derived from Alluvium. This basin has long, sinuous valleys that are incised deeply into the mountainous uplands and that widen into broad

U.S. DEPARTMENT OF AGRICULTURE, SOIL CONSERVATION SERVICE, 1964 AND PREVIOUS DATES. 1965 M-4139

WASHINGTON

OREGON

PACIFIC OCEAN

COLUMBIA RIVER

SUBBASINS
1 TILLAMOOK
2 NEHALEM
3 COLUMBIA

R.10 W. R.9 W. R.8 W. R.7 W. R.6 W. R.5 W. R.4 W. R.3 W. R.2 W. R.1 W.

T. 9 N. T. 8 N. T. 7 N. T. 6 N. T. 5 N. T. 4 N. T. 3 N. T. 2 N. T. 1 N. T. 1 S. T. 2 S. T. 3 S. T. 4 S. T. 5 S. T. 6 S.

124° 00' 123° 30' 123° 00' 46° 00' 45° 30'

Hammond
ASTORIA
WARRENTON
Gearhart
SEASIDE
Cannon Beach
Manzanita
Rockaway
Garibaldi
Bay City
Netarts
Pacific City
Clatskanie
Rainier
Columbia City
ST. HELENS
Vernonia

CLATSOP CO.
TILLAMOOK CO.
COLUMBIA CO.
WASHINGTON CO.
YAMHILL CO.
POLK CO.

Nehalem River
Wilson River
Trask River
Tillamook River
Nestucca River
Clatskanie River
Scappoose Bay
Scappoose Creek
Fishhawk Creek
Beaver Creek
Big Creek
Klaskanine River
Youngs River
Lewis and Clark River
Necanicum River
Ecola Creek
Arch Cape Creek
Nehalem River, N.F.
Nehalem River, E.F.
Wilson River, N.F.
Wilson River, E.F.
Trask River, N.F.
Trask River, E.F.
Tillamook River, N.F.
Tillamook River, E.F.
Nestucca River, N.F.
Nestucca River, E.F.

WILLAMETTE BASE LINE

LOWER WILLAMETTE BASIN
MIDDLE WILLAMETTE BASIN

MID COAST BASIN

COUNTY LOCATION

CLATSOP COLUMBIA TILLAMOOK WASHINGTON YAMHILL LINCOLN POLK

LEGEND

- Soils Derived From Sedimentary Rock
- Soils Derived From Igneous Materials
- Soils Derived From Loess on Uplands
- Soils Derived From Marine Sediments
- Soils Derived From Alluvium
- Drainage Basin Boundary
- Subbasin Boundary
- National Forest Boundary

North Coast Drainage Basin

DRAINAGE BASIN LOCATION

MAP 4

GENERALIZED SOIL MAP
NORTH COAST DRAINAGE BASIN
OREGON

DECEMBER 1964

5 0 5 10 15
SCALE IN MILES

7-E-17751-N

Table 1.--Characteristics and qualities of soils, North Coast Drainage Basin, Oregon, 1964 1/

Soils groups	Classification	Texture surface soil	Reaction surface soil pH value	Texture subsoil	Profile depth Inches	Drainage class	Permeability	Water-holding capacity Inches	Infiltration	Major land use	Special problems	Elevation Feet	Precipitation Inches	Growing season Days
Soils derived from sedimentary rock:														
Astoria	Sol Brun Acide	Silt loam	4.6-5.3	Silty clay loam to silty clay	36-60	Well	Moderate	7-12	Medium	Forest and pasture	Erosion on steeper slopes	100-2,000	80-120	160-200
Melbourne	Reddish Brown Lateritic	Silt loam	5.8	Silty clay loam	48	Well	Moderate	8	Medium	Forest and pasture	Erosion on steeper slopes	30-1,200	60-80	150-200
Trask	Lithosol or Sol Brun Acide	Shaly loam	4.6-4.8	Shaly loam	24	Well	Moderate	2-4	Medium	Forest	Steep slopes and stoniness	500-2,500	80-100+	140-200
Winema	Ando-like	Silt loam	4.5-5.0	Silty clay	60+	Well	Moderately slow	10	Medium	Pasture	Erosion on steeper slopes	50-500	60-90	180-200
Soils derived from igneous materials:														
2/ Hembre	Reddish Brown Lateritic	Silt loam	4.5-5.0	Silty clay	48-60	Well	Moderate	8-10	Medium	Forest and pasture	Erosion on steeper slopes	200-2,500	70-150	160-200
Kilchis	Lithosol	Gravelly silt loam	4.5-5.0	Gravelly silt loam	12-24	Well	Moderate	2-4	Medium	Forest	Steep slopes and stoniness	1,500-3,400	80-120	160-200
2/ Nekia	Reddish Brown Lateritic	Clay	5.6	Clay	30-48	Well	Moderate	6-9	Medium	Forest and pasture	Erosion on steeper slopes	300-1,200	40-60	198
2/ Neskowin	Ando-like	Silty clay loam	5.0-5.5	Silty clay loam	36-48	Well	Moderate	7-10	Medium	Pasture	Erosion on steeper slopes	50-500	70-90	180-200
Olympic	Reddish Brown Lateritic	Clay loam	5.1-6.0	Clay loam	56	Well	Moderate	10	Medium	Forest and pasture	Erosion on steeper slopes	300-1,200	40-65	150-200
Viola	Planosol	Clay loam	5.0-5.4	Clay	12-36	Poorly	Slow to very slow	2-7	Medium	Pasture	Drainage - claypan	400-2,200	35-80	160-200
Soils derived from loess on uplands:														
Cascade	Sols Lessive	Silt loam	5.0	Silty clay loam	60+	Imperfectly	Slow	11	Medium	Forest and cropland	Drainage - moderate fragipan of 24 to 48"	250-1,000	40-70	160-200
2/ Delena	Low Humic Gley	Silt loam	5.4	Silty clay	60+	Poorly	Slow	11	Medium	Forest	Drainage - depressional position	250-1,000	40-70	160-200
2/ Kinton	Reddish Brown Lateritic	Silt loam	5.4-5.8	Silty clay loam	60+	Moderately well	Moderately slow	11.5	Medium	Forest and cropland	Drainage - weak fragipan at 24 to 30"	250-1,000	40-70	160-200
2/ Laurelwood	Reddish Brown Lateritic	Silt loam	5.4-5.8	Silty clay loam	60+	Well	Moderate	12	Moderate	Forest and cropland	Erosion on steeper slopes	250-1,000	40-70	160-200
Soils derived from marine sediments:														
On old stabilized dunes:														
Gearhart	Regosol	Loamy sand	4.6-5.0	Loamy sand	60+	Excessively	Very rapid	5-6	Rapid	Forest	Droughtiness and erosion - coarse texture	20-200	80-100	200-225
Netarts	Podzol	Sandy loam to fine sand	4.5-5.0	Fine sand	60+	Well	Moderately rapid	6-7	Rapid	Forest	Droughtiness and erosion - coarse texture	20-200	80-100	200-225
Warrenton	Ground Water Podzol	Loamy fine sand	4.6-5.0	Sandy clay	60+	Poorly	Rapid	5	Rapid	Forest	Drainage - restrictive layer in subsoil	10-40	80-100	200-225
Yaquina	Podzol	Loamy fine sand	4.8	Fine sand	60+	Imperfectly	Rapid	5	Rapid	Forest and pasture	Drainage - high water table	10-50	80-100	200-225
On recently stabilized dunes:														
Westport	Regosol	Loamy sand	4.5-5.0	Sand	60+	Well	Rapid	4	Rapid	Forest	Droughtiness and erosion - coarse texture	0-30	80-100	200-225
Soils derived from alluvium:														
On terraces, forest vegetation:														
Chitwood	Reddish Brown Lateritic to Humic Gley	Silt loam	5.2	Silty clay	48	Imperfectly	Moderately slow to slow	10	Moderate	Pasture	Drainage - seepage	50-200	65-100	160-200
Hebo	Humic Gley	Silty clay loam	4.5-5.0	Clay	36-48	Poorly	Very slow	6	Slow	Pasture	Drainage - claypan	20-800	65-90	160-200
Knappa	Sol Brun Acide	Silt loam	4.5-5.0	Silty clay loam	36-60	Well	Moderate	8-12	Moderate	Pasture and cropland	None	20-1,500	65-100	160-200
On terraces, grass-fern vegetation:														
Ginger	Ando-like	Silt loam	4.5-5.0	Silty clay	36-50	Imperfectly	Moderately slow	6-8	Moderate	Pasture	Drainage - seepage	30-250	60-90	180-220
Quillayute	Ando-like	Silt loam	4.6	Silty clay loam	60+	Well	Moderate	8-12	Moderate	Pasture and cropland	None	50-200	60-90	180-220
On fan slopes:														
Meda	Alluvial	Gravelly loam	5.6-6.0	Gravelly clay loam	48-60	Well	Moderate	8-10	Moderate	Pasture	Erosion on steeper slopes	20-800	60-90	160-200
On flood plains:														
Braillier	Organic	Muck	4.2-4.5	Muck	24-36	Very poorly	Moderate	10	Rapid	Pasture and cropland	Drainage and diking	0-50	70-90	160-200
Brenner	Low Humic Gley	Silt loam	5.0-5.4	Silty clay	60+	Poorly	Moderately slow	8	Moderate	Pasture	Drainage - high water table	50-200	60-90	160-200
Clatsop	Low Humic Gley or Alluvial	Silty clay to muck loam	5.3	Silty clay	36+	Very poorly	Moderately slow	7	Slow	Pasture	Drainage - tidal overflow	0-5	60-100	200-225
Coquille	Low Humic Gley	Silt loam	4.5-5.0	Silty clay loam	36-60	Poorly	Moderate	6-10	Moderate	Pasture	Drainage - low position	0-10	60-90	160-200
Gardiner	Alluvial	Sandy loam	4.5-5.0	Loamy fine sand	60+	Somewhat excessively	Moderately rapid	5	Rapid	Pasture	Droughtiness - coarse texture	50-200	70-90	160-200
Gauldy	Alluvial	Loam	4.5-5.0	Sandy loam	36-55	Somewhat excessively	Moderately rapid	7	Moderate	Forest and pasture	Drainage - flood inundation	10-1,000	70-100	160-200
Nehalem	Alluvial	Silt loam	5.0-5.5	Silt loam	60+	Well	Moderate	12	Moderate	Pasture and cropland	None	10-1,000	60-90	160-200
Nestucca	Alluvial	Silt loam	5.2	Silty clay loam	60+	Moderately well to imperfectly	Moderate	10	Moderate	Pasture	Drainage - high water table	20-150	60-90	160-200
Sauvie	Low Humic Gley	Silt loam to silty clay loam	4.5-5.0	Sandy clay loam to silty clay loam	36-60	Poorly	Moderate to moderately slow	6-10	Moderate	Pasture and forest	Drainage and diking	0-10	40-90	200-225
Spalding	Organic	Muck	4.2-4.5	Muck	40-50	Very poorly	Moderate	10	Rapid	Pasture and cropland	Drainage and diking	0-50	70-90	160-200
2/ Undifferentiated peat	Organic	Muck	4.2-4.5	Muck	24-50	Very poorly	Moderate	10	Rapid	Pasture and cropland	Drainage and diking	0-50	70-90	160-200

1/ USDA, Soil Conservation Service.
2/ Tentative series, not yet correlated.

Photo 1.--Loose, nonvegetated dunes near Warrenton, Clatsop County, Oregon, as they appeared in July 1937, were being moved inland by the wind. SCS photo.

Photo 2.--This photo taken in July 1955 shows the same location as photo 1. The moving sand has been stabilized by European beachgrass. SCS photo.

lowlands near their mouths. The streams have formed flood plains by depositing sediment and redistributing it at times of higher floods. Associated with the poorly drained soils of the flood plains are wet areas of peat which is partly decomposed plant material. Terraces that are old flood plains occur adjacent to the recent flood plains at a somewhat higher elevation. At the place where the valley wall and valley floor meet, colluvial and alluvial forces have produced fans and footslopes. The parent material for these alluvial soils is of mixed mineralogy from the soils of the uplands.

The flood-plain soils have almost no profile development; the terrace soils have weak to moderate development; and the fan soils have weak development. These soils vary from moderately deep to very deep and overlie silty, sandy, and gravelly sediments or bedrock. The slopes vary from nearly level to moderately sloping. They are suited for agricultural, forestry, urban, recreational, constructional, and other uses. The early settlers homesteaded on these soils and cleared them for agricultural use and most of the present agriculture is on them. They are readily adaptable to irrigation. Flooding and inundation are common on the flood-plain soils.

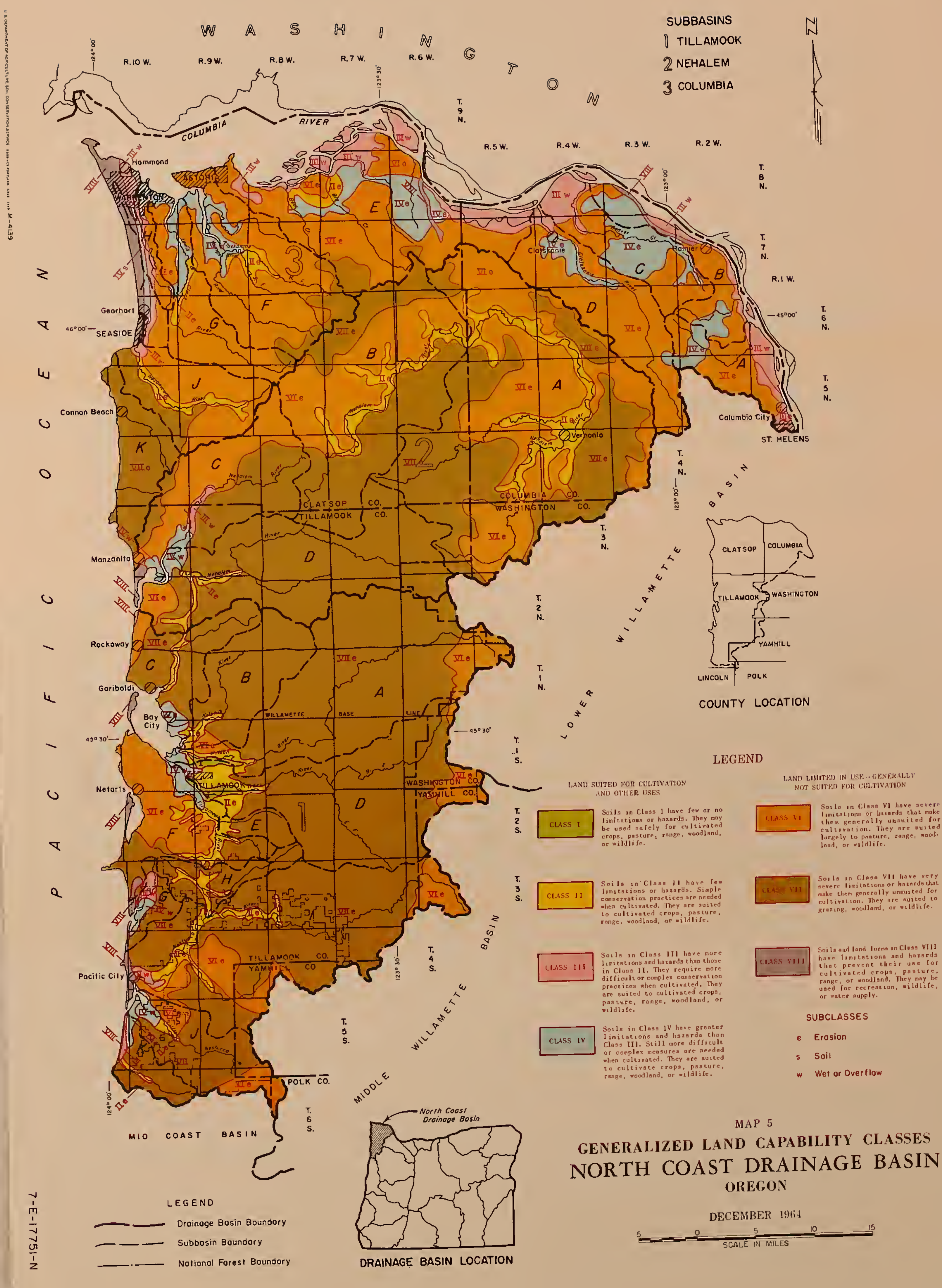
Land Capability

An interpretive grouping of soils into land capability classes has been developed by the Soil Conservation Service. Soil characteristics such as depth, texture, wetness, slope, erosion hazard, overflow hazard, permeability, structure, reaction, water-holding capacity, inherent fertility, and climatic conditions as they influence safe use and management of land are considered in grouping soils into eight land capability classes. These eight classes are designated by Roman numerals as indicated on the generalized land capability map (map 5). The class I land has few hazards or limitations, whereas class VIII land is so limited that it is unfit for safe or economical use for cropland, forestry, and range and should be used only for recreation, wildlife habitat, and watershed.

The classification can be broken into two divisions: (1) land in capability classes I through IV is suited for cultivation and other uses, and (2) land in capability classes V through VIII is best suited for range, forestry, wildlife habitat, and water supply because of limitations. Land capability classes are sometimes broken into subclasses to indicate the dominating limitation or hazard. The subclasses are "e" for wind or water erosion, "w" for wetness or frequent inundation from overflow, "s" for soil limitation, and "c" for climatic limitations.

An estimate of the amounts of land in each watershed has been made for each land capability class and subclass. These data were developed from the Oregon Soil and Water Conservation Needs Inventory 1/ and soil surveys within the North Coast Drainage Basin (table 2).

1/ The Oregon Conservation Needs Committee, Portland, Oregon, September 1962.



MAP 5
GENERALIZED LAND CAPABILITY CLASSES
NORTH COAST DRAINAGE BASIN
OREGON

DECEMBER 1964

Table 2A.--Estimated acreage of land by capability class and subclass, Tillamook, Subbasin 1, North Coast Drainage Basin, Oregon, 1964 1/

Capability class	Watershed A Wilson River	B Kilchis River	C Miami River	D Trask River	E Killam-Fawcett Creeks	F Tillamook River	G Sand Lake	H Beaver Creek	I Nestucca River	J Little Nestucca River	K Neskowin Creek	Total Tillamook Subbasin
	Acres	Acres	Acres	Acres	Acres	Acres	Acres	Acres	Acres	Acres	Acres	Acres
I	1,800	800	230	950	70	1,100	120	200	1,900	270	150	7,590
IIe	500	150	440	2,640	400	1,900	...	130	800	200	30	7,190
IIw	290	100	80	1,900	50	660	400	100	400	200	100	4,280
IIs	10	10	140	200	120	120	30	200	570	20	30	1,450
Total II	800	260	660	4,740	570	2,680	430	430	1,770	420	160	12,920
IIIe	310	130	290	1,200	200	450	350	470	1,700	270	80	5,450
IIIw	230	50	200	530	60	600	820	440	1,100	100	140	4,270
IIIs	...	...	...	...	...	...	...	...	...	...	...	...
Total III	540	180	490	1,730	260	1,050	1,170	910	2,800	370	220	9,720
IVe	280	110	480	2,480	250	900	320	440	1,750	580	460	8,050
IVw	1,000	200	480	1,120	100	2,800	450	200	500	900	130	7,880
IVs	...	...	...	...	...	...	...	...	...	...	...	...
Total IV	1,280	310	960	3,600	350	3,700	770	640	2,250	1,480	590	15,930
Total I-IV	4,420	1,550	2,340	11,020	1,250	8,530	2,490	2,180	8,720	2,540	1,120	46,160
VIe	19,100	6,420	5,150	18,600	1,110	6,490	1,170	2,600	24,960	6,680	2,000	94,280
VIIe	99,200	35,100	27,700	80,070	5,700	35,400	6,400	14,330	110,480	29,020	11,450	454,850
Total VI-VII	118,300	41,520	32,850	98,670	6,810	41,890	7,570	16,930	135,440	35,700	13,450	549,130
VIII	100	70	100	150	...	100	570	60	1,460	30	600	3,240
Total land area	122,820	43,140	35,290	109,840	8,060	50,520	10,630	19,170	145,620	38,270	15,170	598,530
Water area	1,080	860	3,310	460	40	6,780	570	30	980	450	30	14,590
Total in basin	123,900	44,000	38,600	110,300	8,100	57,300	11,200	19,200	146,600	38,720	15,200	613,120

1/ Compiled by USDA, Soil Conservation Service.

Table 2B.--Estimated acreage of land by capability class and subclass, Nehalem, Subbasin 2, North Coast Drainage Basin, Oregon, 1964 1/

Capability class	Watershed				Total Nehalem Subbasin
	A Upper Nehalem	B Middle Nehalem	C North Fork Nehalem	D Lower Nehalem	
	Acres	Acres	Acres	Acres	Acres
I	2,580	1,800	560	710	5,650
IIe	...	...	300	500	800
IIw	500	...	50	50	600
IIs	260	400	110	100	870
Total II	760	400	460	650	2,270
IIIe	900	...	200	300	1,400
IIIw	6,080	...	350	50	6,480
IIIs	100	...	150	100	350
Total III	7,080	...	700	450	8,230
IVe	3,300	...	300	400	4,000
IVw	200	800	700	600	2,300
IVs	...	...	...	...	...
Total IV	3,500	800	1,000	1,000	6,300
Total I-IV	13,920	3,000	2,720	2,810	22,450
VIe	88,790	67,260	30,850	19,400	206,300
VIIe	128,000	57,710	33,590	87,860	307,160
Total VI-VII	216,790	124,970	64,440	107,260	513,460
VIII	40	100	770	...	910
Total land area	230,750	128,070	67,930	110,070	536,820
Water area	750	630	770	1,830	3,980
Total in basin	231,500	128,700	68,700	111,900	540,800

1/ Compiled by USDA, Soil Conservation Service.

Table 2C.--Estimated acreage of land by capability class and subclass, Columbia, Subbasin 3, North Coast Drainage Basin, Oregon, 1964 1/

Capability class	Watershed											Total Columbia Subbasin
	A Tide Creek	B Rainier	C Beaver Creek	D Clatskanie River	E Knappa	F Youngs River	G Lewis and Clark River	H Skipanon River	I Warrenton Beach	J Necanicum River	K Elk Creek	
	Acres	Acres	Acres	Acres	Acres	Acres	Acres	Acres	Acres	Acres	Acres	Acres
I	...	...	...	...	200	160	200	...	...	150	...	710
IIe	300	200	100	800	200	...	...	...	...	...	...	1,600
IIw	2,500	1,000	2,500	100	2,000	...	...	...	...	...	...	8,100
IIs	...	...	...	...	300	250	220	100	...	200	100	1,170
Total II	2,800	1,200	2,600	900	2,500	250	220	100	...	200	100	10,870
IIIe	5,500	6,500	7,000	6,530	1,500	...	...	...	...	...	...	27,030
IIIw	1,100	1,300	2,000	100	11,590	730	800	2,000	1,300	...	...	20,920
IIIs	1,200	400	300	800	300	...	...	...	...	...	...	3,000
Total III	7,800	8,200	9,300	7,430	13,390	730	800	2,000	1,300	...	...	50,950
IVe	4,500	5,500	6,000	5,000	2,300	...	...	...	...	...	...	23,300
IVw	100	400	900	400	1,020	8,100	7,000	800	600	1,000	100	20,420
IVs	600	200	200	200	200	...	...	420	900	100	100	2,920
Total IV	5,200	6,100	7,100	5,600	3,520	8,100	7,000	1,220	1,500	1,100	200	46,640
Total I-IV	15,800	15,500	19,000	13,930	19,610	9,240	8,220	3,320	2,800	1,450	300	109,170
VIe	5,250	5,600	8,900	19,370	50,000	36,460	18,100	1,120	7,310	23,000	14,300	189,410
VIIe	8,000	8,500	13,400	29,000	41,180	29,000	14,230	5,540	6,000	18,350	15,070	188,270
Total VI-VII	13,250	14,100	22,300	48,370	91,180	65,460	32,330	6,660	13,310	41,350	29,370	377,680
VIII	100	300	...	...	...	...	...	120	1,900	300	80	2,800
Total land area	29,150	29,900	41,300	62,300	110,790	74,700	40,550	10,100	18,010	43,100	29,750	489,650
Water area	3,450	6,300	2,700	100	42,610	13,300	3,250	380	15,290	200	50	87,630
Total in basin	32,600	36,200	44,000	62,400	153,400	88,000	43,800	10,480	33,300	43,300	29,800	577,280

1/ Compiled by USDA, Soil Conservation Service.

Table 2D.--Estimated acreage of land by capability class and subclass, North Coast Drainage Basin, Oregon, 1964 1/

Capability class	Subbasin 1 Tillamook	Subbasin 2 Nehalem	Subbasin 3 Columbia	Total Basin
	Acres	Acres	Acres	Acres
I	7,590	5,650	710	13,950
IIe	7,190	800	1,600	9,590
IIw	4,280	600	8,100	12,980
IIs	1,450	870	1,170	3,490
Total II	12,920	2,270	10,870	26,060
IIIe	5,450	1,400	27,030	33,880
IIIw	4,270	6,480	20,920	31,670
IIIs	...	350	3,000	3,350
Total III	9,720	8,230	50,950	68,900
IVe	8,050	4,000	23,300	35,350
IVw	7,880	2,300	20,420	30,600
IVs	...	...	2,920	2,920
Total IV	15,930	6,300	46,640	68,870
Total I-IV	46,160	22,450	109,170	177,780
VIe	94,280	206,300	189,410	489,990
VIIe	454,850	307,160	188,270	950,280
Total VI-VII	549,130	513,460	377,680	1,440,270
VIII	3,240	910	2,800	6,950
Total land area	598,530	536,820	489,650	1,625,000
Water area	14,590	3,980	87,630	106,200
Total in basin	613,120	540,800	577,280	1,731,200

1/ Compiled by USDA, Soil Conservation Service.

SOCIAL AND ECONOMIC FEATURES

Settlement and History

Explorers and traders sailed along the coast in the sixteenth, seventeenth, and eighteenth centuries. They were returning from trading ventures to the Philippines or the Orient, from exploring the coast in search of the Columbia River or other inland passages, or from trading for furs with the Indians of the Northwest. Sea captains representing different countries included: from Spain--Ferrelo, deAguilar, Heceta, and Viscaino; from England--Drake, Cook, Meares, and Vancouver; from Russia--Bering; and from the United States--Gray and Kendrick. These nations were soon competing to establish ownership of this new land. The first recorded landing along the Oregon Coast was made by Gray who stopped at Tillamook Bay in 1788 with the hope of trading with the Indians for supplies. On his second voyage in 1792, he discovered and explored the Columbia River.

Indians of the Chinook, Clatsop, Tillamook, Nehalem, and Nestucca tribes inhabited the basin. Although the area was explored by the white man prior to 1800, the most significant exploration was the Lewis and Clark expedition of 1805-06. They first saw the Pacific from a canoe in the Columbia River on November 7, 1805. They landed in the vicinity of Astoria and claimed the area for the United States. They built Fort Clatsop for winter quarters and spent the winter exploring in the vicinity. A replica of this U. S. military post now stands at the original location which is 4-1/2 miles south of Astoria on the west bank of the Lewis and Clark River.

The first permanent settlement in the basin began with Captain Jonathan Horn, representing John Jacob Astor and his Pacific Fur Company, landed March 22, 1811, from his ship named Tonquin and built a fort and trading post. Settlement was slow for a number of years and was concentrated in the area near Astoria. The densely forested Coast Range acted as a barrier and delayed development because of inadequate transportation. At first, the only routes to the basin were the Columbia River, the ocean, and the beaches and grasslands along part of the coast. By 1870, a trail had been constructed between Clatsop Plains and the Tillamook area. The first family to live on the Clatsop Plains moved to the area from Salem in about 1840. In 1847, the first post office west of the Rockies was established at Astoria. The first settler arrived in the Tillamook area in 1851 after traveling by whale boat from Astoria. The Indians showed him a large, hollow, dead spruce tree which he used for a home until a house was constructed. The Upper Nehalem Valley in Columbia County was not settled until the 1870's.

In the early days between 1811 and 1840, most of the activity was limited to hunting, trapping, and farming for domestic consumption. After 1840, the agricultural industry gradually increased. The first horses were brought to the Clatsop Plains in 1841 and soon after a herd of cattle was driven to the area from the Willamette Valley by way of the Tillamook area. The early agriculture of the area was mainly dairying, livestock production, and potato production with a limited acreage devoted to wheat, oats, barley, and vegetables. Tillamook County became noted for its stable and prosperous dairy industry. Presently, the county leads the state in value of dairy products sold.

The early settlers found the forest to be both an obstacle to progress and a resource for their needs. They cut and burned the trees to clear land to farm and used logs and lumber to build their houses and other structures. The logging and forest products industries began on a commercial basis in 1851 with the construction of the first sawmill. The industries have grown rapidly with the advent of improved transportation, more efficient equipment, and the strong demand for lumber during World Wars I and II.

When the white man came, the Indians were catching salmon for food, a practice which the white man adopted. The salmon-packing industry began on a commercial scale in 1866 with the construction of a cannery. The industry proved to be so successful that dozens of canneries were built along the Columbia River and its tributaries.

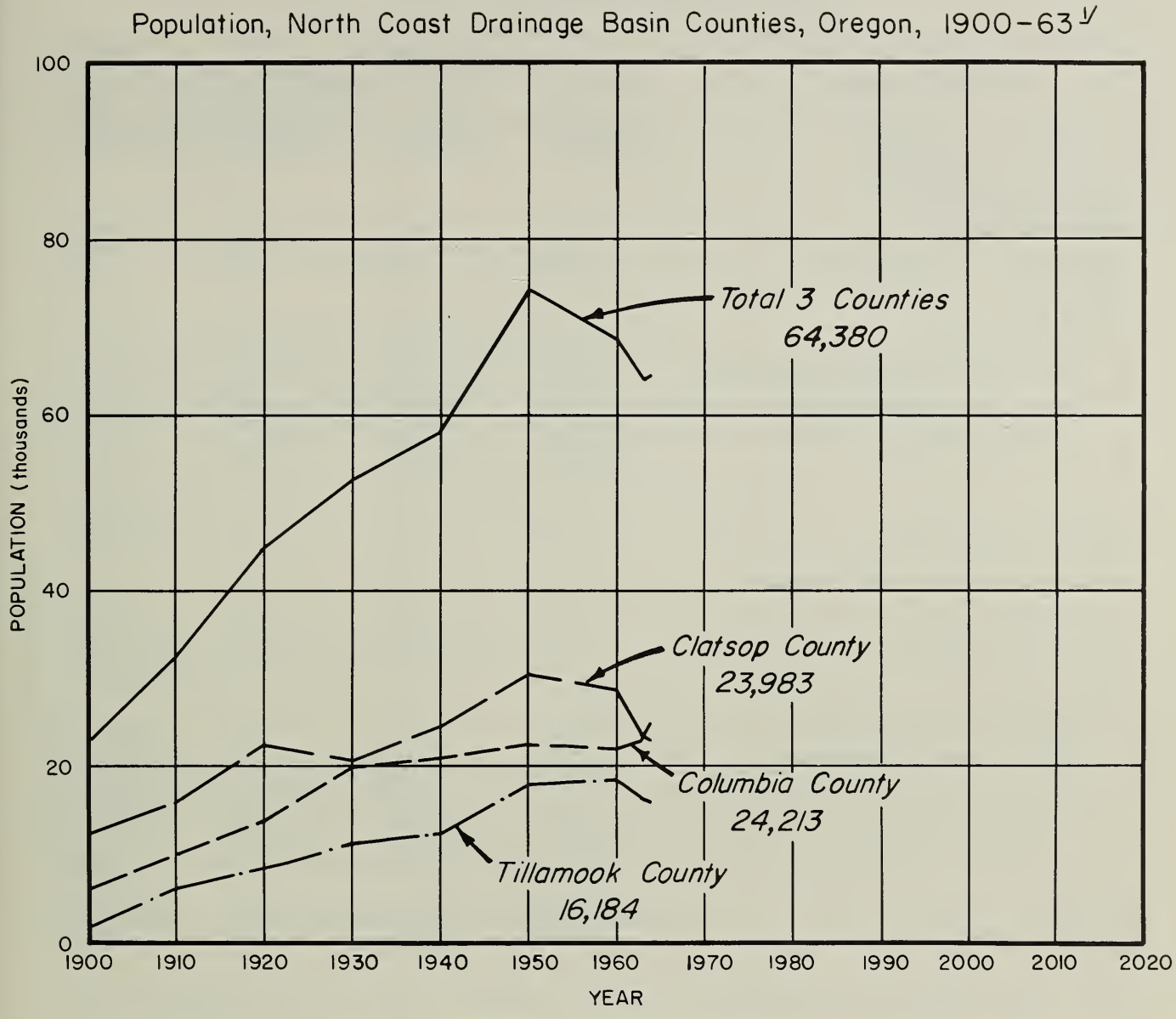
Population and Economy

The population of the basin in 1960 was 62,300 people or about 3.5 percent of the population of the State. The density was 13 persons per square mile as compared to 18 for the State of Oregon. It is estimated that the population had declined to about 58,400 in 1964. Population increased steadily from 1900 to 1950 (figure 1). Population losses from Clatsop County in the twenties were more than compensated for by gains in the other two counties. Since 1950, however, population has declined generally in the area.

The largest cities in the basin are Astoria and Tillamook with populations of 11,220 and 4,260, respectively. There are 17 other incorporated cities in the basin of which eight have populations of 1,000 or more. Most of the 137 unincorporated communities have less than 150 residents. About 10 percent of the people live on farms, 54 percent live in rural residences or in towns with populations of less than 2,500, and 36 percent live in urban areas.

The economy of the North Coast Drainage Basin is based on three basic industries--forestry, agriculture, and fisheries. Recreation, although difficult to measure, is also an important contributor to the economy of the area. All of these industries are oriented to the natural resources of the basin. One measure of the importance of the various sectors of the economy is employment. Although employment data are not available for the basin area, nearly all of the population of Clatsop and Tillamook Counties and 70 percent of the population of Columbia County are within the basin. Employment data for these counties are indicative of employment in the basin.

About 45 percent of the employment in the three counties was attributed directly to the basic industries of forestry, agriculture, and fisheries in 1960 (table 3). The most important basic industry was forestry. Over 19 percent of the workers were engaged in logging and wood manufacturing industries. Agricultural employment was 8.6 percent of the total employment. Food and kindred products manufacturing, an allied industry of agriculture and fisheries, accounted for 6.4 percent of the employment. The fish processing industry was the largest employer in this category. Most of the fish processing is in Astoria, where six companies employed 850 workers. Dairy processing was the other important food processing activity with two



1/ U.S. CENSUS OF POPULATION AND OREGON STATE BOARD OF CENSUS.

Figure 1

processing and manufacturing plants in Tillamook County which employ about 200 workers.

The tertiary industries including construction, transportation, communications, trades and services are indirectly associated with the basic industries enumerated in table 3. Some are also related directly to the other important industry in the area--recreation. About 53 percent of the workers in the basin counties were employed in tertiary activities in 1960.

The forest industry expanded rapidly in the early 1900's and reached its peak in 1929.

Table 3.--Occupations of employed, North Coast Drainage Basin Counties, Oregon, 1960 1/

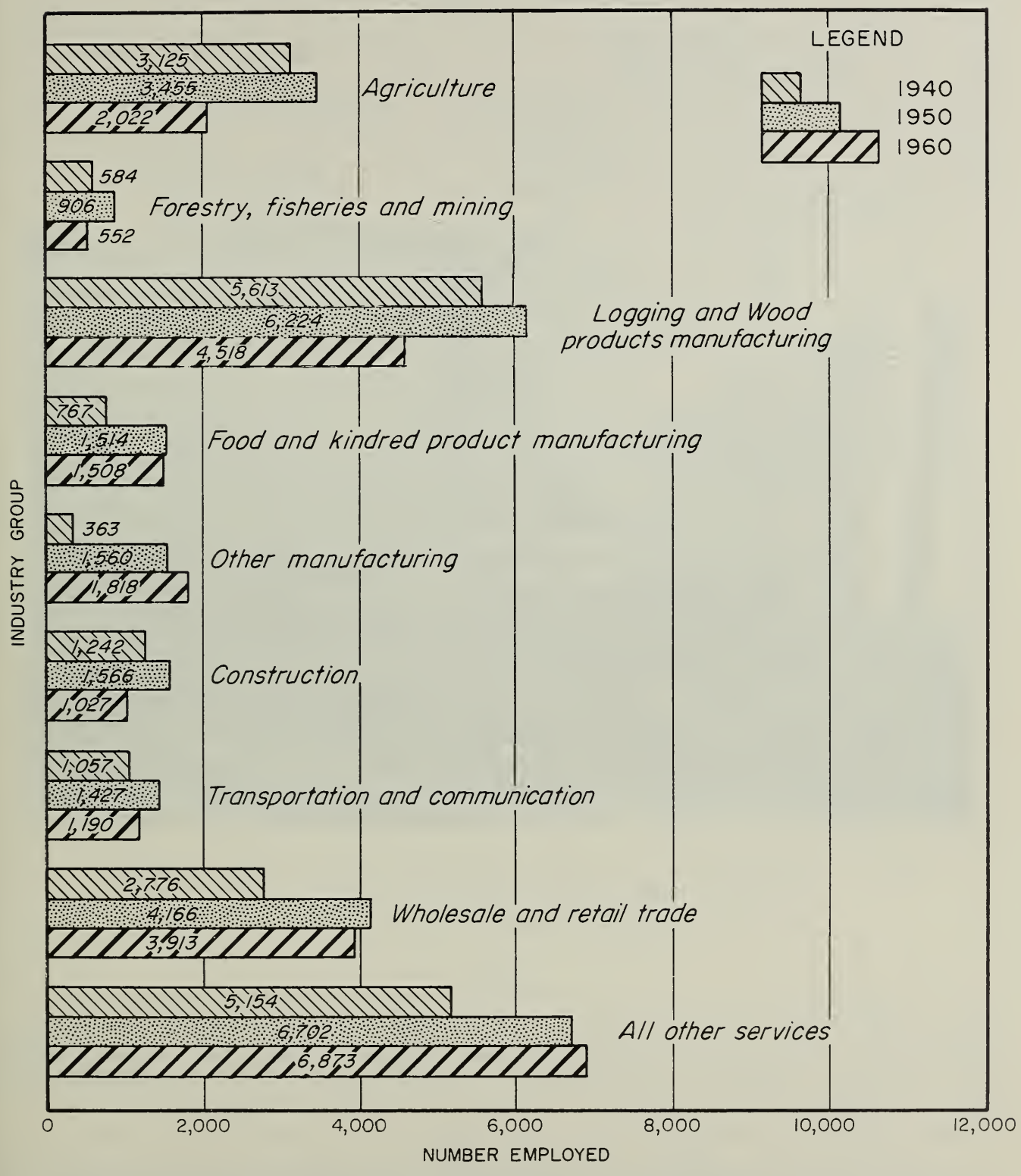
Industry group	Employment			Total three counties
	Clatsop County	Columbia County	Tillamook County	
	Number	Number	Number	Number
Basic activities:				
Agriculture	424	687	911	2,022
Forestry and fisheries	361	60	91	512
Mining	16	16	8	40
Manufacturing:				
Wood products	(1,344)	(1,382)	(1,792)	(4,518)
Food and kindred products	(1,164)	(91)	(253)	(1,508)
Other manufacturing	(278)	(1,458)	(82)	(1,818)
Total manufacturing	2,786	2,931	2,127	7,844
Total basic	3,587	3,694	3,137	10,418
Tertiary activities:				
Construction	435	349	243	1,027
Transportation and communications	546	485	159	1,190
Wholesale trade	68	149	119	336
Retail trade	1,634	942	1,001	3,577
Services:				
Educational services	(488)	(447)	(379)	(1,314)
Public administration	(733)	(313)	(236)	(1,282)
Other services	(1,775)	(889)	(1,139)	(3,803)
Total services	2,996	1,649	1,754	6,399
Total tertiary	5,679	3,574	3,276	12,529
Industry not reporting	294	103	77	474
Total employment	9,560	7,371	6,490	23,421

1/ U. S. Census of Population, General Social and Economic Characteristics, PC(1)39C, Oregon.

The other resource-oriented industries, dairy, commercial fisheries, and recreation, developed early and continued to expand from 1900 to 1940.

The 1940's were years of rapid economic and population growth for the basin counties, and employment increased in all industry groups (figure 2). The dairy industry continued to develop and dairy processing and manufacturing plants expanded in Tillamook County. The fish processing plants in Clatsop County grew into a major industry; employment in food and kindred products manufacturing doubled from 1940 to 1950. During the war, major military installations were constructed at Astoria and Tillamook. Ship-building became an important industry in Astoria. Lumber production expanded as salvage logging of the Tillamook Burn area continued through the 1940's.

Employment by industry group, North Coast Drainage Basin Counties, Oregon, 1940-50-60[1/]



1/ U.S. CENSUS OF POPULATION, 1940, 1950 AND 1960 CLATSOP, COLUMBIA, AND TILLAMOOK COUNTIES.

Figure 2

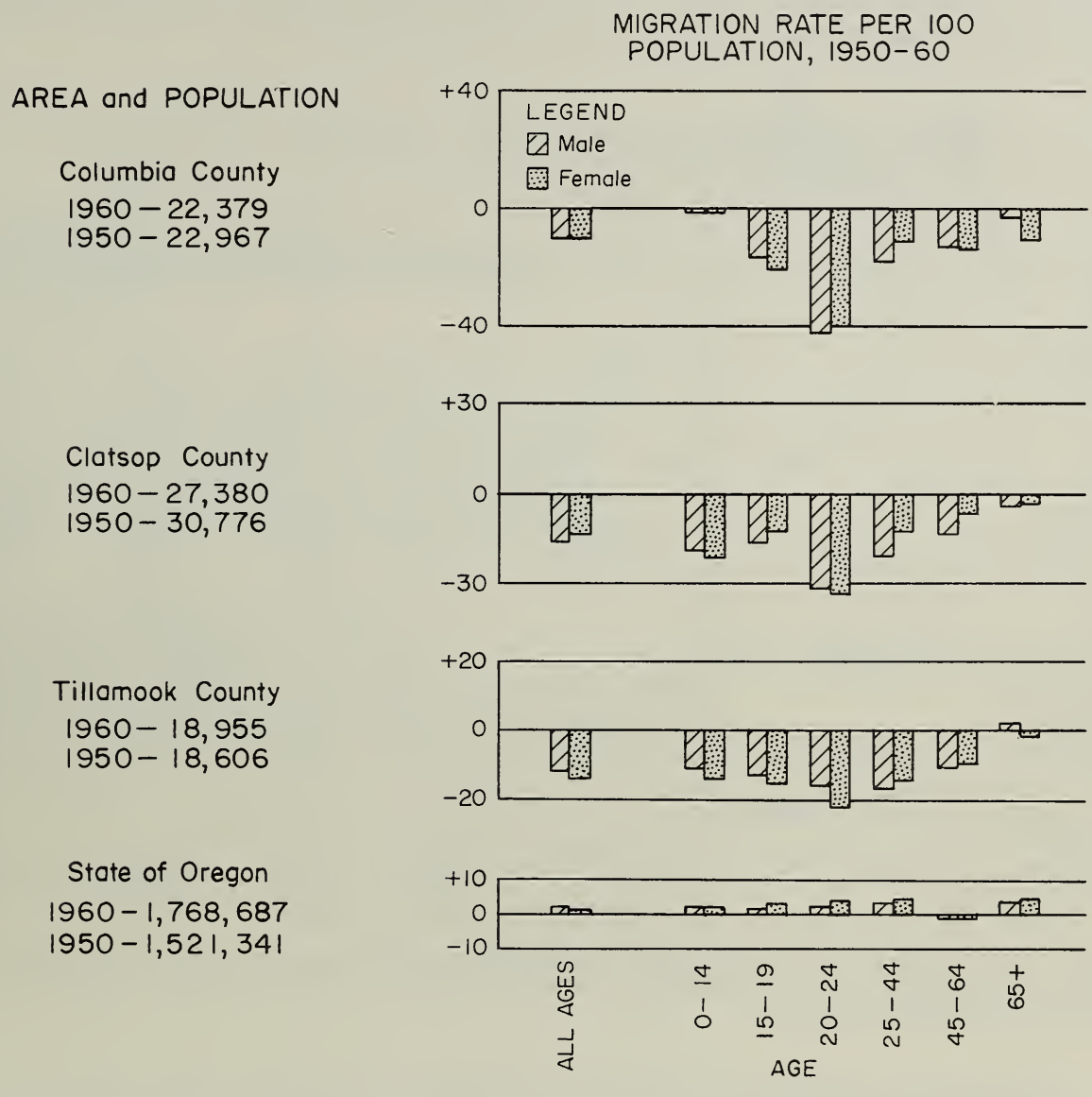
During the 1950's, many of the forces that spurred economic and population growth in the basin counties subsided. Lumber production dropped steadily from 1.08 billion board feet in 1952 to 580 million board feet in 1960 (figure 5). Salvage logging of the Tillamook Burn area was virtually completed, and the area was left without a supply of merchantable timber. This along with increased efficiency and increased exporting of logs from the area resulted in decreased employment in the wood products industry (figure 2). A cutback in military and other activities was reflected in employment in construction, wholesale, and retail trades. Employment also decreased significantly in agriculture, forestry, fisheries, and mining.

Photo 3.--Exporting of logs from the basin has increased significantly. These, being loaded at Astoria, are destined for Japan. RBSP-FS photo.

The only industry groups that did not show losses in employment from 1950 to 1960 were "food and kindred products manufacturing" where employment stayed about the same, and "other manufacturing" and "services" where employment increased slightly. The increase in employment in the "other manufacturing" group was primarily due to expansion of pulp and paper mills in Columbia County.

The result of lessened job opportunities was out-migration of people. From 1950 to 1960, the out-migration was 11 percent for Columbia County, 13 percent for Tillamook County, and 14 percent for Clatsop County, as compared to a rate of 2 percent for the State of Oregon (figure 3). The largest group of migrants was from 20 to 24 years of age, indicating that the young people

Population migration rates by age groups, North Coast Drainage Basin Counties and Oregon, 1950-60 1/



1/ POPULATION BULLETIN P-8, OREGON STATE BOARD OF CENSUS, JUNE 1963.

Figure 3

entering the labor market were most affected by the lack of job opportunities in the area.

People in the area are concerned over the out-migration of young people and the resulting population loss from the area; however, out-migration in the basin counties was probably advantageous to the welfare not only of those leaving the area but also of those remaining. When job opportunities expanded rapidly in the 1940's, population and personal income increased simultaneously but when job opportunities were declining in the 1950's, population increases could have been a serious drag on levels of income.

Levels of income in the basin counties increased at rates comparable to the State of Oregon from 1950 to 1960 (table 4). The smallest increase was for Clatsop County where all family median income increased by 60 percent, and the largest increase was for Tillamook County where income increased by 73 percent as compared to 70 percent for the State.

Table 4.--Changes in population, employment, and income, North Coast Drainage Basin Counties, Oregon, 1950-60 1/

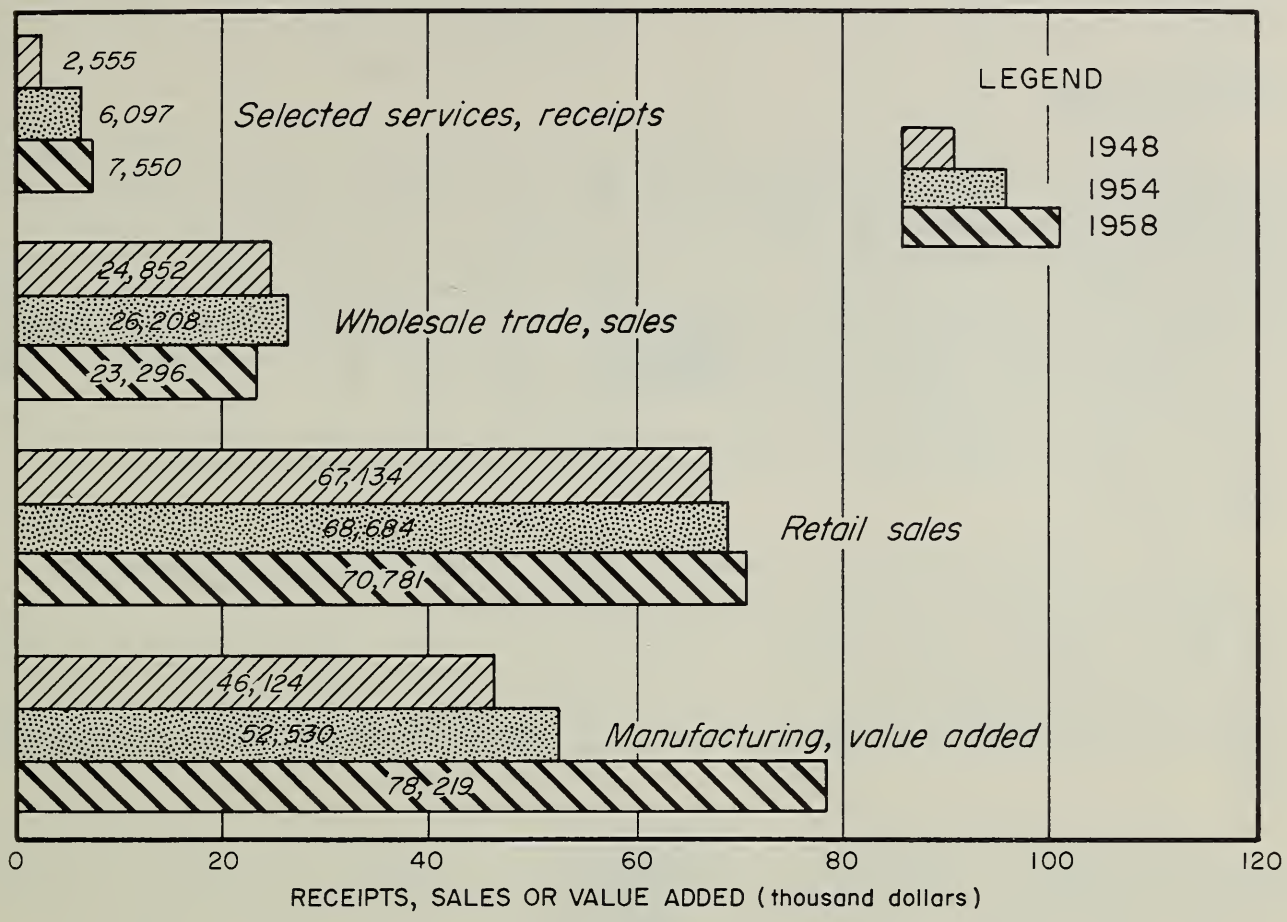
Item and year	Unit	County			Oregon
		Clatsop	Columbia	Tillamook	
Total population:					
1950	People	30,776	22,967	18,606	1,521,341
1960	People	27,380	22,379	18,955	1,768,687
Percentage change	Percent	-11.0	-2.6	+1.9	+16.4
Total employment:					
1950	Workers	11,808	8,595	7,117	576,510
1960	Workers	9,560	7,371	6,490	679,553
Percentage change	Percent	-19.0	-14.2	-8.8	+17.9
Percent of population employed:					
1950	Percent	38.4	37.4	38.3	37.9
1960	Percent	34.9	32.9	34.2	38.4
All family median income:					
1949	Dollars	3,443	3,164	3,115	3,476
1959	Dollars	5,494	5,265	5,382	5,892
Percentage change	Percent	+59.6	+66.4	+72.8	+69.5

1/ U. S. Census of Population, General Social and Economic Characteristics, PC(1)39C, Oregon.

A comparison of the percentage change in population, employment, and median income gives an indication of why out-migration was necessary in order to permit wage levels in the basin to increase at rates comparable to other areas. Note that the rate of change in employment was greater than the change in population in all counties. Given the limited job opportunities, incomes would not have increased to the extent that they did if the population had remained constant or had increased. Thus, out-migration provided the relief valve which permitted levels of living to increase in the basin at rates comparable with other areas.

Another measure of economic activity is dollar value of receipts and sales. Figure 4 illustrates the changes in receipts from services, retail and wholesale sales, and value added by manufacturing. Dollar values increased in all groups except wholesale trade from 1948 to 1958. The largest relative increase was for selected services where receipts trebled from 1948 to 1958. The largest total increase occurred in value added by manufacturing.

Volume of business in dollars, North Coast Drainage Basin Counties, Oregon, 1948-54-58 1/



1/ U.S. CENSUS OF MANUFACTURES, CENSUS OF RETAIL TRADE, WHOLESALE TRADE, AND SELECTED SERVICES DATA FOR CLATSOP, COLUMBIA, AND TILLAMOOK COUNTIES.

Figure 4

In general, the dollar value of business increased, employment decreased, and family incomes increased. This was possible because of increased efficiency and out-migration.

The State Board of Census projects a relatively slow rate of population growth for the basin counties. 2/ It forecasts that out-migration will continue through 1980. Population is projected to increase by 17 to 19 percent from 1960 to 1980 in the basin counties as compared to a rate of 33 to 36 percent for the State.

The manner in which the natural resources of the area are managed and developed will have an important bearing on the future growth and development of the basin. Forestry, agriculture, and the commercial fisheries will undoubtedly continue to be important segments of the economy in the near future. Recreation has long been important to the economy of the basin and indications are that as population, incomes, and leisure time increase, the

amenity resources will become more important. Because of the proximity of the basin to Portland, the major population center of the State, demand for the basin's resources for recreation will probably be especially pronounced.

Transportation

U. S. Highway 101, the main north-south highway through the North Coast Drainage Basin, generally follows the coast and connects the main towns and industrial areas along the coast. U. S. Highway 30 parallels the Columbia River and connects the basin with the metropolitan Portland area. These two highways intersect at Astoria. U. S. Highway 26 and State Highway 6 are the principal east-west arteries through the basin. Other state and local highways and secondary roads extend into or through most of the watersheds. Regular passenger ferry service across the Columbia River is being maintained between Astoria, Oregon, and Megler, Washington, until the interstate bridge on U. S. 101 is completed. A bridge handles traffic between Westport and Puget Island.

Water transportation is important in the northern part of the basin; a 40-foot-deep channel is maintained from the mouth of the Columbia River to Portland. Astoria, the largest seaport in the basin, has facilities to service ocean-going vessels. There are also shore facilities for servicing and moorage of sea-going fishing vessels and other small craft. Facilities for servicing and moorage of small ocean-going vessels are available at Tillamook Bay.

Regular passenger service is provided by bus to mid-coast and Willamette Valley locations. Scheduled air-line passenger service is available between Portland and Astoria. There are several airports classified for public use by the Oregon State Board of Aeronautics. There is no railroad passenger service in the basin. Freight service is provided by several truck lines and two railroads to various locations in the basin.

Landownership and Use

The general pattern of landownership is illustrated in map 6, while the generalized land use is shown in map 7. Table 5 presents a tabulation of landownership and land use.

The land use is related to ownership. The forested portions, 86 percent of the basin, are generally owned by large (over 5,000 acres) private concerns or various public agencies. The areas of cropland, 5 percent of the basin, are privately owned and are generally in smaller parcels. Nine percent of the basin is in other land use categories including rangeland, roads, urban developments, water areas, and sand dunes. This category is generally privately owned.

Federal ownership is limited generally to forest land which is managed on multiple-use, sustained-yield principles. Minor holdings include the

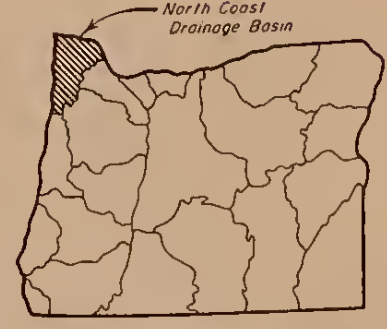
2/ Population and Labor Force by Age and Sex, Population Bulletin, p. 10, Oregon State Board of Census, Portland, April 1964.

SUBBASINS

1 TILLAMOOK
2 NEHALEM
3 COLUMBIA

COUNTY LOCATION

DRAINAGE BASIN LOCATION



LEGEND

- National Forest
- Other Federal
- State of Oregon
- County and Municipal
- Large Private
- Other Private
- Drainage Basin Boundary
- Subbasin Boundary
- Watershed Boundary and Letters

MAP 6

LAND STATUS MAP

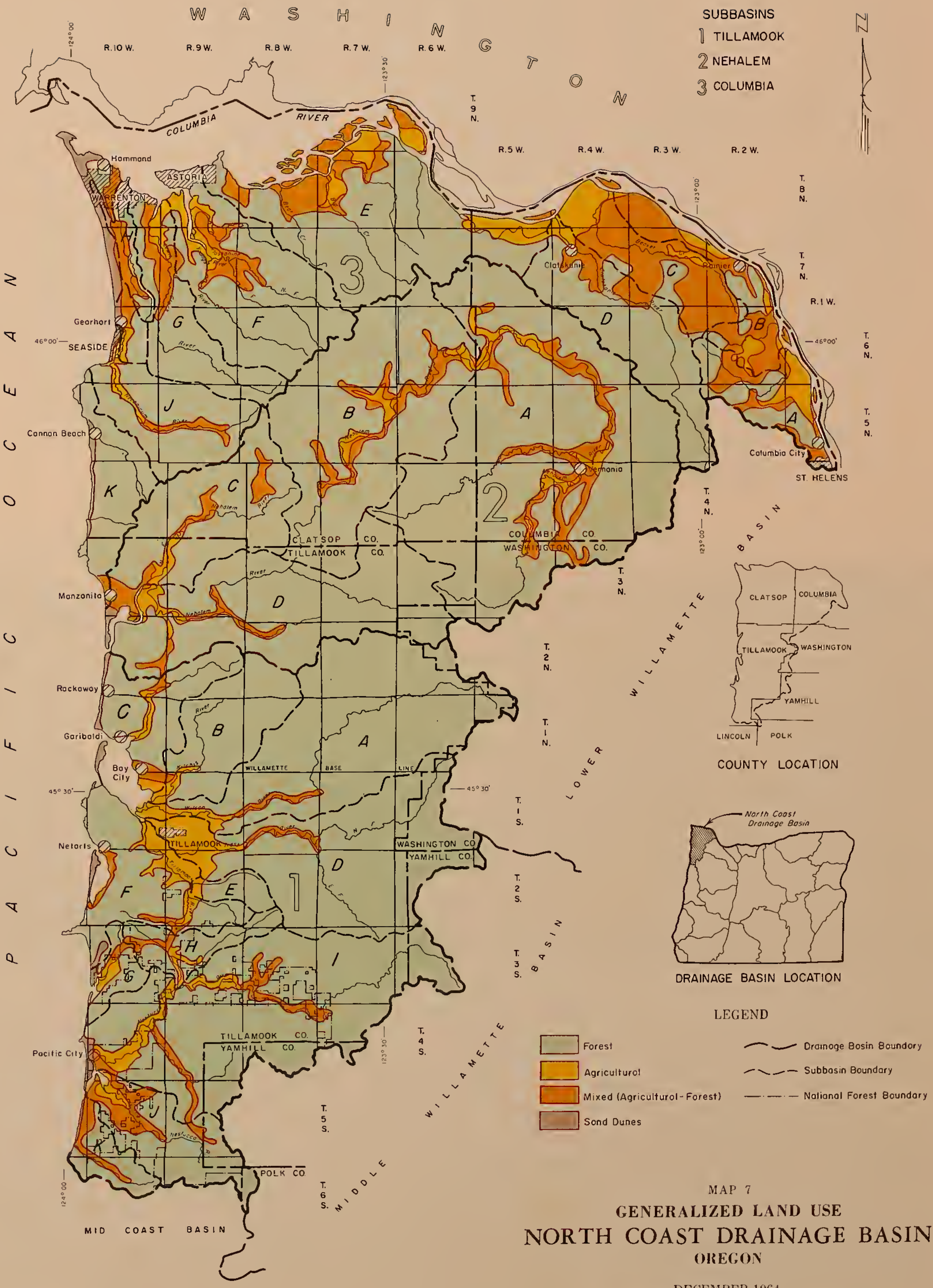
NORTH COAST DRAINAGE BASIN

OREGON

DECEMBER 1964

5 0 5 10 15
SCALE IN MILES

7-E-17751-N



MAP 7
GENERALIZED LAND USE
NORTH COAST DRAINAGE BASIN
OREGON

DECEMBER 1964

Table 5.--Land use and ownership, North Coast Drainage Basin, Oregon, 1964 1/

Class of ownership	Forest	Agriculture	Other	Total
	Acres	Acres	Acres	Acres
Federal:				
National forest	109,800	...	760	110,560
Other federal	60,020	...	2,540	62,560
State	487,580	...	13,170	500,750
County and municipal	21,020	...	6,900	27,920
Private	808,180	81,600	139,630	1,029,410
Total	1,486,600	81,600	163,000	1,731,200

1/ Compiled from data obtained from the U. S. Forest Service, Bureau of Land Management, Oregon State Department of Forestry, and county assessors.

Maritime Commission's fleet storage and Coast Guard installations near Tongue Point, the wildlife refuge at Cape Meares, the Fort Clatsop National Monument, and the old military installation at Fort Stevens.

The State of Oregon owns approximately 29 percent of the land in the basin. Almost all is forest land which the State Forester manages with good timber management practices. A major portion of the Tillamook Burn is state owned and the most prominent management practices have been fire hazard reduction and reforestation. Parks and waysides occupy almost 10,000 acres.

County and municipal land is 75 percent forested. Part of the municipal forest land is reserved for water production. Other portions are managed as county parks or forests. The other 25 percent is found in sand dunes, urban developments, and water areas.

Private owners hold the remaining 1,029,400 acres, or 59 percent of the basin. Seventy-eight percent, 808,200 acres, is forest with almost three-fourths owned by forest industries and managed on various sustained-yield bases. Fourteen percent, 139,600 acres, is devoted to other uses. The remaining private land, 81,600 acres, is cropland which produces hay and pasture.

FOREST LAND MANAGEMENT IN THE BASIN

CHARACTERISTICS OF FORESTED AREAS

The forests, covering 86 percent of the basin, are composed mainly of Douglas-fir, western hemlock, Sitka spruce, and red alder. There are extensive young stands but few old-growth stands left. Growth studies at Cascade Head Experimental Forest reveal that several of the large young-growth stands are growing 1,500 board feet per acre per year.

Along the immediate coast, the forest cover is shore pine and Sitka spruce which has been deformed by wind and salt spray. These uniquely deformed stands add to the scenic attraction of the Oregon coast.

Forty-six percent, or 678,420 acres, of the forest land is publicly owned. Seventy-two percent of this is State land located in a wide band through the center of the basin. Sixteen percent is in the Siuslaw National Forest located in the southern portion of the basin. Nine percent is public domain and revested Oregon and California railroad lands which are administered by the Bureau of Land Management. These lands are located chiefly in the southern portion of the basin. County and municipally owned lands are scattered throughout the basin and account for approximately 3 percent of the publicly owned forest land.

Approximately 808,000 acres of the forest land are privately owned. About 73 percent of this is owned by large private owners and is managed on various continuous production bases.

Forest Land Use

The major uses of forest land in the North Coast Drainage Basin are for commercial timber production, for water production, and for outdoor recreation. Other important uses include wildlife habitat and botanical and ecological study. Much of the private forest land, especially that in large ownerships, is managed intensively for timber production. Most federal and state forest land is managed to accommodate a balance of several uses. Some is used primarily for outdoor recreation with livestock grazing and timber harvesting modified or excluded.

Management of forest land varies considerably. On some private holdings, the only management is that related to the harvesting of timber while on other private holdings, considerable attention is given to measures that will foster sustained-yield production, such as prompt regeneration, thinning, pruning, and planned intermediate cutting. On public land used intensively for outdoor recreation, such as state parks, the management objective is to provide adequate facilities and a safe and aesthetically pleasing environment.

National forest land is managed under the "multiple-use, sustained-yield" concept. As defined by the Multiple Use and Sustained Yield Act of June 1960 (P. L. 86-517), this means the management of forest and related areas in a manner that will conserve the basic land resource itself while at the same time producing high-level, sustained yields of water, timber, recreation, wildlife, and forage in the combination that will best meet the needs of the nation. By law, the majority of the Bureau of Land Management lands are devoted to permanent forest production in conformity with the principle of sustained yield for the purpose of providing a perpetual source of timber supply, protecting watersheds, regulating streamflow, contributing to economic stability of local communities and industries, and providing recreational facilities. BLM's management program of "balanced use" is similar in scope to the Forest Service's "multiple use" program.

Recently there has been rapid expansion in the multipurpose use of forest land, particularly in relation to timber management and outdoor recreation. The major resources of forest land in the basin--water, timber, recreation, wildlife, and forage--are discussed elsewhere in this report.

Land Class and Cover Type Classification. Land class and cover type classification for the North Coast Drainage Basin are shown in table 6. This classification is based primarily on the U. S. Forest Service system of four classes which are commercial forest, noncommercial forest, reserved forest, and nonforest.

Commercial forest land is forest land that is (a) producing, or is physically capable of producing usable crops of wood, (b) economically available now, or prospectively for timber harvest, and (c) not withdrawn from timber harvest. Commercial forest land is further subdivided by cover types.

Noncommercial forest land is forest land that is physically incapable of producing usable crops of wood because of adverse site conditions, or is so physically inaccessible as to be economically unavailable for timber harvesting within the foreseeable future.

Reserved forest land is forest land, either productive or nonproductive with regard to timber growth potential, that is withdrawn from timber harvest through statute, ordinance, or administrative order. Reserved forest land has been included in the noncommercial class in this report.

Nonforest land includes all land that is not at least 10 percent stocked with trees (except for nonstocked cutover forest land). Examples are cultivated land, range, dunes, cities, towns, lakes, and streams.

PROTECTION OF FOREST RESOURCES

Protection from Fire

Fire protection for the forest resources in the North Coast Drainage Basin is primarily the responsibility of the State Forestry Department, but the Federal Government and rural fire districts also have areas of responsibility. The land within the Siuslaw National Forest is protected by the U. S. Forest Service. The rural fire districts protect land and wooded areas

Table 6.--Forest area and timber volumes by forest type and ownership class, North Coast Drainage Basin, Oregon, 1963 1/

Forest type	National forest		Other federal		State of Oregon		County and municipal		Large private		Other private		Total	
	Acres	MMBF	Acres	MMBF	Acres	MMBF	Acres	MMBF	Acres	MMBF	Acres	MMBF	Acres	MMBF
Subbasin 1, Tillamook:														
Commercial forest:														
Softwood:														
Sawtimber 2/:														
Douglas-fir	53,030	2,262	6,930	703	1,760	68	820	65	11,740	1,186	5,580	565	79,860	4,849
Hemlock and other	25,460	2,372	5,630	536	7,220	236	1,170	112	14,500	1,386	12,600	1,190	66,580	5,832
Young growth:														
Douglas-fir	4,030	...	11,640	...	145,830	...	1,590	...	15,260	...	6,000	...	184,350	...
Hemlock and other	1,960	...	11,390	...	13,890	...	1,340	...	32,050	...	9,940	...	70,570	...
Hardwood 2/	22,970	741	13,440	136	7,750	79	1,180	12	17,620	177	8,810	84	71,770	1,229
Nonstocked	2,070	...	4,570	...	48,150	...	2,700	...	12,230	...	6,250	...	75,970	...
Noncommercial forest:														
Reserved	280	26	...	...	1,430	85	...	...	...	...	...	...	1,710	111
Nonproductive	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Total	109,800	5,401	53,600	1,375	226,030	468	8,800	189	103,400	2,749	49,180	1,839	550,810	12,021
Subbasin 2, Clatsop:														
Commercial forest:														
Softwood:														
Sawtimber 2/:														
Douglas-fir	...	...	80	2	850	29	70	7	44,820	1,148	11,480	496	57,300	1,682
Hemlock and other	...	...	140	6	9,600	303	130	12	43,600	2,047	12,310	603	65,780	2,971
Young growth:														
Douglas-fir	...	...	3,040	...	118,240	...	640	...	62,480	...	10,920	...	195,320	...
Hemlock and other	...	...	70	...	20,440	...	240	...	42,810	...	9,470	...	73,030	...
Hardwood 2/	...	...	2,250	...	17,150	51	440	...	55,070	500	9,150	102	84,060	653
Nonstocked	...	...	...	...	32,400	...	300	...	4,720	...	2,190	...	39,610	...
Noncommercial forest:														
Reserved	...	...	...	...	1,850	123	...	...	...	...	...	...	1,850	123
Nonproductive	...	...	...	...	...	...	...	...	...	...	...	...	...	...
Total	...	...	5,580	8	200,530	506	1,820	19	253,500	3,695	55,520	1,201	516,950	5,429
Subbasin 3, Columbia:														
Commercial forest:														
Softwood:														
Sawtimber 2/:														
Douglas-fir	...	...	...	...	80	1	320	8	34,610	714	28,870	454	63,880	1,177
Hemlock and other	...	...	...	...	4,220	172	590	26	69,970	3,039	17,590	692	92,370	3,929
Young growth:														
Douglas-fir	...	...	670	...	30,370	...	2,520	...	36,200	...	25,060	...	94,820	...
Hemlock and other	...	...	90	...	5,590	...	580	...	52,310	...	13,720	...	72,290	...
Hardwood 2/	...	...	80	...	8,510	18	2,190	15	40,290	536	27,730	233	78,800	802
Nonstocked	...	...	...	...	6,200	...	...	...	...	...	230	...	6,430	...
Noncommercial forest:														
Reserved	...	...	...	...	5,300	200	4,200	...	...	...	...	...	9,500	200
Nonproductive	...	...	...	...	750	...	...	...	...	...	...	...	750	...
Total	...	...	840	...	61,020	391	10,400	49	233,380	4,289	113,200	1,379	418,840	6,108
North Coast Drainage Basin:														
Commercial forest:														
Softwood:														
Sawtimber 2/:														
Douglas-fir	53,030	2,262	7,010	705	2,690	98	1,210	80	91,170	3,048	45,930	1,515	201,040	7,708
Hemlock and other	25,460	2,372	5,770	542	21,040	711	1,890	150	128,070	6,472	42,500	2,485	224,730	12,732
Young growth:														
Douglas-fir	4,030	...	15,350	...	294,440	...	4,750	...	113,940	...	41,980	...	474,490	...
Hemlock and other	1,960	...	11,550	...	39,920	...	2,160	...	127,170	...	33,130	...	215,890	...
Hardwood 2/	22,970	741	15,770	136	33,410	148	3,810	27	112,980	1,213	45,690	419	234,630	2,684
Nonstocked	2,070	...	4,570	...	86,750	...	7,200	...	16,950	...	8,670	...	122,010	...
Noncommercial forest:														
Reserved	280	26	...	...	8,580	408	...	...	...	...	...	...	13,060	434
Nonproductive	...	...	...	...	750	...	...	...	...	...	...	...	750	...
Total	109,800	5,401	60,020	1,383	487,580	1,365	21,020	257	590,280	10,733	217,900	4,419	1,486,600	23,558

1/ USFS forest survey and state forest inventory adjusted to 1963.
2/ Includes sawtimber found in stands classed as young growth.

adjacent to the towns. The remainder of the basin is state protected.

Tillamook Burn Area. The area of major concern is the often burned portion of Tillamook and adjacent counties (map 8). Since the turn of the century, this area has been damaged by at least four major fires. The first was in 1918 when several thousand acres in the Kilchis River-Cedar Butte area were burned. Then, "Three times--in 1933, 1939, and 1945--fire erupted to sweep westward toward the sea, with howling east winds, low humidities, and drought its allies. All told some 350,000 acres were burned, of which 255,000 have since been acquired by the state." 1/

After the 1933 fire, a reforestation survey was made by Leo Isaac and G. S. Meagher. They found that the area of the 1918 fire was a barren waste with eroding hillsides. They offered this prediction, "Fire offers a most serious threat to the new forest that is getting on this great burned area. The barren waste on the Cedar Butte double burn furnishes a striking picture of the conditions that might be expected in the future if subsequent fires sweep over the area...". 2/

"The rugged terrain and abundant snags make the Tillamook Burn a fire-fighter's nightmare (photo 4). The 1939 and 1945 fires attained their disastrous proportions simply because there was nothing that could be done to stop them. The initial action was delayed by incomplete detection and lack of access roads, and once the flames had raced up the steep slopes and climbed into the unbroken sea of snags they spread at will with every gust of wind.

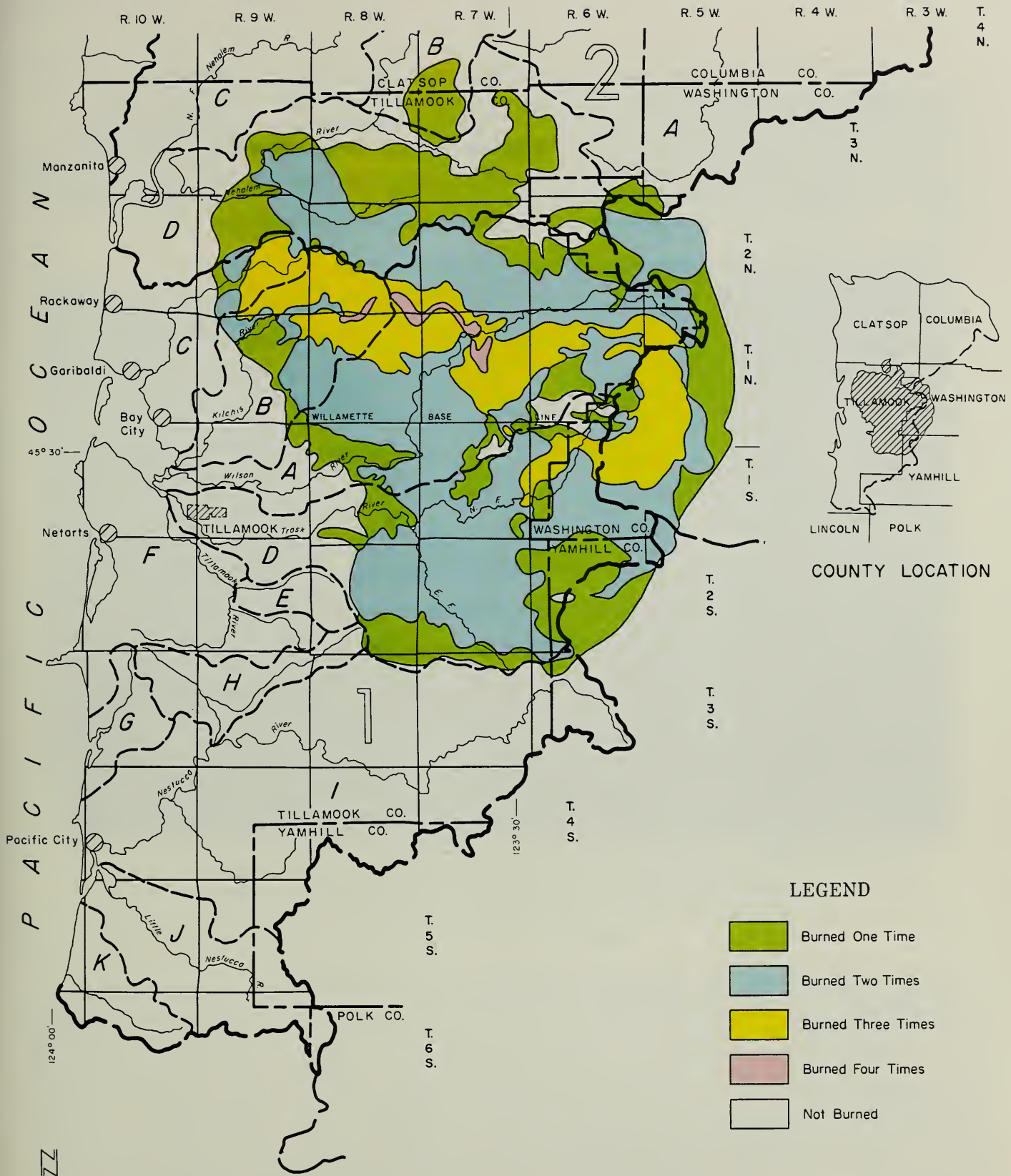
"In 1945 there were 2,000 men available with a virtually unlimited supply of cats, pumps, and fire-fighting tools. There were miles of hand trail and bulldozer trail constructed, and thousands of gallons of water were pumped on the fire. On the ground the fire was stopped--several times--and was held where the snags were scarce. Elsewhere the flames continued to spread from snag to snag until finally quenched by the fall rains.

"With the vivid memory of this experience in mind it was felt that it would be a waste of time and money to proceed with an extensive reforestation program until adequate protection measures had been taken. To 'fireproof' the Burn would be an impossibility. But through improved detection facilities; through the construction of access roads; through the provision of properly located and well equipped suppression crews; and, above all, through the construction of snag-free fire breaks along which firefighters could make a stand the Tillamook Burn could be a reasonable risk." 3/

1/ From Burn to Tillamook Forest, State of Oregon, Department of Forestry, May 1964.

2/ Reproduction on the Tillamook Burn, L. A. Isaac & G. S. Meagher, Forest Research Notes #18, PNWFES, March 25, 1936.

3/ "Rehabilitation of the Tillamook Burn", Oregon State Board of Forestry, D. L. Phipps, State Forester, May 15, 1962.



MAP 8

TILLAMOOK BURN 1918, 1933, 1939 & 1945

NORTH COAST DRAINAGE BASIN

OREGON

DECEMBER 1964

U. S. DEPARTMENT OF AGRICULTURE, SOIL CONSERVATION SERVICE ... M-4139

Strong public sentiment prompted Governor Earl Snell to appoint a committee to explore methods, policies, laws, and actions affecting the state's forestry program. As a result of the committee's recommendations dealing with finance, research, and organization, the 1947 Legislature submitted a constitutional amendment to the voters which provided for a bond issue to finance the protection and rehabilitation of not only the Tillamook Burn but other denuded state-owned lands.

Photo 4.--The rugged terrain and abundant snags make the Tillamook Burn a firefighter's nightmare. RBSP photo.

As a result of the finances made available through the bonding program, considerable progress has been made in reducing the fire hazard in the Tillamook Burn area. Two hundred and twelve miles of snag-free corridors, as much as a half mile wide in spots, have been completed (photo 5). These corridors were planned to divide the Burn into major compartments. These will be supplemented by a secondary system further subdividing the compartments to the extent that conditions of topography and hazard warrant. Besides the corridors, nearly 160 miles of roads for fire, reforestation, and timber sale access have been built, along with three new lookout stations for detection purposes.

The preliminary protection plan called for the construction of five new lookouts and provisions of quarters, personnel, and equipment for five suppression crews with five men in each. At the present time, three lookout stations and one 6-man suppression crew are being provided by rehabilitation funds in addition to the standard-protection facilities for all forest lands

in Northwest Oregon.

A 75-man forest work camp manned by inmates of the State Penitentiary was located on the south fork of the Wilson River to aid in snag-falling, roadbuilding, and tree-planting programs. In 1959, two 20-inmate fire-fighting crews were organized and made available on a statewide basis.

Photo 5.--Ridgetop snags have been cut to form firebreaks around the major drainages in the Tillamook Burn. RBSP photo.

Protection from Insect, Disease, and Animal Damage

Protection of the forests of the North Coast Drainage Basin from insect, disease, and animal damage is primarily the responsibility of the individual landowners and managers; however, many owners join together in combatting forest-pest problems. Their cooperative efforts are coordinated by the Northwest Pest Action Council, an organization of public and private land managers. The U. S. Forest Service makes forest insect and disease detection surveys and provides funds for pest control on all forest lands under the Cooperative Pest Control Act. The State of Oregon and private landowners share in financing pest control projects on private land.

Important forest insect pests include the Douglas-fir beetle, the hemlock looper, the Sitka spruce weevil, and the spruce budworm, all of which have reached epidemic numbers in past years. Insect pest populations are presently at an endemic level, killing an occasional weakened tree. Total losses from insects are, however, quite large. Control of forest insects lies primarily in keeping forest stands in a vigorous condition. This

includes prompt disposal of logging slash and windblown or fire-killed timber which may provide a breeding place for insects, and promptly suppressing epidemic outbreaks of insect populations.

Many areas of extensive blowdown occurred as a result of the Columbus Day storm in 1962. Every effort was made to remove this material from the forests by 1964 to avoid a Douglas-fir beetle epidemic. Because chemical control of this beetle is not feasible, the only means to keep infestations at a safe level is to rely on natural enemies and a healthy, vigorous forest.

In several areas within the basin, deer damage to fir reproduction is heavy. The deer repeatedly browse some young trees until they resemble a cabbage plant. In these trees, the terminal buds are continually removed, and lateral branches are stimulated to grow vertically. If and when the deer are controlled, the tree usually recovers and resumes normal growth habits. Many systems have been tried, but no effective, economical method has yet been found to control deer damage.

Several of the tree farms in Clatsop and Columbia Counties have a management problem arising from black bears tearing away bark and chewing on the cambium of pole-size Douglas-fir trees. If the cambium is destroyed completely around the tree, death results. Even if the tree is not girdled, the wound will serve as an entry way for disease or cause deformation which materially lowers the value of the tree. Because the damage is so widespread, several owners have hired bear hunters, and most owners encourage bear hunting.

TIMBER

Approximately 1,472,000 acres of the basin are classed as commercial forest land and contain 23.1 billion board feet of softwood timber (table 6). 4/

The Coast Range, which gives the basin a broken mountainous terrain, also roughly divides it into two broad, forest types. The western portion is a coastal belt with a climate of moderate temperatures, abundant rainfall, and frequent periods of fogs. Ideal conditions prevail for the western hemlock-Sitka spruce forest type. Hemlock is predominate over a large part of this portion of the basin. It occurs both in pure stands and in mixtures in which spruce is a principal associate and Douglas-fir a minor associate. Red alder, usually in pure stands, covers the bottom lands and lower slopes along stream courses. This hardwood is also frequently found in openings in the conifer types. The eastern portion of the basin, consisting of the western slopes of the Coast Range, is also an area highly favorable for forest growth, especially for Douglas-fir. This is the major species over a very large part of the area, occurring in both pure and mixed stands. Hemlock and red alder are frequent associates, and western red cedar is occasionally present.

Logging and Wood-Using Industries

The logging and sawmill operations were among the earliest in Oregon. They began with the first white settlements in the area; Fort Astoria was

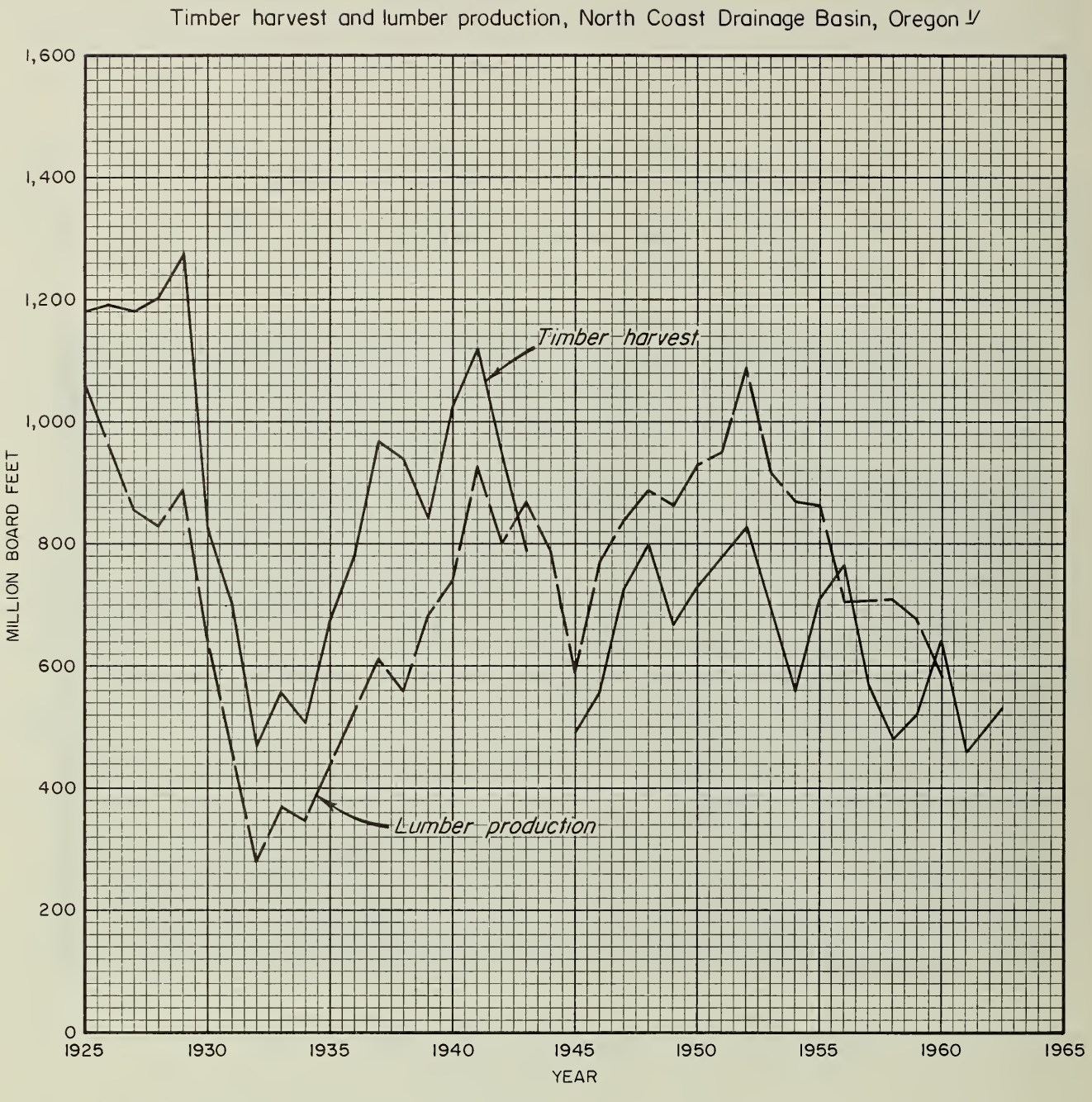
4/ Timber volumes used in this report are in terms of log scale; Scribner rule, in trees 11 inch and larger in diameter.

first settled in 1811. In early years, bull team operations removed the large, old-growth timber adjacent to the Columbia River; later, highlead logging with steam donkey and railroad opened up the interior portions; and since World War II, tractor and truck operations have logged a large area on the coast side.

The industry reached a peak during the 1920's when Columbia and Clatsop Counties vied with each other to lead the state in log volume, but during the 1930's, both logging and milling reached an all-time low. Production increased during the late 1930's and in 1941 almost equalled the all-time high of 1929. Since then, production has generally declined to about half of the peak rate (figure 5).

Photo 6.--Small sawmills such as this were very numerous but have practically vanished. SCS photo.

Lumber production has exceeded timber harvest since the early 1940's. Logs have been imported from other basins to supply the large cargo mills which were established along deep water ports. The number of mills has been reduced markedly in the past 20 years (photo 6). In 1947, there were 84 sawmills which were active compared to 20 in 1957 and 15 in 1963. In addition to the sawmills, there are four plywood and veneer mills and one sulfate process paper mill. The total installed capacity of active mills exceeds 600 million board feet per year.



1/ CLATSOP, COLUMBIA, TILLAMOOK TIMBER HARVEST 1925-30, 1932-62, LINCOLN, TILLAMOOK, COLUMBIA, AND CLATSOP 1931; CLATSOP, COLUMBIA TILLAMOOK, AND LINCOLN COUNTY LUMBER PRODUCTION 1925-40, 1942-60, CLATSOP, COLUMBIA, CURRY, LINCOLN, AND TILLAMOOK COUNTY 1941. USFS AND WCLA.

Figure 5

Harvesting and Regeneration Practices

Harvesting practices have changed greatly over the years. In the early days of logging, Douglas-fir was the king, and clearcutting was the method. A logger would start at one edge of an ownership and work his way to the other side. If a forest fire burned out the operation, he would move to

another area and start again. The general pattern was for whole drainages to be logged at one time, leaving the lower valued species to be destroyed by fire or wind storms.

A system of scattered clearcuts has now evolved. The most common harvesting practice on public lands is the establishment of clearcut units of approximately 40 acres surrounded by green timber which provides a seed source and also breaks the continuity of highly flammable logging slash (photo 7). All species of sawlog size have a market at the present time. Even the so-called "worthless" alder is marketable when the trees are large enough.

Photo 7.--Scattered clearcuts and hilltop seed blocks is the typical timber harvesting practice in the basin. RBSP photo.

Cable logging systems are now generally used on the steep slopes in the Coast Range. Tractors are used on more gentle ground; however, on some areas, old tractor logging roads, stacked one on top of the other like steps, are still visible on the hillsides.

In the days before the development of adequate highways and powerful trucks, the logs were transported to the sawmill by railroad or raft. Log rafts are still moored or towed in the estuaries of the larger streams.

As soon as possible after logging, the slash is burned under controlled conditions. This is done to reduce the fire hazard and to facilitate reforestation by reducing the brush competition. The Siuslaw National Forest

has pioneered summer burning of Douglas-fir logging slash. It has found that by burning when the slash and weather conditions are favorable, it can dispose of its yearly accumulation of slash between April and October, but most generally between June and September. This system usually requires complete mop up of all fires on the burned areas and frequent patrol to put out any hold-over fires. During the past 10 years, the system has proved effective and extremely successful.

In the fall and winter following slash burning, the clearcuts are either planted with 2-year-old Douglas-fir seedlings or seeded with Douglas-fir seed (photo 8). Hemlock and spruce are seldom planted because they will seed from nearby trees quite satisfactorily if the area is not invaded by brush. If planting is delayed past the first winter, a jungle of brush species is likely to take over the site. This brush jungle is composed of various combinations of salal, salmonberry, red alder, vine maple, ocean spray, bracken fern, and several species of blackberries. After a timber site is captured by brush, the brush must be killed by spraying with herbicides to allow the much more valuable conifers to reproduce and develop; a timber crop from the site will be delayed for years until the conifers can become established in the brush and grow through the canopy. A brush invasion may lengthen the period between commercial harvests by 40 years. The economic importance of reforestation cannot be overlooked. The growth rate on average timber land in the basin can be expected to exceed 500 board feet per year. When Douglas-fir stumpage is selling for $30 to $40 per thousand board feet, a landowner is losing $15 to $20 per acre each year that his forest land is not producing a commercial crop.

Most young timber stands need intensive cultural treatment to improve the quality and quantity of wood growth. This can be achieved by thinning, weeding, and intermediate harvest cutting in young stands to remove dying, damaged, and overcrowded trees to give the remaining trees more growing space (photo 9). Public and private owners have been doing limited amounts of thinning or intermediate cutting in stands over 50 years old on gentle terrain; however, little has been done in stands less than 50 years old or in stands on terrain too steep for skidding with horses or small tractors. Improved markets for small logs and development of equipment and techniques for thinning on steep terrain would help to improve the economic feasibility of thinning. Young-growth management research and successful rehabilitation of the Tillamook Burn will play a vital role in the development of forest management in this basin.

Rehabilitation in the Tillamook Burn 5/

The problem of rehabilitating the Tillamook Burn has complications which test the ingenuity and patience of a forester. The more important of these complications are mountains, snags, loggers, and brush.

5/ The basic information for this section is from publications of the State Forester.

Photo 8.--Some cones are cut to determine how many live seeds are available to supply the needs of North Coast Drainage Basin. SCS photo.

Photo 9.--The dead, dying, suppressed, and crowded trees were removed from this young Douglas-fir stand. SCS photo.

The logging complication was a mixed blessing. Salvage logging began in the late 1930's and was greatly accelerated by the demands of World War II. At the time of the 1945 fire, at least 125 operators were logging in the Burn area. Between 5 and 6 billion board feet of Douglas-fir had been salvaged by 1955. Since then, an additional 2 billion board feet has been harvested.

At the beginning of the rehabilitation in the Burn, salvage logging operations were active in every drainage. Logging reduced the number of snags and logging roads provided access for fire protection and reforestation; however, the manner of logging caused complications to the reforestation and fire-proofing projects and slowed the rehabilitation job.

Although the State Board of Forestry became landowner of 250,000 burned acres, the state did not own the snags on all the land. Many of the former owners retained title to the timber for long, and in some cases, indefinite periods of time. The best of the burned timber could be profitably transported to distant points for manufacture of plywood and high-grade lumber. Sawmills within the Burn and immediately adjacent to the perimeter also cut snags into lumber. The much shorter hauling distance to local mills allowed for a much higher degree of utilization. Unfortunately, the salvage logging was not an integrated operation. Contract holders were reluctant to give up any part of a contract area for fear additional salvable material might be lost to them.

This continued logging on large portions of the Burn hampered the rehabilitation projects, particularly reforestation during the first six years of the program. Logging activity has gradually lessened during the past few years. Many of the older operators and companies have moved to other locations or have gone out of business. Several large areas in major drainages are now available for reforestation and this phase of the program is proceeding as rapidly as possible. Brush and animal damage to small seedlings has now replaced the logger as a problem to reforestation. Encroachment of brush species, particularly on the western or coastal side of the Burn, has become more severe with each passing year. As the brush-free areas are reforested, brush eradication techniques become increasingly important on the remaining area. Aerial spraying is effective in controlling some of the brush species. Scarification with tractors has also been used successfully in some areas. Animal damage to seedlings by deer, rabbits, and mountain beaver has also become more severe each year as more tree plantations are established. Buildups in both deer and rodent populations beyond the available food supply are at least partly responsible for the increased damage to young tree growth. No adequate techniques have yet been found to control rodent damage.

Since the inauguration of the rehabilitation program, nearly 54 million seedlings have been planted on almost 70,000 acres of land (photo 10).

The aerial seeding program in the Tillamook Burn began in the fall of 1949. Over 100,000 acres have been seeded. Aerial seeding has definite limitations with respect to cover and exposure. These limitations can be partially overcome by increasing seeding rates or by removing the cover. Local failures can be expected but the failures can be corrected with a small

Photo 10.--Rows of planted trees are becoming more noticeable within the Tillamook Burn. RBSP photo.

additional outlay of a second seeding or hand planting. Since 1956, seeding projects have incorporated the use of endrin as a rodenticide. When endrin is applied directly to the tree seed, it has proved to be less costly than pretreatment of the area. Effective rodent control plus excellent growing conditions during the past few years have produced stocking on aerial seeding projects well above that experienced in earlier ones. Future plans call for the completion of the snag-free corridor system and access road program as rapidly as salvage logging will permit. Reforestation work will be coordinated with forest protection developments so that planted and seeded areas will have the maximum protection from fire. The continued employment of special fire crews and lookouts in the Burn plus the availability of the South Fork crew for fire action will do much toward accomplishing this objective (photo 11).

The rehabilitation program is costly. Approximately 8 million dollars has been invested to date in the program. Soon the project will start yielding returns since the Douglas-fir plantations are now 30 to 35 feet in height. The Burn is becoming a forest. 6/

6/ Rehabilitation of the Tillamook Burn, Oregon State Board of Forestry, May 15, 1962.

Photo 11.--Green fir trees are taking over a landscape that was recently covered only with blackened snags and brush. RBSP photo.

Sustained Yield Potential

The determination of the annual sustained-yield potential for the forested areas is basic to the forecasting of forest-industry development in the basin. Because of the fire history in the past 120 years, old-growth timber is quite rare. Almost all of the commercial timber is less than 100 years old. This basin has been utilizing young-growth timber for a number of years, but because of the high forest site index, large sawtimber (over 21 inches) is not uncommon.

Natural growth conditions are important in the calculation of annual sustained-yield potential, but several additional factors need to be considered. The following assumptions were made in these calculations for the North Coast Drainage Basin:

1. Average site index was 160.
2. Harvested areas would be reforested within five years.
3. Protection level would be maintained and no catastrophies would occur.
4. Stands would tend toward normality as indicated by Empirical Yield Tables published by Weyerhauser Timber Company in 1947.
5. Final harvest cut would be made at age 85.
6. Approximately 10 percent of hardwood stands would be converted to conifers.

7. Forest taxation policies would not force liquidation.

After making these assumptions, the potential annual sustained-yield of softwood timber was estimated to be 998 million board feet per year.

GRAZING

Approximately 26,200 acres of forest land in the basin are grazed. This is predominately private land in the stream bottoms near farms. It consists of land that varies from relatively open, 10 percent stocked to completely stocked forest stands. The slopes vary from gentle to steep except in areas with intermixed cropland where the gentler slopes were cleared for cropland leaving the steeper slopes in forest. The forage is generally of low quality, mostly brush but with some good pasture in small openings in the bottoms.

Approximately 75 head of cattle graze on the Siuslaw National Forest. The grazing permit areas are near the stream bottoms in natural meadows. It is anticipated that this use will be reduced in the future as trees invade the old fields.

WATER

Watershed management, with its associated problems and opportunities for enhancement of the water resource, is discussed in the "Water Related Problems, Needs, and Opportunities Chapter" of this report.

Water Requirements on Forest Land

Few quantitative estimates have been made of the many consumptive and nonconsumptive water requirements on forest land. The largest single consumptive use is for plant growth, but this has not been estimated due to the complexity of measuring the evapo-transpiration process. The consumptive water requirements for the administration and management of forest lands are small; but, even though these requirements are small, they are important and should be considered in planning the development and use of water resources in the basin.

Domestic. Domestic water uses in relation to forest land include the following:

1. Water used at field administrative stations of both public agencies and private companies.
2. Water used at public recreational sites and at recreational facilities such as summer homes, organization camps, and resorts.
3. Water required for domestic purposes by other forest users including loggers, roadbuilders, and local residents while working or living in forested areas.

Water requirements for all these uses are expected to increase as forest areas are used more heavily and managed more intensively. Domestic use for recreation can be expected to increase at the greatest rate. An eightfold increase in recreational visits to this basin is expected in the next 40

years. Water use for recreational areas can be expected to increase at an even greater rate because of the emphasis upon installation of improved water systems and flush toilets in camping and picnic areas.

Recreation. Domestic water use for recreation has been mentioned. Other water requirements are generally nonconsumptive and include habitat for fish and waterfowl and water for boating, swimming, and aesthetic enjoyment.

This use is expected to increase greatly. Any water development should make provision for recreational use, a recognized benefit under the provisions of P. L. 566 and other federal water development laws.

Livestock. Livestock water needs on the Siuslaw National Forest as well as other forested areas in the basin are expected to decrease in the future as the old fields and pastures are restocked with trees.

Industrial. Industrial water requirements on forest land are confined mainly to those required for construction and maintenance of forest access roads and the water used for storage and transportation of logs.

The consumption of water for access road construction and maintenance will probably continue at its present rate until such time as the primary access road system is completed; it is then expected to decrease considerably. Materials other than water will probably be used for dust abatement in the future, reducing water requirements.

Fire Control. Variable quantities of water are required for control of forest and slash disposal fires. Water must be readily available when needed, but it is not anticipated that much will have to be stored to meet these needs in this basin. No great change is seen for this water requirement in the future.

Resource Management

A resource manager in this basin, with its heavy precipitation, steep slopes, and erodible soils, has to deal with all the resources of the drainage, but his aim should be to utilize them in such a way that optimum quantities of clear, usable water are achieved. Watersheds in this basin convert large amounts of rain and some snow to streamflow. For example, in places where 72 inches of precipitation annually reach the soil, a plot only 10 feet square receives and disposes of 18.75 tons of water each year. It is essential that the manager include control of erosion in his plan of management and that he think of water and soils as resources of value like trees and forage.

Roads. Improperly built or maintained roads can be a major source of silt in streams; but well designed, built, and maintained roads will have a relatively minor adverse effect on the watershed. Some points to be considered when building roads are listed below:

1. Plan the road system in advance of construction.
2. Learn to recognize and avoid trouble spots.
3. Avoid sustained steep grades.

4. Provide adequate drainage.
5. Keep roads and fills out of streams.
6. Build with minimum earth movement.
7. Keep roads in good repair.
8. Revegetate disturbed areas such as cuts, fills, and borrows.

A particularly critical point in relation to roadbuilding is found in the vicinity of the "headwall" of the steep drainages of this basin. This is the area of almost perpendicular slopes at the extreme head of a stream. When this area is disturbed by roadbuilding or logging, a slump or "sluice out" is almost sure to follow. The debris from slumps has been known to scour a stream from the headwall area to the wide valley bottom several miles downstream.

Logging. Erosion from logging can be diminished by improving skidding practices and by rehabilitating trouble spots afterward. Logging methods and equipment use play a tremendous part in damaging or preserving water quality. The following points should be considered before logging an area:

1. Do not yard logs in or across streams.
2. Keep skid trails drained by directing the water into areas where the sediment can settle out.
3. Use tractors only on moderate slopes; uphill cable systems are preferred on slopes over 30 percent.
4. Areas with high erosion hazards should be seeded with nonsod-forming grass to assure rapid cover.

Controlled Burning. Controlled burning, a tool of forest management to reduce fire hazards, can be practiced under some conditions; however, some protective cover is always removed, and chances for erosion are increased. Erosion can be kept under control if a few precautions are used.

1. Controlled burning should be carefully supervised by competent foresters.
2. Slash burning should be closely correlated with weather conditions. Summer slash fires should be mopped up and then patrolled to prevent hold-over fires from breaking out later.
3. If fire-killed timber must be salvaged, precautions against erosion should be intensified, not relaxed.

Grazing. Grazing, like timber harvest and controlled burning, is an acceptable watershed practice only if soil disturbance can be minimized. The following principles should be applied to grazed portions of the basin:

1. Forage should be moderately grazed.
2. Livestock should be kept off the area when it is soft from excessive moisture.

These recommended measures for roadbuilding, logging, burning, and grazing are aimed at prevention and control of damage to the water and soil resources. Where they can be applied in each individual watershed, erosion can be kept within acceptable limits. The need for costly remedial measures

in the future will be virtually eliminated. 7/

Domestic and Municipal Water

A large portion of the water used in individual homes and by municipalities comes from forested watersheds. Small watersheds in the Siuslaw National Forest provide water for three towns and suburban water districts. These watersheds are managed to provide reasonably uniform flows of high quality water. In addition to providing water, other uses are permitted including timber production and hunting. Other municipalities, such as Astoria and Tillamook, own and manage significant portions of the watersheds to supply their needs.

There are also numerous individual water developments on both public and private forest land. In some drainages, almost every small stream provides water for at least one home.

As a result of the widespread use of small streams as a source of domestic water, timber-sale foresters check the cutting areas carefully to be sure that no water systems will be damaged as a result of timber harvest.

The U. S. Forest Service policy for management of municipal-supply watersheds restricts the areas for timber harvesting and suggests methods that will provide rapid regeneration and minimum disturbance. This will enhance the watershed.

7/ The basic information for this section was obtained from "Managing Forests to Control Soil Erosion", Dunford and Weitzman, Water, 1955 Yearbook of Agriculture. USDA 1955.

RECREATION IN THE BASIN

Recreational Opportunities

Recreation is a very important segment of the economy of the North Coast Drainage Basin. The major use is found in the shoreline or coastal portion. Several nationally recognized beach areas, as well as many locally used areas, are in the basin.

Camping in the parks, frolicking in the surf, fishing in the sea, gathering shellfish, and sightseeing and beachcombing along the beach are popular in the shoreline portion of the basin. Private and charter boats for deep sea fishing are moored and launched from several harbors in the basin. The streams of the area are recognized for their good runs of anadromous fish. The forests of the interior provide excellent big game hunting and the slough area on the Columbia River and the bays along the coast are popular waterfowl hunting areas.

Shoreline. The shoreline area, a complex of wide, sandy beaches and bluffs or rocky areas, affords easy and active forms of recreation. The Clatsop Sand Plains is a popular shoreline area in the basin. In 1935, the Soil Conservation Service started a reclamation project covering some 3,000 acres of the Clatsop Sand Plains. The sand dunes at this time had crept as far east as Coffenbury Lake and Battery Russell. This area is one of the outstanding examples of coastal dune stabilization in the world. "Going into the surf is fun whether one swims or not. It isn't necessary to be a mountain climber to take walks along the beach, and beachcombing is an activity that appeals to every one from toddler to octogenarian" (photo 12). 1/

One of the rarer beachcombing finds is the glass balls which wash ashore. These are used by the Japanese on their fishing nets as floats and when accidentally freed may be carried by currents to the coast of North America (photo 13).

The shoreline also provides the rock fishermen with the locale for their sport. Many people fish for cod, kelp fish, bass, and perch from the rocks along the coast and from the harbor jetties.

Tidewater. The tidewater area, consisting of narrow valleys with flat bottom lands, extends several miles inland on major streams. The main recreational attractions in these areas are fishing, clam digging, crabbing, waterfowl hunting, boating, and water skiing (photo 14).

1/ Shoreline Recreation Resources of the United States, ORRC Report No. 4, p. 4.

Photo 12.--Sunbathing and water play are popular forms of recreation at the north coast beaches. RBSP photo.

Photo 13.--Japanese glass fishing net floats are beachcombing treasures. RBSP photo.

Photo 14.--Bank or bridge fishing is productive for some fishermen. RBSP photo.

Nehalem Bay, Tillamook Bay, Netarts Bay, Nestucca Bay and the beaches of the Clatsop Plain area from the Columbia River to Seaside are the more popular clamming areas within the north coast area. Accurate figures on total participation in this activity are not available but a few people are always "digging" during low tides.

Many people have built vacation or retirement homes along the banks of the bays and rivers. Even in the shoreline portions of the major streams, fishing and boating take precedence over other forms of recreational use. Every bay has sport-fishing and charter boats to provide ocean fishing for the more adventurous during the summer months. Some of the sport-fishing and charter boats are launched directly through the surf on the south side of Cape Kiwanda at Pacific City (photo 15). Dory fishing, which was popularized in this area, is now spreading to other shoreline areas in the North Coast Drainage Basin. Fishing for salmon, steelhead, and cutthroat trout in coastal bays and rivers is popular during the late fall and winter months.

Interior. The interior of the basin is mostly forest land and a small amount of farmland. The recreational opportunities in this area are fishing, hunting, and the more passive activities of sightseeing and picnicking. One of the more popular places of interest in the interior is the Fort Clatsop National Memorial. The site of Fort Clatsop was preserved by the Oregon Historical Society and later donated to the people of the United States. The 125-acre Fort Clatsop National Memorial was authorized by Congress in 1958 to commemorate the winter encampment of the Lewis and Clark Expedition following its successful crossing of the North American Continent (photo 16).

Photo 15.--Dories are launched through the surf at Cape Kiwanda. RBSP photo.

Photo 16.--This replica of Fort Clatsop is an often visited tourist attraction. The original fort was constructed by Lewis and Clark for their winter encampment of 1805-06. RBSP photo.

Additional recreational developments in the interior portion of the basin consist of a few roadside areas along main roads and primitive camp areas along some of the smaller streams.

Trends in Use

The recreational use figures for this area show heavy use along the shoreline with a majority of the users concentrated at the southern and northern extremes. Relatively mild weather interspersed with dramatic winter storms along the coast allows year long use; however, the main surge of use is during the normal vacation period from Memorial Day to Labor Day.

Of the approximately 50,000 people who visited the recreational areas on the Siuslaw National Forest in this basin during 1963, over 47,000 of them, approximately 96 percent, were primarily interested in camping, picnicking, sightseeing, fishing, and hunting (table 7). Except for the extra surge of visitors as a result of the 1962 World's Fair, there has been a steady increase in recreational visits to national forest recreational areas in the basin in the past five years. The Forest Service anticipates an eightfold increase in recreational use between 1963 and 2000.

Table 7.--National forest recreational use by primary purpose of visit, North Coast Drainage Basin, Oregon, 1959-1963 1/

Primary purpose	1959	1960	1961	1962	1963
	Number	Number	Number	Number	Number
Camping	5,000	7,000	8,500	16,140	12,000
Picnicking	5,000	6,000	6,000	10,000	10,000
Sightseeing	9,400	13,300	12,600	26,100	9,700
Fishing	6,400	6,400	5,100	5,440	8,500
Hunting	1,600	1,500	2,800	4,670	7,200
Hiking	1,700	500	500	600	500
Swimming	700	1,000	1,000	1,600	100
Winter sports	...	...	200	160	100
Other	1,400	200	400	710	1,250
Total	31,200	35,900	37,100	65,420	49,350

1/ Siuslaw National Forest Recreation Statistical Reports.

The Bureau of Land Management has three campgrounds in the interior area. Recreational use figures are not available for these areas, but the BLM anticipates a seventeenfold increase in recreational use of the lands in the next fifty years. This will be caused by increased facilities and by improved access.

Attendance at state parks has increased from 1.0 million in 1959 to 1.1 million in 1963. During the same period, overnight use increased approximately 40 percent (table 8).

Table 8.--Recreational use of state parks, North Coast Drainage Basin, Oregon, 1959-1963 1/

Park	1959	1960	1961	1962	1963
			Day use		
Cape Lookout	151,071	157,617	186,623	159,594	147,964
Ecola	141,147	136,119	5,280	59,358	117,052
Fort Stevens	404,286	376,452	354,129	349,368	399,958
Hug Point	14,517	14,565	26,088	34,218	81,508
Oswald West	145,890	163,782	193,590	227,598	185,317
Saddle Mountain	19,368	19,602	23,544	24,732	26,492
Total	876,279	868,137	789,254	854,868	958,291
			Overnight use		
Cape Lookout	55,559	60,185	69,009	68,128	74,682
Fort Stevens	67,331	74,306	94,421	100,395	102,767
Oswald West	4,436	6,182	5,027	3,854	3,751
Saddle Mountain	795	1,054	1,026	719	463
Total	128,121	141,727	169,483	173,096	181,663
Total use	1,004,400	1,009,864	958,737	1,027,964	1,142,954

1/ Oregon State Highway Department, State Parks & Recreation Division, 1964.

This popularity of beach areas is not an accident. Because of the very nature of the North Coast Drainage Basin, the recreational opportunities available at any beach or shoreline in the world are available here with one possible exception--the surf temperature is too cold to invite swimming although many people play in the water (photo 17).

Not all sections of the shoreline can expect equal use as is indicated by existing use data. Those areas with wide, sandy beaches are the most popular in present patterns of outdoor recreation. Here the land and water are readily accessible. 2/ The safety of the warm sand is only a step away from the violent activity of the pounding surf. The stimulation of the foreign environment of the water and the relaxation of sunbathing are nowhere else so closely associated. Physical sport and mental relaxation are equally available.

The summary of forecast which was made by the Outdoor Recreation Resources Review Commission is considered to be as pertinent to this portion of the Oregon coast as it is to the nation's shorelines in general.

"The year 2000 will probably see a major increase in demand for recreational shoreline of all types to such an extent that in areas of metropolitan

2/ Op. cit., p. 47.

impact, 3/ most of the shoreline will be needed to satisfy the recreational demand, and some of it will have to be managed with much greater efficiency than at present.

"Shoreline which is further from metropolitan centers will receive increasing pressure for recreation use, although this pressure will not be as intense as that which is closer. Some of this shoreline has great value as superior natural environment or wildlife habitat. Other portions of it are valuable for superior recreation areas. All of these values need to be considered on their various merits, in the light of the necessity to assure shoreline use that returns the greatest public benefits." 4/

Photo 17.--Many people play and a few people swim in the surf at Cape Lookout. RBSP photo.

RECREATIONAL FACILITIES

The public recreational facilities available in this basin are as varied as the recreational opportunities. Overnight camping areas offer everything from carry-your-own-water to hot showers; rustle-your-own-firewood to electric hotplaces; furnish-your-own-candle to electric outlets for trailer lights. The more modern and convenient camps, which are found in the shoreline area, are now operated on a user-charge basis while the primitive do-it-yourself camps, which are found in the interior, are free.

3/ Within a two-hour drive of a large population center.
4/ Op. cit., p. 47.

Existing Facilities

The level of development of the existing recreational areas can be associated with the managing agency. The state has fewer recreational sites but they are larger and more intensively developed than those of other public agencies (table 9). For instance, Cape Lookout and Fort Stevens State Parks have facilities for over 600 tents and trailers. The facilities include hot showers and flush toilets; water, electricity, and sewer hookups at trailer sites; and tables and fireplaces at every camp and picnic unit. The federal, county, and municipal recreational areas usually include tables, fireplaces, and a water supply, although Barview County Park has facilities comparable to those found at the state parks. In addition to the publicly owned recreational areas, several camp and picnic areas are maintained by timberland owners in conjunction with tree farms.

Table 9.--Nonurban public recreational facilities, North Coast Drainage Basin, Oregon, 1964 1/

Area and ownership	Camping areas	Picnic areas	Viewpoints	Boat ramps	Area
	Number	Number	Number	Number	Number
Shoreline:					
Federal 2/	2	...	...	...	82
State	3	1	3	1	5,170
County and municipal	3	...	1	1	111
Tidewater:					
Federal 2/	...	...	...	...	...
State	...	1	...	...	5
County and municipal	1	1	...	7	20
Interior:					
Federal 2/	9	2	1	...	225
State	1	5	2	...	4,948
County and municipal	3	1	...	...	2,033

1/ Compiled from data obtained from Forest Service, Bureau of Land Management, State of Oregon, and county publications.

2/ Includes Forest Service, Bureau of Land Management, and National Park Service.

Because of the increased demand for recreational developments such as campgrounds, picnic grounds, boat-launching ramps, and improved hunting and fishing opportunities, all public land managers in the basin are making plans to meet the future requirements. The State of Oregon has four areas within the basin presently in its long-range development plan for state parks. These include additions to Cape Lookout and Fort Stevens State Parks to protect the existing park values. An overnight camping area on the sand spit at Nehalem Bay has been proposed. Also proposed is a new park development on

the Nestucca Sand Spit which would provide excellent beach and fishing opportunities near population centers.

In the Tillamook Burn area, the Oregon State Department of Forestry is considering the development of hunter camps and picnic areas. Because of the increased hunter use, additional control is needed on the location of hunter camps and campfires.

The Forest Service plans to develop approximately 10 additional recreational areas. These would be mostly in the interior. Consideration is being given to additional developments near Sand Lake.

Almost all of the proposed additional recreational facilities will be located close to water. While those along the shore will be few in number, they will be considerably larger than the developments proposed for the interior. The campgrounds and picnic grounds proposed for the interior will generally be located along the small streams for several reasons. In the Coast Range, the only land usually suitable for campground development is the bottom land along streams, and the only water available in the relatively primitive interior portion is along the established streams.

Opportunities for private recreational developments are good in the north coastal area because much of the available land is privately owned. Private recreational developments with a much higher income potential can be expected in the near future.

WILDLIFE

The wildlife resource provides a significant portion of the recreational attraction of the basin. The wildlife and game-fish resources of the state are managed by the Oregon State Game Commission while the commercial or food fishery is managed by the Fish Commission of Oregon. Habitat conditions, which have a marked influence upon the size of wildlife and fish populations, are controlled by the landowners.

Big-Game Animals

Black-tail deer and Roosevelt elk are popular big-game animals throughout the basin. Deer and elk numbers are closely associated with major habitat changes which occur rapidly in the coastal area. Big-game population levels were high immediately following the large Tillamook Burn. The rapid growth of vegetation throughout this large area has resulted in a decrease in the deer population and a relatively stable elk herd. Logging activity creates new habitat about as fast as it is lost to rapid regrowth.

In 1963, 29,000 hunters harvested approximately 10,500 black-tail deer and 1,835 Roosevelt elk in the basin.

Hunting pressure will probably continue to increase in the future. Although some private land is closed to hunting, most commercial timber companies recognize the need for an adequate harvest of big game and for good public relations. They have been encouraging hunting on their tree farms. As access to both public and private land is improved, hunting pressure will

tend to become more uniform. Even with improved hunter distribution, the hunters will continue to hunt the recent clearcuts because they do not like the dense ground cover found in other areas.

Small Game and Fur Animals

The principal upland game birds that inhabit the area are mountain quail, blue and ruffed grouse, and band-tailed pigeons. A few ringneck pheasants and California quail are also in the area. The most important upland game bird is the band-tailed pigeon.

Important fur animals are muskrats, minks, raccoons, otters, and beavers.

Predators are also scattered throughout the basin. The 1962-63 predator control report by the Fish and Wildlife Service indicates that raccoon, oppossum, and bobcat are the most common predators. During the period, 60 bear were taken by federal trappers.

Waterfowl

Migratory waterfowl in significant numbers congregate and winter in the lower Columbia River, Sand Lake, and Youngs, Nehalem, Tillamook, and Netarts Bays in the North Coast Drainage Basin. Farmlands within the basin also support substantial waterfowl populations at various times.

Anadromous Fish

All of the major streams in the basin have valuable runs of chinook salmon, coho salmon, steelhead and cutthroat trout. Chum salmon are present in limited numbers and good runs of shad are found in the larger rivers.

The anadromous fishery resource is extremely important to this basin and every effort should be made to protect and improve spawning access, rearing areas, and quality and quantity in all streams.

Several of the major landowners are cooperating in removal of debris jams which have been restricting passage. Even then, "slash from logging continued to be the primary cause of habitat reduction for salmonids. Considerable effort is necessary to maintain the original spawning and rearing areas." 5/

Sport Fishing

Sport angling for salmon has become a major attraction in the ocean and in bays and river mouths during the summer months. Salmon are taken by anglers in bays and streams when they are on their spawning migration in the fall.

Steelhead and cutthroat trout are not caught by sport or commercial fishermen at sea but they are taken after they have entered the bays and rivers on their spawning migration in the late fall and winter months.

5/ 1962 Annual Report, Oregon State Game Commission Fisheries Division.

In the off-shore summer salmon fishery at the mouth of the Columbia River, the Oregon State Game Commission estimates that anglers caught approximately 163,000 salmon in 1964. In 1965, the catch was over 300,000 salmon. These figures do not include the catch of salmon at Tillamook Bay, lower Nehalem Bay and Pacific City. Game Commission punch card returns show that the basin rivers provided a catch of 25,000 salmon in 1963--exclusive of the off-shore catch. Punch card returns for 1963 show that anglers caught 24,000 steelhead in the basin's rivers.

Commercial Fishing

The commercial fishery for anadromous fish of the North Coast Drainage Basin is of considerable value. From 1943 to 1949, there were over 723 thousand pounds of salmon and steelhead landed each year from the Nehalem River. Tillamook Bay and tributary salmon and steelhead landings averaged over one and a half million pounds annually for the same period.

Commercial fishing is now limited to off-shore waters and the Columbia River. All coastal streams were closed to commercial fishing in 1956.

Shellfish, rockfish, and flatfish that inhabit brackish water contribute to substantial sport and commercial fisheries.

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. Oyster production is dependent on silt-free sea water, with small amounts of fresh-water dilutions, as is found in most bays with entering streams. Oysters are dependent on a stable environment, and disturbance of the bottom or changes in turbidity, temperature, quality, and salinity of the water have adverse effects on these shellfish.

Resident Fish

"Resident fish management as distinguished from the management of migratory fish, such as salmon and steelhead, involves the development of trout and warm-water game fish angling opportunities." 6/

The majority of the streams and lakes contain trout. Based on a sample of 641 stream anglers, the Game Commission found they had caught an average 1-1/4 fish per hour while 448 lake anglers in the northern portion of the basin had caught just less than one fish per hour. In the Tillamook area, the bank fishermen caught approximately one-half fish per hour in the upstream portion while the tidewater bank fishermen caught only 38/100 of a fish per hour. The few drift boats above the tidewater portions did much better than other anglers either up or down stream; they averaged 1.3 fish per hour.

The fresh water lakes in the Seaside-Warrenton area contain varying populations of warm-water fish. The most common is yellow perch which

6/ OSGC Biennial Report, 1961-62.

averages about 7 inches in length. The growth of the large mouth bass, which were released in Burkes Lake as fingerlings in 1960, appears to be good.

Shellfish

Tidelands of Oregon's rivers and bays provide habitats for a variety of species of bay clams. "Bay clams", are species of clams found within the mouth of a river or bay although in some instances they inhabit the outer open beach.

The razor clams are usually found on the open beach but may be present inside several of the bays of Oregon.

The kinds of clams more commonly gathered in the North Coast area are: gaper clams, cockles, softshell clams, butter clams, littleneck clams, and piddocks (photos 18 and 19).

Photo 18.--This man is digging for softshelled clams in Nestucca Bay. RBSP photo.

The bays of the North Coast area where clamming can be enjoyed are the Nehalem, Tillamook, Netarts, and Nestucca. The Fish Commission of Oregon has an excellent publication, The Bay Clams of Oregon, which gives information on location, description, and harvesting of clams.

Clams and Dungeness crabs are gathered along the coast and in the bays both for commercial and recreational purposes. Some oysters are gathered by

Photo 19.--These softshelled clams were dug in the mud flats of Nestucca Bay. RBSP photo.

sportsmen but most are gathered by the commercial enterprises who cultivated them. It is illegal for sportsmen or recreationists to pick up commercially produced oysters without permission of the owner.

AGRICULTURE IN THE BASIN

LAND USE AND AGRICULTURAL PRODUCTION

Agriculture in the North Coast Drainage Basin depends, to a large degree, on production of forage for livestock. The land base for agriculture consists of 26,200 acres of grazed forest land, 19,650 acres of rangeland, and 81,600 acres of cropland (table 10). Only 7.4 percent of the land in the basin is used for agricultural purposes.

Table 10.--Agricultural land use, North Coast Drainage Basin, Oregon, 1964 1/

Land use	Land area	
	Acres	Acres
Grazing land:		
Forest	26,200	
Range	19,650	
Total		45,650
Cropland:		
Irrigated:		
Pasture	6,300	
Hay and silage	2,480	
Small grains	200	
Other crops	920	
Total		9,900
Nonirrigated:		
Pasture	38,300	
Hay and silage	25,120	
Small grains	2,300	
Other crops	1,580	
Total		67,300
Not harvested or pastured	4,400	4,400
Total		81,600
Total agricultural land		127,250

1/ USDA River Basin Survey Staff and U. S. Census of Agriculture.

The range and grazed forest lands are utilized by sheep, beef cattle, and goats. Rangeland is noncropland pasture and grazed forest land is land with at least 10 percent tree canopy that is grazed by livestock. Most of the rangeland is logged areas which have been improved for grazing by slashing, burning, and seeding to perennial grasses or mixtures of annual and perennial grasses. The grazed forest land is usually cutover areas of brush or timber adjacent to other agricultural land.

Pasture, hay, and silage, the most extensively grown crops, occupy 94 percent of the harvested cropland acreage and provide the major feed base for the dairy and livestock farms. The cropland is located on the valley floors adjacent to major streams (see map 7). Use of much of this land is presently limited to the production of pasture or forage crops because of frequent flooding incidence and of inadequate drainage.

About one-fifth of the hay and silage acreage is harvested as silage and the rest as hay. In many cases, forage from a given field may be harvested by a combination of cutting for hay or silage and of pasturing. The decision as to how to harvest in a given year is influenced by weather, feed reserves, and price of hay from other areas.

Photo 20.--A typical pasture being irrigated near Tillamook.
SCS photo.

Small grains, grown on 3 percent of harvested cropland, are mainly "cleanup" crops prior to reseeding to pasture. Other crops, including grass seed, holly, cranberries, vegetables, fruits, and berries, are grown on about 3 percent of the harvested cropland. There are about 1,500 acres of grass

seed in the "other crop" category.

About 14 percent of the cropland pasture and 9 percent of the hay and silage land are irrigated. Forage crops account for 89 percent of the total irrigated acreage in the basin. Small grains account for 2 percent and other crops such as cranberries, vegetables, strawberries, and horticultural specialties account for the other 9 percent.

Trends in agricultural land use for the basin counties are illustrated in figure 6. Harvested cropland increased from 1929 to 1944 as a result of land clearing and has decreased slightly since. Rangeland also increased from 1929 to 1939 as a result of clearing but has decreased significantly since. Most of the decrease in farmland acreage since 1944 has been a result of the sales of forest or range land to timber companies. The increase in the value of timber has been the dominant factor in reducing the acreage of rangeland and grazed forest land.

Forage yields in the basin vary because of such factors as soil, plant type, drainage, flooding, growing season, rainfall, irrigation, and management practices. One source of information on forage yields is the soil survey report for the Tillamook area. 1/ Forage yields were estimated for three levels of management for 29 soil series. The management practices and range in yields for each level are as follows:

Management level A - Soil is properly drained, fertilized with 10 tons of solid and some liquid manure every three years, and harrowed. The pasture is grazed all seasons. Noxious weeds and rodents are controlled. Dry forage yields range from 0.5 to 2.5 tons per acre.

Management level B - In addition to the above practices, improved varieties of grasses and legumes are used, one ton of lime per acre is applied every five years, rotation grazing is practiced, and land is not pastured when the soil is excessively wet. In addition to manure, fertilizer with 80 pounds of available phosphoric acid is applied yearly. Yields range from 1.5 to 3.5 tons per acre.

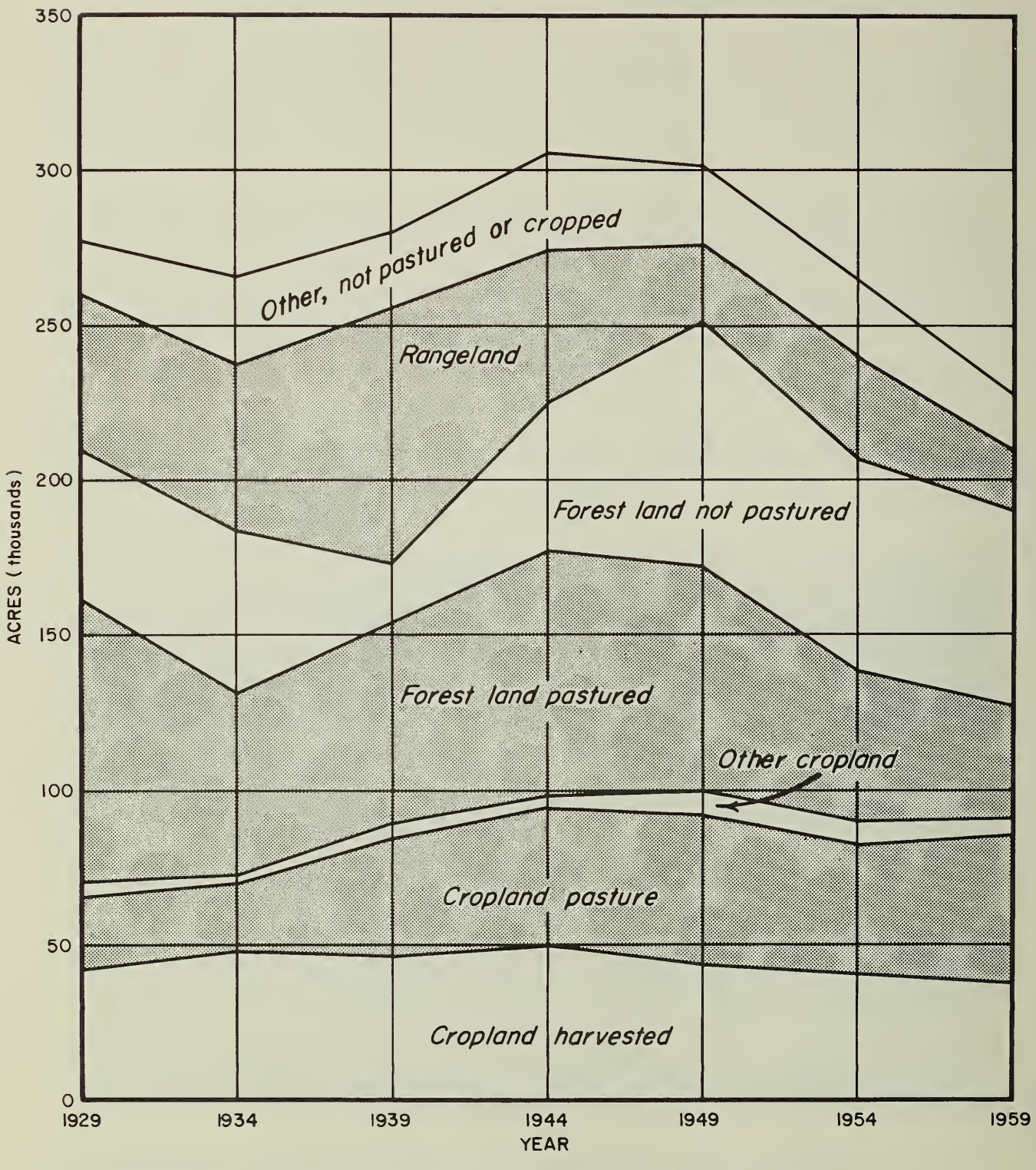
Management level C - In addition to above, supplemental irrigation is applied as needed. Yields range from four to five tons per acre.

Yields for a typical soil (Brenner silt loam, land capability class IIIw) under the three levels of management were estimated at 2.5 tons per acre for A, 3.5 tons per acre for B, and 5 tons per acre for C.

Yield information is also available from the U. S. Census of Agriculture. These yields do not, however, reflect total forage production because, in many cases, the acreage harvested for hay and silage is also pastured. Census data

1/ Soil Survey of the Tillamook Area, Oregon, Soil Conservation Service, USDA and Oregon Agricultural Experiment Station, August 1964.

Farmland use, North Coast Drainage Basin Counties, Oregon, 1939-59 1/



1/ U.S. Census of Agriculture Clatsop, Columbia, and Tillamook counties.

Figure 6

do not show significant differences in hay or silage yields on irrigated and nonirrigated land for a number of census years (table 11). Hay yields were about 0.4 to 0.5 tons per acre higher under irrigation. Silage yields were higher on irrigated land than on nonirrigated land in 1954 but lower in 1959. Increases in yields due to irrigation are apparently reflected in forage harvested as pasture.

Table 11.--Hay and grass silage yields, nonirrigated and irrigated, North Coast Basin Counties, Oregon, 1939-59 1/

Crop and year	Yield per acre	
	Nonirrigated	Irrigated
	Tons	Tons
Hay		
1939	1.94	3.02
1949	1.73	2.20
1954	2.00	2.43
1959	2.00	2.40
Grass silage		
1954	8.34	8.89
1959	8.84	7.25

1/ U. S. Census of Agriculture data for Clatsop, Columbia, and Tillamook Counties.

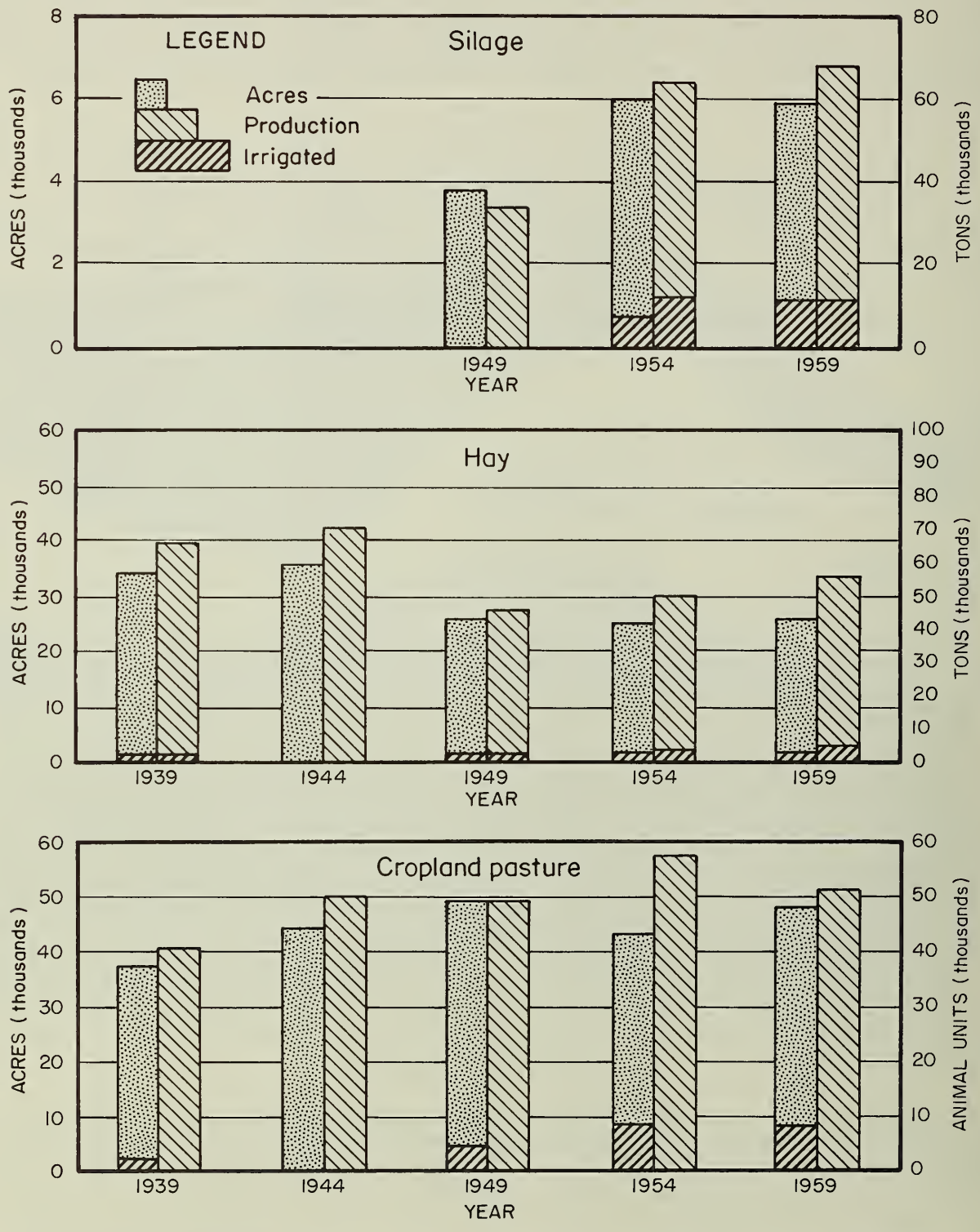
Trends in acreage and production of forage are illustrated in figure 7. Silage acreage and production have been increasing since 1949. Silage has several advantages over hay in the area. Harvesting and drying of hay are often hampered by late, wet springs; storage for winter use is also costly. Wet weather is less of a problem in harvesting silage and storage costs are lower. Also the practice of green-chopping and feeding dairy cattle in lots rather than pasturing is increasing in the area.

Hay acreage decreased significantly from 1944 to 1949 but has remained at about the same level since. Hay production has increased due to higher yields per acre.

Data in figure 7 suggest that total forage production in the basin counties has continued to increase from 1949 to 1959 even though cropland pasture acreage has decreased. Also of significance is that rangeland and grazed forest land decreased during this period which increased the need for feed from cropland pasture.

Forage productivity has been increased through improved pastures. Census data indicate that pastures of improved legume-grass mixtures have increased. Other inputs that have been added are irrigation (figure 7), commercial fertilizer, lime, and drainage (table 12).

Forage, acreage and production, North Coast Drainage Basin Counties, Oregon, 1939-59 1/



1/ U.S. CENSUS OF AGRICULTURE CLATSOP, COLUMBIA AND TILLAMOOK COUNTIES, OREGON

Figure 7

Table 12.--Selected inputs, North Coast Drainage Basin Counties, Oregon, 1949-59

Input and quantity used	Year		
	1949	1954	1959
Commercial fertilizer used: 1/			
Acres fertilized	...	16,469	16,084
Tons used	...	2,272	2,333
Tons per acre	...	.138	.145
Liming materials used: 1/			
Acres limed	...	1,651	1,893
Tons used	...	3,859	6,659
Tons per acre	...	2.34	3.52
Drainage, acres drained 2/	...	8,405	4,456
Feed purchased, thousand dollars 1/	3,544	3,593	3,486

1/ U. S. Census of Agriculture, Clatsop, Columbia, and Tillamook Counties.
2/ Data from Agricultural Stabilization and Conservation Service, USDA, annual reports 1949-59 for the three counties. Acreage shown for 1954 includes all land drained by open and closed drains from 1950 through 1954. Acreage shown for 1959 includes the same for the years 1955 through 1959.

Photo 21.--Liming a field prior to seeding it is a practice that is increasing in the basin. SCS photo.

CHARACTERISTICS OF AGRICULTURE

Number and Size of Farms

Of the 1,950 farms in the basin, 45 percent are commercial farms and 55 percent are part-time or part-retirement farms. 2/ In 1959, 61 percent of the farm operators worked off their farms, and 58 percent of the farm families had income from other sources that exceeded the income from their farms. Thus, nonfarm income is quite important to the farmers of the area.

Most of the part-time farmers work as loggers or in one of the jobs related to the forestry or recreational industries. Other farmers are simply retired people who raise a few products for their own use and for additional income.

Part-time farming in the basin is not new. Historically, half or more of the farmers have worked off their farms (table 13). The timber industry has been the major source of off-farm work and part-time farming was fostered in part by the seasonal and cyclical nature of this industry. Small acreages were sought to be used for subsistence in periods of unemployment.

Table 13.--Number of farms, average size of farms, and percentage of farmers working off farm, North Coast Drainage Basin Counties, Oregon, 1929-59 1/

Year	Farms	Average size of farms	Cropland per farm	Percentage of farmers working off their farms
	Number	Acres	Acres	Percent
1929	3,172	87	22	...
1934	3,753	71	19	49
1939	3,681	76	24	50
1944	3,919	78	17	55
1949	3,765	80	27	62
1954	3,327	79	27	58
1959	2,258 2/	101	40	61

1/ U. S. Census of Agriculture, Clatsop, Columbia, and Tillamook Counties.
2/ Number of farms decreased by 1,069 from 1954 to 1959. The decrease in number was 274 because of the change in definition of a farm by the Bureau of the Census.

2/ Commercial farms are defined in the Census of Agriculture as farms with a value of sales of $2,500 or more. Part-time farms are those with a value of sales of farm products of $50 to $2,499 and operators under 65 years of age who either worked off the farm 100 days or more or had other income from nonfarm sources that was greater than the value of farm products sold. Farms with a value of sales of farm products of $50 to $2,499 were classified as part-retirement if the farm operator was 65 years old or older.

Since 1944, the number of farms decreased in each census but the average size did not increase until the last census (table 13). The reason for this is that the reduction of farms was accompanied by a corresponding reduction of acreage being used for agriculture. Most of the reduction in acreage of agricultural land was either forest land or land suitable for growing timber. The increase in cropland per farm reflects the enlargement of commercial farms.

Livestock Economy

The agricultural land of the basin provides the forage base for 21,700 milk cows, 30,000 other cattle, and other livestock (table 14).

Table 14.--Estimated livestock and poultry numbers, North Coast Drainage Basin, Oregon, 1959 1/

Type of livestock	Total
	Number
Milk cows	21,700
All other cattle	30,800
Sheep	7,800
Goats	400
Hogs	4,000
Horses	900
Broilers	268,800

1/ U. S. Census of Agriculture, op. cit.

The valley pastures are the source of forage for most of the cattle while the sheep and goats are raised predominantly on the rangeland and the forest land.

The number of milk cows increased from 1920 to 1945 but has decreased since. The amount of milk sold, however, has not dropped correspondingly because the production per cow has increased (table 15).

Table 15.--Dairy farms, milk cows, and milk production, North Coast Drainage Basin Counties, Oregon, 1944-59 1/

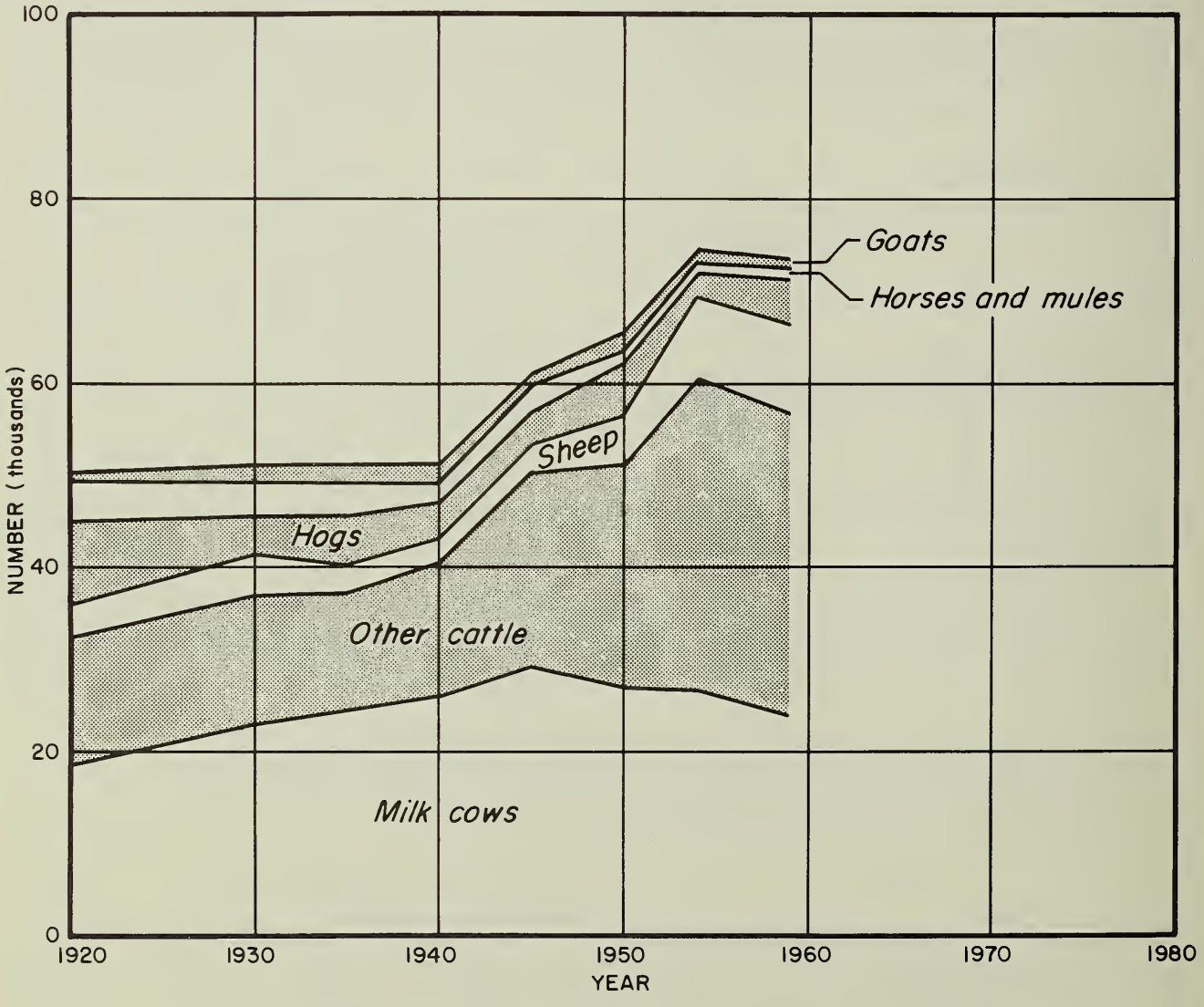
Type	Year			
	1944	1949	1954	1959
Dairy farms, number	1,400	1,008	985	590
Milk cows, number	28,823	26,475	26,570	23,251
Milk sold, million pounds	156.1	144.8	167.6	164.1
Milk sold per cow, pounds	5,420	5,470	6,310	7,060

1/ U. S. Census of Agriculture, op. cit.

The number of dairy farms has decreased because of specialization and increased herd size per farm. The number of milk cows has not decreased in the basin counties to the same extent as in Oregon or the nation. Milk production has increased in the basin counties while production in the state has been decreasing. This indicates that the processors in the basin counties have expanded their market into areas which had been supplied previously by other processors.

Three large milk plants process most of the milk in the basin. Tank trucks are used to transport fluid milk to Portland--the main fresh milk market. California is a major market for the manufactured dairy products. Tillamook cheese has become a major brand name and is marketed throughout the nation.

Livestock, North Coast Drainage Basin Counties, Oregon, 1920-59 1/



1/ U.S. CENSUS OF AGRICULTURE CLATSOP, COLUMBIA, AND TILLAMOOK COUNTIES.

Figure 8

Milk cows are being replaced by beef cattle and sheep as illustrated in figure 8. As dairying becomes more specialized, many of the smaller farmers replace their dairy herds with beef herds. This has been true especially for the part-time operators. Beef and sheep operations require less time and investment than dairy farms, and the economies of size are not as important.

Hog production has never been important in this forage-based agricultural economy. Goats, used in the past for removing brush, have become less numerous in recent years. Horses, no longer needed for power, are decreasing in number.

Agricultural Income

Sales of farm products in the basin were about $11.9 million in 1959 (table 16). Livestock products accounted for 88 percent of sales, farm forest products for 6 percent, and crop products for 6 percent. Sales of mink and other fur-bearing animals, which might also be considered as agricultural income, were about $2.1 million.

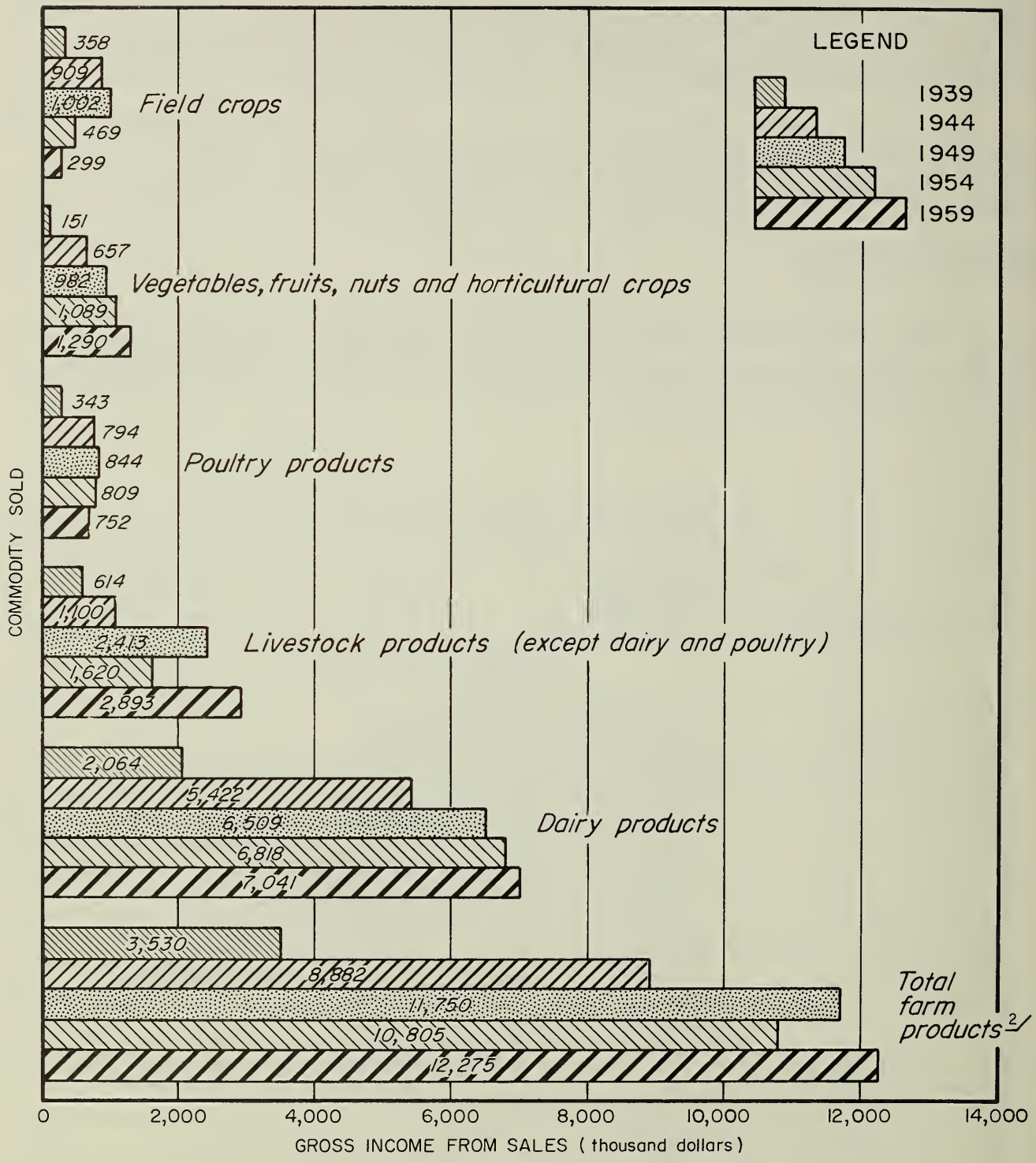
Table 16.--Estimated value of farm sales, North Coast Drainage Basin, Oregon, 1959 1/

Commodity sold	Gross value	Percentage distribution
	Thousand dollars	Percent
Livestock:		
Dairy products	6,662	56.2
Poultry and poultry products	580	4.9
Other livestock products	3,221	27.2
Total	10,463	88.3
Crops:		
Fruits, nuts, and vine crops	269	2.3
Field crops	217	1.8
Horticultural specialties	149	1.2
Vegetables	21	.2
Total	656	5.5
Forest products	738	6.2
Total farm products	11,857	100.0

1/ U. S. Census of Agriculture, op. cit.

Sales of dairy and livestock products have continued to increase since 1939 because of both increased production and higher prices (figure 9). Sales of vegetables, fruits, nuts, and other horticultural crops have increased a little but they are still a minor part of total farm income. Receipts from field crops have decreased because of the replacement of these crops with forage crops. Sales of poultry products have remained at about the same level

Sales of farm products by commodities, North Coast Drainage Basin Counties, Oregon, 1939 - 59 1/



1/ U.S. Census of Agriculture Clatsop, Columbia, and Tillamook Counties.

2/ Except forest products.

Figure 9

since 1944.

Total sales of farm products increased rapidly from 1939 to 1949 but decreased in 1954 and then increased slightly above the 1949 level in 1959. Figure 9 illustrates the increased dependency of agricultural income on dairy and livestock products.

IRRIGATION

Irrigated acreage in the basin varies from year to year depending on moisture available, pasture conditions, and needs for forage. It is estimated that of the 12,040 acres developed for irrigation in the basin, about 9,900 were irrigated in 1964. Some 64 percent of the irrigated acreage produced pasture, 25 percent produced hay or silage, and 11 percent produced other crops.

Sprinkler systems are almost universally used for irrigation in the basin and they are better adapted than flooding systems for several reasons.

1. Water control is an important factor of soil drainage and the amount and distribution of water is better regulated by sprinkler than by flooding.
2. The water supply is generally from large rivers with relatively flat gradients and this makes gravity diversion difficult.
3. Most of the land is adjacent to the streams and in small blocks, therefore, pumping from streams is more practical than gravity diversion.
4. Overflow on irrigated land during flood stages creates a maintenance problem on ditches, diversions, and other structures associated with flood irrigation systems.
5. It is difficult to keep fields smooth enough for flood irrigation where overflow occurs.
6. Sprinkler systems facilitate the control and efficient use of water by part-time farmers who of necessity cannot be present to make the frequent water changes required by flood irrigation.

Irrigation development to date has been accomplished on an individual farm basis. Most of the irrigable land is in small blocks adjacent to the streams, and group facilities have not been necessary.

Because of the relative abundance of rainfall in the basin, irrigation development has not progressed to the degree that it has in the drier regions of the state. The irrigated acreage fluctuates from year to year, but there has been an upward trend in irrigation since 1944 (table 17). The sources of water for irrigation and the acreages and percentages of land irrigated from each source are presented in table 18. Of the 12,040 acres of land developed for irrigation, farmers have obtained water rights on only 8,954 acres, or 74.4 percent. The farmers are being urged to file for rights.

Although the number of farms with irrigation has increased from about 2 percent in 1944 to 16 percent in 1959, the average acreage irrigated per

Table 17.--Irrigated acreage and farms reporting irrigation, North Coast Basin Counties, Oregon, 1939-59 1/

Year	Farms reporting irrigation	Acreage irrigated	Percentage of farms irrigating	Irrigated acres per farm
	Number	Acres	Percent	Acres
1939	108	2,451	2.9	23
1944	71	1,857	1.8	22
1949	281	8,253	7.5	25
1954	439	11,811	13.2	25
1959	369	12,188	16.3	34

1/ U. S. Census of Agriculture.

Table 18.--Irrigation water source and rights, North Coast Drainage Basin, Oregon, 1964 1/

Item	Acreage developed for irrigation
	Acres
Water source:	
Streamflow	11,550
Ground water	340
Small ponds and reservoirs	150
Total	12,040
Water rights 2/	8,954

1/ USDA River Basin Survey Staff.
2/ Oregon State Water Resources Board.

farm is still small. Of the farms in the basin counties on which irrigation was reported in 1959, 60 percent reported less than 30 acres and only 14 percent reported more than 50 acres (table 19).

Future Irrigation

Opportunities for additional cropland by expanding irrigated acreage in the North Coast Drainage Basin are limited from physical, economical, and social standpoints. There are about 177,800 acres of land capability classes I through IV in the basin (table 20) and on the basis of soils, this is the land that is generally susceptible to irrigation; however, only about 81,600 acres are presently being used as cropland or cropland pasture. The rest is in timber, brush, swamp, and other noncropland uses.

Table 19.--Distribution of farms reporting irrigation by number of irrigated acres, North Coast Drainage Basin Counties, Oregon, 1959 1/

Acres irrigated	Farms reporting	Percentage distribution
	Number	Percent
1 to 9	74	20
10 to 19	68	19
20 to 29	79	21
30 to 49	96	26
50 to 99	36	10
100 to 199	16	4
Total	369	100

1/ U. S. Census of Agriculture: Clatsop, Columbia, and Tillamook Counties.

Table 20.--Estimated present and potential cropland and irrigable land, North Coast Drainage Basin, Oregon, 1964 1/

Item	Total basin
	Acres
Land capability classes I-IV	177,800
Total cropland	81,600
Potential cropland	29,000
Land developed for irrigation	12,040
Land irrigated	9,900
Potentially irrigable land	57,600

1/ U. S. Census of Agriculture, Soil Conservation Service, USDA.

Estimates obtained from the USDA reconnaissance survey of the basin indicate that there are about 29,000 acres that could be readily converted to cropland use. It was also estimated that an additional 57,600 acres could be readily irrigated. This includes part of both present nonirrigated cropland and potential cropland.

Soil drainage and flooding are two physical problems that complicate irrigation development in the basin. These problems are covered in detail in the latter section of this report but it should be noted at this point that an area of about 24,100 acres is flooded annually, and about 45,750 acres of arable land have impeded drainage. In many cases, these two problems are present on potential cropland and potential irrigable land.

To adequately assess the feasibility of irrigation, it would be necessary to ascertain not only the effect of irrigation on yields but also the cost of the necessary inputs. It may be that in many cases where capital is limited,

other inputs such as drainage, improved varieties of plants, liming, and fertilization would be better initial investments than irrigation. The Clatsop County Agent 3/ reported that "irrigation is a marginal type venture, although intensively used forage fields can be benefited. Many summers (crops) do not require enough moisture to justify the cost of equipment and time to irrigate, and equal cost and time devoted to other forage practices would likely pay bigger returns". Thus, the feasibility of irrigation depends to a considerable extent on the farm size, management ability, and capital of each individual. In many cases, irrigation is one alternative for increasing productivity and the costs and returns for this practice should be carefully compared with others. Also, many of the other practices such as drainage, fertilization, and liming are prerequisites to irrigation if maximum benefits are to be realized by irrigation.

Agriculture is based predominantly on forage crops which sustain dairy and livestock production. Dairy and livestock products are the source of about 88 percent of the agricultural income. It is anticipated that forage production will continue to be the most important cropland use in the basin. Dairying and livestock operations are well established. Dairying requires major investments in specialized equipment which must be depreciated over a long period of time. Changing from dairying would entail considerable losses in present investments.

Dairying and livestock products have become the main agricultural commodities in the basin because of the favorable climatic conditions for production of pasture. Irrigation enables the farmer to increase forage production in the low rainfall months of June through September. To determine how the increased forage production from irrigation affects farm income would require a detailed study. Developments to date, however, indicate that many farmers have been reluctant to make the required investments for irrigation. In the long run, the demand and the prices for dairy and livestock products and the relative competitive situation between this and other producing areas will have a bearing on irrigation development in the basin.

3/ "Annual Report of Clatsop County Extension Program", Oregon State College Extension Service, 1960.

WATER-RELATED PROBLEMS, NEEDS, AND OPPORTUNITIES

GENERAL

The management of cultivated, forest, and range lands has a direct impact on the yield and quality of water. Land use affects the suitability of water for wildlife, recreation, and people. Land use and management practices can create or aggravate a host of water problems involving water excesses, shortages, and quality. Correction of land use problems will usually result in a reduction of the related water problems.

Water resources influence all segments of the economy of the basin. Better use and development of these resources can contribute to the advancement of agriculture. Industrial and community existence is based on a dependable supply of good quality water. Navigation, recreation, fish life, and pollution abatement are affected by volume and depth of flow; therefore, yield and seasonal availability of water are of prime importance in all areas of use.

WATER SUPPLY AND REQUIREMENTS

Average annual precipitation in the North Coast Drainage Basin ranges from about 40 to 150 inches (map 2). In the agricultural parts of the basin, rainfall probably averages less than 10 inches during June through September; thus, the basin has a summer period of water shortage for agricultural uses and a winter period of water surplus. This problem is accentuated by relatively low mountain elevations which preclude the accumulation of a significant snowpack and the relative shortness of many of these coastal streams which hastens runoff. This combination causes waste of water and necessitates storage to improve efficiency and expansion of water use.

The total water resources of the North Coast Drainage Basin are more than adequate for present and future agricultural needs. Based upon existing runoff records and the isohyetal map compiled by the State Water Resources Board (map 2), the data in table 21 were compiled for each small watershed. The average annual yield after current consumptive use for this 1,731,200-acre basin is about 9,005,900 acre feet. The annual runoff probably ranges from less than 20 to more than 115 inches.

The average annual precipitation for the entire basin is about 90 inches, and the average annual runoff is about 64 inches; more than two-thirds of the precipitation is not used consumptively in the basin at the present time.

Water from wells and springs is limited to domestic, municipal, industrial, livestock, and irrigation use. The supply from wells is often not dependable in either quantity or quality; however, there is usually sufficient water in the alluvial deposits and sand dune areas for domestic and livestock purposes.

Table 21.--Average annual runoff and precipitation by watershed, North Coast Drainage Basin, Oregon, 1964 1/

Watershed	Average annual precipitation	Average annual runoff	
	Inches	Inches	Acre feet
Subbasin 1, Tillamook:			
A. Wilson River	106	101	1,042,800
B. Kilchis River	117	104	381,300
C. Miami River	104	91	292,700
D. Trask River	102	91	839,800
E. Killam-Fawcett Creeks	106	76	51,500
F. Tillamook River	98	61	292,500
G. Sand Lake	97	64	59,700
H. Beaver Creek	108	75	120,000
I. Nestucca River	105	81	994,900
J. Little Nestucca	98	65	209,700
K. Neskowin Creek	92	59	74,900
Subbasin 2, Nehalem:			
A. Upper Nehalem	65	39	752,300
B. Middle Nehalem	92	66	707,800
C. North Fork Nehalem	101	75	429,200
D. Lower Nehalem	112	86	801,700
Subbasin 3, Columbia:			
A. Tide Creek	45	20	54,300
B. Rainier	46	20	60,400
C. Beaver Creek	47	22	80,700
D. Clatskanie River	52	28	144,400
E. Knappa	83	61	568,000
F. Youngs River	92	64	403,300
G. Lewis and Clark River	94	55	184,700
H. Skipanon River	80	41	35,900
I. Warrenton Beach	79	40	61,500
J. Necanicum River	100	61	220,200
K. Elk Creek	97	57	141,700
Total basin	90	64	9,005,900

1/ Soil Conservation Service and State Water Resources Board.

In general, there is a surplus of water in the basin during most of the year but natural streamflow and ground water for agricultural and other uses are barely adequate during the summer months with very little available for expansion.

Irrigation

The major irrigated crops in this basin are grasses and legumes for pasture and hay (table 10). If an efficiency rate of 44 percent is assumed,

the net irrigation requirement for a good pasture is about 2 feet of water per acre. At this rate, only 24,080 acre feet would be required to irrigate 12,040 acres of land, or less than 0.3 percent of the total annual runoff. Less than 5 percent of the runoff occurs during the irrigation season (June through September) and about 6 percent of the water yield during this season is required for irrigation at the present time. Therefore, it would appear that water supplies for the basin are adequate for irrigation; however, there are critical water supply problems in some areas, for instance, four of the watersheds have a water shortage at the present time (table 22). Other watersheds, especially near the tidal areas, have not developed irrigation because of a shortage of dependable fresh water.

Table 22.--Summary of small watersheds with inadequate water for irrigation, North Coast Drainage Basin, Oregon, 1964 1/

Item	Unit	Basin total
Watersheds studied	Number	26
Watersheds with water shortages for presently irrigated land	Number	4
Presently irrigated land with water shortages	Acres	1,140
Watersheds with inadequate water for potentially irrigable land	Number	18
Potentially irrigable land needing surface water development	Acres	30,000

1/ USDA River Basin Survey Staff data.

Estimations indicate that an additional 57,600 acres could be readily irrigated, which is more than four times the acreage presently irrigated. However, there are 177,800 acres in land capability classes I through IV, most of which could be adapted for irrigation in varying degrees (table 2). All watersheds have some potentially irrigable land. If all irrigated and potentially irrigable land were adequately irrigated and growing the same type of crops presently grown, approximately 129,000 acre feet of water would be required. This would amount to less than 2 percent of the annual yield of the basin--nearly one-third of the flow during the irrigation season. Water must be conserved and developed in some areas before irrigation of agricultural land could be expanded to this extent.

Livestock

There is usually an adequate water supply for consumptive use of livestock in this area. In most areas, natural streams and springs provide sufficient quantities without additional developments.

Forestry and Related Uses

Almost all of the annual water yield from the North Coast Drainage Basin comes from forest land; therefore, forest land is vitally important in

controlling quality, quantity, and timing of water yield. At low elevations, forest cover helps maintain soil conditions that encourage infiltration of precipitation. Trees, brush, and organic litter protect the soil from the eroding action of rainfall. Under normal forest conditions, water is percolated into the ground water storage for later gradual release instead of a rapid runoff. Trees provide shade along rivers and streams and help to maintain water temperatures suitable for fish life.

Water yield from forest land can be expected to decrease slightly as the Tillamook Burn is reforested and the forest floor becomes more absorbent. Along with this slight reduction in total runoff, the timing of runoff will be modified. Because more water will be absorbed, less water will run off during a storm, but the later streamflows will be increased by releases from ground storage.

As the area reaches a point of equilibrium when the area logged more or less equals the area reforested, the water supply can be expected to become more uniform.

The water quality can be expected to improve as the watershed is protected by vegetation. There will be a period of development, probably the next 20 years, when road construction will be heavy and during which sediment load in individual streams may be a problem as a result of winter storms. After the development period, additional road construction will have a negligible effect on water quality.

Water supply problems are expected to become greater as use of forest land is intensified and as the demand for water for agriculture and industry increases. Prevention of stream pollution will be a more serious problem with increased recreational use and improved access to all parts of most watersheds.

Concern will increase in maintaining adequate streamflows and lake levels for fish, wildlife, and recreation. Need for larger water supplies for irrigation, domestic, municipal, and industrial uses will have to be met by greater reservoir storage of water from forested watersheds. If reservoirs are drawn down or streamflows lowered during the season of heavy recreational use, water becomes less attractive for recreation, pollution problems increase, and fish life may be endangered.

Large quantities of water may be needed for forest-related industry in the future, particularly mills manufacturing products from wood pulp. Reservoir storage will be needed to provide a dependable supply for such industry in most parts of the basin.

Recreation

More water supply problems are expected with the increase in recreational use. Increasing supplies of potable water will be necessary and it is evident that ground water will have to be utilized. In other areas, treated surface water will be the only source.

Coupled with water supply will be sanitation problems. The existing sanitation facilities are being overtaxed during the vacation season in many

areas. Existing pit toilets and cesspools need to be replaced by approved sewage disposal systems especially in the dune area. It is possible that recreational areas will have to contribute to the maintenance of sanitation districts to solve this increasingly serious problem.

WATERSHED MANAGEMENT PROBLEMS AND OPPORTUNITIES

Maintenance and improvement of the condition of all tributary watersheds in the basin should be continued. In general, the optimum watershed conditions will prevail when all resources are managed for sustained production. The most important management problems and opportunities for improvement pertaining to agriculture, range, and forestry are outlined in the following sections.

Agricultural Land

From an agricultural standpoint, arable land is a more limited resource than the water resource. In order to make the best use of this more limited resource, it must be developed and used more intensively. To do this, more control of the water supply is needed. Many pasture and hay fields of native grasses should be planted to better adapted species of grasses and legumes and managed for increased production (photo 22). Some brush and swamp areas should be cleared and protected from water excesses so they can be put to more intensive agricultural uses. The native grass fields not suited for cultivation should be replanted to trees and managed for this primary use. A summary of the water-related problems and the measures needed to improve them follows.

Flooding. Flood problems in the North Coast Drainage Basin result from both natural factors and human management of the land. Intensified flooding problems have resulted from man's intensive use of the land and other natural resources; however, in some areas, land has been protected from flooding. Map 9 shows the major flood problem areas in the basin.

There are two main sources of floodwaters in this basin--the rapid runoff from rain and snow and tidal action of the ocean.

Floods are most likely to occur during the November to March heavy precipitation period but may occur as early as September or as late as May. Fairly continuous rainfall during this period saturates the soil and causes heavy runoff from the steep, upper portions of the watersheds. Usually very little of the precipitation is retained in the form of snow. When this heavy runoff reaches the lower portions of the streams with flatter gradients, the water overflows the channels, floods many of the fields, and drops sediment and debris.

Inundation from ocean tidal waters is common along the lower parts of the coastal watersheds. Most damage occurs when abnormally high tides and severe winter storms coincide. Dikes and tidegates have been installed to protect many areas, but some of these structures are inadequate or in need of repair (photo 23). Many other areas are entirely without such protection.

Flood damage has been particularly severe when high tides and heavy runoff occur simultaneously because the floodwaters from the higher watershed

Photo 22.--This field near Birkenfeld in the Upper Nehalem River watershed was limed, fertilized, and seeded to a selected grass and legume in alternate rows. Oregon, 1963. SCS photo

Photo 23.--Inadequate dikes and tidegates allow flooding along the Little Nestucca River in Oregon. SCS photo

areas are seriously impeded by the high tides. Such major floods appear to have about a ten-year frequency. The movement of beach sands by wind and water sometimes partially blocks the ocean outlets of some streams, such as the Little Nestucca River, making floods more frequent and severe.

The Columbia River affects the rivers and creeks that flow into it at flood stage. Fortunately, the river crests at a later date, usually around the first of June, when the smaller basin streams are not at peak flow. Despite this variation in timing, the Columbia River backwaters cause many of the basin streams to flood low areas.

The floods from the Columbia River have often been the most devastating. On May 30, 1948, many dikes were broken or topped in the basin causing loss of life and property. The total property damage in the North Coast Drainage Basin was many million dollars. In addition, damage to crops was very severe because it occurred during the growing season and lasted for 36 days. This was the second highest recorded flood. The flood of 1894 was greater; it lasted 52 days and crested at 34.4 feet elevation at Vancouver--4.2 feet higher than in 1948.

Spring and summer floods from cloudbursts are practically unknown in this basin. Such infrequent occurrences affect only small portions of a tributary watershed and cause slight damages.

The problems to agriculture resulting from floods range from erosion and sedimentation to loss of crops and property. Agricultural damages, consisting primarily of crop and property losses, account for much of the total evaluated flood damage. Floods in late spring and early fall have caused loss of all or part of early and late crops (photo 24). Winter and spring floods damage crops by washing out roots, seeds, and seedlings and by burying small plants and seed under sediment. Because of serious drainage problems and frequent flooding, many acres of land have not been developed for cropland.

Man-made structures and improvements are often damaged by flooding. Many of the towns are located above ordinary flood stage; however, some towns are damaged by larger floods (photo 25). A few suffer flood damage almost every year and have been known to receive extensive damages several times in one year. Many country roads in the basin are frequently damaged and closed by high water (photo 26). Municipal water supplies and diversion works are often damaged by high water and sediment. Sudden early fall or late spring floods frequently inundate farm irrigation pumping plants, tractors, and other equipment left in the fields.

It is very costly to remove sand, gravel, logs, and other debris deposited by major floods in channels, fields, ditches, and other improvements (photo 27). Sediment is harmful to fish life, both in the main streams and in the tributaries. Streamflow characteristics may be seriously altered, spawning beds ruined, and food sources reduced.

There is a need for more dredging and diking in the main river channels; for removal of gravel bars, drift, and brush; and for channel enlargement and realignment on the small streams.

Photo 24.--Crops will be killed unless floodwaters are removed in a short time, Oregon, 1964. SCS photo

Photo 25.--Floodwaters from the Clatskanie River flowed through the Clatskanie City Park, flowed across the road, and flowed back into the river channel in 1964. SCS photo

Photo 26.--This farm road near Cloverdale, Oregon, has been frequently damaged and closed by floods. SCS photo

Photo 27.--Debris against U. S. Highway 101 bridge must be removed before the bridge is damaged, Trask River, Oregon, 1956. SCS photo.

Erosion. Land damage from erosion, leaching, scour, and deposition is significant but very difficult to evaluate and is probably inadequately appraised.

Much of the arable land is effectively protected from rill and sheet erosion by perennial sod-forming crops; however, when this land is plowed, care should be taken to insure protection of the soil during the months of high precipitation and overflow. This can be done by careful selection of the time of working and planting the fields or by the use of established winter cover crops.

Wind erosion on agricultural land is not a serious problem at present because most cultivated land is either wet or has fine-textured soils which resist wind action or is protected from wind by crops, trees, or hills. However, wind erosion would be serious on the marine terrace soils near the ocean if they were cleared and cultivated.

Considerable land is lost through streambank erosion. Damage is usually most prevalent along the swifter portions of the streams, but the problem exists also along the larger, slower portions. Bank protection is needed with rock and vegetation and removal of gravel bars, drift, and brush (photos 28 and 29). There is particular need to evaluate stream channel characteristics carefully in order to recommend reservoir releases that will prevent further aggravation of bank erosion. Dredging in the lower parts of the larger streams is sometimes required to increase capacity for navigation. Stream channel work is usually most beneficial when a complete unit of channel is improved in a single coordinated project rather than by piecemeal work by individual landowners.

Irrigation. Irrigation is a major consumptive use of water in the North Coast Drainage Basin. It has been developed by individuals but, in some areas, much of the future development will require action by groups.

Water is applied almost exclusively by sprinklers which is the easiest method to manage under existing conditions. To assure maximum benefits and minimum damage from irrigation, even the best designed systems need careful attention to the amount and frequency of water application which has been adapted to the soil, crop, and weather. The farmer needs more technical assistance and factual information on water-holding capacity and intake rates of soils to facilitate more efficient use of water and to protect the land from leaching and erosion.

Drainage. Approximately 75,250 acres, or about 42 percent of the arable land, have soils with a major wetness problem (table 23). These figures are based upon the Oregon Soil and Water Conservation Needs Inventory 1/ and soil survey report for the Tillamook area 2/ as some of the basin has not been surveyed, and some of the areas that have been surveyed have not been summarized by class and problem.

1/ The Oregon Conservation Needs Committee, Portland, Oregon, September 1962.
2/ Soil Survey of the Tillamook Area, Oregon, Soil Conservation Service, USDA and Oregon Agricultural Experiment Station, August 1964.

Photo 28.--The Clatskanie River has eroded away cropland in the adjoining field, Oregon, 1960. SCS photo

Photo 29.--This portion of the Clatskanie River bank has been protected by rock riprap, Oregon, 1962. SCS photo

Table 23.--Estimate of the acreage of arable land with soils whose major problem is wetness and the acreage needing drainage, North Coast Drainage Basin, Oregon, 1964 1/

Capability class	Subbasin			Total
	1 Tillamook	2 Nehalem	3 Columbia	
	Acres	Acres	Acres	Acres
I	...	...	...	...
II	4,280	600	8,100	12,980
III	4,270	6,480	20,920	31,670
IV	7,880	2,300	20,420	30,600
Total	16,430	9,380	49,440	75,250
Area needing drainage	10,000	4,900	30,850	45,750

1/ USDA River Basin Survey Staff and Soil Conservation Service.

Some wet soils have been drained to a degree suitable for the crop grown or are being used for purposes that do not require drainage (photo 30). An estimated 45,750 acres, or about 61 percent, of the excessively wet soils need to be drained for best production under present use. The majority of this land could be drained with tile although deeper outlets would also be

Photo 30.--Some fields are drained by a pattern-type tile system, Clatskanie Soil Conservation District, Oregon. SCS photo

required in some places (photo 31). Besides increasing production, drainage of this land would also increase the number and variety of crops that could be grown. Because alkalinity is not a problem in this basin, water drained from the land can be used for irrigation.

Photo 31.--Often tile cannot be used successfully to drain land until outlet ditches have been built, Tillamook County, Oregon. SCS photo

The elimination of prolonged and frequent flooding is often a prerequisite to successful drainage. In most cases, this can be classified as flood control (photo 32). Tidal areas frequently fit into this category.

Other soils are wet because they are unable to let the water from the heavy precipitation percolate on through because of soil structure and texture or a high water table. Also very prevalent in this basin is land that needs drainage because of seepage from higher ground (photo 33). Sometimes an interception ditch or tile will solve this problem; however, random- or pattern-type tile systems are usually also necessary if the area is very large.

Forest and Range Lands

Careful management of forest and range resources can result in maximum economic and social benefits without impairment of soil and watershed values; however, improper management of these resources can produce or intensify flood, erosion, and sedimentation problems. Forest and range lands are generally on steep ground where the hazard from erosion is greatest. Erosion by rapid runoff of water was very damaging in large areas of the Tillamook Burn when the protecting vegetation was removed.

Photo 32.--It is impossible to properly drain land such as this area on the Little Nestucca River until the flooding and outlet problems have been solved, Oregon. SCS photo

Photo 33.--This field is too wet for maximum production because of water seepage from higher ground, Tillamook Soil Conservation District, Oregon. SCS photo

Improvement of watershed conditions in the basin is needed. On public land, the policy of good watershed management should be strengthened and included in all phases of forest and range resource management. On private land, watershed management provides little direct profit to the landowner since he seldom uses the water that flows from his land and he may not be aware immediately of any reduction in soil fertility due to poor management. However, proper management of all forest and range land is vital to water users and to landowners in downstream areas. Recently, public pressure and enforcement of antipollution laws have caused some improvement on private land. There is need for much additional improvement. Some factors that would produce better watershed management are:

1. Greater monetary returns from tree farming would encourage landowners to keep their land in a productive condition and provide soil protection. Adequately constructed and maintained roads would be less subject to erosion.
2. Continuation and strengthening of Extension Service, Soil Conservation Service, and State Farm Forester programs to inform landowners and the general public of the value of water and watersheds would encourage a gradual improvement in practices.
3. Increased public pressure from recreationists, fishermen, and other water users could cause many private owners to give greater consideration to good practices.
4. Enactment and enforcement of stricter laws or regulations controlling land management practices that produce stream siltation, debris jams, and flood hazards may be necessary if forest and range landowners fail to meet their responsibilities. Regulation has often been necessary to control other sources of water pollution such as sewage and wastes from manufacturing processes.

Forest land managers need additional knowledge about many phases of resource management to enable them to do a better job of watershed management. One of the most important needs is for more detailed information about soils and geology to identify areas with serious surface erosion, slump, and slide hazards. More detailed hydrological data for forested watersheds are needed for better planning of drainage structures on access roads. Timber-harvesting methods that minimize watershed damage need to be encouraged.

Related to this need for additional technical information is the apparent need for re-orientation of thinking concerning watershed management and its relationship to timber, recreation, wildlife, and range management. Many resource managers think of watershed management as a special category or an individual step in their operations; however, it is an integral part of the total resource management situation and should have an important place in all management decisions.

Improper planning and timing of logging operations without regard for such factors as soil characteristics, steepness of slopes, and moisture conditions magnify the erosion hazards. Improperly planned and constructed roads are major sources of erosion. Slash from logging or road right-of-way clearing that accumulates in streams can block fish passage and create a danger

Photo 34.--Debris from fires and logging is piled several feet deep in this tributary of Wilson River. Note man on top of log jam. RBSP-FS photo

from flash floods during severe winter storms (photo 34).

Climatic conditions in the basin are favorable for rapid revegetation of cutover forest land; however, skid trails, fire lines, and road cut and fill slopes are major erosion hazards and they often need special measures such as adequate drainage and protective plant cover.

Overgrazing of forest and range land is a serious problem. Farmers and ranchers graze cattle, goats, and sheep on cutover forest land. Some forest land is too steep or has too great an erosion hazard to be suited for this use. Overgrazing depletes soil protecting vegetation, destroys tree seedlings, and compacts the soil. Some grazed forest and range lands might be more profitably used for forest development, and the relatively small amount of forage which would be lost could be replaced through better management of cropland pasture.

Many of the forest ownerships are too small for efficient, profitable management on an individual basis. The owners usually lack forestry and range training or experience and do not seek or follow advice from public or private consultants. For these reasons, many small private holdings are rather poorly managed. Data from the 1952 Timber Resources Review indicated that the timber on small private holdings is generally cut at too small a size for maximum profits and that often inadequate provision for regeneration

is made. Small forest holdings owned by farmers tend to be better managed than those owned by nonfarmers; however, farmers tend to put their forest land to other uses such as range that will produce cash returns in a shorter time. Forest values for water, recreation, and wildlife are often neglected on small holdings because of indifference or economics.

Along with increased knowledge and tools for better watershed management goes increased recognition by land managers of their responsibility for management of all resources. Management practices that can enhance watershed values without diminishing the value of forest and grass land for other uses have been stated previously. Public land managers can exert an important influence in encouraging good practices. They play a dominant role in determining the management of public and private land. Thus, they have an opportunity and responsibility to sell watershed management as an integral part of all resource management activities.

Recreation Areas

Careful management of recreation sites is necessary to enhance the existing resource. Misuse of these areas can result in increased runoff, erosion, sedimentation, and debris in streams. To prevent complete destruction of the site, it may be necessary to temporarily close some heavily used recreation areas and allow the scars of excessive use to heal.

Continued development of multiple-use, observation points to make the public aware of good watershed and forest management practices should be encouraged by all land managers--both public and private. The use of interpretive signs is a necessity in these areas. Good management can look like utter devastation to the uninformed viewer when he sees a clearcut immediately after slash burning.

WATER DEVELOPMENT

There is potential for development of the water resources of the North Coast Drainage Basin to better serve all needs. Ground water, surface water, and stored water can all be used to advantage to help meet the increasing water requirements of the area. Provision of adequate water supplies for agriculture will be one of the major purposes of future water development projects in the basin. An estimated 57,600 acres of existing and potential cropland could be irrigated if sufficient water supplies were developed. Better utilization of water supplies can result in ample water to irrigate this land; however, in the future, most major water development projects will need to include several water-related phases such as flood control; navigation; power; domestic, municipal, and industrial uses; fish; wildlife; recreation; and pollution abatement.

There is an increasing need for recognition of fish life, wildlife, pollution abatement, and recreational values in the planning of water development projects throughout the basin. The demand for water-based recreational opportunities will increase. Reservoir projects should include provisions for recreational development. Careful planning and consideration of all resource values are necessary if the maximum beneficial use of water is to be obtained.

Since the delineation of water resource needs for agriculture is a major purpose of this report, agricultural water uses are emphasized in the following sections pertaining to ground water, surface water, and water storage.

Ground Water

Ground water is being used to some extent for municipal, domestic, industrial, and irrigation purposes from shallow wells and springs. Other sources of ground water include sumps and seeps. All sources of ground water have proved to be quite limited in most parts of the basin as to quantity, and in some places, the quality is also poor. Future development of irrigation based upon ground water appears to be limited. Most of the land irrigation from ground water is in the Tillamook Subbasin. In the sand dune areas, there is potential for domestic and industrial uses.

Surface Water

The majority of the streams in the basin have some additional natural surface water available for present use during the irrigation season. It appears that 27,000 additional acres could be irrigated from natural flowing water (table 25D).

Storage

The conservation of excessive, often damaging, runoff water in reservoirs for flood protection and, subsequently, for irrigation, industry, power, domestic and municipal uses, recreation, pollution abatement, and fish life has considerable potential in the basin but has not been utilized extensively to date.

A summary of estimates from various parts of the basin has indicated that it would be necessary to construct both large and small reservoirs to supply water for irrigation of about 30,000 acres for optimum agricultural development (table 25D). This storage capacity can be developed where and when it is needed. There is a definite potential for more farm ponds and small reservoirs such as the one in the Clatskanie Soil Conservation District shown in photo 35. In addition, there are many medium-sized reservoir sites of 100 to 25,000 acre feet storage capacity that should be considered for water development for individual and group needs. Table 24 summarizes reconnaissance data assembled by the Department of Agriculture on 71 sites that appear to have some merit and warrant future consideration. The location of these sites is shown on map 9.

In order to be feasible, almost all new reservoirs need to be developed for multipurpose use, considering all possible uses and benefits from the stored waters.

Photo 35.--This pond, built in 1955, is stocked with rainbow trout and can be used for irrigation, stockwater, fire control, and recreation, Clatskanie Soil Conservation District, Oregon. SCS photo

Table 24.--Reconnaissance data on possible reservoir sites, North Coast Drainage Basin, Oregon, 1964 1/

Subbasin and stream	Watershed index Letter	Reservoir index Number	Location Township	Range	Section	Drainage area Acres	Estimated annual yield Ac. ft.	Storage capacity Ac. ft.	Reservoir water depth Feet	Reservoir surface area Acres	Top length of embankment Feet	Estimated embankment volume Cu. yds.	Fill + storage Cy/ac.ft. 2/	Possibilities Uses 3/
1. Tillamook:														
Misni River	C	1	2N	9W	29	6,720	56,000	9,000	160	190	700	1,133,300	126	I,F,R
Kilchis River	B	2	1N	9W	9	20,220	176,900	6,400	115	190	600	624,100	97	I,R
Do.	B	3	1N	9W	21	24,130	211,100	2,400	80	100	550	291,700	122	I,R
North Fork Trask River	D	4	1S	7W	27	37,500	234,400	1,000	65	50	250	91,500	92	I,R
Do.	D	5	1S	7W	24	34,560	216,000	7,000	125	190	500	543,000	78	I,R
Middle Fork Trask River	D	6	1S	6W	35	5,440	22,700	4,900	75	220	950	427,200	87	I,F,R
Elkhorn Creek	D	7	2S	6W	8	4,160	34,700	6,600	160	140	800	1,275,000	194	R
South Fork Trask River	O	8	2S	8W	25	4,610	34,600	1,100	75	50	450	204,300	178	I,R
East Fork Trask River	D	9	2S	7W	20	15,420	115,600	3,500	115	100	500	482,600	137	I,R
Do.	D	10	2S	7W	28	10,240	76,800	12,200	165	240	900	1,530,700	126	I,F,R
Killam Creek	E	11	2S	9W	15	3,070	21,700	1,200	80	40	500	250,000	212	I,R,S
Fawcett Creek	E	12	2S	8W	19	1,150	8,100	900	80	40	300	145,800	164	R,S
Beaver Creek	F	13	2S	10W	3	580	3,600	200	15	40	300	8,600	36	I,R
Do.	F	14	2S	10W	10&11	450	2,900	2,600	95	90	500	334,800	127	I,F,R
Sutton Creek	F	15	2S	10W	14	450	3,000	500	20	90	900	35,200	66	I,R
Bewley Creek	F	16	2S	10W	24	1,920	12,800	700	25	100	700	44,000	59	I,R
Tillamook River	F	17	2S	10W	35	1,280	8,900	500	25	60	600	30,100	59	I,R
Beaver Creek	N	18	3S	9W	18	16,830	112,200	26,400	75	1,190	800	364,000	14	I,F,R
East Beaver Creek	N	19	3S	9W	15	6,140	43,500	1,300	70	60	500	231,300	178	I,R
Do.	N	20	3S	9W	1	3,970	28,100	2,000	110	60	450	425,800	210	I,R
Bays Creek	I	21	3S	9W	24	2,750	17,600	2,000	80	60	650	354,200	179	I,F,R
Moon Creek	I	22	3S	8W	17	4,100	27,300	3,100	115	90	700	642,800	204	I,R
East Creek	I	23	3S	8W	15	3,460	23,100	1,900	80	80	800	416,700	215	I,R
Walker Creek	I	24	3S	6W	15	1,920	9,800	10,700	105	350	850	738,800	69	I,F,R
Nestucca River	I	25	3S	7W	27	17,600	96,800	3,400	105	110	450	372,200	110	I,R
Do.	I	26	4S	7W	6	31,230	195,200	15,200	160	320	1,200	1,983,400	130	I,F,R
Three Rivers	I	27	4S	9W	30	18,180	113,600	5,000	75	220	500	259,400	52	I,R,S
Little Nestucca River	J	28	5S	10W	22	25,860	150,800	2,900	80	120	400	217,200	75	I,R
Do.	J	29	5S	10W	25	21,180	116,500	21,600	140	510	600	888,900	41	I,F,R
2. Nehalem:														
North Fork Nehalem River	C	1	4N	9W	26	28,800	204,000	4,800	70	220	400	207,700	43	I,F,R
Gods Valley Creek	C	2	4N	9W	36	4,610	32,700	7,800	50	500	500	140,600	18	I,F,R
North Fork Nehalem River	C	3	4N	8W	19	20,100	142,400	4,400	70	220	500	220,400	50	I,F,R
Do.	C	4	4N	8W	9	9,980	72,400	5,500	75	240	450	222,900	41	I,F,R
Humbug Creek	B	5	5N	8W	22	3,460	23,100	4,400	120	120	300	408,900	93	I,F,R
Walker Creek	B	6	6N	7W	25	7,360	37,400	2,000	65	100	400	149,200	75	I,R
Northrup Creek	B	7	6N	6W	17	4,160	21,100	4,200	75	190	750	371,500	88	I,R
Louisignot Creek	B	8	6N	6W	14	2,430	8,300	2,300	55	140	800	232,000	99	I,F,R
Sager Creek	B	9	6N	6W	26	2,370	7,500	2,500	65	120	600	238,700	97	I,F,R
Buster Creek	B	10	5N	6W	19	8,640	40,300	29,600	155	630	850	1,572,000	53	I,F,R
Do.	B	11	5N	6W	21	3,330	14,200	5,500	70	250	700	313,000	57	I,F,R,S
Fishhawk Creek	A	12	7N	5W	20	6,980	23,800	4,200	80	170	400	250,000	60	I,R
Oo.	A	13	7N	5W	32	1,540	5,300	3,700	75	160	850	409,400	109	I,F,R
Oo.	A	14	6N	5W	17	14,850	44,600	9,400	60	540	1,200	384,800	41	I,F,R,S
Oeep Creek	A	15	6N	5W	29	13,630	38,600	9,000	70	420	900	371,300	41	I,F,R
Deer Creek	A	16	6N	4W	31	7,740	20,000	2,100	50	140	400	78,900	38	I,F,R
Do.	A	17	5N	4W	7	3,460	8,900	11,500	95	410	800	537,900	47	I,F,R
Crooked Creek	A	18	5N	4W	20	5,120	13,200	6,400	75	280	900	418,700	66	I,F,R,S
Rock Creek	A	19	5N	4W	32	37,120	142,300	129,800	170	2,530	2,400	5,436,100	42	I,F,R,S
Pebble Creek	A	20	4N	4W	9	13,700	35,400	14,600	75	650	800	371,500	26	I,F,R,S
Nehalem River	A	21	4N	5W	22&23	45,310	173,700	83,600	125	2,230	750	950,300	11	I,F,R
Rock Creek	A	22	4N	6W	15	17,280	87,800	10,100	120	290	900	899,600	89	F,R
Cook Creek	D	23	2N	8W	9	11,840	113,500	3,900	105	120	700	531,600	135	I,R
East Foley Creek	D	24	2N	9W	5&6	1,470	10,400	1,300	80	60	600	291,700	218	I,R
Foley Creek	D	25	2N	10W	23	2,500	15,800	2,200	60	120	500	177,900	79	I,R
3. Columbia:														
Tide Creek	A	1	6N	2W	33	6,720	14,000	4,000	80	170	350	166,700	41	I,F,R
Tributary to Green Creek	B	2	8N	3W	32	2,560	4,500	2,700	50	180	500	94,700	35	I,F,R,S
Beaver Creek	C	3	7N	2W	19	9,540	18,300	5,300	50	360	800	173,700	33	I,F,R,S
Lost Creek	C	4	7N	3W	28	2,240	4,500	2,000	50	130	500	86,800	44	I,F,R,S
Little Clatskanie River	D	5	5N	3W	2	1,660	4,300	1,000	30	110	1,000	83,200	85	R
Clatskanie River	D	6	5N	3W	10	7,360	22,100	5,800	80	240	700	375,000	64	I,F,R
Do.	D	7	7N	4W	35	45,890	130,000	2,500	50	170	350	63,100	25	I,R
Big Creek	F	8	7N	7W	3	14,850	87,900	2,000	65	100	850	306,600	153	I,R,S
Klaskanine River	F	9	7N	8W	36	4,420	28,700	1,000	85	40	250	164,900	174	R,S
South Fork Klaskanine River	F	10	7N	8W	31	11,460	77,400	1,200	75	60	425	167,900	137	I,R,S
Youngs River	F	11	6N	9W	12	14,340	100,400	5,900	85	230	500	230,500	39	I,R,S
Oo.	F	12	7N	9W	27	22,020	148,600	23,100	130	600	500	689,100	30	I,F,R,S
Walluski River	F	13	8N	8W	31	3,200	16,500	3,900	95	140	850	588,000	151	I,F,R,S
Neckard Creek	G	14	7N	10W	24	640	3,300	1,200	40	90	250	34,700	29	I,F,R
Nortill Creek	G	15	7N	9W	30	1,150	6,100	1,500	100	50	350	275,000	187	I,F,R
Klickitat Creek	G	16	7N	9W	31	450	2,500	400	50	30	450	86,800	212	I,R
Lewis and Clark River	G	17	6N	9W	20	13,890	98,400	2,200	65	110	500	214,600	95	I,R

1/ Based on a survey by the U. S. Department of Agriculture River Basin Survey Staff.
2/ A comparative figure derived from dividing the estimated earth fill in cubic yards by the estimated water storage capacity in acre feet.
3/ I - irrigation, F - flood protection, R - recreation--fishing, hunting, and boating, S - water supply--industrial, municipal, and domestic.

SUBBASINS
1 TILLAMOOK
2 NEHALEM
3 COLUMBIA

N

WASHINGTON

PACIFIC OCEAN

COLUMBIA RIVER

R.10 W. R.9 W. R.8 W. R.7 W. R.6 W. R.5 W. R.4 W. R.3 W. R.2 W. R.1 W.

T. 9 N. T. 8 N. T. 7 N. T. 6 N. T. 5 N. T. 4 N. T. 3 N. T. 2 N. T. 1 N. T. 1 S. T. 2 S. T. 3 S. T. 4 S. T. 5 S. T. 6 S.

124°00' 123°30' 123°00' 46°00' 45°30'

Hammond
ASTORIA
WARRENTON
Gearhart
SEASIDE
Cannon Beach
Manzanita
Rockaway
Garibaldi
Bay City
Netarts
Pacific City
Clatskanie
Rainier
Columbia City
ST. HELENS
Vernonia

CLATSOP CO.
TILLAMOOK CO.
COLUMBIA CO.
WASHINGTON CO.
YAMHILL CO.
POLK CO.

WILLAMETTE BASE LINE

LOWER WILLAMETTE BASIN
MIDDLE WILLAMETTE BASIN

Columbia, Clatsop, Tillamook, Washington, Yamhill, Lincoln, Polk

COUNTY LOCATION

North Coast Drainage Basin

DRAINAGE BASIN LOCATION

LEGEND

- Possible Reservoir Sites
- Drainage Basin Boundary
- Subbasin Boundary
- Watershed Boundary
- National Forest Boundary
- Flood Problem Areas

WATERSHED CLASSIFICATION

- Best P.L. 566 Possibilities
- Approved for Construction P.L. 566
- Application Approved P.L. 566
- Others Studied

MAP 9

INDEX MAP OF WATERSHED AREAS, POSSIBLE RESERVOIR SITES AND GENERALIZED FLOOD PROBLEM AREAS

NORTH COAST DRAINAGE BASIN

OREGON

DECEMBER 1964

5 0 5 10 15
SCALE IN MILES

MID COAST BASIN

OPPORTUNITIES FOR WATERSHED PROTECTION AND FLOOD PREVENTION PROJECTS

DESCRIPTION OF PUBLIC LAW 566

The Watershed Protection and Flood Prevention Act, Public Law 566, as amended, authorizes the Secretary of Agriculture to cooperate with local organizations in planning and carrying out works of improvements for flood prevention and/or for the conservation, development, utilization, and disposal of water in watershed or subwatershed areas smaller than 250,000 acres. The act provides for technical, financial, and credit assistance by the U. S. Department of Agriculture to landowners, operators, and other people living in small watersheds. Project-type action under the act is intended to supplement other soil and water conservation programs and other programs for the development and flood protection of major river valleys.

WATERSHED SURVEY

The USDA River Basin Survey Staff made a survey of the potential for P. L. 566 work in the North Coast Drainage Basin to provide information as a guide to long-range coordination and planning of future projects. The basin was divided into 26 tributary watershed areas which are designated by letter and are delineated on map 9. A preliminary survey was made of each watershed gathering basic reconnaissance data on land and water use and water-related problems and summarizing it into tables 25A through 25D.

Information in these tables is based upon estimates by local personnel of the Soil Conservation Service, County Extension Service, and the Forest Service. Although the information is of a reconnaissance nature, it has been checked with U. S. Census of Agriculture data and other sources. These data are used throughout much of this report.

FACTORS THAT IMPROVE FEASIBILITY

A field reconnaissance and an evaluation of available data for each watershed were made to obtain additional information on opportunities for P. L. 566 action based upon watershed area, physiographic conditions, land use, water yield and its seasonal distribution, and water-related problems and needs. Some of this material is limited because of a lack of time for making more detailed field observations; however, many of the water-related problems of the North Coast Drainage Basin could be reduced or solved under P. L. 566. Under existing conditions and laws, it appears that a solution of these problems may be practicable and feasible in several watersheds. The Survey Staff's findings indicate that watersheds with the best possibilities for P. L. 566 action have a combination of some of the following conditions:

1. Most of the watershed lies at low elevations and has relatively low summer water yields.
2. The watershed contains highly erodible soils that are subject to wind and/or water erosion.
3. The watershed has, or has potential for, a high degree of agricultural, residential, or urban development.
4. The watershed has a large area suitable for irrigation development and lacks water sources that can be developed by individual farmers, but has water sources that can be developed by group action.
5. The watershed has localized flooding and/or drainage problems which are related to floods of moderate duration.
6. The watershed contains one or more storage sites which appear feasible for multiple purpose development.

FACTORS THAT LIMIT FEASIBILITY

Some watersheds studied do not appear to be suitable for P. L. 566 action. These watersheds usually have a combination of some of the following conditions:

1. The watershed has high water yield and large peak flows which produce flooding that cannot be controlled by structures within the scope of P. L. 566.
2. Most of the watershed needs are for land treatment on forest and range areas where there is little present economic incentive for land treatment measures.
3. Only a small part of the watershed that would benefit materially from flood protection and drainage is under agricultural, residential, or urban uses, and there is limited potential for expansion of these land uses.
4. The watershed has minor drainage, flooding, and water supply problems that can best be solved through individual action.
5. Group irrigation development is not feasible in the watershed because of land capability factors.

FACTORS THAT COULD CHANGE FEASIBILITY IN THE FUTURE

There are several factors that may affect the future feasibility of a given watershed for P. L. 566 action:

1. Revision of P. L. 566 to provide greater Federal contribution for land treatment, flood protection, recreation, and fish and wildlife benefits would improve the possibility for a project in several watersheds.
2. Increased demands for water arising from urbanization, industrialization, and for specialized agricultural crops may improve the need for P. L. 566 action in some watersheds.
3. Small watershed projects may be feasible in some areas adjacent to, or part of, planned Corps of Engineers' projects. Such small watershed projects could be complementary to a larger project.

Table 25A.--Reconnaissance data on small watersheds, Tillamook, Subbasin 1, North Coast Drainage Basin, Oregon, 1964 1/

Item	Unit	Watershed A: Wilson River	B: Kilchis River	C: Miami River	D: Trask River	E: Killam-Fawcett Creeks	F: Tillamook River	G: Sand Lake	H: Beaver Creek	I: Nestucca River	J: Little Nestucca River	K: Neskowin Creek	Total Tillamook Subbasin
Farms	Number	95	25	42	122	15	124	30	29	157	34	24	697
Watershed area	Acres	123,900	44,000	38,600	110,300	8,100	57,300	11,200	19,200	146,600	38,720	15,200	613,120
GENERAL LAND USE:													
Forest land	Acres	117,450	41,480	31,370	98,100	7,130	44,150	8,450	18,030	135,880	35,910	12,860	550,810
Grazed	do.	300	250	800	500	100	900	100	300	600	800	500	5,150
Nongrazed	do.	117,150	41,230	30,570	97,600	7,030	43,250	8,350	17,730	135,280	35,110	12,360	545,660
Cropland	do.	3,500	1,080	1,300	9,000	820	4,170	670	800	6,700	1,740	800	30,580
Nonirrigated	do.	2,510	810	1,040	7,400	640	3,250	330	610	4,520	1,340	630	23,080
Irrigated	do.	990	270	260	1,600	180	920	340	190	2,180	400	170	7,500
Rangeland	do.	450	300	700	600	50	600	800	100	820	430	600	5,450
Other	do.	2,500	1,140	5,230	2,600	100	8,380	1,280	270	3,200	640	940	26,280
IRRIGATION:													
Water source:													
Streamflow	Acres	920	230	260	1,500	170	920	340	190	2,060	400	170	7,160
Reservoir	do.	...	...	...	...	...	...	...	...	...	...	...	...
Ground water	do.	70	40	...	100	10	...	...	...	120	...	...	340
Method of application:													
Sprinkler	Acres	990	270	260	1,600	180	920	340	190	2,180	400	170	7,500
Water rights	Acres	604	256	147	870	161	721	547	187	1,789	312	101	5,695
Water shortage	Acres	...	...	...	...	180	...	...	...	200	...	...	380
POTENTIAL:													
Cropland	Acres	100	300	700	500	200	500	1,000	400	1,200	200	100	5,200
Available water 2/	Ac.ft.	1,042,800	381,300	292,700	839,800	51,500	292,500	59,700	120,000	994,900	209,700	74,900	4,359,800
Irrigable land	Acres	2,500	600	1,000	3,600	670	3,200	1,500	800	1,300	800	300	16,270
Water source:													
Streamflow	Acres	200	100	300	2,000	70	...	...	300	800	800	200	4,770
Storage	do.	2,300	500	700	1,600	600	3,200	1,500	500	500	...	100	11,500
DRAINAGE:													
Arable land needing drainage	Acres	1,000	300	670	1,600	100	2,000	1,450	250	1,330	1,000	300	10,000
FLOODING:													
Area	Acres	1,200	900	400	2,000	50	2,000	1,000	200	1,300	1,000	50	10,100
STORAGE:													
Ponds (existing)	Number	...	...	...	...	...	...	...	...	7	...	...	7
Reservoirs (existing)	do.	...	...	...	...	...	...	...	...	1	...	...	1
Reservoir sites studied	do.	...	2	1	7	2	5	...	3	7	2	...	29

1/ Based on data collected by the USDA River Basin Survey Staff from local personnel of the Soil Conservation Service and Forest Service.
2/ Average annual yield.

Table 25B.--Reconnaissance data on small watersheds, Nehalem, Subbasin 2, North Coast Drainage Basin, Oregon, 1964 1/

Item	Unit	Watershed A Upper Nehalem	B Middle Nehalem	C North Fork Nehalem	D Lower Nehalem	Total Nehalem Subbasin
Farms	Number	106	60	42	42	250
Watershed area	Acres	231,500	128,700	68,700	111,900	540,800
GENERAL LAND USE:						
Forest land	Acres	220,910	124,860	64,230	106,950	516,950
Grazed	do.	5,400	500	1,000	600	7,500
Nongrazed	do.	215,510	124,360	63,230	106,350	509,450
Cropland	do.	5,500	2,200	1,320	1,650	10,670
Nonirrigated	do.	4,800	1,700	1,120	1,420	9,040
Irrigated	do.	700	500	200	230	1,630
Rangeland	do.	2,700	200	900	800	4,600
Other	do.	2,390	1,440	2,250	2,500	8,580
IRRIGATION:						
Water source:						
Streamflow	Acres	700	500	200	230	1,630
Reservoir	do.	...	...	...	...	...
Ground water	do.	...	...	...	...	...
Method of application:						
Sprinkler	Acres	700	500	200	230	1,630
Water rights	Acres	1,207	485	299	166	2,157
Water shortage	Acres	...	...	...	...	...
POTENTIAL:						
Cropland	Acres	6,200	500	1,100	800	8,600
Available water 2/	Ac.ft.	752,300	707,800	429,200	801,700	2,691,000
Irrigable land	Acres	8,900	1,800	2,100	1,500	14,300
Water source:						
Streamflow	Acres	400	1,800	800	1,000	4,000
Storage	do.	8,500	...	1,300	500	10,300
DRAINAGE:						
Arable land needing drainage	Acres	2,500	800	1,000	600	4,900
FLOODING:						
Area	Acres	4,000	200	1,000	800	6,000
STORAGE:						
Ponds (existing)	Number	2	...	...	...	2
Reservoirs (existing)	do.	2	...	...	...	2
Reservoir sites studied	do.	11	7	4	3	25

1/ Based on data collected by the USDA River Basin Survey Staff from local personnel of the Soil Conservation Service and Forest Service.

2/ Average annual yield.

Table 25C.--Reconnaissance data on small watersheds, Columbia, Subbasin 3, North Coast Drainage Basin, Oregon, 1964 1/

Item	Unit	Watershed A Tide Creek	B Rainier	C Beaver Creek	D Clatskanie River	E Knappa	F Youngs River	G Lewis and Clark River	H Skipanon River	I Warrenton Beach	J Necanicum River	K Elk Creek	Total Columbia Subbasin
Farms	Number	125	175	150	35	280	150	100	53	50	30	5	1,153
Watershed area	Acres	32,600	36,200	44,000	62,400	153,400	88,000	43,800	10,480	33,300	43,300	29,800	577,280
GENERAL LAND USE:													
Forest land	Acres	21,450	21,650	31,000	59,400	96,020	67,100	34,600	8,180	11,140	40,500	27,800	418,840
Grazed	do.	1,500	1,800	2,000	2,000	4,000	500	200	150	1,000	300	100	13,550
Nongrazed	do.	19,950	19,850	29,000	57,400	92,020	66,600	34,400	8,030	10,140	40,200	27,700	405,290
Cropland	do.	4,750	5,440	8,100	1,000	11,060	4,200	3,500	900	800	500	100	40,350
Nonirrigated	do.	4,050	4,990	7,700	990	10,540	4,000	3,140	830	700	400	100	37,440
Irrigated	do.	700	450	400	10	520	200	360	70	100	100	...	2,910
Rangeland	do.	2,000	1,350	1,000	1,000	1,500	500	700	50	600	500	200	9,400
Other	do.	4,400	7,760	3,900	1,000	44,820	16,200	5,000	1,350	20,760	1,800	1,700	108,690
IRRIGATION:													
Water source:													
Streamflow	Acres	570	430	400	10	520	200	360	70	100	100	...	2,760
Reservoir	do.	130	20	...	...	...	...	...	...	...	...	...	150
Ground water	do.	...	...	...	...	...	...	...	...	...	...	...	...
Method of application:													
Sprinkler	Acres	700	450	400	10	520	200	360	70	100	100	...	2,910
Water rights	Acres	...	68	179	17	161	82	...	142	330	96	27	1,102
Water shortage	Acres	380	380	...	...	...	...	...	...	...	...	...	760
POTENTIAL:													
Cropland	Acres	2,700	2,200	1,700	400	3,300	1,500	700	900	1,000	700	100	15,200
Available water 2/	Ac.ft.	54,300	60,400	80,700	144,400	568,000	403,300	184,700	35,900	61,500	220,200	141,700	1,955,100
Irrigable land	Acres	2,700	3,200	6,500	400	8,000	2,500	1,700	430	500	1,000	100	27,030
Water source:													
Streamflow	Acres	1,200	1,200	5,800	...	8,000	600	...	430	500	1,000	100	18,830
Storage	do.	1,500	2,000	700	400	...	1,900	1,700	...	...	...	...	8,200
DRAINAGE:													
Arable land needing drainage	Acres	3,000	1,600	4,000	500	12,000	4,500	3,000	400	1,500	300	50	30,850
FLOODING:													
Area	Acres	2,300	250	600	300	2,800	600	400	200	400	150	...	8,000
STORAGE:													
Ponds (existing)	Number	3	3	8	3	...	3	...	4	...	4	...	28
Reservoirs (existing)	do.	1	3	...	1	1	...	1	...	...	1	...	8
Reservoir sites studied	do.	1	1	2	3	1	5	4	...	...	...	...	17

1/ Based on data collected by the USDA River Basin Survey Staff from local personnel of the Soil Conservation Service and Forest Service.
2/ Average annual yield.

Table 25D.--Reconnaissance data on small watersheds, North Coast Drainage Basin, Oregon, 1964 1/

Item	Unit	Subbasin 1 Tillamook	Subbasin 2 Nehalem	Subbasin 3 Columbia	Total
Farms	Number	697	250	1,153	2,100
Watershed area	Acres	613,120	540,800	577,280	1,731,200
GENERAL LAND USE:					
Forest land	Acres	550,810	516,950	418,840	1,486,600
Grazed	do.	5,150	7,500	13,550	26,200
Nongrazed	do.	545,660	509,450	405,290	1,460,400
Cropland	do.	30,580	10,670	40,350	81,600
Nonirrigated	do.	23,080	9,040	37,440	69,560
Irrigated	do.	7,500	1,630	2,910	12,040
Rangeland	do.	5,450	4,600	9,400	19,450
Other	do.	26,280	8,580	108,690	143,550
IRRIGATION:					
Water source:					
Streamflow	Acres	7,160	1,630	2,760	11,550
Reservoir	do.	...	...	150	150
Ground water	do.	340	...	...	340
Method of application:					
Sprinkler	Acres	7,500	1,630	2,910	12,040
Water rights	Acres	5,695	2,157	1,102	8,954
Water shortage	Acres	380	...	760	1,140
POTENTIAL:					
Cropland	Acres	5,200	8,600	15,200	29,000
Available water 2/	Ac.ft.	4,359,800	2,691,000	1,955,100	9,005,900
Irrigable land	Acres	16,270	14,300	27,030	57,600
Water source:					
Streamflow	Acres	4,770	4,000	18,830	27,600
Storage	do.	11,500	10,300	8,200	30,000
DRAINAGE:					
Arable land needing drainage	Acres	10,000	4,900	30,850	45,750
FLOODING:					
Area	Acres	10,100	6,000	8,000	24,100
STORAGE:					
Ponds (existing)	Number	7	2	28	37
Reservoirs (existing)	do.	1	2	8	11
Reservoir sites studied	do.	29	25	17	71

1/ Based on data collected by the USDA River Basin Survey Staff from local personnel of the Soil Conservation Service and Forest Service.

2/ Average annual yield.

4. The degree of local interest in a given project will influence the immediate prospects for P. L. 566 action in many watersheds where projects appear to be physically and economically feasible. Interest in irrigation and more intensive land use will be particularly important as many potential projects center around irrigation development.
5. In a few instances, modifying the boundaries of a proposed small watershed might improve the possibility for P. L. 566 action. For instance, a watershed with suitable storage sites but small water requirements for irrigation, domestic, or other uses might be combined with an adjacent watershed with large water requirements but no storage potential.
6. Improvements made by individuals or groups in a watershed may reduce future benefits which would adversely affect the possibility of a P. L. 566 project.

SUMMARY OF REPORTS

Further detailed investigations would be necessary to determine engineering and economic feasibility of a given project. The Survey Staff's findings are presented in individual watershed reports summarized in table 26 and shown on map 9.

Table 26.--Summary of watershed reports, North Coast Drainage Basin, Oregon, 1964

Watershed	Project possibilities under P. L. 566
1. Tillamook Subbasin:	
A. Wilson River	A project on the entire area does not appear to be feasible; however, a project near the mouth including flood protection, land treatment, and water development for irrigation and recreation might be feasible but more detailed study is required for determination.
B. Kilchis River	A project including flood protection, land treatment, channel improvement, and water development for irrigation and recreation might be feasible but more detailed study is required for determination.
C. Miami River	A project including flood protection, land treatment, channel improvement, and water development for irrigation and recreation might be feasible, but more detailed study is required for determination.

Table 26.--Summary of watershed reports, North Coast Drainage Basin, Oregon, 1964--Continued

Watershed	Project possibilities under P. L. 566
1. Tillamook Subbasin (cont.)	
D. Trask River	A project does not appear to be feasible; however, one including flood protection, drainage, land treatment, and water development for irrigation might be feasible on a portion of the watershed.
E. Killam-Fawcett Creeks	A project involving flood protection, drainage, land treatment, and water development for irrigation, municipal, and recreation uses appears to be feasible.
F. Tillamook River	A project involving water management for irrigation, drainage, recreation, flood protection, channel improvement, and land treatment appears to be feasible.
G. Sand Lake	A project including flood protection, drainage, irrigation, and land treatment appears to be feasible.
H. Beaver Creek	A project to develop water for irrigation and recreation, flood protection, channel improvement, and land treatment might be feasible but more detailed study is required for determination.
I. Nestucca River	A project does not appear to be feasible on the entire area but might be feasible on some parts of the watershed.
J. Little Nestucca River	A project including flood protection, drainage, channel improvement, and land treatment might be feasible but more detailed study is required for determination.
K. Neskowin Creek	A project has few possibilities under existing conditions and laws.
2. Nehalem Subbasin:	
A. Upper Nehalem	An application for a P. L. 566 plan has been received and approved. A project for flood protection, channel improvement, water management for irrigation and recreation, drainage, and land treatment appears to be feasible for all or parts of the watershed.

Table 26.--Summary of watershed reports, North Coast Drainage Basin, Oregon, 1964--Continued

Watershed	Project possibilities under P. L. 566
2. Nehalem Subbasin (cont.)	
B. Middle Nehalem	A project does not appear to be feasible under existing conditions and laws.
C. North Fork Nehalem	A project including flood protection, drainage, land treatment, channel improvement, and water development for irrigation and recreation might be feasible but more detailed study is required for determination. A project on parts of the watershed appears to be feasible.
D. Lower Nehalem	A project does not appear to be feasible; however, one including flood protection, channel improvement, and water management for drainage, irrigation, and recreation might be feasible on the lower part.
3. Columbia Subbasin:	
A. Tide Creek	A project has few possibilities; however, one might be feasible on part of the watershed near the Columbia River such as Deer Island.
B. Rainier	An application has been received, approved, and terminated on the Rainier portion of this watershed. A project does not appear to be feasible except on parts of the area near the Columbia River such as the drainage district.
C. Beaver Creek	A project to develop water for irrigation and recreation, flood protection, channel improvement, and land treatment might be feasible but more detailed study is required for determination.
D. Clatskanie River	A project including flood protection, drainage, land treatment, and water management for irrigation and recreation might be feasible but the opportunities are quite limited and more detailed study is required for determination.

Table 26.--Summary of watershed reports, North Coast Drainage Basin, Oregon, 1964--Continued

Watershed	Project possibilities under P. L. 566
3. Columbia Subbasin (cont.)	
E. Knappa	A project on the entire area does not appear feasible under existing conditions and laws but some parts of the watershed might be feasible near the Columbia River such as the drainage districts and the Brownsmead area.
F. Youngs River	A project including flood protection, drainage, channel improvement, land treatment, development of water for irrigation, municipal, and recreation might be feasible but more detailed study is required for determination.
G. Lewis and Clark River	A project including flood protection, drainage, channel improvement, land treatment, and water development for irrigation and recreation might be feasible but more detailed study is required for determination.
H. Skipanon River	A project is under construction.
I. Warrenton	A project does not appear to be feasible on the entire area; however, one might be on Neawanna Creek.
J. Necanicum River	A project involving flood protection, water development for irrigation and recreation, and land treatment might be feasible.
K. Elk Creek	A project does not appear to be feasible under existing conditions and laws.

Reconnaissance reports for each watershed are presented as follows.

1. TILLAMOOK SUBBASIN

Watershed A, Wilson River

Description. The Wilson River watershed contains 123,900 acres in Tillamook and Washington Counties. It is in the Tillamook and Washington County Soil and Water Conservation Districts. The Wilson River flows in a

southwesterly direction from the upper reaches of the Coast Range to Tillamook Bay. The watershed is 28 miles long and ranges from 1 to 11 miles in width. Elevations range from sea level to 3,400 feet with the agricultural land below 400 feet. Average annual precipitation is 106 inches with an average growing season in the agricultural area of 180 days.

Upland, alluvial terrace, and flood-plain soils occur in the watershed. The upland soils are medium to fine textured, moderately to very deep, and nearly level to very steep and they were formed from sedimentary rock in the southeastern portion of the watershed and igneous materials in the remaining portion. The soils on the valley flood plains and the alluvial terraces along the lower stream possess a wide range of characteristics and use. Characteristics vary from moderately coarse to fine texture, moderately deep to very deep profiles, and very poor to excessive internal drainage. The soils of the basin are described in more detail in the "General Description of the Basin" section of the report. The kind and extent of each group of soils are shown on the generalized soil map (map 4, *page 6). The prominent characteristics and qualities of each soil series are recorded in table 1, page 7.

A reconnaissance survey indicates that 4,250 acres are used for the production of either crops or livestock. Of this, 300 acres are grazed forest land; 450 acres are rangeland, and 3,500 acres are cropland. About 990 acres are irrigated pasture and hay. The nonirrigated cropland produces pasture, hay, and a small acreage of holly. There are 95 farms in this watershed.

Approximately 117,450 acres of this watershed are forested. The magnitude of the Tillamook Burn can be viewed from Saddle Mountain--all that can be seen to the north, west, and south are burned hills. The snags have been cut along the firebreaks but the areas outside the firebreaks still have snags. The only vegetation readily apparent is low-growing brush.

In other sections of the watershed, conifer plantations are evident with the rows still visible in some cases. Generally, the reproduction is variable on south and west slopes but satisfactory on the north and east slopes. Alder is extremely heavy on the lower slopes and stream bottoms.

Watershed Problems and Needs. Concern for fire protection is evident. Several water tanks along the ridgetop roads with locations indicated by signs offer the only opportunity for filling fire trucks. Because the drainages are steep and the streams are small, it is not possible to construct ponds.

Approximately 1,200 acres are flooded annually. Flooding occurs generally on pasture and range land, but with flood protection measures, some of this land is suitable for more intensive cropping. There is considerable bank erosion and debris deposits. Farms, homes, motels, and other businesses in the lower reaches of the watershed receive flooding and debris damage. There is also damage to roads and bridges. Tide gates and dikes are needed to minimize these problems.

Estimates show that 1,000 acres of arable land need subsurface drainage and that 140 acres require surface drainage. This includes both open and closed drains and improved outlets.

*adjacent to

Approximately 2,500 acres of additional land are suitable for irrigation. Natural streamflow is adequate for 200 acres and storage would be necessary to develop the remainder. No suitable storage sites were studied in this watershed.

Opportunities under P. L. 566. A project on the entire watershed does not appear to be feasible. A project near the mouth including flood protection, land treatment, and water development for irrigation and recreation might be feasible but a more detailed study is required before a determination could be made.

Watershed B, Kilchis River

Description. The Kilchis River watershed contains 44,000 acres in Tillamook County. It is in the Tillamook Soil and Water Conservation District. The Kilchis River flows in a southwesterly direction to Tillamook Bay. The watershed is about 14 miles long and averages about 5 miles wide. Elevations range from sea level to 3,294 feet with most of the agricultural land below 400 feet. Average annual precipitation is 116 inches. The average growing season in the agricultural area is around 180 days.

Soils occurring the watershed include those on uplands, alluvial terraces, and flood plains. The upland soils are from medium to fine textured, moderately deep to very deep, and nearly level to very steep. The soils in most of the area were formed from igneous materials; however, there is a small southwestern portion in which sedimentary rock is the parent material. The soils on the flood plains and the alluvial terraces along the lower stream possess a wide range of characteristics and use. Characteristics vary from moderately coarse to fine texture, moderately deep to very deep profiles, and very poor to excessive internal drainage. The soils of the basin are described in more detail in the "General Description of the Basin" section of the report. The kind and extent of each group of soils are shown on the generalized soil map (map 4, *page 6). The prominent characteristics and qualities of each soil series are recorded in table 1, page 7.

A reconnaissance survey indicates 1,630 acres are used for the production of either crops or livestock. Of this, 250 acres are grazed forest land; 300 acres are rangeland; and 1,080 acres are cropland. About 270 acres are irrigated hay and pasture. The nonirrigated cropland produces hay and pasture. There are 25 farms in this watershed.

Approximately 41,480 acres of this watershed are forested. The lower end of the drainage has heavy stands of small timber on slopes and ridges. The middle and upper portions, which were in the Tillamook Burn, have vegetative cover, but very little conifer reproduction shows above the low-growing brush. Many snags stick out above the green timber stands. There is good conifer reproduction on north slopes and side drainages in the upper portion of the Little South Fork.

Watershed Problems and Needs. Several small washouts in side streams have deposited chunks and cull logs in the South Fork. There is a project underway to remove the floatable debris from the channel.

*adjacent to

Approximately 900 acres are flooded annually. The affected land is generally in pasture and hay, but with flood protection measures, it could be used for more intensive agriculture. There is considerable bank erosion and debris damage. Irrigation facilities and roads are subjected to some minor damage. Tide gates and dikes in the lower reaches and upstream storage are needed to reduce flooding damage.

Estimates show that 300 acres of arable land need subsurface drainage and 200 acres need surface drainage. Open and closed drains are needed as well as land shaping and improved outlets.

Approximately 600 acres of additional land are suitable for irrigation development. Natural streamflow is adequate for 100 acres while storage would be required to develop all of the potentially irrigable land. Two reservoir sites (index numbers 2 and 3) with a combined storage of 8,850 acre feet were investigated on the Kilchis River. These sites are suitable for multiple use although they would have little effect on flood protection due to the large yield of the drainage.

Opportunities under P. L. 566. A project including flood protection, land treatment, channel improvement, and water development for irrigation and recreation might be feasible but a more detailed study is required before a determination could be made.

Watershed C, Miami River

Description. The Miami River watershed in Tillamook County contains 38,600 acres. It is in the Tillamook Soil and Water Conservation District. In addition to the Miami River drainage, this watershed includes numerous small creeks which drain into the Pacific Ocean and Tillamook Bay from Nehalem Bay south to Idaville. The Miami River flows in a southwesterly direction into Tillamook Bay at Garibaldi. The area is 11 miles long and ranges from 2 to 11 miles wide. Elevations range from sea level to 2,780 feet with most of the agricultural land below 400 feet. Average annual precipitation is 104 inches. The average growing season in the agricultural area is around 180 days.

Upland, marine, and alluvial terrace, and flood-plain soils occur in the watershed. The upland soils are medium to fine textured, moderately deep to very deep, and nearly level to very steep. Parent material is both igneous and sedimentary rock. In the coastal area near Rockaway, the soils were developed from recent marine sediments. They are very deep, coarse textured, undulating in topography, and are vulnerable to wind erosion when the vegetation is removed. Flood-plain and terrace soils possess a wide range of characteristics and use. Characteristics vary from moderately coarse to fine texture, moderately deep to very deep profiles, and very poor to excessive internal drainage. The soils of the basin are described in more detail in the "General Description of the Basin" section of the report. The kind and extent of each group of soils are shown on the generalized soil map (map 4, *page 6). The prominent characteristics and qualities of each soil series are recorded in table 1, page 7.

*adjacent to

A reconnaissance survey indicates 2,800 acres are used for the production of either crops or livestock. Of this, 800 acres are grazed forest land; 700 acres are rangeland; and 1,300 acres are cropland. About 260 acres are irrigated hay and pasture. The nonirrigated cropland produces hay, pasture, and some nursery stock. There are 42 farms in this watershed.

Approximately 31,370 acres of this watershed are forested. Above Garibaldi, there is a heavy cover of alder, willow, and vine maple with many snags and only a few conifers stand out over the low-growing brush. Occasional islands of green timber are surrounded by old gray snags and low-growing brush in the repeatedly burned upper reaches of this watershed.

Watershed Problems and Needs. Although the stream is rather shallow and mild appearing in the summer, it caused much damage during the winter of 1963-64. Very few bridges serving the logging spurs still exist. Spur-road construction has triggered slides on tributary streams. In one case, the debris blocked the entire river.

Approximately 400 acres are flooded annually. Three-fourths of this area is cropland and it receives considerable damage from streambank erosion and debris deposits. Some rangeland flooding occurs with very little damage. Roads and bridges receive some damage. Dikes and tide gates along the lower reaches would help to reduce this problem.

Estimates show that 670 acres of arable land need improved subsurface drainage.

Approximately 1,000 acres of additional land are suitable for irrigation. Of this acreage, 300 acres could be developed with natural streamflow. The remaining 700 acres would need storage to develop. One reservoir site (index number 1) with a potential storage of 9,000 acre feet was investigated on the upper reaches of the Miami River. This site is suitable for multiple purpose use, but due to the large yield of the drainage, it would give only minor flood protection.

Opportunities under P. L. 566. A project including flood protection, land treatment, channel improvement, and water development for irrigation and recreation might be feasible but a more detailed study is required before a determination could be made.

Watershed D, Trask River

Description. The Trask River watershed contains 110,300 acres in Tillamook, Yamhill, and Washington Counties. It is mostly in the Tillamook Soil and Water Conservation District with small acreages of the upper watershed in the Washington County and Yamhill Soil and Water Conservation Districts. The Trask River flows in a westerly direction from the summit of the Coast Range to Tillamook Bay. The watershed is about 28 miles long and ranges from 2 to 16 miles in width. Elevations range from sea level to 3,423 feet with most of the agricultural area below 400 feet. Average annual precipitation is 102 inches. The average growing season in the agricultural area is around 180 days.

Large areas of upland and alluvial terrace and flood-plain soils occur in the watershed. Upland soils were formed from sedimentary rock in the east half and from both sedimentary rock and volcanic materials in the west portion. They are from medium to fine textured, moderately deep to very deep, and nearly level to very steep. The upstream section of the flood plain is narrow and the downstream section features a wide flood plain and a broad alluvial terrace. Characteristics vary from moderately coarse to fine texture, moderately deep to very deep profiles, and very poor to excessive internal drainage. The soils of the basin are described in more detail in the "General Description of the Basin" section of the report. The kind and extent of each group of soils are shown on the generalized soil map (map 4, *page 6). The prominent characteristics and qualities of each soil series are recorded in table 1, page 7.

A reconnaissance survey indicates 10,100 acres are used for the production of either crops or livestock. Of this, 500 acres are grazed forest land; 600 acres are rangeland; and 9,000 acres are cropland. About 1,600 acres are irrigated pasture and hay. Hay and pasture are produced on the nonirrigated cropland. There are 122 farms in the watershed.

Approximately 98,100 acres of this watershed are forested. The largest island of old-growth timber in the Tillamook Burn is at the head of the North Fork. The stand was bypassed by all three fires and will yield up to 150,000 board feet per acre. The rest of the watershed appears desolate with bleached logs, charred stumps, and scrawny snags scattered throughout (photo 35). Sapling- and pole-size conifers are found on the east and south sides and, over the remainder, brush with small islands of reproduction is growing.

Watershed Problems and Needs. Many of the tributary stream channels are practically filled with cull logs and chunks. After almost 20 years of protection, the watershed is recovering from the effect of forest fires and appears reasonably stable.

Approximately 2,000 acres are flooded annually. The majority of this area is cropland with damage mainly in the form of streambank erosion and debris deposition. Some suburban homes and farmsteads in the lower areas are damaged as are roads and bridges. A combination of dikes, tide gates, and upstream storage is needed to reduce the flooding.

Estimates show that 1,600 acres of arable land need subsurface drainage and 500 acres also need improved surface drainage. Open and closed drainage systems as well as land shaping and improved outlets are needed to reduce the drainage problems. The Dougherty Slough and Tillamook Drainage Districts serve about 1,719 acres of this watershed.

Approximately 3,600 acres of additional land are suitable for irrigation. Natural streamflow appears to be adequate to develop this land. Seven reservoir sites (index numbers 4 through 10) were investigated in this watershed with a combined potential storage of 36,300 acre feet. These sites are suitable for multiple use although they would give only minor downstream flood protection because of the large yield of the watershed.

*adjacent to

Photo 36.--View of Tillamook Burn on the East Fork of the Trask River shows burned snags, bleached logs, and low-growing vegetation. FS photo

Opportunities under P. L. 566. A project does not appear to be feasible except in cooperation with another agency. A project including flood protection, drainage, land treatment, and water development for irrigation might be feasible on the lower portion of the watershed.

Watershed E, Killam and Fawcett Creeks

Description. The Killam and Fawcett Creek watershed contains 8,100 acres in Tillamook County. It is in the Tillamook Soil and Water Conservation District. Killam Creek and Fawcett Creek, both tributaries of the Tillamook River, flow westerly into this river. The watershed is about seven miles long and two miles wide. Elevations range from 80 feet to over 3,100 feet with the agricultural land below 400 feet. Average annual precipitation is 106 inches. The average growing season in the agricultural area is around 180 days.

An upland area on the east and an alluvial terrace in the west section dissected by narrow alluvial flood plains constitute the soil pattern of the watershed. The upland soils are from medium to fine textured, moderately deep to very deep, and nearly level to very steep. Parent material is mainly volcanic material with a small area of sedimentary rock in the west portion. The alluvial soils are moderately coarse to fine textured, moderately deep to very deep, and very poorly to excessively drained. The soils of the basin

are described in more detail in the "General Description of the Basin" section of the report. The kind and extent of each group of soils are shown on the generalized soil map (map 4, *page 6). The prominent characteristics and qualities of each soil series are recorded in table 1, page 7.

A reconnaissance survey indicates 970 acres are used for the production of either crops or livestock. Of this, 100 acres are grazed forest land; 50 acres are rangeland; and 820 acres are cropland. Pasture and hay are raised on 180 acres of irrigated cropland as well as 640 acres of nonirrigated land. There are 15 farms in this watershed.

Approximately 7,130 acres of this watershed are forested. The forested portion is well stocked with young hemlock, Douglas-fir, and spruce. The watershed is in good condition with little evidence of use and is the source of municipal water for Tillamook.

Watershed Problems and Needs. Approximately 50 acres are flooded annually. The area flooded is cropland with damage confined mostly to streambank cutting and debris deposits. Two bridges on Fawcett Creek and roads receive annual damage. The Tillamook city water supply dam on Killam Creek has been damaged from logs and debris. A combination of dikes, stream channel work, and upstream storage could greatly reduce flooding.

Estimates show that 100 acres of arable land need subsurface drainage. Tile drains and outlets are needed for this area.

Approximately 670 acres of additional land are suitable for irrigation development. Natural streamflows are only adequate for 50 acres. The remainder will need storage for maximum development. Two reservoir sites, (index number 11 and 12) with a potential storage of 2,070 acre feet, were investigated in this watershed. These sites are suitable for multiple use. They would provide minor flood protection because of the large water yield of the watershed.

These two streams are the city of Tillamook's domestic water supply. There is a need to develop additional water for domestic and municipal use.

Opportunities under P. L. 566. A project involving flood protection, drainage, land treatment, and water development for irrigation, municipal, and recreation appears to be feasible.

Watershed F, Tillamook River

Description. The Tillamook River watershed contains 57,300 acres in Tillamook County. It is in the Tillamook Soil and Water Conservation District. The Tillamook River flows in a northwesterly direction to Tillamook Bay near Tillamook. This watershed contains numerous small coastal streams from Cape Meares to Camp Meriwether and it includes Netarts Bay. The watershed is irregular in shape due to the coastline and bay drainages. Elevations range from sea level to 2,916 feet with the agricultural land below 400 feet. Average annual precipitation is 98 inches. The average growing season in the agricultural area is around 180 days.

*adjacent to

Soils in the watershed have developed on uplands, marine, and alluvial terraces, and flood plains. The upland soils are medium to fine textured, moderately deep to very deep, and nearly level to very steep. In a large portion of the watershed, the parent material is from sedimentary rock; however, there are three separate smaller areas of igneous parent material. Marine sediments have accumulated on the beaches along the coast and on spits around the bays. The sediments vary from loose, unconsolidated, unvegetated sand along the shore to old stabilized dunes farther inland. They are very deep, coarse textured, and are vulnerable to wind erosion when vegetation is absent. The flood plains are narrow in the upstream section and the downstream section along the Tillamook River features a wide flood plain and a broad alluvial terrace. These soils have a wide range of characteristics and use suitability. Characteristics vary from moderately coarse to fine texture, moderately deep to very deep profiles, and very poor to excessive internal drainage. Small areas of organic soils occur on the flood plains. The soils of the basin are described in more detail in the "General Description of the Basin" section of the report. The kind and extent of each group of soils are shown on the generalized soil map (map 4, *page 6). The prominent characteristics and qualities of each soil series are recorded in table 1, page 7.

A reconnaissance survey indicates 5,670 acres are used for the production of either crops or livestock. Of this, 900 acres are grazed forest land; 600 acres are rangeland; and 4,170 acres are cropland. Pasture and hay are raised on the cropland of which 920 acres are irrigated. There are 124 farms in this watershed.

Approximately 44,150 acres of this watershed are forested. The two capes in this watershed present pictures of different stages of forest management. Because Cape Lookout has been covered with a network of access roads, a large portion has been harvested and reforested. The major portion of Cape Meares is untouched and still supports a stand of merchantable hemlock and spruce.

Watershed Problems and Needs. There is little evidence of watershed damage on Cape Lookout. The roads are well designed, constructed, and maintained. The cutting units have been well planned and executed even though the Columbus Day, 1962, storm accelerated the harvesting program.

Approximately 2,000 acres are flooded annually. This area is mainly cropland which is flooded three or four times each year. The major damage is because of silt and debris deposits, but there is also some streambank erosion. Fences and roads as well as about 20 suburban homes and farmsteads receive damage. Dikes, tide gates, and upstream storage or a combination of them would be needed to reduce flood damage.

Estimates show that 2,000 acres of arable land need drainage. Subsurface drainage is needed on the total area as well as improved surface drainage on 400 acres. The South Prairie, Trask, and Stilwell Drainage Districts serve about 2,148 acres of land on the lower reaches of this watershed.

Approximately 3,200 acres of additional land are suitable for irrigation. Natural streamflow is not available so storage would be needed. There is a

*adjacent to

possibility of the development of some underground water. Five reservoir sites (index numbers 13 through 17) were investigated with a combined storage potential in excess of 4,600 acre feet. The sites are not large but are located in small drainage areas just upstream from potentially irrigable land. These sites also have some multiple use possibilities other than flood protection.

Opportunities under P. L. 566. A project involving water management for irrigation, drainage, recreation, flood protection, channel improvement, and land treatment appears to be feasible.

Watershed G, Sand Lake

Description. The Sand Lake watershed contains 11,200 acres in Tillamook County. It is in the Tillamook Soil and Water Conservation District. Sand Creek is the principal stream in the watershed and flows in a southerly direction to Sand Lake. Sand Lake is largely a mud flat with very little water surface during low ocean tide. The watershed is about 8 miles long and varies from 1.5 to 4 miles wide. Elevations range from sea level to 1,684 feet with the agricultural land below 100 feet. Average annual precipitation is 97 inches. The average growing season in the agricultural area exceeds 180 days.

Three general groups of soils occur in the watershed. Upland soils occupy approximately half of the area and most are formed from sedimentary materials; however, a small portion of soils in the north are formed from igneous materials. They are medium to fine textured, moderately deep to very deep, and nearly level to steep. Marine sediments deposited along the coast have formed a spit at the mouth of the bay. They vary from loose, unconsolidated, unvegetated sand to stabilized, vegetated dunes farther inland. The soils are very deep, coarse textured, and are vulnerable to wind erosion when unvegetated. The alluvial soils, including a large area of flood plain and a small area of terrace, possess a wide variation of characteristics and suitability for use. Characteristics vary from moderately coarse to fine texture, moderately deep to very deep profiles, and very poor to excessive internal drainage. The soils of the basin are described in more detail in the "General Description of the Basin" section of the report. The kind and extent of each group of soils are shown on the generalized soil map (map 4, *page 6). The prominent characteristics and qualities of each soil series are recorded in table 1, page 7.

A reconnaissance survey indicates that 1,570 acres are used for the production of either crops or livestock. Of this, 100 acres are grazed forest land; 800 acres are rangeland; and 670 acres are cropland. Pasture, hay, and a few acres of cranberries are raised on 340 acres of irrigated cropland. The nonirrigated cropland raises hay, pasture, and a few acres of blueberries. There are 30 farms in this watershed.

Approximately 8,450 acres of this watershed are forested. Sand dunes are encroaching on the forested portions near the coast. The forest cover is mainly hemlock and spruce with alder in the stream bottoms.

*adjacent to

Watershed Problems and Needs. Approximately 1,000 acres are flooded annually. This flooding is from both precipitation and high tides which inundate pasture and range lands. The main problem is caused by the salt water which limits crops that can be grown. A combination of storage dikes and tide gates would be required to eliminate this problem.

Estimates show that 1,450 acres of arable land need drainage. Subsurface drainage is needed on the total acreage while the majority also requires surface drainage and improved outlets.

Approximately 1,500 acres of additional land are suitable for irrigation. The natural streamflow is inadequate to develop this land so reservoir storage would be needed. No reservoir sites were investigated in connection with this report; however, there may be some small sites.

There is an area of approximately 750 acres of sand dunes that presents problems of stabilization. Some of the area has been planted with grasses and trees but additional plantings are needed.

Opportunities under P. L. 566. A project including flood protection, drainage, irrigation, and land treatment appears to be feasible on this watershed.

Watershed H, Beaver Creek

Description. The Beaver Creek watershed contains 19,200 acres in Tillamook County. It is in the Tillamook Soil and Water Conservation District. Made up of two large tributaries which join just south of Hemlock, Beaver Creek flows south to its confluence with the Nestucca River at Beaver. The watershed is about 13 miles from east to west and 4 miles from north to south. Elevations in the watershed range from 90 feet to over 3,000 feet with the agricultural land below 400 feet. Average annual precipitation is 108 inches. The average growing season in the agricultural area is 180 days.

The parent material of the upland soils is volcanic material in the east portion of the watershed and sedimentary rock in the west portion. The soil characteristics are medium to fine texture, moderately deep to very deep profiles, and nearly level to very steep slopes. The soils on the flood plains and alluvial terraces possess a wide range of characteristics and use. They are moderately coarse to fine textured, moderately deep to very deep, and very poorly to excessively drained. Small areas of organic soils occur on the flood plain. The soils of the basin are described in more detail in the "General Description of the Basin" section of the report. The kind and extent of each group of soils are shown on the generalized soil map (map 4, *page 6). The prominent characteristics and qualities of each soil series are recorded in table 1, page 7.

A reconnaissance survey indicates that 1,200 acres are used for the production of either crops or livestock. Of this, 300 acres are grazed forest land; 100 acres are rangeland; and 800 acres are cropland. Hay and pasture are raised on the cropland with 190 acres being irrigated. There are 29 farms in this watershed.

*adjacent to

Approximately 18,030 acres of this watershed are forested. Young hemlock and spruce comprise the forests which are found on the upper portion of the drainage. The eastern point extends into the Tillamook Burn but even this portion is reforested. The stream bottoms which are not in cropland are generally covered with red alder.

Watershed Problems and Needs. Approximately 200 acres are flooded annually. Flooding is on cropland and rangeland with damage being mainly debris deposition. There is some bank cutting and damage to fences. The channels are well entrenched in most areas. Some channel alignment and clearing along with upstream storage would greatly reduce the flooding.

Estimates show that 250 acres of arable land need drainage. Subsurface drainage and improved outlets are needed on almost all of this acreage.

Approximately 800 acres of additional land are suitable for irrigation. The natural streamflow appears to be adequate for 300 acres and storage of water would be necessary to develop the remaining acreage. Three reservoir sites (index numbers 18, 19, 20) with a total potential storage of 29,730 acre feet were investigated. These reservoirs are suitable for multiple use and could produce some flood protection.

Opportunities under P. L. 566. A project to develop water for irrigation and recreation, flood protection, channel improvement, and land treatment might be feasible but a more detailed study would be required before a determination could be made.

Watershed I, Nestucca River

Description. The Nestucca River watershed contains 146,600 acres in Tillamook and Yamhill Counties. It is in the Tillamook and Yamhill Soil and Water Conservation Districts. The Nestucca River flows in a southwesterly direction from the Coast Range to Nestucca Bay which empties into the Pacific Ocean. The watershed is about 30 miles long and averages about 8 miles in width. Elevations in the watershed range from sea level to over 3,100 feet on Mount Hebo with most of the agricultural land below 400 feet. Average annual precipitation is 105 inches. The average growing season in the agricultural area is 180 days.

A large area of upland and smaller areas of marine terraces, of alluvial terraces, and of flood-plain soils occur in the watershed. The parent material of a major portion of the upland soils is sedimentary rock and a smaller portion on the west is developed from volcanic material. They are medium to fine textured, moderately deep to very deep, and nearly level to very steep. A terrace of marine sediments along the coast near Pacific City and around Nestucca Bay is one-half to one mile wide. The soils from the sediments are coarse textured, very deep, undulating in topography, and are vulnerable to wind erosion when unvegetated. The band of alluvial soils which borders the streams is narrow in the upstream section and averages about a mile wide in the downstream section. They are moderately coarse to fine textured, moderately deep to very deep, and very poorly to excessively drained. There are small areas of organic soils. The soils of the basin are described in more detail in the "General Description of the Basin" section of the report. The

kind and extent of each group of soils are shown on the generalized soil map (map 4, *page 6). The prominent characteristics and qualities of each soil series are recorded in table 1, page 7.

A reconnaissance survey indicates 8,120 acres are used for the production of either crops or livestock. Of this, 600 acres are grazed forest land; 820 acres are rangeland; and 6,700 acres are cropland. Pasture and hay are the principal crops. The area irrigated contains 2,180 acres. There are 157 farms in this watershed.

Approximately 135,880 acres of this watershed are forested. The forests in the upper watershed are mainly Douglas-fir poles and sawtimber. There is very little brush and the old clearcuts are being reforested. Toward the middle of the drainage, alder becomes a problem but conifers are still the primary cover. In the lower portion, alder occupies almost half of the site, but hemlock, spruce, and Douglas-fir sawtimber is found on the ridges.

Watershed Problems and Needs. When the Meadow Lake dam broke, the water scoured several miles of the stream channel and left debris at the high water line. If the river ever reaches this level again, a lot of material will form debris dams with the possibility of more damage.

Approximately 1,300 acres are flooded annually. Most of the flooding occurs on cropland with damage causing severe bank erosion and debris deposition. About 300 acres of forest land are flooded with minor damage. Fences, roads, several homes, and an airport are damaged or are affected by flooding. Channel alignment and clearing, dikes, and upstream storage are all needed to reduce damages from flooding.

Estimates show that 1,330 acres of arable land need drainage. Subsurface drainage is needed on the total acreage while improved surface drainage is needed on about 700 acres. The Pacific City, Big Nestucca, and North Side Big Nestucca Drainage Districts serve 1,262 acres in the watershed.

Approximately 1,300 acres of additional land are suitable for irrigation. About 800 acres of this could be irrigated from natural streamflow. Storage is necessary for additional development and supplementary water in August and September for 200 acres of land presently under irrigation. Seven reservoir sites (index numbers 21 through 26) were investigated with a combined storage potential of 41,370 acre feet. These sites are suitable for multiple purpose usage and part of them would give some flood protection.

Opportunities under P. L. 566. A project on the overall watershed does not appear to be feasible but projects on portions of the watershed might be feasible; however, further study would be necessary.

Watershed J. Little Nestucca River

Description. The Little Nestucca River watershed contains 38,720 acres in Tillamook, Yamhill, and Polk Counties. Except for a small area in Polk County, the watershed is in the Tillamook and Yamhill Soil and Water Conservation Districts. The Little Nestucca River flows in a northwesterly direction

*adjacent to

from its origin to Nestucca Bay which empties into the Pacific Ocean. The watershed is about 15 miles long and averages 4 miles wide. Elevations in the watershed range from sea level to 2,227 feet on Mount Gauldy with most of the agricultural land below 400 feet. Average annual precipitation is 98 inches. The average growing season in the agricultural area is 180 days.

Three general groups of soils occur in the watershed. The area of upland soils is almost equally divided between those developed from sedimentary rock and those developed from volcanic material. These soils are medium to fine textured, moderately deep to very deep, and nearly level to very steep. A very small area of coarse textured soils formed from marine sediments occur near the mouth of the Nestucca Bay. A large area of alluvial soils about a mile wide extends from Nestucca Bay approximately five miles upstream. These soils are from moderately coarse to fine textured, moderately deep to very deep, and very poorly to excessively drained. Small areas of organic soils occur intermittently on the flood plain. The soils of the basin are described in more detail in the "General Description of the Basin" section of the report. The kind and extent of each group of soils are shown on the generalized soil map (map 4, *page 6). The prominent characteristics and qualities of each soil series are recorded in table 1, page 7.

A reconnaissance survey indicates 2,970 acres are used for the production of either crops or livestock. Of this, 800 acres are grazed forest land; 430 acres are rangeland; and 1,740 acres are cropland. Pasture and hay are the principal crops raised. Four hundred acres of the cropland are irrigated. There are 34 farms in this watershed.

Approximately 35,910 acres of this watershed are forested. Sawtimber is found on the ridges and upper slopes. The midslopes support stands of brush and conifer pole timber. The lower slopes and stream bottoms are either covered with brush and conifers or are cleared for pastures.

The watershed is in good condition. The logging and roadbuilding have been planned to reduce any possible damage. The old units are being reforested well in most cases.

Watershed Problems and Needs. Approximately 1,000 acres are flooded annually. About 600 acres of cropland are flooded three to four times a year because dune sand restricts the mouth of the bay. Four hundred acres of range are also flooded causing minor damage. Streambanks and dikes as well as irrigation facilities receive some damage from flooding and debris deposits. Channel clearing, dikes, and upstream storage are needed to reduce flooding and resulting damage.

Estimates show that 1,000 acres of arable land need drainage. Subsurface drainage is needed on the total acreage while only 600 acres are in need of surface drainage and improved outlets. The Little Nestucca Drainage District serves 346 acres in the watershed.

Approximately 800 acres of additional land are suitable for irrigation. Natural streamflow appears to be adequate to develop this acreage. Two reservoir sites (index numbers 28 and 29) with a combined potential storage of 24,500 acre feet were investigated. These are suitable multiple purpose sites

*adjacent to

and would give some flood protection.

Opportunities under P. L. 566. A project including flood protection, drainage, channel improvement, and land treatment might be feasible; however, a more detailed study is required for determination.

Watershed K, Neskowin Creek

Description. The Neskowin Creek watershed contains 15,200 acres in Tillamook and Lincoln Counties. It is in the Tillamook and Lincoln Soil and Water Conservation Districts. The Neskowin Creek watershed includes all the coastal drainage north of Neskowin Creek to the mouth of Nestucca Bay. Neskowin Creek flows in a northwesterly direction to the Pacific Ocean just south of the town of Neskowin. The watershed is seven miles long and varies from five miles wide along the coast to two miles in the upper reaches. Elevations in the watershed range from sea level to over 1,300 feet with the agricultural land below 400 feet. Average annual precipitation is 92 inches. The average growing season in the agricultural area exceeds 180 days.

A large area of upland soils and small areas of marine sediments and alluvial soils along the streams occur in the watershed. Most of the upland soils have developed from volcanic material; however, a smaller east portion of the watershed has soils developed from sedimentary rock. The characteristics are medium to fine texture, moderately deep to very deep profiles, and nearly level to very steep slopes. An area bordering the coastline is composed of marine sediments. The soils developed from these deposits are very deep, coarse textured, and are vulnerable to wind erosion when unvegetated. Flood plain and alluvial terrace soils in the valley bottoms vary from moderately coarse to fine textured, moderately deep to very deep, and very poorly to excessively drained. Included on the flood plain are areas of organic soils. The soils of the basin are described in more detail in the "General Description of the Basin" section of the report. The kind and extent of each group of soils are shown on the generalized soil map (map 4, *page 6). The prominent characteristics and qualities of each soil series are recorded in table 1, page 7.

A reconnaissance survey indicates 1,900 acres are used for the production of either crops or livestock. Of this, 500 acres are grazed forest land; 600 acres are rangeland; and 800 acres are cropland. Pasture and hay are the principal crops raised. Irrigated cropland amounts to 170 acres. There are 24 farms in this watershed.

Approximately 12,860 acres of this watershed are forested. Except for the broader stream bottoms and some natural meadows near the ocean, the watershed is forested with hemlock, spruce, and Douglas-fir. Several species of brush have invaded the cutting units.

The forested portion includes the Cascade Head Experimental Forest. Several different logging systems have been studied to find the best methods for harvesting and reforesting the coastal forests.

Watershed Problems and Needs. Approximately 50 acres are flooded annually. Flooding occurs on some cropland but damage is minor. There is

*adjacent to

some streambank cutting and debris deposition. The golf course at Neskowin is flooded frequently and silt and debris is often deposited. Diking, channel clearance and alignment, and upstream storage would reduce this problem.

Estimates show 300 acres of arable land need subsurface drainage.

Approximately 300 acres of additional land are suitable for irrigation. Natural streamflow is adequate for 200 acres while reservoir storage would be needed for the remainder. No reservoir sites were investigated in the watershed but there may be some small sites.

Opportunities under P. L. 566. A project has very little possibility under the existing conditions and laws.

2. NEHALEM SUBBASIN

Watershed A, Upper Nehalem River

Description. The Upper Nehalem River watershed contains 231,500 acres in Columbia, Clatsop, and Washington Counties. It is in the Columbia, Clatsop, and Washington County Soil and Water Conservation Districts. This watershed includes the upper reaches of the Nehalem River starting at river mile 63 which is about two river miles downstream from Birkenfeld. Elevations in the watershed range from 450 feet to 2,675 feet with most of the agricultural land below 800 feet. Average annual precipitation is 65 inches. The average growing season in the agricultural area is approximately 180 days.

The soil pattern of the watershed is mountainous uplands with soils developed from sedimentary rock, volcanic materials, and loess and entrenched valleys with soils developed from alluvium on terraces and flood plains. The soils from sedimentary and volcanic materials are medium to fine textured, moderately deep to very deep, and nearly level to very steep. Those from loess are moderately fine to fine textured, very deep, poorly to well drained, and gently to strongly sloping. The alluvial soils possess a wide variation of characteristics. They are moderately coarse to fine textured, moderately deep to very deep, and poorly to excessively drained. The soils of the basin are described in more detail in the "General Description of the Basin" section of the report. The kind and extent of each group of soils are shown on the generalized soil map (map 4, *page 6). The prominent characteristics and qualities of each soil series are recorded in table 1, page 7.

A reconnaissance survey indicates 13,600 acres are used for the production of either crops or livestock. Of this, 5,400 acres are grazed forest land; 2,700 acres are rangeland; and 5,500 acres are cropland. Pasture, hay, and a few acres of berries are grown on 700 acres of irrigated land. The nonirrigated cropland is generally pasture and hay with about 400 acres of grain and small acreages of Christmas trees, berries, and holly. There are 106 farms in this watershed.

Approximately 220,910 acres of this watershed are forested, consisting mainly of 40-to 60-year-old Douglas-fir. There are some good conifer sites

*adjacent to

occupied by alder, maple, and noncommercial brush. Some 30-year-old Douglas-fir stands are already yielding high value telephone poles. Other older stands have also been thinned. These stands yield pulpwood, sawlogs, and poles.

Watershed Problems and Needs. Approximately 4,000 acres are flooded annually. In general, the flood plain is in hay and pasture and grazed forest land. Damages include bank erosion and debris deposits. The flooding problem is increased by the meandering of the river and by the flat stream gradient. There have been a few cases of loss of farm livestock by drowning. In addition, roads, bridges, and some farmsteads have been damaged as a result of flooding. On some of the smaller timber holdings, better logging practices are needed to reduce erosion and debris in the streams.

Estimates show 2,500 acres of arable land need drainage. Closed subsurface drains are needed on the entire acreage. About 400 acres also require improved outlets.

Approximately 8,900 acres of additional land are suitable for irrigation. Natural streamflow could be utilized for only about 400 acres. The remaining acreage would require storage to develop its full potential.

Eleven reservoir sites (index numbers 12 through 22) with a total storage potential of 200,710 acre feet were investigated. Some of these sites may have limited use due to size and/or location. There is some opposition to structures on the main river from the anadromous fish protection standpoint which may rule out one of the larger sites.

Opportunities under P. L. 566. An application for a P. L. 566 plan has been received and approved. A project for flood protection, channel improvement, water management for irrigation and recreation, drainage, and land treatment appears to be feasible for all or parts of the watershed.

Watershed B, Middle Nehalem River

Description. The Middle Nehalem River watershed contains 128,700 acres in Tillamook and Clatsop Counties. It is in the Tillamook and Clatsop Soil and Water Conservation Districts. This watershed includes that portion of the Nehalem River from the confluence with Salmonberry River at Salmonberry upstream to river mile 63 just downstream from Birkenfeld. This portion of the river is 41 miles long and flows in a southwesterly direction. Elevations in the watershed range from 200 feet to over 2,200 feet. Average annual precipitation is 92 inches. The average growing season in the agricultural area is 180 days.

The upland soils formed from the underlying rock and narrow valleys of alluvial terrace and flood plain constitute the soil pattern of the watershed. About three-fourths of the upland soils are derived from sedimentary rock, and the remainder is derived from volcanic materials. They are from medium to fine textured, moderately deep to very deep, and nearly level to very steep. The soils of the alluvial terraces and flood plains are moderately coarse to fine textured, moderately deep to very deep, and very poorly to excessively drained. The soils of the basin are described in more detail in the "General

Description of the Basin" section of the report. The kind and extent of each group of soils are shown on the generalized soil map (map 4, *page 6). The prominent characteristics and qualities of each soil series are recorded in table 1, page 7.

A reconnaissance survey indicates 2,900 acres are used for the production of either crops or livestock. Of this, 500 acres are grazed forest land; 200 acres are rangeland; and 2,200 acres are cropland. Pasture and hay are produced on 500 acres of irrigated cropland. The nonirrigated cropland produces hay, pasture, and grain. There are 60 farms in this watershed.

Approximately 124,860 acres of this watershed are forested. The cover type ranges from brush and hardwoods in the south to Douglas-fir poles in the north. The south-facing slopes throughout the watershed are generally brush covered.

Watershed Problems and Needs. Even though this drainage has been repeatedly burned in some spots, there are still some islands of green sawtimber remaining in the southern end. The eroded portions are beginning to heal and the general watershed condition is improving. Several old debris dams should be removed.

Approximately 200 acres are flooded annually. The cropland receives moderate damage from streambank erosion and debris and sediment deposition. Also, some minor damage exists in forest lands from streambank erosion and debris in channels. Roads, bridges, and fences are subject to minor damage. Channel clearing and alignment in some reaches are needed to reduce flood damages.

Estimates show 800 acres of arable land need subsurface drainage. Improved outlets are also necessary for a portion of this area.

Approximately 1,800 acres of additional land are suitable for irrigation. Natural streamflow appears to be adequate to develop this acreage.

Seven reservoir sites (index numbers 5 through 11) were investigated with a total storage potential of 50,510 acre feet. These sites are all suitable for multiple purpose usage. They are located on streams tributary to the Nehalem River.

Opportunities under P. L. 566. A project on this portion of the Nehalem River drainage does not appear to be feasible under existing conditions and laws.

Watershed C, North Fork Nehalem River

Description. The North Fork Nehalem River watershed contains 68,700 acres in Clatsop and Tillamook Counties. It is in the Tillamook and Clatsop Soil and Water Conservation Districts. The North Fork Nehalem River flows in a southwesterly direction to its confluence with the Nehalem River about one mile north of the city of Nehalem. The watershed is about 20 miles long and 6 miles wide. Elevations in the watershed range from 2,385 feet to sea level

*adjacent to

with most of the agricultural land below 400 feet. Average annual precipitation is 101 inches. The average growing season in the agricultural area exceeds 180 days.

A large area of upland and small areas of marine and alluvial terrace, and flood-plain soils occur in the watershed. The parent material of a major portion of the upland soils is sedimentary rock. They are medium to fine textured, moderately deep to very deep, and nearly level to very steep. A marine terrace, 0.5 to 1.5 miles wide, stretches along the coast near Manzanita around Nehalem Bay and to the spit. The soils are coarse textured, very deep, undulating in topography, and vulnerable to wind erosion when vegetation is removed. The upstream flood plains are narrow while the downstream section near Nehalem and the bay features a wide flood plain and narrow alluvial terrace. These soils are moderately coarse to fine textured, moderately deep to very deep, and very poorly to excessively drained. There are small areas of organic soils. The soils of the basin are described in more detail in the "General Description of the Basin" section of the report. The kind and extent of each group of soils are shown on the generalized soil map (map 4, *page 6). The prominent characteristics and qualities of each soil series are recorded in table 1, page 7.

A reconnaissance survey indicates 3,220 acres are used for the production of either crops or livestock. Of this, 1,000 acres are grazed forest land; 900 acres are rangeland; and 1,320 acres are cropland. Pasture and hay are produced on 200 acres of irrigated cropland and 1,120 acres on nonirrigated cropland. There are 42 farms in this watershed.

Approximately 64,230 acres of this watershed are forested. Much of this rugged area has been logged but the ridge tops and some steep slopes still have stands of sawtimber.

Watershed Problems and Needs. Approximately 1,000 acres are flooded annually. About 400 acres are cropland which are damaged by streambank cutting and debris and sediment deposition. The remaining area is range and forest land with only minor damage. The city of Nehalem receives flooding during major floods. Erosion on forest land from road construction is a problem in areas where vegetation is sparse (photo 36).

The following practices are needed to reduce flooding and to reduce the damages caused by flooding: streambank stabilization, channel alignment, channel clearing, upstream storage, and diking. Estimates show that 1,000 acres of arable land need improved drainage. The total acreage needs subsurface drainage while about 600 acres require diking and tide gates to handle surface drainage problems. The inactive North Fork Nehalem Drainage District includes 400 acres of land along the lower reaches of the river.

Approximately 2,100 acres of additional land are suitable for irrigation. Natural streamflow appears adequate for about 800 acres while the remaining acreage would need storage.

There were four reservoir sites (index numbers 1 through 4) investigated with a total storage potential of 22,490 feet. These sites are all suitable for multiple purpose use.

*adjacent to

Photo 37.--This gully was caused by road construction near Anderson Creek in the Nehalem Subbasin in Tillamook County. FS photo

Opportunities under P. L. 566. A project including flood protection, drainage, land treatment, channel improvement, and water development for irrigation and recreation might be feasible, but a more detailed study is required for determination. A project on portions of the watershed appears to be feasible.

Watershed D, Lower Nehalem River

Description. The Lower Nehalem River watershed contains 111,900 acres in Tillamook and Clatsop Counties. It is in the Tillamook and Clatsop Soil and Water Conservation Districts. The watershed includes the Nehalem Bay and the main Nehalem River to a point just upstream of Salmonberry River. The watershed is about 26 miles long and averages 7 miles in width. Elevations in the watershed range from sea level to 3,600 feet with most of the agricultural land below 400 feet. Average annual precipitation is 112 inches. The average growing season in the agricultural area exceeds 180 days.

Two groups of soils occur in the watershed. The parent material of a major portion of the upland soils is volcanic material and a small portion in the west is from sedimentary rock. They are medium to fine textured, moderately deep to very deep, and nearly level to very steep. A narrow band of alluvial soils which exceeds 0.25 mile in width only in the downstream section borders the Nehalem River and its tributaries. They are moderately

coarse to fine textured, moderately deep to very deep, and very poorly to excessively drained. The soils of the basin are described in more detail in the "General Description of the Basin" section of the report. The kind and extent of each group of soils are shown on the generalized soil map (map 4, *page 6). The prominent characteristics and qualities of each soil series are recorded in table 1, page 7.

A reconnaissance survey indicates 3,050 acres are used for the production of either crops or livestock. Of this, 600 acres are grazed forest land; 800 acres are rangeland; and 1,650 acres are cropland. Pasture and hay are raised on 230 acres of irrigated cropland and 1,420 acres of nonirrigated cropland. There are 42 farms in this watershed.

Approximately 106,950 acres of this watershed are forested. The western end is heavily stocked with hemlock sawtimber but the eastern two-thirds has been in two of the Tillamook fires and contains almost no conifer timber. The ground cover consists almost entirely of red alder and vine maple, with old snags standing above the brush.

Watershed Problems and Needs. Approximately 800 acres are flooded annually. About 300 acres of this area are cropland and flooded three to four times each year. The remainder is rangeland, and damage from flooding is minor. Streambank cutting and debris and sediment deposits are the most common flood problems. Many of the streams in the forested area contain debris. Until this material is removed or deteriorates completely, it will continue to build jams and cause washouts. The State Forestry Department rebuilt many of the bridges which were washed out in the 1963 winter storms. Streambank stabilization, channel clearance, diking, and upstream storage are needed to reduce flood damage.

Estimates show that 600 acres of arable land need improved drainage. Subsurface drainage in the form of open and closed drains are needed on the total acreage. Improved surface drainage and outlets are needed for 180 acres. Two drainage districts, Sunset and Peninsula, serve about 1,552 acres of land along the lower reaches of the river.

Approximately 1,500 acres of additional land are suitable for irrigation. Natural streamflow appears to be adequate for 1,000 acres. The remaining 500 acres would need storage. Three reservoir sites (index numbers 23 through 25) were investigated on tributary streams with a potential storage of 7,530 acre feet. These sites are suitable for multiple purpose use.

Opportunities under P. L. 566. A project does not appear to be feasible on the entire watershed. A project including flood protection, channel improvement, and water management for drainage, irrigation, and recreation might be feasible on the lower portion.

*adjacent to

3. COLUMBIA SUBBASIN

Watershed A, Tide Creek

Description. The Tide Creek watershed contains 32,600 acres in Columbia County. It is in the Columbia Soil and Water Conservation District. This watershed includes Tide Creek, Deer Island, and all drainages south of Tide Creek to St. Helens. Tide Creek flows a distance of 13 miles from the mountains to its confluence with the Columbia River. Elevations in the watershed range from 1,252 to around 30 feet with most of the agricultural area below 400 feet. Average annual precipitation is 45 inches. The average growing season in the agricultural area is around 200 days.

This watershed contains two soil groups based on parent material and physiography. In the hill area, the soils are developed from loess. They are moderately fine to fine textured, very deep, poorly to well drained, and gently to strongly sloping. The area of alluvial soils includes Deer Island and other smaller islands in the Columbia River, a relatively wide terrace and flood plain bordering the river, and narrow flood plains along the small streams. Their characteristics vary from moderately coarse to fine texture, moderately deep to very deep profiles, and poor to excessive internal drainage. The soils of the basin are described in more detail in the "General Description of the Basin" section of the report. The kind and extent of each group of soils are shown on the generalized soil map (map 4, *page 6). The prominent characteristics and qualities of each soil series are recorded in table 1, page 7.

A reconnaissance survey indicates 8,250 acres are used for the production of either crops or livestock. Of this, 1,500 acres are grazed forest land; 2,000 acres are rangeland; and 4,750 acres are cropland. About 700 acres of cropland are irrigated producing hay and pasture. The nonirrigated cropland produces mainly hay and pasture, but there are also smaller acreages of grain, strawberries, orchards, and caneberries. There are 125 farms in this watershed.

Approximately 21,450 acres of this watershed are forested. Most of this land is found on slopes and stream bottoms with Douglas-fir pole-size timber the predominant type. Large areas are covered with noncommercial brush species, but Douglas-fir is gradually growing through the brush canopy and becoming dominant.

Watershed Problems and Needs. Approximately 2,300 acres are flooded annually. The flooded area is largely in the vicinity of Deer Island. About 700 acres are cropland; the remainder is pasture and a small area of forest land. Damage is generally minor being mostly debris and sediment deposition. Farm facilities, roads, and bridges also receive some minor flood damage. Tide gates, dikes, and channel work are needed to reduce flooding. Upstream storage on Tide Creek would have some beneficial effects.

Estimates show that 3,000 acres of arable land need improved drainage. Subsurface drainage in the form of open and closed drains is needed on the total acreage. The Deer Island Drainage District serves 3,660 acres of Deer Island.

*adjacent to

Approximately 2,700 acres of additional land are suitable for irrigation. Natural streamflow appears to be adequate for 1,200 acres. The remaining 1,500 acres would require storage to develop the total irrigation potential.

One reservoir site (index number 1) was investigated on Tide Creek with a potential storage of 4,030 acre feet. This site is also suitable for limited flood protection and recreational use.

Opportunities under P. L. 566. A project on the entire watershed has little possibility. One might be feasible on part of the watershed near the Columbia River such as Deer Island.

Watershed B, Rainier

Description. The Rainier watershed contains 36,200 acres in Columbia County. It is in the Columbia Soil and Water Conservation District. This watershed includes all drainages along the Columbia River from Tide Creek downstream to about one mile past Mayger. Elevations in the watershed range from 1,209 feet to 10 feet. Average annual precipitation is 46 inches. The average growing season in the agricultural area is 200 days.

Based on parent material and physiography, two soil groups occur in the watershed. The hill area is mantled by loessial soils which are characterized by moderately fine to fine texture, very deep profiles, poor to good internal drainage, and gentle to strong slopes. The area of alluvial soils is a relatively wide terrace and flood plain along the Columbia River and narrow flood plains bordering the small streams. Small areas of organic soils are interspersed along the flood plain. They are moderately coarse to fine textured, moderately deep to very deep, and very poorly to excessively drained. The soils of the basin are described in more detail in the "General Description of the Basin" section of the report. The kind and extent of each group of soils are shown on the generalized soil map (map 4, *page 6). The prominent characteristics and qualities of each soil series are recorded in table 1, page 7.

A reconnaissance survey indicates 8,590 acres are used for the production of either crops or livestock. Of this, 1,800 acres are grazed forest land; 1,350 acres are rangeland; and 5,440 acres are cropland. About 450 acres of cropland are irrigated producing pasture, hay, row crops, and mint. The remaining cropland produces hay, pasture, grain, strawberries, caneberries, orchards, and specialty crops. There are 175 farms in this watershed.

Approximately 21,650 acres of this watershed are forested. The forest area is predominantly Douglas-fir poles, but with almost 50 percent of the forested area covered with vine maple and small-size alder. Sawlog-size big leaf maple is found in the stream bottoms. The steep slopes on the banks of the Columbia River are covered with Douglas-fir, red alder, and big leaf maple.

Watershed Problems and Needs. Approximately 250 acres are flooded annually. Pasture and range are the predominate land uses in the flooded areas. Minor damage is caused from sediment and debris deposition and some streambank erosion. A small acreage of cropland is affected and farm

*adjacent to

facilities, roads, and bridges are damaged slightly. Stream channel clearing, upstream storage, and land treatment are needed to reduce damage from flooding.

Estimates show that 1,600 acres of arable land need improved drainage. Open and closed subsurface drainage is needed on the total acreage and 200 acres require diking. The Rainier Drainage District serves 1,187 acres northwest of Rainier along the Columbia River.

Approximately 2,800 acres of additional land are suitable for irrigation. Natural streamflow appears to be adequate for 1,200 acres and the remaining areas would require storage. About 380 acres of land presently irrigated also needs supplementary water around the middle of July.

One reservoir site (index number 2) was investigated with a potential storage of 2,710 acre feet. Flood protection and irrigation from this site would be limited to the vicinity of Downing.

Opportunities under P. L. 566. An application has been received, approved, and terminated on the Rainier Drainage District portion of this watershed. A project does not appear to be feasible except on parts of the watershed near the Columbia River such as the drainage district.

Watershed C, Beaver Creek

Description. The Beaver Creek watershed contains 44,000 acres in Columbia County. It is in the Columbia Soil and Water Conservation District. Beaver Creek flows in a northwesterly direction to the lower reaches of the watershed where it flows into sloughs and on into the Columbia River. The watershed is about 15 miles long and 4½ miles wide. Elevations in the watershed range from 1,200 feet to 10 feet. Average annual precipitation is 47 inches. The average growing season in the agricultural areas is in excess of 200 days.

Loess deposits on the upland and alluvial deposits on the terraces, flood plains, and islands constitute the soil pattern of the watershed. The loessial soils are moderately fine to fine textured, very deep, poorly to well drained, and gently to strongly sloping. The alluvial soils are moderately coarse to fine textured, moderately deep to very deep, with very poor to excessive internal drainage. Organic soils occur on most of Beaver Island and part of other islands and on the flood plain. They are very poorly drained and vary from more than 60 inches of peat to less than 12 inches of peat over mineral soil. There are areas with 12 to 36 inches of mineral soil overlying the peat and also areas with alternating horizons or layers of organic and mineral soil. The soils of the basin are described in more detail in the "General Description of the Basin" section of the report. The kind and extent of each group of soils are shown on the generalized soil map (map 4, *page 6). The prominent characteristics and qualities of each soil series are recorded in table 1, page 7.

A reconnaissance survey indicates 11,100 acres are used for the production of either crops or livestock. Of this, 2,000 acres are grazed forest land; 1,000 acres are rangeland; and 8,100 acres are cropland. About 400

*adjacent to

acres of cropland are irrigated producing pasture, hay, row crops, and mint. The principal crops are pasture, hay, grain, bentgrass seed, and strawberries on the nonirrigated cropland. There are 150 farms in this watershed.

Approximately 31,000 acres of this watershed are forested. Pole-size Douglas-fir, with a heavy mixture of alder and big leaf maple, compose the forest cover. Some commercial-size alder is found in the lower reaches of the drainage. Some of the farmland is being converted to forest land while in other areas brushland is being cleared for pasture.

Watershed Problems and Needs. Approximately 600 acres are flooded annually. Two-thirds of this area is cropland which is damaged primarily by silt and debris deposition. The remaining flooded area is forested and it has little to no damage. Roads and bridges receive some minor damage from sediment and debris. Channel clearing and enlargement are needed as well as upstream storage to reduce flooding problems.

Subsurface drainage, both open and closed, is needed on 4,000 acres of arable land and 600 acres require improved outlets. Three drainage districts, Beaver, Clatskanie, and Johns, serve 5,197 acres in the lower reaches of this watershed.

Approximately 6,500 acres of additional land are suitable for irrigation. Natural streamflow appears to be adequate for 5,800 acres; however, the remaining area would need storage.

Two reservoir sites (index numbers 3 and 4) were investigated with a total storage of 22,800 acre feet. These sites could be used for irrigation, flood protection, and recreation.

Opportunities under P. L. 566. A project to develop water for irrigation and recreation, flood protection, channel improvement, and land treatment might be feasible but a more detailed study would be required before a determination could be made.

Watershed D, Clatskanie River

Description. The Clatskanie River watershed contains 62,400 acres in Columbia County. It is in the Columbia Soil and Water Conservation District. The Clatskanie River flows in a northwesterly direction to the Columbia River. The watershed is about 23 miles long and ranges from two to six miles wide. Elevations in the watershed range from 2,000 feet to 10 feet. Average annual precipitation is 52 inches. The average growing season is 197 days at Doraville in the upper reaches and about 250 days in the lower areas.

Four general groups of soils based on parent material and physiography occur in the watershed. The south and west portion of the upland is made up of soils developed from sedimentary rock and volcanic materials. They are medium to fine textured, moderately deep to very deep, and nearly level to very steep. The north and east portion of the upland contains soils developed in loess. They are moderately fine to fine textured, very deep, poorly to well drained, and gently to strongly sloping. The area of alluvial soils includes a fairly wide flood plain and terrace near the Columbia River and

narrow flood plains along the smaller streams. They are moderately coarse to fine textured, moderately deep to very deep, and very poorly to excessively drained. Small areas of very poorly drained organic soils are interspersed along the flood plain. The soils of the basin are described in more detail in the "General Description of the Basin" section of the report. The kind and extent of each group of soils are shown on the generalized soil map (map 4, *page 6). The prominent characteristics and qualities of each soil series are recorded in table 1, page 7.

A reconnaissance survey indicates 4,000 acres are used for the production of either crops or livestock. Of this, 2,000 acres are grazed forest land; 1,000 acres are rangeland; and 1,000 acres are cropland. Only 10 acres of the cropland are irrigated producing hay and pasture. The nonirrigated cropland produces hay, pasture, grain, strawberries, and row crops. There are 35 farms in this watershed.

Approximately 59,400 acres of this watershed are forested. This area has been cut over and is reforesting. Douglas-fir is the primary conifer. Where reforestation was delayed or where a fire occurred, alder and other hardwood shrubs have taken over the site. In many areas, Douglas-fir is slowly gaining a foothold and, in time, will again be the dominant cover.

Watershed Problems and Needs. Approximately 300 acres are flooded annually. Most of the flooding occurs on forest and range lands. Damage is generally from deposits of sediment and debris, but there is some streambank erosion. Farm facilities, roads, bridges, and a park are damaged from sediment and debris. Channel clearing and alignment in some areas as well as upstream storage are needed to reduce damages caused by flooding.

Estimates show that 500 acres of arable land need improved drainage. Subsurface drainage, both open and closed, is needed on the total acreage and dikes and improved outlets are required for 200 acres.

Approximately 400 acres of additional land are suitable for irrigation. Water for this area would have to be developed from storage because the Clatskanie River is closed for further irrigation water rights.

Three reservoir sites (index numbers 5 through 7) were investigated with a storage potential of 9,320 acre feet. Two of these sites are on the Clatskanie River and are suitable for flood protection and recreation. Additional smaller sites on tributary streams could be investigated.

Opportunities under P. L. 566. A project that includes flood protection, drainage, land treatment, and water management for irrigation and recreation might be feasible but the opportunities are quite limited and a more detailed study would be required.

Watershed E, Knappa

Description. The Knappa watershed contains 153,400 acres in Columbia and Clatsop Counties. It is in the Clatsop and Columbia Soil and Water Conservation Districts. This watershed includes all drainages which drain into

*adjacent to

the Columbia River from the Clatskanie River west to the eastern edge of the city of Astoria. The largest stream in this watershed is Big Creek which is 13 miles long. Elevations in the watershed range from 3,020 feet on Nicolai Mountain to 10 feet. Average annual precipitation is 83 inches. The average growing season is 250 days in the agricultural areas.

An upland of soils developed from the underlying rock and wide flood plains, many islands, and intermittent terraces constitute the soil pattern of the watershed. Parent material from sedimentary rock occurs in the upland throughout the watershed and from volcanic materials in the central and eastern sections. These soils are medium to fine textured, moderately deep to very deep, and nearly level to very steep. The alluvial soils are moderately coarse to fine textured, moderately deep to very deep, and very poorly to excessively drained. Very poorly drained organic soils occur on the flood plain in Columbia County. Depth varies from more than 60 inches to less than 12 inches to mineral soil and, in some places, the peat may have an overlay of mineral soil. The soils of the basin are described in more detail in the "General Description of the Basin" section of the report. The kind and extent of each group of soils are shown on the generalized soil map (map 4, *page 6). The prominent characteristics and qualities of each soil series are recorded in table 1, page 7.

A reconnaissance survey indicates 16,560 acres are used for the production of either crops or livestock. Of this, 4,000 acres are grazed forest land; 1,500 acres are rangeland; and 11,060 acres are cropland. Pasture, hay, and vegetable crops are raised on 520 acres of irrigated cropland. The non-irrigated cropland is producing hay, pasture, grain, orchards, and small acreages of berries, bentgrass seed, and holly. There are 280 farms in this watershed.

Approximately 96,020 acres of this watershed are forested with varied cover. The eastern portion is stocked mainly by Douglas-fir varying in size from pole to sawlog. The central portion has a mixture of brush and conifers while the western portion is generally brush covered with scattered patches of conifers. Little effort has been made to reduce the slash on some of the recently logged land. The combination of slash and heavy fern makes a rather serious fire hazard.

Bear Creek drainage provides municipal water for Astoria. The entire watershed has been either cut over or burned in the past but is now being reforested. Even though large areas are not forested, the general condition is good because practically all of the land is covered with some type of permanent vegetation.

Watershed Problems and Needs. Approximately 2,800 acres of cropland, rangeland, and forest land are flooded annually. Damages in the upper reaches are a result of streambank cutting and sediment and debris deposition. The lower areas along the river are subject to extensive flooding and inundation and need dikes for protection. Some farm equipment, buildings, fences, and power poles receive minor flood damage from debris and sediment. There is considerable erosion damage to and from logging roads. Needs include dikes,

*adjacent to

tide gates, channel improvement, land treatment, and upstream storage.

Estimates show that 12,000 acres of arable land need improved drainage. Subsurface drainage practices are needed on 4,200 acres while 1,000 acres require diking and outlets. Several drainage districts serve over 8,000 acres of this watershed.

Approximately 8,000 acres of additional land are suitable for irrigation. Natural streamflow appears to be adequate to develop this potentially irrigable land.

In portions of this watershed, development of domestic and municipal water is needed. A reservoir site (index number 8) on Big Creek was investigated and would be suitable for storage for irrigation, domestic, municipal water development and recreation. The potential storage at this site is 2,010 acre feet.

Opportunities under P. L. 566. A project does not appear to be feasible under existing conditions and laws on the entire watershed but some parts near the Columbia River such as the drainage districts and Brownsmead area might be feasible.

Watershed F, Youngs River

Description. The Youngs River watershed contains 88,000 acres in Clatsop County. It is in the Clatsop Soil and Water Conservation District. The Youngs River flows in a northwesterly direction from Saddle Mountain to its confluence with Youngs Bay near Astoria. The watershed is 18 miles long and ranges from 3 to 9 miles in width. Two large tributaries of the Youngs River--Klaskanine and Walluski Rivers--are also included in this watershed. Elevations in the watershed range from 3,283 feet on Saddle Mountain to sea level. Average annual precipitation is 92 inches. The average growing season is 273 days at Astoria.

The soil material on the uplands is from sedimentary rock except for the tops of peaks and high hills in the south section which are of igneous origin. These soils are medium to fine textured, moderately deep to very deep, and nearly level to steep. The alluvial terraces and flood plains of the downstream section of Youngs River are from one to two miles in width; however, in the upstream section, they are much narrower. The soils are moderately coarse to fine textured, moderately deep to very deep, and very poorly to excessively drained. The soils of the basin are described in more detail in the "General Description of the Basin" section of the report. The kind and extent of each group of soils are shown on the generalized soil map (map 4, *page 6). The prominent characteristics and qualities of each soil series are recorded in table 1, page 7.

A reconnaissance survey indicates 5,200 acres are used for the production of either crops or livestock. Of this, 500 acres are grazed forest land; 500 acres are rangeland; and 4,200 acres are cropland. Hay and pasture are raised on 200 acres of irrigated cropland. The nonirrigated cropland is planted to hay, pasture, bentgrass seed and small acreages of orchards and grain. There are 150 farms in this watershed.

*adjacent to

Approximately 67,100 acres of this watershed are forested. There are some stands of sawtimber almost at the city limits of Astoria, good stands of poles in the upper watershed, and conifers scattered through brush patches in the lower portions. The Walluski River drainage is a good example of reforestation. It has extensive stands of 40- to 50-year old hemlock and fir poles which are being thinned now. Large rotten stumps of the previous forest are still visible in the pole stands testifying to the productivity of the land. Forty-five years ago, this drainage probably looked devastated but it is now a fine looking young forest.

Watershed Problems and Needs. Approximately 600 acres are flooded annually. Flooding occurs, in general, on the lower reaches of the watershed. The land use is mixed, some in range, some in cropland pasture, and some in forest. Damage is minor, mostly from logs and debris deposits. Additional dikes are needed to keep sea water out during high tides as well as upstream storage to control runoff. Some channel improvement is also needed. Estimates show that 4,500 acres of arable land need improved drainage. Open and closed subsurface drains as well as improved outlets are needed on the total acreage.

Approximately 2,500 acres of additional land are suitable for irrigation. Natural streamflow appears to be adequate for only 600 acres and the remaining acreage would need storage.

A need also exists for a supplemental source of municipal water by the city of Astoria. Five reservoir sites (index number 9 through 13) were investigated with a storage potential of 35,040 acre feet. The potential exists here for irrigation development, flood protection, municipal water supply, recreation, and fisheries enhancement.

Opportunities under P. L. 566. A project including flood protection, drainage, channel improvement, land treatment, development of water for irrigation, municipal, and recreation might be feasible. A more detailed study would be required before a determination could be made.

Watershed G, Lewis and Clark River

Description. The Lewis and Clark River watershed contains 43,800 acres in Clatsop County. It is in the Clatsop Soil and Water Conservation District. The Lewis and Clark River flows in a northerly direction to Youngs Bay. The watershed is about 20 miles long and averages 3 miles in width. Elevations range from 3,283 feet on Saddle Mountain to sea level. Average annual precipitation is 94 inches. The average growing season is 270 days in the agricultural areas.

This watershed contains two general soil groups based on soil material and physiography. The soil material on the uplands is from sedimentary rock except for the tops of peaks and high hills in the south section which are from volcanic material. The soils are medium to fine textured, moderately deep to very deep, and nearly level to steep. The band of alluvial terraces and flood plains is approximately a mile wide in the upstream sections. These soils are moderately coarse to fine textured, moderately deep to very deep, and very poorly to excessively drained. The soils of the basin are described in more detail in the "General Description of the Basin" section of the report.

The kind and extent of each group of soils are shown on the generalized soil map (map 4, *page 6). The prominent characteristics and qualities of each soil series are recorded in table 1, page 7.

A reconnaissance survey indicates 4,400 acres are used for the production of either crops or livestock. Of this, 200 acres are grazed forest land; 700 acres are rangeland; and 3,500 acres are cropland. Pasture and hay are raised on 360 acres of irrigated cropland. The nonirrigated cropland produces hay, pasture, and bentgrass seed. There are 100 farms in this watershed.

Approximately 34,600 acres of this watershed are forested. The timber land at the head of the drainage is generally well stocked with hemlock, spruce, and Douglas-fir which range in size from large poles through sawtimber. Scattered at random through the watershed are rather large clearcuts which have very little bare soil. The more recent units have ground cover consisting almost exclusively of low-growing shrubs while the units approximately ten years old have conifers appearing above the shrubs. Even though brush is present, it does not seem to be a problem in the upper watershed as it is in other areas in the basin; however, in the middle portion of the watershed, there are large patches of brush. This brush has apparently resulted from early clearcuts where no attention was given to reforestation or fire protection. At the extreme lower end of the watershed, the conifers are larger but are growing in scattered patches with large blocks of brush in between.

Watershed Problems and Needs. Approximately 400 acres are flooded annually. The flooded area is almost entirely cropland with damage from sediment and debris deposition. Farming operations are also hindered by inundation of the land. Minor to severe streambank erosion occurs along cropland and rangeland. There are some minor damages to roads and fences. Some channel improvement is needed as well as dikes and upstream storage to reduce flooding.

Estimates show that 3,000 acres of arable land need improved drainage. Closed subsurface drains are required on 1,000 acres while 600 acres need improved outlets.

Approximately 1,700 acres of additional land are suitable for irrigation. The water required to develop this acreage will have to come from storage because the Lewis and Clark River has been withdrawn from filing for irrigation. Four reservoir sites (index numbers 14 through 17) were investigated with a potential storage of 5,310 acre feet.

Opportunities under P. L. 566. A project that includes flood protection, drainage, channel improvement, land treatment, and water development for irrigation and recreation might be feasible. A more detailed study would be required to determine feasibility.

Watershed H, Skipanon River

Description. The Skipanon River watershed contains 10,480 acres in Clatsop County. It is in the Warrenton Dune and Clatsop Soil and Water Conservation Districts. The Skipanon River flows in a northerly direction to

*adjacent to

Photo 38.--These flood gates on the Skipanon River are part of the P. L. 566 project near Warrenton. SCS photo

Opportunities under P. L. 566. A project is in the construction stages that includes flood-gate construction, stream channel improvement, land treatment measures, and recreational facilities.

Watershed I, Warrenton Beach

Description. The Warrenton Beach watershed contains 33,300 acres in Clatsop County. It is in the Warrenton Dune Soil and Water Conservation District. This watershed, as shown on map 9, includes all the coastal area from Clatsop Spit south to the Necanicum River near Gearhart. It also includes Neawanna Creek, a tributary of the Necanicum River south of Gearhart. The longest stream in the watershed is Neacoxie Creek which flows south from Sunset Lake to its confluence with Neawanna Creek south of Gearhart. Elevations in the watershed range from over 1,000 feet to sea level. Average annual precipitation is 79 inches. The average growing season is 272 days.

Terraces of marine sediments on a major portion of the watershed, alluvial terrace and flood plains in the north and south section, and uplands of sedimentary rock in the south section constitute the pattern of soil material. The youngest sediments on the beach are loose, nonvegetated, and still in the process of being moved inland by the winds; whereas farther inland, old stabilized dunes are fairly well protected by vegetation. The topography is undulating with nearly level to strongly sloping slopes and dune-like with

long, parallel ridges. The soils are very deep, coarse textured, and highly erodible. The alluvial terrace and flood-plain soils vary from moderately coarse to fine texture, moderately deep to very deep, and very poorly to excessively drained. Associated with these soils are wet areas of organic soils. The upland soils formed from sedimentary rock are from medium to fine textured, moderately deep to very deep, and nearly level to steep. The soils of the basin are described in more detail in the "General Description of the Basin" section of the report. The kind and extent of each group of soils are shown on the generalized soil map (map 4, *page 6). The prominent characteristics and qualities of each soil series are recorded in table 1, page 7.

A reconnaissance survey indicates 2,400 acres are used for the production of either crops or livestock. Of this, 1,000 acres are grazed forest land; 600 acres are rangeland; and 800 acres are cropland. Pasture and hay are produced on 100 acres of irrigated cropland. There are 50 farms in this watershed.

Approximately 11,140 acres of this watershed are forested. Except for the extreme southern end, the forests of this watershed are composed of sapling- and pole-size shorepine, hemlock, and spruce with large blocks of brush. In the southern end, east of Seaside, there are some stands of saw-timber and relatively recent cutting units which are restocking with hemlock and spruce.

Watershed Problems and Needs. Approximately 400 acres are flooded annually. Damage is mainly to cropland and farmsteads from debris and sediment. Land is inundated for extended periods which hinders farming operations. There is some damage to roads and bridges on Neawanna Creek. Forest land and rangeland receive only minor damage from flooding. Channel work and diking are needed to reduce the damage from flooding.

Estimates show that 1,500 acres of arable land need improved drainage by the use of both tile systems and land shaping.

Approximately 500 acres of additional land are suitable for irrigation. Natural streamflows appear adequate to develop this potentially irrigable land.

There is considerable potential in this area for recreational development. A large area of this watershed is covered by sand dunes which have been stabilized by various means, both structural and vegetative.

Opportunities under P. L. 566. A project does not appear to be feasible on the entire watershed; however, the Neawanna Creek area might have some possibility but would take further study before a determination could be made.

Watershed J, Necanicum River

Description. The Necanicum River watershed is in Clatsop County. It is in the Clatsop Soil and Water Conservation District. The Necanicum River flows in a northwesterly direction through the city of Seaside where it

*adjacent to

empties into the Pacific Ocean between Seaside and Gearhart. The watershed is about 12 miles long and ranges from one-half mile to 10 miles in width. Elevations in the watershed range from 2,858 to sea level. Average annual precipitation is 100 inches. The average growing season exceeds 250 days.

A large area of upland, a small area of marine sediments, and a band of terraces and flood plains along the streams make up the soil pattern. A major portion of the upland soils was developed from sedimentary rock; however, there are several smaller areas with soils developed from volcanic materials. They are medium to fine textured, moderately deep to very deep, and nearly level to very steep. A terrace of marine sediments in the vicinity of Seaside has soils which are coarse textured, very deep, undulating in topography, and are vulnerable to wind erosion when unvegetated. The alluvial-terrace and flood-plain soils are characterized by moderately coarse to fine texture, moderately deep to very deep profiles, and poor to excessive internal drainage. The soils of the basin are described in more detail in the "General Description of the Basin" section of the report. The kind and extent of each group of soils are shown on the generalized soil map (map 4, *page 6). The prominent characteristics and qualities of each soil series are recorded in table 1, page 7.

A reconnaissance survey indicates 1,300 acres are used for the production of either crops or livestock. Of this, 300 acres are grazed forest land; 500 acres are rangeland; and 500 acres are cropland. Pasture and hay are produced on 100 acres of irrigated cropland and 400 acres of nonirrigated cropland. There are 30 farms in this watershed.

Approximately 40,500 acres of this watershed are forested. This watershed has been logged and now is well stocked with hemlock and spruce of pole to sawtimber size. Some plantations date from 1930. These areas are heavily stocked with small hemlock. It, too, has areas not stocked with commercial species but the conifers are slowly invading these brush patches. Where the terrain is suitable, the young stands are being thinned and otherwise intensively managed.

Watershed Problems and Needs. Approximately 150 acres are flooded annually. About 100 acres of this area are cropland with damages from bank erosion along the lower 10 miles of channel and deposition of sediment and debris. Some minor damage is also noticed on rangeland and forest land. Floods frequently damage nine farmsteads, a stretch of state highway about one mile long and a golf course at Seaside. Some channel clearing and diking are needed to reduce flooding.

Estimates show that 300 acres of arable land need improved drainage and both tile systems and improved outlets are required.

Approximately 1,000 acres of additional land are suitable for irrigation. Natural streamflow appears to be adequate to develop this potentially irrigable land.

There is considerable potential in this area for recreational development.

*adjacent to

Opportunities under P. L. 566. A project including flood protection, water development for irrigation and recreation, and land treatment might be feasible but more detailed study is required for determination.

Watershed K, Elk Creek

Description. The Elk Creek watershed contains 29,800 acres in Clatsop and Tillamook Counties. It is in the Clatsop and Tillamook Soil and Water Conservation Districts. The Elk Creek watershed includes Elk Creek and several small streams draining into the Pacific Ocean from Seaside south to Manzanita. Elevations in the watershed range from 3,064 feet to sea level. Average annual precipitation is 97 inches. The average growing season exceeds 250 days.

Large areas of upland and small areas of marine terraces and alluvial terraces and flood plains occur in the watershed. The soil material of most of the upland is of volcanic origin; however, some small areas of the upland have soil material from sedimentary rock. They are from medium to fine textured, moderately deep to very deep, and nearly level to very steep. A small area of marine sediments has accumulated along the shore near Cannon Beach. The soils developed from these sediments have very deep profiles, coarse texture, undulating topography, and are vulnerable to wind erosion when vegetation has been depleted. The alluvial soils are moderately coarse to fine textured, moderately deep to very deep, and poorly to excessively drained. The soils of the basin are described in more detail in the "General Description of the Basin" section of the report. The kind and extent of each group of soils are shown on the generalized soil map (map 4, *page 6). The prominent characteristics and qualities of each soil series are recorded in table 1, page 7.

A reconnaissance survey indicates 400 acres are used for the production of either crops or livestock. Of this, 100 acres are grazed forest land; 200 acres are rangeland; and 100 acres are cropland. Pasture and hay are produced on the cropland which is nonirrigated. There is no irrigated cropland in this watershed. There are five farms in the watershed.

Approximately 27,800 acres or 93 percent of this watershed are forested. The major portion has been logged and is now reforested with various sizes of hemlock and spruce. Along the ocean front, the forest consists of shorepine and spruce which will probably never have any commercial value. This area provides many spectacular viewpoints of forests dropping down almost vertical slopes into the ocean.

Watershed Problems and Needs. There are no apparent problems from flooding in this watershed. The drainages are, in general, fairly short and flow directly to the ocean. Most of the development is along the coast.

Estimates show that 50 acres of arable land are in need of improved subsurface drainage.

Approximately 100 acres of additional land are suitable for irrigation. natural streamflow from Elk Creek appears to be adequate for this potential.

*adjacent to

There is considerable potential in this watershed for additional recreational development.

Opportunities under P. L. 566. A project in this watershed does not appear to be feasible under existing laws and conditions.

MEANS TO ACCOMPLISH NEEDED WORK

PROGRAMS OF USDA

Several agencies within the U. S. Department of Agriculture administer programs that are directly concerned with various aspects of water and related land resources. Many of the Department's activities and programs are, or can be, helpful in the solution of problems and the accomplishment of needed work in the North Coast Drainage Basin.

COORDINATION OF USDA PROGRAMS AND OTHER BASIN ACTIVITIES

In general, the forestry and agricultural aspects of water and related land resource problems are often intimately connected with uses of land and water for other purposes such as cities and towns, recreation, navigation, industry, and highways. The degree of relationship varies between geographic areas depending primarily upon the resource base available and pressures upon that base.

The U. S. Department of Agriculture is concerned with all agricultural and forest lands in the basin and is responsible for the administration of the six percent of the basin that is in National Forests. The U. S. Department of Interior is responsible for the administration of about four percent of the area; therefore, the Federal Government is directly responsible for the administration of approximately ten percent of the North Coast Drainage Basin. In addition, the State of Oregon owns and manages 29 percent of the basin area. The management of this land is an important factor in the economy of the basin and influences the timing of water flows and the quality of water flowing from the upper watersheds.

The Corps of Engineers, U. S. Army under assignment by Congress, is charged with the public civil works program to control, regulate, and improve river and harbor resources, to administer the laws pertaining to the preservation of navigable waters, and to plan, construct, and operate flood control works. Many of the existing and possible future projects under the Corps' jurisdiction affect agricultural lands. Substantial assistance in the solution of basin agricultural problems has and will accrue from the coordination of the Corps' work and that of other interests in the basin.

The Bureau of Reclamation is authorized at the public request to locate, construct, operate, and maintain works for storage, diversion, and development

of waters for the reclamation of arid and semiarid lands in the Western States. Projects constructed by the Bureau should be coordinated with other land and water developments in the basin.

Private and municipal water developments for power and industrial uses in some instances affect agricultural and forest lands. In many cases, substantial mutual benefits can result from the coordination of projects so as to solve or mitigate existing problems.

From an agricultural standpoint, there is a need for coordination of effort on present and future problems on an individual group and project basis. In turn, it is important that agricultural water control and utilization developments recognize to the extent feasible all other land and water uses and values. Such coordination is necessary to secure a diminishment of mutual problems instead of their compoundment. Notable coordination has occurred and should be continued. This coordination ranges from informal contacts on individual problems to formal liaison between organizations and agencies on the inter-relationship of major projects.

Future small watershed projects need to be coordinated to insure the inclusion of all feasible features to enhance the use of both the watershed and its waters for all worthwhile purposes. In addition, small watershed projects need to complement other major water projects in the basin and make the best use of improvements provided under other programs.

It is hoped that the information in this report and the data gathered for its preparation will be of assistance to others in future coordination of the water and related land resources in the North Coast Drainage Basin.

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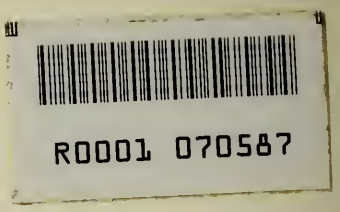
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