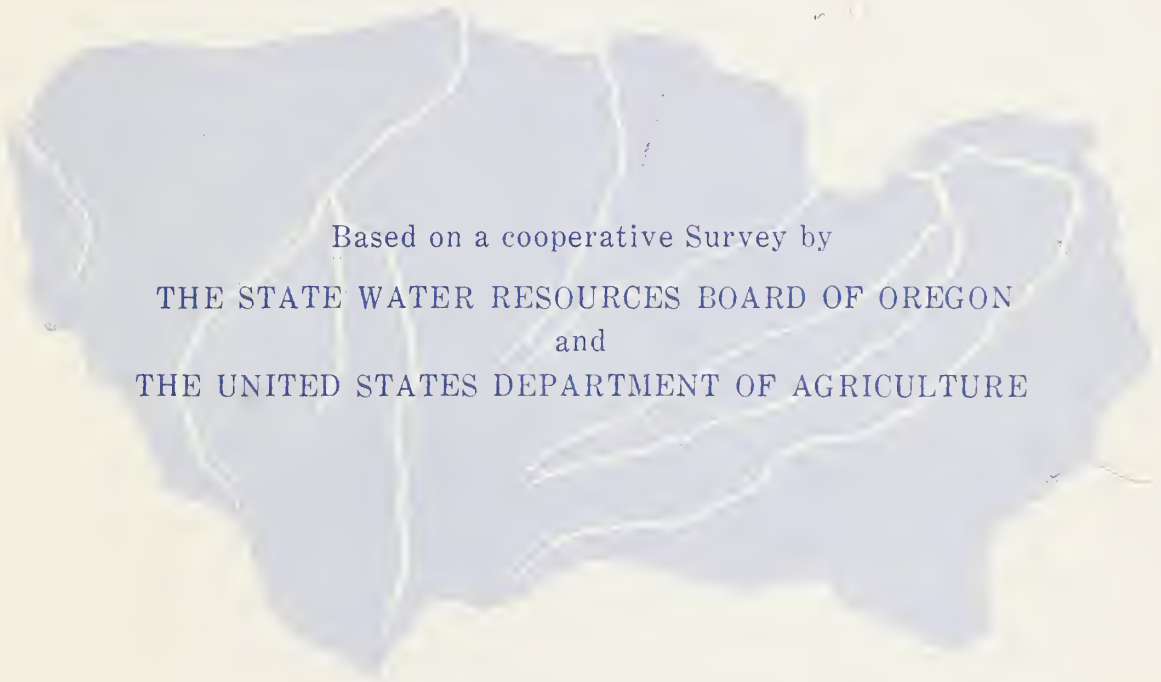
USDA Report on
WATER and RELATED LAND RESOURCES

HOOD DRAINAGE BASIN
OREGON



Based on a cooperative Survey by

THE STATE WATER RESOURCES BOARD OF OREGON

and

THE UNITED STATES DEPARTMENT OF AGRICULTURE

Prepared by · · ECONOMIC RESEARCH SERVICE · · FOREST SERVICE · ·
SOIL CONSERVATION SERVICE

February 1964

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February 1964

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INTRODUCTION

This report presents information concerning the water and related land resources of the Hood Drainage Basin and is the result of a cooperative study by the U. S. Department of Agriculture and the State Water Resources Board of Oregon.

The State Water Resources Board of Oregon is making a survey and investigation of the Hood Drainage Basin to develop information needed for planning the coordinated development of the area's water resources. The information needed for its study includes: (1) the kind and location of desirable water resource developments; (2) the amounts of water required; (3) the physical opportunities for developments to meet water needs; and (4) the broad economic aspects of possible development. The State will use this information to formulate plans and programs to secure the most beneficial use and control of the area's water resources. The State's programs are intended, by legislative decree, to be dynamic in nature with provision for changes as new information is available and as the physical or economic situation changes. The current survey is only the beginning of the State's work in this area.

Upon request of the State Water Resources Board, the U. S. Department of Agriculture cooperated in this survey under the provisions of section 6 of the Watershed Protection and Flood Prevention Act (Public Law 566, 83rd Congress, as amended).

The broad objectives of the cooperative survey were to gather basic data and information pertinent to the use and control of water for agriculture in the area, to highlight such major water related problems as erosion, flood prevention, and drainage, and to outline a general program for water and related land resource management to be used as a background for future detailed study and planning.

This report should be of use to anyone interested in the area's land and water resources. It should be of value in appraisal of present and future use of water for agriculture in relation to other water uses for planning, evaluation, development, and operation of the various agricultural programs of federal, state, and local agencies.

The survey consisted partly of an accumulation and evaluation of previously recorded data, both published and unpublished, much of which was furnished by other cooperating groups. In addition, the USDA River Basin Survey Party 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 Party.

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 various field offices of the Forest Service, the Pacific Northwest Forest and Range Experiment Station, 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 Hood Drainage Basin includes all of the tributaries of the Columbia River between Bonneville and the Deschutes River. The basin includes two areas that differ significantly in topography, soils, climate, and hydrology. For the purpose of this report, these two areas will hereafter be referred to as the Hood Resource Area and the Wasco Resource Area. The basin was first visited by white men in 1805 when the Lewis and Clark expedition traveled down the Columbia River. The first permanent settler in the Hood River Valley filed a donation land claim in 1854, the same year that Wasco County was established. In the 1860's The Dalles served as a trading center during the gold rush in eastern Oregon. Ranching was the first agricultural activity followed soon by dryland wheat farming in the Wasco Resource Area and fruit orchards in the Hood Resource Area. Logging started with the arrival of the first settlers, and sawmilling began in 1861. At the present time, manufacturing, construction, trades, and services are the major sources of employment. Only 14 percent of the 30,970 people in the basin now live on farms.

The basin is in a transition zone between the temperate maritime climate of western Oregon and the temperate, semiarid, continental climate of eastern Oregon. Precipitation ranges from 9 inches in the eastern portion to 130 inches on the Cascade summit; temperatures range from -30^{o} to 115^{o} at The Dalles. The frost-free season in the cropland area ranges from 100 to 217 days.

Mount Hood (elevation 11,245 feet) is the most prominent topographic feature, while the main structural features are two northeast-southwest trending folds in the north central section and a north-south trending fault along the east side of the Hood River Valley. Most of the soils in the agricultural areas and the uplands between Hood River and Wasco Counties were derived from transported materials while soils in the Cascades were derived from volcanic materials.

Sixty-one percent of the basin is privately owned. Fifty-six percent is forest; 24 percent is cropland; 13 percent is range; and the remaining 7 percent of the basin is devoted to other uses. Ninety-eight percent of the publicly owned land is forested.

FOREST AND RANGE RESOURCES

The major uses of forest land are for the production of commercial timber, water, and outdoor recreation.

There are approximately 304,750 acres of commercial forest in the basin with an estimated 4.89 billion board feet of softwood timber. Approximately 66 percent of the commercial forest is in the Hood Resource Area. The six sawmills in the basin have an annual production capacity of 170 million board feet. The potential allowable cut for the basin is estimated to be 75.1 million board feet.

The general trend in recreation use is toward one day round trips with only a small increase in the number of overnight visitors. Winter sports, which have had a minor increase in the past five years, are expected to increase rapidly if the hopes and plans of local skiers and mountaineers are realized at Hood River Meadows. As the Hood Drainage Basin and surrounding areas become more heavily populated, forested areas available for recreation will become increasingly important. All agencies managing public land are planning to provide more facilities to meet future demand.

The most numerous and popular game animal is the Columbia black-tailed deer. Hunting pressure on other game is light.

Most of the streams have runs of anadromous fish. Many of the lakes and streams with native trout populations are heavily fished. Hatchery fish are used to supplement the natural reproduction. Reasonably uniform flows of cool, clean water with few physical barriers to fish movement are necessary for the maintenance of the fish population.

Most of the 88,000 acres of range and 72,400 acres of grazed forest land is in the Wasco Resource Area. Generally the Wasco Resource Area range is in fair to poor condition while the national forest range in the Hood Resource Area is poor.

Because 85 percent of the annual water yield from the Hood Drainage Basin comes from forest land, the primary aim of every watershed manager should be to utilize all the resources in such a way that insures maximum quantities of clear, useable water. Although few quantitative estimates of water requirements on forest land have been made, evapo-transpiration is considered to be the largest water use. Other water uses on forest land include domestic, livestock, wildlife, fish life, industrial, and fire. Overall water consumption on forest land is expected to increase slightly, due mainly to expected increases in domestic use at recreation sites.

AGRICULTURE IN THE BASIN

The economic base of the Hood Drainage Basin has historically been agriculture. The most important crops are pears, apples, cherries, wheat, and barley. Livestock are also raised in the basin but are of relative minor importance. Although only 16 percent of the basin's work force is actively engaged in producing the raw agricultural products, these products form the economic base that generates the local processing and packing industries and much of the other industries.

The major use of the 21,100 acres of cropland in the Hood Resource Area is for the production of apples and pears. Ninety percent of the cropland

is irrigated. Fruit acreage and production have been increasing steadily, with pears gradually replacing apples.

In the Wasco Resource Area, where rainfall is lower and topography rougher, wheat and barley are grown on about 89 percent of the 140,900 acres of cropland. Cherries, pasture, and hay are the other important crops. Only 6,200 acres are irrigated in this area.

About 52 percent of the 780 farms in the Hood Resource Area are commercial operations compared to 74 percent for the 460 in the Wasco area. Agricultural changes in the Wasco area have been more pronounced than in the Hood area. The number of beef cattle has been increasing in both areas while most other types of livestock have been on the decrease.

Farm income from the sale of crops and livestock produced in the basin was about 15.2 million dollars in 1959. Crops accounted for 88 percent of the total, and livestock accounted for the other 12 percent.

In the Hood area water development for irrigation has been accomplished almost entirely by seven organized irrigation districts while in the Wasco area water development has occurred on an individual farm basis. Streamflows are the major source of water in both areas. Future irrigation development will be governed by several factors. It is estimated that an additional 6,200 acres in the Hood area and 15,300 acres in the Wasco area could readily be irrigated. Storage facilities would be necessary to provide adequate water. The major economic factor that will govern the expansion of irrigation in the basin is the future financial returns to fruit growers.

WATER RELATED PROBLEMS, NEEDS, AND OPPORTUNITIES

Crop, forest, and range lands present problems peculiar to their individual uses. Land use also influences the quality, quantity, and use of water.

The average rainfall in the agricultural part of the basin during the irrigation season is less than 10 inches.

The average annual water yield after current consumptive use is about 1,400,000 acre feet, most of which comes from the Hood Resource Area. The annual runoff probably ranges from 0 to 110 inches in the basin. The average for the entire basin is 26 inches. Water shortages are seasonal and most severe in the Wasco Resource Area.

Approximately 100,800 acre feet, or about 16 percent of the surface water yield during the irrigation season, are used to irrigate 25,200 acres of land. However, water supplies are inadequate during the irrigation season in 5 of the 9 watersheds.

Water for livestock is usually adequate in the spring but often is in short supply in the summer and fall, especially in the eastern part of the basin.

Flood problems in the Hood Drainage Basin result from both natural and man-made conditions. Floods can occur in some areas of the basin almost any time of year. Agricultural damages consisting primarily of crop and property losses usually account for much of the total evaluated flood damage; however, land damage from erosion and deposition is significant but is difficult to evaluate and probably inadequately appraised.

Irrigation has been a major consumptive use of water in the basin since its settlement by white man. In the Hood Resource Area it has been developed mostly by community projects while in the Wasco Resource Area most irrigation is the result of efforts by individuals. However, most development in the future depends on group action in both areas. The sprinkler method of application used on about 84 percent of the irrigated land is increasing in use because it adapts easily to the rolling land surface.

Approximately 7,500 acres, or less than three percent of the arable soils, have a major wetness problem.

Careful management of forest and range resources can result in maximum economic and social benefits without impairment of soil and watershed values. Most watersheds are in need of improvement. On public land, good watershed management is a matter of policy, but many private ownerships are often too small for efficient, profitable management on an individual basis.

There is a great potential for development of water resources in the basin to better serve all phases of the economy. Water storage, and in some places surface and ground water, can be used to advantage to help meet the water requirements of the future. There are many potential water storage sites, both large and small, that could be developed for multipurpose use to aid in the future development and growth of the area.

OPPORTUNITIES FOR WATERSHED PROTECTION AND FLOOD PREVENTION PROJECTS

The USDA Oregon River Basin Survey Party made a study of the potential for P. L. 566 work in the Hood Drainage Basin to provide information as a guide to long range coordination and planning of possible future projects. The basin was divided into nine tributary watersheds, and a reconnaissance and summary report was made on each. It was concluded that four projects appear to be feasible and two might prove feasible under existing conditions and laws, but a more detailed study is required to make a decision. An application for assistance under P. L. 566 has been approved for the Oak Grove watershed, one of the four that appears to be feasible. The Middle Fork Hood River watershed project is now being constructed under the same program.

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

GENERAL DESCRIPTION OF THE BASIN

LOCATION AND SIZE

The Hood Drainage Basin of Oregon includes all the tributaries of the Columbia River between Bonneville and the divide of the Deschutes River Basin, from approximately river mile 145 to river mile 202 (fig. 1). It is bounded on the west by the Lower Willamette River Basin, on the south and east by the Deschutes River Basin, and on the north by the Columbia River. The basin has a total area of about 654,500 acres which is about 1.1 percent of the total area of Oregon. There are approximately equal areas in the Hood River and Wasco Counties and a very small area in Multnomah County. It contains 91 percent of Hood River County, 22.4 percent of Wasco County, and 400 acres in Multnomah County.

For the purpose of discussion, the basin can be divided into two almost equal areas on the basis of soils, climate, and hydrology. These areas have a common boundary that is almost the county line between Wasco and Hood River Counties and will be referred to as the Wasco Resource Area and the Hood Resource Area. The basin is further divided for study purposes into nine watersheds, ranging in size from 38,900 acres to 163,300 acres. They are designated as follows: A, Fifteenmile Creek; B, Eightmile Creek; C, The Dalles, and D, Mosier Creek in the Wasco Resource Area; and in the Hood Resource Area E, East Fork Hood River; F, Oak Grove; G, Columbia Gorge; H, Middle Fork Hood River; and I, West Fork Hood River.

SETTLEMENT AND HISTORY

Mount Hood was first seen by white men on October 29, 1792, by W. R. Broughton and the Vancouver expedition. It was seen from somewhere near the mouth of the Willamette River and was named in honor of Lord Hood of the British Admiralty. However, it was not until October 1805 when the Lewis and Clark expedition came down the Columbia River that white men first visited the Hood Drainage Basin. Trappers, fur traders from British and American fur companies, and pioneer settlers traveled through this area on their way to the Willamette Valley and the coast.

Development at The Dalles reflects the influence of its river location. Many of the settlers on their way to the Willamette Valley and the coast traveled by flatboat or raft from the confluence of the Snake and Columbia Rivers. The journey down the river was interrupted by The Dalles rapids. Portage and transshipping from this point stimulated growth of the settlement.

The Donation Land Claim Law provided free land to immigrants in 1850 and encouraged rapid and widespread homesteading. The first permanent set-

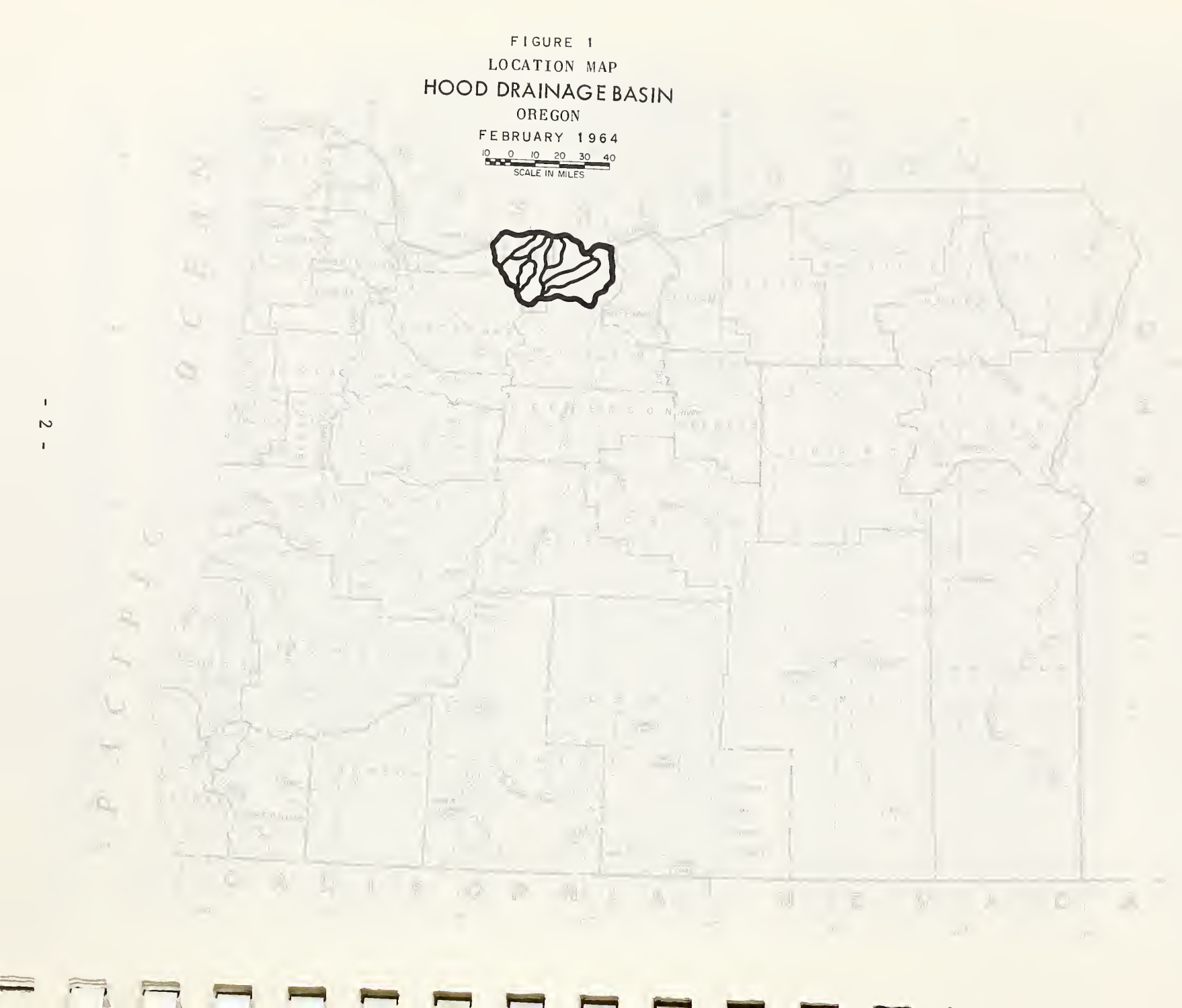
FIGURE 1

LOCATION MAP

HOOD DRAINAGE BASIN

OREGON

FEBRUARY 1964



tler in the Hood River Valley filed a donation land claim in 1854 on land now included in the city of Hood River, and in 1858 a post office was established. Wasco County was established in 1854 and included a large area east of the Cascades. In 1908 Hood River County was created from part of Wasco County.

The Dalles with a population of 3,000 to 10,000, including transients, served as a trading center during the gold rushes in eastern Oregon in the 1860's. By 1870, following the collapse of the mining boom, the population dropped to about 1,000 persons and has increased slowly and steadily from that time.

Ranching operations, which were the first agricultural activity, began with cattle in the 1860's and later included sheep. The development of dryland wheat farming began soon after in the Wasco Resource Area and has expanded while livestock production decreased. In the Hood Resource Area and The Dalles and Mosier Creek watersheds of the Wasco Resource Area, fruit production is the major agricultural enterprise. The first commercial orchard was planted in 1876, and the first irrigation system was put in operation in 1897. Prior to 1920 apples were the main fruit crop in the Hood Resource Area, but since then pears have become more important. The main fruit crop in the Wasco Resource Area is cherries followed by peaches and apricots.

The first sawmill was built in 1861. Since that time, the lumbering enterprise has increased and is now one of the major sources of income.

The processing of agricultural products was the first industrial development in the basin followed by the processing of forest products. Industrial activity has expanded and increased because of the availability of low-cost electrical power from the Columbia River.

POPULATION

In 1962, the population of the basin was 30,970, or 1.7 percent of the state's population. The population density is 30 persons per square mile as compared to 19 persons per square mile for the state.

The largest city in the Hood Resource Area is Hood River with a population of 3,660. The rest of the people are scattered throughout the valley, with 2,660 living on farms and 7,080 living in small towns, communities, or rural residences (table 1).

The Dalles, with a population of 10,680, is the largest city in the Wasco Resource Area. The farm population is 1,660 with the remaining 5,230 people residing in small towns, communities, or rural residences.

Population in Hood River County has continually increased since its formation in 1908 (chart 1). The fastest growth was from 1930 to 1940 while Bonneville Dam was under construction. Since 1940, the increase in population has been less than the natural increase of births over deaths. The out-migration totaled 342 people between 1940 and 1950 and 1,200 between 1950 and 1960.

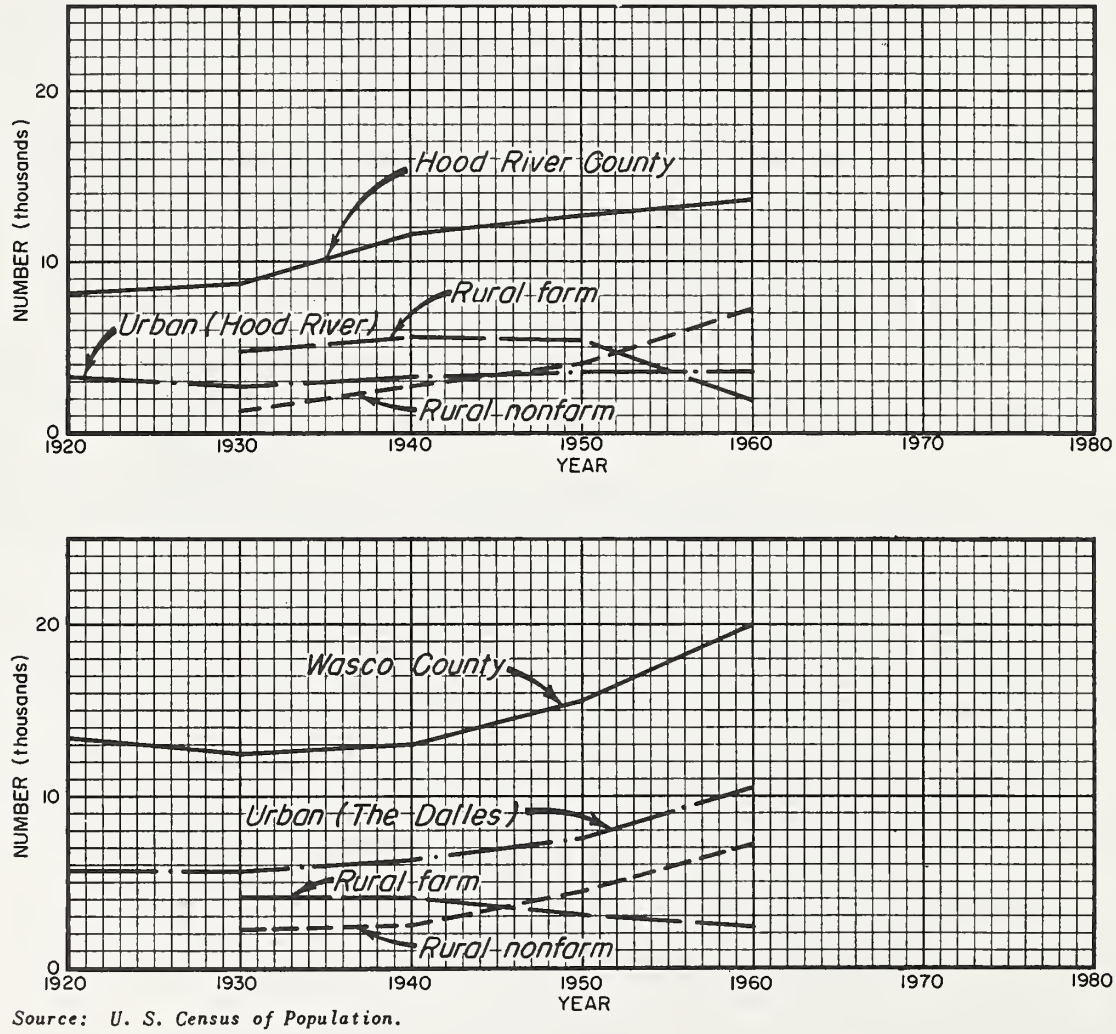
Table 1.--Population, Hood Drainage Basin, Oregon, 1962

Place of residence	Resource area: Hood	Wasco	Total
	Number	Number	Number
Urban 1/	3,660	10,680	14,340
Rural:			
Farm	2,660	1,660	4,320
Nonfarm	7,080	5,230	12,310
Total	13,400	17,570	30,970

1/ Cities having 2,500 or more inhabitants.

Source: Rural farm population estimated on the basis of number of farms. Other data furnished by the State Water Resources Board of Oregon.

Population, Hood River and Wasco Counties, Oregon, 1920 - 1962.



Source: U. S. Census of Population.

Chart I

Population in Wasco County declined from 1920 to 1940 but has increased substantially since 1940 (chart 1). The major factors influencing growth since 1940 were the construction of The Dalles Dam which was completed in 1957 and the construction of the Harvey Aluminum Plant in The Dalles. The net in-migration for Wasco County was 1,442 between 1940 and 1950 and 2,055 between 1950 and 1960.

Rural farm population has declined considerably in both counties while rural nonfarm population has continued to increase. The growth of the rural nonfarm population is primarily due to the expansion of the suburban areas around Hood River and The Dalles.

EMPLOYMENT

The 1960 Census of Population shows that 12,493 people were employed in Hood River and Wasco Counties in April and 1,047, or 7.7 percent, were unemployed. The unemployment percentage was 10.4 for women and 6.7 for men. Because of the relatively high unemployment, both counties have been classed by the Area Redevelopment Administration as areas of "substantial and persistent unemployment". Work associated with the fruit industry is highly seasonal, reaching a high point in the summer and a low point in the winter months. Therefore, the unemployment figures need further clarification since it is probable that some people who work in temporary jobs at peak periods would not necessarily desire permanent jobs.

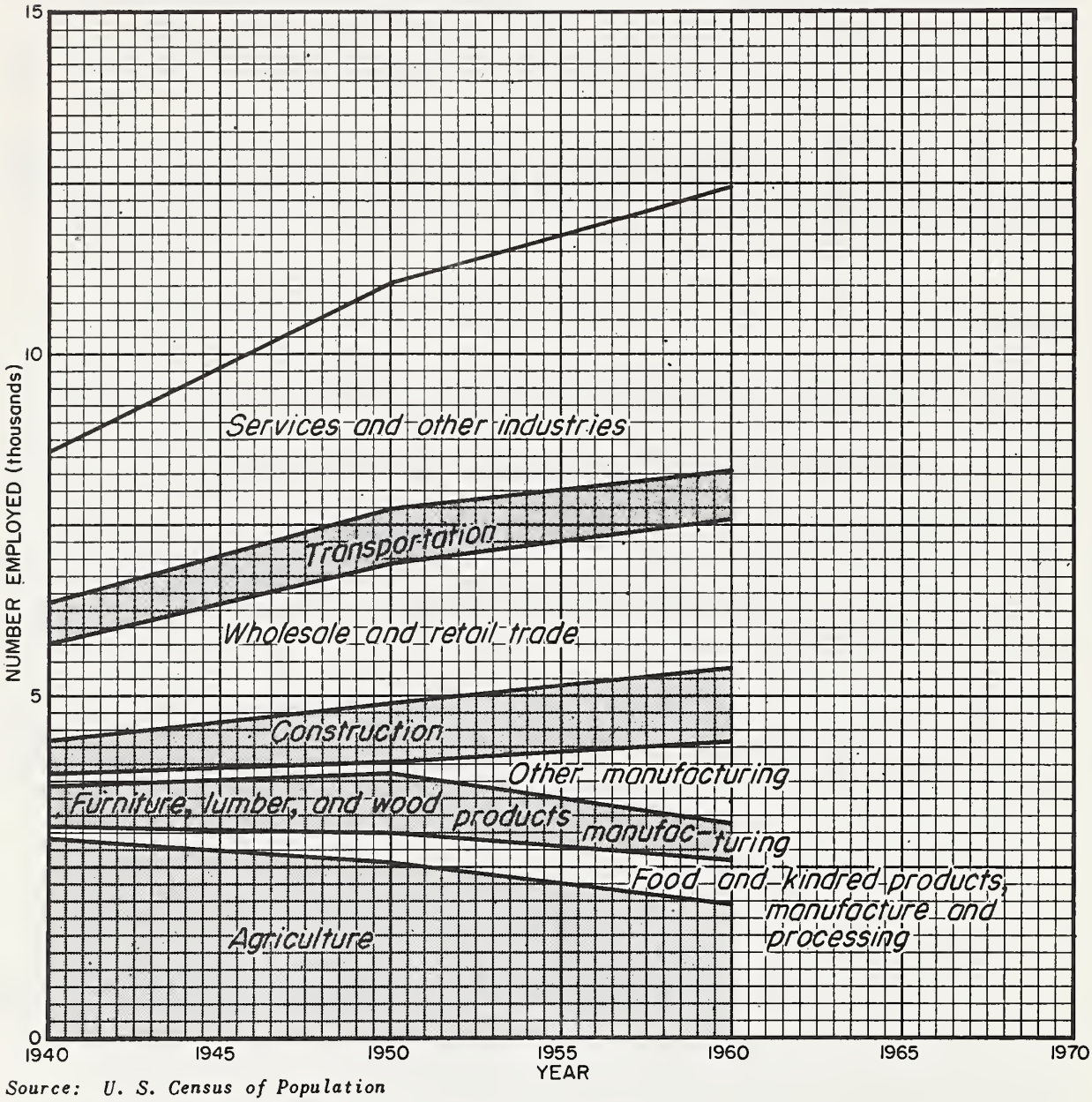
Table 2 shows the employment in Hood River and Wasco Counties by employment groups, and chart 2 illustrates the trends. Since 1940, employment in agriculture has decreased by 878 workers while employment in food and kindred products manufacturing and processing has increased by 479.

Table 2.--Employment, Hood River and Wasco Counties, Oregon, 1960

Employment group	Hood River County		Wasco County		Total	
	Number	Percent	Number	Percent	Number	Percent
Agriculture	992	19.6	971	13.0	1,963	15.7
Manufacturing:						
Food and kindred products	527	10.4	121	1.6	648	5.2
Furniture, lumber, and wood products	447	8.8	369	5.0	816	6.5
Other manufacturing	351	6.9	574	7.7	925	7.4
Construction	301	5.9	790	10.6	1,091	8.7
Wholesale and retail trade	738	14.6	1,444	19.5	2,182	17.5
Transportation	181	3.6	489	6.6	670	5.4
Services and other industries	1,527	30.2	2,671	36.0	4,198	33.6
Total employed	5,064	100.0	7,429	100.0	12,493	100.0

Source: U. S. Census of Population, 1960.

Employment in Hood River and Wasco Counties, Oregon, 1940-1960.



Source: U. S. Census of Population

Chart 2

Employment in furniture, lumber, and wood products manufacturing and transportation has decreased somewhat since 1950 while employment in all of the other groups has increased. Significant gains were made in the "construction" and "services and other industry" groups.

TRANSPORTATION

The northern populated parts of the Hood Drainage Basin are readily accessible by a variety of transportation facilities. The southern portion has two primary and several secondary access roads. The basin is traversed on the northern edge by Interstate Highway 80 N (formerly U. S. 30) connecting Cascade Locks, Hood River, Mosier, and The Dalles. U. S. Highway 197 bisects the eastern portion of the basin in a north-south direction from The Dalles through Dufur. State Highway 35 starts at Hood River, extends southward through the Hood River Valley, loops westward around Mount Hood, and connects with U. S. Highway 26. Most of the population centers, irrigated tracts, and wheat farming areas are linked with improved county roads. Access across the Columbia River to Washington points is supplied by the Bridge of The Gods at Cascade Locks, Hood River Bridge, and The Dalles Bridge.

The main line of the Union Pacific Railroad serves towns along the Columbia River providing transcontinental passenger and freight service. The Mount Hood spur line connects Hood River, Dee, and Parkdale to transport fruit and timber products. The Oregon Trunk Railway traverses the Deschutes River Valley immediately to the east of the basin. Regular freight and bus service is available to almost all towns.

There are no airports within the basin used regularly by commercial airlines. The Dalles Airport is across the Columbia River in Washington. Hood River and Cascade Locks have airport facilities for smaller planes.

The ports of Hood River and The Dalles supply docks for vessels and barges for up to 27 foot draft; bulk handling equipment between water, rail, and highway carriers; boat basins and moorage. In 1961, Columbia River traffic amounted to 4,000,000 tons, of which 289,000 tons was local traffic at The Dalles.

According to the Corps of Engineers, U. S. Army waterways and harbors report, barge traffic on the Columbia River increased 23.6 percent for the first six months of 1963 over the same period for 1962. This is the greatest increase for any United States inland waterway and shows its favorable position over the Willamette River barge traffic which decreased 14.6 percent. Large item movements include grain, animal products, wood products, petroleum, building materials, metal products, industrial chemicals, and fertilizers.

POWER

The Hood Drainage Basin is a power deficient area if only that generated from basin water supplies is considered. However, when you include power from the Bonneville and The Dalles Dams generated from Columbia River energy, this statement is no longer true. The basin is adequately supplied for present and future use by its integration with the Northwest Power Pool. Distribution lines provided mainly by Pacific Power and Light Company, Northern Wasco County Peoples Utility District, Wasco Electric Cooperative, Inc., Hood River Electric Cooperative, and Cascade Locks Municipal Power Company are adequate for the area.

There is one hydroelectric generating plant and one sawdust thermal plant on Hood River. They are the Powerdale Plant owned by Pacific Power and Light Company and the Dee Plant owned by Edward Hines Lumber Company. There is potential for development of a few small plants, but under the present circumstances it does not appear probable that they will be developed in the near future.

PHYSICAL ASPECTS

Climate

The Hood Drainage Basin lies in a climate transition zone between the temperate maritime zone of western Oregon and the temperate, semi-arid, continental zone of central Oregon. Physiographic features which affect the climate are the Columbia Gorge and the elevation variation from south and west to north and east.

Photo 1.--Winter snowpack is an important source of summer streamflow. Note two men at mouth of snow cave, Mount Hood Wild Area, August 1963. Poppino photo. NO. 1

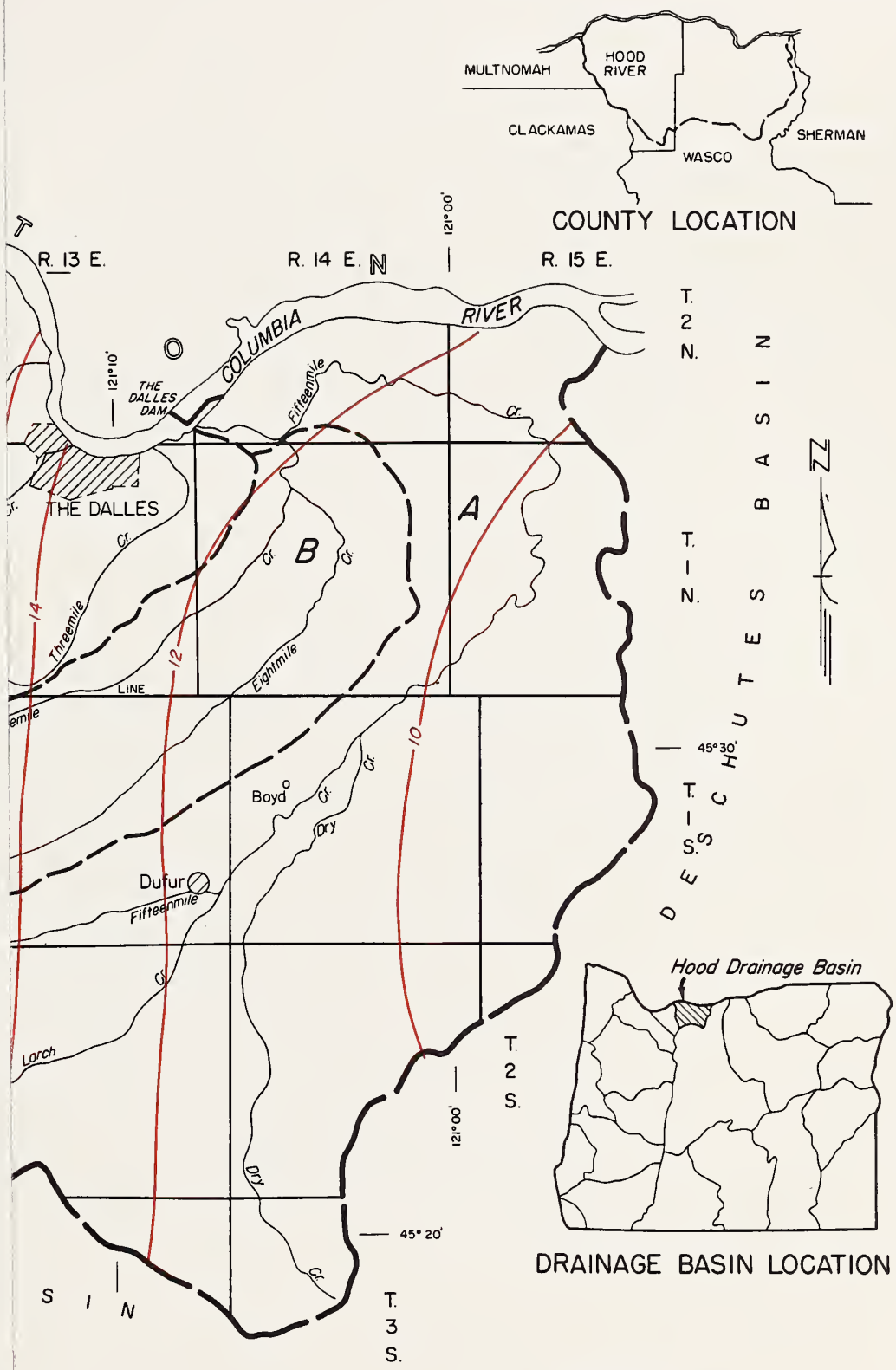


FIGURE 2

PRECIPITATION MAP

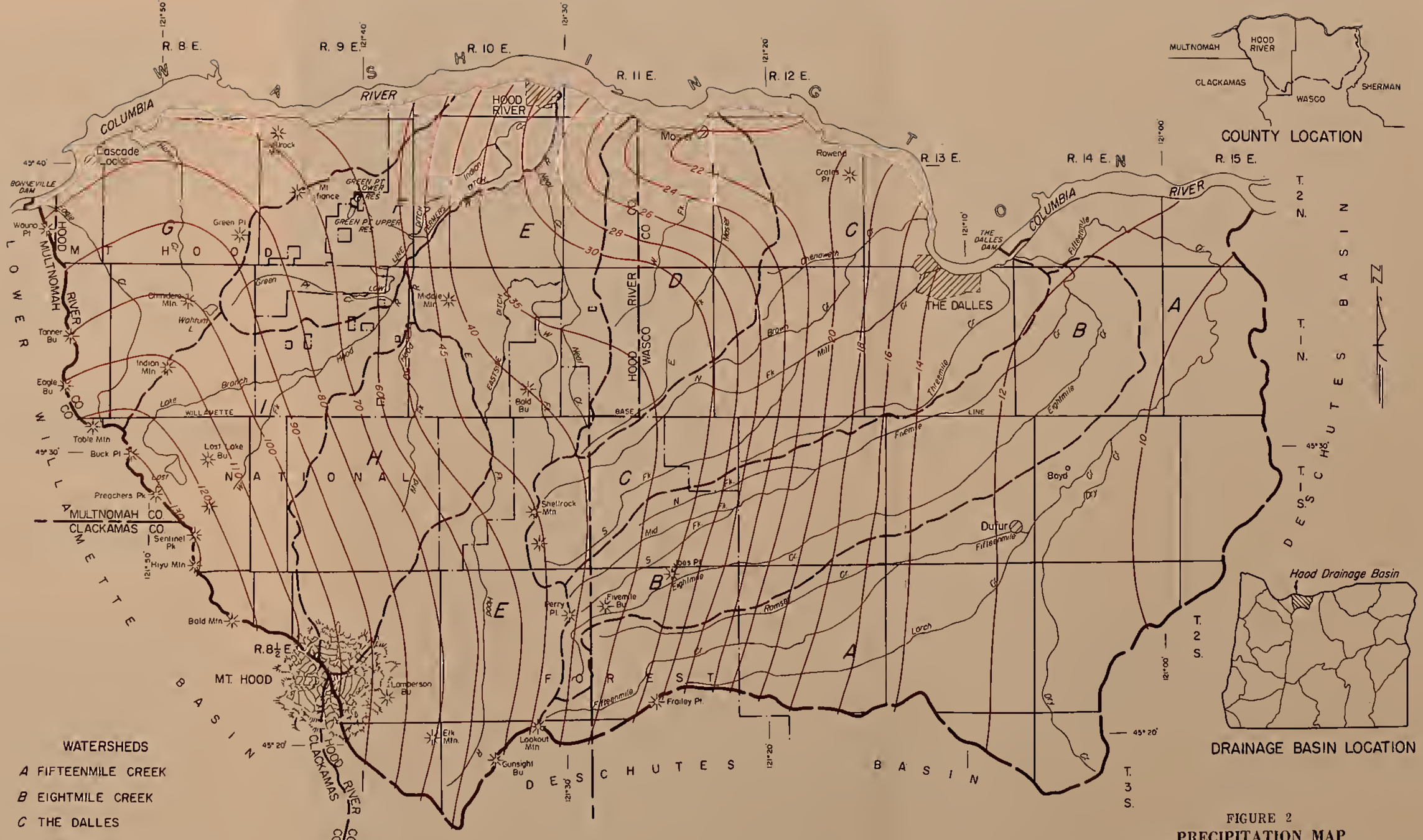
HOOD DRAINAGE BASIN

OREGON

FEBRUARY 1964

SCALE IN MILES

7-E-17559-N



COUNTY LOCATION

DRAINAGE BASIN LOCATION

WATERSHEDS

- A FIFTEENMILE CREEK
- B EIGHTMILE CREEK
- C THE DALLES
- D MOSIER CREEK
- E EAST FORK HOOD RIVER
- F OAK GROVE
- G COLUMBIA GORGE
- H MIDDLE FORK HOOD RIVER
- I WEST FORK HOOD RIVER

LEGEND

- —50— Normal Annual Precipitation in Inches
- Drainage Basin Boundary
- Watershed Boundary
- National Forest Boundary

SOURCE: Compiled by USDA River Basin Survey Party and State Water Resources Board from Weather Bureau and Corps of Engineers data.

FIGURE 2

PRECIPITATION MAP

HOOD DRAINAGE BASIN

OREGON

FEBRUARY 1964

SCALE IN MILES 0 1 2 3 4 5

7-E-17559-N

M-4039

The precipitation gradually decreases from about 130 inches at the Cascade summit on the west to about 9 inches at the east end of the basin (fig. 2). The average annual precipitation is 77 inches at Cascade Locks, 30 inches at Hood River, and 45 inches at Parkdale in the Hood Resource Area, 12 inches at Dufur and 15 inches at The Dalles in the Wasco Resource Area. Less than one-fourth of the precipitation comes during the irrigation season of April 1 to October 30. Thunderstorms and hailstorms are infrequent and usually not severe in the Hood Resource Area, but violent summer storms of small areal extent and high intensity occur occasionally in the Wasco Resource Area. Snowfall is usually light at the lower elevations and very heavy in the mountain area, sometimes reaching a depth of 30 feet at timberline on Mount Hood. This accumulation of snowpack is an important source of summer streamflow (photo 1).

The highest temperatures occur in July and August and the lowest temperatures in January. Extremes of temperature show maximums of 108° at Cascade Locks, 110° at Dufur, 106° at Hood River, 105° at Parkdale, and 115° at The Dalles. Minimum temperatures recorded are -9° at Cascade Locks, -28° at Dufur, -27° at Parkdale, and -30° at The Dalles. The frost-free season in the cropland area varies from 100 to 217 days and decreases to less than 30 days at the higher elevations in the Cascades.

The prevailing winds in the basin are predominantly westerly. At Cascade Locks, Hood River, and The Dalles the prevailing wind is westerly in summer and easterly in winter. At Parkdale the prevailing wind is westerly both summer and winter. At Dufur the prevailing wind is northwesterly in summer and northeasterly in winter.

A long growing season including a large number of sunny days, good air drainage, and good soils are factors combining to make this a productive basin. Perhaps the major climatic limitation for agriculture is the limited precipitation during the growing season.

Topography and Geology

The Hood Drainage Basin is in north central Oregon on the east slope of the Cascade Mountains. Located on the southwestern edge of the basin is Mount Hood which is the highest and most prominent topographic feature. The Columbia River Gorge along the north boundary is the most picturesque topographic feature. The west boundary is the uplifted crest of the Cascade Mountains and the east boundary coincides with the west edge of the anticlinal valley of the Deschutes River. Two northeast-southwest trending folds located in the north central section and a north-south trending fault along the east side of the Hood River Valley are the main structural units. The fault divides the basin into two physiographic sections which are previously described as the Wasco Resource Area and the Hood Resource Area. The rock formations (fig. 3) are relatively young. The oldest formation is a late Eocene lava flow and the most prominent is the Columbia River basalt which is, also, the most productive acquifer.

Structural changes such as uplifting, folding, and faulting have made significant contributions to the present topography of the basin. In late Miocene to early Pliocene time folding took place forming two major folds in the north central section and numerous minor folds throughout the basin. In

the Wasco Resource Area the Dalles syncline forms the valley for the Fifteenmile drainage and, prior to the formation of Mount Hood, may have joined with the Sandy drainage to serve as an ancient valley of the Columbia River. The Ortley anticline is the upland located west of The Dalles. Before the Columbia River cut through it, this structural upland dammed the river and created a lake from which part of the Dalles sediments originated. The valley of Mosier Creek is located in the Mosier syncline. The Bingen anticline is the east wall of the Lower Hood River Valley.

In early or middle Pliocene time a north-south trending fault occurred along the east side of the Hood River Valley. The down dropped side of the fault is the present Hood River Valley and may have been the location of a south flowing river before the development of the present Columbia River. The main valley is wide and maturely eroded, but the tributary valleys are in a youthful stage. The uplifted side of the fault is an east sloping upland with summit elevations varying from 1,600 to 4,200 feet and drainages flowing east into the Mosier and Dalles synclines.

A gentle arching of the older rock units in late Pliocene time and the outpouring of the Cascan volcanics in Plio-Pleistocene time built the Cascade Range to its present towering heights. The elevations vary from 2,800 to 4,500 feet along the main summit and rise to 11,245 feet on Mount Hood. Most of the streams are deeply incised and are in steep and rugged canyons. The valleys on the slopes of Mount Hood are the exception where glaciers have eroded steep and rugged U-shaped canyons.

The Columbia River has cut down through many feet of rock. Its erosive, deep, and narrow gorge indicates that it is a youthful stream.

The oldest formation in the basin is a series of late Eocene lava flows that may be equivalent to the Goble volcanics in western Oregon and the Clarno formation in eastern Oregon. It crops out on the north bank of the Columbia River and underlies the rock formations of the basin. The oldest formation exposed in the basin is the Eagle Creek formation of late Oligocene or early Miocene age. It may be equivalent to the John Day formation of eastern Oregon. This formation of about 500 feet of semi-consolidated andesitic pyroclastic rocks crops out in the vicinity of Bonneville and the lower valley of Eagle Creek.

The most prominent rock in the basin is the Columbia River basalt. This middle Miocene series is made up of lava flows of dark gray to black, dense, very fine grained basalt in thicknesses up to 2,000 feet with well developed columnar jointing. It was extruded on a surface of low relief and later gently deformed into synclines and anticlines, and in places interrupted by faults. The basalt is present in the whole basin and is exposed in large areas in the north and east sections of the basin. Making up the walls of the Columbia River Gorge, it can be seen at many well known water falls and gorges. It is exposed along the drainages in the Wasco Resource Area and along the fault scarp and on Middle Mountain in the Hood Resource Area.

An extensive middle Pliocene alluviation known as the Dalles formation overlies Columbia River Basalt and is similar to the Troutdale formation in the Portland basin. These sediments are beds of a mixture of micaceous and quartzose sandstone and conglomerate from older formations far upstream in

FIGURE 3

GENERALIZED GEOLOGIC MAP
HOOD DRAINAGE BASIN
OREGON

FEBRUARY 1964

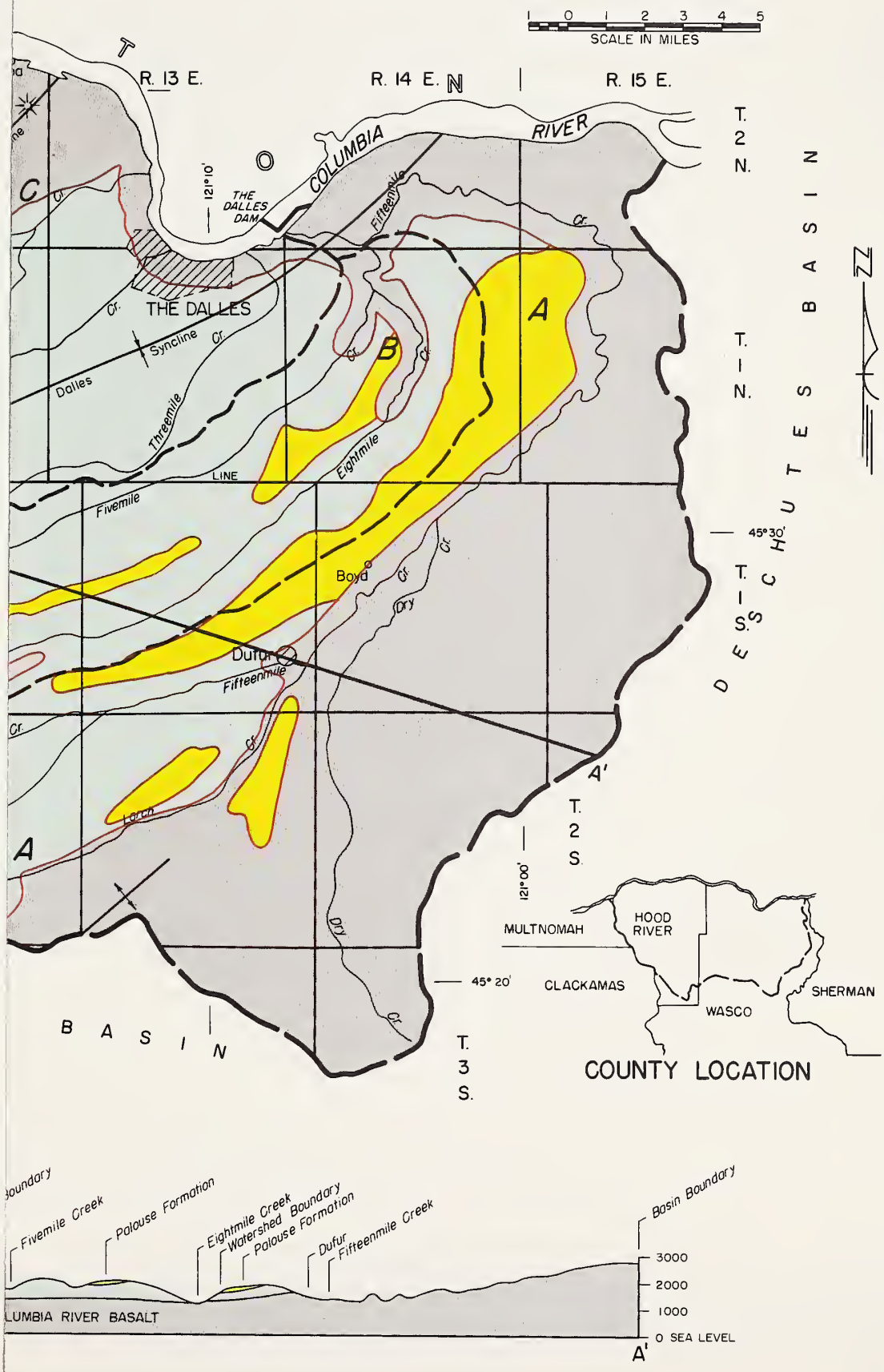


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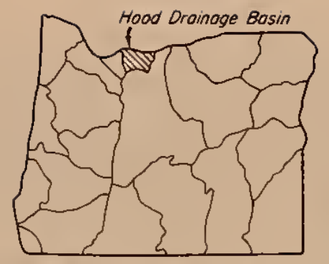
FIGURE 3

GENERALIZED GEOLOGIC MAP
HOOD DRAINAGE BASIN
OREGON

FEBRUARY 1964

SCALE IN MILES 0 1 2 3 4 5



DRAINAGE BASIN LOCATION

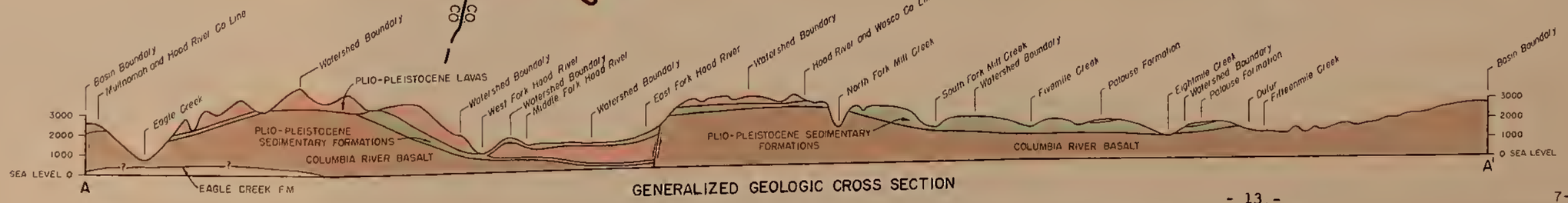
WATERSHEDS

- A FIFTEENMILE CREEK
- B EIGHTMILE CREEK
- C THE DALLES
- D MOSIER CREEK
- E EAST FORK HOOD RIVER
- F OAK GROVE
- G COLUMBIA GORGE
- H MIDDLE FORK HOOD RIVER
- I WEST FORK HOOD RIVER

LEGEND

- Plio-Pleistocene Sedimentary Formations
- Polouse Formation (shown where over five feet deep)
- Plio-Pleistocene Lavas
- Columbia River Basalt
- Anticline Axis
- Syncline Axis
- Fault Traces
- Drainage Basin Boundary
- Watershed Boundary
- National Forest Boundary

COUNTY LOCATION



GENERALIZED GEOLOGIC CROSS SECTION

7-E-17559-N

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the Columbia drainage and of tuffaceous siltstone, sandstone, and conglomerate from local volcanic sources in the Cascade Range. These two kinds of sediments are mixed in varying proportions and in some areas the beds are composed almost wholly of stream carried volcanic material. The Dalles formation undoubtedly covered the lower elevations of the basin when originally deposited but has been removed by water in some areas. There are 800 feet of the sediments in Hood River Valley and 500 feet on the hill between Eightmile and Fivemile Creeks.

A long period of volcanism in the Cascade Mountains began during the last portion of the Dalles alluviation. This volcanic extrusion in late Pliocene to Pleistocene time, called the Cascan formation, built the Cascades to their present heights. The early phase was of explosive nature and included ash, breccia, and conglomerate which was partly incorporated into the Dalles sediments. Volcanic ash was spewed out and mantles a large area in the central section of the basin. It has filled the upper Hood River Valley to a depth of 5 to 20 feet and covers the hills south of the Hood River Valley and the west portion of the Wasco Resource Area to a depth of 2 to 5 feet or more. The later phase of volcanism was a quiet extrusion of andesitic and basaltic flows of light to medium gray, massively jointed vesicular lava. Mount Hood is a cinder cone of flows, ash, and breccias which has been intruded by dikes and other intrusions and eroded by glaciers leaving unsorted bouldery gravel moraines and stratified gravel, sand, silt, and clay deposits.

In Pleistocene time the Palouse formation was deposited over most of the east quarter of the basin. This thick, structureless, light brown, silty loess overlies the Columbia River basalt and Dalles formations. Fairly large areas that are over 5 feet deep are delineated on the map.

The last great event that affected this basin was the flood or floods of the Columbia River in Pleistocene time that accompanied the melting of the continental glaciers. The floodwaters reached an elevation of 1,000 to 1,100 feet and spilled over a low divide into Fifteenmile Creek. It swept away talus and soil on large areas along the canyon walls. Large deposits of coarse alluvium were left in the area, and many icebergs were grounded with their loads of erratic boulders. During a quiet water stage of alluviation, considerable amounts of silts and sand were deposited.

Alpine glaciers on the slopes of Mount Hood developed and melted during Pleistocene time. Much of the coarse alluvium that is now on the floodplains was deposited by swollen glacier-fed streams. In Recent time the Columbia River was dammed occasionally and temporarily by a mud or lava flow or a landslide. Deposits of lacustrine material of considerable depth occur in much of the basin up to an elevation of approximately 850 feet.

Three possible sources of ground water exist in the basin. Columbia River basalt is the chief water bearing unit and produces moderate amounts of good quality water. Water is known to be in the upper scoriaceous layers of the flows in two zones, one at 35 to 100 feet and the other at 300 to 375 feet. In areas where structural barriers occur water is plentiful and may have artesian pressure. The Dalles formation is essentially impermeable and yields small quantities in some areas. The alluvial material is moderate to highly permeable and is a variable source of water. The intermediate alluvium produces a moderate supply of water.

Soils

The soils of the Hood Drainage Basin will be discussed in eight general groups. The areas in which these groups occur are delineated on the generalized soil map (fig. 4). A description of these soil groups and areas is included in the narrative and the table of soil characteristics (table 3). The factors used in grouping the soils are: physiography, kind and shape of landform; geology, kind and source of parent and underlying material; and soil genesis, soil profile characteristics. Alluvial soils adjacent to the streams and intermixed miscellaneous land types are associated with each group.

Soils Derived from Lacustrine Materials on Terraces. These soils occur in the lower Hood River Valley on nearly level to gently sloping, deeply dissected terraces of water laid volcanic deposits. In Recent geologic time as a result of a lava or mud flow or landslide damming the Columbia River and creating a lake, sediments of gravel, sand, and silt were deposited in varying depths on these terraces. Soils developed from this lacustrine material are deep to very deep, excessively to imperfectly drained.

Soils Derived from Colluvium on Terraces. Terrace soils developed from colluvial and glacial sediments are located along the west side of lower Hood River Valley. The colluvial sediments were moved by gravity from the hills on the west. The glacial sediments, overlying the colluvium in places, were deposited by the Columbia River as a result of the melting of the continental glaciers. These terraces are rolling and undulating and dissected by V-shaped stream channels. The soils are moderately deep to deep, well to imperfectly drained and may have stony profiles.

Soils Derived from Volcanic Ash on Terraces. These soils are on gently to moderately sloping, moderately dissected terraces in upper Hood River Valley. The terraces are formed from intermixed water laid, semi-consolidated andesitic gravel, sand, and mud flow breccia and Recent basaltic and andesitic flows and breccias. Over this mixed material 5 to 20 feet of volcanic ash was deposited. The parent material of the soils is volcanic ash and a minor amount of other volcanic material. Soils have developed that are moderately deep to very deep, well to imperfectly drained, and some soils have a firm to very firm horizon or a gravelly substratum.

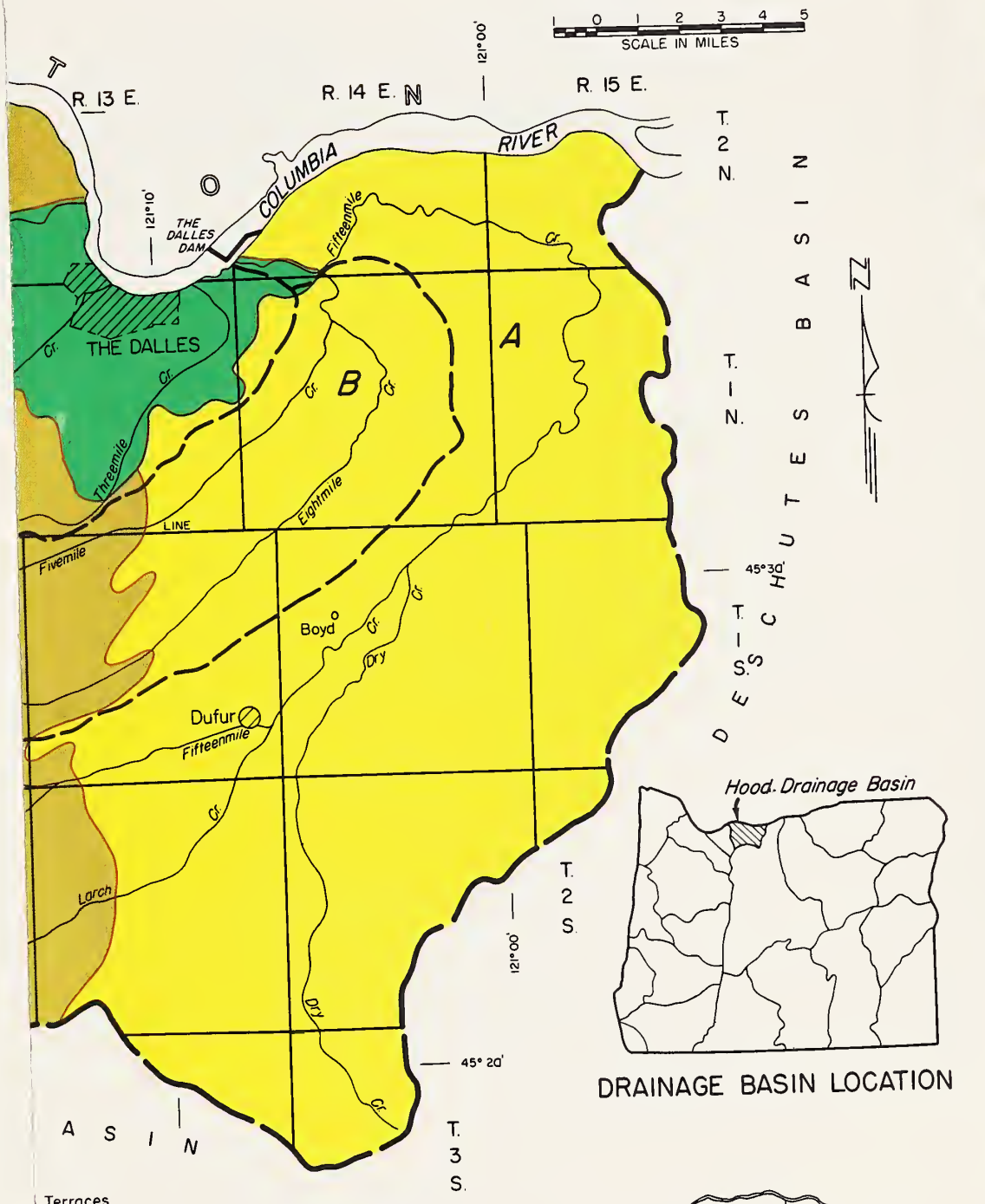
Soils Derived from Volcanic Materials on Uplands. Upland residual soils occur in the mountainous area west and south of the Hood River Valley and extend from the Columbia River to Mount Hood and to the east. The volcanic material is basalt, andesite, consolidated breccias and tuffs, and volcanic ash. Considerable glacial action from Mount Hood has left areas of unsorted bouldery, gravelly moraines and stratified gravel, sand, silt, and clay deposits. Most of the soils are moderately deep to deep, excessively to well drained, and stony to non-stony.

Soils Derived from Volcanic and Sedimentary Materials on Uplands. These soils are located on Middle Mountain and on the uplands between the Hood and Wasco Resource Areas and extends northward from Shellrock Mountain to the Columbia River. This upland is characterized by gently to moderately sloping ridgetops and steep to very steep canyons. The soil parent material is basalt and andesite rock, consolidated breccias and tuffs, volcanic ash, and sediments of Recent to Pliocene geologic age. The soils are moderately deep to

FIGURE 4

GENERALIZED SOIL MAP
HOOD DRAINAGE BASIN
OREGON

FEBRUARY 1964



Terraces

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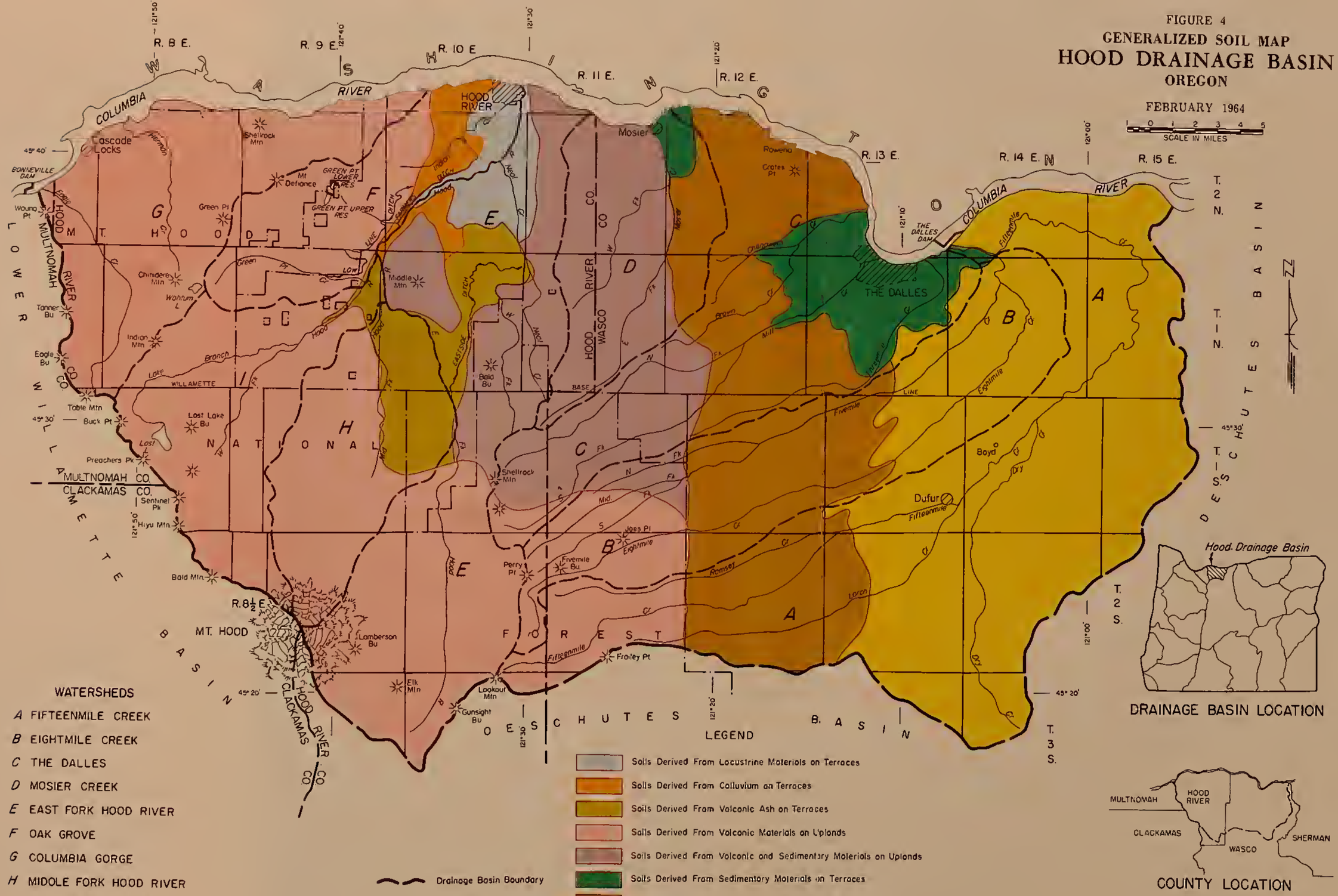
7-E-17559-N

FIGURE 4

GENERALIZED SOIL MAP
HOOD DRAINAGE BASIN
OREGON

FEBRUARY 1964

SCALE IN MILES 0 1 2 3 4 5



WATERSHEDS

- A FIFTEENMILE CREEK
- B EIGHTMILE CREEK
- C THE DALLES
- D MOSIER CREEK
- E EAST FORK HOOD RIVER
- F OAK GROVE
- G COLUMBIA GORGE
- H MIDOLE FORK HOOD RIVER
- I WEST FORK HOOD RIVER

LEGEND

- Soils Derived From Locustrine Materials on Terraces
- Soils Derived From Colluvium on Terraces
- Soils Derived From Volcanic Ash on Terraces
- Soils Derived From Volcanic Materials on Uplands
- Soils Derived From Volcanic and Sedimentary Materials on Uplands
- Soils Derived From Sedimentary Materials on Terraces
- Soils Derived From Aeolian and Sedimentary Materials on Terraces
- Soils Derived From Loess on Uplands

- Drainage Basin Boundary
- Sub-Watershed Boundary
- National Forest Boundary

DRAINAGE BASIN LOCATION

COUNTY LOCATION

U. S. DEPARTMENT OF AGRICULTURE, SOIL CONSERVATION SERVICE ... M-4039

7-E-17559-N

Hood Drainage Basin, Oregon, 1964

ility	Water-holding capacity (Inches/foot)	Infiltration	Suitability for irrigation	Major land use	Special problems	Elevation mean sea level (Feet)	Annual precipitation (Inches)	Length of growing season (Days)
ely	1.5	Medium	Good	Orchard	Gravel substratum	400-650	28-40	180
ely to w	2.0	Medium	Excellent	Orchard	None	550-850	28-40	180
e	1.5	Medium	Good	Orchard	Drainage	400-750	28-40	180
ely	2.0	Medium	Good	Pasture and orchard	Drainage	550-850	28-40	180
e	1.5	Medium	Excellent	Orchard	None	800-2,500	30-45	160
e	1.0	Medium	Fair	Forest	Stoniness	500-1,200	30-45	160
	2.5	Rapid	Excellent	Orchard	None	1,000-2,500	32-60	140-160
	2.0	Medium	Fair	Pasture	Drainage	1,000-2,500	32-60	140-160
	2.5	Rapid	Fair	Orchard and pasture	Drainage	1,000-2,500	32-60	140-160
e	1.5	Medium	Excellent	Orchard	None	200-900	14-22	180-200
e	2.2	Medium	Good	Orchard	None	500-1,100	14-18	180-200
	1.5	Rapid	...	Forest	None	2,500+	40-120	30-100
e	2.0	Medium	...	Forest	Stoniness	1,000+	40-130	100-160
	1.5	Rapid	...	Forest	Gravelly, hardpan	2,000-4,000	45-60	100-130
	1.0	Rapid	...	Forest	Stoniness	1,000-2,500	35-45	130-160
ely	1.5	Moderately rapid	...	Forest	Slope	1,000-3,000	35-50	110-160
ely	2.0	Medium	...	Forest	None	1,000+	40-130	80-130
ely	2.0	Medium	Fair to good	Forest	None	500-4,200	22-45	80-140
e	1.4	Medium to rapid	...	Forest	None	900-4,200	14-45	80-200
ely	1.7	Rapid	...	Range	Stoniness	200-4,200	14-45	80-200
ely	2.5	Medium	Fair	Range, forest, cultivated	Erodibility	1,000-3,600	14-28	80-140
e	0.7	Medium	...	Range	Slope	1,000-3,500	14-30	80-140
ely	1.2	Rapid	Fair	Range, forest, cultivated	Droughtiness	200-1,000	14-22	160-200
e to ately id	1.5-2.1	Medium	Excellent	Cultivated	None	300-2,300	9-15	130-190
e	2.3	Medium	Good	Cultivated	None	800-1,800	9-15	150-200
e	2.5	Medium	Good	Cultivated	None	700-3,300	9-15	120-155
ely	1.5	Medium	...	Range	Slope	300-1,800	9-15	165-190
ely	2.5	Medium	...	Range	Slope	1,700-3,000	9-15	120-150
e	1.5	Medium	...	Range	Shallow and stony	300-1,800	9-15	160-190
ely	0.5	Medium	...	Range	Shallow and stony	700-3,300	9-15	120-190
ely	0.5	Medium	...	Range	Shallow and stony	700-3,600	9-20	110-190
	1.0	Rapid	Good	Forest and pasture	Droughtiness	200-1,500	28-120	140-180
ely	2.0	Rapid	Good	Forest and pasture	Drainage	300-1,500	28-120	140-180
ely	1.0	Medium	Good	Orchard and hay	Gravelly	400-1,200	30-45	160
	2.0	Medium	Good	Orchard and forest	None	1,000-2,500	32-60	140-160
e	2.1	Medium	Excellent	Cultivated	None	200-2,700	9-28	110-200
ely	1.5	Rapid	Good	Cultivated	Gravelly soil	200-1,800	9-28	150-200
ely	1.5	Rapid	Poor	Pasture	Drainage, gravelly soil	200-1,800	9-28	150-200

Table 3.--Characteristics, qualities, and other data of soils, Hood Drainage Basin, Oregon, 1964

Soil groups	Classification	Texture surface soil	Reaction surface soil pH value	Texture subsoil	Profile depth Inches	Drainage class	Permeability	Water-holding capacity Inches/foot	Infiltration	Suitability for irrigation	Major land use	Special problems	Elevation mean sea level Feet	Annual precipitation Inches	Length of growing season Days
Soils derived from lacustrine materials on terraces:															
Wind River	Regosol	Gravelly loam	6.1-6.4	Gravelly loam	30-50	Well to somewhat excessively	Moderately rapid	1.5	Medium	Good	Orchard	Gravel substratum	400-650	28-40	180
Hood	Gray Brown Podsolic	Loam	5.6-6.6	Loam	48-60+	Moderately well to well	Moderately slow to slow	2.0	Medium	Excellent	Orchard	None	550-850	28-40	180
1/ Van Horn	Brunizem	Sandy loam	6.0-6.2	Sandy clay loam	60+	Moderately well to well	Moderate	1.5	Medium	Good	Orchard	Drainage	400-750	28-40	180
1/ Wyeast	Low Humic Clay	Silt loam	5.6-6.6	Silt loam	38-40	Poorly to imperfectly	Moderately slow	2.0	Medium	Good	Pasture and orchard	Drainage	550-850	28-40	180
Soils derived from colluvial materials on terraces:															
1/ Oak Grove	Reddish Brown Lateritic	Loam	6.0-6.4	Clay loam to clay	56-72	Well	Moderate	1.5	Medium	Excellent	Orchard	None	800-2,500	30-45	160
Rockford	Brunizem	Stony, shotty loam	6.2-6.5	Stony clay loam	20-48	Imperfectly to moderately well	Moderate	1.0	Medium	Fair	Forest	Stoniness	500-1,200	30-45	160
Soils derived from volcanic ash on terraces:															
Parkdale	Regosol	Shotty, gravelly loam	6.2-6.8	Loam	48-60	Well	Rapid	2.5	Rapid	Excellent	Orchard	None	1,000-2,500	52-60	140-160
1/ Bassler	Regosol	Loam	5.2-6.0	Loam	20-60+	Imperfectly	Slow	2.0	Medium	Fair	Pasture	Drainage	1,000-2,500	32-60	140-160
1/ Dar	Regosol	Loam	5.8-6.4	Loam	48-60+	Imperfectly	Rapid	2.5	Rapid	Fair	Orchard and pasture	Drainage	1,000-2,500	32-60	140-160
Soils derived from sedimentary materials on terraces:															
Chenowith	Brunizem	Loam	6.0-6.8	Loam and silt loam	60+	Well	Moderate	1.5	Medium	Excellent	Orchard	None	200-900	14-22	180-200
Cherryhill	Brown Forest	Silt loam to loam	6.0-6.8	Loam and silt loam	23-60	Well	Moderate	2.2	Medium	Good	Orchard	None	500-1,100	14-18	180-200
Soils derived from volcanic materials on uplands:															
1/ Hutson	Podzol	Very fine sandy loam	5.4-6.3	Fine sandy loam	48-60	Well	Rapid	1.5	Rapid	...	Forest	None	2,500+	40-120	30-100
1/ Bins	Soil Brun Acids	Loam	5.6-6.2	Stony loam to clay loam	48-60	Well	Moderate	2.0	Medium	...	Forest	Stoniness	1,000+	40-130	100-160
1/ Olvera	Soil Brun Acids	Very gravelly loam	5.2-5.8	Stony loam	20-48	Somewhat excessively	Rapid	1.5	Rapid	...	Forest	Gravelly, hardpan	2,000-4,000	45-60	100-150
1/ Wygant	Regosol	Extremely stony loam	5.4-6.0	Extremely stony loam	48+	Excessively	Rapid	1.0	Rapid	...	Forest	Stoniness	1,000-2,500	33-45	150-160
1/ Tallant	Regosol	Stony loam	5.4-6.2	Stony loam	24-36	Well	Moderately rapid	1.5	Moderately rapid	...	Forest	Slope	1,000-3,000	55-30	110-160
1/ Fouts	Reddish Brown Lateritic	Shotty loam	5.2-6.0	Clay loam	60+	Well	Moderately slow	2.0	Medium	...	Forest	None	1,000+	40-130	80-130
Soils derived from volcanic and sedimentary materials on uplands:															
1/ Keithum	Soil Brun Acids	Loam	6.0-6.8	Clay loam	48-60+	Well	Moderately rapid	2.0	Medium	Fair to good	Forest	None	500-4,200	22-45	80-140
1/ Frailey	Regosol	Loam	6.4-7.0	Loam	24-60	Well	Moderate	1.4	Medium to rapid	...	Forest	None	900-4,200	14-45	80-200
1/ Bald	Brunizem	Stony loam	6.0-6.6	Clay loam	20-48	Well to somewhat excessively	Moderately rapid	1.7	Rapid	...	Range	Stoniness	200-4,200	14-45	80-200
Soils derived from aeolian and sedimentary materials on uplands:															
1/ Wamic	Regosol	Loam	6.4-7.0	Loam	24-60	Well	Moderately slow	2.5	Medium	Fair	Range, forest, cultivated	Erodibility	1,000-3,600	14-28	80-140
1/ Skyllos	Lithosolic Brunizem	Very stony loam	6.0-6.6	Stony loam	12-24	Well	Moderate	0.7	Medium	...	Range	Slope	1,000-3,500	14-30	80-140
1/ Crates	Regosol	Fine sandy loam to loamy fine sand	6.4-7.0	Fine sandy loam to loamy fine sand	50-60	Well	Moderately rapid	1.2	Rapid	Fair	Range, forest, cultivated	Droughtiness	200-1,000	14-22	160-200
Soils derived from loess on uplands:															
Walla Walla	Chestnut	Silt loam	6.0-7.0	Silt loam	20-60+	Well	Moderate to moderately rapid	1.5-2.1	Medium	Excellent	Cultivated	None	500-2,500	9-15	130-190
1/ Dufur	Chestnut	Silt loam	6.4-7.0	Silt loam	20-60	Well	Moderate	2.5	Medium	Good	Cultivated	None	800-1,800	9-15	150-200
Condon	Chestnut	Silt loam	6.4-7.0	Silt loam	20-60	Well	Moderate	2.5	Medium	Good	Cultivated	None	700-5,500	9-15	120-133
Nansene	Chernozem	Silt loam	6.6-7.0	Silt loam	24-60	Well	Moderately rapid	1.5	Medium	...	Range	Slope	500-1,800	9-15	165-190
Wrentham	Chernozem	Silt loam	6.4-6.8	Silt loam to silty clay loam	24-60	Well	Moderately slow	2.5	Medium	...	Range	Slope	1,700-5,000	9-15	120-150
Starbuck	Brown	Stony loam	6.6-7.0	Very stony silt loam	12-26	Well	Moderate	1.5	Medium	...	Range	Shallow and stony	300-1,800	9-15	160-190
Lickskillet	Lithosolic Brown	Very stony loam	6.4-7.0	Very stony clay loam	12-30	Well	Moderately slow	0.5	Medium	...	Range	Shallow and stony	700-5,500	9-15	120-190
Bakeoven	Lithosol	Very stony loam	6.6-7.0	Very stony clay loam	5-12	Well	Moderately slow	0.5	Medium	...	Range	Shallow and stony	700-3,600	9-20	110-190
Soils derived from recent alluvium:															
In Hood Resource Area:															
Bonnevilla	Alluvial	Loamy sand	6.2-6.6	Stony sand and loamy sand	36-48	Somewhat excessively	Rapid	1.0	Rapid	Good	Forest and pasture	Droughtiness	200-1,500	28-120	140-180
Wimer	Alluvial	Loam	6.4-6.8	Loam	24-60	Moderately well	Moderately rapid	2.0	Rapid	Good	Forest and pasture	Drainage	500-1,500	28-120	140-180
1/ Gilhouly	Alluvial	Gravelly loam	6.0-6.4	Clay loam	48-60	Moderately well	Moderately rapid	1.0	Medium	Good	Orchard and hay	Gravelly	400-1,200	30-45	160
1/ Culbertson	Alluvial	Loam	6.2-6.6	Clay loam	60+	Moderately well to well	Rapid	2.0	Medium	Good	Orchard and forest	None	1,000-2,500	32-60	140-160
In Wasco Resource Area:															
Onyx	Alluvial	Silt loam	7.0-7.8	Silt loam	36-60	Well	Moderate	2.1	Medium	Excellent	Cultivated	None	200-2,700	9-28	110-200
Yakima	Alluvial	Gravelly loam	6.6-7.0	Loam	20-60	Somewhat excessively	Moderately rapid	1.5	Rapid	Good	Cultivated	Gravelly soil	200-1,800	9-28	150-200
1/ Tygh	Alluvial	Gravelly sandy loam	6.4-6.8	Sandy loam	20-30	Imperfectly	Moderately rapid	1.5	Rapid	Poor	Pasture	Drainage, gravelly soil	200-1,800	9-28	150-200

1/ Tentative series, not yet correlated.

Source: USDA, Soil Conservation Service.

deep, somewhat excessively to well drained, and medium textured, and some soils have stony to very stony profiles. Talus slopes, rock bluffs and escarpments, and outcrops of sediments are interspersed in the area.

Soils Derived from Sedimentary Materials on Terraces. Soils in the Mosier and The Dalles area occur on high, smooth, rolling terraces dissected by deep, narrow drainageways. This terrace is composed of basalt and sediments of Dalles formation over which a layer of Recent to Pleistocene loess and sediments was deposited. Part of this material was wind-worked later. The soils are moderately deep to very deep, well drained, and medium textured.

Soils Derived from Aeolian and Sedimentary Materials on Uplands. These upland soils are in western Wasco County in a band varying from one to eight miles wide from the Columbia River to the south boundary of the basin. This upland is characterized by wide, nearly level ridgetops and steep to very steep, V-shaped canyons. The soil parent material is volcanic ash deposited over consolidated sediments of Dalles formation except in the northern section where basalt underlies the volcanic ash. In areas of shallow volcanic ash, a portion of the soil profile has developed from basalt and Dalles sediments. The soils are moderately deep to deep, medium textured, and well drained. On the steep slopes, talus, rock escarpments, and outcrops of sediments are common.

Soils Derived from Loess on Uplands. Loessial soils occupy an upland area in the east end of the basin with nearly level to rolling ridgetops and steep to very steep canyons. The parent material of these soils is predominately loess of the Palouse formation which overlies Columbia River basalt and Dalles formation in depths of five feet or less. Where the mantle of loess is less than five feet, the underlying basalt and sediments have contributed to the soil material and in places the basalt has added stoniness. Very shallow to very deep well drained soils have developed. The very shallow soils known as "scabland" and "biscuit scabland" when occurring in a complex are on ridgetops and gentle south slopes. Shallow stony soils with rock outcrops are on the south exposures, and deep to very deep soils are on the north exposures.

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 (fig. 5). The hazards and limitations of use increase as the class number increases. Class I land has few hazards or limitations, whereas, class VIII land is so limited that it is unfit for safe or economical cropland, forest, or range use and should be used only for recreation, wildlife habitat, and watershed.

Generally speaking, 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

Table 4.--Estimated acreage of land by capability class and subclass, Hood Drainage Basin, Oregon, 1964

Capability class	Wasco Resource Area				Hood Resource Area					
	A	B	C	D	E	F	G	H	I	
	Fifteenmile Creek	Eightmile Creek	The Dalles	Mosier Creek	East Fork Hood River	Oak Grove	Columbia Gorge	Middle Fork Hood River	West Fork Hood River	Total
	Acres	Acres	Acres	Acres	Acres	Acres	Acres	Acres	Acres	Acres
I	...	...	...	...	500	200	...	300	...	1,000
IIe	6,700	2,800	800	600	3,600	1,900	500	3,700	800	21,400
IIs	...	...	...	...	...	800	...	...	...	800
IIc	9,400	100	...	...	...	...	...	...	...	9,500
Total II	16,100	2,900	800	600	3,600	2,700	500	3,700	800	31,700
IIIe	50,800	20,600	6,200	2,000	9,700	4,800	700	3,400	2,800	101,000
IIIw	...	...	...	...	2,900	1,000	...	2,500	300	6,700
IIIs	...	...	200	...	...	...	...	1,000	...	1,200
Total III	50,800	20,600	6,400	2,000	12,600	5,800	700	6,900	3,100	108,900
IVe	35,900	15,400	13,300	2,300	19,900	5,900	10,900	10,500	8,300	122,400
IVw	...	...	...	...	600	200	...	...	...	800
IVs	...	...	...	...	3,400	2,500	...	...	5,000	10,900
Total IV	35,900	15,400	13,300	2,300	23,900	8,600	10,900	10,500	13,300	134,100
Total I-IV	102,800	38,900	20,500	4,900	40,600	17,300	12,100	21,400	17,200	275,700
VIe	13,000	12,800	20,500	16,300	32,900	12,600	18,200	6,200	15,800	148,300
VIs	...	...	...	1,000	...	...	...	3,000	...	4,000
Total VI	13,000	12,800	20,500	17,300	32,900	12,600	18,200	9,200	15,800	152,300
VIIe	1,500	5,900	11,300	10,200	12,000	4,800	18,100	5,000	8,300	77,100
VIIs	44,800	16,900	33,400	10,900	6,000	2,500	6,300	1,000	4,000	125,800
Total VII	46,300	22,800	44,700	21,100	18,000	7,300	24,400	6,000	12,300	202,900
Total VI-VII	59,300	35,600	65,200	38,400	50,900	19,900	42,600	15,200	28,100	355,200
VIII	1,200	1,200	2,000	900	6,000	1,700	3,700	3,900	3,000	23,600
Total in basin	163,300	75,700	87,700	44,200	97,500	38,900	58,400	40,500	48,300	654,500

Source: Compiled by USDA, Soil Conservation Service.

FIGURE 5

GENERALIZED LAND CAPABILITY CLASSES
HOOD DRAINAGE BASIN
OREGON

FEBRUARY 1964

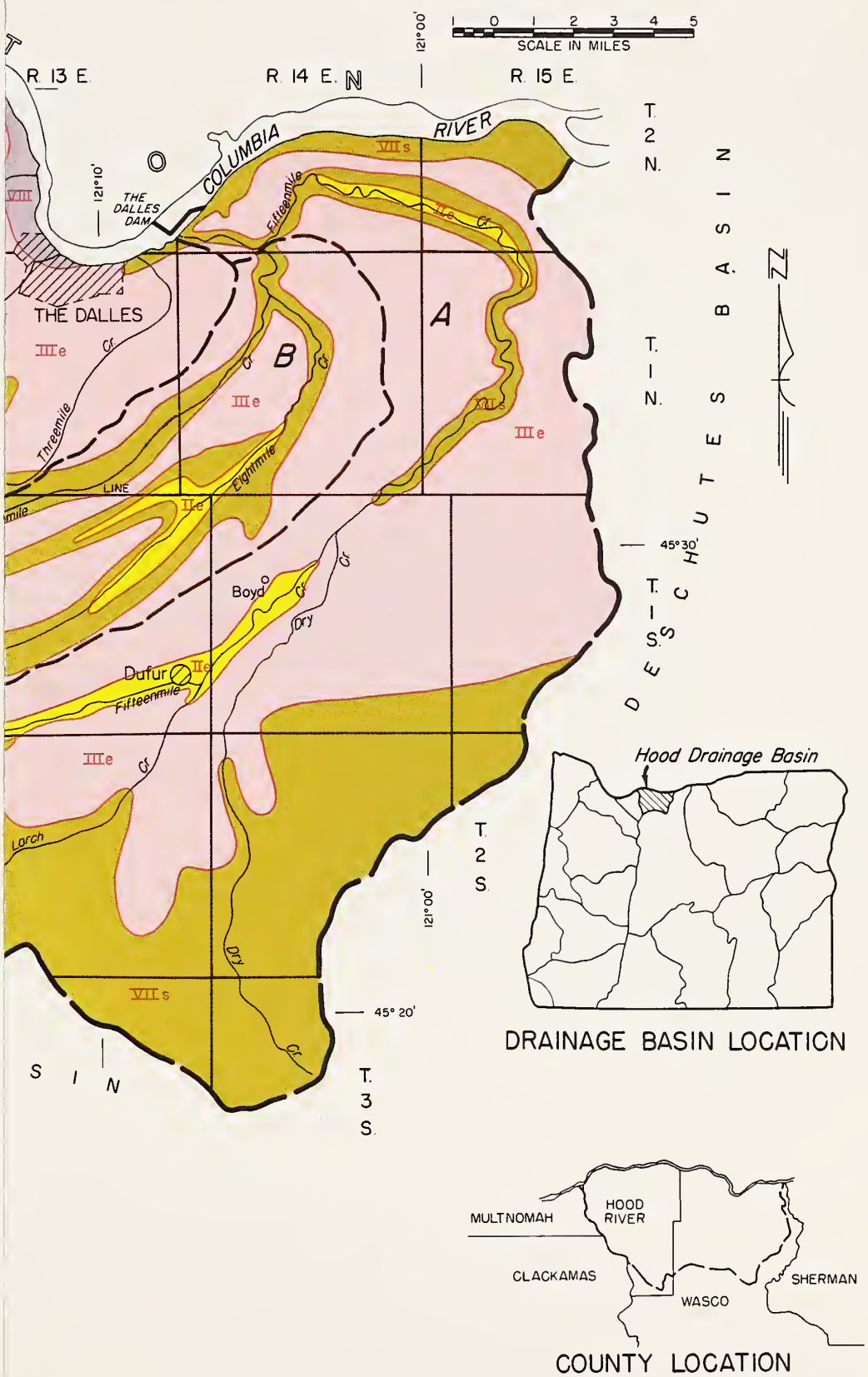


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FIGURE 5

GENERALIZED LAND CAPABILITY CLASSES
HOOD DRAINAGE BASIN
OREGON

FEBRUARY 1964

SCALE IN MILES 0 1 2 3 4 5

LEGEND

LAND SUITED FOR CULTIVATION AND OTHER USES

CLASS II — Soils in Class II have few limitations or hazards. Simple conservation practices are needed when cultivated. They are suited to cultivated crops, pasture, range, woodland, or wildlife.

CLASS III — Soils in Class III have more limitations and hazards than those in Class II. They require more difficult or complex conservation practices when cultivated. They are suited to cultivated crops, pasture, range, woodland, or wildlife.

CLASS IV — Soils in Class IV have greater limitations and hazards than Class III. Still more difficult or complex measures are needed when cultivated. They are suited to cultivate crops, pasture, range, woodland, or wildlife.

LAND LIMITED IN USE—GENERALLY NOT SUITED FOR CULTIVATION

CLASS VI — Soils in Class VI have severe limitations or hazards that make them generally unsuited for cultivation. They are suited largely to pasture, range, woodland, or wildlife.

CLASS VII — Soils in Class VII have very severe limitations or hazards that make them generally unsuited for cultivation. They are suited to grazing, woodland, or wildlife.

CLASS VIII — Soils and land forms in Class VIII have limitations and hazards that prevent their use for cultivated crops, pasture, range, or woodland. They may be used for recreation, wildlife, or water supply.

SUBCLASSES

e Erosion
w Wetness
s Soil

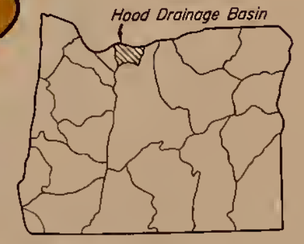
WATERSHEDS

A FIFTEENMILE CREEK
B EIGHTMILE CREEK
C THE DALLES
D MOSIER CREEK
E EAST FORK HOOD RIVER
F OAK GROVE
G COLUMBIA GORGE
H MIDDLE FORK HOOD RIVER
I WEST FORK HOOD RIVER

LEGEND

Drainage Basin Boundary
Watershed Boundary
National Forest Boundary

DRAINAGE BASIN LOCATION



COUNTY LOCATION

7-E-17559-N

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M-4039

for range, forestry, and wildlife because of its own 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 Conservation Needs Inventories and soil surveys within the Hood Drainage Basin and are summarized in table 4.

LANDOWNERSHIP

Landownership has been classified as federal, state, county and municipal, and private (table 5). The general pattern of landownership is shown in figure 6. Because of the differences between the two areas, landownership will be discussed separately for the Hood and Wasco Resource Areas.

Table 5.--Land use and ownership, Hood Drainage Basin, Oregon, 1964

Class of ownership	Forest	Range	Cropland	Other	Total
	Acres	Acres	Acres	Acres	Acres
Hood Resource Area:					
Federal	158,400	200	...	14,300	172,900
State	2,600	...	...	...	2,600
County and municipal	28,500	...	...	800	29,300
Private	36,800	8,200	21,100	12,700	78,800
Subtotal	226,300	8,400	21,100	27,800	283,600
Wasco Resource Area:					
Federal	47,300	...	...	400	47,700
State	400	100	...	100	600
County and municipal	2,900	1,000	...	...	3,900
Private	92,100	78,500	140,900	7,200	318,700
Subtotal	142,700	79,600	140,900	7,700	370,900
Hood Drainage Basin:					
Federal	205,700	200	...	14,700	220,600
State	3,000	100	...	100	3,200
County and municipal	31,400	1,000	...	800	33,200
Private	128,900	86,700	162,000	19,900	397,500
Total	369,000	88,000	162,000	35,500	654,500

Source: Forest Service, Soil Conservation Service, County Assessors, and estimates by USDA River Basin Survey Party.

Hood Resource Area

Sixty-one percent of the Hood Resource Area is owned by the Federal Government and administered almost exclusively by the Forest Service. Small scattered parcels are administered by the Bureau of Land Management and the Corps of Engineers, U. S. Army.

Ten percent is owned by Hood River County and managed as a county forest. This land is in relatively large tracts generally near the center of the county.

One percent is state owned. Most of this is in state parks and state forest land. No acreages are shown for state highway rights-of-way.

Twenty-eight percent is privately owned. With the exception of forest ownerships which are scattered generally throughout the county, the private land is in the northeast portion of the area.

Wasco Resource Area

In contrast to the Hood Resource Area, only 14 percent of the Wasco Resource Area is publicly owned. This land is found mainly in the southwest portion and is largely within the Mount Hood National Forest. The Dalles, Bureau of Land Management, and the state are the other public owners.

LAND USE

Land use differs significantly between the Hood and Wasco Resource Areas as shown on figure 7. Forest is the main land use in the Hood Resource Area while agriculture and range is the main use in the Wasco Resource Area.

Hood Resource Area

Orchards, pastures, and forests are mixed in much of the Hood Resource Area (photo 2).

Forest accounts for 47 percent of the land; of this 70 percent is in the Mount Hood National Forest. Hood River County owns 13 percent; the state owns 1 percent; and private owners control the remaining 16 percent of the forest land in the area.

Farming, a very important segment of the county's economy, utilizes 27 percent of the land.

Other uses including range, urban development, roads, lakes and rivers, and rocky barren areas account for 26 percent of the area.

Wasco Resource Area

Agriculture is the primary land use, accounting for 44 percent of the land in the Wasco Resource Area.

FIGURE 6

LAND STATUS

HOOD DRAINAGE BASIN

OREGON

FEBRUARY 1964

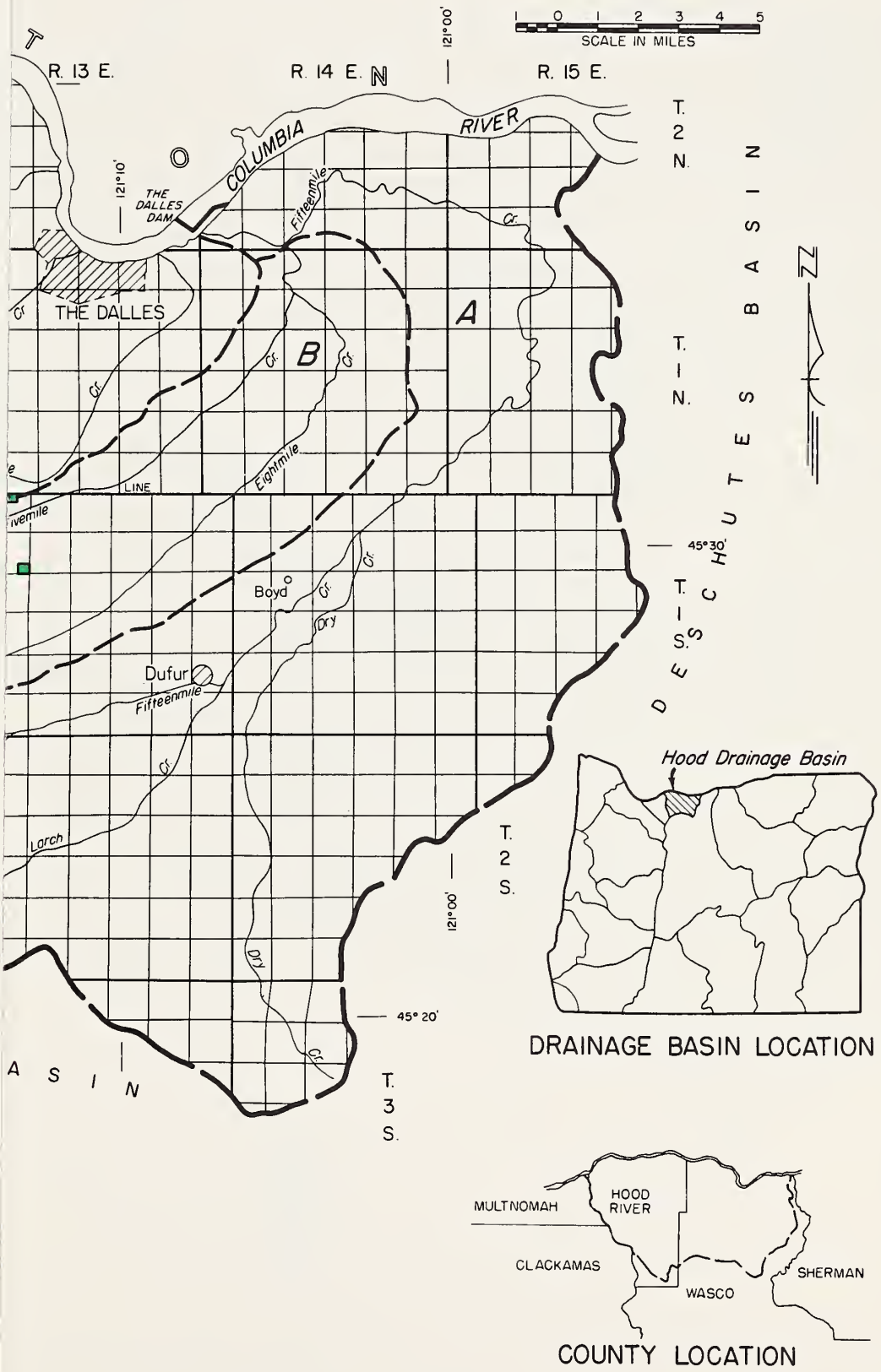

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FIGURE 6

LAND STATUS

HOOD DRAINAGE BASIN

OREGON

FEBRUARY 1964

SCALE IN MILES 0 1 2 3 4 5

WATERSHEDS

- A FIFTEENMILE CREEK
- B EIGHTMILE CREEK
- C THE DALLES
- D MOSIER CREEK
- E EAST FORK HOOD RIVER
- F OAK GROVE
- G COLUMBIA GORGE
- H MIDDLE FORK HOOD RIVER
- I WEST FORK HOOD RIVER

LEGEND

- U S Forest Service
- Bureau of Land Management
- County and Municipal
- State of Oregon
- Private
- Drainage Basin Boundary
- Sub-Watershed Boundary
- National Forest Boundary

DRAINAGE BASIN LOCATION

COUNTY LOCATION

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FIGURE 7

GENERALIZED LAND USE
HOOD DRAINAGE BASIN
OREGON

FEBRUARY 1964

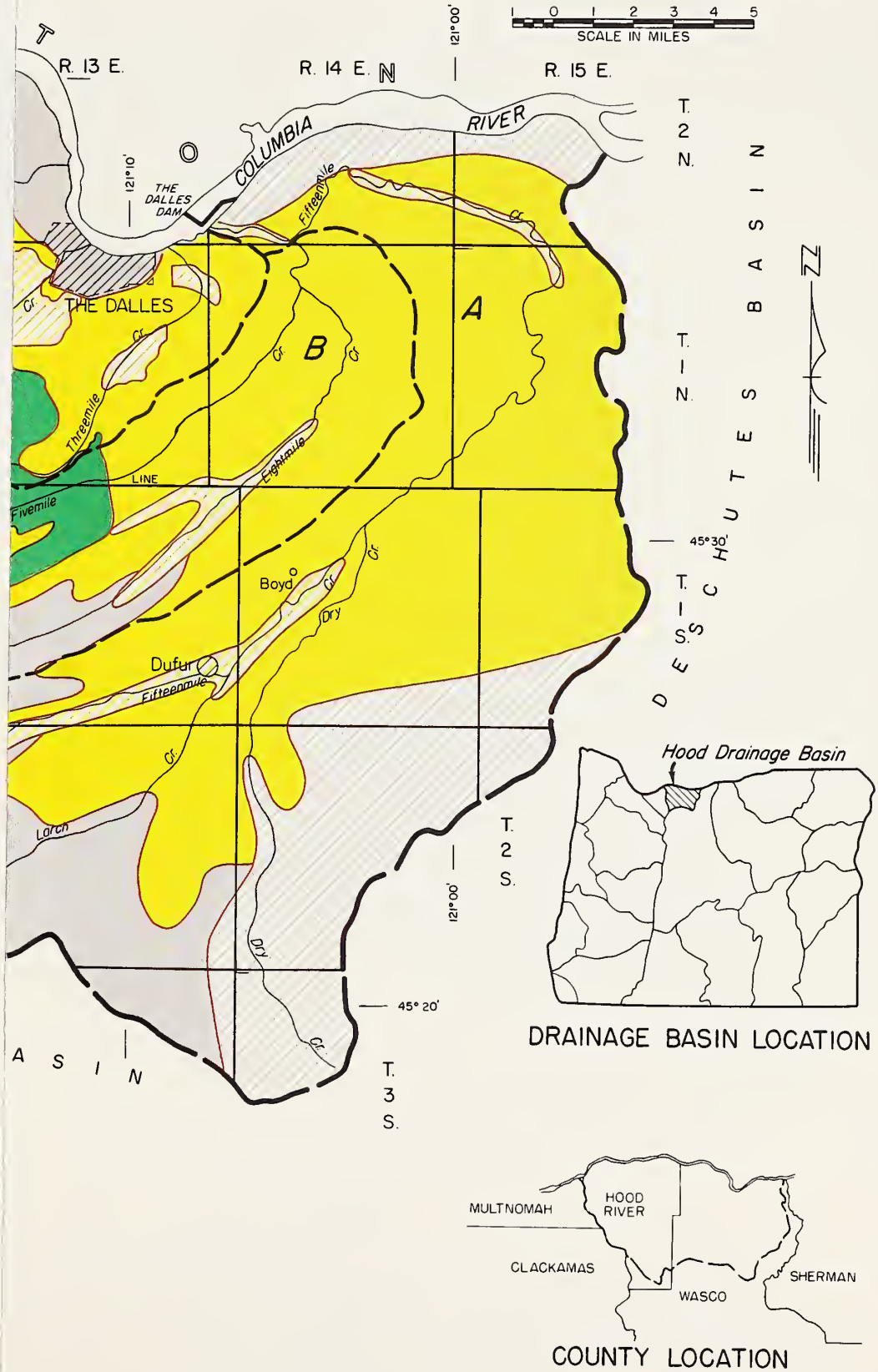

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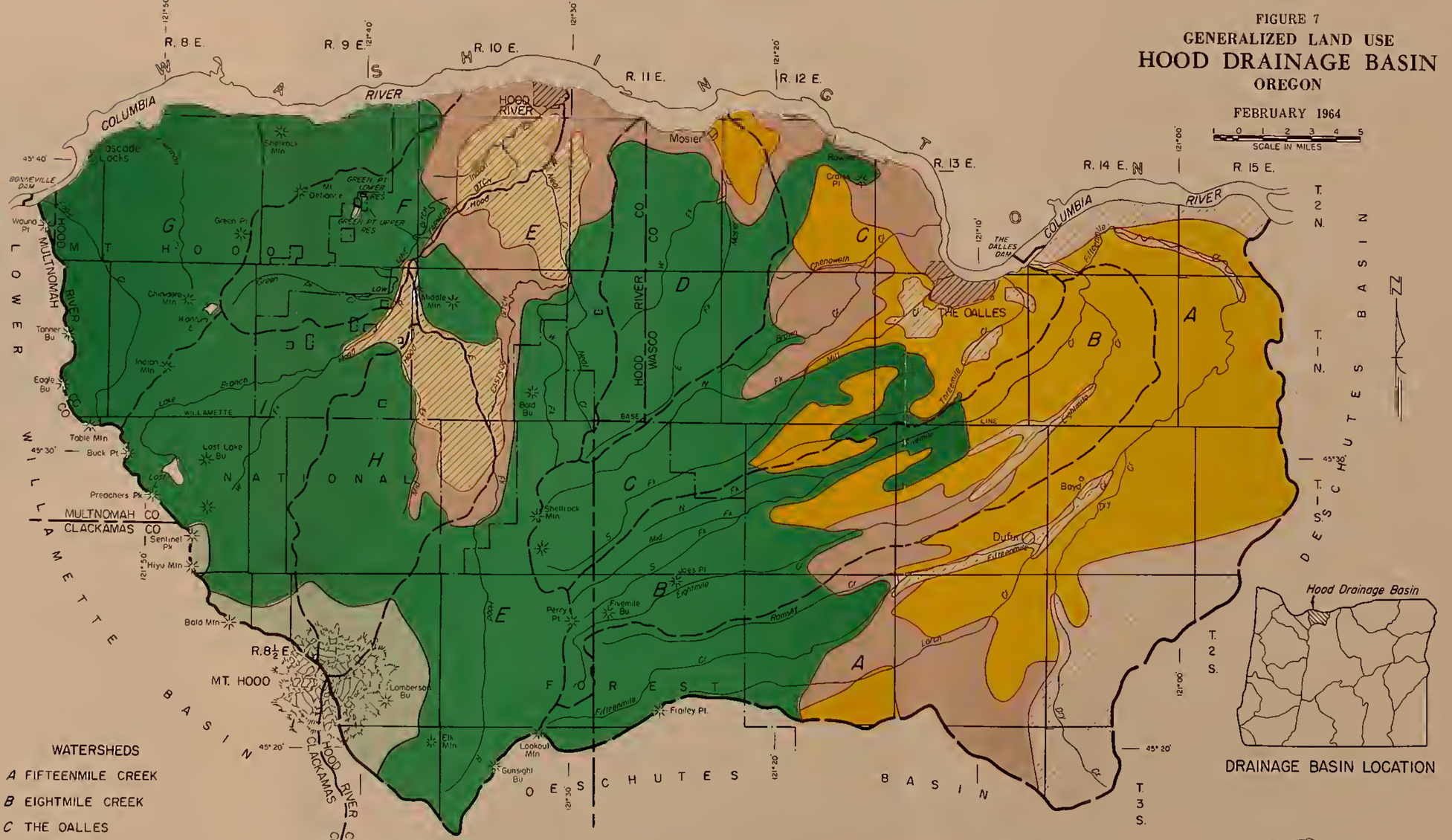
FIGURE 7

GENERALIZED LAND USE

HOOD DRAINAGE BASIN

OREGON

FEBRUARY 1964



SCALE IN MILES 0 1 2 3 4 5

WATERSHEDS

- A FIFTEENMILE CREEK
- B EIGHTMILE CREEK
- C THE DALLES
- D MOSIER CREEK
- E EAST FORK HOOD RIVER
- F OAK GROVE
- G COLUMBIA GORGE
- H MIDDLE FORK HOOD RIVER
- I WEST FORK HOOD RIVER

LEGEND

- Land Use Boundary
- Drainage Basin Boundary
- Watershed Boundary
- National Forest Boundary
- Forest
- Irrigated Cultivated
- Dry Cultivated
- Range
- Mixed Land Use
- Upper Slope Forest and Alpine Zone

DRAINAGE BASIN LOCATION

COUNTY LOCATION

U.S. DEPARTMENT OF AGRICULTURE, SOIL CONSERVATION SERVICE — M-4039

7-E-17559-N

Photo 2.--Land use in the Hood Resource Area is often intermingled. FS photo. NO. 468481

Range accounts for 25 percent of the land and is a secondary use on a large segment of the forest land.

Forests are found on 24 percent of the land in the area. Sixty-five percent of the forest land is privately owned; of this 61 percent is commercial forest. Thirty-two percent of the forest land is within the Mount Hood National Forest and is approximately 98 percent commercial forest. The remaining 3 percent of the forest land is managed by Bureau of Land Management, State of Oregon, and The Dalles.

Other uses including urban development, roads, lakes and streams, and rocky barren areas comprise the remaining two percent of the Wasco Resource Area.

On the basis of ecology and climate the forest stands of the Hood Drainage Basin can be divided into two broad areas--Hood and Wasco Resource Areas. Most of the Hood Resource Area is located in Hood River County where precipitation exceeds 30 inches annually; the Wasco Resource Area is located in Wasco County with precipitation ranging downward from 30 inches to the lower limits of tree growth.

HOOD RESOURCE AREA

The forests of the Hood Resource Area can be divided into the following resource associations: principal forest, upper forest, and alpine.

Photo 3.--Old-growth western hemlock and Douglas-fir in the principal forest zone of Hood Resource Area. FS photo. NO. 437118

Principal Forest Association

The principal forest association extends from the valley floor to ap-

proximately 3,500 feet. The climate is characterized by 40 to 120 inches of precipitation occurring mostly as winter rain with little snowpack development. Approximately 90 percent of the land is forested. Stands of Douglas-fir predominate with lesser amounts of western hemlock, true firs, and western red cedar. Stands of maple and red alder occur in the stream bottoms and where the original coniferous stand has been removed. In the Columbia Gorge significant areas of barren rock cliffs occur. Most of the forest land in this zone is publicly owned.

Upper Forest Association

The upper forest association begins at approximately 3,500 feet and extends to approximately 5,500 feet. The climate of this zone is characterized by precipitation ranging from 90 to 130 inches, heavy winter snowfall with a significant snowpack, and cool summer temperatures. Approximately 75 percent is forest; the remainder consists of rock outcrops, shallow stony soils, meadows, and a few lakes. True fir-mountain hemlock stands predominate. Most of the land is in the Mount Hood National Forest.

Photo 4.--Whitebark pine and subalpine fir growing at the timberline on Mount Hood. FS Mount Hood photo. NO. 1

Alpine Association

The alpine association extends from approximately 5,500 feet to the upper limits of tree growth. The climate is characterized by heavy winter snowfall and an average frost-free growing season of approximately 30 days. The principal tree species--subalpine fir, mountain hemlock, whitebark pine,

and Alaska yellow cedar--grow in scattered stands intermingled with meadows and barren areas. This zone is all national forest land.

WASCO RESOURCE AREA

The Wasco Resource Area can also be divided into three zones: grass-shrub, principal forest, and upper slope forest zones.

Grass-Shrub Zone

The grass-shrub zone is found in the 12 to 25 inch precipitation zone. The forests in this zone are characterized by fairly dense stands of scrub oak on the benches and south slopes. The north slopes in the higher precipitation area are likely to have stands of Douglas-fir. In areas with more than 16 inches of precipitation, scattered ponderosa pine is found with the more open grown oaks. This area is mainly privately owned and used for grazing.

Principal Forest Zone

The principal forest zone is found generally between 2,000 and 4,500 feet elevation where the precipitation ranges from 20 to 35 inches. Ponderosa pine, the most valuable species, is found growing on south slopes and benches. Douglas-fir and associated species--white fir, lodgepole pine, Englemann spruce, true firs, and hemlock--are found on north slopes and at the higher elevations. In the lower areas where forage is abundant, grazing is an important secondary use. Approximately one-third of the area is privately owned.

Upper Slope Forest Zone

The upper slope forest zone is found along the ridge separating the Fifteenmile drainage from the Hood River drainage. The climate in this area is characterized by 30 to 35 inches of precipitation, moderate winter snowpack, and generally cool temperatures. True fir, mountain hemlock, lodgepole pine, and western larch are the primary species. This area is entirely within the Mount Hood National Forest.

FOREST LAND USE

The major uses of forest land in the Hood Drainage Basin are production of commercial timber, watershed management, and outdoor recreation. Other uses including wildlife habitat and production of forage for livestock are also important. Most forest land is used for several purposes. Some of the private forest land, especially that in large ownerships, is managed primarily for timber production. Most of the public forest land is managed to accommodate a balance of several uses, but some is used primarily for outdoor recreation with uses such as livestock grazing and timber harvesting modified or excluded.

There is considerable variation in the management of forest land. On many private holdings the only interest is that related to harvesting timber

while on other private holdings considerable attention is given to measures that will enhance continuous timber production. On public lands used intensively for outdoor recreation such as state parks, management efforts are aimed at providing adequate facilities and a safe and aesthetically pleasing environment.

The national forest land is managed under the "multiple use-sustained yield" concept. As defined by the Multiple Use-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 while at the same time producing high-level sustained yields of forage, recreation, timber, water, and wildlife in the combination that will best meet the needs of the nation. Under sustained yield management, the old-growth timber harvest is parceled out while younger stands are growing so as to provide a fairly uniform annual cut.

The Hood River County forest lands are managed on a sustained yield basis as a result of a 100 year agreement between the county and the Forest Service. "The primary consideration underlying this agreement is one of mutual interest in securing the public benefits that will be derived from long-term sustained-yield management of the timber on the forest lands of the County." 1/

Recently there has been rapid expansion in the multipurpose use of forest land, particularly timber management and recreation. The major resources of forest land in the basin--timber, recreation, range, wildlife, and water--are discussed in detail later in this report.

Land Class and Cover Type Classification

Land class and cover type classification for the Hood Drainage Basin is shown in table 6. This classification is based primarily on the Forest Service system of four classes: commercial forest, noncommercial forest, reserved forest, and nonforest.

Commercial forest land is (a) producing, or physically capable of producing, useable crops of wood, (b) economically available now or prospectively for timber harvest, and (c) not withdrawn from harvest. Publicly owned commercial forest land where timber harvesting is modified to protect or improve watershed or recreational values is termed "modified commercial" forest land. Commercial forest land is further subdivided by cover types.

Noncommercial forest land will not produce trees of commercial quality because of poor growing conditions or inaccessibility within the foreseeable future.

Reserved forest land is withdrawn from timber harvest through statute, ordinance, or administrative order. This land can be either commercial or noncommercial quality.

1/ Cooperative Agreement, Hood River County, Oregon, and USDA, Forest Service, March 2, 1955, as amended.

Table 6.--Forest acres and volumes, Hood Drainage Basin, Oregon, 1963

	Hood Resource Area		Wasco Resource Area		Hood Drainage Basin	
	Acres	MMBF	Acres	MMBF	Acres	MMBF
Commercial forest:						
Sawtimber:						
Forest Service	76,000	2,602.8	37,500	996.3	113,500	3,599.1
County and municipal	16,500	279.5	1,500	1/	18,000	279.5 1/
Other public	500	20.0	...	...	500	20.0
Private	10,600	332.8	9,500	190.0	20,100	522.8
Subtotal	103,600	3,235.1	48,500	1,186.3	152,100	4,421.4
Poletimber:						
Forest Service	42,000	228.4	5,300	48.1	47,300	276.5
County and municipal	4,500	9.7	700	1/	5,200	9.7 1/
Other public	300	2.2	1,000	1/	1,300	2.2 1/
Private	6,000	74.4	32,000	35.0	38,000	109.4
Subtotal	52,800	314.7	39,000	83.1	91,800	397.8
Reproduction:						
Forest Service	17,100	27.4	1,600	2.5	18,700	29.9
County and municipal	3,750	...	300	1/	4,050	... 1/
Other public	200	...	200	1/	400	... 1/
Private	16,700	36.2	13,700	...	30,400	36.2
Subtotal	37,750	63.6	15,800	2.5	53,550	66.1
Hardwoods (all sizes):						
Forest Service	1,600	2.5	...	1/	1,600	2.5
County and municipal	...	...	100	1/	100	... 1/
Other public	100	...	...	...	100	... 1/
Private	2,000	19.8	200	...	2,200	19.8
Subtotal	3,700	22.3	300	...	4,000	22.3
Cutover-nonstocked:						
Forest Service	...	...	...	...	...	...
County and municipal	1,500	0.3	...	...	1,500	0.3
Other public	100	...	...	...	100	...
Private	1,000	...	700	...	1,700	...
Subtotal	2,600	0.3	700	...	3,300	0.3
Noncommercial and reserved:						
Forest Service	21,500	...	900	...	22,400	...
County and municipal	2,250	...	300	...	2,550	...
Other public	1,600	...	1,200	...	2,800	...
Private	500	...	36,000	...	36,500	...
Subtotal	25,850	...	38,400	...	64,250	...
Total by ownership class:						
Forest Service	158,200	2,861.1	45,300	1,046.9	203,500	3,908.0
County and municipal	28,500	289.5	2,900	1/	31,400	289.5 1/
Other public	2,800	22.2	2,400	1/	5,200	22.2 1/
Private	36,800	463.2	92,100	225.0	128,900	688.2
Total	226,300	3,636.0	142,700	1,271.9	369,000	4,907.9

1/ Not available for Wasco Resource Area.

Source: Forest Service, Oregon State Tax Commission. Adjusted to basin by USDA Survey Party.

Nonforest land is that which is less than 10 percent stocked with trees (except for nonstocked cutover forest land) and includes range, roads, lakes, cultivated land, and cities and towns.

PROTECTION OF FOREST RESOURCES

Protection from Fire

Fire protection for forest resources in the Hood Drainage Basin is shared by the Forest Service, the State of Oregon, and several rural fire protection districts. Generally, the Forest Service protects land within the national forests; the state protects the principal forest zone land outside the national forest; and the rural districts protect land in the lower Hood River Valley.

The major causes of fire in the basin are smokers, lightning, debris burning, campers, and logging operations. Approximately 75 percent of the forest fires in the basin have been man caused during the last five-year period. These occur most commonly in the recreation areas and along highways. The lightning fires occur mainly along the crest of the Cascades and along the ridge separating Hood River and Wasco Counties. Wild fires resulting from slash burning operations are most likely during the fall slash burning period.

Protection forces are adequate to control average fires. However, they are not adequate to control fires under extreme conditions. Fire protection agencies need to increase their capability to mobilize trained crews for rapid fire suppression under emergency fire conditions.

Protection from Insect, Disease, and Animal Damage

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

Important forest insect pests are the spruce budworm, Douglas-fir beetle, western pine beetle, pine needle scale, and Ips, all of which have a record of reaching epidemic numbers. Insect populations are presently endemic now, killing an occasional weakened tree. However, total losses from insects are quite large. Control of forest insects is best achieved by keeping forest stands in a vigorous condition, promptly disposing of logging slash and windthrown or fire killed timber that provides a breeding place, and promptly eradicating epidemic outbreaks.

There are several important diseases of forest trees in the basin. Dwarf mistletoe is a parasite which slows growth and deforms trees. White

pine blister rust is locally making the growth of this species questionable. Several fungus rots are causing decay in forest trees.

TIMBER

The Resource

There are an estimated 304,750 acres of commercial forest in the basin with an estimated volume of 4.89 billion board feet 1/ of softwood timber (table 6).

Approximately 66 percent of the commercial forest land in the basin is in the Hood Resource Area. Douglas-fir, the principal species in this area, is generally sound with an average defect of 10 to 15 percent on the Mount Hood National Forest. This species has the highest net growth percent on the Mount Hood National Forest westside working circle.

Ponderosa pine, the most valuable species, comprises approximately 30 percent of timber volume on the Mount Hood National Forest in the Wasco Resource Area. Associated species--true firs, hemlock, and lodgepole pine--are very defective, especially in sizes over 25 inches in diameter. "In some of the stands the defect runs as high as 80 percent. These stands should be converted to young stands as rapidly as possible." 2/

Logging and Wood-Using Industries

Logging started with the arrival of the first settlers, and Peter Neal built the first sawmill in 1861 on Neal Creek. By 1948, there were 27 sawmills in Wasco and Hood River Counties producing 103 million board feet of lumber. Current lumber production figures for the basin are not available, but the available combined lumber production and timber harvest statistics for the two counties are shown in chart 3. Chart 4 presents the same information for Hood River County for comparison. It is assumed that the general relationships between lumber production and timber harvest are continuing and that lumber production in the two counties is closely related to the timber harvest.

Recently the "...industry has been going through a period of adjustment which has seen the smaller mills close. Virtually all of the milling (in Hood River County) is now being done by four mills.... The Cascade Locks Company gets nearly all of its logs from Gifford Pinchot forest in Washington state while the others rely predominantly on cuts in Hood River County." 3/

1/ Timber volumes in this report are in terms of log scale, Scribner rule in trees 11 inches in diameter and larger.

2/ Timber Management Plan, Mount Hood National Forest, Eastside Working Circle, January 14, 1963.

3/ Growth...Hood River County 1963, Bureau of Municipal Research and Service, University of Oregon, p. 13.

Timber harvest 1933-1961 and lumber production 1933-1948, Hood River and Wasco[1/] Counties, Oregon.

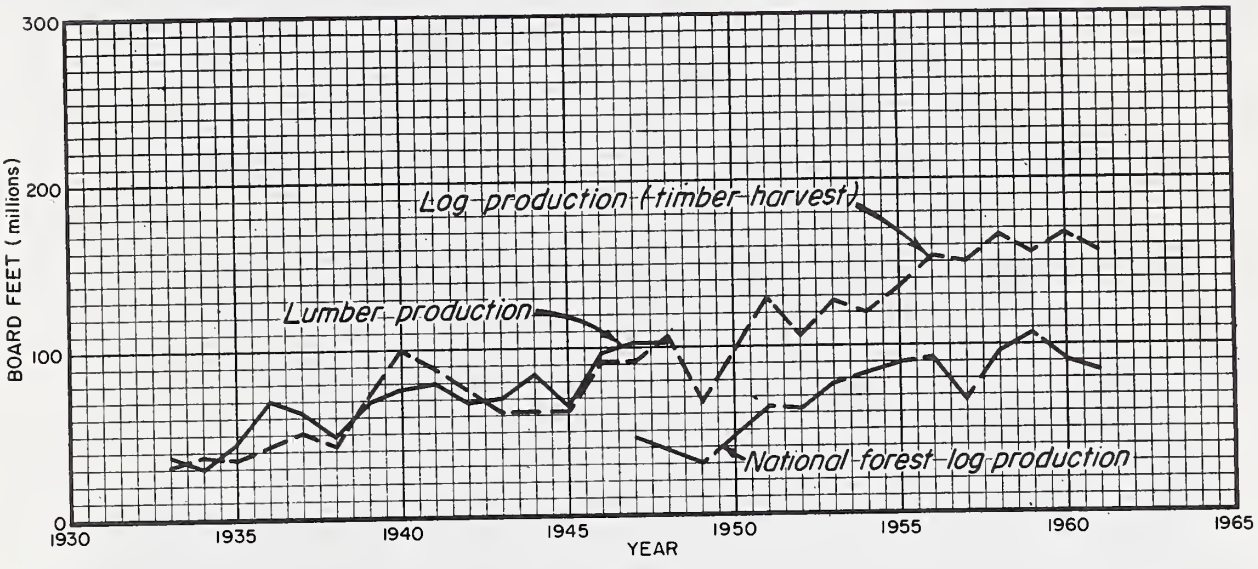
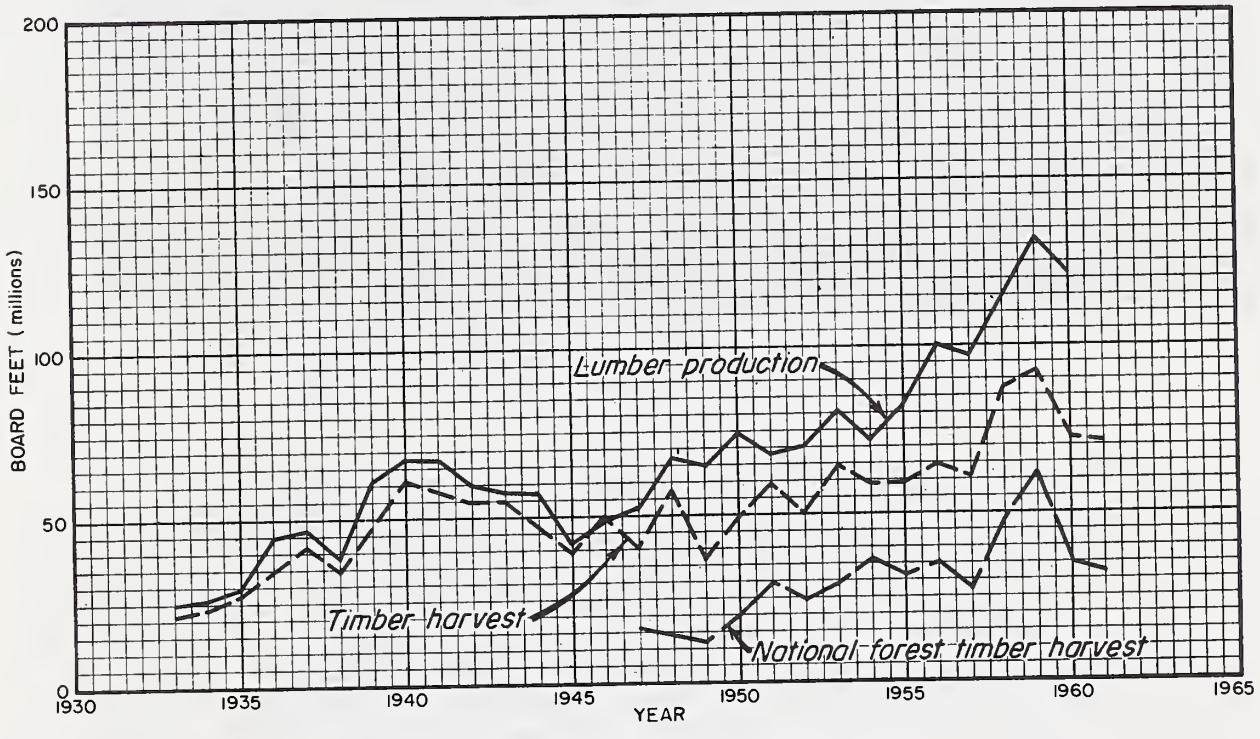


Chart 3

Timber harvest and lumber production, Hood River County, Hood Drainage Basin, Oregon, 1933-1961.



1/ Wasco County timber harvest volume has been combined with Jefferson County 1932-34, 1938-42, and 1951. Harvest from Indian lands not included after 1947.

Source: U. S. Forest Service and West Coast Lumbermens' Association.

Chart 4

There are six sawmills in the basin which have an annual production capacity of approximately 170 million board feet. In addition, there is a hardboard plant that is operating on sawmill residues.

Harvesting and Regeneration Methods

Timber harvesting and regeneration methods vary greatly between the two resource areas in the basin.

Hood Resource Area. Clearcutting in areas of 30 acres or more is the most widespread harvesting practice in the old-growth stands. This method is well suited to the harvesting of old-growth Douglas-fir stands on steep topography. Most logging in this area is done by cable methods which are suited to steep terrain and usually cause less soil disturbance than tractors. Logs are hauled to the mills by trucks.

Photo 5.--Scattered clearcuts are the typical harvesting practice in the Hood Resource Area. FS Mount Hood photo. NO. 2

The slash and cull logs left from logging operations are usually disposed of by broadcast burning or spot burning of heavy accumulations in early fall during periods of low fire danger. Broadcast slash burning, if properly employed, reduces the fire hazard and may encourage natural regeneration if the fires are of moderate intensity. Slash disposal practiced by the public agencies under terms of timber sale contracts is normally done in accordance with a previously determined slash disposal plan. Opinions vary among foresters and landowners as to the desirability of broadcast slash burning as related to fire protection, regeneration, soils, and watershed management. Unburned old-growth slash is a serious fire hazard for which the landowner is responsible under state law. Therefore, slash burning may continue to be a widespread practice so long as old-growth timber is being harvested or until more complete utilization reduces the slash remaining after logging.

Wasco Resource Area. The ponderosa pine stands are generally selectively cut, with emphasis on removing the mature and high risk trees. The stands of associated species are generally clearcut in a manner similar to the Hood Resource Area. Tractor logging is generally employed in the pine selection areas except cable systems should be used on slopes steeper than 30 percent. All of the logs are hauled on trucks.

Slash disposal differs from the Hood Area in that broadcast burning is very limited. Heavy concentrations of slash on the clearcut areas are generally scattered with tractors. Along roads and in some selective areas slash is piled and covered to be burned in the late fall and winter.

Photo 6.--Planting and natural seeding combine to restock cutover lands. FS Mount Hood photo. NO. 3

Regeneration Methods

Much of the forest land in the basin has site conditions favorable to rapid regeneration of cutover areas, and natural regeneration is often adequate if cutting areas are small and near a seed source. Planting of nursery grown seedlings and direct seeding are methods used to supplement natural regeneration.

The Forest Service is changing its silvicultural practices in several areas where regeneration has been difficult. Much of the land east of Parkdale is now being cut by a shelterwood method rather than clearcut in an attempt to overcome this problem.

Because of regeneration problems in the Wasco Resource Area, pine is being used to replace some stands of Douglas-fir and associated species.

Young stands need intensive cultural treatment to improve quality and quantity of wood growth. An effective measure is thinning young stands to remove dead, dying, damaged, and over crowded trees, giving desirable trees more growing space. Public and private owners have been doing limited amounts of thinning in young stands on gentle terrain. However, little thinning has been done in stands on land too steep for logging with horses or small tractors. Improved markets for small logs and development of equipment and techniques for thinning on steep slopes would help to improve the economic possibility for thinnings.

Sustained Yield Potential

Old-growth timber is still the dominant raw material for wood-using industries of the Hood Drainage Basin, but young-growth is increasing in importance. The remaining old-growth timber will probably be completely harvested within 40 years. Therefore, the potential sustained yield growth of the basin's forests is of great importance in determining how much raw material will be available annually.

The long term sustained yield of the basin's forests will depend upon several factors including the following:

1. The site quality of forest land.
2. Promptness and adequacy of regeneration on cutover land.
3. Adequacy of protection from fire, insects, diseases, and animal damage.
4. Cultural treatment applied to young stands.
5. Maintenance of optimum stocking and growth throughout the life of the stand.
6. Age at which final harvest is made.
7. Availability of markets for wood which is not presently marketable.
8. The amount of forest land converted to and from other uses.
9. Taxation policies.

In addition to these points, the following assumptions were made in calculating the potential allowable cut for the basin.

1. Regeneration period of five years.
2. No allowance for intensive management.
3. Stands presently growing hardwoods will not be converted.
4. Presently nonstocked areas are not included.
5. Hood Resource Area:
   a. Pole stands are 50 years old.
   b. Seedling stands are 20 years old.
   c. Stands will have 10 percent of gross volume defective or broken.
6. Stands in the Wasco Resource Area:
   a. Are similar in composition and stocking to average of Eastside Working Circle, Mount Hood National Forest.
   b. Have same growth rate as average of all species, all sizes of Eastside Working Circle, Mount Hood National Forest.
   c. Have a 5 percent deduction for defect and breakage.

The estimated potential allowable cut for the Hood Drainage Basin is 75.1 million board feet per year, Scribner rule. The Hood Resource Area accounts for 58.2 million board feet while the Wasco Resource Area accounts for 16.9 million board feet.

RECREATION

Pattern of Use

Outdoor recreation is an important segment in the lives of Oregon residents. Hunting and fishing are a part of the pioneer heritage. Recently increased urbanization has caused more people to seek the out-of-doors to "get away from it all" through sightseeing, picnicking, winter sports, and related activities. Better and faster transportation, higher family incomes, and increased leisure time have enabled people to spend more time and money on recreation and to travel farther for recreation. All of these factors have brought about an increase in the recreation use of forest land.

The two areas in the basin with the greatest increase in use are the high mountain area and the Columbia Gorge, which are two of three principal recreation areas in Oregon.

The high mountain country is an attraction enjoyed by sightseers, hikers, and winter sports enthusiasts. There has been an increase in the hikers on the Skyline and Timberline Trails and winter sports enthusiasts in the Hood Resource Area. Car counts on the Bennett Pass-Lookout Mountain road indicate that there has been a large increase in the number of sightseers during the last few years.

The Columbia Gorge with its cliffs and spectacular waterfalls is probably the most visited spot in the basin. In addition to the visitors who make the trip specifically to view the scenery or otherwise enjoy the recreation facilities, thousands of travelers on Interstate 80 N pass through this area.

Water areas throughout the basin have been receiving increasingly heavy use. Lost Lake, Sherwood, and Robinhood Campgrounds account for 95 percent of the recreation visits to the Hood River Ranger District. In 1961, Lost Lake Campground received 620 visitors per unit. Sherwood and Robinhood Campgrounds, located on the East Fork Hood River, were used by fishermen and picnickers.

Other lakes, reservoirs, and streams are popular spots for fishermen and boaters. The Corps of Engineers, U. S. Army report that an average of 645 pleasure boats per year pass through the Bonneville Locks, and 180 per year pass through The Dalles Locks. They predict that when the two remaining authorized dams are constructed on the Snake River larger pleasure boats from all parts of the world will cruise on the 500 miles of the scenic Columbia and Snake Rivers.

Photo 7.--Picnics in the mountains are enjoyable on warm summer days. FS Mount Hood photo. NO. 4

The major boating facilities presently available in the Mid-Columbia region are located in the basin. These are the boat basins and marinas at Hood River and The Dalles.

Table 7.--Recreational visits to state parks and national forests, Hood Drainage Basin, Oregon, 1958-1962

Resource area	1958	1959	1960	1961	1962
	Thousands of visits				
Hood:					
National forests	559.7	545.1	571.3	659.0	1,079.5
State parks	269.4	219.6	226.6	150.3	...
Wasco:					
National forests	18.4	14.8	16.4	18.4	18.0
State parks (1958-61)	7.3	9.2	38.9	46.2	...

Source: Forest Service and Oregon State Highway Department.

Recreation Zoning

Because of the importance of recreation, it is necessary to manage the natural attractiveness of forest land for recreation use. Landscape management zones have been established on national forest land around potential and developed recreational sites, lakes, streams, roads, and trails used for recreation travel. These landscape zones vary in size according to the topography; the aim is to create a pleasing view of the forest. Commercial activities are modified to preserve a suitable recreational environment. Timber management is carried on with the objective of producing a healthy forest that is aesthetically pleasing.

It is also important to preserve some areas in near natural condition for recreation or for scientific study and observation. The 14,170 acre Mount Hood Wild Area is one of the tracts classified by the Forest Service primarily for wilderness recreation. It contains spectacular alpine scenery including Mount Hood, the highest peak in Oregon. The 9,080 acres of the wild area in the basin received an estimated 700 visits in 1962.

Recreation receives special consideration in the management of other national forest areas also. In addition to the 9,080 acres in the Mount Hood Wild Area and the stream, lake, road, and trail zones there are the 25,000 acre Columbia Gorge Recreation Area and the Eagle Creek Limited Area. Various proposals have been made concerning recreation and timber harvest in the Eagle Creek drainage and more recently in the Columbia Gorge. Studies are in progress to determine the best program for this area.

Trends in Use

Comprehensive recreation use data for the entire basin is not available, but data from the Mount Hood National Forest and a State of Oregon recreation study indicate that more and more people are making one day trips for sightseeing or picnicking. The general trend is toward one day round trips with a small increase in the number of overnight visitors. 1/ In addition to sightseeing, boating and wilderness travel have had significant increases, but they represent only a fraction of the total visits.

Winter sports, which have had a minor increase in the past five years, are expected to increase rapidly if the hopes and plans of local skiers and mountaineers are realized. Studies are underway in the Hood River Meadows area to determine the feasibility of developing a first class ski area.

National forest recreation use is expected to increase about 500 percent in the next 40 years. Use of state parks and other land is expected to almost double in the next 15 years. As the Hood Drainage Basin and surrounding areas become more heavily populated, forested areas that are available for recreation will become increasingly important. In the next 40 years the Forest Service is planning to develop 2,000 acres in this basin for camping, picnicking, boating, and winter sports.

1/ Oregon Outdoor Recreation, a Study of Non-urban Parks and Recreation, Parks and Recreation Division, Oregon State Highway Department, 1962.

Photo 8.--Barrett Spur is one example of the alpine scenery found in the Mount Hood Wild Area. Poppino photo. NO. 2

Photo 9.--Cooper Spur Ski Area is popular with local skiers. FS Parkdale photo. NO. 1

Some of the principal findings of the state recreation study would seem to be pertinent to this discussion of recreation trends. The following points have been extracted from the summary of that report. 1/

"Of all summer outdoor recreational activities, state park visitors prefer picnicking, with swimming and fishing the second and third choices respectively.

"The greatest pressure in Oregon for recreational accommodations is exerted on areas providing water recreational activities.

"Oregon has sufficient land for recreational development, but the major undeveloped recreational lands in the state are owned and administered by the Federal Government.

"Recreational visits to Forest Service lands have increased at a rate more than twice that of the rate of increase of visits to state parks.

"Many state parks need 'buffer zones' to protect natural scenic values.

"Potential areas of statewide significance exist in all areas of the state."

Public Recreational Facilities

Recreational facilities in the basin consist mainly of national forest campgrounds and state park picnic areas, although there are county and privately owned areas.

There are 25 national forest camp and picnic grounds in the basin with 176 camp units and 207 picnic units. Most of these areas are located at lakes or along streams away from the more heavily traveled highways.

There are 10 state parks, waysides, and rest areas. Viento is the only park with camping facilities, but there are six others with picnic facilities, and the remaining three are rest areas. These are all located along heavily traveled highways, but mainly on Interstate 80 N.

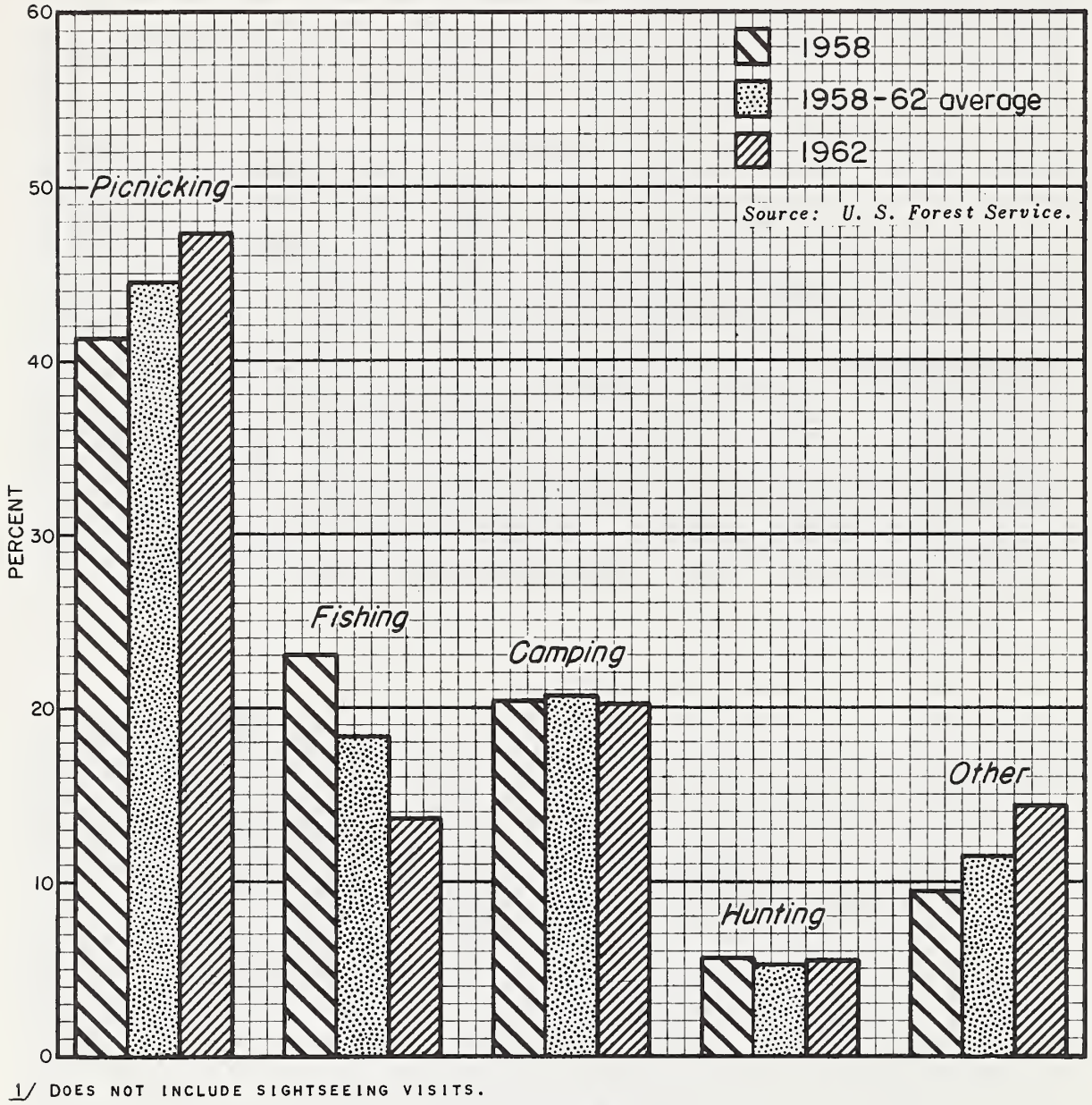
Hood River County has two areas with a total of 76 acres.

There is one seven acre noncommercial private park on Fifteenmile Creek in Wasco County which is maintained by the Ramsey Park Grange.

Three organizations have special-use permits for ski lodges on the slopes of Mount Hood.

1/ Ibid., p. 6.

Primary purpose of national forest recreation visits as a percentage of total recreation visits[1/], Hood Drainage Basin, Oregon, 1958-1962.



1/ DOES NOT INCLUDE SIGHTSEEING VISITS.

Chart 5

WILDLIFE

The wildlife and game fishery resources of the state are managed by the Oregon State Game Commission while the food fishery resource is managed by the Oregon State Fish Commission. The habitat conditions, which have a marked influence upon the fish and wildlife populations, are controlled by the land owners.

Big Game

The most numerous big game animal in the basin is the Columbia blacktailed deer. In addition there are fair populations of mule deer in the eastern portion of the basin. Elk occur in moderate numbers and are increasing. The predominate blacktailed deer populations are also continuing to increase. This is due mainly to expanding habitat brought about by patch type clearcut logging.

Photo 10.--Columbia blacktailed deer are found throughout the basin. FS Mount Hood photo. NO. 5

Blacktail deer is also the most popular game animal. In 1961, 27 percent of the hunters in Hood River County were successful while 47 percent of the hunters in Wasco County killed their deer. 1/ These percentages, which are below the state average, can be attributed to excellent cover and somewhat limited access in the high country where the deer are located during hunting season.

Small Game

There are several species of game birds in the basin, in addition to rabbits and squirrels. Hunting pressure for these species has been light.

1/ Oregon State Game Commision Annual Report, 1962.

Anadromous Fish

Most of the streams in the basin maintain runs of anadromous fish. During 1961, 106 summer steelhead were trapped at Punchbowl Falls. The West Fork Hood River is closed to all angling to protect spawning steelhead. The rest of the stream is open to fishing.

Minimum water quantity and quality requirements for fish life are not known, but it is known that stream turbidity and low summer flows accompanied by high water temperatures are detrimental to migration and spawning.

Operation of the three fish hatcheries in the basin is dependent upon sustained flows of cool, clear water.

Native Fish

Many of the lakes and streams are heavily fished so the Game Commission supplements natural stocking with hatchery raised fish. The 1961 Annual Report of the Game Commission indicates that fishermen caught approximately one fish per hour in several of the streams and lakes throughout the basin.

Reasonably uniform flows of cool, clear, clean water with few physical barriers to fish movement are necessary for the maintenance of the native fish population. Because of the influence on water temperature, siltation, and flows, good forest conditions in the basin can do much to perpetuate both the native and anadromous fish populations.

RANGE

There are approximately 88,000 acres of range in the basin in addition to the 72,400 acres of grazed forest land. Almost 80,000 of these range acres are located in the Wasco Resource Area. The remainder is found on the grassy ridges and exposed south slopes in the Hood Resource Area.

Hood Resource Area

It is estimated that there are 9,800 acres of range and grazed forest land in the Hood Resource Area. The majority of this land is on open ridge-tops, south slopes, and high elevation meadows on the east side of the area (photos 11 and 12).

The grazed land on the Mount Hood National Forest consists mainly of powerline rights-of-way and meadows. These areas are mainly browse range, with the key forage in small stringer meadows which are in poor condition, and complete nonuse is needed to rehabilitate them. A recent range survey indicated that an 85 percent reduction in the numbers of animals was warranted on this area.

Wasco Resource Area

It is estimated that there are 150,600 acres of range and grazed forest land in the Wasco Resource Area. This can be broken down into three range types--oak-grass, conifer-shrub, and open grass range.

Photo 11.--Open ridges and exposed south slopes provide much of the rangeland in the Hood Resource Area. Poppino photo. NO. 3

Photo 12.--Overgrazing has resulted in poor range and watershed conditions in this mountain meadow. FS Parkdale photo. NO. 2

Oak-Grass. The oak-grass type can be characterized by Oregon white oak (Quercus garryana) with a mixed grass understory. The oak overstory frequently intermingled with ponderosa pine provides litter regardless of the condition of the range. Open spaces are frequently overgrazed and deficient in litter or plant residue and are subject to both serious runoff and topsoil losses.

Photo 13.--The oak-grass types is one of the main range types in the Wasco Resource Area. Poppino photo. NO. 4

This area is predominately privately owned and used in spring, summer, and fall. With proper management, range improvement through natural seeding is fairly rapid.

Conifer-Shrub. Both ponderosa pine and Douglas-fir occur as dominant trees in the conifer-shrub type. Bitterbrush, bluebunch wheatgrass, Idaho fescue, and needlegrass grow over much of the lower elevation portion.

Most of this type is in the Mount Hood National Forest, but grazing is limited to the North Fork Mill Creek drainage. The remainder of the forest in the Wasco Resource Area is closed to grazing to protect the municipal water supplies for Dufur and The Dalles. The grassland areas in the South Fork Mill Creek drainage are in good condition with possible upward trends although browse species have been severely damaged by heavy game use. 1/

1/ Range Survey Report - Long Prairie Allotment, Mount Hood National Forest.

It is important that the inter-relationships between range and timber production be considered in the management of these two resources. Neither one can be maximized on forested ranges without some impact on the other. Grazing damage to seedlings is common enough to require consideration in grazing management plans on timbered areas. Limited damage may occur even after the trees are well grown. Rubbing, horning, and similar activities result in broken branches or bark through which disease may enter. 1/

Open Grass. The open grass type is found in the lower rainfall portions of the basin. This type has several key forage and browse species which by their abundance and condition are good indicators of range condition. These are: bluebunch wheatgrass, bluegrass, blue wild-rye, needlegrass, pinegrass, mountain bromegrass, elk sedge, soap bloom, and service berry. When these species are present in significant amounts and are grazed to utilize 50 percent or less of the current growth, the range condition is probably improving. Good range condition is also evidenced by a mellow, spongy topsoil which soaks up water rapidly allowing little runoff or erosion. Presently this range is in fair to poor condition.

WATER

Water Requirements on Forest Land

There are many kinds of water requirements, both consumptive and non-consumptive, on forest land, but few quantitative estimates have been made of them. Estimates of certain consumptive water requirements on national forest land in the basin are presented in table 8 as a sample of water use on forest land. While the estimated consumptive requirements are small, it is essential that they be considered in planning the development and use of water resources of the basin.

Table 8.--Estimates of some national forest yearly consumptive water uses 1/, Hood Drainage Basin, Oregon

Use	Resource area		Total
	Hood	Wasco	
	Millions of gallons		
Domestic:			
Administrative sites 2/	0.01	3/	0.01
Recreation sites	0.80	0.09	0.89
Livestock	1.15	...	1.15

1/ Includes only water used and should not be confused with amount stored to provide for this consumption.
2/ Does not include water obtained from municipal sources.
3/ Less than 10,000 gallons.

1/ Range Management, Chapter 9, McGraw-Hill Co., 1955.

The largest single use of water on forest land is for plant growth. This consumptive use is known as the evapo-transpiration process and is seldom measured.

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

1. Water used at administrative stations of both public agencies and private companies. Some stations are located in towns and are served by municipal supplies.
2. Water used at public recreation sites and at recreation facilities such as summer homes, organization camps, and resorts.
3. Water required for domestic purposes by other forest users including loggers, road builders, stockmen, 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 in recreation can be expected to increase the most. A five times increase is expected in forest recreation in the Pacific Northwest in the next 40 years. Water use can be expected to increase at an even greater rate because of the emphasis upon installation of improved water systems and flush toilets in the recreation areas such as Lost Lake and Eagle Creek Campgrounds.

Recreation. Domestic water uses for recreation users has been mentioned. Other water requirements are of a nonconsumptive nature. These include habitat for fish and water for boating, swimming, and aesthetic enjoyment.

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

Livestock. Livestock water needs are expected to decrease on national forest lands in the future as a result of the recent range survey. Because of the deteriorated condition of the national forest range, a large reduction in livestock numbers could be expected in the next few years.

Wildlife. Water requirements for wildlife on forest land include the following:

1. Water consumed.
2. Water required as environment for wildlife such as waterfowl and certain furbearers. Fairly uniform water levels must be maintained for some species, and water must be kept free of pollution.

Wildlife water requirements are expected to remain reasonably stable.

Fish Life. Water requirements for fish life include the water in streams and lakes that is a necessary environment for fish. There are certain water quality requirements pertaining to temperature, oxygen content, and freedom from pollution and turbidity which must be maintained if fish and the aquatic plants and animals they use for feed are to thrive. An important part of

maintaining water quality is providing adequate streamflows and lake levels. When water levels are low, especially during summer months, the water temperature is likely to climb, oxygen level decrease, and pollution increase because wastes are not carried away promptly. Flow depths must be adequate and stream channels open so that fish can travel to the spawning areas. Water and streambed conditions in the spawning areas must be suitable for each species.

Industrial. Water requirements for forest industries on forest land include the following:

1. Water for construction and maintenance of access roads.
2. Water for operation of timber harvesting equipment.
3. Water for storage and transportation of logs.

Water requirements for road construction and maintenance will probably decrease as the primary access road system is completed and dust abatement materials other than water become more widely used for road maintenance. Water requirements for timber harvesting, storage, and transportation may increase as harvesting of second growth increases. Large quantities of small logs may be harvested as thinnings and log sizes will be smaller. This could result in an increase of water needed per unit of log production, but industry has been lowering water needs while increasing production in other processing phases. Generally speaking water requirements for industry are not expected to change greatly in the near future.

Fire Control. Variable quantities of water are required for control of forest and slash disposal fires. Water must also be stored in ponds and tanks so that it is readily available when needed. The amount of water required for this purpose is not expected to change greatly in the future.

Watershed Management

A watershed manager, whether he is a logging superintendent, a rancher, a tree farmer, or a forest ranger, deals with all the resources of the drainage, but his primary aim should be to utilize them in such a way that maximum quantities of clear useable water are achieved. Watersheds convert large amounts of rain and snow to streamflow. For example, in places where 24 inches of precipitation annually reaches the soil, a plot only 10 feet square receives and disposes of 6.25 tons of water each year. It is essential that he include control of erosion in his plan of management and that he think of water and soil 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 can have a relatively minor adverse effect on the watershed. Some points to be considered before building roads are listed below:

1. Plan the road system in advance of construction.
2. Learn to recognize and avoid trouble spots.
3. Avoid steep roads.
4. Provide adequate drainage.
5. Do not build roads in or near stream channels.
6. Build with a minimum of earth movement.
7. Keep road in good repair during use.

Photo 14.--Permanent forest roads should be surfaced with rock and graded with a center crown to provide for surface drainage. FS Mount Hood photo. NO. 6

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

1. Do not yard logs in stream channels.
2. Keep skid trails drained by directing the water into areas where the sediment can settle out.
3. Keep tractors on moderate slopes; use high lead or other cable system on slopes over 45 percent.
4. Seed erosive areas with non-sod-forming grasses to get a quick cover.

Fire Prevention. Fire aggravates erosion by destroying vegetative cover which normally holds soil in place. Burned areas should be revegetated promptly to avoid soil loss. Loss of vegetation can be minimized in controlled burning such as slash disposal with good supervision and timing to avoid too hot a burn.

Grazing. Grazing, like timber harvest and fire, is an acceptable watershed practice only if soil disturbance can be avoided. The following principles should be applied to grazing practice in the forested watersheds of the basin:

1. Forage should be moderately grazed.

2. Livestock should be kept off the range while it is still saturated from winter snow and rain.
3. Keep a close watch on range condition to prevent overgrazing.

These recommended measures for roadbuilding, logging, burning, and grazing are aimed at prevention and control. Where they can be applied to the needs of each individual watershed, erosion can be kept within acceptable limits. The need for costly remedial measures in the future will be virtually eliminated. 1/

Water Yield

It is estimated that 85 percent of the annual water yield from the Hood Drainage Basin comes from forest land. 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. More water is percolated into the ground water storage for later gradual release instead of rapidly running off over the surface. At high elevations, forest cover helps to prolong melting of winter snowpacks which provide much of the late spring and summer flows in streams rising in the Cascades (photo 16). Trees provide shade along rivers and streams, helping to maintain water temperatures suitable for fish life.

Photo 15.--A drink from a free flowing stream of cool, clear water is one of the joys of wilderness hiking. Poppino photo. NO. 5

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

Photo 16.--Forest cover slows melting of winter snowpacks to provide late spring and summer streamflows. FS Mount Hood photo. NO. 7

Municipal Water

The Dalles, Dufur, and Cascade Locks obtain their municipal water from watersheds within the Mount Hood National Forest. These watershed areas are managed primarily for water production, but other uses are permitted. Because domestic water is so important, it is necessary that the watershed be managed so as to provide uniform flows of high quality water.

These cities have agreements with the Secretary of Agriculture and the Forest Service concerning the management of their water source. The agreements are not identical, but they do identify points of common concern. The 1912 agreement between The Dalles and the Secretary of Agriculture provides for sanitation, protection, care, and harvest of forests. Specific methods were not identified, but since then (1912) a general policy for timber harvest in watershed areas has evolved. This policy, in general terms, provides for timber harvesting in areas and by methods which will provide rapid regeneration and minimum disturbance so as to enhance the watershed while harvesting the timber resource.

AGRICULTURE IN THE BASIN

INTRODUCTION

The economic base of the Hood Drainage Basin has historically been agriculture. The most important agricultural products are pears, apples, cherries, wheat, and barley. Livestock are also raised in the basin but are of relative minor importance. Although only 16 percent of the basin's work force is actively engaged in producing the raw agricultural products, these products form the economic base that generates the local processing and packing industries and much of the transportation, wholesale and retail trade, and service industries.

The relationship of the Hood and Wasco Resource Areas to Hood River and Wasco Counties was explained in a preceding section of this report (see figure 7). It should be noted at this point that since the agricultural lands of Hood River County coincide with the agricultural lands of the Hood Resource Area, county data are applicable. The Wasco Resource Area, however, includes only half of the Wasco County cultivated lands so interpretation and allocation of county data is necessary.

AGRICULTURAL LAND USE

The use of land for agricultural purposes in the basin is influenced by climate, soils, topography, and economic factors. These factors have led to the differences in agricultural land use for the two resource areas.

Hood Resource Area

The land base for agriculture in the Hood Resource Area consists of 21,100 acres of cropland located in two major valleys, commonly called the Upper Valley and Lower Valley (fig. 7). The valley areas are characterized by terrace soils on gently rolling topography. The average annual rainfall is 30 inches at Hood River in the Lower Valley and 45 inches at Parkdale in the Upper Valley. The growing season is about 150 days in the Upper Valley and 180 days in the Lower Valley. The predominant use of agricultural land is for the production of apples and pears. These two fruits account for 63 percent of the cropland and 96 percent of the total acreage in fruits (table 9). Other fruits raised in the area include cherries and peaches. Pasture and hay are the other major crops grown in the area. Crops of minor importance include small grains, strawberries, potatoes, and vegetables. Most of the cropland in the area is irrigated. In addition to the cropland, 9,800 acres of forest and rangeland are used for grazing livestock.

Trends in agricultural land use in the Hood Resource Area are illustrated in chart 6. Note that the acreage devoted to fruit has been increas-

Table 9.--Agricultural land use, Hood Drainage Basin, Oregon, 1963

Agricultural land use	Resource area					
	Hood			Wasco		
	Irrigated	Dryland	Total	Irrigated	Dryland	Total
	Acres	Acres	Acres	Acres	Acres	Acres
Grazing land:						
Forest	...	1,400	1,400	...	71,000	71,000
Range	...	8,400	8,400	...	79,600	79,600
Total	...	9,800	9,800	...	150,600	150,600
Cropland:						
Wheat	...	200	200	200	33,700	33,900
Barley	20	150	170	100	13,300	13,400
Other	20	30	50	...	4,100	4,100
Subtotal	40	380	420	300	51,100	51,400
Alfalfa hay	1,110	100	1,210	600	1,100	1,700
Other hay	1,080	130	1,210	400	600	1,000
Subtotal	2,190	230	2,420	1,000	1,700	2,700
Tree fruits and vines	13,300	50	13,350	3,200	2,900	6,100
Other crops	370	20	390	250	50	300
Total harvested	15,900	680	16,580	4,750	55,750	60,500
Pasture	2,800	200	3,000	1,200	5,900	7,100
Not harvested or pastured	300	1,220	1,520	250	73,050	73,300
Total cropland	19,000	2,100	21,100	6,200	134,700	140,900

Source: Compiled from data from the USDA River Basin Survey Party and the U. S. Census of Agriculture.

Cropland and pasture acreage, Hood River County, Oregon, 1929-1959.

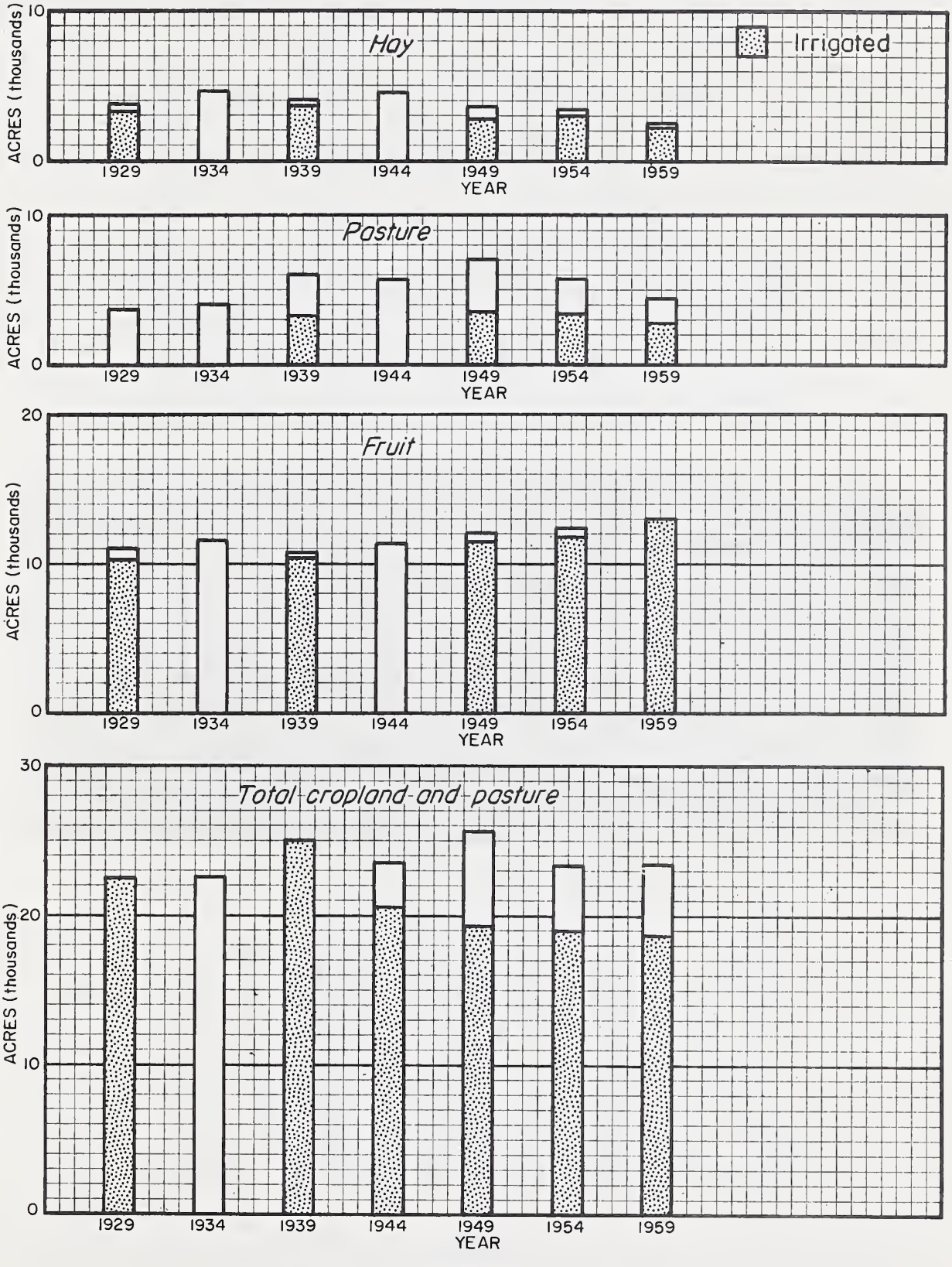


Chart 6

ing while hay and pasture acreage has been decreasing. Essentially all of the fruit acreage was irrigated in 1959. Farmers are evidently shifting irrigation water from pasture and hay land to orchard land.

Fruit has been the major agricultural enterprise in the Hood Resource Area since 1900. Apples, the predominant crop in the early 1900's, have since been replaced by pears (charts 7 and 8). This trend began in 1919 when a heavy freeze killed many of the apple trees and growers interplanted apple orchards with pear trees. The trend during recent years is better explained by economic factors.

Photo 17.--Fruit, the major agricultural use of land in the Hood Resource Area. FS photo. NO. 392925

The costs of producing apples and pears in the Hood Resource Area has been the subject of intensive study by Oregon State University. 1/ Data were collected from a sample of farms for the years 1947 through 1956, and costs of production and net income were calculated for each year. In three years out of the ten, costs of producing apples exceeded gross income while gross income from winter pears exceeded costs every year. The average cost of producing apples per acre during this period was $493 while the gross returns averaged $576, leaving a net income of $83 per acre. The average cost of producing winter pears during this same period was $458 per acre,

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1/ Cost of Producing Apples and Pears in the Hood River Valley, by Green, Irish, and Mumford, Agricultural Experiment Station Bulletin 573, Oregon State College, Corvallis, May 1960.

Number of apple trees and production, Hood River County, Oregon, 1939-1959.

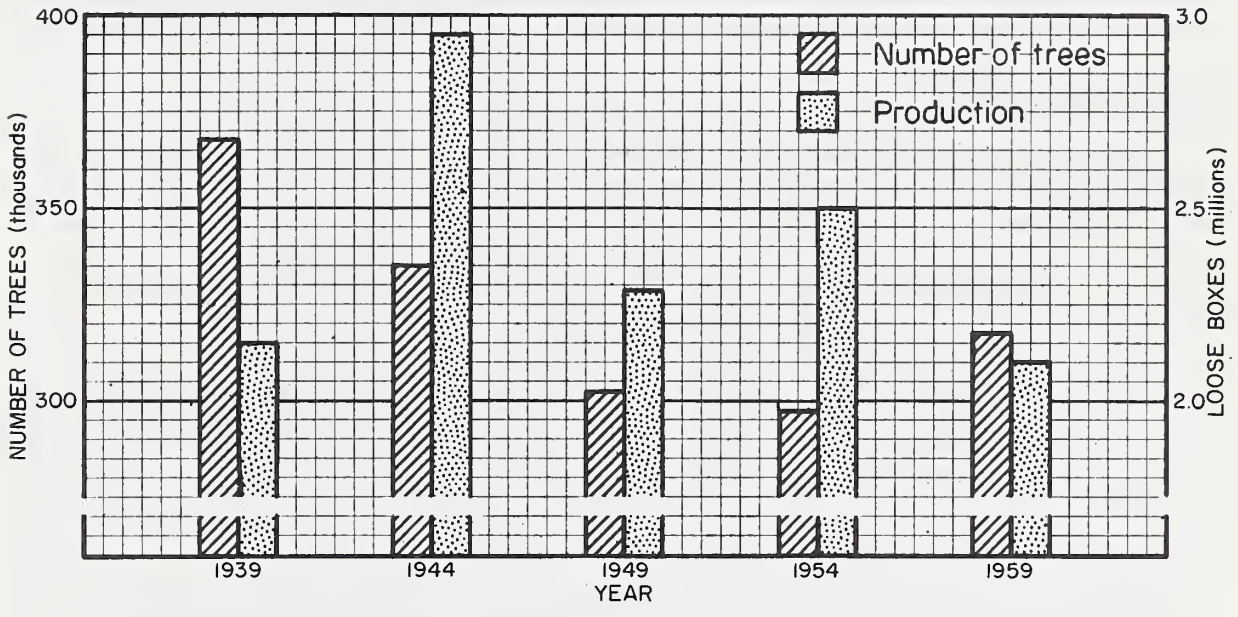
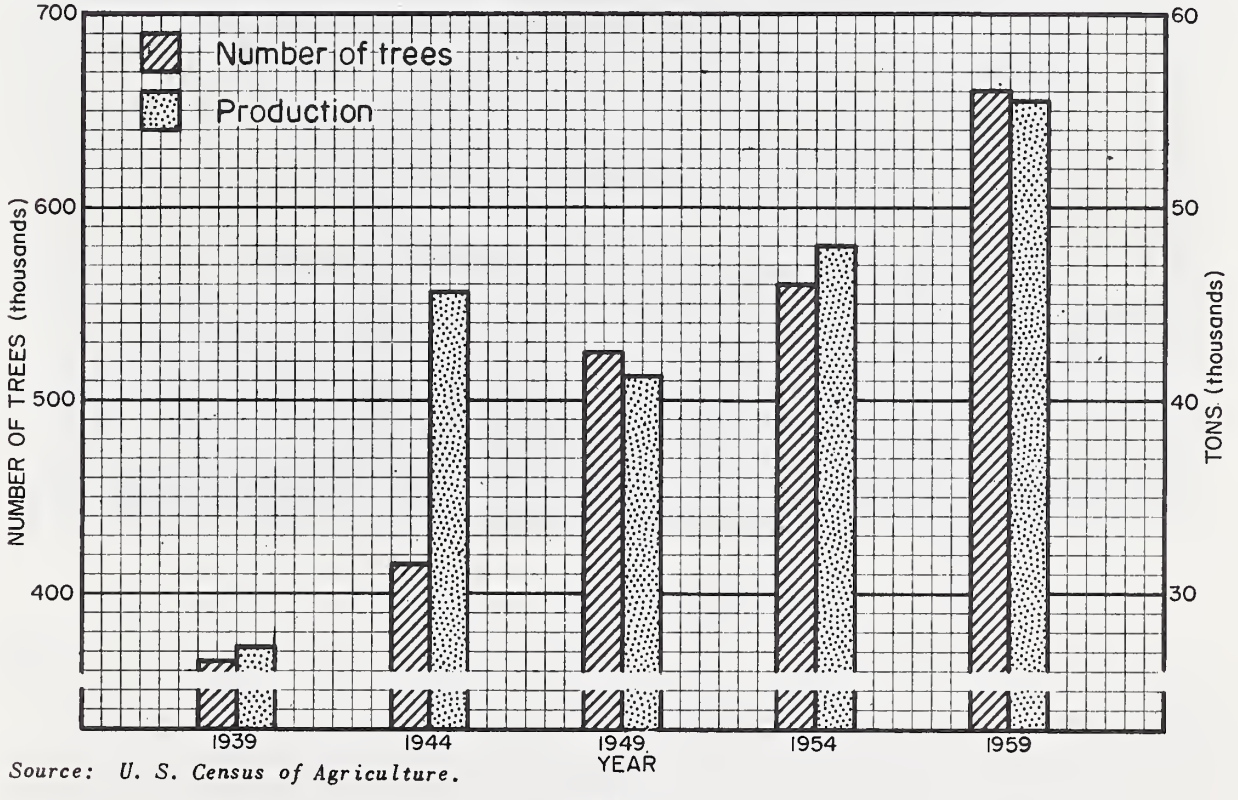


Chart 7

Number of pear trees and production, Hood River County, Oregon, 1939-1959.



Source: U. S. Census of Agriculture.

Chart 8

and the average gross returns were $713, leaving a net income of $255 per acre. The corresponding costs for producing Bartlet pears were $451 per acre, the gross returns were $570, and the net income was $119 per acre.

Wasco Resource Area

Agriculture in the Wasco Resource Area is of a more diversified nature. Lower rainfall and rougher topography are two important factors influencing the use of agricultural lands in this area. The major agricultural lands lie in the central and eastern portion of the area (see figure 7). Annual precipitation averages from 20 inches in the central to 10 inches in the east.

The 51,400 acres of small grains, mostly wheat and barley, are grown on the rolling uplands. The 73,300 acres of cropland not harvested is also predominantly used for growing small grains in alternate years. Thus, about 89 percent of the cropland in the area is used for grain production. Fruit production is concentrated in areas around the cities of The Dalles and Mosier.

Photo 18.--Wheat, the major cropland use in the Wasco Resource Area. SCS photo. NO. 7-1282-8

Although only 4 percent of the cropland is used for the production of fruit, it is one of the most important sources of agricultural income. Cherries are the leading fruit crop, but some peaches, apricots, and prunes are also raised in the area. About half of the fruit acreage is irrigated. Hay and cropland pasture are produced in the upland meadows and narrow valleys where

irrigation water is available. The 150,600 acres of grazing land is located on the fringes of the wheat land and in the transition area between cropland and forest.

Trends in agricultural land use in Wasco County are illustrated in chart 9. The acreage devoted to orchards has been increasing since 1929. Essentially all of the fruit grown in Wasco County is produced in the Wasco Resource Area. The percentage of orchard land irrigated increased from 27 percent in 1949 to 48 percent in 1959.

Since only about 25 percent of the Wasco County hay and pasture acreage is in this basin, trends in the use of land for these purposes are less applicable. It is noteworthy, however, that irrigation of pasture is decreasing while irrigation of hay land is increasing. While irrigation has increased since 1929, it was practiced on less than 5 percent of the Wasco Resource Area cropland in 1963.

Production trends for the three major crops in the area, cherries, wheat, and barley, are illustrated in charts 10 and 11. Cherry trees and fruit production have increased substantially since 1939. A major factor contributing to the expansion of cherry output was the development of irrigation.

Wheat and barley production has been increasing steadily over the last 20 years. Part of the increase is attributed to more acres used for growing the crops, and part is due to higher yields per acre. Since 1954, wheat acreage has been reduced as a result of federal programs, but this has been offset by a corresponding increase in the acreage and production of barley. Since about 60 percent of the Wasco County wheat and barley acreage is within the Wasco Resource Area, trends for the county are indicative of trends for the area.

Wheat yields in Wasco County averaged 35 bushels per acre in 1963. Yields in the past 10 years varied from a low of 25 bushels per acre in 1956 to a high of 39 bushels per acre in 1962. Average yields were in the 30 to 35 bushels per acre range in 7 of the 10 years. Barley yields corresponded roughly to wheat yields.

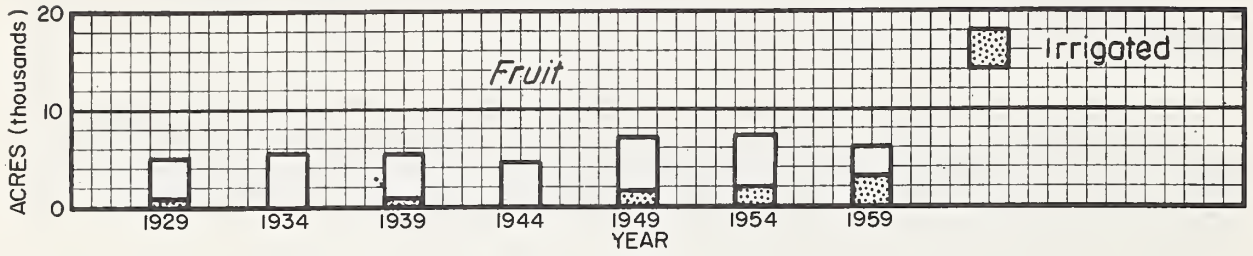
FARM CHARACTERISTICS

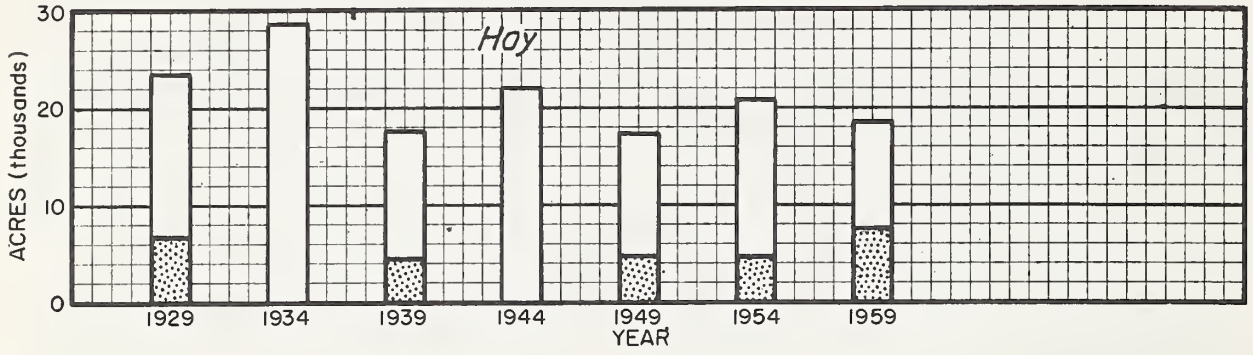
There are 780 farms in the Hood Resource Area and 460, or about 70 percent of the Wasco County farms, in the Wasco Resource Area. Some of the characteristics of farms in each area are shown in table 10.

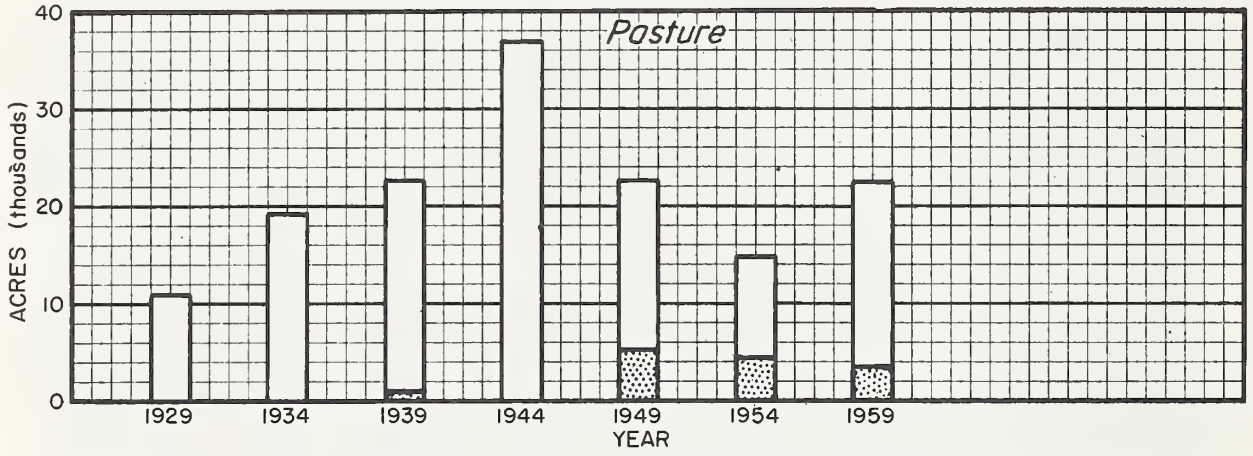
Note that half of the farms in the Hood Resource Area are commercial operations compared to about three-fourths for the Wasco Resource Area. Opportunities for part-time employment are more limited in the Wasco Area.

Fruit farms are by far the most important farm type in the Hood Resource Area. Most of the farms listed as "general and other" are also predominantly orchards operated on a part-time basis. Grain and fruit are the two major types of farms in the Wasco Resource Area.

Cropland and pasture acreage, Wasco County, Oregon, 1929-1959.







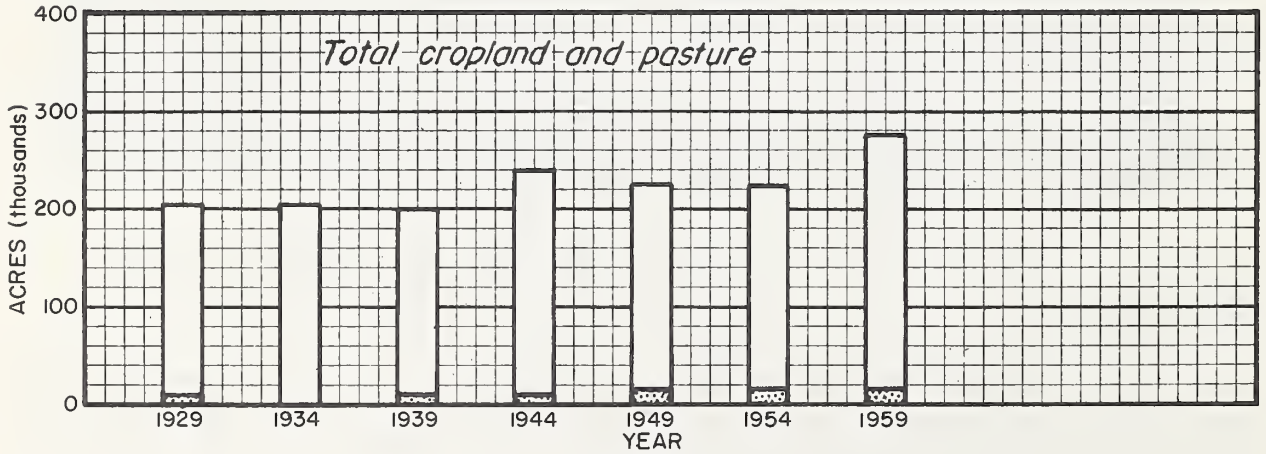


Chart 9

Number of cherry trees and production, Wasco County, Oregon, 1939-1959.

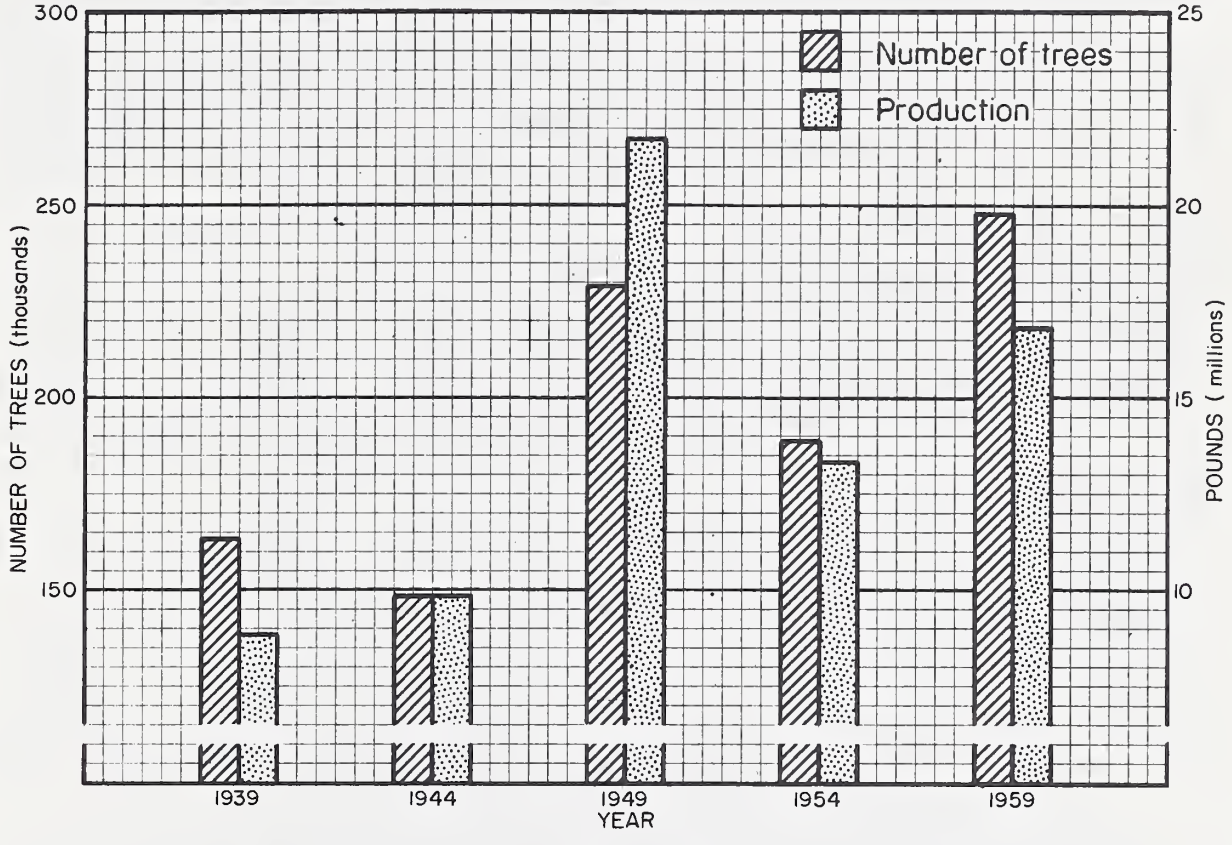


Chart 10

Wheat and barley acreage and production, Wasco County, Oregon, 1939-1959.

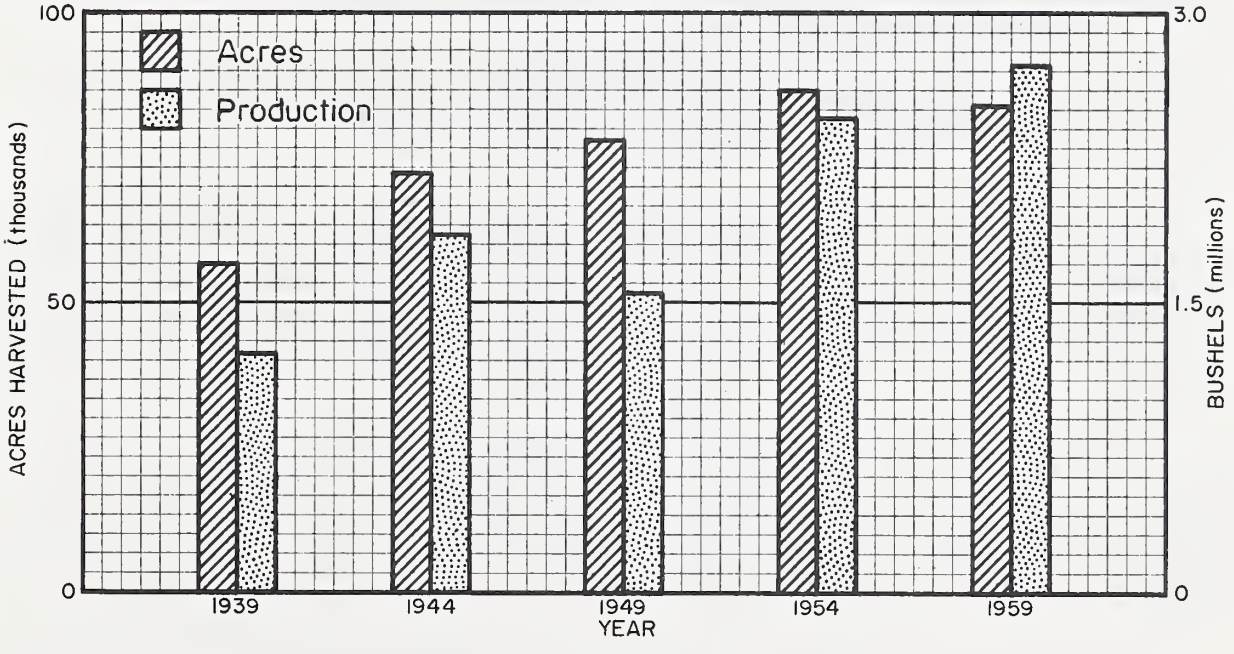


Chart 11

Table 10.--Farm characteristics, Hood and Wasco Resource Areas, Oregon, 1963

Item	Resource area			
	Hood		Wasco	
	Number	Percent	Number	Percent
Number of farms	780	...	460	...
Economic class of farm 1/:				
Commercial	405	52	340	74
Part-time	265	34	100	22
Part-retirement	110	14	20	4
Total	780	100	460	100
Type of farm:				
Cash grain	...	...	130	28
Fruit	365	47	150	33
Poultry	10	1	5	1
Dairy	20	3	5	1
Livestock 2/	10	1	30	7
General and other	365	48	140	30
Total	780	100	460	100

1/ Commercial farms are defined in the census report as farms with a value of sales amounting to $2,500 or more. Part-time farms are farms 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 total 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.

2/ Other than poultry and dairy.

Source: Based on data from the USDA River Basin Survey Party and the U. S. Census of Agriculture.

In 1959, 75 percent of the farms in the Hood Resource Area were under 50 acres in size, and 91 percent were smaller than 100 acres. Similar information is not available for the Wasco Resource Area, but interpretation of county data reveals that most of the farms fall into two size categories, those under 50 acres (fruit farms) and those over 500 acres (grain and beef farms).

Most of the farmers in both resource areas own their farms. In the Hood Resource Area where farms are small, 86 percent of the farmers are full owners, 9 percent are part-owners, and 5 percent are tenants. In the Wasco Resource Area where farms are larger and investment requirements higher, 65 percent are full owners, 24 percent are part-owners, and 11 percent are tenants.

In order to understand the present it is often necessary to study the past. This is especially true of agriculture where changes often occur

rapidly. Historical data for Hood River and Wasco Counties show some of the agricultural adjustments that have occurred (table 11). This information indicates that agricultural adjustments in Wasco County have been greater than in Hood River County. For instance, while the number of farms has been decreasing in both areas, the reduction has been much more pronounced in Wasco County. The other two measures, farm size and value of land and buildings per farm, have also changed considerably more in Wasco than in Hood River County. These differences are at least partially explained by the types of products raised. The main product raised in Hood River County has historically been fruit while grain has been the most important product in Wasco County. Fruit production, unlike grain, has not been conducive to economies of scale. In a study of apple and pear production, Oregon State University found that orchards from 20 to 39 acres in size were able to produce fruit for less cost per unit than either smaller or larger orchards. 1/ This explains the low variance in farm size over time in Hood River County. The economies of scale in grain production, however, have led to the replacement of labor by capital and improved technology. Whereas fruit production still requires high labor inputs, machines have replaced much of the muscle power once required for producing grain. As new equipment and technology are adopted, they often become a fixed expense and must be spread over a larger number of acres to be economically justified. The results of the adoption of more efficient machines and techniques in Wasco County can be observed in table 11. Since 1920, the number of farms has decreased by one-half while the average acreage per farm and the investment in land and buildings has increased by four times.

Table 11.--Number of farms, average size of farms, and value of land and buildings per farm, Hood River and Wasco Counties, Oregon, 1920-59

Census year	Number of farms		Average size of farms		Value of land and buildings per farm	
	Hood River County	Wasco County	Hood River County	Wasco County	Hood River County	Wasco County
	Number	Number	Acres	Acres	Dollars	Dollars
1959	782	669	47	2,049	28,848	61,799
1954	1,002	805	39	1,315	19,321	42,639
1950	1,030	864	41	1,269	16,501	24,484
1945	1,032	845	38	1,156	10,462	16,319
1940	1,142	1,007	35	870	5,558	10,885
1935	1,125	1,188	35	690	5,318	7,986
1930	967	1,076	39	829	10,378	13,777
1920	876	1,339	43	544	14,338	15,203

Source: U. S. Census of Agriculture.

1/ Ibid.

Livestock

Beef cattle and milk cows are the two most important types of livestock in the basin.

Milk cows are raised predominantly in the irrigated areas of the basin where forage from irrigated pasture and hay is readily available. Milk cows have been decreasing in number in both areas (charts 12 and 13). This decrease is consistent with the national trend and is associated with the decline in consumption of dairy products per capita and the rapid rise in milk production per cow.

Table 12.--Livestock numbers, Hood Drainage Basin, Oregon, 1960

Type of livestock	Resource area		Basin total
	Hood	Wasco	
	Number	Number	Number
Beef cattle and calves	2,730	7,500	10,230
Milk cows	1,000	680	1,680
Sheep and lambs	710	6,640	7,350
Hogs	890	370	1,260
Horses	230	300	530

Although beef cattle are raised in both resource areas, they are most numerous in the Wasco Resource Area where extensive grazing land is available. Beef is often raised as a supplementary enterprise to grain to utilize the forage on intermingled rangeland and grain stubble. The trend in number of beef cattle has been up in both areas since 1930.

Sheep, once numerous in the Wasco Resource Area, have decreased in number since 1930. Relatively low prices for sheep products in relation to beef has led to the replacing of sheep with beef cattle.

Hogs and horses are of minor importance in both resource areas. With the advent of mechanized power on farms, horses are no longer needed and have continually decreased in numbers since 1920. No significant trends are apparent in hog production.

The usual array of other livestock such as chickens and turkeys are also raised in the basin but are of minor importance in relation to other agricultural products.

The net result of the changes in animal units in the two counties is shown in terms of animal units in charts 12 and 13. The trend in animal units in Hood River County is up while in Wasco County a downward trend is apparent.

Livestock numbers, Hood River County, Oregon, 1920-1962.

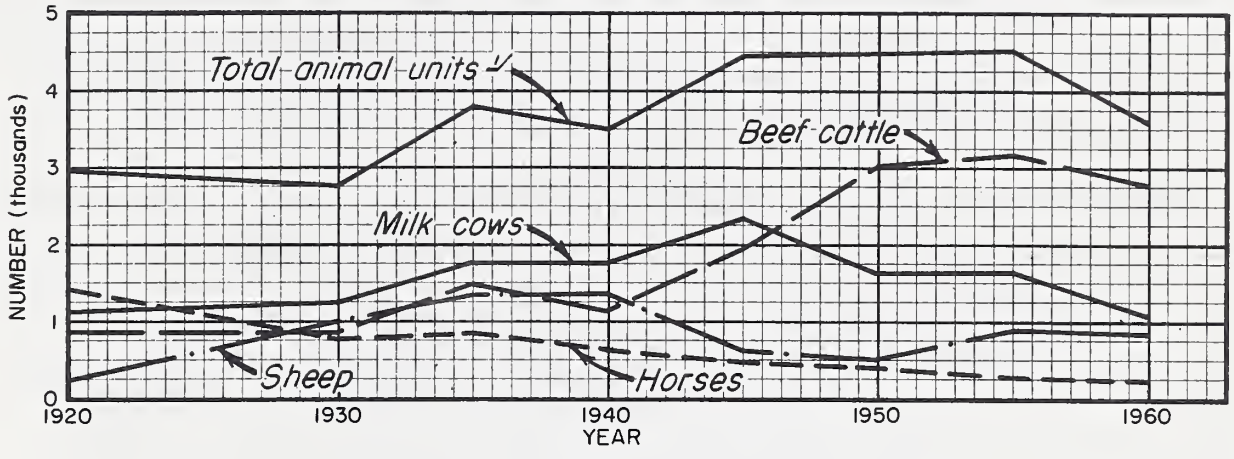
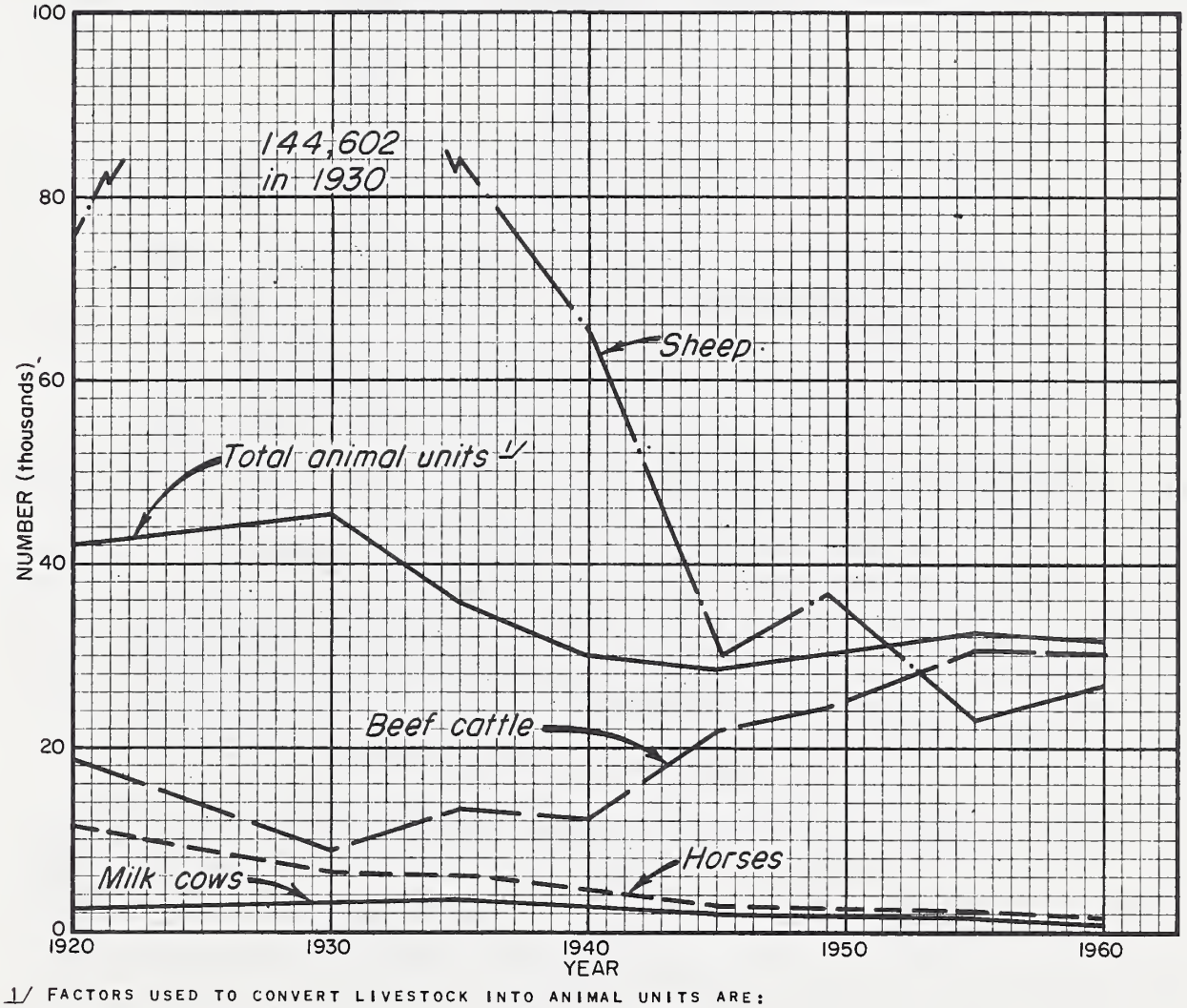


Chart 12

Livestock numbers, Wasco County, Oregon, 1920-1962.



1/ FACTORS USED TO CONVERT LIVESTOCK INTO ANIMAL UNITS ARE: MILK COWS, 1 AU; BEEF CATTLE AND HORSES, .8; SHEEP, .2 AU; AND HOGS, .01 AU.

Source: U. S. Census of Agriculture.

Chart 13

Agricultural Income

Farm income from the sale of crops and livestock produced in the basin was about 15.2 million in 1959 (table 13). Crops accounted for 88 percent of the total, and livestock accounted for the other 12 percent.

Table 13.--Value of farm products sold, Hood Drainage Basin, Oregon, 1959

Commodity sold	Value		
	Resource area		Total basin
	Hood	Wasco	
	Thousand dollars	Thousand dollars	Thousand dollars
Field crops 1/	63	2,651	2,714
Fruits	7,667	2,793	10,460
Other crops	36	100	136
Total crops	7,766	5,544	13,310
Beef cattle	243	500	743
Dairy products	272	200	472
Sheep and wool	20	92	112
Other livestock products	358	159	517
Total livestock	893	951	1,844
Total	8,659	6,495	15,154

1/ Other than vegetables and fruits.

Source: Based on data from the U. S. Census of Agriculture.

Fruits accounted for 89 percent of the income in the Hood Resource Area while livestock products accounted for about 10 percent. Fruits were also the most important source of income in the Wasco Resource Area with field crops (wheat and barley) second in dollar value. The intensity of land use for agriculture has a definite impact on the economy of an area. Field crops produced on 36 percent of the Wasco Resource Area's cropland accounted for 41 percent of the income while fruit grown on 5 percent of the cropland accounted for 43 percent of the income. It does not necessarily follow, however, that net farm income to individual farmers is higher for the more intensive crops. In fact, studies show that net income from wheat farms is generally higher than from fruit farms.

Charts 14 and 15 illustrate the trends in farm income for the two areas. Note the wide fluctuation in farm income for Hood River County as opposed to the steady increase in income for Wasco County. This reflects the major disadvantage of specialization of an area in a single agricultural commodity. Historically, prices for fruit have fluctuated much more from year to year than prices for grain and livestock products. Also, due to the large number of climatic and biological elements that affect fruit, production varies considerably. The consequence of both low production and prices for fruit coinciding in the same year is illustrated in chart 14 for the year 1949.

Value of farm products sold, Hood River County, Oregon, 1939-1959.

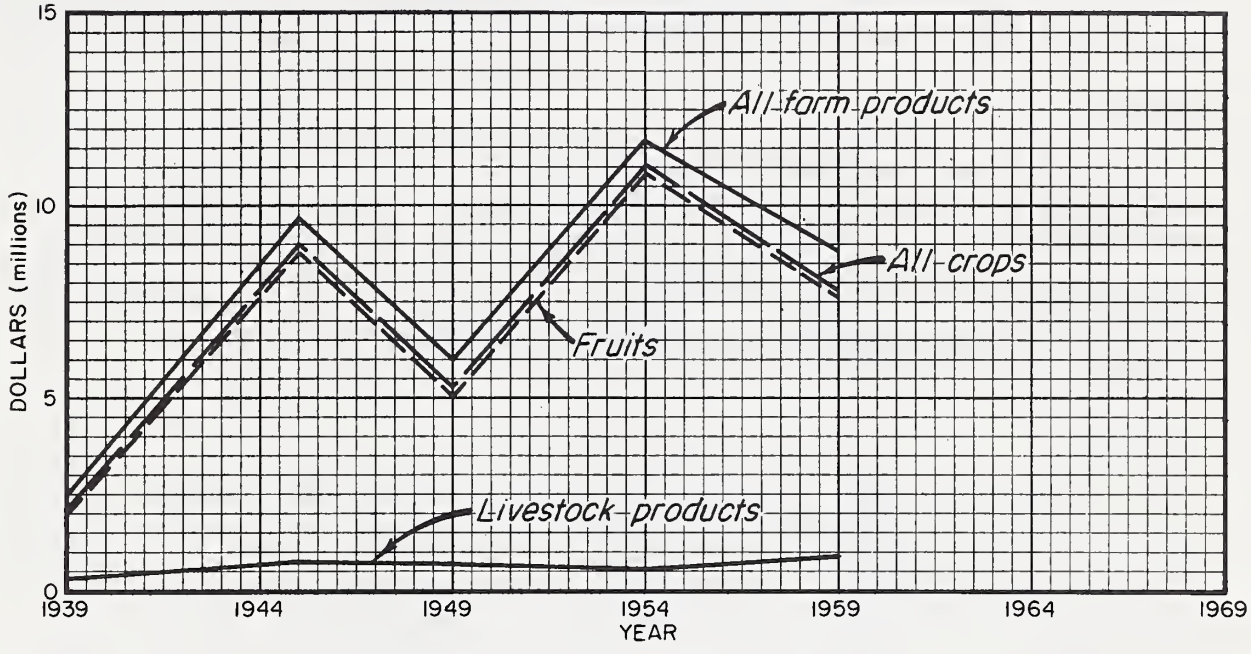
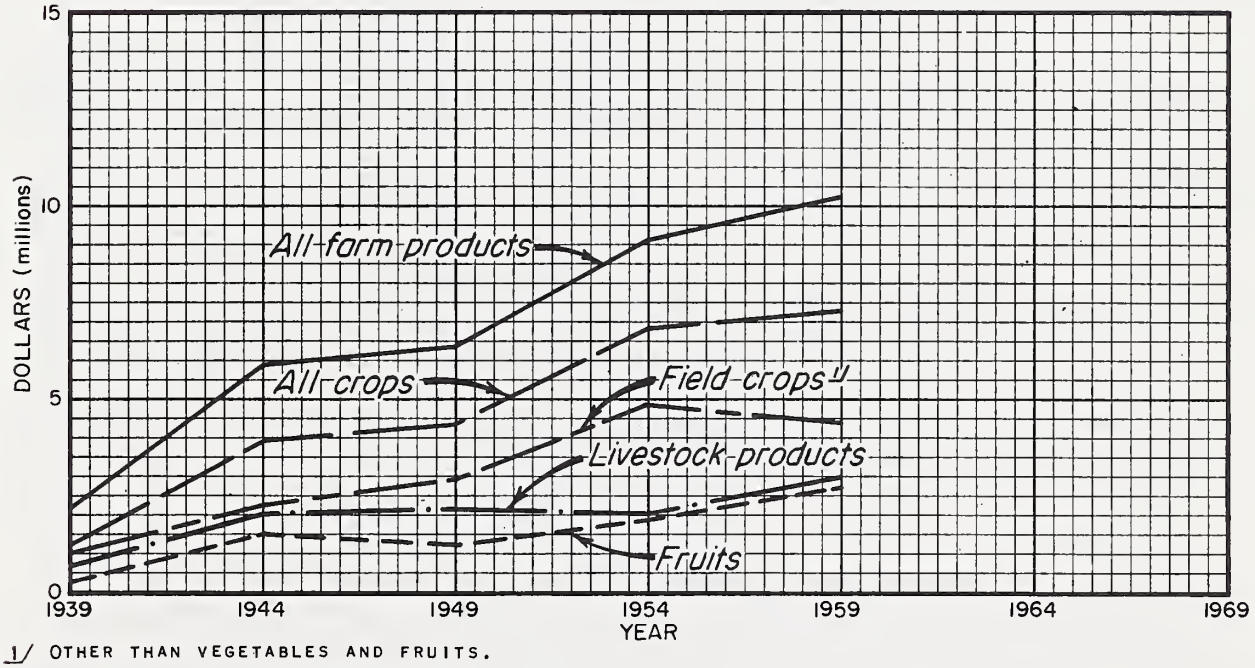


Chart 14

Value of farm products sold, Wasco County, Oregon, 1939-1959.



1/ OTHER THAN VEGETABLES AND FRUITS.

Source: U. S. Census of Agriculture.

Chart 15

Trends in farm income for a more diversified agricultural area are shown in chart 15. Since fruits are but a component of the farm income in Wasco County, gross farm income from the area has been less variable.

Markets

Since the basin has no large population centers, most of the agricultural products are marketed outside of the basin. Wheat and barley are transported via rail, truck, and barge to Portland where they are marketed worldwide. Fruits are processed and packed locally and marketed nationwide with some also going to foreign countries. Cattle and sheep are sold through local and Portland markets. Most of the milk is marketed locally.

IRRIGATION

Due to the dry summer months, irrigation has become an important practice in the basin. Although the annual precipitation in the Hood Resource agricultural area averages from 30 to 45 inches, only about a fourth occurs during the summer months of April through October. Distribution of the 10 to 20 inches of annual rainfall in the Wasco agricultural area is similar to that of the Hood.

Fruit is the major irrigated crop in both resource areas, accounting for 70 percent of the irrigated land in the Hood area and 52 percent in the Wasco area. Most of the other irrigated land is used for the production of pasture or hay. A breakdown of irrigated cropland use is presented in table 9.

History of Irrigation Development

Water development for irrigation in the Hood Resource Area has been accomplished almost entirely by seven organized irrigation districts. Development began with the construction of the Farmer's Irrigation Ditch in 1897. Other districts were formed in the early 1900's and by 1939, 25,074 acres were under irrigation (table 14). Irrigation was accomplished by diverting streams through a system of canals and pipes to the contiguous tracts of land in the valley. Through the years the water distribution systems have been maintained and improved, but no major new blocks of land have been brought under irrigation since 1939. Total irrigated acreage has decreased somewhat while irrigated orchard land has increased (table 14 and chart 6). The percentage of farms reporting irrigation and the average acres irrigated per farm have remained at about the same levels since 1929. Thus, these data indicate that irrigation development in the area occurred at an early date and has not changed significantly in the last 40 years.

Unlike the Hood area, water development in the Wasco Resource Area has occurred on an individual farm basis. Since the irrigable tracts are small in size and scattered throughout the narrow valleys, group facilities were not necessary and individual farm diversion systems were developed. The limited streamflows were soon appropriated. Since 1944, ground water has been the source of water for most land brought under irrigation. Most of the wells are in the vicinity of The Dalles. In recent years the ground water level in this area has been receding due to over-development.

Although only a third of the Wasco County irrigated acreage is within the basin, irrigation trends for the county as presented in table 14 give some indication of past irrigation development in the Wasco Resource Area.

Table 14.--Irrigated acreage and farms reporting irrigation, Hood River and Wasco Counties, Oregon, 1909-59

County and year	Acres irrigated	Average acres irrigated per farm	Farms reporting irrigation	Percentage of farms reporting irrigation
	Acres	Acres	Number	Percent
Hood River:				
1909	8,071	17	464	62
1919	19,765	24	811	93
1929	22,370	25	906	94
1939	25,074	24	1,037	91
1944	20,460	22	949	92
1949	19,117	20	939	91
1954	18,899	21	914	91
1959	18,424	25	749	96
Wasco:				
1909	5,703	65	88	7
1919	9,382	35	267	20
1929	9,559	33	293	27
1939	8,945	26	345	34
1944	11,257	53	212	25
1949	16,131	46	351	41
1954	15,190	46	331	41
1959	16,840	55	304	45

Source: U. S. Census of Agriculture.

Source of Water and Method of Application

Streamflow is the chief source of irrigation water in both resource areas (table 15). In the Hood area natural streamflows are the source of water for 93 percent of the irrigated acreage, and two storage reservoirs are the source for the rest. In the Wasco area, natural streamflows are the source of water for 60 percent of the irrigated acreage, storage reservoirs are the source for 6 percent, and ground water is the source for 34 percent.

Sprinklers are used to apply water on 85 percent of the irrigated land in the Hood area and 82 percent of the irrigated land in the Wasco area. In addition to supplying irrigation water, sprinkler systems are also often used for preventing frost damage to orchards.

Table 15.--Source of irrigation water and method of application, Hood Drainage Basin, Oregon, 1963

	Resource area		Total basin
	Hood	Wasco	
	Acres	Acres	Acres
Source of water:			
Streamflow	17,700	3,700	21,400
Storage reservoir	1,300	360	1,660
Ground water	...	2,140	2,140
Total	19,000	6,200	25,200
Method of application:			
Sprinkler	16,200	5,060	21,260
Gravity	2,800	1,140	3,940
Total	19,000	6,200	25,200

Source: USDA River Basin Survey Party data.

Costs of Irrigation

Information on water costs for individual irrigation developments is not available. The only current data on water costs are for irrigation districts in the Hood Resource Area. In 1962, delivery costs varied from $4.50 per acre for the East Fork Irrigation District to $12.00 per acre for the Dee Irrigation District. 1/

Future Irrigation

Future irrigation in the basin will be governed by several physical and economic factors. The two most important physical factors are the availability of suitable irrigation water. There are about 275,700 acres of land in capability classes I through IV in the basin (table 16). On the basis of soils alone this is the amount of land that is generally susceptible to irrigation. However, location of the land in relation to available water supplies and the present use and ownership of this land precludes the possibility of irrigating much of it in the foreseeable future.

In the Hood Resource Area 21,100 acres of the 108,600 acres of class I through IV land is presently being used as cropland. The other 87,500 acres is in timber, brush, and other noncropland uses. It is anticipated that most of this land will remain in its present use for various reasons. Much of it is owned by timber companies or the Federal Government. In many cases it lies in small tracts, and accessibility would be a problem. Also, most of it would have to be cleared. It is estimated that only about 9,100 acres is of such a nature that it might be cleared and developed for agricultural purposes in the foreseeable future. Presumably all of the 2,100 acres of cropland not now irrigated and 9,100 acres of potential cropland is adaptable to

1/ Twenty-ninth Biennial Report of the State Engineer, Chris L. Wheeler, State Engineer, June 30, 1960.

Table 16.--Estimated present and potential cropland and irrigated land, Hood Drainage Basin, Oregon, 1963

Item	Resource area		Total basin
	Hood	Wasco	
	Acres	Acres	Acres
Land capability classes I-IV	108,600	167,100	275,700
Total cropland	21,100	140,900	162,000
Potential cropland	9,100	2,200	11,300
Irrigated land	19,000	6,200	25,200
Potentially irrigable land	6,200	15,300	21,500

Source: USDA River Basin Survey Party data.

irrigation. However, because of the location of the land in relation to water supplies, it is estimated that only 6,200 additional acres could readily be irrigated. Natural flows would be adequate to irrigate about 2,300 acres, and storage would be necessary for the rest.

At the present time, steps are being taken to improve the quality and reliability of water supplies in some of the watersheds. A project for the utilization of natural flows for irrigation is under construction in the Middle Fork watershed. The Middle Fork Irrigation District, with technical and financial assistance from the Department of Agriculture, is constructing an irrigation system that will provide silt-free water for 6,000 acres of presently irrigated land and an additional 2,000 acres of dryland. This project will add an approximate additional cost of $3.00 an acre to the $5.50 presently paid annually by irrigators in the district.

The major economic factor that will govern the expansion of irrigation in the Hood Resource Area is the future financial returns to fruit growers. Irrigation is a necessary input for the production of fruit, and irrigated fruit acreage has been increasing steadily for a number of years. Because of higher returns, water has been taken from the less intensive crops and applied to orchards. Theoretically, orchard acreage could be increased by about 5,700 acres by taking water from the other crops. However, because some soils are suitable for pasture or hay but not for fruit and because some farmers will continue to prefer raising livestock, it is anticipated that forage crops will continue to be grown in the area. Thus, any sizable increase in fruit acreage will require storage of irrigation water. Since costs for stored water will be higher than those now paid, it is anticipated that water development will be predominantly for the more intensive crops with the highest returns. The average net returns to pasture in the area as reported in the watershed work plan 1/ are $17 per acre. The average net returns to fruit for a period of years are presented in table 17. Note that

1/ Watershed Work Plan, Middle Fork of Hood River Watershed, Hood River County, Oregon, prepared by the Hood River Soil Conservation District, April 1962.

Table 17.--Apple and pear production costs, ten year averages (1947-1956), Hood River County, Oregon

Item	Apples	Winter pears	Bartlet pears
	Dollars	Dollars	Dollars
Labor cost per acre:			
Pruning	34.24	42.70	32.53
Irrigating	12.45	10.98	12.74
Thinning	40.35	.31	39.98
Harvesting	107.47	90.29	57.11
Other	66.58	63.15	65.46
Total labor	261.09	207.43	207.82
Nonlabor costs per acre:			
Fertilizer	14.72	15.16	15.88
Irrigation water	6.21	6.10	5.78
Sprays	41.19	41.51	38.51
Building and machine repairs	15.03	16.42	16.14
Gas, oil, and electricity	21.93	24.92	24.62
Property taxes and insurance	24.88	26.12	26.00
Depreciation	30.92	33.79	31.86
Interest	47.82	54.83	51.47
All other costs	29.49	32.19	33.16
Total nonlabor	232.19	251.47	243.42
Total costs per acre	493.28	458.47	451.24
Gross returns per acre	576	713	570
Net returns per acre	83	255	119

Source: Cost of Producing Apples and Pears in the Hood River Valley, by Green, Irish, and Mumford, Agr. Exper. Sta. Bul. 573, Oregon State University, Corvallis, May 1960.

irrigation water represents less than 2 percent of the total costs of fruit production. Thus, somewhat higher costs for stored water would not in itself seem to be a deterrent to the expansion of fruit acreage and production.

In order to adequately assess the potential for expanding markets for fruit grown in the basin a comprehensive study of the competitive advantages and disadvantages of this area with competing areas would be necessary. However, since this information has not yet been developed, speculation as to the future growth of the fruit industry in the Hood Resource Area must be based on information at hand.

There are a number of factors that point toward a continued growth of the fruit industry in the area. First of all, the environmental conditions in the basin have proven to be conducive for the production of high quality apples and pears. In 1959, apples raised in the Hood Resource Area accounted for 83 percent of the Oregon production and 1.5 percent of the U. S. production. Pears accounted for 54 percent of the Oregon production and almost 10

percent of the U. S. production. The processing and marketing industries have become well established in the area and have marketing outlets throughout the United States. Since the marketing channels exist, if demand for fruit continues to increase, there is no reason to indicate that the area would not receive its share of the market.

A study of table 17 would seem to indicate that due to the favorable returns from fruit, farmers would be expected to increase fruit acreages rapidly. However, it should be noted that these figures represent average costs and returns over a ten year period, and although they give insight as to what has happened in the past, the price-cost relationships do not necessarily apply to the future. Also, wide fluctuations occur in fruit prices and yields from year to year. These, in turn, cause net incomes to vary considerably. For instance, from 1947 to 1958 both apple and Bartlet pear producers incurred net losses in 4 out of 12 years. Winter pear growers had net gains every year during this period, but net incomes also varied widely.

Because of the high labor requirements, many farms are already operating at optimum scale. Furthermore, orchards represent sizable investments of over $1,200 per acre, and several years are required to establish an orchard. Thus, capital limitations and risks are important factors.

If additional fruit could be marketed without significantly changing the price-cost relationship that prevailed in the past, it is likely that

Photo 19.--Orchards on Mill Creek in the vicinity of The Dalles, Oregon. A portion of this area will be provided water by the irrigation project. SCS photo. RO-735-6

the 6,200 acres of potentially irrigable land in the area will eventually be brought under irrigation. While irrigation development will probably increase slowly, this potential need for water should be considered in any water program.

In the Wasco Resource Area, 140,900 acres are used for growing crops, and an additional 2,200 acres could be developed for crop production. About 6,200 acres are irrigated, and the rest is devoted primarily to the production of dryland wheat and barley. It is estimated that an additional 15,300 acres is located in relation to water supplies so that it could readily be irrigated. There are indications that some additional development of natural streamflows and ground water might be possible, particularly in the Mosier Creek watershed. However, since ground water is limited and natural flows are already almost fully utilized, storage facilities would be necessary for any sizable increase in irrigated acreage.

A project for the utilization of Columbia River water is now under construction. The Bureau of Reclamation is constructing a system for pumping water from the Columbia River to irrigate 5,420 acres of orchard in the vicinity of The Dalles (photo 19). Water under pressure will be piped to the farms for a cost of about $25 per acre per year.

To meet water costs of this magnitude it will be necessary to raise high value crops such as cherries. In 1959, cherry production in the Wasco Resource Area accounted for 43 percent of Oregon production and about 10 percent of the United States production. If cherry production in the area can be expanded without significantly changing the price-cost relationship that has prevailed in the past, additional irrigation development will probably occur. However, water costs for other projects that might be proposed would have to be significantly lower than $25 per acre per year before irrigation of less intensive crops such as pasture and hay would be feasible.

WATER RELATED PROBLEMS, NEEDS, AND OPPORTUNITIES

GENERAL

Crop, forest, and range lands present problems peculiar to their individual uses and management practices. Individually and collectively they influence water as it affects wildlife, recreation, and other human uses of resources. Thus, they create or aggravate a host of water problems involving water excesses, shortages, and quality. Improvement or correction of land problems will usually result in improvement of the related water problems.

Water resources influence all segments of the economy of the basin. Better use and development of these resources are necessary for the advancement of agriculture. Industry and community existence is based upon a dependable supply of good quality water for their use. Navigation, recreation, fish life, and pollution abatement are affected by volume and depth of flow. Thus, yield and seasonal availability of water are of prime importance in all areas of use.

WATER SUPPLY AND REQUIREMENTS

Average annual precipitation in the Hood Drainage Basin ranges from about 130 to 9 inches (fig. 2). The agricultural part of the Hood Resource Area probably averages less than 10 inches during April through October while the Wasco Resource Area averages about one-half this amount during the irrigation season. Thus, the basin has a summer period of water shortage for agricultural uses and a winter period of water surplus. In the Hood Resource Area the situation is somewhat ameliorated by a more uniform hydrograph on most streams due to higher elevation of the upper watershed. Glaciers on Mount Hood as well as the heavier snow cover contribute to the more uniform flow. There are great variations in the amount of water in some sections, owing to both seasonal and geographic conditions within the basin. This combination results in waste of water and necessitates planned storage to improve efficiency of use. In the eastern section storage is necessary for agricultural expansion.

The total water resources of the Hood Resource Area are more than adequate for present and future agricultural needs, but the Wasco Resource Area is not as fortunate unless it can capitalize on waters of the Deschutes and Columbia Rivers to supplement that from within its boundaries.

Based upon existing runoff records and figure 2, the data in table 18 was compiled for each watershed. Summarizing the data in this table gives and estimated 1,400,000 acre feet as the total average annual yield after current consumptive use for this 654,500 acre basin. The Hood Resource Area

has 283,600 acres with a runoff of 1,300,000 acre feet, and the Wasco Resource Area of 370,900 acres yields about 100,000 acre feet to the Columbia River.

The annual runoff probably ranges from 0 to near 110 inches in the basin. The Hood Resource Area varies from about 9 to 110 inches while the Wasco Resource Area could range from 0 to 36 inches.

Table 18.--Average annual runoff and precipitation by watershed, Hood Drainage Basin, Oregon, 1963

Watershed	Average annual precipitation	Average annual runoff	
	Inches	Inches	Acre feet
A. Fifteenmile Creek	13.9	3.5	47,000
B. Eightmile Creek	20.1	4.0	25,000
C. The Dalles	23.9	3.6	26,000
D. Mosier	28.0	6.2	23,000
Total Wasco Resource Area	19.2	3.9	121,000
E. East Fork Hood River	49.3	36.4	296,000
F. Oak Grove	57.7	46.0	149,000
G. Columbia Gorge	85.5	59.2	288,000
H. Middle Fork Hood River	71.6	77.0 1/	260,000
I. West Fork Hood River	103.7	81.0	326,000
Total Hood Resource Area	70.3	55.8	1,319,000

1/ The result of melting glaciers and ground water that fell as precipitation outside of this watershed.

Source: Soil Conservation Service and State Water Resources Board.

The average annual runoff for the entire Hood Drainage Basin is 26 inches or, in other words, about two-thirds of the precipitation is not consumptively used in the basin at the present time.

Large quantities of water are stored in the high Cascades in the form of snow, glaciers, and ground water, thereby causing higher, more uniform streamflows through the summer months. Little is known of the extent, storage capacity, and annual recharge of the ground water of the porous rock formations, all of which are significant factors in the hydrology of the major streams flowing from the higher Cascades. Much of the domestic, municipal, industrial, and irrigation water in the basin has its origin from springs or wells. Springs are most common in the Hood Resource Area, but many are used to furnish water for domestic and livestock in the Wasco Resource Area. Most of the irrigation water in the vicinity of The Dalles is from wells. (This will no longer be true when the Bureau of Reclamation completes The Dalles Project using Columbia River water.) The faults and folds in the basalt complicate the determination of source, rate, and route of the movement of ground water since they act as barriers to movement in some strata, facilitate movement in others, and serve as channels for lateral

movement. For these reasons the development of wells for irrigation water supply has proven to be too expensive for most crops as well as often being uncertain.

Alluvial deposits along streams hold minor quantities of ground water and add to the local domestic water supply.

In general, it can be concluded that the summer season water shortages, all sources considered, are most severe in the Wasco Resource Area.

Photo 20.--A cave in a snowbank formed from running water on Compass Creek Mount Hood Wild Area. Picture taken August 9, 1963. Poppino photo. NO. 6

Irrigation

Based upon an assumed 4 feet of water per acre (the maximum crop net requirement with 42 percent efficiency), the approximate water requirement for the 25,200 acres of irrigated crops in the basin (table 9) is 100,800 acre feet, or about 16 percent of the total surface water yield during the irrigation season. In addition to the acreage irrigated by natural flows 2,100 acres are irrigated from ground water and 1,700 acres from storage reservoirs.

In the Wasco Resource Area about 60 percent of the gross yield during the irrigation season of April through October is used for irrigation. However, most of the surface water flows during the early part of the irrigation season when the demand is light.

Two of the small watersheds in the Hood Resource Area have seasonal water shortages for the irrigated land while in the Wasco Resource Area most of the watersheds are already short of water (table 19). The watersheds in the eastern part of the basin usually have less than 2 percent of their annual flow in August and September; consequently, most water rights based upon natural flow are short almost every year.

Table 19.--Summary of small watersheds with inadequate irrigation water supply, Hood Drainage Basin, Oregon, 1963

Item	Unit	Resource area		Total
		Hood	Wasco	
Watersheds studied	Number	5	4	9
Watersheds with water shortages for presently irrigated land	Number	2	3	5
Presently irrigated land with water shortages	Acres	6,600	3,830	10,430
Watersheds with inadequate water for potential irrigable land	Number	2	3	5
Potential irrigable land needing surface water development	Acres	3,900	13,300	17,200

Source: USDA River Basin Survey Party data.

It is estimated that an additional 21,500 acres could be readily irrigated. This would almost double the acreage presently irrigated. However, there are 275,700 acres in land capability classes I through IV, most of which is adaptable to irrigation in varying degrees (table 4). All watersheds have some potentially irrigable land. If all irrigated and potentially irrigable land was adequately irrigated and growing about the same types of crops presently grown, approximately 186,700 acre feet of water would be required. This would amount to about 12 percent of the annual basin yield, but in the Wasco Resource Area such optimum development would require about twice as much water as the yield during the irrigation season. It is apparent that water must be conserved, developed, and brought in from outside sources before irrigation of agricultural land could be expanded to this extent. The Dalles Project now under construction by the Bureau of Reclamation recognizes this fact as it will bring into the basin water from the Columbia River to irrigate the project. Thus, stored water that can be developed on the small basin streams in the future can be used on land more distant from the river.

Livestock

There is usually an adequate water supply for consumptive use of livestock in the Hood Resource Area. In those areas where it was not adequate from natural streams and springs sufficient quantities have been supplied through developments for irrigation and domestic use.

Normally water for animals is adequate in the Wasco Resource Area during the spring. However, water from ponds and wells is required to supplement the perennial streams and springs during the summer and fall (photo 21).

Photo 21.--Stock ponds are built for stock water during the dry months in the Wasco Resource Area. SCS photo. NO. 7-1198-3

Since grazing is only one of the important uses of land in the basin, it has to be considered in relationship to forest, watershed, wildlife, recreation, and mining. Such problems as farm forest and farm watershed management are of concern even on private land. It is particularly important that water be kept on land and absorbed in such a way that there is a minimum of loss from runoff and damage from erosion. This means there must be careful use of forage cover so as not to decrease its value for watershed purposes.

Nearly all arid watershed lands, so important for irrigation, are in grazing areas. Here it is imperative that grazing management be adjusted to provide for maximum yield of good water. Actually, if some of the low rainfall watersheds were managed entirely for water production, the value as a watershed would far outweigh the actual value for forage production. However, good range management is compatible with good watershed management.

Range condition and trend analyses have not been made over the whole area. However, range surveys have been completed on national forest lands, and new range management plans are being put into effect in an attempt to eliminate abuse from overgrazing. The Bureau of Land Management is planning to survey their land by 1965. The BLM lands are distributed throughout the range zone of the basin, and some generalizations might possibly be made from the results of this survey. The SCS has completed ranch plans on many of the ranches in the area. The public range leased by these ranchers is included in their plans for good management and balanced stocking. Thus,

the use of water on the range should not change materially, but the quality and perhaps quantity of water coming from the rangeland could be gradually improved.

Forestry and Related Uses

There are few water supply problems on forest land in the Hood Drainage Basin. Natural streamflows are generally adequate to meet all consumptive requirements. Some pollution and siltation problems have developed where careless timber harvesting has occurred or where forest fires have burned over watersheds that are a source of municipal water supplies.

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 improvement of access to all parts of most watersheds.

There will be increasing concern in maintaining adequate streamflows and lake levels for fish, wildlife, and recreation. Additional needs for larger water supplies for irrigation and industry will have to be met by greater reservoir storage of water from forested watersheds. If reservoirs are drawn down during the season of heavy recreational use, the water becomes less attractive for recreation, pollution problems increase, and fish life may be endangered. Natural lake levels and streamflows may also be lowered by increased water consumption.

The water needed to meet consumptive and nonconsumptive needs on forest land now and in the future is inadequately protected from appropriation for industrial, agricultural, and other water uses. Public agencies seldom file for water rights for protection of domestic or recreational water supplies or to maintain streamflows and lake levels.

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

The pressures from an increasing population and its accompanying industrial and urban developments are exerting an increasing strain on land and water resources of the Hood Drainage Basin. In order to make the best use of these resources it is imperative that they be developed and improved to the greatest extent possible. In order to do this there is need for more control of the water supply. Many marginal hay and pasture fields should be replanted to productive adapted species of grasses and legumes and managed for increased production. The rangeland should be used within its capabilities for sustained production. That is, the areas that are suited to

forage production need more intensive development while the areas best suited for forest production should be managed and developed for this primary use. A summary of the water related problems and the measures needed to improve them follows.

Flooding. Flood problems in the Hood Drainage Basin result from both natural factors and human management of the land. Modern man has greatly intensified flooding problems through his intensive use of the land and other natural resources.

Floods can occur in portions of the basin almost any time of the year. The most common floods are from snowmelt often combined with rain in the winter and spring. They are most serious when the ground is frozen, and warm south to southwest chinook winds cause rapid melting of snow.

The floods that occur in late spring and throughout the summer are the results of convective storms, commonly called cloudbursts. This type is common in the Wasco Resource Area but are quite infrequent in the Hood Resource Area.

The low areas along the bank of the Columbia River are also subject to flooding in May and June. The flood of 1894 caused considerable damage to the downtown section of The Dalles.

Several of the small glacier fed creeks in the Hood Resource Area have caused much damage by the rapid melting of the glaciers and sudden release of temporarily ponded water from behind terminal moraines. These have been especially damaging to irrigation facilities and forest lands (photos 22 and 23).

This type flood is often called a mud flow. A Bonneville Power Administration geologist's report on such a disaster on Ladd Creek says, "The flow started at the 6,500 to 7,500 elevation by an avalanche of snow, ice, and rock that temporarily blocked a V-shaped canyon. Melting snow and ice caused a mud flow. For the first four miles it tore out a path 50 to 100 feet wide and 25 feet deep removing trees and canyon fill. At mile point four where the creek spreads out on a large debris fan the mud flow flattened out into a wide sheet 750 feet wide and 1,500 feet long flowing through the forest still removing trees near the main flow or former channel of Ladd Creek".

Sometimes this type flood continues until it gets to the intermediate elevations of the channel where it can demolish bridges and diversion structures. The rock flour is difficult to remove from the water and is extremely abrasive. It can wear out pipes, pumps, impellers and bearings, and sprinkler heads in one season. This "white water" is one of the main water problems of many streams in the Hood Resource Area (photo 24). Because this condition happens during the growing season, it limits the use of much of the water when it is most needed. One of the main purposes of the Middle Fork Hood River watershed P. L. 566 plan is to provide a supply of water free from rock flour. There is need for a long range study to find ways of filtering out the rock flour by natural or artificial means to make this water more useable for irrigation, industry, fish life, and recreation. In some cases it may be possible to divert troublesome glacial water out of streams into another where the water is not needed for these purposes.

Photo 22.--This terminal moraine from Coe Glacier formed a dam of rock and rock flour. When the dam broke at this point in 1958, it caused a flood which scoured the canyon for several miles. Poppino photo. NO. 7

Photo 23.--Typical results of the glacier caused summer flooding in forest land. USDA Survey Party photo. NO. 7-667-1

Photo 24.--When the glaciers are rapidly melting, the water is white as milk with highly abrasive rock flour, Hood Resource Area. SCS photo. NO. 7-1036-12

The problems resulting from other types of floods range from erosion and sedimentation to losses of crops and property. Agricultural damages consisting primarily of crop and property losses account for much of the total evaluated flood damage. Crop damage is especially heavy from floods that occur during the growing season, but the spring and winter ones also often damage crops by washing out roots, seeds, and seedlings. The expenses of removing debris and silt from fields before re-establishing a crop is often almost prohibitive (photo 25).

Man made structures and improvements are often damaged by flooding. The two major cities in the basin, Hood River and The Dalles, have in the past suffered from flood damage. Many country roads are damaged by the destruction of bridges, culverts, undercutting, and sedimentation (photo 26). Municipal water supplies and diversion works are often damaged by high water and sediment.

It is very costly to remove sand, gravel, logs, and other debris deposited in channels, fields, ditches, and other improvements by major floods (photo 27). Sediment is harmful to fish life by altering streamflow characteristics, ruining spawning beds, and reducing food sources.

There is need for more stream channel improvement, bank protection, and storage capacity in reservoirs to reduce flood damages.

Photo 25.--Flood damages by destruction of crops, fences, debris, and sedimentation on Fifteenmile Creek in early spring of 1961, Oregon. SCS photo. NO. 7-1099-9

Photo 26.--Topsoil has been graded off a market road like snow in the Wasco Resource Area, Oregon. SCS photo. NO. 7-1091-5

Photo 27.--A gravel and debris bar has almost filled the channel on Fifteenmile Creek during one flood which caused severe bank erosion, Oregon. SCS photo. NO. 7-1099-1

Erosion. Land damage from erosion, leaching, scour, and deposition contributes a significant part of the total but is difficult to evaluate and is probably inadequately appraised.

Sheet, gully, and rill erosion is the most serious problem on cultivated land left fallow or otherwise unprotected by vegetative cover during the winter months (photo 28).

Erosion on cultivated land is mainly the result of water action as erosion from wind action is usually negligible.

Considerable land is lost through streambank erosion. Damage is usually most prevalent in the swifter portions of the streams, but larger slower portions have also contributed to the total problem. Stream channel work is usually most beneficial when a complete unit of stream channel is improved in a single coordinated project rather than by piecemeal work of individual landowners.

Some arable land is effectively protected from sheet, rill, and gully erosion by perennial sod forming crops. Some annual and clean cultivated perennial crops require annual protection from winter precipitation and overflow. This problem can be solved each year by carefully selecting the time of working and planting fields or by the use of good, well established winter cover crops (photo 29).

Photo 28.--Severe rill erosion on cropland left unprotected during winter months, 1961. Note how rills follow drill tracks, Wasco Resource Area, Oreg. SCS photo. NO. 7-1091-7

Photo 29.--The soil in this cherry orchard is protected by a winter cover crop which is disced into the soil for a green manure crop, Wasco Resource Area. SCS photo. NO. F-338-9

Two other water erosion control practices that are needed to help protect land cropped to annuals are contour cropping and permanent grassed waterways (photo 30).

Photo 30.--A natural waterway is protected by a permanent grass crop, Wasco Resource Area. SCS photo. NO. 7-744-4

In this basin, annual winter cover crops are usually worked into the soil as a green manure crop in the spring to help maintain the organic content of the soil. This helps the soil maintain a high water intake rate and high water-holding capacity.

Sediment produced by erosion of cultivated hill lands in the Wasco Resource Area is one of the most serious problems facing the economic and future agricultural development of this area. It is a serious threat to the development of water since it increases maintenance cost of irrigation structures and shortens the life of all storage reservoirs. It may be the major factor in determining the economic feasibility of some projects.

Irrigation. Irrigation has been a major consumptive use of water in the Hood Drainage Basin since the early days of agriculture. In the Wasco Resource Area irrigation water development has been accomplished mostly by individual efforts. However, recently The Dalles Improvement District was organized to pump water from the Columbia River for 5,420 acres of land. This project is under construction with assistance from the Bureau of Reclamation. The project will furnish supplemental water to existing surface and ground water rights that were developed by individuals and small groups as well as irrigate an additional acreage of dry ground in The Dalles watershed.

Both ground and surface water supply in this area have been quite limited. The State Engineer declared it a critical ground water area in 1959.

In contrast, the Hood Resource Area irrigation has been developed almost entirely by seven organized groups (table 20).

Table 20.--Organized irrigation groups in the Hood Resource Area, Hood Drainage Basin, Oregon, 1962

Item	Irrigated land	Potential irrigation
	Acres	Acres
Aldrich Ditch Company	75	55
Dee Irrigation District	890	310
East Fork Irrigation District	10,700	1,000
Farmers Irrigation Company, Inc.	4,800	300
Hood River Irrigation District	3,201	240
Middle Fork Irrigation District	5,740	2,624
Mount Hood Irrigation District	860	523

Source: State Engineers Report and Hood River County Watershed Committee.

Photo 31.--This large Power Trol Boom sprinkler is introduced on Fifteenmile Creek. SCS photo. NO. RO-732-8

Most of the future irrigation development in the entire basin depends on group action.

Irrigation water is applied by many different methods, but only 16 percent is applied by flooding methods. The trend seems to be to increase the use of sprinklers (photo 31) because the sprinkler method is easier to manage for proper water and land use on the rolling hills of this basin. But to assure maximum benefits and least damage from irrigation even the best designed systems need careful attention to the amount and frequency of water application. Both should be adapted to the soil, crop, and weather. The technical advisor and farmer are in need of more factual information on water-holding capacity and intake rates of the soils to facilitate more efficient use of water and to protect the land from erosion.

Drainage. Approximately 7,500 acres, or less than three percent of the arable soils, have a major wetness problem (table 21). These figures are based upon the Conservation Needs Inventory as some of the basin has not been surveyed, and those areas that have been surveyed have not been summarized by class and problem.

Table 21.--Estimate of soils whose major problem is wetness within land capability classes I-IV and areas needing drainage, Hood Drainage Basin, Oregon, 1963

	Unit	Resource area		
		Hood	Wasco	Total
I	Acres	...	...	...
II	Acres	...	...	...
III	Acres	6,700	...	6,700
IV	Acres	800	...	800
Total	Acres	7,500	...	7,500
Area needing drainage	Acres	3,700	...	3,700
Distribution of soils with major problems of wetness	Percent	100	...	100
Distribution of acres needing drainage	Percent	100	...	100

Source: USDA River Basin Survey Party 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. An estimated 3,700 acres, or about one-half 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 open outlets would also be required in some places.

Forest and Range Land

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 grassland are generally on steep ground where the hazard from water erosion is intensified. Water erosion by rapid runoff of precipitation may be very damaging if protecting vegetation is removed from large areas.

There is need for improvement of the condition of watersheds in the basin. On public land, good watershed management is a matter of public policy which should be strengthened and extended to all phases of forest and range resource management. On private land, good watershed management provides few direct profits to the landowner since he uses little of the water that flows from his land and any reduction in soil fertility due to poor watershed management may not be apparent for a long time. However, good watershed management on 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 in watershed management on private land. There is need for much additional improvement. Some factors that would tend to produce better watershed management are:

1. Greater monetary returns from tree farming would encourage landowners to keep their land in a productive condition and help provide for soil protection. Roads constructed and maintained in a good condition would tend to be a lesser source of 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 and the importance of good watershed management would encourage a gradual improvement in watershed management practices.
3. Increased public pressure from recreationists, fishermen, and other water users would cause many private owners to give greater consideration to good watershed management practices.
4. Enactment and enforcement of stricter 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 watershed management 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 forestry 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 so areas with serious surface erosion, slump, and slide hazards may be recognized. Increased detailed hydrological data for forested watersheds is also needed for better planning of drainage structures on access roads. Timber harvesting methods that minimize watershed damage need to be encouraged.

Planning and timing of logging operations without adequate regard for such factors as soil characteristics, steepness of slopes, and moisture conditions magnifies the erosion hazards. Poorly planned and constructed roads are major sources of erosion. Slash resulting from logging or road right-

of-way clearing that accumulates in streams can block fish passage and pose a threat of flash floods during severe winter storms.

Climatic conditions in the Hood Resource Area are generally favorable for rapid revegetation of cutover forest land. However, skid trails, fire lines, and road cut and fill slopes present major erosion hazards and often need special measures such as adequate drainage and installation of a protective plant and mulch cover (photo 32).

Photo 32.--Roadbank erosion control by vegetative methods on the Bear Creek road. FS Parkdale Ranger District photo. NO. 3

Overgrazing of forest and range land is a serious watershed management problem in the eastern part of the basin (photo 33). Farmers and ranchers graze cattle and sheep on cutover forest land. Some grazed forest land is too steep or has too great an erosion hazard to be suitable for the present intensity of 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 increased production from more suitable cropland pasture.

Conflicts between big game management and other uses have been widespread. Excess game populations are detrimental to good watershed management. There has been deer damage to tree seedlings and farm crops; they also compete with livestock for forage. Control is being attempted through

Photo 33.--Rangeland on the left is overgrazed leaving a hazardous watershed condition and low carrying capacity. SCS photo. NO. 7-137-6

special hunting seasons, issuance of permits for hunting anterless deer, and by providing alternate sources of food for deer.

Many of the ownerships are too small for efficient, profitable management on an individual basis. The owners often lack forestry and range training or experience and will not consult or follow advice from USDA consultants. For these reasons, many small private holdings are rather poorly managed. For instance, data from the 1952 Timber Resources Review indicated that the timber on small private holdings is generally cutover at too small a size for maximum profits, and there is often inadequate provision for regeneration. However, small forest holdings owned by farmers tend to be better managed than those owned by nonfarmers, but 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.

Large ownerships account for most of the land in the principal forest zone of the basin. Generally, watershed management conditions in this zone can be identified with the policies of the landowner or public agency.

The upper slope and alpine forest zones are mostly in federal ownership. Overgrazing of mountain meadows by livestock and heavy use of trails by recreational visitors have contributed to some erosion problems. Problems associated with roads and logging areas may also occur. Here the soils are

shallow and highly susceptible to erosion because of steeper slopes, greater climatic extremes, and the more delicate biological balance of vegetation.

Along with increased knowledge and tools for better watershed management must go increased recognition by forest and range land managers of their responsibility for management of all resources. Management practices that can help enhance watershed values without diminishing the value of forest and grass land for other uses have been stated previously. The public land managers, particularly the men trained in forest or range management, can exert an important influence in encouraging good watershed management practices. They play a dominant role in determining the management of public and private land. Thus, they have an opportunity and responsibility to sell multiple use management of all watershed resources.

WATER DEVELOPMENT

There is a great potential for development of the water resources of the Hood Drainage Basin to better serve all phases of the economy. Ground water, surface water, and stored water can all be used to advantage to help meet the water requirements of the growing population. Provision of adequate water supplies for agriculture will be a major purpose of future water development projects in the basin. For instance, an estimated 21,500 acres of existing and potential cropland could be irrigated if sufficient water supplies were developed. Better utilization of ground and surface 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 phases of water use and control such as flood control, navigation, power, domestic, municipal, industrial, fish, wildlife, recreation, and pollution abatement.

For instance, 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. There will be an increasing demand for water-based recreational opportunities and an increasing need for reservoir projects to include provision for recreational development. Careful planning and consideration of all resource values is 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

Agriculture in the basin already uses considerable ground water. It has been estimated that over 2,000 acres, or about 8 percent of the total irrigated acreage, are presently irrigated from wells (table 22). It accounts for over one-third of the irrigated area of the Wasco Resource Area.

Ground water is still a source for limited future development in some areas of the basin. A ground water shortage has occurred in the vicinity of The Dalles. Records of The Dalles City Hall well indicate a decline in

Table 22.--Reconnaissance data on small watersheds, Hood Drainage Basin, Oregon, 1964

Item	Unit	Wasco Resource Area				Hood Resource Area					
		A	B	C	D	E	F	G	H	I	
						East Fork:			Mid Fork:	West Fork:	
		Fifteenmile:	Eightmile:		Mosier	Hood			Hood	Hood	
		Creek	Creek	The Dalles:	Creek	River	Oak Grove:	Gorge	River	River	Total
Farms	Number	100	60	240	60	220	240	20	240	60	1,240
GENERAL LAND USE:											
Forest land grazed	Acres	18,600	8,700	27,400	16,300	1,200	200	...	...	...	72,400
Forest land not grazed	do.	16,400	20,000	13,800	21,500	73,000	28,600	52,000	27,800	43,500	296,600
Cropland	do.	93,200	31,500	14,000	2,200	7,500	5,300	200	7,000	1,100	162,000
Rangeland	do.	33,000	14,400	29,400	2,800	7,600	300	100	200	200	88,000
Other	do.	2,100	1,100	3,100	1,400	8,200	4,500	6,100	5,500	3,500	35,500
Total watershed area	do.	163,300	75,700	87,700	44,200	97,500	38,900	58,400	40,500	48,300	654,500
CROPLAND USE:											
Dryland	Acres	90,700	30,400	11,600	2,000	500	400	100	1,000	100	136,800
Irrigated land	do.	2,500	1,100	2,400	200	7,000	4,900	100	6,000	1,000	25,200
Water source:											
Streamflow	Acres	2,400	440	800	60	7,000	3,600	100	6,000	1,000	21,400
Storage reservoir	do.	...	360	...	...	...	1,300	...	...	...	1,660
Ground water	do.	100	300	1,600	140	...	...	...	...	...	2,140
Method of application:											
Sprinkler	Acres	1,700	760	2,400	200	6,000	3,900	100	5,400	800	21,260
Gravity	do.	800	340	...	...	1,000	1,000	...	600	200	3,940
Water shortage	do.	2,050	980	800	...	3,600	3,000	...	...	...	10,430
POTENTIAL:											
Potential cropland	Acres	1,000	600	400	200	3,500	2,300	300	2,000	1,000	11,300
Potential available water	Ac. ft.	47,000	25,000	26,000	23,000	296,000	149,000	288,000	260,000	326,000	1,440,000
Potential irrigable land	Acres	8,000	1,000	5,000	1,300	2,000	2,000	100	2,000	100	21,500
Water source:											
Natural flow and ground water	Acres	100	100	500	1,300	100	...	100	2,000	100	4,300
Storage needs	do.	7,900	900	4,500	...	1,900	2,000	...	...	...	17,200
DRAINAGE:											
Land needing drainage	Acres	...	...	...	...	1,000	1,800	...	500	400	3,700
STORAGE:											
Ponds	Number	15	35	20	14	3	7	2	6	2	104
Reservoirs	do.	3	...	1	...	...	...	...	...	...	4
Possible reservoir sites studied	do.	12	4	3	1	...	1	...	...	2	23
FLOODED AREAS:											
Area	Acres	1,500	800	100	10	50	40	100	600	200	3,400

Source: Based on estimates gathered by the USDA River Basin Survey Party from local personnel of the Soil Conservation Service, U. S. Forest Service, County Extension Service, and Agricultural Stabilization and Conservation Service.

the water table of about 52 feet during the 35 year period, September 1928 to September 1963. Recharging experiments in the area indicate possibilities in this field.

Surface Water

Additional individual and group irrigation systems are needed to provide irrigation water for lands that are reasonably close to the Columbia River. In addition to natural flow water, there is water available from the storage reservoirs built by the Corps of Engineers, U. S. Army. Sometimes water can be pumped directly from the stream by individuals or small groups, but it will be necessary to develop major irrigation systems for transmission, control, and delivery of water to larger compact blocks of farmland if the optimum use of this major source of water is to be realized.

Most streams in the Hood Resource Area have a limited amount of natural surface water that can be used beneficially for agriculture.

It is estimated that 4,000 additional acres could be irrigated in the basin from natural flow, ground water, and existing stored water.

Storage

The conservation of excessive, often damaging, runoff water in reservoirs for flood protection and subsequent use for irrigation, industry, domestic, recreation, pollution abatement, and fish life has considerable potential in the Hood Drainage Basin.

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 about 17,000 irrigated acres for optimum agricultural development (table 22). This storage capacity can be developed where and when it is needed. There is a definite potential for more farm ponds and small reservoirs. 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 23 summarizes reconnaissance data assembled by the Department of Agriculture on 23 sites that appear to have some merit and warrant future consideration. The location of these sites are shown in figure 8.

The Bureau of Reclamation and Soil Conservation Service have dams under consideration which would store water for irrigation purposes. 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.

Table 23.--Reconnaissance data on some reservoir sites, Hood Drainage Basin, Oregon, 1964

Watershed and stream	Watershed index	Reservoir index	Location			Drainage area	Estimated annual yield	Storage capacity	Reservoir water depth	Reservoir surface area	Top length of embankment	Estimated embankment volume	Fill ÷ storage	Possibilities
			Township	Range	Section									
	Letter	Number				Sq. mi.	Ac. ft.	Ac. ft.	Ft.	Acres	Ft.	Cu. yds.	Cy/ac.ft. 1/	Uses 2/
Fifteenmile Creek:														
Dry Creek	A	1	1S	14E	16	75.2	12,000	2,000	50	100	900	173,700	87	I,F,R
Do.	A	2	1S	14E	20	60.1	9,600	15,550	120	324	1,400	1,404,200	90	I,F,R
Do.	A	3	1S	14E	29	51.0	8,200	2,000	50	100	900	173,700	87	I,F,R
Trib. Dry Creek	A	4	2S	13E	1	18.0	2,900	5,000	100	125	800	560,000	112	I,F,R
Dry Creek	A	5	2S	14E	18	21.7	3,500	6,000	100	150	1,200	784,000	131	I,F,R
Larch Creek	A	6	2S	13E	15	26.2	11,200	8,000	100	200	1,700	1,064,000	133	I,F,R
Do.	A	7	2S	13E	19	15.6	7,500	5,000	100	125	1,300	840,000	168	I,F,R
Do.	A	8	2S	12E	28	6.2	3,300	900	58	39	700	150,000	167	I,F,R
Fifteenmile Creek	A	9	2S	12E	19	15.5	11,600	3,750	125	75	700	758,300	202	I,F,R,S
Do.	A	10	2S	12E	15	17.8	12,400	19,920	200	249	1,200	2,994,400	150	I,F,R,S
Do.	A	11	2S	12E	14	18.5	12,500	680	55	27	480	109,700	161	I,F,R,S
Ramsey Creek	A	12	2S	12E	3	9.0	5,800	320	53	15	500	105,400	329	I,F,R
Eightmile Creek:														
Eightmile Creek	B	13	1S	12E	26	21.0	7,300	3,750	125	75	700	716,200	191	I,F,R
Do.	B	14	1S	13E	19,30	30.8	10,400	10,000	200	125	900	2,138,900	214	I,F,R
Jap Hollow	B	15	1N	14E	31	11.5	2,700	3,670	70	131	900	319,300	87	I,F,R
Fivemile Creek	B	16	1N	13E	25	33.3	10,600	3,390	80	106	600	260,000	77	I,F,R
The Dalles:														
Rowena Creek	C	17	2N	12E	16	5.0	1,100	610	80	19	400	185,700	304	I,F,R
Chenoweth Creek	C	18	2N	12E	36	19.9	5,300	790	53	37	500	123,300	155	I,F,R,S
Mill Creek	C	19	1N	11E	25	8.8	4,700	330	65	13	200	57,900	175	I,F,R,S
Mosier Creek:														
Mosier Creek	D	20	2N	12E	31	22.9	8,900	6,400	160	100	900	1,558,300	243	I,F,R
Oak Grove:														
Green Point Creek	F	21	1N	9E	11	20.0	80,400	1,240	100	31	550	392,000	316	I,R
West Fork Hood River:														
Lake Branch	I	22	1N	9E	29	25.1	99,000	7,890	186	106	400	934,600	118	I,R
Do.	I	23	1N	8E	26	10.6	52,200	8,960	200	112	700	1,834,700	205	I,R

1/ A comparative figure derived from dividing the estimated earth fill in cubic yards by the estimated water storage capacity in acre feet.
2/ I-irrigation, F-flood protection, R-recreation--fishing, hunting, and boating, S-water supply--industrial, municipal, and domestic.

Source: Based on a survey by the U. S. Department of Agriculture Survey Party.

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 Party made a survey of the potential for P. L. 566 work in the Hood Drainage Basin to provide information as a guide to long range coordination and planning of possible future projects. The basin was divided into nine tributary watershed areas which are designated by letter and are delineated on figure 8. A preliminary survey was made of each watershed to gather basic reconnaissance data on land and water use and water related problems, which are summarized in tables 4 and 22.

Information in these tables is based upon estimates by local personnel of the Soil Conservation Service, County Extension Service, Agricultural Stabilization and Conservation Service, and the Forest Service. Although it is of a reconnaissance nature, published material such as the U. S. Census of Agriculture was used as a cross check on many items. Data from this survey have been 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, it was decided many of the water related problems of the Hood 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 party's findings indicate that watershed with the best possibilities for P. L. 566 action have a combination of some of the following conditions:

1. Part of the watershed is at higher elevation with relatively high water yields.
2. The watershed contains highly erodible soils that are subject to action from wind and/or water.
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 which are not influenced by flooding of large streams outside the watershed under consideration.
6. The watershed contains one or more storage sites which appear feasible for multipurpose 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 and drainage problems that are beyond 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 or lack of a potential water supply.

ADDITIONAL FACTORS

There are several factors that were not taken into account in this study that may affect the feasibility of a given watershed for P. L. 566 action:

1. Changes in basic laws and policies to give greater recognition to land treatment, flood control, recreation, wildlife, and fish life benefits would improve the possibility for P. L. 566 action in several watersheds.
2. Unforeseen demands for water arising from increased urbanization, industrialization, and demand for certain agricultural

FIGURE 8

INDEX MAP OF WATERSHED AREAS AND POSSIBLE RESERVOIR SITES

HOOD DRAINAGE BASIN

OREGON

FEBRUARY 1964

SCALE IN MILES 0 1 2 3 4 5

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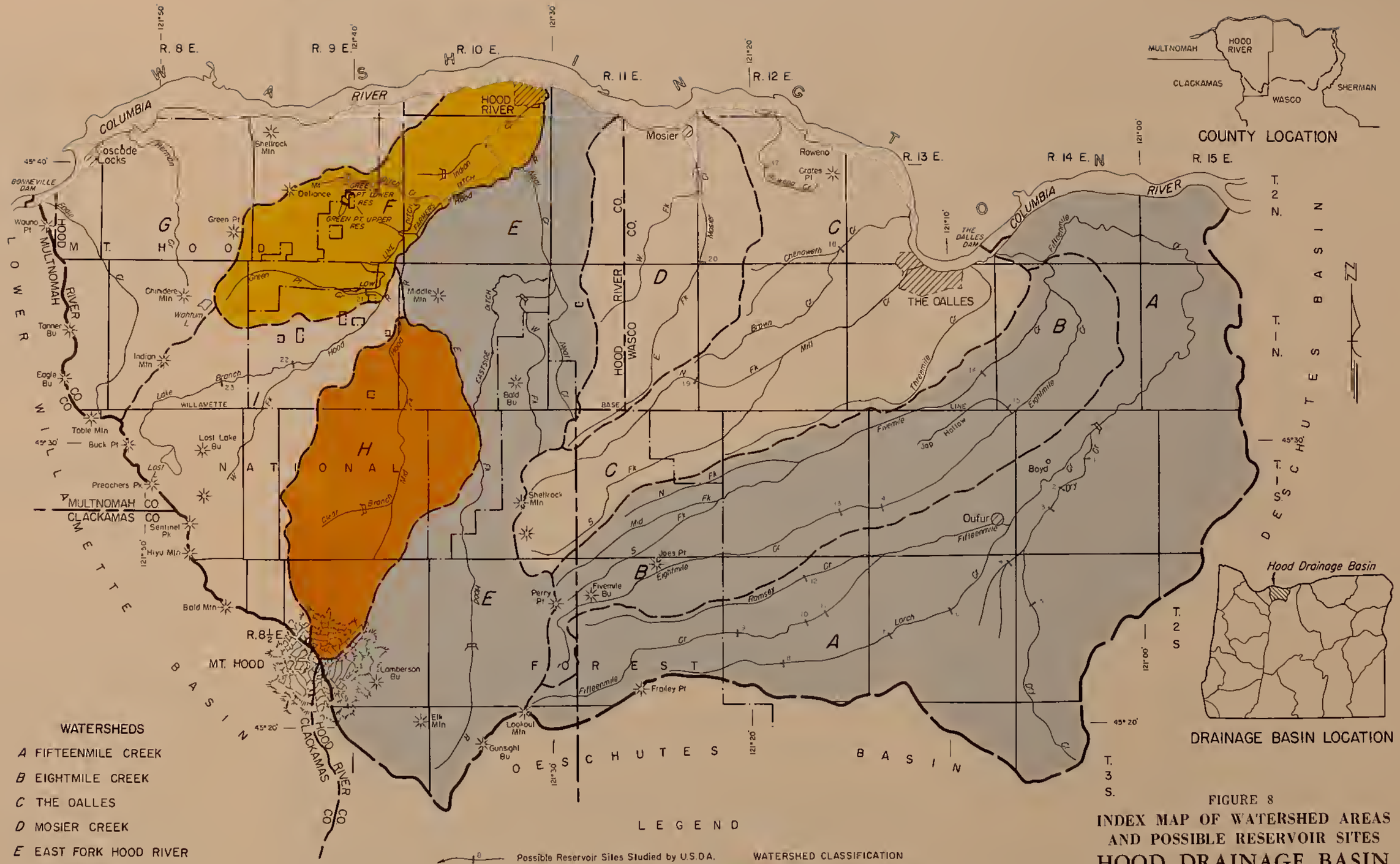

WATERSHEDS

- A FIFTEENMILE CREEK
- B EIGHTMILE CREEK
- C THE DALLES
- D MOSIER CREEK
- E EAST FORK HOOD RIVER
- F OAK GROVE
- G COLUMBIA GORGE
- H MIDDLE FORK HOOD RIVER
- I WEST FORK HOOD RIVER

LEGEND

- Possible Reservoir Sites Studied by U.S.D.A.
- Possible Reservoir Sites Studied by Others
- Watershed Boundary and Letters
- River Basin Boundary
- National Forest Boundary

WATERSHED CLASSIFICATION

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

U.S. DEPARTMENT OF AGRICULTURE SOIL CONSERVATION SERVICE M-4039

FIGURE 8

INDEX MAP OF WATERSHED AREAS AND POSSIBLE RESERVOIR SITES

HOOD DRAINAGE BASIN

OREGON

FEBRUARY 1964

SCALE IN MILES 0 1 2 3 4 5

7-E-17559-N

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 Bureau of Reclamation projects. Such small watershed projects could be supplementary to the larger project.
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, changing the boundaries of an area proposed for small watershed development 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 adversely affecting the possibilities 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 party's findings are presented in individual watershed reports summarized in table 24 and shown on figure 8.

Table 24.--Summary of watershed reports, Hood Drainage Basin, Oregon, 1963

Watershed	Project possibilities under P. L. 566
A. Fifteenmile Creek.....	A project including flood protection, land treatment, and water development for irrigation, municipal, and recreation use appears to be feasible.
B. Eightmile Creek.....	A project including flood protection, land treatment, and water development for irrigation and recreation appears to be feasible.
C. The Dalles.....	The Dalles Project for irrigation by the Bureau of Reclamation is under construction. It will reduce the benefits for other projects in the watershed, but a project might be feasible in conjunction with it to give flood protection, land treatment, and water development for recreation and irrigation.

Table 24.--Summary of watershed reports, Hood Drainage Basin, Oregon, 1963--Continued

Watershed	Project possibilities under P. L. 566
D. Mosier Creek.....	An application for a project by the Bureau of Reclamation under the Small Project Act has been filed, and engineering plans are being made. If this project does not materialize, a project under P. L. 566 might be feasible.
E. East Fork Hood River....	A project involving flood protection, drainage, land treatment, and water development for irrigation and recreation appears to be feasible.
F. Oak Grove.....	An application for a P. L. 566 plan has been received and approved. A project for water development for irrigation and recreation, flood protection, and land treatment appears to be feasible.
G. Columbia Gorge.....	A project does not appear to be feasible under existing conditions and laws.
H. Middle Fork Hood River..	A project under P. L. 566 is in the construction stage to develop water for irrigation and recreation.
I. West Fork Hood River....	A project has little possibility under existing conditions and laws.

Reconnaissance reports for each watershed are presented as follows.

Watershed A, Fifteenmile Creek

Description. The Fifteenmile Creek watershed, a tributary of the Columbia River, contains 163,300 acres in Wasco and Hood River Counties. It is in the Central Wasco and Hood River Soil and Water Conservation Districts. Fifteenmile Creek originates on Lookout Mountain and flows in a northeasterly direction through Dufur toward the Columbia River. It changes to a westerly direction in the lower reaches of the watershed and empties into the Columbia River near The Dalles Dam. The watershed is about 40 miles long and 2 to 12 miles wide. Elevations range from 6,525 feet on Lookout Mountain to around 120 feet at the Columbia River. Average annual precipitation ranges from 10 to 44 inches with 11.4 inches at Dufur. The average growing season in the Dufur area is 137 days, increasing in the lower watershed to 214 days at Big Eddy.

Upland soils developed from loess and volcanic materials, and recent alluvial soils occur in this watershed. The loessial soils, Walla Walla,

Dufur, Condon, Nansene, Wrentham, Starbuck, Lickskillet, and Bakeoven, covering more than half of the watershed, are the most productive. Walla Walla, Dufur, and Condon, moderately deep to deep, medium textured, well drained soils, are used mainly for cropland. Erosion control on steeper slopes is the major management consideration, and under irrigation they are good to excellent. Nansene and Wrentham on the steep north exposures, Starbuck and Lickskillet on the moderate to steep south exposures, and Bakeover "scabland" on ridgetops are used mostly for range. West of Dufur is an area of Wamic, Frailey, and Skyline soils which were developed from volcanic ash and Dalles sediments. Wamic, an erodible, moderately deep to deep, medium textured, well drained soil on nearly level to sloping hilltops, is used mostly for cropland. Frailey, a deep soil on the steep north exposures, is used for forest and range, and Skyline, a shallow stony soil on steep south exposures, is used for range. The soils of the higher elevations, Hutson and Fouts, are deep to very deep, medium textured, well drained and are used for forest. Miscellaneous land types interspersed throughout the watershed are escarpments of Dalles formation and talus, bluffs, and escarpments of basalt. Table 4 shows the estimated acreage by land capability class and subclass. Recent alluvial soils occurring along the streams are used for irrigated and nonirrigated cropland and pasture. Onyx, a medium textured, well drained soil, is very well suited for irrigation. Tygh, a gravelly and imperfectly drained soil, has tillage and drainage problems.

About 144,800 acres are used for the production of either crops or livestock. Of this acreage, 93,200 acres are crop; 33,000 acres are range; and 18,600 acres are grazed forest. Approximately 2,500 acres of cropland are irrigated with pasture and hay accounting for the largest acreage; some grain and vegetable crops are also irrigated. Grain, pasture, and hay are raised on the nonirrigated cropland. There are about 100 farms in the watershed.

This watershed, with its 35,000 acres of forest land, is the source of municipal water for Dufur. There has been only minor timber harvesting, and from Lookout Mountain it appears almost untouched. The upper slope forests are old growth true firs and hemlock which give way to ponderosa pine, Douglas-fir, and associated species at lower elevations. The pine, which is found mainly on the south slopes, gives way to grass and scrub oak near the forest boundary.

Watershed Problems and Needs. Approximately 1,500 acres are flooded annually in this watershed. Flood damage in forested areas, in general, is limited to minor streambank erosion; this is also a problem on rangeland in addition to considerable rill and gully erosion. Croplands are subject to considerable gully and sheet erosion damage on class II through VI land. They also suffer severe damage from deposition of silt and debris. The upstream reaches of Fifteenmile Creek above Boyd experience severe channel and streambank erosion. Flooding is also a problem to farm facilities, roads, and bridges; debris and silt cause expensive cleanup and maintenance. Some years the city of Dufur has experienced damage from flooding.

Estimates show that 8,000 acres of additional land are readily suitable for irrigation development. At present, streamflow is inadequate early in July for 85 percent of the irrigated acreage. Reservoir storage is needed for supplementary irrigation as well as for potential irrigation development.

Several reservoir sites (index numbers 1 through 12) were studied in this watershed. There are also numerous other sites suitable for smaller structures. Some of these sites are suitable for multipurpose structures while others due to location and capacity would have only limited use. The city of Dufur places its citizens on a rotation system for watering yards in the summer because of inadequate supply.

Opportunities under P. L. 566. A project appears to be feasible that includes irrigation, flood protection, land treatment, recreation, municipal water development, and possibly wildlife uses. Some small tributaries within this watershed might be feasible as separate projects.

Watershed B, Eightmile Creek

Description. The Eightmile Creek watershed, a tributary of Fifteenmile Creek, contains 75,700 acres in Wasco and Hood River Counties. It is in Central Wasco, North Wasco, and Hood River Soil and Water Conservation Districts. Eightmile Creek flows in a northeasterly direction from the mountains to its confluence with Fifteenmile Creek near Petersburg. Fivemile Creek is an important tributary in this watershed. The watershed is about 28 miles long and averages 4 miles wide. Elevations vary from 5,500 feet in the upper reaches to 280 feet where it joins Fifteenmile Creek. Average annual precipitation ranges from 11 to 42 inches. The average growing season in the agricultural area is around 175 days.

Three genetically different areas of upland soils occur in the watershed. On the lower elevations, Walla Walla, Dufur, Nansene, Starbuck, and Bakeoven, developed from loess, are the most productive. Walla Walla and Dufur are moderately deep to deep, medium textured, and well drained. They are used mainly for cropland, the major management problem is erosion control on steeper slopes, and they rate good to excellent for irrigation. Nansene on the steep north exposures, Starbuck on the moderate to steep south exposures, and Bakeoven "scabland" on ridgetops are used mostly for range. Wamic, Frailey, and Skyline in the intermediate area were developed from volcanic ash and Dalles sediments. Wamic, an erodible, moderately deep to deep, medium textured, well drained soil on nearly level to sloping hilltops, is used mostly for cropland. Frailey, a deep soil on the steep north exposures, is used for forest and range, and Skyline, a shallow stony soil on steep south exposures, is used for range. The soils of the higher elevations, Hutson and Fouts, are deep to very deep, medium textured, well drained and are used for forest. Miscellaneous land types interspersed throughout the watershed are Dalles formation escarpments and basalt bluffs, escarpments, and talus. Recent alluvial soils occurring along the streams are used for irrigated and nonirrigated cropland and pasture. Onyx, a medium textured, well drained soil, is very well suited for irrigation. Yakima, a moderately coarse textured soil, is well suited for irrigation. Tygh, a gravelly and imperfectly drained soil, has tillage and drainage problems.

About 54,600 acres are used for the production of either crops or livestock. Of this, 31,500 acres are crop; 14,400 acres are range; and 8,700 acres are grazed forest. Approximately 1,100 acres are irrigated; hay, pasture, and grain are the principal crops. Grain is the main dryland crop with some acreage in hay and pasture. There are about 60 farms in the watershed.

The 28,700 acres of forest land in this watershed are found mainly in the Mount Hood National Forest. In the upper sections of the watershed, the timber on the south slopes is thin and scattered while rather dense stands of Douglas-fir and associated species are found on the north slopes. The cover on south slopes and ridgetops changes to oak-grass in the middle portion of the drainage.

Watershed Problems and Needs. Up to 800 acres flood annually. Forest land receives some minor damage from streambank erosion. Rangeland also has minor streambank erosion along with considerable gully and rill erosion. Croplands are subject to considerable gully and sheet erosion damage on class II through VI land; silt and debris deposition is also a severe problem. Floodwaters cause a serious maintenance problem to irrigation diversion ditches and facilities. Maintenance is also an expensive item on fences, roads, and bridges due to debris and silt deposits.

Estimates show an additional 1,000 acres of land suitable for irrigation development. Approximately 10 percent of this potential could be irrigated from ground water with the remainder requiring storage. At present, a large percentage of the irrigated land experiences a water shortage early in the summer.

Four reservoir sites (index numbers 13 through 16) having a potential storage of over 20,000 acre feet were investigated. One site on Jap Hollow Gulch is in the same location as a larger site investigated by others with a storage potential of 25,000 acre feet. These sites could provide flood protection, water for irrigation, recreation, and wildlife.

Opportunities under P. L. 566. A project that would include flood protection, land treatment, water development for irrigation, recreation, and wildlife appears to be feasible under present laws.

Watershed C, The Dalles

Description. The Dalles watershed contains an area of 87,700 acres in Wasco and Hood River Counties. This area includes three major streams, Threemile Creek, Mill Creek, and Chenoweth Creek, all of which are tributary to the Columbia River. It is in North Wasco, Central Wasco, and Hood River Soil and Water Conservation Districts. The watershed is about 20 miles long, originating in the Shellrock Mountain area and extending to the city of The Dalles. Rowena Creek is also included in this watershed. Elevations range from 4,900 feet in the upper reaches to around 100 feet along the Columbia River. Average annual precipitation ranges from 12 to 46 inches with 13.8 inches at The Dalles. The average growing season is about 200 days in the principal agricultural areas of the watershed.

In this watershed, there are upland soils from volcanic, aeolian, and sedimentary materials, terrace soils from sedimentary materials, and floodplain soils of recent alluvium. The upland soils, Bins, Ketchum, Bald, Crates, Skyline, Frailey, and Wamic, are moderately deep to very deep, moderately coarse to moderately fine textured, and well to somewhat excessively drained. Associated with these soils there are rockland, riverwash, rock outcrops, rubble land types. Wamic and Crates are used for forest, range, and crops. Bins is used for forest and range; Ketchum is used for forest;

and Skyline and Bald are used for range. Wamic and Crates are fairly well suited for irrigation. Chenoweth and Cherryhill are medium textured, well drained, terrace soils. Chenoweth is very deep and is very well suited for orchard production and irrigation. Erosion control on the steeper slopes is the major problem on these soils. The recent alluvial soils, Onyx, Yakima, and Tygh, are moderately deep to deep, moderately coarse to medium textured, imperfectly to somewhat excessively drained. Onyx and Yakima are adapted for irrigation and have few management problems. Tygh is rated poor for irrigation and has cultivation problems from gravel and wetness; it is used mostly for pasture.

About 70,800 acres are used for the production of agricultural products. Of this, 27,400 acres are grazed forest; 29,400 acres are in range; and 14,000 acres are cropped. Approximately 2,400 acres are irrigated producing fruit, pasture, hay, and vegetables. The nonirrigated land is producing grain, fruit, pasture, and hay. There are about 240 farms in the watershed. Two irrigation districts, The Dalles Improvement District and Chenoweth Irrigation District, are active in this area.

The Dalles watershed contains approximately 41,200 acres of forest land. South Fork Mill Creek is the source of municipal water for The Dalles. The timber in this watershed is composed of thrifty poles and saplings with areas of over mature old growth Douglas-fir and associated species in the upper reaches. The middle portion of the watershed has conifers on the north and east slopes with grass on the west slopes. The conifers are mainly Douglas-fir and associated species from pole to small sawtimber size. The south slopes have open stands of ponderosa pine and grass. Proceeding down the drainage, oak and grass take over with the oak giving way to grass as the rainfall decreases.

In the Threemile Creek drainage, oak is found in rather dense stands along the streams and slopes with grass and wheat land on the flat ridgetops.

Watershed Problems and Needs. Approximately 100 acres are flooded annually in the Mill Creek drainage. Flooding is very minor on the other tributaries of this watershed. Some minor streambank erosion occurs throughout the watershed on all streams. Considerable gully and rill erosion occurs on cropland. Flooding has caused minor damage to fences, roads, and small bridges.

Before the city-owned-land in The Dalles watershed area was managed cooperatively by the Forest Service, logging severely damaged some of the area. After many years, the scars are starting to heal, but the lands have not yet reforested.

Estimates show an additional 5,000 acres to be suitable for irrigation. At present, the area irrigated from wells has sufficient water for the irrigation season, but that irrigated from streamflow is short by the middle of June. Storage will be required for any additional land and to supplement the area irrigated from streamflow.

Three reservoir sites (index numbers 17, 18, and 19) were studied in the watershed, one on Rowena Creek, one on Chenoweth Creek, and one on Mill Creek.

There have also been investigations by others on these streams, but it appears the Columbia River is the best source of water for the lower area.

Opportunities under P. L. 566. The Dalles Project for irrigation by the Bureau of Reclamation is under construction. This project will reduce the benefits for other projects in the watershed, but a project might be feasible in conjunction with it to give flood protection, land treatment, and water development for recreation and irrigation.

Watershed D, Mosier Creek

Description. The Mosier Creek watershed, a tributary of the Columbia River, contains 44,200 acres in Wasco and Hood River Counties. It is in North Wasco, Central Wasco, and Hood River Soil and Water Conservation Districts. Mosier Creek flows in a northerly direction from the mountains to its confluence with the Columbia River at Mosier. The watershed is about 13 miles long and averages 2 1/2 miles wide. Elevations range from 4,185 feet to about 100 feet at Mosier. Average annual precipitation is about 28 inches ranging from 22 to 40 inches. The average growing season in the agricultural area is around 200 days.

The upland area is large, but the terrace and floodplain areas are small in this watershed. On the upland Bins, Ketchum, Bald, Crates, Skyline, Frailey, and Wamic soils and some miscellaneous land types have developed from volcanic, aeolian, and sedimentary parent material. The soils are moderately deep to very deep, moderately coarse to moderately fine textured, well to somewhat excessively drained. The miscellaneous land types are rockland, riverwash, rock outcrops, and rubble land. The Wamic and Crates are used for forest, range, and crops. Land use is forest and range on Bins, forest on Ketchum and Frailey, and range on Skyline and Bald. Wamic and Crates are rated fair for irrigation. The terrace soils, Chenoweth and Cherryhill, are moderately deep to very deep, medium textured, and well drained. They are well suited for orchards and are good to excellent under irrigation. Yakima and Tygh are gravelly, moderately textured, recently alluvial soils. Yakima is somewhat excessively drained and is well suited for cultivation and irrigation. Tygh is imperfectly drained, used for pasture, and poorly adapted to irrigation.

About 21,300 acres are used either for the production of crops or livestock. Of this 16,300 acres are grazed forest; 2,800 acres are range; and 2,200 acres are crop. Approximately 200 acres are irrigated fruit, pasture, and hay. Hay, pasture, fruit, and grain are raised on the nonirrigated land. There are about 60 farms in the watershed.

The 37,800 acres of forest land in this watershed are almost exclusively privately owned and outside the national forest. The upper portions of the watershed have forest conditions typical to the Wasco Resource Area. The north and east slopes have pole size stands of Douglas-fir and associated species while the south and west slopes support stands of ponderosa pine. The forest cover in the lower portions is composed of oak and grass on the ridgetops with ponderosa pine on the slopes and rougher ground.

Watershed Problems and Needs. Flooding is minor with only about 10 acres being affected. Rangeland and cropland receive minor damage from erosion.

Estimates show that 1,300 acres of additional land is suitable for irrigation.

A reservoir site (index number 20) with a storage potential of 6,400 acre feet was studied. A report has been prepared by a private engineering firm for the Mosier Irrigation District under the Small Project Act of the Bureau of Reclamation showing a reservoir site farther downstream. Water from the Columbia River should also be considered for development within this watershed.

Opportunities under P. L. 566. An application for a project by the Bureau of Reclamation under the Small Project Act has been filed, and engineering plans are being made. If this project does not materialize, a project under P. L. 566 might be feasible.

Watershed E, East Fork Hood River

Description. The East Fork Hood River watershed, a tributary of the Hood River, contains 97,500 acres in Hood River County. It is in the Hood River Soil and Water Conservation District. The East Fork Hood River originates on the east slopes of Mount Hood as Clark and Newton Creeks. It flows in a northerly direction until it joins the West Fork to form Hood River which enters the Columbia River at the city of Hood River. The watershed is about 30 miles long and from 2 to 8 miles in width. Elevations range from 11,245 feet on Mount Hood to around 100 feet at the Columbia River. Average annual precipitation ranges from 25 to 100 inches. The average growing season is 135 days in the agricultural area of the watershed.

Upland soils from volcanic and sedimentary material, terrace soils from volcanic ash, lacustrine, colluvial, and glacial sediments, and floodplain soils of recent alluvium occur in this watershed. The upland soils are Hutson, Bins, Fouts, Divers, Wygant, Yallani, Ketchum, Frailey, Bald, and miscellaneous land types. The soils are moderately deep to very deep, medium to moderately fine textured, well to somewhat excessively drained. The miscellaneous land types include riverwash, basalt and andesite bluffs, escarpments, rockland, Dalles formation escarpments, and talus. Forest is the main land use on all except Bins and Frailey which have both forest and range and Bald which has only range. The terrace soils, Wind River, Hood, Wyeast, Van Horn, Oak Grove, Rockford, Parkdale, Pooley, Bassler, and Dee, are moderately deep to very deep, moderately coarse to moderately fine textured, poorly to excessively drained. The floodplain soils, Bonneville, Wyeth, Winans, Gilhouly, and Culbertson, are moderately deep to very deep, moderately coarse to moderately fine textured, moderately well to somewhat excessively drained. The terrace and floodplain soils are adapted to orchard, pasture, hay, grain, and forest production. An estimate of the acreage of land in each land capability class and subclass is shown in table 4. Rockford, Bassler, and Dee are rated fair for irrigation, and the other soils rate good to excellent. Hood, Oak Grove, Wyeth, Culbertson, and Parkdale possess few management problems except for erosion control on the steeper slopes. Moderately coarse textured profiles in the Wind River and Bonneville cause a drought-

iness problem. Van Horn, Wyeast, Winans, Bassler, and Dee have drainage problems caused from fragipans, fine textured subsoils, or depressional position. Rocks or gravels in the Rockford, Gilhouly, and Pooley increase cultivation problems.

About 16,300 acres of land are used for agricultural production. Of this 7,600 acres are range; 7,500 acres are crop; and 1,200 acres are grazed forest. Over 90 percent of the cropland is irrigated fruit, hay, pasture, and berries. The dry farmed area is hay and pasture. There are about 220 farms in the watershed.

Two irrigation districts serve this watershed, the East Fork Irrigation District and the Mount Hood Irrigation District.

There is approximately 74,200 acres of forest land. The forest cover varies from twisted pines and true firs at timberline to Douglas-fir and hemlock sawtimber in the upper valley. The forest cover remaining in the middle and lower valley is mainly Douglas-fir and hemlock poles with intermixed areas of brush. A portion of the watershed is included in the Mount Hood Wild Area where it is reserved from timber harvest.

Watershed Problems and Needs. Approximately 50 acres are flooded annually with minor damage. There is some minor damage to irrigation facilities resulting from debris and sediment deposits. Estimates show 1,000 acres of arable land are in need of improved drainage practices. This problem could be relieved through the installation of tile drains. Approximately 2,000 acres of additional land are suitable for irrigation. To develop this potential, water storage would be required. Two large reservoir sites have been investigated by others, one on the East Fork Hood River at Horsethief Meadows and the other on the West Fork Neal Creek. The total combined storage is around 56,000 acre feet. The sediment load carried in the glacial fed streams is a major problem. This sediment or rock flour is difficult to filter out of the water and has an extremely abrasive character.

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

Watershed F, Oak Grove

Description. The Oak Grove watershed contains 38,900 acres in Hood River County. It is in the Hood River Soil and Water Conservation District. There are three principal drainages in the watershed--Indian Creek, Ditch Creek, and Green Point Creek. The watershed is about 16 miles long and averages 4 miles in width. Elevations range from 4,960 feet on Mt. Defiance to around 100 feet along the Columbia River. Average annual precipitation ranges from 29 to 95 inches. The average growing season in the agricultural area is about 135 days with 165 days at the Hood River Experiment Station.

In this watershed there are upland soils from volcanic materials, terrace soils of lacustrine, colluvial, and glacial sediments, and floodplain soils of recent alluvium. The upland soils, Bins and Fouts, are moderately deep to very deep, medium to moderately fine textured, and well drained. They are all well suited for forest use. The terrace soils, Wind River,

Hood, Van Horn, Wyeast, Oak Grove, and Rockford, are moderately deep to very deep, moderately coarse to moderately fine textured, and poorly to excessively drained. The floodplain soils, Bonneville, Winans, Gilhouly, and Culbertson, are moderately deep to very deep, moderately coarse to moderately fine textured, moderately well to somewhat excessively drained. The terrace and floodplain soils are adapted to orchard, pasture, hay, grain, and forest. An estimate of the acreage of land in each land capability class and subclass is shown in table 4. Most of the soils are rated good to excellent for irrigation except Rockford which is fair, and Bins and Fouts are unsuitable for irrigation. Hood, Oak Grove, and Culbertson soils possess few management problems except for erosion control on the steeper slopes. A droughtiness problem in the Wind River and Bonneville is caused by moderately coarse textured profiles. Van Horn, Wyeast, and Winans have drainage problems caused from fragipans, fine textured subsoils, or depressional position. Rocks or gravel in the Rockford and Gilhouly cause tillage problems.

About 5,800 acres are used for agricultural production; of this 200 acres are grazed forest; 300 acres are range; and 5,300 acres are cropped. Approximately 4,900 acres of crops are irrigated orchards, hay, pasture, berries, and some grain. Pasture and hay are the only nonirrigated crops. There are about 240 farms in this watershed. Two irrigation organizations supply most of the water in the watershed; they are Hood River Irrigation District and Farmers Irrigation Co., Inc.

The 28,800 acres of forest are concentrated in the upper two-thirds with fingers of Douglas-fir poles and hardwoods reaching into the agricultural land. There are extensive areas of good quality small sawtimber and pole stands between the community of Oak Grove and Upper Green Point Reservoir. In the many recent cutover areas alder and vinemaple have crowded out the commercial timber species.

Watershed Problems and Needs. Approximately 40 acres are subject to annual flooding. Some silt and debris deposition occurs, but damage is negligible. About 1,800 acres of arable land are in need of improved drainage, mostly in the form of tile systems. Estimates show that an additional 2,000 acres of land are suitable for irrigation development. Additional reservoir storage will be needed. Two sites have been proposed in a P. L. 566 application, one on Indian Creek storing about 1,700 acre feet and the Cedar Swamp site on the North Fork Ditch Creek. An additional site was studied on Green Point Creek with a potential storage of 1,200 acre feet. There is also a need to improve ditches to reduce water losses.

Opportunities under P. L. 566. An application for a P. L. 566 plan has been received and approved. A project for water development for irrigation and recreation, flood protection, and land treatment appears to be feasible.

Watershed G, Columbia Gorge

Description. The Columbia Gorge watershed contains 58,000 acres in Hood River and Multnomah Counties. It is in the Hood River and East Multnomah Soil and Water Conservation Districts. The watershed consists of several creeks tributary to the Columbia River; the largest are Eagle Creek and Herman Creek. The watershed is a triangular area whose north boundary is the Columbia River from Bonneville Dam and continuing upstream for 19

miles. Elevations in the watershed range from 4,960 feet on Mt. Defiance to around 100 feet along the Columbia River. Average annual precipitation ranges from 45 to 125 inches with 76.6 inches at Cascade Locks. The average growing season in the agricultural area is 222 days.

This watershed is an upland area composed of volcanic materials. The soils developed from this material are Bins, Fouts, and miscellaneous land types. The soils are moderately deep to very deep, medium to moderately fine textured, and well drained. The miscellaneous land types include riverwash, basalt bluffs and escarpments, and talus. The recent alluvial soils along the deeply incised streams include Bonneville, Winans, and Culbertson. They are moderately deep to very deep, moderately coarse to moderately fine textured, and moderately well to somewhat excessively drained. All the soils are suited for the production of forest; the recent alluvial soils are also suited for production of pasture and orchard. The minor quantity of land which is suited for irrigation is rated good to excellent. Management problems vary from droughtiness and erosion control to tillage problems.

About 300 acres are used for agricultural production. One-third of this acreage is range and one-third nonirrigated hay and pasture. The 100 acres of irrigated land produce pasture, hay, fruits, and vegetables. There are about 20 farms in the watershed.

The watershed with its 52,000 acres of forest land is characterized by the rocky cliffs and deep, steep canyons which are found at the northern edge. The sawtimber has been removed from the accessible private land. Sawtimber and poles are found on flat ridgetops and stream bottoms on national forest land in the southern portion of the watershed. The steep, rocky slopes support thin stands of Douglas-fir.

A survey is being conducted of this watershed to determine its value for recreation use. Under consideration are proposals for aerial tram ways from the highway to viewpoints on the canyon wall, wild area classification for portions of the Eagle Creek drainage, scenic area withdrawals for the cliff area, and other uses. This study is considering all resources and potential uses while attempting to determine the most beneficial use and directing multiple use management to enhance it.

Watershed Problems and Needs. About 100 acres are flooded annually. This is mostly Columbia River frontage with minor damage. Some flooding also occurs along the lower reaches of Herman and Eagle Creeks. Estimates show that an additional 100 acres are suitable for irrigation. There is an adequate water supply in this watershed for all present and potential irrigation.

The main potential of the river frontage along the Columbia River is for recreation.

Opportunities under P. L. 566. A project does not appear to be feasible under existing conditions and laws.

Watershed H, Middle Fork Hood River

Description. The Middle Fork Hood River watershed, a tributary of Hood River, contains 40,500 acres in Hood River County. It is in the Hood River

Soil and Water Conservation District. The Middle Fork Hood River flows from Mount Hood to the north joining the East Fork to form Hood River which joins the Columbia at the city of Hood River. The watershed is 14 miles long and averages about 4 miles wide. Elevations range from 11,245 to 1,150 feet. Average annual precipitation ranges from 43 to 105 inches with 46 inches at Parkdale. The irrigated area has a frost-free growing season of about 110 days.

The parent material of the soils is of volcanic source. The upland soils, Hutson, Bins, Fouts, Divers, Wygant, Yallani, and miscellaneous land types, have developed from basalt, andesite, consolidated breccias and tuffs, and volcanic ash. They are moderately deep to very deep, medium to moderately fine textured, and well drained. Divers, Wygant, and Yallani are very stony or gravelly, and Bins is stony. Miscellaneous land types include steep stony slopes along drainageways, basalt and andesite bluffs, escarpments, talus, lava flows, and rock slides. The upland soils are used mostly for forest. An estimate of the acreage of land in each land capability class and subclass is shown in table 4. The terrace soils, Parkdale, Bassler, and Dee, have developed from volcanic ash. They are moderately deep to very deep, medium textured, and imperfectly to well drained. They are used for orchard, hay, pasture, and forest. Parkdale is rated excellent for irrigation and has few management problems except erosion control on steeper slopes. Bassler and Dee are rated fair for irrigation. They have a drainage problem caused by a depressional position. The recent alluvial soils are Bonneville, Winans, Gilhouly, and Culbertson. They are moderately deep to very deep, moderately coarse to moderately fine textured, and moderately well to somewhat excessively drained. Orchard, hay, pasture, and forest is the land use. They are rated good for irrigation. Management problems result from droughtiness and drainage.

About 7,200 acres are used for agricultural production. Of this 200 acres are in range, and 7,000 acres are cropped. Approximately 6,000 acres are irrigated with fruit as the principal crop. Pasture, hay, and berries are also grown under irrigation. The nonirrigated cropland is used to produce pasture and hay. There are about 240 farms in the watershed. This watershed is served by the Middle Fork Irrigation District.

The 27,800 acres of forest land are found from the lower end of the watershed to the upper limits of tree growth on Mount Hood. The forest cover consists of all ages and sizes of several species including Douglas-fir, western hemlock, mountain hemlock, true firs, and various species of hardwoods. Except for the action of the glaciers, the watershed is reasonably stable.

Watershed Problems and Needs. Approximately 600 acres of land are flooded annually with damage being extensive in the higher areas. The Coe Branch bridge has been destroyed several times as a result of high water from glacial melt. There is also severe erosion damage along Coe Branch channel and Eliot Branch.

The sediment load carried by the glacier fed streams is a major problem. This problem causes extensive damage due to its abrasive character.

About 500 acres of arable land needs improved drainage from closed drains.

Estimates show an additional 2,000 acres of land suitable for irrigation. Streamflows are adequate to irrigate this area, but the quality of water needs improving. A reservoir is to be built on Clear Branch to store a sediment free water supply.

Land treatment measures are also needed on this watershed.

Opportunities under P. L. 566. A P. L. 566 project is in the construction stage to develop water for irrigation and recreation. This project also includes land treatment measures.

Watershed I, West Fork Hood River

Description. The West Fork Hood River watershed, a tributary of the Hood River, contains 48,300 acres in Hood River County. It is in the Hood River Soil and Water Conservation District. The West Fork Hood River flows in a northeasterly direction where it joins the Hood River and flows on to the Columbia River. The watershed is about 14 miles long and 8 miles wide at its widest point. Elevations range from 10,000 feet on Mount Hood to 800 feet at the confluence of the West Fork Hood River and Hood River. Average annual precipitation ranges from 50 inches to 130 inches. The irrigated area has a frost-free growing season of around 130 days.

The soils of the watershed have developed from volcanic materials. The largest area is the upland on which occurs the Hutson, Bins, Fouts, Divers, Wygant, Yallani, and miscellaneous land types. They have developed from basalt, andesite, consolidated breccias and tuffs, and volcanic ash and are moderately deep to very deep, medium to moderately fine textured, and well drained. Divers, Wygant, and Yallani are very stony or gravelly, and Bins is stony. Miscellaneous land types include steep stony slopes along drainageways, basalt and andesite bluffs, escarpments, talus, lava flows, and rock slides. All this area is best suited for forest use. An estimate of the acreage by land capability class and subclass is shown on table 4. The terrace soils, Parkdale, Bassler, and Dee, are formed from volcanic ash and are moderately deep to very deep, medium textured, and imperfectly to well drained. They are used for orchard, hay, pasture, and forest. Parkdale which has few management problems except erosion control on steeper slopes is excellent for irrigation. Bassler and Dee are rated fair for irrigation. They have a drainage problem caused by a depressional position. The recent alluvial soils are Bonneville, Winans, Gilhouly, and Culbertson. They are moderately deep to very deep, moderately coarse to moderately fine textured, and moderately well to somewhat excessively drained. The land use is orchard, hay, pasture, and forest. Irrigation suitability is good on these soils, and management problems include droughtiness and drainage.

About 1,300 acres are used for agricultural production. Of this 200 acres are in range and 1,100 acres in cropland. Approximately 1,000 acres are irrigated with fruit as the principal crop. Other irrigated crops include berries, pasture, and hay. The nonirrigated cropland is used to produce pasture. There are about 60 farms in the watershed. This area is served by the Dee Irrigation District and the Aldrich Ditch Co.

The 43,500 acres of forest in this watershed represent the whole range of forest types found in Hood River County. The lowlands supported heavy stands of hemlock and Douglas-fir sawtimber which have been harvested since 1920. These lands now have thrifty stands of second growth interspersed with heavy stands of brush. In the stream bottoms further up the drainage good stands of Douglas-fir are still found. In areas of thin soil and on the ridgetops the trees are growing slowly and are of poor quality.

Watershed Problems and Needs. Approximately 200 acres are flooded annually. Flooding results from glacial melt and land damage is minor. There is considerable damage to diversion flumes and other irrigation structures. About 400 acres of arable land needs improved drainage from closed drains.

The steep, rocky slopes require extra precautions during logging. Skyline logging systems which reduce soil disturbance are being considered for such soil problem areas.

Estimates show an additional 130 acres are suitable for irrigation development for which streamflows are adequate.

Two reservoir sites were investigated with a potential storage of about 16,000 acre feet.

Opportunities under P. L. 566. A project has little possibilities under existing conditions and laws.

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 Hood 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 land in the basin and is responsible for the administration of 33 percent of the basin within the Mt. Hood National Forest. 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 Hood Drainage Basin.