A Compilation of Flood Abatement Projects in Oregon

by

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ABBREVIATIONS

AF	acre feet
cfs	cubic feet per second
CNPCFS	Columbia-North Pacific Comprehensive Framework Study
Fig.	Figure
RC&D	Resource Conservation and Development
SWRB	State Water Resources Board
USDA	United States Department of Agriculture

A COMPILATION OF FLOOD ABATEMENT PROJECTS IN OREGON

FOREWORD

This report is designed to serve as a convenient inventory of and reference to flood abatement projects in Oregon. It presents an organized compilation of the location, capacity, and type of flood abatement projects within the state. Maps of many of the projects cited herein are available from the appropriate agencies.

Flood abatement projects, which are usually structures, are here defined as those engineering works which are built and/or operated to control flood waters. More specifically, the primary engineering tehcniques employed to abate flooding are levees, reservoirs, channel improvements, spillways or a combination of these (Murphy, 1958). Although all physical structures affect the circulation of water, this report includes only those projects that are specifically designed and/or operated for flood control. Opinion about the function of a structure is not always consistent. In cases of conflicting opinion, if either the literature or an interviewed official recognizes a project as having a flood control function, it is included in the report.

As the period of the study was limited to the months of July and August 1971, no field verification or field search for projects was possible. The study was accomplished by library research, interviews with federal and state officials, and correspondence with numerous local and private organizations involved in flood prevention. Of the three techniques used, the interviews with federal and state officials were the most beneficial, especially with personnel of the following agencies: the North Pacific Division and Portland District of the Corps of Engineers, the Portland and Salem offices of the Soil Conservation Service, the Salem office of the Bureau of Reclamation, the United States Weather Service in Portland, the Office of the State Engineer in Salem, and the State Water Resources Board in Salem.

The least satisfactory source of information was correspondence with local branches of government and private individuals. Over 270 questionnaires were sent to planners of all incorporated areas of Oregon and to the thirty-six county planners. Less than 20% responded. Over 200 questionnaires were sent to drainage districts, water improvement companies, diking districts, and irrigation districts. Less than 50% responded. One bright spot was the almost complete response from the County Cooperative Extension Agents. It is felt that had time permitted, much additional information could have been gathered by interviewing county officials.

The report is in the following format. An introductory section outlines the major factors which influence flooding in Oregon. The bulk of the report treats flood characteristics and projects in Oregon on a watershed by watershed basis. The basins used are those delineated by the State Water Resources Board (Fig. 1). Materials for each basin are selected from various federal, state, and local reports. Each of these chapters presents the pertinent characteristics of topography, geology, climate, river regime, and flooding patterns within the basin. Each chapter concludes with a list of flood abatement projects within the basin. All projects listed herein were confirmed by Federal and/or nonfederal entities responsible for flood information. Most chapters have a map showing flood prone areas in a basin.

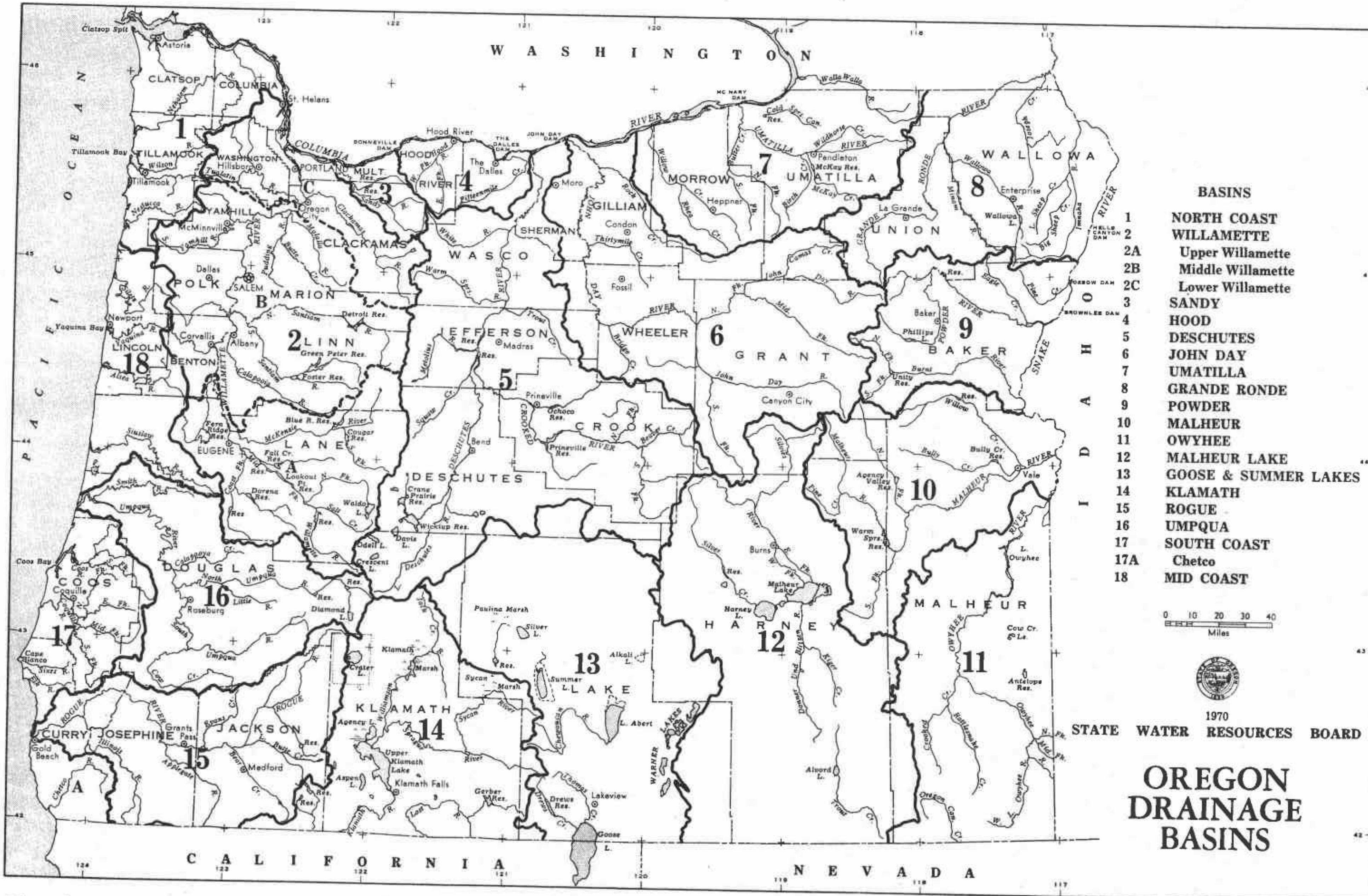

BASINS
1 NORTH COAST
2 WILLAMETTE
2A Upper Willamette
2B Middle Willamette
2C Lower Willamette
3 SANDY
4 HOOD
5 DESCHUTES
6 JOHN DAY
7 UMATILLA
8 GRANDE RONDE
9 POWDER
10 MALHEUR
11 OWYHEE
12 MALHEUR LAKE
13 GOOSE & SUMMER LAKES
14 KLAMATH
15 ROGUE
16 UMPQUA
17 SOUTH COAST
17A Chetco
18 MID COAST
0 10 20 30 40
Miles
1970
STATE WATER RESOURCES BOARD
OREGON
DRAINAGE
BASINS
WASHINGTON
IDAHO
CALIFORNIA
NEVADA
PACIFIC OCEAN

Fig. 1

INTRODUCTION

Floods are stream discharges which exceed bankfull stage (Willamette Basin Comprehensive Study, Appendix E, Flood Control, p. 1-5). This normal phenomenon of runoff results from a complex of factors, including the duration, intensity, type, and amount of precipitation. Runoff is modified by the relief, rate of soil infiltration (Thornbury, 1965), vegetal cover, and surface storage within the watershed (Table 1).

Since precipitation is usually the key to runoff and flooding, the spatial and temporal distribution of precipitation in Oregon are briefly considered. The amount and type of precipitation a watershed receives significantly influences the regime of the streams and rivers. In Oregon, the amount and type of precipitation a watershed receives is primarily the result of: 1) its distance from the coast; 2) whether it is on the leeward or windward side of mountain ranges that are aligned parallel to the coast; and 3) its elevation.

In general the closer a basin is to the Pacific Ocean, the more precipitation it receives. Mountains modify this in several ways. First, orographic lift results in heavy precipitation on the crests and windward slopes of the Coast Range and Cascades (Fig. 2). Also orographic lift in the mountains of eastern Oregon accounts for much heavier precipitation there than in the surrounding lowlands. Second,

Table 1. Classification of runoff-producing characteristics.
Modified from: Farm Planners' Engineering Handbook for the Upper Mississippi Watershed, U. S. Soil Conservation Service, Milwaukee, Wis., 1953.

Designation of Watershed Characteristics	Runoff-producing characteristics			
	100 Extreme	75 High	50 Normal	25 Low
Relief	40 Steep, rugged terrain; average slopes over 30%	30 Hilly; average slopes of 10-30%	20 Rolling; average slopes of 5-10%	10 Relatively flat land; average slopes of 5%
Soil Infiltration	20 No effective soil cover; negligible infiltration capacity	15 Slow to take up water; low infiltration capacity	10 Normal deep loam; infiltration about equal to prarie soil	5 Water taken up readily and rapid; infiltration high
Vegetal cover	20 No effective plant cover	15 Poor to fair; clean cultivated crops or poor natural cover	10 Fair to good; about 50% of area in good cover	5 Good to excellent; about 90% of area in good cover
Surface	20 Negligible; no ponds; drainage ways steep and small	15 Low, well-defined system of small drainage ways; no ponds or marshes	10 Normal; much surface storage ponds, marshes less than 2%	5 High; much surface storage; large flood plain storage; many lakes; marshes

Each column shows the contribution of the different watershed characteristics, relief, soil infiltration, vegetation, and surface storage to a particular amount of runoff. For example, under extreme conditions of 100% runoff, relief accounts for 40% of the runoff, while the other three elements account for 20% each.

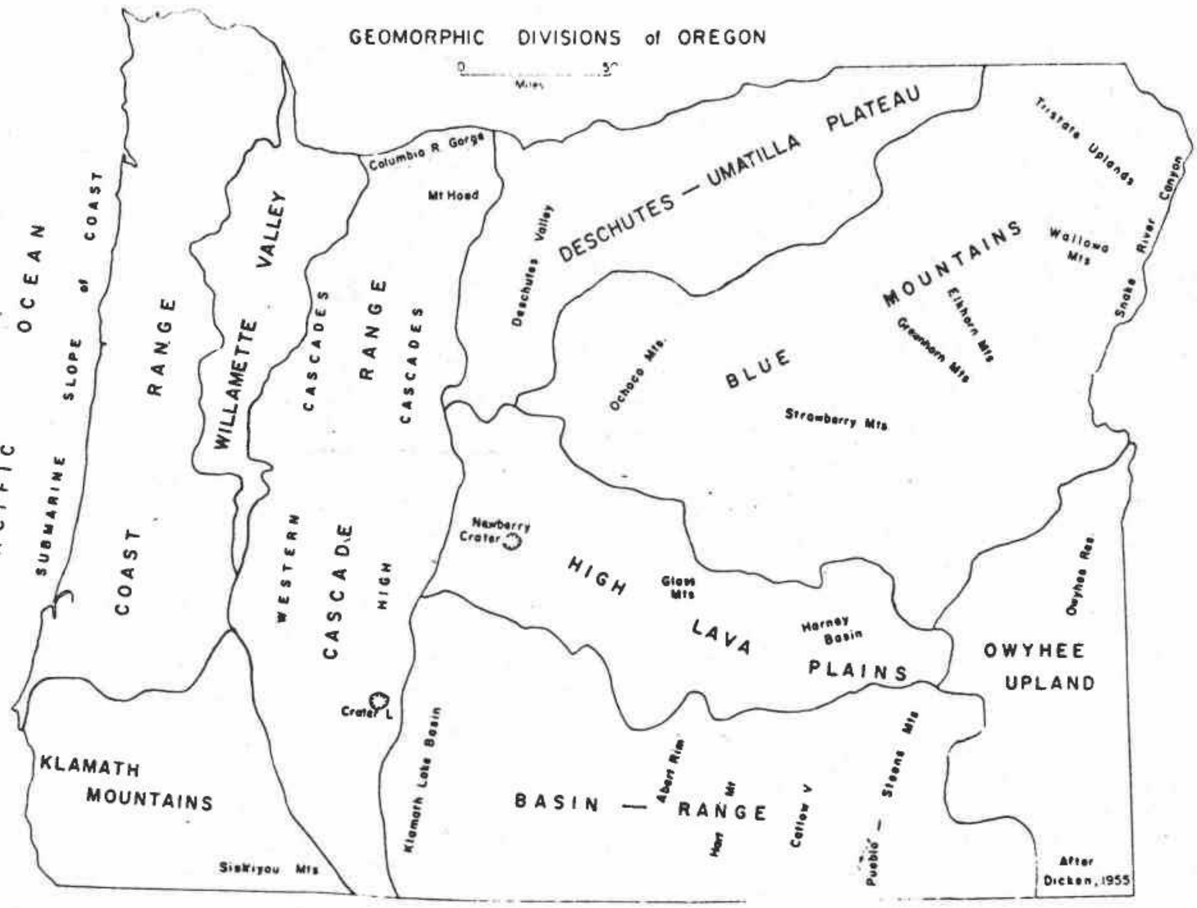


Fig. 2 Geomorphic Divisions of Oregon From Baldwin, 1964

mountains also cause a rainshadow effect on their leeward side, especially in eastern parts of the state where large areas receive less than 20 inches of precipitation annually. Finally, at higher elevations a large proportion of the precipitation is received as snow, which means the runoff is delayed usually until the spring. Because Oregon is located in the mid-latitudes on the west side of a continent, maximum precipitation is during the late fall and winter.

The aforementioned factors cause different flow regimes in western and eastern Oregon. Floods west of the Cascades are primarily in the winter, resulting from late fall and winter rains; while floods in the eastern two-thirds of the state result primarily from spring snow-melt in the mountains and to a lesser degree from summer thunderstorms. The magnitude of flood damage varies markedly from year to year. Table 2 lists the estimated flood damages in Oregon for 1955-1969.

These differences are examined in greater detail in the following chapters.

Table 2. Estimated flood damages in Oregon, 1955-1969
From: Climatological Data National Summary. Annual 1970. vol. 21, no. 13. p. 98. 1971.

Year	$ Estimated Damage
1955	9, 515, 000
1956	6, 376, 000
1957	310, 000
1958	363, 000
1959	20, 000
1960	360, 000
1961	757, 000
1962	1, 550, 000
1963	299, 000
1964	187, 101, 000
1965	5, 679, 000
1966	2, 283, 000
1967	1, 044, 000
1968	538, 000
1969	938, 000

NORTH COAST BASIN

The hydrology, geology, geography, and potential development of the North Coast Basin are taken up by the State Water Resources Board of Oregon (SWRB) in North Coast Basin (1961) and by the United States Department of Agriculture (USDA) in cooperation with the SWRB in USDA Report on Water and Related Land Resources North Coast Drainage Basin Oregon (1966). The basin, which covers 2705 square miles, is in the northwest corner of Oregon (Fig. 1, 2) on the west slope of the Coast Range anticline. The basin is characterized as an area of (SWRB, 1961, p. 25) "Impervious rocks, steep slopes, and narrow valleys; and the coast belt likewise has relatively impervious rocks forming a narrow band of steep hills . . ." The soils have only a moderate rate of infiltration. The sub-basins of the area are small and the streams short. The Nehalem River drainage area, the largest in the basin, is only 830 square miles and the Nehalem River, the longest, is 118 miles. All streams drain directly into the Pacific Ocean or into the Columbia River (Fig. 3); thus no one stream dominates drainage by concentrating basin wide runoff through one channel. The shoreline along the Pacific Ocean alternates between river mouth estuaries with associated lowlands and rugged, volcanic headlands. The Columbia River is characterized by numerous islands and relatively broad tributary valleys near their mouth.

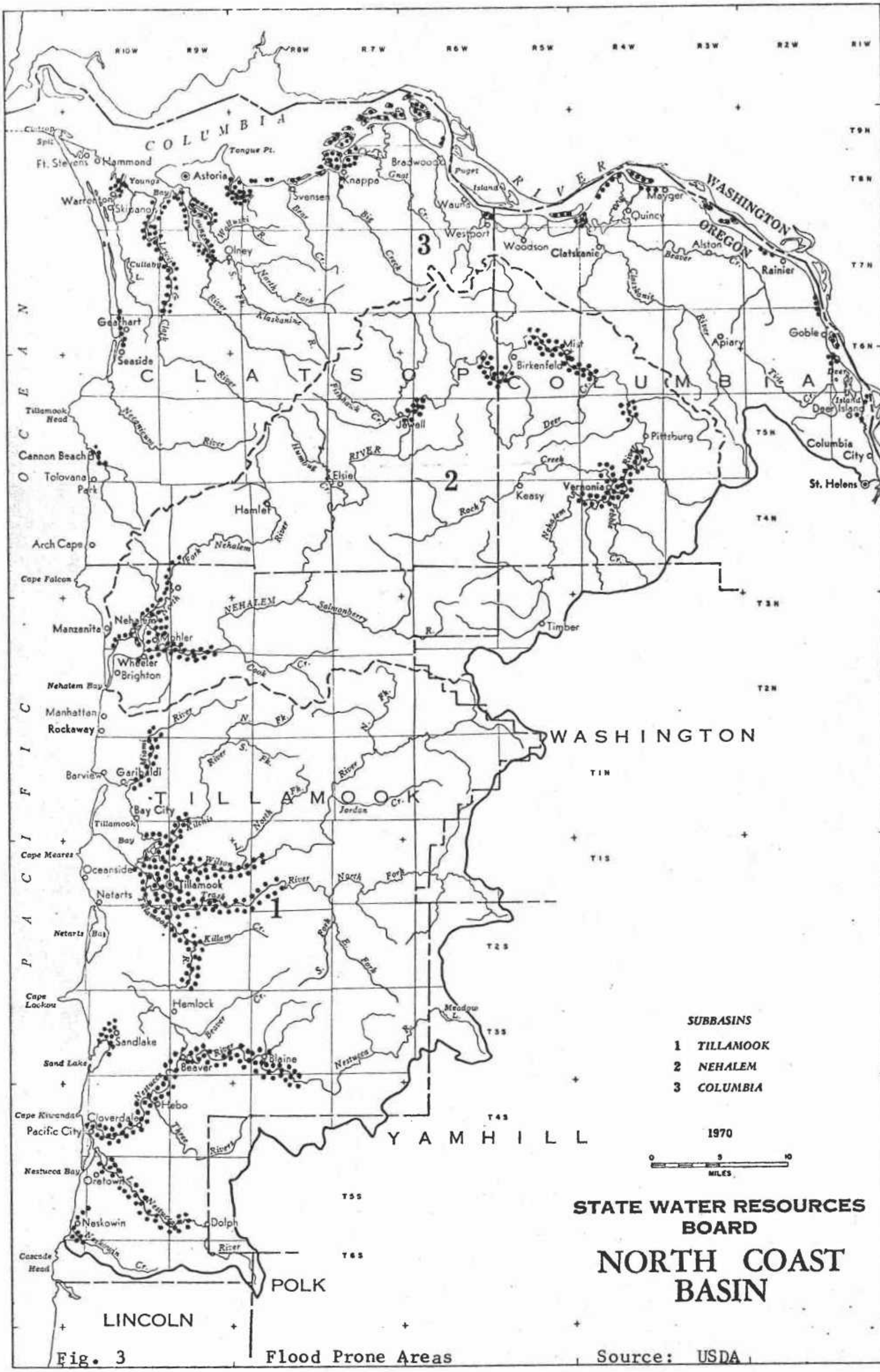
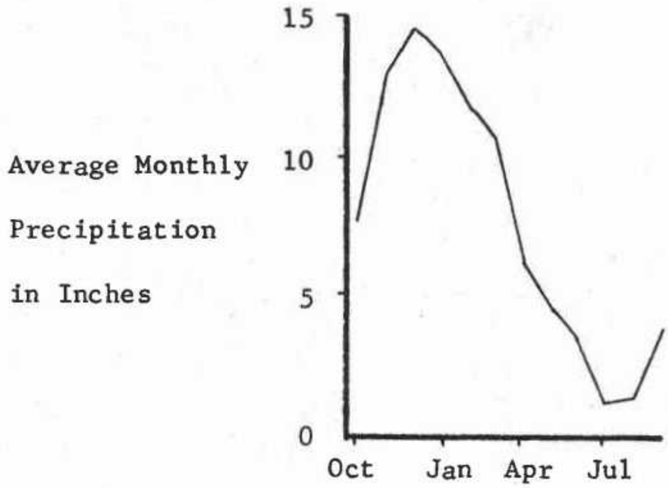


Fig. 3 Flood Prone Areas Source: USDA

The climate of any site in the basin is influenced by its proximity to the Pacific Ocean, its elevation, and its position relative to the Coast Range. Precipitation ranges from about 40 inches near Rainier, in the rainshadow of the mountains, to over 150 inches in the headwaters of the Kilchis and Wilson Rivers, on the windward slope of the Coast Range. Maximum precipitation occurs during the period of moderate, continuous rains in the late fall and winter; minimum precipitation occurs during the summer (Fig. 4). Although temperatures range from a maximum 106° F to a minus 8° F, average annual temperatures throughout the lower elevations of the basin are quite uniform, ranging from 49° F to 52° F. The SWRB cites Tillamook as representative of the Basin and gives the following figures:

Mean Annual Temperature Range:	42° F - 59° F
Mean Minimum:	35° F - January 48° F - August
Mean Maximum:	49° F - January 69° F - August

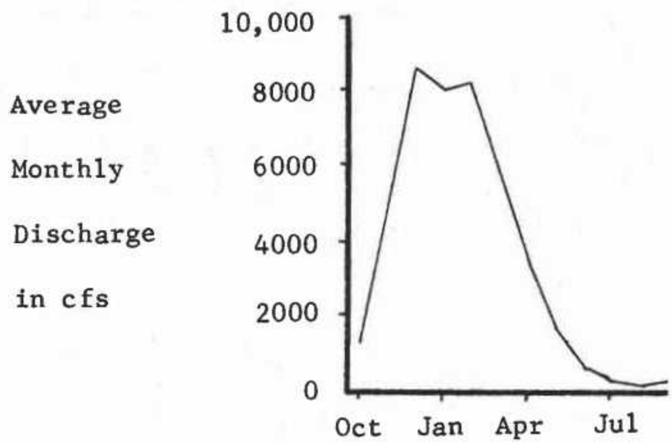
Excluding the Columbia River, stream flow reflects precipitation with only a slight lag time due to initial soil saturation. Maximum discharge is during December, January, and February; minimum discharge is during July, August, and September (Fig. 5). Snow which ranges in annual amount from five inches at Astoria to 47 inches at Lees Camp "does not have an appreciable effect on the pattern of stream runoff" (SWRB, 1961, p. 3). Extremes may



Tillamook

Source: SWRB

Fig. 4



Nehalem River

Source: SWRB

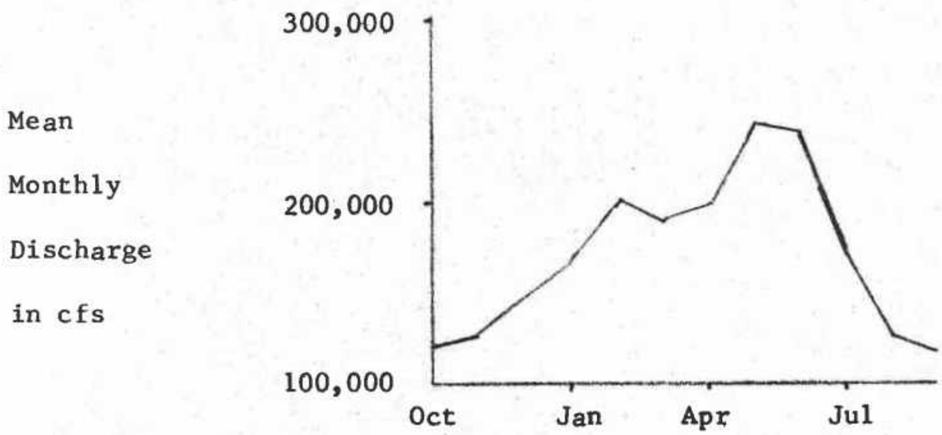
Fig. 5

reach as much as five times the maximum monthly average. In contrast to the other streams of the basin, the Columbia River does not crest until spring (Fig. 6). Thus the peak discharge of the tributaries does not supplement the peak of the Columbia River to raise heights in the lower tributary valleys.

Because of the favorable climate, man has occupied the arable lands. Man has generally limited himself to intensive use of the wider river valleys and the estuarine lowlands. It is these areas of intensive use that floods have become a major problem. Figure 3 shows those areas of the North Coast Basin which the USDA (1966) designates as flood prone areas. On the smaller streams floods normally occur from November to March (the period of maximum precipitation and maximum runoff); but the flood season is from September to May. Flooding along the Columbia River usually occurs during the spring snowmelt throughout the entire Columbia River Basin. Table 3 lists those structures across the Columbia and Snake Rivers which are partially within Oregon.

Structural flood abatement projects are concentrated along the populous Pacific coast and Columbia River. The following are the projects in the North Coast basin.

> Flood Control Projects along the Columbia River
>
> Construction and rehabilitation by the Corps of Engineers of levees, revetments, pumping stations, canals, and tide boxes.



Columbia River at The Dalles

Source: CNPCFS

Fig. 6

Table 3. Dams in Oregon across the Columbia and Snake Rivers.

Structure	Flood Control
Bonneville Dam	Incidental (very little effect)
The Dalles Dam	Incidental (very little effect)
McNary Dam	Incidental (very little effect)
John Day Dam	500,000 acre-feet
Hells Canyon Dam	20,000 acre-feet
Oxbow Dam	10,000 acre-feet
Brownlee Dam	980,250 acre-feet joint storage*

* Joint storage - the active pool capacity for all functions including flood control.

Beaver Drainage District
City of Warrenton Drainage District No. 1, No. 2, No. 3
Clatsop County Drainage District No. 1, No. 2, No. 5 - No. 15
Deer Island Drainage District
Magruder Drainage District
Marshland Drainage District
Midland Drainage District
Rainier Drainage District
Webb District Improvement Company
Westland District Improvement Company
Woodson Drainage District
Source: 54, 55*

Bank Protection along the Columbia River
Improvements and building dikes
Beaver Drainage District
Clatsop County Drainage District No. 1 and No. 6
Midland Drainage District
Svensen Island District Improvement Company
Port of Astoria
Source: 54, 55

Skipanon Project - PL 566 Project on the Skipanon River
Channel Improvement, flood gate
Source: 36

Nehalem River near Nehalem
Source: 54, 55

Tillamook Area: Levees and tidegates	Area (acres)
South Prairie Drainage District	1033
Trask Drainage District	1100
Stillwell Drainage District	444
Dougherty Slough	1079

Source: 4

Cloverdale Area: Levees and tidegates	
North Side Big Nestucca Drainage District	626
Pacific City Drainage District	160
Big Nestucca Drainage District	1377
Little Nestucca Drainage District	346

Source: 4

* Refers to listings in Selected Bibliography.

	Area (acres)
Nehalem Area: Levees and tidegates	
Sunset Drainage District	918
Peninsula Drainage District	600
Source: 4	
Diked area on Goodspeed Road	400
Diked area of Throop and Stashley	177
Diked area of Clifford Chambers	88
Diked area of Condor Estate and Kiser	72
Diked area of Kiser and Craven	100
Diked area on Beltz Estate	50
Diked area of C. H. Meyers	50
Area diked by Railroad near Idaville	50
Area diked by road along Tillamook River not in Drainage District	500
Source: 4	

Small flood Control Projects by the Corps of Engineers
Section 205 of the 1948 Flood Control Act

Beaver Creek near Tillamook
Tillamook Bay, Stillwell Drainage District
Source: 54

Snagging and clearing projects by the Corps of Engineers
Section 2 of the 1937 Flood Control Act

Necanicum River at Lyon Location
Source: 54

Protection of Public Works by the Corps of Engineers
Section 14 of the 1946 Flood Control Act

Necanicum River at Seaside
Nestucca River at Pacific City
Wilson River near Highway 101, Tillamook
Source: 54

Emergency flood control works and activities by the
Corps of Engineers

PL 84-99 Authorizes flood emergency preparation, flood fighting, rescue work, repair or restoration of flood control work threatened or destroyed by flood.
Source: 54

WILLAMETTE BASIN

The hydrology, geology, geography, and potential development of the Willamette Basin are examined by the SWRB in the series Upper Willamette Basin (1961), Middle Willamette Basin (1963), Lower Willamette Basin (1965), and Willamette River Basin (1967) and by the USDA in cooperation with the SWRB in USDA Report on Water and Related Land Resources Lower Willamette River Basin Oregon (1963) and Middle Willamette River Basin (1962). Flood control projects are discussed by the Willamette Basin Task Force of the Pacific Northwest River Basins Commission in Willamette Basin Comprehensive Study Water and Related Land Resources Appendix E Flood Control (1969) and by the Pacific Northwest River Basins Commission in Columbia-North Pacific Region Comprehensive Framework Study of Water and Related Lands Appendix VII Flood Control (1971).

The 11, 741 square mile basin is in northwest Oregon (Fig. 1, 2, 7). Most tributaries of the Willamette have their headwaters either along the eastern slope of the Coast Range physiographic unit or along the western slope of the Cascade physiographic unit. These headwater areas are rugged and mountainous with steep slopes and intrenched streams. The Willamette Valley physiographic unit varies from level expanses in the upper valley to a series of hills in the

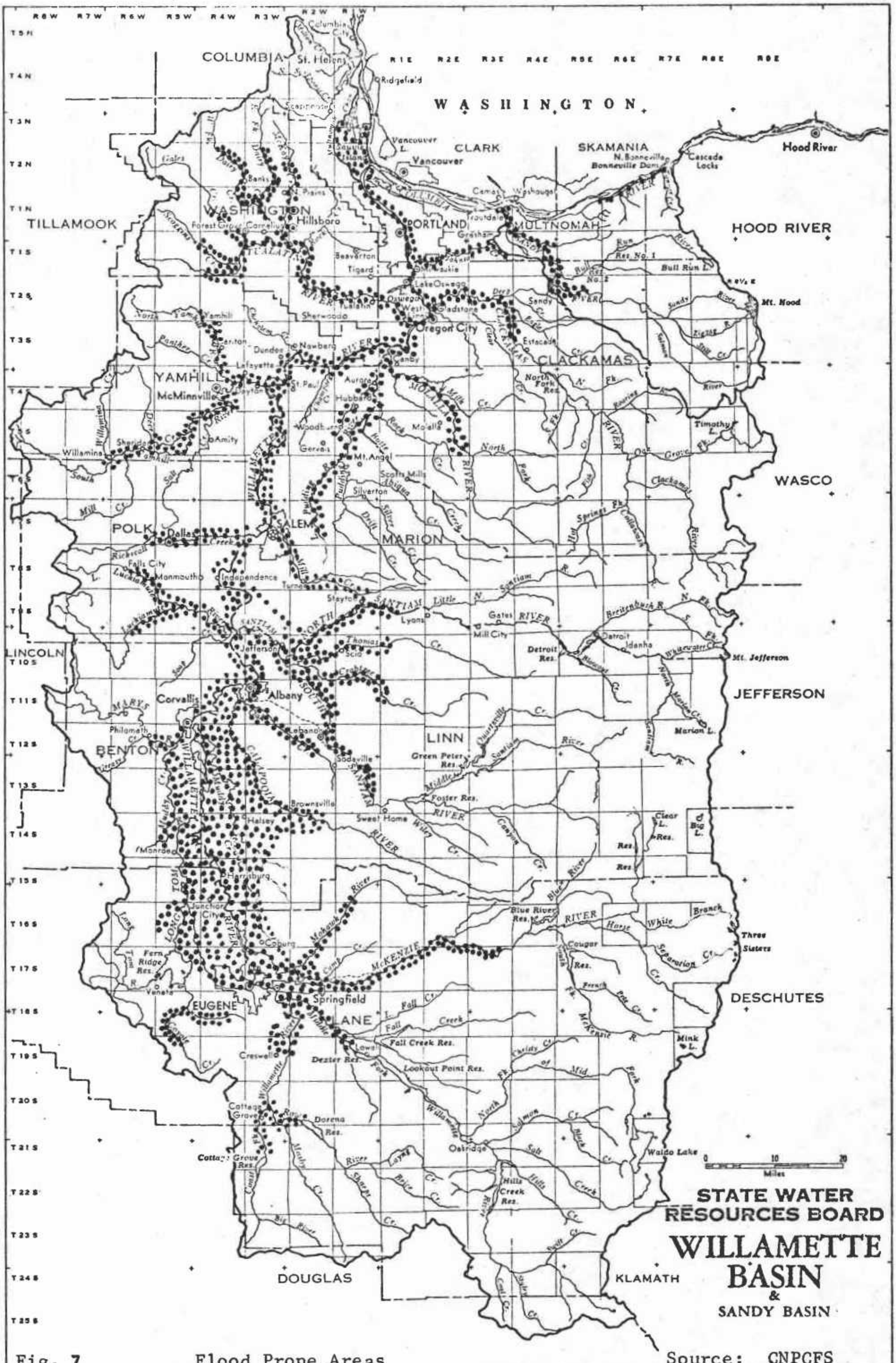
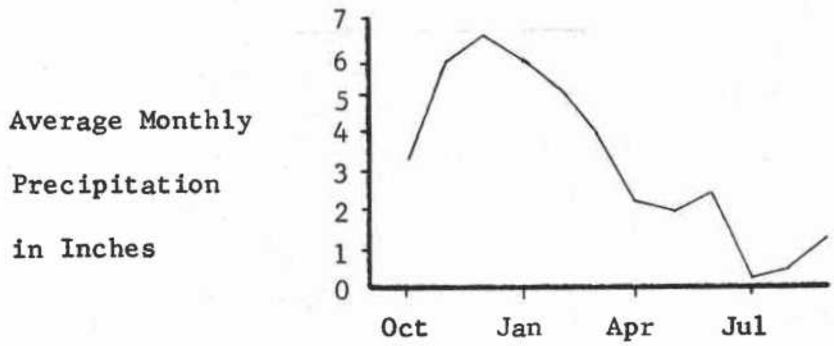


Fig. 7 Flood Prone Areas Source: CNPCFS

lower valley. Elevations in the basin range from below ten feet along the Columbia River to over 10,000 feet along the crest of the Cascades and over 4000 feet in the Coast Range. Infiltration varies from one formation and exposure to the next.

The climate of the Basin varies, showing the influence of the Pacific Ocean, elevation, and mountain barriers. Precipitation in the rainshadow of the Coast Range varies from 30-50 inches per year (Fig. 8). In the mountains, precipitation may be as high as 140 inches annually. The USDA states that the "Intensity of precipitation and the proportion of precipitation that is snow increases with elevation" (USDA, 1962, p. 14). Snow is only 2% of precipitation on the Valley floor but is over 75% at elevations of more than 7500 feet. Maximum precipitation is in the late fall and winter; minimum is in the summer (Fig. 10). Temperatures range from below zero to over 100° F. At Albany the mean temperature for January is 39° F; the mean July temperature is 67° F.

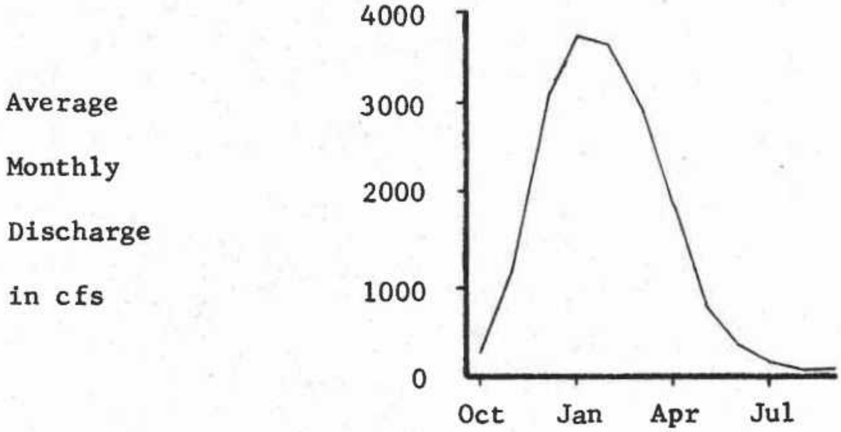
Discharge from tributaries originating in the Coast Range differs from that rising in the Cascades. In that most of the precipitation in the Coast Range is rain and the ground is described by the SWRB (1967) as generally impermeable, the discharge rather closely corresponds to precipitation (Fig. 9). The tributaries from the Cascades have a more even distribution from late fall to spring because precipitation at higher elevations accumulates as snow and



Albany

Source: Highsmith

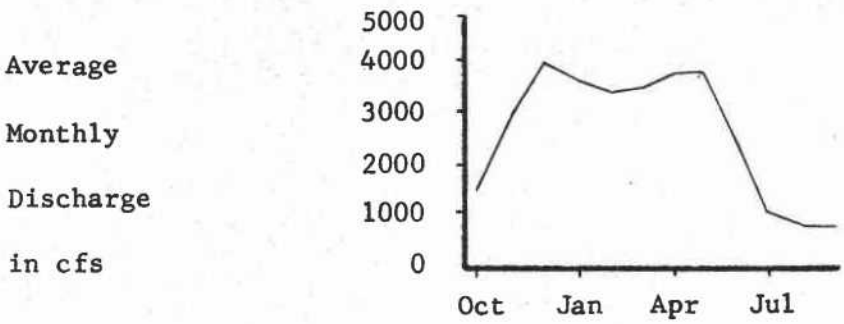
Fig. 8



Tualatin River at
West Linn

Source: SWRB

Fig. 9



Clackamas River at
Estacada

Source: SWRB

Fig. 10

the ground is more porous (Fig. 10). In addition, flood control structures are on most of the major streams on the east side of the Valley.

According to the Willamette Task Force, floods in the basin result from rain and snowmelt. Major floods occur from late fall to early spring when intensive, continuous rains fall on saturated or frozen ground and warm spells prematurely melt snow. These floods can last for up to ten days. Tributary flooding tends to be "flashy". Figure 7 shows the flood plains of the basin. Note: more detailed maps have been completed and are presently being compiled by the Corps of Engineers, the Soil Conservation Service, and the U. S. Geological Survey.

The following are the flood abatement projects in the basin.

Flood Control Projects along the Columbia River
Construction and rehabilitation by the Corps of Engineers of levees, revetments, pumping stations, and canals

Multnomah County Drainage District No. 1
Peninsula Drainage District No. 1 and No. 2
Sauvie Island Drainage District
Scappoose Drainage District
Source: 54, 55

Bank Protection along the Columbia River
Improvements and building dikes
Multnomah County Drainage District No. 1
Peninsula Drainage District No. 1
Sauvie Island Drainage District
Scappoose Drainage District
Source: 54, 55

Willamette Basin Bank Protection
Source: 38, 39, 55

Willamette Basin Channel Improvement
Source: 38, 55

Blue River Dam on Blue River
Drainage Area: 88 square miles
AF for flood control: 85,000
Corps of Engineers
Source: 38, 54, 55

Cottage Grove Dam on Coast Fork of Willamette River
Drainage Area: 104 square miles
AF for flood control: 30,060
Corps of Engineers
Source: 38, 54, 55

Cougar Dam on South Fork McKenzie River
Drainage Area: 208 square miles
AF for flood control: 155,000
Corps of Engineers
Source: 38, 54, 55

Detroit Dam on the North Santiam River
Drainage Area: 438 square miles
AF for flood control: 300,000
Corps of Engineers
Source: 38, 54, 55

Dorena Dam on the Row River
Drainage Area: 265 square miles
AF for flood control: 70,500
Corps of Engineers
Source: 38, 54, 55

Fall Creek Dam on Fall Creek
Drainage Area: 184 square miles
AF for flood control: 115,000
Corps of Engineers
Source: 38, 54, 55

Fern Ridge Dam on Long Tom River
Drainage Area: 275 square miles
AF for flood control: 110, 000
Corps of Engineers
Source: 38, 54, 55

Green Peter and Foster Dams on Middle Santiam River
Drainage Area: 277 square miles
AF for flood control: 270, 000
Corps of Engineers
Source: 38, 54, 55

Hills Creek Dam on Middle Fork Willamette River
Drainage Area: 389 square miles
AF for flood control: 200, 000
Corps of Engineers
Source: 38, 54, 55

Lookout Point Dam on Middle Fork Willamette River
Drainage Area: 991 square miles
AF for flood control: 337, 000
Corps of Engineers
Source: 38, 54, 55

Scoggins Dam (under construction) on Scoggins Creek by the Bureau of Reclamation
30, 000 AF joint use
Source: 29

Beaver Creek Project - PL566
channel work
Source: 36, 38

Little Pudding River Project - PL566
channel work, dikes
Source: 36, 38

Lower Amazon and Flat Creek Project - PL566
channel work, dikes
Source: 36, 38

Lynx Hollow Creek Project - PL566
channel work, flood diversion
Source: 36, 38

Willakenzie Project - PL566
(under construction)
channel improvement, dikes
Source: 36, 38

Central District Flood Protection RC&D Project
channel improvement
Source: 38

Lewellyn Road RC&D Project
channel improvement
Source: 38

Little Muddy Creek RC&D Project
channel improvement
Source: 38

Little Oak Creek RC&D Project
channel improvement
Source: 38

River Road RC&D Project
channel improvement
Source: 38

Amazon Creek
channel improvement
Source: 54, 55

City of Albany storm sewer works and ditch
modification of North Fork of Periwinkle Creek
Source: 24

Levees between river mile 25-30 on South Yamhill River
Source: 26

Keizer Diking District - Levees
Source: 34

East Salem Sewer and Drainage District No. 1
Source: 34

Small Flood Control Project by the Corps of Engineers
Section 205 of the 1948 Flood Control Act
Clackamas River, Dixon Farm Location
McKenzie River, Walterville Water Control District
Molalla River, Milk Creek, Ressel Location
Salmon Creek, Oakridge
Source: 54

Snagging and clearing projects by the Corps of Engineers
Section 2 of the 1937 Flood Control Act
Amazon Creek
Calapooia River around Brownsville
Clackamas River near Dixon Farm
Coast Fork Willamette River, mouth to river mile 6
Middle Fork Willamette River, upstream from Fall Creek
North Santiam River near Kingston Levee
Willamette River at Corvallis and Lambert Slough
Source: 54

Protection of Public Works by the Corps of Engineers
Section 14 of the 1946 Flood Control Act
Clackamas River near Gladstone
North Santiam River at Stayton and Stayton Intercounty Bridge
Santiam River at Miller and Banick Locations
South Santiam River near Lebanon
South Yamhill River at Bellevue-Hopewell Location
Willamette River near Camp Adair
Source: 54

Emergency flood control work and activities by the Corps of Engineers
PL84-99 Authorizes flood emergency preparation, flood fighting, rescue work, repair or restoration of flood control work threatened or destroyed by flood
Source: 54

SANDY RIVER BASIN

The hydrology, geology, geography, and potential development of the Sandy Basin are surveyed by the SWRB in Lower Willamette River Basin (1965), Willamette River Basin (1967), by the SWRB in cooperation with the USDA in USDA Report on Water and Related Land Resources Lower Willamette River Basin Oregon (1963) and by the Willamette Basin Task Force of the Pacific Northwest River Basins Commission in the Willamette Basin Comprehensive Study Water and Related Land Resources (1969). The 575 square mile basin is a series of small tributaries of the Columbia River draining the northwest corner of the Cascade physiographic region (Fig. 1, 2, 7). The basin is mountainous with elevations from less than 40 feet along the Columbia River to over 11,000 feet at Mt. Hood. The surface is mostly igneous rocks in the uplands and alluvium along the rivers. Infiltration depends on the particular characteristics of an area (p. .6).

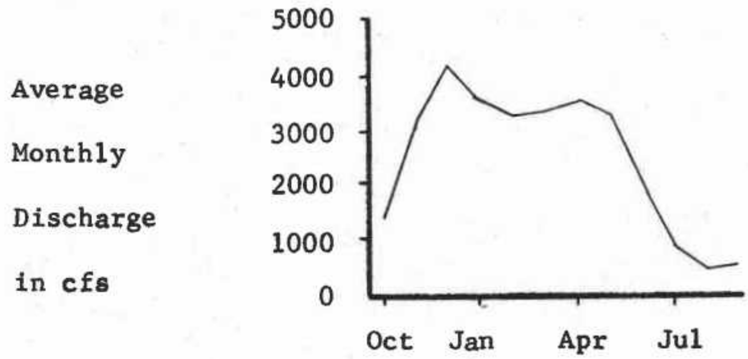
Precipitation and temperature reflect elevation. Precipitation ranges from less than 50 inches annually near the confluence of the Sandy and the Columbia Rivers to over 140 inches near the crest of the Cascades. As in the Willamette Basin, precipitation is at a maximum from late fall to early spring and at a minimum during the summer. Temperatures are similar to those of the same exposure in the Willamette Valley (p. 21).

The Sandy River has a relatively even distribution of runoff from November through May, but a marked dry period from June through October (Fig. 11). The SWRB states that this stream is typical of streams which drain the Cascades in that it peaks early in December and then stays high as a result of snowmelt. Discharge is modified by Portland's water supply developments within the basin.

Flooding is limited to only 2600 acres, 600 acres along the Columbia River in the eastern half of the basin and 2000 acres at confluence of the Sandy and Columbia Rivers and along the Sandy and Bull Run Rivers. Floods are like those in the Willamette Basin for the east side of the valley (p. 21). Figure 7 shows those areas susceptible to flooding.

Only one structural flood abatement project was found to exist in the Sandy Basin.

Sandy Drainage District, Levees, revetments
Source: 54, 55



Sandy River below
Bull Run River

Source: SWRB

Fig. 11

HOOD BASIN

The hydrology, geology, geography, and potential development of the Hood Basin are discussed by the SWRB in Hood Basin (1965) and by the USDA in cooperation with the SWRB in USDA Report on Water and Related Land Resources Hood Drainage Basin Oregon (1964). The 1023 square mile Hood Basin is a roughly rectangular basin (Fig. 1, 2, 12) straddling the boundary between the Cascades and the Deschutes-Umatilla Plateau geographic regions in north central Oregon. The western region is one of lava flows along the eastern edge of the Cascade anticline. The Deschutes-Umatilla area is a series of anticlines and synclines having a surface of igneous and sedimentary rocks. As classified by the USDA, all soils have either a medium or rapid rate of infiltration. The Hood River dominates flow in the Cascade physiographic region. The eastern part of the basin, 543 square miles, is not dominated by any one stream as each syncline has its own tributary to the Columbia.

The climate is one of contrasts. Precipitation ranges from less than ten inches along the eastern border to over 130 inches along the Cascade divide. This is an excellent example of the rain-shadow caused by the Cascades. Parkdale is used by the SWRB to illustrate the climate in the Hood River drainage area. Maximum precipitation is during the winter (Fig. 13). The mean annual

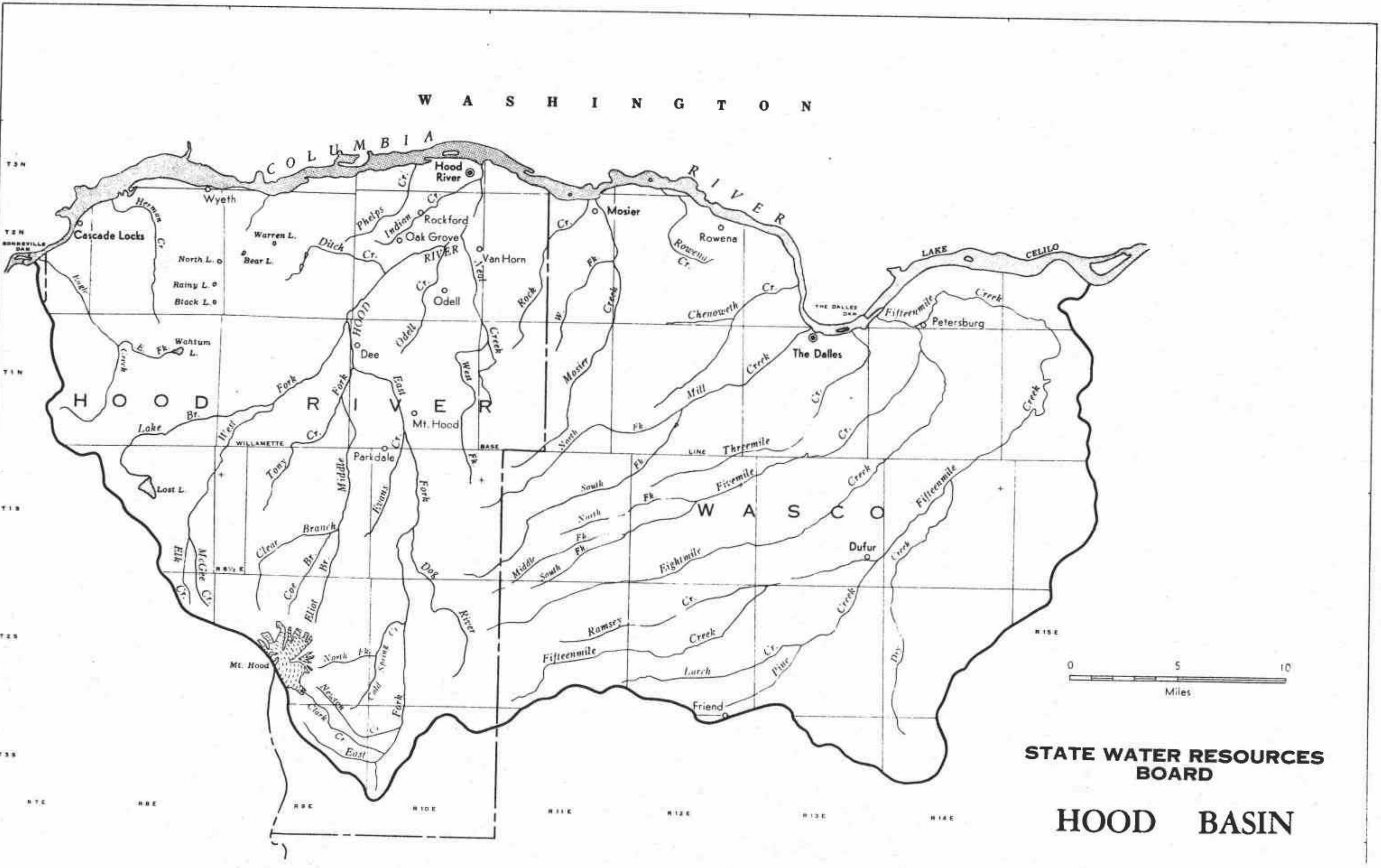
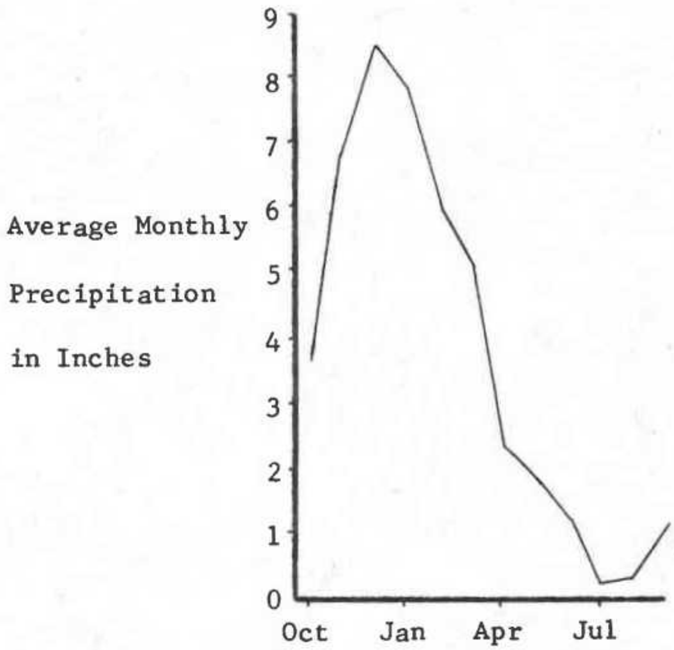

WASHINGTON
COLUMBIA RIVER
LAKE CELILO
Hood River
Wyeth
Cascade Locks
Mosier
Rowena
The Dalles
Petersburg
Rockford
Oak Grove
Van Horn
Odell
Dee
Mt. Hood
Parkdale
Dufur
Friend
Warren L.
Bear L.
North L.
Rainy L.
Black L.
Wahtum L.
Lost L.
HOOD RIVER
WASCO
WILLAMETTE BASE LINE
THE DALLES DAM
BONNEVILLE DAM
Chenoweth Cr.
Mill Creek
Threemile Cr.
Fivemile Creek
Eightmile
Fifteenmile Creek
Ramsey Cr.
Larch
Pine Cr.
Dry Creek
Mosier Creek
Rowena Cr.
Rock Creek
Neal Creek
West Fk.
Dog River
East Fork
Middle Fork
West Fork
Lake Br.
Tony Cr.
Clear Branch
Coe Br.
Eliot Br.
Evans Cr.
Odell Cr.
Ditch Cr.
Phelps Cr.
Indian Cr.
Herman Cr.
Eagle Creek
McGee Cr.
Elk Cr.
Newton
Clark Cr.
Cold Spring Cr.
0 5 10
Miles
STATE WATER RESOURCES BOARD
HOOD BASIN

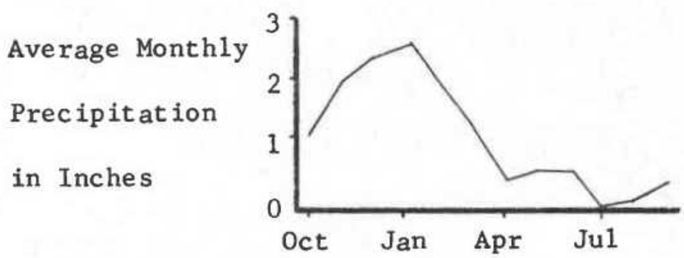
Fig. 12



Parkdale

Source: SWRB

Fig. 13



The Dalles

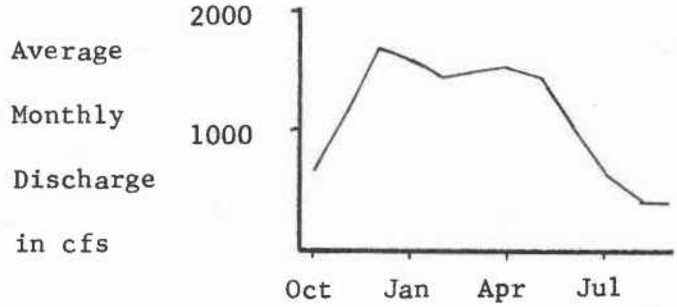
Source: SWRB

Fig. 14

temperature is 47° F and the January and July means are 30° F and 63.5° F respectively. The Dalles is representative of the more semiarid eastern part of the region. Maximum precipitation is also during the late fall and winter; the minimum is during the summer (Fig. 14). The average annual temperature is 54° F; the mean January temperature is 34° F and the mean July temperature is 73° F.

In this basin, discharge does not mirror precipitation. Hood River, Figure 15, shows no extreme in discharge, but a rather well distributed flow with a small peak in December. Fifteenmile Creek, Figure 16, shows the peak discharge for an eastern area stream to be in spring. Both curves are affected by spring snowmelt in the higher elevations of their watersheds, but it is far more significant in the subhumid, eastern part of the basin. An extreme of 34,000 cubic feet per second (cfs) was recorded on the Hood River in 1923 and 3540 cfs on Fifteenmile Creek near Wrentham in 1953.

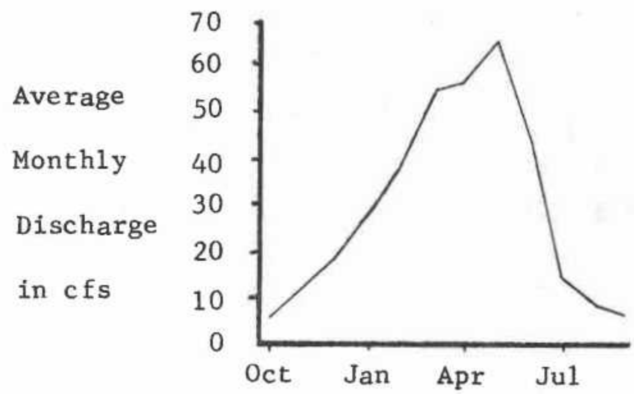
There are two causes of floods noted by the USDA (1964). First is the rapid snowmelt caused by chinook winds during the winter or a warm period during the spring. The second is thunderstorms which occur during the late spring and summer usually in the eastern part of the basin. However, throughout the basin large floods do not seem to be a problem except in the Fifteenmile Creek drainage area where 1500 acres are inudated annually.



Hood River near Hood River

Source: SWRB

Fig. 15



Fifteenmile Creek near Dufur

Source: SWRB

Fig. 16

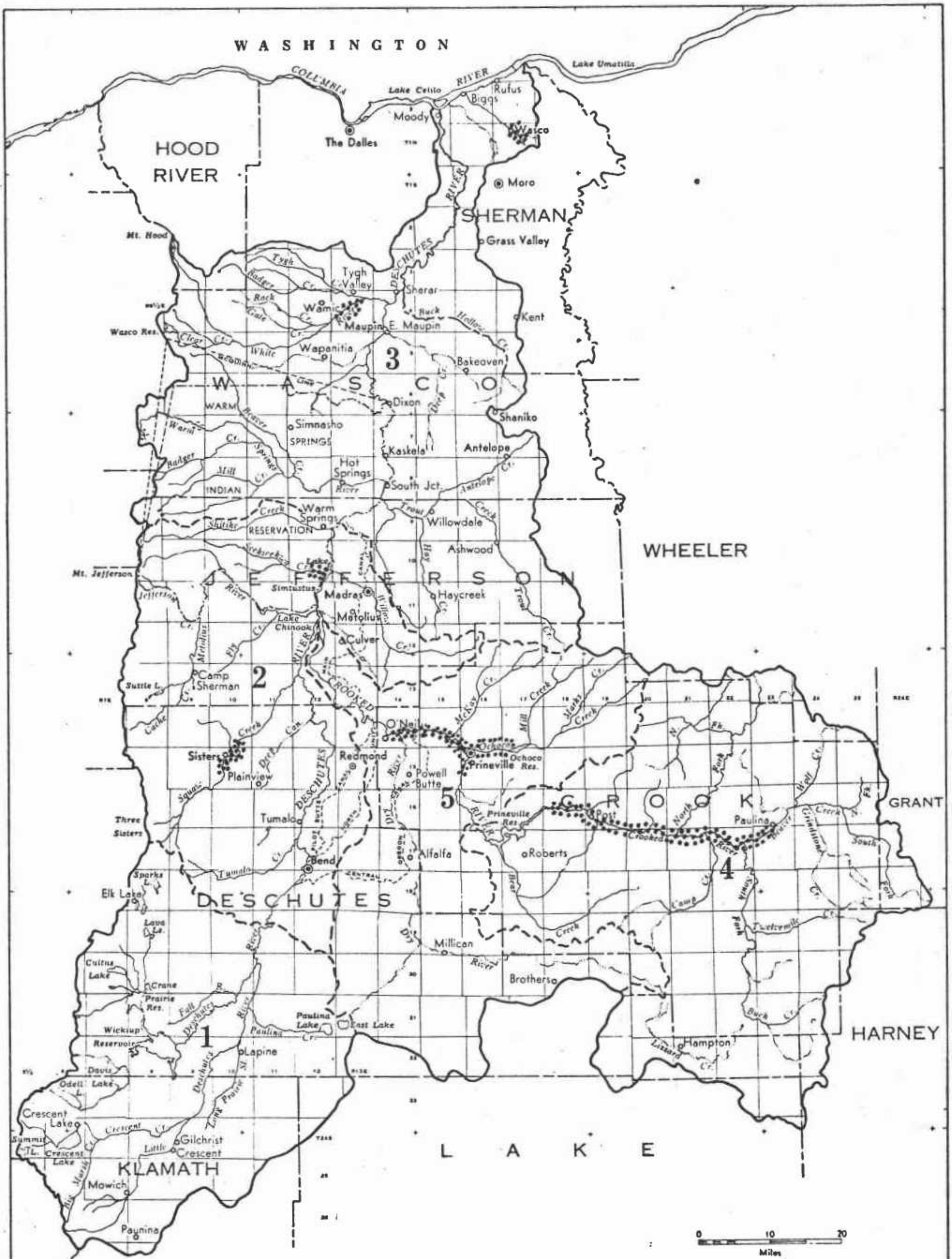
Only one structural flood abatement project was found.

The Dalles area, levees
Source: 23

DESCHUTES RIVER BASIN

The hydrology, geology, geography, and potential development of the Deschutes River Basin are reviewed by the SWRB in Deschutes River Basin (1961). The Deschutes River Basin (10,400 square miles) has the headwaters of the watershed in the Cascade, Basin-Range, High Lava Plateau, and Blue Mountain geographic regions and flows through the Deschutes-Umatilla Plateau (Fig. 1, 2, 17). Each region displays its own characteristic topography. Permeability and infiltration vary greatly among the numerous exposed strata of sedimentary and igneous rocks. Some lavas are extremely porous and absorb water rapidly as do some alluvial deposits. Other lavas and sedimentary formations are very dense and do not absorb much percipitation. The 252 mile Deschutes River discharges into the Columbia River.

The climate is directly influenced by the rainshadow of the Cascades and by the uplands on the eastern boundary of the basin. Precipitation ranges from over 100 inches per year near the crest of the Cascades to nine inches annually in the Deschutes Valley to over 20 inches per year in the Ochoco Mountains. Relative snow distribution is similar. Throughout the basin the maximum precipitation occurs in the late fall and winter with a smaller secondary peak in the late spring. Minimum precipitation is during the summer



SUBBASINS

1 *UPPER DESCHUTES*
2 *MIDDLE DESCHUTES*
3 *LOWER DESCHUTES*
4 *UPPER CROOKED*
5 *LOWER CROOKED*

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DESCHUTES BASIN

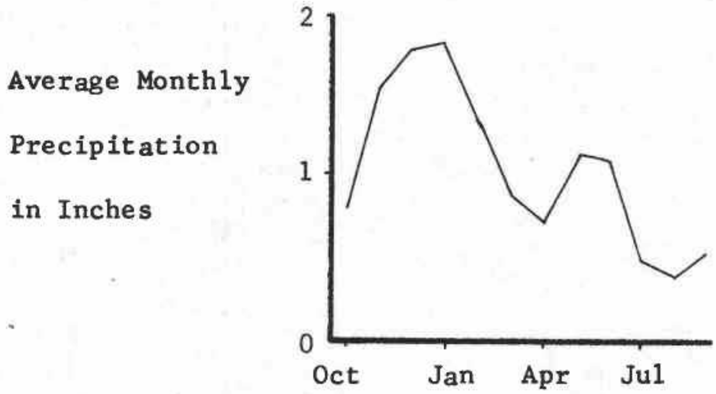
Fig. 17 · Flood Prone Areas . Source: CNPCFS

(Fig. 18). Recorded extreme temperatures range from minus 45° F to 119° F. Because of the complexity of the basin, no one station can be called typical for illustrative purposes. Bend is shown because it is the most populous part of the Deschutes Basin.

Natural stream discharge across the basin shows the peak during the winter (Fig. 19). However, many streams now are under some type of control for irrigation during the summer. Thus, the discharge curves of the regulated streams show peaks during the summer and minimum discharge during the winter (Fig. 20).

According to the SWRB, major flooding is only a problem in the arid regions of the Crooked River. This is the result of unseasonably hot temperatures in the spring melting snow and combining with light rains. The Upper Deschutes sub-basin has only minor flood problems because of the regulatory structures which exist for irrigation and because of the high porosity of the basalt. In the Middle Deschutes sub-basin, cloudbursts occasionally cause some minor flooding along some streams. In the Lower Deschutes sub-basin minor floods on some tributaries of the Deschutes are caused by heavy spring precipitation and rapid snowmelt. The Deschutes has a relatively uniform flow. It is the smaller tributaries which have extreme discharge and consequently flood problems.

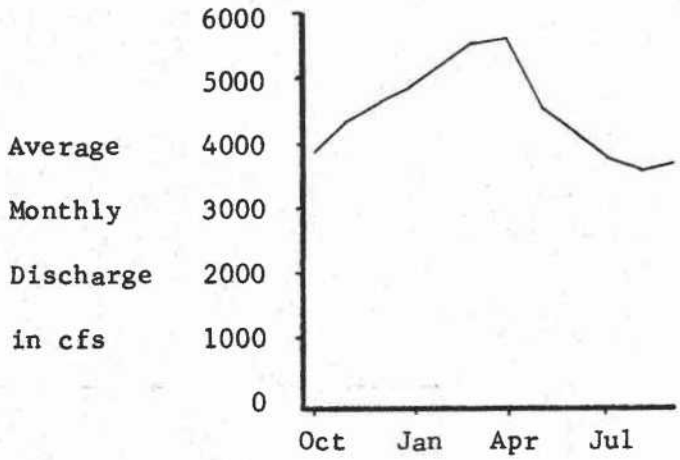
Numerous structures, as dams, ditches, and channel improvements, exist throughout the basin for irrigation and power. Of these



Bend, Oregon

Source: SWRB

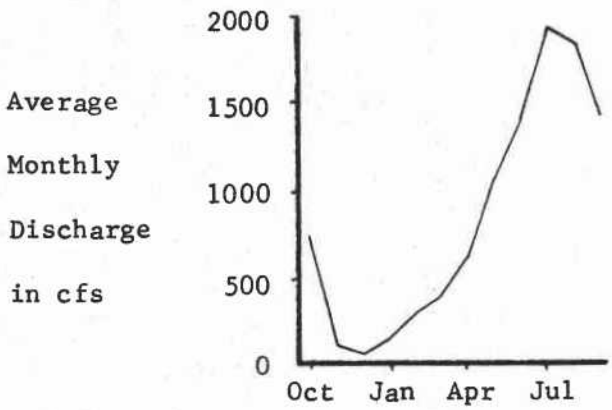
Fig. 18



Deschutes River near
Madras

Source: SWRB

Fig. 19



Deschutes River below
Wickiup Reservoir near Lapine

Source: SWRB

Fig: 20

only three exist with a stated flood control function.

Prineville Reservoir on the Crooked River
Drainage Area: 2700 square miles
Acre-feet for flood control: 60, 000 for joint storage
Bureau of Reclamation
Source: 29

Ochoco Reservoir on Ochoco Creek
Drainage Area: 3000 square miles
AF for flood control: 16, 500, joint storage
Bureau of Reclamation
Source: 29

Crooked River - flood control at and near Prineville, includes channel clearing, rectification, and bank protection along Crooked River and Ochoco Creek.

Source: 54, 55

JOHN DAY RIVER BASIN

The hydrology, geology, geography, and potential development of the John Day River Basin are treated by the SWRB in John Day River Basin (1962). The John Day Basin covers 8010 square miles in north central Oregon (Fig. 1, 2, 21). The headwaters of the John Day River rise in the Blue Mountain geographic region. The river passes through the Deschutes-Umatilla Plateau before discharging into the Columbia River. The geology is predominantly igneous extrusives but areas of sandstone, shale, and alluvium are present. The Blue Mountains have some relatively wide, steep-sided valleys among the uplands. The Deschutes-Umatilla Plateau is a region of deeply intrenched streams separating broad, level uplands. Except for some small tributaries to the Columbia River, all precipitation which falls within the basin and exits as runoff must flow through the John Day River.

The climate is one of extremes with elevation having an important influence. Average annual precipitation ranges from less than ten inches per year near the Columbia River to over 50 inches annually in the Blue Mountains. Some locations in the mountains have recorded an average yearly snow fall of 190 inches while Arlington, near the Columbia River, averages only 15 inches per year. Precipitation has a primary maximum during the late fall and

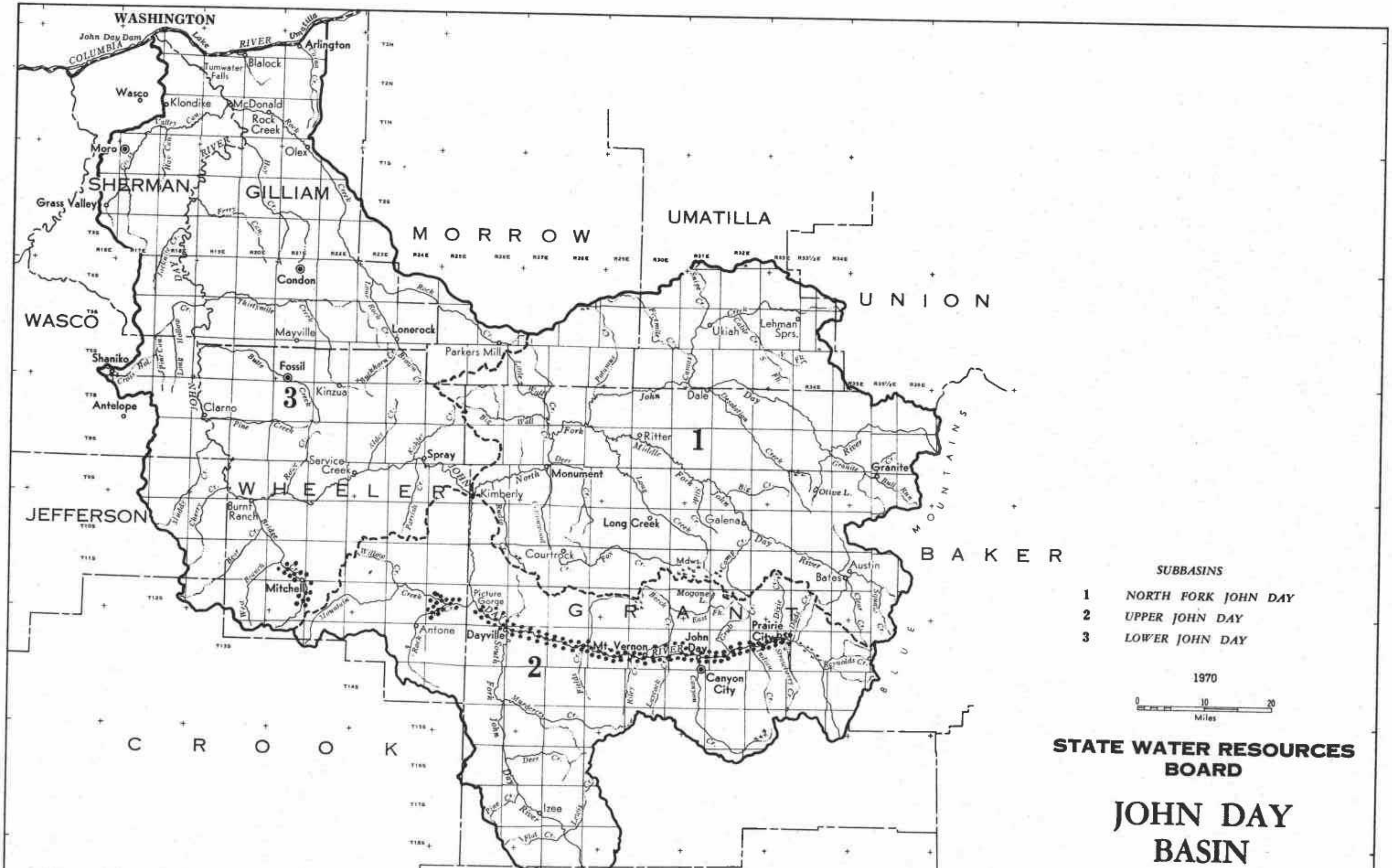


Fig. 21 Flood Prone Areas

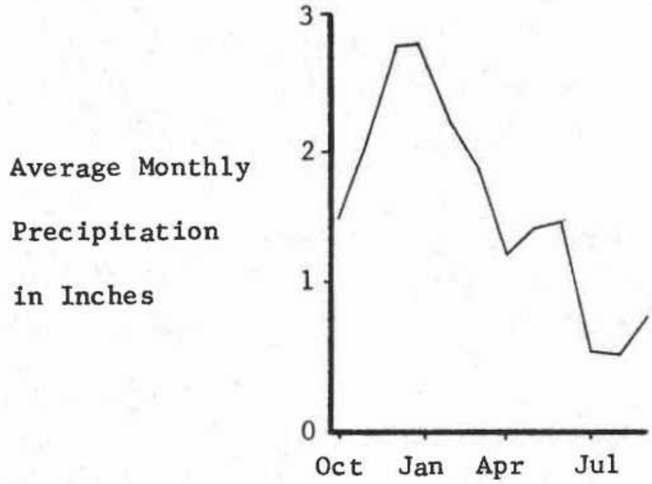
Source: CNPCFS

winter and a secondary maximum during the spring. Minimum precipitation is during the summer (Fig. 22), as illustrated by the graph of Austin on the Middle Fork of the John Day River. Temperatures vary as much as precipitation. Extremes range from 54° F below zero to 114° F above. Although mean temperatures depend on elevation, Condon in Gilliam County (elev. 2844 ft) is used by the SWRB to represent the basin. The mean monthly temperature for the coldest month is 29° F in January, while the mean for the warmest month is 67° F in July. But it must be remembered that elevation is very important in estimating averages.

Because the John Day River is in a semiarid region, the variation between high and low stages is extreme. Maximum discharge is the result of spring snowmelt which is immediately followed by a summer minimum (Fig. 23). The extreme recorded at McDonald Ferry was 27, 800 cfs in 1907. Discharge curves are affected by elevation in that lower streams flood earlier while higher streams do not flood until late spring or early summer.

The SWRB attributes flooding primarily to spring snowmelt as it is affected by rain. They also cite thunderstorms as a second cause of flooding. These latter are dismissed as infrequent. Flood damage is low because floodplain development is limited.

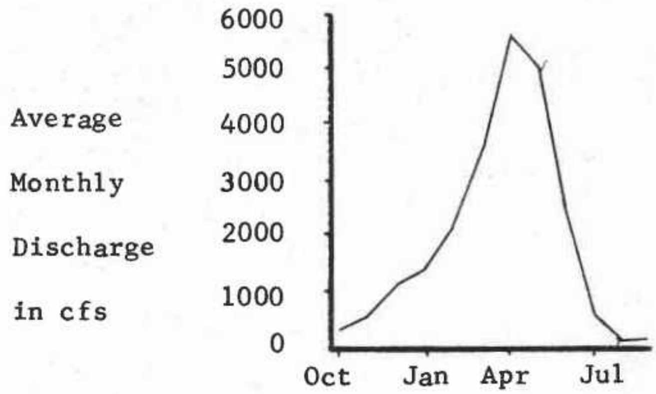
Only two structural flood abatement projects were found in the John Day River Basin.



Austin, Oregon

Source: SWRB

Fig. 22



John Day River at
McDonald Ferry

Source: SWRB

Fig. 23

Levee Work in the John Day area on Canyon Creek
Source: 54, 56

Emergency flood control works and activities of the Corps of Engineers
PL84-99 authorizes flood emergency preparation, flood fighting, rescue work, repair or restoration of flood control work threatened or destroyed by flood.

Source: 54

UMATILLA RIVER BASIN

The hydrology, geology, geography, and potential development of the Umatilla River Basin are diagnosed by the SWRB in Umatilla River Basin (1963), and by the USDA in cooperation with the SWRB in USDA Report on Water and Related Land Resources Umatilla Drainage Basin Oregon (1962). The Umatilla River Basin covers 4554 square miles and is located in two physiographic providences: The Blue Mountains and the Deschutes-Umatilla Plateau (Fig. 1, 2, 24). The headwaters of the three main streams of the basin, Willow Creek, the Umatilla River, and the Walla Walla River, drain the north slope of the Blue Mountain anticline. These streams cross and drain the eastern half of the Deschutes-Umatilla Plateau. The 2666 square miles of the Umatilla River drainage area is the largest of the three. The Blue Mountains at the headwaters of the streams is a broad level area with steep canyons and narrow valleys. At lower elevations along the streams, the valleys become even wider. The igneous formations, especially the Columbia River basalt, are characterized as porous and permeable. The Plateau is a slightly dissected, rolling syncline, the texture of which the USDA describes as "five types of terrace-like deposits" of heterogeneous deposits of alluvial, glacial, and igneous deposits. Infiltration in this type of material should be moderate to high.

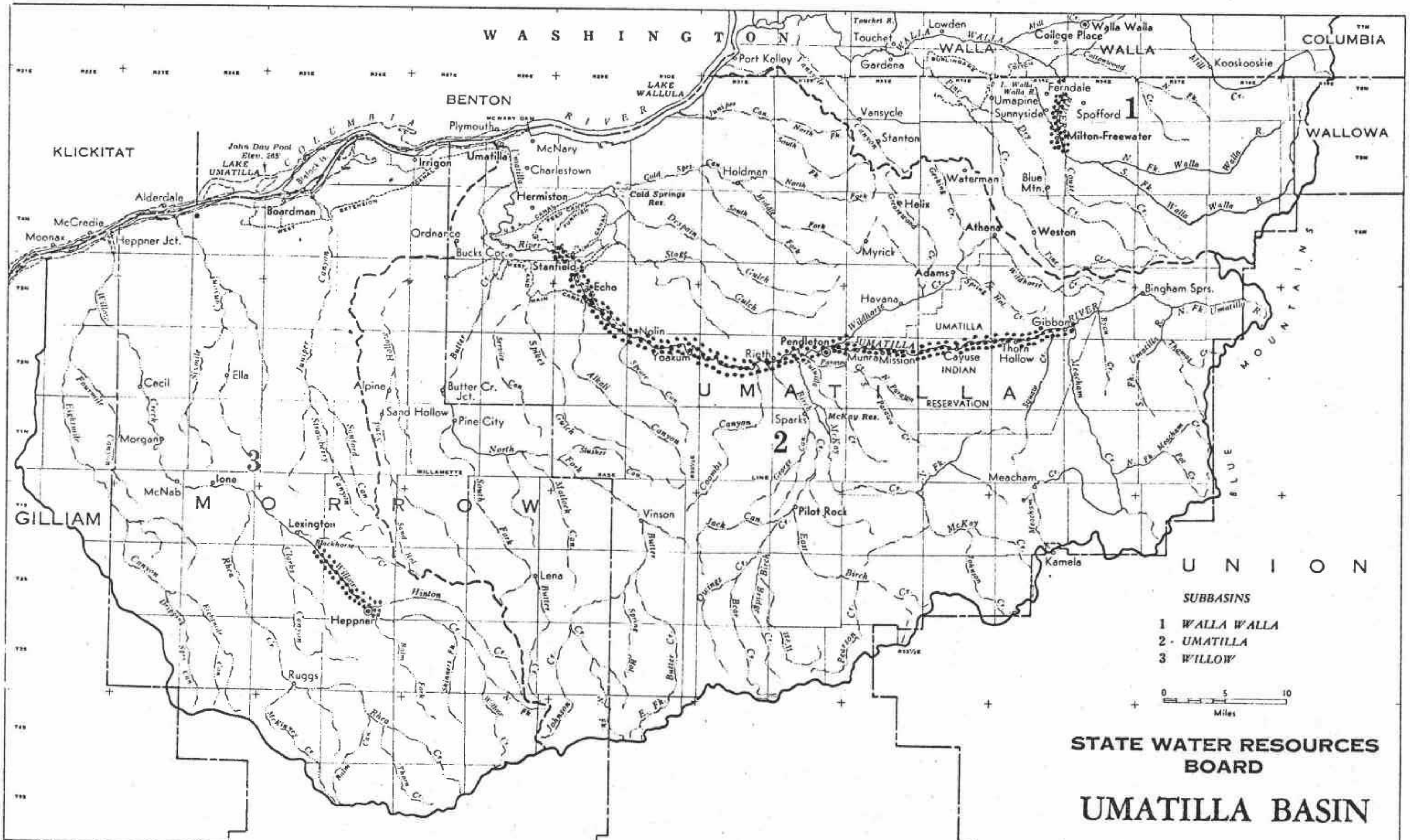
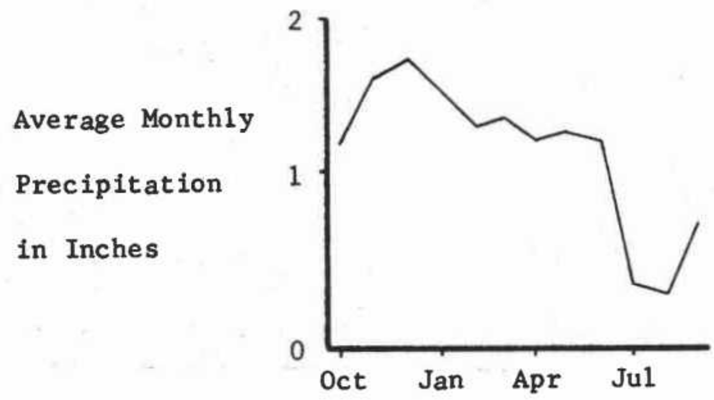


Fig. 24 Flood Prone Areas Source: CNPCFS

Elevation has a marked effect on climate. In general, the area has low precipitation and extreme temperatures during the summer and winter. Precipitation ranges from 50 inches in the mountains to less than eight inches in the lower areas, but all areas have relatively dry summers (Fig. 25). Snowfall is greatest in the mountains, averaging over 150 inches in some areas. Extreme temperatures given by the SWRB for Pendleton vary from minus 25° F to 112° F. Temperature means for different stations reflect elevations with January having the lowest mean and July the highest. For example, Pendleton has a January mean temperature of 32° F and a July mean temperature of 73° F.

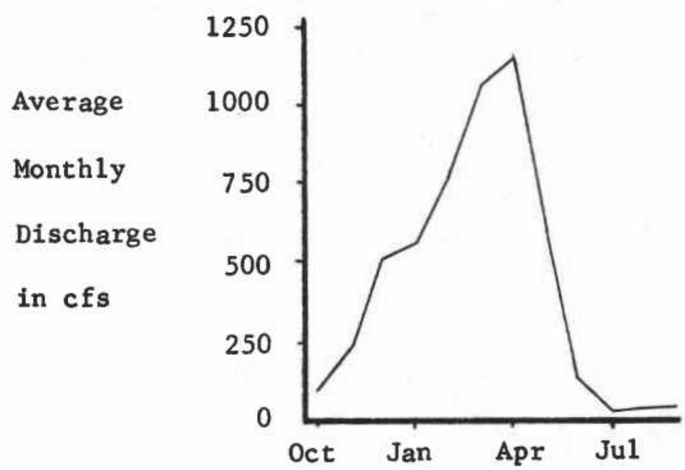
Streamflow in this semiarid area shows a wide variation from year to year. The seasonal distribution of streamflow illustrates the heavy dependence of the discharge on snowmelt from the mountains (Fig. 26). Maximum discharge is during the spring, minimum during the summer. The amount is dependent on the area of the watershed which accumulates snow. The Walla Walla River has a higher base level because it is partially spring fed. Daily extremes of discharge are the result of thunderstorms. The SWRB uses the example of Willow Creek near Arlington which shows a zero discharge minimum and one-half hour later a maximum discharge of 1400 cfs. Although large fluctuations of discharge are not uncommon in arid regions, they can cause great loss of life and property. In Heppner over 200



Milton-Freewater

Source: SWRB

Fig. 25



Umatilla River near
Umatilla

Source: SWRB

Fig. 26

people were killed by such a flood in 1903.

The SWRB differentiates between two causes and seasons of flooding. One cause is snowmelt associated with chinook winds combining with rain of wide extent and long duration. In this case runoff is high as the ground is frozen during the winter and early spring. The extent of flood naturally varies with the intensity of each contributing factor, but the resulting floods are the largest of the basin. The second cause is thunderstorms which concentrate water on a small area over a short period of time. This normally occurs during the late spring.

Some structural flood control projects exist in the basin. The following are the projects in the Umatilla River Basin.

McKay Reservoir on McKay Creek
Drainage Area: 191 square miles
AF for flood control: Incidental
Source: 39

Levees and channel work on the Umatilla River at Pendleton
Source: 54, 56

Levees, channel improvement and revetments near Milton-Freewater on the Walla Walla River
Source: 54, 56

Heppner, Lexington and Ione areas, minor improvements to Willow Creek
Source: 43

Lexington area, channel improvements and dikes along Blackhorse Creek
Source: 43

Snagging and clearing projects by the Corps of Engineers

Section 2 of the 1937 Flood Control Act

Heppner

Source: 21

Emergency flood control works and activities of the Corps of Engineers

PL84-99 authorizes flood emergency preparation, flood fighting, rescue work, repair or restoration of flood control work threatened or destroyed by flood

Source: 54

GRANDE RONDE RIVER BASIN

The hydrology, geology, geography, and potential development of the Grande Ronde River Basin are diagnosed by the SWRB in Grande Ronde River Basin (1960). The 5265 square mile basin is in the northeastern corner of the state completely within the Blue Mountain physiographic region (Fig. 1, 2, 27). The SWRB (1960, p. 2) describes the area as a "compound structural depression formed by folding and faulting." Headwaters for the three major streams in the basin, the Grande Ronde River, the Wallowa River, and the Imnaha River, rise in the mountains. Over half of the basin is classified as mountainous. The Wallowa and Grande Ronde valleys are the largest lowlands in the region. Infiltration depends on location as it is poor in areas of dense igneous and sedimentary rock and high along the alluvial fans.

Precipitation and temperature are dependent on elevation. Precipitation ranges from an annual average of over 60 inches per year in the mountains to less than 12 inches per year in the northeast corner of the basin. Those stations listed by the SWRB have a uniform seasonal distribution with only the summer months being somewhat lower than the rest of the year (Fig. 28). Temperatures also reflect elevation. Extremes range from below zero during the winter in the mountains to over 100°F in the valleys during the summer.

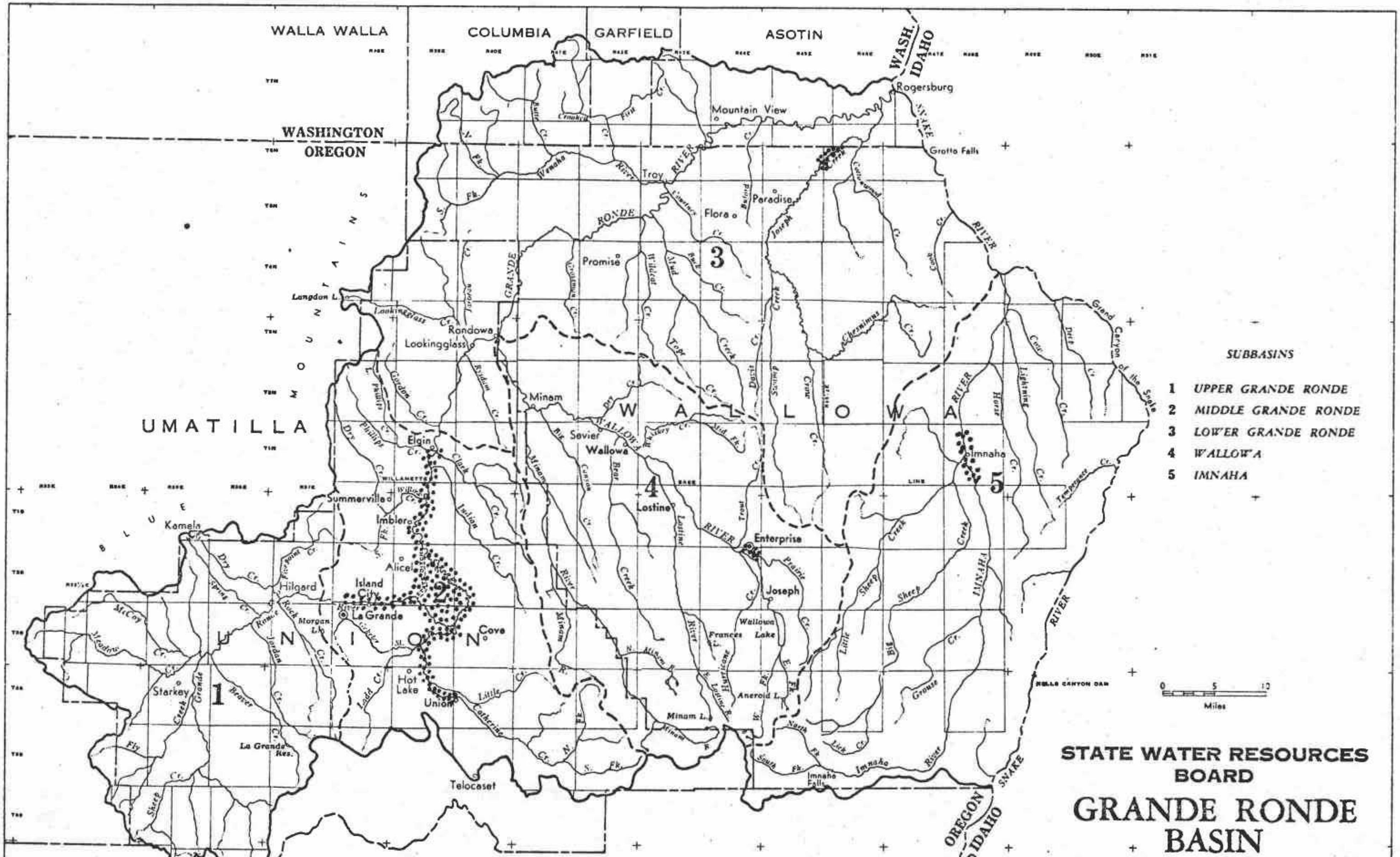
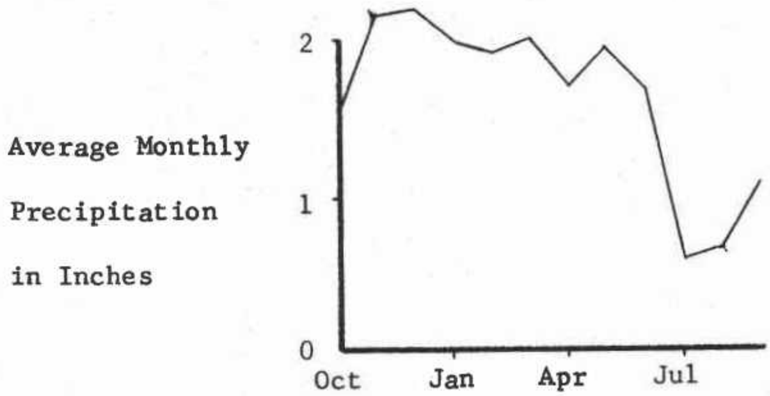


Fig. 27 Flood Prone Areas

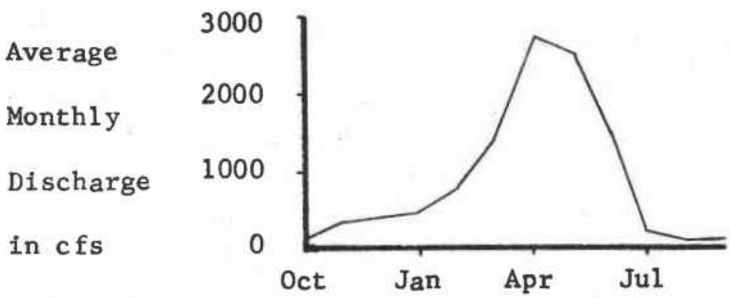
Source: CNPCFS



LaGrande

Source: SWRB

Fig. 28



Grande Ronde River near Elgin

Source: SWRB

Fig. 29

Mean July temperatures at LaGrande are in the upper 60's whereas mean January temperatures are in the upper 20's.

Figure 29 is characteristic of discharge curves for the basin. The flow peaks in spring as flow is dependent on snowmelt. Minimum discharge is during the late summer after snowmelt. Rains add to the discharge in spring to increase the stage.

Floods are the result of spring runoff or heavy rains during the winter and early spring. The SWRB estimates that up to 60,000 acres are susceptible to flooding, mostly along the lower reaches of valleys (Fig. 27).

Some structural flood control projects exist in the basin. The following are the projects in the Grande Ronde Basin.

State Ditch and private levees and channel improvements along the Grande Ronde River
Source: 39

Grande Ronde and Catherine Creek dikes built under ASCS program
Source: 33

Channel improvement and dikes in Union
Source: 23

Channel clearing and snagging project in and near La Grande
Source: 23

Protection of Public Works by the Corps of Engineers
Section 14 of the 1946 Flood Control Act
Wallowa River, Weaver Bridge Location
Source: 54

Emergency flood control works and activities by the Corps of Engineers

PL84-99 authorizes flood emergency preparation, flood fighting, rescue work, repair or restoration of flood control work threatened or destroyed by flood.

Source: 54

POWDER RIVER BASIN

The hydrology, geology, geography, and potential development of the Powder River Basin are considered by the SWRB in Powder River Basin (1967) and by the USDA in cooperation with the SWRB in USDA Report on Water and Related Land Resources Powder River Basin Oregon (1966). The 3240 square mile basin is in the eastern part of the Blue Mountain physiographic region draining into the Snake River through three systems (Fig. 12, 30). The Powder River accumulates runoff from the northern two-thirds of the basin, while the Burnt River concentrates water in the southern part of the basin. Pine Creek and miscellaneous systems drain the northeastern corner of the basin directly into the Snake River. All the major streams have headwaters in the surrounding mountains. The larger valleys of the basin have almost level floors. The USDA (1966, p. iii) summarizes the region as one of "mixed alluvium on flood plains, older terraces, alluvial fans, and lake basins and ... igneous or metamorphic rocks on uplands". Infiltration in the basin is classified as moderate to slow.

The precipitation and temperature are a function of elevation which varies considerably in the basin. Annual precipitation ranges from eight inches near Haines to over 80 inches in some parts of the Wallowa Mountains. The USDA reports that only 25% of the

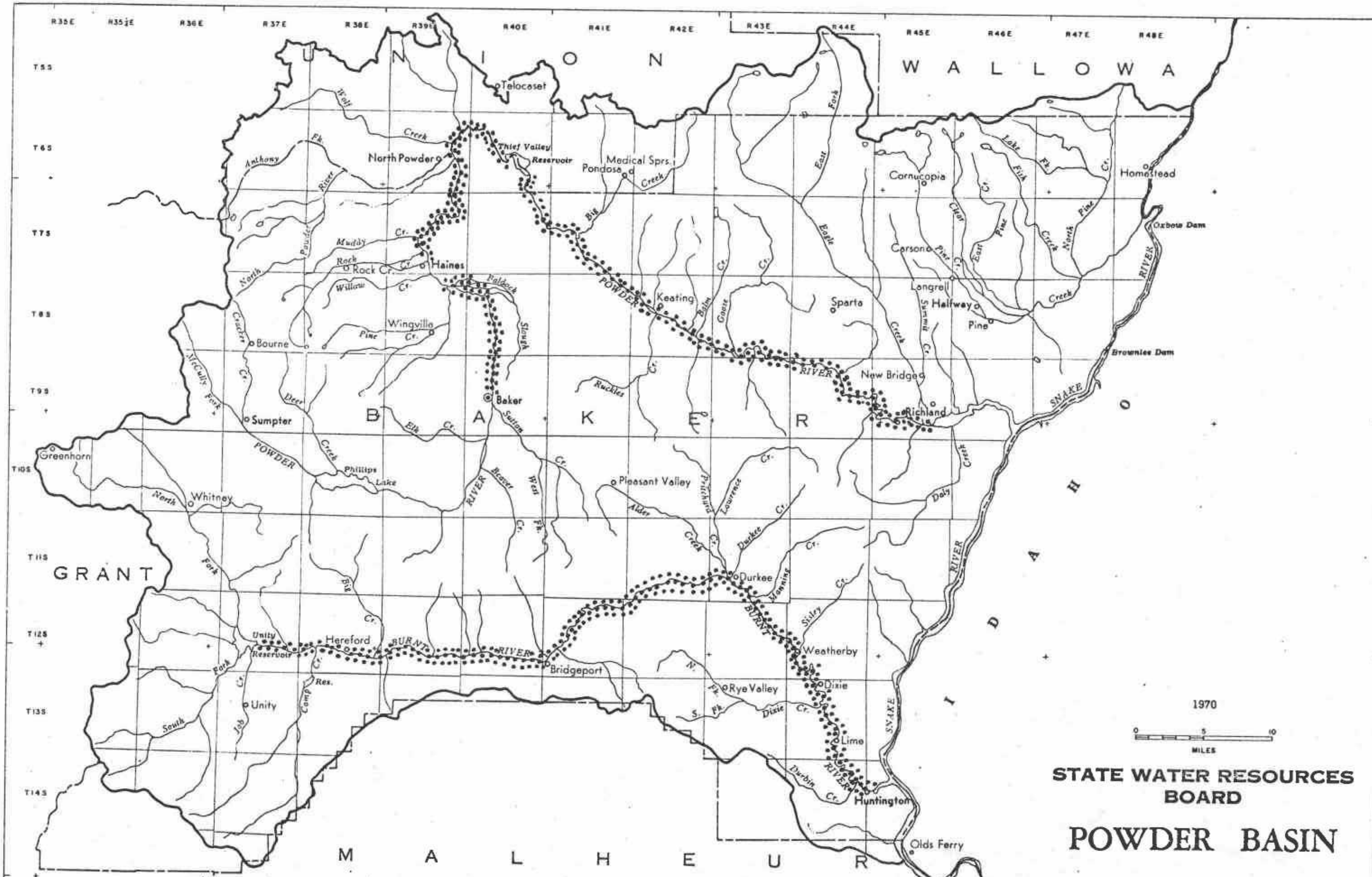


Fig. 30 Flood Prone Areas

Source: CNPCFS

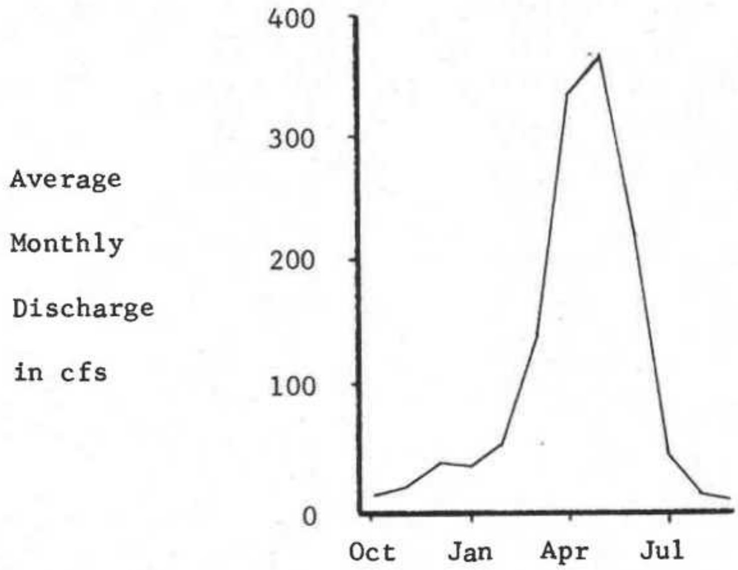
precipitation falls during the period April through September. Snow reaches over 290 inches in the Wallowa Mountains but only traces are recorded along the Snake River. The SWRB used Baker (elev. 3471 ft.) as the representative station for temperature.

Average Annual Temperature	:	46.7 °F
Mean January Temperature	:	25 °F
Mean July Temperature	:	68 °F

The SWRB uses the flow characteristics of the Powder River as exemplifying river regimes of the basin. The Powder River at Robinette has an average annual runoff of 412, 100 acre-feet. Extreme maximum annual flows can be up to twice the annual flow. Seasonal distribution (Fig. 31) is similar to those in other eastern Oregon streams. Maximum discharge is during the spring, minimum is during the summer. Marked fluctuation, now partially controlled through irrigation storage, results from rapid snowmelt runoff combined with rain during the spring. Thunderstorms occur during the summer.

According to the SWRB floods affect 11, 400 acres of land along the main rivers and their tributaries (Fig. 30). The streams normally flood during the spring, but inundation may occur as a result of summer cloudbursts. Flooding may last for weeks or show a rapid rise and fall characteristic of thunderstorm runoff.

Three structural flood abatement projects are found to exist in the basin.



Powder River near
Baker

Source: SWRB

Fig. 31

Mason Dam on the Powder River
Drainage Area: 230 square miles
AF for flood control: 17,000 exclusive
21,000 joint use
38,000 Total
Bureau of Reclamation
Source: 29

Thief Valley on the Powder River
(incidental)
Drainage Area: ?
AF for flood control: 17,400 usable storage
Bureau of Reclamation
Source: 39

Unity Reservoir on the Burnt River
(incidental)
Drainage Area: ?
AF for flood control: 25,200 usable storage
Bureau of Reclamation
Source: 39

Snagging and clearing projects by the Corps of Engineers
Section 2 of the 1937 Flood Control Act
Powder River at Baker
Source: 54

MALHEUR-OWYHEE BASINS

The hydrology, geology, geography, and potential development of the Malheur and Owyhee Basins are diagnosed together by the SWRB in Malheur-Owhyee Basins (1969). In this report they are also considered as one unit. The 11, 247 square miles of the basins are partially in the Blue Mountains, High Lava Plains, Basin-Range, and Owyhee physiographic regions of southeastern Oregon (Fig. 1, 2, 32, 33). The major Malheur Basin streams, the Malheur River, Bully Creek, and Willow Creek, have their headwaters in the Blue Mountains and High Lava Plain. The Owyhee River, the single dominant stream in the Owyhee Basin, drains the Owyhee uplands, much of which is in Idaho and Nevada. In general the topography of the basins is either mountainous or incised plateau. Broad valleys are concentrated along the lower reaches of the Owyhee and Malheur Rivers. Infiltration is a function of local factors as discussed in the Introduction (Table 1).

The basins have a semiarid climate of hot summers, cold winters, and low yearly precipitation. Annual average precipitation is eight inches near Rome and 25 inches in the headwaters of the Malheur River. The precipitation (Fig. 34) is presented for Danner and Vale as the SWRB feels these stations represent the upper and lower reaches in the basins. Precipitation is distributed throughout

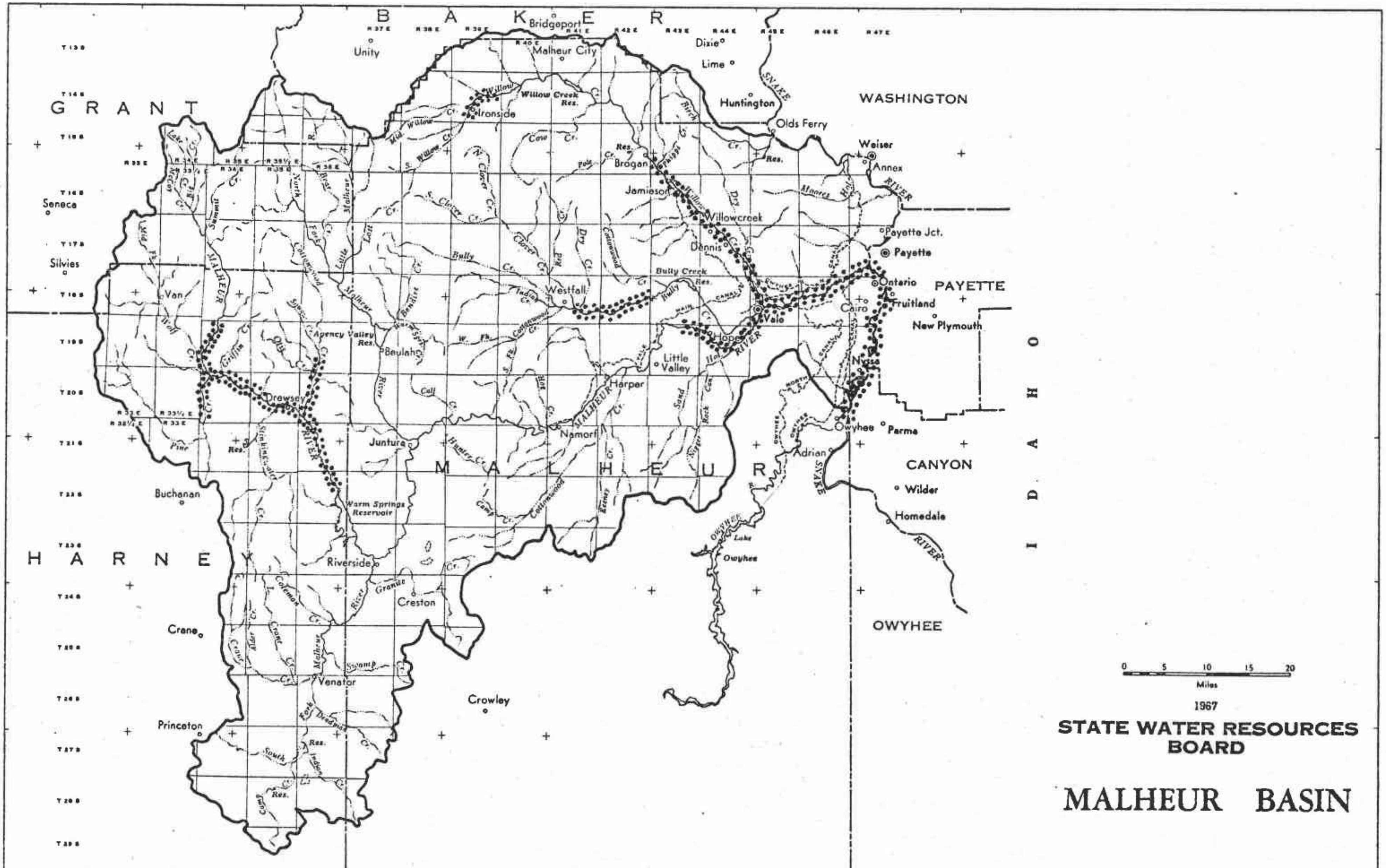


Fig. 32 Flood Prone Areas

Source: CNPCFS

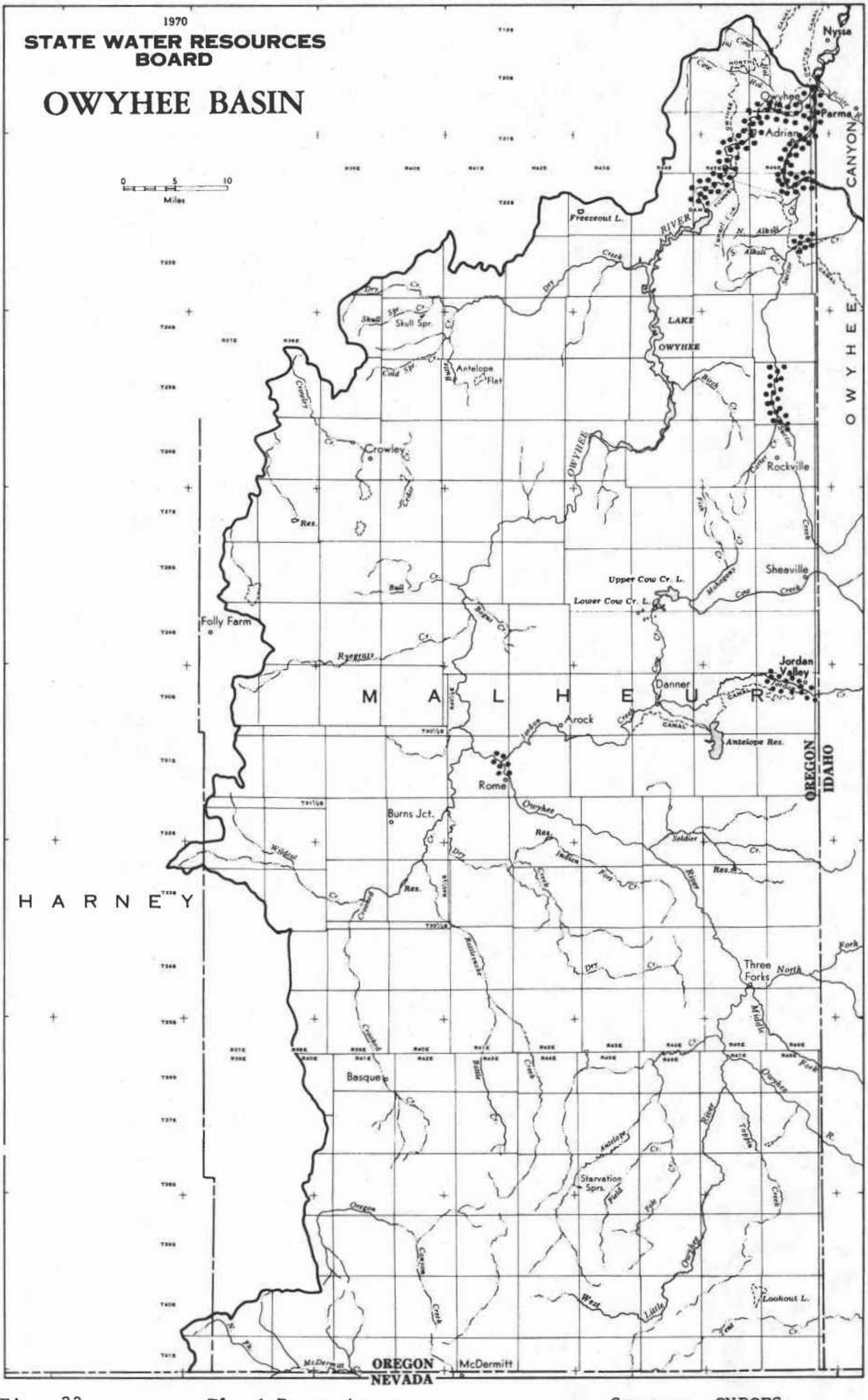


Fig. 33 Flood Prone Areas Source: CNPCFS

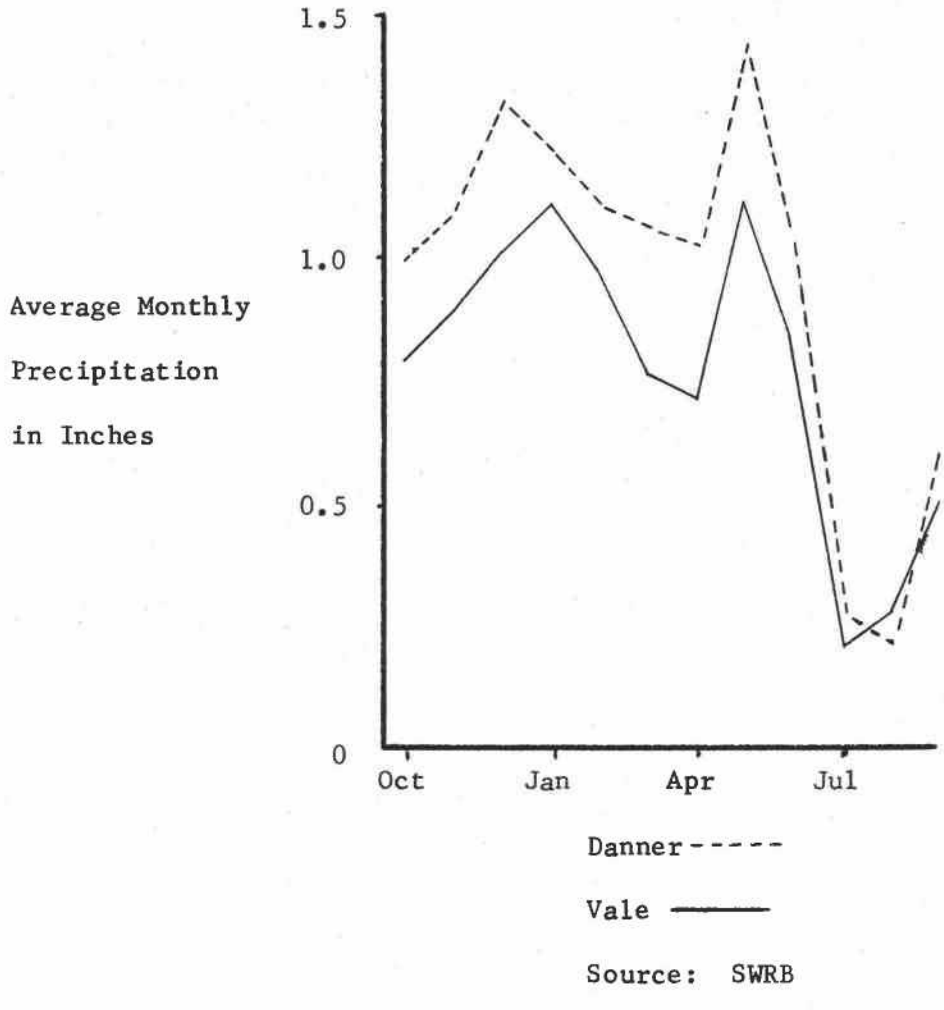

1.5
1.0
0.5
0
Average Monthly
Precipitation
in Inches
Oct
Jan
Apr
Jul
Danner - - - - -
Vale ———
Source: SWRB

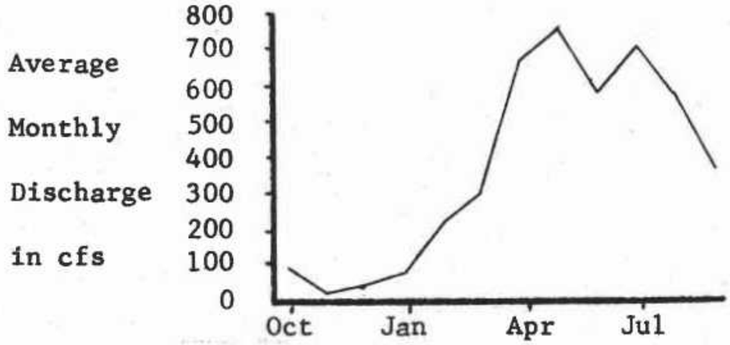
Fig. 34

the year, but there is a marked dry spell during the summer. Temperatures range from a July mean in the low 70's to a January mean in the low 30's

Stream discharge varies in the upper and lower reaches of most larger streams as a result of irrigation regulation by dams. Without dams the stream regimes show marked fluctuations (Fig. 36). Dams have modified these wide fluctuations. Figure 35 illustrates this modification: the spring freshets are suppressed and then released during the irrigation season. Occasional thundershowers below the dams can cause flooding.

Floods are still destructive along the lower reaches of the Malheur and Owyhee Rivers and along Succor, Jordan, Bully, and Willow Creeks. The SWRB estimates that 7100 acres are subject to a flood once every five years in the Malheur Basin and 1600 acres are subject to flood once every five years in the Owyhee Basin (Fig. 32, 33). Floods occur during the spring from snowmelt and in the summer from thunderstorms.

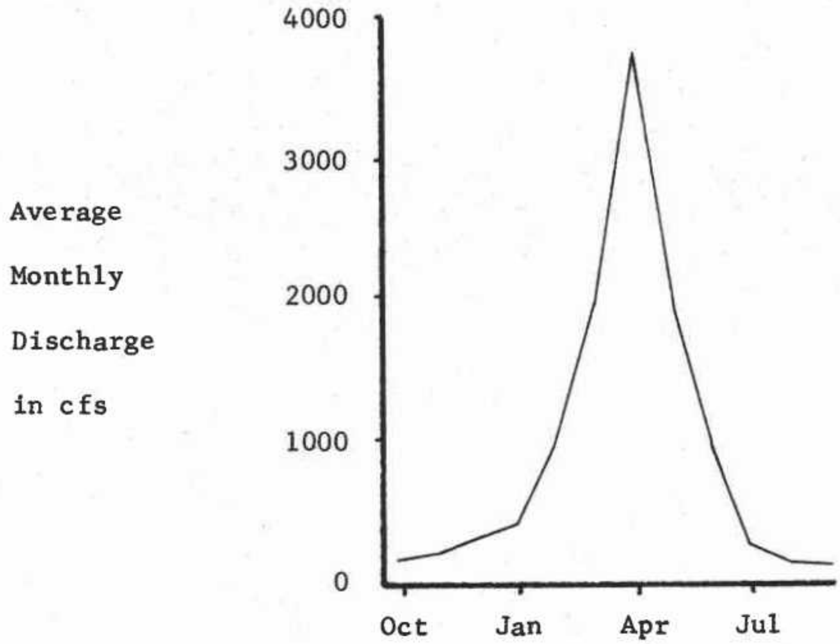
The following are the structural flood abatement projects in the Malheur River Basin.



Malheur River near Namorf

Source: SWRB

Fig. 35



Owyhee River above
Lake Owyhee

Source: SWRB

Fig. 36

Agency Valley Reservoir on Malheur River
Drainage Area: 440 square miles
AF for flood control: 10,000 joint use
Bureau of Reclamation
Source: 29

Bully Creek Reservoir on Bully Creek
Drainage Area: 547 square miles
AF for flood control: 10,000 joint use
Bureau of Reclamation
Source: 29

Warm Springs Reservoir on Malheur River
Drainage Area: 1100 square miles
AF for flood control: 54,400 joint use
Bureau of Reclamation and Private
Source: 29

Levees on the left bank of the Snake River across from Weiser, Idaho 500 acre area
Source: 54, 56

Levees at Vale on Malheur River and Bully Creek
Source: 54, 56

Emergency flood control activities by Corps of Engineers
PL84-99 authorizes flood emergency preparation, flood fighting, rescue work, repair or restoration of flood control work threatened or destroyed by flood.

Source: 54

Only one confirmed structural flood abatement project exists in the Owyhee Basin.

Owyhee Reservoir on Owhyee River
Drainage Area: 11,160 square miles
AF for flood control: 715,000 usable storage
Bureau of Reclamation
Source: 58

MALHEUR LAKE BASIN

The hydrology, geology, geography, and potential development of the Malheur Lake Basin are diagnosed by the SWRB in Malheur Lake Basin (1967) and by the USDA in cooperation with the SWRB in USDA Report on Water and Related Land Resources Malheur Lake Drainage Basin Oregon (1967). The Malheur Lake Basin (Fig. 1, 2, 37) covers 9965 square miles in three physiographic regions. From the north to south these three regions are: the Blue Mountains, the High Lava Plains, and the Basin-Range. The basin contains a series of broad, flat valleys between 4000 and 4600 feet in elevation which are among mountains reaching to over 9600 feet. Infiltration rates vary from one region to the next, but in general are medium to rapid at higher elevations and slow in the valleys. Internal drainage into playas is characteristic of the basin.

The basin is semiarid. Annual average precipitation ranges from less than 10 inches in the lower areas to over 40 inches in the mountains. The SWRB classifies Burns as typical of the valley situations where precipitation is more or less evenly distributed throughout the year but has a small peak in the winter and low in the summer (Fig. 38). Snow from late fall to spring is a large part of the precipitation. Amounts range from a few inches in the lowlands to over 70 inches in the mountains. Extreme temperatures range

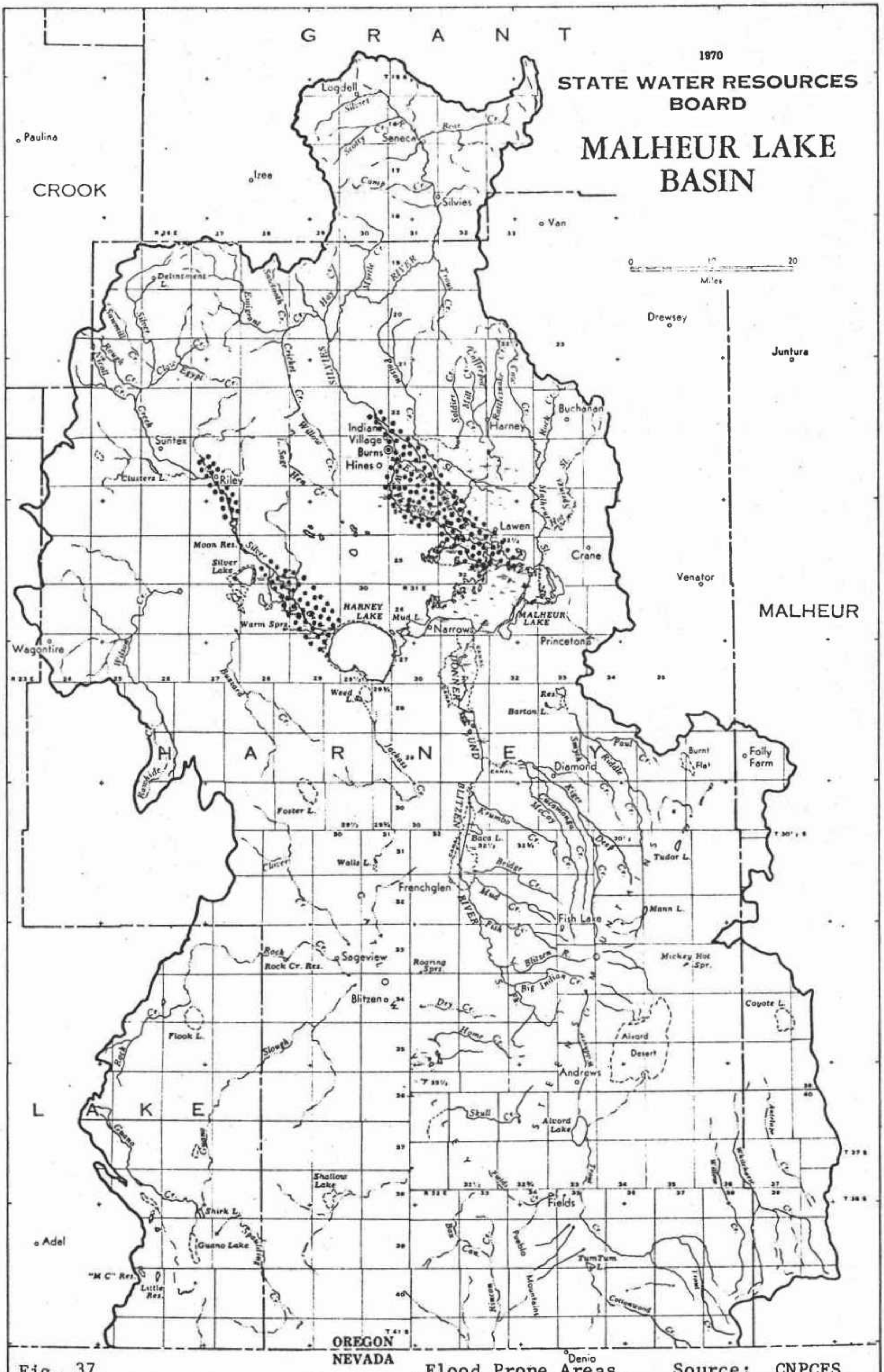
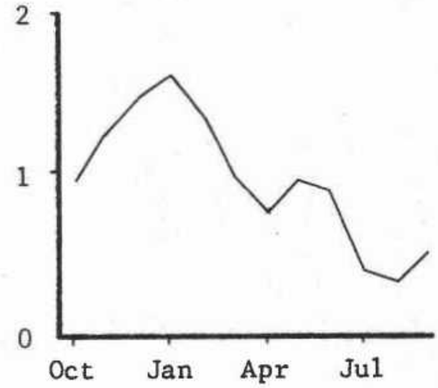


Fig. 37 Flood Prone Areas Source: CNPCFS

Average Monthly

Precipitation

in Inches



Burns

Source: SWRB

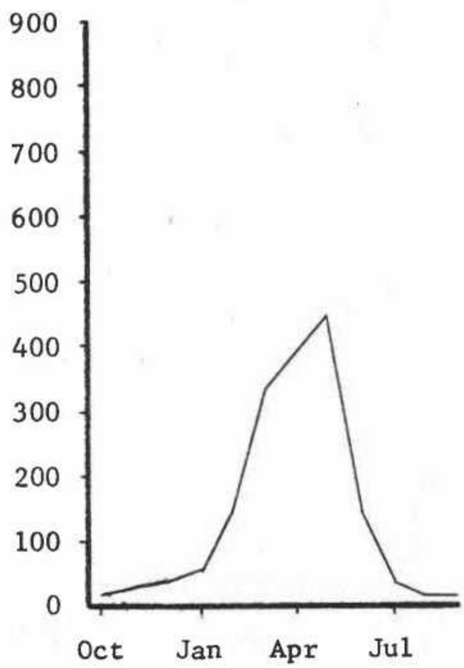
Fig. 38

Average

Monthly

Discharge

in cfs



Silvies River near
Burns

Source: SWRB

Fig. 39

from minus 54° F to 107° F. The temperatures at Burns are:

Average Annual Temperature:	46.5° F
Average January Temperature:	25.0° F
Average July Temperature:	68.6° F

At lower elevations, evaporation averages about 42 inches per year; this is very high relative to precipitation. Thunderstorms are common during the summer months.

The annual stream discharge varies greatly from year to year. For example, the Silvies River has had annual extremes of 45,000 acre feet to 270,000 acre feet. Evaporation is very high in the basin, causing the loss of about 190,000 acre feet anually from Malheur and Harney Lakes. Seasonal distribution is characteristic of semi-arid regions, i.e., high spring runoff due to snowmelt and low discharge the rest of the year (Fig. 39).

Floods are normally the result of snowmelt, but may also occur as a result of rain combining with snowmelt or as thunderstorm runoff during the summer. The SWRB points out that flooding is only a problem in the Harney Valley as it is the only area within the basin with moderate population density. Flooding in that and other areas is used as a means of irrigating fields. It is estimated that a total of only 50,000 acres are annually inundated along main streams and their tributaries (Fig. 37).

Only one flood abatement structure was in the Malheur Lake Basin.

Levees around Burns
Source: 39

GOOSE AND SUMMER LAKES BASIN

The hydrology, geology, geography, and potential development of the Goose and Summer Lakes Basin are treated by the SWRB in Goose and Summer Lakes Basin (1963). The 8600 square miles of the basin are part of the Basin-Range and the High Lava Plains physiographic regions of south central Oregon (Fig. 1, 2, 40). The basin is one of horsts and grabens in the Basin-Range region. Most valleys are broad, smooth playas surrounded by steep escarpments. The High Lava Plain region is a dissected plateau. The valleys are at 4500 feet elevation and the mountains may be as high as 7000 feet. Infiltration rates vary widely depending on the site location vis-à-vis, relief, vegetal cover, etc. (Table 1).

The basin has low precipitation and extreme temperatures. Valleys have an annual average precipitation of only five inches whereas mountains may have 30 inches per year. Seasonal distribution is quite even throughout the year, but with a marked drier period in summer (Fig. 41). Precipitation is in the form of snow from late fall to early spring, valleys averaging 15 inches per year, mountains 70 inches. The snows in the valleys normally melt rapidly, but snows in the mountains accumulate. Temperatures range from minus 40° F to 109° F. The SWRB feels that Lakeview is representative of valley locations and cites the following:

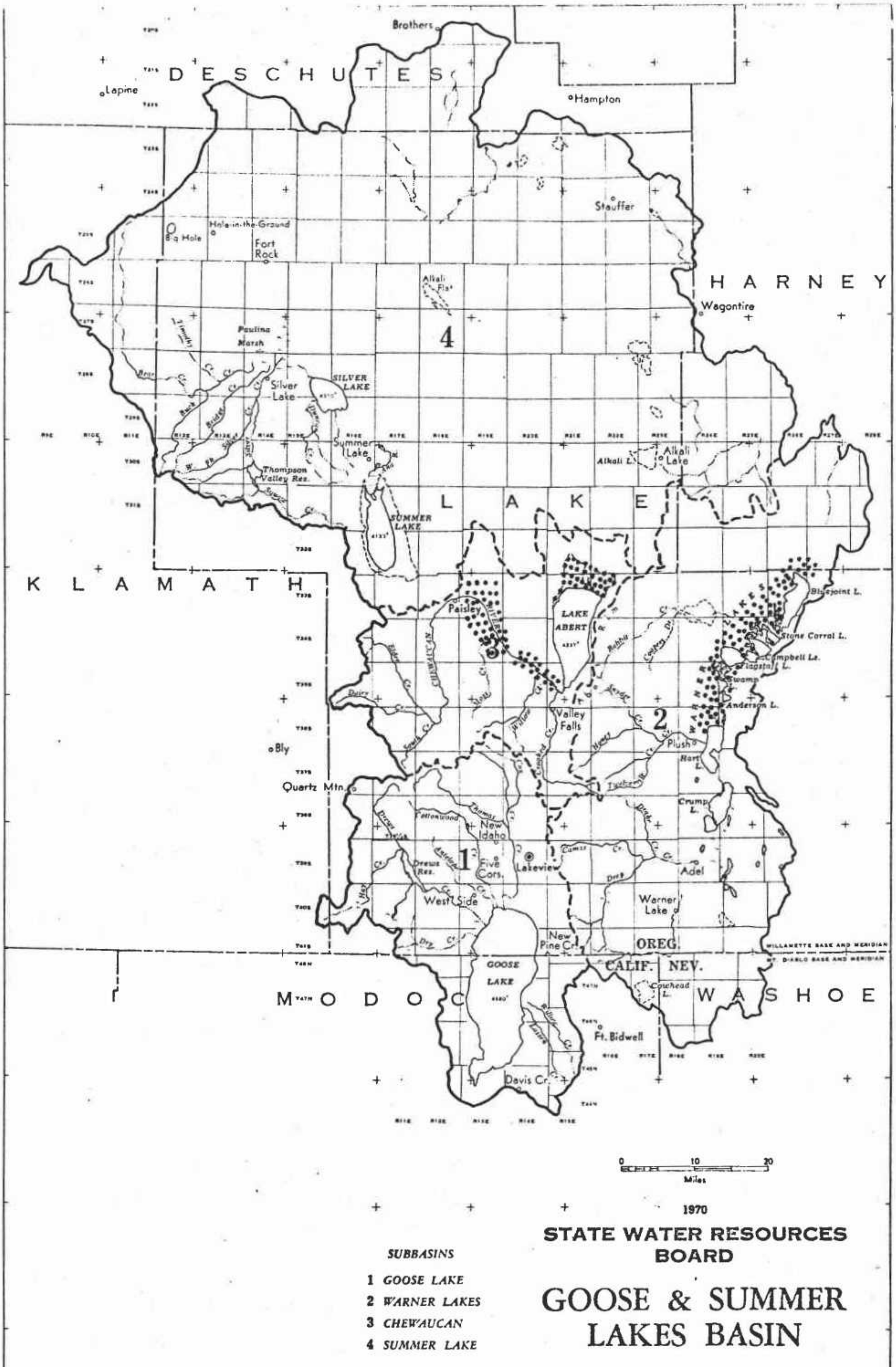
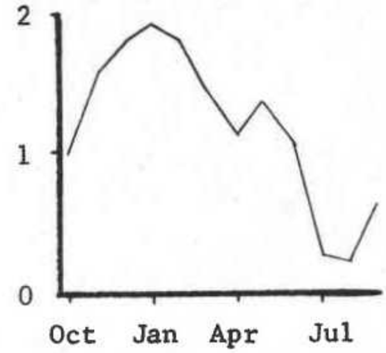


Fig. 40 Flood Prone Areas Source: CNPCFS

Average Monthly

Precipitation

in Inches



Lakeview

Source: SWRB

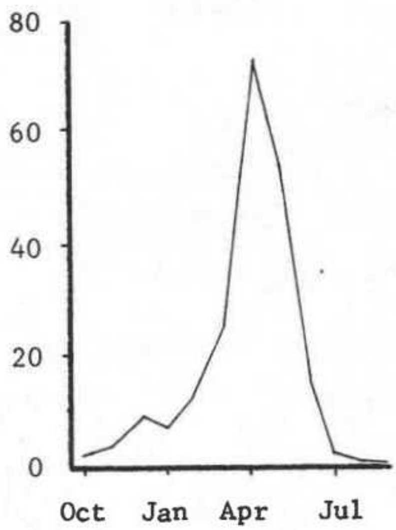
Fig. 41

Average

Monthly

Discharge

in cfs



Thomas Creek near
Lakeview

Source: SWRB

Fig. 42

Mean minimum for January:	18° F
Mean maximum for January:	37° F
Mean minimum for July:	49° F
Mean maximum for July:	85° F

Streams are fed from snowmelt in the mountains. The SWRB believes the Chewaucan River has the highest average annual yield and this is only 122,000 acre feet. Yearly discharge may fluctuate from 10% to over 300% of the average flow. Seasonal distribution likewise fluctuates widely. Peak discharge is during the spring snowmelt; minimum discharge, usually a dry streambed, is during the summer (Fig. 42). Seventy-five percent of the stream flow is during the spring, only three percent from June through October. Most streams throughout the basin are classified as intermittent.

Flooding normally occurs during the spring snowmelt. Winter flooding may occur along the Chewaucan River in the Paisley and other areas as a result of winter rains. Figure 40 shows those areas defined by the Columbia-North Pacific Region Comprehensive Framework Study (1971) as susceptible to flooding.

The following are the flood control projects in the basin.

Levees on the Chewaucan River in the Paisley area
Source: 39

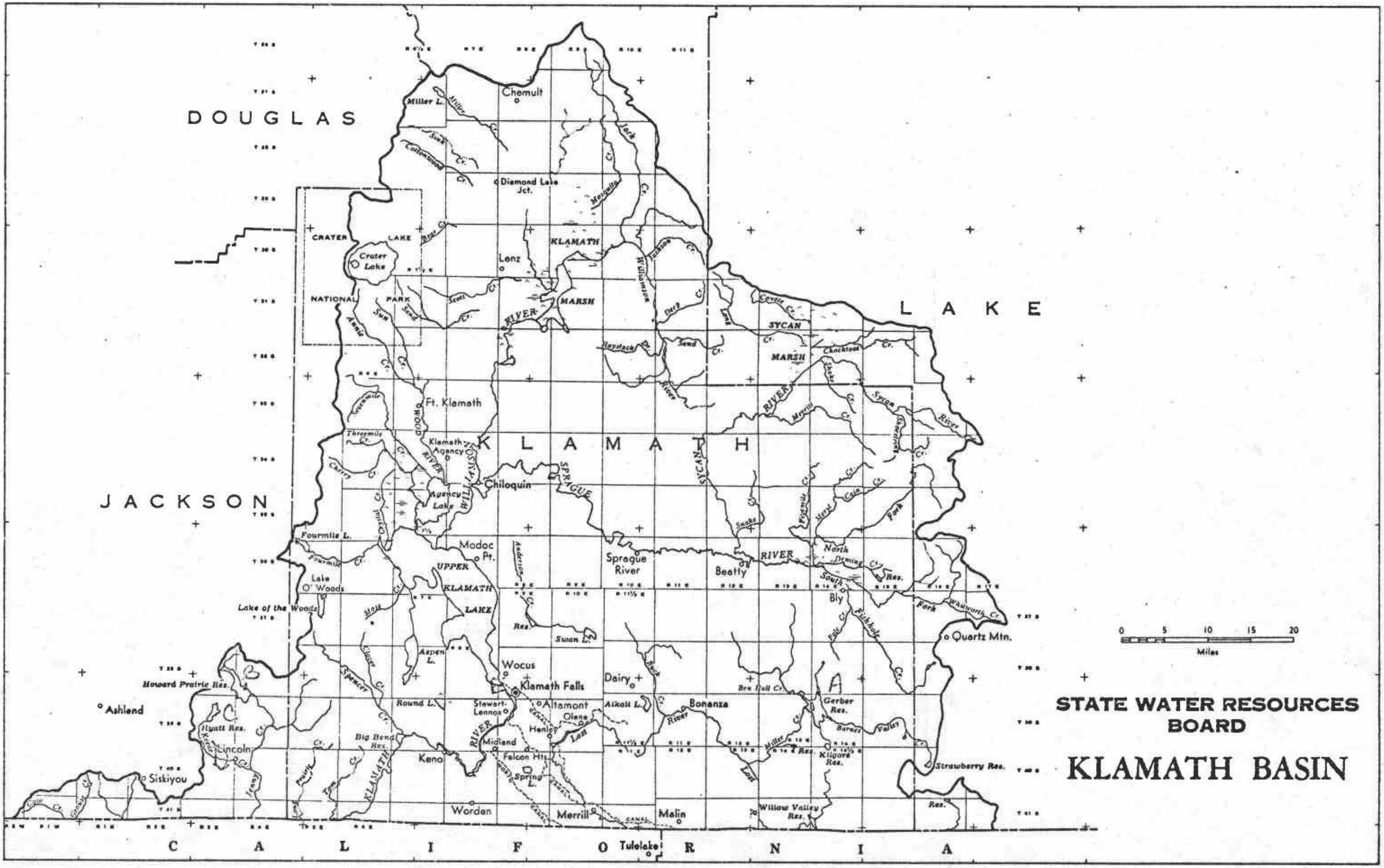
Emergency flood control works and activities by the Corps of Engineers
PL84-99 authorizes flood emergency preparation, flood fighting, rescue work, repair or restoration of flood control work threatened or destroyed by flood.

Source: 54

KLAMATH BASIN

The hydrology, geology, geography, and potential development of the Klamath Basin are diagnosed by the Bureau of Reclamation in Upper Klamath River Basin Oregon-California (1954) and by the SWRB of California in Interim Report on Klamath River Basin Investigation Water Utilization and Requirements (1954). The 3792 square miles of the basin are in the Basin-Range and southeastern corner of the Cascade physiographic providences of south central Oregon (Fig. 1, 2, 43). The Basin-Range region is an area of horsts and grabens. The Bureau of Reclamation (1954) describes the valley floors as flat and often marshy and the mountain slopes as rugged. Infiltration is a function of the circumstances of particular locality (Table 1).

The basin is a transition zone between the humid, western half of Oregon and the semiarid eastern part. Annual precipitation ranges from over 60 inches in the mountains on the western side of the region to less than nine inches in the valleys. Maximum precipitation is during the late fall and winter and minimum is during the summer (Fig. 44). Snow varies with elevation. Crater Lake receives an average of approximately 600 inches annually; Klamath Falls receives about 50 inches. At Klamath Falls, the region's population center, temperatures range from a mean January temperature of 29° F to a mean July temperature of 69° F. Extremes vary from



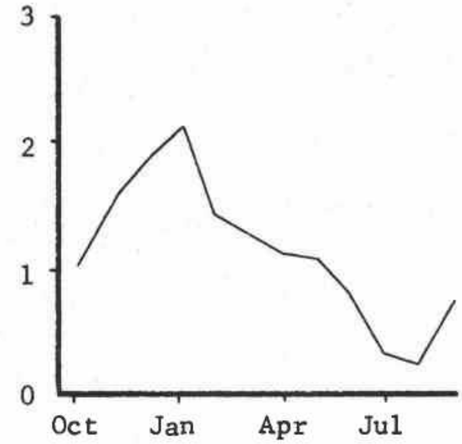
DOUGLAS
JACKSON
LAKE
KLAMATH
CALIFORNIA
STATE WATER RESOURCES BOARD
KLAMATH BASIN
Miles
0 5 10 15 20
Chemult
Diamond Lake Jct.
Lenz
Crater Lake
CRATER LAKE NATIONAL PARK
Ft. Klamath
Klamath Agency
Agency Lake
Chiloquin
KLAMATH MARSH
SYCAN MARSH
UPPER KLAMATH LAKE
Modoc Pt.
Sprague River
Beatty
Bly
Quartz Mtn.
Fourmile L.
Lake O' Woods
Lake of the Woods
Howard Prairie Res.
Ashland
Hyatt Res.
Lincoln
Siskiyou
Big Bend Res.
Keno
Worden
Round L.
Aspen L.
Wocus
Klamath Falls
Stewart-Lennox
Altamont
Olene
Henley
Midland
Falcon Hts.
Spring L.
Merrill
Malin
Tulelake
Dairy
Alkali L.
Bonanza
Swan L.
Gerber Res.
Klippel Res.
Willow Valley Res.
Strawberry Res.
Miller L.
SPRAGUE
SYCAN
WILLIAMSON

Fig. 43

Average Monthly

Precipitation

in Inches



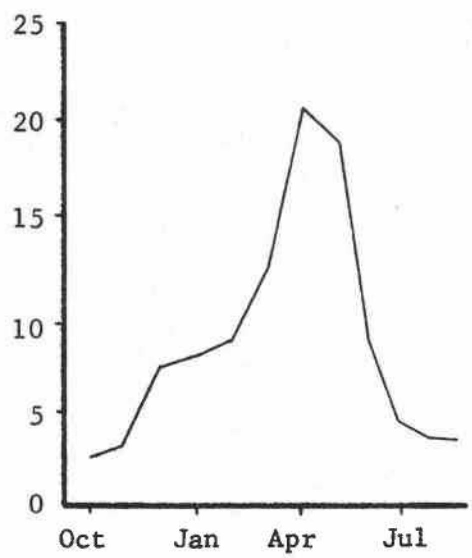
Klamath Falls

Source: Bureau of Reclamation

Fig. 44

Percentage

Annual Runoff



Sprague River near
Beatty

Source: Bureau of Reclamation

Fig. 45

below zero to over 100° F.

Natural stream runoff patterns are, in general, the result of snowmelt during the late winter and spring (Fig. 45). At present this pattern is largely limited to streams of the upper watersheds as many of the streams in the lower areas are regulated to gain maximum benefits from summer irrigation. Numerous diversions, dams, and levees control the water as it makes its way through the basin.

Floods are the result of spring snowmelt and rains. The County Cooperative Extension Agent reports that the area most extensively flooded is that along the Sprague River. The Klamath County Water Resources Committee reports floods along Lost River. Sprague River, Fishhole Creek, and the Sycan. Peaks in runoff depend on the rapidity of snowmelt in the watersheds of these rivers and the possibility of accompanying intense rains. No maps were found which show the flood-prone areas.

A number of structural flood abatement projects are in the basin.

Gerber Reservoir on Miller Creek
Drainage Area: 220 square miles
AF for flood control: 94, 270 joint use
Bureau of Reclamation
Source: 59

Howard Prairie Reservoir on Beaver Creek
Drainage Area: 79 square miles
AF for flood control: incidental - 62, 000 total
Bureau of Reclamation
Source: 23, 30, 59

Hyatt (Hyatt Prairie) Reservoir on Keene Creek
Drainage Area: 12 square miles
AF for flood control: incidental - 16, 200 total
Bureau of Reclamation
Source: 23, 30, 59

Keene Creek Reservoir on Keene Creek
Drainage Area: 111 square miles
AF for flood control: 19, 700 usable storage
Bureau of Reclamation
Source: 23, 59

Link River Dam on Klamath River
Drainage Area: 3810 square miles
AF for flood control: 525, 000 joint use
Pacific Power and Light Company
Source: 59

Channel clearance of Keno reef on Klamath River
by Pacific Power and Light
Source: 32

ROGUE RIVER BASIN

The hydrology, geology, geography, and potential development of the Rogue River Basin are surveyed by the SWRB in the Rogue River Basin (1959). Most of the 5100 square miles of the basin (Fig. 1, 2, 46), are within the Klamath Mountain physiographic region of southwestern Oregon and the remainder is part of the Cascade region. The eastern part of the basin in the Cascades is rugged mountains with narrow canyons and steep slopes. Toward the middle of the basin is the area classified as the Central Valley by the SWRB. This area is a series of tributary valleys ranging up to 46,000 acres in size. The rest of the basin is mountainous, the valleys being steep and narrow. Discharge is concentrated in the Rogue River which empties into the Pacific Ocean at Gold Beach. Infiltration depends on the location of the site in question (Table 1).

Precipitation and temperature are strongly influenced by the mountains. There is orographic precipitation on the windward side of the mountains and a rainshadow on the leeward side. Precipitation ranges from over 120 inches per year along the crest of the Klamath Mountains to less than 18 inches annually in the Central Valley. Seasonal distribution reflects the proximity of the basin to the Pacific Ocean and the pattern of shifting pressure cells and winds. Minimum precipitation is during the summer, maximum is during the winter

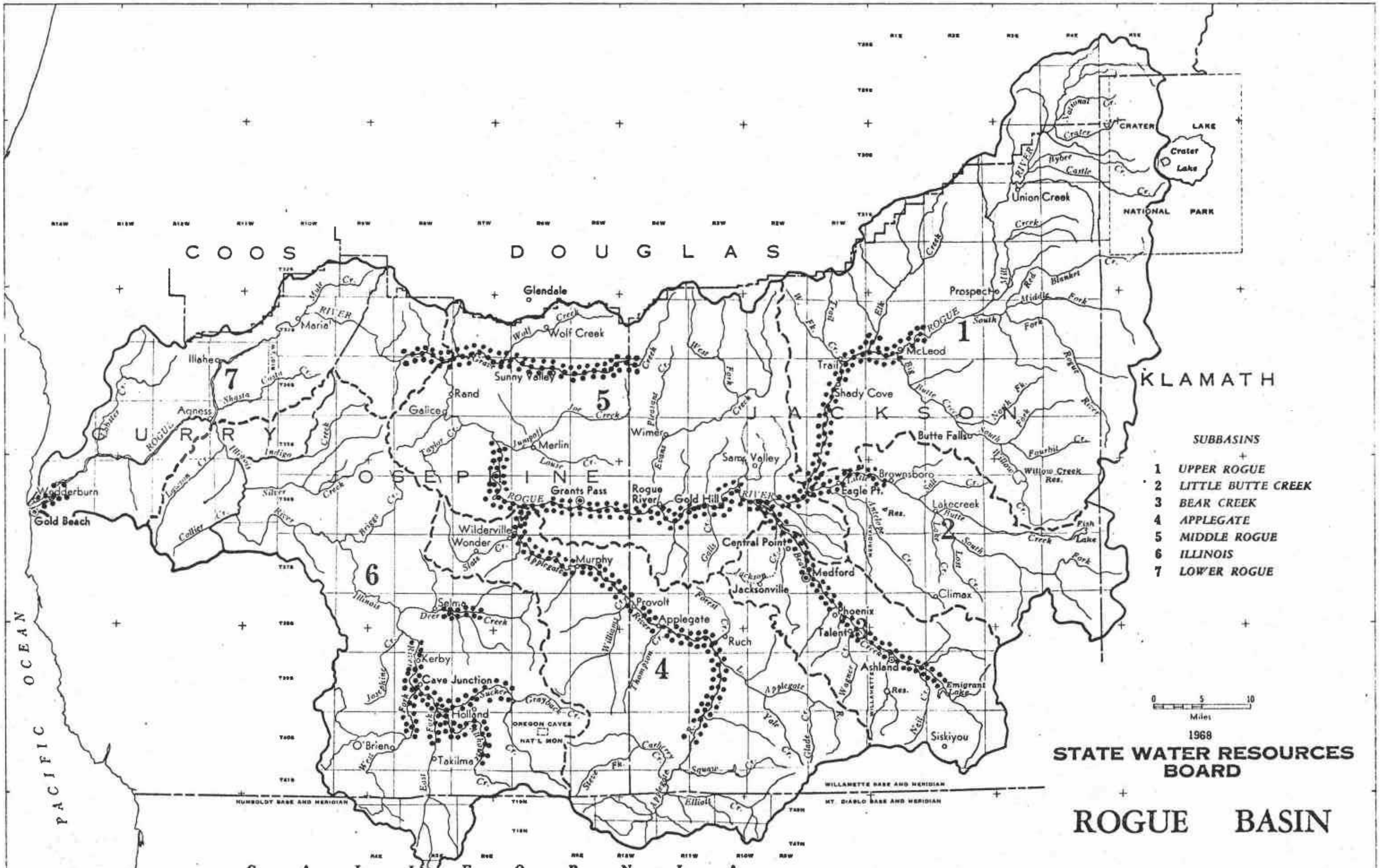


Fig. 46 Flood Prone Areas Source: CNPCFS

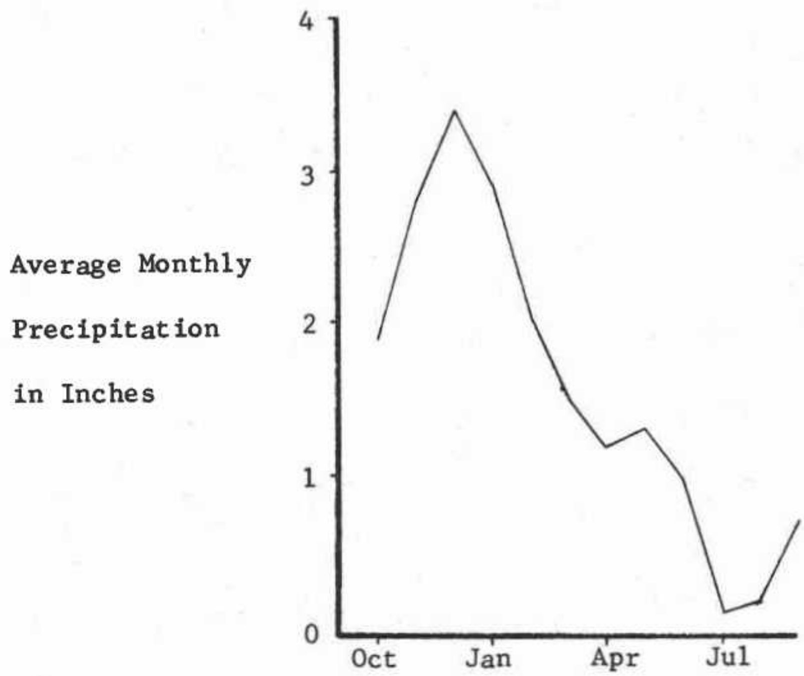
(Fig. 47). Snowfall varies from a few inches in the valleys to over 300 inches near the crest of the Cascades. Temperatures range from below zero in the mountains to over 100° F in the valleys. Medford, representative of the populated central valley, has a mean January temperature of 37° F and a mean July temperature of 72° F.

Stream discharge also shows the influence of elevation. Lower streams have a peak discharge during the months of high precipitation (Fig. 48). Streams at higher elevations have a discharge dependent on snowmelt; consequently, they have a discharge skewed toward the spring months (Fig. 49). The Rogue River shows the influence of winter rains more than spring snowmelt (Fig. 50). In some areas discharge is controlled by irrigation practices.

The flood plains of the Rogue River Basin are defined by the SWRB (Fig. 46). Major floods in the basin normally occur in the late fall and winter although floods have occurred as early as October. The SWRB describes the floods as "flashy" and of extremely high peaks.

The following are the structural flood abatement projects in the basin.

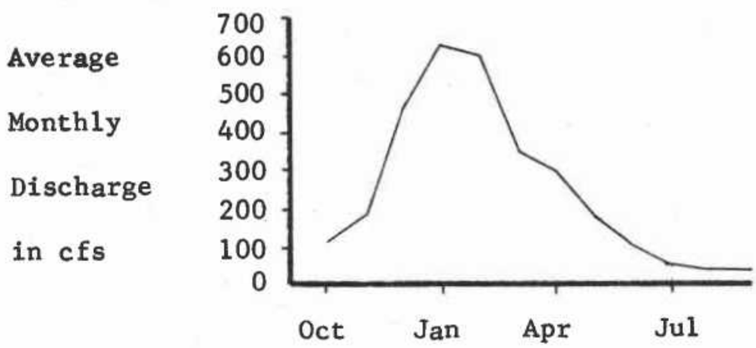
Agate Reservoir on Dry Creek
Drainage Area: 9.5 square miles
AF for flood control: Incidental
Bureau of Reclamation
Source: 30



Medford

Source: Highsmith

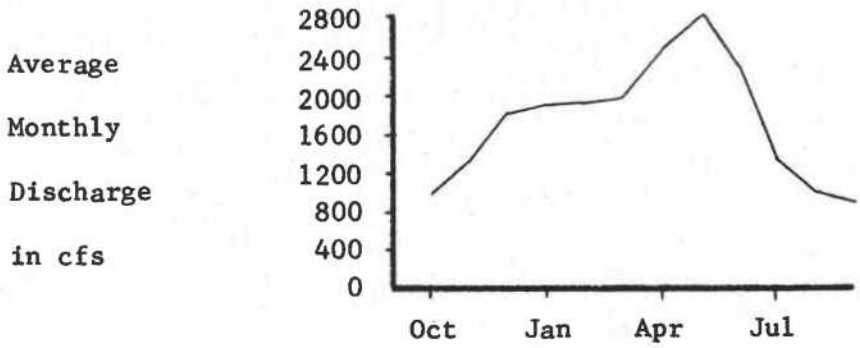
Fig. 47



Evans Creek

Source: SWRB

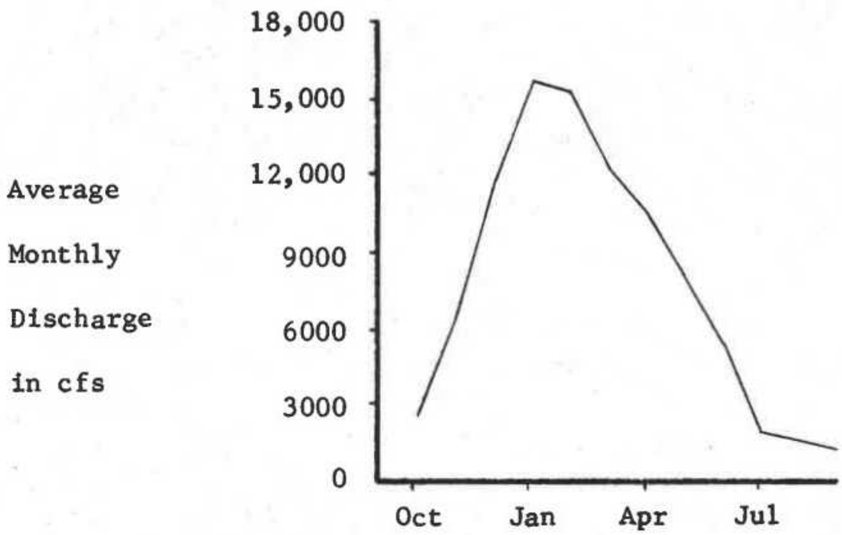
Fig. 48



Rogue River above mile 164

Source: SWRB

Fig. 49



Rogue River at mouth

Source: SWRB

Fig. 50

Emigrant Reservoir on Emigrant Creek
Drainage Area: 62 square miles
AF for flood control: 20,000 usable storage
Bureau of Reclamation
Source: 29

Lost Creek Dam on the Rogue River
(Under construction)
Drainage Area: 674 square miles
AF for flood control: 315,000 usable storage
Corps of Engineers
Source: 54, 55

Snagging and clearing projects by the Corps of Engineers
Section 2 of the 1937 Flood Control Act
Applegate River, Hoopes, Kingle, and Krouse Locations
Rogue River
Rogue River at the mouth of the Applegate River
Source: 54

Protection of Public works by the Corps of Engineers
Section 14 of the 1946 Flood Control Act
Bear Creek at Medford, revetment
Rogue River at Pierce Riffle, revetment
Source: 54

Emergency flood control works and activities by the Corps of Engineers
PL84-99 authorizes flood emergency preparation, flood fighting, rescue work, repair or restoration of flood control work threatened or destroyed by flood.

Source: 54

UMPQUA RIVER BASIN

The hydrology, geology, geography, and potential development of the Umpqua River Basin are surveyed by the SWRB in the Umpqua River Basin (1958). The 4560 square miles of the basin lie within parts of the Klamath Mountain, Cascade, and Coast Range physiographic regions of southwestern Oregon. The Umpqua River is 211 miles long, discharging into the Pacific Ocean at Reedsport (Fig. 1, 2, 51). Most streams have their headwaters in the three mountainous regions within the basin. Except for the area near the confluence of the North and South Umpqua Rivers, the basin is rugged, with steep-sided canyons. Valleys in the mountains are seldom over a mile wide across the floor. Infiltration rates vary according to local conditions (Table 1).

The climate of a site within the basin depends upon its location relative to the mountains and its elevation. Precipitation ranges from 25 inches annually in the area of the confluence of the North and South Umpqua Rivers to over 110 inches in the mountains. As in all of western Oregon, precipitation is at a maximum during the late fall and winter and at a minimum during the summer (Fig. 52). Temperatures are controlled by the moderating effect of the Pacific Ocean and by elevation, so that extremes range from sub-zero to over 100° F. At Roseburg the mean January temperature is 41° F and the mean

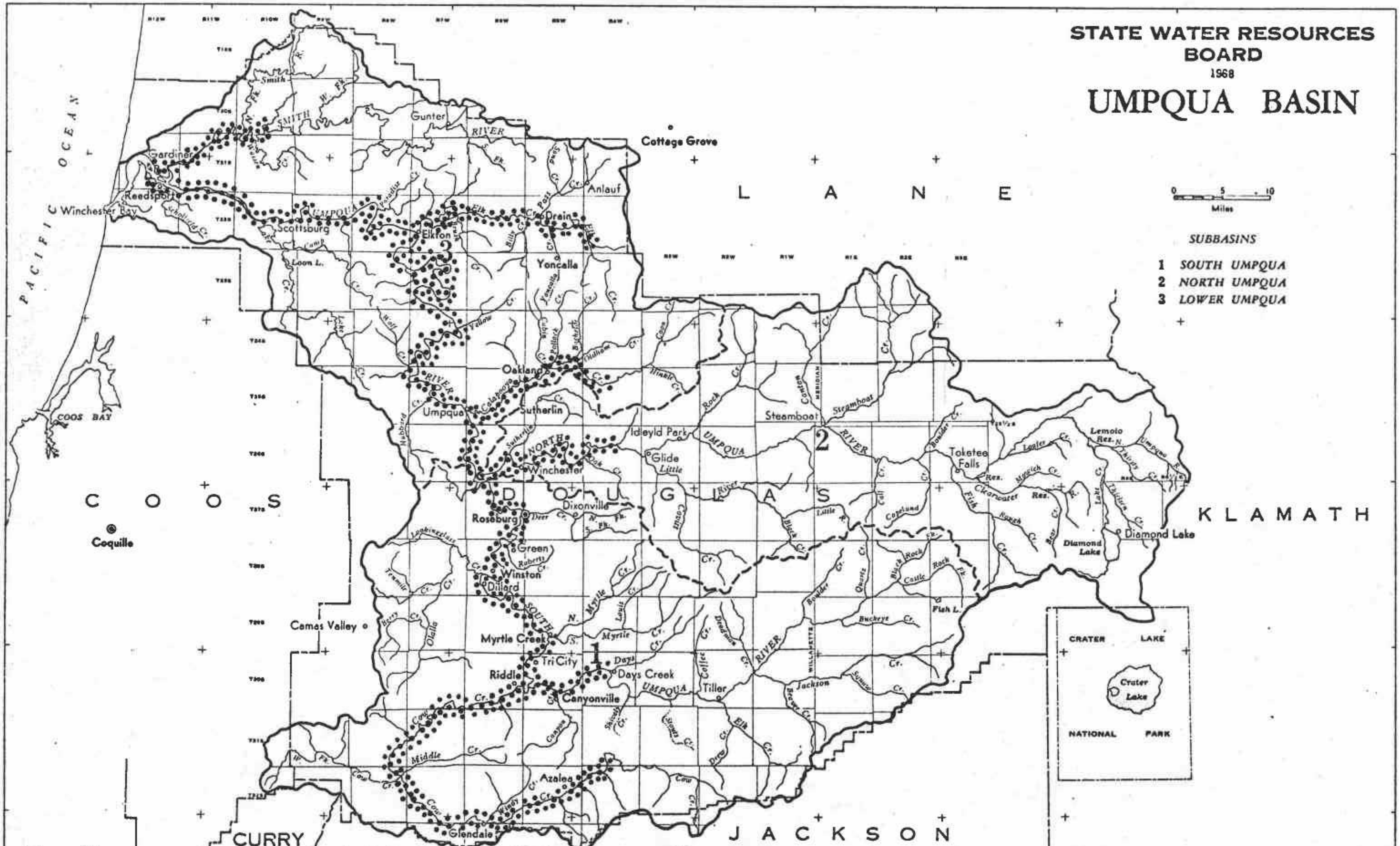
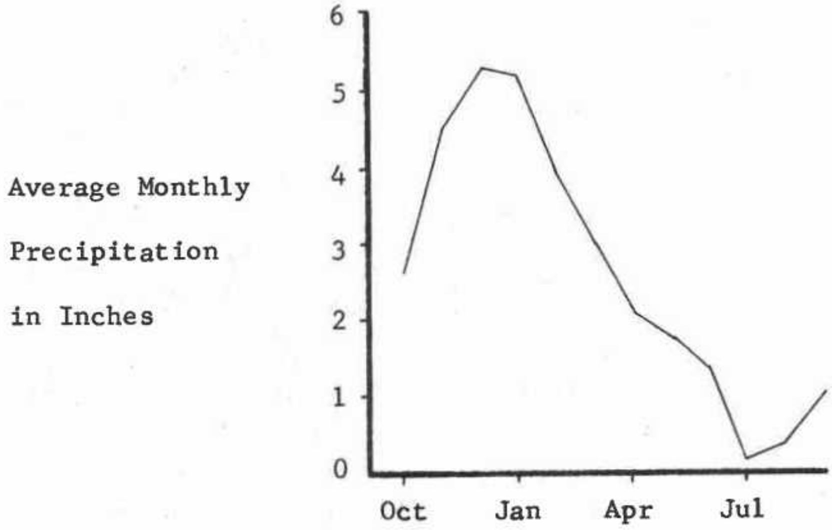


Fig. 51

Flood Prone Areas

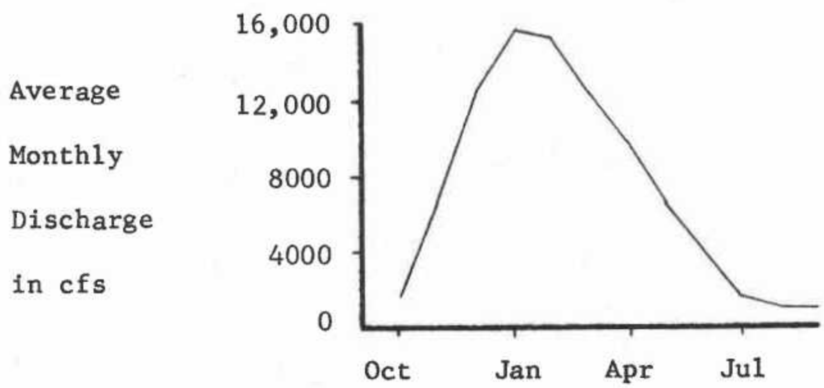
Source: CNPCFS



Roseburg

Source: Highsmith

Fig. 52



Umpqua River at Elkton

Source: SWRB

Fig. 53

July temperature is 69° F.

Maximum stream discharge is a result of the winter precipitation. Minimum discharge is during the summer. Snowmelt keeps discharge relatively high during the spring (Fig. 53). The drainage area of the North Umpqua has much land at higher elevations and the ground is generally porous; thus water is retained which sustains flow later in the season. The basin of the South Umpqua in contrast has little land in snow accumulating elevations and the geologic formations are relatively impervious, resulting in a closer relationship between precipitation and runoff.

Floods for the most part still are more a consequence of rainfall than snowmelt. Floods occur normally during the late fall to early spring. The hydrograph of the December 1955 flood in the SWRB report of 1958 shows the river at Elkton rose from just over 6000 cfs on December 21 to almost 220, 000 cfs on December 22 and fell below 6000 cfs on December 24. The Columbia-North Pacific Comprehensive Framework Study defines flood susceptible areas (Fig. 51).

The following are the flood control projects in the Basin.

Levees and floodwall, along the Umpqua River at Reedsport
Source: 54, 55

Leeves, revetments, and channel clearing along the
Umpqua River and Tributaries at Smith River
Area, Gardiner Flats Area, Leeds Island Area,
Loon Lake Area, and Conn Ford - Melrose Area

Source: 54, 55

Sutherlin Creek Project - PL 566 on Sutherlin and Cooper
Creeks
two reservoirs and channel improvements
Source: 36

Channel Improvement by Douglas County Road Department
no location given
Source: 27

Emergency flood control works and activities by the
Corps of Engineers
PL84-99 authorizes flood emergency preparation,
flood fighting, rescue work, repair or restoration
of flood control work threatened or destroyed by flood

Source: 54

SOUTH COAST BASIN

The hydrology, geology, geography, and potential development of of the South Coast Basin are diagnosed by the SWRB in South Coast Basin (1963) and by the USDA in cooperation with the SWRB in USDA Report on Water and Related Land Resources South Coast Basin Oregon (1962). The South Coast Basin, totaling 2980 square miles, is divided into two noncontiguous sections by the Rogue River Drainage (Fig. 1, 2, 54). The south section lies entirely within the Klamath Mountain Region and the other within the Klamath Mountains and Coast Range Region. The USDA divides the basin into two topographic areas: the coastal front and the interior. The former contains rugged headlands, sea terraces, allubial floodplains, and sand dunes. The latter is a mountainous area of steep, narrow valleys. The SWRB reports the rocks of the basin to be usually impermeable.

Orographic precipitation characterizes the basin. Minimum yearly precipitation is about 50 inches along the coast whereas maximum precipitation is over 120 inches near the crest of the mountains. Seasonal distribution shows a maximum during the late fall and winter and a minimum during the summer (Fig. 55). Temperatures are also influenced by the proximity of the ocean. At lower elevations along the coast and in the valleys, average annual temperature ranges from 50° F to 54° F. The SWRB cites Port Orford as typifying temperature conditions along the coast:

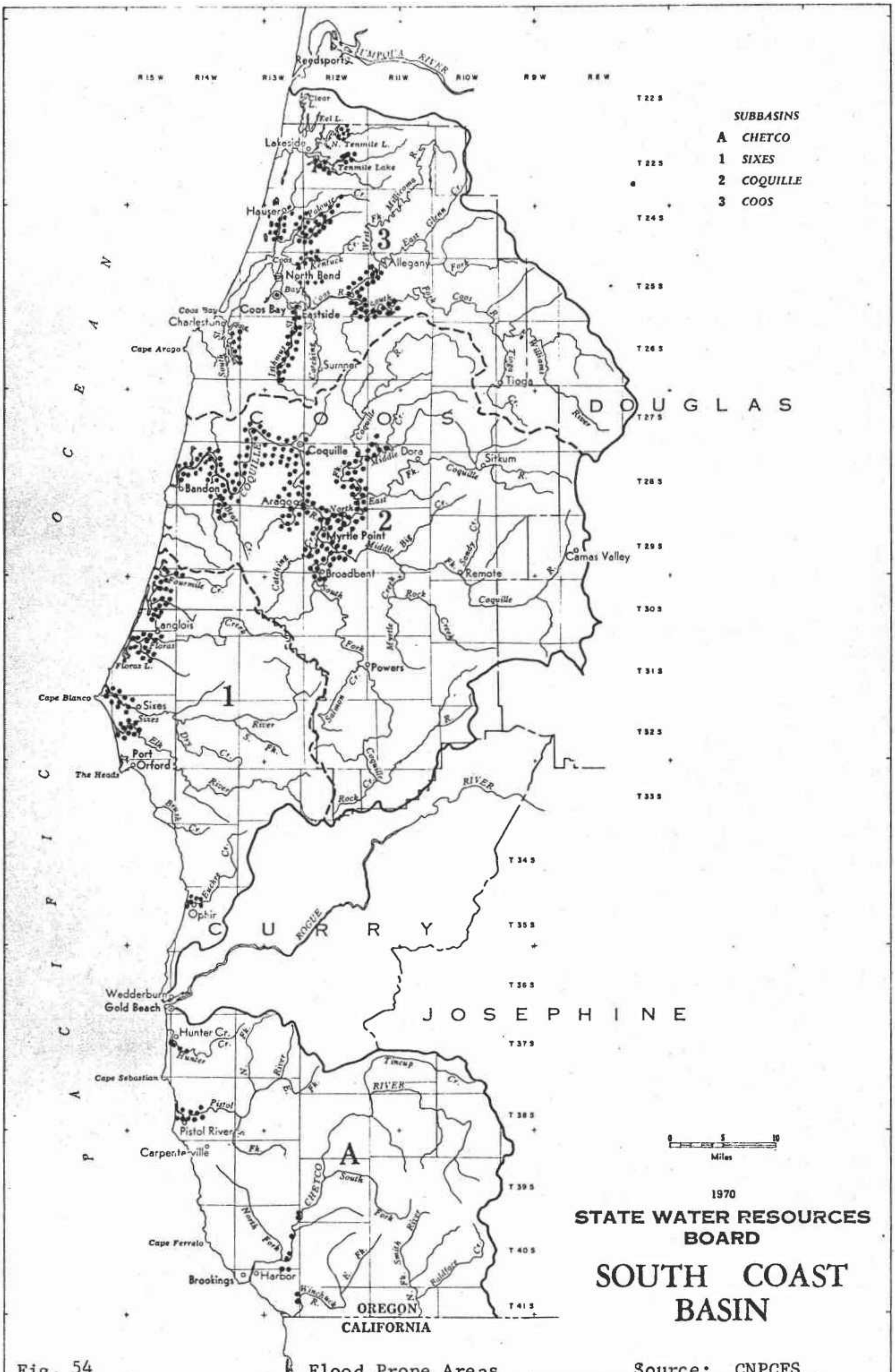
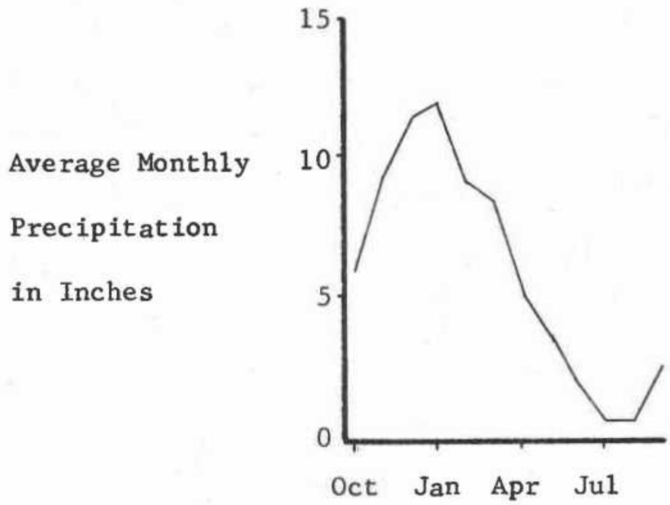


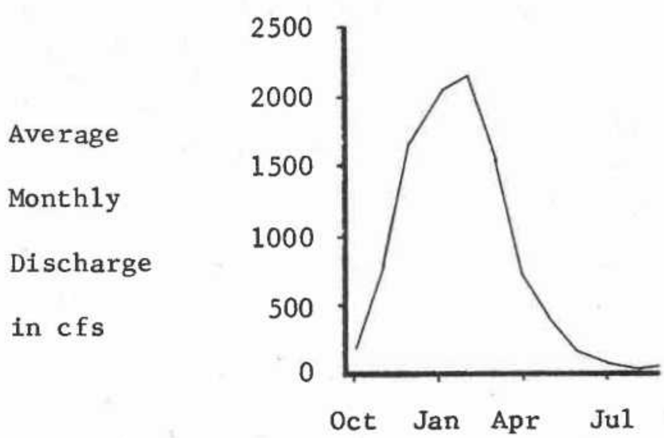
Fig. 54 Flood Prone Areas Source: CNPCFS



Port Orford

Source: SWRB

Fig. 55



Middle Fork Coquille
River near Myrtle Point

Source: SWRB

Fig. 56

Average January Temperature: 46°F
Average August Temperature: 59°F

Extreme temperatures range from near 0°F to over 100°F.

All headwaters are in the mountains. Except near the coast the separate stream valleys are short but steep. Discharge reflects precipitation so that maximum discharge is during the winter and minimum discharge is during the summer (Fig. 56). Because of the relative impermeability of the formations, streams rise rapidly after rains.

According to the SWRB floods are the result of rapid runoff, tidal action, or both in the lower areas of the basin (Fig. 54). Populations are concentrated in the lower valleys along the coast. The normal flood season is from November to March, but may occur any time from September to May.

The following are the projects in the South Coast Basin.

Small flood control projects by the Corps of Engineers
Section 205 of the 1948 Flood Control Act, as amended
Coos River, Catching Inlet Drainage District
Source: 54

Snagging and clearing projects by the Corps of Engineers
Section 2 of the 1937 Flood Control Act
Larsen Inlet, Coos Bay
Source: 54

Coquille River from Coquille to Beaver Slough
Flood gates, dikes, pumps in Beaver Slough
Drainage District
Source: 45

Fat Elk Drainage south and east of Coquille
Structures and pumps
Source: 45

Coos sub-basin - local improvements of dikes and tide gates by the Haynes Drainage District on the Haynes Inlet,
Kentuck Drainage District on Kentuck Slough,
North Slough Drainage District on North Slough,
Willanch Drainage District on Willanch Slough, and
Coalbank Slough area.

Source: 45

Emergency flood control works and activities by the Corps of Engineers
PL84-99 authorizes flood emergency preparation, flood fighting, rescue work, repair or restoration of flood control work threatened or destroyed by flood.

Source: 54

MID-COAST BASIN

The hydrology, geology, geography, and potential development of the Mid-Coast Basin are diagnosed by the SWRB in Mid-Coast Basin (1965) and by the USDA in cooperation with the SWRB in USDA Report on Water and Related Land Resources Middle Coast Drainage Basin Oregon (1964). The Mid-Coast Basin is a series of independent watersheds draining into the Pacific Ocean along the western slope of the Coast Range anticline (Fig. 12, 57). Within the Basin, which is 2361 square miles, the topography varies from mudflats to sea terraces to rugged headlands along the coast and to mountainous in the interior. In the mountains the streams have eroded steep-sloped valleys through the impervious sandstone and volcanic formations; nearer the ocean they form relatively wider valleys. Infiltration is classified by the USDA as dominately moderate to slow throughout the basin except for those coastal areas with dunes where infiltration is rapid.

The moderate, moist climate results from the ocean-mountain relationship and the orographic precipitation. Precipitation increases from approximately 60 inches along the coast, to over 110 inches along the Coast Range divide, to less than 40 inches in the rainshadow at the upper reaches of the Siuslaw River. Regardless of elevation, maximum precipitation here as along the rest of the coast is during

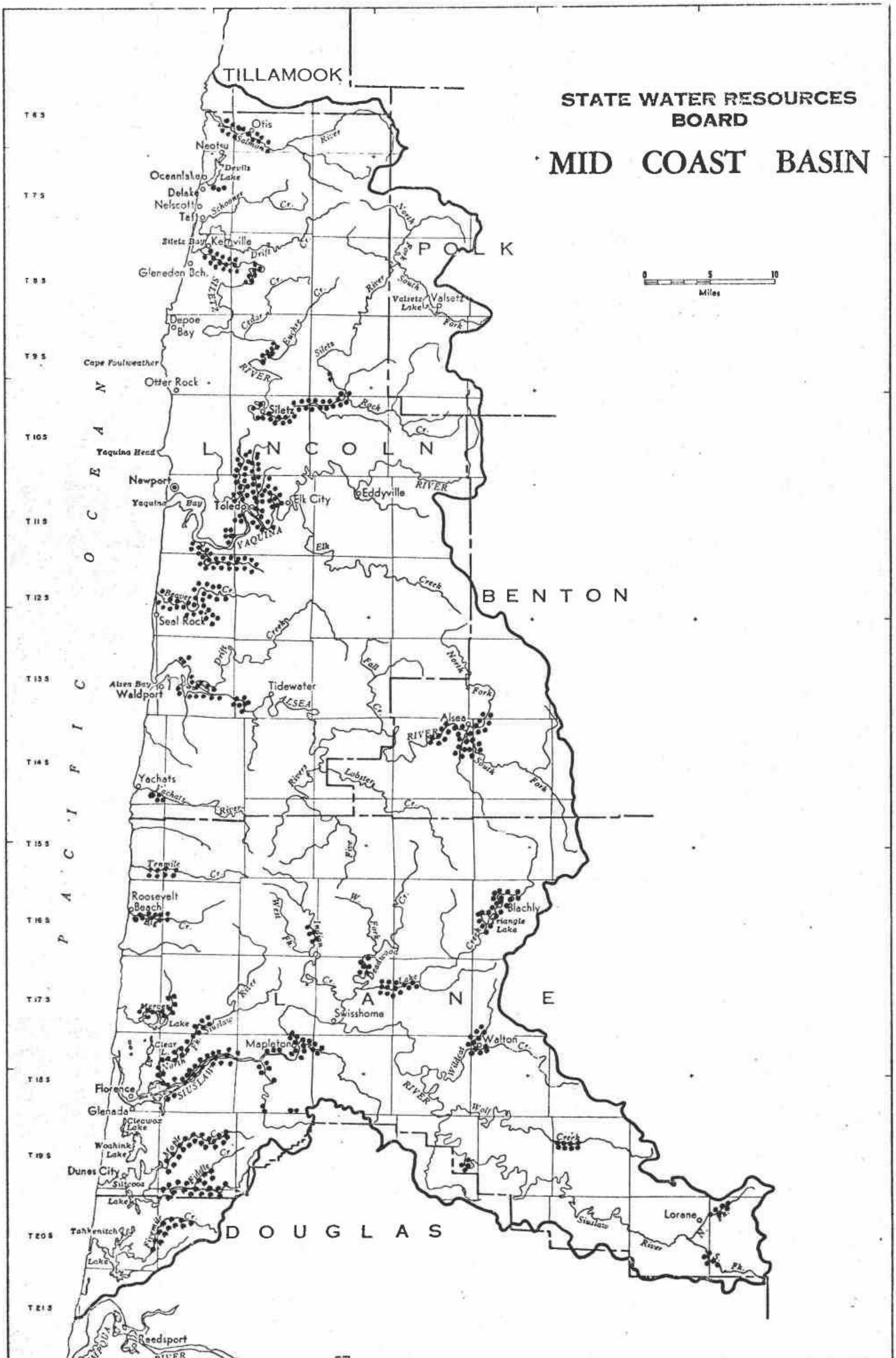


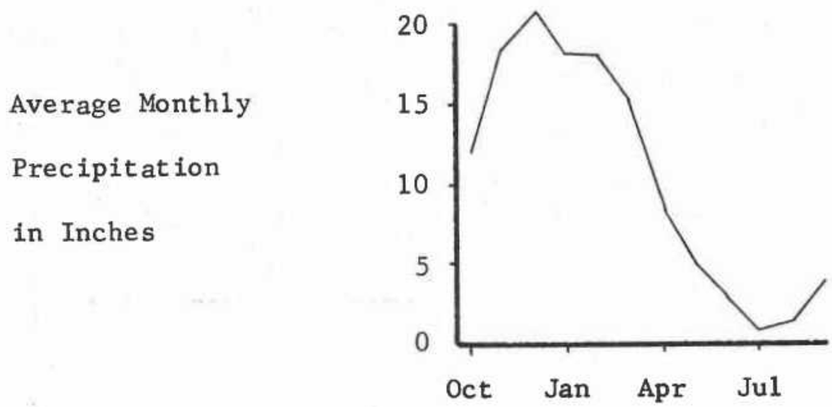
Fig. 57 Flood Prone Areas Source: CNPCFS

the late fall and winter. Minimum precipitation, as a consequence of the shifting air masses offshore, is during the summer (Fig. 58). The winter precipitation can take place as "moderate to heavy storms that may continue without interruption over prolonged periods" (SWRB, 1965, p. 4). Extreme temperature ranges from about zero to over 100° F along the coast and in the lower valleys. Mean temperatures throughout the year are only between 40° F and 60° F.

Stream discharge mirrors precipitation with only a short lag time because of the small retention as ground water or snow. Maximum monthly discharge is in the late fall and winter and minimum is in the summer (Fig. 60). The rapid runoff in the basin leads to extreme variation within a few days. The Alsea River near Tidewater is a case in point. The SWRB (1965) notes that its fluctuation has been from less than 4000 cfs to over 22,000 cfs and back to under 5000 cfs over a week period.

Floods in the basin result from rains at higher elevations in the watersheds and from tides. Water rises rapidly, but peaks are of short duration. The SWRB defines the problem areas to be mostly along the lower portions of streams (Fig. 58), the area where population is concentrated. The USDA reports 17,260 acres to be flood prone.

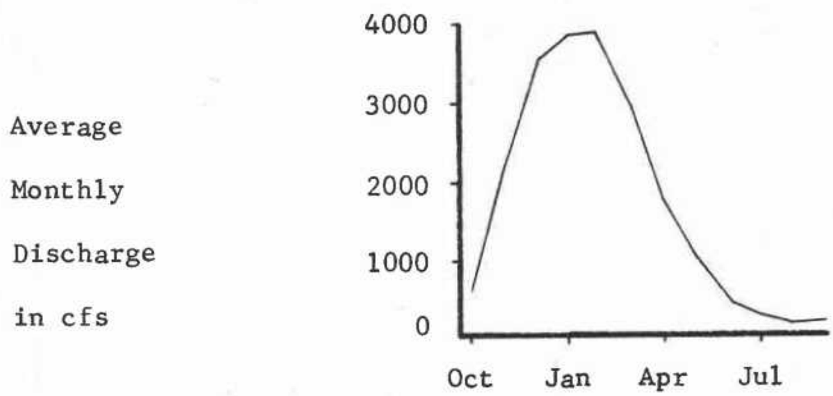
The following are the structural flood abatement projects in the basin.



Valsetz

Source: SWRB

Fig. 58



Alsea River near
Tidewater

Source: SWRB

Fig. 59

Leeves at Newport
Source: 39

Yaquina River near Toledo
Source: 54, 55

Emergency flood control works and activities by the Corps of Engineers
PL84-99 authorizes flood emergency preparation, flood fighting, rescue work, repair or restoration of flood control work threatened or destroyed by flood

Source: 54

FLOOD PLAIN MANAGEMENT AS AN APPROACH TO FLOOD DAMAGE REDUCTION

The initial stages of a new approach to flood damage control are just getting underway in Oregon. This approach is flood plain management as encouraged through flood insurance. The insurance was promulgated in the National Flood Insurance Act of 1968, as amended. Engineering techniques are designed to keep the water away from man, but increasing use of partially protected flood plains has frequently offset decreased flood damages that the structures initially provided. Flood plain management is designed to keep man away from the water.

To help county and local planners qualify their areas for insurance, the Department of Housing and Urban Development recommends one or more of the following: zoning ordinances, subdivision regulation, health regulations, building codes, and a system of flood potential warning signs. As of June 1971, Oregon had only six areas eligible for insurance: the unincorporated areas of Jackson, Josephine, Lane, Clackamas, and Curry Counties and the City of Springfield. According to Mr. Bob Evans, the coordinator for flood plain insurance with the State Water Resources Board, most counties in the high precipitation area west of the Cascades are studying the insurance program. In the remainder of the state only a few counties in the north central and northeast are even considering the program. If implemented, the insurance program could be an excellent complement to the engineering projects.

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