GRANDE RONDE RIVER BASIN

STATE WATER RESOURCES BOARD
SALEM, OREGON
September 1960

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COVER PICTURE

Wallowa River with Mt. Enterprise in the background. Oregon State Highway Department Photo.

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PURPOSE AND INTRODUCTION

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

The Board's investigation activities were completed in mid-1960. The study was made in conformity with ORS 536.300(1) which states:

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

Having completed the study necessary to formulate and implement an integrated, coordinated water resources program, the Board proposes to adopt a program for the Oregon portion of the Grande Ronde River and Imnaha River Drainage Basins. This program will fulfill the requirements of ORS 536.300(2) which states:

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

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

Data for study and evaluation were made available through (1) physical field activity, (2) review of available reports and data, (3) extensive personal contact, (4) formal hearings on the basin's water needs and problems (La Grande, April 22, 1958 and Enterprise, December 11, 1958), and (5) submission of data to the Board, at its request, by local, state, and federal agencies and other groups.

GENERAL CONCLUSIONS

1. There is enough water on an average annual yield basis from surface runoff (1.2 to 4.1 million acre-feet) to supply all needs; existing and contemplated, with the exception of the use of water to dilute major untreated waste product discharges.

2. Although total basin yields are adequate in average years with the exception of the use of water to dilute major untreated waste product discharges, seasonal and geographic maldistribution of supplies will result in water supply shortages for contemplated needs, consumptive and nonconsumptive, if reliance is placed on existing patterns of streamflow.

3. Ground water supplies exist in certain portions of the Grande Ronde system but the amounts available for sustained use are not known.

4. There is enough water on a critical year basis, assuming a greatly increased degree of water development and control, to meet existing and contemplated consumptive needs but not enough to meet optimum levels for nonconsumptive purposes.

5. On individual streams within the Grande Ronde system, depletion potentials in the form of existing water rights exceed the supply capabilities during low flow periods.

6. Important streams and stream segments in the system do not have sufficient flow in periods of low, but not critical, flow to sustain desirable minimum levels for the nonconsumptive public uses of fish life and recreation.

7. The expansion of industrial uses will, in part, depend on the development of stable water supplies from surface runoff and/or ground water potentials.

8. Potentials for industrial use of water are important to the economy of the basin but foreseeable needs are not large quantitatively in comparison with potential irrigation, fish life, and recreation possibilities.

9. Major problems of municipal use of water are currently problems of physical facilities rather than basic supply.

10. Potential for agricultural development lies primarily in a change to more extensive irrigation. Supplies could be developed from surface runoff by storage. In some areas, potential for the development of ground water resources exist but the costs of this type of development are not as well defined as the use of surface water storage.

11. The basin has physical potential for the development of hydroelectric power but physiographic, hydrologic, and economic factors exclude possibilities of major hydroelectric development in the foreseeable future.

12. Some hydroelectric development might be of slightly better than marginal feasibility in connection with multi-purpose projects.

13. Certain major streams, or major sections of these streams, and numerous minor streams and creeks are by the nature of their physiography, location, land ownership, or economic potential, available only for limited water uses.

14. Major foreseeable quantitative needs for water will be for irrigation, fish life, and recreation.

15. Full development of the fisheries potentials of the basin cannot be realized without the improvement of low flow conditions in many streams of the basin. Control of excessively high flows would also aid in the protection of the fishery resources.

16. Material improvement in minimum and low streamflows cannot be achieved without the development of surface water storage.

17. Development of storage reservoirs, at some locations, would have adverse effects on existing spawning areas for anadromous fish.

18. The improvement of low flows for fish life, recreation, and pollution abatement would bring benefits to the state and the basin but the relationships between cost and benefits accruing to desirable base flow improvement are not well established.

19. The Grande Ronde and Imnaha River systems have, jointly, many lakes and a few reservoirs but their aggregate surface area is small, less than 3,000 acres.

20. The basin has great potential for recreation use of water but the variety of water-based recreational use is limited. The recreation activities of boating, swimming, skin diving, and water skiing will be restricted by the nature of the streams of the system and the relatively small lake and reservoir surface area in the system.

21. Large areas in the Grande Ronde and Wallowa Valleys have drainage problems due to a high water table aggravated by seepage from over-irrigation.

22. A large section of the High Wallowas is subject to a severe water erosion problem. Much of this is within the boundaries of the Eagle Cap Wilderness Area.

23. Pollution abatement problems in the basin are an aggregate of small difficulties that have an undesirable cumulative effect during periods of low flow in particular. An improvement in minimum flows would help to alleviate that portion of the problem that cannot be corrected with waste treatment facilities.

GENERAL CONCLUSIONS

24. Flood control is an item of major interest and economic concern to the people of the basin.

25. Major flood problem areas are in the Grande Ronde and Wallowa Valleys.

(A) The Grande Ronde Valley incurs substantially greater economic losses on an average annual basis.

(B) Local individuals have made definite and substantial attempts to resolve their own flood problems.

(C) The resolution of the total flood problem on an individual basis would be extremely difficult.

(D) There is a demonstrated need and a value in obtaining flood control in the Grande Ronde Valley. The value has not yet been established for the Wallowa Valley.

(E) There are several alternatives for correcting the flood control problem in the Grande Ronde Valley.

(1) Channel improvement (includes diking).

(2) Upstream storage which could not control incremental downstream inflow possibly resulting in somewhat lesser benefits.

(3) A combination of upstream storage and channel improvement (includes diking).

(F) The economics of all the alternatives of flood control in the Grande Ronde and Wallowa Valleys have not yet been fully evaluated.

26. Satisfaction of contemplated needs in the Grande Ronde Basin will be achieved only through the storage and subsequent use of excess winter and spring runoff.

27. The physical and economic potentials for water development and control are limited and should not be utilized in a manner that would limit multi-purpose development.

28. There is diversion of water out of the basin at the present and additional physical potentials for such water control exist but the economic merits of such proposals are not established.

29. Establishment of restrictions on further appropriations would prevent an increase in depletion potential on some streams in the system. This would aid in maintaining higher minimum flow where streams are not now appropriated beyond their natural capacity at low flow periods. For streams seasonally overappropriated, such actions would have limited practical effect until additional flows become available from storage or from future upstream developments.

30. An essential requirement in the determination of the most complete program of use and control of the waters of the Grande Ronde and Imnaha Rivers is the development of criteria that will establish the levels of desirable base flows for fish life, wildlife, recreation, and pollution abatement. These criteria have not been made available to the board.

GRANDE RONDE RIVER BASIN STUDY

CHAPTER I THE BASIN

LOCATION AND SIZE

The Basin under study lies in the northeast corner of the State of Oregon with a small portion in the southeast corner of the State of Washington.

The Grande Ronde Basin, for purposes of this report, includes the land drained by the Imnaha River and its tributaries and also Snake River drainage in Oregon lying between the Imnaha and Snake Rivers along with the drainage basin proper of the Grande Ronde River.

Containing 5,265 square miles, the Basin includes nearly all of Wallowa County, a large part of Union County and small portions of Umatilla and Baker Counties, all in Oregon; and small segments of Asotin, Garfield, and Columbia Counties in Washington. Areas of counties lying within the Grande Ronde Basin are listed in Table 1 along with 1960 preliminary population figures. The drainage area of the Grande Ronde River itself is approximately 3,950 square miles.

TABLE 1

AREA AND POPULATION BY COUNTY
WITHIN THE GRANDE RONDE RIVER BASIN

COUNTY	STATE	AREA		POPULATION
		Square Miles	Acres	
Wallowa	Oregon	3,113	1,992,320	7,036
Union	Oregon	1,745	1,116,800	16,700
Umatilla	Oregon	50	32,000	50
Baker	Oregon	8	5,120	0
Total in Oregon		4,916	3,146,240	23,786*
Asotin	Washington	186	119,040	400
Columbia	Washington	110	70,400	50
Garfield	Washington	53	33,920	60
Total in Washington		349	223,360	510**
TOTAL IN BASIN		5,265	3,369,600	24,296

* Estimated values based on preliminary 1960 census figures
** Based on 1950 figures

THE BASIN

STREAM SYSTEM

More than 3,100 streams, totaling over 5,600 miles in length, comprise the Basin's drainage system. Seven hundred and sixty of these streams are named. Major streams originate in either the Blue Mountains which form the western boundary of the Basin or the Wallowa Mountains in the east and southeast sections.

The major streams vary in length from 212 miles for the Grande Ronde River to 31 miles for the Lostine. Many of the smaller tributaries are less than two miles in length and flow intermittently, carrying water only during spring snowmelt runoff or following heavy rains. Figure 1 shows the stream system for the Grande Ronde Basin with river miles noted for major streams.

Most of the more important streams head in the higher elevations of the Blue or Wallowa Mountains and have very steep gradients in their upper reaches. This is illustrated in Figure 2, a profile of the Grande Ronde stream system. Figure 2 also illustrates the extreme flatness of the Grande Ronde Valley proper, which drops 40 feet in 46 stream miles for an average gradient in that stretch of less than one foot per mile.

GEOLOGY

The Grande Ronde Drainage Basin is a compound structural depression formed by folding and faulting. It is structurally bounded on the west and northwest by the Blue Mountain anticline which extends along its entire length to the Snake River, on the southwest by the domed Elkhorn Range, and on the southeast by the Wallowa Mountains uplift. Although the Imnaha River Drainage Basin to the east forms no part of the Grande Ronde Drainage System, it too was probably formed by the folding and faulting characteristic of this part of northeastern Oregon.

The oldest exposed rocks in the area were laid down approximately 200 million years ago during the Permian Period. These consist of altered volcanic flows and sedimentary rocks in the northeastern part of the Wallowa Mountains. The Basin is made up of four major rock types; sedimentary, igneous, volcanic, and alluvial. The oldest, a sedimentary unit consisting mainly of shales, limestones, and sandstones, crops out in the Wallowa Mountains, along the Snake River, Catherine Creek, and the headwaters of the Grande Ronde River. An igneous unit of quartz diorite and granodiorite subsequently intruded much of the Wallowa Mountains during Cretaceous times to form the Wallowa batholith. A volcanic unit made up of Columbia River basalt and associated andesite flows, by far the most extensive and covering the remainder of the Basin except where overlain by alluvium, was extruded during Miocene times. The youngest unit, consisting of alluvial deposits of Pleistocene and Recent age, occurs mainly in the Grande Ronde, Elgin, and Wallowa Valleys.

THE BASIN

The geologic history of the Basin starts with the Permian andesitic flows and marine sediments, some fossiliferous, that covered the region later to become the northeastern part of the Wallowa Mountains. During Triassic times the land again subsided and was covered by marine waters that deposited the limey sediments later to become the vast limestone and marble beds now exposed along Lake and Hurricane Creeks, and the Lostine, Imnaha, and Snake Rivers.

As uplift and folding increased in late Cretaceous times, the earth's crust weakened to the extent that underlying magmas forced their way upward through the sediments to form the Wallowa batholith, a large intrusive body of granitic rock making up the main mass of the Wallowa Mountains. The metallic ore bodies throughout the Wallowas were emplaced during the last stages of this intrusion. Contemporaneously with the intrusion, the Wallowa and Blue Mountains were born. With the uplifting of the mountains, a period of great erosion took place during the early Tertiary Period. This is strikingly shown by the accordant ridge tops of the Wallowa Mountains. Much of the remainder of the Basin was reduced to relatively low relief. Uplift probably renewed and provided the weakened structures through which the great outpourings of basic lavas called the Columbia River basalts issued during Miocene times. These flows, three or four thousand or more feet thick, occurred approximately 20 to 25 million years ago. Many of the interflow zones of these flows, often filled with permeable erosional debris, are good aquifers for ground water.

The end of the Tertiary Period witnessed the upthrusting of the Wallowa region as a great fault block or horst about 50 miles long by 15 to 20 miles wide, the arching of the Blue Mountain anticline, and the establishment of the present outlines of the Blue and Wallowa Mountains. The Pleistocene epoch brought about further arching of the Blue Mountain anticline, great faulting that produced the steep northern slopes of the Wallowa Mountains, the down-dropped block or graben that formed the Grande Ronde and Elgin Valleys, and the glaciation of much of the Wallowa Mountains. Wallowa Lake and many others in the region are glacier-formed. Starting in the Pleistocene and continuing to the present, the Basin has undergone erosion with the deposition of great quantities of alluvium in the valleys. The more permeable now forms good ground water aquifers.

TOPOGRAPHY

The Basin is characterized by rugged mountains in the headwater areas which give way to the valleys of the Grande Ronde and Wallowa Rivers. The lower reaches flow through precipitous canyons, isolated plateaus, and semi-wilderness areas.

Peaks in the Wallowa Mountains approach 10,000 feet in elevation and the Blue Mountains reach to about 7,700 feet. Many prominent peaks and mountains also of substantial elevation are located on the divides separating the major watersheds within the Basin. More than one-half of the Basin can be classified as mountainous. The balance is made up of the Wallowa and Grande Ronde Valleys, small shoestring valleys, and the elevated plateaus of the Basin.

The Grande Ronde Valley lies at a relatively high elevation, generally between the 2,600 and 2,700-foot contours. The Wallowa Valley, the next largest generally flat area in the Basin, ranges from 2,800 to approximately 4,300 feet in elevation. Many plateaus in the downstream reaches of the Basin are found at elevations above 4,000 feet.

CLIMATE

Annual precipitation averages about 18 inches in the Grande Ronde Valley but is variable over the valley. The isohyetal map, Figure 3, indicates variations from 14 to 24 inches. Figure 3 shows average annual precipitation for the Basin based upon the 50-year period 1896-1945. This is a generalized plot indicating the relative annual precipitation pattern for the Basin. The distribution of precipitation in the Basin by months for selected stations is shown in Table 2.

Temperatures in the Grande Ronde Valley are relatively high in the late spring and summer and occur together with long, cloud-free periods, giving conditions favorable for growing high quality crops. These conditions provide an average frost-free period of about 160 days each year at La Grande and somewhat less at Union.

In the Wallowa Valley, lower temperatures result in a shorter growing season, about 130 days annually in the Joseph area, and the occurrence of frost is a possibility at any time during the growing season.

Winter snowfalls have reached 40 inches in the La Grande area but snow rarely remains on the ground more than a week or ten days at a time. In the Wallowa Valley, snowfall ranges up to 66 inches, depending on elevation, and many feet of snowpack accumulates in the adjacent mountains. A portion usually remains the year round.

Climatological data for the Grande Ronde Basin are largely limited to the lower basin elevations. Information for mountainous areas is very sparse.

POPULATION

Table 3 lists the 1960 preliminary population for incorporated cities as given by the

TABLE 2

MEAN MONTHLY AND ANNUAL PRECIPITATION

STATION	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	OCT	NOV	DEC	ANNUAL
Cove													
Mean	2.18	1.91	2.25	2.32	2.39	2.38	.55	.76	1.40	2.05	2.55	2.53	23.27
Years	43	43	42	43	43	43	43	43	43	42	43	42	
Elgin													
Mean	2.50	2.76	2.21	1.53	1.93	1.85	.55	.61	1.05	2.19	2.99	3.18	23.35
Years	17	17	18	17	21	20	21	20	22	22	21	19	
Gumboot													
Mean	4.11	2.69	2.30	2.65	2.70	1.96	.80	.55	1.30	1.80	3.11	2.97	26.94
Years	12	12	12	12	12	12	12	12	12	12	12	13	
La Grande													
Mean	2.01	1.92	2.01	1.77	1.99	1.69	.57	.62	1.10	1.58	2.18	2.22	19.66
Years	70	70	70	70	71	72	72	71	70	71	69	71	
Starkey													
Mean	1.54	1.52	1.27	1.57	2.05	1.88	.93	.75	1.19	1.43	1.86	1.55	17.54
Years	27	26	27	26	25	28	28	27	27	26	26	26	
Union													
Mean	1.08	1.00	1.24	1.39	1.64	1.68	.48	.58	.88	1.19	1.19	1.21	13.56
Years	48	48	48	48	48	48	48	48	48	48	49	49	
Wallowa													
Mean	1.74	1.55	1.51	1.42	1.74	1.77	.63	.65	1.12	1.52	2.00	1.85	17.50
Years	55	55	57	57	56	56	55	57	57	57	56	54	

Source: U. S. Weather Bureau

TABLE 3

1960 POPULATIONS

GROUP*	CITY	POPULATION
A	La Grande	8,997
	Enterprise	1,916
	Union	1,457
	Elgin	1,310
	Wallowa	980
	Joseph	781
	Cove	309
	Lostine	239
	Island City	158
	Imbler	135
	Summerville	76
B	May Park	837
	Flora	76
	Telocaset	76
	Minam	75
	Perry	75
	Troy	50
	Alicel	40
	Maxville	35
	Hilgard	30
	Starkey	30
	Kamela	29
	Imnaha	23
	Lookingglass	20
	Hot Lake	10
	Rondowa	2
	Union Junction	2
C	Other	6,528
	TOTAL - GRANDE RONDE BASIN	24,296

* Group A - Incorporated cities; preliminary population figures - Bureau of Census - 1960

B - Unincorporated towns; population estimated from latest available information - 1950

C - Estimated rural population in addition to groups A and B

U. S. Bureau of Census. Other population given is for rural and unincorporated towns from the latest available figures - 1950. Estimated population by counties within the Basin was shown in Table 1. The total, 23,786 persons in Oregon, is about 1.3 percent of the total population of the state.

Nearly half of the Basin's residents are found in the La Grande area followed by, in order of population, Enterprise, Union, Elgin, and Wallowa. These five cities, all having populations over 1,000, account for more than two-thirds of the Basin's residents.

LAND OWNERSHIP

The development potential of an area depends, in part, upon land ownership. Table 4 gives the present pattern of ownership within the Basin.

Nearly 58 percent of the Basin area is in federal, state, or other public ownership. Fifty-seven percent is controlled by either the Forest Service or the Bureau of Land Management. The remaining 42 percent is primarily under private ownership.

Land ownership is distributed in such a manner that the major forest areas are in federal ownership and the main agricultural areas, the Grande Ronde and Wallowa Valleys, are predominantly privately owned. This is indicated by Table 4 which shows the percentage of federal ownership in the Middle Grande Ronde and Wallowa sub-basins, the major valleys, to be much less than the other sub-basins which are largely mountainous in nature.

TRANSPORTATION

Transportation facilities between centers of population in the Basin are good. Access from outside the Basin is also good.

The major highway in the Basin is U. S. 30 which crosses the Grande Ronde Valley, following the old Oregon Trail, and links La Grande with Pendleton and Baker. State Highway 82 traverses both the developed valleys linking the centers of population in each and leads to the head of Wallowa Lake, the main recreation center in the Basin. Regular bus and freight services are maintained on these routes.

Access roads of secondary importance into the Basin, which also serve as internal service roads, are State Highways 3 and 204 entering from the north and Highways 203 and 237 coming from the south. None of these routes have regular bus service but regular freight service is maintained on some of them.

TABLE 4

FEDERAL, STATE, AND PUBLIC LANDS

SUB-BASINS AND MAJOR TRIBUTARIES	TOTAL AREA	FOREST SERVICE & BLM AREA		PUBLIC DOMAIN AREA		STATE LAND BOARD	
	Sq. Mi.	Sq. Mi.	% of Total	Sq. Mi.	% of Total	Sq. Mi.	% of Total
UPPER GRANDE RONDE	680	474	69.7	1.5	0.2	0.9	0.1
MIDDLE GRANDE RONDE	385	91	23.6	2.1	0.5	0.5	0.1
Catherine Creek	335	96	28.7	3.0	0.9	0.1	0.0
Total sub-basin 2	720	187	26.0	5.1	0.7	0.6	0.1
LOWER GRANDE RONDE	898	332	37.0	9.4	1.1	1.3	0.1
Joseph Creek	555	287	51.7	7.7	1.4	2.1	0.4
Wenaha River	293	286	97.6	0.3	0.1	0.0	0.0
Snake River Tributaries	91	66	72.5	2.4	2.7	0.8	0.9
Total sub-basin 3	1,837	971	52.9	19.8	1.1	4.2	0.2
WALLOWA	696	239	34.3	1.8	0.3	0.3	0.0
Minam River	232	208	89.7	0.0	0.0	0.0	0.0
Total sub-basin 4	928	447	48.2	1.8	0.2	0.3	0.0
IMNAHA	532	506	95.1	1.4	0.3	0.2	0.0
Big & Little Sheep Creeks	344	177	51.5	3.5	1.0	0.1	0.0
Snake River Tributaries	224	222	99.1	1.8	0.8	0.2	0.1
Total sub-basin 5	1,100	905	82.3	6.7	0.6	0.5	0.0
In Oregon	4,916 sq. mi.						
In Washington	349 sq. mi.						
TOTAL - GRANDE RONDE BASIN	5,265	2,984	56.7	34.9	0.7	6.5	0.1

Source: U. S. Forest Service, Oregon State Land Board, Bureau of Land Management, and U. S. Geological Survey

The main line of the Oregon-Washington Railroad and Navigation Company, part of the Union Pacific system, passes through the Grande Ronde Valley and a branch line provides connections between La Grande and Joseph. Regular air service connects La Grande with Pendleton and Baker.

Upland areas used as range land for livestock have a fair network of gravel and dirt roads, some of which are passable in dry weather only. Sections of the Wallowa Mountains in the south and the Blue Mountains in the north are served only by trails and large areas along the Snake River, Joseph Creek, Wenaha River and Lookingglass Creek are without roads.

SUB-BASINS

Because of differences in physical characteristics, level of economic development, and needs and uses of water between areas, the study was made by sub-basins. The five sub-basin divisions, Upper, Middle and Lower Grande Ronde, Wallowa, and Imnaha, are outlined in the stream system map of Figure 1. Chapter V is devoted to a detailed inventory of each sub-basin.

CHAPTER II WATER AND THE BASIN ECONOMY

THE GENERAL ECONOMY

Agriculture and timber production are major economic activities in the Basin. Other activities include mining, wholesale and retail trade, and service industries. A contribution is made to the economy of the Basin by recreational activities but the values cannot be definitely determined.

Some measure of the relative importance of various activities, excluding agriculture, can be obtained from "Oregon Employment and Payrolls in Covered Industries" published by the State Department of Employment. In 1959, payrolls for various classifications were as listed in the following table:

TABLE 5

1959 PAYROLLS FOR SELECTED ACTIVITIES
GRANDE RONDE BASIN - UNION AND WALLOWA COUNTIES

Contract Construction	$1,239,157
Manufacturing	7,849,635
Transportation, Communications, and Public Utilities	785,644
Wholesale and Retail Trade	3,443,913
Finance, Insurance, and Real Estate	381,231
Services	636,006
Government	2,393,083

Of the nearly 7.9 million dollars attributed to manufacturing, approximately 7.3 million is accounted for by lumber and wood products. The $7,279,854 accredited to lumber and wood products represents approximately 90 percent of the reported manufacturing payrolls.

Agriculture

Agriculture, which was initiated in the Grande Ronde Valley about 1862, continues to be the principal economic activity in the Basin. Commencing with the grazing of livestock in the Grande Ronde Valley by the early settlers, the activities expanded to include production of small grains, potatoes, vegetables, and fruit. At present, there are two main areas of agriculture in the Basin; the Grande Ronde Valley and the Wallowa

Valley. Since the boundaries of the combined area of Union and Wallowa Counties closely follow the boundaries of the Basin, statistics published for these two counties are generally representative of activities within the Basin.

Table 6 gives agricultural land use and livestock data for Union and Wallowa Counties based on the Census of Agriculture for the year 1954. Total land in farms in the two counties exceeds 1,300,000 acres and is nearly 40 percent of the combined land areas of the two counties. The greater part of the land, about 1,000,000 acres, is used for pasture with cropland accounting for the remaining 300,000 acres. In 1954 there were over 90,000 head of cattle in the two counties and over 40,000 sheep. The value of all farm products sold amounted to over $14,000,000 and represented four percent of agricultural products sold in the state. Value of crops sold amounted to 50 percent of all farm products while livestock and livestock products amounted to 47 percent.

TABLE 6

AGRICULTURAL LAND USE AND LIVESTOCK DATA BY COUNTIES

1954

		UNION	WALLOWA	TOTAL
Approximate land area	acres	1,300,480	2,033,920	3,334,400
Land in farms	acres	575,301	747,574	1,322,875
Cropland	acres	179,297	121,950	301,247
Land pastured	acres	378,855	626,771	1,005,626
Woodland	acres	183,690	183,050	366,740
Irrigated land	acres	31,137	43,860	74,997
Cattle and calves	number	41,097	51,714	92,811
Horses and mules	number	1,594	2,129	3,723
Hogs	number	6,234	8,533	14,767
Sheep and lambs	number	13,770	26,540	40,310
Value of crops sold	dollars	5,164,569	1,877,166	7,041,735
Value of livestock and livestock products	dollars	2,834,324	3,799,655	6,633,979
Value of forest products sold	dollars	224,038	216,090	440,128
All farm products sold	dollars	8,222,931	5,892,911	14,115,842

Source: Census of Agriculture

Figure 4 shows the total value of farm products sold for Union and Wallowa Counties for years where comparable data exists. Generally the trend in values is upwards. Ranging from two to eight million dollars for Union County and from two to six million dollars for Wallowa County from 1940 to 1954. Comparison of individual breakdowns between categories is not readily available because of differences in reporting techniques.

Figures published for Union County are representative of the Grande Ronde Valley while those for Wallowa County closely represent the Wallowa Valley. Table 6 indicates that Union County has a larger area of cropland than Wallowa County while Wallowa County has the greater production in livestock. For the combined counties, however, crops and livestock are of equal significance to the Basin agricultural economy. Union County agricultural income for 1958 was $11¼ million of which $3½ million was from livestock and the remainder from crops. Comparable figures are not available for Wallowa County for 1958.

Irrigation plays an important role in the agricultural activities of the Basin. Table 7 shows the use of irrigated land in the two counties for 1954. About 800 farms, representing nearly half the total number in the two counties, use irrigation in all or part of

TABLE 7

IRRIGATED LAND USE BY COUNTIES

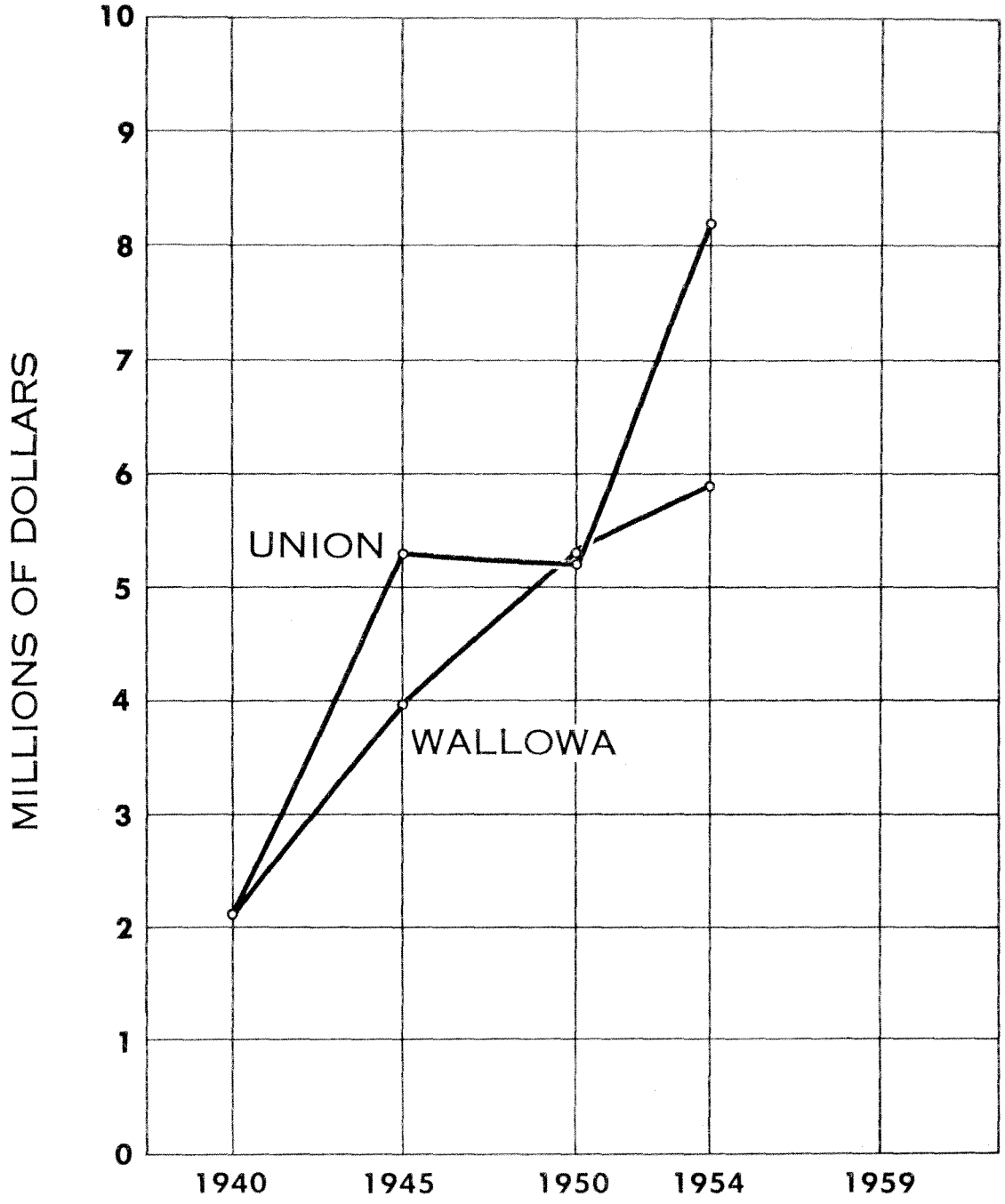
1954

		UNION	WALLOWA	TOTAL
Irrigated farms	number	324	481	805
Proportion of all farms	percent	32.9	70.1	48.1
Farms with all harvested crops irrigated	number	150	263	413
Irrigated cropland harvested	acres	23,311	29,843	53,154
Irrigated pasture	acres	7,826	14,017	21,843
Land irrigated	acres	31,137	43,860	74,997
Small grains harvested from irrigated land	acres	6,525	10,416	16,941
Hay harvested from irrigated land	acres	13,036	16,514	29,550

Source: Census of Agriculture

FARM PRODUCTS SOLD

UNION AND WALLOWA COUNTIES



Data Source: Census of Agriculture

8.8052 / 1 - 61

Figure 4

their lands. About 400 farms use irrigation for all harvested crops. The 1954 Census of Agriculture placed land in farms in the Basin at approximately 1,322,875 acres with five percent, or nearly 75,000 acres, classified as irrigated land. Of the total land irrigated in Union and Wallowa Counties, about 70 percent is irrigated cropland and the balance is irrigated pasture. County figures include lands outside the Grande Ronde Basin. A portion of Union County covers land in the Powder River drainage. Hay occupies the greatest acreage of irrigated cropland with small grains limited to a relatively small area. Combined irrigated pasture and irrigated lands producing hay exceed 51,000 acres. Two-thirds of all irrigated lands in the two counties are, therefore, devoted to fodder. The total area in the Basin which is classed as irrigable land is 120,000 acres as shown in Figure 5. Irrigation development is shown in Figure 5C.

Figures 5A and 5B indicate the land estimated to be under irrigation for various years dating from 1899 to 1959. Care is required in drawing conclusions from these data as reporting and evaluation techniques have been modified from time to time.

Timber

Next to agriculture, the timber industry is the most important economic activity in the Basin. About 1,900,000 acres of land in Union and Wallowa Counties, constituting 58 percent of the combined land area of the two counties, is forest land. Excluding a small area of productive timber in reserved land, about 80,000 acres, nearly 86 percent (1,656,000 acres) of the total forest lands are classed as commercial available for and capable of producing marketable timber.

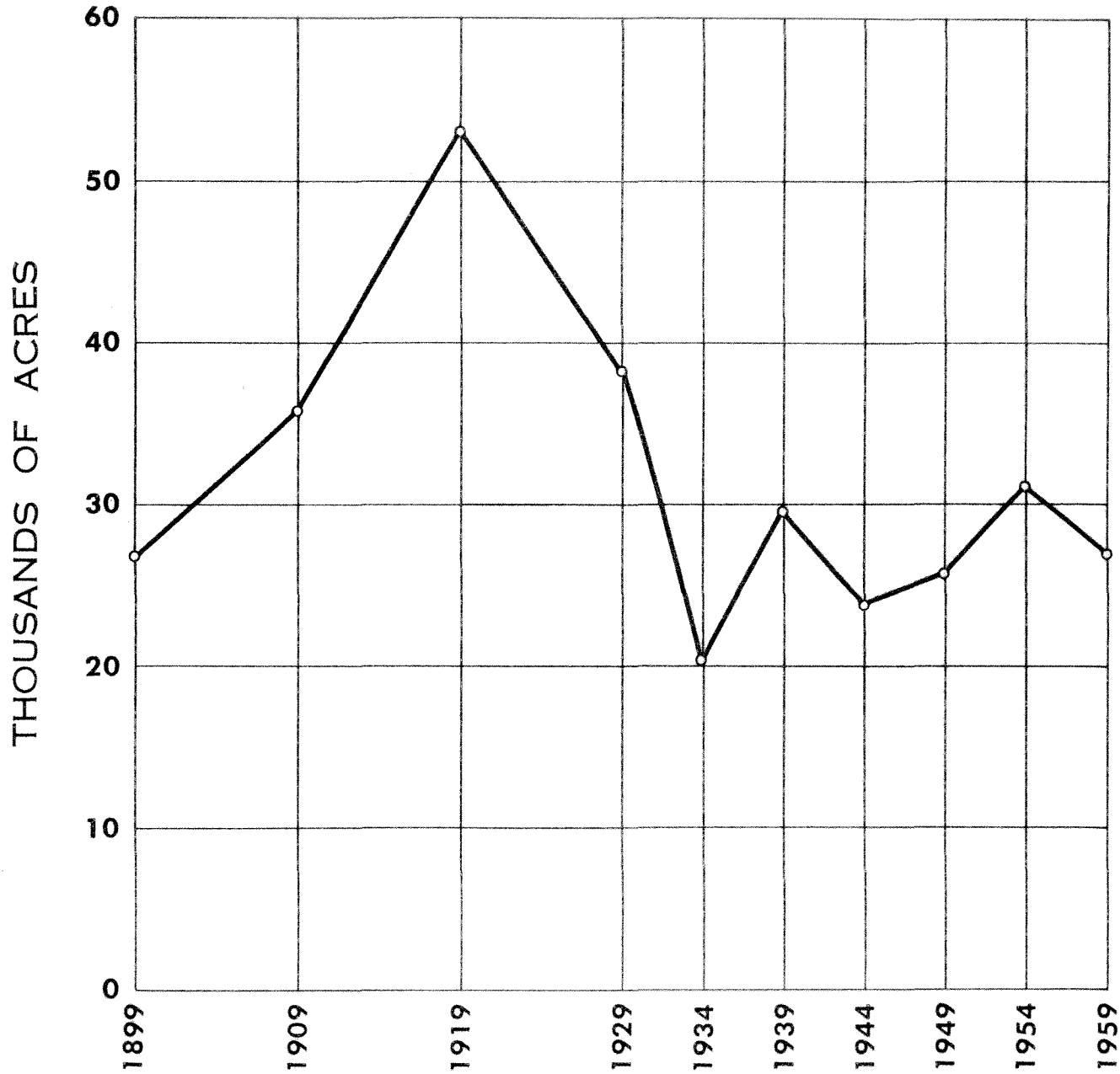
Ponderosa pine is the predominant species in the area and the chief source of sawmill timber. It is found growing from the "dry timberline" bordering the grass and sagebrush areas to an elevation of about 5,500 feet, changing, according to the direction of the slope, from pure stands to a mixture with other pines. Ponderosa covers an area of about 590,000 acres or about 60 percent of the commercial forest lands. At the higher elevations, ponderosa gives way to white fir, lodgepole pine, western larch and other species. Very little area is occupied by Douglas-fir. No hardwoods of commercial value exist. Small quantities of Douglas-fir, western larch, and occasionally Engelmann spruce are sawed.

There are no major water-using industries in the Basin based on timber processing. Sawmills and remanufacture units of the type located in the Basin do not require much water. Their needs are generally confined to log pond replenishment, washing, cold-deck sprinkling, fire fighting, and boiler feed requirements. None of these are large users of water.

Log production in Union and Wallowa Counties is given in Figure 6. Production in

IRRIGATED LAND

UNION COUNTY



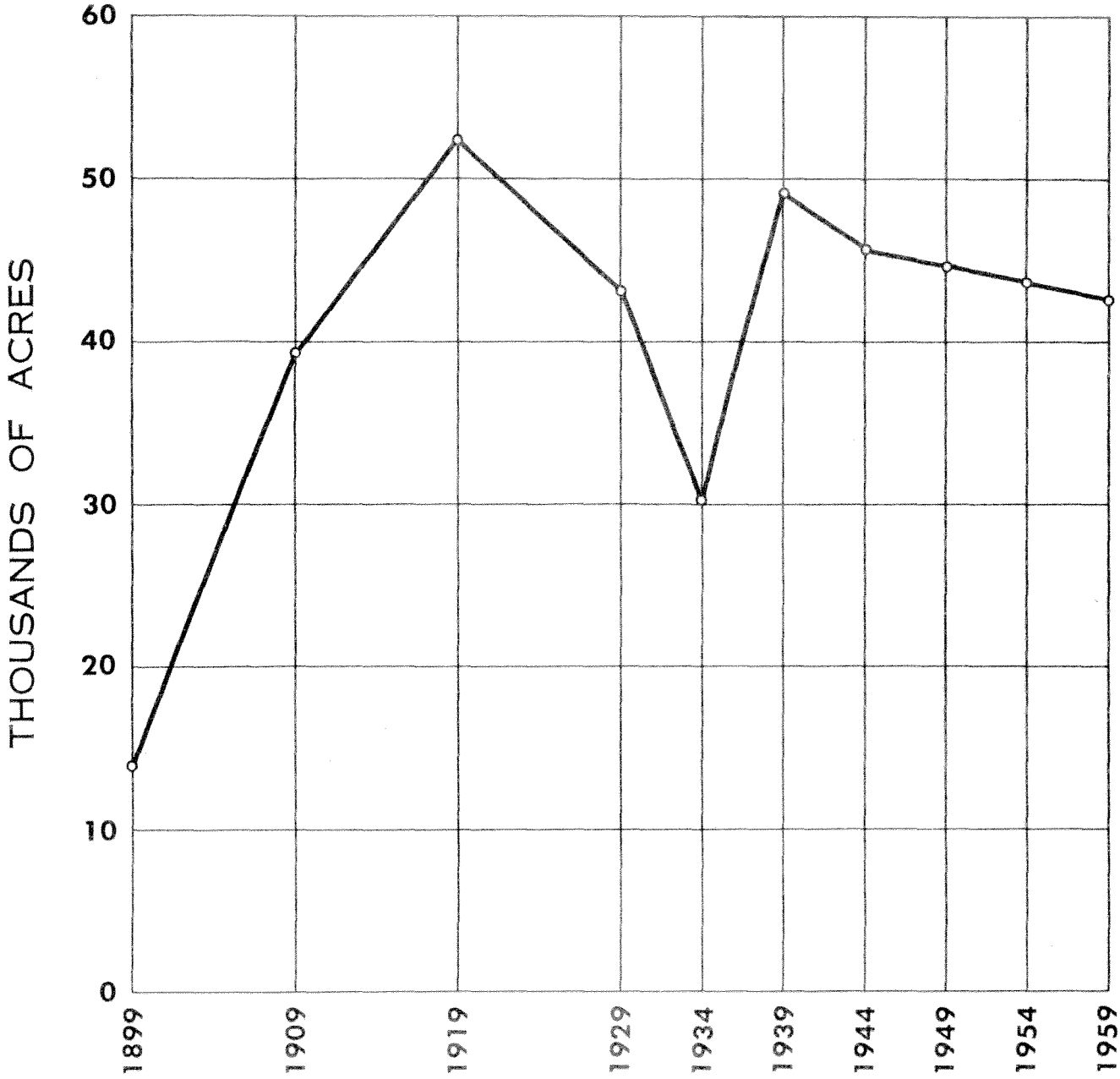
Data Source: Census of Agriculture

8.10312 / 1 - 61

Figure 5A

IRRIGATED LAND

WALLOWA COUNTY



Data Source: Census of Agriculture

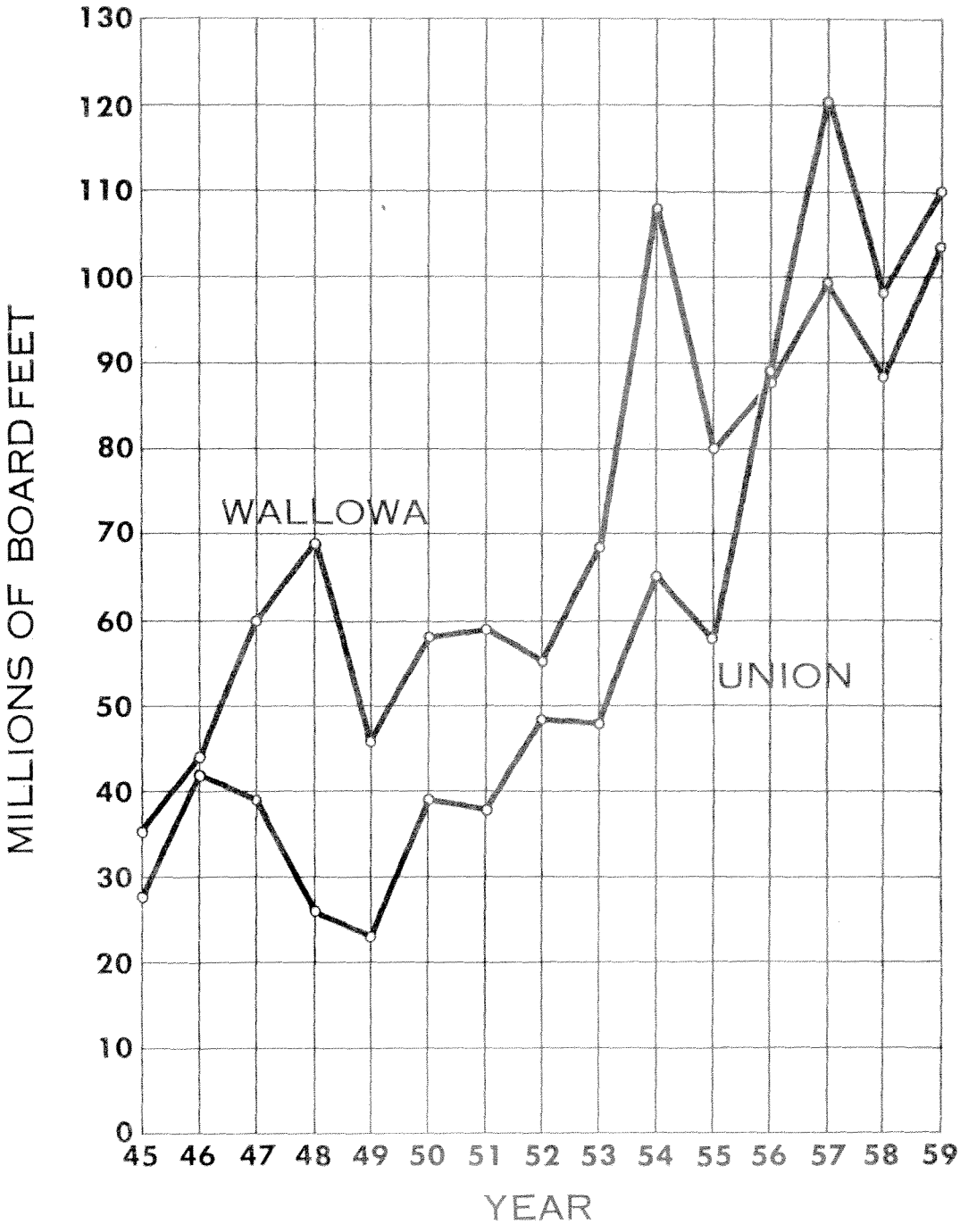
8.10312 / 1 - 61

Figure 5B

LOG PRODUCTION

UNION AND WALLOWA COUNTIES

1945 - 1959



Data Source: U. S. Forest Service
Oregon State Dept. of Forestry

Drawn 9 - 21 - 60
Grande Ronde
File No. 8.8

Figure 6

Union County increased from about 30 million board feet in 1945 to 110 million (120 million peak in 1957) in 1959 and for the same period, production in Wallowa County increased from 35 million to 103 million (108 million peak in 1954) board feet. Quantity of saw timber available at present approximates 2,568,000 cubic feet for the two counties. In 1958 there were ten sawmills located in the Basin with employment varying from 10 to over 100 persons. In addition to the mills, there were more than 40 logging operations in the Basin. Manufacture of furniture, doors, boxes and other timber products is carried out in the Basin on a limited scale. Wood chips are being shipped outside the Basin. Sustained yield figures for timber production in the Basin are not available.

Recreation

The Grande Ronde Basin has important recreational facilities and is visited annually by many vacationers, fishermen and hunters. The picturesque Wallowa Mountains with their alpine scenery, the rugged canyon of the Snake River, and the Blue Mountains are major scenic attractions. They receive much recreational use. A popular state park is located at the head of 1,600-acre Wallowa Lake where facilities exist for water-based sports. Game fish, including salmon, steelhead, and trout, are found in the waters of the Basin. The Basin is an important habitat for wildlife and is one of the leading centers for big game hunting in the state. Rocky Mountain elk and mule deer are hunted in the Wallowa and Blue Mountains, while the Wallowa and Grande Ronde Valleys provide hunting for waterfowl.

Usage of its recreational facilities by visitors contributes to the economy of the Basin. As an indication of this, income for 1957 from tourist use of boating facilities, hotels, cabins, store and lodge at Wallowa Lake was in excess of $60,000 and an additional $140,000 annual income is estimated for other camps, motels, etc. in Wallowa County. Several communities in the Basin derive a large part of their income from the tourist industry.

Minerals

The 1954 Census of Mineral Industries lists five mining operations in Union County and three in Wallowa County. Operations in Union County consist of sand and gravel, clay, and placer gold operations. Placer mining is limited to a few deposits on the headwaters of the Grande Ronde River where operations are intermittent, due in large part to the seasonal water supply. Mining in Wallowa County consists mainly of sand and gravel, and limestone operations. The principal limestone quarry is located in the Wallowa Mountains southwest of Enterprise at an elevation of nearly 6,000 feet.

This quarry also produces a jet-black marble that is used for ornamental stone.

The value of mineral production in Union County in 1958 was $448,000 excluding gold. The value of the gold is not known. The mineral production in Wallowa County for the same year was $243,000. No information is available on the production costs in either of these counties.

Limestone deposits occur in three large areas in the Wallowa Mountains. Much of the rock is relatively pure and burns to a high-calcium lime, suitable for cement manufacture. Multi-colored marbles, well-suited for building stone and other architectural uses, occur locally with the limestones. With the exception of the Black Marble quarry southwest of Enterprise, these limestone and marble deposits are generally so remote from transportation and markets that they have but little economic value at the present time.

The location of mineral deposits of economic significance in the Basin are shown in Figure 7.

THE ROLE OF WATER

General

The Grande Ronde River discharges, in an average year, about 2,415,000 acre-feet of water into the Snake River and the Imnaha about 400,000 acre-feet. The beneficial uses which are made of this water have an important influence on the economy of the Basin.

The number and size of water rights in the Basin are suggestive of the important part played by water. Figure 8 shows the general location of the point of diversion of each water right in the Grande Ronde Basin. Table 8 is the numerical summation of consumptive rights and total rights in the Grande Ronde system from the headwaters to the mouth of the Grande Ronde. The plot shows that the 1,430 rights total nearly 3,200 cubic feet per second in the Basin and that consumptive rights amount to about 2,400 cubic feet per second which represent a legal annual depletion potential of 473,000 acre-feet.

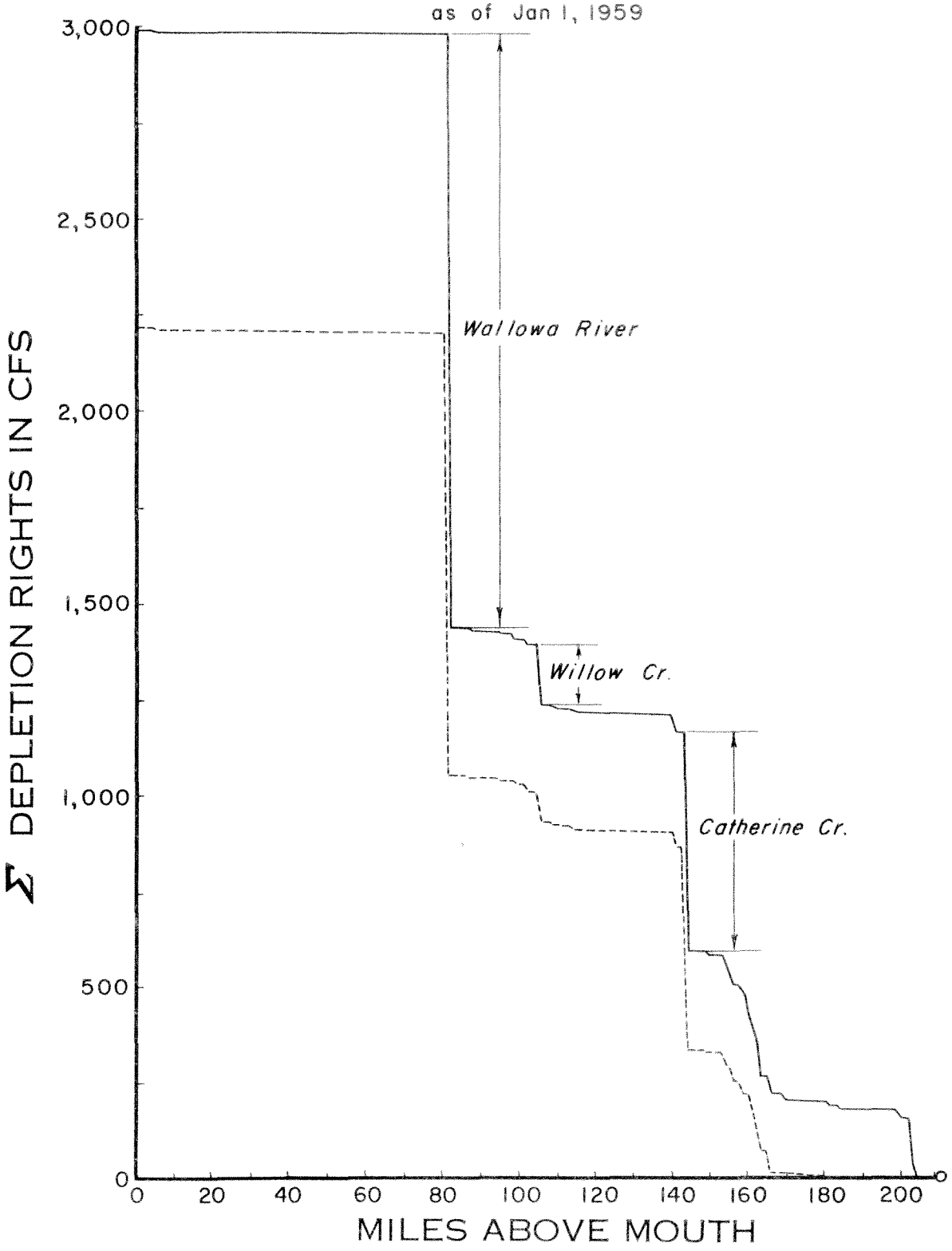
Figure 9 is a theoretical representation of depletion potential which assumes all rights being exercised simultaneously. From a practical viewpoint, this situation is seldom experienced because of diversity of use. Thus depletion can be normally expected to be less than indicated. In addition, adjudication or permit stipulations may provide for regulating procedures that result in lower depletion level for a given number of rights.

LEGAL DEPLETION RIGHTS

BY STREAM MILE

GRANDE RONDE RIVER

as of Jan 1, 1959



Consumptive Rights ------

Total Legal Rights ——————

Drawn 6-5-59
Grande Ronde
File No. 8.302
Figure 9

The following sections separate these rights into the ten beneficial uses of water: domestic, municipal, irrigation, power, industrial, mining, recreation, wildlife, fish life, and pollution abatement; plus the related items drainage, reclamation, and flood control.

TABLE 8

WATER RIGHTS SUMMARY*

GRANDE RONDE BASIN

USE	TOTAL CFS
Domestic	11.8
Municipal	31.8
Irrigation	2,197.1
Recreation	0.3
Industrial	194.6
Power	553.5
Mining	181.8
Wildlife	0
Fish Life	39.8
Pollution Abatement	0
TOTAL	3,210.7

* As of January 1959

Domestic

Under domestic category is included such water from surface runoff and springs as are used for household, stock, camp, and park requirements, excluding water supplied from municipal systems. About 180 water rights exist in the Basin specifically for domestic use. These rights total about 12 cubic feet per second which, if used continuously, is equivalent to a volume of 8,760 acre-feet per year. In addition to specific domestic rights, about 300 water rights for other uses include domestic usage as well. All rights involving domestic usage therefore total about 480.

Municipal

Adequate water supplies are essential for the establishment and growth of cities. Use of municipal water is not restricted to purely domestic needs. Included in this category is water for fire fighting, street cleaning, park use, commercial use, and in varying amounts industrial requirements. Water quality is important from the public health as well as industrial standpoint and treatment of surface supplies is almost always necessary. High quality of available water helps to reduce cost of treatment with consequent benefits to the consumers. Municipal water, therefore, governs the health and comfort of the community and is a significant factor in the economic development through its application in industry.

Municipal rights in the Basin total about 32 cubic feet per second, which, if used continuously, amount to about 29,400 acre-feet per year. The total of these rights is relatively small, about one percent of total rights in the Basin.

Irrigation

In common with other parts of the state, the Basin receives low rainfall during the summer months, when agricultural water needs are greatest. This factor combined with the existence of irrigable land and water from streamflow, has resulted in the extensive use of irrigation in the Basin. Agricultural statistics for 1954 reveal that five percent of all irrigated land in the state is contained in the Grande Ronde Basin. Irrigation practice has made possible use of land for pasture and hay production which would otherwise have been of little economic value. Additional irrigable land and water are available for future use. These lands, along with presently irrigated lands, are shown in Figure 5.

Irrigation is by far the major consumptive use of water in the Basin. The rights total about 2,200 cfs and constitute nearly 70 percent of all rights in the Basin.

It is interesting to compare the 1954 U. S. Census of Agriculture figure of 74,997 acres under irrigation with that represented in the 2,164 cfs of rights held for irrigation in the same year. This 2,164 cfs represents the rights to irrigate approximately 99,000 acres. In the granting of water rights, adjudications and permits frequently include restrictions on the volume of water that can be utilized in a given period. If they could be continuously used throughout an irrigation period of five months, the rights would represent 300,000 acre-feet of water.

Power

Present development of hydroelectric power in the Grande Ronde Basin is nominal.

Listed* installed capacity for four plants, in 1957, was less than 2,500 KW. Since that date one plant with an installed capacity of nearly 400 KW has become inactive.

Existing rights for the use of water for power totaled 550 cfs in September 1959. Some of these rights were inactive at that time.

Industrial

Industrial activity in the Basin is limited to processing of local products. The greater part is devoted to lumber and timber products and occupies a significant position in the economy of the area. Present industrial water use is mainly for mill ponds and boilers. Although these requirements are small, only 195 cfs, they must be met.

Mining

Economic mining deposits are generally lacking in the Basin and mining water needs are therefore small. In the past, placer gold deposits were extensively mined in the headwaters of the Grande Ronde River and occasional mining is still done at a greatly reduced scale. The placer operations are dependent on large quantities of water, and as the supply is seasonal, penstocks or dams were constructed along the streams being worked. The total mining water rights in the Basin of 181.8 cubic feet per second, with the exception of one cubic foot per second allocated in the Imnaha sub-basin, are located in this headwaters region of the Grande Ronde River in the Upper Grande Ronde sub-basin. The use of water in these mining operations is nonconsumptive and the water becomes available for further use at downstream locations. Although mining creates a temporary pollution problem by rendering the streams turbid, the sediments eventually settle out.

Recreation

The economic value that results from recreational activity includes revenue from water-based sports including boating, water skiing, swimming, and of course fishing.

Within the Basin numerous establishments depend heavily on recreation seekers for a good portion of their income. Motels, lodges, hotels, and camps are important facilities of this type.

Generally the economic aspects of recreation are not easily identified. One illustration

* Hydroelectric Power Resources of the U.S.: Developed and Undeveloped - F. P. C. - 1957

in the Basin is the lodge at Wallowa Lake. This facility, open three months each year, grossed $15,000 in 1957 on boating facilities, $36,000 on the lodge and cabins, and $10,000 on the store operated in connection with them.

At Wallowa Lake, the state operated park accommodated 12,521 persons for overnight camping.

Lakes and reservoirs in the Basin have a combined surface area of 4.5 square miles and are listed in Table 9. Nearly 83 percent of this lake and reservoir area is within the Wallowa sub-basin. Approximately 41 percent of the lake area of the Grande Ronde Basin is contained in Wallowa Lake. Areas of lakes and reservoirs are itemized by sub-basins in Table 9. Established recreational areas are shown in Figure 9A.

Wildlife

Wildlife plays a definite part in the economy of the Basin but methods for its precise evaluation do not exist.

Of major value are the populations of big game in the Basin. In 1957 deer and elk hunting attracted an estimated 12,200 and 11,000 hunters to Union and Wallowa Counties; for all practical purposes this is identical with the Grande Ronde Basin, as defined in this report. It is estimated that more than 8,000 deer and nearly 2,500 elk were killed. Special hunts attracted an additional 1,100 hunters.

The expenditures of these individuals add to the sales of a variety of establishments and contribute to the economy of the Basin. Game Commission figures estimating the value of big game hunting to the Basin approximate $1,000,000 annually.

The activities of upland game hunters, numbers estimated at 2,000 hunter days, also contribute to area economy but estimates on a dollar-value basis are not available.

Commercial hunting provides income for some 70 licensed trappers who take pelts of beaver, mink, muskrat, and other furbearers, whose value is estimated at nearly $10,000 annually. Because of reduction in habit due to man's activities, potentials in this activity have been materially reduced.

While the contribution of wildlife and activities connected with it are not subject to accurate economic analysis, the contributions to the welfare of the citizens of the Basin is nonetheless real and important.

Past practices have not included the acquisition of water rights specifically for wildlife use.

TABLE 9

AREA OF LAKES AND RESERVOIRS

NAME	ACRES	SQUARE MILES
UPPER GRANDE RONDE SUB-BASIN		
Grande Ronde Lake	6	
La Grande Reservoir	50	
TOTAL	56	.09
MIDDLE GRANDE RONDE SUB-BASIN		
Beverage Reservoir	2	
Spence Reservoir	7	
Morgan Lake	90	
Conley Lake (dry)	130	
TOTAL	229	.36
LOWER GRANDE RONDE SUB-BASIN		
Langdon Lake	163	
Roberts Lake	1	
Thomason Meadow Reservoir	5	
TOTAL	169	.26
WALLOWA SUB-BASIN		
Frazier Lake	11	
Little Frazier Lake	7	
Prospect Lake	18	
Glacier Lake	50	
Blue Lake	16	
Mirror Lake	22	
Moccasion Lake	22	
Douglas Lake	32	
Crescent Lake	10	
Craig Lake	2	
Lee Lake	18	
Lilly Lake	2	
Horseshoe Lake	24	
Unit Lake	9	
Razz Lake	15	
Ice Lake	60	
Sunshine Lake	1	
Jewitt Lake	3	
Dollar Lake	4	
Aneroid Lake	45	

TABLE 9 (Continued)

AREA OF LAKES AND RESERVOIRS

NAME	ACRES	SQUARE MILES
WALLOWA SUB-BASIN (Continued)		
Roger Lake	7	
Upper Lake	5	
Minam Lake	50	
Pocket Lake	10	
Tombstone Lake	22	
Diamond Lake	11	
Cheval Lake	8	
Swamp Lake	10	
Steamboat Lake	45	
Long Lake	45	
Hazel Lake	1	
Green Lake	19	
Maxwell Lake	22	
John Henry Lake	12	
Laverty Lakes	8	
Hobo Lakes	8	
Bear Lake	6	
Chimney Lake	21	
Wood Lake	7	
Little Storm Lake	12	
Billy Jones Lake	5	
Echo Lake	7	
Deadman Lake	7	
Frances Lake	52	
Legore Lake	3	
Wallowa Lake	1,600	
TOTAL	2,374	3.71
IMNAHA SUB-BASIN		
Soldier Lake	3	
Lake Frances	7	
Twin Lakes	20	
Warm Lake	6	
Bonny Lakes	8	
Papoose Lake	3	
Kinney Lake	28	
TOTAL	75	.12
TOTAL GRANDE RONDE BASIN	2,903	4.54

Fish Life

A variety of fishes utilize the Grande Ronde Basin. Anadromous species include the spring chinook and silver salmon and the steelhead trout. Excellent stocks of blueback salmon once inhabited the Wallowa system but the anadromous run has long since become extinct. Table 10 gives estimates of the average annual runs of anadromous species into the Grande Ronde and Imnaha river systems.

TABLE 10

ANADROMOUS FISH

ANNUAL RUN

SPECIE	GRANDE RONDE SYSTEM	IMNAHA SYSTEM
Spring chinook	20,000	9,500
Fall chinook	1,500	500
Steelhead trout	22,500	6,000
Silver salmon	unknown	unknown

SPRING CHINOOK SPAWNING DISTRIBUTION

STREAM	PERCENT OF TOTAL GRANDE RONDE SYSTEM	IMNAHA SYSTEM
Wenaha River	20	
Lookingglass Creek	15	
Catherine Creek	15	
Grande Ronde above La Grande	5	
Minam River	20	
Lostine River	15	
Wallowa River	10	
	100	
Imnaha River		95
Sheep Creek		5
		100

Source: Values estimated by the Oregon Fish and Game Commissions

Resident species include the rainbow trout, eastern brook, cutthroat, Dolly Varden, and golden trout, as well as whitefish and others, including the land-locked sockeye salmon, or kokanee of Wallowa Lake.

Data taken prior to the closing of The Dalles Dam indicate 5,000 to 6,000 angler trips per season for salmon and steelhead. Resident fish are pursued at the level of many thousands of angler days each year.

Data are not available that would allow the demonstration of the monetary value of fishery resources to the Basin. It is generally accepted that such monetary values accrue but methodologies and data are not adequate for the development of specific values.

The anadromous fish which are a product of the streams of the Grande Ronde system make a definite contribution to the commercial ocean fishery as well as that of the Columbia River. The sports fishery provided by the Grande Ronde to the Columbia also contributes to the economic activity of the States of Oregon and Washington but its specific economic value cannot be demonstrated with present knowledge.

Sport fishing in the Grande Ronde Basin for both resident and anadromous species is an unevaluated economic asset to the area. Expenditures made in the pursuit of sport fishing provide direct income for motels, hotels, restuarants, sporting goods establishments and other enterprises.

In Wallowa County, there are 15 business houses dealing in fishing equipment with gross sales of $19,500 excluding oil, gas, and groceries. A trout hatchery valued at $100,000 is located near Enterprise.

The Union County Water Resources Committee also lists about 15 establishments dealing in sport fishing equipment. The Committee estimates the Grande Ronde steelhead catch for 1956 to be worth $45,000 to $50,000.

The economic value of the fishery resource in the future will depend upon the maintenance of sufficient fish to attract sportsmen as well as provide for the out-of-basin sports and commercial fishery.

Pollution Abatement

There is no direct measure of the economic impact of pollution abatement problems on the Basin. Domestic and municipal sewage and industrial effluents are sources of pollution. Mining, gravel, and logging operations, and return flows from irrigation cause sporadic problems and create undesirable conditions at times.

Fisheries interests feel that undesirable practices, particularly mining activities, gravel operations, and poor land practices in the Basin have had adverse effects on fish production by harming spawning areas. The economic values cannot be adequately identified in monetary terms.

The simplest method of disposal of pollutants and generally the most undesirable is through discharge into rivers. Where the quantity of flow is insufficient for adequate dilution or the nature of the pollutant will not lend itself to dilution, other methods of control become necessary.

Flood Control

The Grande Ronde Valley, due to topography, is particularly susceptible to floods. Land subject to inundation has been developed so flood damages are relatively high, averaging $582,000 annually. About 60,000 acres are subject to flooding when the flow of the Grande Ronde at La Grande and Catherine Creek at Union is at the level of the 1894 flood.

Protection from floods will require a combination of channel improvement, levees, and upstream storage. Reservoirs result in numerous other benefits to which values cannot always be assigned and which would often become evident only after completion of projects.

The Wallowa sub-basin has no major flood control problems. Damages of limited amount occur with a 10-year frequency flood and up to $40,000 agricultural damage may occur at a 60-year frequency level. Information on roads, bridges, industrial, and municipal damage is not available at this flood level.

Drainage

High water table or standing water sometimes prevent the use of land for agricultural or building purposes. Such lands are usually located on alluvial deposits near rivers and therefore have a high agricultural potential. Such adverse water conditions are commonly caused by absence or inadequacy of natural drainage channels and are often aggravated by floods and excessive application of irrigation water to adjacent land. Besides rendering the land unfit for use, excess water will provide breeding places for mosquitos, and other insects capable of transmitting disease, thereby creating health hazards.

Areas in the Basin needing drainage are shown in the generalized plot of Figure 10 along with the flood plain and areas subjected to severe water erosion.

CHAPTER III WATER PROBLEMS

QUANTITY

General

In studying the adequacy of surface water, possible diversion of water from the Grande Ronde for use in adjacent basins is not taken into account.

Water resources in a specified area can be described as adequate if they are capable of satisfying the needs of beneficial uses at the present time and in the foreseeable future. However, the relationship between the pattern of availability of the resource and the pattern of the demand for it needs further clarification.

Location of water uses and needs follow the development pattern which, in turn, is governed by topography, soil conditions, climate, mineral deposits and other factors. Seasonal character of water needs is controlled by growing seasons, fish spawning seasons, and climatological characteristics. Geographical and seasonal distribution of supply from streamflow may not coincide with that of demand. Maldistribution of surface water, both with respect to location and time, can often be ameliorated by the use of storage reservoirs, diversions and watershed management. Adequacy of the resource implies that such measures can be taken, where necessary, at feasible cost to the users.

Main areas of consumptive water use in mountainous country are valleys which have relatively large areas of fairly level land and favorable soil and climate conditions. Streamflow supplying valley lands is derived from mountainous uplands, the conditions of which have a bearing on patterns of flow. Aside from climatic conditions, seasonal variations of flow, water quality and water temperature are governed by the characteristics of the watershed above. Elevation, stream gradients, vegetative cover, geologic structure, and orientation with respect to moisture-laden winds are some of the factors effecting the yield of the watersheds sustaining streamflow in the valleys.

While wet season flows are generally high and impose certain limitations on use, dry season flows are usually low and exercise an even greater restrictive factor in water limitation over water use. Since dry season flow is dependent on natural storage in the upland areas, depth and distribution of snowpack is an important characteristic of a watershed.

Major areas of water use in the Basin are the Grande Ronde and Wallowa Valleys. Part of the former utilizes streamflow derived from the Blue Mountains, and the rest of the valley, together with the whole of Wallowa Valley, depends on flow from the Wallowa Mountains. The chief difference between these two watersheds is that of elevation. Higher elevations receive greater precipitation, and since the proportion of snow to rain increases with elevation, the amount of stored water in general increases with elevation. The Wallowa Mountains, which are higher than the Blue

Mountains, carry a greater snowpack at the end of winter. Snow fields in the Wallowa Mountains may last through the entire summer while those in the Blue Mountains are usually exhausted relatively early so streams originating in the Blue Mountains depend primarily on ground water during part of the dry season.

Sustained flows from the Wallowa Mountains are utilized in both valleys and about 80 percent of all irrigation rights are based upon them. Unregulated streamflow has been generally sufficient to meet requirements in the Wallowa Valley but falls short of needs in the Grande Ronde Valley. Spring and early summer flows often cause damage through floods but, for the most part, cannot be utilized for beneficial purposes because of lack of storage. If this runoff were stored in reservoirs for release during low flow periods, water needs of the Basin could be met during most seasons.

The critical flow and yield conditions in the Basin are summarized for selected locations in Tables 11 and 12. Gaging stations, which measure these conditions, are located as shown in Figure 11.

Domestic

Domestic water needs are supplied by both streamflow and ground water. Ground water is available in the alluvial deposits making up the rich agricultural lands and serves as a relatively dependable domestic supply, in terms of quantity.

Municipal

Municipal water supply systems in the Basin are located at La Grande, Enterprise, Union, Elgin, Wallowa, Joseph, and Lostine and a privately-owned system at Cove. Supplies at source are adequate to meet present needs and increased demands in the foreseeable future, including industrial requirements. Shortages that exist in certain communities are due, in part, to limitations of transmission and distribution systems or lack of storage.

La Grande, the largest municipal water user in the Basin, obtains its supply from Beaver Creek with supplementary water from wells. Water rights totaling 8.5 cubic feet per second held by the city on Beaver Creek permit use of over 5.5 million gallons per day. Estimated yield to present reservoir in a low flow year is 7,000 acre-feet which can meet the anticipated demands in the foreseeable future, provided additional storage is developed. The supply can be increased by tapping other tributaries of Beaver Creek. In addition to water from surface runoff, greater utilization of ground water can be made.

Enterprise, the second largest city in the Basin, takes its supply from two springs. Yield

TABLE 11

MINIMUM FLOW WATER YEARS

Summary

LOCATION	WATER YEARS OF RECORD	MINIMUM FLOW Water Year	MINIMUM FLOW Flow cfs	DATA SOURCE
Grande Ronde near Hilgard	1938-56	1940	6.0	USGS WSP 1447
Grande Ronde at La Grande	1904-57 1/	1940	3.9	USGS WSP 1447
Grande Ronde at Rondowa	1927-57	1936	225.0	USGS WSP 1447
Grande Ronde at Troy	1945-57	1953	434.0 2/	USGS WSP 1447
Wallowa at Joseph	1905-57 3/	1937	0	USGS WSP 1447
Bear near Wallowa	1925-57	1937	3.0	USGS WSP 1447
Lostine near Lostine	1913-57 4/	1937	10.0	USGS WSP 1447
Catherine near Union	1912-57 5/	1955	6.5 2/	USGS WSP 1447
Indian near Imbler	1938-50	1940	0.1	USGS WSP 1317
Imnaha at Imnaha	1929-57	1932	16.0	USGS WSP 1447

1/ 7 years missing or incomplete
2/ Result of freezeup
3/ 17 years missing or incomplete
4/ 12 years missing or incomplete
5/ 14 years missing or incomplete

TABLE 12

MINIMUM YIELD WATER YEARS

Summary

LOCATION	WATER YEARS OF RECORD	MINIMUM ANNUAL YIELD		DATA SOURCE
		Water Year	Acre-Feet	
Grande Ronde near Hilgard	1938-56	1944	93,600	USGS WSP 1317
Grande Ronde at La Grande	1904-57 1/	1915	111,000	USGS WSP 1317
Grande Ronde at Elgin	1905-19 2/	1915	226,200	SWRB Correlation
Grande Ronde at Zindel	1905-12	1915	1,147,000	SWRB Correlation
Wallowa at Minam	1905-14 2/	1940	363,000	SWRB Correlation
Wallowa at Joseph	1905-57 3/	1937	37,030	USGS WSP 1317
Bear near Wallowa	1925-57	1926	50,200	USGS WSP 1317
Lostine near Lostine	1913-57 4/	1926	89,400	USGS WSP 1317
Catherine near Union	1912-57 5/	1930	48,400	USGS WSP 1317
Indian near Imbler	1938-50	1944	16,720	USGS WSP 1317
Imnaha at Imnaha	1929-57	1931	179,000	USGS WSP 1317

1/ 7 years missing or incomplete
2/ 3 years missing or incomplete
3/ 17 years missing or incomplete
4/ 12 years missing or incomplete
5/ 14 years missing or incomplete

of the springs is adequate for present needs and a third spring is available for use as requirements increase. The Wallowa River is an additional source and the city holds a seven cfs water right on this river.

Catherine Creek supplies water to the City of Union and this city is the only one in the Grande Ronde Valley relying entirely on surface water. At times irrigation water handled through the municipal system is restricted because of limited supplies. Elgin's water comes from wells and no quantity problems are known to exist. Wallowa holds a water right for six cfs on Bear Creek for municipal water needs and, similarly, Lostine has a water right on the Lostine River amounting to 2.5 cfs. Both streams have periods of low flow which create quantity problems. Joseph gets its supply from Wallowa Lake which is adequate for present and foreseeable future demand. The private system at Cove obtains its water from springs of 6,000 gallons per day capacity.

Irrigation

Irrigation is by far the larger use of water in the Basin. Extensive irrigated lands are located in two major valleys, each having different water problems.

The Grande Ronde Valley has about 31,000 acres under irrigation using water from unregulated streamflow. More than one-half of this area is supplied by water from Catherine Creek, while about a third is dependent on the Grande Ronde. Willow, Mill, Clark, Phillips, and Indian Creeks provide water for the rest of the area.

Flow in these streams is high during spring and early summer and low during the rest of the year. Seasonal flow patterns do not, therefore, satisfy irrigation patterns which require substantial quantities in late summer. High spring flow, especially in Catherine Creek, is an inducement to farmers to divert excess water to their fields to insure saturation of soils against the dry summer months. Excess application of water may impoverish the soil through erosion and leaching.

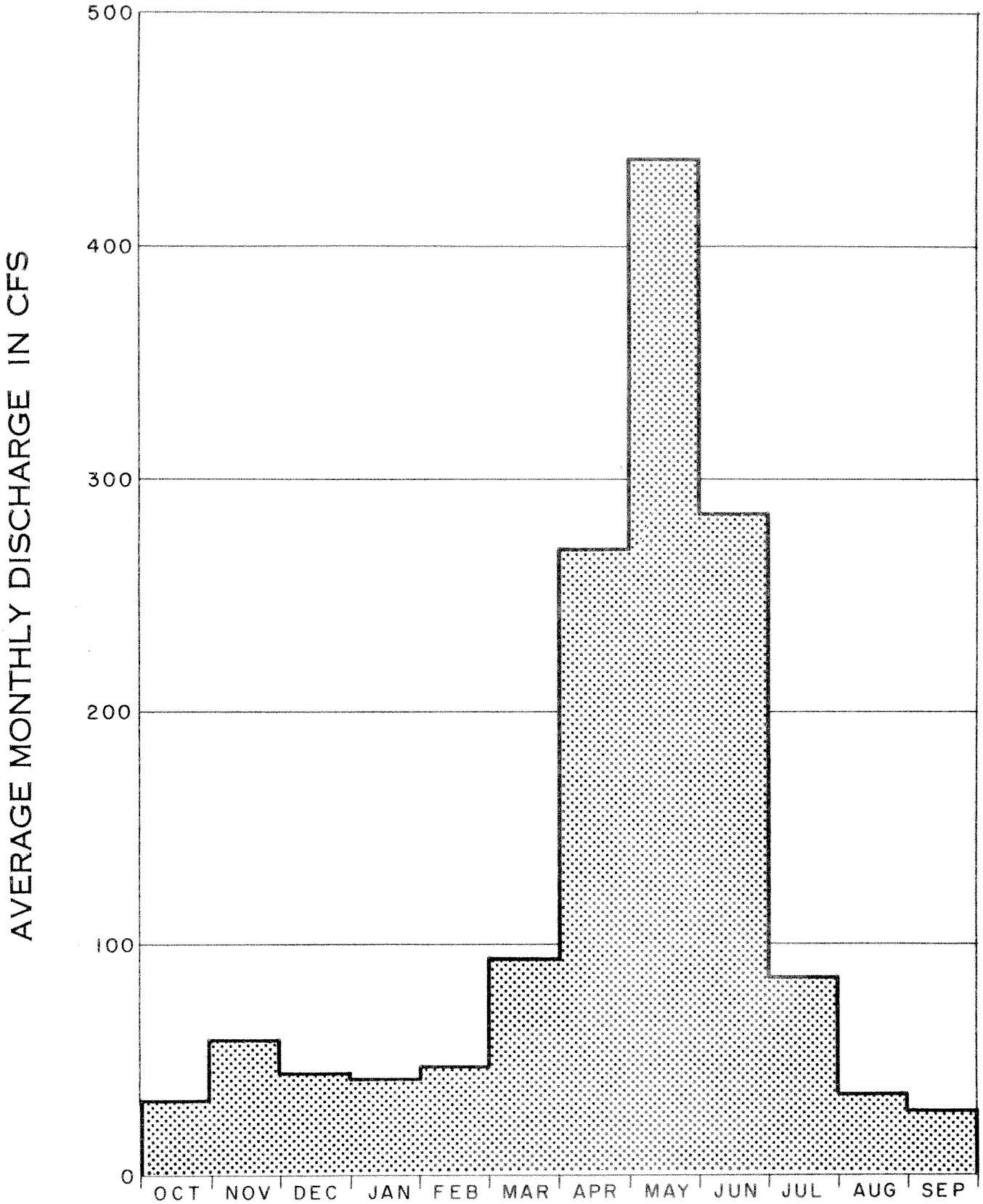
A comparison between average monthly flows during the irrigation season and existing irrigation rights illustrates the shortage in water required for full irrigation. Average flows in Catherine Creek near Union, Figure 12, during June, July, and August, the months of high irrigation demand, are 283, 86, and 34 cfs, respectively, while total irrigation rights on Catherine Creek are 500 cfs. Since flows are measured above the areas of diversion it is obvious supplies are not adequate to meet all rights simultaneously. Similarly, average flows in the Grande Ronde at La Grande, Figure 13, for the same months are 462, 105, and 29 cfs, respectively, and irrigation rights on the main Grande Ronde total over 300 cfs.

Inadequacy of streamflow to satisfy irrigation needs, has restricted irrigation development. According to the Bureau of Reclamation, not more than 3,300 acres in the Grande

DISCHARGE

CATHERINE CREEK NEAR UNION

1912, 1919, 1926 - 1957

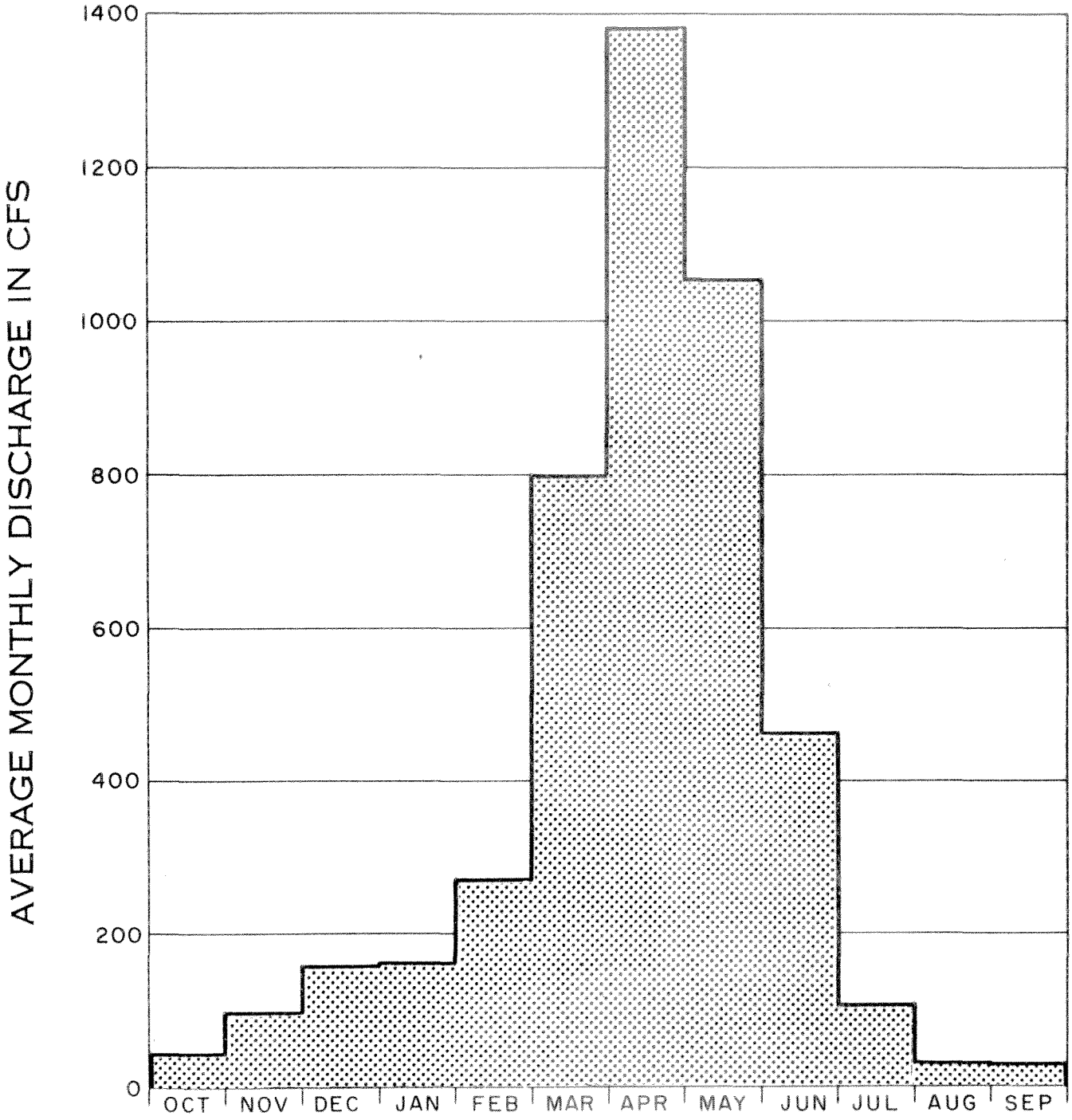


Drawn 9-29-59
Grande Ronde
File No. 8.202
Figure 12

DISCHARGE

GRANDE RONDE RIVER AT LA GRANDE

1904 - 1957



Drawn 6-2-59
Grande Ronde
File No. 8.202

Figure 13

Ronde Valley have adequate water supply. This acreage amounts to about 10 percent of the area classified as irrigated and is only 5 percent of the total irrigable area of about 59,000 acres.

Yield of the watershed above the Grande Ronde Valley floor is more than adequate for the entire valley irrigable area of 59,000 acres. About three-quarters of this area can be supplied from the Grande Ronde main stem with Catherine, Little, Mill, and Warm Creeks irrigating the remaining quarter. Storage is required on both the Grande Ronde River and Catherine Creek to supply additional irrigation needs. Suitable dam sites with adequate reservoir capacities are available on both streams and have been investigated by the Bureau of Reclamation for irrigation needs.

The other large irrigated tract in the Basin is located in the Wallowa Valley and has an area of about 44,000 acres. Much of the irrigation water is provided by unregulated flow originating in the high watershed of the Wallowa Mountains. Water is taken not only from the Wallowa River and tributaries which flow through the irrigated lands but also from the watershed of the Imnaha River. Streamflow is generally adequate for irrigation needs. According to the County Water Resources Committee, over 22,000 acres receive a full supply each year and about 20,000 acres are subject to a moderate shortage towards the end of the season. The rest of the irrigated lands receive a poor supply. There is very little additional irrigable land in this area.

Power

Present power production within the Basin is limited. Hydroelectric installed capacity utilizing the stream of the system is less than 3,000 kilowatts.

Any substantial future development of hydro power in the system depends on the availability of economical storage for stream regulation. The distribution of runoff in the Basin is indicated in Table 13. Storage will be required to fit the resource into the potentials for its use.

The problems of economic feasibility of storage are geologic and topographic in the most part.

Industrial

Although industrial development in the Basin is limited, its economic significance cannot be overlooked because it is based upon, and adds to, the value of the Basin's natural resources.

TABLE 13

PERCENT OF MEAN ANNUAL YIELD DISTRIBUTION BY MONTHS

Values Based in Part on Correlations

		OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEPT	MEAN ANNUAL YIELD ACRE-FEET
Sub-basin 1 GR at La Grande														
1904-57	Mean Q cfs	45	100	158	162	272	800	1380	1054	463	107	31	30	277,155
	% of Mean Annual Yield	1.0	2.2	3.4	3.5	5.9	17.4	29.9	22.9	10.0	2.3	0.7	0.7	
Sub-basin 2 GR at Elgin														
1904-57	Mean Q cfs	90	225	330	372	800	1427	2782	2514	1373	240	53	40	617,065
	% of Mean Annual Yield	0.9	2.2	3.2	3.6	7.8	13.9	27.2	24.5	13.4	2.3	0.5	0.4	
Sub-basin 3 GR at Zindel														
1904-57	Mean Q cfs	910	1530	1890	1800	2960	5210	7670	8020	5700	2200	860	800	238,190
	% of Mean Annual Yield	2.3	3.9	4.8	4.6	7.5	13.2	19.4	20.2	14.4	5.6	2.2	2.0	
Sub-basin 4 Wallowa at Mouth														
1904-57	Mean Q cfs	460	540	605	585	580	1060	1590	2614	2755	1130	475	375	769,013
	% of Mean Annual Yield	3.6	4.2	4.7	4.6	4.5	8.3	12.4	20.5	21.6	8.8	3.7	2.9	
Sub-basin 5 Imnaha at Mouth														
1929-57	Mean Q cfs	155	190	245	200	235	420	1190	1700	1350	550	180	140	394,775
	% of Mean Annual Yield	2.4	2.9	3.7	3.1	3.6	6.4	18.2	26.0	20.7	8.4	2.8	2.1	
Upper Grande Ronde Dam Site														
1928-48	Mean Q cfs	25.2	48.5	89.7	72.5	114.1	360	653	542	262.9	55.6	15.4	16.8	135,850
	% of Mean Annual Yield	1.1	2.1	4.0	3.2	5.1	15.9	28.9	24.0	11.6	2.5	0.7	0.7	
Lower Grande Ronde Dam Site														
1928-48	Mean Q cfs	31.5	60.8	112.5	90.8	142.9	451	818	679	329.5	69.6	19.4	21	170,196
	% of Mean Annual Yield	1.1	2.2	4.0	3.2	5.1	16.0	29.0	24.0	11.7	2.5	0.7	0.7	
Catherine Creek Dam Site														
1928-48	Mean Q cfs	26.9	31.8	40.0	36.4	41.7	85.7	250	385	247	70.2	28.4	24.3	76,329
	% of Mean Annual Yield	2.1	2.5	3.2	2.9	3.3	6.8	19.7	30.4	19.5	5.5	2.2	1.9	
Wenaha Dam Site														
1928-48	Mean Q cfs	765	1066	1750	1533	1914	3899	6589	6745	5007	1657	660	655	1,941,654
	% of Mean Annual Yield	2.4	3.3	5.4	4.8	5.9	12.1	20.4	20.9	15.5	5.1	2.0	2.0	

Industrial water needs are both consumptive and nonconsumptive, the latter being by far the greater. Seasonal low flows, particularly in the Grande Ronde Valley, have imposed limitation problems in industrial operations. For instance, mills located at Island City have had to curtail operation of water turbines due to inadequate supply. A lumber mill at La Grande experiences water shortages for existing operations and has, in the past, been precluded from adopting a more economical operation due to a lack of water. Expansion contemplated by this mill will further increase its water demand.

Present industrial requirements could be satisfied, partly, by improved municipal supplies. Storage of a part of the heavy spring runoff would provide water for industrial requirements.

Mining

Mining operations in the headwaters of the Grande Ronde River are limited by seasonal supplies of water. Many of the creeks are intermittent and flow only during periods of rapid snowmelt or heavy rain. The large quantities of water required by the placer gold operations were obtained at intervals by constructing dams and penstocks upstream from the diggings. These placer deposits are now largely depleted and are worked only occasionally. The mining use of the water is of a nonconsumptive nature.

Recreation

Recreational activities such as swimming and boating require relatively large bodies of still water, such as lakes, and wide, slow-moving rivers. Most streams in the Basin are unsuitable for water-based recreation. Wallowa Lake, the only large lake in the Basin with highway access, adequately satisfies the needs of Wallowa Valley but the Grande Ronde Valley lacks similar facilities. Multi-purpose storage reservoirs would prove beneficial to recreation in the Basin.

Table 9 lists the surface area of lakes within the Basin and shows the inadequacy of such features, from a recreational standpoint, over much of the Basin. Water requirements for fish and wildlife, which support other important recreational activities, are discussed under their respective headings.

Wildlife

Consumptive water needs of wildlife are relatively small in quantity and existing supplies are adequate. Increasing numbers of big game, particularly elk, have created a winter grazing problem which is gradually being offset through State Game Commission

developments in the Wenaha Game Management Area. Ponds, marshes, and swamps provide habitat for waterfowl and, to a certain extent, furbearers. Marshes and swamps, when drained, often provide good agricultural land and reclamation in the Grande Ronde Valley and parts of the Wallowa Valley have greatly reduced waterfowl habitat. According to the County Water Resources Committee, during the past 10 years over 2,000 acres have been reclaimed from swamps in Wallowa Valley. The two valleys still contain the principal habitat for waterfowl and preservation of this resource will require consideration of its needs in the planning and execution of drainage and reclamation works.

Furbearers, such as muskrat, mink, and beaver, are directly affected by water and suffer from widely-fluctuating water levels in streams and lakes.

Fish Life

High and low streamflow can be detrimental to fish life. Floods often remove eggs from gravel beds and fry from stream channels entailing heavy losses to both. Transport of sediment, a natural flood phenomenon, but frequently intensified by man, creates a condition harmful to fish and the subsequent deposition damages spawning beds.

Inadequate streamflow harms fish life by limiting the production of aquatic food and reducing living space. Low flows create temperature, spawning, and pollution problems. Low streamflows occur annually in many parts of the Basin, particularly in the Grande Ronde Valley. Excessive depletions sometimes cause stretches of streams to be dry or nearly dry and future increases in depletions will aggravate this situation unless low flows are augmented by releases from stored water or unless further critical period use is curtailed.

Pollution Abatement

Sewage treatment facilities in the Basin are, in many instances, inadequate for existing conditions. This factor, combined with streamflow which is inadequate to provide sufficient dilution of wastes, dictates a need for more extensive and more complete treatment, including industrial wastes.

In view of existing shortages of supply for many other beneficial uses, water should not be used for pollution abatement by dilution in lieu of other proper waste treatment procedures.

QUALITY

General

Quality of water is dependent on bacterial content, chemicals in solution, matter in suspension, and temperature. All water uses are effected by quality but, unlike quantity, effects vary with type of use. Water quality problems in the Grande Ronde are not as pronounced but are equally as important as those of water quantity.

Domestic

Ground water supplies in the Grande Ronde Valley are generally of poor quality. Bacterial contamination has been found in some locations at depths of 80 feet. In the La Grande-Island City area ground water tests have indicated high iron and manganese content not related to industrial contamination. An instance of ground water pollution by oil has occurred near La Grande. Further ground water data are needed with particular reference to the eastern part of the Grande Ronde Valley and the entire Wallowa Valley before quality problems of ground water in the Basin can be completely evaluated. Quality of surface water is generally satisfactory except for bacterial contamination in some populated areas. Turbidity is a problem at times with surface waters.

Municipal

Tests run on water from Wallowa Lake and Catherine Creek, municipal sources for the Cities of Joseph and Union, indicate any bacteriological problems could be overcome with adequate sterilization. Contamination of water in Wallowa Lake can be expected to increase with growing use of the lake and watershed above for recreational purposes and may in the future pose a problem to the municipal supply. Union's water supply has an occasional bad taste and turbidity while that of Wallowa, obtained from Bear Creek, has a turbidity problem. Quality problems do not affect the other municipal water systems in the Basin with the exception of bacterial contamination which is a hazard present in all supplies, in particular, surface supplies. Water of satisfactory quality for municipal use is available from extensive and unpopulated watersheds above the valleys.

Irrigation

Irrigated areas in the Basin are located mainly in the Grande Ronde and Wallowa Valleys. From the standpoint of quality of irrigation water in the Grande Ronde Valley, the Bureau of Reclamation states as follows:

> "Analysis of water from various sampling points on Grande Ronde River and Catherine Creek indicates the water supply has a good-to-excellent rating. Samples obtained from low flows at the end of the irrigation season and in reaches where return flow would normally appear showed only a slight reduction in water quality. Although the percent sodium found was low the percent sodium possible was quite high, indicating the need for adequate drainage to prevent accumulation of harmful sodium compounds in the soil. However, based on past use the waters proposed for use for irrigation would be satisfactory from the standpoint of quality of water."

Water quality data with reference to irrigation use are not available for Wallowa Valley.

Power

Water quality is not a primary problem associated with present or future power production in the Basin.

Industrial

Industrial use of water in the Basin is small and of such a nature that water quality does not present any major problems to industrial operations. Nonconsumptive use of water by industry and discharge of industrial effluents into streams, however, cause quality problems to other users. Millpond discharges and effluent from creameries and meat packing plants cause river pollution and logging operations cause silt loads in rivers mainly through inadequate soil management practices. Due to low seasonal streamflows, the assimilation capacity of streams in the developed areas of the Basin is not capable of handling additional industrial wastes unless satisfactory treatment practices are used.

Mining

Water quality is not a problem to present mining operations but, as with industry, nonconsumptive water use in mining often creates quality problems to other users. Silting of the Grande Ronde has been caused by placer gold and gravel operations.

Recreation

Water used for recreational purposes needs to be of good quality. Color, temperature,

and odor are important from an aesthetic standpoint while health requirements demand a low content of pathogenic bacteria and harmful chemicals. Extensive recreational use of water in lakes and rivers can create a pollution hazard, particularly when the water is used at downstream locations for municipal and domestic purposes. Recreational use of Wallowa Lake, for instance, has created a pollution hazard with respect to the municipal water supply of Joseph.

Wildlife

Water which is unsatisfactory to fish life from a pollution standpoint is generally not suited to the needs of wildlife. Water quality problems affecting wildlife alone are not evident in the Basin.

Fish Life

Water quality as measured by temperature, silt, and organic content has a direct and significant bearing on fish life.

High water temperatures cause loss of life mainly through disease and low temperatures reduce activity and thereby limit growth. Anadromous fish runs are subject to heavy losses through high temperatures since the spawning cycle demands passage of both the adult fish and the fingerling through the lower stretches of a river which often are characterized by higher temperatures. High temperature conditions occur seasonally in most parts of the Basin.

Siltation of spawning beds causes damage to fish eggs by either covering the beds entirely or by obstructing flow through the gravel thus preventing the supply of oxygen needed by the eggs. Sources of silt load in the Grande Ronde are discussed under Mining.

Pollution Abatement

Of the water uses in the Basin, fish life and municipal are among the most sensitive to quality problems. When water is being used to dispose of pollution, temperature is a primary factor in maintaining the dissolved oxygen content at levels necessary for other water users. Capacity of water to deal with pollution, while maintaining the required level of dissolved oxygen, increases with decreasing temperatures.

Organic loading depletes the dissolved oxygen level of a stream thereby reducing its

downstream dilution potential. This condition is greatest during heavy runoff but the harmful effect is, however, reduced by the large quantity of water available for dilution.

FLOOD CONTROL

General

Floods occur annually in the Grande Ronde Valley with moderate floods having an average recurrence interval of 3 to 4 years and major floods having a recurrence interval of 25 years or more*. Large floods generally occur during the heavy snowmelt period of spring. Exceptionally heavy rainfall during winter or early spring sometimes causes flash floods. Flood flows of the Grande Ronde River, Catherine Creek, Willow Creek, and Ladd Creek inundate up to 60,000 acres depending upon flood magnitude.

History of Floods

Details of notable floods on the Grande Ronde River and Catherine Creek from 1865 to date are shown in Table 14. Prior to the construction of existing flood protection works, nearly 72,000 acres in the Grande Ronde Valley were subject to flooding and in some years about 60 percent of the valley floor was inundated as long as five months of the year. Estimated areas inundated during some of the floods are given below:

Year of Flood	Area Inundated in Acres
1894	50,840
1917	30,000
1948	19,340
1949	5,920

Flood Damages

The flood of 1894, in addition to flooding nearly 51,000 acres in the Grande Ronde

* Design Memorandum #2 - General Plan and Detailed Cost Estimate Local Flood Protection Project - Grande Ronde Valley - Office District Engineer, Corps of Engineers, Walla Walla, Washington

TABLE 14

NOTABLE FLOODS AT LA GRANDE AND UNION

FLOOD		GRANDE RONDE AT LA GRANDE PEAK DISCHARGE CFS	CATHERINE CREEK AT UNION PEAK DISCHARGE CFS
April - May	1865	10,000	3,000
May	1876	9,000	2,500
December	1881	10,000	---*
April - May	1882	---*	2,600
May	1890	5,500	---*
June	1891	---*	1,200
April	1893	5,000	1,500
March - April	1894	9,500	---*
July	1895	---*	2,000
April	1896	8,000	---*
April	1897	5,000	---*
April	1898	---*	1,200
May	1899	5,500	---*
April	1904	6,200	---*
May	1907	---*	1,100
March	1908	5,650	---*
March - June	1908	---*	1,600
March	1910	7,100	---*
April - May	1912	4,700	1,530
March	1917	6,500	1,150
May	1917	6,800	1,800
May	1918	---*	1,100
May	1919	---*	1,350
March	1921	5,820	---*
May - June	1921	---*	1,550
April	1922	6,400	1,000
June	1927	---*	1,070
January	1928	5,800	---*
May	1928	---*	1,470
May	1929	---*	1,200
April	1931	8,500	---*
May	1931	---*	600
March	1932	8,880	---*
April - May	1932	---*	960
May - June	1933	---*	1,240
April	1935	---*	680
April	1936	4,380	---*
April - May	1936	---*	900
April - May	1938	---*	1,100
March	1939	4,480	---*
April	1939	---*	750
December	1946	5,320	---*
May	1948	4,620	1,740

* Unknown

Note: Accurate gage data were not available until 1904 at La Grande and 1912 at Union

Source: Corps of Engineers

Valley, inundated nearly two-thirds of the City of La Grande. Subsequent improvements made to the river channel give partial protection from floods to main areas in the city. A flood of equal magnitude to that of 1894 would nevertheless affect about 260 city blocks, causing severe economic loss and creating a health hazard. The flood of 1948 inundated 15 city blocks in Union and it is estimated that a flood peak similar to that which occurred in 1865 would inundate over 110 city blocks. On the basis of 1949 valuation figures, the damages resulting from a major flood and a moderate flood are estimated at about $3,840,000 and $1,000,000, respectively. Estimated damages include losses in both agricultural and urban areas. Annual flood damages, also based on the 1949 Corps of Engineers' valuation figures, has been estimated at about $580,000 of which over 85 percent consists of agricultural losses.

Existing Flood Protection Works

Flood protection and drainage works have been carried out in the Grande Ronde Valley over a long period of time and date back to the early settlers. The replacement cost of works existing in 1949, consisting of cutoffs, channel improvements, levees, and revetments, was estimated at about $2,000,000. Works which are located mainly in the southern half of the valley have been constructed by several organizations and individuals including the State of Oregon, a soil conservation district, and municipalities.

Methods of Flood Damage Reduction

Commonly accepted measures of reducing flood damages are:

1. Reduction of peak flows by reservoirs;
2. Local protective works;
3. Reduction of peak stage by increased discharge resulting from channel improvement;
4. Diversion of flood waters through bypasses and floodways;
5. Temporary or permanent evacuation of the flood plain (flood plain zoning); and
6. Reduction of flood runoff by watershed management.

Flood damage reduction measures include one or more of the methods enumerated,

depending upon the nature of the floods and the property requiring protection.

Use of the first method, reservoir storage, is desirable in a comprehensive flood protection project in the Grande Ronde Valley in view of the many attendant benefits, including conservation of water for other uses.

Local protective works in the form of levees and revetments have been effective in the past and their extension and improvement would be an essential feature of future projects.

The meandering course of the Grande Ronde River through the flood plain calls for cutoffs to shorten the length of the stream and, thereby, increase gradient and velocity. Several cutoffs are already in existence, including the "State Ditch", constructed by the State of Oregon in 1872, but considerable potential still exists for channel improvements by this method. Improvement of the river channel at its point of exit from the valley by removal of existing constriction will help to reduce flood stages, particularly in the northern part of the valley. Enlargement and deepening of channels will further reduce flood stages by increasing discharge capacity.

The valley does not lend itself to the construction of flood bypasses other than the cutoffs referred to above.

Drainage

Large areas in the Grande Ronde and Wallowa Valleys are subject to high water table conditions which are aggravated, in some locations, by seepage from irrigated fields at higher elevations. These lands, which require drainage treatment for full agricultural use, are shown in Figure 10. In the Grande Ronde Valley, parts of the seeped areas have become alkalied because of ground water conditions. In addition to alkali conditions, some areas in the southern part of this valley have outlet and gradient limitations in addition to soil with poor drainage properties. Conditions indicate that economic land treatment for drainage may not be possible in these areas. Other areas of the Grande Ronde Valley with high water table conditions would benefit from a system of deep open drains.

CONFLICTS

There are a number of different types of conflict between water use and users in the Grande Ronde Basin. Existing conflicts can be expected to expand and intensify if growth in water use is expanded in the future. Individual areas can expect to experience conflicts that presently do not exist if development and demand grow.

It can be anticipated that both quality and quantity interference will result from added water use.

Nonconsumptive Uses

Conflict based on quality exists between mining and fish life uses of water. Silt loads created in the Grande Ronde River by placer and gravel operations are unfavorable to fish life. Resulting effects on fish life are discussed earlier in this chapter under Quality.

A major potential conflict between nonconsumptive uses is between anadromous fisheries resources and potential hydro power production. For the foreseeable future economic hydro development will depend on the feasibility of storage. Storage projects with pools that fluctuate to a major degree have especially difficult problems in the downstream passage of anadromous fish. Inundation of spawning grounds will be a problem at some locations that appear advantageous for storage development.

Consumptive Versus Nonconsumptive Uses

Depletion of streams by irrigation use results in streamflows below that necessary for fish life. Since part of the irrigation season coincides with periods of low flows, low summer discharges in the Grande Ronde and Catherine Creek are further reduced by irrigation diversions. Resulting flows, in addition to being below the optimum needed for fish life, facilitate the creation of high temperatures which also is unfavorable to fish life. Return irrigation flow, which occurs at certain locations, is sometimes turbid and creates a pollution condition inimical to fish life.

The development of the Grande Ronde potentials for further irrigation would have some effect on the production of power downstream because of the consumptive character of irrigation use. Other consumptive uses would have a similar effect but are of much less significance.

Consumptive Uses

Any expansion of any consumptive use will create conflict with other consumptive uses or within that use during periods of short supply. No major consumptive use can reasonably be expected in many areas without storage development. In the areas of major municipal, irrigation, and industrial potential lack of storage is the limiting factor in water supply.

CHAPTER IV THE BASIN POTENTIAL

FUTURE GROWTH

An important factor in determining the future needs of any area is the rate at which the population of that area increases. Both Union and Wallowa Counties show a relatively stable population, as indicated in Figure 14, although there has been a slight decline in population since 1930. A further indication of population in Union and Wallowa Counties is given by Figures 15 and 16 which chart the trend in population of incorporated cities within those counties from 1920 through 1960. The major cities in the Basin have shown a major increase in population since 1950 which, when compared to the gradual decline in the county population, indicates a movement from rural to urban areas.

Other indications of growth, including economic trends, are shown in the following:

1. Figure 17 lists county motor vehicle registrations from 1930 to 1959 for both Union and Wallowa Counties and shows that the number of registrations has approximately doubled in the Basin during that period.

2. Figure 18, a plot of bank debits in Union and Wallowa Counties covering the period 1947 through 1959. The general trend is towards overall increase in bank debits for Union County and a relatively stable level of debits in Wallowa County.

3. Figure 19, a plot of building permit valuations for La Grande covering the period 1947 through 1959. Valuations have widely fluctuated during that period hitting a record high in 1957 followed by a very sharp drop in 1958 with the 1958 level being about 50 percent greater than the 1947 level.

4. Figures 20A through 21B showing the overall trend and seasonal fluctuation in Union and Wallowa Counties' covered employment for the period 1948 through 1959. The total number of covered employees has generally been increasing at a steady, although gradual, rate in both counties since 1954. This is reflected most in the employment categories of services and manufacturing although finance, insurance, and real estate activity shows an appreciable gain, in both counties, for 1956-57.

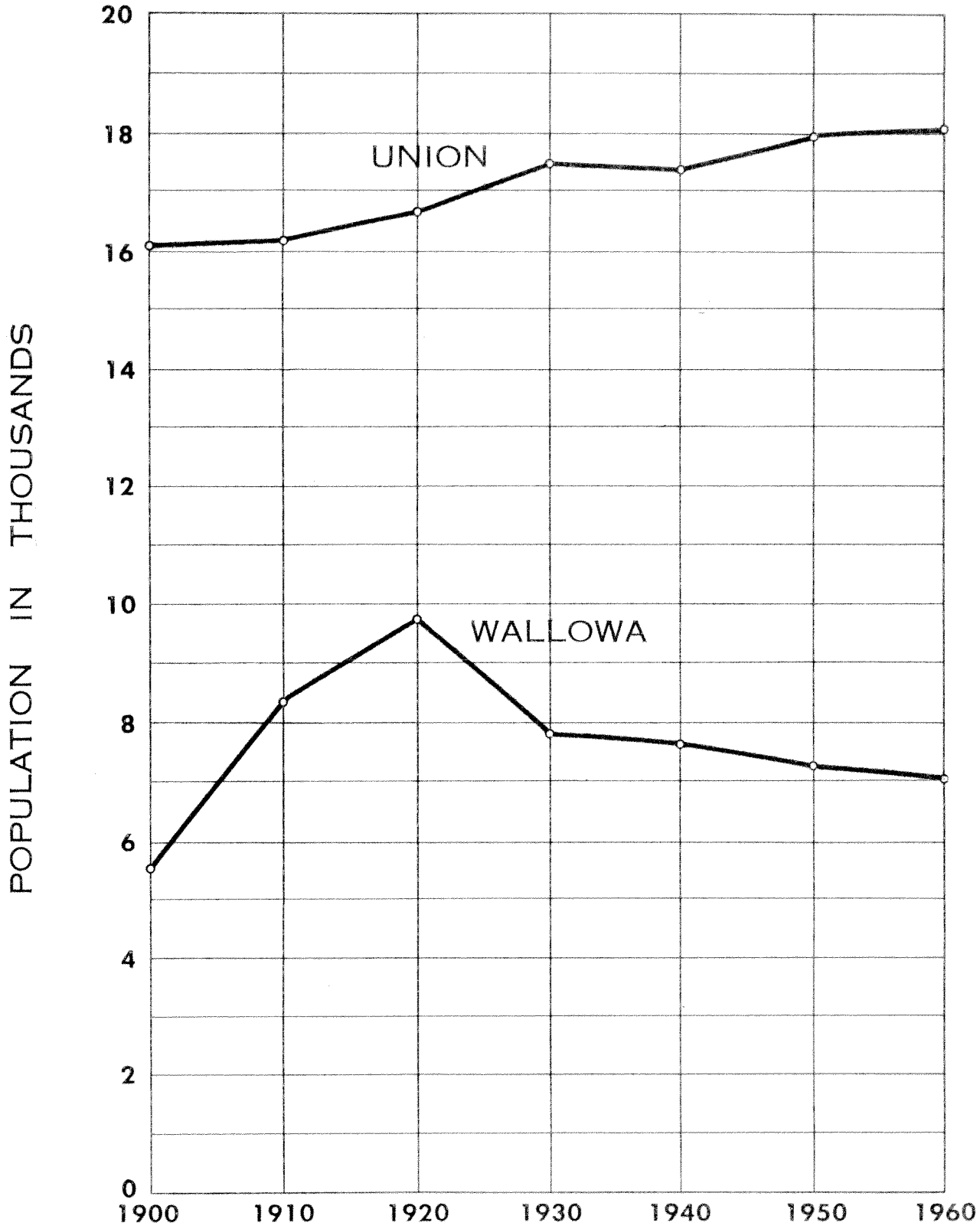
WATER SUPPLY

Relatively stable population and economic growth trends mean that an appreciably economic change in the Basin will depend primarily upon changes that take place in

POPULATION TRENDS

UNION AND WALLOWA COUNTIES

1900 - 1960



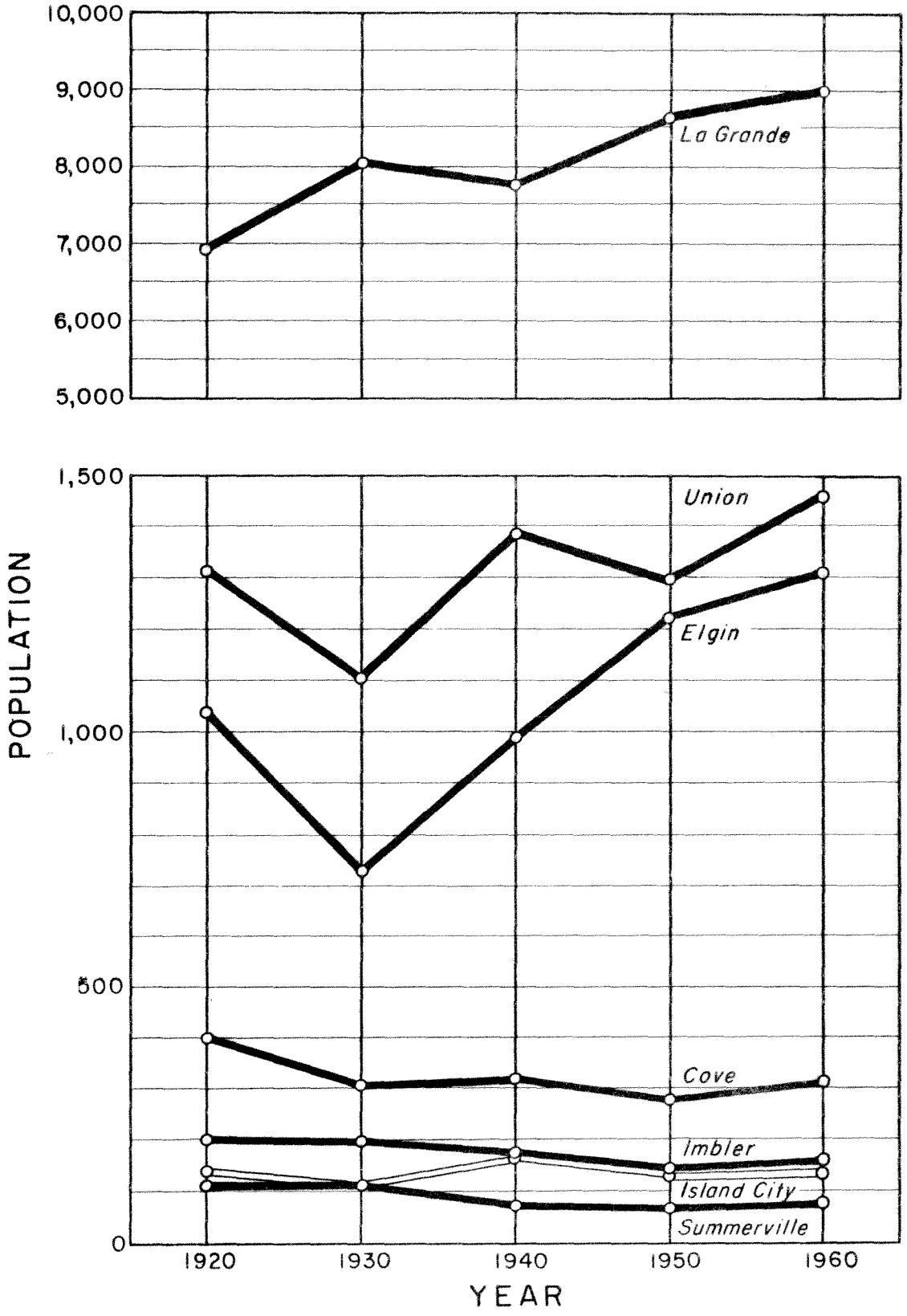
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Figure 14

POPULATION TRENDS

UNION COUNTY INC. CITIES

1920 - 1960



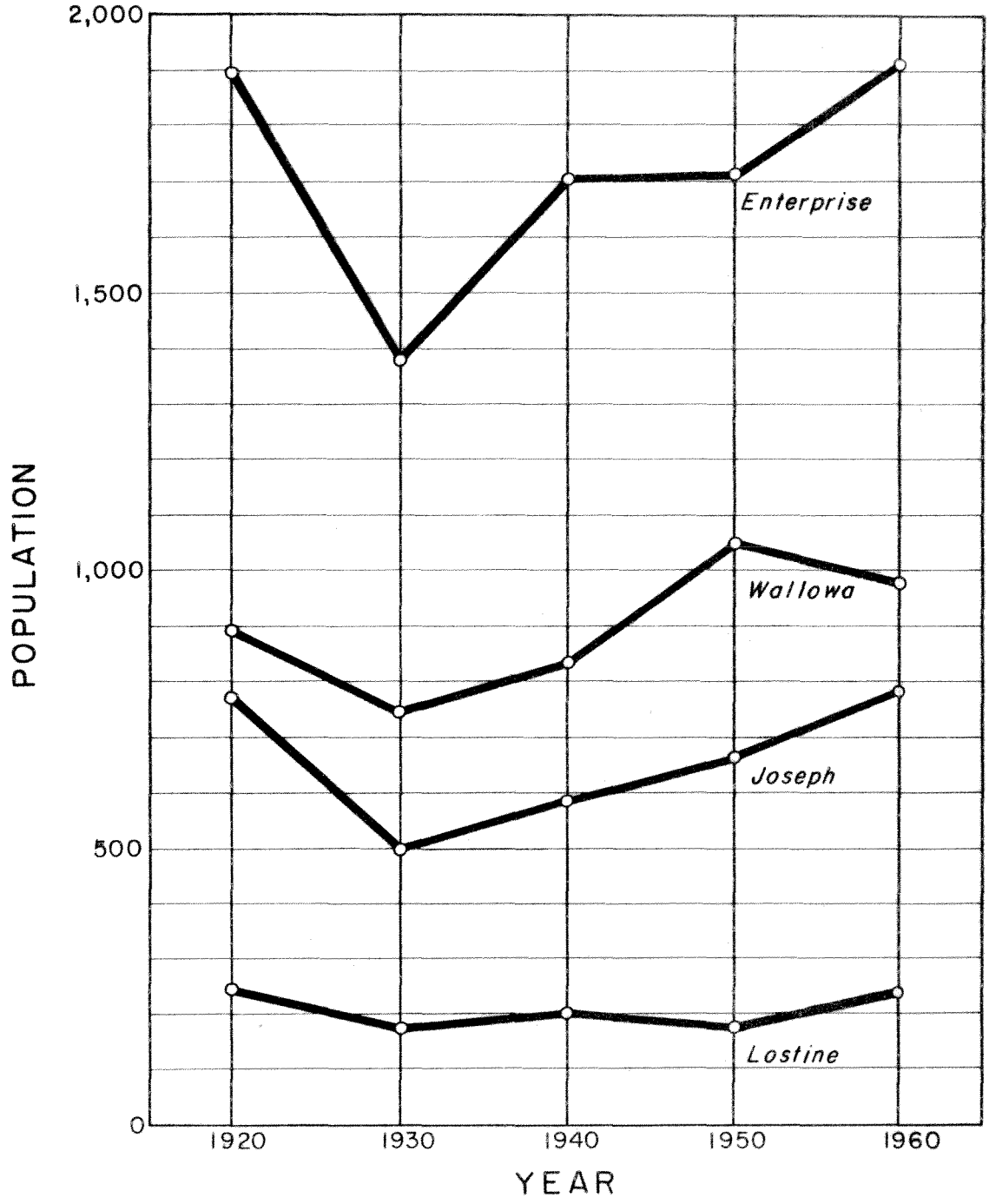
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Figure 15

POPULATION TRENDS

WALLOWA COUNTY INC. CITIES

1920 - 1960



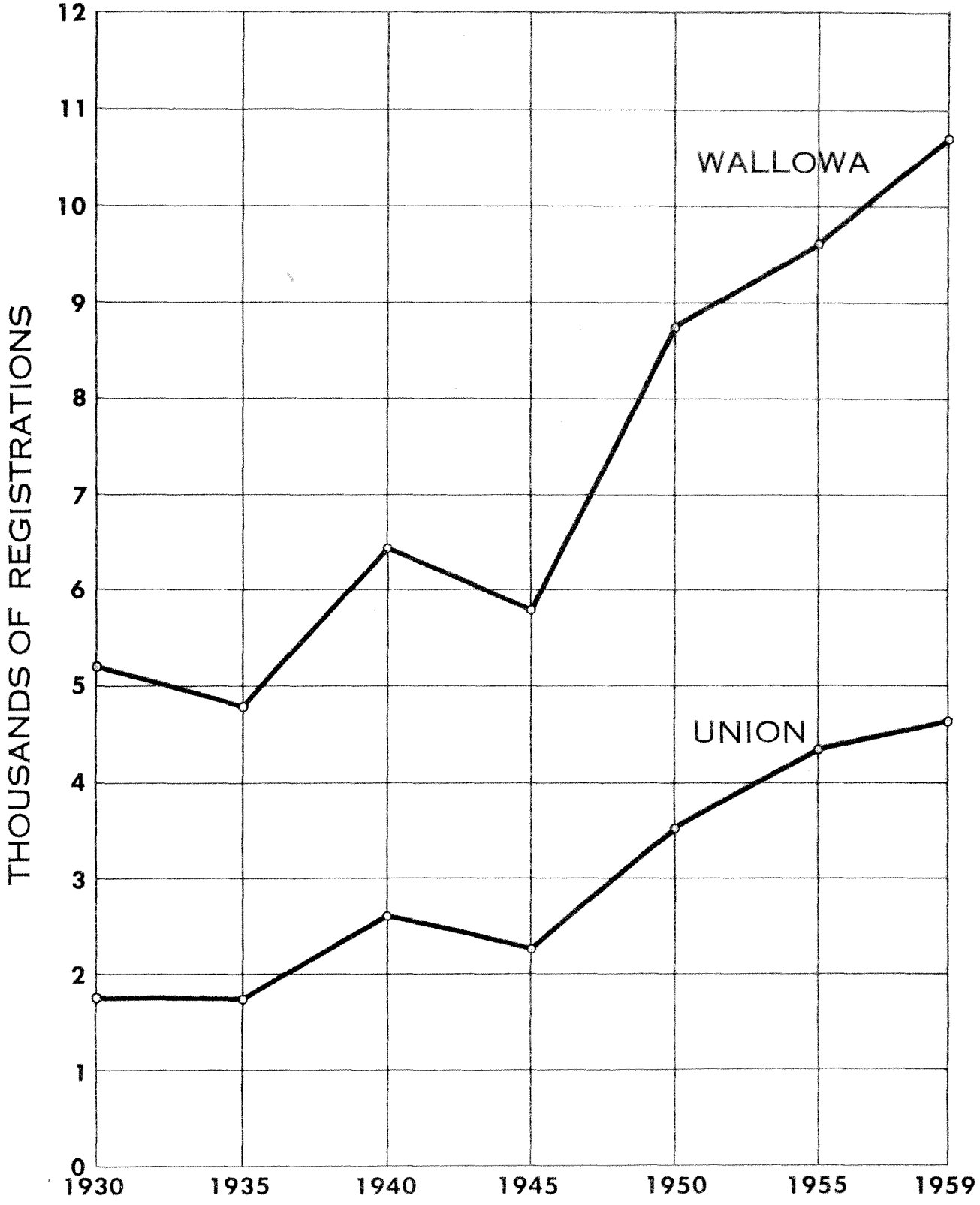
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Figure 16

MOTOR VEHICLE REGISTRATIONS

UNION AND WALLOWA COUNTIES

1930 - 1959



SOURCE: Oregon State Dept. of Motor Vehicles

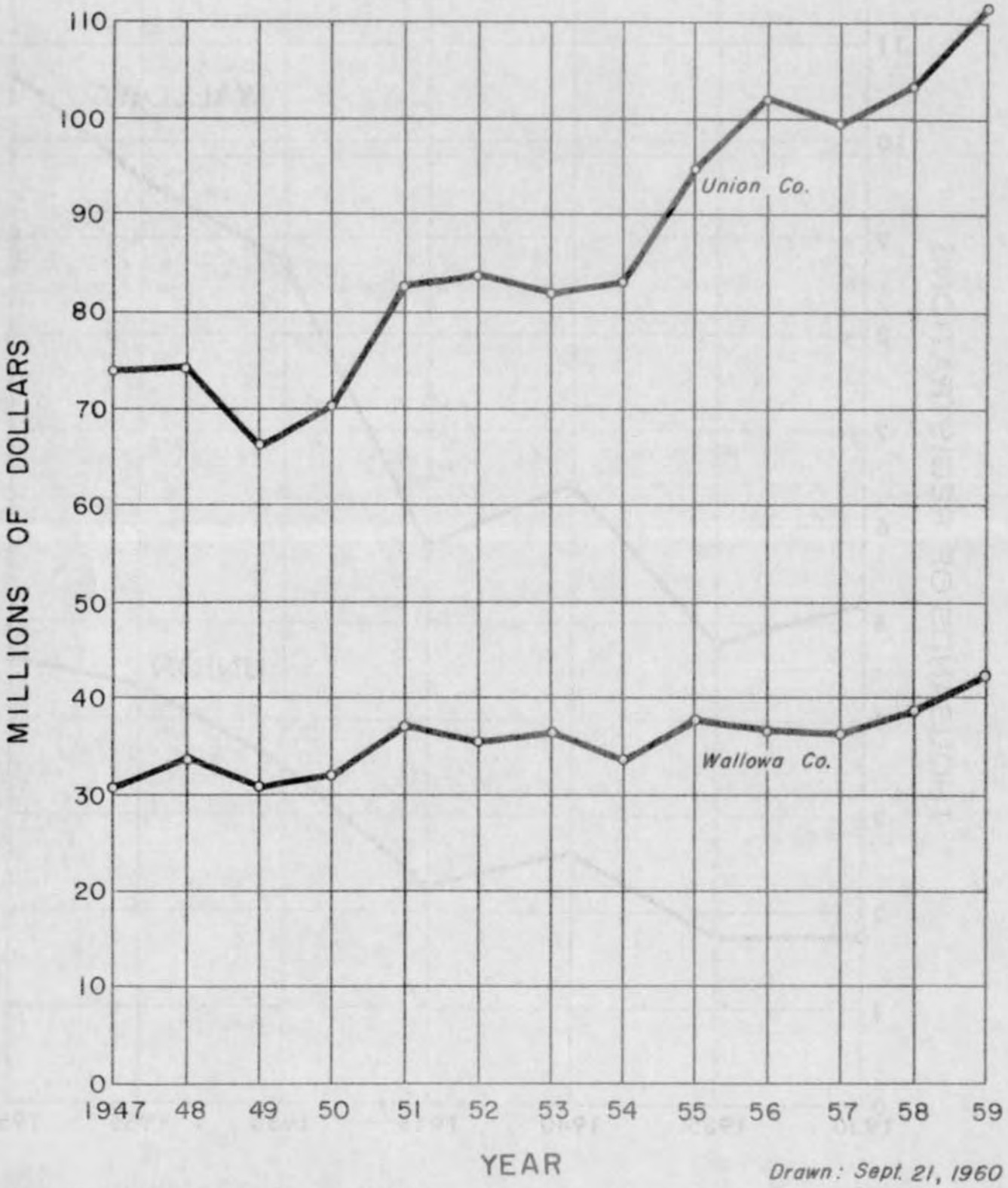
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Figure 17

BANK DEBITS

UNION AND WALLOWA COUNTIES

1947 – 1959

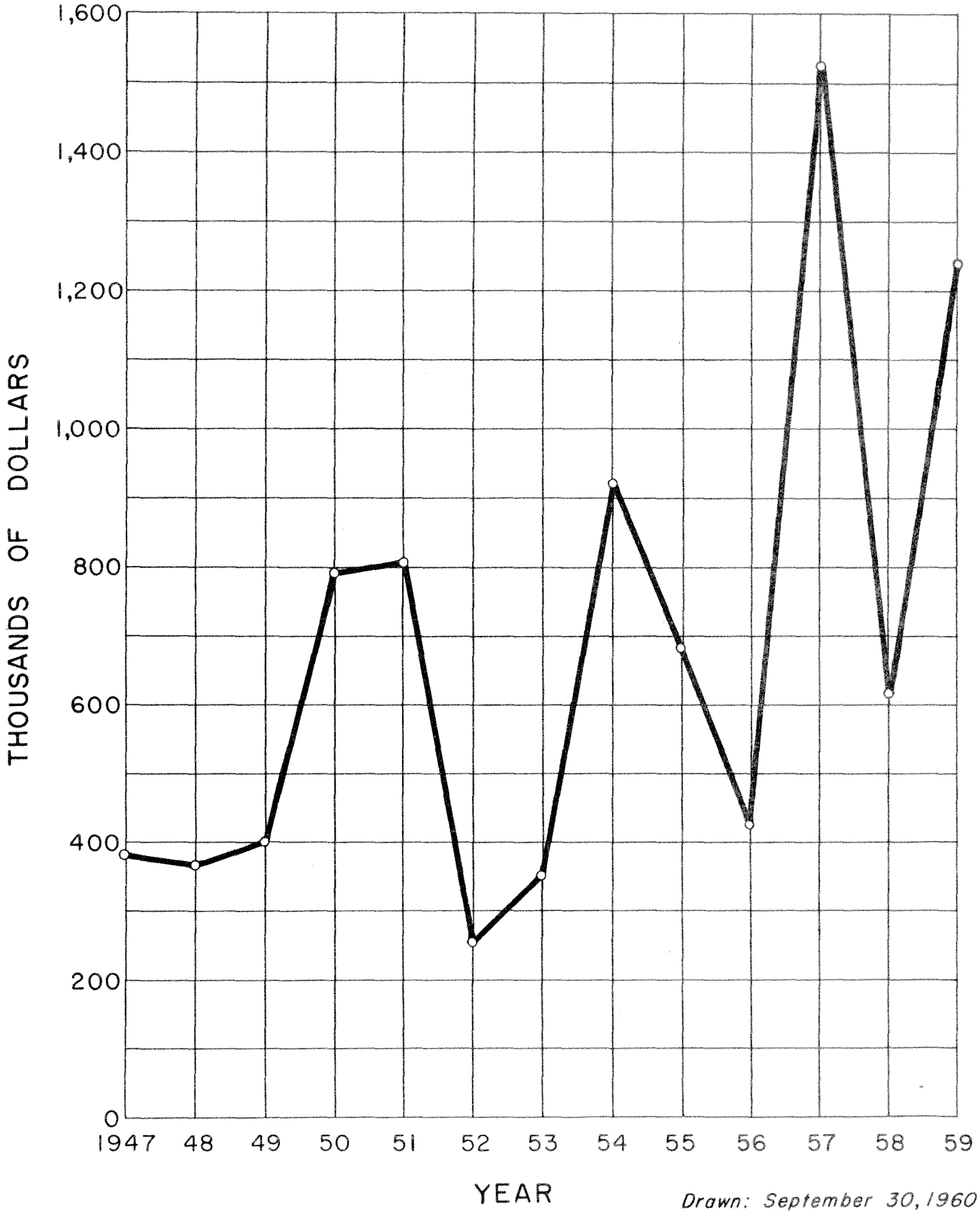


Data source: University of Oregon Bureau of Business Research

Drawn: Sept. 21, 1960
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Figure 18

BUILDING PERMIT VALUATIONS
LA GRANDE
1947 – 1959



Data source: University of Oregon Bureau of Business Research

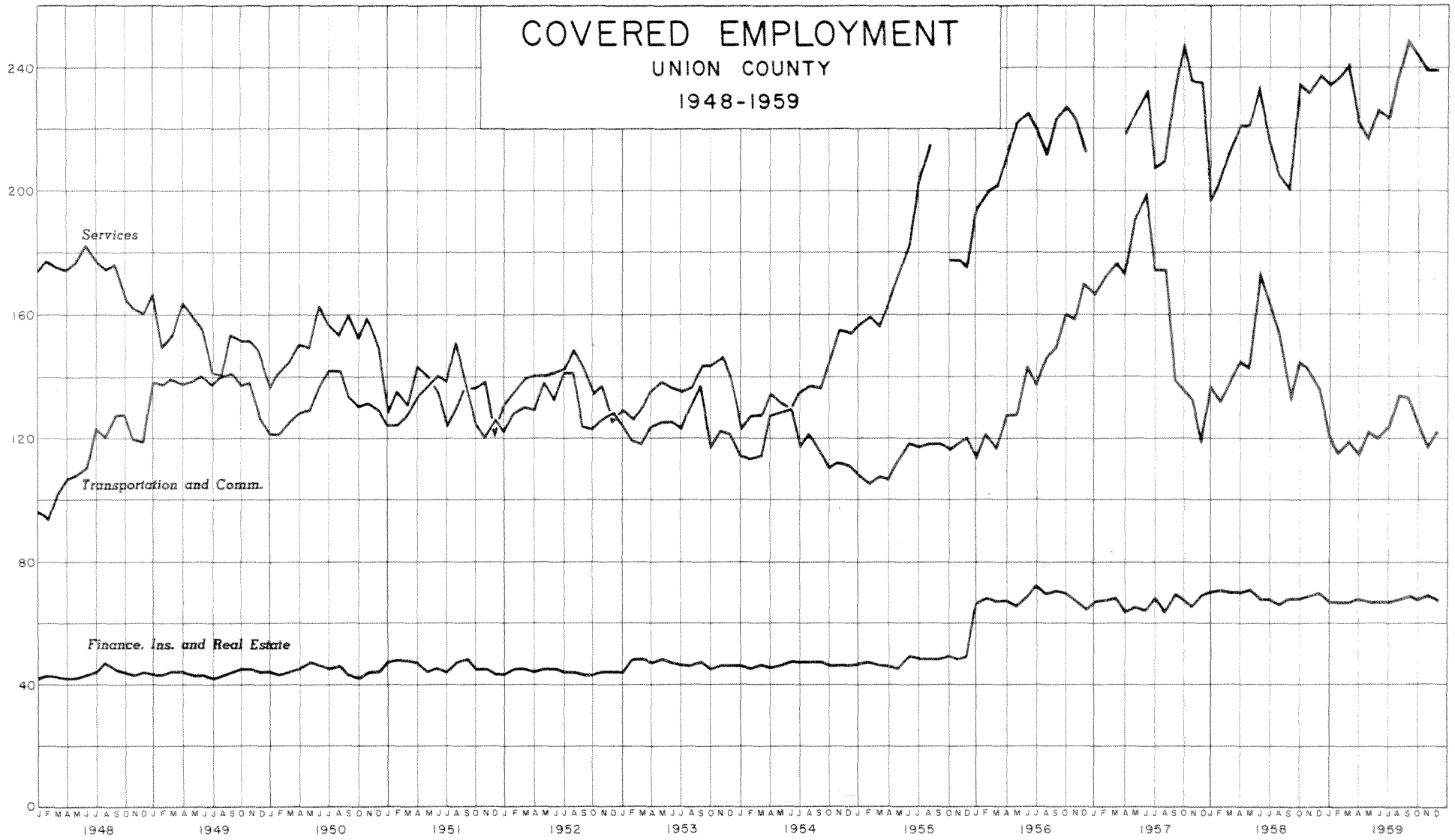
Drawn: September 30, 1960
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Figure 19

Figure 20A



Source: Oregon State Unemployment Compensation Commission

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Grande Ronde
File No. 8.8

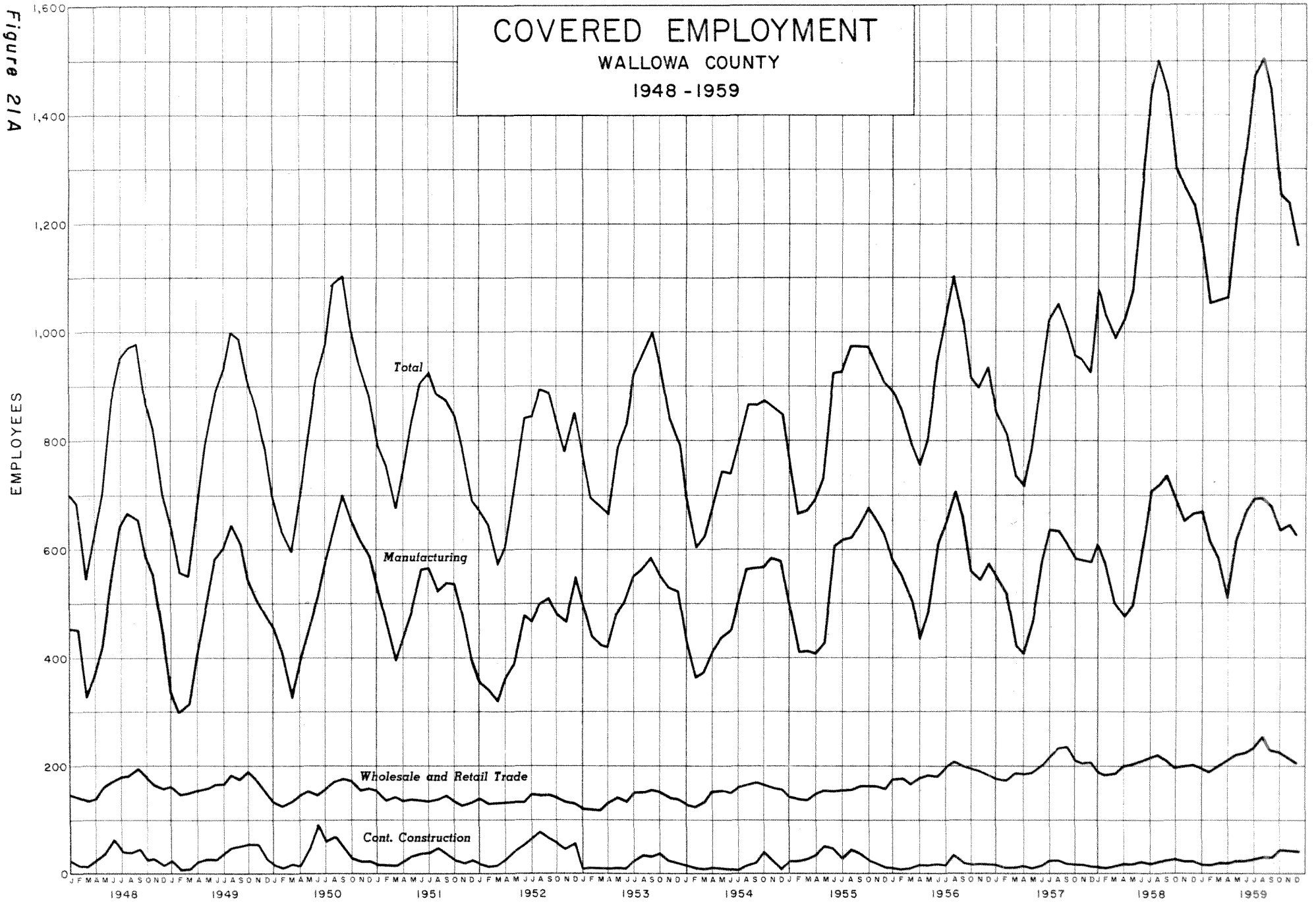


Source: Oregon State Unemployment Compensation Commission

Drawn: Sept. 21, 1960
Grande Ronde
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Figure 20B

Figure 21A



Source: Oregon State Unemployment Compensation Commission

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Grande Ronde
File No. 8.8

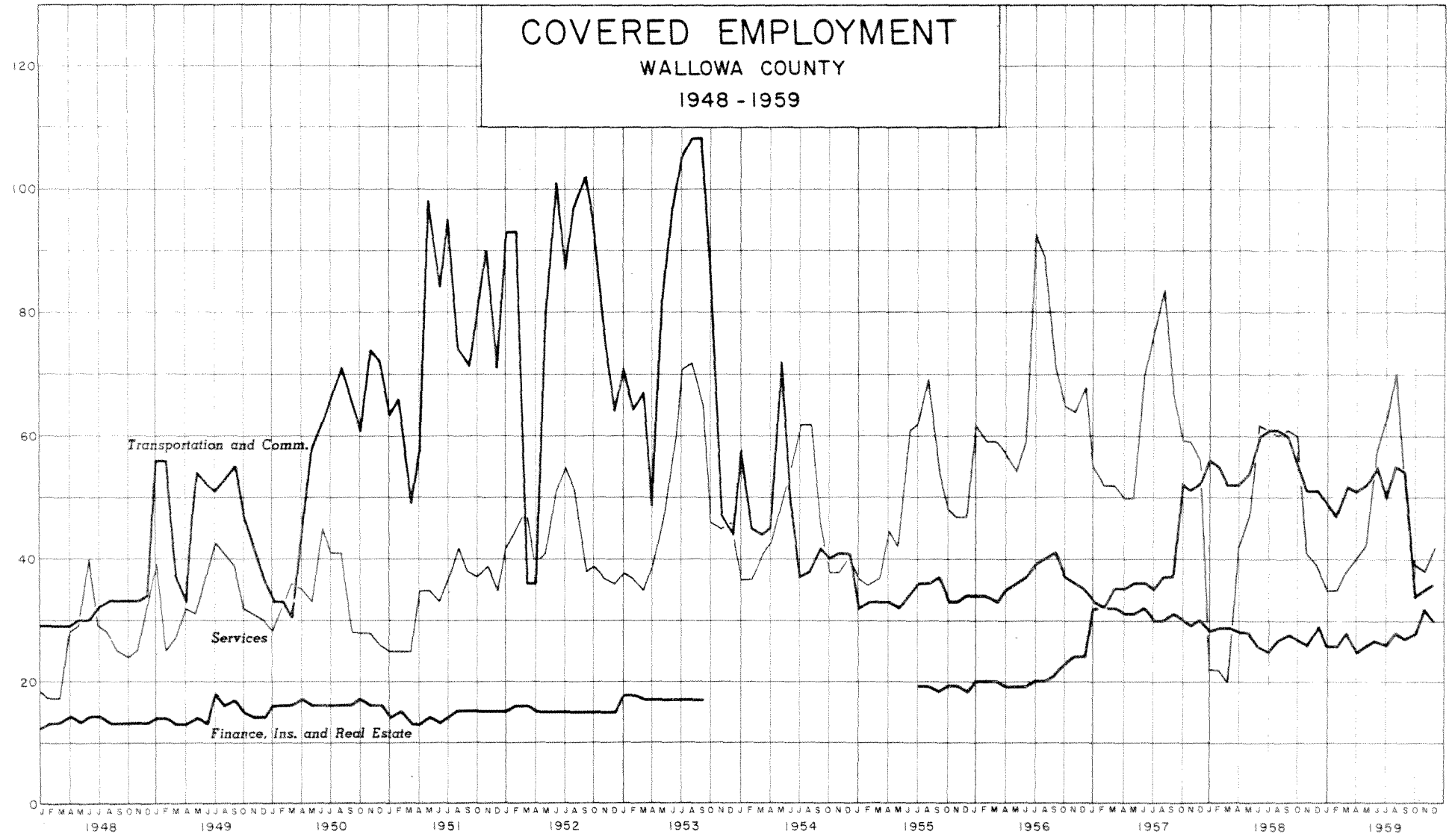


Figure 21B

Source: Oregon State Unemployment Compensation Commission

Drawn: Sept. 22, 1960
Grande Ronde
File No. 8.8

the utilization of the natural resources. Since water is the controlling factor in all resource development, the potential of the Basin depends primarily upon the quantity of water available for development use and its cost.

Yield

The annual yield of water in the Basin is sufficient to meet all existing needs and future needs with the possible exception of pollution abatement. However, the distribution of the annual yield with respect to time, as shown in Figure 22, is such that all needs cannot be satisfied during periods of low flow and high demand. On the other hand, large quantities of water pass out of the Basin unused during periods of high flow. Storage is necessary to achieve optimum use of the available annual yield.

Yield diagrams for sub-basins are included in Chapter V, Sub-Basin Inventory, under the respective sub-basins.

Depletion

The total of 3,012 cfs of water rights existing in the Grande Ronde stream system, Figure 9, plus 198 cfs in the Imnaha system, represents the total of all legal rights in the Basin without regard to the pattern of usage. Since the majority of consumptive rights are for irrigation and would be exercised as needed only during the irrigation season, and rights for power and mining are nonconsumptive in nature so that water used for those purposes becomes available for other uses at downstream locations, the total, 3,210 cfs, is not representative of the existing depletion potential. Considering consumptive rights only, and taking into account the seasonal nature of irrigation rights, the maximum legal consumptive use which could take place each year is 473,000 acre-feet. By comparison, the average annual observed yield of the Basin, which is the water remaining after consumptive use has taken place, is approximately 2,800,000 acre-feet.

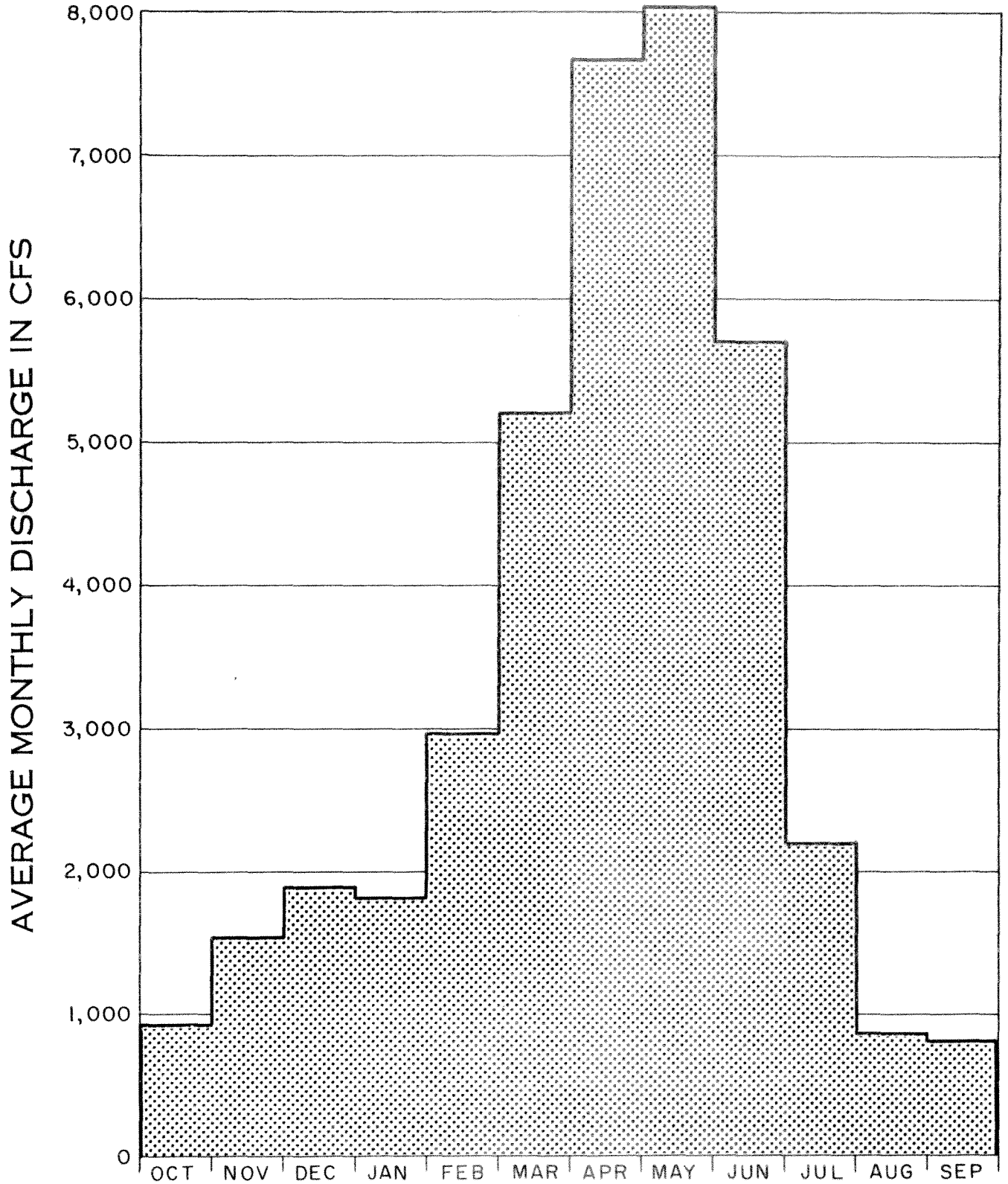
Distribution

The major water supply problem facing the Basin is not one of annual yield but rather of seasonal distribution. The percent distribution of yield by months was indicated in Table 13. Examination of this table shows the large percentage of runoff that occurs in the spring and early summer months. Approximately 67 percent of the Grande Ronde drainage proper runoff occurs in the period March through June. The percentage is even more condensed in sub-basins which have substantial portions of their area at elevations

DISCHARGE

GRANDE RONDE RIVER AT ZINDEL

1904 - 1957



Drawn 6-2-59
Grande Ronde
File No. 8.202
Figure 22

greater than 5,000 feet mean sea level. The Imnaha - 65 percent, April through June; the Upper Grande Ronde - 70 percent, March through May; Catherine Creek, at dam site - 70 percent, April through June. This maldistribution is indicative of the problem of modifying resources availability to meet resources needs.

Figure 22, which illustrates the distribution with respect to time of estimated flows of the Grande Ronde near its mouth, shows the low flows which occur during the critical summer months when the level of water use is at or near its highest. Similar plots for other points in the Basin are included in the Sub-basin Inventory section in Chapter V.

IRRIGATION AGRICULTURE

There is considerable potentially irrigable land in the Basin which is presently undeveloped and a large portion of land classed as developed does not receive adequate irrigation water. The climatological pattern in the Basin is such that irrigated lands produce crops of exceptionally high quality which helps to make irrigation a successful venture.

Because of the runoff distribution pattern in the Basin, full agricultural development cannot take place by irrigation from diversions alone. Storage is essential to augment low flows. Investigations along this line have been made by several entities including the Bureau of Reclamation which recommended storage on Catherine Creek to provide supplemental water to approximately 13,000 acres of land in the Basin and storage on the Upper Grande Ronde main stem to provide water for 46,000 acres of new land. The extent of presently irrigated and potentially irrigable land in the Basin is shown in the generalized plot of Figure 5 and existing irrigation development in Figure 5C.

POWER

The yield of water and the head available in the Grande Ronde system appear to offer good possibilities for additional hydro-power development. Nevertheless, the feasible potential for further development in the foreseeable future appears limited. Studies by the U. S. Geological Survey, Corps of Engineers, Bureau of Reclamation, and private entities have resulted in recommendation for only one project containing power facilities, and that one, Wenaha, on a deferred basis. The basis for deferral is the fish passage problem.

Potential projects listed by the Federal Power Commission for the Grande Ronde total 263,700 kilowatts of installed capacity. In House Document 531, 82nd Congress, 2nd

Session ("308 Review Report") the Corps of Engineers visualized a future potential of five projects in the lower 95 miles of the main stem with active storage totaling 1,589,000 acre-feet and a nominal prime capability of 194 megawatts.

Early USGS studies, of a preliminary nature, envisioned a minimum basin potential of 90 megawatts of continuous power plus 82 megawatts of development on the Snake and Columbia creditable to the Grande Ronde projects.

The latest proposal of the Corps of Engineers (Major Water Plan, 1959) visualizes the construction of one project, Weneha mile 26, whose firm power capability would approximate 60 megawatts during a 31-month critical period under 1985 load conditions. The average annual generation of this facility would approach 72 average megawatts. The kilowatt hours generated in an average year is only 14 percent of the 4,390,000,000 kilowatt hours it is estimated is physically possible of development, if the average estimated flow were run over all available head.

Comparison of figures between studies is difficult because of differences in pattern of development, differences in basic assumptions as to project feasibility and future need, differences in concepts of system operation, and differences in techniques, methods, and scope of analysis.

A number of factors account for the large difference between what has been recommended and what is theoretically possible (see Figures 23, 24, and 25).

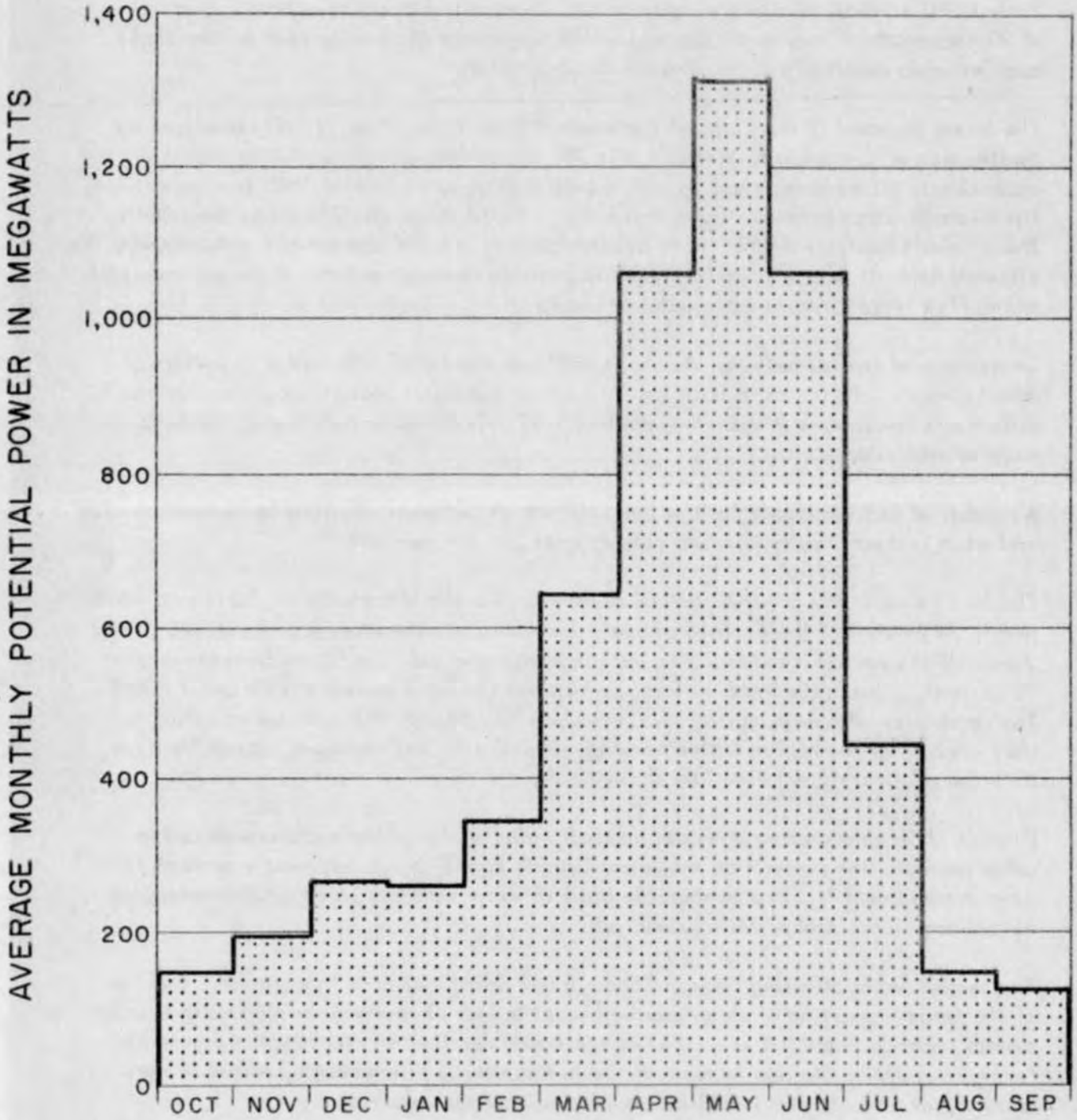
The first factor is the adverse pattern of runoff. For the Grande Ronde Basin as a whole nearly 54 percent of the average annual runoff occurs in the months of April, May, and June. If the period is extended to include March and July the figure becomes nearly 73 percent. This is the same period in which the Columbia system has its major runoff. The production of energy during this period would intensify the problem of excess secondary energy for the region without adding significantly to firm power unless the river could be adequately regulated by storage.

Because of its comparative downstream location in the Columbia system compared to other projects, the projects on the lower Grande Ronde do not add nearly as much to downstream benefits, on a comparable basis of water release, as do projects at higher elevations, i.e., Libby, Mica Creek, etc.

The second factor affecting Grande Ronde power development is topography. Because of the large proportion of steep gradient and the lack of reservoir width in the stream system, storage possibilities in the Grande Ronde are limited reducing the potentials for river control. Storage in some of the better sites is eliminated by virtue of agricultural, municipal, and industrial development of the reservoir areas.

POTENTIAL POWER

GRANDE RONDE BASIN

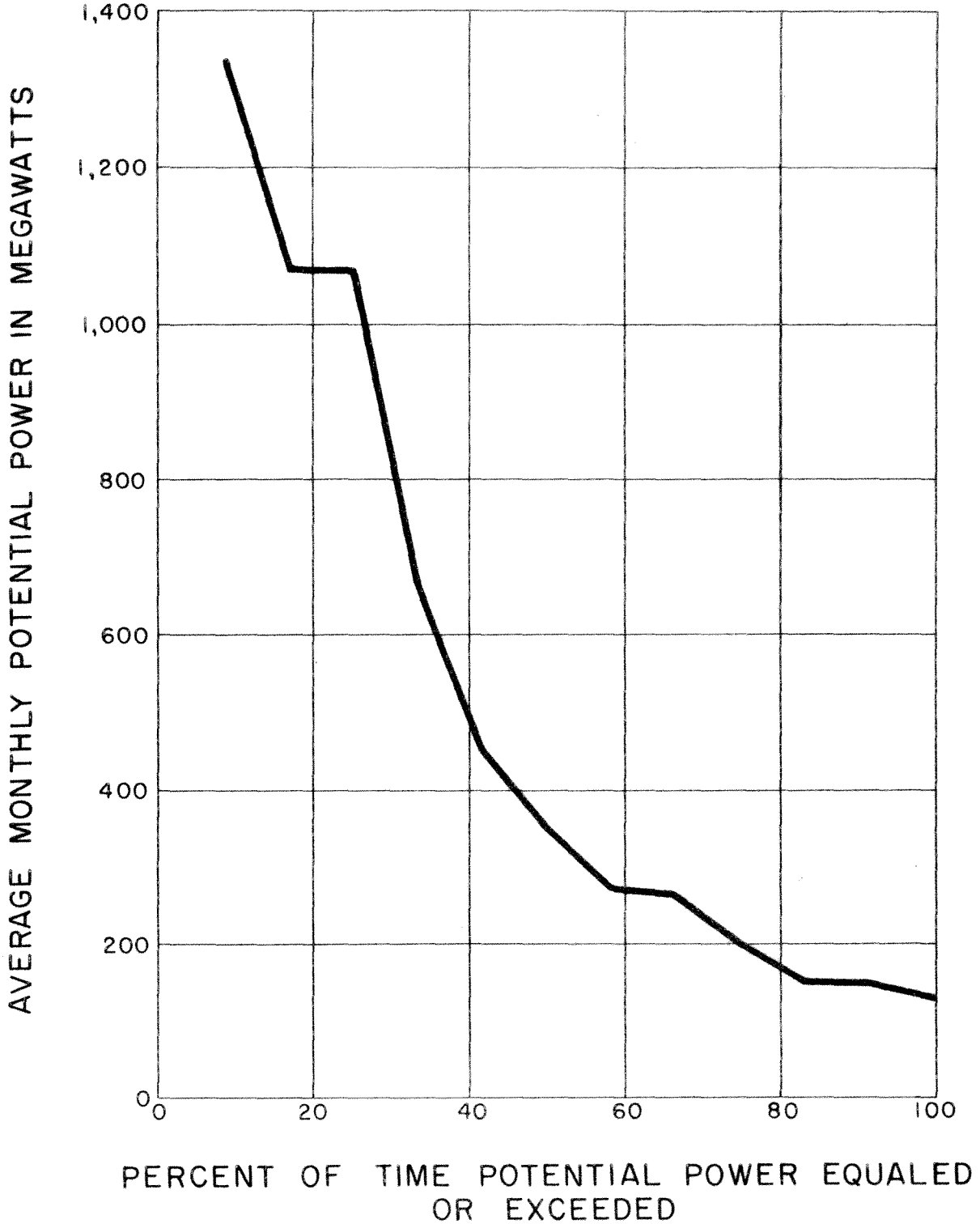


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Figure 23

POTENTIAL POWER DURATION

GRANDE RONDE BASIN



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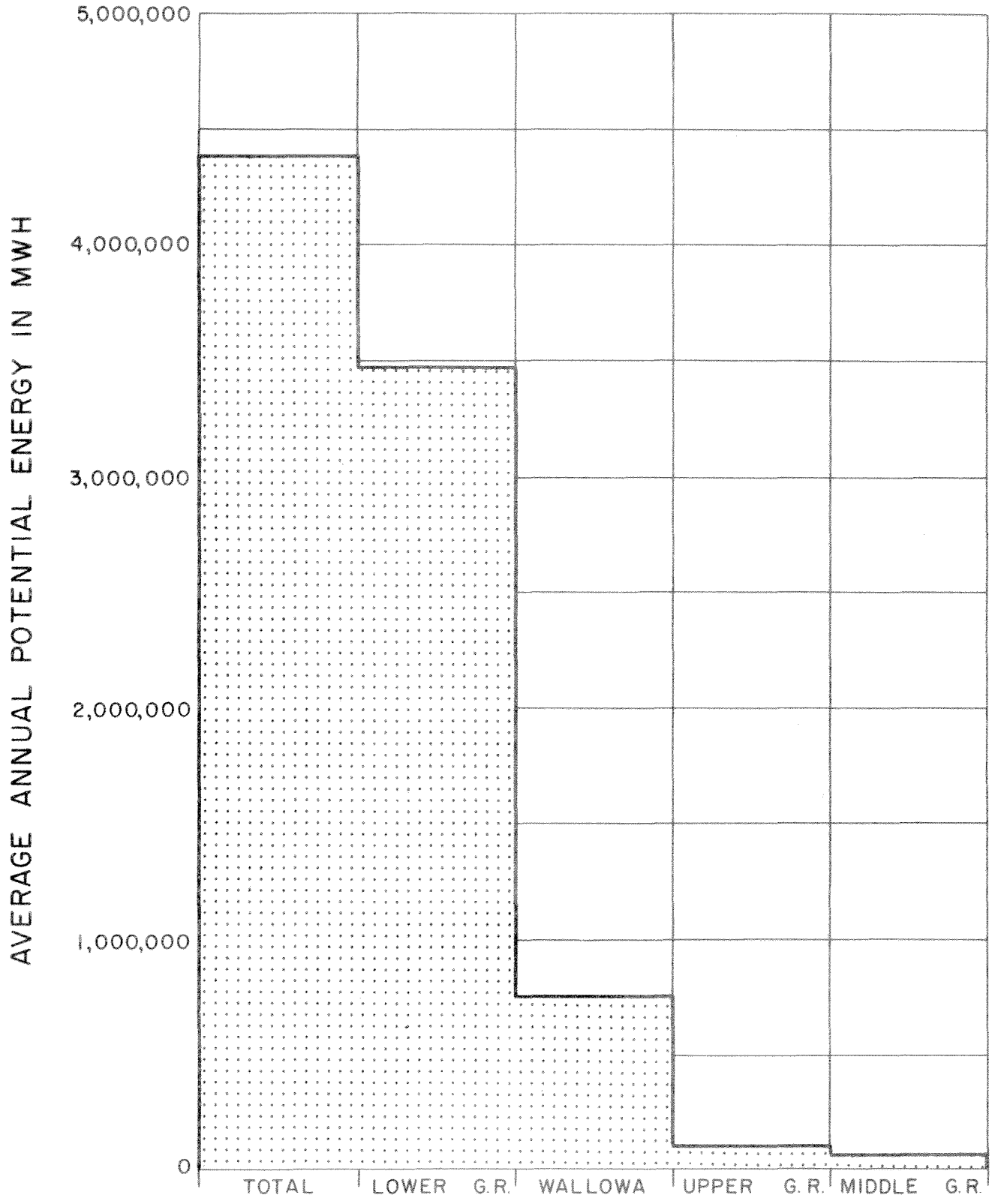
Grande Ronde

File No. 8.1046

Figure 24

POTENTIAL ENERGY

GRANDE RONDE BASIN



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Figure 25

A third factor affecting economic development of storage is adverse geology. Geology may affect both site and reservoir feasibility and frequently does so at available sites on the Grande Ronde. A number of sites on the lower river, the reach of most promise, would be expensive or impractical because of geologic problems.

Finally a conflict of interest exists between the fisheries resources of the system and the development of hydro power, particularly with storage. Of major concern is the problem of the downstream passage of anadromous fish through reservoirs with largely fluctuating pools. Present knowledge indicates no immediate solution of this problem.

The general economics of water resource development and the economics of specific power project justification rule out, for the foreseeable future, achievement of much of the Grande Ronde potential.

When such development does come it appears power benefits will carry power costs but will not be able to assume much of the financial burden of carrying other water resource development. Therefore, power development must come as part of multi-purpose development.

INDUSTRIAL

Potential in the Basin for major water-using industrial developments will most likely occur with expanded or more effective use of the timber and agricultural resources.

The net volume of all timber on commercial forest land in Union and Wallowa Counties is 1,914,000,000 cubic feet and 1,830,000,000 cubic feet, respectively. The Union County figures are for 1958, while Wallowa County figures are for 1957. Of the 3,744,000,000 cubic feet of timber in these two counties, approximately 48,000,000 cubic feet is in cull trees, both sound and rotten, and salvable dead trees. The annual cut of growing stock for Wallowa County during the period 1953-1958 was approximately 24,276,000 cubic feet, while that of Union County for 1954-1958 was 19,497,000 cubic feet. In the absence of official estimates, it can be assumed that this annual cut of growing stock might roughly represent the sustained yield output of these two counties and for practical purposes, the Grande Ronde Basin within the State of Oregon.

Forest Survey Report 134 - April 1960, entitled "Forest Statistics for Wallowa County, Oregon" and Forest Survey Report 135 - April 1960, "Forest Statistics for Umatilla and Union Counties, Oregon", both of which are published by the Pacific Northwest Forest and Range Experiment Station, U. S. Department of Agriculture - Forest Service, indicates that approximately 41¼ million cubic feet of the average annual cut of growing

stock ends up as a timber product of one kind or another while approximately 2½ million cubic feet ends up as logging residue. Assuming that mill waste is approximately equal to logging residue, about five million cubic feet would be available annually for utilization by processes such as the production of pulp or paper. This amount of material would provide the raw stock for a pulp operation of something slightly less than 100 tons per day. Assuming, for illustrative purposes, that this material was converted to a bleached sulfate pulp, water requirements for processing would approximate from 10 to 12 cfs. Although the combination of timber presently wasted and other supplemental resources appear sufficient to support a pulp and paper production of about 100 tons per day in the Basin, present technology restricts the economical development of units to capacities greater than 250 tons per day. This factor may be overcome with future technological advances. For an unbleached kraft operation, the water requirements would be diminished and could be estimated at approximately four cfs for processing of the material for a 100-ton plant.

An approximation of the ultimate use of water for processing the timber resources of the Basin can be made by assuming an annual sustained yield cut of from 40 to 50 million cubic feet all being utilized for the production of bleached sulfate pulp. Using rough approximation for wood density, pulp yield and water use, the maximum pulping potential approaches 625 to 675 tons per day resulting in a water-use requirement of from 85 to 95 cfs.

Although it is highly improbable that all the timber resources of the Basin would be converted to bleached kraft paper production, it is difficult to visualize any combination of uses of these resources that would result in a greater need for industrial water than the illustrative case used. Higher capacity levels could be realized by importing raw materials into the Grande Ronde Basin from other adjacent areas. At the present time, the flow of raw materials for pulp is out of, rather than into, the Grande Ronde Basin.

An additional major problem in the development of the pulp and paper potential existing in the Basin is the matter of effluent disposal to prevent stream pollution. Because of the extremely low streamflows that occur throughout this Basin during the late summer periods, it is expected that substantial treatment levels would be required. The exact amount of water required to dilute residual waste loadings after treatment would depend upon a number of factors including plant location, process, and requirements of the regulatory authorities.

In view of the inadequate supplies of surface water for present industries during certain seasons, water supply from natural surface runoff would not be adequate to sustain any major capacity in many sections of the Basin.

Expanding the agricultural base through more intensive and varied cropping practices, primarily from the increase of irrigation, would create a potential for a food processing industry. Such industry would require industrial water which in many areas would not be available from natural surface runoff during critical flow periods. Such problems would be particularly acute in the Grande Ronde Valley proper.

MINING

Mineral deposits in the Basin having economic significance and presently active operations are shown in Figure 7. Development of these deposits will depend upon more detailed knowledge of the extent of the deposits, the cost of development, and the prevailing market.

The mineral resources of the Basin are not sufficiently known to estimate the magnitude of industrial growth that could result from their utilization. On the basis of available data, however, it is not anticipated that such growth will be appreciable. Pollution problems resulting from the development of mineral resources in the Basin could be severe but probably would be local in nature and controllable under such criteria as may be established by the State Sanitary Authority.

RECREATION

Exclusive of the recreational activities connected with hunting and fishing, which are covered in other sections of this report, the Grande Ronde Drainage Basin has a large but rather undiversified potential for recreation. Much of this potential is due to the undeveloped, uninhabited lands of the Basin within the boundaries of national forests, wilderness areas, and private forest lands.

From data available, it appears that the major potentials for recreational development lie along lines of picnicking, camping, forest area utilization, and the aesthetic recreational pursuits which require water as a necessary adjunct for their enjoyment and utilization.

The potentials for the more active type of water-based recreation, such as boating, water skiing, skin diving, and allied activities, are limited in the Grande Ronde Basin. At the present time, the major location suitable for active water recreation is Wallowa Lake with a surface area of some 1,600 acres. This body of water includes nearly 58 percent of the total water surface area embodied in lakes and reservoirs in the Oregon portion of the Grande Ronde drainage. The next largest lake in the Basin is Langdon Lake which has an area of approximately 163 acres. This is the only body of water in the entire Basin, other than Wallowa Lake, with an area in excess of 100 acres. There

are 7 lakes or reservoirs with areas between 50 and 100 acres. Of the 1,164 acres of water surface in the Basin excluding Wallowa Lake, 778 acres are in the small lakes within the Eagle Cap wilderness area. Because of location or topography, as well as dedicated purpose, these lakes cannot be considered available for expansion of power boating or water skiing activities.

It has been estimated that for the safe pursuit of water skiing an area of approximately 50 acres should be available for each water skier. If this premise is utilized and it is further assumed that all the lake and reservoir surface in the Grande Ronde Basin, (2,764 acres), were available for this purpose, maximum potential would be in the neighborhood of 60 water skiers operating simultaneously. For all practical purposes, it is reasonably certain that the lake area actually available for heavy boating and water skiing is restricted to Wallowa Lake and to a limited extent Langdon Lake giving a total available area for utilization of less than 1,800 acres. The significance of this figure in terms of accommodating heavy recreational uses of water can be estimated by comparison with the water areas available in facilities in the Willamette Basin. Fern Ridge Reservoir in the vicinity of Eugene, Oregon has an area at normal pool somewhat in excess of 10,000 acres. The boating, sailing, and water skiing potential of the entire Grande Ronde Basin is less than one-fifth of that of the Fern Ridge facility.

The Upper and Middle Grande Ronde sub-basins, which embrace the area roughly from Elgin upstream, offer very little possibility for mechanized water-base sports. Although some limited boating can be attained on stretches of the Grande Ronde main stem, the low summer flows restrict utilization of this stretch for any extensive activity. The various forest camps, forest wayside points, and the state parks in the Middle and Upper Grande Ronde sub-basins are utilized to a substantial degree but their attractiveness is somewhat reduced during the later part of the recreational season by low streamflows which occur at some locations. During periods of low flow, some of the camps or state parks do not have sufficient flows to provide even fair swimming conditions.

The Lower Grande Ronde sub-basin, which extends roughly from Elgin downstream to the Oregon-Washington line, also has limited recreation potentials in terms of boating activity and water skiing. While it is true that certain stretches of the stream are utilized for boating, particularly as related to fishing activities, the numerous rapids and fast water limit the usability of this section. These sections will be used for these purposes in the future but the controlling factor will be the degree of hazard involved.

Many of the restrictions that apply to the Lower Grande Ronde apply to the Joseph Creek drainage. Problems in this drainage are further intensified by the problem of very low flows during most of the recreational season. Although specific flow data are not available for this stream, it is known that levels are extremely low during summer months posing a restriction on water-borne recreational activities.

THE BASIN POTENTIAL - RECREATION

The potentials of the Imnaha Basin are restricted by the same problems that prevail in the Lower Grande Ronde and Joseph Creek drainages. Although the flows of the Imnaha system are greater than Joseph Creek, the river itself and its tributaries are precipitous streams and do not lend themselves to extensive boating utilization. It is doubtful if there are any areas in the Imnaha drainage that could be used for water skiing. This drainage will lend itself strongly to recreational activities, such as camping, picnicking, hiking, fishing, and hunting. Snake River power development could add boating and water skiing activity to the lower 10-12 miles of the Imnaha system.

From data available, it seems apparent that the water recreational potentials of the Grande Ronde Basin are restricted in terms of diversification. This is largely due to the topography and water supply patterns of the Basin. While it can be anticipated that the mechanized water recreational pursuits of boating and water skiing may intensify on Wallowa Lake and to a very limited extent on some of the streams of the system, the major recreational use of this river system will be along the lines of meeting increased needs for state parks, forest camps, and recreational waysides for picnicking, overnight camping, hiking, packing, and similar activities.

WILDLIFE

Settlement and development of an area restrict the numbers of the more wilderness type animals but, at the same time, improves the habitat for other forms resulting in population increases. According to the Oregon State Game Commission, the number of animals any given water supply can support is limited by the distance an animal will willingly travel to reach it. Since wild animals do not tolerate crowding, maintenance of bird and animal life will depend upon the adequacy of water supplies.

The most notable wildlife species in the Basin are deer and elk herds which draw many hunters and tourists each year. Suitable habitat for these animals is continually being increased and improved by the Oregon State Game Commission particularly in the Wenaha area. Logging operations also help to increase the area of habitat suitable for big game.

Upland game, waterfowl, and furbearers also have significant populations in the Basin. These wildlife species are showing a decline in some areas but increases are taking place in the more remote areas so the overall trend seems to be for relatively stable populations. In view of the relatively stable conditions in the Basin, it is unlikely that significant changes will take place in the population of these species in the future.

FISH LIFE

Although the Grande Ronde stream system is considered the most important in Eastern

Oregon in respect to anadromous fish, little detailed information is available. Table 10 lists the annual run of spring and fall chinook and steelhead trout estimated by the Oregon Fish and Game Commissions and shows the spawning distribution, by percentage, of the spring chinook run. A small unknown number of silver salmon also use the Basin and there once existed a run of blueback but only the landlocked variety, "kokanee", remain.

Low summer streamflows existing in the Basin, particularly in the Grande Ronde system, are unfavorable to fish life. A 1954 report by the U. S. Fish and Wildlife Service and the Oregon Fish and Game Commissions recommended as an optimum flow for the proper management of the fishery resource a value of 85 cfs in the Grande Ronde River at La Grande. Drought frequency studies indicate that the average of at least one month's flow each year is less than 40 cfs at that location, which is far below the optimum value. Due to changing conditions, particularly in the Columbia and Snake Rivers, the optimum value mentioned above is no longer valid and probably should be revised upward. If that is the case, the condition illustrated will be even more pronounced.

The same comparison for Catherine Creek at Union shows an optimum flow of 50 cfs with an average of at least one month's flow each year of less than 40 cfs. Increasing low flows which presently exist in the stream system to a desirable level for fish can be achieved only through storage.

Available information indicates that unfavorably high temperatures occur during the late summer months. Data supplied by the State Fish Commission show temperatures in the low 70's occurring in late July and early August in the headwater regions of the Grande Ronde. It is very probable that downstream, in the valley stretches of the river, water temperatures become as much as, or more than, 10 degrees higher than in the headwater areas. Increasing low flows through storage releases might, with proper reservoir regulation, decrease summer water temperatures.

The potentials for enhancement of the anadromous fishery resources of the Grande Ronde and Imnaha Rivers are discussed in the "Environmental Survey Report Pertaining to Salmon and Steelhead in Certain Rivers in Eastern Oregon and the Willamette River and its Tributaries - Part I - Survey Reports of Eastern Oregon Rivers" dated June 1960, published by the Fish Commission of Oregon.

The report expresses the position that potentials exist for improvement in chinook salmon, silver salmon, and possibly blueback and sockeye salmon. The potential may be realized through the transplant of stocks, particularly fall spawning chinooks; removal of stream obstructions; screening of diversions; better control of flows in critical stream areas; and effective use of hatching and rearing facilities. The report points out detailed areas and makes specific recommendations for stream improvements. Included are estimates of the area and capacity of spawning grounds that will provide for the potential.

In addition to evaluation of potentials data on terrain and gradient, slope and bank cover, shade, stream cross section, bottom materials, flow and temperature, and other physical items are given.

The report does not deal with the cost of achieving this potential.

FLOOD CONTROL

Investigations pertaining to control of floods in the Basin have been performed for more than 90 years by a number of entities. The most recent was by the Corps of Engineers in 1950. Average annual flood damages for the Grande Ronde Valley were estimated at $582,000. Damages resulted primarily from inundation of land and crops, destruction of fences and levees in agricultural areas, and damage to structures in urban areas during the more serious floods.

Proposals for alleviating flood damages include channel improvements, levees, dikes, and upstream storage. The most recent investigations have been made by the Corps of Engineers which has prepared plans and cost estimates for flood protection works. The Corps' latest proposals consider only channel improvement and levees. Adequate storage for the single purpose of flood control cannot meet the test of economic justification under present levels of development. Any storage for flood control will, of necessity, be included as part of multiple-purpose projects.

UPPER GRANDE RONDE

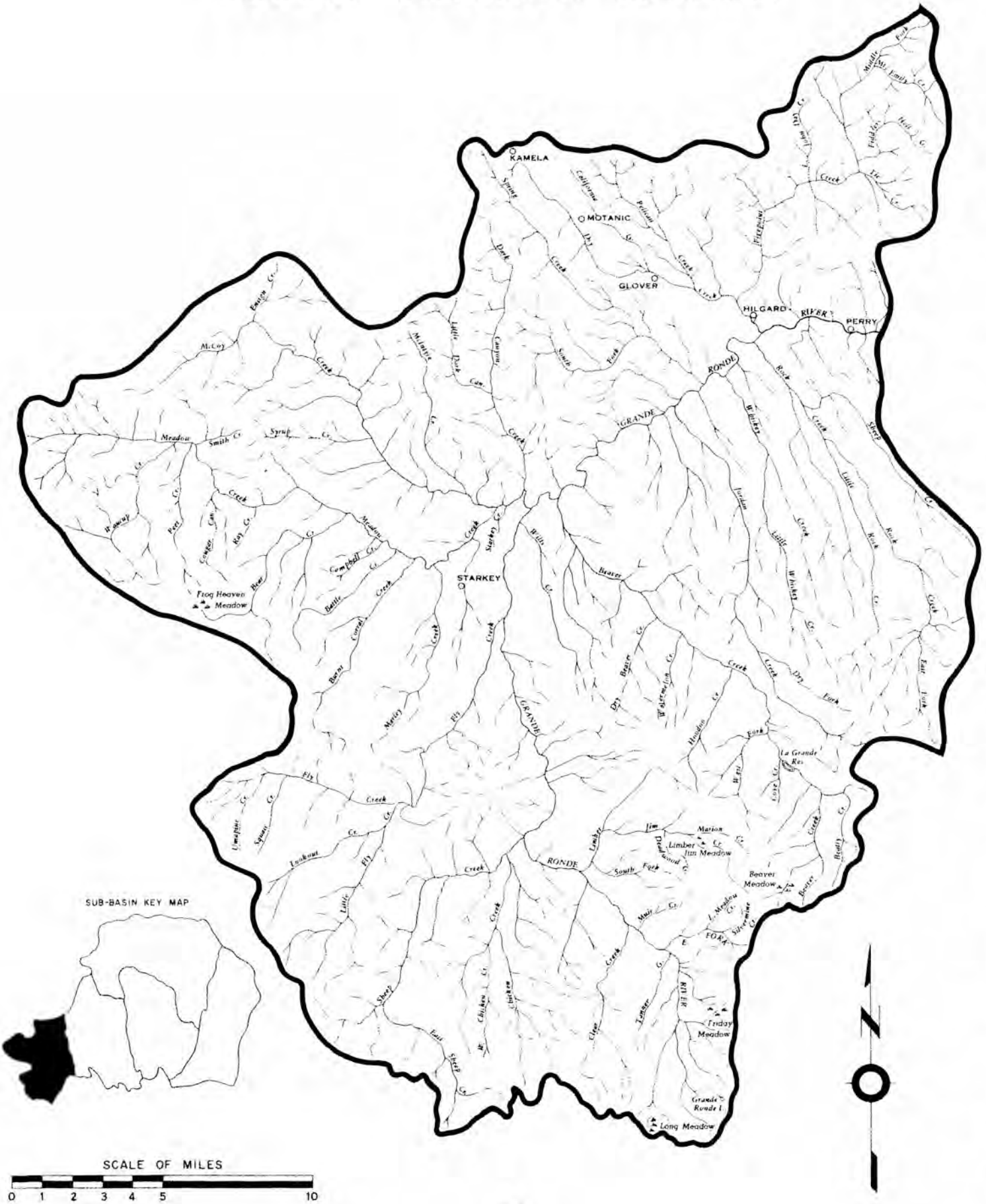


Figure 26

CHAPTER V SUB-BASIN INVENTORY

SECTION 1 UPPER GRANDE RONDE BASIN

GENERAL DATA

Location

The Upper Grande Ronde sub-basin comprises the drainage area lying at the western end of the Basin. It includes all land that drains into the river above river mile 164, a point approximately one mile below the community of Perry.

Lying entirely within the Blue Mountains, its boundaries are the divides between this sub-basin and the neighboring river basins of the Umatilla to the north, John Day to the west, and Powder to the south. Ridges to the east of Fivepoint Creek and Rock Creek separate the sub-basin from the main basin. Figure 26 shows the complete stream system and boundaries for this sub-basin.

Size

With an area of 680 square miles, this is the smallest of the five sub-basins, making up 13 percent of the entire area of the Grande Ronde Basin. Six hundred and forty-three square miles of the sub-basin fall within Union County while 37 square miles, consisting of narrow strips of land on the western and northern periphery of the sub-basin, fall within Umatilla County.

The Grande Ronde and its tributaries within the sub-basin have a total length of 696 miles, 12 percent of the total stream miles of the Grande Ronde River system. Of a 212-mile total length, about 49 miles of the Grande Ronde main stem lies in this sub-basin. Meadow Creek, approximately 22 miles in length; Beaver Creek, 19 miles; Fly Creek, 16 miles; and Sheep Creek, 12 miles are the main tributaries.

Geology

The oldest rocks in the sub-basin are a series of metamorphosed sedimentary and volcanic rocks made up of schists, quartzites, and greenstones that crop out below the confluence of Sheep Creek in the southern part of the area. These metamorphic rocks are mostly tight and poorly permeable, and therefore, contain little, if any, ground water. During Cretaceous time, these rocks were in part intruded by igneous masses having the general composition of diorite. This granitic rock is part of the Bald Mountain batholith and is exposed at points on Limber Jim Creek, Clear Creek, and on the main stem of the Grande Ronde River near the confluence of Sheep Creek. The diorite forms a soil zone only a few feet thick and where found in place, is massive, tight,

and but slightly permeable. These rocks were in turn overlain by tuff breccia and andesitic lava flows of probably Miocene age. Outcrops of these volcanic rocks occur at several scattered points on Sheep Creek, Chicken Creek, Limber Jim Creek, and the Grande Ronde River above the confluence of Fly Creek. These rocks are relatively impermeable and will probably yield only small quantities of water to wells. Outcrops of all the above rocks occur in the headwater region of the Grande Ronde River in the southernmost part of the sub-basin. The tuff breccia and andesite flows were then covered in late Miocene times by flow upon flow of accordantly layered Columbia River basalt and associated volcanic rocks, principally andesite. Individual lava flows of this unit generally range in thickness from 10 to 50 feet. These flows form the main bedrock unit of the sub-basin as well as that of the entire Grande Ronde Basin. The porous interflow zones in the upper part of the flows form aquifers yielding small to large quantities of water to wells. This is one of the main sources of ground water in the area. The youngest rock unit, principally of Pleistocene age, is fanglomerate which has a maximum thickness of about 250 feet and covers an area of approximately five square miles in the vicinity of Starkey. This rock, originally an alluvial fan, is now loosely cemented and its cleaner beds of gravel and coarse sand would ordinarily be good aquifers except that most of the deposit now lies above the regional water table. The youngest geologic unit in the sub-basin is the Recent alluvium that covers the floors of the larger stream canyons and valleys. This alluvium consists of river-washed, sorted and unsorted sand and gravel. The alluvial fill in both the Beaver Creek and Spring Creek Valleys, derived in part from the fanglomerate, form small ground water reservoirs of potential local importance.

The major geologic structures in the sub-basin are the Blue Mountain anticline which forms the northwest boundary, the Grande Ronde syncline through which part of the Grande Ronde River and the lower part of Meadow Creek flow, and the Elkhorn Range which forms the southern boundary. Of equal structural importance to these large folds are the northwest-trending normal faults. These faults are important to ground water because they cut and block off the interflow zones and so cause reservoirs to form. This folding and faulting, which attained its maximum development in late Pleistocene times, are principally responsible for the topography and stream patterns that exist today.

Some gold and antimony have been mined in the southeast part of the sub-basin. Gold was found on Hoodoo Creek, Tanner Gulch, and near Friday Meadow; antimony was found near Beaver Meadow. The production value is not known, but is not believed to be great.

Topography

The lowest point in the sub-basin is at an elevation of 2,900 feet; the highest point

in the Elkhorn Range of the Blue Mountains has an elevation of 7,620 feet. In the northern section of the sub-basin, the Blue Mountains attain heights in excess of 5,000 feet reaching a maximum elevation of 6,064 feet on Mount Emily. Much of the sub-basin consists of mountainous uplands with deeply entrenched canyons. Steep, mountainous terrain characterizes 80 percent of the sub-basin while 37 square miles, 5.4 percent, are classified as agricultural lands.

From its source on the Elkhorn Range at the most southerly point in the sub-basin, the Grande Ronde flows northwards in the direction of the town of Starkey. Here it meets the line of the Grande Ronde syncline and follows this line in an easterly direction. The course of the river from its source on the Elkhorn Range to its point of exit from the sub-basin near Perry forms an arc of a circle. The area within the arc, while constituting one-third of the sub-basin, can be expected to contribute less than one-third of the total sub-basin yield due to its lower average elevation. The major tributary of this area is Beaver Creek. The area lying outside the arc formed by the river, containing the balance of the sub-basin, is drained by four tributaries of significance; Sheep, Fly, Meadow, and Fivepoint Creeks. Much of the yield in the Upper Grande Ronde Basin is derived from the relatively heavy snowfall and rain occurring on the Blue Mountain watershed drained by these creeks.

From its headwaters, mile 212 and elevation 5,100, the Grande Ronde has an average gradient of 44 feet of drop per mile to mile 188. An average gradient of about 64 feet per mile occurs over the next 13 miles to mile 175. Below this point the gradient averages 30 feet per mile to where the river leaves the sub-basin at an elevation of 2,900 feet. A partial profile of the Grande Ronde Basin stream system is shown in Figure 2.

Climate

Average annual precipitation varies from 18 inches at Starkey, elevation 2,700 feet, to 38 inches in the mountains at elevations over 7,000 feet. At high elevations, over 50 percent of the precipitation falls during the months of November through February in the form of snow. Average annual snowfall at Starkey is 44 inches. Although precipitation at high levels is often in the form of snow, some storms consist largely of rain which, when supplemented by snowmelt, produce runoff of significant proportions. Average annual precipitation for the Grande Ronde Basin is indicated in Figure 3.

Average monthly air temperature at Starkey ranges from 25 to 44 degrees Fahrenheit in winter and from 45 to 61 degrees Fahrenheit in the summer. Although winters are generally not severe, short periods of sub-zero temperatures sometimes occur.

Population

The sub-basin is a sparsely inhabited area with a population of less than 250. Populations of towns in the sub-basin as of 1950 were: Perry, 75; Starkey, 30; Hilgard, 30; and Kamela, 29. Populations of all incorporated cities in the Grande Ronde Basin as of 1960 are listed in Table 3.

Land Ownership

Federal land amounts to 474 square miles, about 70 percent of the sub-basin, managed by either the Forest Service or the Bureau of Land Management. Public domain land and state land include less than 3 square miles leaving approximately 200 square miles as private land. Federal, state, and public land ownership for the Grande Ronde Basin is shown in Table 4.

Transportation

Highway U. S. 30 linking La Grande with Pendleton cuts across the northeast corner of the sub-basin and provides the principal access to the area. This highway, the only paved road within the sub-basin, follows the main stem of the river to a point south of Hilgard and then up Dry Creek to Kamela on the northern watershed.

The main road serving the sub-basin follows the Grande Ronde to Starkey, which is the center of a system of roads leading to the north, south, and west. Roads leading to the northern watershed are mainly located on ridges while roads leading to the south follow the canyons of the Grande Ronde River, Fly Creek, Sheep Creek, and Chicken Creek.

Many are classified as improved roads of which the main road from Hilgard to Starkey is the principal one. Other improved roads connect principal points within the sub-basin and lead into the John Day and Powder River Basins. Many dirt roads extending from the system of improved roads give access to more isolated areas within the sub-basin.

The main line of the Oregon-Washington Railroad and Navigation Company, part of the Union Pacific system, follows Highway U. S. 30 across the northeast corner of the sub-basin with stations at Glover, Hilgard, and Perry.

A privately-owned landing strip exists at the confluence of Sheep Creek and the Grande Ronde River.

U. S. 30 is the only road within the sub-basin with regular bus and freight service.

Present Economy

Nearly the entire sub-basin is classified as forest land with ponderosa pine as the dominant species in about 60 percent of the land area. Logging is the main economic activity with livestock occupying a secondary position.

Of the extensive placer mining operations which once existed on the headwaters of the Grande Ronde, only a few are still active.

Elk and deer in the Blue Mountains attract hunters and many of the streams provide good fishing. Wildlife and fish life are, therefore, of economic significance to the sub-basin.

AMOUNT AND DISTRIBUTION OF THE RESOURCE

Precipitation Data

Precipitation records were kept at Hilgard and Starkey from 1909 to 1926 and in 1948, respectively. A station was opened in 1958 called La Grande 19 WSW which is the only active station in the sub-basin maintaining precipitation records. Average annual precipitation for the Basin is shown in Figure 3, and precipitation in the sub-basin was discussed under Climate. Climatological stations are located as shown in Figure 11.

Stream Gaging

No active stream gaging stations exist in the sub-basin. Stations were maintained in the past on the Grande Ronde near Hilgard and Starkey and on Meadow Creek near Starkey. Streamflow records from these stations are published in the Water Supply Papers of the U. S. Geological Survey. The records maintained at the gaging station on the Grande Ronde at La Grande just below the terminal point of the sub-basin reflect the sub-basin yield. Location of gaging stations in the Basin, active and otherwise, is shown in Figure 11.

Yield

Annual yield from 1904 through 1957 of the Grande Ronde River at La Grande is given

in Figure 27. Yield varied from a minimum of 111,000 acre-feet in 1915 to 511,000 acre-feet in 1921 with the average for the period being 276,000 acre-feet.

Mean monthly discharges at La Grande, Figure 13, show the distribution of the average annual yield with respect to time. High flows occur from March through June with an average monthly peak of nearly 1,400 cfs in April. Monthly flows are generally low during the remaining eight months of the year with extremely low flows occurring in August, September, and October.

Flow characteristics of the water year of minimum discharge at the La Grande gaging station are shown in Figure 28. Minimum discharge was four cfs occurring on August 26, 1940. Tables 11 and 12 summarize the critical flow and yield conditions which have occurred in the Grande Ronde Basin.

Flood and drought frequency curves for the Grande Ronde at La Grande are shown in Figure 29. Curves indicate that a maximum flood flow of 7,400 cfs can be expected at La Grande with an average recurrence interval of 10 years and that a minimum flow of 11 cfs for 30 consecutive days can be expected with the same frequency.

AMOUNT AND DISTRIBUTION OF THE RESOURCE UNDER APPROPRIATION

Water Rights

Water rights in this sub-basin are few in number as can be seen by Figure 8 which shows the location of water rights in the Grande Ronde Basin by their legally-defined point of diversion. Rights total about 286 cfs of which 206 cfs, 72 percent, are nonconsumptive. Consumptive rights total about 80 cfs or 28 percent of total sub-basin rights.

Mining, which has water rights totaling 181 cfs, is the largest nonconsumptive use. Mining rights in this sub-basin are all located on the headwaters of the Grande Ronde and its tributaries. Since the use is nonconsumptive, the water would be available for re-use at downstream locations.

Power rights amount to 25 cfs of which one for 10 cfs is located on Clear Creek near the source of the Grande Ronde and another for 15 cfs is located on Sheep Creek at the lower end of the sub-basin.

Industrial water rights total 59 cfs, while irrigation rights only amount to 12 cfs.

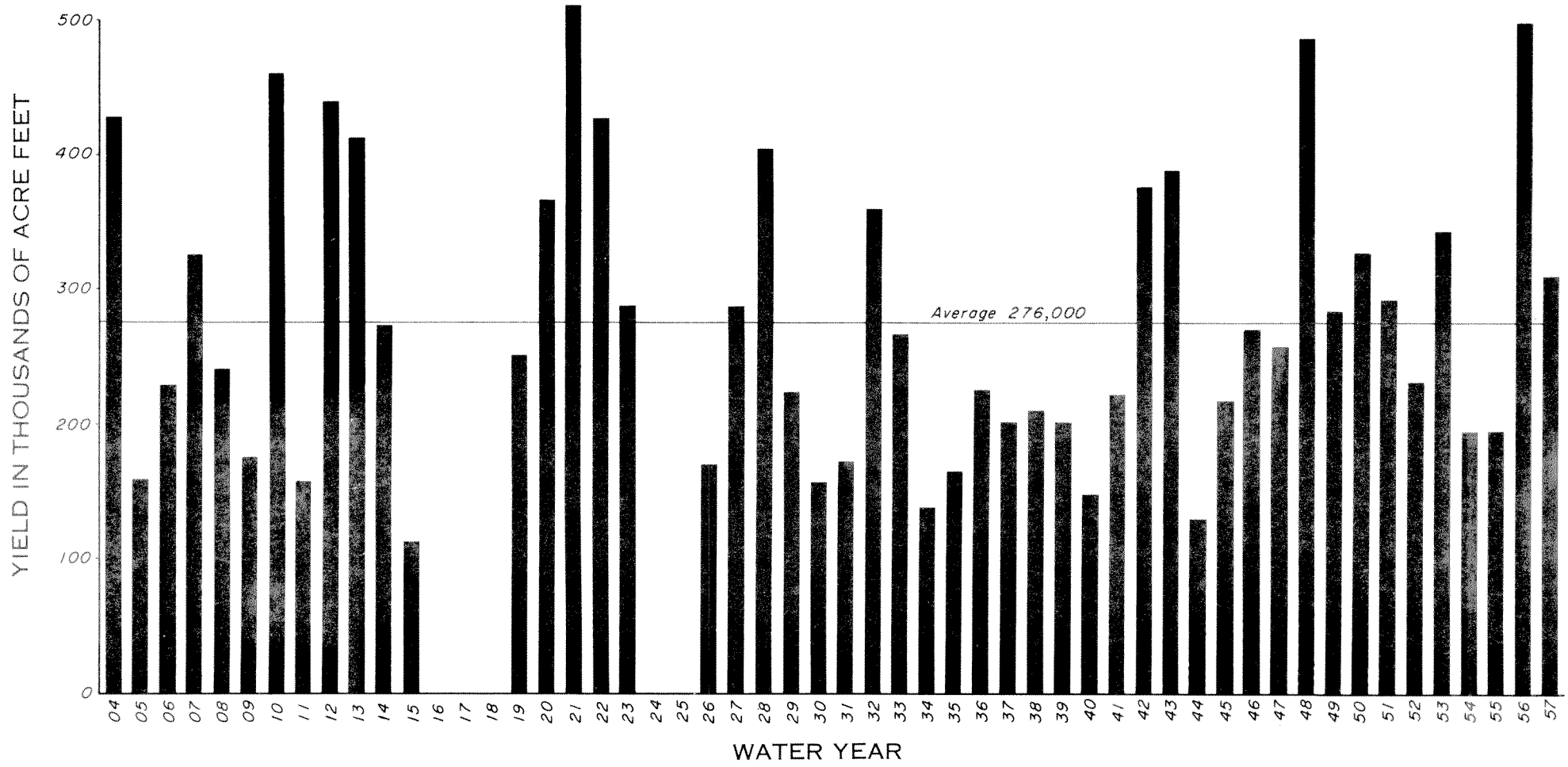
Two municipal rights for a total of 8.5 cfs on Upper Beaver Creek are for use by the City of La Grande which is located outside of the sub-basin.

A summary of water rights by uses is given in Table 15, and Table 8 indicates the relative magnitudes of the different uses for the entire Grande Ronde Basin.

ANNUAL YIELD

GRANDE RONDE RIVER AT LA GRANDE

DRAINAGE AREA 680 SQ. MI.

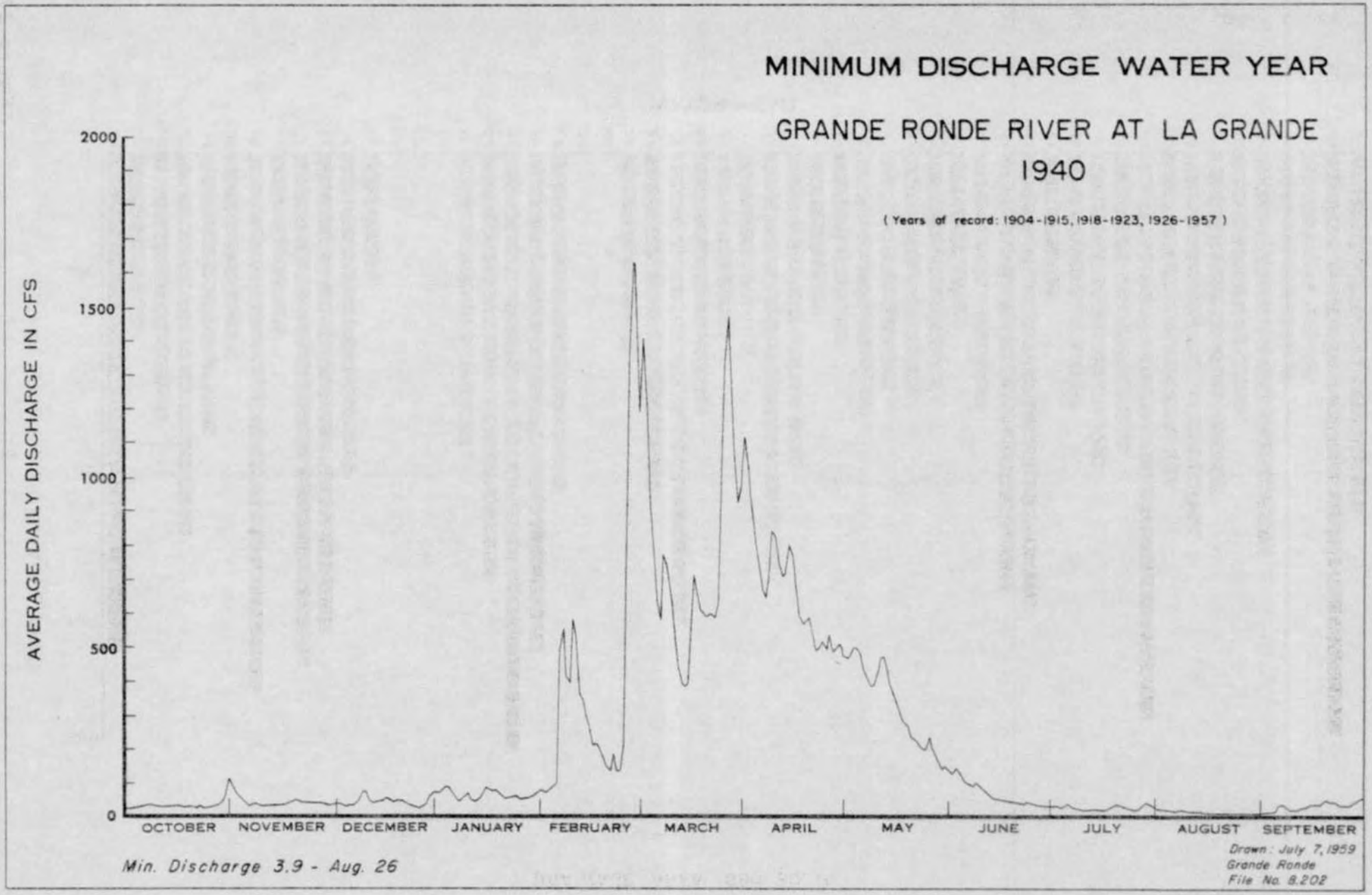


All values from U.S.G.S. Water Supply Papers

Drawn 5-5-59
Grande Ronde
File No. 8.220

Figure 27

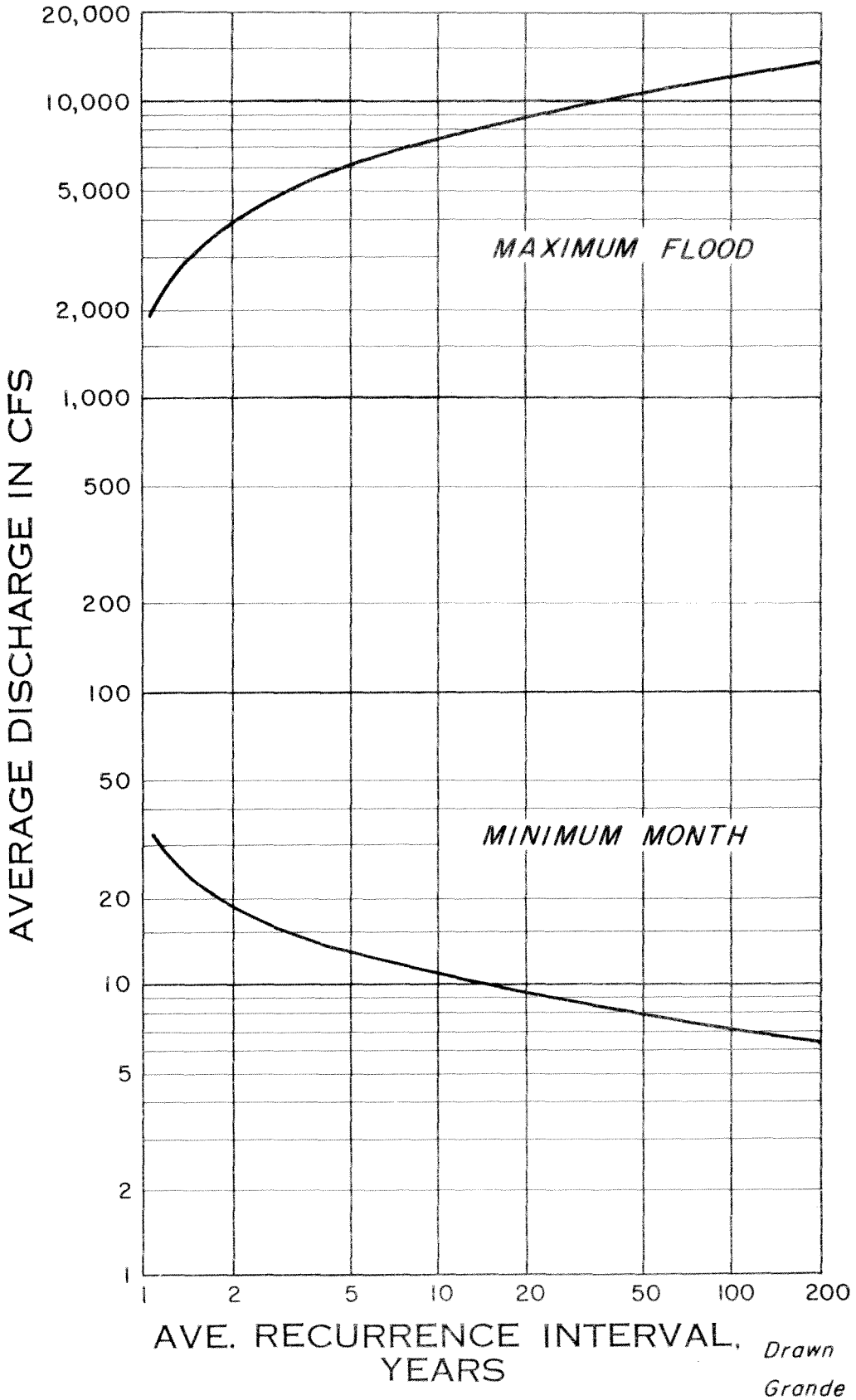
Figure 28


MINIMUM DISCHARGE WATER YEAR
GRANDE RONDE RIVER AT LA GRANDE
1940
(Years of record: 1904-1915, 1918-1923, 1926-1957)
AVERAGE DAILY DISCHARGE IN CFS
2000
1500
1000
500
0
OCTOBER
NOVEMBER
DECEMBER
JANUARY
FEBRUARY
MARCH
APRIL
MAY
JUNE
JULY
AUGUST
SEPTEMBER
Min. Discharge 3.9 - Aug. 26
Drawn: July 7, 1959
Grande Ronde
File No. 8.202

FLOOD & DROUGHT FREQUENCY

GRANDE RONDE RIVER AT LA GRANDE

1904 - 1957



Drawn 6-1-59
Grande Ronde
File No. 8.203
Figure 29

Two municipal rights for a total of 8.5 cfs on Upper Beaver Creek are for use by the City of La Grande which is located outside of the sub-basin.

A summary of water rights by uses is given in Table 15, and Table 8 indicates the relative magnitudes of the different uses for the entire Grande Ronde Basin.

TABLE 15

WATER RIGHTS SUMMARY*

UPPER GRANDE RONDE BASIN

USE	STREAM	TOTAL RIGHTS CFS
Domestic	Grande Ronde River	0.6
Municipal	Grande Ronde River	8.5
Irrigation	Grande Ronde River	12.1
Recreation	Grande Ronde River	0.3
Industrial	Grande Ronde River	59.0
Power	Grande Ronde River	25.0
Mining	Grande Ronde River	180.8
Wildlife	None	
Fish Life	None	
Pollution Abatement	None	
	TOTAL UPPER GRANDE RONDE BASIN	286.3 cfs

* As of January 1, 1959

Depletions

Depletion diagrams of consumptive rights and total legal rights versus stream miles for the Upper Grande Ronde are shown in Figure 30. This plot shows that a maximum legal depletion of 286 cfs could occur if all the rights were exercised simultaneously. This condition seldom occurs in practice for the following reasons:

(a) The greater part of the depletions is caused by nonconsumptive uses and such water is available for re-use at downstream locations.

(b) Streamflow on the headwaters of the Grande Ronde would be inadequate to permit simultaneous exercise of all mining rights for natural flow during the low flow seasons.

(c) The exercise of some rights follow a seasonal pattern and all depletions would not necessarily coincide.

Values on the plot do not include supplemental irrigation rights and these are not a part of Table 15. Supplemental rights permit alternate sources of supply but do not add to original rights.

EXISTING NEEDS

Domestic

Rights for domestic usage of streamflow total only about one-half cfs and, therefore, this use is not significant.

Municipal

A large part of the water supply for the City of La Grande is drawn from the Beaver Creek Reservoir lying within the Upper Grande Ronde sub-basin. Water rights for this purpose total 8.5 cfs representing 5,525,000 gallons per day. Existing transmission capacity is only 2,600,000 gallons per day so the city does not, at present, fully exercise its right.

Irrigation

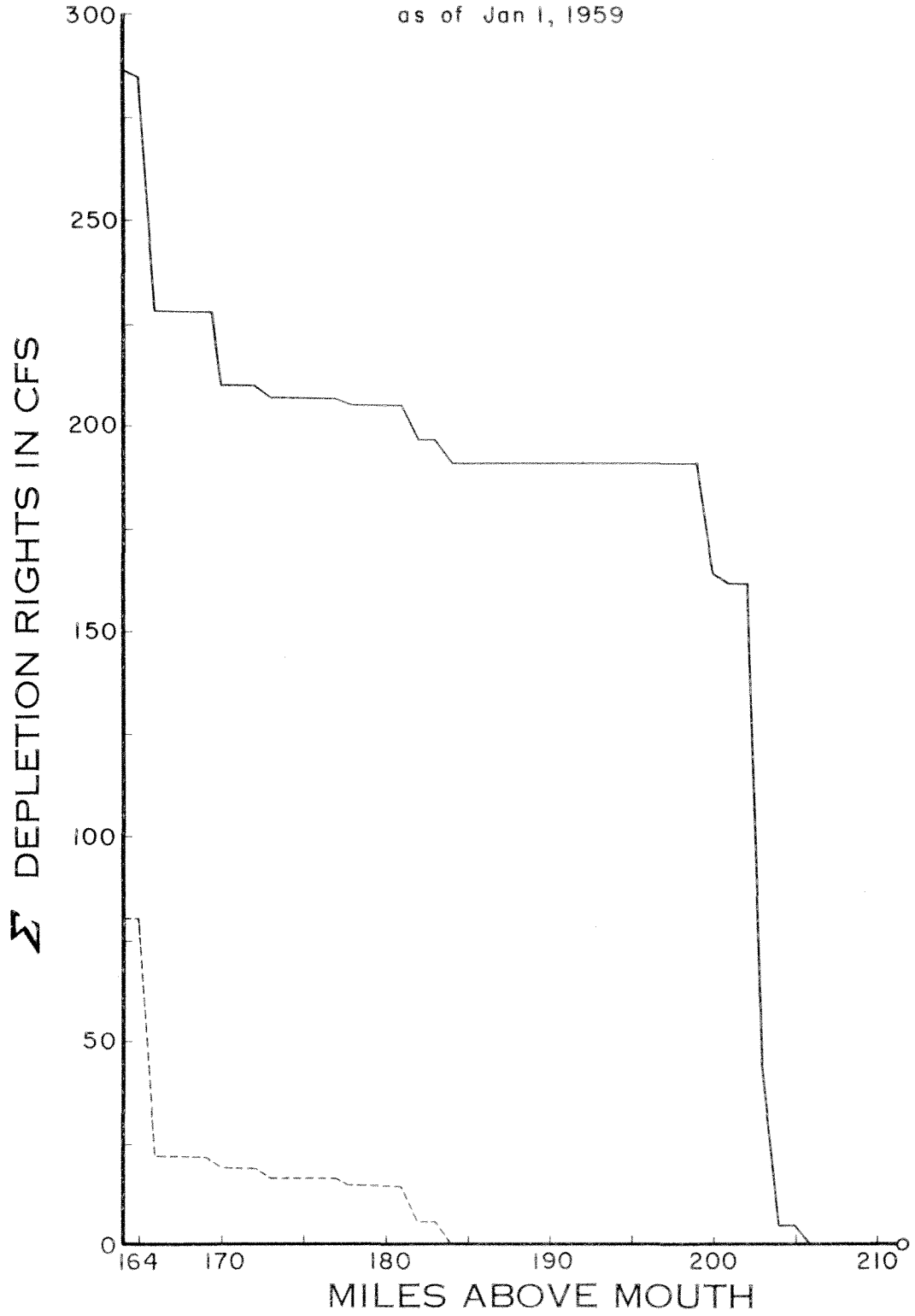
Irrigated lands in the Grande Ronde Basin are shown in Figure 5. The area involved

LEGAL DEPLETION RIGHTS

BY STREAM MILE

UPPER GRANDE RONDE RIVER

as of Jan 1, 1959



Consumptive Rights ------

Total Legal Rights ——

Drawn 6-3-59

Grande Ronde

File No. 8.302

Figure 30

in this sub-basin consists of only 845 acres holding water rights totaling about 12 cfs.

Power

Power rights in this sub-basin are no longer active.

Industrial

Industrial rights in this sub-basin are all associated with the timber industry and are nearly all for Grande Ronde main stem water.

Mining

Water rights for mining account for 63 percent of the total rights in the sub-basin. A right for 100 cfs exists on Clear Creek and is associated with the 10 cfs inactive power right. The drainage area of Clear Creek at this point is about five square miles. The yield of this portion of the sub-basin is not known but it is unlikely that the mean yield per square mile of drainage area exceeds eight cfs for any one month and is probably less than one cfs for nine months each year. On this basis, the mean monthly flow at the location of the Camp Carson water rights would be less than 5 cfs for the greater part of the year and may reach 40 cfs during one month. Therefore, total mining and power rights of 110 cfs would never be realized. Similarly the water rights for mining that are located around Limber Jim Meadow and Beaver Meadow are greatly in excess of the flows in the corresponding streams. Only a fraction of the water rights for mining, 181 cfs, could actually be exercised at any given time.

Recreation

The only water right existing in the sub-basin for recreation is for 0.25 cfs for use at the wayside park near Hilgard.

Recreation facilities in the sub-basin consist of three state parks, including Hilgard, and one forest camp. These, and other facilities in the Grande Ronde Basin, are located as shown in Figure 9A.

Wildlife

Mule deer and Rocky Mountain elk are found in the sub-basin, together with species

of upland game. Their needs for water are small and easily satisfied due to the low level of development in the area.

Fish Life

It is estimated by the Oregon Fish Commission that of the annual escapement of 20,000 spring chinook into the Grande Ronde River system, only five percent are found in the Upper Grande Ronde sub-basin. The Oregon Game Commission states, "In most years this area is not utilized by salmon".

Steelhead trout are found in all the tributaries of the Upper Grande Ronde with Meadow and Fivepoints Creek being particularly favored. No estimate of the portion of the total annual escapement of 22,500 steelhead trout which utilizes the Upper Grande Ronde system is available.

Due to the limited numbers of fall chinook and silver salmon annually escaping to the Grande Ronde system (2,000 fall chinook, silvers unknown), spawning ground surveys have not been made.

Information is lacking on the numbers and species of native fish inhabiting the Upper Grande Ronde.

Pollution Abatement

Due to the undeveloped state of the sub-basin, pollution abatement problems associated with domestic sewage and industrial effluents are absent. Limited pollution may occur near Starkey from domestic sewage and log mill operation but is not serious except in unusually low flow years.

A serious problem caused by placer mining operations in the headwater areas of the Grande Ronde is that of siltation extending as far downstream as Hilgard.

Another occasional problem is debris from logging operations which is conveyed by surface runoff into the smaller tributaries sometimes obstructing the stream bed with resulting detrimental effects on fish life.

Flood Control

Steep gradients of the Grande Ronde and its tributaries within the sub-basin (Figure 2)

create high velocity streamflow. Heavy runoff from precipitation combined with snowmelt is rapidly conveyed out of the sub-basin by the drainage system eliminating the possibility of floods of any great magnitude within the sub-basin. Upon leaving this sub-basin, the river enters the Grande Ronde Valley where the velocity drops sharply and the river adopts a characteristic meandering course. Lowering the capacity of the river causes the water to rise above bankfull stage and inundate large areas of the valley floor during peak runoff periods. Thus the rapid and efficient drainage of the Upper Grande Ronde sub-basin is a contributory cause of floods in the valley below. Work intended to alleviate flood damage in the valley should, therefore, include detention in upstream reservoirs.

FUTURE NEEDS

Domestic

No significant increase of population within the sub-basin is expected. Future domestic needs can be met by surface runoff.

Municipal

The City of La Grande obtains a large part of its municipal water supply from the upper reaches of Beaver Creek which has an estimated yield of 7,000 acre-feet in a low flow year. With adequate storage, that yield could maintain a daily supply of 6.5 million gallons which is in excess of the total estimated city demand in 1988.

Irrigation

According to the Bureau of Reclamation, about 45,000 acres lying in the flat valley floor of the Middle Grande Ronde sub-basin are potentially irrigable with water obtained from the Upper Grande Ronde sub-basin. This proposal envisages the use of natural flow of the Grande Ronde together with storage from a reservoir of 157,000 acre-feet by the construction of a dam on the Grande Ronde near Hilgard. In addition to the benefits of such a reservoir to downstream users, it would benefit the Upper Grande Ronde sub-basin by increasing the recreational potential. Irrigation development, existing and proposed, is shown in Figure 5C, and irrigation lands in Figure 5. Development potential for lands in the sub-basin is not significant.

Power

The feasibility of hydro-power development in the Upper Grande Ronde appears marginal. There have been no studies to date that recommend any power development.

Feasibility of power projects in this area depends on the possibility of storage development. Storage is needed to control the sub-basin runoff which has nearly 80 percent of its mean annual yield in the period March through June. This sub-basin runoff occurs simultaneously with a major portion of the Columbia Basin runoff.

Several storage possibilities have been identified in the sub-basin. They are as follows:

Site	Dam	Acre-feet
Sheep Creek	113 ft.	27,570
Fly Creek	Unavailable	
Meadow Creek	114 ft.	45,300
Upper Grande Ronde Site A	193 ft.	74,100
Lower Grande Ronde	(125 ft.	88,100
	(	
	(165.5 ft.	141,000

Of these projects, the Lower Grande Ronde site offers more for power development because of its greater storage and control over a greater portion of the runoff from the sub-basin. A project at this site would control nearly 74 percent of the sub-basin area.

Reconnaissance figures of the Lower Grande Ronde site offer a basis for determining the scope of the sub-basin projects. A project, 166 feet in height, stores approximately 141,000 acre-feet of water at this location. Ninety-eight thousand acre-feet of active storage acting through an average head of 144 feet would create about 1½ megawatts of prime capability at site.

In the process of regulation, the project would increase prime flow at site and downstream by 126 cfs. One hundred and twenty-six cfs at Snake and Lower Columbia plants would represent approximately seven megawatts of prime power.

More detailed studies than those undertaken to date would be necessary to establish average annual energy contributions both at site and downstream. As an indication of downstream average annual energy potentials, the contribution of the Wenaha Project on the Lower Grande Ronde with 900,000 acre-feet of storage in the "Major Water Plan", last added under 1985 load conditions, has a downstream 240-month average energy

increment of nine megawatts. The Lower Grande Ronde site with 98,000 acre-feet of active storage and control of 505 square miles of the Basin as compared to approximately 3,356 square miles for Wenaha can be expected to have a much smaller increment.

The other sub-basin sites have active storage capacities less than the Lower Grande Ronde site and control a smaller portion of the Basin's yield, therefore, even smaller downstream benefits will accrue to these units.

It is estimated that the use of the average annual flow over all the physically available head in the sub-basin would result in a theoretical average annual energy production of 106,000,000 KWH, about 2.4 percent of the Grande Ronde Basin's theoretical average annual energy potential (see Figure 31).

Industrial

The only industry of significance that the sub-basin is likely to support is that associated with timber and it is not expected that the facilities existing at present will be expanded an appreciable amount in the foreseeable future.

Mining

Mineral deposits of present economic importance in the sub-basin are limited to gold and antimony and occur in the headwaters of the Grande Ronde. Placer mining is active at present and is likely to continue intermittently. Streamflows in the mining area are insufficient to permit continuous operations and operations are, therefore, intermittent and utilize water from storage. Mining is not expected to increase appreciably in scope and its water needs will probably remain at or near present levels.

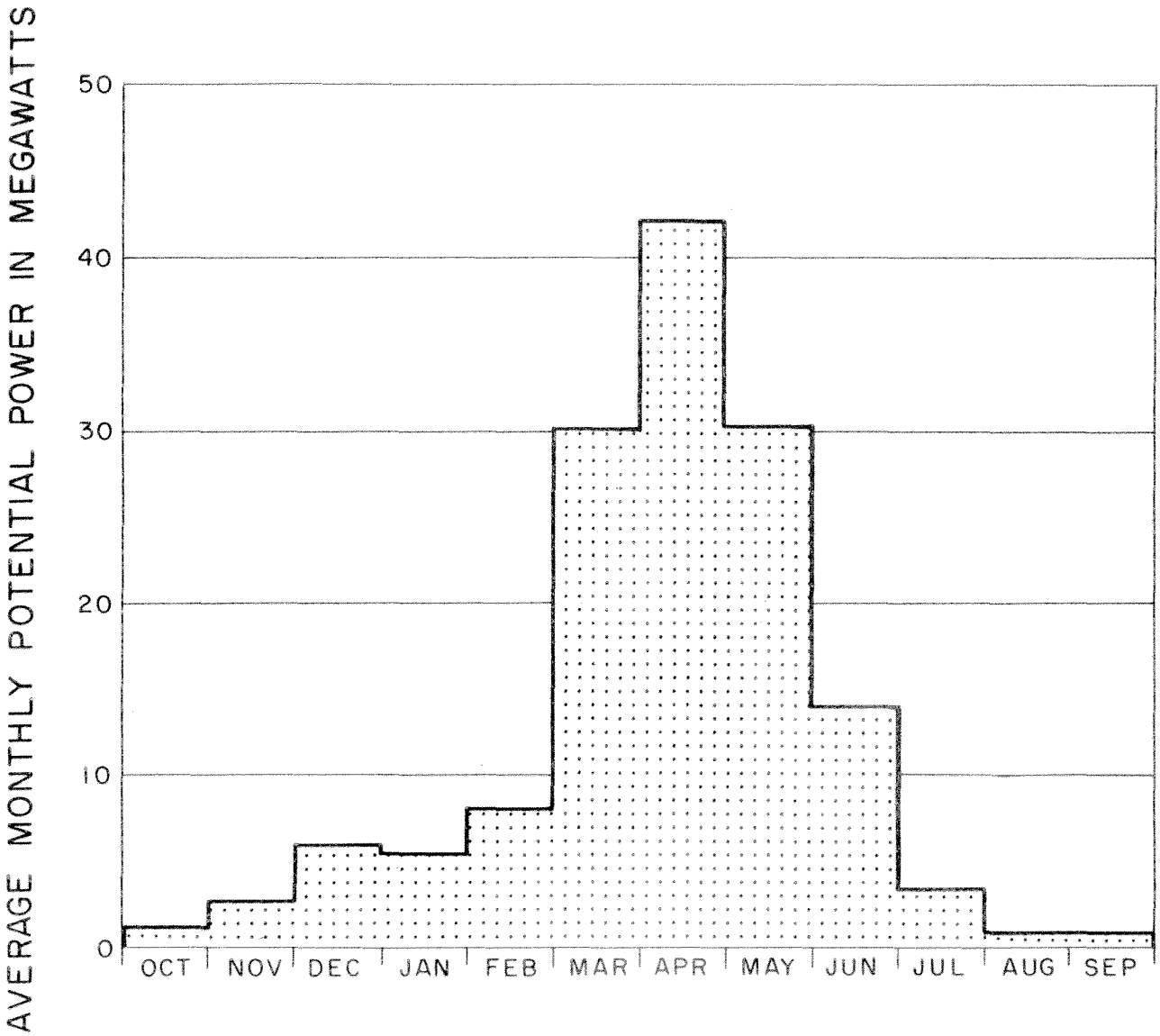
The location of mineral deposits of economic importance in the Grande Ronde Basin is shown in Figure 7.

Recreation

Beyond the pattern of natural streamflow, improved if possible, to augment fish life, there would be no major needs for water for recreational purposes. Storage reservoirs, if constructed for multi-purpose use, would enhance the recreational potential in the sub-basin, which would benefit the population of La Grande and the Grande Ronde Valley in general.

POTENTIAL POWER

UPPER GRANDE RONDE SUB-BASIN



Drawn 9-15-59
Grande Ronde
File No. 8.1046

Figure 31

Wildlife

Consumptive water needs of wildlife being small, even a substantial increase in numbers would not pose a supply problem. It is probable that wildlife population will not materially increase.

Fish Life

The Upper Grande Ronde sub-basin is utilized by runs of chinook salmon and steelhead trout as well as resident fish.

Chinook salmon are known to spawn in the Upper Grande Ronde main stem, however, Sheep Creek is the only tributary which they are known to utilize for spawning. Other tributaries are known to accommodate young-of-the-year salmon in their lower reaches.

The chinook run occurs early in the year and is recognized as composed of spring-run fish. Observed redds in 1954 approximate 100 in number.

Potentials for increases in salmon populations for the sub-basin appear limited due to access problems.

Information on the status of steelhead populations is limited to the knowledge that steelhead do utilize the stream system. The extent of present populations is unknown and the potentials for enhancement are not identified. It is believed spawning is general throughout the headwaters where flows and temperatures are adequate.

The problems of anadromous fish maintenance and enhancement are logging and mining interferences with stream quality and the major problem of inadequate flow during summer and early fall months.

Pollution Abatement

In the absence of potential for a large population or industrial expansion in the sub-basin, the need for pollution abatement is not expected to increase.

Flood Control

Need for flood control in the sub-basin will not become a major problem and if measures are taken to regulate the flow in the Upper Grande Ronde, they would be for the benefit of the valley below.

MIDDLE GRANDE RONDE

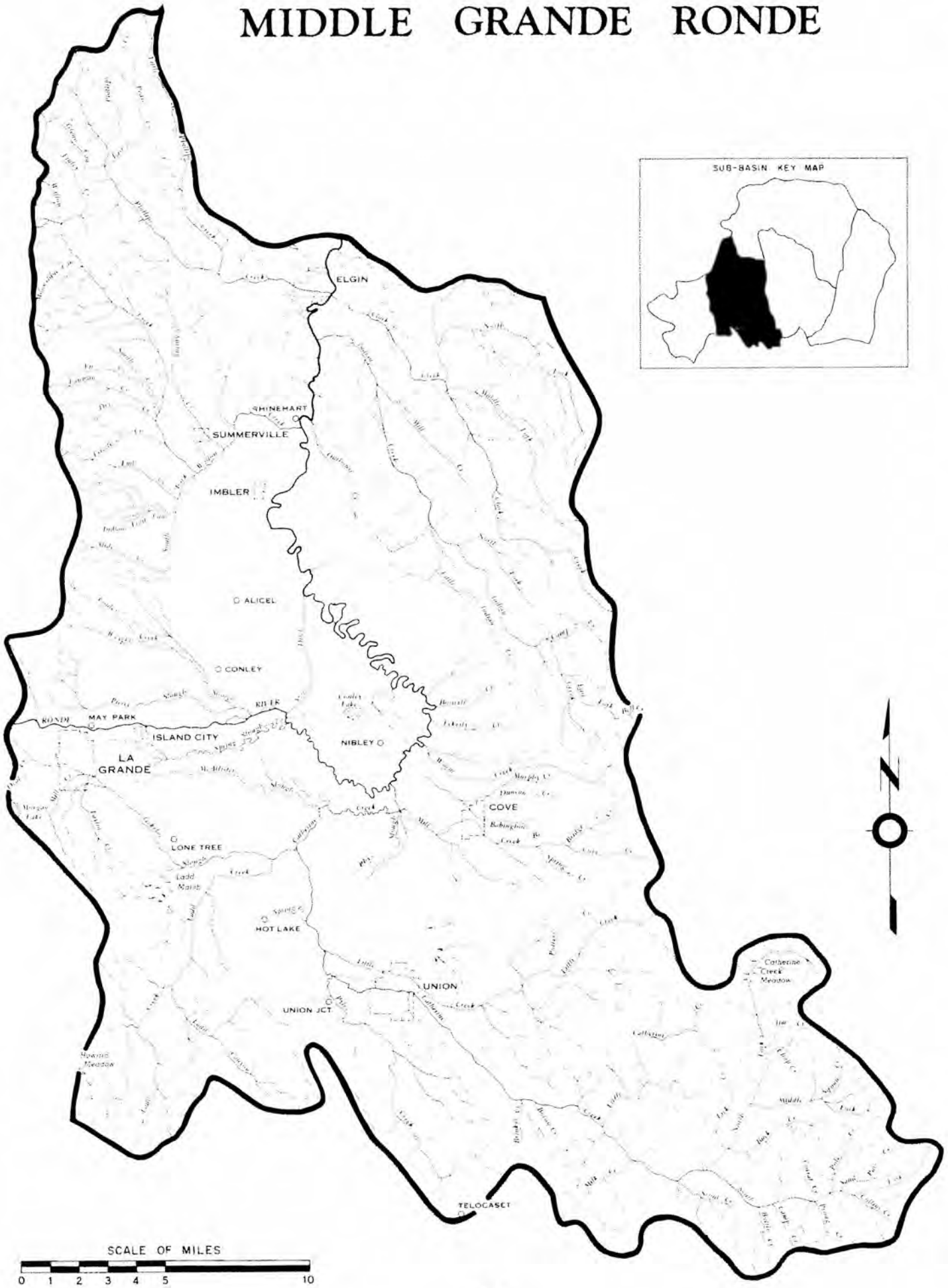


Figure 32

SECTION 2 MIDDLE GRANDE RONDE BASIN

GENERAL DATA

Location

All land draining into the Grande Ronde between river miles 164 on map and 96 is defined, for the purpose of this report, as the Middle Grande Ronde sub-basin. It is bounded on the north by the ridge between Phillips Creek and Gordon Creek, the northern limits of Clark Creek drainage area, and a part of the Blue Mountains. The southern limits are determined by a series of mountains belonging to the Blue Mountain group; namely, Craig Mountain, Clark Mountain, Reeves Mountain, Frazier Mountain, and Bald Hill. The sub-basin is bounded on the east and the west by the Wallowa and the Upper Grande Ronde sub-basins respectively. Figure 32 shows the complete stream system for this sub-basin.

Size

With an area of 720 square miles, which is a little more than one-eighth of the Grande Ronde Basin, the Middle Grande Ronde is one of the smaller of the five sub-basins. It lies entirely within Union County except for a narrow strip on the northwestern border consisting of three square miles in Umatilla County.

Streams total 741 miles in length. The main stem of the Grande Ronde within the sub-basin is 67 miles in length. Catherine Creek, 33 miles, is the longest tributary in the sub-basin and one of the most important in the Grande Ronde Basin. Willow Creek and Indian Creek are also tributaries of significance.

Geology

The oldest rocks in the sub-basin are pre-Tertiary marbles, greenstones, and argillites that crop out above river mile 25 in the Catherine Creek drainage basin situated in the southeast part of the sub-basin. These rocks are in part intruded by the Wallowa Mountains batholith of Cretaceous age, a large igneous mass of quartz diorite and granodiorite. Outcrops of these granitic rocks are generally prominent, well-rounded knobs whose more gentle slopes weather to form soil but a few feet thick. The remainder of the high ground in the sub-basin is overlain by flow upon flow of Columbia River basalt and associated volcanics of Miocene age. A thickness of over 3,000 feet of this rock is exposed along the Mount Fanny escarpment near the east border of the sub-basin. Some Recent volcanics occur in the northern part of the area. The sedimentary fill of the Grande Ronde and Elgin Valleys is mainly Pliocene-Pleistocene lake bed deposits of clay, silt, and fine sand more than 2,000 feet deep. Contemporaneously deposited with this

material are five well-developed alluvial fans that occur in the Grande Ronde Valley where the Grande Ronde River, Willow Creek, Ladd Creek, Mill Creek, and the trio of Catherine, Little, and Pyle Creeks leave their canyons to enter the valley. The fanning-out of the water and resultant decrease in the rate of transport of the sediments caused the depositions. The fans consist of unconsolidated, poorly stratified material ranging in size from boulders to clay that become progressively finer grained toward the downstream edges. The fans are suitable for gravity irrigation because of their generally good soils, good drainage properties and gentle slopes. The Cities of La Grande, Union, and Cove are situated on these fans. Fanglomerate, colluvium, and Recent alluvial deposits also occur in the valleys.

The folding and faulting that formed the present outlines of the sub-basin occurred in the Pleistocene epoch. The Blue Mountains attained their maximum height with the re-arching of the Blue Mountain anticline, along with the formation of the Indian Creek syncline. Coinciding with and continuing after the folding, a series of great, normal block faults collectively dropped the land several thousand feet to form the grabens or depressions now known as the Grande Ronde and Elgin Valleys. A vertical displacement of about 4,000 feet is visible along the east side of the graben near Cove, whereas a displacement of nearly 3,000 feet occurs across the valley on the west side at Mount Emily. Individual faults along the west escarpment have vertical displacements ranging from 200 to 1,500 feet. The Grande Ronde and Elgin Valleys are separated by Pumpkin Ridge, an up-faulted block or horst located about 1½ miles north of Rhinehart. The approximately 10-mile-square Elgin Valley is delineated on its north end by another bedrock outcrop near the mouth of Gordon Creek. These two depressions filled with water and existed as lakes until filled by sedimentary deposits. Subsequent lowering of the bedrock outlets by erosion caused the removal of about 100 feet of material from the top of the valley fill.

The water table of the sub-basin is generally near or slightly above the major drainage. It closely resembles the surface topography of the valley floor and slopes upward to the valley walls. Most of the valley fill in the Grande Ronde and Elgin Valleys decreases in grain size with depth, becoming progressively less permeable, so that but little ground water is found below 300 feet. The alluvial fans, being of coarser materials, generally yield good supplies of ground water at shallow depths. Many wells are in operation in the La Grande fan. Only small amounts of water have been obtained by wells drilled into the colluvium, an alluvium made up of angular basalt and andesite fragments mixed with some sand and clay. Wells drilled into the interflow zones of Columbia River basalt that contain enough erosional debris such as breccia to transmit water, are good sources of ground water. At least 11 wells in the Grande Ronde and Elgin Valleys obtain water from this source. The quality of the ground water in the two valleys is generally excellent. It is potable and within the desirable ranges of hardness and salinity for public supply, agricultural, and most industrial uses.

The principal mining activities in the sub-basin at this time are the operations of the sand and gravel plant at Island City; and the clay, brick, and tile plant at La Grande.

Topography

The main topographic feature in the sub-basin is the Grande Ronde Valley consisting of a 300-square mile depression in the Blue Mountains. The flat valley floor is 22 miles long and 16 miles wide and has a slight, though general, downward slope to the north. Elevation of the valley varies from 2,600 to 2,700 feet. A small section of the plain near Elgin is separated from the rest by a short stretch of rocky canyon through Pumpkin Ridge.

Though the valley floor is flat in the general sense, the surface is marked by comparatively smooth lowlands and ridge-like areas which exert an important influence on the drainage in parts of the valley. A number of sand ridges, low terraces, and the border fringe of alluvial fans with a few isolated higher hills standing in the valley floor constitute the details of surface relief within the valley.

Mountains surrounding the plains have steep slopes and reach elevations of 5,000 feet or more. Higher elevations occur in the southeast corner, where Catherine Creek originates, the highest point being Granite Butte with 8,679 feet. Mount Fanny with an elevation of 7,132 feet and Mount Harris with 5,572 feet are prominent heights on the eastern edge of the valley, while Mount Emily, elevation 6,062 feet, is prominent on the north. To the east of the Mount Harris-Mount Fanny range lies a plateau at an elevation of 6,000 feet cut by the deep canyons of Indian and Clark Creeks. Pumpkin Ridge is the name given to the cultivated hills at the north end of the valley. This ridge rises rather abruptly to a height of 500 or more feet from the valley floor but, with the exception of several deep, steep-sided canyons, the land is smooth enough for cultivation.

The Grande Ronde enters the sub-basin from the west and flows for about eight miles due east through an alluvial fan with a relatively steep gradient. Through the remainder of its course in the valley floor, the river meanders and is extremely sluggish. The river drops 200 feet in seven miles from mile 164 to 156. Over the next 46 miles it drops only 40 feet with a gradient of less than one foot per mile. In the next 14 miles it drops 20 feet and makes its exit at the northern end of the sub-basin. Drainage of the central part of the valley floor has been improved by the State Ditch which shortened the river channel 29 miles.

Major tributaries in this sub-basin are: Catherine Creek which originates in the Wallowas and drains about 340 square miles which is nearly one-half of the sub-basin area; Little and Mill Creeks which drain the mountains on the eastern periphery of the sub-basin;

Indian and Clark Creeks which drain part of the south and east portions of the sub-basin, and Willow and Phillips Creeks which originate in the Blue Mountains to the north.

All of the tributaries flowing into the Grande Ronde between La Grande and Rhinehart have meandering and sluggish courses where they cross the flat valley floor.

Steep slopes render much of the land surrounding the valley floor unsuitable for agricultural use.

Climate

Average annual precipitation in the valley is about 19 inches with a range of 16 to 22 inches. In the mountains above the 4,000-foot contour, precipitation ranges from 26 inches to 36 inches. July and August are nearly always dry and the rainfall is evenly distributed throughout the rest of the year. Average annual snowfall in the sub-basin varies from 30 inches at Elgin, 25 inches at Union, and 40 inches at La Grande, to several feet on the surrounding mountains. Snow rarely remains on the ground in the valley longer than a week or ten days at a time.

Winter temperatures in the valley vary between 27 and 48 degrees Fahrenheit and summer temperatures average between 48 and 70 degrees Fahrenheit. The mean annual temperature at La Grande is 49.2 degrees Fahrenheit and the maximum range in temperature is about 140 degrees Fahrenheit. Average frost-free season in the valley is about 160 days from the end of April to the beginning of October. Killing frost, however, has occurred at La Grande as late as June 11 and as early as August 30.

Prevailing winds in winter are from the southeast and during the rest of the year from the west. Tornadoes and very destructive winds are unknown. The climate is stimulating and healthful and, although high temperatures are common in summer, the heat is not oppressive.

Population

The first permanent settler arrived in the Grande Ronde Valley in 1861, almost a hundred years ago, and in the following year, a number of families established homes there. Located on the Old Oregon Trail, the valley attracted the attention of many home seekers on their way to Western Oregon. In 1884, the railway was built and gave an added impetus to settlement.

Today the valley contains about two-thirds of the total population of the Grande Ronde

Basin. La Grande, located at the western end of the valley floor, has a population of a little less than 9,000 within the city limits. If the developed area outside the city limits is included, the population would approximate 12,000. Almost one-half of the population of the Basin live in La Grande or its outskirts. Besides being the largest city in the Basin, it is the county seat of Union County. Union, on Catherine Creek at the southeast corner of the valley, has a population of 1,457 and Elgin, at the northern end of the valley, has a population of 1,310, almost as large. May Park, across the river from La Grande, has over 800 and Cove on Mill Creek on the eastern edge of the plain has approximately 300. Imbler and Island City have approximately 150 each and Telocaset, Summerville, Alicel, and Hot Lake have less than 100 each.

Population trends (1922-60) for Union County incorporated cities are shown in Figure 15.

Land Ownership

Private land covers nearly three-quarters of the sub-basin. Government land managed by the Forest Service and the Bureau of Land Management amounts to 187 square miles and public domain and state land consists of a little over six square miles. Federal, state, and public land ownership is summarized in Table 4.

Transportation

The Grande Ronde Valley is served by an extensive network of paved and graveled roads. Principal access to the valley is provided by Highway U. S. 30 which approaches the valley from the direction of Baker and, following Ladd Canyon, enters La Grande from the southeast. Leaving the city on the west, the highway follows the Grande Ronde and enters the adjoining sub-basin of the Upper Grande Ronde.

State Highway 203 linking La Grande with Baker by way of Union, Medical Springs, and Pondosa provides a paved road across the southern part of the sub-basin. It follows Catherine Creek from Union up to the 30th river mile.

State Highway 237 which leaves U. S. Highway 30 south of the sub-basin enters the Grande Ronde watershed near Telocaset and follows Pyles Creek into Union. It continues north to Cove and then west to Island City.

State Highway 82 linking La Grande with Enterprise cuts through the valley to Elgin and gives access to the sub-basin from the north while serving as the main highway within the valley.

Many gravel roads serve lands on the valley floor while some follow creeks up to the surrounding mountains.

The main line of the Oregon-Washington Railroad and Navigation Company, a part of the Union Pacific system, links La Grande with Baker on the south and Pendleton on the north. A short branch line from La Grande to Enterprise follows State Highway 82 to Elgin. It follows the main stem of the Grande Ronde north of Elgin to the Wallowa River.

La Grande Municipal Airport, located about six miles southeast of the city, has scheduled air service of West Coast Air Lines.

Western Greyhound Lines maintain a regular passenger service on U. S. 30 and the Wallowa Valley Stages of La Grande have a similar service between La Grande and Joseph.

Regular freight service exists on U. S. Highway 30, on State Highway 203 between La Grande and Medical Springs via Union, and on State Highway 82 between La Grande and Joseph.

Present Economy

Economy of the sub-basin is based on agriculture with support from the lumber industry, the railroad, and highway organizations.

Agriculture in the Grande Ronde Valley began almost one hundred years ago. The first agricultural interests were centered in raising livestock. The animals found a ready sale in the mining camps to the south and east where populations had already exceeded the 5,000 mark. Stimulated by this demand and by the need for food products, small grains, potatoes, and many vegetables and fruits were introduced.

An indication of the place of agriculture in the sub-basin economy is the 1958 figures for Union County which show a total agricultural income of $11¼ million of which $3½ million was from livestock and the remainder from crops. These values are itemized in Table 6.

In addition to the Boise Cascade Company which has a large mill in La Grande employing more than 100 people, about 25 logging and lumber establishments employing from 1 to 100 people are listed in Manufacturer's Directory and Buyer's Guide. Furniture manufacturing, meat packing, and milk processing are other industries in La Grande while flour milling is carried out in Island City.

Numbers of employees in various occupations covered by the State Unemployment Compensation Commission from 1948-59 are shown in Figures 20A and 20B. These show a seasonal fluctuation in employment, particularly in manufacturing, but the overall trend in total number of employees has not changed appreciably in the 10-year period.

AMOUNT AND DISTRIBUTION OF THE RESOURCE

Precipitation Data

Climatological stations in the sub-basin are located at La Grande, Union, Cove, and Elgin. Both precipitation and temperature are collected at all four stations with the one at La Grande being active since 1887. Average annual precipitation for the Grande Ronde Basin is shown in Figure 3 and precipitation in the sub-basin is discussed under Climate.

Stream Gaging

Stream gaging stations in the sub-basin are located as shown in Figure 11. Only three of the stations are active at present; two are on the Grande Ronde, one at La Grande and the other near Elgin, and the third is on Catherine Creek above Union. Records from these stations are published in USGS Water Supply Papers.

Yields

Annual yield of the Grande Ronde at Elgin is shown in Figure 33. The average annual yield at this location for the period 1904 through 1957 is 624,000 acre-feet. Of this quantity, 276,000 acre-feet represents the yield of the Upper Grande Ronde sub-basin. The difference between these two quantities, 348,000 acre-feet, represents the observed yield of the Middle Grande Ronde sub-basin after consumptive use has taken place.

During the period of 55 years from 1904 to 1957, inclusive, the yield at Elgin was highest in 1949, estimated as exceeding 1,200,000 acre-feet, and was lowest in 1916, less than 230,000 acre-feet.

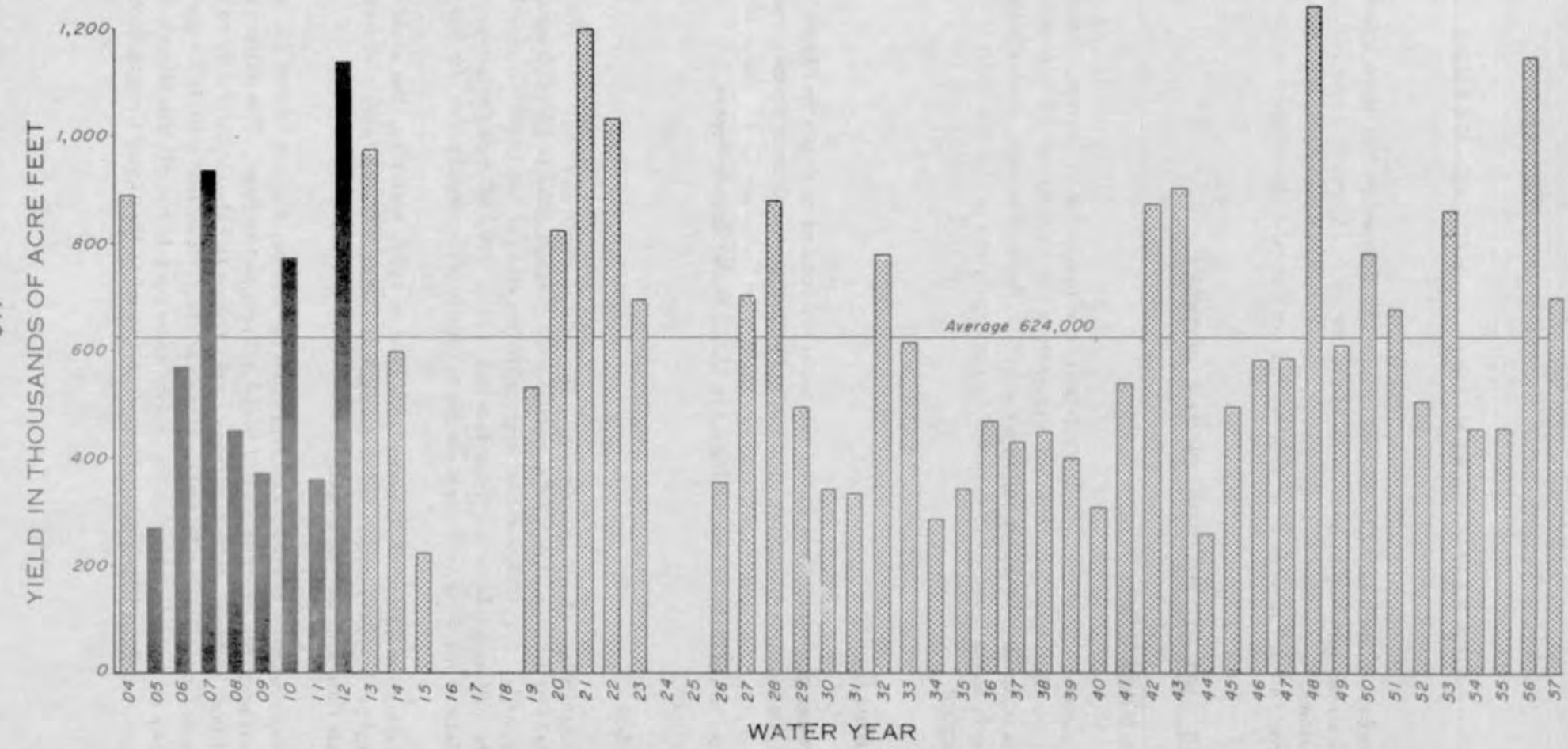
Mean monthly discharges at Elgin and La Grande, Figures 34 and 13, show the distribution of the average annual yield with respect to time. The pattern of flow is similar at both stations, with low flows from October to February and July to September, and peak flow occurring in April. However, high flows last a little longer at Elgin than they do in La Grande due to heavier snow pack in the Middle Grande Ronde sub-basin resulting from higher elevations as compared to the Upper Grande Ronde. Average

Figure 33

ANNUAL YIELD

GRANDE RONDE RIVER NEAR ELGIN

DRAINAGE AREA 1400 SQ. MI.



From U.S.G.S. Water Supply Papers

From Correlations

Drawn 5-5-59

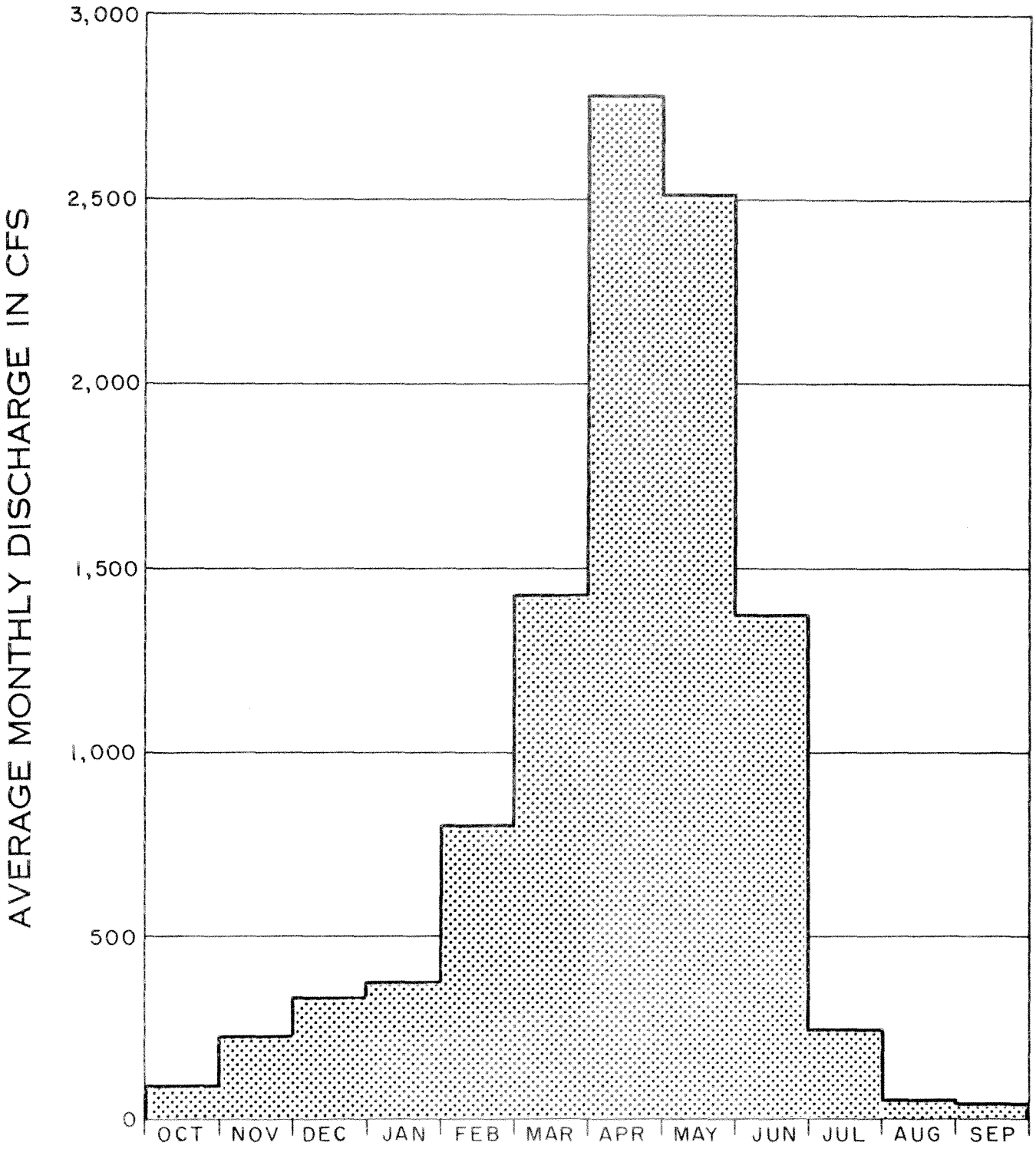
Grande Ronde

File No. 8.220

DISCHARGE

GRANDE RONDE RIVER NEAR ELGIN

1904 - 1957



Drawn 6-2-59

Grande Ronde

File No. 8.202

Figure 34

monthly discharge at Elgin for April, the month of peak discharge, is about 2,800 cfs while the average discharge for September, month of lowest flow, is about 50 cfs.

Discharge characteristics for 1940, minimum discharge water year at the La Grande gaging station, is shown in Figure 28. Minimum discharge of less than four cfs occurred on August 26.

Flows in Catherine Creek near Union for 1955, minimum discharge water year, is shown in Figure 35. The minimum recorded discharge of 6.5 cfs occurred on February 4.

Flood and drought frequency curves for the Grande Ronde at La Grande are shown in Figure 29. These curves indicate that a maximum flood flow of 7,400 cfs can be expected at La Grande with an average recurrence interval of 10 years and that a minimum flow of 11 cfs for 30 consecutive days can be expected with the same frequency.

Figure 36, flood and drought frequency curves for Catherine Creek near Union, shows that a maximum flood of 1,700 cfs and a minimum flow of 15 cfs for 30 consecutive days could be expected to occur with a 10-year frequency.

Drought frequency studies for the Grande Ronde near Elgin, Figure 37, show that for an average frequency of 10 years, a minimum flow of 14 cfs for 30 consecutive days can be expected.

The recurrence interval cited in the above examples does not mean that the flow conditions will occur once in every 10 years.

AMOUNT AND DISTRIBUTION OF THE RESOURCE UNDER APPROPRIATION

Water Rights

Distribution of location of water rights in the Grande Ronde Basin is shown in Figure 8. A summary of the water rights within the Middle Grande Ronde sub-basin is given in Table 16. Total water rights exceed 1,100 cfs of which about 85 percent are for consumptive use and the remainder for nonconsumptive uses. Irrigation is the principal consumptive use and power the main nonconsumptive use. Water rights for domestic, industrial, municipal, and fish life total only about 17 cfs.

Almost all of the industrial water rights are located on the Grande Ronde near La Grande. Of the power rights, amounting to over 175 cfs, about 40 percent are located on Willow Creek and 30 percent on the Grande Ronde. The remaining power rights are located either on Catherine Creek or Mill Creek.

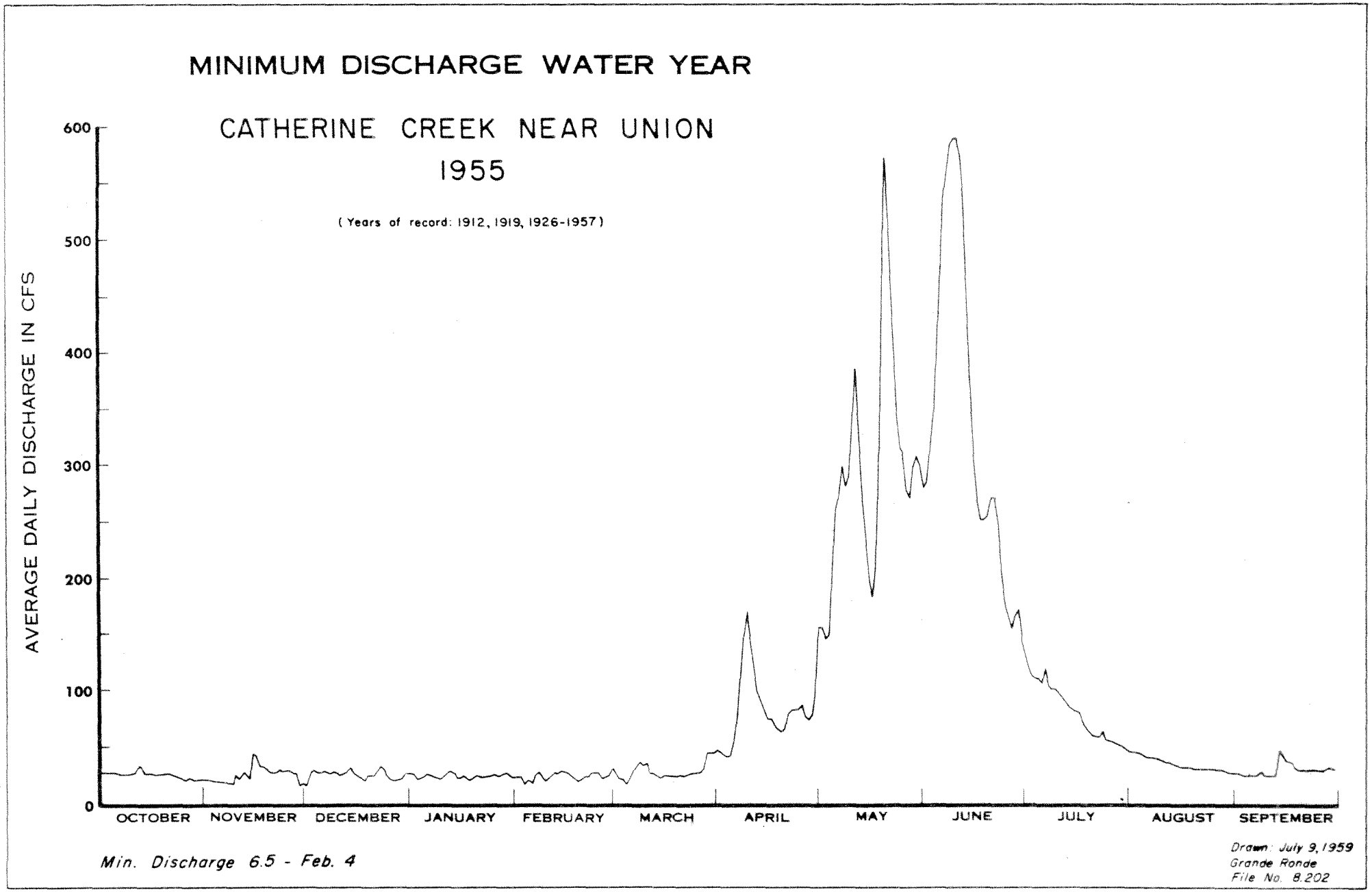
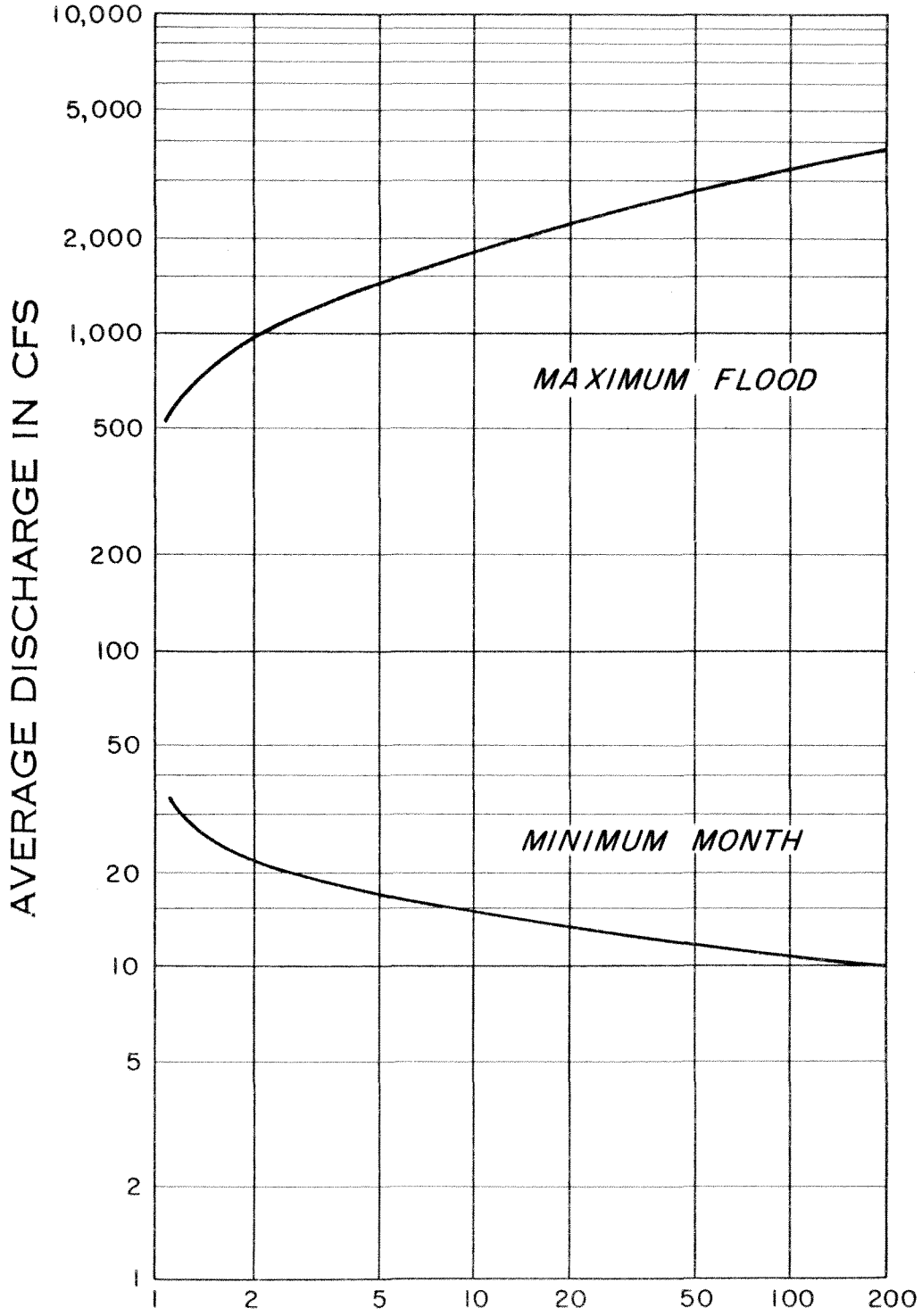

MINIMUM DISCHARGE WATER YEAR
CATHERINE CREEK NEAR UNION
1955
(Years of record: 1912, 1919, 1926-1957)
AVERAGE DAILY DISCHARGE IN CFS
600
500
400
300
200
100
0
OCTOBER
NOVEMBER
DECEMBER
JANUARY
FEBRUARY
MARCH
APRIL
MAY
JUNE
JULY
AUGUST
SEPTEMBER
Min. Discharge 6.5 - Feb. 4
Drawn: July 9, 1959
Grande Ronde
File No. 8.202

Figure 35

FLOOD & DROUGHT FREQUENCY

CATHERINE CREEK AT UNION

1912 - 1957



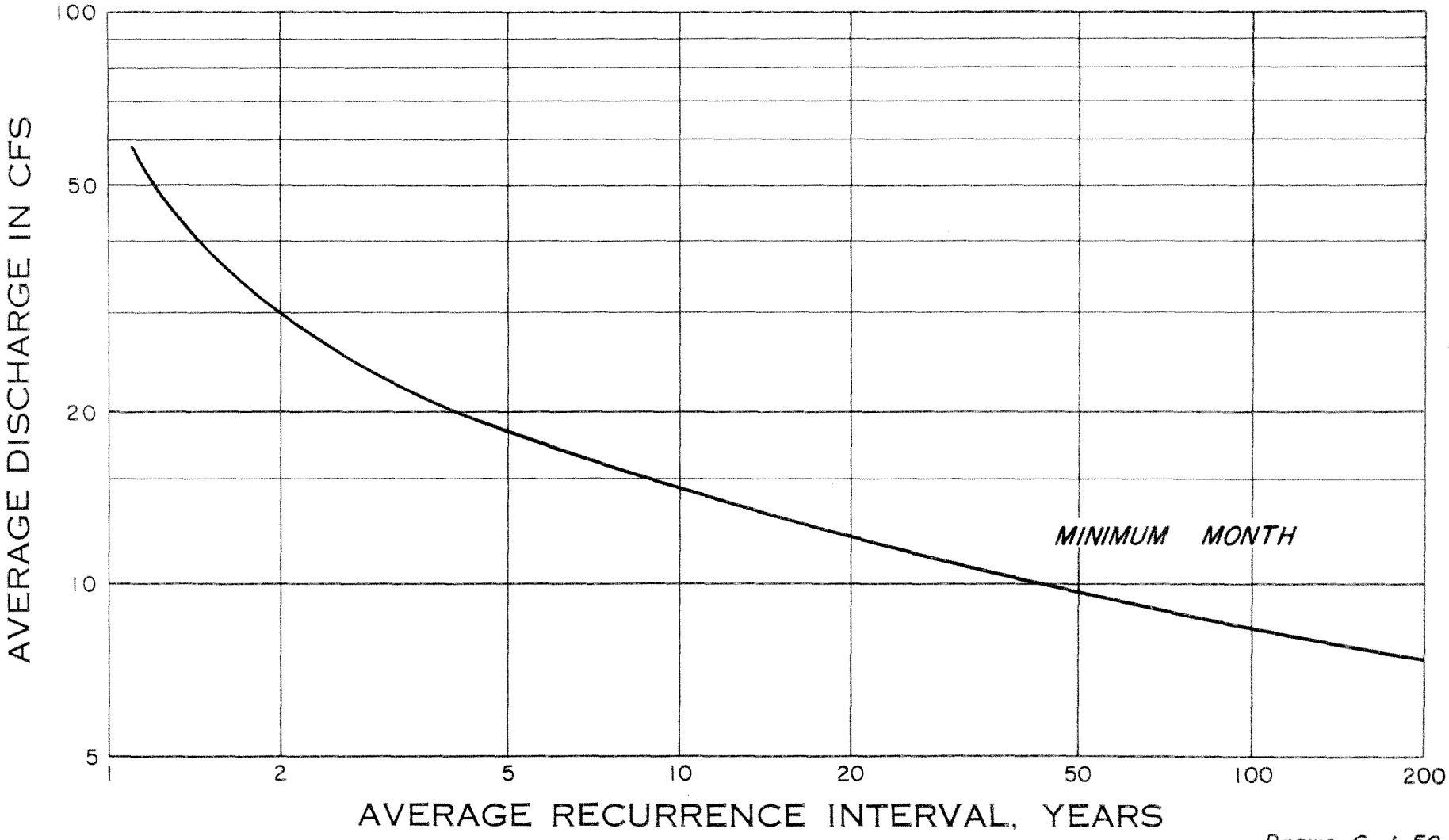
Drawn 6-1-59
Grande Ronde
File No. 8.203

Figure 36

DROUGHT FREQUENCY

GRANDE RONDE RIVER NEAR ELGIN

1904-1957



Drawn 6-1-59
Grande Ronde
File No. 8.203

Figure 37

TABLE 16

WATER RIGHTS SUMMARY*

MIDDLE GRANDE RONDE BASIN

USE	STREAM	TOTAL RIGHTS CFS	
Domestic	Catherine Creek	1.0	
	Grande Ronde River	1.7	
	Mill Creek	0.6	
	Willow Creek	0.4	
	Total Domestic		3.7
Municipal	Grande Ronde River	0.8	
	Mill Creek	0.1	
	Total Municipal		0.9
Irrigation	Catherine Creek	501.1	
	Clarks Creek	4.9	
	Grande Ronde River	315.9	
	Indian Creek	11.4	
	Mill Creek	26.5	
	Phillips	7.2	
	Willow Creek	80.6	
	Total Irrigation		947.6
Recreation	None		
Industrial	Grande Ronde River	11.8	
	Total Industrial		11.8
Power	Catherine Creek	33.6	
	Grande Ronde River	51.0	
	Willow Creek	77.2	
	Mill Creek	13.6	
	Total Power		175.4
Mining	None		
Wildlife	None		
Fish Life	Catherine Creek	0.8	
	Willow Creek	0.2	
	Total Fish Life		1.0
Pollution Abatement	None		
	TOTAL MIDDLE GRANDE RONDE BASIN		1,140.4 cfs

* As of January 1, 1959

Irrigation rights of nearly 70 cfs from Catherine Creek are for water which is diverted outside the Basin. This water is conveyed by means of Big Creek Ditch for use in the Powder River Basin.

Depletions

A depletion diagram, Figure 38, shows the maximum legal depletion rights versus stream miles in the Middle Grande Ronde. The diagram emphasizes the magnitude of consumptive rights relative to nonconsumptive rights in the sub-basin and the importance of Catherine Creek as a source of water but does not necessarily show the actual use which takes place because all rights are not exercised to their maximum or simultaneously. Also, water for nonconsumptive use becomes available for re-use at downstream locations.

EXISTING NEEDS

Domestic

Total rights for domestic usage are less than four cfs of surface flow and are distributed among the many streams in the valley floor.

Municipal

Water supply for La Grande is obtained from the Upper Grande Ronde sub-basin and only a few towns in the valley rely on the Middle Grande Ronde for their water. Total municipal rights amount to less than one cfs.

Irrigation

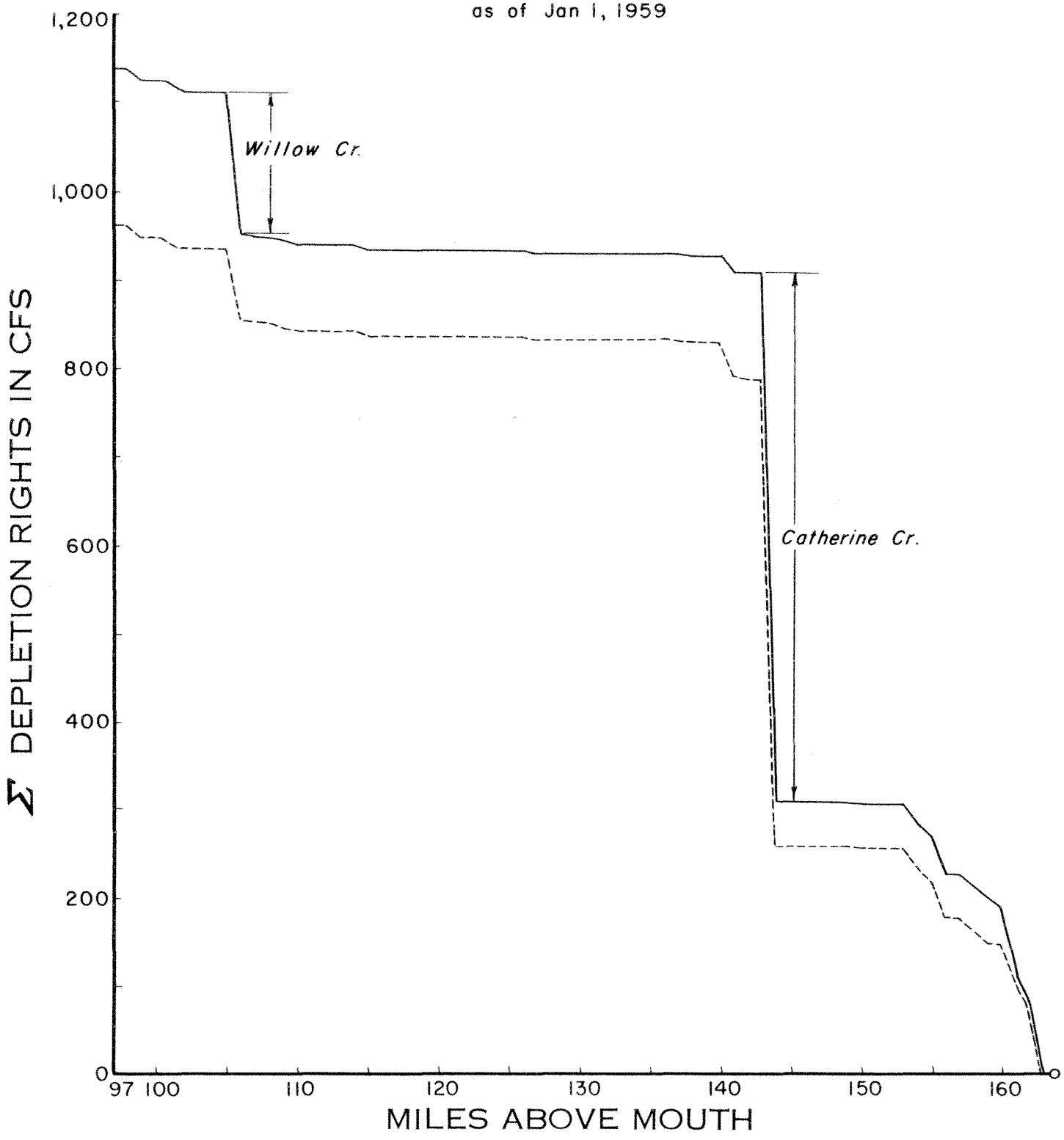
According to the Bureau of Reclamation "although a total of 26,400 acres is classed as irrigated land, not more than 3,300 acres, approximately 12½ percent, have an adequate water supply". Low streamflows during the height of the irrigation season is the main deterrent with inefficient irrigation works as a contributory cause in some areas. The county committee on agricultural uses of water agrees with these figures but adds that the water rights granted total 32,478 acres. According to the State Engineer's records, existing irrigation rights cover 46,000 acres. On the basis of the figures quoted by the Bureau of Reclamation, only one-eighth of the land classed as irrigated receive adequate water. Irrigation development in the Grande Ronde Basin is shown in Figure 5C, and irrigation lands in Figure 5.

LEGAL DEPLETION RIGHTS

BY STREAM MILE

MIDDLE GRANDE RONDE RIVER

as of Jan 1, 1959



Consumptive Rights _____

Total Legal Rights _____

Drawn 6-3-59

Grande Ronde

File No. 8.302

Figure 38

Power

Hydroelectric generation in the Middle Grande Ronde sub-basin is limited primarily to the Cove plant of the California Pacific Utilities Company which gets its supply from Mill Creek. Its installed capacity is 300 KW.

Total rights in the sub-basin for power amount to approximately 175 cfs and include miscellaneous rights on Willow and Catherine Creeks as well as the Grande Ronde River. Most Basin power is imported.

Industrial

Industrial rights, amounting to less than 12 cfs, are located almost entirely on the Grande Ronde. This water is used primarily by the timber industry for boiler and log pond needs.

Mining

There are no water rights for mining in the sub-basin. The only active mining operation is obtaining gravel from the river bed near Island City. While this operation helps to keep the river channel open by removal of the materials of deposition, it creates a pollution problem by rendering the river turbid. Location of mineral deposits and active mining operations is shown in Figure 7.

Recreation

There are no water rights for recreation use in the sub-basin. Four forest camps, two state parks, and a municipal park are located within the sub-basin, as shown in Figure 9A. Three of these parks are located on streams. According to the Recreational Water Resources Study Group, these parks are used to capacity in early summer but visitors show less interest late in the season when stream levels are low. As an example of use, Hilgard Park registered 45,000 visitors in 1957. Some of the lakes in the Wallowa Mountains are accessible from the sub-basin though only by horseback or on foot. Two lakes that are accessible by automobile are subject to legal restrictions controlling boats with motors.

Wildlife

There is considerable use of the valley by waterfowl. Principal nesting species are mallards and cinnamon teal with mallards, pintails, and teals as migrants. Due to the severe winters, the valley is not an important wintering ground.

Some mule deer inhabit the brushy areas adjacent to farm lands while the Wallowa Mountains in the southeast corner and the Blue Mountains to the north provide regular habitat for elk and deer in the sub-basin. Streamflow is adequate to meet the needs of wildlife.

Fish Life

Of the average spawning population of 20,000 spring chinook entering the Grande Ronde River, about 15 percent use Catherine Creek. Steelhead trout spawn in Catherine Creek, Indian Creek, and others and travel through the sub-basin to reach the Upper Grande Ronde.

Among the resident species, rainbow trout are the most abundant and are found in all the streams. Cutthroat and Dolly Varden are less numerous. Such warm water species as channel catfish, perch, and bass are found in some of the sloughs and ponds around La Grande.

According to the State Game Commission, the Grande Ronde becomes too low and warm in the reaches around La Grande to support much salmonoid production. In the opinion of the local sportsmen, inadequate flows during late summer prevent migration of silver salmon. Inadequate flows also cause stream water temperature to rise. Warm water temperatures, while hindering the production of salmon and trout, enhance the production of scrap fish. With the growth of scrap fish populations, the competition for food further hinders the production of game fish. Local sportsmen state that seriously inadequate flows exist in Catherine Creek from its confluence up to Union, Little Creek, Grande Ronde River from La Grande to Elgin, Indian Creek and Willow Creek. Unscreened diversions of irrigation water cause heavy loss to fingerlings.

Pollution Abatement

The only sewage treatment works in the sub-basin serves La Grande. The present process is inefficient and the effluent discharged into Mill Creek, about 2.5 million gallons a day, does not meet the desired level of treatment. Sawdust and log pond discharge is a frequent source of pollution associated with all sawmills in the sub-basin. Other industrial pollution problems are normally related to slaughter houses, meat packing, and creamery plants. Pollution to streamflow from sewers also occurs at Union and Elgin. La Grande is studying a new sewage treatment works which would greatly reduce the quantity of effluent discharged into the river and improve its quality. Treatment works are needed at Union and Elgin as well as additional sewers.

A siltation problem exists on the Grande Ronde at Island City due to sand and gravel

operations. Return irrigation water, highway construction, and logging operations are also causes of pollution.

Need for mosquito control, although not strictly a pollution problem, should be considered. The presence of mosquitos responsible for the transmission of encephalitis is presently a threat to horses and could become a human problem. Inadequate drainage and wasteful irrigation practice leads to localized accumulations of water which provide breeding places for mosquitos.

Flood Control

High velocities of flow in the upper reaches of the Grande Ronde River and Catherine Creek, combined with low velocities which characterize streamflow through the valley, result in regular flooding of valley lands. The flood problem is primarily one of land inundation but loss of land through erosion and damage to developments occur in the La Grande and Union areas. High flows are caused by the rain storms which occur during winter and spring months and by the melting of mountain snow fields due to rising temperatures during spring and early summer. The largest floods occur during the snowmelt period with Catherine Creek reaching a peak about two or three weeks later than the Grande Ronde River. The floods of April and May, 1865, and December 1881 had peaks approximating 10,000 cfs at La Grande. Two other historical floods in 1876 and 1894 had estimated peaks of 9,000 cfs and 9,500 cfs, respectively.

Investigations pertaining to irrigation uses and control of flood waters have been performed by federal, state, and local governmental agencies as well as by private interests during the past 90 years. The most recent investigations have been carried out by the Corps of Engineers who have prepared plans and cost estimates for flood protection works.

About 60,000 acres of agricultural land is subject to flooding and the average annual damage from floods was estimated in 1950 to approximate $582,000 of which about $504,000 occurs in the agricultural area. Flood protection measures proposed consist of levees and channel improvements in combination with storage. An essential part of channel improvement is the removal of the constriction to flow existing in the channel at the lower end of the valley.

Drainage

Much of the area subject to flooding also has drainage problems and the two water control problems are closely related. The practice of over-irrigating early in the season when a lot of water is available adds to the drainage problem since the ground usually is already saturated, or nearly so, from rains and runoff.

FUTURE NEEDS

Domestic

Supplies from streamflow are adequate for future needs.

Municipal

Supplies are adequate for future needs. La Grande, the major municipal user, obtains part of its supplies from Beaver Creek in the Upper Grande Ronde sub-basin and the remainder from wells. Beaver Creek runoff is adequate but the distribution system from the reservoir is too small to meet the demand during peak demand periods.

Irrigation

The Bureau of Reclamation has published proposals for irrigation works in the Grande Ronde Valley consisting of two storage reservoirs, on the Grande Ronde River and Catherine Creek, and related facilities to supply an adequate quantity of irrigation water to an area of about 59,000 acres. Approximately 75 percent of this area would be provided with irrigation water from the Grande Ronde and the balance with supplies from Catherine Creek supplemented by water from Little, Warm, and Mill Creeks. The reservoirs proposed would be multi-purpose use including storage to minimize floods. Irrigation lands and irrigation development are indicated in Figures 5 and 5C.

Power

Because the major portion of this sub-basin is occupied by the Grande Ronde Valley, the potentials for power development are greatly reduced. Reported potentials for hydro installation are limited to Catherine and Indian Creeks. The FPC Report of 1957* lists only one project, that on Indian Creek with a possible installed capacity of 2,700 KW from a 616-foot head. This development was originally examined by the Bureau of Reclamation in connection with irrigation studies. At the time of the Bureau study, it was determined that benefits were not sufficient to justify the inclusion of power facilities.

Potential for power facilities in connection with an irrigation facility on the Little Minam

* Hydroelectric Power Resource of the United States - Developed and Undeveloped - 1957 - Federal Power Commission

River and utilizing the existing Cove plant were examined by the Bureau of Reclamation and reported on briefly in 1941*. Nothing has materialized on this project which involves multi-purpose use facilities.

Also examined for power potential was the possible Catherine Creek Project. In 1941, the Bureau of Reclamation's conclusion was that "storage capacity at the Catherine Creek site is too costly to justify providing additional storage for power use, or for increasing dead storage to increase the power head". The plan of development outlined in the report, "Grande Ronde Project, Oregon", March 1955, by the Bureau of Reclamation, did not recommend any power facilities in connection with recommended irrigation development.

Reconnaissance studies indicate the unregulated prime flow at the Catherine Creek site to be only 19 cfs. A project with a hydraulic height of 121 feet utilizing 11,200 acre-feet of active storage from a gross of approximately 16,000 acre-feet would increase prime flow from 19 to 45 cfs. A flow of 45 cfs would give a prime flow of approximately 0.3 of a megawatt at site and only 2.5 megawatts at Snake and Columbia River plants.

Utilizing all physical feasible head and average monthly flow, monthly outputs would theoretically vary from 1,500 to 28,000 KW for this sub-basin (see Figure 39). The theoretical average annual energy on this basis would be about 22,000,000 KWH, about two percent of the Grande Ronde theoretical maximum potential.

Industrial

Expansion of timber processing in the area would require an increased supply of industrial water as well as either greater summer flows or waste treatment for pollution abatement. Development of a small pulp mill in the area may become economically feasible but the problem of effluent disposal from such a mill would be a serious problem. Other types of major water-using industrial development is possible in connection with food processing.

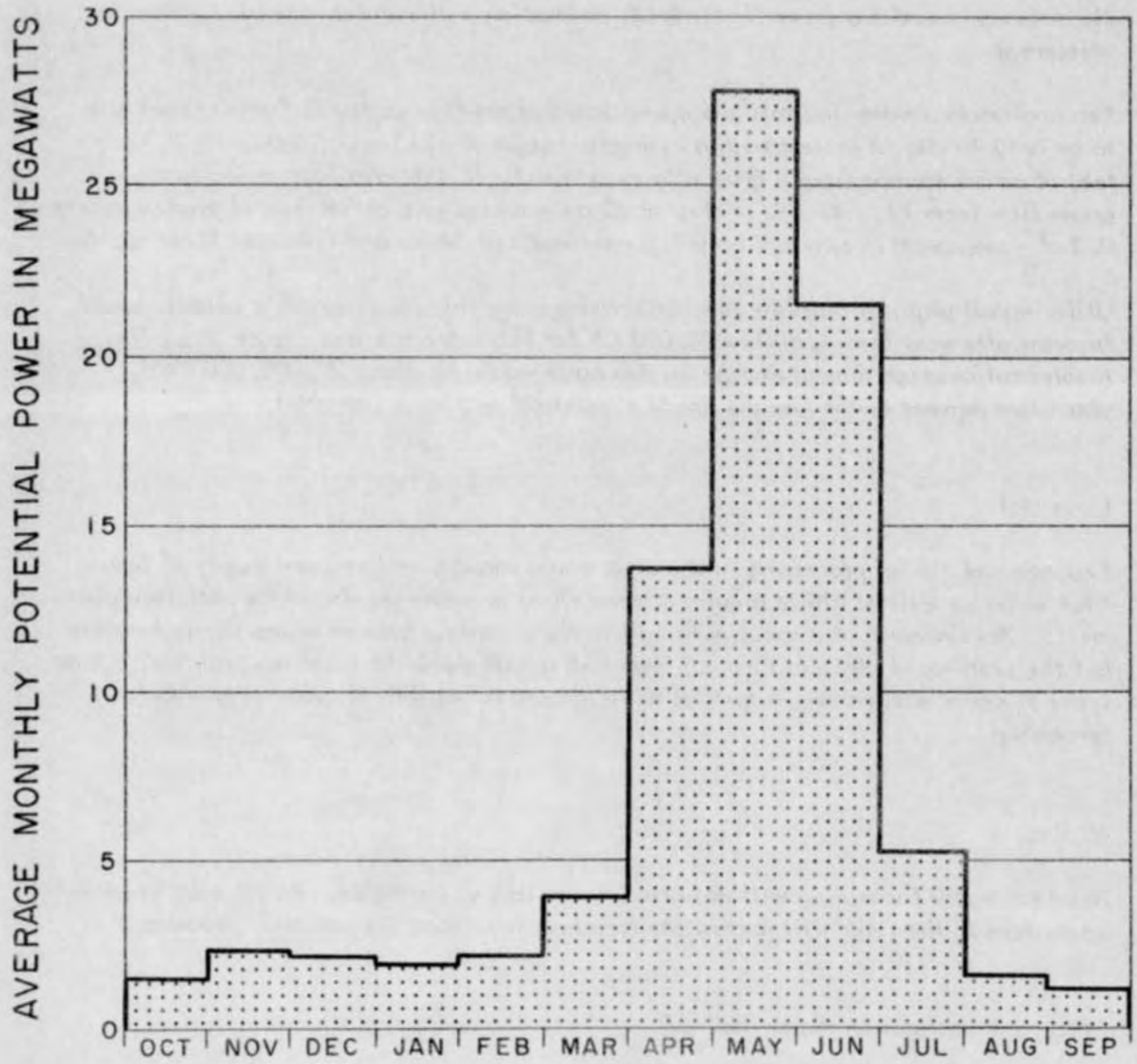
Mining

Need for water for mining will not arise due to lack of potential. An increase in gravel operations in the river will necessitate measures to combat the pollution problem.

* Project Investigation Report No. 57

POTENTIAL POWER

MIDDLE GRANDE RONDE SUB-BASIN



Drawn 8-12-59
Grande Ronde
File No. 8.1046

Figure 39

Recreation

Future recreational needs will require the preservation and enhancement of fish and wildlife. Increasing interest shown in boating and water sports indicate that reservoirs constructed in or near the sub-basin would be beneficial to the area.

Wildlife

Streamflow is adequate to meet the future needs of wildlife. Implementation of proposed flood protection will tend to reduce the numbers of fur-bearing animals and waterfowl.

Fish Life

The dominant anadromous species in the Middle Grande Ronde Basin are the chinook salmon and steelhead trout.

Of the estimated 20,000 spring chinook entering the Grande Ronde River, it is estimated that approximately 15 percent spawn in Catherine Creek in the Middle Grande Ronde sub-basin. Below La Grande, chinook have been observed only in Indian Creek.

There is evidence of relatively recent presence of silver salmon in Catherine Creek by virtue of fingerlings collected in 1953.

Potential exists for the enhancement of salmon population in this sub-basin. Important among possibilities is the introduction of fall spawning chinook. From Gordon Creek to Indian Creek, spawning possibilities for at least 400 redds exist. Supplementing aids are incubation stations and rearing impoundments.

Potentials exist for the transplantation of silver salmon into Spring, Indian, and Clark Creeks. Other activities, including obstruction removal, screening, and stream shading, will be desirable.

Transplantations do not seem to offer any additional potential for Catherine Creek because of the already established populations of salmon and steelhead. Improvements in existing population could come through additional diversion screening, stream shading, and rearing impoundments.

Little data is available relating to steelhead trout or resident fish in this sub-basin.

Pollution Abatement

Population trends show a decline in the rural areas and an increase around La Grande, the overall result being to maintain a steady population in the sub-basin. The rate of increase in the La Grande area is not of sufficient magnitude to pose a sewage pollution problem much greater than that which presently exists and the same is true of other areas in the sub-basin.

Flood Control

Need for flood control and the conservation of water for multi-purpose use will continue to exist in the valley. Flood protection that is consistent with future water utilization will require a combination of channel improvement, levees, and upstream storage.

Drainage

Drainage problems will be helped, to some degree, by providing adequate flood protection. Better irrigation practices will also help to alleviate drainage problems. Water control problem areas in the Basin are outlined in the generalized plot of Figure 10.

SECTION 3 LOWER GRANDE RONDE BASIN

GENERAL DATA

Location

The watershed of the Grande Ronde below river mile 96, with the exception of the watershed of the Wallowa River and tributaries, together with the area drained into the Snake River between Imnaha Rapids and the mouth of the Grande Ronde, is defined, for the purpose of this report, as the Lower Grande Ronde sub-basin.

It is bounded on the north and the west by the Blue Mountains, while the Snake River and the watershed of the Imnaha forms the eastern boundary. The southern boundary is the watershed of the Wallowa River. Figure 40 shows the entire sub-basin stream system.

Size

This is the largest sub-basin covering an area of 1,837 square miles and occupying 35 percent of the entire Grande Ronde Basin. The actual Grande Ronde River drainage for this sub-basin totals approximately 1,620 square miles. It includes parts of six counties, some located in Washington.

About 1,233 square miles or 67 percent of the sub-basin lie in Wallowa County, and 245 square miles or 13 percent in Union County. About 10 square miles on the headwaters of Lookingglass Creek fall within the boundary of Umatilla County, bringing the total sub-basin area within the State of Oregon to 1,488 square miles. The balance, 249 square miles, is shared among Asotin, Columbia, and Garfield Counties of Washington.

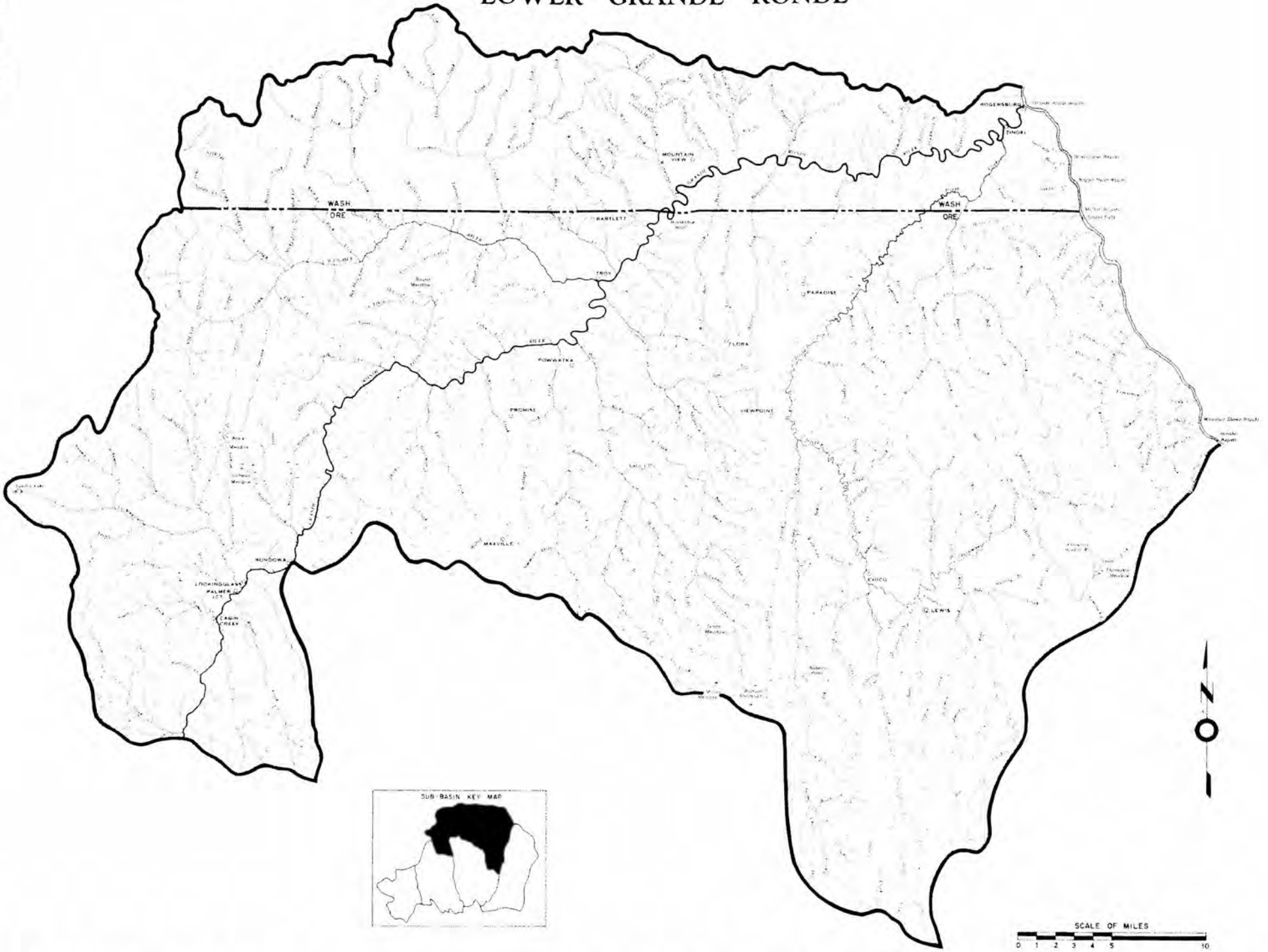
The main stem of the Grande Ronde below mile 96 together with the major and minor tributaries in the sub-basin, including those flowing directly into the Snake River, total more than 1,900 stream miles which is nearly 34 percent of the total stream miles in the Grande Ronde Basin. Wenaha River with a length of 30 miles and Joseph Creek with 75 miles are the two main tributaries of the Lower Grande Ronde. Of the minor tributaries, Lookingglass Creek with a length of 15 miles and Mud Creek with 20 miles are the most significant.

Geology

Limited information is available concerning the geology of a large part of this sub-basin. Miocene Columbia River basalt is the predominant rock type and is believed to cover the

Figure 40

LOWER GRANDE RONDE



greater part of the area not overlaid by alluvium. These basalts contain relatively thin interlayers of other volcanic and pyroclastic rocks such as andesite and tuff. The individual basalt flows generally range from 10 to 50 feet in thickness, but may attain thicknesses of 150 feet or more. Some exposures reveal 20 or more separate flows. The basalt sometimes cools to form columnar structures, whereas the andesite often cools in the form of plates.

The geologic structure of the sub-basin is believed to be essentially one of alternating synclines and anticlines (troughs and arches) cut by northwest trending faults. Both structures characterize this part of Northeastern Oregon. The Grande Ronde River follows in a northeasterly direction what may well be a synclinal trough or a down-dropped fault block or graben.

Ground water may be found between the Columbia River basalt flows wherever coarse sand, gravel, or boulders accumulated to form a permeable zone. Seepage from these water-bearing interflow zones, where they have been opened by down-cutting streams, helps to sustain summer flow in many drainage routes. The lacustrine or lake bed deposits filling much of the Elgin Valley, in the extreme southwesternmost part of the sub-basin, are not good aquifer materials. They consist of medium-to-fine-grained sand with much silt and clay that provide but little pore space for the movement of water.

The only known mineral occurrence in this sub-basin is a copper deposit in the northeastern part. As no information concerning it is available, it is believed to be of minor importance.

Topography

The lowest point in the sub-basin, elevation 800, is at the confluence of the Grande Ronde and Snake Rivers. Oregon Butte (elevation 6,401) on the headwaters of Crooked Creek in the Blue Mountains is the highest point. Many peaks with elevations higher than 5,000 feet exist in the Blue Mountains on the northern boundary and a few on the southern boundary in the headwaters of Joseph Creek.

The topography of the sub-basin follows the general pattern of the Grande Ronde Basin. It consists of a plateau at an elevation of 3,500 feet to 4,500 feet which is dissected by deep canyons. The Blue Mountains on the northern boundary of the watershed form a continuous ridge running east-west having an elevation of more than 5,000 feet. Terrain over most of the sub-basin is characterized by steep canyon slopes making the land generally unsuitable for crops.

The main stem of the Grande Ronde enters the sub-basin at its southwestern corner and flows in a general northeasterly direction until it enters the State of Washington. From

here its direction of flow changes to an easterly course to its confluence with the Snake River at Rogersberg.

Drainage areas of the two major tributaries, Wenaha River and Joseph Creek, occupy 45 percent of the Lower Grande Ronde drainage proper. If Lookingglass Creek is included, the three tributaries together make up 50 percent. The valleys and canyons in which Joseph Creek and its tributaries flow have, for the most part, a north-south orientation. The western limits of Joseph Creek drainage system is a ridge which forms a significant, though secondary topographic feature. The deep canyon that has been cut by the Grande Ronde is the most significant topographic feature in the sub-basin.

The bed of the Grande Ronde drops 1,800 feet in the course of the 96 miles through the sub-basin. The gradient averages 19 feet per mile throughout this distance. While the river bed is dropping in the course to the Snake River, the elevation of the plateau remains fairly constant. Therefore, the depth of the river valley progressively increases with a consequent reduction in the area of the plateau.

Crow Creek and Chesnimnus Creek, tributaries of Joseph Creek, have steep average gradients of about 50 feet drop per mile. This feature is maintained with a slight reduction by Joseph Creek below Chico. The creek drops 1,880 feet between Chico and the state line, a distance of 40 stream miles, and the gradient averages 49 feet of drop per mile. In the 7.6 miles from the state line to the Grande Ronde, the stream gradient increases with a total drop of 460 feet and a gradient of 60.5.

Tributaries of the Wenaha River, flowing down the steep slopes of the Blue Mountains, have correspondingly steep gradients. The Wenaha itself falls approximately 1,600 feet in 21 miles from the confluence of the forks to the Grande Ronde at Troy with a relatively steep gradient of 76 feet per mile.

Figure 2 is a profile of the Grande Ronde stream system.

Climate

Average annual precipitation in the sub-basin ranges from 12 inches on the headwaters of Joseph Creek to over 50 inches on parts of the Blue Mountains. Long-term air temperature and snow data for the sub-basin are not available.

Population

Of the estimated sub-basin population of 700, about 75 live in Flora, 50 in Troy, 35 in Maxville, and 20 in Lookingglass. The balance are scattered throughout the sub-basin.

Land Ownership

The Forest Service and the Bureau of Land Management control 971 square miles representing about 53 percent of the sub-basin area. Almost the entire drainage basin of the Wenaha River and half of Joseph Creek are included in federal lands. Public domain and state lands cover about 20 square miles. About 70 square miles of agricultural land exist in the portion of the sub-basin falling within Union County. Figures relating to Wallowa County are not available. Federal, state, and public land ownership for the Basin is summarized in Table 4.

Transportation Facilities

Despite the scarcity of population, the sub-basin has an extensive system of secondary roads. State Highway 3 from Enterprise to Lewiston, Idaho follows the ridge on the western end of the Joseph Creek drainage area. An important access road into the sub-basin, it forms a base for a number of dirt roads serving upland areas.

State Highway 82 from Elgin to Enterprise cuts through a small portion of the sub-basin at the western end. These two highways are the only paved roads within the sub-basin with the exception of about two miles of State Highway 204 lying near Landon Lake on Lookingglass Creek.

An improved gravel road linking Elgin with Troy and following the canyon of the Grande Ronde to meet State Highway 3 is the most important of local roads. Other improved roads connect the few small communities found in the sub-basin.

A number of unimproved roads serve the area between Joseph Creek and the Snake River. Drainage areas of the Wenaha River, Lookingglass Creek, and Joseph Creek below Chico have no roads.

A short stretch of the Oregon-Washington Railroad and Navigation Company's branch line from La Grande to Enterprise follows the course of the Grande Ronde upstream from Rondowa.

State Highway 82, a short stretch of which crosses the western end of the sub-basin, is the only road in the area having regular bus service. On the other roads, passenger services are limited to charter and irregular trips. Freight facilities follow the same pattern, regular service on State Highway 82 and charter service on other roads.

Present Economy

Sub-basin economy is based on timber operations supported by stock raising and dry

farming. Saw timber consisting of ponderosa pine and larch covers about 40 percent of the sub-basin.

AMOUNT AND DISTRIBUTION OF THE RESOURCE

Precipitation Data

Precipitation data are available from a climatological station about 16 miles from Enterprise which was opened in June 1958. Hourly precipitation observations are made at Tollgate but not continuously. In the past, precipitation records were kept for short periods at Fry Meadow Ranger Station, Troy, and Wallowa but much of the data are not available in published form and those stations are now inactive.

Average annual precipitation for the Basin was shown in Figure 3, and precipitation in the sub-basin is discussed under Climate. Climatological stations are located as shown in Figure 11.

Stream Gaging Stations

Two stream gaging stations are active in the sub-basin, both on the Grande Ronde River. The earlier of the two was established at Rondowa in 1927, the other at Troy in 1944. A gaging station was active on the main stem at Zindel from 1904 through 1913. Streamflow records were kept on Joseph Creek at Chico from 1931 through 1933. The location of these stations is shown in Figure 11. Stream gaging records are published in Water Supply Papers of the U. S. Geological Survey.

Yields

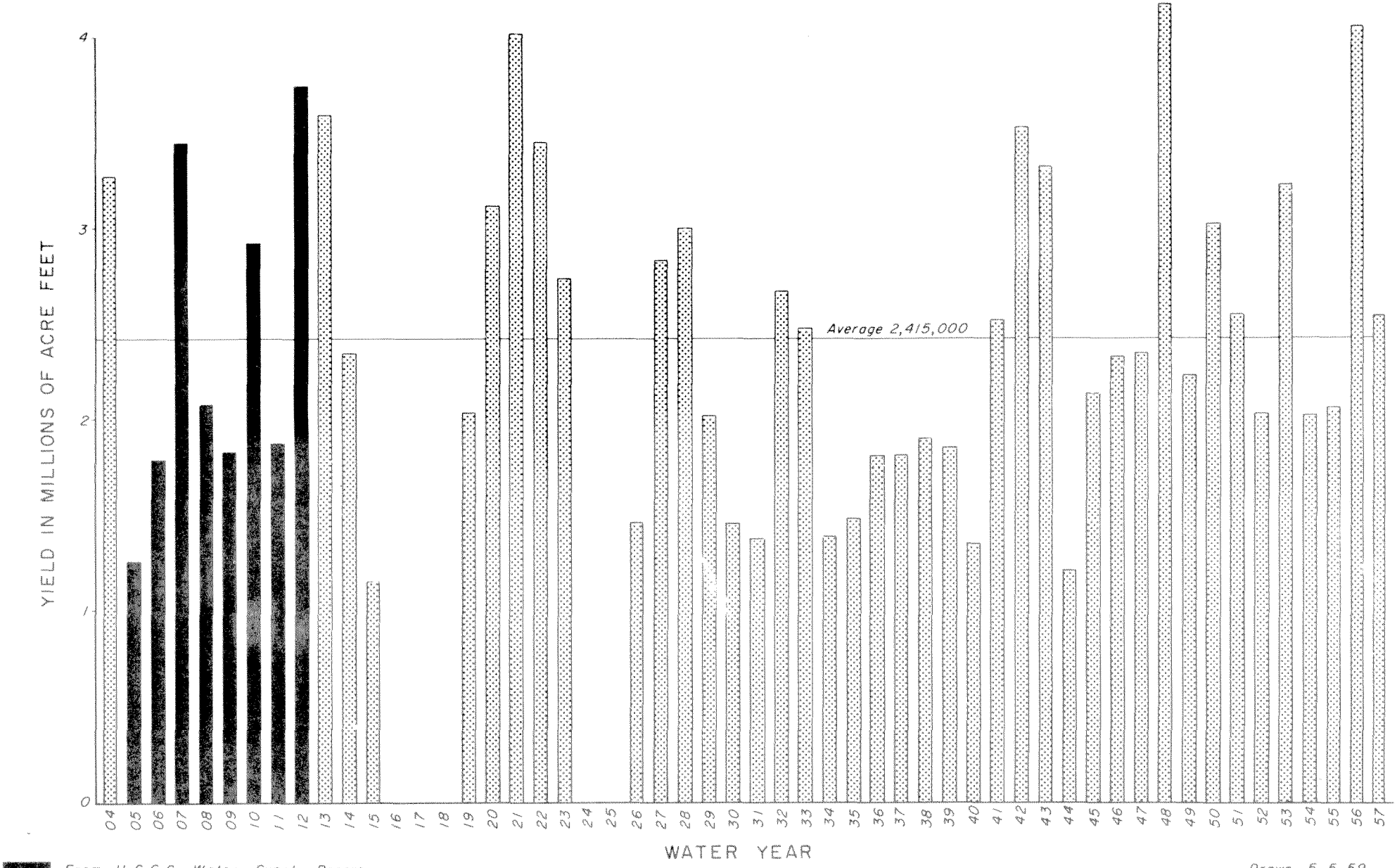
Annual yields of the Grande Ronde at Zindel is shown in Figure 41. Drainage area at this point is 3,950 square miles which is nearly the entire area drained by the Grande Ronde River proper and its tributaries. Yield values were based on correlations except for the period 1905 through 1912 when they were based on actual measurements recorded in Water Supply Papers of the U. S. Geological Survey. Average annual yield of the Grande Ronde at Zindel is estimated at 2,415,000 acre-feet. Maximum estimated yield, 4,170,000 acre-feet, occurred in 1948 and minimum estimated yield, 1,150,000 acre-feet, in 1915.

Mean monthly discharges of the Grande Ronde at Zindel are shown in Figure 22. The plot shows the distribution of the average annual yield with respect to time. The characteristic pattern in the Grande Ronde is high flows from March through June and low flows

ANNUAL YIELD

GRANDE RONDE RIVER AT ZINDEL

DRAINAGE AREA 3950 SQ. MI.



From U.S.G.S. Water Supply Papers

From Correlations

Drawn 5-5-59

Grande Ronde

File No. 8.220

Figure 41

the rest of the year. Maximum flows at Zindel occur in May while April is the month of maximum flows at Elgin and La Grande. This is due to later peak flows on the Wallowa River resulting from later snowmelt. Minimum flows at Zindel occur in September and average 800 cfs.

Drought frequencies for the Grande Ronde River at Zindel, Figure 42, indicate that an average flow of 415 cfs for at least one month occurs with an average recurrence interval of 10 years.

AMOUNT AND DISTRIBUTION OF THE RESOURCE UNDER APPROPRIATION

Water Rights

In keeping with the undeveloped character of the sub-basin, the water rights are negligible both in number and in quantity. Water rights for nonconsumptive uses do not exist and only 15.3 cfs have been appropriated for consumptive use. Of this amount, 13.5 cfs are for irrigation while 1.5 cfs and 0.3 cfs are for domestic and industrial uses, respectively, as shown in Table 17. The majority of water rights for irrigation use are in the Gordon Creek area in the southwestern corner of the sub-basin. This area is influenced by the agricultural development of the adjacent Grande Ronde Valley. A few irrigation rights exist on Crow Creek and Upper Joseph Creek.

Depletions

A comparison of total and consumptive legal depletion rights for the Lower Grande Ronde is shown in Figure 43. As the plot indicates, nearly the entire depletion in the lower river system occurs in the major tributary, the Wallowa River, and depletion within the Lower Grande Ronde sub-basin proper is negligible.

EXISTING NEEDS

Domestic

Rights for domestic consumption are too low to be of significance.

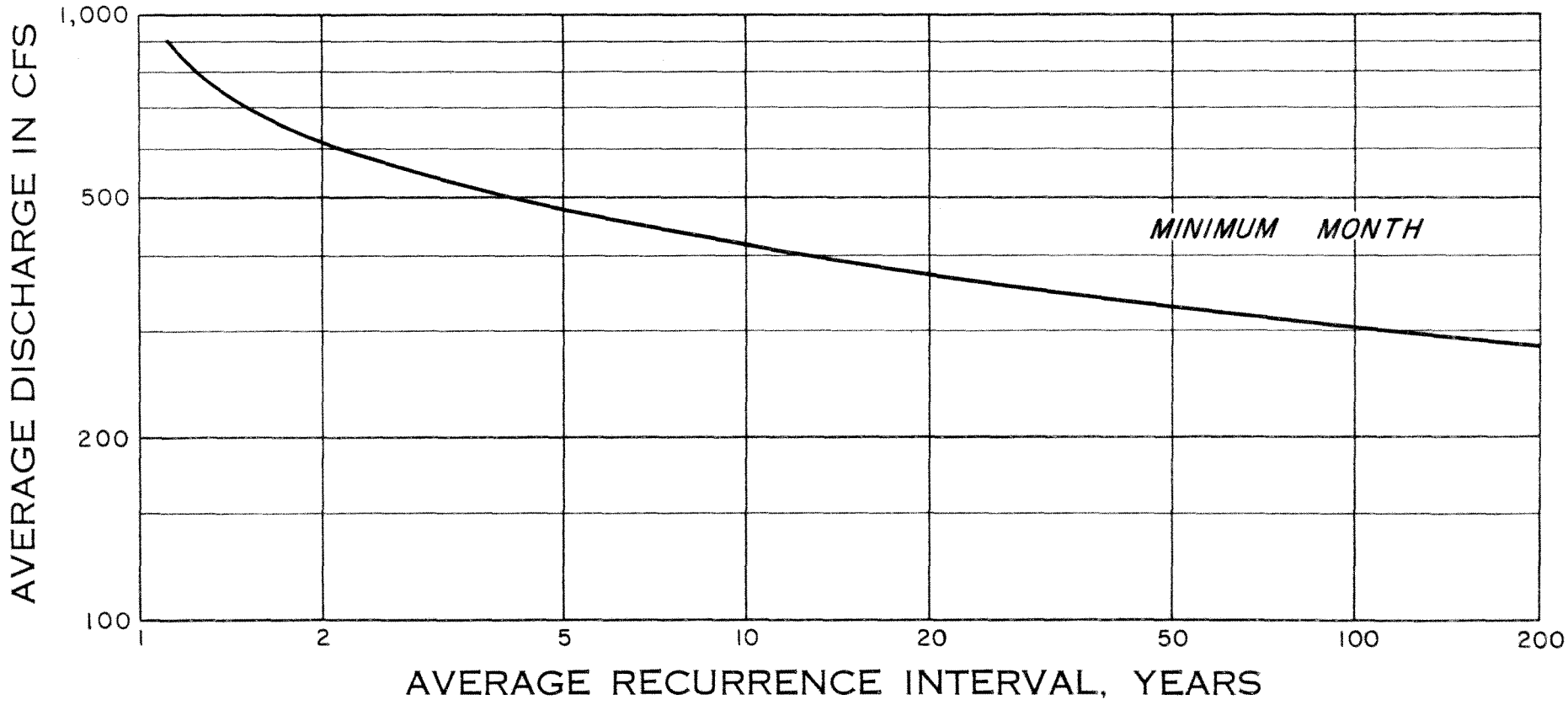
Municipal

No water rights for municipal use exist in the sub-basin.

DROUGHT FREQUENCY

GRANDE RONDE RIVER AT ZINDEL

1904 - 1957



Drawn 6-1-59
Grande Ronde
File No. 8.203

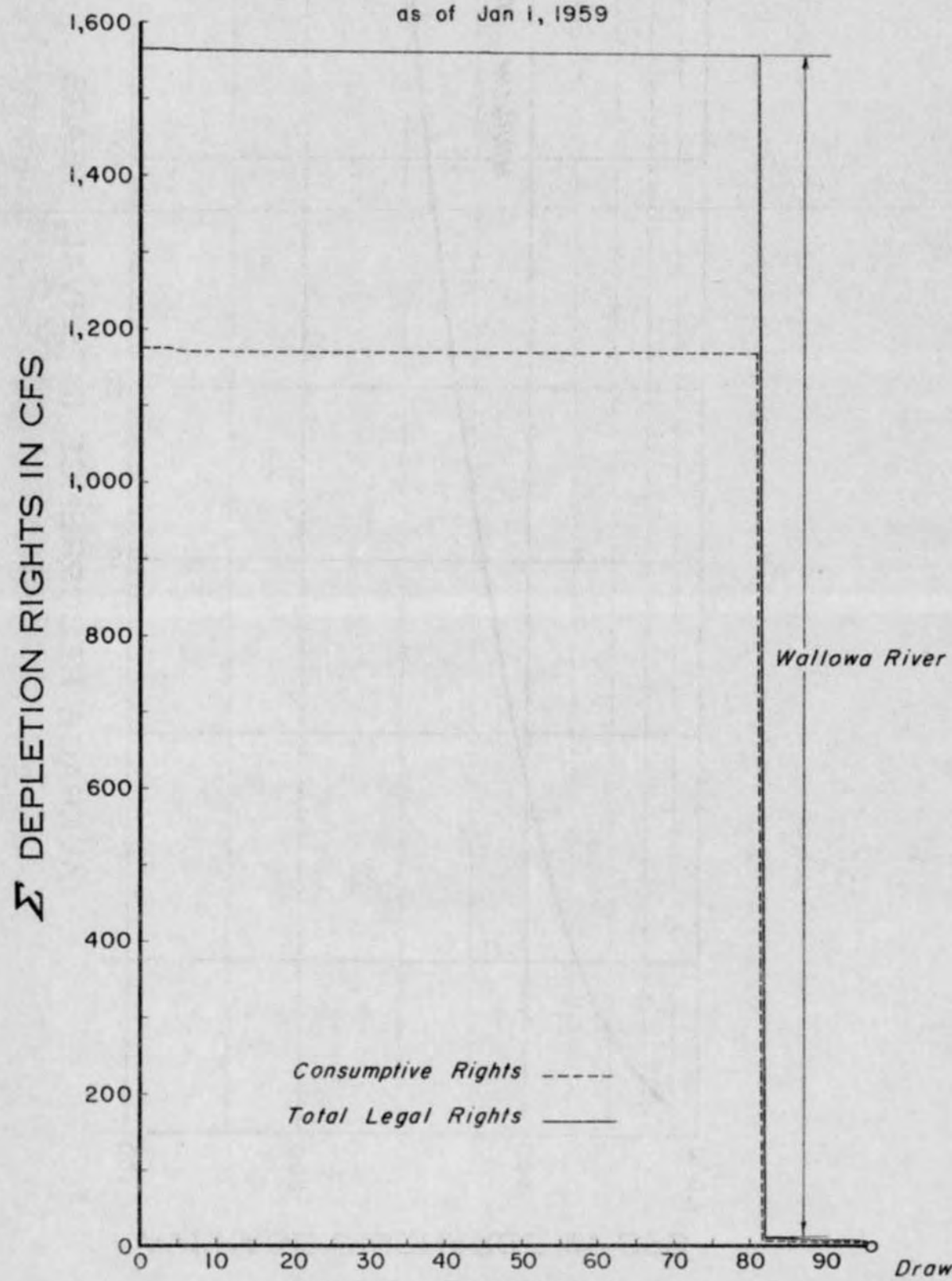
Figure 42

LEGAL DEPLETION RIGHTS

BY STREAM MILE

LOWER GRANDE RONDE RIVER

as of Jan 1, 1959



Drawn 6-3-59
Grande Ronde
File No. 8.302

Figure 43

TABLE 17

WATER RIGHTS SUMMARY*

LOWER GRANDE RONDE BASIN

USE	STREAM	TOTAL RIGHTS CFS	
Domestic	All		1.5
Municipal	None		
Irrigation	Grande Ronde River	5.4	
	Gordon Creek	5.0	
	Joseph Creek	3.1	
	Total Irrigation		13.5
Recreation	None		
Industrial	All		0.3
Power	None		
Mining	None		
Wildlife	None		
Fish Life	None		
Pollution Abatement	None		
	TOTAL LOWER GRANDE RONDE BASIN		15.3 cfs

* As of January 1, 1959

Irrigation

Water rights for 13.5 cfs have been established to irrigate 910 acres. These rights represent an annual use of 4,100 acre-feet if they were exercised simultaneously during the period May 15 - October 15. Compared to the average annual yield of the sub-basin, 1,012,000 acre-feet, irrigation use of water is minor.

Power

No power rights exist in the sub-basin.

Industrial

Present industrial use of water in the sub-basin is negligible.

Mining

No mining rights exist in the sub-basin.

Recreation

No water rights exist for recreation use. Fishing and hunting are popular recreational activities in the sub-basin. There are 15 forest camps, 1 state park, and 2 ski resorts in the sub-basin located as shown in Figure 9A.

Wildlife

Consumptive use of water by wildlife is negligible in terms of quantity but, nevertheless, is very important because of the value of the wildlife resource.

The Wenaha Game Management Project was initiated in 1953 to provide a 17,652-acre winter range for elk and deer that occupy the Wenaha watershed. About 6,700 acres of the project areas have been acquired by the State Game Commission and about 400 acres have been tilled and planted to pasture in order to provide winter range for herds which helps to alleviate conflicts with agriculture. These ranges serve about 1,500 elk and many deer.

Fish Life

With 96 miles of the Lower Grande Ronde included in the sub-basin, all anadromous fish runs in the Grande Ronde stream system pass through at least a part of this sub-basin. Fish runs and spawning grounds are significant features of the sub-basin and are of importance to the entire Basin.

In 1958, the runs were estimated at 20,000 spring chinook, 2,000 fall chinook, 22,500 steelhead trout and a small run of silver salmon. Spawning ground surveys indicated that 20 percent of the spring chinook spawn in the Wenaha River and 15 percent in Lookingglass Creek. Both streams head in the Blue Mountains. Due to the undeveloped state of the Wenaha River and Lookingglass Creek drainage areas, fish runs in these streams have adequate quantities of water of suitable quality.

Pollution Abatement

Pollution abatement problems are minor due to the low density of population and low level of development.

Flood Control

No flood control problems exist in the sub-basin.

FUTURE NEEDS

Domestic

Supplies from surface runoff are adequate for future needs since the potential for an increase in population is limited.

Municipal

There is very little potential for municipal use of water.

Irrigation

Potentially irrigable land in the sub-basin is very limited in area and, if developed, will not create a significant demand for water. Supplies in the perennial streams are adequate to meet any future needs for irrigation use.

Power

Profile maps of the Grande Ronde River, prepared by the U. S. Geological Survey, show that this stream drops 1,800 feet in its course through the Lower Grande Ronde sub-basin. Indications are that something in excess of 1,650 feet of the head in this stretch could be developed for power generation. Some plans indicate a slightly greater head potential. The portion of the Grande Ronde River Basin encompassed in the sub-basin offers the greatest potentials for hydroelectric for any section of the stream system. Studies looking to potential development of this reach of the Grande Ronde have been made by the U. S. Geological Survey and the U. S. Army Corps of Engineers.

In its most recent report entitled, "Water Utilization in the Grande Ronde River, Oregon and Washington", by R. O. Helland, dated 1947, four alternatives of development of the Lower Grande Ronde River are outlined. These plans in general are as follows:

Plan A - Use of all residual flow for power at sites on the Grande Ronde, Snake, and Columbia Rivers.

Plan B - Diversion to Walla Walla Basin for power and irrigation.

Plan C - Diversion to Umatilla River Basin for power and irrigation.

Plan D - Plans B and C combined.

Plan A is the plan which would result in the greatest power development for the reach of the river under consideration in this sub-basin and briefly is as follows: It involves the construction of a dam between 320 and 350 feet high below Rondowa with nearly 360,000 acre-feet of storage and a dam about 300 feet high at the Rays Ferry site to develop nearly 200,000 acre-feet of live storage. Supplementing these two storage reservoirs would be a series of eight additional dams ranging from 65 to 135 feet in height with short conduits in order to develop the remaining head between the Rondowa site and elevation 885 feet mean sea level.

The potential of this combination from natural flow is estimated at 22,000 KW. With the regulation available from the storage sites at Rondowa and Rays Ferry, it is estimated that the output of approximately 90,000 KW would be available for one hundred percent of the time. The report indicates that an estimated 1,550 second feet of regulated flow from the Grande Ronde River, that is below Rays Ferry, could be available through 885 additional feet of head in the Snake and Columbia Rivers, yielding an approximate additional 82,000 KW of continuous power. The total value of Grande Ronde flow for the sub-basin and for the lower rivers would accordingly be 172 KW.

Plans B and C, which involve the use of much of the flow for irrigation out-of-basin, would result in a lesser development of the power potential of this sub-basin.

In the recent report of the Division Engineer, Corps of Engineers, North Pacific Division, entitled "Water Resource Development Columbia River Basin", dated June 1958, the Major Water Plan, which is a recommended program for the development of the Columbia River and its tributaries include one project on the Grande Ronde River. This project is included in the plan as an additional unit to be considered on a deferred basis because of conflict with the fisheries resources on the Grande Ronde.

This project, the Wenaha Project, envisions 900,000 acre-feet of storage at a location approximately eight miles above the Rays Ferry site. Under the system described in the Major Water Plan, and under 1985 load conditions, the 31-month average continuous power at load center, last added by this project amounts to 60 megawatts of at-site capacity and 28 megawatts of downstream capacity on the Snake and Columbia Rivers for a total of slightly less than 90 megawatts of average continuous power. The average annual energy generation of this project is estimated to approximate 70 megawatts of average generation at-site and 9 megawatts of average generation downstream on the Snake and Lower Columbia. The project, as outlined, has a benefit-cost ratio of 3.34 to 1 for early construction and 1.10 to 1 for construction after the 800,000-second-foot flood control limit has been achieved for The Dalles.

Preceding data indicate the need for storage development to make realistic use of the power potentials of the Grande Ronde River within the Lower Grande Ronde sub-basin. One factor of considerable importance in establishing the value of power development in this sub-basin will be the problem of conflict between the basic resources of power development and fisheries. Present knowledge does not provide any method for resolving in particular the problem of fish passage for downstream migrants passing through reservoirs with large fluctuations.

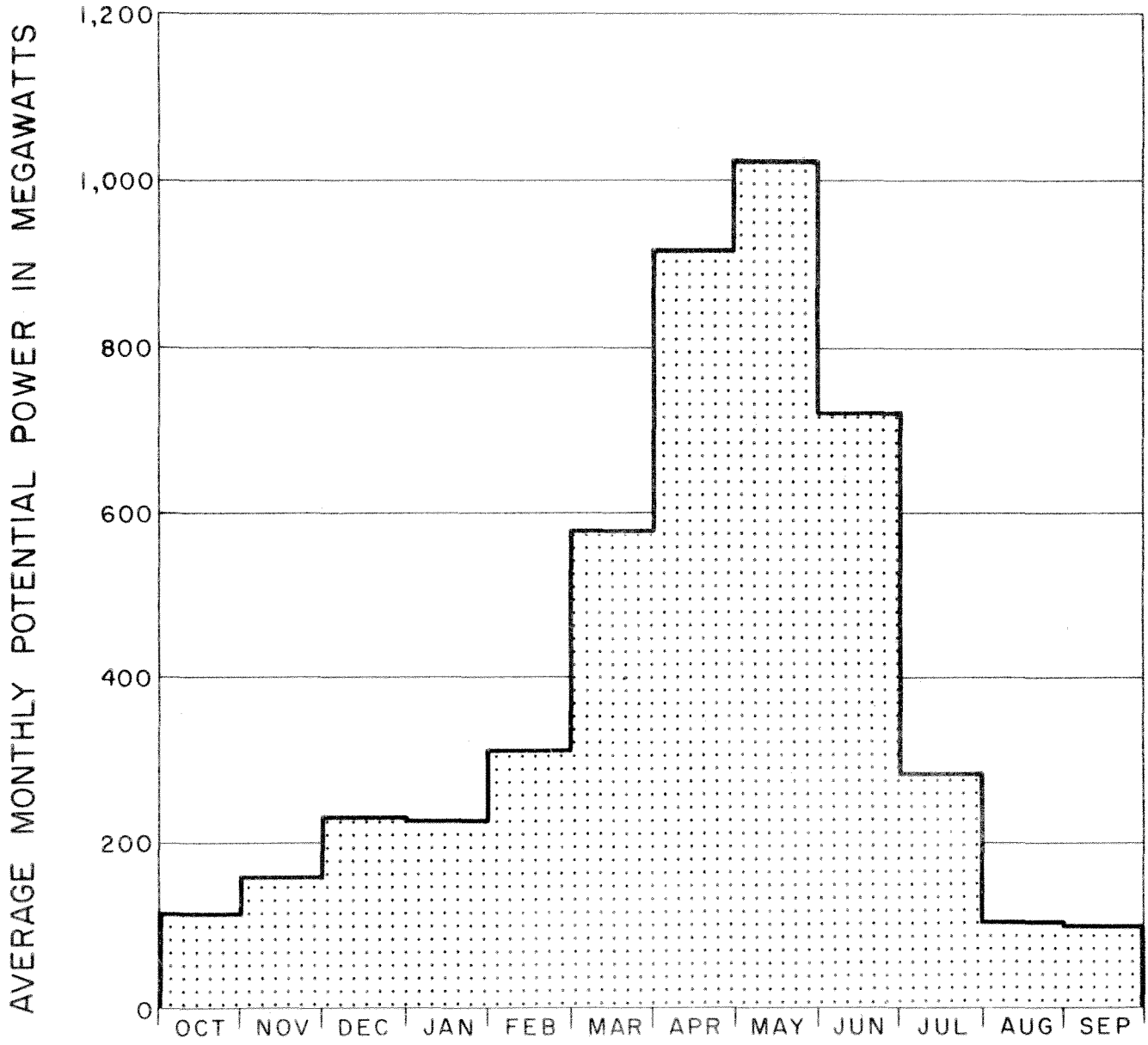
The theoretical potential of the Lower Grande Ronde River for energy production, utilizing average annual flow over all available physical head, would approximate 3,470,000,000 KWH annually. Average annual energy generation at the Wenaha site would approximate 600,000,000 KWH annually, or approximately 17 percent of the Basin's theoretical potential. Generation, based on average monthly flow and physically available head, would vary from a September low of 98,000 KW output to a May high of 1,022,000 KW (see Figure 44).

Industrial and Mining

Little potential exists for industrial or mining development in this sub-basin.

POTENTIAL POWER

LOWER GRANDE RONDE SUB-BASIN



Drawn 8-12-59
Grande Ronde
File No. 8.1046

Figure 44

Recreation

Future recreational needs can best be served by preservation of the existing resources such as fish and wildlife which, in turn, need an adequate quantity of water of proper quality. Construction of multi-purpose reservoirs would enhance the water-based recreational potential of the sub-basin but would be extremely detrimental to fish life.

Wildlife

Water supply for wildlife needs will not be a problem in the future.

Fish Life

In addition to resident species, anadromous fish utilize the Lower Grande Ronde sub-basin. No runs of chinook salmon and steelhead trout occur. Chinook salmon population are associated particularly with the Wenaha River drainage. Steelhead trout are known to be present in numbers in the Wenaha River and Joseph Creek. However, the distribution of steelhead is believed to include many of the smaller tributaries.

There is no evidence that the Lower Grande Ronde main stem is used for chinook spawning, but it is probably used as a rearing area.

The Wenaha River is utilized by chinook salmon for spawning. The best area is on the South Fork. Milk, Butte, and Crooked Creeks are also important spawning areas.

Little is known about steelhead populations in the Wenaha drainage. Although it is believed that silver salmon once utilized this drainage, there is no evidence that they presently do so.

There are indications that Joseph Creek, a tributary of the lower main stem, once supported populations of both spring and fall run chinook; there is no evidence that this specie remains.

Joseph Creek is reported to have a good steelhead population on its main stem and on tributaries. It is believed that Chesnimnus, Swamp, and Crow Creeks all support steelhead within their drainage.

The existence of silver salmon in the Joseph Creek drainage has not been established.

The recent report* of the Oregon Fish Commission indicates potential for enhancement of the anadromous fishery of the Lower Grande Ronde River drainage.

The best possibility appears to be in the transplantation of fall spawning chinook salmon. A conservative estimate of spawning gravel in 81 miles of the lower main stem exceeds 85,000 square yards.

In the drainage of the Wenaha it is suggested that fish transplants of fall spawning chinook and silver salmon be made. A rough estimate of redd potential is 1,250 for fall spawners and 900 for silvers. Fall spawning chinook would be planted in the lower main stem of the Wenaha and silvers in Butte and Crooked Creeks.

Other possibilities include removal of obstructions, development of impoundment areas, and measures for stream improvement.

Joseph Creek offers potential of over 50 miles in the drainage that could be utilized by fall spawning chinook and silver salmon. Redd potential is not established.

Obstructions, screening, impoundment sites and stream improvements are also items of consideration.

All indications are that the Lower Grande Ronde sub-basin is functioning well below its potential in the production of anadromous fish.

Pollution Abatement

Pollution abatement will not be a problem in view of the lack of potential for development in the sub-basin although sound watershed management is essential.

Flood Control and Drainage

In view of the topography and limited degree of development, the need for flood control in the sub-basin will not arise. There are no drainage problems in the sub-basin.

* Environmental Survey Report Pertaining to Salmon and Steelhead in Certain Rivers of Eastern Oregon and the Willamette River and its Tributaries - Part I

SECTION 4 WALLOWA BASIN

GENERAL DATA

Location

This sub-basin comprises all the land drained by the Wallowa River and its tributaries. It occupies a central position in the Grande Ronde Basin, being almost entirely surrounded by three of the sub-basins. It is bounded on the north, east, and west by the Lower Grande Ronde, Imnaha, and Middle Grande Ronde sub-basins, respectively. In the south, it has a common boundary with the Powder River Basin of about 12 miles of the Wallowa Mountains. The entire stream system for this sub-basin is shown in Figure 45.

Size

This sub-basin has an area of 928 square miles, being the third sub-basin in order of size and containing almost 18 percent of the Basin area. The major part of the sub-basin, 788 square miles, including developed lands, is in Wallowa County. The balance is in Union County.

Streams within the sub-basin total 1,027 miles in length or 18 percent of total stream miles in the Basin. Wallowa River, which is the major tributary of the Grande Ronde, has a length of nearly 66 miles. It has four principal tributaries; the Minam River with a length of 50 miles, Lostine - 31 miles, Bear Creek - 25 miles, and Hurricane Creek - 19 miles.

Geology

The oldest rocks in the sub-basin are Triassic sediments which comprise a thick series of slates, sandstones, and limestones that occupy a large area between the Lostine River and the West Fork of the Wallowa River. Partial intrusion of these rocks by quartz diorite and granodiorite occurred during Cretacious times. The intrusion, of batholithic proportion and making up most of the Wallowa Mountains, extended west to the Minam River in this sub-basin. Columbia River basalt, extruded in Miocene times and the most extensive rock unit in the Basin, covers the remainder of the area except for overlying alluvium in the valleys.

The Wallowa River between the confluence of the East and West Forks and the 18th river mile, the Lostine River below the 15th mile, and Bear Creek below the 5th mile, flow through alluvial deposits. There are three large alluvial areas in the sub-basin, all potential sources of ground water as they consist principally of sand, gravel, and

WALLOWA RIVER

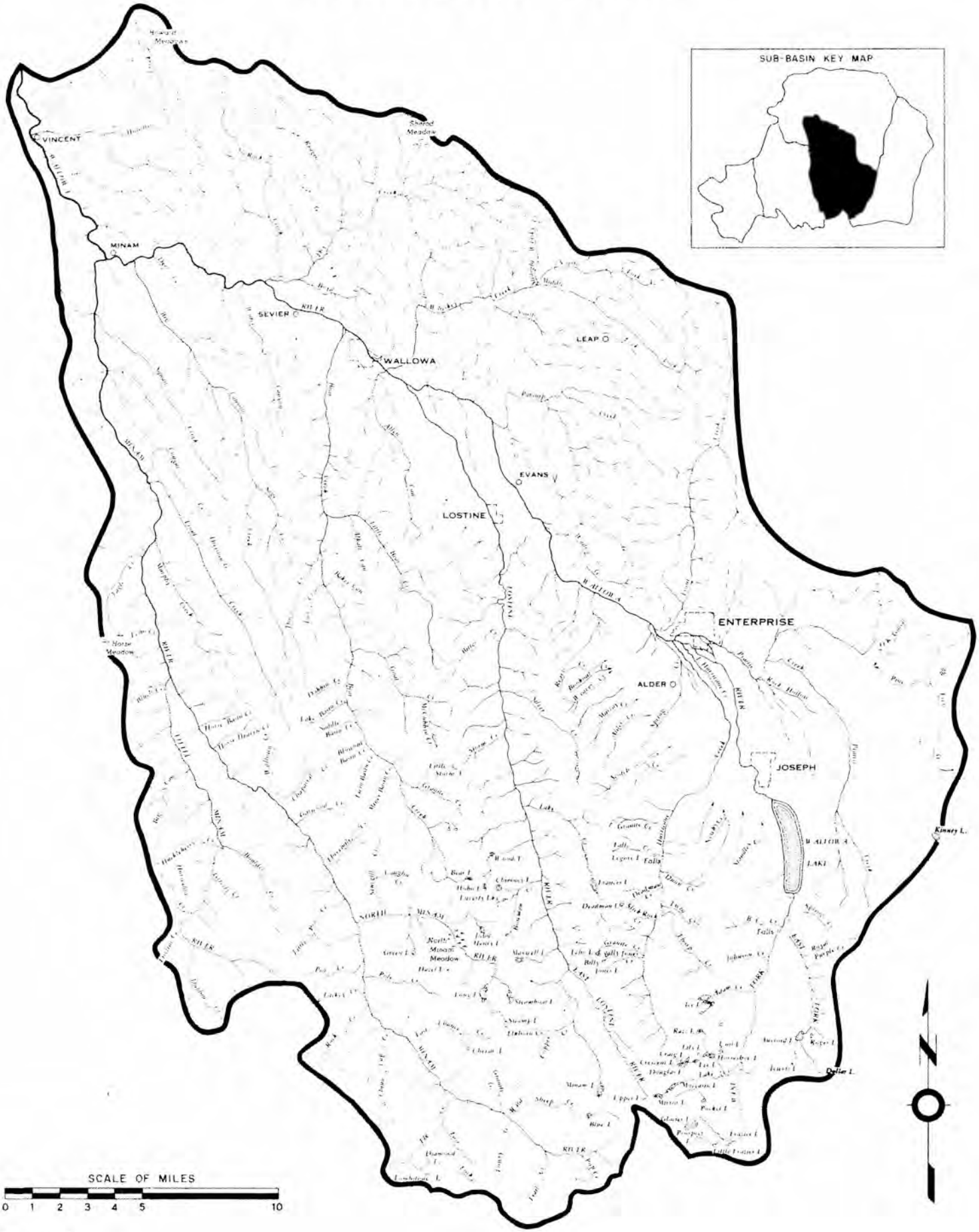


Figure 45

morainal material. The largest of these possible aquifers extends from the headwaters of Wallowa Lake to the City of Enterprise and has an area of about 100 square miles. Alluvial fill in the narrow area between the Lostine and Wallowa Rivers forms another large deposit of about 30 square miles. The third, at the confluence of Bear Creek, covers about 10 square miles. The best cultivable lands in the sub-basin are located on these alluvial deposits.

The outstanding geologic structures in the sub-basin are the syncline striking about N. 30° W. in the region between Hurricane Creek and the Lostine River; the vertical faults that displace the limestones near the mouth of Hurricane Creek about 1,500 feet and about 500 feet near the mouth of Lake Creek; and the vertical displacement of 7,000 to 9,000 feet that forms the scarp on the northeast side of the Wallowa Mountains. Wallowa Lake and the many smaller lakes in the sub-basin were formed by the gouging and daming action of glaciers.

The three main limestone deposits in the Wallowa Mountains are situated in this sub-basin. These deposits are all of the same bed of limestone, but that along the Lostine River and Hurricane Creek has been mineralized with pyrite due to the proximity of the granitic intrusive, whereas the more removed limestone along the range front is relatively pure. The Lostine River deposits occur in parts of Sections 3, 4, and 9, Township 2 South, Range 43 East, in the river canyon approximately six miles south of Lostine. This is a thick massive limestone, light gray in color and considerably re-crystallized into a finely-granulated texture. Years ago the rock was quarried and burned into quicklime for local consumption, but little or no use is now made of it. Analysis indicates that this limestone is suitable for cement, but that too much pyrite (iron sulfide) is present for use as high-grade quicklime. A bed of similar marble occurs opposite the old quarry, at an elevation of about 5,000 feet, and forms cliffs 300 to 500 feet high for nearly six miles up the Lostine River. The range front deposits are the most promising in the sub-basin due to the purity and accessibility. The main operator is the Black Marble Quarry in Sections 19 and 20, Township 2 South, Range 44 East, at an elevation of about 6,000 feet and approximately five and one-half miles from a plant rail siding on the Wallowa River. This is a well-bedded, dense, black limestone quarried for burned lime and as it polishes to a handsome jet-black stone, for ornamental and building purposes. The outcropping bed is 50 to 500 feet thick. The limestone burns to a superior grade of lime with a very desirable texture. The lime slacks easily and works smoothly. The operating company has a mill near Enterprise capable of producing 10,000 tons of quicklime a year. The Hurricane Creek deposits occur on parts of Sections 9, 10, 15, and 16, Township 3 South, Range 44 East, approximately nine miles south of Enterprise. The occurrence extends south about five miles to the Matterhorn Peak in Sections 10 and 11, Township 4 South, Range 44 East. This limestone varies from high to low-grade purity, contains pyrite in places, and is crystallized to marbles of pure white in the region of the Matterhorn.

Metallic minerals found in the south part of the sub-basin are copper, gold, lead, molybdenum, silver tungsten, and zinc. As far as is known, these are small deposits and it is doubtful if many have economic potential.

Location of mineral and other important deposits are given in Figure 7.

Topography

The rugged Wallowa Mountains, occupying an area of about 100 square miles at the southern end, overlook the plateau that comprises most of the rest of the sub-basin. These mountains, by far the most significant topographical feature in the area and one of the most important in the Basin, consist of high peaks with perennial snow, steep slopes, and numerous lakes. Many peaks exceed elevations of 9,000 feet and Matterhorn, with an elevation of 9,845 feet, is the highest. Most of the lakes are small, measuring less than 25 acres in extent while some are less than 10 acres. Ice Lake with an area of 60 acres is the largest of 45 named lakes in the mountains, all of which are accessible only by mountain trails.

Wallowa, Minam, and Lostine Rivers and Hurricane Creek originate within a few miles of each other near Matterhorn while Bear Creek finds its source at the northeastern sector of the mountains. Steep gradients are common to all streams within the mountains. West Fork of Wallowa River drops about 3,700 feet in 12 miles and the East Fork nearly 3,000 feet in 5 miles.

At the foot of the mountains, the Wallowa River enters the lake bearing its name. Formed by glaciation, Wallowa Lake is about 3.5 miles long and has an area of 1,600 acres. It is the largest body of water in the Basin and, because of its magnitude and location, is one of the most important recreational areas in the Grande Ronde Basin.

Leaving Wallowa Lake at the northern end, the river drops about 300 feet in 3 miles and from there on it follows a relatively uniform gradient in a northwesterly direction. The total drop in this section of the river is about 1,750 feet in 47 miles. The course of the river from the 20th river mile to the confluence with the Grande Ronde lies in a canyon.

Hurricane Creek drops about 4,300 feet in about 17 miles to join the Wallowa at Enterprise. Lostine River drops about 3,300 feet in the first 15 miles and another 1,000 feet in the next 15 miles before it joins the Wallowa at the 25th river mile. Bear Creek commences its course with extremely steep gradients and drops over 4,200 feet in 17 miles. In the following 7.5 miles, it drops 700 feet and meets the Wallowa near river mile 22. Minam River, the longest of the tributaries, drops about 4,000 feet in 23 miles and 1,200 feet in the next 26 miles, meeting the Wallowa at the 10th river mile.

While the more important tributaries flow northwards from the Wallowa Mountains to join the Wallowa River on the west bank, several minor tributaries draining the bench land along the northeastern boundary of the sub-basin meet the Wallowa on the east bank. About 52 percent of the sub-basin's area is comprised of mountainous terrain. Figure 2 shows the stream system profile for the Basin.

Climate

Average monthly temperature varies between 22 and 44 degrees Fahrenheit in winter and between 45 and 65 degrees Fahrenheit in summer in elevation ranges between 2,900 feet and 4,200 feet. Enterprise and Joseph and the agricultural lands in the Wallowa Valley fall within this range.

Annual average precipitation varies from about 56 inches in the Wallowa Mountains at elevations of 9,600 feet to 12 inches along the northeastern border of the sub-basin. Agricultural lands in the Wallowa Valley have an annual precipitation range of 13 inches to 17 inches. Average annual snowfall in the Wallowa Valley ranges from 46 inches to 66 inches according to elevation. Heaviest snowfall occurs at higher elevations.

The average length of growing season is 108 days at Wallowa, elevation 2,935 feet, and 134 days at Joseph, elevation 4,400 feet.

Population

The Wallowa Valley has the largest population in the Basin with the exception of the Grande Ronde Valley. Statistics published for Wallowa County show that the county population dropped by nearly 2,000 between 1920 and 1930. There has been a slight increase since 1950 as shown in Figure 14. Population trends in the cities are given in Figure 16.

Enterprise, the largest city in the Basin next to La Grande, had a population in 1960 of 1,916. Wallowa, at the lower end of the valley, had 980 while Joseph, Lostine, and Minam had 781, 239, and 75, respectively.

Land Ownership

More than half the land in the sub-basin is privately owned. Federal land management by the Forest Service and the Bureau of Land Management amounts to 447 square miles and public domain and state lands total about two square miles.

Transportation

Wallowa Valley is served by an extensive system of gravel roads. Access is provided by two paved roads, State Highway 82 coming from the west and State Highway 3 from the north. The former enters the sub-basin near the confluence of the Minam with the Wallowa and follows the valley to the head of Wallowa Lake. It connects the centers of population in the valley and is the principal road in the sub-basin. State Highway 3 leads into Enterprise from the north. Developed lands are served by gravel roads and dirt roads follow the large tributaries of the Wallowa with the exception of the Minam.

A branch line of the Oregon-Washington Railroad and Navigation Company from La Grande follows the Wallowa River to Joseph.

The sub-basin has airports at Enterprise, Joseph, Wallowa, and on the Minam River, of which only the first is a public-use airport. The one at Wallowa is state owned and that on the Minam, located on the 24th river mile, serves a ranch.

Regular passenger and freight services are maintained on State Highway 82.

Present Economy

Agriculture, supported by the lumber and tourist industry, forms the sub-basin economy. Livestock is the principal agricultural activity. Statistics are not available for the sub-basin but published figures for Wallowa County can be accepted as representing the activities of the sub-basin. According to the Bureau of the Census, 41.8 percent of those employed were engaged in agriculture and 15.3 percent in manufacturing in 1954. The value of farm products sold in 1954 was $5,893,000 of which livestock, livestock products accounted for $3,769,000 and crops amounted to $1,877,000.

Lumber mills are located at Enterprise, Joseph, and Wallowa and the Manufacturer's Directory and Buyer's Guide lists 22 logging operations in the sub-basin. Milk processing is carried out in Enterprise and Wallowa.

The sub-basin contains the most important recreational area within the Basin. Scenic attractions of the Wallowa Mountains, lake fishing provided by the numerous lakes and streams, and hunting for elk and deer attract many thousands of vacationers, fishermen, and hunters into the area every year. In 1956 over 12,000 persons used overnight camping facilities at the head of Wallowa Lake. Boating and hotel facilities on Wallowa Lake earned over $60,000 in the three months during which the facilities operated in 1957. An additional annual income of about $140,000 is estimated for other establishments in Wallowa County catering to tourists.

AMOUNT AND DISTRIBUTION OF THE RESOURCE

Precipitation Data

Active climatological stations in the sub-basin are located at Enterprise, Minam, and Wallowa. The station at Wallowa is the oldest, having been started in 1903, while those at Minam and Enterprise date back to 1909 and 1931, respectively. Both temperature and precipitation are recorded at the three stations. Average annual precipitation for the Grande Ronde Basin is shown in Figure 3 and precipitation in the sub-basin is discussed under Climate. Climatological stations in the Basin are located as shown in Figure 11.

Stream Gaging

Stream gaging stations in the sub-basin are located as shown in Figure 11. In addition to the gaging stations on irrigation canals, stations exist on three tributaries; Hurricane Creek, Lostine River, and Bear Creek. Three stations are located on the Wallowa River, at Joseph, at the outlet of Wallowa Lake and on the East Fork. Records from these stations are published in USGS Water Supply Papers.

Yields

Annual yield of the Wallowa River at its mouth is shown in Figure 46. Average annual yield at this point for the period 1904 through 1957 is 779,000 acre-feet. Since the drainage area is 928 square miles, the average annual yield per square mile is over 800 acre-feet. Average annual yield of the Grande Ronde at Zindel for the period 1904 through 1957 is 2,415,000 acre-feet. The yield of the Wallowa sub-basin is, therefore, 32 percent of the total yield at the Grande Ronde while its area is only 18 percent of the Basin. During the 55-year period, the estimated sub-basin yield was highest in 1949, exceeding 1,200,000 acre-feet, and lowest in 1941, about 200,000 acre-feet.

The mean monthly discharge of the Wallowa River at the mouth, Figure 47, shows the distribution of the average annual yield with respect to time. The flow pattern is similar to the Grande Ronde except that peak flows in the Wallowa occur in June while in the Middle Grande Ronde they generally occur in April.

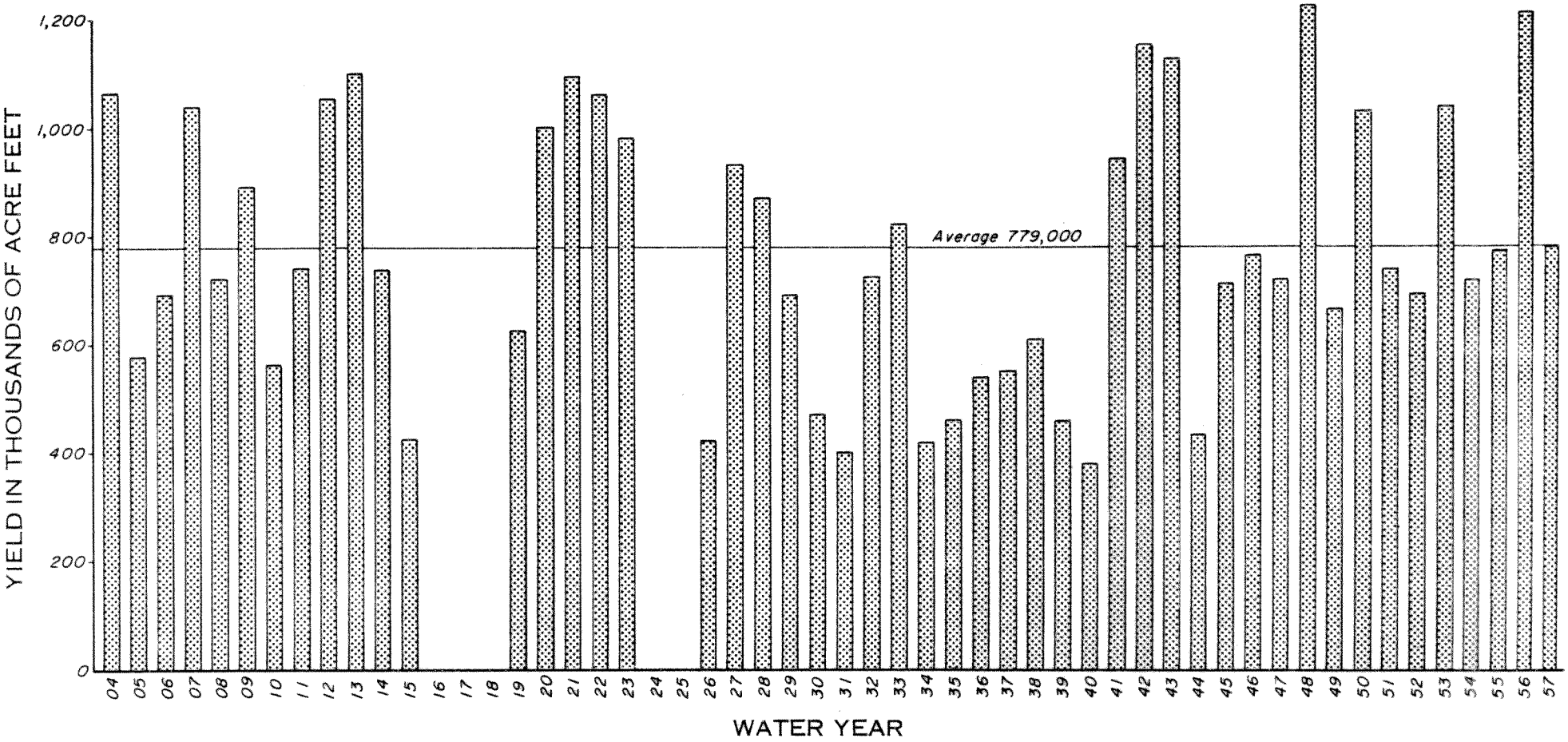
Average monthly discharge at the mouth of the Wallowa varies from 380 cfs in September to 2,740 in June. Figure 48 shows the flow pattern for 1936, the year of minimum flow, of the Lostine River at Lostine, and Figure 49 shows the same information with respect to Bear Creek near Wallowa for 1937.

Figure 46

ANNUAL YIELD

WALLOWA RIVER AT MOUTH

DRAINAGE AREA 928 SQ. MI.



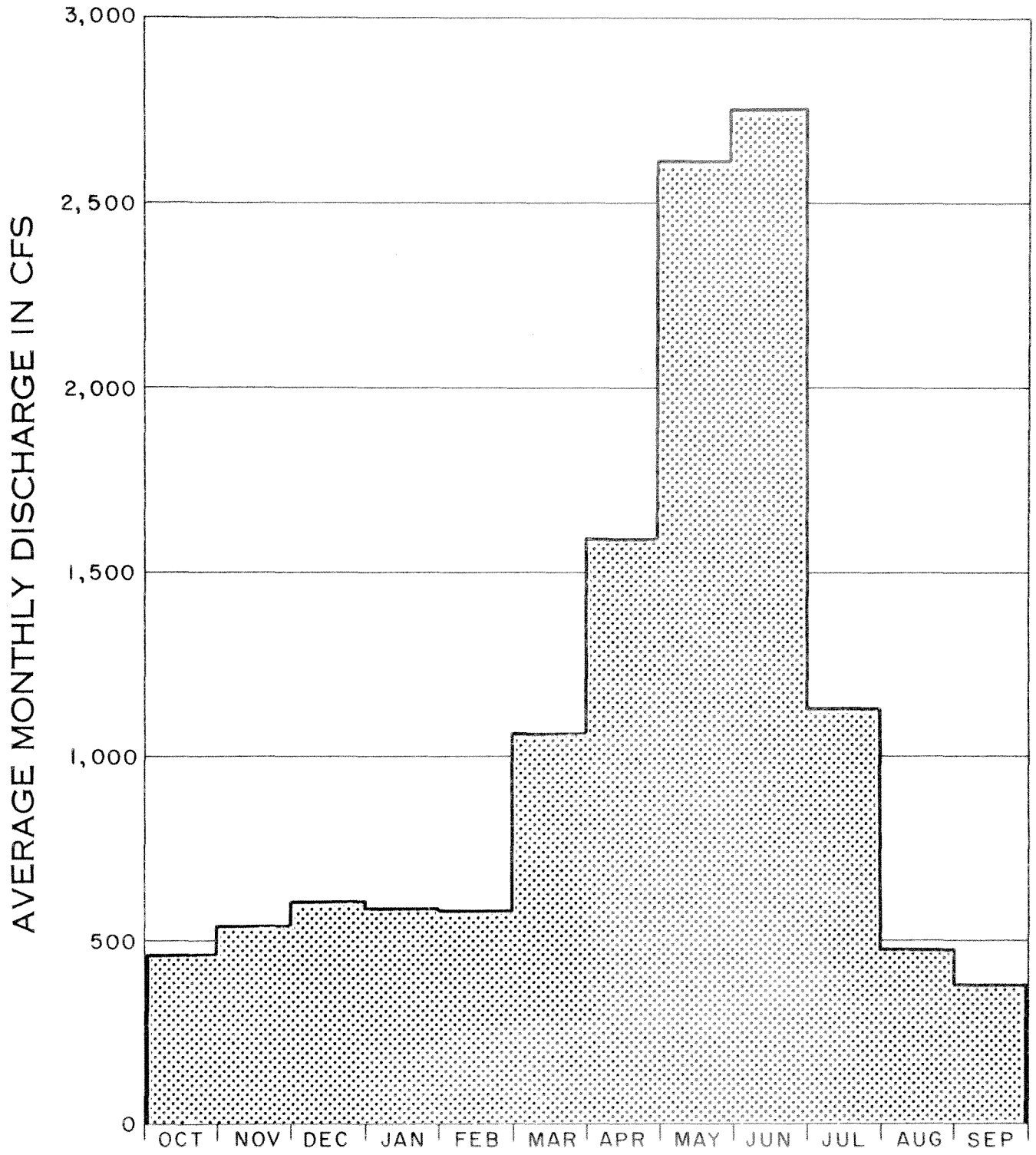
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DISCHARGE

WALLOWA RIVER AT MOUTH

1904 - 1957



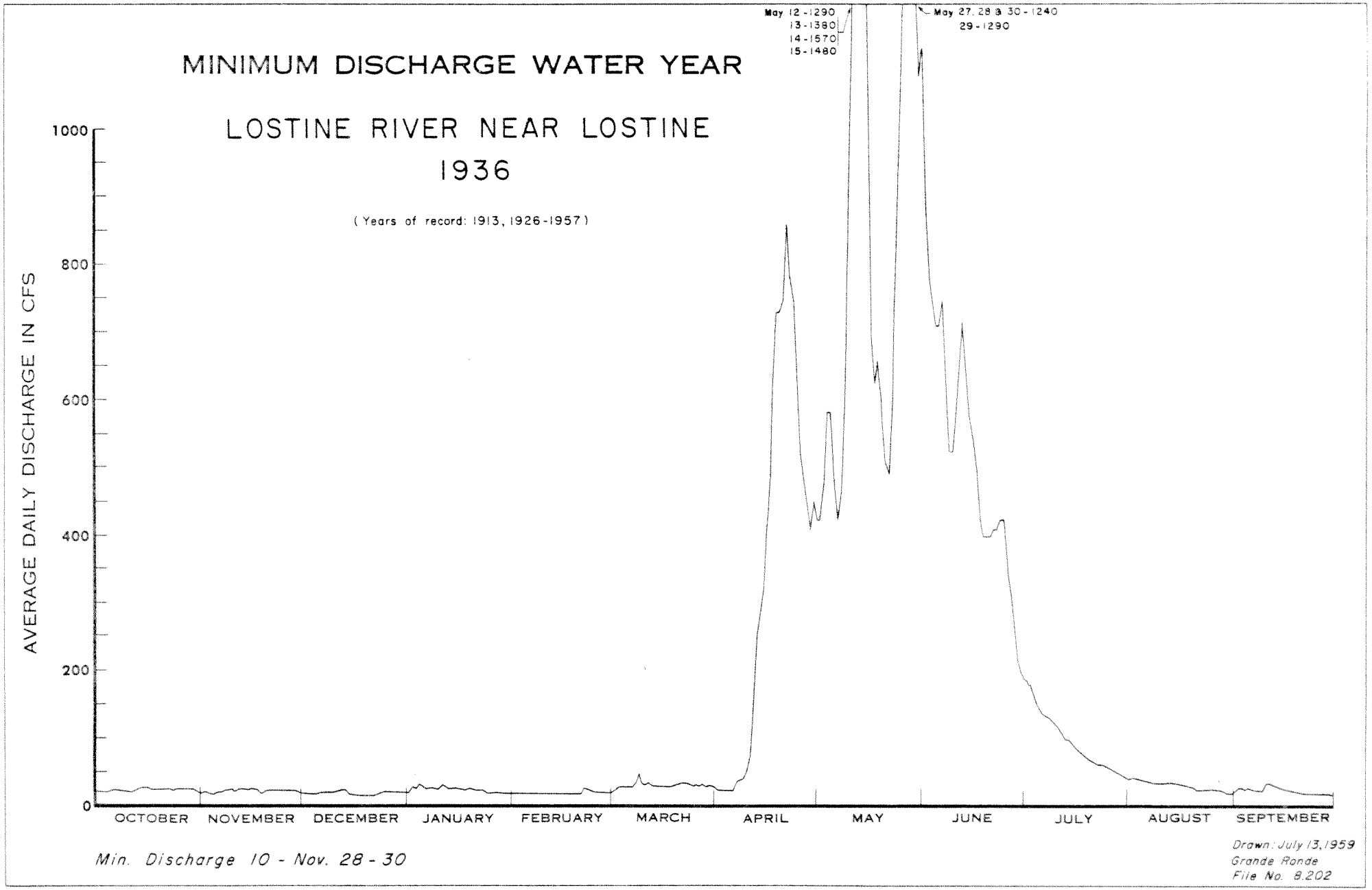
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Grande Ronde

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Figure 47

Figure 48


MINIMUM DISCHARGE WATER YEAR
LOSTINE RIVER NEAR LOSTINE
1936
(Years of record: 1913, 1926-1957)
May 12 - 1290
13 - 1380
14 - 1570
15 - 1480
May 27, 28 & 30 - 1240
29 - 1290
AVERAGE DAILY DISCHARGE IN CFS
1000
800
600
400
200
0
OCTOBER
NOVEMBER
DECEMBER
JANUARY
FEBRUARY
MARCH
APRIL
MAY
JUNE
JULY
AUGUST
SEPTEMBER
Min. Discharge 10 - Nov. 28 - 30
Drawn: July 13, 1959
Grande Ronde
File No. 8.202

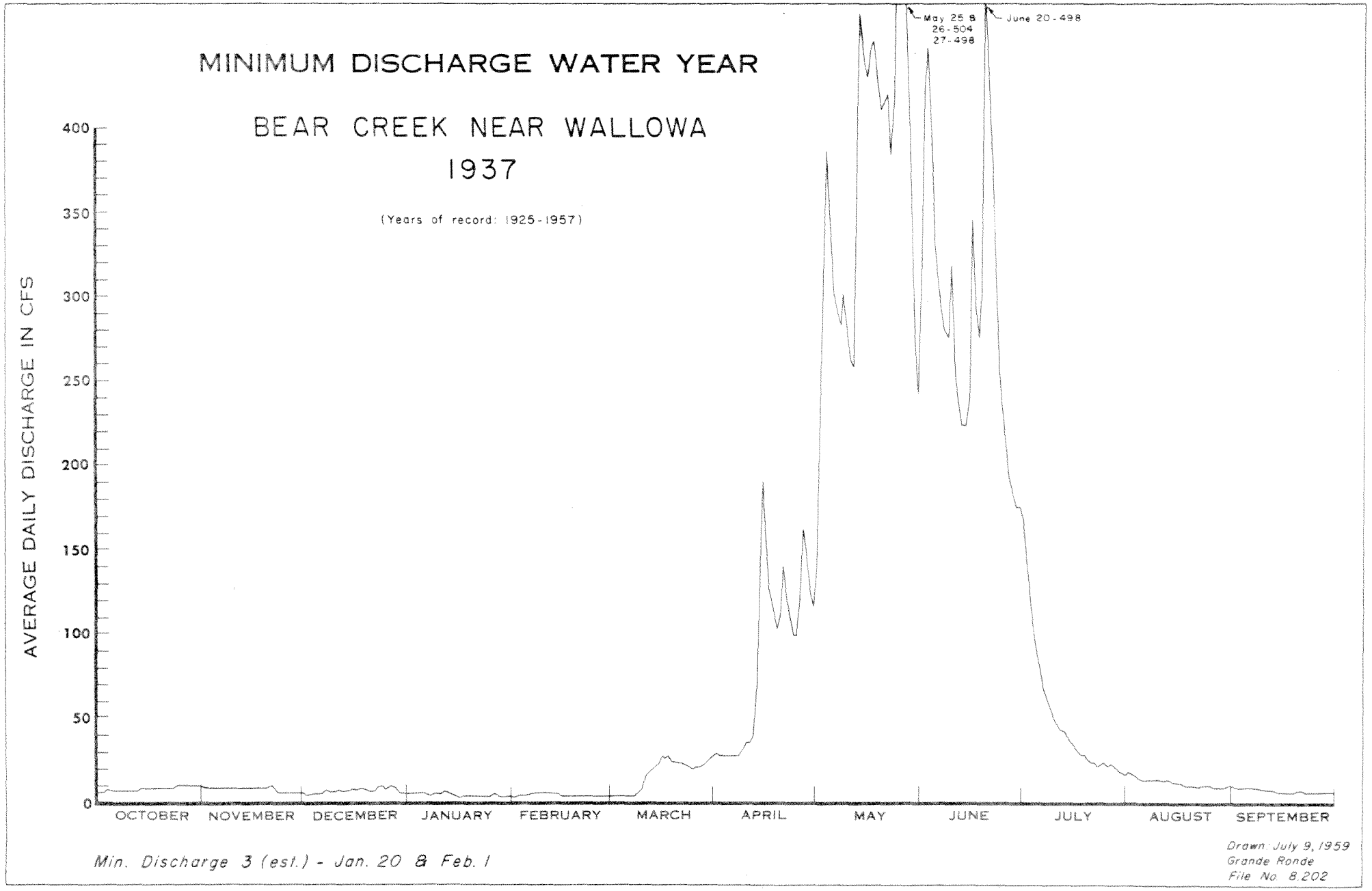


Figure 49

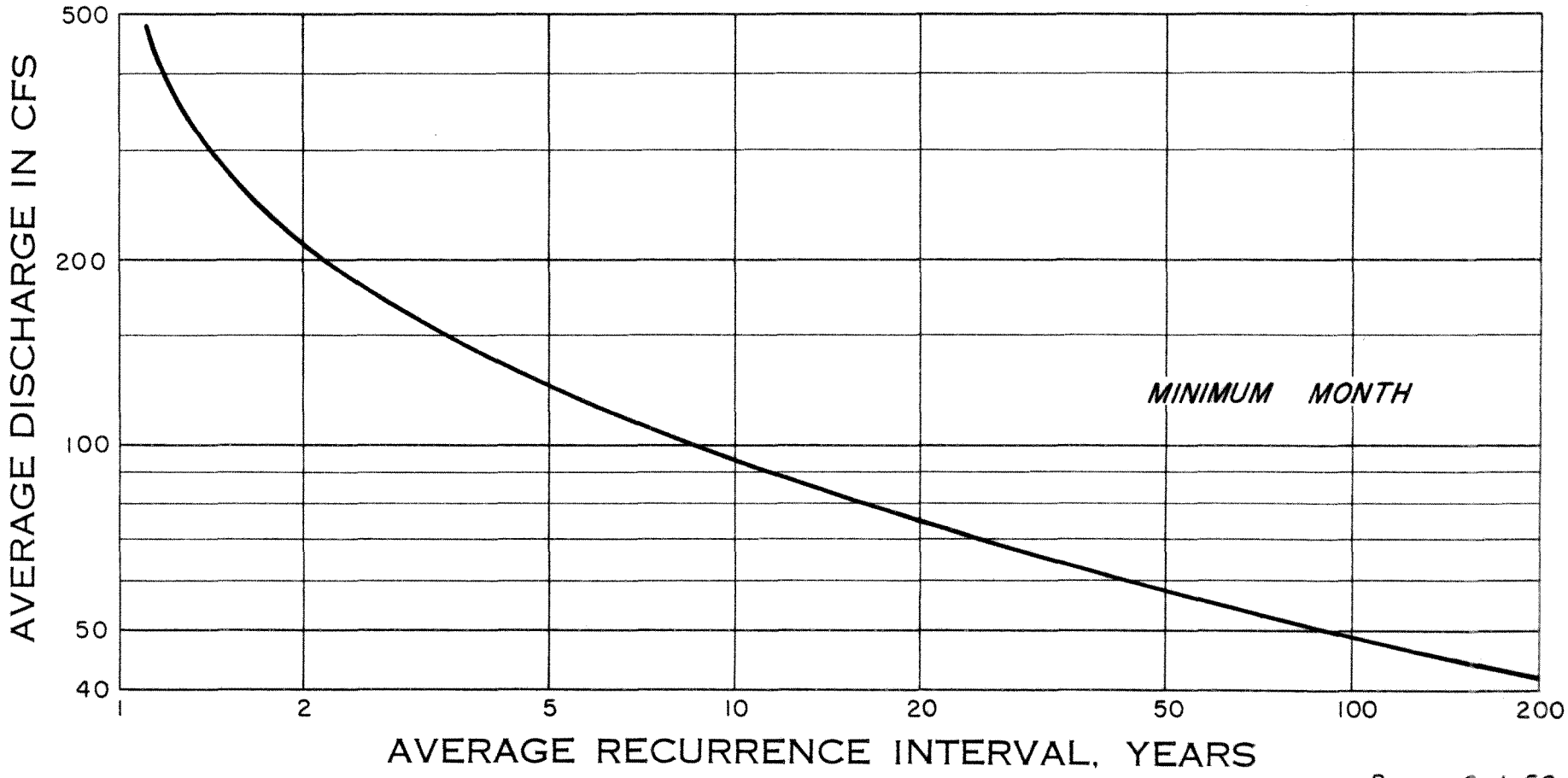
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Figure 50

DROUGHT FREQUENCY

WALLOWA RIVER AT MINAM

1904 - 1957



Drawn 6-1-59
Grande Ronde
File No. 8.203

Drought frequencies for the Wallowa River at Minam, Figure 50, indicate that a minimum flow of 95 cfs for 30 consecutive days can occur at the average recurrence interval of 10 years.

AMOUNT AND DISTRIBUTION OF THE RESOURCE UNDER APPROPRIATION

Water Rights

Distribution of the location of water rights in the Grande Ronde Basin is shown in Figure 8 and a summary of the water rights within the Wallowa sub-basin is given in Table 18.

Water rights total about 1,570 cfs of which 75 percent are consumptive and the balance nonconsumptive. Irrigation is the chief consumptive use and such rights are located principally on the Wallowa and Lostine Rivers and Hurricane and Bear Creeks.

Power rights, constituting the main nonconsumptive use, exist chiefly on Wallowa and Lostine Rivers and Hurricane Creek. Municipal and industrial rights, which also are consumptive, are located on Wallowa River. Municipal rights exist also on Bear Creek and Lostine River.

Depletions

A depletion diagram, Figure 51, indicates the legal depletion rights versus stream miles in the Wallowa River and shows that the rights exist over the entire stream system with large depletions occurring at many locations. This plot shows the total of all rights but does not indicate the actual water use, due in part, to the seasonal nature of irrigation and mining use and the existence of return flows from irrigation.

EXISTING NEEDS

Domestic

Rights for domestic usage amount to less than six cfs and are distributed among the many streams in the sub-basin.

Municipal

Enterprise, the largest city in the sub-basin, is dependent on springs for its water. The

TABLE 18

WATER RIGHTS SUMMARY*

WALLOWA BASIN

USE	STREAM	TOTAL RIGHTS CFS	
Domestic	Bear Creek	0.1	
	Hurricane Creek	0.7	
	Lostine River	0.4	
	Prairie Creek	0.1	
	Wallowa River	4.4	
	Total Domestic		5.7
Municipal	Bear Creek	6.0	
	Lostine River	2.5	
	Wallowa River	13.9	
	Total Municipal		22.4
Irrigation	Bear Creek	73.2	
	Hurricane Creek	166.0	
	Lostine River	196.4	
	Minam River	1.3	
	Prairie Creek	13.1	
	Wallowa River	576.7	
	Total Irrigation		1,026.7
Recreation	None		
Industrial	Hurricane Creek	0.2	
	Minam River	100.0	
	Wallowa River	23.2	
	Total Industrial		123.4
Power	Hurricane Creek	30.9	
	Lostine River	64.0	
	Prairie Creek	12.0	
	Wallowa River	246.2	
	Total Power		353.1
Mining	None		
Wildlife	None		
Fish Life	Bear Creek	0.5	
	Hurricane Creek	5.0	
	Lostine River	0.1	
	Wallowa River	33.1	
	Total Fish Life		38.8
Pollution Abatement	None		
	TOTAL WALLOWA BASIN		1,570.3 cfs

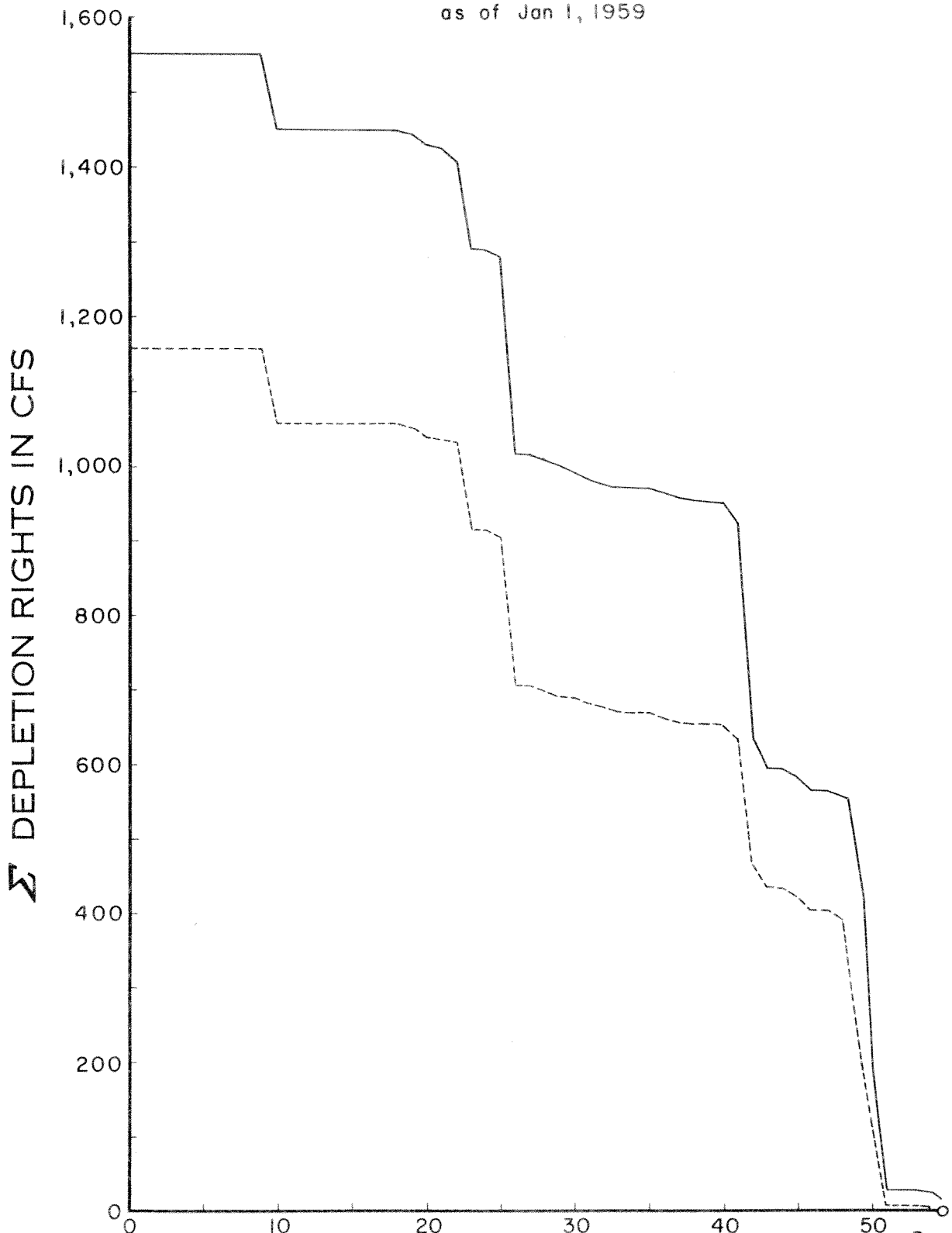
* As of January 1, 1959

LEGAL DEPLETION RIGHTS

BY STREAM MILE

WALLOWA RIVER

as of Jan 1, 1959



Drawn 6-4-59
Grande Ronde
File No. 8.302
Figure 51

present supply is adequate and further quantities are available near the existing source. Water quality is high and obviates need for treatment.

Water supply for Joseph comes from Wallowa Lake. The quantity is sufficient and sanitary authorities consider the water to be of acceptable quality for municipal use provided it is chlorinated. However, increasing use of the lake for recreation purposes will lower the water quality.

Lostine, which receives its supply from Lostine River, and Wallowa, which depends on Bear Creek for its water, use ultra-violet ray and chlorine treatment methods, respectively.

Irrigation

Irrigated lands in the sub-basin are shown in Figure 5. According to the Wallowa County Water Resources Committee, about 45,000 acres are provided with gravity irrigation in the sub-basin of which 6,500 acres receive water from the adjacent Imnaha sub-basin. An additional small acreage is irrigated by pumping from streams. Irrigation from wells is on a very small scale. The County Committee estimates that 22,600 acres or about half the irrigated area receive a full supply of irrigation water annually and that about 20,000 acres or 45 percent experience deficiency late in the season but the effect of the deficiency is not serious. The rest of the irrigable land, amounting to 2,400 acres, suffers from a shortage of irrigation water during the latter part of the irrigation season.

Figure 10 shows areas needing drainage. Present practices of over irrigation early in the season tend to aggravate drainage problems.

Power

Power rights in the sub-basin exceed 230 cfs of which rights for 140 cfs are located on the Wallowa River and the balance is distributed over three of the tributaries. Two hydroelectric power plants, both of which utilize the Wallowa, exist in the sub-basin. The Joseph plant has an installed capacity of 1,000 KW and the Wallowa Falls plant 800 KW. Capacity of these plants is insufficient to meet demand and power is, therefore, imported. By these arrangements, power loads in the area have been met.

Industrial

Industrial rights of about 15 cfs for sawmill use are located chiefly on the Wallowa River. Existing industrial needs are met both in respect to quantity and quality.

Mining

No water rights for mining use exist in the sub-basin.

Recreation

There are no water rights for recreation use but most of the recreational facilities offered by the sub-basin are based on water. Wallowa Lake is the most popular recreation ground within the Basin and attracts many vacationers. A state park with overnight camping facilities is located at the head of the lake which provides fishing and other water-based recreation. The area forms a center for mountaineering, fishing, and hunting associated with the Wallowa Mountains. The Lostine and Wallowa Rivers are popular fishing streams in the sub-basin. There are 15 forest camps and 3 state parks within the sub-basin located as shown in Figure 9A.

Wildlife

The rugged land south of the Wallowa Valley is an important habitat for Rocky Mountain elk. Mule deer also inhabit the area. About 15 species of ducks and migratory waterfowl inhabit Wallowa Lake, Kenney Lake, and other lakes, as well as swamps. Muskrat is the most numerous fur-bearing animal requiring water, others being mink, coon, and beaver. Existing water needs of wildlife are satisfied.

Fish Life

Fish life is a significant natural resource of the sub-basin. In addition to the many streams, the sub-basin has about 2,370 acres of lakes which support fish. The streams are inhabited by rainbow and Dolly Varden while the lakes have been stocked with rainbow, cutthroat, eastern brook, and mackinaw. Wallowa Lake contains the landlocked variety of blueback salmon, locally known as kokanee, which is an important sports fish.

A significant part of the spawning grounds in the Basin used by anadromous fish is located in the Wallowa sub-basin. The State Fish Commission estimates that of the spawning population of spring chinook in the Grande Ronde Basin, 20 percent use the Minam River, 15 percent the Lostine River, and 10 percent the Wallowa River. This means that 45 percent of the total chinook spawning grounds now used are located in the Wallowa sub-basin. Recent data indicates that a comparatively large portion of the Grande Ronde River run of silver salmon spawned in the Wallowa River system.

A trout hatchery having an annual output of 225,000 rainbow, 500,000 kokanee, and 60,000 mackinaw is located in Enterprise. It is estimated that hatchery-released fish amount to 85 percent of the catch in lakes and 25 percent in streams.

Local fishing interests state that water problems both of quantity and quality are to be found in the sub-basin. Bear Creek, Hurricane Creek, and a part of Wallowa River below the lake are almost dry during part of the summer. Turbid streamflow is one of the quality problems. Unscreened irrigation diversions and the practice of dozing gravel from stream beds to form revetments are additional factors causing loss to fish life.

Pollution Abatement

In addition to pollution associated with the lumber industry, a known pollution problem exists at Wallowa caused by sewage effluent and creamery waste. A new municipal sewage treatment plant with extensions to sewers and disposal facilities to deal with creamery waste are needed to control pollution. Tests run on Wallowa Lake, source of the water supply to Joseph, did not indicate a raw water bacteriological problem if adequate chlorination facilities were maintained.

Turbidity problems exist and are associated with return irrigation water, logging roads, and logging operations.

Flood Control

According to the County Water Resources Committee, extensive flood damage to agricultural lands and facilities seldom occurs. Floods, having an average frequency of 10 years, may cause damage to stream banks, ditch diversions, bridges, etc., amounting to about $11,000.

FUTURE NEEDS

Domestic

Supplies from streamflow are adequate for foreseeable future needs.

Municipal

Supplies are adequate for foreseeable future needs. Improvements are necessary in the systems supplying Lostine and Wallowa, particularly in regard to quality. Increasing

recreational development at the head of Wallowa Lake will require a more adequate water supply system.

Irrigation

With the exception of a few small isolated tracts, there is no additional irrigable land in the sub-basin. Cropping practices have remained consistent over the years and if this trend continues, additional water will not be needed for existing lands with the exception of increasing the water available during low flow periods. Diversions can be reduced by better irrigation practice and improved ditch systems. Streamflow will, therefore, be adequate for foreseeable future irrigation needs.

Power

Physical potentials for power development exist in the Wallowa Basin but the feasibility of development is limited. Such small projects as may be feasible from an economic point of view are not significant.

As with other Grande Ronde hydro development, storage is needed to provide stream control and provide water when needed. Because of the steep gradients of the streams of this sub-basin, and previous development in the best areas, storage reservoirs are few.

Some small storage would be available at headwaters, lakes, and at sites on Minam River, Bear Creek, Lostine River, and Hurricane Creek. All these possibilities added together would total less than 60,000 acre-feet with the largest single unit approximating 20,000 acre-feet with a dam of 250 feet estimated height.

One project is listed in the 1957 FPC Report*. It is on the North Minam and has a potential installed capacity of 4,800 KW with a 950-foot head.

In the U. S. Geological Survey Report, entitled "Water Utilization in the Grande Ronde River - Oregon and Washington", 1947, it is concluded the Lostine River, Bear Creek, and Hurricane Creek projects are of little interest. Nothing has developed to change this conclusion.

The potentials of the sub-basin are for small run-of-river units primarily and are of little significance as important sources of usable power for the foreseeable future.

* Hydroelectric Power Resources of the U. S. - Developed and Undeveloped, 1957 - Federal Power Commission

Using average monthly flows over all physically feasible head output would range from 24,000 KW in February to 315,000 KW in June (see Figure 52). Theoretical average annual energy on the above basis would approximate 750,000,000 KWH, about 17 percent of the Grande Ronde Basin theoretical total, a small portion of which has potential for development.

Industrial

Potential is lacking in the sub-basin for industrial expansion and consequent increase in industrial use of water.

Mining

A significant need for water for mining use is not expected to arise due to the lack of potential.

Recreation

Future recreational needs will require preservation of the scenic grandeur of mountains and lakes and conservation of fish and wildlife which constitute some of the most important assets of the Wallowa sub-basin. A large part of the recreational potential remains to be developed and exploited.

Wildlife

Streamflow is adequate to meet future needs of wildlife.

Fish Life

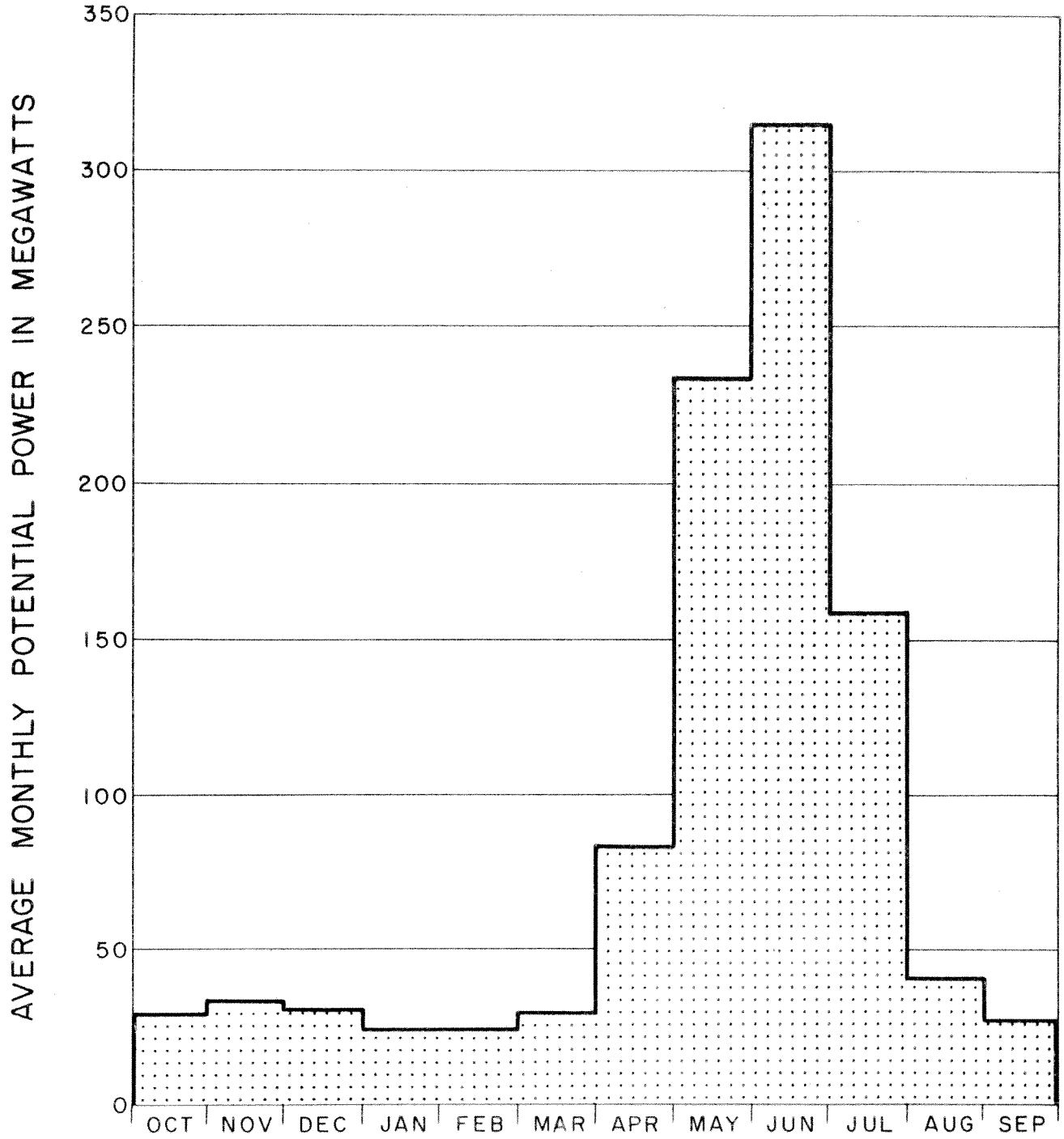
The Wallowa River drainage is utilized by several species of anadromous fish. These include the chinook salmon, silver salmon, and steelhead. Blueback salmon, once the most abundant variety, are now extinct.

Spring chinook salmon are the primary specie of chinook that inhabit the system. There is evidence that fall spawning chinook populations exist.

Silver salmon are known to utilize the area of the main stem between Joseph and Enterprise. Their spawning area coincides closely with that of the spring chinook.

POTENTIAL POWER

WALLOWA SUB-BASIN



Drawn 8-12-59
Grande Ronde
File No. 8.1046
Figure 52

SUB-BASIN INVENTORY - WALLOWA

Little data is available with regard to steelhead trout populations. It is thought that Wallowa upper main stem, Prairie, Trout, Whiskey, Dry, Big Canyon, and Howard Creeks are all important to steelhead production.

Hurricane Creek supports spring chinook and steelhead trout production, as does Bear Creek.

The Lostine River supports spring chinook, silver salmon, and steelhead trout. Evidence is available to show that the nucleus of a fall spawning chinook population exists in this stream. Along with the Wallowa proper, this river is the only stream known to support a silver salmon population. Forty-nine redds of silver salmon were observed in November of 1957.

Index unit counts for spring chinook over an eight-mile stretch varies from 3 to 261 redds in the period 1948-1957.

The steelhead populations of the Lostine are assumed to spawn primarily in the main stem because of the steep gradients of the tributaries.

The Minam River accommodates runs of spring chinook salmon and steelhead trout in its main stem and some of its tributaries. Past records indicate silver salmon populations once existed.

Most of the spawning activity takes place in a stretch from the mouth of the Little Minam six miles upstream. Redd counts in this area have varied from 0 to 224 in the period 1949 to 1959.

The Little Minam supports a spring chinook population in a four-mile stretch starting from river mile one.

Potentials exist for enhancement of the anadromous fishery resources of the Wallowa drainage. Many problems exist relative to the maintenance of existing runs and the development of potentials. Included are stream temperatures, low flows at critical times, stream obstructions, unscreened diversion, and other factors.

Potential enhancement activities include, along with the correction of items above, the possible development of impoundment rearing areas and the transplantation of fish.

Possibility of rehabilitating runs of fall spawning chinook by transplantation of specie and manipulation of remnant stocks is a possibility. Potential from Enterprise to the mouth of the Wallowa is placed at 3,000 redds.

Subject to problems of adequate flow and competition with other specie, it may prove desirable to introduce silver salmon to Hurricane, Bear, Prairie, and Big Canyon Creeks. Redd potentials for Bear, Big Canyon, and Prairie Creeks are estimated at 300, 300, and 500, respectively.

Numerous sites are available for off-channel rearing purposes for salmon.

Potential for transplanting fall spawning chinook is indicated for the lower 9.5 miles of the Lostine River. Redd potential for this section is placed at 500 units.

Improved rearing techniques could provide for increases in silver salmon production in the Lostine.

The Minam River appears to have undeveloped possibilities for fall spawning chinook between its mouth and its confluence with the Little Minam. Redd potential is estimated at 550 units. The use of an incubator station and off-channel holding ponds may provide a supplement to the salmon production.

Data on steelhead potential are not available.

Fish Commission studies on the feasibility of re-establishing blueback salmon in Wallowa Lake indicate the following conditions must be met:

1. A suitable donor stock must be available.
2. Unscreened diversions will have to be screened.
3. Additional summer flows must be provided in appropriate stream sections.
4. Some diversion dams must be laddered.
5. An egg taking and egg incubation station must be provided and maintained.

Additional studies will be necessary before a final decision on rehabilitation can be reached.

Pollution Abatement

Pollution associated with industries and municipal sewage effluents will not materially increase. However, development at the head of Wallowa Lake and the increasing numbers of people using camping and other facilities in the sub-basin are presenting an ever-increasing pollution problem in that respect.

Flood Control

Floods do not present a serious threat to the valley and only minor protection works may be needed.

Drainage and Erosion

A large portion of the agricultural lands are in need of drainage. Improved irrigation practices would help to alleviate the situation.

The headwater areas of the Wallowa system are subjected to severe erosion due to steep slopes and, in some areas, lack of adequate ground cover. Most of the area affected lies within the Eagle Cap Wilderness Area and, therefore, the erosion problem is probably not serious in an economic sense.

Water control problem areas in the Basin are generalized in Figure 10.

SECTION 5 IMNAHA BASIN

GENERAL DATA

Location

This sub-basin comprises the entire drainage basin of the Imnaha River and its tributaries in addition to the left bank tributaries of the Snake River from the confluence of the Imnaha to Nelson Creek. Although the Imnaha flows directly into the Snake River and forms no part of the Grande Ronde River system, it is included in the Grande Ronde Basin because it is an integral part of the economic activities of Wallowa County.

The sub-basin lies between the Snake River and the Grande Ronde system and is bounded on the north and east by the Snake River, on the west by the watershed of the Grande Ronde and on the south by the Powder River Basin. The sub-basin is approximately rectangular in shape with a northeast-southwest orientation. The entire sub-basin stream system is shown in Figure 53.

Size

The sub-basin, measuring approximately 55 miles by 20 miles, has an area of 1,100 square miles. Second in order of size of the five sub-basins, it constitutes 21 percent of the area called the Grande Ronde Basin in this report. All of the sub-basin, except eight square miles in Baker County, fall within the boundaries of Wallowa County. The Imnaha drainage proper approximates 875 square miles in area.

Stream miles within the sub-basin have a total length of 1,282 miles, being 22.5 percent of the total Basin stream miles. It should be noted that the stream miles per unit area in this sub-basin are greater than that of any of the other sub-basins. Big Sheep Creek with a length of 40 miles and Little Sheep Creek with 30 miles are the longest tributaries. Streams flowing directly into the Snake River are short in length and of limited significance.

Geology

The oldest rocks of the Grande Ronde Drainage Basin crop out in the vicinity of the North, Middle, and South Forks of the Imnaha River in the southwest corner of this sub-basin. The area is in the northeastern part of the Wallowa Mountains. These rocks consist of Permian age volcanic andesite, and sedimentary sandstone, conglomerate, and some chert. The remainder of the sub-basin is predominantly covered with Columbia River basalt of late Miocene to early Pliocene age.

The structural geology of most of the area has not been mapped, but probably consists

IMNAHA RIVER

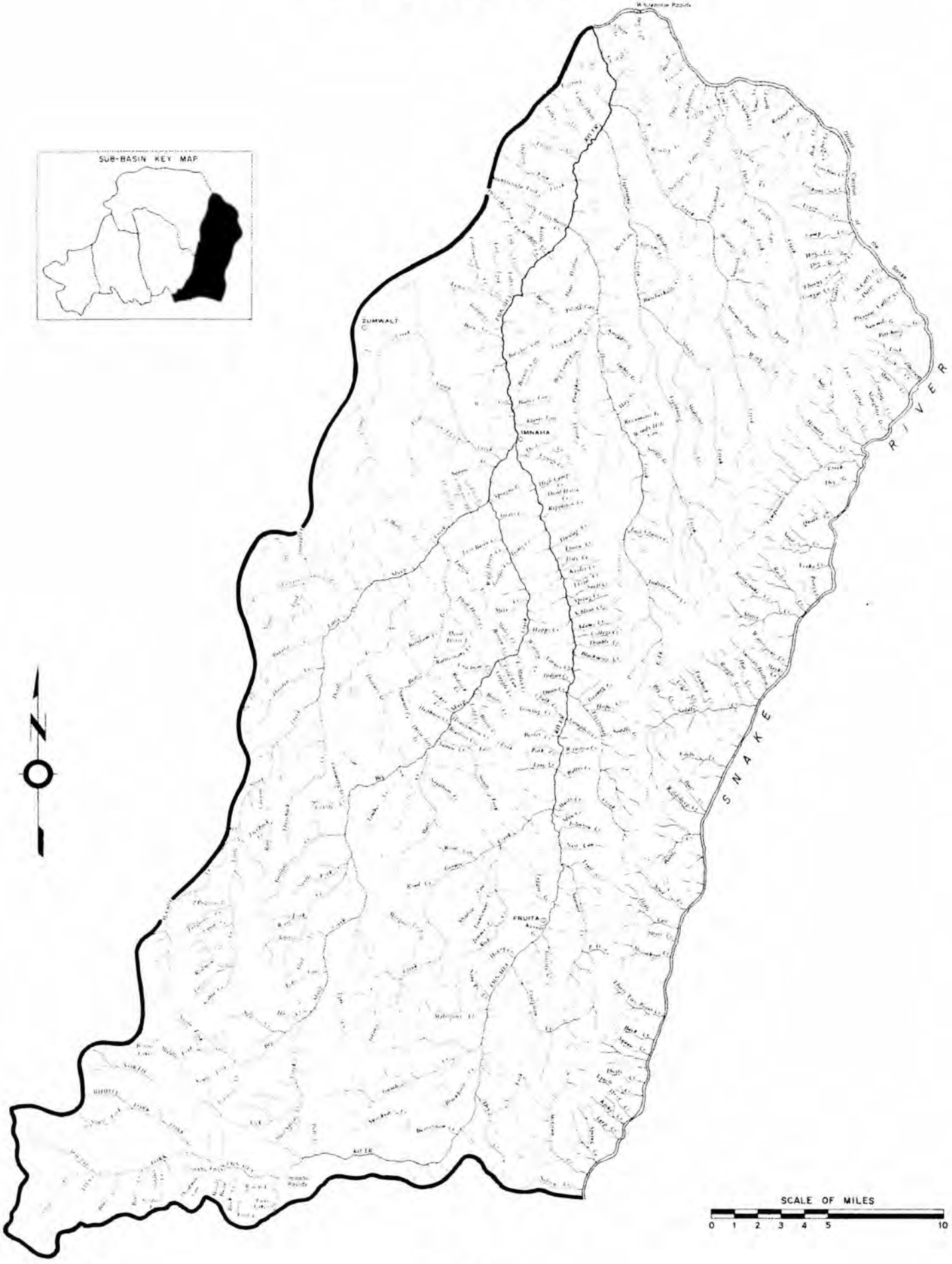


Figure 53

of gentle northerly folds cut by northwest trending faults that reached their major development during Pleistocene times. The Imnaha River, in its straight northerly course, likely flows in one or more of these folds or troughs. Pleistocene faulting also uplifted the Wallowa Mountains to their maximum height and may have caused the abrupt east-to-north turn of the Imnaha River near the southeast corner of the sub-basin. The drainage pattern of the main part of the river is rectangular or trellis-shaped, characteristic of regions covered by volcanic rock.

Little is known about the ground water conditions in this sub-basin. Due to the consistently steep gradients of the streams, it is unlikely that sufficient alluvial material has been deposited to form aquifers. The more porous, upper interflow zones of the Columbia River basalts, however, would be expected to contain sufficient quantities of ground water for domestic and stock use.

The main mining activity in the sub-basin has been along narrow fracture fillings in a granitic intrusive body occupying an area of about five square miles surrounding the junction of the Imnaha and Snake Rivers in Oregon. The area has 62 patented lode claims on which extensive development work was done prior to 1943. The main materials were copper and iron, with negligible values of gold and silver. Considering the quantity and grade of the ore, it is doubtful that this was a commercial mining operation. No production figures are available.

Limestone of Triassic age, estimated at a minimum 9,000,000 long tons and possibly suitable for cement manufacture, crops out along the Imnaha River on Section 15, Township 3 South, Range 48 East. The limestone is thick-bedded, light gray, slightly recrystallized, and considerably silicified. Its inaccessibility and remoteness from centers of population, as well as its quality, precludes it from any but local use at the present time.

Small amounts of molybdenum and tungsten have been found near the south border of the sub-basin.

Topography

This sub-basin has a plateau varying in elevation from 4,500 feet in the north to over 6,000 feet in the south where it meets the high peaks of the Wallowa Mountains. Aneroid Mountain, the highest point in the sub-basin with an elevation of 9,702 feet, lies on the headwaters of Big Sheep Creek. Petes Point, Red Mountain, Sentinel Peak, and Krog Peak, located on the headwaters of the Imnaha are over 9,000 feet in elevation. There are peaks in the eastern half of the Wallowa Mountains which occupy the southwestern corner of the sub-basin and form its most significant topographical feature.

The high elevation of the plateau has resulted in the formation of deep canyons with steep slopes which have appreciably decreased the area of flat land in the sub-basin. Almost 90 percent of the total area in the sub-basin is classified as mountainous.

The Imnaha and its principal tributaries, Big Sheep Creek, and Little Sheep Creek, have their sources in the Wallowa Mountains and flow northwards in the general direction of the slope of the plateau.

Streams within the Wallowa Mountains are governed by steep gradients. The North Fork of the Imnaha River drops 2,680 feet in 7 miles; South Fork, 2,180 feet in 9.6 miles; North Fork of Big Sheep Creek, 1,500 feet in 2.4 miles; and Middle Fork, 1,100 feet in the same distance.

The average gradient of the Imnaha below mile 65 is 60 feet of drop per mile. The gradient of Big Sheep Creek, below the confluence of the forks, progressively decreases from 292 feet per mile between stream miles 39 and 33 to 84 feet per mile between miles 28 and 0. The gradient of Little Sheep Creek is greater than that of other streams with 440 feet of drop per mile between miles 29 and 21, and 109 feet below mile 21.

Lightning Creek, 25 miles long, and Horse Creek, 23 miles, two of the larger tributaries flowing into the Imnaha at the 5th and 11 miles, respectively, have steep average gradients of 213 and 206 feet of drop per mile, respectively.

Climate

Climatic conditions vary greatly within the sub-basin due to its wide range in topography. Along the Snake River, the mean annual temperature is higher than in most of Eastern Oregon. Winters along the Snake and Lower Imnaha are very mild. Snow seldom falls and never remains for more than a few days. Summer temperatures are high, often reaching more than 100 degrees. In sharp contrast, the high mountains in the south have cool summers and extreme winters with snow remaining nearly all year in sheltered areas.

Precipitation varies with the topography, the lowest elevations receiving the least and the high mountains the most. Average annual precipitation varies from 14 inches in the north of the sub-basin to 29 inches at Gumboot on the southern boundary. On the high Wallowa Mountains, at the southwestern corner, average annual precipitation exceeds 60 inches.

Population

The Imnaha has the lowest density of population of the five sub-basins. An estimated 226

inhabitants, including 23 at the town of Imnaha, represents almost five square miles per inhabitant.

Land Ownership

The U. S. Forest Service and Bureau of Land Management control 905 square miles of federal land, representing more than 80 percent of the sub-basin area. Public domain land amounts to nearly seven square miles while state land is less than one-half square mile. The balance of almost 180 square miles is under private ownership.

Transportation

The sub-basin has few roads. One follows the course of the Imnaha from river mile 5 to river mile 64. Another road branches off at Imnaha and follows the course of Little Sheep Creek almost to its source where it sweeps around to the east to meet the former near river mile 60 on the Imnaha. Another road branches southeast from Imnaha and following the ridge which forms the boundary between the drainage areas of Horse Creek and the main stem of the Imnaha, leads to Memaloose Guard Station.

In addition to the gravel roads described above, a number of dirt roads give access to the main ridges west of the Imnaha. The sub-basin has no paved roads and no railways. Access to the sub-basin is provided by a paved road leading from Joseph in Wallowa sub-basin.

There are two airstrips, one near Memaloose Guard Station at the southern end of Summit Ridge and the other on Lord Flat at the northern end of Summit Ridge. No regular bus or freight routes serve the sub-basin.

Present Economy

Stock raising and logging are the main activities in the sub-basin. Benches in the sheltered canyons between the Imnaha and the Snake Rivers provide grazing all the year round. About one-half of the sub-basin consists of range land and the other half is forest. About one-third of the forest area contains saw timber.

AMOUNT AND DISTRIBUTION OF THE RESOURCE

Precipitation Data

No stations exist in the sub-basin where precipitation records are regularly maintained.

Hourly observations are made at Imnaha at irregular intervals. Precipitation records kept at Gumboot from 1909 through 1951 are available but no data are available with respect to the former stations at Pittsburg, Brockman Ranch, and Divide. Average annual precipitation for the Basin was shown in Figure 3 and precipitation in the sub-basin was discussed under Climate. Climatological stations are located as shown in Figure 11.

Stream Gaging

The only active gaging station in the sub-basin is on the Imnaha River at Imnaha which was opened in 1928. Stations were active for varying periods in the past on the Imnaha above Gumboot and on Big Sheep Creek and Little Sheep Creek near Joseph. Streamflow records from these stations are published in the Water Supply Papers of the U. S. Geological Survey. Location of the gaging stations in the Basin is given in Figure 11.

Yield

Annual yield of the Imnaha at mouth for the period 1929 through 1957 was determined by correlations and is given in Figure 54. Yield varied from a minimum of about 200,000 acre-feet in 1931 to a maximum of over 600,000 acre-feet in 1956, the average for the period being 400,000 acre-feet. Drainage area of the Imnaha receives relatively low rainfall and streamflow is dependent on snowmelt in the Wallowa Mountains. In common with other streams that have their sources in the high Wallowas, the yield of the Imnaha has greater uniformity than the Upper Grande Ronde.

Mean monthly discharges at the mouth of the Imnaha, Figure 55, show the distribution of the average annual yield with respect to time. High flows are restricted to the three months of April, May, and June, with maximum monthly average of 1,700 cfs occurring in May. The month of maximum flow occurs earlier in the Imnaha than in the Wallowa River due probably to the lower elevation of snow pack in the Upper Imnaha. September is the month of lowest average flow, 140 cfs.

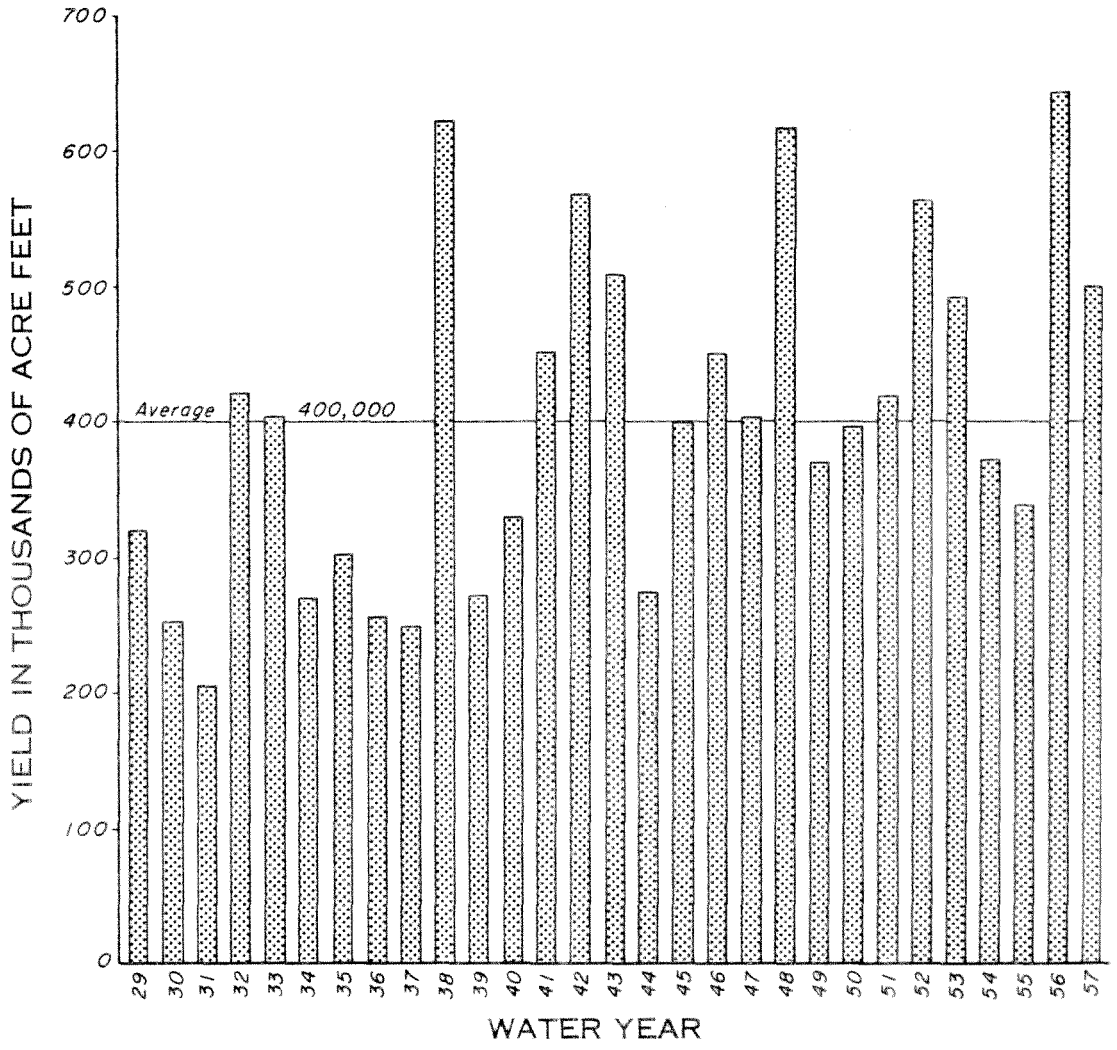
Figure 56 shows the flow pattern for 1932, which was the year of minimum discharge during the period of observation. A minimum discharge of 16 cfs was recorded on November 22.

Drought frequencies for the Imnaha at its mouth, Figure 57, indicate that a minimum flow of 90 cfs for 30 consecutive days has an average recurrence interval of 10 years.

ANNUAL YIELD

IMNAHA RIVER AT MOUTH

DRAINAGE AREA 875 SQ. MI.



All values from Correlations

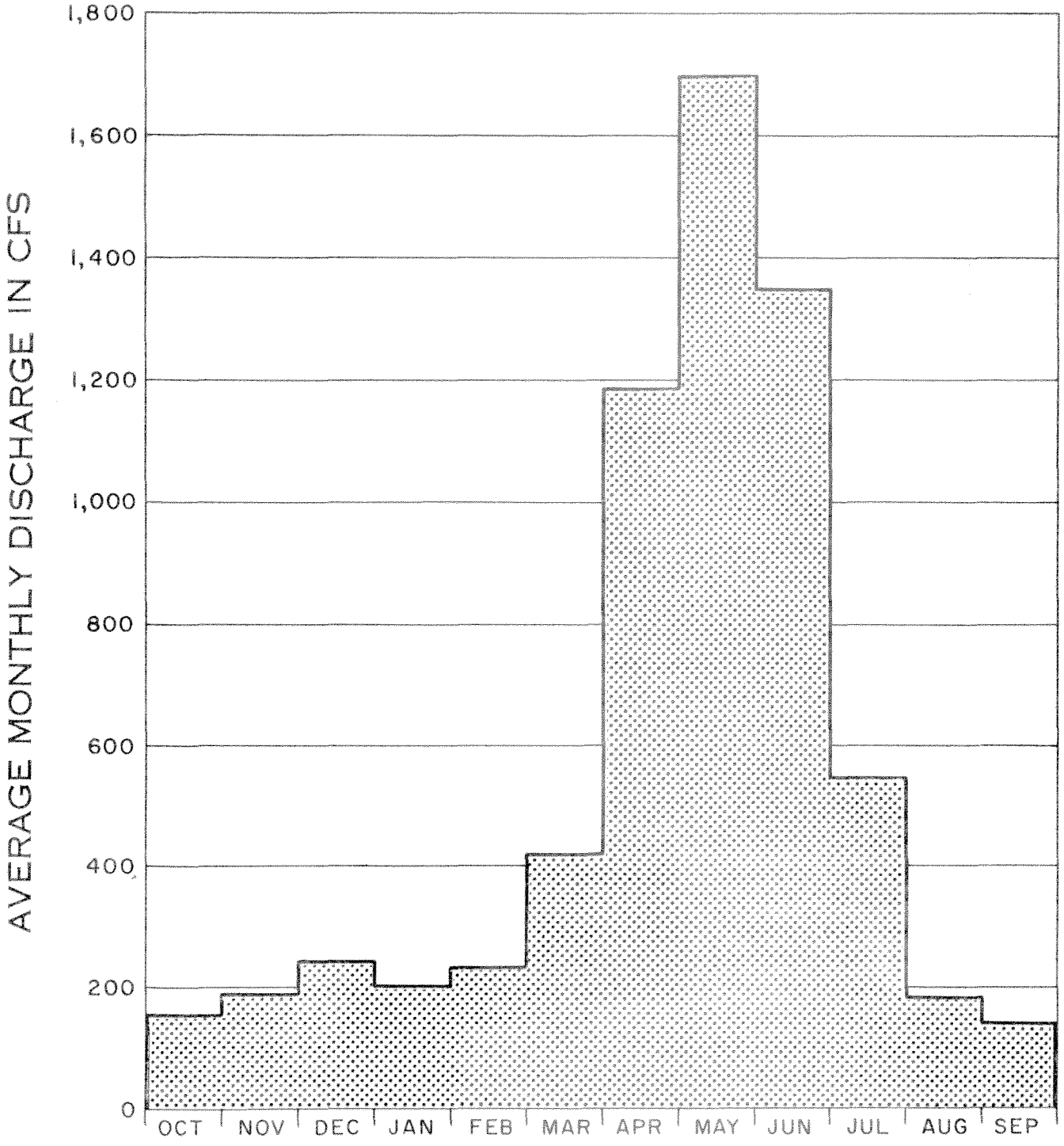
Drawn 5-5-59
Grande Ronde
File 8.220

Figure 54

DISCHARGE

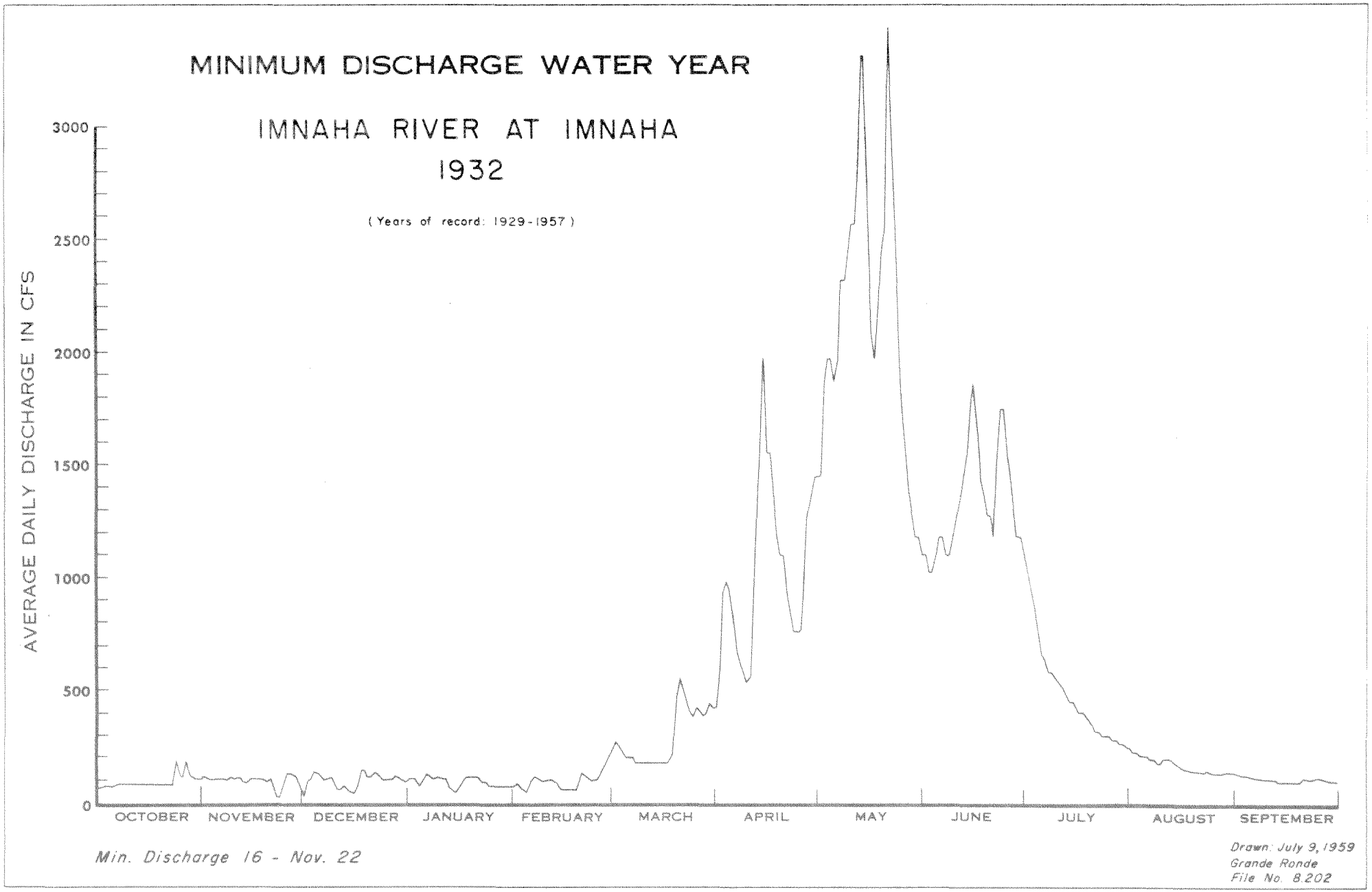
IMNAHA RIVER AT MOUTH

1929 - 1957



Drawn 6-2-59
Grande Ronde
File No. 8.202

Figure 55



179

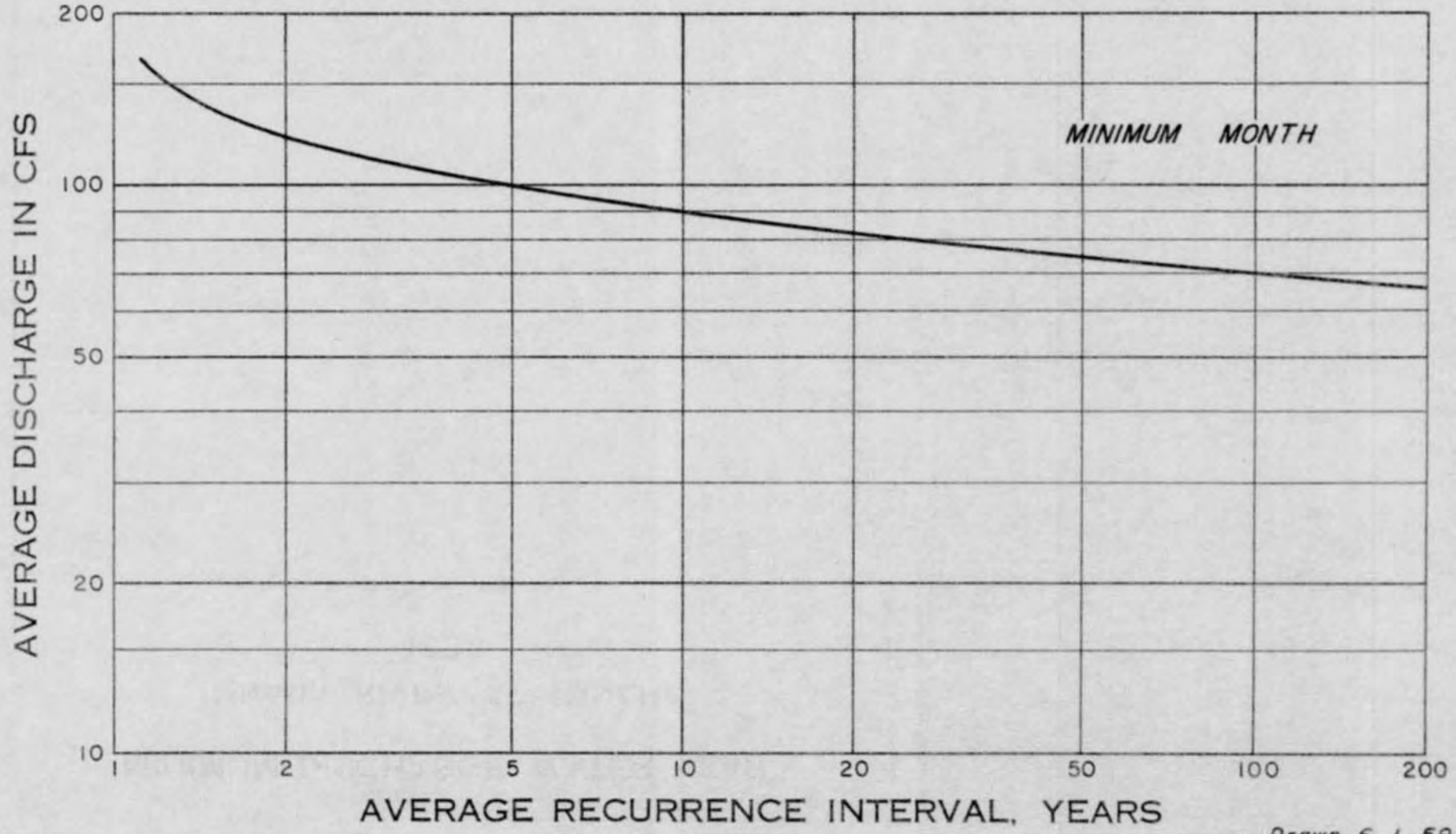
Figure 56

Figure 57

DROUGHT FREQUENCY

IMNAHA RIVER AT MOUTH

1929 - 1957



Drawn 6-1-59
Grande Ronde
File No. 8.203

AMOUNT AND DISTRIBUTION OF THE RESOURCE UNDER APPROPRIATION

Water Rights

There are total rights for almost 200 cfs in the sub-basin of which 1 cfs is for a nonconsumptive use, namely mining, and the balance for consumptive uses (see Table 19). All consumptive water rights are for irrigation use, with the exception of three rights for domestic use totaling less than 0.5 cfs. About 80 percent of the water rights are located on the headwaters of Little Sheep Creek and Big Sheep Creek for the benefit of nearly 7,000 acres in the Wallowa sub-basin. The remaining water rights, with few exceptions, are located either on the main stem of the Imnaha or on small tributaries close to the main stem.

Depletions

Legal depletion rights per stream mile on the Imnaha are shown in Figure 58. Of the depletion rights, totaling about 160 cfs indicated on the 23rd stream mile, two-thirds occur on Little Sheep Creek and one-third on Big Sheep Creek.

EXISTING NEEDS

Domestic

Existing water rights for domestic use total less than 0.5 cfs and are easily met from surface sources.

Municipal

No water rights exist for municipal use in the sub-basin.

Irrigation

The greater part of the water rights for irrigation use benefits land outside the sub-basin. The Wallowa Valley Improvement Canal diverts water from Big Sheep Creek, Little Sheep Creek, and their tributaries for the purpose of irrigating nearly 7,000 acres in the Wallowa sub-basin east of Wallowa Lake. Irrigated tracts within the sub-basin consist of narrow strips on or close to the main stem of the Imnaha known locally as shoestring ranches. Flows in the larger streams are adequate for irrigation needs but water shortages can occur in the small streams during years of low precipitation.

TABLE 19

WATER RIGHTS SUMMARY*

IMNAHA BASIN

USE	STREAM	TOTAL RIGHTS CFS	
Domestic	Big Sheep Creek	0.1	
	Imnaha River	0.2	
	Snake River	0.1	
	Total Domestic		0.4
Municipal	None		
Irrigation	Big Sheep Creek	25.6	
	Little Sheep Creek	107.9	
	McCully Creek	24.8	
	Imnaha River	35.4	
	Sheep Creek	2.3	
	Snake River	1.2	
	Total Irrigation		197.2
Recreation	None		
Industrial	None		
Power	None		
Mining	Imnaha River	1.0	
	Total Mining		1.0
Wildlife	None		
Fish Life	None		
Pollution Abatement	None		
	TOTAL IMNAHA BASIN		198.6

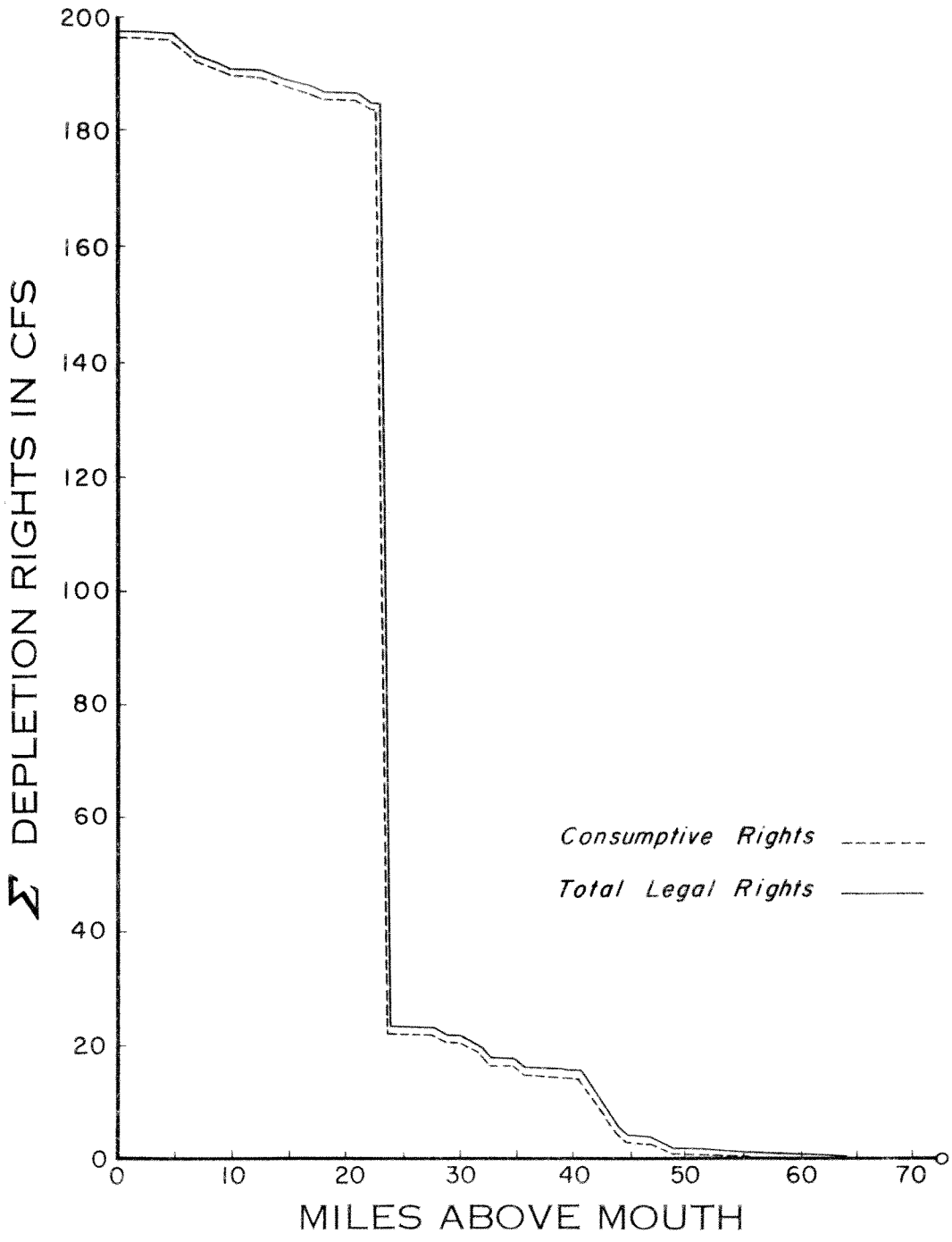
* As of January 1, 1959

LEGAL DEPLETION RIGHTS

BY STREAM MILE

IMNAHA RIVER

as of Jan 1, 1959



Drawn 6-4-59
Grande Ronde
File No. 8.302
Figure 58

Power

No power rights exist in the sub-basin.

Industrial

No industrial rights exist in the sub-basin.

Mining

A mining right for one cfs is located on the Imnaha near the 57th mile. The flow is adequate to meet this demand.

Recreation

No water rights exist for recreation use. Fishing in the Imnaha, however, provides recreational use of water in a wider sense. There are seven lakes varying in size from 3 acres to 28 acres in the sub-basin. There also are nine forest camps in the sub-basin located as shown in Figure 9A.

Wildlife

Included in the sub-basin is a part of the rugged Wallowa Mountains, one of the most important habitats for big game in northeastern Oregon. Rocky Mountain elk and mule deer are distributed throughout the sub-basin. Consumptive water needs of animals is small and can easily be met by the numerous streams.

Fish Life

The Imnaha is one of the most important spawning streams for anadromous fish in the Grande Ronde Basin. Runs in this river are estimated by the State Fish Commission at 9,500 spring chinook, 500 fall chinook, and 6,000 steelhead trout. Due to the undeveloped state of the sub-basin, streamflows are adequate both in quality and in quantity to support the fish runs.

Pollution Abatement

Pollution abatement problems do not exist in view of the small population and absence of development.

Flood Control

Flood control problems do not exist in the sub-basin.

FUTURE NEEDS

Domestic

Supplies from streamflow are adequate for future needs which will not materially increase over existing requirements.

Municipal

There is little potential for municipal water use in the future.

Irrigation

Large tracts of irrigable land do not exist within the sub-basin. Land in the adjoining sub-basin of Wallowa which was irrigable with water drawn from the Imnaha sub-basin has already been developed. Future irrigation needs will be limited to sprinkler irrigation on bench land for hay production. Supplies will be adequate for this use.

Power

The future needs for power in the Imnaha Basin are not well defined. Development within the sub-basin will be limited because of lack of potential and, therefore, growth in electrical load will not be significant in terms of quantity.

The potential for hydroelectric development within the Basin for in-basin use and out-of-basin transport is limited by the same characteristics that affect the Grande Ronde Basin adversely. The main factors being topography and distribution of runoff.

The stream gradient of the Imnaha is steep almost from its mouth and the potentials for economic storage of water are limited.

Storage is necessary to regulate streamflow and make water available at a time when the power that can be generated is needed. Approximately 65 percent of the average annual yield of the sub-basin falls within the period April through July with 47 percent in May and June.

Suggested possibilities for development are contained in Appendix I, House Document No. 531. An out-of-basin diversion project at the Coverdale site, approximately mile 56, would develop about 23 megawatts of nominal prime capability. Storage in the amount of 67,000 acre-feet could be provided by a large physical installation. Hold-over storage and a regulated minimum flow of 148 cfs could be provided.

At mile 34.5, a possible project exists at the Saddle Creek site. An 85-foot dam would provide approximately 5,000 acre-feet of storage to maintain adequate supplies for downstream rights if an out-of-basin diversion should be constructed upstream.

The economic feasibility of the foregoing sites has not been established.

Industrial and Mining

Need for water will not arise due to the probable lack of industrial and mining potential in the sub-basin.

Recreation

Future recreational needs require the preservation of fish and wildlife which are dependent on streamflow.

Wildlife

Streamflow is adequate to meet the future needs of wildlife.

Fish Life

It is known that substantial populations of spring chinook salmon and steelhead trout utilize the Imnaha River drainage. Spring chinook utilize a 30-mile stretch of stream from approximately Freezeout Creek upstream on the main stem. Annual counts on an under stretch of approximately 14 miles have given redd counts up to 698 units.

Little is known about the populations of steelhead trout. It has been claimed that fall run chinook utilize the lower main stem below Imnaha.

Horse Creek and Lightning Creek are not known to support any specie of salmon. Although data are limited, they are considered to contribute substantially to the steelhead fishery.

Big Sheep Creek supports runs of anadromous fish. Spring chinook and steelhead are the species. Index measurements, generally within an 11-mile stretch, gave redd counts up to 147 units. Lick Creek, a tributary of Big Sheep Creek, supports a spring chinook run as well as steelhead.

Potentials for increased anadromous fish production exist in the Lower Imnaha. In particular, a 10-mile stretch between the town of Imnaha and Horse Creek has a potential of over 600 redds. This potential would be achieved with fall spawning chinook.

Horse and Lightning Creeks appear to have potentials for the production of silver salmon. Additional studies are necessary to evaluate these possibilities.

The lower 11 miles of Big Sheep Creek have an adequate spawning area for 500 redds of fall spawning chinook or 900 redds of silver salmon. Little Sheep and Camp Creeks have redd potentials of 200 and 150 silver salmon redds for 11- and 6-mile sections, respectively. Studies to more fully identify possibilities are needed.

Removal of obstructions, screening of diversions, supplemental rearing, and stream improvement are important aspects here as in the Grande Ronde River drainage.

Among items of a serious nature will be the effects of proposed Middle Snake River water development projects on the anadromous fish populations of the Imnaha.

Pollution Abatement

Pollution abatement problems will not become serious due to lack of potential for development.

Flood Control

Flood control needs will not arise in the absence of development potential.

APPENDIX

AUTHORITY

The authority for the preparation and presentation of this report is set forth in ORS 536.300. The Legislative Assembly recognizes and declares in ORS 536.220(1) that:

"(a) The maintenance of the present level of the economic and general welfare of the people of this state and the future growth and development of this state for the increased economic and general welfare of the people thereof are in large part dependent upon a proper utilization and control of the water resources of this state, and such use and control is therefore a matter of greatest concern and highest priority.

"(b) A proper utilization and control of the water resources of this state can be achieved only through a coordinated, integrated state water resources policy, through plans and programs for the development of such water resources and through other activities designed to encourage, promote and secure the maximum beneficial use and control of such water resources, all carried out by a single state agency.

"(c) The economic and general welfare of the people of this state have been seriously impaired and are in danger of further impairment by the exercise of some single-purpose power or influence over the water resources of this state or portions thereof by each of a large number of public authorities, and by an equally large number of legislative declarations by statute of single-purpose policies with regard to such water resources, resulting in friction and duplication of activity among such public authorities, in confusion as to what is primary and what is secondary beneficial use or control of such water resources and in a consequent failure to utilize and control such water resources for multiple purposes for the maximum beneficial use and control possible and necessary."

The authority for the report, the study on which it is based, and the actions effected are specifically delegated to the State Water Resources Board in ORS 536.300(1) and (2) which state:

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

"(2) Based upon said studies and after an opportunity to be heard has been given to all other state agencies which may be concerned, the board shall

progressively formulate an integrated, coordinated program for the use and control of all the water resources of this state and issue statements thereof."

Within the limits of existing data and knowledge, the study has taken into full consideration the following declarations of policy under ORS 536.310:

"(1) Existing rights, established duties of water, and relative priorities concerning the use of the waters of this state and the laws governing the same are to be protected and preserved subject to the principle that all of the waters within this state belong to the public for use by the people for beneficial purposes without waste;

"(2) It is in the public interest that integration and coordination of uses of water and augmentation of existing supplies for all beneficial purposes be achieved for the maximum economic development thereof for the benefit of the state as a whole;

"(3) That adequate and safe supplies be preserved and protected for human consumption, while conserving maximum supplies for other beneficial uses;

"(4) Multiple-purpose impoundment structures are to be preferred over single-purpose structures; upstream impoundments are to be preferred over downstream impoundments. The fishery resource of this state is an important economic and recreational asset. In the planning and construction of impoundment structures and milldams and other artificial obstructions, due regard shall be given to means and methods for its protection;

"(5) Competitive exploitation of water resources of this state for single-purpose uses is to be discouraged when other feasible uses are in the general public interest;

"(6) In considering the benefits to be derived from drainage, consideration shall also be given to possible harmful effects upon ground water supplies and protection of wildlife;

"(7) The maintenance of minimum perennial streamflows sufficient to support aquatic life and to minimize pollution shall be fostered and encouraged if existing rights and priorities under existing laws will permit;

"(8) Watershed development policies shall be favored, whenever possible, for the preservation of balanced multiple uses, and project construction and planning with those ends in view shall be encouraged;

"(9) *Due regard shall be given in the planning and development of water recreation facilities to safeguard against pollution;*

"(10) *It is of paramount importance in all cooperative programs that the principle of the sovereignty of this state over all the waters within the state be protected and preserved, and such cooperation by the board shall be designed so as to reinforce and strengthen state control;*

"(11) *Local development of watershed conservation, when consistent with sound engineering and economic principles, is to be promoted and encouraged; and*

"(12) *When proposed uses of water are in mutually exclusive conflict or when available supplies of water are insufficient for all who desire to use them, preference shall be given to human consumption purposes over all other uses and for livestock consumption, over any other use, and thereafter other beneficial purposes in such order as may be in the public interest consistent with the principles of this Act under the existing circumstances."*

CONCLUSIONS, RECOMMENDATIONS, AND STATUS INFORMATION FROM SELECTED REPORTS AND STUDIES

This material is presented in reverse chronological order. Data deals only with the major reports pertinent to water resources investigations and developments in the Grande Ronde Basin.

ENVIRONMENTAL SURVEY REPORT PERTAINING TO SALMON AND STEELHEAD IN CERTAIN RIVERS OF EASTERN OREGON AND THE WILLAMETTE RIVER AND ITS TRIBUTARIES - PART 1. SURVEY REPORTS OF EASTERN OREGON RIVERS - RESEARCH DIVISION - FISH COMMISSION OF OREGON - JUNE 1960

This survey report covers those portions of the Grande Ronde system of significance to the fisheries resource. Data includes information on terrain and gradient, slope and bank cover, shade, stream cross section, bottom materials, obstructions and diversions, impoundment and hatchery sites, and flow and temperature information. The report also deals with existing anadromous fish populations, presently utilized spawning grounds, potential spawning grounds, and redd development potential.

The report contains detailed recommendations which cover the categories of potential fish transplants, removal of stream obstructions and barriers, fish passage facilities, screening of diversions, the development of impoundment (rearing) and hatchery sites, and recommendations for more detailed analyses of appropriate sections of the Grande Ronde system. Potentials for stream improvement for fisheries resources include installing works to control velocity and the deposition of gravel.

GEOLOGY AND GROUND WATER RESOURCES OF THE UPPER GRANDE RONDE RIVER BASIN, UNION COUNTY, OREGON - U. S. GEOLOGICAL SURVEY - JANUARY 1959 (OPEN FILE REPORT)

A detailed review of the geology and ground water resources of the Upper Grande Ronde River Basin. A Department of the Interior information release, dated March 22, 1959, attributes the following conclusion to the report: "Supplies of ground water in the Upper Grande Ronde River Basin, Union County, Oregon, are adequate to meet foreseeable future requirements." The report itself indicates adequate supplies of ground water for various beneficial uses can be obtained from properly constructed wells utilizing ground water from alluvial fan materials, valley fill, and the Columbia River basalts. It states that relatively small amounts of the available natural supplies of ground water have been put to use as of the present.

WATER RESOURCE DEVELOPMENT - COLUMBIA RIVER BASIN - U. S. ARMY ENGINEER DIVISION - NORTH PACIFIC - JUNE 1958 - VOLUME I

This report points out two items with respect to development in the Grande Ronde Basin. First, storage projects on the upper reaches of the main stem and on tributary streams are limited in capacity and adapted only to local needs. Second, there are possible projects on the Lower Grande Ronde River in the reach downstream of its confluence with the Wallowa.

The investigations leading to this report reviewed possible projects on the Lower Grande Ronde River considered in House Document 531, 81st Congress, 2nd Session.

The report indicates that a number of the alternatives of development in the Lower Grande Ronde reach are restricted in their economic practicality by the relocation problems existent due to railroads and highways. Other sites are unsuitable because of the lack of adequate storage.

Comparative studies of alternatives demonstrated that the Wenaha Project of the Grande Ronde at approximate river mile 26.5 was the most feasible.

This project, which would be constructed for power and flood control with minor recreation benefits, was recommended by the Division Engineer, North Pacific Division, Corps of Engineers, for inclusion in the Major Water Plan with a five-to-seven-year delay in construction to provide time to solve the fish passage problems for the anadromous species that utilize the Grande Ronde River.

The Board of Engineers for Rivers and Harbors did not recommend the project for authorization by Congress. This view was concurred in by the Chief of Engineers.

Project justification ratios are 1.3 to 1 where the project could be utilized for flood control to the 800,000-second foot level in the Columbia River system; and 1.02 to 1 where such flood control would come subsequent to the 800,000-second foot control level.

DESIGN MEMORANDUM NO. 2 - GENERAL PLAN AND DETAIL COST ESTIMATE - LOCAL FLOOD PROTECTION PROJECT - GRANDE RONDE VALLEY - OFFICE OF DISTRICT ENGINEER, U. S. CORPS OF ENGINEERS, WALLA WALLA, WASHINGTON - APRIL 1, 1957

This memorandum deals with the development to ameliorate the flood damage problem. It outlines specifics for a conditionally authorized project for this area.

The memorandum concludes a flood control problem justifying early correction does exist in the Grande Ronde Valley; annual damage and loss by flood discharge will continue unless project works are developed; the project outlined in the memorandum is economically justifiable and would confine flood waters, up to the project design flood, to the improved channel in all reaches. It states that channel work will be required for any adequate plan of protection, and will be required whether or not upstream storage is provided in the future. The project, as recommended, is designed to function with future control of discharges by upstream storage on the Grande Ronde River proper and Catherine Creek. Under future coordinated development, the project would provide full control of the standard project flood throughout the entire valley.

It recommends that future action be suspended on the project and data held to be available for reactivation when local interests perfected an organization financially capable of sponsoring the project. It recommended that the memorandum be approved as the definite design study for an economically feasible Grande Ronde Valley project.

DESIGN MEMORANDUM NO. 1 - ECONOMIC FEASIBILITY OF HEADWATER STORAGE RESERVOIRS - GRANDE RONDE VALLEY, OREGON - OFFICE OF DISTRICT ENGINEER, U. S. CORPS OF ENGINEERS, WALLA WALLA, WASHINGTON - APRIL 28, 1955

This memorandum is a preliminary report on alternative plans of development for flood control in the Grande Ronde River Valley.

The conclusion is that further detailed hydraulic and cost studies should be undertaken in connection with the preparation of the general design memorandum.

The data developed were subsequently considered in the preparation of conclusions and recommendations for Design Memorandum No. 2, previously cited.

GRANDE RONDE PROJECT, OREGON - BUREAU OF RECLAMATION - MARCH 1955

This report covers the data for a physical development of the irrigation potential of the Grande Ronde Valley, Union County, Oregon. It covers land classification, physical facilities of a proposed project, water supply, water use requirements, and project costs.

The analysis was not extended to economic feasibility, repayment, or an allocation analysis.

In the foreword, it states that there is no apparent wide-spread desire on the part of local residents for future irrigation development at the time and, therefore, further investigative work was unwarranted.

REPORT ON LOCAL FLOOD PROTECTION PROJECT - GRANDE RONDE VALLEY, OREGON - WALLA WALLA DISTRICT, U. S. CORPS OF ENGINEERS - JUNE 1, 1950

This report concludes that a flood problem justifying early correction existed in the Grande Ronde Valley. It indicates present flood damages were predominantly agricultural in character although urban losses were also severe. It concludes that improvements by local interest are of insufficient extent to provide reasonable flood protection. Flood control by channel improvement and levees would be a logical step towards an ultimate plan which would include storage. Economic justification is deemed adequate and protection highly desirable. It assumed that future storage providing incremental flood protection should be credited with economic benefits on an equal basis instead of on the basis of incremental benefit. It concludes that actual benefits would depend upon the relationship of available flood storage to channel capacities and their relative accomplishment in reducing flood discharge.

The District Engineer recommended that the project described in the report be adopted for construction and that such funds be allocated from appropriations available under the Flood Control Act of 1950, 81st Congress, 2nd Session; provided that local interests provide the necessary easements, relocations, save the United States free from damages due to construction works, and maintain and operate the work after completion in accordance with the regulations prescribed by the Secretary of the Army.

HOUSE DOCUMENT 531, 81ST CONGRESS, 2ND SESSION

Volume 4, Section 9, of this document deals with the Grande Ronde River. The conclusions presented relative to development in the Grande Ronde Basin were as follows:

1. The plan of development includes provisions for flood control, major drainage, extension of irrigable lands, supplemental water for lands now irrigated, development of power on the main stem below Rondowa, and almost complete regulation of the river's contribution to downstream floods in the Snake and Columbia.

2. The development would proceed by stages as justified by economic need. First and most immediate unit would be flood protection and drainage works in the Grande Ronde Valley which would ultimately include multi-purpose flood control and irrigation reservoirs. Power development below

Rondowa would be integrated into basin development when such power developments became economically feasible.

3. *The development on the Grande Ronde below its confluence with the Wallowa would be entirely for power. Five sites were listed as potentials for development with a total of 194 megawatts nominal prime capability. These projects were Rondowa, Elbow Creek, Troy, Rays Ferry, and Narrows.*

4. *Economic studies indicate that power development on the Grande Ronde would not be feasible at the power rates prevailing in the Pacific Northwest.*

5. *The report visualizes the ultimate plan would provide flood protection for about 35,000 acres of developed agricultural lands and urban properties, irrigation for about 96,000 acres, and the production of approximately 194 megawatts of nominal prime power capability.*

WATER UTILIZATION IN THE GRANDE RONDE RIVER, OREGON AND WASHINGTON - R. O. HELLAND - GEOLOGICAL SURVEY - DEPARTMENT OF THE INTERIOR - 1947

This publication is a preliminary or reconnaissance level report dealing with four alternatives of water utilization of the Grande Ronde River. The report deals with the physical possibilities and does not attempt to make any economic analyses of the alternatives presented.

The possibilities for development consist of the following alternatives:

Plan A - The use of flows of the Grande Ronde system for the generation of power at sites on the Grande Ronde, Snake, and Columbia Rivers.

Plan B - The diversion of the residual flows in the Grande Ronde Basin, after irrigation use in the upper areas, to the Walla Walla Basin for power generation and irrigation.

Plan C - The diversion of residual flows, after irrigation use in the Upper Grande Ronde Basin, to the Umatilla River Basin for power and irrigation.

Plan D - A modification and combination of Plans B and C.

The report arrives at some preliminary conclusions with respect to the development of power in the Grande Ronde Basin.

1. It is concluded that although minor power potentials exist in the Wallowa Basin, development has probably almost reached its limit with existing installations in operation at the time of the report.

2. It is concluded that the potential power available at undeveloped sites on the Grande Ronde and its tributaries above the confluence with the Wallowa is so small, or so clearly subordinated to irrigation, that it did not justify consideration in the report.

3. Economical development of power in the main stem of the Grande Ronde below Rondowa would be highly dependent on the development of storage for stream regulation.

With respect to water resources utilization, the report gives a preliminary description of 10 undeveloped reservoir sites of interest in the basin. It also deals with the potential power sites, nine of which are on the main stem of the Grande Ronde River at or below Rondowa. The report summarizes the power potential of the Rondowa-Snake River reach of the Grande Ronde, after ultimate diversions for irrigation, at 82,000 continuous KW and 172,000 KW at mean discharge.

Plan B involves storage on the Grande Ronde River below Rondowa, diversion of water from the Grande Ronde Basin to the Walla Walla Basin through a 17-mile tunnel and distribution to irrigable lands in the Walla Walla Valley. Plan B also discusses the possibility of obtaining power production in connection with the irrigation diversion scheme. Storage on the Grande Ronde would range from 360,000 to 480,000 acre-feet in the plan depending whether water is to be delivered at a uniform rate or on irrigation demand schedule.

Plan C involves the construction of Rondowa Reservoir with a capacity of from 400,000 to 480,000 acre-feet and the tunnel 17 miles long with its outlet discharging to the Umatilla River. The report concludes that the most economical use of flow and head under Plan C might be for irrigation with minor power development which could be utilized for pumping.

Plan D anticipates the possibility of diversion to the Umatilla and Walla Walla areas for irrigation and suggests that power generation would be a minor factor.

REPORT ON THE GRANDE RONDE PROJECT, OREGON - PROJECT INVESTIGATIONS REPORT NO. 57 - BUREAU OF RECLAMATION - MARCH 1941

This report covers an unpublished compendium of physical and economic data covering alternatives of development in the Upper Grande Ronde Basin.

Included among the potentials examined were projects which were later covered in the report - Grande Ronde Project - Oregon, dated March 1955.

PROGRESS REPORT - GRANDE RONDE - R. F. WALTER - BUREAU OF RECLAMATION - OCTOBER 1935

This report deals with the topographic and geologic conditions at six dam sites on the Grande Ronde River above the City of La Grande. Two of the sites are on the main stem near the confluence with Spring Creek, three on the main stem and the vicinity of the confluence of the main stem and Meadow Creek, one on Meadow Creek above its confluence with Dark Canyon Creek, and the last on the main stem downstream of the confluence of Sheep Creek and the main stem. The report states that the geology for the one site on Meadow Creek and the five downstream sites on the Grande Ronde River does not show reassuring foundation conditions for the development of a project for storage. The project on the main stem below the junction of Sheep Creek appears more attractive than any other site investigated in the study. The report deals with the availability of water to a limited extent as well as the utilization of proposed reservoirs for flood control, irrigation, municipal purposes, and industrial use.

The report indicates that additional monies are required to complete investigations for the Grande Ronde Valley and submits estimated cost figures for required work.

POTENTIAL WATER POWER IN THE GRANDE RONDE RIVER BASIN - R. O. HELLAND AND J. T. PARDEE - U. S. GEOLOGICAL SURVEY - 1932

This report deals with the power potential of the Grande Ronde Basin. It indicates the physical developments possible both from the point of view of storage sites and potential power sites. Potential facilities are limited to the Wallowa River Basin and the main stem of the Grande Ronde below Rondowa including the Wenaha River and Joseph Creek.

The report concludes that total potential water power of the basin in Oregon without storage is approximately 69,000 KW for 90 percent of the time and 149,000 KW for 50 percent of the time. The report expressly points out that the figures do not include

potential of possible sites in the Grande Ronde Basin above Rondowa. It indicates that the problem of utilization in the Upper Grande Ronde area is one relating primarily to irrigation with minimal potentials for power.

The report indicates that the scarcity of suitable dam sites and lack of adequate storage are factors unfavorable to the development of power in the Grande Ronde Basin. Storage available is in the lower reaches of the river which adversely affects the potentials for power development.

It deals with three principal storage sites but concludes that geologic conditions at two sites are possibly not feasible, due to leakage. The exclusion of these two sites would reduce the potential storage capacity from 842,000 acre-feet to an estimated 530,000 acre-feet.

TABLE A

POTENTIAL WATER DEVELOPMENT PROJECTS - DAM AND RESERVOIR SITES - GRANDE RONDE BASIN

SITE NAME	REF. NO. ***	PURPOSE	STREAM	DAM			POWER			Channels or Conduit Feet	RESERVOIR					AVERAGE ANNUAL YIELD Acre-feet	LOCATION				DRAINAGE AREA Sq. Mi.
				Height Feet	Crest Length Feet	Type	Installed Capacity KW	Annual Generation 1,000 KWH	Gross Head Feet		Min. Pool Elev. Ft.-MSL	Max. Pool Elev. Ft.-MSL	Max. Area Acres	Usable Storage Acre-Feet	Total Storage Acre-feet		Sec.	Twp.	Rng.	W.M.	
ANEROID LAKE	2	S		15									57		950		16&21	4S	45E		
" "	6	S-P		15					1,750				57		950		16&21	4S	45E		
BEAR CREEK	10	S-I	Bear Creek	100	600								200		12,000	73,000	34	1N	42E		
BEAVER CREEK	2	P	Wenaha				4,360*		1,460	135,000							36	6N	40E		
" "	6	P	"						1,460	135,000							36	6N	40E		
" "	13	P	"				9,800	68,700	1,366												
" "	17	P	"				9,800	68,700	1,366												
CATHERINE CREEK	3		Catherine Creek														7&8	5S	41E		
" "	7	I	" "	150	650	R.F.						3,384	500								96
" "	8	I	" "	150	650	R.F.						3,366		27,500	28,500		7&8	5S	41E		
" "	9	I-P	" "				790	3,300						22,300	23,300						
" "	10	S	" "														7&8	5S	41E		
" "	11	I	" "	155	660	E.F.							554		29,000	87,000					
" "	12	I	" "	155	660	E.F.							554		29,000	87,000					
" "	14	I-FC	" "	155		E.F.									32,000						
" "	15	I	" "									3,400			32,000		8	5S	41E		
" " Plan 1 & 2	16	FC	" "	78							3,296	3,336		6,000	7,000						96
" " Plan 3	16	FC	" "	91							3,296	3,354		11,000	12,000						96
" " Plan 4	16	FC-P	" "	153							3,296	3,398		31,000	32,000						96
CHICO (Joseph Creek)	2	P	Joseph Creek	140			8,800**		1,934						70,000	64,000	10	3N	45E		
" "	6	P	"	140											70,000		10	3N	45E		
COVERDALE	11	P	Imnaha River	238	1,000	C.G.	34,000			30-35,000					67,000	170,000				56	79
"	12	P	" "	238	1,000	C.G.	34,000			30-35,000					67,000	170,000				56	79
"	13	P	McGraw Creek				34,000	201,500	2,300												
"	17	P	" "				34,000	202,000	2,300												
"	18		Imnaha River	235								4,530	800		70,000						
" (The Tunnel)	6	S-P	" "	245	930	R.F.			2,635				820		70,000	136,000	23	5S	47E		
COW CREEK	6	P	Imnaha River	275					275								6	3N	49E		
DRY GULCH	2	S	Wenaha																	3	
ELBOW CREEK	4		Grande Ronde														26	5N	41E	64.8	
" "	6	P	" "						270								26	5N	41E		
" "	10	P	" "	107			6,450**		107								26	5N	41E		
" "	11	P	" "	302	1,300	C.G.								71,000						63.6	
" "	12	P	" "	302	1,300	C.G.								71,000						63.6	
" "	13	P	" "				56,000	245,300	302												
" "	17	P	" "				56,000	245,000	302												
FLY VALLEY	5	S	Fly Creek													20,000					42
" " (Fly Creek)	16	FC	" "	80							4,145	4,180		1,500	1,900						38
GRANDE RONDE LAKE	6	S													640		1	7S	36E		2
GRANDE RONDE, LOWER	8	I	Grande Ronde	190	2,000	E.F.						3,235	2,800	204,000	206,000		11&12	3S	36E		
" " "	9	I-P	" "				3,930	11,400						175,000	177,000						505
" " "	11	I	" "	191	2,000	R.F.										175,000					
" " "	12	I	" "	191	2,000	R.F.										175,000					
" " "	13	P	" "				3,900	12,000	136												
" " "	14	I-FC	" "	180		R.F.									157,000						
" " "	15	I	" "									3,216			157,000						
" " "	17	P	" "				3,900	12,000	136												
" " " Plan 1	16	FC	" "	78							3,080	3,123		19,000	21,000						505
" " " Plan 2	16	FC	" "	55							3,080	3,100		6,500	8,500						173
" " " Plan 3	16	FC	" "	98							3,080	3,143		37,000	39,000						505
" " " Plan 4	16	FC-P	" "	171							3,080	3,216		155,000	157,000						505
" " " Site 2 (Upper)	5	S	" "	125								3,175	1,477		88,100	200,000	11&12	3S	36E		505
" " " Site 1 (Lower)	5	S	" "														12	3S	36E		
" " " Site 1 (Lower)	7	I	" "														12	3S	36E		531
" " " Site 2 (Upper)	7	I	" "	190	2,000	R.F.						3,230	2,800		206,000		11	3S	36E		505
GRANDE RONDE, UPPER																					
Site A (Upper)	5	S	Grande Ronde	213								3,500	1,149		95,700	100,000	36	3S	36E		213
Site B (Middle)	5	S	" "														36	3S	36E		
Site C (Lower)	5	S	" "	230								3,500	3,208		251,300	160,000	25&36	3S	35E		400
Site A (Upper)	7	S	" "													97,000	36	3S	35E		213
Site B (Middle)	7	S	" "														36	3S	35E		
Site C (Lower)	7	S	" "													160,000	25&36	3S	35E		400

* @ 90%

** With Regulation

*** See data sources for potential water development projects

TABLE A (Continued)

POTENTIAL WATER DEVELOPMENT PROJECTS - DAM AND RESERVOIR SITES - GRANDE RONDE BASIN (Continued)

SITE NAME	REF. NO. ***	PURPOSE	STREAM	DAM			POWER				RESERVOIR					AVERAGE ANNUAL YIELD Acre-feet	LOCATION				DRAINAGE AREA Sq. Mi.
				Height Feet	Crest Length Feet	Type	Installed Capacity KW	Annual Generation 1,000 KWH	Gross Head Feet	Channels or Conduit Feet	Min. Pool Elev. Ft.-MSL	Max. Pool Elev. Ft.-MSL	Max. Area Acres	Usable Storage Acre-feet	Total Storage Acre-feet		Sec.	Twp.	Rng.	W.M.	
HORSESHOE BEND	10	P	Grande Ronde	104			11,190**		121	1,000							32	7N	46E		
HURRICANE CREEK	2	P	Hurricane Creek				820*		1,400	30-40,000							28	3S	44E		
" "	10	S	" "	250	800	C.G.							160		20,000	40,000	15	3S	44E		
HURRICANE RAPIDS	10	P	Hurricane Creek				120*		200								27	3S	44E		
INDIAN CREEK	7	I	Indian Creek	334		E.F.						3,960	938		98,821	30,300	32&33	1S	40E		38
INDIAN CREEK, LITTLE	7	I	L. Indian Creek	132	930	E.F.						4,002	315		11,500		5	2S	40E		7
" " "	8	I	" " "	132	930	E.F.						4,005		11,050	11,500		5	2S	40E		
" " "	9	I-P	" " "				2,660	9,000													
" " "	11	I	" " "	132	930	E.F.							360		14,500	23,000					
" " "	12	I	" " "	132	930	E.F.							360		14,500	23,000					
" " "	13	P	Indian Creek				2,700	9,000	616												
" " "	17	P	" "				2,700	9,000	616												
LOG CREEK	6	S	Imnaha	175	400												9	2N	48E		
LOSTINE RIVER	2	P	Lostine				820*		850	35-45,000							2	3S	43E		
" "	10	S-I	"	100	1,000								200		15,000	127,000	27	1S	43E		
MEADOWBROOK	SEE MEADOW CREEK																				
MEADOW CREEK	5	S	Meadow Creek	174								3,500	1,794		125,700	60,000					164
" "	6	S-I	" "	105									750		31,400		35	3S	35E		
" "	7	S	" "													58,800	35	3S	45E		162
" "	16	FC	" "	51							3,357	3,381		6,000	7,300						162
" " (Meadowbrook)	1	S	" "	105		E.F.						1,000	755		31,375						165
MILE 7	10	P	Grande Ronde	70			10,180**		110	3,000							27	7N	46E		
MILE 59	10	P	Grande Ronde	117			7,120**		117								29	5N	42E		
MILE 72	10	P	Grande Ronde	133			11,190**		190								13	4N	40E		
MINAM	2	P	Wallowa				5,100*		240	53,000											
"	6	P	"						240	53,000											
MINAM CREEK, LITTLE	2	P	Minam				4,910*		823								10	2S	41E		171
" " "	6	P	"						823	105,000							10	2S	41E		171
" " "	7	I-P	Little Minam	207	1,000	R.F.						5,330	172		11,870		27	3S	41E		
" " "	13	P	Minam				5,600	43,600	590												
" " "	17	P	"				5,600	43,600	590												
MINAM CREEK, NORTH	2	P	Minam				2,835*		950	75,000							26	3S	42E		116
" " "	6	P	"						950	75,000							26	3S	42E		90
" " "	13	P	"				4,800	36,800	950												
" " "	17	P	"				4,800	36,800	950												
NARROWS	2	S-P	Grande Ronde	234	1,070	C.G.	8,950*		238				1,450	137,000			26	7N	46E		3,445
"	4		" "														26	7N	46E	4.4	
"	6	S	" "	234		R.F.			198	500				137,000			26	7N	46E	8.6	
"	11	P	" "	142	900	C.G.				1,300			680		38,000					8.6	
"	12	P	" "	142	900	C.G.				1,300			680		38,000					8.6	
"	13	P	" "				49,000	210,200	150												
"	17	P	" "				49,000	210,000	150												
POLE BRIDGE	10	P	Lostine				240**		200								15	2S	43E		
RAY'S FERRY	2	S-P	Grande Ronde	381	1,730	C.G.	13,650*		381				3,460		530,000		3	6N	45E		3,415
" "	4		" "														3	6N	45E	18.7	
" "	6	S	" "	381	1,730										530,000						
" "	10	S-P	" "	301		C.A.	16,040**		174			1,400	2,116	200,000	223,950		3	6N	45E		
" "	11	P	" "	379		C.G.							3,450	358,000	480,000	2,040,000				18.6	3,390
" "	12	P	" "	379		C.G.							3,450	358,000	480,000	2,040,000				18.6	3,390
" "	13	P	" "				106,000	464,300	379												
" "	17	P	" "				135,000	633,000	379												
ROGERSBURG	2	P	Grande Ronde				1,865*		50	13,500											

* Q 90%

** With Regulation

*** See data sources for potential water development projects

TABLE A (Continued)

POTENTIAL WATER DEVELOPMENT PROJECTS - DAM AND RESERVOIR SITES - GRANDE RONDE BASIN (Continued)

SITE NAME	REF. No.	PURPOSE	STREAM	DAM			POWER				RESERVOIR					AVERAGE ANNUAL YIELD	LOCATION				DRAINAGE AREA
				Height Feet	Crest length Feet	Type	Installed Capacity KW	Annual Generation 1,000 KWH	Gross Head Feet	Channels or Conduit Feet	Min. Pool Elev., Ft. MSL	Max. Pool Elev., Ft. MSL	Max. Area Acres	Usable Storage Acre-feet	Total Storage Acre-feet	Acre-Feet	Sec.	Twp.	Rge.	W.M.	Sq. Mi.
RONDOWA	6	P	Grande Ronde						277	65,000							11	3N	45E		
"	10	S-I-P	" "	360								2,600	4,170		107,700		11	3N	45E		
"	11	I-P	" "	420									6,400	660,000	850,000	1,500,000				79.2	2,555
"	12	I-P	" "	420									6,400	660,000	850,000	1,500,000				79.2	2,555
"	13	P	" "				76,000	332,900	420												
"	17	P	" "				76,000	332,000	420												
" (Troy)	2	P	" "			R.F.	16,640*		698								11&12	3N	45E		2,644
" (Sheep Creek)	4		" "														11&14	3N	45E	79.6	
SADDLE CREEK	11	I	Imnaha	85	250	C.G.									3,000					34.5	
" "	12	I	"	85	250	C.G.									3,000					34.5	
SANDERSON SPRINGS (Willow Creek)	7	I	Spring Creek	100											16,000						
SHEEP CREEK	SEE RONDOWA																				
SHEEP RANCH	16	FC	Grande Ronde	68							4,017	4,038		5,000	6,500						102
SHEEP RANCH, LOWER	5	S	Grande Ronde														12	5S	35E		
SHEEP RANCH, UPPER	5	S	Grande Ronde	230								4,200	2,469		321,400	70,000	19	5S	36E		133
" " "	7		" "	190								4,160	1,987		126,690	71,900	19	5S	36E		
STATELINE	10	P	Grande Ronde	136			11,190**		176	3,300							11	6N	43E		
THE FORKS	6	P	Imnaha						600								19	5S	46E		
THE FORKS	6	P	Wenaha				955*		1,000												
" "	13	P	"				2,900	21,500	1,000												
" "	17		"				2,900	21,500	1,000												36
" " (North Fork)	2	P	"						500	32,000							17	6N	40E		18
" " (South Fork)	2	P	"				240*		1,000	42,500							8	5N	40E		38
THE RAPIDS	6	P	Imnaha														19	5S	47E		
" "	13	P	"				3,700	29,300	950												
" "	17	P	"				3,700	29,300	950												
THE TUNNEL	SEE COVERDALE																				
TROY	6	I-P	Grande Ronde	243									2,000		175,000	2,000,000	24	6N	43E		3,240
"	10	P	" "	65			6,640**		107	6,500							9	5N	43E		
"	11	P	" "	410	1,950	C.G.							4,250		680,000	1,980,000				41	3,215
"	12	P	" "	410	1,950	C.G.							4,250		680,000	1,980,000				41	3,215
"	13	P	" "				102,000	446,800	410												
"	17	P	" "				102,000	447,000	410												
" (Boundary)	2	S-P	" "	243	1,100		3,280*		92				2,000		175,000		24	6N	43E		3,240
WALLOWA	2	P	Wallowa				3,135*		228	43,000							31	2N	45E		
"	6	P	"						228	43,000							31	2N	45E		
" (Canyon)	10	S	"			R.F.											33	2N	45E		
WALLOWA DIVERSION	15	P	Wallowa				1,015**		160	30-32,000							32	2N	45E		
WALLOWA (EAST FORK)	2	P	East Fork Wallowa				395*		1,320	10-12,000							9	4S	45E		
WALLOWA (WEST FORK)	2	P	West Fork Wallowa				1,790*		1,500												
WENAHA	19	P-FC	Grande Ronde	370		R.F.	134,000	630,000	320		1,575	1,770	6,330	900,000	1,220,000	2,140,000				26.7	3,330
"	20	P	" "											900,000							
"	21	P	" "				134,000														
WILDCAT CREEK	18	P	Grande Ronde	117			8,670**		141		5,300						19	5N	43E		
WILLOW CREEK	SEE SANDERSON SPRINGS																				
12 HP 1 SITE	6	P	Grande Ronde	100	200				200	7,900							13	5S	38E		130
12 HP 2 SITE	6	P	Grande Ronde						150								35	4S	38E		

* @ 90%
** With Regulation
*** See data sources for potential water development projects

DATA SOURCES FOR POTENTIAL WATER DEVELOPMENT PROJECTS

REFERENCE NUMBER

1 Report to President and Directors of Grande Ronde Reservoir Company - by Young and Kelsey, Civil Engineers, Portland, Oregon - February 23, 1907.

2 Potential Water Power in Grande Ronde River Basin - U. S. Geological Survey Report - by R. O. Helland and J. T. Pardee - 1932.

3 Catherine Creek Reservoir Site near Union, Oregon and Dam Sites (one plan sheet with dam sites and cross sections) - by U. S. Geological Survey - 1933.

4 Plan and Profile of Grande Ronde River, Oregon and Washington, and Tributaries showing Miscellaneous Dam Sites, (three plan sheets, three profile sheets, and one sheet showing dam sites with cross sections) - by U. S. Geological Survey - 1934.

5 Progress Report on Grande Ronde Investigations, Oregon - by R. F. Walters, Bureau of Reclamation - October 1935.

6 Water Utilization in the Snake River Basin - WSP 657, U. S. Geological Survey - by W. G. Hoyt - 1935.

7 Report on Grande Ronde Project - by Bureau of Reclamation - March 1941.

8 Report on Emergency and Immediate Post War Projects, to the Advisory Committee of the Northwest States Development Association - by Charles E. Stricklen and R. H. Baldock - October 1943 and November 1943.

8 Preliminary Report of Committee on Reclamation to Committee on Post War Readjustment and Development - by G. O. Aiken and others - April 1944.

9 The Columbia River - by Bureau of Reclamation - February 1947.

10 Water Utilization in the Grande Ronde River, Oregon and Washington - by R. O. Helland - 1947, USGS.

11 Review Report on Columbia and Tributaries, Appendix 1, Middle and Lower Snake River Basin - by Corps of Engineers, North Pacific Division - October 1, 1948.

DATA SOURCES FOR POTENTIAL WATER DEVELOPMENT PROJECTS

REFERENCE NUMBER

12 *Columbia River and Tributaries, Northwestern United States - House Document 531, 81st Congress, Volume IV - 1950.*

13 *Hydroelectric Power Resources of the United States, Developed and Undeveloped - by Federal Power Commission - 1953.*

14 *Upper Columbia River Basin Commission of Oregon Annual Report - June 30, 1954.*

15 *Grande Ronde Project, Oregon - by Bureau of Reclamation, Region 1 - March 1955.*

16 *Economic Feasibility of Headwater Storage Reservoirs, Grande Ronde Valley, Oregon - Design Memorandum No. 1 - by Corps of Engineers, Walla Walla District - April 28, 1955.*

17 *Hydroelectric Power Resources of the United States, Developed and Undeveloped - by Federal Power Commission - 1957.*

18 *Plan of Coverdale Reservoir and Dam Site, Imnaha River, Oregon (one plan sheet showing dam site and area capacity) - by U. S. Geological Survey - 1957.*

19 *Water Resource Development, Columbia River Basin, Volume I and II - by Corps of Engineers, North Pacific Division - June 1958 (Review of House Document 531).*

20 *Report on Ultimate Capacities for Planning Purposes of Power Plants in the Columbia River System - by the Power Planning Subcommittee to the Columbia Basin Inter-Agency Committee - October 1958.*

21 *Review of Power Planning in the Pacific Northwest, Fiscal Year 1960 - by Power Planning Subcommittee to the Columbia Basin Inter-Agency Committee - October 18, 1960.*

SELECTED BIBLIOGRAPHY

1920 *Engineering Report on the Mountain Sheep Irrigation District; State Engineer*

1932 *Potential Water Power in the Grande Ronde River Basin; Bureau of Reclamation*

Sept. 1933 *Irrigation System, Water Rights and Water Supply of Wallowa Valley Improvement District No. 1; State Engineer*

Sept. 1933 *Wallowa Valley Improvement District No. 1, Soil Agricultural and Economic Report; Oregon Agricultural Experiment Station*

1937 *Nonmetallic Mineral Resources of Eastern Oregon; U. S. Geological Survey Bulletin No. 875*

1938 *The Geology of Part of the Wallowa Mountains, Bulletin No. 3; Oregon State Department of Geology and Mineral Industries*

1939 *Oregon Metal Mines Handbook (Bulletin No. 14A); Oregon State Department of Geology and Mineral Industries*

March 1941 *Report on Grande Ronde Project, Oregon; Bureau of Reclamation*

1941 *Geology and Physiography of the Northern Wallowa Mountains, Oregon, Bulletin No. 12; Oregon State Department of Geology and Mineral Industries*

1947 *Water Utilization in the Grande Ronde River, Oregon and Washington; U. S. Geological Survey*

July 1947 *Program Planning Atlas for Union County, Oregon; Soil Conservation Service*

1948 *Program Planning Atlas for Wallowa County, Oregon; Soil Conservation Service*

March 1950 *House Document No. 531, 81st Congress, 2nd Session*

June 1950 *Report on Local Flood Protection Project, Grande Ronde Valley, Oregon; Corps of Engineers*

SELECTED BIBLIOGRAPHY

Feb. 1954 *Water Supply Sources and Water Use in 187 Oregon Cities; Bureau of Municipal Research and Service, University of Oregon*

March 1955 *Grande Ronde Project, Oregon; Bureau of Reclamation*

April 1955 *Grande Ronde Valley, Oregon, Economic Feasibility of Headwater Storage Reservoirs; Corps of Engineers*

1956 *1954 Census of Agriculture; U. S. Bureau of the Census*

April 1957 *Grande Ronde Valley, Oregon, General Plan and Detailed Cost Estimate, Local Flood Protection Project; Corps of Engineers*

1957 *1954 Census of Mineral Industries; U. S. Bureau of the Census*

April 1958 *Grande Ronde Basin Hearing; Oregon State Water Resources Board*

Dec. 1958 *Hearing on Middle Snake River Basin; Oregon State Water Resources Board*

1958 *Union County Agricultural Income, 1957-58; Union County Agent*

Jan. 1959 *Geology and Ground-Water Resources of the Upper Grande Ronde River Basin, Union County, Oregon; U. S. Geological Survey*

March 1959 *Manufacturer's Directory and Buyer's Guide, 1959; Oregon State Department of Planning and Development*

June 1960 *Environmental Survey Report Pertaining to Salmon and Steelhead in Certain Rivers of Eastern Oregon and The Willamette River and Its Tributaries, Part 1, Survey Reports of Eastern Oregon Rivers; Fish Commission of Oregon*

ABBREVIATIONS AND SYMBOLS

ac	acre
Ave.	average
Br.	branch, bridge
Can.	canyon
cfs, CFS	cubic feet per second
Co.	county
Comm.	communications
Cont.	contract
Cr.	creek
DA	drainage area
Dom.	domestic
E.	east
F.C.	forest camp
Fig.	figure
Fk.	fork
ft.	feet, foot
G.	gulch
Gen.	general
gpd	gallons per day
gpm	gallons per minute
H	head
Hwy.	highway
Inc.	Incorporated
Ind.	industrial
Ins.	insurance
Irrig.	irrigation
Jct.	junction
KW	kilowatts
KWH	kilowatt hours
L.	little, lake
Lat.	lateral
Lks.	lakes
mgd	million gallons per day
mi	mile
Min	mining
Mt.	mount
Mtn.	mountain
Mun.	municipal
M.P.	municipal park
msl, MSL	mean sea level
MWH	megawatt hours
N.	north
No.	number
nr.	near
OSHD	Oregon State Highway Department
Pt.	point
P.O.	post office
Pow.	power
ppm	parts per million
Q	rate of flow
quad	quadrangle
R	range
R.S.	ranger station
R.	river
Rec.	recreation
Res.	reservoir
Sec.	section
Ser.	Series
Σ	sigma (a summation)
S.	south
Spr.	spring
Sq.	square
S.P.	state park
SWRB	State Water Resources Board
T	township
USGS	United States Geological Survey
W.	west
W.P.	wayside park
WSP	water supply papers

APPROXIMATE HYDRAULIC EQUIVALENTS

1 acre foot
- = *a volume 1 acre in area and 1 foot in depth*
- = *326,000 gallons*
- = *43,560 cubic feet*
- = *0.5 cubic feet per second for 1 day*

1 cubic foot per second
- *falling 8.8 feet will produce 1 horsepower**
- *falling 11.8 feet will produce 1 kilowatt**
- = *7.5 gallons per second*
- = *450 gallons per minute*
- = *2.0 acre feet per day*
- = *650,000 gallons per day*

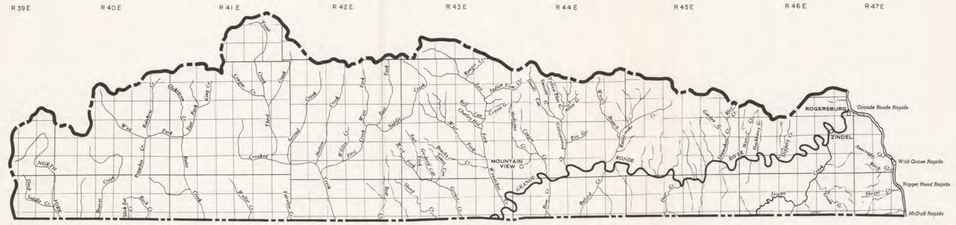
1 inch per day
- = *0.04 cubic feet per second per acre*
- = *27 cubic feet per second per square mile*
- = *19 gallons per minute per acre*

1 inch per hour
- = *1.0 cubic feet per second per acre*
- = *640 cubic feet per second per square mile*
- = *450 gallons per minute per acre*

1 million gallons per day
- = *690 gallons per minute*
- = *1.5 cubic feet per second*
- = *3.0 acre feet per day*

* *theoretical for water at standard conditions*

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W A S H I N G T O N

I D A H O

LEGEND

METALS

1 Antimony
2 Copper
3 Gold
4 Lead
5 Molybdenum
6 Silver
7 Tungsten
8 Zinc

NON-METALLICS

9 Clay, Brick & Tile
10 Limestone
11 Marble

ACTIVE MINE

UMATILLA BASIN

JOHN DAY BASIN

POWDER BASIN

SNAKE RIVER

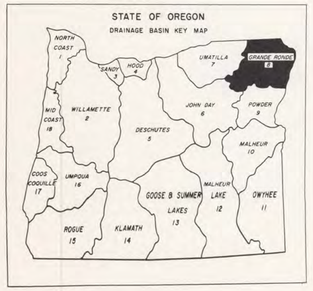


Figure 7
25

SCALE OF MILES
0 1 2 3 4 5 6 7 8 9 10 15

Planimetric control — U.S.G.S. Quad. maps & O.S.H.D. Gen. Hwy. Ser. maps

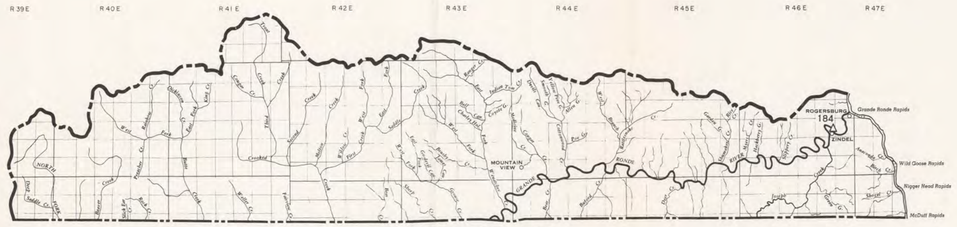
STATE WATER RESOURCES BOARD
SALEM, OREGON

GRANDE RONDE DRAINAGE BASIN

MINERAL DEPOSITS

Drawn	J. P. M.	date	2-24-59
Checked		date	
Revised	Twp and Range grid added	date	3-4-59
Redrawn	Mineral Deposits added	date	7-28-59
Approved		date	

File No. 8.106



GRANDE RONDE BASIN OUTSIDE OREGON

LEGEND

Active	Inactive	
▲ 172	△ 183	Stream Gaging Stations
▲ 1825	△ 1834	Canal Gaging Stations
—●— Cove	—○— Bue	Air Temperature & Precipitation Stations
● Imnaha	○ Divide	Precipitation Stations



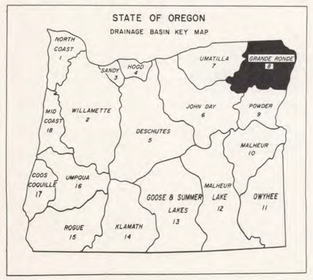




Figure 11
42

SCALE OF MILES
0 1 2 3 4 5 6 7 8 9 10 15

Planimetric control — U.S.G.S. Quad. maps & O.S.H.D. Gen. Hwy Ser. maps

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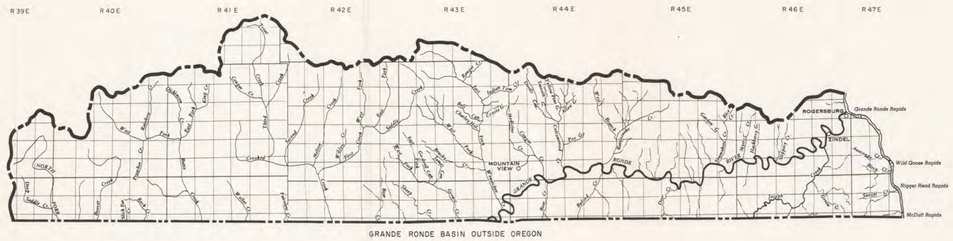
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GRANDE RONDE DRAINAGE BASIN

STREAM GAGES & CLIMATOLOGICAL STATIONS

Drawn	J. T. H.	date 2-24-53
Checked		date
Revised	Twp's and Range grid added	date 1-2-73
Addition	Stream G & Climatological Sta	date 6-9-59
Approved		date

File No. 8.201



GRANDE RONDE BASIN OUTSIDE OREGON

W A S H I N G T O N

I D A H O

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LEGEND

- Area Subject to Flooding (1894 Flood)
- Area Needing Drainage
- Severe Water Erosion

UMATILLA BASIN

JOHN DAY BASIN

POWDER BASIN

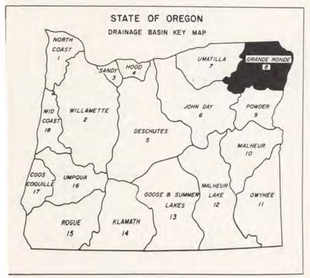


Figure 10
38

DATA SOURCE:
CORPS OF ENGINEERS
SOIL CONSERVATION SERVICE

SCALE OF MILES
0 1 2 3 4 5 6 7 8 9 10 15

Planimetric control ___ U.S.G.S. Quad. maps & O.S.H.D. Gen. Hwy. Ser. maps

STATE WATER RESOURCES BOARD
SALEM, OREGON

GRANDE RONDE DRAINAGE BASIN

PROBLEM AREAS

Drawn	J.M.H.	date 2-24-59
Checked		date
Revised	Twn'ship and Range grid added.	date 3-2-59
Redrawn	PROBLEM AREAS ADDED	date 9-28-59
Approved		date

File No. 8.207

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ELEVATION IN FEET ABOVE MSL

STREAM MILES ABOVE MOUTH

☆ Data Variation

data not available

Figure 2
4

STATE WATER RESOURCES BOARD
SALEM, OREGON

GRANDE RONDE DRAINAGE BASIN

PROFILE

Drawn	JCH	date	7-1-59
Checked		date	
Revised		date	
Redrawn		date	
Approved		date	

File No. 8 .213

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GRANDE RONDE BASIN OUTSIDE OREGON

LEGEND

9999.....A plain number is the application number for a permit to use water under the provisions of the 1909 water code.

C9999.....A number preceded by the letter C indicates a vested right to use water as established by adjudication procedures set forth in the 1909 water code.

R9999.....A number preceded by the letter R is the application number for a permit to store water under the provisions of the 1909 water code.

D999.....A number preceded by the letter D indicates a ground water filing made under the terms of the 1927 Ground Water Code.

GR999.....A number preceded by the letters GR indicates the registration of ground water rights established through beneficial use prior to enactment of the 1955 Ground Water Law.

G999.....A number preceded by the letter G indicates a ground water filing made under the terms of the 1955 Ground Water Law.

NOTE: The priority of rights established by the provisions of the 1909 water right code cannot be determined by comparing the relative magnitude of numbers. Numbers as placed on the map indicate the approximate physical locations of diversions for the indicated rights. For precise definition of location, reference should be made to the files in the State Engineer's office.
For summary of water rights information, including application, permit, and certificate numbers; priority date; types of use; and place of use by township, range, and section, refer to State Water Resources Board Form Engineering No. 1, Basin No. 8 Grande Ronde. Includes all applications, permits, and certificates for use of water recorded in the State Engineer's office as of Jan. 1, 1959.

W A S H I N G T O N

I D A H O

UMATILLA BASIN

JOHN DAY BASIN

POWDER BASIN

SNAKE RIVER

MILL CREEK (A) (B) (C)

LITTLE CREEK (D)

CATHERINE CREEK (E)

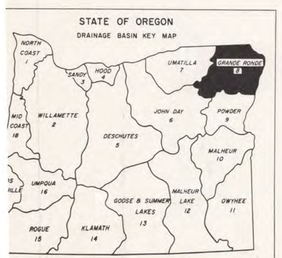


Figure 8
26

SCALE OF MILES
0 1 2 3 4 5 6 7 8 9 10 15

Planimetric control — U.S.G.S. Quad. maps and O.S.H.D. Gen. Hwy. Ser. maps

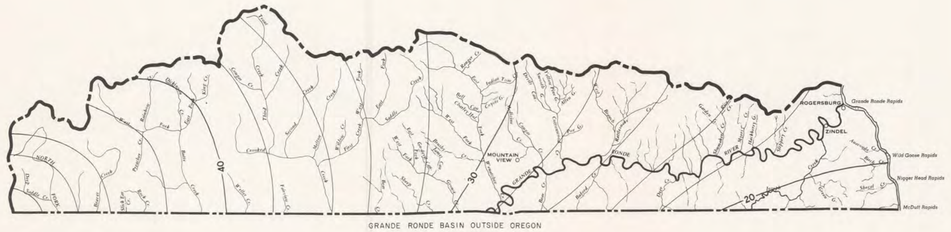
STATE WATER RESOURCES BOARD
SALEM, OREGON

GRANDE RONDE DRAINAGE BASIN

WATER RIGHTS

Drawn	date 2-24-59	File No. 8.301
Checked	date	
Revised	date	
Addition WATER RIGHTS	date 4-7-59	
Approved	date	

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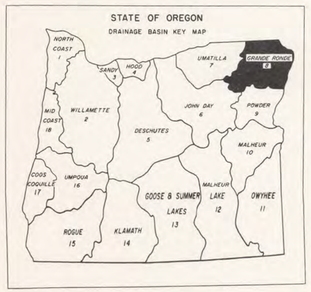
W A S H I N G T O N

I D A H O

UMATILLA BASIN

JOHN DAY BASIN

POWDER BASIN



Isohyets indicate average annual precipitation for the 50-year period 1896 - 1945.

DATA SOURCE:
U.S. Corps of Engineers

Figure 3
8

SCALE OF MILES
0 1 2 3 4 5 6 7 8 9 10 15

Planimetric control — U.S.G.S. Quad. maps & O.S.H.D. Gen. Hwy. Ser. maps

STATE WATER RESOURCES BOARD
SALEM, OREGON

GRANDE RONDE DRAINAGE BASIN

AVERAGE ANNUAL PRECIPITATION

Drawn	J.T.H.	date	2-24-59
Checked		date	
Revised	AVE. AN. PRECIP. ADDED	date	6-9-59
Redrawn		date	
Approved		date	

File No. 8.409



GRANDE RONDE BASIN OUTSIDE OREGON

W A S H I N G T O N

I D A H O

UMATILLA BASIN

JOHN DAY BASIN

POWDER BASIN

LEGEND

PROPOSED	EXISTING	
		Reservoir
		Storage dam
		Diversion dam
		Canal or Ditch
		Project area (Bureau of Reclamation)
		Improvement District

LA GRANDE DIVISION

CATHERINE CREEK DIVISION

WALLOWA VALLEY IMPROVEMENT DISTRICT

BARTLETT · TROY · PARADISE · CYLORA · POWWATKA · PROMISE · VIEWPOINT · RONDOWA · MAXVILLE · CHICO · LEWIS · ZUMWALT · MINAM · SEVEY · WALLOWA · LEAP · ELGIN · LOOKINGGLASS · PALMER JCT. · CABIN CREEK · VINCENT · IMBLER · SUMMERVILLE · ZAMELA · MOTANIC · ALICEL · CONLEY · GLOVER · HIGGARD · PERRY · WEST SIDE DAM · LA GRANDE · ISLAND CITY DAM · ISLAND CITY · NIBLEY · COVE · LONE TREE · HOT LAKE · STARKEY · UNION · TELOCASET · EVANS · LOSTINE · ENTERPRISE · ALDER · JOSEPH · ALLEN · SNAKE RIVER

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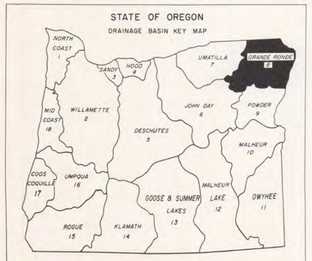
Figure 5C
21

SOURCE:
Corps of Engineers
Bureau of Reclamation
Soil Conservation Service
Geological Survey

SCALE OF MILES
0 1 2 3 4 5 6 7 8 9 10 15

Planimetric control — U.S.G.S. Quad maps & O.S.H.D. Gen Hwy Ser maps

STATE OF OREGON
DRAINAGE BASIN KEY MAP



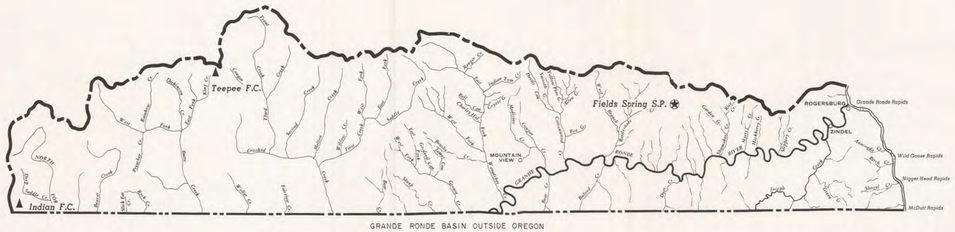
STATE WATER RESOURCES BOARD
SALEM, OREGON

GRANDE RONDE DRAINAGE BASIN

IRRIGATION DEVELOPMENT

Drawn	date 2-24-59	File No.
Checked	date	8
Revised	date	.704
Addition Irrigation Development	date 8-18-59	
Approved	date	

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GRANDE RONDE BASIN OUTSIDE OREGON

W A S H I N G T O N

I D A H O



LEGEND

- Resort
- State Park
- Municipal Park
- Forest Camp
- Boat Landing

UMATILLA BASIN

JOHN DAY BASIN

POWDER BASIN

N

STATE OF OREGON
DRAINAGE BASIN KEY MAP

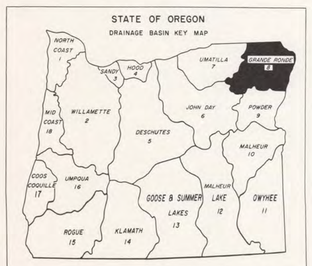


Figure 9A
34

SCALE OF MILES
0 1 2 3 4 5 6 7 8 9 10 15

Planimetric control — U.S.G.S. Quad. maps & O.S.H.D. Gen. Hwy. Ser. maps

STATE WATER RESOURCES BOARD
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GRANDE RONDE DRAINAGE BASIN

RECREATION AREAS

Drawn	J.T.H.	date	2-24-59
Checked		date	
Revised		date	
Addition	Recreation Areas	date	7-29-59
Approved		date	

File No. 8.708

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W A S H I N G T O N

I D A H O

UMATILLA BASIN

JOHN DAY BASIN

POWDER BASIN

LEGEND

Irrigated Land

Potentially Irrigable Land





Figure 5
18

SCALE OF MILES
0 1 2 3 4 5 6 7 8 9 10 15

Planimetric control ___ U.S.G.S. Quad. maps & O.S.H.D. Gen. Hwy. Ser. maps

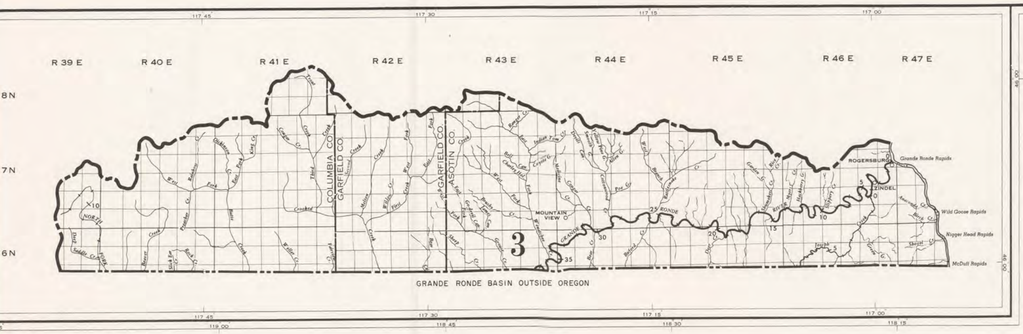
SOURCE Soil Conservation Service

STATE WATER RESOURCES BOARD
SALEM, OREGON

GRANDE RONDE DRAINAGE BASIN

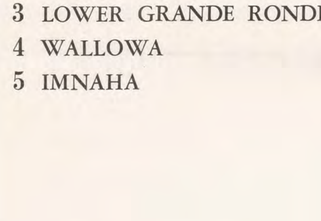
IRRIGATION LANDS

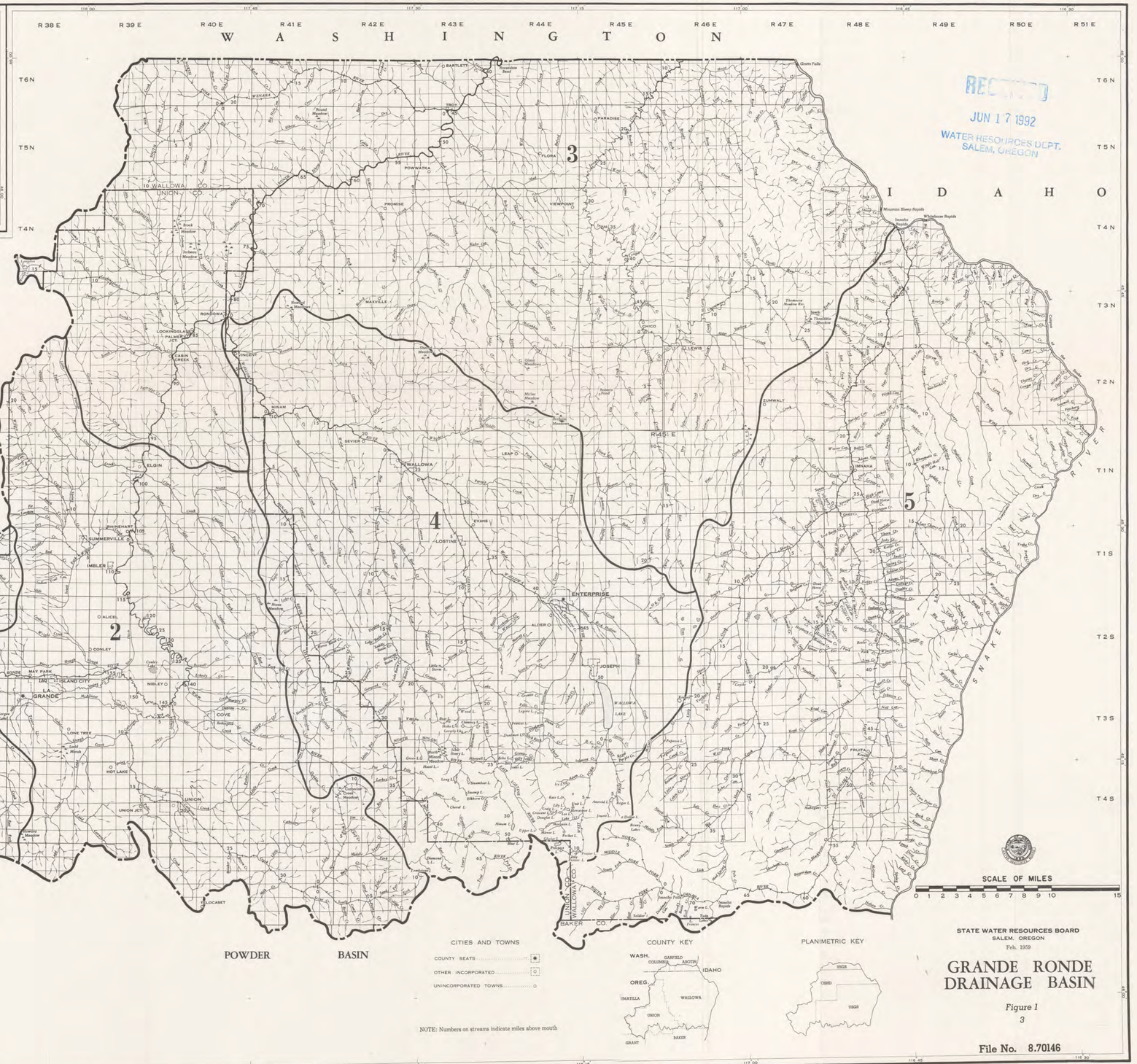
Drawn	date 2-24-92	File No.
Checked	date	8
Revised	date	.1031
Addition IRRIGATION LANDS	date 8-25-92	
Approved	date	



SUB-BASINS

1 UPPER GRANDE RONDE
2 MIDDLE GRANDE RONDE
3 LOWER GRANDE RONDE
4 WALLOWA
5 IMNAHA





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SALEM, OREGON
Feb. 1959

GRANDE RONDE DRAINAGE BASIN

Figure 1
3

File No. 8.70146