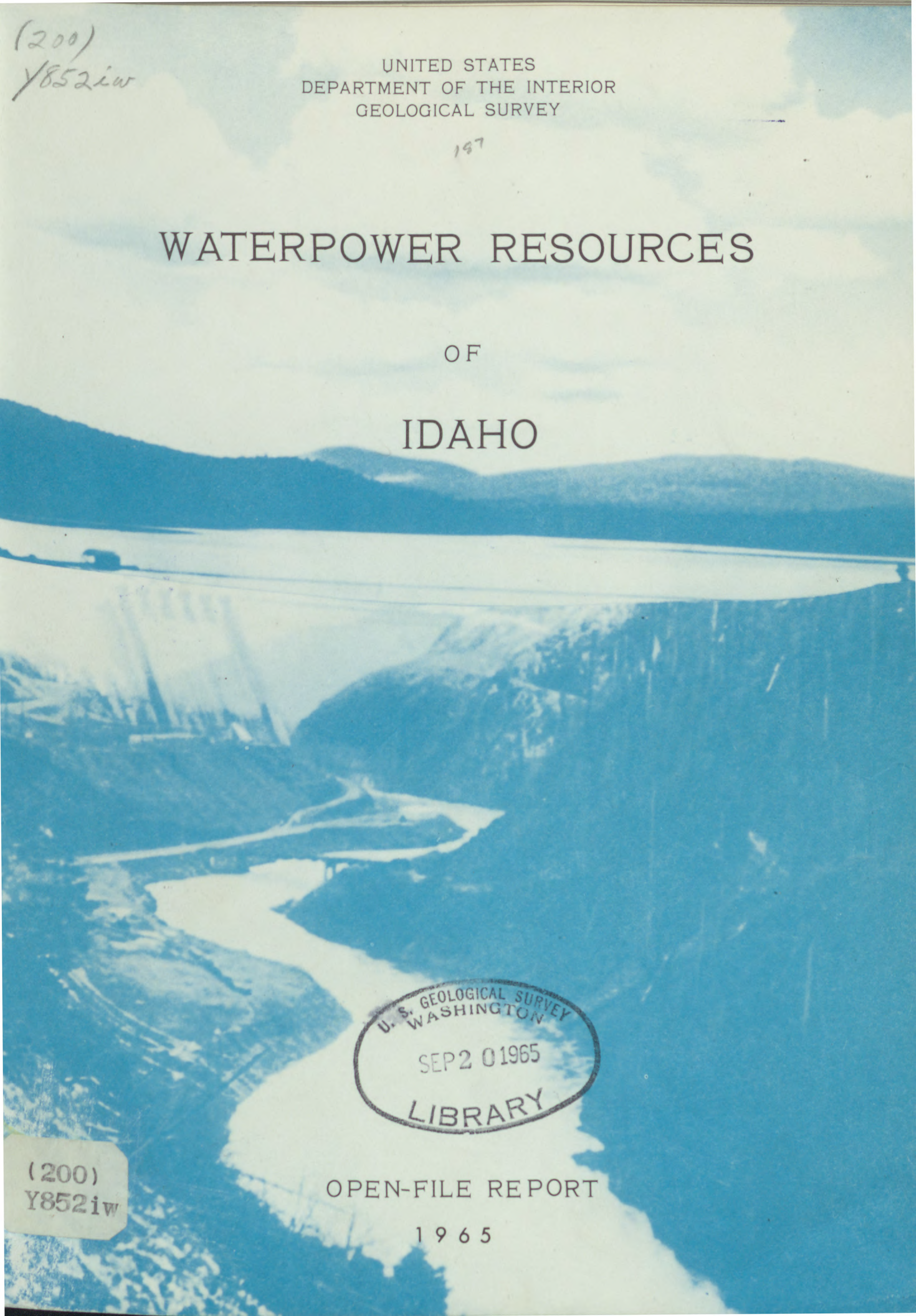
UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

WATERPOWER RESOURCES

OF

IDAHO



OPEN-FILE REPORT

1965

UNITED STATES DEPARTMENT OF THE INTERIOR

GEOLOGICAL SURVEY

CONSERVATION DIVISION

WATERPOWER RESOURCES OF IDAHO

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A summary of gross theoretical waterpower with descriptions of developed projects and of the structures estimated to be required at undeveloped sites.

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Abstract

There are 46 developed waterpower projects having a total installed generating capacity of 1,472 megawatts (1 MW equals 1,000 kilowatts) in Idaho or on the State boundary line. When sites affecting two or more States are divided equally with the adjoining State, Idaho's allotment is 44 plants with an installed capacity of 1,025 megawatts. The gross theoretical capacity of the developed sites is 1,396 megawatts and of the undeveloped sites is 9,279 megawatts or a total of 10,675 megawatts. Power was computed for gross head, 100 percent efficiency, and average discharge. Grouped by magnitude of capability, there are 781 megawatts at 122 sites with individual capabilities of 1 to 4.99 megawatts, 2,744 megawatts at 120 sites with capabilities between 5 and 19.99 megawatts, and 7,150 megawatts at 63 sites with capabilities greater than 20 megawatts.

The Snake River and its tributaries drain about 87 percent of Idaho's total area and contain 94 percent of its potential waterpower. The greatest areal concentration of waterpower, except for isolated reaches of the Snake River, is in the Clearwater River basin with about 264 kilowatts of theoretical potential per square mile. The gross theoretical power of the Salmon River basin, 3,326 MW, is the greatest of all Idaho rivers including the main stem of the Snake River.

The first hydroelectric plant in Idaho was placed in operation in 1881. Waterpower has played an important part in the economy of Idaho since that time, and the State is in ninth place nationally in installed capacity of waterpower plants. Privately-owned plants produce 87.5 percent of the present average annual hydroelectric energy, and publicly-owned plants produce 12.5 percent. The principal producers are Idaho Power Company, Washington Water Power Company, Utah Power and Light Company, the Bureau of Reclamation, and the Corps of Army Engineers. The waterpower resources of Idaho are being actively developed at the present time and indications are that this active development rate will continue or accelerate.

Introduction

This report was prepared as an aid in classification of federally-owned lands valuable for the development of waterpower or for conservation of water. It will be useful at the time of segregation of lands in powersites or reservoir sites and during consideration of alienation applications for such lands or for applications for rights to use them for power or multiple purposes. This is the most complete estimate of the waterpower resources of Idaho made to date. An attempt has been made to include every reach of stream that meets the basic World Power Conference requirements for powersites and thereby obtain the potential power resources of the State--the aggregate of the gross theoretical power at all powersites developed and undeveloped. The gross theoretical power concept, which prescribes the use of gross head and 100 percent efficiency together with the inclusion of all sites, large or small (sites with a gross theoretical capacity of 1 MW or more at Q50 discharge are included), assures that the potentials shown must be greater than can be realized by actual utilizations. Between the preliminary appraisals in this report and proof of economic feasibility, many of the included sites will be eliminated. Even after a site is demonstrated to be economically developable, sociological, political, and related considerations may prevent or delay development. A great many of the smaller sites will not be seriously considered if the present trend to large units continues.

The installed capacities shown are actual amounts and a comparison between these and the potential power of a site will give a rough idea as to whether the site is completely developed or whether a redevelopment to more fully utilize the potential of the site might be desirable. A rule of thumb for making this determination is to assume that installations eventually will approximately equal the gross theoretical capacity of average discharge. If installations will not utilize average discharge, the size of the stream and the relative amount of regulating storage should be considered. Average-flow installations probably are not justified on unregulated streams (especially on small streams) whereas plants on regulated streams (especially on highly controlled small streams) may have installed capacities that can use water at a rate several times greater than average discharge for producing peaking power.

In 1962 the Geological Survey made a detailed inventory of developed and undeveloped waterpower sites for the Western States and Alaska. The inventory for the State of Idaho was made in three regional offices of the Conservation Division, U. S. Geological Survey. Richard N. Doolittle and Kenneth W. Sax of the California-Nevada Region with headquarters in Sacramento, California, made the inventory for Great Basin Drainage (Basin 10-H, Bear River). Gordon C. Giles and Jack B. Dugwyler of the Northwest Region with headquarters in Tacoma, Washington, prepared the inventory for the Columbia Basin upstream from Snake River which in Idaho includes part of area 12-A of the Kootenai River basin, part of area 12-D of the Pend Oreille River basin, and part of area 12-E of the Spokane River basin. The remaining parts of Idaho are all within the Snake River basin (areas 12-G, 12-H, 12-J, 12-K, and 12-L). The gross theoretical power estimate for these areas was made in the Oregon-Idaho Region with headquarters in Portland, Oregon. Grace M. Flaherty made the duration analyses required to determine Q95, Q50, and average discharge rates at the powersites. Terry N. Trantow prepared the river profiles showing the developed and undeveloped powersites and the river basin maps. The procedures used in making the estimates were formulated by Arthur Johnson, Chief, Branch of Waterpower Classification, and conform with World Power Conference standards.

Gross theoretical waterpower

There are 46 developed waterpower projects having a total installed generating capacity of 1,472 MW (1 MW equals 1,000 kilowatts) in Idaho or on the State boundary line. Cabinet Gorge (200 MW) on Clark Fork extends into Montana, Palisades (114 MW) on the Snake River extends into Wyoming, and Brownlee (360.4 MW), and Oxbow (220 MW) are on the Snake River between Idaho and Oregon. When these sites are divided equally between Idaho and the adjoining State, Idaho's allotment is 44 plants with an installed capacity of 1,025 MW. The gross theoretical power capability assignable to Idaho at developed sites is 1,396 MW and at undeveloped sites 9,279 MW, giving a gross theoretical waterpower potential of 10,675 MW for gross head and 100 percent efficiency and average discharge.

The above amounts were extracted from a reappraisal of gross theoretical potential waterpower of Idaho made in 1962. The estimate was based upon the latest standards of the World Power Conference (1962) and the following definitions from those standards outline the nature and scope of the study made.

> Powersites. Waterpower sites, or "powersites", are definite sections of a stream which are developed or are capable of being developed for the production of waterpower.
>
> Potential Power Resources. The potential power resources of any country, section, or river basin shall be the aggregate of the gross theoretical power at all the powersites, developed and undeveloped where development may reasonably be assumed to be eventually practicable.
>
> Gross Theoretical Power of Powersites. The "gross theoretical power" of a powersite shall be the full potential output at 100 percent efficiency expressed in kilowatts, and shall be determined by the formula
>
> $$Kw = 0.085\ Qh$$
>
> when the head "h" is in feet and the flow "Q" is in cubic feet per second.
>
> Heads at Powersites. The "gross head" shall be the difference in elevation at the time of such flow between the water surface at the beginning and at the end of the powersite, without reduction for losses.
>
> Rates of Flow. The gross theoretical power of powersites shall be computed for three different rates of flow, defined as follows: flow available 95 percent of the time (Q95), flow available 50 percent of the time (Q50), and arithmetical mean flow. (The present actual discharge of all streams is used considering regulating reservoirs actually in operation.)

Key to developed and undeveloped powersites shown in figure 1.

Developed sites

1 Soda	22 Idaho Falls #4	38 Lower Malad
2 Grace	23 American Falls	40 Bliss
3 Cove	25 Minidoka	43 C. J. Strike
4 Oneida	28 Twin Falls	44 Swan Falls
6 Moyie #2	29 Shoshone Falls	49 Anderson Ranch
7 Cabinet Gorge	30 Clear Lakes	57 Black Canyon
8 Albeni Falls	32 1000 Springs	58 Brownlee
10 Post Falls	34 Upper Salmon "B"	59 Oxbow
11 Palisades	35 Upper Salmon "A"	2/60 Hells Canyon
18 Ashton	36 Lower Salmon Falls	2/88 Dworshak (Bruces Eddy)
20 Idaho Falls #2	37 Upper Malad	91 Lewiston
21 Idaho Falls #1		

Principal undeveloped sites 1/

5 Low Katka	47 Blackjack Butte	71 Cumtux
9 Fitzgerald Falls	3/48 Twin Springs	72 Crevice
12 Swan Valley	4/50 Arrowrock	73 Freedom-Riggins
13 Lynn Crandall	4/51 Lucky Peak	74 Lower Canyon
14 Lower Rush Beds	52 Garden Valley	75 China Gardens
15 Lookout Butte	53 Garden Valley Rereg.	76 Asotin
16 Falls (Mesa)	54 Scriver Cr. (Upper)	78 White Cap
17 Warm River	55 Scriver Cr. (Lower)	79 Moose Cr.
3/19 Fremont	56 Horseshoe Bend	80 Pinchot
24 Eagle Rock	61 High Mtn. Sheep	81 Five Islands
26 Bickel	62 Cronks Canyon	82 Penny Cliffs
27 Kimberly	63 Salmon	83 Kooskia
31 Clear Lakes	64 Salmon Valley	84 Orofino
33 Lower 1000 Spgs.	65 Shoup	85 Weitas Cr.
39 High Bliss	66 Aparejo	86 Rock Cr.
41 Pasture	67 Porcupine	87 Salmon Cr.
42 Indian Cove	68 Pinnacle Falls	89 Big George
45 Guffey	69 Dillinger	90 Arrow
46 Marsing	70 Hay Flat	

1/ Gross theoretical potential of 20 MW or more 50% of the time.

2/ Under construction.

3/ Under investigation (gross theoretical less than 20 MW 50% of the time).

4/ Existing reservoir.

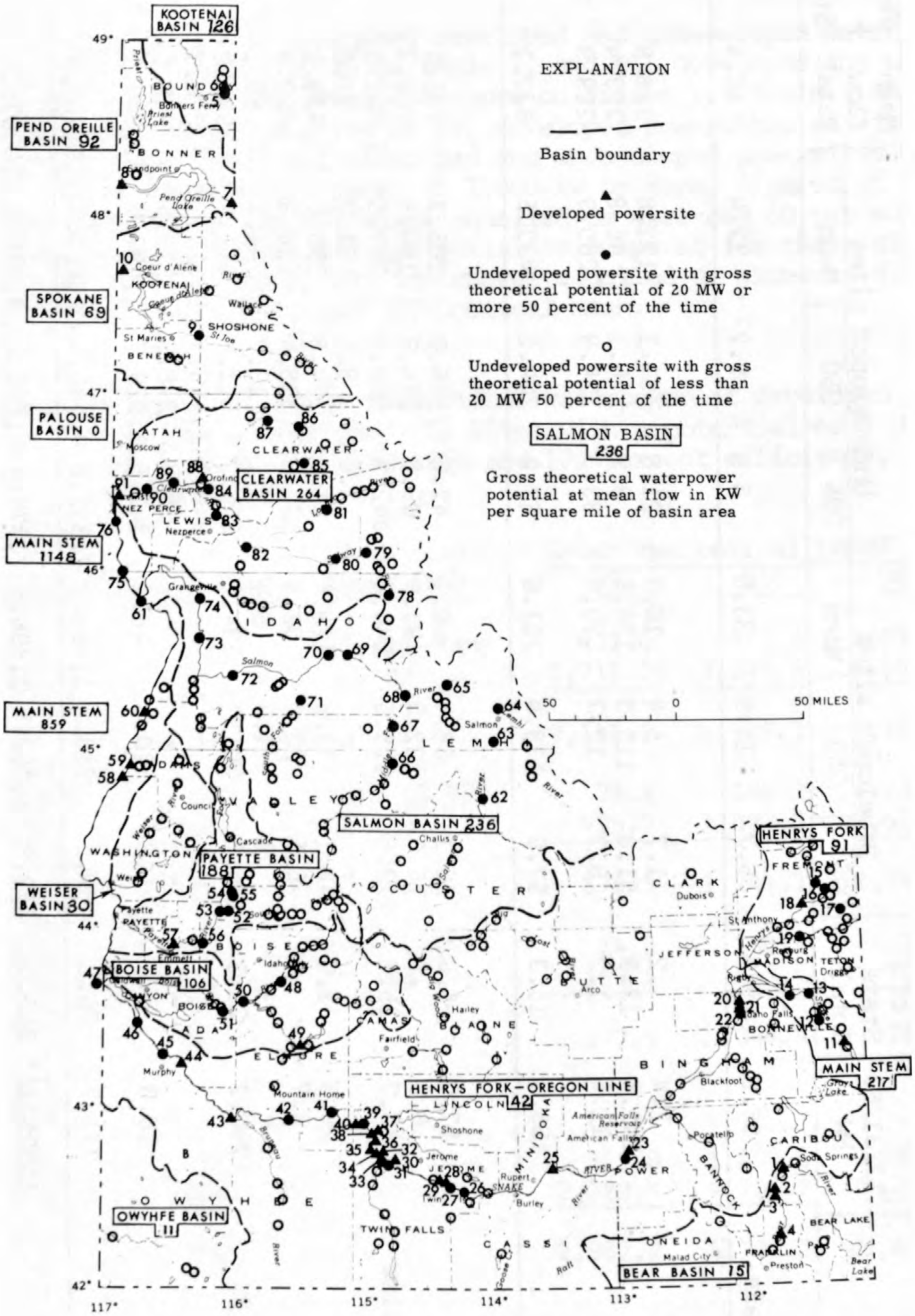


Figure 1.--Developed and undeveloped powersites in Idaho.

Table 1.--Summary of developed and undeveloped waterpower in Idaho.

Basin / Stream	Installed 12/31/63 MW	Installed Percent of State Total	Gross theoretical power at gross head and 100 percent efficiency Thousands of kilowatts (MW): Developed sites Q95	Developed sites Q50	Developed sites Mean	Undeveloped sites Q95	Undeveloped sites Q50	Undeveloped sites Mean	Mean Flow Total	Percent of State
Great Salt Lake basin										
Bear R. & basin totals	96.9	9.5	6.7	15.9	33.0	3.4	9.2	17.4	50.4	.5
Columbia River basin										
Kootenai River	2.4	.2	1.7	5.4	16.0	21.0	53.1	122.8	138.8	1.3
Pend Oreille River	142.6	13.9	51.0	110.3	156.6	8.9	26.1	46.8	203.4	1.9
Spokane River	11.5	1.2	5.2	17.7	29.0	33.3	124.9	260.9	289.9	2.7
Columbia Basin totals	156.5	15.3	57.9	133.4	201.6	63.2	204.2	430.5	632.1	5.9
Snake River basin										
Wyoming-Henrys Fork	57.0	5.6	16.1	38.4	66.1	42.6	125.2	205.3	271.4	2.5
Henrys Fork River	8.6	.8	16.6	32.0	43.9	69.0	116.3	164.8	208.7	2.0
Henrys Fork-Oregon line	366.7	35.7	223.6	425.6	544.8	342.8	600.5	797.5	1,342.3	12.6
Owyhee River	-	-	-	-	-	3.0	9.4	31.0	31.0	.3
Boise River	29.5	2.9	43.1	73.5	128.5	81.3	124.8	295.6	424.1	4.0
Payette River	9.7	.9	6.5	20.0	32.5	137.8	335.4	588.3	620.8	5.8
Weiser River	-	-	.1	1.4	5.4	2.2	13.2	44.7	50.1	.5
Weiser R. to Salmon R.	290.2	28.3	145.9	241.7	294.0	351.2	511.8	651.2	945.2	8.8
Salmon River	-	-	-	-	-	840.1	1,453.7	3,325.7	3,325.7	31.2
Salmon-Clarkston	-	-	-	-	-	99.4	175.9	229.5	229.5	2.1
Clearwater River	10.0	1.0	6.3	20.6	46.7	343.5	1,020.7	2,497.4	2,544.1	23.8
Snake Basin totals	771.7	75.2	458.2	853.2	1,161.9	2,312.8	4,486.9	8,831.0	9,992.9	93.6
Totals	1,025.1 1/	100.0	522.8	1,002.5	1,396.5	2,379.4	4,700.2	9,278.9	10,675.4	100.0

1/ Installations of 447.2 MW allotted to adjoining States: Montana, 100 MW at Cabinet Gorge plant; Wyoming, 57 MW at Palisades plant; and Oregon 290.2 at Brownlee and Oxbow plants.

A summary of the estimated developed and undeveloped waterpower resources of Idaho is given in table 1, and all developed and undeveloped sites in the State are shown on figure 1. Table 1 shows the installed power capacity at all developed powersites and the potential capacity at all developed and undeveloped powersites which have a gross theoretical power of 1,000 kw or more, figured at 100 percent efficiency for discharge equalled or exceeded 50 percent of the time. Gross theoretical potential is computed for these sites for three rates of flow: Q95 (discharge equalled or exceeded 95 percent of the time), Q50, and arithmetical mean.

Table 2.--Summary of gross theoretical waterpower at developed (1) and undeveloped (2) sites with a potential of 1 MW or more at Q50 discharge and 100 percent efficiency, State of Idaho.

Category	No. of sites	Potential Range (MW)	Gross theoretical power (MW) Q95	Q50	Qmean
(1)	13	20 and over	430.0	821.8	1,092.5
(2)	50	do	1,716.2	3,295.5	6,057.6
	63		2,146.2	4,117.3	7,150.1
(1)	14	5 to 19.99	78.8	144.1	230.1
(2)	106	do	499.7	1,097.0	2,514.5
	120		578.5	1,241.1	2,744.5
(1)	9	1 to 4.99	14.0	36.6	74.0
(2)	113	do	163.5	307.7	706.8
	122		177.5	344.4	780.8
Totals					
(1)	36 1/		522.8	1,002.5	1,396.5
(2)	269		2,379.4	4,700.2	9,278.9
	305		2,902.2	5,702.7	10,675.4

1/ There are 7 developed powersites in Idaho with potential capacities too small to be included in the inventory and the Swan Falls site potential is included in the undeveloped Guffey site (36 + 8 = 44 plants assignable to Idaho).

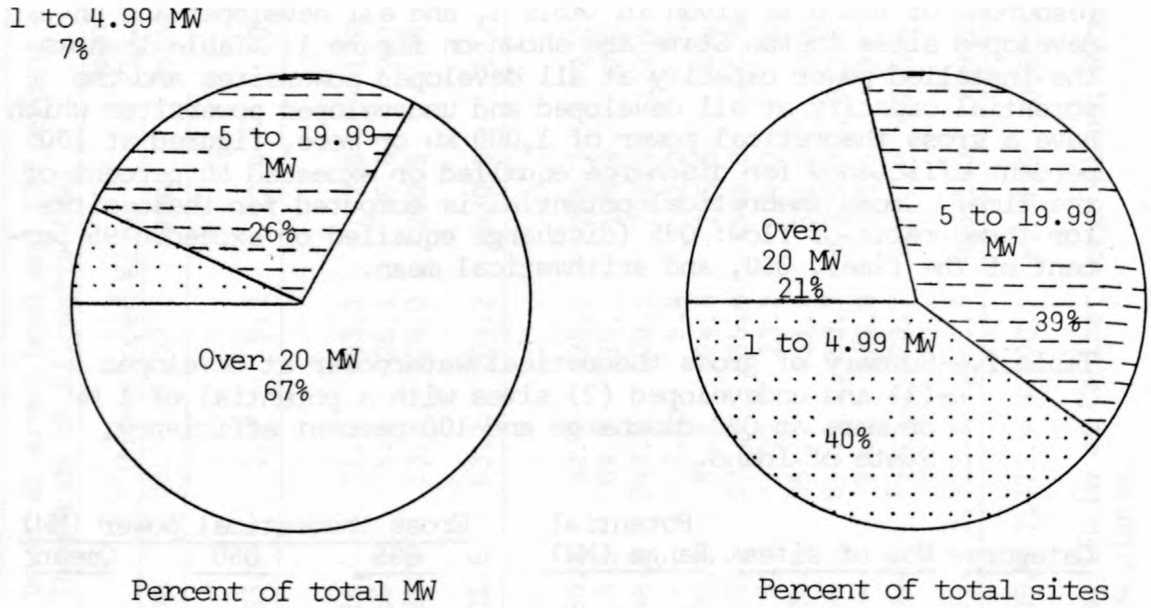


Figure 2. Percentages of developed and undeveloped potential waterpower by size categories (potential capacities in MW for Q50 discharge, gross head, and 100 percent efficiency) and percentages of total number of sites by size categories, State of Idaho.

There are 269 undeveloped powersites and 36 developed sites with individual gross theoretical potential of 1 MW or more in Idaho, 305 sites in all (sites on boundary lines counted as one-half). Of these sites, 63 (21%) have gross theoretical potential capacities of more than 20 MW at Q50 discharge, 120 (39%) have Q50 capacities of 5 to 19.99 MW, and 122 sites (40%) have Q50 capacities between 1 and 4.99 MW. In contrast, sites with a capacity of 20 MW and over account for 4,117 MW (67%), sites with capacities between 5 and 19.99 MW have a capacity of 1,241 MW (26%), and the remainder 344 MW (7%) represent the gross theoretical power of powersites with Q50 capacities of 1 to 4.99 MW. Or, 21% of the sites have 67% of the capacity and 60% of the sites have 93% of the capacity. These comparisons are presented more fully in tables 2 through 6 and are shown relatively in figure 2.

Sites are listed in the same downstream order used in the annual series of water-supply papers, and an identification number relates each site to a gaging station. When a powersite is at a gaging station, or near enough to have the same drainage area, the gaging station number is used. For other sites an appended number indicates the nearness to the upstream gage. For example, 13-2365 indicates a site at a gaging station. Number 13-2365+10 would indicate a nearby site downstream from the gage. A group of asterisks (***) in the margin indicates an existing development at the site.

Table 3.--Developed waterpower sites with a gross theoretical potential of 20 MW or more at Q50 and 100 percent efficiency, State of Idaho.

Stream Site	Site No.	Gross Head (feet)	Gross theoretical power, MW, with gross head, 100% efficiency and flows at Q95	Q50	Qmean	Installed Capacity MW
Clark Fork						
Cabinet Gorge (½)	12-3915	97	30.75	62.85	91.65	100.0
Pend Oreille River						
Albeni Falls	12-3955	28.3	20.2	47.8	65.0	42.6
Snake River						
Palisades (½)	13-0324+50	245	16.1	38.45	66.15	57.0
American Falls	13-0765	117	7.16	55.7	66.8	27.5
Minidoka	13-0800	51	3.33	27.4	32.7	13.4
Twin Falls	13-0895+50	145	5.36	23.9	39.4	13.5
Shoshone Falls	13-0900	226	8.65	38.0	63.0	10.88
Upper Salmon "B"	13-1080+60	37	17.2	23.5	27.3	16.5
Upper Salmon "A"	13-1080+70	44	20.5	28.0	32.5	18.0
Lower Salmon Falls	13-1080+80	59	27.5	37.5	43.5	60.0
Bliss	13-1525+80	70	36.4	48.6	54.6	75.0
C. J. Strike	13-1715	88	53.1	71.1	75.5	82.8
Arrowrock*	13-1940	156	11.1	20.0	33.1	0
Lucky Peak*	13-2015	240	20.4	36.7	60.6	0
Brownlee (½)	13-2897	272	100.57	166.45	202.3	180.2
Oxbow (½)	13-2900	122	45.35	75.2	91.7	110.0
Lewiston	13-3425+20	36	6.3	20.6	46.7	10.0
Totals			430.06	821.75	1,092.5	817.38

½ Divided with adjoining State.

* Constructed reservoir without powerplant.

Table 4.--Developed waterpower sites with a gross theoretical potential of 5 to 19.99 MW at Q50 and 100 percent efficiency, State of Idaho.

Stream Site	Site No.	Gross Head (feet)	Gross theoretical power, MW, with gross head, 100% efficiency and flows at Q95	Q50	Qmean	Installed Capacity MW
Bear River						
Grace	10-0800	524	4.5	8.5	16.9	44.0
Moyie River						
Moyie No. 2	12-3080	200	1.7	5.35	16.0	2.0
Spokane River						
Post Falls	12-4185+50	56	5.19	17.7	29.0	11.25
Snake River						
Ashton	13-0460	150	6.4	13.5	17.3	5.8
Felt	13-0540+20	535	7.50	12.5	17.74	2.1
Idaho Falls #2	13-0595+10	21	2.95	6.43	9.04	2.4
Idaho Falls #1	13-0595+20	42	5.9	12.8	18.1	2.0
Idaho Falls #4	13-0595+30	32	4.5	9.8	13.8	3.0
Thousand Springs	13-1080+40	182	7.0	8.0	9.0	8.0
Upper Malad	13-1525+40	129	8.17	9.26	13.1	7.2
Lower Malad	13-1525+50	145	11.0	12.3	18.4	13.5
Anderson Ranch	13-1900	330	6.3	7.17	17.5	27.0
Boise Diversion	13-2020+10	44	3.74	6.73	11.1	1.5
Black Canyon	13-2495	92	3.91	14.1	23.1	8.0
Totals			78.76	144.14	230.08	137.75

Table 5.--Undeveloped waterpower sites with gross theoretical potential of 20 MW or more at Q50 discharge and 100% efficiency, State of Idaho.

Stream Site	Site No.	Gross Head (feet)	Gross theoretical power, MW, with gross head, 100% efficiency and flows at Q95	Q50	Qmean
Kootenai R., Low Katka (½)	12-3055+50	125	16.3	38.55	77.65
St. Joe R., Fitzgerald-Falls	12-4145+20	330	10.4	32.1	71.5
Snake R., Lynn Crandall	13-0365	270	29.8	93.4	154.4
Lower Rush Beds	13-0370+10	75	8.41	26.3	43.5
Falls (Mesa)	13-0430+95	320	11.7	22.0	25.8
Warm River	13-0455+70	230	12.7	27.2	28.2
Eagle Rock	13-0770+50	53	3.08	25.2	30.1
Bickel	13-0880+60	320	6.94	30.7	51.0
Kimberly	13-0880+80	220	4.86	21.5	35.5
Clear Lakes	13-0940+20	198	10.25	45.5	75.0
Lower 1000 Springs	13-1080+50	72	30.6	42.8	48.9
High Bliss	13-1525+70	84	43.5	58.1	65.4
Pasture	13-1525+90	94	49.0	65.4	73.5
Indian Cove	13-1553+20	35	19.3	25.9	29.1
Guffey	13-1725+20	117	71.1	96.5	101.0
Marsing	13-1725+30	30	18.4	24.7	26.0
Blackjack Butte (½)	13-1730+50	40	15.3	19.7	22.8
Payette R., Garden Valley	13-2377+90	415	24.2	68.8	108.2
Scriver Cr. (Upper)	13-2455+10	440	8.23	33.7	48.6
Scriver Cr. (Lower)	13-2455+20	753	16.3	40.3	65.3
Horseshoe Bend	13-2475+10	250	15.5	40.4	71.8
Snake R., Hells Canyon+ (½)	13-2902+10	173	66.15	107.3	132.3
High Mountain Sheep+ (½)	13-2920+30	595	278.3	379.5	468.05
Salmon R., Cronks Canyon	13-3020+20	435	17.6	31.2	67.8
Salmon	13-3020+90	460	19.5	34.6	75.3
Salmon Valley	13-3050+70	230	11.7	20.7	45.0
Shoup	13-3060+30	563	32.5	57.4	124.3
M.F. Salmon R., Aparejo	13-3090+95	415	19.8	28.2	72.2
Porcupine	13-3100+70	363	23.7	33.6	86.2
Salmon R., Pinnacle Falls	13-3102+20	342	45.7	80.9	176.0
Dillinger	13-3102+30	445	75.6	133.8	291.0
Hay Flat	13-3102+40	105	18.1	31.9	69.6
Crevice	13-3150+10	600	124.4	220.3	479.4
Freedom-Riggins	13-3165+70	270	63.7	112.7	245.0
Lower Canyon	13-3170+10	660	160.4	283.9	617.0
Snake River China Gardens (½)	13-3177+20	70	38.65	68.4	89.25
Asotin (½)	13-3340+10	110	60.75	107.5	140.25

Table 5.--continued.

Stream Site	Site No.	Gross Head (feet)	Gross theoretical power, MW, with gross head, 100% efficiency and flows at Q95	Q50	Qmean
Selway R., White Cap	13-3360+20	1000	8.5	23.0	65.5
Moose Creek	13-3360+80	300	7.65	21.4	29.3
Pinchot	13-3360+87	295	8.25	23.2	66.2
Lochsa R., Five Islands	13-3365+90	600	11.2	34.2	90.3
M.F. Clearwater					
Penny Cliffs	13-3370+20	595	43.5	127.0	354.2
Clearwater R., Kooskia	13-3390+10	174	18.3	54.3	146.4
Orofino	13-3395+80	86	9.79	27.8	70.9
N.F. Clearwater					
Kelly Fork	13-3400+40	380	7.43	22.6	46.8
Weitas Creek	13-3400+50	410	13.6	39.3	81.8
Rock Creek	13-3405+20	460	17.2	48.9	103.2
Salmon Cr.	13-3405+40	250	11.9	33.4	70.1
Dworshak+	13-3410	626	50.5	143.6	302.2
Clearwater R.					
Big George	13-3410+40	84	12.4	40.9	94.8
Arrow	13-3410+50	90	13.6	45.3	104.0
Totals			1,716.24	3,295.55	6,057.6

+ Authorized or under construction

½ Divided with adjoining State

Table 6.--Undeveloped waterpower sites with gross theoretical potential of 5 to 19.99 MW at Q50 discharge and 100% efficiency, State of Idaho.

Stream Site	Site No.	Gross Head (feet)	Gross theoretical power, MW, with gross head, 100% efficiency and flows at Q95	Q50	Qmean
Moyie R., Meadow Creek	12-3065+50	330	2.52	7.85	24.8
Eileen	12-3070+90	255	2.17	6.72	20.4
Priest R., Priest No. 6	12-3940+70	175	4.66	13.5	23.7
Priest River	12-3950+10	62	1.84	5.27	8.75
Coeur d'Alene R.					
Teddy Cr.	12-4105+50	243	.93	5.87	13.8
Leland Glen	12-4110+50	293	3.36	15.9	33.1
Enaville	12-4130	161	3.08	13.7	27.4
St. Joe River, Simmons	12-4140+50	320	1.63	5.3	11.8
Niagara Cr.	12-4140+55	280	1.9	6.43	14.3
Prospector	12-4140+70	280	3.09	9.52	21.2
Avery	12-4140+80	320	5.71	17.7	39.4
St. Maries R., No. 2	12-4145+80	380	1.45	8.4	11.1
No. 1	12-4150	370	1.72	10.0	17.3
Snake R., Henrys Fork					
Lookout Butte	13-0435+50	300	10.2	19.1	22.2
Sheep Falls	13-0470+50	400	5.8	9.4	14.6
Squirrel	13-0475	140	3.75	5.65	8.87
Anderson	13-0475+10	260	6.96	10.5	16.5
Teton R., Fremont +	13-0542+60	295	7.52	12.4	17.8
Snake R., Bennett Bridge	13-0595+40	30	4.26	9.32	13.1
Monroe	13-0600+20	27	3.84	8.4	11.8
Blackfoot R., Rawlins Cr.	13-0655+60	290	3.15	5.12	6.10
Spring Cr.	13-0655+70	300	2.12	5.53	6.63
Alridge	13-0655+80	320	2.34	6.09	7.26
Wolverine Cr.	13-0655+90	260	1.44	5.19	7.67
Snake R., Ferry Butte	13-0695+10	25	1.70	6.50	8.33
Portneuf R., Blackrock	13-0750+50	470	4.6	7.8	9.4
Birch Cr., Reno	13-1170	1300	3.31	5.52	8.28
Bruneau R., Hot Springs	13-1685+50	580	2.22	8.87	18.2

+ *Authorized*

Table 6.--continued.

Stream Site	Site No.	Gross Head (feet)	Gross theoretical power, MW, with gross head, 100% efficiency and flows at Q95	Q50	Qmean
Boise R., King	13-1840+15	590	4.51	7.51	18.5
N.F. Boise R.					
Barber Flats	13-1840+70	500	4.89	8.92	21.6
Boise R., Twin Springs	13-1845+90	405	10.3	18.9	46.0
Slide Gulch	13-1850	180	4.66	8.57	20.7
S.F. Boise R.					
Boardman Cr.	13-1855+40	400	4.59	6.80	16.0
Casey Ranch	13-1860+10	280	5.47	8.09	19.4
Raspberry	13-1905+20	295	10.0	11.5	27.9
Long Gulch	13-1905+30	259	9.57	10.9	26.4
Payette R., (S.F.)					
Warm Springs	13-2342+30	440	5.98	8.60	17.6
Archie Cr.	13-2342+50	375	7.49	11.2	22.8
Deadwood R., Scott Cr.	13-2365+20	360	1.37	6.12	10.4
Cloverleaf (Upper & Lower)	2365+30	865	3.31	14.7	25.0
S.F. Payette R.,					
Ox Bow Bend	13-2365+50	245	7.07	13.1	29.7
Big Pine Creek	13-2365+60	295	8.95	16.7	37.6
Payette R., Garden Valley					
Reregulating	13-2380	120	6.99	19.9	31.3
N.F. Payette, Bogus Cr.	13-2450+80	182	3.25	13.1	18.6
Payette R., Montour Valley	-2475+20	53	3.29	8.57	15.2
Weiser R., Galloway	13-2655+20	360	.7	7.65	27.2
Wildhorse R., Wildhorse	13-2897+30	995	1.27	5.92	12.7
Salmon R., Stanley	13-2955	347	7.23	11.5	21.2
Robinson Bar	13-2965+10	343	8.73	13.7	30.6
Clayton	13-2965+30	360	11.0	19.3	36.7
Bayhorse	13-2985	325	10.1	17.8	40.0
Challis	13-2985+10	100	4.25	6.80	12.40
Lemhi R., Lemhi	13-3050+10	385	1.14	5.56	6.54
Kenney	13-3050+30	340	1.01	5.49	6.36

Table 6.--continued.

Stream Site	Site No.	Gross Head (feet)	Gross theoretical power, MW, with gross head, 100% efficiency and flows at Q95	Q50	Qmean
Napias, Panther Crks,					
Leacock	13-3060+40	980	4.17	7.08	15.4
Panther Cr., Deer Creek	13-3060+60	460	3.71	6.61	14.3
M.F. Salmon R.,					
Bear Valley	13-3090+10	290	3.80	5.27	13.6
Chinook	13-3090+20	335	4.39	6.10	15.7
Fuller Ranch	13-3090+30	320	5.03	7.15	18.4
Sheepeater	13-3090+40	580	9.12	12.9	33.3
Pungo	13-3090+50	385	10.5	14.9	38.3
Bacon	13-3090+60	400	12.4	17.7	45.6
Loon Cr., Falconberry	13-3090+70	360	3.89	5.54	14.2
Franklin	13-3090+80	525	5.89	8.34	21.4
Camas Cr., Meyers Cove	13-3090+85	500	3.87	5.52	14.1
Yellowjacket	13-3090+90	645	5.48	9.32	21.9
Big Cr. M.F., Cabin Cr.	13-3095+70	600	11.4	16.1	41.3
E.F., S.F., Salmon R.					
Parks-Scott	13-3130+20	1400	10.6	18.9	66.4
Secesh R., Butterfly-Scott	-3135+40	1440	5.51	9.79	34.3
S.F. Salmon R.,					
Tailholt-Scott	13-3135+50	360	7.44	13.2	46.5
Cumtux	13-3140+10	355	8.15	14.5	48.3
Porphyry	13-3140+20	460	11.7	19.5	66.5
Warren Cr., Rugged Cr.	13-3145+20	2395	4.07	12.2	22.4
Little Salmon R., Hazard	13-3160+60	500	3.44	6.03	13.2
Lockwood	13-3160+70	600	5.92	10.5	22.8
Sheep Creek	13-3160+80	460	6.14	10.9	23.6
Captain John	13-3160+90	295	5.02	8.78	20.1
Selway R., Magruder	13-3360+10	950	3.23	8.08	24.2
Running Creek	13-3360+30	300	3.83	11.0	31.1
Bear Cr., Bear Creek	13-3360+40	1000	3.40	8.5	23.8
Selway R., Pettibone	13-3360+50	300	5.87	16.6	21.4

Table 6.--continued.

Stream Site	Site No.	Gross Head (feet)	Gross theoretical power, MW, with gross head, 100% efficiency and flows at Q95	Q50	Qmean
E.F. Moose Cr.,Double Cr.	13-3360+70	850	1.81	5.42	15.2
N.F. Moose Cr.,Bailey Mtn.	-3360+75	1550	2.63	15.8	54.0
Meadow Cr.					
Upper Meadow Creek	13-3360+90	900	1.91	5.35	13.8
Lower Meadow Creek	13-3360+95	1045	4.00	11.1	32.0
Crooked Fork Cr.					
Lolo Pass	13-3365+10	1000	2.12	6.8	17.0
White Sand Cr.					
Hidden Lake	13-3365+20	1000	3.4	11.1	28.1
Lochsa R., Powell	13-3365+30	560	5.71	16.2	42.8
Squaw Creek	13-3365+40	340	3.76	11.6	29.5
Warm Springs Cr.					
Wind Lakes	13-3365+50	1500	1.91	6.37	16.6
Lochsa R., Jerry Johnson	13-3365+60	200	3.06	9.18	24.6
Weir Creek	13-3365+80	200	3.57	10.7	29.6
Bright Angel	13-3369+10	245	5.82	17.9	48.0
S.F. Clearwater R.					
Elk City	13-3375+10	580	1.97	5.67	16.8
Tenmile Creek	13-3375+20	420	2.14	6.07	17.5
Twentymile Creek	13-3375+50	600	3.31	9.18	27.0
Johns Creek	13-3375+80	785	6.00	16.3	48.0
South Fork	13-3380+10	355	2.87	8.00	23.6
Clearwater R., Eldorado	13-3390+50	1900	5.65	16.1	46.8
Ahsahka	13-3400+10	26	3.09	8.62	22.1
Kelly Cr., Kellys Thumb	13-3400+30	500	5.31	16.1	33.6
Skull & Quartz Creeks					
Bald Knob	13-3405+30	550	2.10	6.07	12.6
Little N.F.					
Buzzards Roost	13-3405+50	400	1.7	5.44	10.9
Gateway	13-3405+60	500	2.97	8.92	17.8
Boehls Butte	13-3405+70	600	4.60	14.3	28.6
Clearwater R., Hog Island	-3415+40	34	5.92	19.2	43.7
Totals			499.69	1,096.95	2,514.49

Areal distribution of waterpower

In addition to showing the location of powersites, figure 1 also shows the major drainage basin boundaries in Idaho and the per-square-mile potential waterpower of each basin. Table 7 contains this information in tabular form for easier reference. The distribution of developed and potential waterpower is further illustrated in figure 3. It will be noted that the Pend Oreille and Bear Rivers appear to be almost fully developed, that the Snake River has the greatest total development and that there are no power developments on the Salmon River, the stream with greatest waterpower potential. A few small plants have been operated in the Salmon Basin but these are now abandoned.

Statewide the waterpower potential of Idaho is about 128 kilowatts per square mile. The Payette, Salmon, and Clearwater Rivers as well as certain reaches of the main stem of the Snake River exceed the State average. The remaining streams are below it.

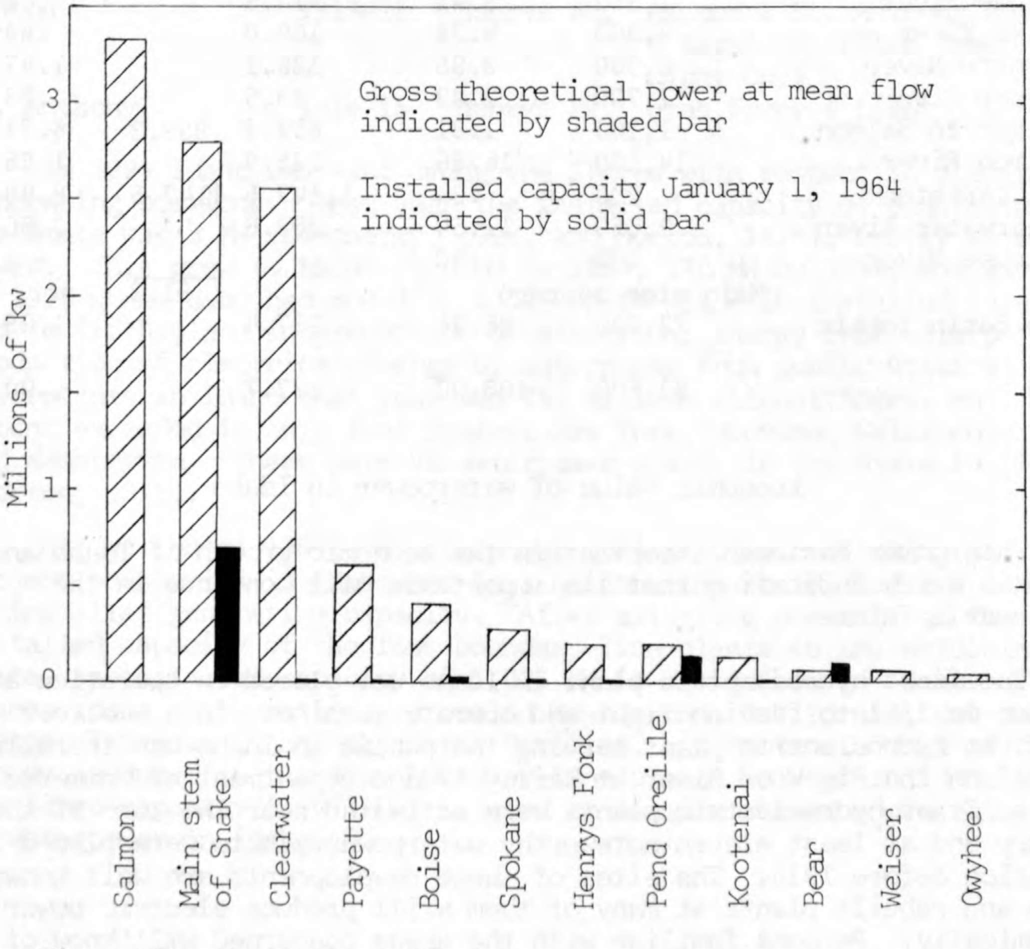


Figure 3.--Gross theoretical waterpower and installed capacity in Idaho by river basins.

Table 7.--Areal distribution of gross theoretical potential waterpower in Idaho.

Basin	Area (sq.mi.)	Area Percent of Total	Potential at mean flow (kw/sq.mi.)		Potential at mean flow Ratio to average	
Bear River	3,400	4.06	14.8		.12	
Upper Columbia Basin						
Kootenai River	1,100	1.31	126.2		.99	
Pend Oreille River	2,200	2.63	92.5		.72	
Spokane River	4,200	5.02	69.0		.54	
Columbia Basin totals	7,500	8.97	84.3		.66	
Snake River basin						
To Henrys Fork	1,250	1.49	217.1	217.1	1.70	1.70
Henrys Fork	2,300	2.75	90.7		.71	
To Oregon line	31,750	37.98	42.3	42.3	.33	.33
Owyhee River	2,850	3.41	10.9		.08	
Boise River	4,000	4.78	106.0		.83	
Payette River	3,300	3.95	188.1		1.47	
Weiser River	1,700	2.03	29.5		.23	
Weiser to Salmon	1,100	1.31	859.3	859.3	6.73	6.73
Salmon River	14,100	16.86	235.9		1.85	
To Clarkston	200	.24	1,147.5	1147.5	8.99	8.99
Clearwater River	9,650	11.54	263.6		2.06	
Palouse River	500	.60	–		–	
(Main stem average				81.3		.63)
Snake Basin totals	72,700	86.96	137.4		1.08	
State	83,600	100.00	127.7		1.00	

Economic value of waterpower in Idaho

Waterpower has been important in the economic growth of Idaho and there is every indication that its importance will continue in the foreseeable future.

The first hydroelectric plant in Idaho was placed in operation at Ketchum in 1881 to furnish light and operate machinery in a smelter. The first hydroelectric plant serving the public in Idaho was installed in 1885 on the Big Wood River at Hailey (Idaho Department of Commerce 1963). Other hydroelectric plants were activated near the turn of the century and at least eleven noteworthy waterpower plants were placed in operation before 1915. The sites of these developments are well known today and rebuilt plants at many of them still produce electric power economically. Persons familiar with the areas concerned will know of the original powerplants shown in table 8.

Table 8.--Selected pioneer powerplants in Idaho.

Plant	Constructed	River	Owner
Salmon City (Upper)	1897	Lemhi	Ed Mingle (Idaho Power Co.)
Swan Falls	1901	Snake	Trade Dollar Consolidated Mining Co. (Idaho Power Co.)
Horseshoe Bend	1902	Payette	Boise-Payette Electric Power Co. (Idaho Power Co.)
Highland	1903	Boise	Highland Valley Power Co.
Shoshone Falls	1901-07	Snake	Hollister and Perrine (Idaho Power Co.)
Post Falls	1906	Spokane	Washington Water Power Co.
Minidoka	1907	Snake	U.S. Bureau of Reclamation
Oxbow	1908-14	Snake	Idaho-Oregon Light & Power Co. (Idaho Power Co.)
Malad	1911	Big Wood	Beaver River Power Co. (Idaho Power Co.)
Thousand Springs	1912	Snake	Thousand Springs Power Co. (Idaho Power Co.)
Ashton	1913-15	Henrys Fk.	Ashton & St. Anthony Power & Light Co. (Utah Power & Light Co.)
St. Anthony	1914-15	Henrys Fk.	Utah Power & Light Co.

In 1899 Idaho was 41st among the States with respect to electric generating stations. That year the installed capacity of plants in the State was 3 MW (Daugherty, 1928, and Horton, 1928), mostly waterpower. This grew to about 22.5 MW by 1909, 170 MW by 1921, and 220 MW by 1925 when Idaho had moved up to eleventh place in installed capacity and to fifth place in production of electrical energy from waterpower. Production of electrical energy by waterpower from public utility powerplants in Idaho that year was 752 million kilowatthours, an amount exceeded in only four States; New York, Montana, California, and Washington. There were 48 waterpower plants in the State in 1925 (Horton, 1928).

At the end of 1964, 46 waterpower projects, four of which had project boundaries in Idaho and in a neighboring State, had 1,472 MW of installed generating capacity. After allotting one-half of the installed capacity of the four boundary-line plants to the adjoining State, an installed capacity of 1,025 MW is assignable to Idaho. This places Idaho ninth nationally behind Washington, California, New York, Oregon, Tennessee, Alabama, North Carolina, and Montana. Most of the energy produced in the four boundary-line plants is used in Idaho and the large capacity (1,472 MW) is used to measure the economic value of waterpower in Idaho.

Idaho's undeveloped waterpower resources were estimated at three million kilowatts in 1924 (Horton, 1928). As more data on streamflow and topography became available and as new and better ways of developing waterpower were adopted, the undeveloped resources were found to be greater and it now is estimated that installations at hydroelectric sites may eventually reach 11,000 MW, (Federal Power Commission, 1965). This estimate compares favorably with the estimate of the gross theoretical power of the State already discussed and the two are in agreement with a rule of thumb that ultimate installations in a large area may be expected to equal the gross theoretical potential of all streams at mean flow.

About 85 percent of the installed capacity in Idaho is privately owned and about 88 percent of all the energy now produced is from these privately-owned plants. Table 9 shows the distribution of developed power by plant ownership with average annual and 1962 production.

Electrical energy available for consumption in Idaho in 1962 is indicated to have been about 10,600 kwhr per capita. This compares to 5,075 kwhr per capita consumed in the United States which is in fourth place by country. Norway led with 10,346 kwhr per capita and in Canada and Sweden the per-capita consumption was 6,290 kwhr and 5,268 kwhr, respectively (Federal Power Commission, 1964).

Table 9. Installed capacity in MW, and 1962 production in MWhr of waterpower plants in Idaho.

Owner	No. of Plants	Installed Capacity (MW)	Production 1/ (MWhr)
Privately owned			
Idaho Power Co.	16	927.6	5,027,000
Washington Water Power Co.	3	221.2	755,000
Utah Power & Light Co.	8	102.7	217,000
Other Companies	7	3.8	15,000
Total private	34	1,255.3	6,014,000
Publically owned			
Municipalities	6	10.5	74,000
Federally owned	6	206.5	1,000,000
Total public	12	217.0	1,074,000
Total hydroelectric 2/	46	1,472.3	7,088,000

1/ From Moody's Public Utilities Manual, 1963, or estimated.

2/ Includes all of Cabinet Gorge, Palisades, Brownlee, and Oxbow capacity and production. These are divided equally with the adjoining State elsewhere in this report for determining areal distribution of gross theoretical waterpower.

There are six steam and internal combustion generating stations in Idaho with a total installed capacity of 29.09 MW (only 2 percent of total installations) and an estimated annual output of 152,500 MWhr. The plant factor of the thermal plants is 60 percent and of the hydroelectric plants is 65 percent.

Idaho Power Company began operations in Idaho on October 1, 1916 upon consolidation of five companies which themselves were derived from some 50 enterprises dating back to 1887. The total investment in 1916 was about $14 million and the total installations in operation were about 20,000 kilowatts. Today the company properties are valued at $347 million and the installed capacity of plants operated by the company is about one million kilowatts. The company spent $11,177,000 on new construction in 1962 and between $10 to $15 million, most of it in Idaho, in 1963. The gross revenue from 1962 sales of energy was $44,326,000 at 8.82 mills per kwhr. The company paid more than $8 million in salaries and about $14 million in taxes (Moody, 1963, p. 1476-1477).

The installed capacity and energy production from Idaho Power Company plants in 1962 is shown in the following table.

Plants, installed capacity and 1962 production

Idaho Power Company

Plant	Installed MW	Production MWhr
American Falls	27.5	133,243
Twin Falls	13.5	72,462
Shoshone Falls	10.9	87,360
Clear Lakes	2.5	18,000 1/
Thousand Springs	8.0	58,935
U. Salmon Falls (A&B)	34.5	288,019
L. Salmon Falls	60	260,000 1/
Upper Malad	7.2	58,732
Lower Malad	13.5	94,633
Bliss	75	370,833
C. J. Strike	82.8	458,779
Swan Falls	10.3	96,000 1/
Cascade	1.5	-
Brownlee	360.4 2/	1,949,147
Oxbow	220 2/	1,081,000
Total	927.6	5,027,143

1/ Average annual. Other amounts are from Moody.

2/ Total installation which is equally divided with Oregon elsewhere in this report.

The Washington Water Power Company was established in 1889 and operates from Spokane, Washington. It serves parts of nine counties in Idaho and was the first to bring electric power to the Coeur d'Alene mining country. At one time the line from Spokane to Coeur d'Alene was said to be the longest high voltage transmission line in the world. The Post Falls plant, constructed on the Spokane River in 1906, was the company's first plant in Idaho. The Grangeville and Lewiston plants on the Clearwater River were added by 1927. In 1952 the company completed the third largest plant in Idaho at Cabinet Gorge on Clark Fork (Moody, 1963, p. 1518).

In 1962 plants of Washington Water Power Company had the installed capacity and production shown in the following table.

Plants, installed capacity and 1962 production

Plant	Installed MW	Production MWhr
Cabinet Gorge	200 2/	615,557 1/
Post Falls	11.2	81,000
Lewiston	10	58,000
Total	221.2	754,557

1/ From Moody's 1962 statistics. Other production amounts are annual averages.
2/ Total--divided with Montana elsewhere.

The value of this energy is about $6,720,000, if the average value of a kwhr produced by Idaho Power Company (8.82 mills per kwhr) is used.

Utah Power and Light Company, successor to Ashton and St. Anthony Power and Light Company and Telluride Power Company, operated the following plants in Idaho in 1962.

Plants, installed capacity and 1962 production

Plant	Installed MW	Production MWhr
Paris	.7	2,900 1/
Soda	14.0	17,400
Grace	44.0	98,732
Cove	7.5	18,017
Oneida	30.0	42,791
St. Anthony	.5	3,600
Ashton	5.8	33,147
Malad City	.2	800 1/
Total	102.7	216,587

1/ Estimated.

The value of this energy is about $1,879,000, according to the average return to the Idaho Power Company of 8.82 mills per kwhr.

Other private companies operated the following plants in Idaho in 1962.

Plants, installed capacity and 1962 production

Plant	Installed MW	Production MWhr
Hecla Mine	.25	700
Ponds Lodge	.2	10
Felt	2.1	9,000
Barber	1.0	5,000
Lowman	.03	-
Deadwood Lodge	.15	700
Moose Creek Ranch	.02	-
Total	3.75	15,410

Following is a list of the municipally-owned powerplants in Idaho showing installed capacity and average annual generation.

Plants, installed capacity and average annual generation

Plant	Installed MW	Average annual Generation (MWhr)
Soda Springs	.7	3,600
Moyie #2	2.0	19,300
Moyie #1	.4	1,600
Idaho Falls #2	2.4	16,000
Idaho Falls #1	2.0	14,000
Idaho Falls #4	3.0	20,000
Total	10.5	74,500

At 8.82 mills per kwhr the value of this production is $670,320.

The federally-owned plants, their installed capacities, and average annual generation are as follows:

Plants, installed capacity and average annual generation

Plant	Installed MW	Average annual Generation (MWhr)	Corrected by Bureau of Reclamation Sept. 1, 1965
Albeni Falls	42.6	230,000	—
Palisades	114.0 1/	532,000	508,000
Minidoka	13.4	94,000	98,000
Anderson Ranch	27.0	137,000	139,000
Boise Diversion	1.5	7,000	5,000
Black Canyon	8.0	-	62,000
Total	206.5	1,000,000	

At 8.82 mills per kwhr the value of the above production is $8,820,000.

1/ Total--divided with Wyoming elsewhere.

The Bureau of Reclamation reports 1963 MWhr production: Minidoka 84,300, Anderson Ranch 97,800, Boise Diversion 8,200, Black Canyon 75,200, Palisades 534,200. Estimating 230,000 MWhr for Albeni Falls, the 1963 production would be 1,009,700 MWhr.

By applying the value of a kilowatthour to the Idaho Power Company to the 7.1 billion kwhr of electrical energy produced in 1962, the income that year from all hydroelectric energy produced in Idaho is shown to be more than $62 million. This is about five percent of all the income in the State ($1,236,000,000 in 1961) (Idaho Department of Commerce, 1963). It is about 14 percent of 1962 income from agriculture ($450,200,000) and 75 percent of the value of all minerals produced in 1962 ($82,600,000) (Fulkerson and others, 1963). Taxes or payments in lieu of taxes from the producers of electrical energy are nearly $20,000,000 a year at the present time.

Waterpower sites developed to date in Idaho have cost an average of $211 per kilowatt of installed capacity. The average annual production expense of the existing plants was $1.77 per year per kilowatt of installed capacity. In 1961 an average of 260 employees were employeed at the powerplants in occupations directly related to energy production.

Table 10 contains the data used to determine the average cost of the constructed waterpower plants and the annual cost of operating the plants.

Table 10.--Hydroelectric plant construction cost and 1961 production expenses for selected plants in Idaho. 1/

Builder and Plant	Installed Capacity MW	Construction Cost per kw (dollars)	Construction Cost Total ($1000)	1961 Production expenses per kw (dollars)	1961 Production expenses Total (dollars)	Employees
Idaho Power Co.						
Twin Falls	13.5	65	877.5	2.67	36,045	3
U. Salmon Falls	34.5	167	5,761.5	2.23	76,935	9
L. Salmon Falls	60.0	162	9,720	1.87	112,200	12
Bliss	75	154	11,550	1.41	105,750	10
C. J. Strike	82.5	215	17,737.5	1.23	101,475	11
Brownlee	360.4	190	68,476	.71	255,884	12
Oxbow	190	249	47,310	1.32 2/	250,000 2/	10
Totals	815.9		161,432.5		938,289	67
Avg. Unit Cost		197.8		1.15		
Utah Power & Light						
Soda	14	234	3,276	3.79	53,060	7
Grace	44	163	7,172	4.43	194,920	23
Oneida	30	97	2,910	3.53	105,900	14
Totals	88		13,358		353,880	44
Avg. Unit Cost		151.8		4.02		
Wash. Water Power Co.						
Cabinet Gorge	200	224	44,800	.70	140,000	13
Lewiston	10	386	3,860	10.7	107,000	5
Totals	210		48,660		247,000	18
Avg. Unit Cost		231.7		1.17		
Federal						
Albeni Falls	42.6	741	31,566.6	8.00	340,800	20
Palisades	114	135	15,390	1.57	178,980	29
Minidoka	13.4	124	1,661.6	8.88	118,992	27
Anderson Ranch	27	182	4,914	2.52	68,040	13
Black Canyon	8	169	1,352	10.38	83,040	12
Totals	205		54,884.2		789,852	101
Avg. Unit Cost		267.7		3.85		

Table 10.--continued.

Builder and Plant	Installed Capacity MW	Construction Cost per kw (dollars)	Construction Cost Total ($1000)	1961 Production expenses per kw (dollars)	1961 Production expenses Total (dollars)	Employees
Other plants -						
Totals	156.7		33,064		277,359	30 2/
Avg. Unit Cost		211 2/		1.77 2/		
State Totals	1,475.6 3/		311,398		2,606,380	260
State Avg. Unit Cost		211		1.77		

1/ Federal Power Commission data where not otherwise specified.

2/ Estimated.

3/ Includes all of Cabinet Gorge, Palisades, Brownlee, and Oxbow which are divided equally with the adjoining State elsewhere in this report.

The normal pattern of developing the easiest and least expensive sites first was followed in Idaho. Many sites where low-cost power can be produced remain undeveloped, however, and only a fraction of the total potential expected to become economic has been developed. Many of the sites are within reasonable transmission distance of load centers in Idaho and points of junction with networks extending into Montana, Wyoming, and Utah, as well as to all parts of Oregon and Washington through the Pacific Northwest system. The authorized transmission link between the northwest and the southwest may open a new market for waterpower from Idaho.

Forecasters predict continued progress in the development of waterpower in Idaho, but the time sequence of individual developments cannot be foreseen at this time. Relatively complete development of the main stem of the Snake River may be achieved before projects on the tributaries are undertaken. Dworshak Dam on the North Fork Clearwater River, at a site formerly known as Bruces Eddy, is the only large project under construction on a Snake River tributary. The effect that this dam will have upon the basin and the area may be a large factor in determining the time and place for undertaking other major projects on the tributary streams.

River basin and powersite descriptions

Bear River basin

Bear River rises in the northeastern part of Utah, flows northward into the southwest corner of Wyoming, turns west and re-enters Utah, returns to Wyoming, flows northwestward to a point near Soda Springs, Idaho, turns abruptly to the southwest and finally re-enters Utah and empties into Great Salt Lake. This circuitous course is more than 500 miles long and the drainage area is about 6,900 square miles. The airline distance from the source of the river to its mouth is only 90 miles, however.

Bear River enters Idaho at an altitude of about 6,050 feet and leaves Idaho at an altitude of about 4,480 feet after traversing about 60 miles of valley. The channel is usually meandering and maps are not adequate for accurately measuring its actual length. The drainage area in Idaho is 3,400 square miles.

The headwaters of the Bear River are about 60 miles east of Salt Lake City on the north slopes of the high peaks of the Uinta Mountains. Among these high peaks, which range between 9,000 and 13,000 feet in altitude, are many small glacial lakes and basins that serve as excellent precipitation catchment areas. The greater part of the precipitation falls in the form of snow and the direct source of supply of the small headwater streams is usually from small, scattered springs.

The north slopes of the Uinta Mountains are covered with a heavy growth of timber and in summer are used for grazing sheep. The river valley broadens to nearly two miles in width at the Wyoming boundary and is skirted on both sides by rolling hills. Grazing of cattle and sheep and some dry farming are the principal uses of this part of the basin. The bottomlands are all irrigated by diversions from the river. Several fairly large canals supply the town of Evanston, Wyoming, and adjacent hay ranches.

North of Cokeville the river enters The Narrows, a three-mile long rocky gorge, parallel to the Utah-Wyoming line, and then turns sharply west to Woodruff, Utah. Downstream from Woodruff, the valley widens to a width of three to six miles and is increasingly used for raising of hay, and for irrigated pastureland between Woodruff and Randolph. The river re-enters Wyoming about 12 miles north of Randolph, Utah. The canyon narrows again near the Idaho-Wyoming boundary after which it passes through a large, transverse valley at the junction of Thomas Fork. Thomas Fork Valley is parallel to Bear Lake Valley both extending north and south. Bear River has cut a rather deep, zigzag canyon across Bear Lake Plateau (the Preuss Range) and enters Bear Lake Valley near Dingle about five miles north of Bear Lake. Bear Lake, which is 20 miles long and seven miles wide, is surrounded on all sides except the north by steep hills from which many small streams flow into the lake.

Before 1915 the outlet of the lake was a meandering channel that extended north across some 15 miles of swamp lands and joined the Bear River near the north end of Bear Lake Valley at a point where the rolling hills close in and form a narrow canyon. The river did not flow directly into Bear Lake but flooded the marshlands during high water and backed water into the lake. After the flood season this water flowed back through the marshlands into the river so that the lake had a modifying effect upon the regimen of the river. In order to make better use of the lake as a regulating reservoir, an inlet canal was built from the river near Dingle, Idaho, to the lake and the natural causeway at the north end of the lake was improved by dredging and straightening. A pumping plant was installed at the outlet for maintaining uniform flow during time of drought so that the flow of the Bear River is now regulated as desired. After leaving Bear Lake Valley the river continues to flow northward in a well-defined channel through hilly grazing lands and vast stretches of lava plain. Near Soda Springs, Idaho, it turns west, passes through a deep narrow channel cut through the lava sheet, bends around the north end of the Bear River Range, and flows south into Gentile Valley.

The benchland on each side of Bear Lake Valley has an average altitude of 5,950 feet above sea level and is adapted for raising hay, grain, and potatoes by irrigation. Irrigation water is diverted from the Bear River as well as from the natural flow of the numerous small streams that enter the valley from both sides. Gentile Valley with an altitude of about 5,500 feet above sea level is a prosperous agricultural area. Rolling lands recede to the foothills on each side of the valley bottom. These rolling lands are used for grazing, for raising wheat and forage plants, and are irrigated wherever possible by diverting the small mountain streams that enter the valley from both sides. Dry farming is practiced very successfully in the foothills on lands that cannot be reached by the irrigation ditches.

Acorss Gentile Valley and downstream from it, the river flows generally southward. The valley narrows to canyon widths about four miles north of Oneida, passes through a steep and narrow section south of Oneida in a four-mile long reach known as Oneida Narrows, and enters Cache Valley about eight miles northeast of Preston, Idaho, and about 15 miles north of the Idaho-Utah boundary. Cache Valley is about 4,700 feet in altitude at Preston and is one of the largest and finest valleys in the Bear River basin. It is about 30 miles long and 10 miles wide with smooth fertile hills on both sides that slope gently toward the river. Extensive agricultural developments in Cache Valley support many towns in Idaho and Utah.

Development of waterpower in the Bear River basin, Idaho, began about 1901 when Telluride Power Company initiated a plan to use Bear Lake as a reservoir and constructed a canal to divert the flood waters from Bear River to the lake for use both in developing power and irrigation (Woolley, 1924). Most, if not all, of the developable sites in the Bear River basin inside Idaho are downstream from Bear Lake.

Bear River leaves the Bear Lake Valley at an altitude of about 5,900 feet, passes through a series of valleys and canyons and enters Cache Valley at an altitude of about 4,600 feet. The total fall is about 1,300 feet. The Telluride Power Company and its successor, Utah Power and Light Company, have developed about 850 feet of this head in four waterpower plants as follows:

Plant	Constructed	Head	Installed Capacity (MW)
Grace	1908	524	44
Oneida	1915	145	30
Cove	1917	98	7.5
Soda	1924	79	14
Totals		846	95.5

Two additional power developments may be feasible on Bear River; one at the Lava site that would develop 100 feet of head between the Soda plant tailrace and the Grace plant diversion, and the other at the Oneida Narrows site that would develop 115 feet of head downstream from the Oneida plant tailrace. Installed capacities of 13.4 and 20 MW, respectively, have been proposed for these sites. There are a number of sites on tributaries where small plants could be constructed to produce power for ranchers or small settlements, should that become desirable. Woolley (1924) describes a number of small sites in the basin, eight of which are in Idaho. Two existing plants of this kind are Soda Springs on Soda Creek (.7 MW), built in 1908 by the City of Soda Springs; and Paris (.7 MW), on Paris Creek, built in 1910 by the Bear Lake Company and sold to Utah Power and Light Company in 1914.

Two small plants built in 1905 and 1908 were operated for many years by Utah Power and Light Company. They now appear to have been abandoned. The Georgetown plant on Georgetown Creek in unsurveyed sec. 3, T. 11 S., R. 44 E., was started in 1904 and completed in 1905 by the Montpelier Electric Light Company. It was sold to Bear Lake Power Company in 1908 and was acquired by the Utah Power and Light Company in 1914. The installed capacity was .225 MW and the operating head was 130 feet.

The High Creek plant diverted water from the Cub River in sec. 24, T. 15 S., R. 40 E., Boise Meridian, and by canal and penstock carried the water to the powerhouse in sec. 34 of the same township. This plant, built about 1908, by High Creek Electric Company was sold to Utah Power and Light Company about 1913. The powerhouse contained two .375 MW turbines that required about 29 cfs each under a head of 177 feet. The static head was 182 feet.

In describing the powersites throughout this report, developed sites and reservoirs are indicated by a group of asterisks (***) placed in the margin.

The Bloomington site (10-0586) on Bloomington Creek has a powerhouse site about four miles west of Bloomington in sec. 19, T. 14 S., R. 43 E. The site is described briefly by Woolley (1924, p. 113). According to the Preston and Montpelier 1:125,000-scale topographic quadrangle maps the water would be diverted in unsurveyed sec. 22, T. 14 S., R. 42 E., and carried along the right bank of Bloomington Creek about three miles to the powerhouse site. The drainage would be about 25 square miles and head would be developed between altitudes 7,250 feet and 6,250 feet, approximately. The terrain appears suitable for a pipeline on either side of the creek.

*** The Paris plant (10-0600) of the Utah Power and Light Company on Paris Creek is at mile 5, sec. 9, T. 14 S., R. 43 E., utilizes water from 19 square miles of Paris Creek, and develops 346 feet of head. The plant is authorized as Federal Power Project No. 703 and its actual annual average generation is 2,900 kilowatthours, which indicates a plant factor of about 33 percent. The plant was constructed in 1910.

*** The Soda Springs plant (10-0770+10) of the City of Soda Springs, sec. 36, T. 8 S., R. 41 E., utilizes water from a drainage area of 58 square miles of Soda Creek. The drainage area is probably unimportant, however, as the plant is spring fed. Woolley (1924, p. 75) says that the plant was built by private individuals about 1908 and was acquired by the Soda Springs Electric Company that same year. The plant develops the head between altitude 5,940 feet and 5,850 feet, approximately. The plant is on private land.

*** The Soda plant (10-0790) of the Utah Power and Light Company is licensed as Project No. 20. The plant is on the Bear River at mile 118, sec. 17, T. 9 S., R. 41 E., at the 11,800 acre-foot Soda Point reservoir, but this plant, like all of the plants on Bear River downstream from Bear Lake, benefit from 1,432,000 acre-feet of storage in the lake. The potential power assumes a development between altitude 5,719 feet and 5,640 feet and is based upon discharge between 1953 and 1960. The regimen of Bear River has been changed somewhat during the last few years to build Bear Lake back to normal level.

The Lava site (10-0790+10) has a powerhouse site at mile 114, sec. 31, T. 9 S., R. 41 E., where the drainage area is 3,840 square miles. Development would be between altitudes 5,640 feet and 5,541 feet. This leaves one foot of fall between the Lava site tailrace altitude and the backwater limit of the Grace forebay. Irrigation requirements limit the water available at this site. It would, however, benefit from Bear Lake storage.

*** The Grace plant (10-0800) of the Utah Power and Light Company, constructed in 1908 at mile 106, sec. 21, T. 10 S., R. 40 E., where the drainage area is 3,840 square miles, develops head between altitudes 5,540 and 5,016 feet. Irrigation requirements further deplete the Bear River above the Grace plant intake.

The Cove plant (10-0800+50) of the Utah Power and Light Company, *** at mile 104, sec. 33, T. 10 S., R. 40 E., where the drainage area is 3,860 square miles, develops head between altitudes 5,016 and 4,918 feet, approximately. Return flow from irrigation increases the discharge somewhat over that available to the Grace plant.

The Oneida plant (10-0860) of the Utah Power and Light Company, *** mile 76, sec. 23, T. 13 S., R. 40 E., where the drainage area of Bear River is 4,130 square miles, develops head between altitudes 4,852 and 4,707 feet. The Oneida reservoir of 11,500 acre-feet reregulates the river which has been completely controlled at Bear Lake by 1,432,000 acre-feet of storage.

The Oneida Narrows site, or Mink site, (10-0865+50) with damsite in sec. 21, T. 14 S., R. 40 E., where the drainage area is 4,139 square miles would develop the head remaining in the Bear River upstream from Cache Valley, altitude 4,707 feet to altitude 4,592 feet. This appears to be the most likely future development on the Bear River. The Bureau of Reclamation proposes to build a storage reservoir without power facilities to provide water for irrigation purposes in Utah and Idaho. The dam would be built on Bear River 10 miles northeast of Preston. The reservoir would have a capacity of 375,000 acre-feet for use in northern and western Cache Valley and in the Malad Valley. It is understood that the Utah Power and Light Company proposes to develop the site for power under Federal Power Commission license utilizing about 10,000 acre-feet of storage capacity.

The Mink Creek site (10-0875+20) would utilize water from 28 square miles of Mink Creek in a powerhouse site in sec. 1, T. 14 S., R. 40 E. (Woolley, 1924, p. 116). Springs in the upper part of Mink Creek canyon produce substantial flows. Irrigation canals divert water from the creek and arrangements would have to be made to use the water above the diversion points. The development illustrated assumes head utilization between altitudes 5,400 and 5,000 feet.

Upper Columbia River drainage in Idaho

The section of Idaho designated as Upper Columbia in this report includes small portions of the Kootenai and Pend Oreille River basins and the major part of the Spokane River basin, including all of its major tributaries.

Kootenai River basin

Idaho contributes only 1,100 square miles to the Kootenai River drainage and it appears that runoff from the Idaho portion is somewhat less than that from other upstream areas. The only developed powersites in the basin are the two small plants operated by the Village of Bonners Ferry on the tributary Moyie River. The potential power of the Kootenai River in Idaho is due principally to the large volume of water flowing in it as it enters the State. There are no existing powerplants on the main Kootenai River in Idaho and only one (Low Katka) appears to offer promise for development. The Low Katka site could create a head of 125 feet by means of a dam. Immediately downstream from this site the river enters a wide, flat, and highly developed valley which extends to the Canadian boundary. Bonners Ferry lies in this valley.

The Low Katka site (12-3055+50), mile 161, sec. 25, T. 62 N., R. 2 E., has a drainage area of 11,780 square miles. A dam that would raise the water from its present altitude of about 1,775 feet to altitude 1,900 feet would have a crest length of about 700 feet. The damsite is 7.5 miles downstream from the State boundary line and the reservoir would extend 28 miles upstream, of which 20.5 miles are in Montana. The principal relocation problems would concern the railway line and the highway. A small cultivated valley at the mouth of the Yaak River and reaches of narrow canyon make up the reservoir site. The Katka damsite surveyed by the Geological Survey in 1934 is in sec. 31, T. 62 N., R. 3 E., about one mile upstream.

Moyie River

The Meadow Creek site (12-3065+50) could develop 330 feet of head by means of a dam at mile 10.9, secs. 2 and 11, T. 63 N., R. 2 E., and a powerhouse at mile 8.9, sec. 12, of the same township. The water surface altitude at the damsite is 2,380 feet and a dam to raise it to altitude 2,620 feet (the water surface at the Canadian boundary) would create a reservoir with a storage capacity of 275,000 acre-feet. Such a dam would have a crest length of about 1,000 feet. By taking advantage of a bend in the river it would be possible to utilize all of the stored water above an altitude of about 2,460 feet by diverting the water through a tunnel half a mile long together with a half-mile long pressure conduit to the powerhouse site at altitude 2,290 feet. The drainage area at the damsite is 700 square miles.

The Eileen site (12-3070+90) would consist of a dam on the Moyie River at mile 5.4, sec. 25, T. 63 N., R. 2 E., where the drainage area is 750 square miles, and a conduit about two miles long, probably along the right bank of the river to the powerhouse site at mile 3.2, sec. 2, T. 62 N., R. 2 E. This arrangement would develop the head between the Meadow Creek site tailrace, altitude 2,290 feet, and the intake for the Moyie No. 2 development, altitude 2,035 feet. The water surface altitude at the damsite is 2,150 feet and it would have a crest length of about 300 feet at altitude 2,290 feet.

*** Moyie No. 2 plant (12-3080) of the Village of Bonners Ferry is on the Moyie River in sec. 14, T. 62 N., R. 2 E., mile 1.4, where the drainage area is about 760 square miles. The potential power of the site has been computed by assuming a development between altitudes 2,035 and 1,835 feet. It is assumed that the Moyie No. 2 plant would use all of the water and head now developed by the No. 1 and No. 2
*** plants. The Moyie No. 1 plant has been assigned number 12-3080+10.

Pend Oreille River basin

Pend Oreille River, like Kootenai River, has a very small portion of its drainage basin in Idaho. The Kootenai flows through Idaho in a wide, open valley while the Pend Oreille (Clark Fork above Pend Oreille Lake) traverses the State through the large and beautiful Pend Oreille Lake. The lake provides a substantial control of the flow of the river and enhances its value for waterpower by smoothing out the flow for use at downstream powersites. Priest River, including Priest Lake, is the principal Pend Oreille tributary originating inside Idaho. It drains an area of high runoff and because of it, Idaho contributes more than the average unit runoff of the river at Albeni Falls. Even though the total drainage area inside Idaho is only about one-eleventh (2,200 square miles) of the 24,200 square-mile Clark Fork-Pend Oreille drainage area at the Idaho-Washington boundary, unit runoff increases from .973 cfs per square mile on the Clark Fork River at Cabinet Gorge near the Idaho-Montana boundary to 1.05 cfs per square mile on the Pend Oreille River at the Idaho-Washington boundary. The unit runoff rate for the area upstream from Cabinet Gorge may be understated because of diversions for irrigation in Montana.

There are two large waterpower developments in the basin in Idaho--Cabinet Gorge on the Clark Fork, and Albeni Falls on the Pend Oreille. There are four potential sites, all on the Priest River. One is near the Priest Lake outlet and would control the lake. The others would develop head downstream from the lake. The site at the lake outlet and the next one downstream have been included in an application for Federal Power Project 2141.

The Cabinet Gorge dam (12-3915) mile 150, sec. 25, T. 55 N., R. 3 E., where the Clark Fork River drainage area is 21,840 square miles, was completed in 1952 by the Washington Water Power Co. The gross head developed is between altitudes 2,175 and 2,078 feet and the reservoir contains 42,780 acre-feet of water. The Cabinet Gorge dam and powerplant are in Idaho but the reservoir lies principally in Montana, and the power is divided equally between the two States.

The Priest Lake New Outlet Control site (12-3930+30) (Federal Power Project application 2141) would be developed by a dam at mile 41, sec. 18, T. 59 N., R. 4 W., where the drainage area is 572 square miles, to control the lake near its present level. The present river surface at the damsite is about 2,390 feet and a dam that would raise it to the present lake-surface altitude of 2,438 feet would have a crest length of about 400 feet. A conduit about one mile long on the right bank of Priest River would lead to the powerhouse site in sec. 19 of the same township where the tailrace altitude would be 2,353 feet.

Priest No. 4 site (12-3930+70), at mile 35.1, sec. 31, T. 59 N., R. 4 W., would utilize a damsite in sec. 29, where the drainage area is 615 square miles and the present water surface altitude is 2,305 feet. A dam less than 500 feet long would be required to raise the water surface to the New Outlet Control site described above. This site is included in the application for Federal Power Project 2141.

The Priest No. 6 site (12-3940+70) with a powerhouse site at mile 8.6, sec. 32, T. 57 N., R. 4 W., would consist of a dam at mile 9.8, sec. 29 of the same township where the drainage area is about 800 square miles, and a tunnel nine-tenths of a mile long on the right bank of Priest River. A dam with a crest length of about 900 feet would raise the river surface from its present altitude of 2,170 feet to an altitude of 2,300 feet. At this altitude a reservoir with a capacity of 384,000 acre-feet would be created in the broad valley that extends upstream to a point about one mile downstream from Damsite No. 4, and includes the mouths of the East River, Fox Creek, Big Creek, and Blue Creek. The tailrace altitude would be about 2,125 feet.

The Priest River site (12-3950+10) with damsite in sec. 24, T. 56 N., R. 5 W., mile 1.5, where the Priest River drainage area is about 907 square miles would develop the river between the Priest No. 6 tailrace site altitude 2,125 feet, and the Albeni Falls reservoir altitude 2,062.5 (2,063) feet. The crest length of the dam at altitude 2,125 feet would be about 700 feet according to a 1934 river survey by the U. S. Geological Survey. The reservoir would back to mile 8.6 on the Priest River and to mile 5 on Lower West Fork and would have a capacity of 15,000 acre-feet. According to the river survey, relocation problems would not be too great.

*** The Albeni Falls project (12-3955) was completed by the Corps of Engineers in 1955. The dam is at mile 90 of the Pend Oreille River, secs. 19, 20, 29, and 30, T. 56 N., R. 5 W., where the drainage area is 24,200 square miles. The project consists of a concrete-gravity dam on the Pend Oreille River about 2.5 miles upstream from the Washington-Idaho line. The normal full reservoir is at elevation 2,062.5 feet and the dam provides 1,155,000 acre-feet of usable storage by lowering Pend Oreille Lake 12.8 feet below this altitude for firming up low flows on the Columbia River in addition to generating power at the site. The average altitude of the tailrace is 2,034.2 feet. These altitudes were used to compute the gross theoretical power presented in the tabulation.

Spokane River basin

Spokane River drains Coeur d'Alene Lake and the headwaters tributary to the lake. These tributaries originate on the Idaho side of the Bitterroot Range. They are the Coeur d'Alene and St. Joe Rivers, which empty into Coeur d'Alene Lake, and St. Maries River, which joins St. Joe River about 10 miles upstream from its mouth. Average discharge of the Spokane River is 1.648 cfs per square mile, a greater unit yield than the Pend Oreille and Kootenai Rivers. The latter two rivers have greater potential waterpower per unit of area

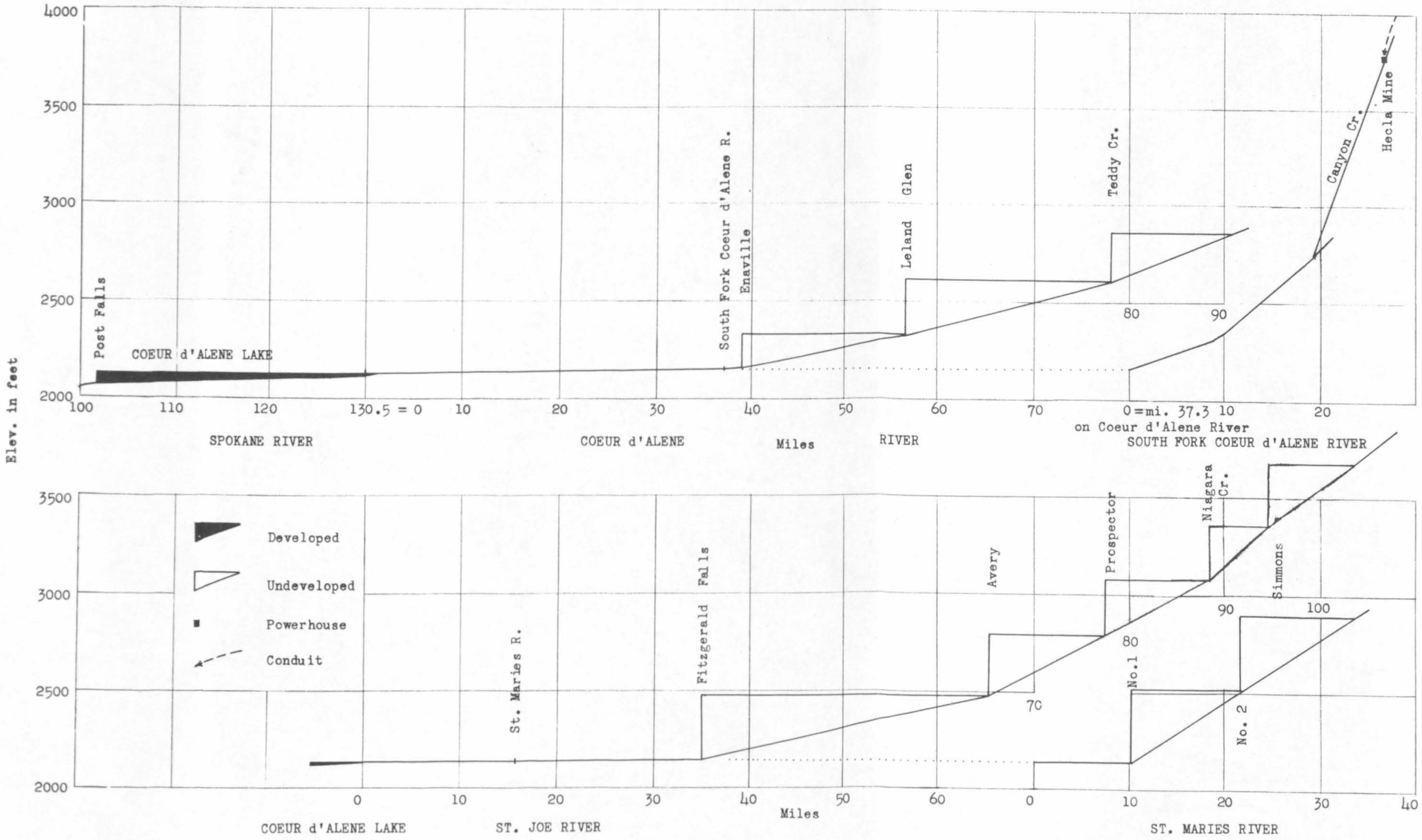


FIGURE 4.--PROFILE OF SPOKANE RIVER SHOWING DEVELOPED AND UNDEVELOPED POWERSITES

in Idaho, however, because of the large quantities of water flowing in them that originates in Montana.

Mining and smelting activities, especially in the vicinity of Kellogg on the South Fork Coeur d'Alene River, created an early market for power, and long-distance transmission of high voltage energy was pioneered there (Idaho Dept. of Comm. 1963). The Spokane River regulated by storage in Coeur d'Alene Lake was a good source for the power, and plants at Spokane and Post Falls furnished most of it. The Post Falls plant constructed in 1906, was the first plant of the Washington Water Power Company in Idaho. The only other existing developed site in the basin within Idaho is the 250 kw Hecla Mine Plant.

There are three undeveloped sites on the Coeur d'Alene River and seven on the St. Joe and St. Maries Rivers in the Spokane River basin in Idaho.

Coeur d'Alene River

The <u>Teddy Creek site</u> (12-4105+50) is 41 miles above the mouth of the South Fork where the Coeur d'Alene River drainage area is about 300 square miles. The damsite is in sec. 10, T. 51 N., R. 3 E., at water surface altitude 2,617 feet. A dam that would raise the water surface to an altitude of 2,860 feet would have a crest length a little less than 1,100 feet long, and a reservoir at this altitude would have a capacity of 250,000 acre-feet.

The <u>Leland Glen site</u> (12-4110+50) is located 19.5 miles above the mouth of the South Fork where the Coeur d'Alene River has a drainage area of 595 square miles. The damsite is located in secs. 25 and 26, T. 50 N., R. 3 E., at water surface altitude 2,324 feet. A dam that would raise the water surface to an altitude of 2,617 feet would have a storage capacity of 582,000 acre-feet. The damsite has been surveyed to altitude 2,600 feet, and a dam would have a crest length of about 950 feet at that altitude. The reservoir would flood valleys at the junctions of Big, Lost, Prichard, Beaver, and Cedar Creeks. The settlements of Prichard and Eagle, and important roads throughout the reservoir site would have to be relocated.

The <u>Enaville site</u> (12-4130) has been placed at mile 36 in the Corps of Engineers proposal which, also, gives slightly different altitudes for the forebay and tailrace. That study would include part of the Leland Glen site in the Enaville reservoir. As studied here, the damsite is at mile 39, sec. 19 and 30, T. 49 N., R. 2 E., where the Coeur d'Alene River has a drainage area of 895 square miles. The water surface at the damsite is 2,163 feet and a dam that would raise the water to an altitude of 2,324 feet would have a crest length of about 1,150 feet according to the damsite survey made by the Geological Survey in 1936. The reservoir would have a storage capacity of 304,000 acre-feet, and would occupy valley bottoms at the mouths of Graham, Steamboat, and Thomas Creeks, and the junction of the North Fork Coeur d'Alene River. The reservoir would flood the Bumble Bee site on the North Fork and would back about 9¼ miles up that stream. Several small settlements, some farms, and important roads would have to be relocated to higher ground.

*** The developed Hecla Mine powersite (12-4130+20) in unsurveyed secs. 9 and 10, T. 48 N., R. 5 E., on Canyon Creek, does not have sufficient theoretical power to be included in the tabulation of gross theoretical power.

St. Joe River

The Simmons site (12-4140+50) would create a small storage reservoir behind a dam at mile 94.8 on the St. Joe River, sec. 24, T. 44 N., R. 8 E., below the mouth of Simmons Creek where the drainage area is 165 square miles. The damsite is at an altitude of 3,360 feet and water raised to an altitude of 3,680 feet would require a dam with a crest length of about 1,300 feet according to the 1957 Simmons Peak 15-minute topographic quadrangle map. The map indicates that a better damsite might be found a short distance upstream. The area is in the St. Joe National Forest and a forest service road follows the river. This road would have to be relocated as would several campgrounds.

The Niagara Creek site (12-4140+55) is at mile 88.5, sec. 9, T. 44 N., R. 8 E., where the St. Joe River has a drainage area of 223 square miles. This is a new site selected to replace the Quartz Creek site of earlier plans. The 15-minute Simmons Peak quadrangle map made in 1957 indicates that the water surface altitude at the site is about 3,080 feet (the altitude formerly supposed for the water surface at the Quartz Creek or Quartz-Bluff site). The river is flowing in a narrow canyon throughout the reservoir area and reservoirs behind dams at either the Niagara Creek or Quartz Creek sites will be small in relation to the height of dam required. For this reason it seems advisable to retain the 3,080-foot altitude for the next downstream site, the Prospector site reservoir, and develop the remaining head between the Simmons and Prospector sites by means of a dam at the Niagara Creek site. A dam 600 feet long, about half the length of the one required at the Quartz Creek site for the same height of dam, would raise the water surface from its present altitude of 3,080 feet to altitude 3,360 feet. The Quartz Creek site, at mile 84.5, sec. 36, T. 45 N., R. 7 E., where the St. Joe River has a drainage area of 304 square miles, will be flooded if the Prospector site is developed as described.

The Prospector site (12-4140+70) is at about mile 77.5, sec. 20, T. 45 N., R. 7 E., where the drainage area is 366 square miles. The Avery 30-minute topographic quadrangle map made in 1914 shows the dam and reservoir site area but does not permit any accurate estimate of the required dam dimensions and reservoir capacity. The principal required relocations would be the forest service road that follows the St. Joe River and some campgrounds which occupy small bottomland areas.

The Avery site (12-4140+80) at mile 65.4, sec. 15, T. 45 N., R. 5 E., where the drainage area is 594 square miles, including 114 square miles contributed by the North Fork St. Joe River, would develop head between the water surface at the damsite of about 2,480 feet and the Prospector site tailrace altitude of about 2,800 feet. The Avery 30-minute topographic quadrangle map shows the dam and reservoir site area but estimation of dam and reservoir site sizes have not been made. The settlement of Avery is at the damsite suggested here, and relocation would be required of improvements there, of roads on the St. Joe and North Fork Rivers, and five miles of railroad on the North Fork.

The Fitzgerald Falls site (12-4145+20) at mile 35, sec. 24, T. 46 N., R. 1 E., where the St. Joe River has a drainage area of 1,098 square miles, would develop head between the water surface altitude of 2,150 feet and 2,480 feet by means of a dam about 1,800 feet long. Compared with other reservoir sites on the St. Joe River, the Fitzgerald Falls site is relatively spacious. Water would back about 30 miles up river and the bottomland valleys at the mouths of Fishhook, Slate, Black Prince, Big, Mica, Bear, and Trout Creeks would add to the storage capacity. The railway locations of Ethelton, Hoyt, Marble Creek, Erlmo, Herrick, and Calder are in the reservoir site. A surfaced road and the tracks of the Chicago, Milwaukie, St. Paul, and Pacific Railway follow the river throughout the reservoir site. The railway leaves the river at Avery, the backwater limit, and goes over St. Paul pass to the St. Regis River by way of the North Fork and Loop Creek.

Powersite No. 2 (12-4145+80) on the St. Maries River at mile 21.7, sec. 1, T. 44 N., R. 2 W., where the drainage area is 350 square miles would develop head between the water surface altitude of 2,520 feet and 2,900 feet. The dam would be about 2,500 feet long at the crest according to the Emida 1:62,500-scale topographic quadrangle map.

The St. Maries site No. 1 (12-4150) at mile 10.3, secs. 17 and 18, T. 45 N., R. 2 W., is on the St. Maries River about one mile downstream from Carlin Creek near the U. S. Geological Survey gaging station where the drainage area is 437 square miles. The water surface at the damsite is about 2,150 feet and a dam that would raise it to an altitude of 2,520 feet, the site No. 2 tailrace altitude, would have a crest length of about 1,400 feet plus an additional dike 700 feet long across a low saddle at the east end of the dam. The Chicago, Milwaukie, St. Paul, and Pacific Railway is in this reach of river and would constitute the principal relocation made necessary by the reservoir. The reservoir would be small in comparison to the height of dam, however, and a diversion-conduit type development might be preferable. The head could be developed by a five-mile conduit along the right bank of St. Maries River from a diversion dam 80 feet high in sec. 35, T. 45 N., R. 2 W. The conduit route includes a tunnel section about one mile long.

Spokane River

*** The Post Falls plant (12-4190) of the Washington Water Power Company at mile 102 utilizes water from a drainage area of 3,840 square miles. This is the most downstream development on the Spokane River in Idaho. The plant tailrace is at altitude 2,072 feet and forebay at altitude 2,128 feet. The reservoir has 225,000 acre-feet of usable storage capacity available for power production by slightly manipulating the water surface altitude in Coeur d'Alene Lake. The Post Falls plant was constructed in 1906, the first plant built by Washington Water Power Company in Idaho.

Snake River basin

The Snake River basin comprises about 108,500 square miles of mountains, foothills, and plains in the States of Wyoming, Idaho, Utah, Nevada, Oregon, and Washington. The river is more than 1,000 miles long and more than half of its length is in canyons. In Idaho the drainage area is about 72,700 square miles and the length of river channel is about 775 miles. The reach of river across Idaho between the Idaho-Wyoming and Idaho-Oregon boundaries flows alternately in deep narrow gorges and broad valleys where only shallow channels guide it. These combinations make practically complete utilization for irrigation possible without serious impairement to waterpower values. Continual increasing use of water for irrigation in southeastern Idaho appears to be increasing the low-water flow at points below King Hill. Forty-two reservoirs with a capacity of 5,000 acre-feet or more have been constructed in the Snake River basin within Idaho. Many of these reservoirs store water for irrigation only but an increasing number of them are being designed for other purposes too. Power and flood control features are now usually added to irrigation benefits and some reservoirs are built for power only.

In point of drainage area the Snake River is one of the larger rivers of the United States being exceeded, in the order named, only by the Missouri, Columbia excluding Snake River, Rio Grande, Colorado, Ohio, Arkansas, and the Mississippi above the Missouri. In point of mean flow the Snake exceeds the Arkansas, Colorado, and Rio Grande Rivers of those named above.

The river has its source on Two Ocean Plateau on the western slope of the Continental Divide near the northeast corner of Yellowstone National Park, Wyoming. According to the Two Ocean pass 1:62,500-scale topographic quadrangle map the main river is a perennial stream at an altitude of over 9,700 feet above sea level and the small lake at the head of tributary Plateau Creek is more than 10,000 feet in altitude. There are many small lakes on the plateau at altitudes greater than 9,000 feet, and Mariposa Lake on a tributary of Plateau Creek has a surface area of about 30 acres and lies at an altitude of approximately 9,000 feet.

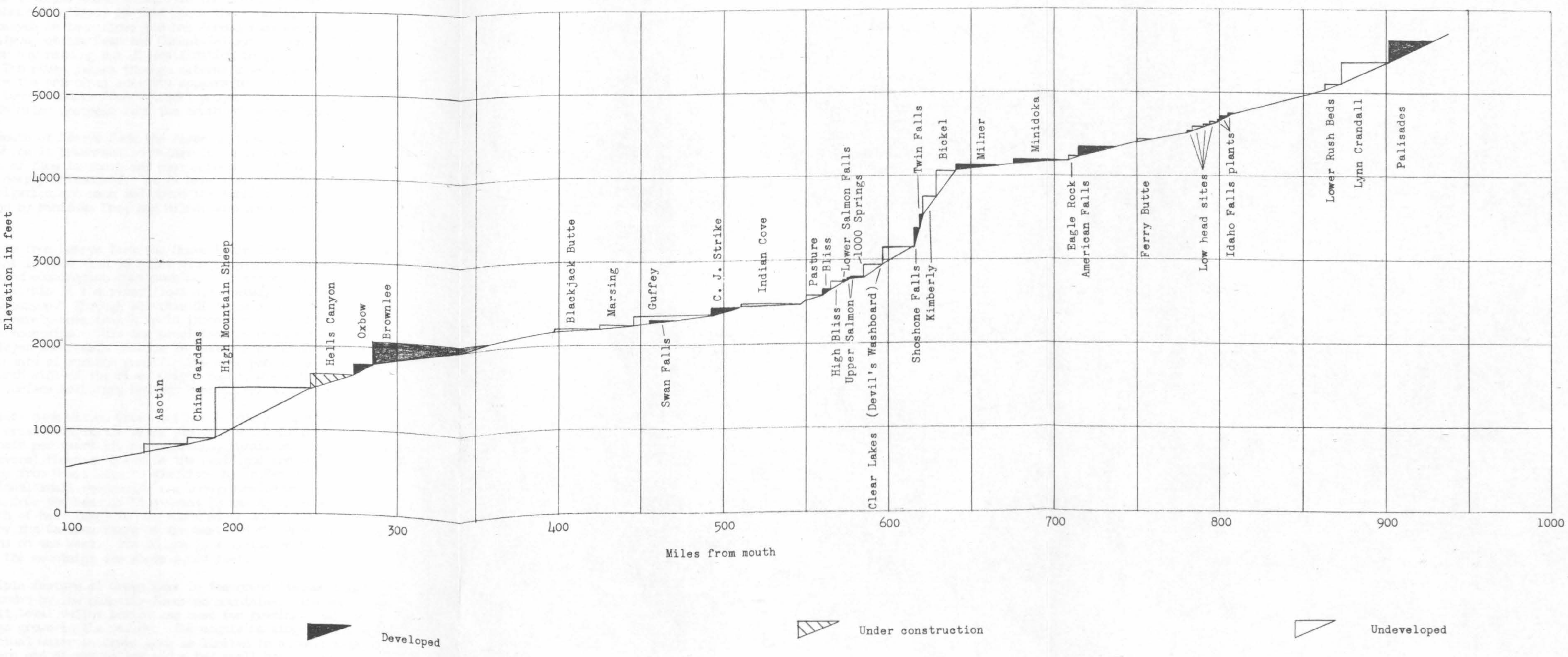


FIGURE 5.--PROFILE OF SNAKE RIVER SHOWING DEVELOPED AND UNDEVELOPED POWERSITES.

The river flows generally southwestward through Wyoming to the Idaho-Wyoming line near the mouths of the Grays and Salt Rivers. After entering Idaho it flows northwestward to the mouth of Henrys Fork, a distance of about 80 miles. In this reach the river has eroded a rather wide canyon in lava flows and has formed some exceptionally beautiful valleys notably Swan and Conant Valleys. Swan Valley is cultivated for hay raising but diversification to grain and potatoes is evident. The river passes through alternate valleys and canyon sections where the principal activity appears to be stock raising. The proposed Lynn Crandall (Burns Creek) project is in this reach of river about 34 miles upstream from the mouth of Henrys Fork.

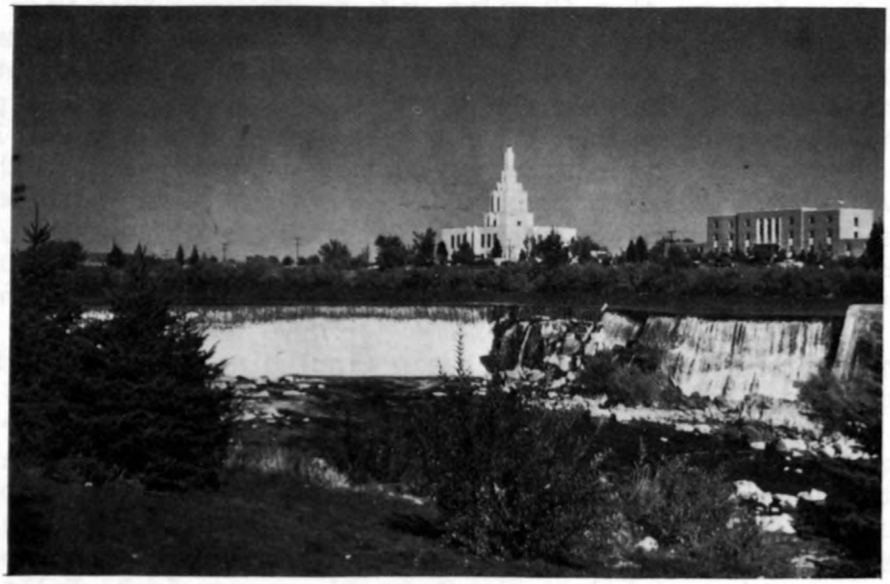
At the mouth of Henrys Fork the river is flowing on the Snake River plain which it traverses to Milner for a distance of 180 miles. The direction of flow is south and west across this plain and the river is not deeply entrenched. It is here that the principal diversions for irrigation are made and where the American Falls, Lake Walcott formed by Minidoka Dam, and Milner storage reservoirs are located.

Downstream from Henrys Fork the Snake River flows in an elongated depression that is more than 50 miles wide in places. This wide valley-benchland combination continues most of the way to the Idaho-Oregon line. Within it the river flows alternately in valley bottom and in narrow canyon. Through all this distance average annual precipitation is rarely more than 8 to 10 inches in the valley and 16 inches on the mountains. This low precipitation combined with the porous lava layer underneath combine to leave large areas with barely measurable amounts of surface runoff. The most porous lava fields are on the north side of the river (right bank), where there is not an important surface tributary between Henrys Fork and Boise River.

On the left bank Willow Creek basin (including Grays Lake) is one of these areas with little water yield. As dry as it is (.3 inches of runoff per year) it, nevertheless, furnishes water for irrigating several thousand acres in the basin and irrigation water has been taken from Grays Lake to Blackfoot Marsh Reservoir since 1924. Additional small reservoirs are under consideration. The basin extends from the head of Slug Creek in the Aspen Range (about 35 miles north of Bear Lake) to the Snake River near Idaho Falls. It is enclosed by the Caribou Range on the east and the Aspen and Blackfoot Mountains on the west. Its course is a little west of north. Altitudes in the mountains are above 8,000 feet.

A principle feature of Grays Lake is the round flat-bottomed valley surrounded by low scantily-forested mountains. The mountains and the almost level valley bottom are used for grazing. Hay and grain are also grown in the valley. The mountains slope gently northwestward. Actual water in Grays Lake is limited to a small section of the southern end of the valley and a few small bogs rimmed with bulrushes in its northwest end. The outlet stream has cut its way through a rolling sagebrush covered bench.

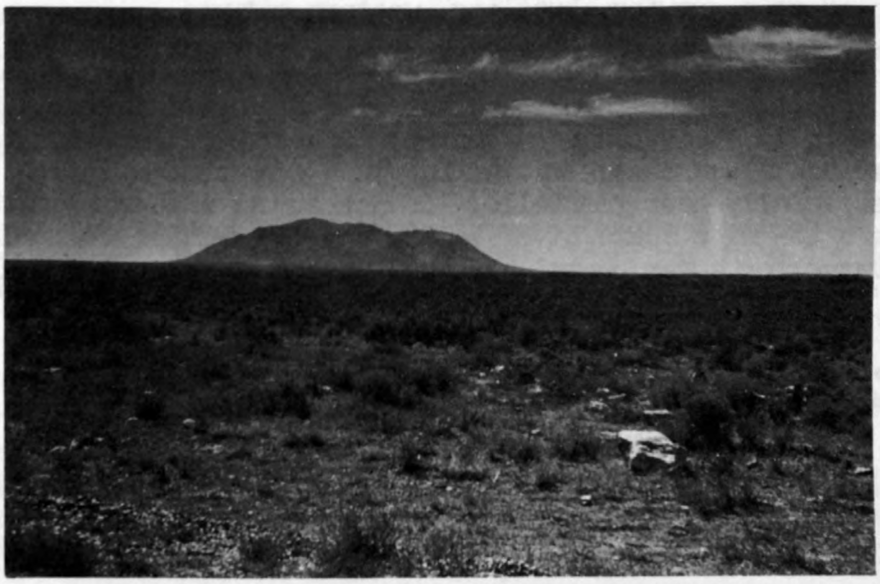
Entering Idaho Falls on Highway 20 and 191, the traveler passes through green fields on both sides of the road which exhibit a diversity of crops ranging from grain through hay, sugar beets, and potatoes. Idaho Falls provided both the reason and the beautiful setting for a settlement. The falls bring the Snake River to almost valley level and it was easy for early pioneers to divert water and to utilize it for irrigation and production of energy. These early uses have continued to the present. The city of Idaho Falls has three powerplants in or near the city which produce electricity for municipal purposes and canals divert water to farms on both sides of the river. Idaho Falls might well be called the "Queen City" of the Snake River basin. Its wide clean streets with ample shade, well-kept houses and yards, up-to-date functional churches and school buildings, and an excellent, well-groomed municipal golf course set a pattern for many other Snake River basin towns both upstream and downstream. Planted trees in towns and on farms are welcome sights because a principal feature of the primitive Snake River Valley between Wyoming and Oregon is the complete absence of trees. Sagebrush and cheat grass grow wherever soil has covered the lava.



Idaho Falls

Highway 91 and 191 between Idaho Falls and Blackfoot follows the Borderline between the cultivated and uncultivated portions of the Snake River Valley bottom. Today's value of a fat steer or lamb make even the uncultivated side of the road valuable real estate. About midway between Idaho Falls and Blackfoot the canals leading from the Snake River and those leading from the Blackfoot River intermingle to serve private and Indian lands on and near the Fort Hall Indian Reservation.

Between Idaho Falls and American Falls the Snake River flows generally near the valley level with no deep canyon entrenchment. The valley together with low benchlands extends for many miles on each side of the river. There is not enough water to irrigate all of this valley but a wide strip on each side of the river is cultivated. This was one of the early sugar beet producing regions and that crop together with the famous Idaho potatoes are much in evidence today. The highway is on the left bank (east side of the river). Looking westward across the river towards the Sawtooth Mountains, the cinder cones of the Craters of the Moon area may be seen. This is the vast wasteland into which Birch Creek, Little Lost, Big Lost, Little Wood and Big Wood Rivers empty and disappear. These streams are surely the source of the many springs issuing from the right bank of the canyon from Shoshone Falls to Malad (Wood) River and beyond.



Craters of the Moon area

The Blackfoot River is the most important stream entering the Snake in this reach. It is a left bank tributary with headwaters in Aspen Ridge, a ridge approximately parallel to the Idaho-Wyoming State line. The Blackfoot River has been controlled since 1909 by the Blackfoot Marsh Reservoir. The reservoir has a capacity of 300,000 acre-feet and could readily be enlarged. Its waters are used principally to serve Indian lands of the Fort Hall Indian Reservation.

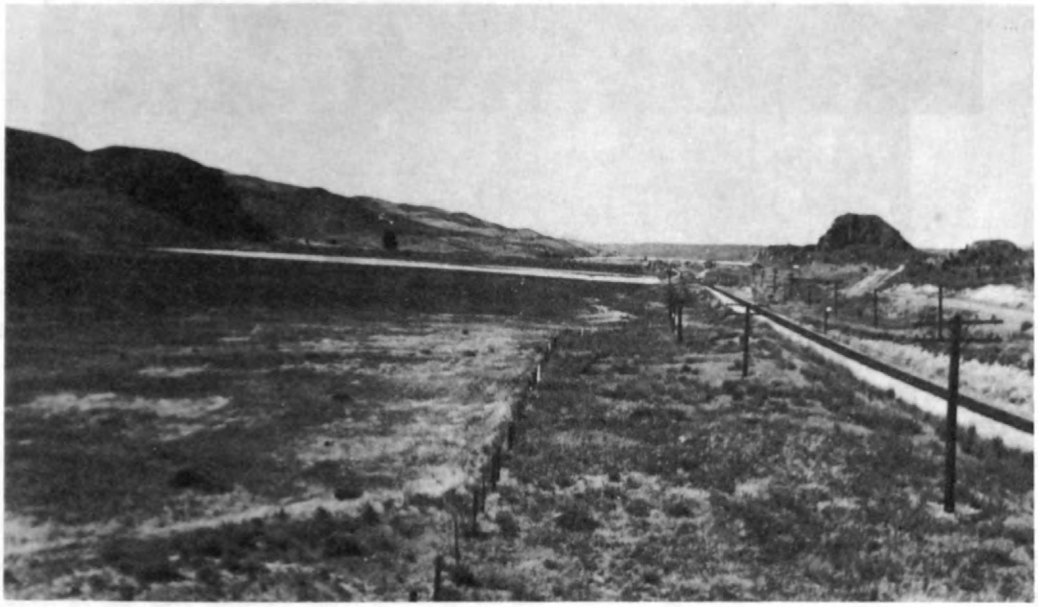
The Blackfoot River headwaters areas are characterized by brush-covered ridges and dry mountain valleys. The ridges are of volcanic origin and divide the area into large valleys, such as Dry Valley, Long Valley, and Blackfoot Marsh, in which the Blackfoot Marsh Reservoir is situated. Many, if not all, of these valleys are lake beds gone dry because more water leaks out than runs in, or because the retaining barrier has been washed away. Below the dam the Blackfoot River has cut a shallow but narrow channel through the lava flow by which it emptied Blackfoot Marsh in ancient times.

First settlement in this area was a trading post constructed by Nathaniel Wyeth in 1834. The trading post was sold to Hudson's Bay Company in 1838 and continued to be used by travelers along the Oregon and California trail until 1864.

Pocatello at the mouth of the Portneuf River is the most important city in southeastern Idaho. In addition to serving the agricultural area industrial plants generally associated with extraction and refining of minerals and manufacturing fertilizer are located here. It is the site of fast-growing Idaho State University. Evidences that Pocatello is an old town are seen; however, the principal impression is of a growing, bustling, western city.

Upstream from Pocatello the Portneuf River flows in quite narrow canyons which it has cut through basalt of fairly recent age. Portneuf Reservoir in the headwaters controls the stream there but there is considerable flood damage caused by flash-type floods in the lower reaches, especially near Pocatello. Downstream from Pocatello the river enters the wide Snake River Valley and the fertile bottomlands are cultivated for sugar beets, hay, and potatoes.

Some interesting prehistory is found in the Portneuf Basin. Its tributary, Marsh Creek, on one occasion at least, carried water from ancient Lake Bonneville to the Snake-Columbia system.



Looking down Marsh Creek from a point inside old Lake Bonneville near Red Rock Pass and Swan Lake, Idaho.

Lake Bonneville, believed to be contemporaneous with Wisconsin glaciation, formed its highest major terrace (the Bonneville Terrace) at an altitude of about 1,000 feet above the present level of Great Salt Lake. This terrace is evidence that the lake was at that stage for a long period then overflowed the basin rim into the Snake River by way of Marsh Creek at Red Rock Pass. Marsh Creek continued to drain the huge lake until it had fallen at least 400 feet below the Bonneville Terrace level and about 600 feet above the surface of the present Great Salt Lake. At this stage a resistant limestone retarded the cutting action of the stream and the lake became stable again. Remaining at the new altitude for a long period the lake formed the Provo Terrace (Pack 1939). The Bonneville and the Provo are the most prominent terraces left by the ancient lake and can be identified almost anywhere along the old shore lines.

Evidence of the earliest attempts to develop power on the Snake River may be seen at American Falls--the island station 1902 and 1908 and the west side station 1902-05. American Falls Dam was built in 1927 by the Bureau of Reclamation. The head in the falls below the present dam is utilized by the Idaho Power Company for power production. Plans for further development of the site include the utilization of the head created by the dam as well.

Raft River, the next left-bank tributary, has formed a depression approximately one mile wide in the Snake River bench and furnishes enough water to irrigate this bottomland for the purpose of raising hay.

The bench on both sides of the Raft River valley is dry and desolate and is covered with sagebrush and cheat grass. It is probably quite satisfactory for grazing. Even though the Snake seems large and is flowing in a shallow depression in this area, the barren bench is evidence that more water could be used if it were available.

Before the arrival of the irrigation farmer in the Snake River Valley, water was a rare commodity on the valley and benchlands for almost the entire distance across the State of Idaho. The Minidoka Dam and Diversion achieved in 1907-09 changed this, especially for the area around Twin Falls where a large bench is green with hay, sugar beets, fruit trees, and various cereal crops. The reservoir behind Minidoka Dam, Lake Walcott, has a capacity of 210,000 acre-feet. The farms are generally worked from Twin Falls or from surrounding settlements--at least that was the tradition in the past. Movement toward living on the farms seems to be underway at the present time, however, and beautiful, modern homes are often seen on the farms themselves. Good roads and abundant automobiles have largely counterbalanced the advantages of living within established communities.

The Snake River is completely diverted at Milner during some parts of the irrigation season. Return flow and springs build it back up almost immediately, however, and by the time it reaches Twin and Shoshone Falls there is sufficient water to produce power again. In fact, a modern development might be feasible upstream from Twin Falls.

Below Milner the river cuts into the lava and associated sedimentary rocks and continues westward and northward through the plain in a deep canyon that widens into fertile valleys at Hagerman, Glenns Ferry, and Grandview. Near Murphy the canyon widens again and the river follows the shallow channel across a valley that enlarges as the river is joined by the Owyhee, Boise, Malheur, Payette, and Weiser Rivers. Extensive irrigation is carried on in this area in both Idaho and Oregon, but the principal source of the irrigation water is above the named tributaries.

The Idaho Power Company has plants at both Twin and Shoshone Falls and that company together with the Bureau of Reclamation and Corps of Engineers are planning developments in the reach between Shoshone powerplants and Upper Salmon Falls. This reach of the river probably will be developed soon.

The next downstream left-bank tributary below Shoshone Falls is Salmon Falls Creek. Its waters have been used to irrigate benchlands for many years. The reservoir, Salmon Falls Creek Reservoir, was constructed in 1911 on the main stream and Cedar Creek Reservoir was placed in service in 1920. Both reservoirs were built by local irrigation companies.

Highway 30 returns to the Snake River bottom down Salmon Falls Creek. The valley bottom, while narrow, is cultivated wherever possible. It is a popular recreational area. The Idaho Power Company has developed powerplants at Upper Salmon Falls, Thousand Springs, and Lower Salmon Falls. The highway crosses the river at Thousand Springs and continues on the right bank.

Rows of closely-spaced and obviously old poplars are indicators that Hagerman was one of the first settlements of this reach of the Snake River. Springs issuing from the right canyon wall furnish readily accessible irrigation and domestic water for the Hagerman Valley. The Malad (Wood) River formed by the Big and Little Wood Rivers, enters the Snake River a few miles downstream from Hagerman. Large springs high on the canyon wall are tapped and carried to powerhouses along the lower reaches of the Malad (Wood) and the water is also used for irrigation. The fertility of the river bottom and easy access to irrigation water combine to make agricultural development very extensive both upstream and downstream from Hagerman. This agricultural use is the principal deterrent to development of a large reservoir in this reach of river such as has been considered at times at the High Bliss damsite.

After crossing the Malad (Wood) River the highway climbs out of the canyon onto the bench. The outer limits of the irrigated areas around Gooding can be seen from here. The highway continues on the bench for some distance and bypasses the recently modernized Bliss Plant of the Idaho Power Company.

A vast depression cuts the benchland near the Gooding County line and forces the road back to the river bottom which it reaches near King Hill. In its lower reaches the bottomland in the depression is cultivated for hay raising. The road follows the Snake River's right bank to Hammett. Small valley bottoms are cultivated. These bottoms widen considerably until there is a good-sized valley at Glenns Ferry. It appears that more land could be irrigated in this vicinity. A water resource development here would be at the King Hill, Glenns Ferry, Hammett, or Indian Cove potential dam and reservoir sites.

At Hammett a right-bank tributary has formed a fair-sized valley that is irrigated and cultivated for sugar beets, potatoes, and hay. From Hammett to Boise Highway 30 crosses a high bench north of the river. It bypasses the developed C. J. Strike and Swan Falls plants of Idaho Power Company. Bruneau River is a left-bank tributary of this reach of the Snake River. The Bruneau River furnishes irrigation water to benches along the river and near its mouth. The lower Bruneau is inundated by the backwaters from C. J. Strike.

Right-bank tributaries in this stretch are Bennett and Rattlesnake Creeks, both within the limits of the Mountain Home Project. They drain the dry side of the mountains which form the north rim of the Snake River Valley and do not produce much water. Small reservoirs are planned, however, to increase the effectiveness of such water as there is. The town of Mountain Home is experiencing a vigorous boom as a result of defense activities related to the missile base network.

The C. J. Strike plant in addition to furnishing water for power production provides storage and diversion works for irrigation water, according to Idaho Power Company, at no cost. Undeveloped sites are Guffey and Marsing. One of these will likely be developed if the exchange of ground water for Boise River water can be worked out with the irrigators.

The first Swan Falls powerplant was built in 1901, has been rebuilt several times, and needs modernizing again. Located in a deep canyon it makes a pretty picture.

In this reach the river has turned northwestward between the Sawtooth, on the right, and the Owyhee Mountains, on the left. Near Murphy, downstream from the Guffey damsite, the valley widens and the river reaches the Idaho-Oregon State boundary line in a vast bottomland area created by alluvial deposits from the Owyhee, Boise, Malheur, Payette, and Weiser Rivers.

Downstream from the Weiser and Burnt Rivers the Snake has cut its largest and deepest canyon, Hells Canyon, which becomes progressively deeper and rugged until it passes the Seven Devils Mountains area about 40 miles north of Weiser. In the remaining distance to Clarkston the canyon decreases in depth but not in ruggedness.

He-Devil Mountain, 5.4 air miles from the river, rises 9,393 feet above sea level, and on the Oregon side along Summit Ridge, Black Mountain, only two miles away, reaches an altitude of 6,862 feet. The river surface is about 1,360 feet above sea level making the canyon more than 8,000 feet deep on the Idaho bank and 5,500 feet deep on the Oregon side. Near the Hells Canyon damsite, Cliff Mountain, Idaho, is 7,384 feet above sea level and Barton Heights, Oregon, 3.6 miles away, is 5,743 feet in altitude. Hells Canyon dam now under construction in sec. 15, T. 22 N., R. 3 W., will be 320 feet high and only 994 feet long at the crest. The 500-foot dam originally planned for this site was to have been only 1,600 feet long at the crest. The canyon continues deep and wild as the river proceeds northward, and is still more than a mile deep between Dry Diggins Ridge (7,606 feet) and Hat Point, Oregon, 6,982 feet. The river is flowing at an altitude of 1,300 feet in this reach. The Powder, Imnaha, Salmon, and Grande Ronde Rivers join the Snake in this canyon without forming valleys of any appreciable size and the river is flowing in a canyon 4,000 feet deep downstream from the mouth of the Salmon River. North of the mouth of the Grande Ronde River the canyon depth and ruggedness moderates but is still 300 feet deep near the towns of Lewiston, Idaho, and Clarkston, Washington. A fair-sized valley has been formed at the mouth of the Clearwater River and a large area of tableland south of the Clearwater River indicates that the two streams occupied a larger valley in ancient times.

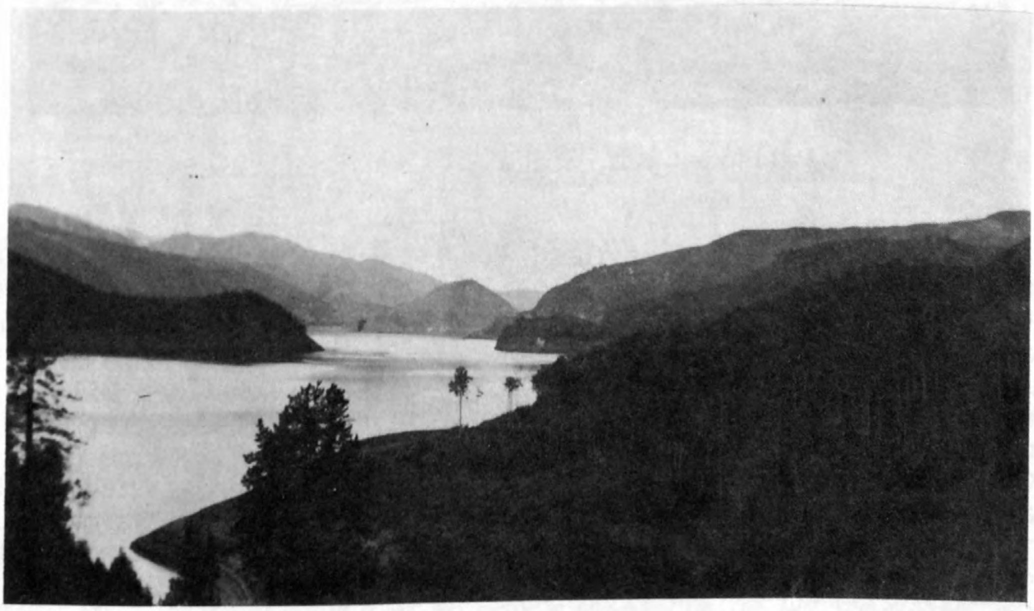
Below Clarkston the canyon narrows again and is more than 2,000 feet deep in places. At the Idaho-Wyoming boundary line the water surface of the river reaches an altitude of 5,620 feet above sea level in the Palisades Reservoir when it is full. At Clarkston on the Idaho-Washington boundary line the water surface of the river is about 715 feet. The total fall across the State is 4,905 feet in 780 miles, or about 6.3 feet per mile.

With the exception of the Anderson Ranch Powerplant on the South Fork Boise River (installed capacity 27 MW), all developed waterpower plants in Idaho with a capacity of more than 10,000 kilowatts are on or near the main stem of the Snake River. The early plants were small and used only part of the water flowing past them, whereas the modern ones have storage reservoirs and utilize all of the flow. The early plants include Swan Falls (1901), Shoshone Falls (1901-07), Oxbow (1908-14), and Thousand Springs (1912). The new larger plants are C. J. Strike (1952), Palisades (195 Brownlee (1958), and Oxbow (1961). A number of reaches of the river in the section between the Idaho-Wyoming, and Idaho-Oregon boundary lines remain undeveloped. The completed Brownlee and Oxbow dams and powerplants together with the Hells Canyon project now under construction and the High Mountain Sheep project, recently approved for a Federal Power Commission license, will almost complete the development of the reach of river forming the Idaho-Oregon boundary line. This is the section of the Snake River having the greatest waterpower potential per mile. The reach is 142 miles long and falls 1,162 feet (from altitude 2,077 feet at the Brownlee backwater limit near Weiser, Idaho, to altitude 915 feet at the tailwater of the proposed High Mountain Sheep dam near the mouth of the Salmon River). This reach of river has an average capacity of 1,540 kw per foot of fall.

Salmon River basin has the largest gross theoretical power potential of all Snake River tributaries and has the greatest potential of any single river in the State, exceeding even that of the Snake River. The Clearwater Basin is next and is followed, but not closely, by the Payette and Boise Basins.

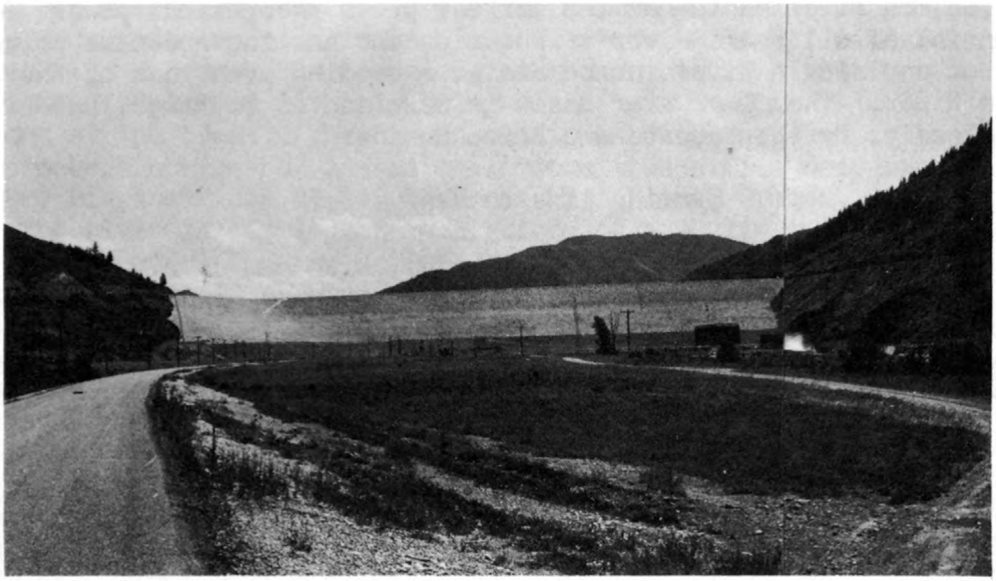
Wyoming line to Henrys Fork

The Palisades Reservoir (13-0324+50), with dam at river mile 901.6, sec. 17, T. 1 S., R. 45 E., where the Snake River has a drainage area of 5,208 square miles, was constructed primarily as a holdover facility to provide supplemental water for 650,000 acres of land. Most of the water is derived from above-average streamflow ***



Palisades Reservoir in September 1961

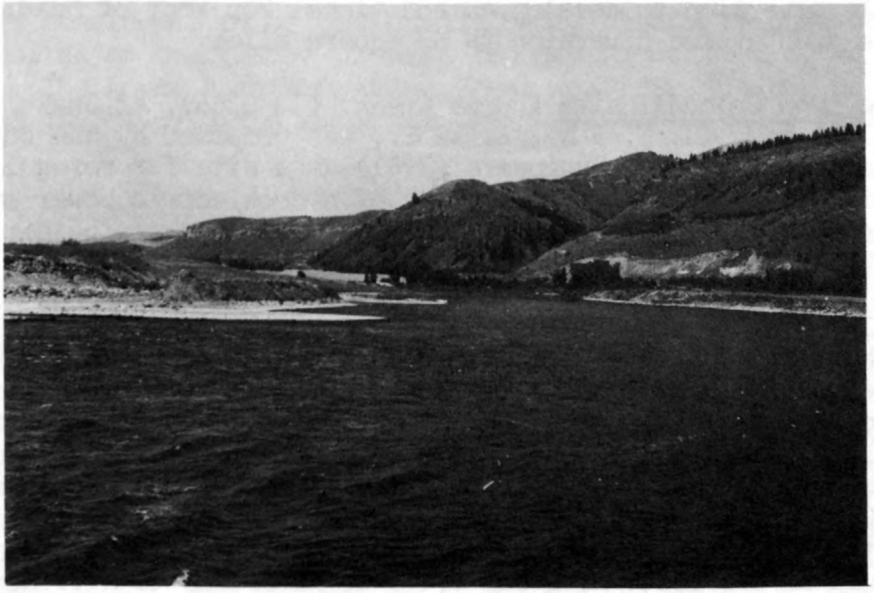
years and used in below-average years. About 135,000 acre-feet per year are obtained from reduction in winter diversions between Heise and Milner Dam (Bureau of Reclamation-Corps of Engineers 1961). Further integration of power systems would make it possible to increase the installations at Palisades so that almost all of the water passing the dam could be used for power production. Palisades Dam is an earthfill structure containing 13,800,000 cubic yards. It is 270 feet high and 2,100 feet long at the crest. The powerhouse contains four 28.5-MW generating sets. The full reservoir is at altitude 5,620 feet and the plant tailwater is at altitude 5,375 feet.



Palisades Dam, Snake R., Idaho, Aug. 1964

Palisades Creek joins the Snake River from the right bank about three miles downstream from Palisades Dam. The Palisades Lakes site (13-0330+10) would utilize Upper Palisades Lake as a storage basin and by diverting water from Corral Creek to it the drainage area above the diversion point would be increased to 42 square miles. A six-mile diversion from the lake would reach the Snake River in sec. 35, T. 1 N., R. 44 E., at the backwater limit from the Lynn Crandall (Burns Creek) site and develop head between altitudes 6,620 and 5,375 feet. Actual development on this creek might be made at the Lower Palisades Lake site (13-0330+20) by a dam about half a mile downstream from the lower lake's outlet. The gross head would be decreased by 400 or 500 feet depending upon the height of the dam below Lower Palisades Lake. The diversion and penstock route would be decreased, however, and this might make the project feasible in the future.

Palisades Dam USBR Photo



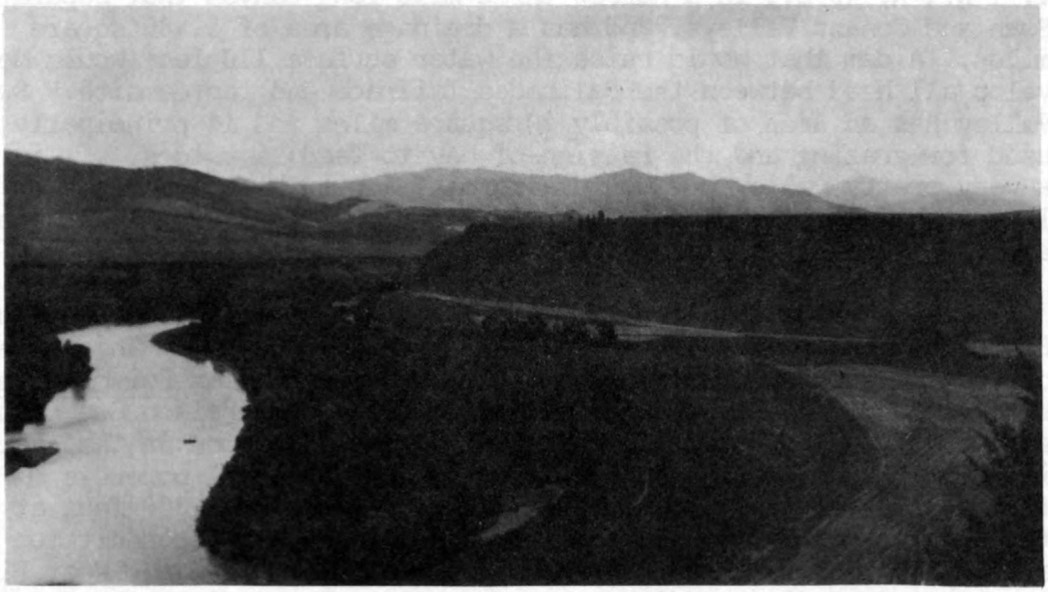
Snake R. looking downstream from Palisades Dam, Idaho, Aug. 1964

The Swan Valley damsite (13-0350) is at river mile 888, sec. 4, T. 1 N., R. 43 E., in a narrow three-mile long canyon that separates Swan and Conant Valleys, and has a drainage area of 5,486 square miles. A dam that would raise the water surface 110 feet would develop all head between the Palisades tailrace and the damsite. Swan Valley has an area of possibly 20 square miles and is principally used for grazing and the raising of hay to feed livestock. It is a very pretty valley but would also make a very beautiful lake. The potential power of this site is being considered for development at Lynn Crandall.

Pine Creek is the next downstream tributary. It joins the Snake River from the right bank in sec. 17, T. 2 N., R. 43 E. This creek offers two sites for developing upstream storage. The Poison Creek site (13-0350+10) has a damsite just upstream from Poison Creek in sec. 29, T. 3 N., R. 44 E. The water surface altitude at that point is about 5,900 feet above sea level and the potential power is measured by assuming a dam that would raise the water 300 feet at the damsite and develop 100 feet of head in a 1½-mile conduit to sec. 31 of the same township. To provide sufficient water West Pine Creek would be diverted into the reservoir. The drainage area is estimated to be 45 square miles.

The Lower Pine Creek site (13-0355) could be developed by a dam in sec. 12, T. 2 N., R. 43 E., at an altitude of about 5,700 feet that would raise the water 100 feet to the Poison Creek tailrace and a 1½-mile diversion to develop an additional 200 feet of head. The drainage area at the diversion is 63 square miles.

The Lynn Crandall site (Burns Creek) (13-0365), at Snake River mile 872.5, sec. 10, T. 3 N., R. 42 E., was proposed by the Bureau of Reclamation-Corps of Engineers (1961) as a site for reregulating the Palisades releases for production of hydroelectric power and for storage of irrigation water. The drainage area at the damsite is 5,659 square miles. The original plan, called Burns Creek, was to have provided 100,000 acre-feet of storage for use on lands presently under irrigation between Lynn Crandall damsite and Milner Dam. The total capacity of the reservoir would have been 234,000 acre-feet and the reservoir would have extended 18 miles upstream. This proposal has been turned down by Congress and a larger reservoir is now being studied that would back water the entire 32 miles upstream to the Palisades tailrace. Its capacity might be as much as 1,460,000 acre-feet. Presumably the powerplant would be much larger than the 90,000 kw recommended in the first study. Gross head would be 270 feet, altitude 5,375 at Palisades to altitude 5,105 at the damsite. The high dam is used to measure the potential power of the entire reach and includes other possible lower-head developments at Conant and Swan Valleys.



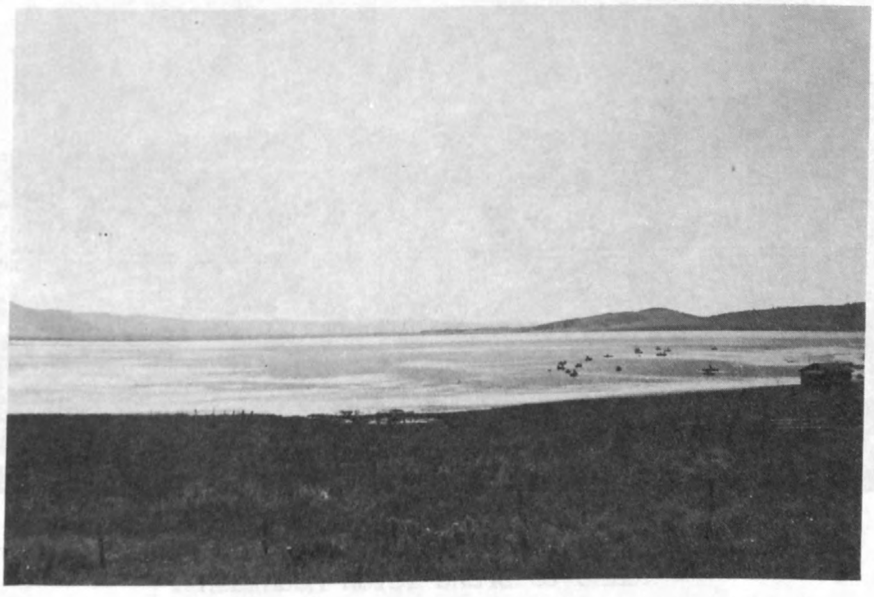
View of Snake River looking upstream from
U.S. highway 26 below Lynn Crandall site.

Lower Rush Beds site (13-0370+10) is at mile 862.8, sec. 8, T. 3 N., R. 41 E., and could develop 75 feet (altitudes 5,105 to 5,030 feet) of the 305 feet of fall between the Lynn Crandall site tailrace and the mouth of Henrys Fork. The remaining 230 feet of fall is considered to be technically undevelopable because of lack of damsites or topography suitable for developing head by other means. The Lower Rush Beds development would be by a dam near the head of the Riley ditch where the drainage area is 5,745 square miles.

Henrys Fork

Henrys Fork joins the Snake River from the right bank about 34 channel miles downstream from Burns Creek. Here the valley and the benches widen and are irrigated. Cultivation of potatoes and sugar beets begins to outstrip the acreage used for raising hay and grain.

The headwaters of Henrys Fork are on the Continental Divide in and west of Yellowstone National Park. Representative altitudes on the divide are Bald Mountain, 10,145 feet, and Mount Two Top 8,720 feet above sea level. Like the main Snake, Henrys Fork tributaries descend quickly into large valleys. The principal differences are that the Henrys Fork valleys are wider and the mountains are farther away and not so precipitous.



Henrys Lake, Henrys Fork

Large storage reservoirs now occupy parts of two of these valleys--Henrys Lake constructed in 1922 by the Consolidated Farmers, et al, and Island Park constructed in 1938 by the Bureau of Reclamation. The high mountain valleys (parks) are excellent grazing lands and are extensively used as summer range for cattle and sheep.

Buffalo River which joins Henrys Fork just downstream from Island Park Dam has a small developed powerplant which furnishes electricity for Ponds Lodge. Other waterpower developments in the area are the Ashton and St. Anthony plants of the Utah Power and Light Company on Henrys Fork and the Felt plant of the Falls River Rural Electric Company on the Teton River. No less than 50 potential water resource development sites have been investigated on Henrys Fork. The most promising small reservoir sites are on Moose, Sheep, and Sheridan Creeks, Buffalo River, Warm River, Robinson Creek, Falls River and Teton River.

Henrys Fork was one of the first of Idaho's streams to be used for irrigation. Additional regulation, especially of its tributaries, will make it possible to irrigate more land along Henrys Fork and downstream along the Snake.

Looking eastward across Teton Valley (Pierres Hole), Idaho to Grand Teton Mountains.

The Teton River and its tributaries drain the western slopes of the Grand Tetons. The river emerges quickly into Teton Valley and then drops over the successive wide benches left by the Snake River as it wore away the lava underlying a 100-mile-wide valley

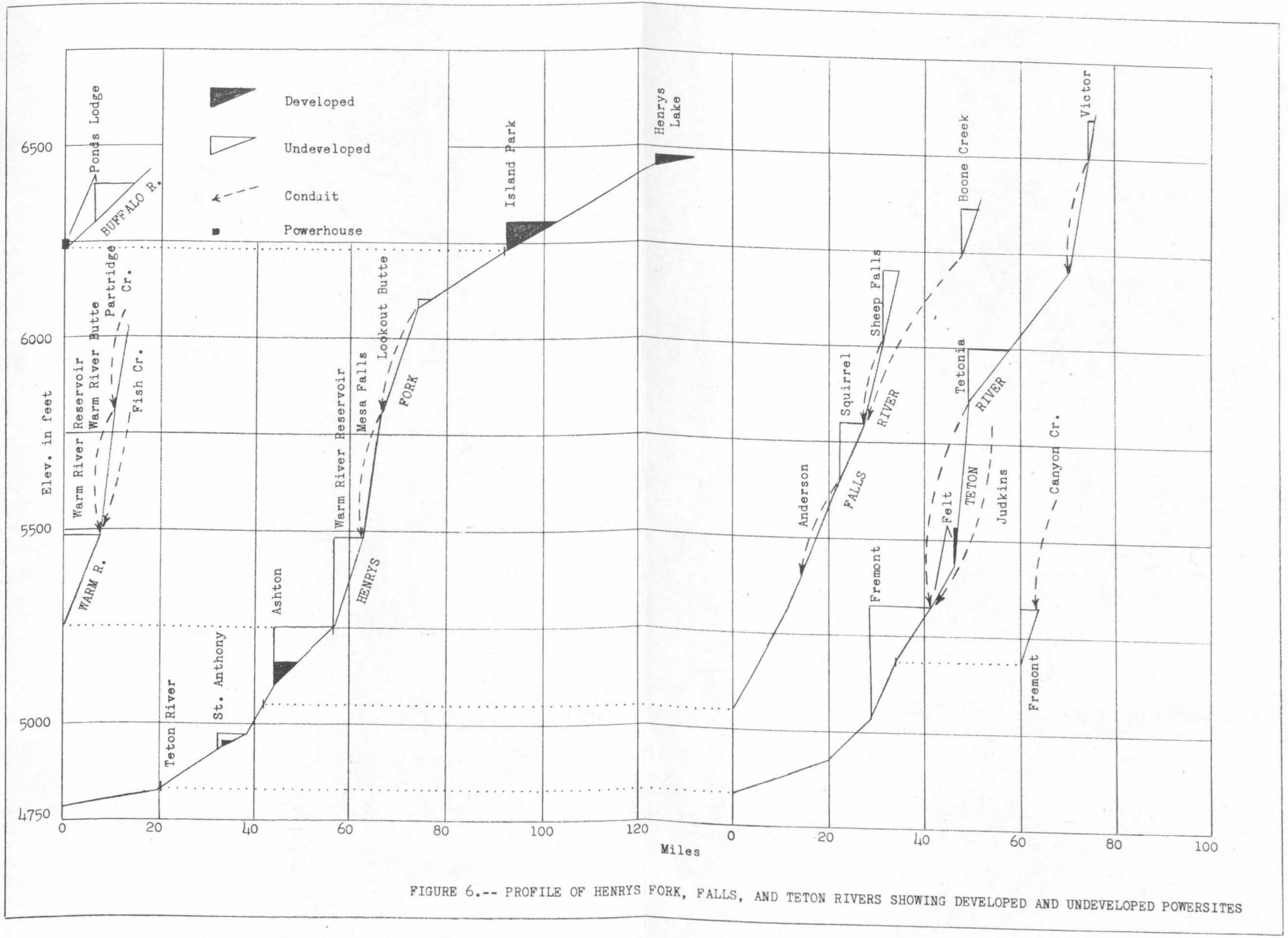
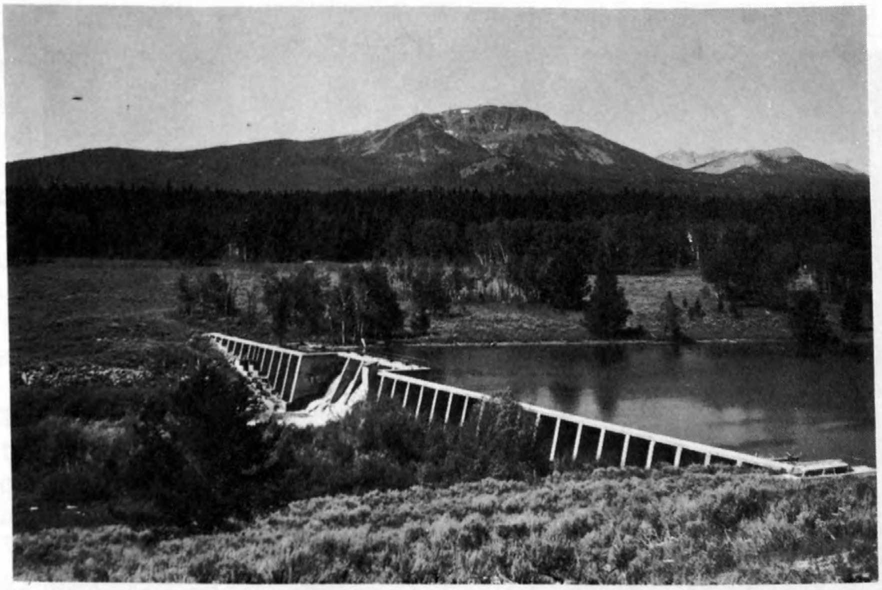


FIGURE 6.-- PROFILE OF HENRYS FORK, FALLS, AND TETON RIVERS SHOWING DEVELOPED AND UNDEVELOPED POWERSITES

lying between the Grand Tetons and Lost River Mountains. The river is used extensively for irrigation, especially in its lower reaches. The higher valleys and the benches are generally too high for crops other than hay and grain. There is not enough water for all tillable land. Fortunately, however, sufficient rainfall on the lower benches make them ideal for growing dry-land wheat and prosperous-looking wheat ranches are seen everywhere, practically all of them worked from the nearby towns.

Rexburg, one of the oldest farming settlements in the area, was established by Mormons in 1883. Earlier settlers were astonished to see how well the soil would produce when watered. Rexburg is situated on a gently sloping terrace of the South Fork Teton River near Henrys Fork and is an exceptionally beautiful town with green lawns and shade trees. It is the site of Rick's College established and supported by the LDS Church. In Rexburg the old, substantial dwellings and other buildings of the pioneers are seen side by side with the most ultra-modern buildings and residences.

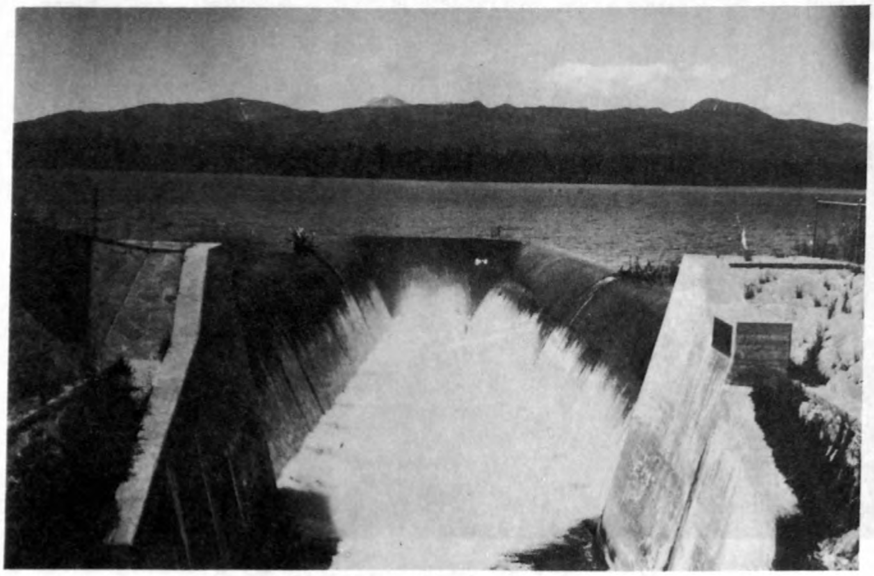


Henrys Lake Dam, Henrys Fork

<u>Henrys Lake</u> (13-0390) is formed by a low concrete-buttress dam at mile 124, sec. 26, T. 15 N., R. 43 E., where the drainage area is 98 square miles. Even though the dam raises the original lake level only 15 feet to altitude 6,472 feet, the reservoir stores 79,400 acre-feet of water for irrigation. The site has no power value except for storing water for downstream use. The reservoir controls the river completely, the average discharge there being only 34,000 acre-feet per year. Releases from the reservoir are held to very ***

small amounts, sometimes as low as 1 cfs, and the water is used for irrigation principally in July and August. During water year 1961, for example, 32,000 acre-feet was released, 23,800 acre-feet of it being utilized between July 1 and September 12.

*** Island Park (13-0420) is the largest constructed reservoir in the Henrys Fork basin. The dam at mile 93, sec. 28, T. 13 N., R. 43 E., where the drainage area is 481 square miles, contains 564,000 cubic yards of earth and rockfill. Its structural height is 91 feet and the length of the crest is 9,448 feet. The reservoir's capacity is 127,000 acre-feet between altitudes 6,239 and 6,302 feet for irrigation and flood control under the supervision of the Bureau of Reclamation. About 600 acre-feet of dead storage occupy altitudes 6,230 to 6,239 feet. The average discharge of the river at Island Park is 550 cfs (398,000 acre-feet). No waterpower is developed or contemplated in connection with this reservoir, but the releases are spread out over a longer period so that the site has a capacity of 2.78 MW for 50 percent of the time, and, conceivably, power for pumping water for irrigation could be developed at the dam if desired. The dam was constructed in 1938 by the Bureau of Reclamation.



Island Park Reservoir, Henrys Fork
from spillway, July 9, 1959

*** Ponds Lodge Plant (13-0425+90) is at the mouth of Buffalo River (mile 92.6 of Henrys Fork), sec. 33, T. 13 N., R. 43 E., where the drainage area is about 35 square miles. The plant is licensed as Federal Power Project No. 1413 and supplies light and energy for Ponds Lodge, a resort hotel-motel near Island Park Reservoir. According to the drawings that accompanied the application for a license, head is developed between altitudes of about 6,255 and 6,225 feet by a rock-crib dam and a short conduit. Buffalo River discharge at the site is quite constant. Island Park 7½-minute quadrangle map indicates that the terrain is not suitable for adding more head at the present site by a higher dam or a longer conduit. The redevelopment possibility shown is at a damsite at about river mile 6, sec. 20, T. 13 N., R. 44 E. A dam there that would raise the river surface from its present altitude of about 6,300 feet to an altitude of 6,400 feet would be between 1,350 and 1,400 feet long at the crest and the reservoir formed would have a capacity of 17,000 acre-feet. Split Creek could be diverted to Buffalo River basin by a tunnel about half a mile long that would begin and end in sec. 35, T. 13 N., R. 44 E. Split Creek water would reach the reservoir site in a tributary of Chick Creek. With Split Creek added the drainage area at the damsite would be 46 square miles (14 from Buffalo River and 32 from Split Creek) which, it is estimated, would furnish the same amount of water as that estimated for Buffalo River at the developed Ponds Lodge Plant.

Downstream from the mouth of Buffalo River, Henrys Fork flows leisurely in a broad valley for six or seven miles and a waterpower development either by reservoir or by conduit seems quite unlikely in the reach. An offstream lake, Swan Lake, marks the downstream end of the valley and the beginning of a reach of river which falls rapidly in a lava-walled canyon, a reach which might be developed by conduit along the left bank canyon rim at an altitude of about 6,100 feet. A diversion dam in sec. 13, T. 11 N., R. 42 E., where the drainage area is 580 square miles and the water surface altitude is about 6,080 feet, that would raise the water to the 6,100-foot altitude and a conduit about seven miles long on either river bank would reach the <u>Lookout Butte powerhouse site</u> (13-0435+50) in sec. 9, T. 10 N., R. 43 E., where a tailrace altitude of 5,800 feet is estimated.

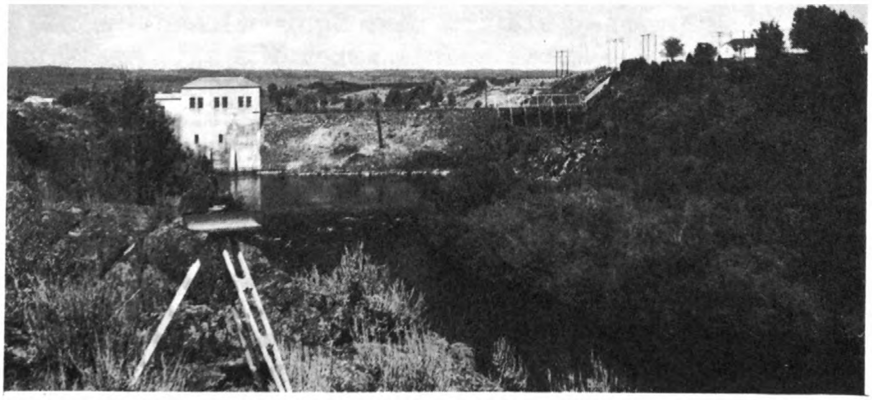
The <u>Mesa Falls site</u> (13-0435+90) would require rediversion of the stream below the Lookout Butte plant where the drainage area is 630 square miles. Head development would be between altitudes 5,800 feet and 5,480 feet in a three-mile long conduit to a powerhouse site in sec. 24, T. 10 N., R. 43 E. The Bureau of Reclamation-Corps of Engineers investigators considered a diversion dam, penstock, 15,000 kw powerplant, and fish protection facilities (Bureau of Reclamation-Corps of Engineers, 1961, p. 7-23).

Warm River is a left-bank tributary to Henrys Fork that gets a large amount of its discharge from springs along the eastern edge of the Henrys Fork Valley. The <u>Partridge Creek site</u> (13-0440+50) with a powerhouse site in sec. 33, T. 11 N., R. 44 E., (mile 10) on Warm River might be developed by a three-mile diversion and conduit from a drainage area of 120 square miles above altitude 6,070 feet. A diversion dam below Partridge Creek would raise the water about 25 feet. Warm River could be rediverted at the Partridge Creek site tailrace altitude of 5,800 feet, drainage area 140 square miles, and carried about 6 miles to a powerhouse site near Warm River Butte (13-0440+70), sec. 32, T. 10 N., R. 44 E. (mile 4). The water surface altitude is 5,480 feet at the powerhouse site, the altitude of the Warm River reservoir site backwater. The Warm River Butte powerhouse could also house the turbines and generators for the Fish Creek powersite (13-0450+30) or a separate location in sec. 8, T. 9 N., R. 44 E., might be used. To get enough water for the Fish Creek site, it would be necessary to divert by means of 10 or 15 miles of conduit from Fish, Snow, Robinson, and Rock Creeks at an altitude of about 5,800 feet. A drainage area of 82 square miles would be available.

Warm River damsite (13-0455+70) is at mile 56.9, sec. 14, T. 9 N., R. 43 E., on Henrys Fork approximately a quarter of a mile downstream from the mouth of Warm River where the drainage area is 963 square miles and at a water surface altitude of 5,250 feet. The canyon is about 700 feet wide at the bottom and rises abruptly. A rockfill dam 265 feet in height and 1,600 feet in length at the crest (altitude 5,485 feet) has been suggested (Bureau of Reclamation-Corps of Engineers, 1961, p. 7-25). Water raised 230 feet would back about 10 miles upstream to the Falls site tailrace. The reservoir would cover 1,600 acres of land in the Targhee National Forest presently used for recreation, grazing, and timber production. Nine miles of newly constructed highway, seven miles of Union Pacific Railroad line, and a forest camp would have to be relocated. The project would be operated in conjunction with downstream projects for pumping irrigation water.

Utah Power and Light Company has maintained a plant at the *** Ashton site (13-0460) on Henrys Fork since 1917. The river is raised by an earth and rockfill dam 226 feet long and 60 feet high at mile 44, sec. 28, T. 9 N., R. 42 E., drainage area 1,040 square miles. An 82-foot long spillway controlled by six 10-foot Taintor gates, a reservoir with 404 acres of surface area at elevation 5,156.6 feet, a concrete powerhouse containing three hydroelectric units rated at 5,800 kw complete the present installation. It is understood that the company is again modernizing this development and that the dam will be increased in height. The potential power of the site is measured by assuming a reservoir high enough to create 150 feet of gross head between altitudes 5,100 and 5,250 feet. The **proposed plan for redeveloping this site** would increase the head by 50 feet (Bureau of Reclamation-Corps of Engineers, 1961, p. 7-28).

Falls River, another left-bank tributary, is near Henrys Fork in the vicinity of Ashton but does not actually join it until both streams have meandered 10 or 12 miles across the valley that begins near the mouth of Warm River. Falls River and its tributaries drain the southwestern corner of Yellowstone National Park and adjacent parts of Idaho and Wyoming. The highest altitudes in the basin are in the Park. Pitchstone Plateau has an altitude of 8,977 feet and



Ashton Dam & Powerplant, Henrys Fork, Idaho, 8/24/64

Madison Plateau on the Continental Divide has an altitude of more than 8,600 feet. In addition to the sites listed there are a few small powersites in the Park and in Wyoming.

The Sheep Falls site (13-0470+50) on the Falls River is the first site entirely inside Idaho. It would require a 200-foot dam in sec. 17, T. 9 N., R. 46 E., drainage area 270 square miles, and a four-mile diversion to a powerhouse site at mile 27, sec. 27, T. 9 N., R. 45 E. to develop 400 feet of head between altitudes 6,200 and 5,800 feet.

The Boone Creek site (13-0470+60) would require a dam on Boone Creek in sec. 30, T. 9 N., R. 46 E., that would raise the water 120 feet (altitude 6,240 feet to altitudes 6,360 feet) and a 2½-mile conduit, possibly to the Sheep Falls powerhouse site at the back-water limit of the Squirrel site on the Falls River. This combined powerhouse site is in sec. 27, T. 9 N., R. 45 E. The drainage area is 40 square miles.

The Squirrel site (13-0475 could be developed entirely by a dam with connecting powerplant on the Falls River at mile 22, sec. 36, T. 9 N., R. 44 E., drainage area 348 square miles. Head development would be between altitudes 5,660 and 5,800 feet, and the dam would be about 1,500 feet long. The damsite is downstream from the existing Marysville canal head. This would limit drawdown in the reservoir to an altitude of about 5,750 feet (a 50-foot drawdown) or water would have to be pumped into the canal during the irrigation season if the reservoir were drawn below that altitude. Only a limited amount of water would be available for power production during the irrigation season unless storage to compensate for it is provided.

The Anderson site (13-0475+10) would divert the Falls River at the Squirrel site tailrace altitude of 5,660 feet and in a six-mile long conduit develop as much as 260 feet of head at a powerhouse site at mile 14, sec. 35, T. 9 N., R. 43 E., drainage area 348 square miles. Computations for the site are based on the existing flow of the stream at the gaging station near Squirrel and include water diverted in Marysville canal. This makes the site quite unlikely of development as the diversions may amount to one-third of the annual runoff. The development might be feasible, however, if upstream storage sites of sufficient capacity are developed.

Conant Creek, which drains about 100 square miles, joins the Falls River from its left bank about seven miles northeast of St. Anthony. The headwaters are on the northwest end of the Grand Teton Mountains where altitudes are near 9,000 feet above sea level. Irrigation requirements probably would eliminate power development on Conant Creek.

*** The Utah Power and Light Company has a plant at St. Anthony (13-0505) with an installed capacity of 500 kw. Water is diverted at a small fall at mile 33.2, drainage area 1,770 square miles, within the St. Anthony city limits and is carried a short distance along the right bank to the powerhouse site which is also within the city limits in sec. 1, T. 7 N., R. 40 E. Head for the existing plant is only 10 or 15 feet. An enlarged development of this plant has been assumed. A head of 40 feet might be developed by raising the water 20 feet at the falls, altitudes 4,970 to 4,930 feet, and carrying it 3,000 feet in a pressure pipe. This would make it possible to install 4,000 or 5,000 kilowatts.

The Teton River has a drainage area of approximately 890 square miles at a gaging station near St. Anthony. The average altitude of the basin upstream from the gage is 7,000 feet above mean sea level. Existing maps show the river having two forks flowing into Henrys Fork--the North Fork joining Henrys Fork about 10 miles southwest, and the South Fork about 15 miles southwest of the gaging station. These forks drain an estimated additional 60 square miles, all of it on the cultivated valley floor.

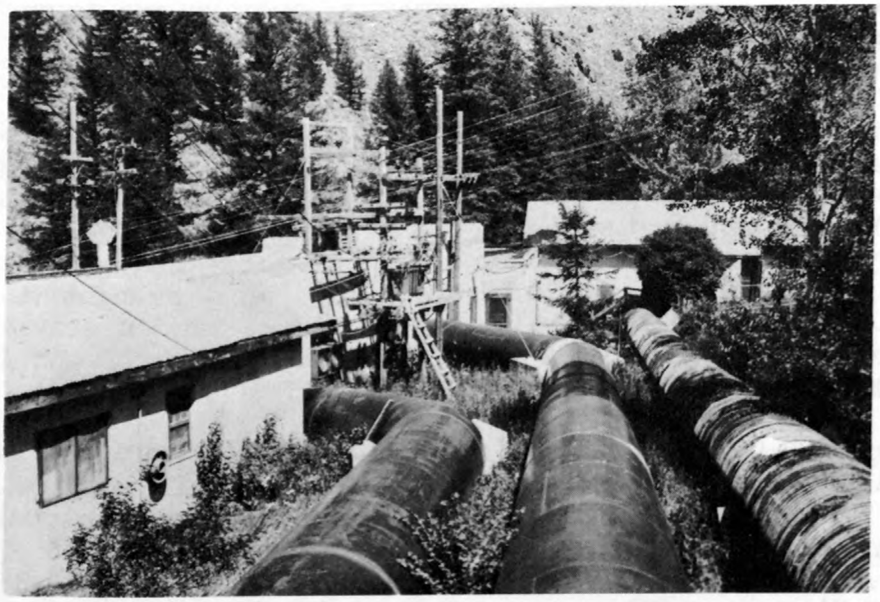
In its headwaters area the Teton River basin is made up of the North Fork Teton River, Badger Creek, Teton Creek, Darby Creek, Fox Creek, Game Creek, Moose Creek, and Teton River, listed from north to south. These streams drain the west side of the Teton Mountains including Dry Ridge Mountain (10,317 feet), Green Lakes Mountain (10,263 feet), Littles Peak (10,710 feet), Table Mountain (11,101 feet), Middle Teton (12,798 feet), Buck Mountain (11,923 feet), Mount Meek (10,677 feet), Mount Bannon (10,960 feet), Fossil Mountain

(10,912), and Housetop Mountain (10,533 feet). Mt. Moran (12,594 feet), Grand Teton (13,766 feet), and South Teton (12,505 feet) are east of the divide. The streams descend rapidly to Teton Valley (Pierre's Hole) which has bottom altitudes varying between 5,900 and 6,300 feet above sea leve. Six powersites were chosen to estimate the gross theoretical potential power of the Teton River basin.

The Victor site (13-0510+50) is the most upstream of these sites. A dam 120 feet high in sec. 30, T. 3 N., R. 46 E., where the water surface altitude is 6,480 feet, and a four-mile diversion to the powerhouse site in sec. 1, T. 3 N., R. 45 E., would be necessary to develop 400 feet of head between altitudes 6,600 and 6,200 feet. By picking up Moose and Game Creeks a total drainage area of about 60 square miles would be available. This arrangement leaves 150 feet of fall undevelopable because of lack of suitable drop sites. Maps of the area are old and exact altitudes and dam dimensions cannot be ascertained.

The Teton Creek dam (13-0512), is the major feature proposed in the Alta project of the Bureau of Reclamation. The damsite is in sec. 24, T. 44 N., R. 118 W., where the water surface altitude of Teton Creek is about 6,844 feet. The drainage area is 33 square miles. A dam that would raise the water to an altitude of 6,924 feet would have a crest length of about 1,250 feet and would require a short auxiliary dam in a saddle south of the main structure. The reservoir formed would have a capacity of 7,000 acre-feet at normal pool (6,916 feet). The lands to be irrigated are in the Teton Creek Valley on both sides of the Idaho-Wyoming boundary line and total 6,480 acres of which 490 acres are not presently irrigated. Three damsites were investigated and the upstream one chosen because of geologic and topographic superiority. Losses by seepage of about 25 cfs are estimated for the site as against losses up to 50 cfs at downstream sites in glacial outwash and glacial moraine. This would be a multiple purpose project, especially enhancing the recreational value of a scout camp and benefiting fish life by screening the irrigation ditches to offset losses caused by reduction of spawning area. The natural seepage through the reservoir would tend to increase low flows. Since it would be impractical to operate the reservoir on a forecast basis, there would be no winter flows available for power production and no power facilities have been included in the plan.

The Tetonia site (13-0540+10) with damsite at mile 49 on the Teton River, sec. 3, T. 6 N., R. 44 E., is a modification of an old Bureau of Reclamation proposal for the Driggs reservoir. A dam to raise the water surface from its present altitude of about 5,860 feet to altitude 6,000 feet would back water about 19 miles upstream and flood a large acreage of marshland in the Teton Valley. Low-head pumps could lift the water from the reservoir to hay and grasslands which border the reservoir site. The powerhouse would be at the dam where the drainage area is 475 square miles.

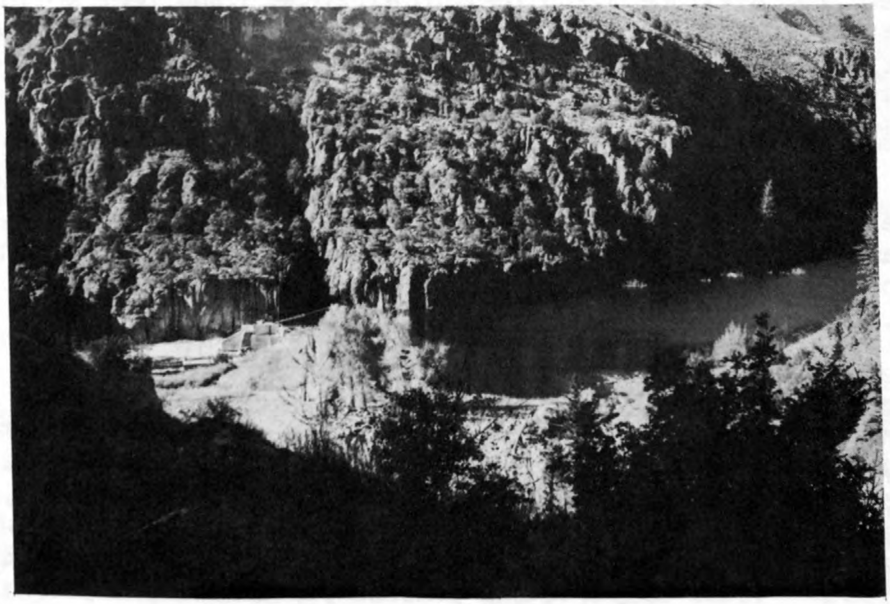


Felt Powerplant, Teton River, August 1964

*** The Felt Plant (13-0540+20) is located at mile 46, sec. 29, T. 7 N., R. 44 E. The Teton Valley Power and Light Company constructed this plant in 1921 and it is now operated by Fall River Rural Electric Association. The potential power of the Felt site is measured by assuming that a diversion will be made at the tailrace of the Tetonia site, altitude 5,860 feet, sec. 3, T. 6 N., R. 44 E., and the water carried by conduit along the left bank of the Teton River to a powerhouse site at the backwater limit from the Fremont reservoir, mile 43, sec. 19, T. 7 N., R. 44 E., about one mile downstream from the mouth of North Fork at elevation 5,325 feet. About half of the diversion might be through tunnels.

The Felt powerhouse site at the Fremont reservoir backwater limit might also be used to house the turbines and generators for the Judkins site (13-0542+20). This site would develop 103 square miles of the North Fork Teton River by a diversion at an altitude of about 5,800 feet in sec. 18, T. 7 N., R. 45 E. (mile 6.5 approximately), and water from 53 square miles of Badger Creek turned into the North Fork or added to the diversion canal, making a total drainage area of 156 square miles. Better maps, and more investigation, are necessary to determine whether all of the head between altitudes 5,800 and 5,325 feet may be developed by a high dam or whether a conduit-type development would be necessary. In either case the reservoir or the diversion altitude are at a point upstream from the existing Felt Plant.

Lindermans Dam (13-0542+40) is located on Teton River at mile 37.5, sec. 16, T. 7 N., R. 43 E., where the drainage area is about 700 square miles. This is an interesting waterpower development constructed by Shayne Linderman in 1960. The dam is a concrete buttress type structure with removable flashboards. The forebay is at altitude 5,159 feet and the tailrace at altitude 5,143 feet. The turbine operates mechanical pumps to lift water for the Linderman ranch where it is used for drinking, stock watering, and primarily for potatoes and alfalfa situated 500 or 600 feet above the streambed. The dam will be flooded by the proposed Fremont reservoir.



Lindermans Dam, Teton River

The Canyon Creek site (13-0542+50) would have a powerhouse site at mile 3.2 on Canyon Creek, sec. 1, T. 6 N., R. 42 E. A 200-foot-high dam, raising the water to altitude 6,000 feet, and a six-mile long diversion to altitude 5,325 feet, the backwater of the Fremont reservoir site, would develop the 675 feet of gross head. The drainage area is 68 square miles. The water available and the duration of discharge cannot be accurately estimated, however, because the Canyon Creek and Teton River drainage basins are somewhat different.

The Bureau of Reclamation is now studying the Fremont project (13-0542+60) which will have a dam at mile 28.4 on the Teton River, sec. 30, T. 7 N., R. 42 E., drainage area 853 square miles. The plan of development includes the Fremont dam, powerplant, irrigation facilities, and related works. The Bureau has found the project feasible and has made a preliminary report on it entitled "Teton

Basin Project, Lower Teton Division, Idaho, March 1962". The Bureau's plan calls for a dam that would raise the water surface 295 feet, altitude 5,030 feet to 5,325 feet, creating a reservoir of 315,000 acre-feet capacity. The dam is planned as an earth and gravel fill 300 feet high and 2,800 feet long with the crest at altitude 5,330 feet. The powerplant would have a capacity of 22,000 kilowatts and would furnish power for pumping and for sale in the amount of 75,500,000 kilowatthours annually. Project authorized Sept. 7, 1964.

The Moody site (13-0550+10) at mile 10 on Moody Creek, sec. 3, T. 5 N., R. 41 E., might be a desirable storage reservoir, but it does not have sufficient power to be included in the inventory. The drainage area is 61 square miles. A dam that would raise the water from altitude 5,200 feet to altitude 5,300 feet would create a reservoir with a capacity to store 8,600 acre-feet of water. The reservoir would be very beneficial to the existing irrigation system and might also serve other purposes such as recreation and conservation.

The following tabulations compare the gross theoretical waterpower of the Teton River, and of Henrys Fork including Teton River by area equated to the tailrace altitudes 4,970 and 4,800 feet, respectively, with the amounts of actual sites.

Teton River (avg head 2,080)

Duration	cfs	Gross MW by area	Gross MW by site	Percent
Q95	283*	50	19	
Q50	498*	88	35	
Qmean	750	133	52	
Mean/sq mi	.84	.149	.058	39

Henrys Fork (avg. head 1,850)

Duration	cfs	Gross MW by area	Gross MW by site	Percent
Q95	1,012*	159	86	
Q50	2,153*	339	148	
Qmean	2,950+	464	209	
Mean/sq mi	1.0	.157	.071	45

*Computed weighted discharge rates
+ 1 cfs/sq mi estimated runoff

Henrys Fork to Oregon Line

Grays Lake Basin to Blackfoot River

The Willow Creek-Grays Lake Basin is a left-bank tributary to the Snake River immediately downstream and opposite from Henrys Fork. Even though runoff is only about 0.34 inches per year, enough water is available to irrigate several thousand acres of land for raising hay and assorted other crops. A small amount of water is diverted from Grays Lake to the Blackfoot River by the Bureau of Indian Affairs. Two reservoir sites have been considered for storing water to improve its value for irrigation. Both these sites have small potential power capabilities.

The Tex Creek site (13-0580+10) with damsite at mile 16.3 on Willow Creek, sec. 3, T. 1 N., R. 40 E., drainage area 556 square miles, would develop head between altitudes 5,500 and 5,175 feet by means of a dam. The Hell Creek 1:62,500-scale topographic quadrangle map shows that the dam would have a crest length of about 1,750 feet. The low and undependable streamflow at the site makes its feasibility doubtful.

The Ririe damsite (13-0580+20) is on Willow Creek at about mile 9, sec. 3, T. 2 N., R. 40 E., where the drainage area is 618 square miles. The Corps of Engineers has been authorized to construct this site for storage irrigation water and other purposes but does not contemplate any waterpower development. According to the plan the tailwater altitude would be 4,995 feet and the dam would have a crest elevation of 5,183 feet with a normal pool at 5,175 feet. The damsite is in a canyon with steeply sloping sidewalls so that a dam with a crest length of about 580 feet will suffice. The geologic stratigraphic units at the site are rhyolites, sediments, basalt, and rhyolite tuff. Runoff varies upwards from a minimum of about 2,100 acre-feet per year (Bureau of Reclamation-Corps of Engineers, 1961, p. 7-48).

The Snake River passes over a series of falls and rapids at Idaho Falls where the city operates three powerplants. Idaho Falls Upper No. 2 (13-0595+10) is at mile 804.7, sec. 36, T. 3 N., R. 37 E., where the drainage area is estimated to be 9,750 square miles. The plant forebay has pondage storage only and the 21-foot head is between altitudes 4,736 and 4,715 feet, or 4,735 and 4,714 feet. ***

Idaho Falls City Lower No. 1 plant (13-0595+20) is at mile 799.9, sec. 24, T. 2 N., R. 37 E., where the drainage area is about 9,760 square miles. Head is developed between altitudes 4,694 and 4,672 feet. A potential alternative site assumes a development between altitudes 4,715 feet, Upper No. 2 tailrace, and altitude 4,672 feet. ***

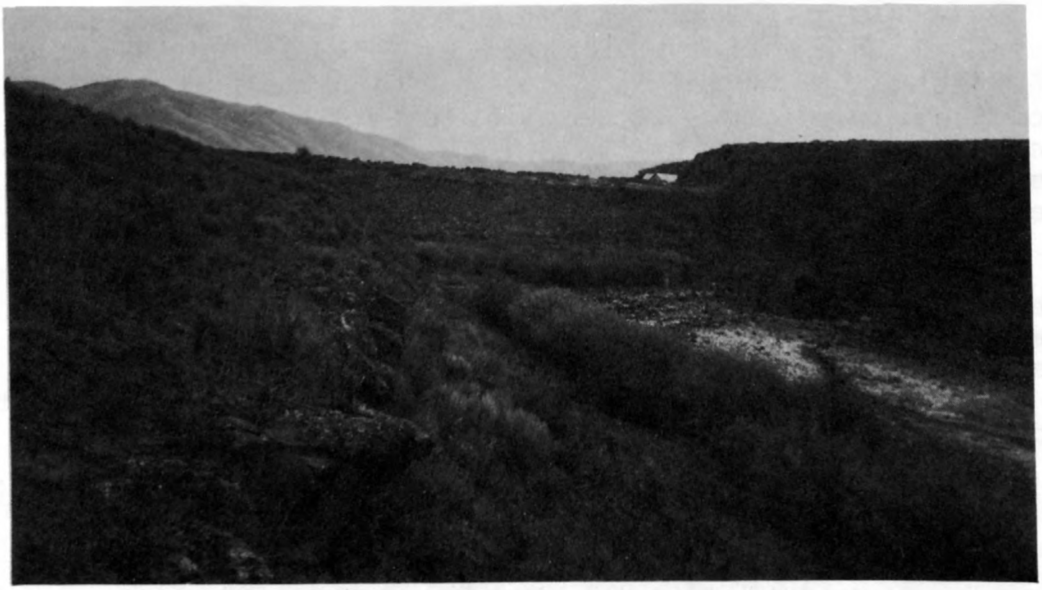
*** Idaho Falls Lower No. 4 plant (13-0595+30) is at mile 798.1, sec. 25, T. 2 N., R. 37 E., and has a drainage area of about 9,760 square miles. The existing development is between altitudes 4,672 and 4,654 feet. The potential development assumes the same forebay altitude but would lower the tailrace to altitude 4,640 feet. The potential powerhouse site is in sec. 3, T. 1 N., R. 37 E., immediately downstream from the Snake River Valley canal headgate. These are small plants, but due to the ease of exploitation have proven to be economic. The falls keep the river close to the valley bottom and diversion of sufficient water to run the plants is not too difficult.

Downstream from the plants of the City of Idaho Falls, the river falls only 82 feet in 18 miles. Four low-head developments might be technically feasible in this reach by utilizing low overflow dams with bulb turbine-generator units installed as follows: Bennett Bridge (13-0595+40), mile 792.8, sec. 16, T. 1 N., R. 37 E., drainage area 9,790 square miles. Head development would be between altitudes 4,640 and 4,610 feet; Woodville (13-0600+10) mile 789.6, sec. 19, T. 1 N., R. 37 E., drainage area about 9,795 square miles. Head development would be between altitudes 4,610 and 4,595 feet; Monroe (13-0600+20) mile 782.8, sec. 7, T. 1 S., R. 37 E., where drainage area is about 9,800 square miles. Head development would be between altitudes 4,595 and 4,568 feet; Firth (13-0600+30) mile 780.3, sec. 24, T. 1 S., R. 36 E., where drainage area is about 9,805 square miles. Head development would be between altitudes 4,568 and 4,558 feet. Large bulb units might make the development of falls of this height feasible provided sufficient water is allowed to pass the several diversions for irrigation in the reach.

Blackfoot River to Portneuf River

The headwater streams of the Blackfoot River basin pass through many valleys where water could be stored but runoff usually is too small to make development feasible. The only sites that might eventually be development are at and downstream from the constructed *** Blackfoot Marsh Reservoir. Blackfoot Marsh Reservoir (13-0650) was constructed by the Bureau of Indian Affairs in 1908 and 1909 and rebuilt by that agency in 1922, 1923, and 1924. The dam is at mile 78, sec. 12, T. 5 S., R. 40 E., and the drainage area is 581 square miles. The present dam is earth and rockfill, structural height is 49 feet, and length of crest is 305 feet. There is a current plan to enlarge the reservoir by heightening the dam. A dam that would raise the water an additional 26 feet (to altitude 6,150 feet) and a 2½-mile conduit would develop a head of 150 feet. Releases from the existing reservoir provide the necessary Q95 and Q50 discharges to make this site large enough to be included in the waterpower resources inventory.

Downstream from the Blackfoot Marsh site the river falls 1,380 feet in 24 miles. The theoretical potential power of this reach of river has been measured assuming development at five sites described below. The sites are small and it is not likely that any of them will be developed in the foreseeable future.



Blackfoot Marsh Dam, Blackfoot River, Oct. 21, 1960

Graves Creek (13-0655+50) at mile 61.4 on Blackfoot River, sec. 29, T. 4 S., R. 39 E., drainage area 725 square miles, would develop head between altitudes 6,000 and 5,790 feet. A dam 2,000 feet long would be required according to the Paradise Valley 1:62,500-scale topographic quadrangle map.

Brush Creek (13-0655+60) mile 52.9 on the Blackfoot River, sec. 29, T. 3 S., R. 39 E., where drainage area is 799 square miles, would develop head between altitudes 5,790 and 5,500 feet. According to the Paradise Valley 1:62,500-scale topographic quadrangle map, a dam 600 feet long in sec. 33 of the same township would develop head between altitudes 5,600 and 5,790 feet, approximately, and a one-mile long conduit would develop the remaining head to altitude 5,500 feet. The damsite is immediately downstream from the mouth of Brush Creek at mile 54.6.

Spring Creek (13-0655+70) mile 46.7, sec. 10, T. 3 S., R. 38 E., drainage area 835 square miles, would develop head between altitude 5,500 feet and 5,200 feet. According to the Paradise Valley 1:62,500-scale topographic quadrangle map, the canyon is very narrow and steep and a 300-foot dam to altitude 5,500 feet would have a crest length of only 700 feet.

Alridge site (13-0655+80), mile 44.7 on the Blackfoot River, sec. 4, T. 3 S., R. 38 E., drainage area 860 square miles would develop head between altitudes 5,200 and 4,880 feet. The damsite would require a dam 1,200 to 1,300 feet long according to the Yandell 1:62,500-scale quadrangle map.

Wolverine Creek (13-0660) mile 34.3 on Blackfoot River, sec. 12, T. 2 S., R. 37 E., would develop head between altitudes 4,880 and 4,620 feet with a dam from 4,660 to 4,880 feet, and a one-mile diversion to the powerhouse. The dam, located about one mile downstream from Wolverine Creek in sec. 7, T. 2 S., R. 38 E., where the drainage area is 909 square miles, would have a crest length of about 1,700 feet according to the Goshen 7½-minute quadrangle map.

Between the mouth of the Blackfoot River and the backwater from American Falls Reservoir, a head of 25 feet could be developed by an overflow dam at the Ferry Butte site (13-0695+10), mile 750 on the Snake River, sec. 31, T. 3 S., R. 34 E., where the drainage area is 11,310 square miles. Its forebay would be at altitude 4,425 feet and its tailrace at altitude 4,400 feet, approximately. The river is 350 feet wide and the distance between the 4,425-foot contours is 1,800 feet according to the Pingree 1:24,000-scale quadrangle map.

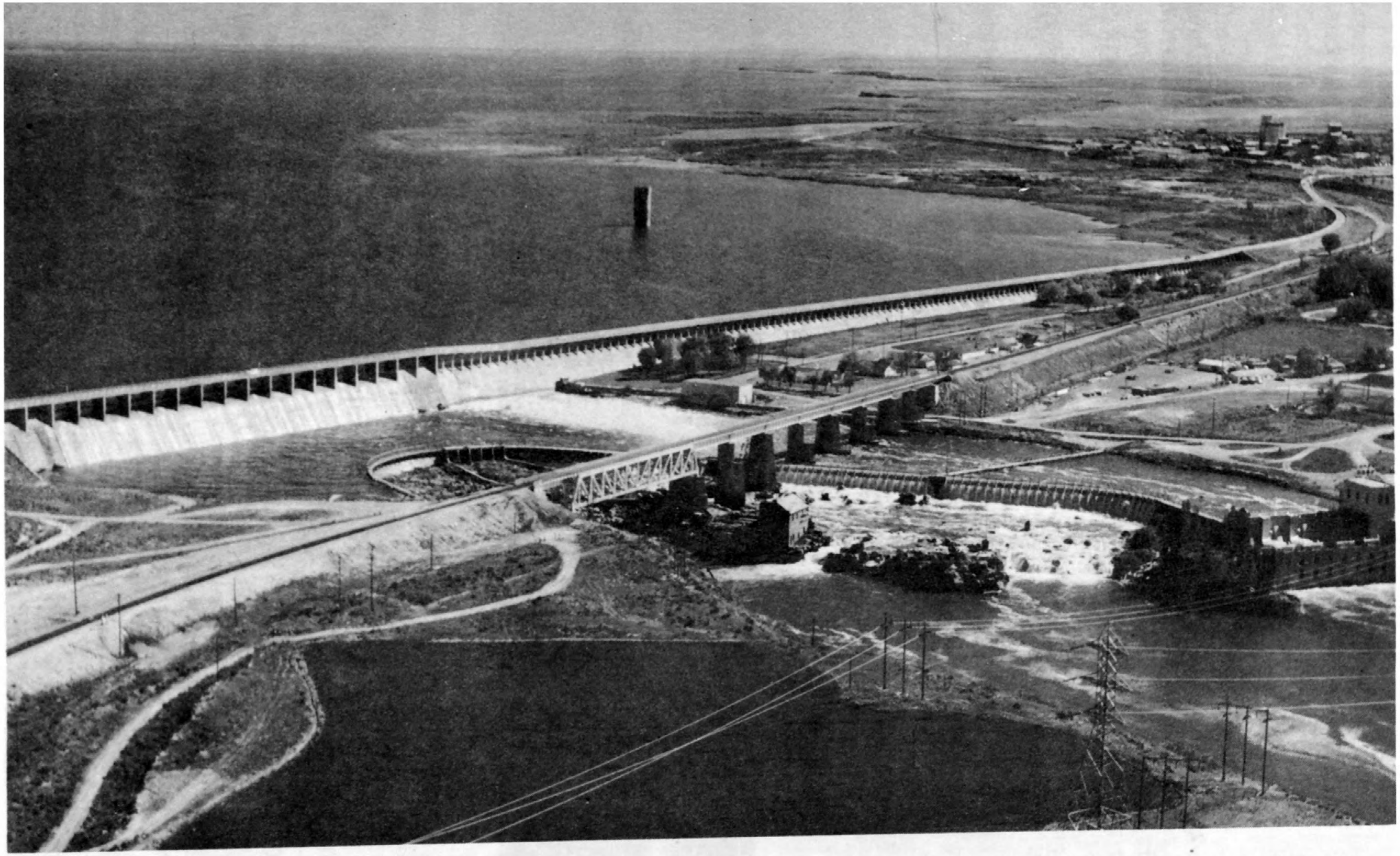
Portneuf River to Salmon Falls Creek

*** The Portneuf Reservoir (13-0702) is located at mile 85, sec. 24, T. 6 S., R. 38 E., drainage area 92 square miles. The site does not have sufficient power potential to be included in the inventory. The Portneuf Reservoir was originally constructed in 1912. It was rebuilt in 1950 by Portneuf-Marsh Valley Canal Co., is earthfill with structural height of 56 feet and crest length of 1,650 feet.

The Lava Hot Springs site (13-0730) would be a dam and reservoir development at mile 50.3 on the Portneuf River, sec. 19, T. 9 S., R. 38 E., where the drainage area is 570 square miles. It would appear to have little possibility of development because of the Hot Springs resort, the Union Pacific Railroad line, and U.S. Highway 30 N in the canyon at that point.

*** The Malad City Plant (13-0737+50) of Utah Power and Light Company is at mile 7.1 on Birch Creek, sec. 28, T. 12 S., R. 36 E., where the drainage area is estimated at 3.5 square miles. Birch Creek is a tributary by way of Marsh Creek of the Portneuf River. The site is too small to be used for measuring potential waterpower.

The Blackrock site (13-0750+50) at mile 26 on the Portneuf River, sec. 22, T. 7 S., R. 35 E., drainage area 897 square miles, would seem to have more likelihood of being developed as a flood control and water supply reservoir than for power. Flood control by channel improvement is now underway in the Marsh Creek area of the Portneuf

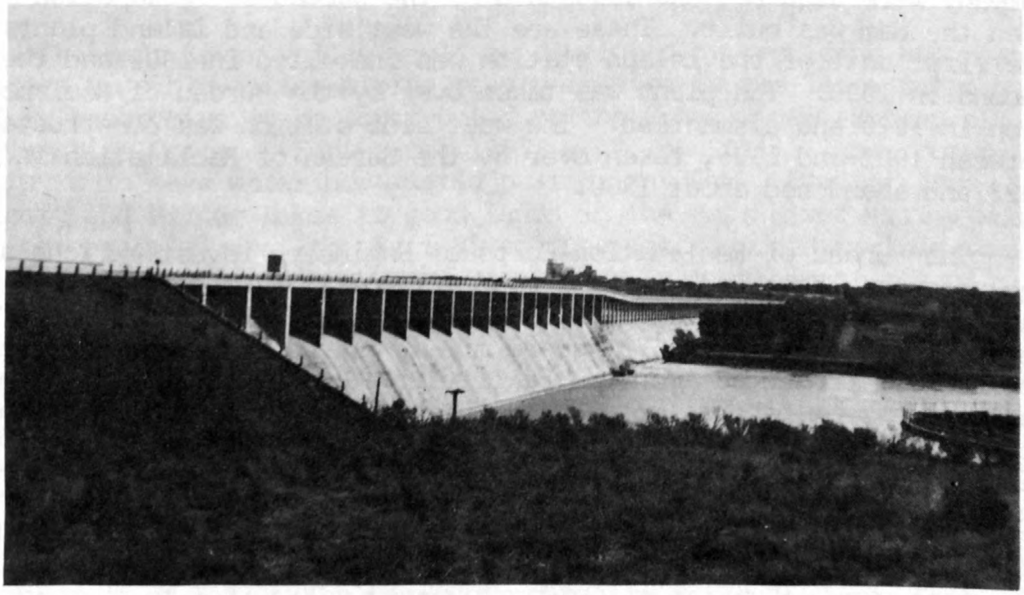


American Falls Dam

USBR Photo

River. Road and railroad relocation requirements will retard its development, however. The damsite is between Blackrock school, now abandoned, and the settlement of Portneuf where a dam with a crest length of 2,500 feet would be required to raise the water from altitude 4,480 to 4,950 feet.

The Pocatello site (13-0757+10) would be a diversion development beginning at the tailrace of the Blackrock site and continuing to the raised American Falls Reservoir developing between altitudes 4,480 and 4,365 feet. Because the water will be allotted to domestic and irrigation uses, there probably will never be enough available to make this site a reality.



American Falls Dam, Snake River, Sept. 14, 1961

The existing American Falls Dam and Reservoir (13-0765) for which the dam is located at river mile 714.0, sec. 30, T. 7 S., R. 31 E., drainage area 13,580 square miles, is the next downstream powersite. The dam is a concrete gravity structure having a structural height of 94 feet, a crest length of 5,227 feet and containing 313,600 cubic yards of concrete. It stores 1,700,000 acre-feet of water for irrigation, power, flood control, and water supply. The reservoir is operated principally for regulating the river to provide irrigation water, with power storage a secondary purpose. Normal pool elevation is 4,354.5 feet. ***

The Idaho Power Company powerplant located in sec. 31 of the same township takes the water below the dam into a forebay and short conduit to the existing plant. The first unit of this plant was built in 1913, and the remaining ones in 1923, 1926 and 1927. Head developed by the reservoir is not utilized. The addition of a powerplant to the American Falls Reservoir has been authorized and, in addition, consideration is being given to increasing the storage capacity of the reservoir by heightening the dam. The planned powerplant will have 30,000 kw but will cost more than the limitation placed upon it in the authorization bill. It will be necessary, therefore, to obtain a new authorization. The gross theoretical power computations are based upon a maximum water surface of 4,365 feet above sea level, not necessarily the planned new pool level. The dam is located upstream from the falls and the reservoir plus the falls would provide 117 feet of gross head. The dam alone would create only 60 feet of head.

Two powerplants originally owned and operated by Idaho Power Company were acquired and abandoned by the Bureau of Reclamation when the dam was built. These are the west side and island plants. The first unit of the island station was installed in 1902 and the second in 1908. The plant was taken over by the Bureau of Reclamation in 1923 and dismantled. The west side station was constructed between 1902 and 1905, taken over by the Bureau of Reclamation in 1923 and abandoned about 1930.

The Bureau of Reclamation-Corps of Engineers investigations also included the Eagle Rock power project (13-0770+50) for which the damsite is at river mile 708.4, sec. 21, T. 8 S., R. 30 E., where the drainage area is 13,672 square miles. It would develop the head between the projected American Falls tailwater, 4,248 feet, and the backwaters from Lake Walcott, 4,195 feet. Like American Falls, the powerplant would have an installed capacity of 30,000 kw located within the main body of the dam. (Bureau of Reclamation-Corps of Engineers, 1961, v. 4, p. 68).

From American Falls Reservoir to Burley, the Snake River is flowing between lava benches on the right (north) bank and north-south trending valleys and ridges on the left bank. The ridges are the Bannock Range, Deep Creek Mountains, Sublett Range and Cotterell Range. The valleys are Arbon, Rockland, Raft River, and Goose Creek. The Bureau of Reclamation-Corps of Engineers (1961) study included proposals for developments in these left-bank valleys. The Rockland project would firm up the water supply for existing irrigated lands and introduction of a modest amount of new land. The project includes Rock Creek reservoir (13-0775+90) near Mollys Nipple about four miles south of Rockland on South Fork Rock Creek. The damsite is in sec. 28, T. 10 S., R. 31 E. Rock Creek reservoir would have a total capacity of about 7,000 acre-feet with a dam 50 feet above the streambed and 1,630 feet long at the crest (Bureau of Reclamation-Corps of Engineers, 1961, v. 4, p. 191). Several small reservoirs of which Curlew Reservoir is the largest give a small degree of regulation to the South Fork at the present time. The streams in this area have no powersites large enough to be included in the inventory.

The Minidoka Dam which forms Lake Walcott (13-0810) is one of the older Bureau of Reclamation projects. The dam, which was constructed by the Bureau of Reclamation between 1907 and 1909, is at river mile 675, sec. 1, T. 9 S., R. 25 E., where the gross drainage area is 22,600 square miles. The net contributing area is 15,700 square miles. The dam is earth and rockfill with a buttress section. Structural height is 86 feet, crest length is 4,475 feet, and volume of fill is 257,300 cubic yards. The reservoir holds a total of 210,000 acre-feet of water of which 95,000 acre-feet is active storage for irrigation, power, and flood control. The 13.4 MW powerplant is at the right-bank end of the dam. The plant contains seven units of which five, rated at 1.2 MW each were installed between 1909 and 1911. The sixth and seventh units are rated at 2.4 and 5 MW and were installed in 1927 and 1942, respectively. Since the storage is principally for irrigation, the plant operates essentially on a run-of-river basis. Its plant factor was 68 percent in 1960. ***

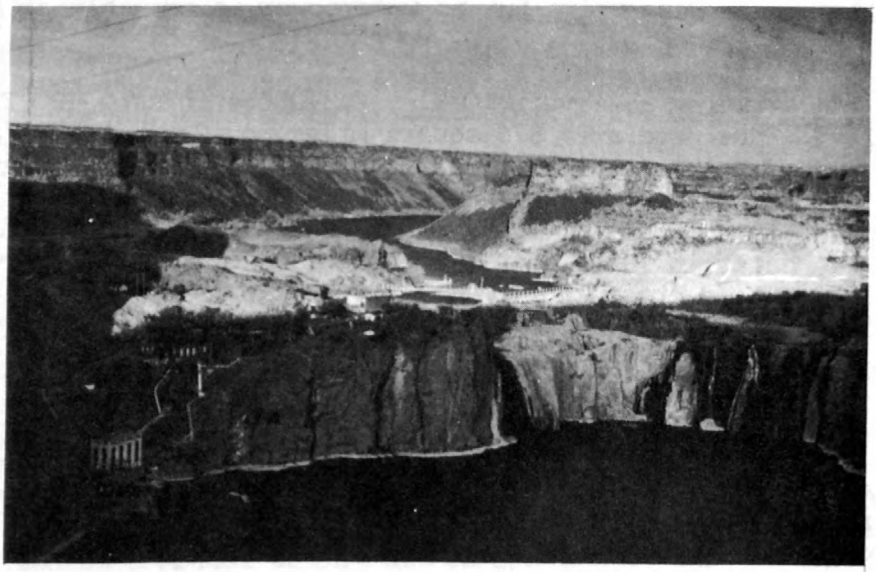
The Raft River valley would be developed by providing upstream storage possibly at the Alpine reservoir site in the Teton Basin and in reservoirs to be constructed on the Grays River (Bureau of Reclamation-Corps of Engineers, 1961, v. 4, p. 204). These reservoirs would save water now wasted past Milner Dam. Pumping from Walcott and Milner Lakes to good lands in the Raft River Valley would be increased. Two of the Raft River subprojects would include some small storage reservoirs but no waterpower is possible at any of the sites.

An existing reservoir, Oakley (13-0835) in sec. 19, T. 14 S., R. 22 E., drainage area 670 square miles, on Goose Creek, and artesian and pumped wells provide irrigation water for the bottomlands in Goose Creek Valley. Runoff is too low to provide water for other purposes in this basin. Oakley Dam is owned by Oakley Canal Company and was built in 1913. It is an earthfill with a structural height of 145 feet, a crest length of 1,050 feet, and contains 1,074,000 cubic yards of fill. The reservoir capacity is 74,350 acre-feet. The water is used for irrigation and domestic supply. ***

The drainage basin on the north side of the river in this reach is even less productive of water than that of the south side because, in addition to receiving the same low amounts of rainfall, lava beds of recent origin trap the water and conduct it to the Snake River through underground channels.

Milner Dam (13-0880) is at mile 640, sec. 29, T. 10 S., R. 21 E., where the drainage area is 17,180 square miles. The Twin Falls Canal Company and the Northside Canal Company built the Milner Dam in 1905. It is a rockfill with a structural height of 86 feet, a crest length of 2,320 feet, and a fill volume of 286,000 cubic yards. The capacity of the reservoir is 80,000 acre-feet which is used only for providing diversion elevation for irrigation. Water is diverted on both sides of the river, by gravity and by pumping. The diverted water is stored in Wilson Lake Reservoir on the north side canal and in the Murtaugh (Dry Creek) Reservoir on the south side *** of the river. The water is used on flat and gently sloping, benchlands that extend along the river for a distance of 50 miles. The valley widens to as much as 35 miles in the vicinity of Twin Falls. A maximum head of 53 feet (altitudes 4,080 to 4,133 feet) is available at the present Milner Dam and, for measuring the potential power of the site, a gross head of 85 feet has been assumed. The 32 feet of additional head would be obtained by raising the reservoir 12 feet and locating the powerplant half a mile downstream. It seems unlikely, however, that the reservoir will be raised the additional 12 feet because of injury to highly developed areas in the vicinity of Burley.

In the reach of river between Milner Dam and the Twin Falls powerplant forebay the river falls 540 feet. This head could be developed by diversions or by dams at several sites. The Bickel site (13-0880+60) might have its dam, or if by diversion, its powerhouse in sec. 25, T. 10 S., R. 19 E. Another site, Kimberly (13-0880+80), is in sec. 10, T. 10 S., R. 18 E., 2.4 miles upstream from the Twin Falls plant. The Kimberly reach of river could actually be developed as an addition of 220 feet to the present 147 feet of head at the Twin Falls plant.



Shoshone Falls Powerplant, Snake River

The Twin Falls-Shoshone Falls rapids reach constitute a fall of 371 feet in 2.3 miles, most of which is already developed at the Twin Falls and Shoshone Falls plants of the Idaho Power Company.
*** The Twin Falls plant (13-0895+50) was constructed in 1935 at mile 618, sec. 4, T. 10 S., R. 18 E. Head is developed between altitudes
*** 3,519 and 3,372 feet. The Shoshone Falls plant (13-0900) is one of

Idaho's oldest plants having been constructed in 1907. The powerhouse at mile 615, sec. 31, T. 9 S., R. 18 E., develops head between altitudes 3,362 and 3,148 feet. Potential power is computed between altitudes 3,374 and 3,148 feet.

Rock Creek is a left-bank tributary with headwaters in rugged, dry mountains southeast of Twin Falls where high mesas and peaks reach altitudes between 7,000 and 8,000 feet above sea level. The creek descends rapidly from the mountains to the Snake River plain about 15 miles southeast of Twin Falls near the Twin Falls-Cassia County boundary. Its waters are diverted for irrigation and lateral canals of the Snake River system cross it. The potential power of the Rock Creek basin has been measured by assuming development of a dam, reservoir, and three-mile conduit below the mouth of West Fork Rock Creek (13-0900+50). According to the Twin Falls 1:250,000-scale quadrangle map prepared by the Army Map Service in 1955, the dam would be in sec. 26 with a three-mile diversion to the powerhouse in sec. 11, T. 12 S., R. 18 E. An additional head of 1,052 feet could be developed by a 15-mile diversion between the West Fork Rock Creek tailrace site and the Shoshone Falls powerhouse, the Perrine powersite (13-0900+60).

The Bureau of Reclamation-Corps of Engineers study (1961) did not contemplate any power development on Rock Creek but would pump return irrigation flow from Cedar Draw and Rock Creek into the existing laterals.

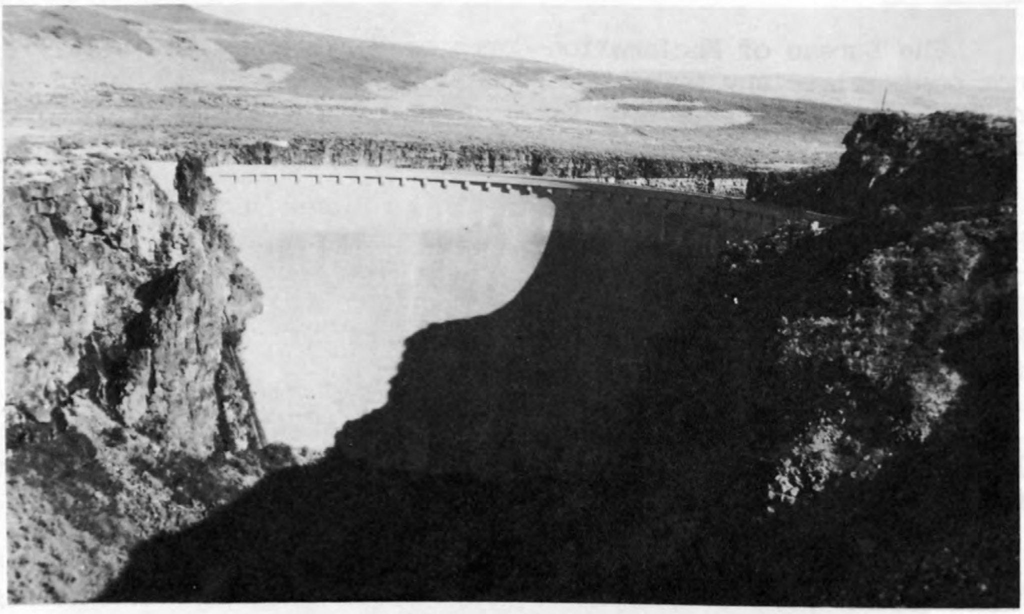
Fertile bottomlands along the Snake River in the vicinity of Hagerman have thus far prevented a large development by reservoir of the reach of Snake River downstream from Shoshone Falls. The Bureau of Reclamation at one time made a study of a high dam at the Bliss site for this purpose but now appears to prefer a site upstream from Hagerman.

The developed Clear Lakes power project (13-0940+10) of the Idaho Power Company is in sec. 2, T. 9 S., R. 14 E. It uses water from springs on the right bank of the Snake River.

The Clear Lakes damsite (13-0940+20) studied by the Bureau of Reclamation and Corps of Engineers (1961), also called Devils Washboard site, is at mile 596.3, sec. 1, T. 9 S., R. 14 E. A dam rising about 320 feet above the streambed with a crest length of about 3,400 feet is planned. It would back water to altitude 3,260 feet and flood the existing Shoshone Falls site. Its main purpose in that plan would be to furnish water for pumping to the Bruneau plateau and it would have a total capacity of 1,070,000 acre-feet, of which 500,000 acre-feet would be inactive storage for conservation purposes. A 115,000-acre-foot reservoir (Grindstone Butte) would be constructed to reregulate the pumped water near the Bruneau project. Potential power is computed for fall between the Shoshone Falls plant tailrace and the present water surface at the damsite, altitudes 3,148 and 2,950 feet.

Salmon Falls Creek

The Salmon Falls Creek basin is a rolling rugged sagebrush desert except where irrigated or where moist drains encourage growth of grasses and small trees. The river heads on the northeast slopes of the Ruby Mountains in the northeast corner of Nevada and drains about 900 square miles each in Nevada and Oregon. The headwaters area is in the eastern fringe of the Humboldt National Forest. This is a region of lava flows and the creek has cut through a rim of lava near the Idaho-Nevada boundary to leave the upland valley around San Jacinto which is about 5,100 feet in altitude. This valley is partly irrigated and provides grass and hay for supplementing the needs of the cattle raised in the surrounding hills. At the Idaho-Nevada boundary the river canyon begins to narrow and the canyon has
*** almost vertical walls at the Salmon Falls Creek Dam (13-1065) about 17 miles north of the State boundary line at river mile 46, sec. 18, T. 14 S., R. 15 E. The canyon remains narrow and deep most of the remaining length. Its mouth is on the left bank of the Snake River in sec. 19, T. 8 S., R. 14 E.

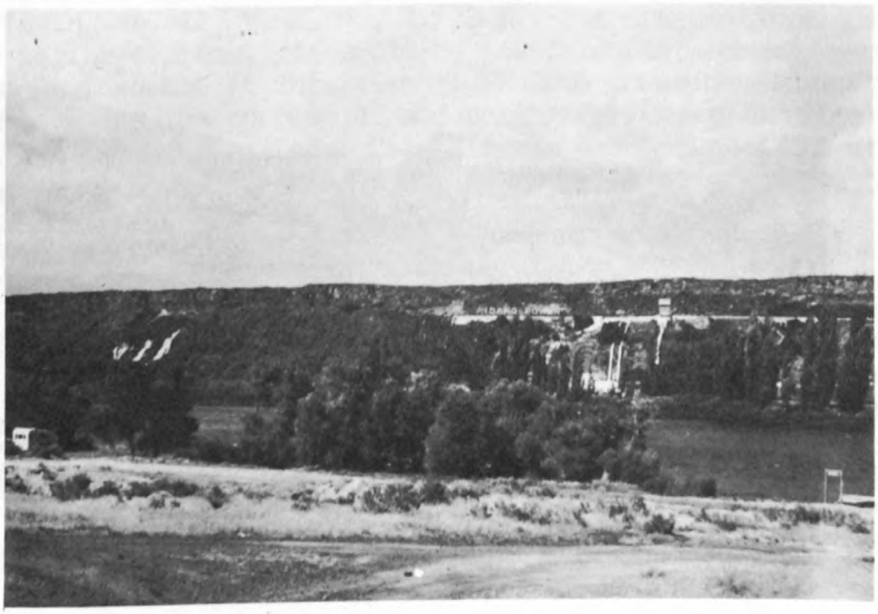


Salmon Falls Dam, Salmon Falls Creek, Sept. 25, 1962

The Salmon Falls Creek Reservoir was completed in 1911 by the Salmon River Canal Company. Storage began in 1910. The drainage area is 1,610 square miles. Salmon Falls Creek Dam is a concrete arch with a structural height of 200 feet and a crest length of 490 feet. Its storage capacity is 228,000 acre-feet (182,650 acre-feet usable) for irrigation but the reservoir has never been full. The maximum capacity ever observed was 123,700 acre-feet on May 30 and 31, 1922. Only leakage is allowed to pass the dam and the canal diverts an average of 106 cfs. Regulation required to save water until the irrigation season eliminates the site from the inventory. The diversion is by a tunnel near the dam to the right bank of Salmon Falls Creek.

Cedar Creek, a left-bank tributary of Salmon Falls Creek, has a constructed reservoir created by Cedar Creek Dam (13-1067), built in 1920 by the Cedar Mesa Company. The dam is in sec. 12, T. 14 S., R. 13 E., where the drainage area is 128 square miles. Cedar Creek Dam is earthfill, has a structural height of 78 feet, and a crest length of 480 feet. Its storage capacity is 26,000 acre-feet, all for irrigation. The low water yield of this drainage area makes it necessary for the irrigation company to completely stop the flow of the river for more than half of the time and the site thus has no value for power purposes. The water is diverted about six miles downstream from the dam to the benchlands around the settlement of Roseworth and is returned to Cedar Creek and Salmon Falls Creek downstream from their junction by canyons which were dry before irrigation began. ***

Salmon Falls Creek was measured again near Buhl in sec. 36, T. 9 S., R. 13 E., during the 1956 and 1957 water years when it had an average of 106 cfs each year. This discharge is composed of leakage past the Salmon Falls Creek and Cedar Creek Dams and of return seepage and waste water from irrigation, and flows very uniformly. It is estimated that Q95 would be about 75 cfs and Q50 about 85 cfs. These discharges could be dropped through a head of 420 feet by a diversion-conduit type development near Balanced Rock and a similar one near Lucerne. These sites have been designated as Balanced Rock (13-1070+30 and Lucerne (13-1080+20). The diversions would each be about six miles long and the powerhouse sites in sec. 10, T. 10 S., R. 13 E., and sec. 12, T. 9 S., R. 13 E., respectively.



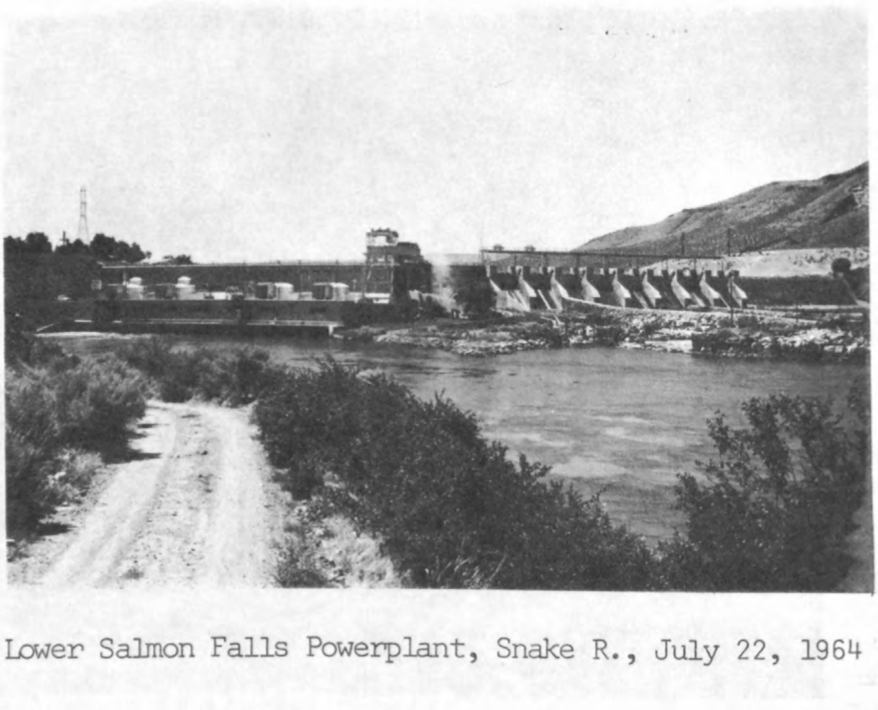
General view of Thousand Springs power development

Salmon Falls Creek to Wood River

*** Thousand Springs powersite (13-1080+40) was first developed in 1912 by the Idaho Power Company or one of its predecessors. The powerhouse is at mile 584.4, sec. 8, T. 8 S., R. 14 E., and is fed by springs originating high on the right canyon wall of the Snake River.

The Lower Thousand Springs reservoir site (13-1080+50) was selected to measure the potential power of the Snake River between the Clear Lakes reservoir site tailrace and the backwater from the existing Upper Salmon "B" Reservoir. The damsite is at mile 584.4, sec. 8, T. 8 S., R. 14 E. A dam raising the water to the Clear Lakes tailrace would inundate the existing Thousand Springs powerplant but this could be relocated at approximately its present datum at the Lower Thousand Springs site powerhouse. The Bureau of Reclamation-Corps of Engineers report (1961) page 7-108, considered an installation of 150,000 kw initially and 400,000 ~~kw~~ a-f ultimately.

What would normally be surface runoff from the right-bank tributaries of the Snake River in this reach emerges in the Snake River canyon in the form of well-regulated springs. The large reservoirs contemplated for the reach, nevertheless, would have a considerable flood control value for the protection of the highly developed valley formed by the almost common junctions of the Owyhee, Boise, Malheur, Payette, Weiser, and Burnt Rivers near the Idaho-Oregon boundary.



Lower Salmon Falls Powerplant, Snake R., July 22, 1964

The existing plants in this reach of river are Upper Salmon "B" (13-1080+60) at mile 582, sec. 2, T. 8 S., R. 13 E.; Upper Salmon "A" (13-1080+70), mile 581, sec. 3, T. 8 S., R. 13 E.; and Lower Salmon Falls (13-1080+80), mile 572.9, sec. 2, T. 7 S., R. 13 E. These plants would not be altered to any great extent by complete development as assumed for the present waterpower resources inventory. ***

Mud Lake-Lost River-Wood River area

The Snake River Valley has been widened to 50 or 60 miles in the Mud Lake-Lost River-Wood River basin area by a layer of basalt. At the mouths of streams that drain the south side of the Bitterroot Range, the Big and Little Lost River Ranges, White Knob, and Pioneer Mountains, this basalt is covered by a blanket of alluvial silt. The Bitterroot Range, Little Lost River Range, and Big Lost River Range are the confining ridges for the south draining streams Birch Creek, Little Lost and Big Lost Rivers. These ridges continue northwestward as the Continental Divide, Lemhi Range, and Pahsimeroi Range and the corresponding valleys carry the drainage northwestward to the Salmon River or Lemhi River, Pahsimeroi River, and Warm Springs Creek.

The alluvial deposits on the lava are deep enough in many places to make agriculture by irrigation feasible, notably around Mud Lake on Medicine Lodge Creek, Reno on Birch Creek, Venice on Little Lost River, and the Mackay-Arco section of the Big Lost River.

Medicine Lodge Creek is an exceptionally even-flowing stream in its headwaters area. It might be developed for waterpower together with some of its tributaries in an alpine-type water gathering arrangement in connection with the proposed Medicine Lodge Project (13-1160) which includes a reservoir of about 12,000 acre-feet capacity. The damsite is in sec. 12, T. 11 N., R. 33 E., a short distance upstream from the gaging station. It would be possible but probably not economically feasible at this time to include power development in the project. For the purpose of accounting for the theoretical power capabilities of Medicine Lodge Creek it was assumed that the stream would be diverted at the dam outlet, altitude 5,700 feet, and carried in a 10-mile open conduit on the left bank of Medicine Lodge Creek to a steep hillside overlooking Deep Creek southwest of Small where it could be dropped to an altitude of about 5,200 feet. The powerplant would be located in sec. 17, T. 10 N., R. 34 E. Assuming that the water in the forebay on the hillside would be at an altitude of at least 5,700 feet, a gross head of 500 feet would be developed. About 35 square miles of Indian Creek drainage and about 50 square miles of Middle Creek drainage could be diverted to the Medicine Lodge Creek reservoir to increase the 165 square-mile area at the damsite to 250 square miles. For the purpose of estimating the gross theoretical power this is assumed. The total length of the necessary diversion conduits would be about 25 miles.

The Bureau of Reclamation and Corps of Engineers (1961, v. 4, p. 258) studied a 24,000-acre-foot reservoir on Birch Creek. This is designated the Reno site (13-1170). The damsite is in sec. 3, T. 10 N., R. 29 E., where the drainage area is 295 square miles. This dam would have a tailwater outlet of about 6,350 feet. If the water were diverted at the damsite and carried along the left bank of Birch Creek about 20 miles to a point near the Clark-Jefferson County line, it could be dropped to a powerhouse site at an altitude of 5,000 feet in sec. 3, T. 8 N., R. 32 E., and still be usable on the lands contemplated for irrigation. Water could reach the powerplant forebay at an altitude of at least 6,300 feet above sea level thereby making a gross head of 1,300 feet available for development. Average discharge at a gage about three miles downstream from the damsite is 79 cfs.

The Howe site (13-1185+50) would require diversion from the Little Lost River near the junction of Deer Creek where the water surface altitude is about 5,700 feet and the drainage area about 510 square miles. An eight-mile long conduit along the right bank would reach an altitude of about 5,400 feet in sec. 2, T. 7 N., R. 27 E., the powerhouse site.

The Castle Creek site (13-1200+50) would require a dam and reservoir at a damsite in unsurveyed sec. 32, T. 7 N., R. 21 E., where the drainage area of the East Fork Big Lost River is about 190 square miles. A dam that would raise the water surface from its present altitude of 7,170 feet to altitude 7,400 feet would have a crest length of about 1,700 feet according to the Mackay 2 NW topographic quadrangle map at a scale of 1:24,000. The reservoir at altitude 7,400 feet would cover about 1,500 acres and store 119,000 acre-feet of water. An additional 170 feet of head could be created in a conduit three miles long to the backwater limit of the Garden Creek reservoir site. The powerhouse site probably would be in unsurveyed sec. 35 or 36, T. 7 N., R. 20 E.

The Garden Creek damsite (13-1200+80) is on the Big Lost River, sec. 35, T. 8 N., R. 20 E., where the drainage area is 430 square miles. Development would be by a dam to raise the water from its present altitude of about 6,700 feet to altitude 7,000 feet. According to the Hailey topographic quadrangle map at a scale of 1:125,000, a dam 100 feet high would be about 1,200 feet long at the crest and a dam 300 feet high would be about 2,500 feet long at the crest.

The Bartlett Point site (13-1205+20) would use the Big Lost River water diverted at the Garden Creek site tailrace, altitude 6,700 feet, and carried about seven miles along the right bank of the river to the powerhouse site, altitude 6,400 feet, sec. 12, T. 8 N., R. 21 E. The drainage area would be the same as for Garden Creek, about 430 square miles.

Mackay Reservoir (13-1260) is formed by a dam across the Big Lost River in sec. 12, T. 7 N., R. 23 E., where the drainage area is 788 square miles. The dam is an earth and rockfill dating to 1915 and reconstructed in 1917 and 1918. It is 70 feet in structural height and 1,380 feet long. In September 1956 the reservoir was enlarged by raising the spillway five feet. The present reservoir has a capacity of 44,370 acre-feet between gage heights 7 and 66.5 feet, the crest of the spillway. Dead storage is estimated to be about 125 acre-feet. About 33,000 acres of land are irrigated by the stored water. Because of the demands on this reservoir for irrigation regulation, power development does not appear feasible.

The Antelope Creek reservoir (13-1310) has been studied by the Bureau of Reclamation to supplement Mackay Reservoir in supplying water to inadequately irrigated lands. The damsite is in sec. 29, T. 5 N., R. 25 E., where the drainage area is 210 square miles. According to the report, an abundance of semipervious material and rockfill material is available on the reservoir floor for construction of the dam and impervious material is found in the valley walls. The dam planned is to be an earthfill about 75 feet above the streambed with a crest length of about 1,200 feet. The crest of the dam would be at altitude 5,955 feet and the maximum water surface 5,947 feet. The reservoir would have a capacity of 7,500 acre-feet above the minimum water surface elevation of 5,905.5 feet (Bureau of Reclamation-Corps of Engineers 1961, v. 4, part 1, p. 268). The potential waterpower is too small to be included in the inventory.

The Baker Creek site (13-1350+10) would divert the Big Wood River, Pasture Creek, and Baker Creek at an altitude of 7,000 feet, and carry the water to a powerhouse site at an altitude of 6,600 feet near the mouth of Baker Creek at mile 123.6 of the Big Wood River.

The Boulder Flats site (13-1350+20) at mile 109.4, in unsurveyed T. 5 N., R. 17 E., measures the potential capacity of the Boulder Flats dam and reservoir site, and has been investigated as a multiple-purpose project including flood control, conservation, and recreation. An earth and rockfill dam 180 feet high with a maximum pool level of 6,540 feet was considered but not recommended because of unfavorable benefit cost ratio at this time (Bureau of Reclamation-Corps of Engineers 1961). The dam would be 1,400 feet long and could be raised another 60 feet by adding an additional 1,000 feet to its length.

Downstream from the Boulder Flats damsite the Big Wood River flows in a rather wide valley to Ketchum. The stream falls 360 feet between the Boulder Flats damsite and the mouth of Lake Creek and the reach could be developed by a nine-mile long diversion or by a long dam at the Lake Creek (Upper Ketchum) site (13-1355+20 at mile 100.8. This site would be an alternative to the Boulder Flats site if developed by reservoir as there probably will not be justification for both reservoirs.

Warm Springs Creek joins the Big Wood River at Ketchum where an investigation has been made for a dam and reservoir site. The reservoir would be for water conservation and the site does not meet criteria for being included in the inventory of waterpower sites.

Downstream from Ketchum the river flows in a rather wide valley but falls rapidly enough to create a head of 300 feet in about six miles of conduit length. This site has been designated Ketchum (13-1365+20). The powerhouse site is in secs. 29 and 30, T. 4 N., R. 18 E., mile 94 (the lower Ketchum damsite). Downstream from the Ketchum site, the Hailey site (13-1365+40) with a powerhouse in sec. 9, T. 2 N., R. 18 E., could develop 400 feet of head in a nine-mile long conduit. Rediverting the water at the Hailey site tailrace, drainage area 640 square miles, and carrying it about six miles along the right side of the Big Wood Valley to the Bellevue site (13-1395) in sec. 12, T. 1 N., R. 18 E., would develop 240 feet of head. This site and those described for the upstream Big Wood River might be individually feasible at some future time but are somewhat in the nature of alternatives because of the demands on the river for irrigation. Some of the reservoirs may be developed either for waterpower or for water conservation at some future time.

Camas Creek runs from west to east in a 40-mile-long by 15-mile-wide trough between the main Sawtooth Mountains and Mount Bennett. The creek contributes an average of 151 cfs to Big Wood River as gaged at a point downstream from the principal diversion sites, but the flow is so distributed that the power potential does not meet the requirements for the inventory.

*** Magic Reservoir (13-1420) at mile 60, with dam in sec. 18, T. 2 S., R. 18 E., where the drainage area is 1,600 square miles, was constructed between 1909 and 1917 by the Idaho Irrigation Co. Magic Valley Dam now owned by Big Wood Canal Company is earthfill, has a structural height of 135 feet, a crest length of 2,900 feet, and a volume of fill of 200,000 cubic yards. The reservoir with a capacity of 192,000 acre-feet is for irrigation and water supply.

Big Wood River falls steeply from its headwaters in the Sawtooth Mountains, falling more than 4,000 feet in the approximately 60 miles of main river upstream from Magic Reservoir. The Magic Dam spillway is at altitude 4,797 feet. Peaks on both sides of the river reach altitudes of 10,000 or 11,000 feet. Galena Peak is 11,070 feet, Easley Peak is 11,115 feet, and Boulder Peak is 11,010 feet above sea level. Precipitation amounts to as much as 40 inches per year in the mountains and averages about 15 inches at Hailey. Runoff occurs principally in the late spring and early summer months as a result of rapid snow melt and, under these circumstances, the stream does not have much value for waterpower development.

Like other streams in this vicinity the Little Wood River descends rapidly from the mountains and disappears in the lava which separates the foothills from the main channel of the Snake River. A strip of alluvial land adjacent to the foothills is irrigated and water from the spring runoff is saved for this purpose in the Little Wood and Carey Reservoirs on the Little Wood River and in Fish Creek Reservoir on Fish Creek. Estimates of runoff and its distribution indicate that a small power development, Upper Little Wood (13-1479+50), might be effected by diverting from a drainage area of 116 square miles to a powerhouse site at an altitude of about 5,200 feet in sec. 26, T. 2 N., R. 20 E. The tailrace altitude of this site is based on inadequate maps and may be 37 feet too low if an indicated full reservoir altitude of 5,237 feet for Little Wood Reservoir is correct.

The Little Wood Reservoir (13-1482) at mile 71, sec. 18, T. 1 N., R. 21 E., where drainage area is 279 square miles might have a small powerplant added. Little Wood Dam is earthfill, 122 feet high, and 2,500 feet long. Its storage capacity of 30,000 acre-feet is for irrigation under the supervision of the Bureau of Reclamation. ***

The Carey site (13-1482+50) would develop about 200 feet of head and a small amount of power by diverting the water at the Little Wood site tailrace and a five-mile conduit to the vicinity of the lands now irrigated at an altitude of about 4,800 feet. The site would have a drainage area of 303 square miles and the powerhouse might be located in sec. 10, T. 1 S., R. 20 E.

Downstream from Magic Reservoir, the Big Wood River is diverted to irrigate more than 155,000 acres of land. A powersite using return flow from irrigation and other seepage might be developed. The Tuttle site (13-1525+20) with a powerplant site at mile 2.1, SW¼ of sec. 25, T. 6 S., R. 13 E., at the Upper Malad Powerplant intake has a drainage area of about 3,000 square miles. A dam near the center of sec. 30, T. 6 S., R. 14 E., and a 1½-mile long conduit to a powerhouse site was assumed for measuring the capacity of this site. Diversions for irrigation near the above damsite have not been considered. The amount of water diverted is not known but it is believed that sufficient water would be available to operate the plant and supply the irrigation needs.

The Upper Malad Plant (13-1525+40) of the Idaho Power Company is at mile 1.4, sec. 35, T. 6 S., R. 13 E. It utilizes water from springs in Big Wood River and a diversion flume at its tailrace carries water to the Lower Malad Powerhouse (13-1525+50) in sec. 34, T. 6 S., R. 13 E. The Upper Malad Plant was constructed in 1948. The Lower Malad Plant began producing power in 1911. ***

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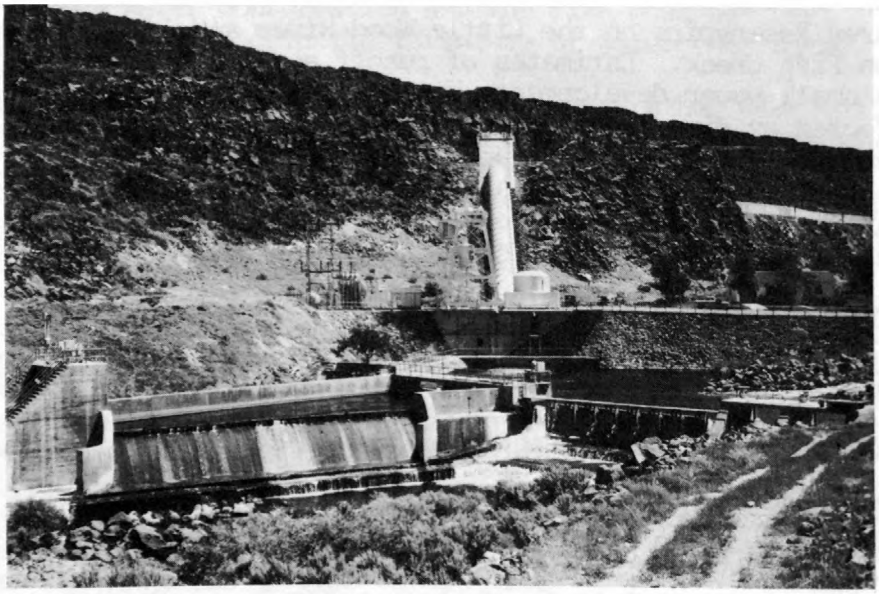


Upper Malad Plant, Big Wood River, Idaho, July 1964

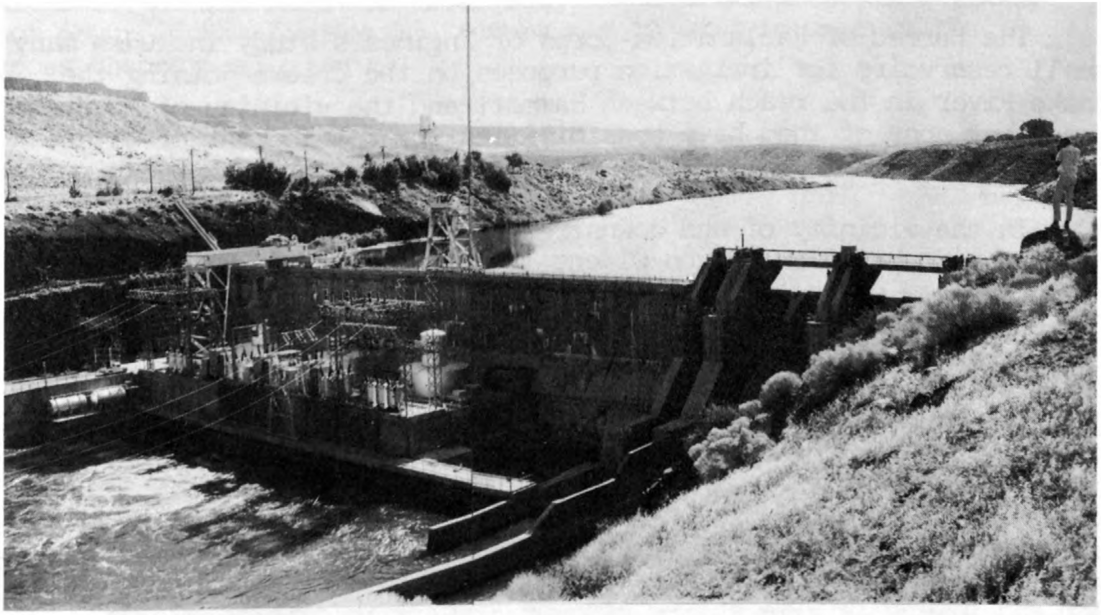
Wood River to Oregon line

The High Bliss site (13-1525+70) with damsite at mile 565, sec. 12, T. 6 S., R. 12 E., (drainage area 33,927 square miles) on the Snake River might better be named the Upper Bliss site. At one time a high dam was proposed for developing this reach of river. Fertile valleys near Hagerman and downstream made it desirable to look for reservoir sites farther upstream and only a relatively low-head development seems possible at the High Bliss site. The arrangement chosen backs water to the Lower Salmon tailrace and encroaches on the tailrace of the Lower Malad Powerplant but this is justifiable because of the additional power that would be made available by combining the Wood River and Snake River water.

*** The Bliss project (13-1525+80) of the Idaho Power Company was redeveloped in 1949 and 1950 as authorized under Federal Power Project 1975. The dam is at mile 560, sec. 7, T. 6 S., R. 12 E. and drainage area is about 34,000 square miles. Bliss is a gravity dam, with a structural height of 120 feet, a crest length of 540 feet, and a volume of 117,178 cubic yards of concrete. Its usable storage capacity is only 1,000 acre-feet and 75 MW are installed in its powerplant. The water is raised from altitudes 2,654 to 2,584 feet.

Downstream from Bliss, damsites in the vicinity of Hammett and Glenns Ferry have been considered from time to time, but like the

Hagerman Valley, the valley around Hammett and Glenns Ferry presents right-of-way obstacles that have not been overcome. Development of all of the head at one damsite seems unlikely, because of the large amount of developed agricultural land that would be flooded in the valleys around Glenns Ferry and Hammett. Extensive relocation requirements would include a large part of the town of Glenns Ferry, the railroad yard and facilities supporting it in Glenns Ferry, six to ten miles of the Union Pacific Railroad, and an equal mileage of U. S. Highway 30 now being developed as Route 80 N.



Bliss Dam and Powerplant, Snake River, Idaho, July 22, 1964

A more likely plan of development would be to construct a low dam at the Indian Cove site near the backwater limit from the C. J. Strike Reservoir, that would raise the water surface to an altitude of about 2,490 feet. Encroachment on farmland and property relocations would be minimized in the Hammett and Glenns Ferry areas by a reservoir to this altitude. The backwater would reach the Pasture powersite tailrace.

The plan for the <u>Pasture site</u> (13-1525+90), suggests a dam at mile 550.5, sec. 29, T. 5 S., R. 11 E., at a water surface altitude of about 2,510 feet to raise the water surface to the tailrace of the existing Bliss Plant, altitude 2,584 feet above sea level, and a tunnel three miles across a tongue of land forming a horseshoe bend in the Snake River to reach altitude 2,490 feet, sec. 23, T. 5 S., R. 10 E. Or, since the tunnel is relatively long in comparison with the additional head developed, the 20 feet of fall in the reach of river immediately adjacent to King Hill might be left undeveloped and the Pasture powerhouse located at the dam.

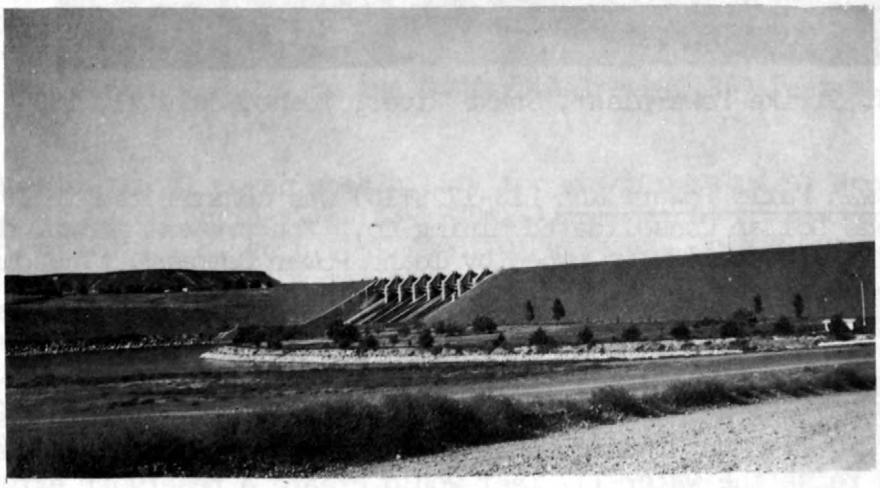
The Indian Cove damsite (13-1553+20) is at mile 519.2, sec. 34, T. 5 S., R. 7 E., slightly within the backwater limit of the existing C. J. Strike Reservoir. The drainage area is 37,065 square miles. Its tailrace would be at altitude 2,455, the full pool altitude of the C. J. Strike Reservoir. The Indian Cove reservoir would have a capacity of 70,000 acre-feet with backwater at altitude 2,490 feet. The Pasture-Indian Cove combination probably would inundate some of the lands now being studied for irrigation by pumping from the Snake River. The Indian Cove reservoir, however, would reduce pumping requirements on other lands which might be substituted for those inundated.

The Bureau of Reclamation-Corps of Engineers study includes many small reservoirs for irrigation purposes on the creeks joining the Snake River in the reach between Hammett and the vicinity of Mountain Home, but none of them have possibilities for development of waterpower.

In the vicinity of and downstream from the mouth of the Bruneau River the Snake River canyon widens into flat benches that continue on both sides of the river to the vicinity of Swan Falls development. The Bureau of Reclamation-Corps of Engineers study included an irrigation project which would use water pumped from the Snake River and would provide water for 36,950 acres of new land at a higher altitude from the Bruneau River and by pumping from other creeks entering the Snake River from the left bank in this vicinity. The report lists many reservoir sites in the Bruneau River basin but inadequate runoff, high unit cost, unfavorable geology, and economic infeasibility make them unattractive for development at this time (Bureau of Reclamation-Corps of Engineers, 1961, v. 1, table 21, p. 10). The Forks dam and reservoir site on the Bruneau River with damsite in sec. 4, T. 10 S., R. 7 E., with a storage capacity of 100,000 acre-feet is considered as an alternative to the above-mentioned pumping from the C. J. Strike Reservoir for the Wickahoney Division. Another alternative, with a higher unit cost, is the Hot Springs dam and reservoir site in sec. 13, T. 8 S., R. 6 E., of the Bruneau River.

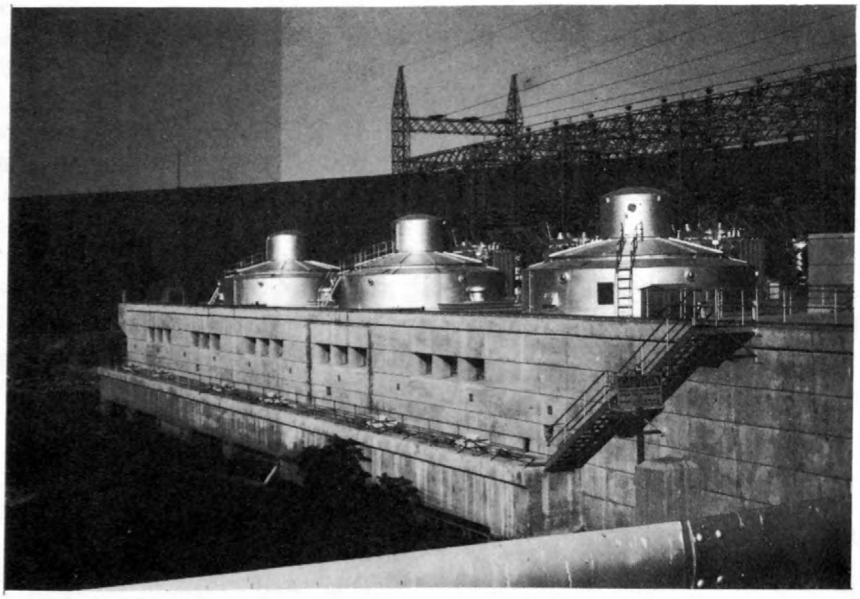
By developing high heads, the Bruneau River could be made to produce some waterpower and its potential is measured in the following sites: Jarbidge site (13-1627+50) on the Bruneau River near mile 59, sec. 33, T. 12 S., R. 7 E., just downstream from the mouth of Jarbidge River; Sheep Creek (13-1628+50) on the Bruneau River near mile 44.5, sec. 2, T. 11 S., R. 7 E., where the drainage area is 1,612 square miles; The Forks site (13-1685+20) is on the Bruneau River at mile 37, sec. 4, T. 10 S., R. 7 E. This site has a drainage area of 2,300 square miles. Head development would be between altitudes 4,000 and 3,700, 3,700 and 3,400, and 3,400 and 3,180 feet, respectively. The Bruneau Canyon-Hot Springs site (13-1685+50) at mile 25.7, sec. 13, T. 8 S., R. 6 E., has a drainage area of 2,546 square miles. The Bureau of Reclamation-Corps of Engineers study (1961, sheet 10 of table 1B.1), lists the Hot Springs reservoir as being too costly.

Further, the damsite is not suitable topographically for a dam to raise the water to the Forks site tailrace altitude of 3,180 feet. In order to raise the water to that altitude, the dam would have to be located at mile 27.4, sec. 24, of the same township. Water surface at this damsite is 2,740 feet and a dam that would raise it to altitude 3,180 feet would have a crest length of about 700 feet. By including some tunneling a conduit 5 or 5½ miles long would reach the powerhouse site at altitude 2,600 feet near mile 22, sec. 35, T. 7 S., R. 6 E. The powerhouse site is near the Harris diversion dam, one of the most upstream irrigation ditch heads on the lower river. This arrangement actually makes two sites out of the reach of river but, since development will likely not occur in the foreseeable future, it is used to measure the gross theoretical power.



C. J. Strike Dam, Snake River, Idaho, July 21, 1964

The C. J. Strike Plant (13-1715) of the Idaho Power Company was constructed in 1952 under F.P.C. authority, Project 2055. The dam is at mile 492, sec. 34, T. 5 S., R. 4 E., and the drainage area is 40,786 square miles. The reservoir backs about 15 miles up the Bruneau River and about 30 miles up the Snake River, and has a gross capacity of 250,000 acre-feet. Most of this storage is required to maintain head. C. J. Strike Dam is earthfill, 132 feet in structural height, 3,220 feet long at the crest and contains 2,320,000 cubic yards of fill. The powerplant tailrace is at altitude 2,367 feet and the full reservoir is at altitude 2,455 feet. ***



C. J. Strike Powerplant, Snake River, Idaho, July 21, 1964

*** The Swan Falls Powerplant (13-1725+10) was constructed in 1901 by the Trade Dollar Consolidated Mining Co. The present plant, dating to the 1910-1918 period, is owned by Idaho Power Company. The dam is at mile 456, sec. 18, T. 2 S., R. 1 E. The undeveloped power value of this reach has been assigned to the Guffey site.

The Guffey damsite (13-1725+20) is at mile 445.5, sec. 27, T. 1 S., R. 2 W., where the water surface altitude is about 2,250 feet above sea level. The drainage area is 42,064 square miles. A dam that would raise the water 117 feet would create a reservoir extending to the C. J. Strike tailrace. This is 13 feet higher than the plan described in the Bureau of Reclamation-Corps of Engineers report (1961, v. 4, p. 334). The study recommended an earthfill dam 125 feet above streambed (210 feet overall height) with a maximum water surface altitude of 2,354 feet and an 85-MW powerplant to provide power for pumping to irrigate lands in the Mountain Home project.

The principal facilities planned for the Guffey, Long Tom, and Hillcrest units, Mountain Home Division, are the Long Tom Diversion downstream from Anderson Ranch Dam and Powerplant on South Fork Boise River, Long Tom tunnel,

East and West Long Tom irrigation units, East and West lakes (reservoirs to catch waste water from West Long Tom unit), and Guffey dam and powerplant. The purpose of power production would be to meet the heavy irrigation pumping needs. Surplus power will be marketed by Bonneville Power Administration. The Guffey powerplant would operate principally as a run-of-river plant and the main purpose of Guffey dam is to provide head. A total of 130,750 acres of land will be irrigated and shortages for 325,000 acres of presently irrigated land will be eliminated according to the June 1965 proposed report of the Bureau of Reclamation.

Exchange of ground water for Boise River water was considered, as was a 30 MW powerplant at Lucky Peak. The present proposal substitutes storage in Lucky Peak reservoir and water pumped from the Snake River in place of the ground water exchange. A 25 MW powerplant was considered but no longer recommended. The plant would have been located in sec. 3, T. 6 S., R. 6 E., and would have operated on water diverted at the Long Tom diversion dam (Indian Point) on Boise River. The Canyon Creek plant would have operated during the irrigation season only.

The possibility of constructing a dam at the Marsing site (13-1725+30) mile 425, sec. 14, T. 2 N., R. 4 W., was also investigated by the Bureau of Reclamation and Corps of Engineers study group (1961, sheet 7, table 21, v. 1). The study found the Guffey site preferred. Drainage area at the Marsing damsite is 42,450 square miles and a dam 2,800 feet long would raise the water surface from altitude 2,220 to the Guffey tailrace 2,250 feet above sea level.

An additional power possibility for which no studies are known is the Blackjack-Butte site (13-1730+50). A dam at mile 397.2, sec. 3, T. 22 S., R. 46 E., Willamette Meridian, Oregon, would back water to the Marsing site tailrace. The drainage area is 43,110 square miles and the water surface of the Snake River is 2,180 feet. The Marsing and Blackjack-Butte reservoirs would completely fill the river channel in the vicinity of Homedale and Marsing and they probably would have to be drawn down during periods of high water to prevent damage to farmlands and improvements in that vicinity. These low heads might be suitable for development by dams with bulb units installed in the sluice gates.

Owyhee River

The Owyhee River rises in a high rolling rugged region in north central Nevada and flows generally northward to its confluence with the Snake River about five miles south of Nyssa, Oregon. Its drainage area is about 11,300 square miles, 2,850 of which are in Idaho. The only cultivated lands in the Owyhee Basin inside Idaho are the Duck Valley Indian Reservation at the Idaho-Nevada boundary on the main river and in the Pleasant Valley area of Jordan Creek on the Idaho-Oregon boundary. There are no known proposals to develop reservoirs for water conservation or waterpower inside Idaho.

Two possible developments by dam and reservoir are used to measure the gross theoretical potential power of the Owyhee River in Idaho. Each of these sites is assumed to be developable even though topographic maps in the area are not suitable for determining altitudes and dam dimensions. Juniper Canyon (13-1760+40) is the most upstream of these sites. The damsite is about five miles downstream from Juniper Canyon in sec. 19, T. 14 S., R. 1 W., where the drainage area is 1,140 square miles. Water raised from an altitude of 4,800 feet to an altitude of 5,200 feet as shown on the Jordan Valley 1:250,000-scale quadrangle map would reach the vicinity of the irrigated lands in Duck Valley.

The Red Canyon site (13-1776+50) is at mile 184, sec. 15, T. 13 S., R. 5 W., where the drainage area is 4,949 square miles. The damsite is about two miles downstream from the junction of the main river and the South Fork Owyhee River. Some maps designate the Owyhee in this area as the South Fork Owyhee River and the Owyhee River upstream from this point as the East Fork Owyhee River. The Water Resources Division discharge records show both these reaches to be the Owyhee River. We prefer the Water Resources Division names.

Boise River

The Boise River is formed by the junction of its north and middle forks in T. 4 N., R. 7 E. It flows generally southwest to the mouth of the South Fork, now in the backwater of Arrowrock Dam. A fourth large tributary, Mores Creek, drains an area of 426 square miles and empties into Lucky Peak Reservoir. The North Fork drains 382 square miles and has its source on the southwest slopes of the Sawtooth Range. The Middle Fork drains 380 square miles and originates among high peaks of the Sawtooth Range about 15 miles southwest of North Fork. The South Fork drains 1,300 square miles. From T. 5 N., R. 13 E., it flows between the Sawtooth Mountains on the north and Soldier Mountain on the south. Its course is generally south to Smoky Creek and west to Featherville. It then makes a semicircle south, southwest, west, and northwest to its mouth. Downstream from the South Fork the river's course is almost west. It leaves its canyon about six miles upstream from Boise and flows across the broad Snake River valley to its junction with the Snake River in T. 6 N., R. 6 W.

There is confusion between mileage numbers assigned by different agencies on these streams. The mileages shown for the Boise River and for the Middle Fork Boise River are miles from the river survey map of Middle Fork Boise River made by the Geological Survey in 1927, adjusted to the mouth of the Boise River by adding 74 (the CBIAC mileage for Arrowrock Dam and the apparent zero point for the river survey.

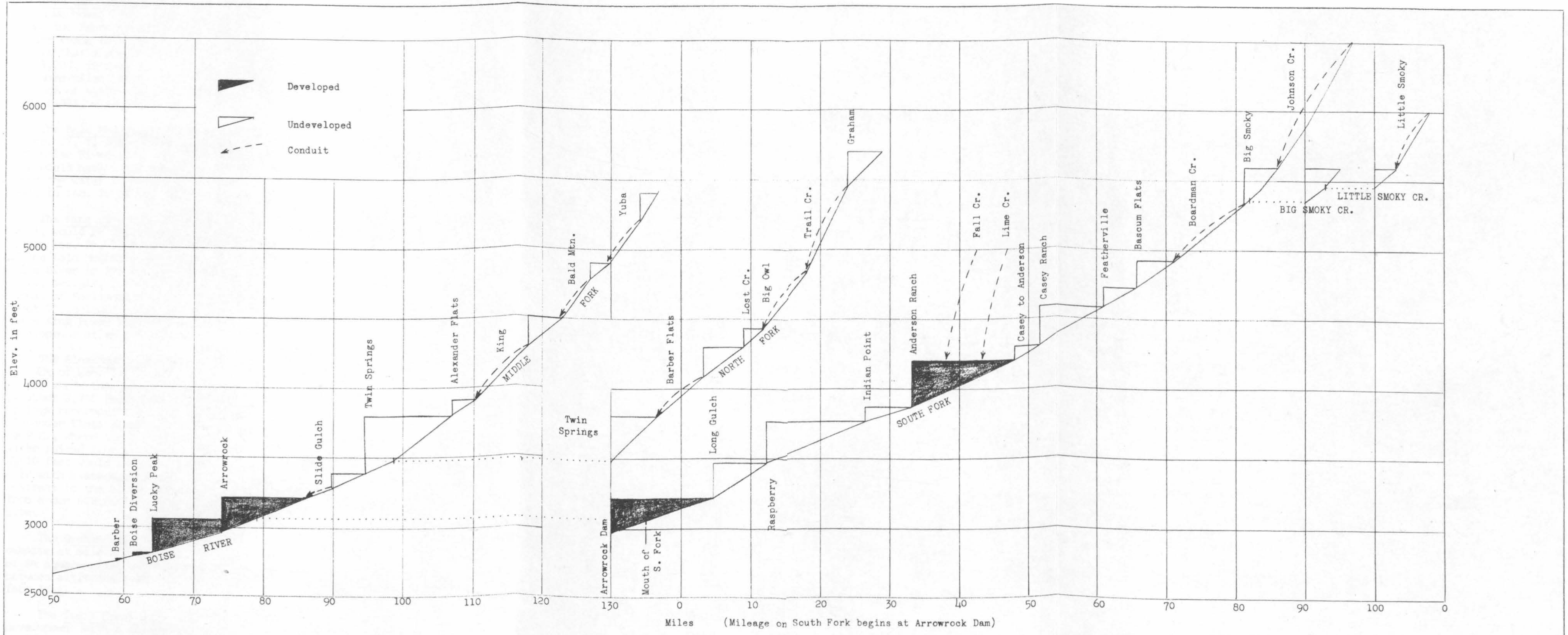


FIGURE 7.--PROFILE OF BOISE RIVER AND TRIBUTARIES SHOWING DEVELOPED AND UNDEVELOPED POWERSITES

Yuba dam and reservoir (13-1840+05) on Middle Fork Boise River, with powerhouse site at mile 129.9, sec. 36, T. 6 N., R. 10 E., replaces two formerly developed sites (Atlanta and Monarch) including a short reach of river that was undeveloped between them. The assumption is that a dam 200 feet high would be built at water surface altitude 5,200, in sec. 3, T. 5 N., R. 11 E., where the drainage area is 63 square miles, with a four-mile conduit to the powerhouse at an altitude of 4,900 feet. The Bureau of Reclamation-Corps of Engineers study (1961, v. 1, table 21, sheet 7) preferred Twin Springs site.

The Bald Mountain site (13-1840+10) would be developed by a dam in sec. 27, T. 6 N., R. 10 E., where the drainage area of the Middle Fork Boise River is 182 square miles. The water surface in the reservoir would have a maximum altitude of 4,900 feet and a conduit would carry the water to the powerhouse site at mile 123.1, altitude 4,500 feet, in sec. 29 of the same township.

The King site (13-1840+15), also known as Boise King Power Project No. 1, would be essentially a run-of-river development with a 220-foot dam in sec. 34, T. 6 N., R. 9 E., to raise the water to the tailrace of the Bald Mountain site where the drainage area of the Middle Fork Boise River is 225 square miles. The powerhouse would be at mile 110.3, sec. 11, T. 5 N., R. 8 E. at the 3,910-foot altitude. The Bureau of Reclamation-Corps of Engineers study (1961, v. 1, table 21, sheet 7) included two sites to develop this 590 feet of head (the Boise King Power Project Nos. 1 and 2). The report does not recommend development at this time.

The Alexander Flats site (13-1840+20) was originally located in the NE¼ of sec. 24, T. 5 N., R. 7 E. (river mile 105.1) (Hoyt, 1935, p. 86) where the normal water surface of the Middle Fork Boise River is about 3,730 feet above sea level. To accomodate the higher Twin Springs reservoir now being studied by the Corps of Engineers, the Alexander Flats damsite is here located at mile 107, sec. 17, T. 5 N., R. 8 E., where the Middle Fork Boise River drains 356 square miles. Water raised from its present surface of about 3,800 feet to altitude 3,910 feet would require a dam 700 feet long and would create a reservoir with a storage capacity of about 15,000 acre-feet. This is in contrast to the 50,000 acre-foot reservoir that would have resulted from a dam 600 feet long to altitude 3,910 feet at the downstream site.

The Graham site (13-1840+30) on the North Fork Boise River with damsite at mile 34, sec. 19, T. 7 N., R. 10 E., has a drainage area of 84 square miles and would create a reservoir of 44,000 acre-feet between altitudes 5,450 and 5,700 feet. The dam would be about 1,100 feet long.

The Trail Creek site (13-1840+40) would be a diversion-conduit development with a diversion dam near the Graham site in sec. 19, T. 7 N., R. 10 E., where the drainage area of the North Fork Boise

River is 84 square miles, and a 5.8-mile conduit to a powerhouse site, altitude 4,850 feet, in sec. 28, T. 7 N., R. 9 E., (river mile 28.2). Other planners have suggested a lower head development for this site.

The Big Owl site (13-1840+50) also known as Lower Deer Park site would divert water at the mouth of Trail Creek, sec. 28, T. 7 N., R. 9 E., (drainage area 111 square miles) and carry it to a powerhouse site in sec. 3, T. 6 N., R. 8 E. (river mile 21.8). The diversion would be 6½ miles long and would develop head between altitudes 4,850 and 4,435 feet.

The Lost Creek site (13-1840+60) would develop head between altitudes 4,435 feet and 4,300 feet by a dam about 500 feet long in sec. 17, T. 6 N., R. 8 E., (river mile 18.9) or by a diversion about 2.8 miles long to that point from the Big Owl tailrace in sec. 3, T. 6 N., R. 8 E. The drainage area at the damsite is 186 square miles.

The Barber Flats site (13-1840+70) with the damsite at mile 13.2, sec. 6, T. 5 N., R. 8 E., where the drainage area of the North Fork Boise River is 310 square miles, would create a reservoir of 76,000 acre-feet (Bureau of Reclamation-Corps of Engineers, 1961, v. 1, table 21, sheet 7). A 5½-mile conduit along the left bank would reach the powerhouse site at mile 6.7, sec. 15, T. 5 N., R. 7 E., at the Twin Springs projected backwater. Total head would be 500 feet, 220 feet by dam and 280 by conduit, and probably would be developed in two segments each having its own powerhouse.

The Twin Springs damsite (13-1845+90) is in secs. 7 and 18, T. 4 N., R. 7 E., at mile 94.5 of the Boise River where the drainage area is 816 square miles. The Bureau of Reclamation-Corps of Engineers study found this site preferable for construction at this time to other sites on the Boise River and recommends early construction of the project. A rockfill dam with impervious core has been recommended. The project will be multiple purpose and the dam will be capable of raising the water from its present altitude of 3,395 feet to 3,800 feet above sea level. The spillway crest elevation will be 3,765 and Taintor gates will control the storage above that elevation. Storage capacity of the reservoir is 410,000 acre-feet at maximum pool and usable storage above altitude 3,665 is 285,000 acre-feet. A total of 40 MW in two equal-sized units will be installed in the powerhouse. At altitude 3,810 feet the dam will have a crest length of about 1,300 feet. Including the spillway the length of the structure will be about 1,700 feet (Bureau of Reclamation-Corps of Engineers, 1961, v. 4, p. 350).

The Slide Gulch site (13-1850) would be developed by a dam in sec. 22, T. 4 N., R. 6 E., on the Middle Fork Boise River, and a two-mile tunnel to the powerhouse site at mile 86.1, sec. 28 or 29, T. 4 N., R. 6 E., at the backwater limits of Arrowrock Reservoir. Head development would be between altitudes 3,395 and 3,215 feet.

The Johnson Creek site (13-1855+10) is based on the diversion of 35 square miles of Johnson Creek and Ross Fork drainage in the South Fork Boise River headwaters at an altitude of 6,500 feet on each stream and carry the water, either on the right or left bank of the South Fork Boise River to a power drop site at mile 95.7, sec. 27, T. 4 N., R. 13 E., near the mouth of Skunk Creek where the water surface is at an altitude of 5,600 feet. More investigation should be made to determine whether the estimated amounts of water at Q95, Q50, and average discharge are available. The powerhouse site has been selected to conform with the Big Smoky site maximum flow line. Drainage area to the powerhouse site is about 90 square miles and, it is possible that the Johnson Creek site might be developed by a dam there or at an intermediate site upstream. This would increase the amount of water at the expense of head.

The Little Smoky site (13-1855+20) might be a combination dam and conduit development. The Bureau of Reclamation-Corps of Engineers study included a reservoir site at the Worswick Hot Springs, mile 7.7, sec. 28 or 33, T. 3 N., R. 14 E., that would have a capacity of 12,000 acre-feet. The study found that this site was not needed because Anderson Ranch regulates the river. Little Smoky would divert at the Worswick damsite and carry the water about 4½ miles by tunnel and conduit to the Big Smoky site backwater limit of 5,600 feet altitude in Little Smoky Creek, sec. 19, T. 3 N., R. 14 E.

The Big Smoky site (13-1855+30) assumes the creation of a reservoir behind a dam in sec. 8, T. 3 N., R. 13 E., mile 91.1, drainage area 324 square miles, on the South Fork Boise River. The powerhouse would be combined with the dam. Head development would be between altitudes 5,600 and 5,330 feet.

The Boardman Creek site (13-1855+40) would divert the water in sec. 8, T. 3 N., R. 13 E., at the Big Smoky tailrace and carry it about seven miles to the powerhouse site at mile 81, sec. 17, T. 3 N., R. 12 E., to develop the South Fork Boise River between altitudes 5,330 and 4,930 feet. This reach of river has often been divided into smaller sites for which head might be developed by dams or by shorter conduits.

The Bascum Flats site (13-1855+50) would be by a dam 200 feet high at mile 75.5, drainage area 447 square miles, sec. 9, T. 3 N., R. 11 E. This would develop the fall in the South Fork Boise River between altitudes 4,930 and 4,730 feet. This would flood Bascum Flats and create a reservoir with a capacity of about 90,000 acre-feet. The damsite is near the head of the canyon downstream from Willow Creek and is in a granite outcrop.

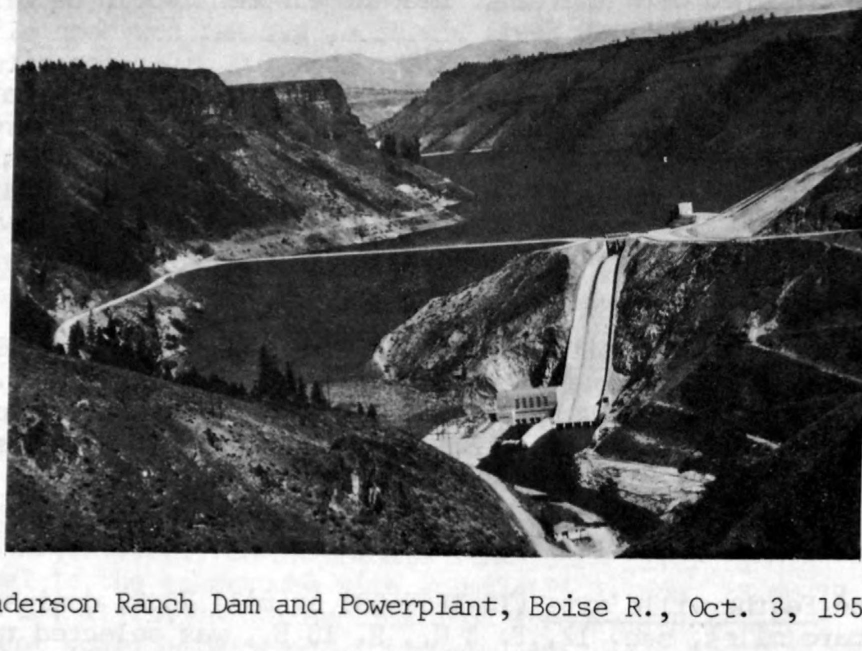
The Featherville site (13-1855+60) at mile 70.8, drainage area 465 square miles, sec. 12, T. 3 N., R. 10 E., was selected to develop 150 feet of head between altitudes 4,730 and 4,580 feet on the South Fork Boise River. The river flows through a narrow canyon 4.7 miles long in this reach and the reservoir would not be large.

The Casey Ranch (Dog Creek site) (13-1860+10), would develop 280 feet of head (altitudes 4,580 to 4,300 feet) by a dam at mile 61.7, sec. 7, T. 2 N., R. 10 E., where the drainage area on the South Fork Boise River is 627 square miles.

The Casey Ranch to Anderson site (13-1860+20) would develop 102 feet of head remaining between the Casey Ranch site and the Anderson Ranch Reservoir backwater, altitudes 4,198 to 4,300 feet. The powerhouse site selected is at mile 57.9, sec. 30, T. 2 N., R. 10 E., and the drainage area is the same as for the Casey Ranch reservoir site.

The Lime Creek site (13-1864+80) by a diversion from Lime Creek at altitude 5,000 feet in sec. 8, T. 1 N., R. 11 E., and by conduit along the right bank of the creek to the backwater altitude from Anderson Ranch Reservoir in sec. 16, T. 1 N., R. 10 E., (about five miles) could pick up an unnamed tributary and have an effective drainage area of 120 square miles.

The Sawmill site (13-1869+80) would divert water from 40 square miles above altitude 5,000 feet drained by Fall Creek, a right bank tributary, and would carry the water, probably along the right bank of Fall Creek, to a point near the backwater altitude from Anderson Ranch. The diversion site is in sec. 28, T. 2 N., R. 9 E., and the powerhouse site in sec. 16, T. 1 N., R. 9 E.



Anderson Ranch Dam and Powerplant, Boise R., Oct. 3, 1959

*** The constructed Anderson Ranch Dam (13-1900), sec. 1, T. 1 S., R. 8 E., river mile 43.2, drainage area 980 square miles, was completed in 1951 by the Bureau of Reclamation. The dam is earthfill, 456 feet in structural height, 1,350 feet long at the crest, and utilizes 9,653,000 cubic yards of fill. The capacity of the reservoir is 493,200 acre-feet (423,000 acre-feet active) for irrigation, power and flood control. The powerplant has 27 MW installed. The normal pool is at altitude 4,196 feet and a head of 330 feet is developed. The 1960 plant factor was 58 percent.

Between the Anderson Ranch tailrace and the Arrowrock backwater limit a head of 652 feet might be developed by dams at the Indian Point, Raspberry, and Long Gulch damsites.

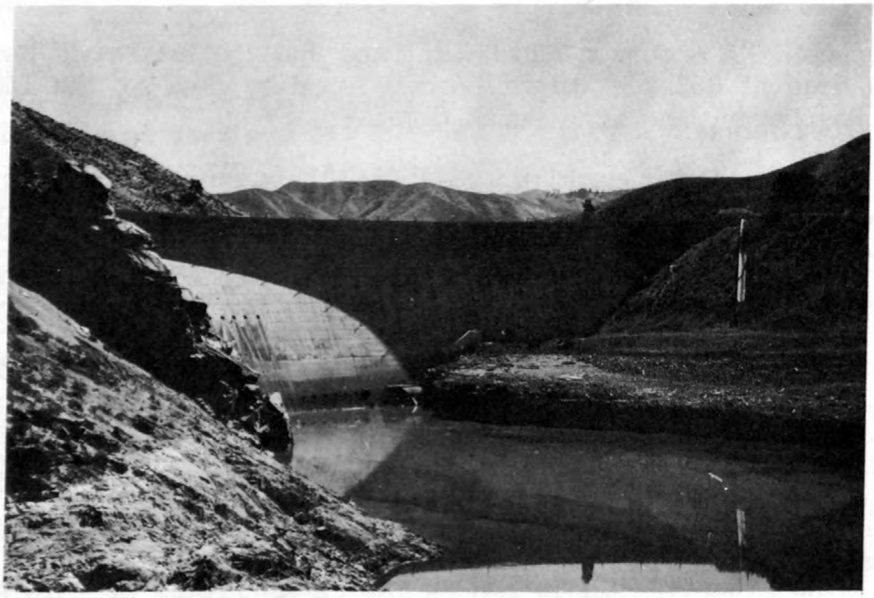
The Indian Point damsite (13-1905+10) is in the northwest quarter of sec. 8, T. 1 S., R. 8 E., mile 36.4, where the drainage area of the South Fork Boise River is 1,001 square miles. A dam at this site that would raise the water surface from 3,770 feet to the Anderson Ranch tailrace (altitude 3,868 feet) would have a crest length of about 515 feet. To measure the potential power it is assumed that all of the water passes on downstream and none diverted to the Mountain Home project which diversion is now being studied (Bureau of Reclamation-Corps of Engineers 1961, v. 1, p. 7-125). The Bureau-Corps studies call the Indian Point dam the Long Tom diversion dam. A tunnel 6.95 miles in length, capable of carrying 1,900 cubic feet per second is being studied. The Bureau-Corps studies include a plan to replace the Boise River water with ground water. The diversion would reduce the capabilities of this site as well as those downstream from it on Boise River.

Canyon Creek powersite (13-1905+15) is in sec. 3, T. 3 S., R. 6 E. The plant was planned as a unit in the related Guffey, Long Tom, and Hillcrest units, Mountain Home Division, but has now been eliminated from the plan. Water diverted at the Long Tom diversion site would have been rediverted into a power canal from Canyon Creek in sec. 12, T. 2 S., R. 6 E. The power diversion canal would have been 6.5 miles long and an installed capacity of 25 MW was planned. This site is not included for the purpose of determining gross theoretical waterpower as all of the water now flowing past the Long Tom diversion point is accounted for in powerplants on the Boise River.

Raspberry damsite (13-1905+20) is in sec. 30, T. 2 N., R. 7 E., mile 22.3, where the drainage area is 1,090 square miles. The damsite is in a narrow canyon section immediately upstream from Raspberry Gulch Rapids and a dam that would raise the water surface to an altitude of 3,770 feet is used to measure the potential waterpower. Several locations in about one-fourth mile of river might be suitable for the dam and the water surface altitude is about 3,475 feet. By taking advantage of the rapids below the damsite an additional five feet of head could be realized. If the narrowest canyon section is selected the crest length of the dam would be about 800 feet.

The third site, Long Gulch (13-1905+30) is in sec. 34, T. 3 N., R. 6 E., mile 14.7, where the drainage area is 1,174 square miles, at the backwater limit of the existing Arrowrock Reservoir, altitude

3,216 feet. A dam that would raise the water surface from this altitude to the Raspberry site tailrace altitude of 3,475 feet would be about 600 feet long at the crest.



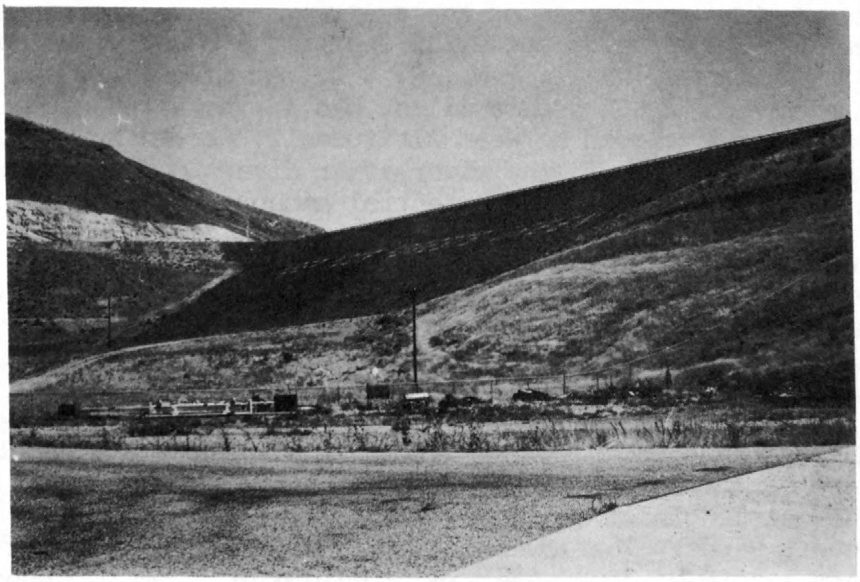
Arrowrock Dam, Boise R., Sept. 9, 1960

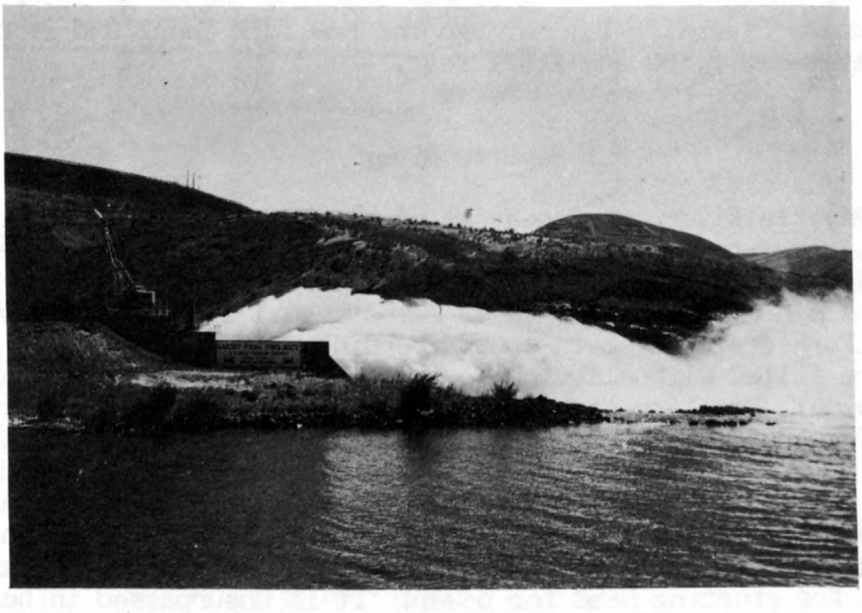
*** Arrowrock Reservoir (13-1940) is formed by a dam in sec. 13, T. 3 N., R. 4 E., 74 miles above the mouth of the Boise River. The drainage area is 2,210 square miles. The dam is a gravity arch 305 feet in structural height and 1,150 feet long at the crest. The volume of concrete in the dam is 635,969 cubic yards. The dam was built by the Bureau of Reclamation in 1915 for irrigation and flood control. It raises the Boise River from an altitude of about 2,950 feet at the dam to 3,216 feet and stores 286,600 acre-feet. There are no known proposals to add a powerplant. The Arrowrock and Lucky Peak sites are included with undeveloped powersites with a capacity of 20 MW or more at Q50 discharge in table 5 and with the developed sites, because of their reservoirs, in table 12.

*** Lucky Peak Dam (13-2015) is on the Boise River in sec. 12, T. 2 N., R. 3 E., at mile 63.8. The drainage area is 2,680 square miles. Lucky Peak Dam was built in 1955 by the Corps of Engineers for irrigation and flood control. It is an earthfill dam with a structural height of 340 feet and a crest length of 1,700 feet. It contains 6,299,000 cubic yards of fill. The tailwater altitude at Lucky Peak is about 2,820 feet, the normal pool water surface is about 3,060 feet, and the maximum pool is 3,072 feet. This backs water 110 to 122 feet higher than the toe of Arrowrock Dam when the flood control storage space is in use. Lucky Peak Reservoir has gross and active storage of 307,000 and 279,000 acre-feet, respectively.

Arrowrock Dam

USBR Photo





Lucky Peak Dam (upper) and
Lucky Peak ski-jump spillway (lower) Boise R., Idaho

The Bureau of Reclamation-Corps of Engineers study included plans for a 30 MW powerplant at Lucky Peak Dam. (Bureau of Reclamation-Corps of Engineers 1961, v. 1, p. 7, 127-132).

Downstream from Lucky Peak the Boise River has two small power developments. Boise Diversion Dam (13-2020+10) in sec. 3, T. 2 N., ***

R. 3 E., at mile 61.2 where the drainage area is 2,685 square miles, has a 1.5 MW powerplant. The dam and, the powerplant were constructed by the Bureau of Reclamation in 1912. It develops head between altitudes 2,787 and 2,818 feet. The constructed Barber
*** Plant (13-2025) in sec. 29, T. 3 N., R. 3 E., at mile 58.9, where the drainage area is 2,690 square miles, had an installed capacity of 1 MW. Head was developed between altitudes 2,753 and 2,767 feet. The plant has been dismantled. Flows estimated to remain in the river after diversions at the Boise Canal were used to determine the potential amounts.

*** Two Deer Flat Dams which form Lake Lowell (13-2035) are in sec. 35, (upper) and sec. 19, (lower), T. 3 N., R. 3 W. They could produce a small amount of power from discharges over and above present consumptive uses by diverting this surplus water at the Barber tailrace. Lake Lowell was completed in 1908 by the Bureau of Reclamation in an offstream reservoir site which required the damming of two ancient river channels in the broad valley between the Snake and Boise Rivers. Both dams are earthfill. The upper dam has a structural height of 74 feet, a crest length of 4,000 feet, and a volume of fill of 1,245,000 cubic yards. The lower dam has a structural height of 46 feet, a crest length of 7,200 feet and a volume of 1,240,000 cubic yards of fill. The reservoir stores a total of 190,100 acre-feet, 169,000 acre-feet of which is available for irrigation. Water is diverted from the Boise Diversion Dam through the New York Canal and is stored between altitudes 2,500 and 2,531 feet.

Payette River

The Payette River comes nearest of all Idaho's rivers to possession of balanced resources. Its South Fork is rugged and inaccessible, draining the Sawtooth Mountains from east to west. Its Middle Fork drains a north-south trench of almost equal inaccessibility. The North Fork drains a north-south trending trough whose upper reaches are filled with alluvium to form valleys which in places are 10 miles wide. The largest valleys are in the vicinity of Payette Lake and Cascade Reservoir. Downstream from Cascade Reservoir the stream is well sustained by flow from springs, and fall is rapid. The lower reaches of the main Payette are about half in canyon and half in broad fertile valley. The basin has timber, grazing land, mineral resources, dry and irrigated farmland, abundant water, and ample fall for creating head for power. It is unsurpassed in beauty and is the locale for some of the nation's best hunting and fishing grounds. Payette Lakes and Cascade Reservoir offer large water surfaces for water related recreational activities. Except for irrigation storage, however, the stream remains essentially undeveloped.

Payette River has been gaged for 27 years (1935 to 1962) at a gage 4.1 miles above its mouth in sec. 10, T. 8 N., R. 5 W. Its average discharge over that period was 3,052 cfs (2,210,000 acre-feet per year), excluding diversions above the station for irrigation of some 188,000 acres of land. Flow is regulated by Deadwood Reservoir

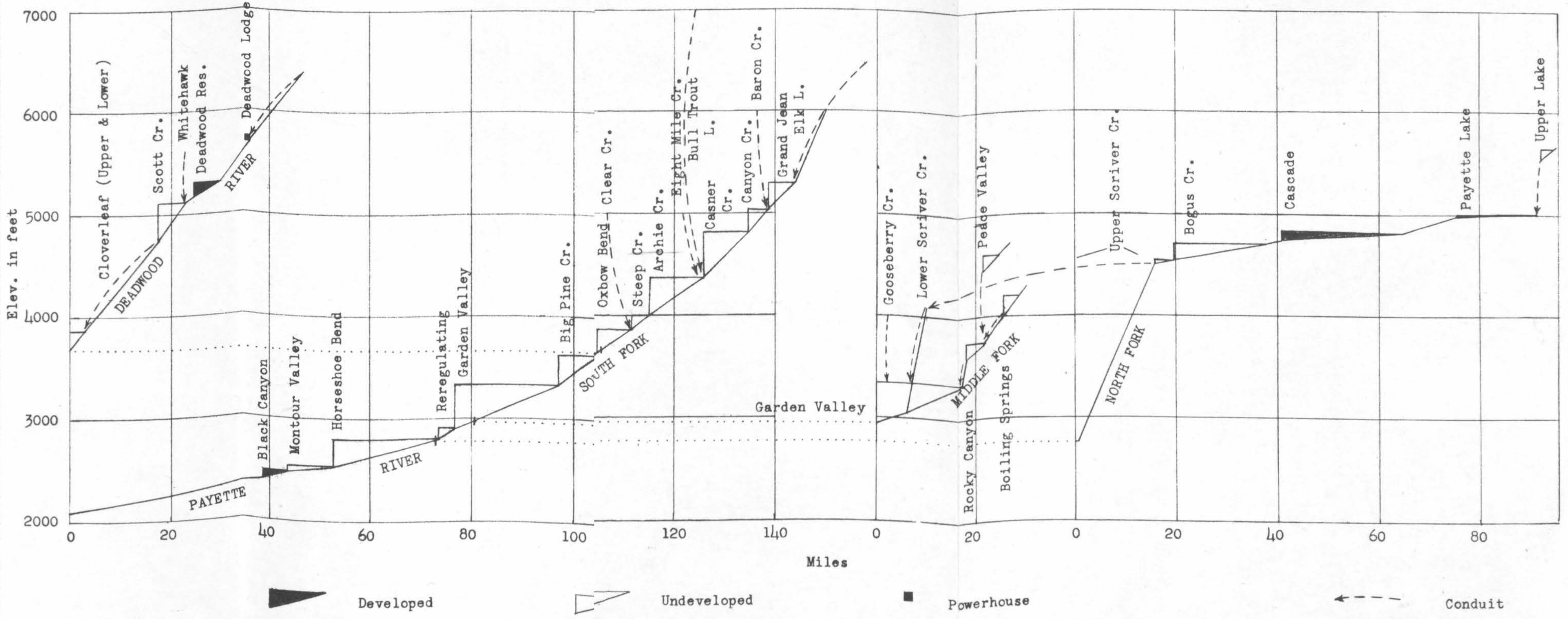


FIGURE 8.--PROFILE OF PAYETTE RIVER AND TRIBUTARIES SHOWING DEVELOPED AND UNDEVELOPED POWERSITES

on the Deadwood River, a tributary to the South Fork Payette River, by control of the natural Payette Lakes at McCall, by Cascade Reservoir, and by Black Canyon Reservoir.

The Bureau of Reclamation-Corps of Engineers report (1961, v. 1, p. 7-134 and forward) studies additional projects that appear to be desirable for providing irrigation water, flood control, hydroelectric power, plus conservation and recreation benefits. The study recommends an additional 80,000 acre-feet of storage on Gold Fork, pumping water from Cascade Reservoir to lands in Long Valley east and south of Cascade and to Round Valley bordering Long Valley on the south, an intrabasin diversion of water from North Fork by way of Scriver Creek to Garden Valley producing power on the way, and storage in a proposed Garden Valley reservoir together with powerplants and reregulating structures. The water stored in Garden Valley would be so regulated that it could furnish water for pumping to lands near Montour both north and south of the river, to lands on Little Willow Creek and Willow Creek south of the Payette River, and by further pumping to the Boise River basin. It could be pumped from there below Lucky Peak Dam to a large area of land, possibly 82,000 acres, on Initial Butte south of Boise between the Boise and Snake Rivers.

The Bureau-Corps of Engineers report leaves many power and storage sites in suspension as being substitutes for the developments chosen or as being less desirable because of physical characteristics and costs. In describing the potential powersites, these Bureau of Reclamation-Corps of Engineers projects will be mentioned as they are encountered in the downstream order of presentation. There is some confusion between mileage numbers assigned by different agencies. The mileages shown for the Payette River and the South Fork Payette River are miles on a river survey map made by the Geological Survey in 1925 adjusted to the mouth of Payette River.

The <u>Elk Lake project</u> (13-2340+80) assumes diversion from a drainage area of 28 square miles at an altitude of 6,500 feet, and a six-mile-long diversion probably along the right bank of the South Fork Payette River to a powerhouse site at altitude 5,300 feet. This area is poorly surveyed topographically and there are no cadastral surveys so that it is not possible to locate the site accurately. The powerhouse has been roughly located as being in unsurveyed T. 9 N., R. 11 E. (44° 06' N. and 115° 09' W.).

The <u>Baron Creek site</u> (13-2340+90) would be an alpine-type water collection development utilizing water at an altitude of about 6,000 feet from Goat, Baron, and Grand Jean Creeks, and dropping it to the Grand Jean powerhouse site in unsurveyed sec. 33, T. 10 N., R. 11 E., mile 138.8 (mile 65.8 of the 1925 river survey). It would have a drainage area of 36 square miles.

The <u>Grand Jean site</u> (13-2342) with a dam in unsurveyed sec. 33, T. 10 N., R. 11 E., where the drainage area is 121 square miles, would develop head between altitudes 5,040 and 5,300 feet. It was assigned a potential capacity of 88,000 acre-feet of water by the Bureau of Reclamation-Corps of Engineers study (1961, v. 1, table 21, sheet 8). The site was passed over for the Garden Valley proposal.

The Fogus site (13-2342+10) with a powerhouse site in sec. 27, T. 10 N., R. 10 E., mile 134.6, (mile 61.6 of the 1925 river survey) would utilize water from a drainage area of 20 square miles in the headwaters of Canyon Creek with the diversion at 5,800 feet and tailrace at 4,815 feet in the Canyon Creek site powerhouse.

The Canyon Creek site (13-2342+20) with a dam at mile 134.6, sec. 27, T. 10 N., R. 10 E., where the drainage area is 160 square miles on the South Fork Payette River, was passed over as a possible power development with high unit cost in the Bureau of Reclamation-Corps of Engineers study cited above. The site illustrated here would have a maximum water surface of 5,040 feet and a tailrace of 4,815 feet in altitude.

The Bull Trout Lake site (13-2342+25) as illustrated would divert from 14 square miles on Warm Springs Creek in unsurveyed sec. 8, T. 11 N., R. 10 E., at 7,000 feet. A 10-mile long conduit near the top of the mountain, plus a two-mile long penstock would deliver the water to the Casner Creek powerhouse site in sec. 15, T. 9 N., R. 9 E., mile 125.7 (mile 52.7 of the 1925 river survey) at 4,375 feet. The drainage area includes a tributary with mouth below the damsite. If undertaken, a development here would include additional water from the Salmon River basin and a dam on Warm Springs and Cape Horn Creeks. The Bureau of Reclamation-Corps of Engineers report cited above reports unfavorable geology with possible excessive leakage from the 15,000 acre-foot reservoir studied.

The Casner Creek site (13-2342+30), sec. 15, T. 9 N., R. 9 E., mile 125.7 on the South Fork Payette River, has a drainage area of 251 square miles. Development of head between altitudes 4,375 and 4,815 feet is assumed to be by a dam. This site as shown would flood the Warm Springs site, sec. 32, T. 10 N., R. 10 E., and the Tenmile Creek site, sec. 7, T. 9 N., R. 10 E. The Bureau of Reclamation-Corps of Engineers study cited above found this site to be a possible power development with high unit cost.

The Eight Mile Creek site (13-2342+40) would utilize runoff from 22 square miles of Eight Mile Creek and its East Fork above 5,000 feet. The water would be dropped to generating equipment in the Casner Creek site powerhouse in sec. 15, T. 9 N., R. 9 E., and both plants would have a tailrace altitude of 4,375 feet.

The Archie Creek site (13-2342+50) in sec. 33, T. 9 N., R. 8 E., mile 115.2, has a drainage area of 369 square miles and would develop head between altitudes 4,375 and 4,000 feet. Like other sites in this vicinity the Bureau of Reclamation-Corps of Engineers study cited above found this site to have a high unit cost. The study also considered a damsite in sec. 32 of the same township and either site would be limited to 100 feet of head.

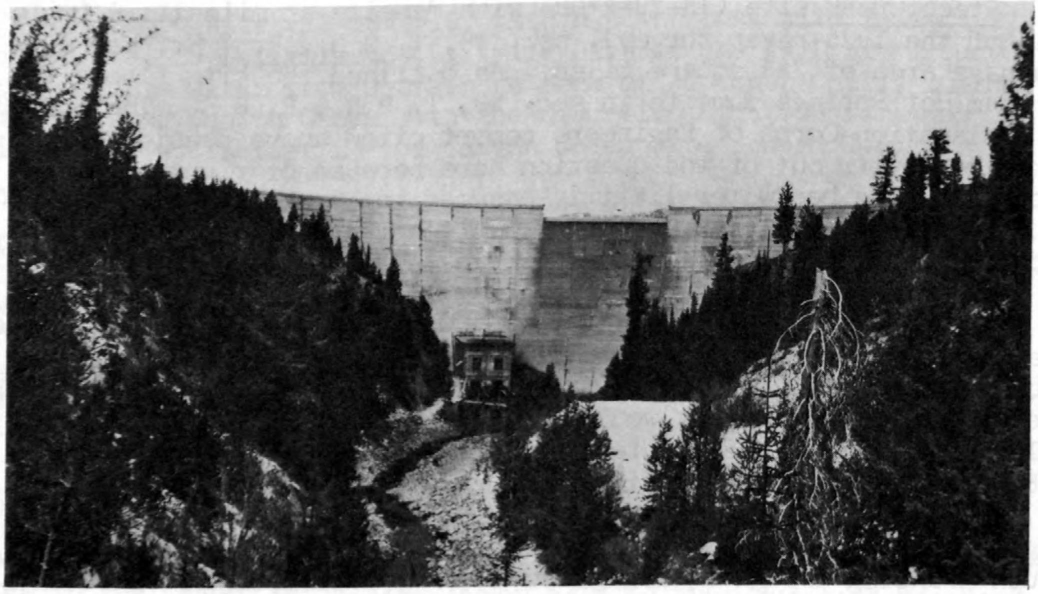
Steep Creek site (13-2342+60) with damsite at mile 111.6 (mile 38.6 of the 1925 river survey), sec. 36, T. 9 N., R. 7 E., has a drainage area of 383 square miles. As outlined the site floods the Kirkham Hot Springs damsite in sec. 33, T. 9 N., R. 8 E. The Bureau of Reclamation-Corps of Engineers report cited above considered a large reservoir out of the question here because of right-of-way problems. The backwater limit is assumed to be about altitude 4,000 and the tailwater altitude about 3,875 feet, according to the plan and profile made in 1925.

The Clear Creek site (13-2342+90) would redevelop, with a higher head, the private plant, Lowman (13-2342+95), for which the powerhouse is in sec. 27, T. 9 N., R. 7 E., near the mouth of Clear Creek. The projected development would have a drainage area of 41 square miles above altitude 5,000 feet and the tailrace would be about 3,875 feet connected by a five-mile-long conduit. ***

Deadwood River occupies the southward draining end of a north-south trending trough or fold in the Sawtooth Mountains. Johnson Creek, in the South Fork Salmon River basin, occupies the same depression north of the divide. Johnson Creek is parallel to the South Fork Salmon River and in its turn, Deadwood River is approximately parallel to the Middle Fork Payette River. The Deadwood River descends rapidly at first and then flows more leisurely in a valley that widens to three or four miles at the Deadwood Reservoir. Downstream from that point the canyon narrows and steepens again and the river flows in an almost inaccessible canyon for the remainder of its length to the Payette River which it joins in sec. 32, T. 9 N., R. 7 E.

The Deadwood Lodge Plant (13-2355+50) in sec. 11, T. 13 N., R. 7 E., utilizes water from about four square miles on Stratton Creek. The potential of this site would add another six square miles by diverting the main river and all right-bank tributaries to Stratton Creek at an altitude of about 6,400 feet. The present plant was constructed in 1924 in connection with a mining venture and serves the Deadwood Lodge, store, and cottages. ***

Deadwood Reservoir (13-2360) with a dam at mile 24.4, sec. 8, T. 11 N., R. 7 E., has a drainage area of 112 square miles. The crest of the spillway is at altitude 5,311 feet and the reservoir has a capacity of 161,900 acre-feet, all for irrigation. Storage began in 1930 and the dam was completed in 1931, by the Bureau of Reclamation. It is a gravity arch, 165 feet in structural height, having a crest length of 749 feet, and a volume of 56,360 cubic yards. The reservoir is capable of completely controlling the river and its Q50 discharge is not capable of generating 1,000 kilowatts of power. ***



Deadwood Dam, Deadwood R, June 6, 1960

Downstream from Deadwood Reservoir the river might have power developments at a number of locations. Three have been selected to represent the potential power value of the stream. Whitehawk site (13-2365+10) with the powerhouse site on the Deadwood River at mile 22.6, would gather water above 5,600 feet from a 32-square-mile drainage area composed of creeks entering the Deadwood River immediately downstream from the dam on the left bank, which are Wilson, Warm Springs, and Whitehawk. These creeks drain the west side of Whitehawk Mountain which reaches an altitude of more than 8,000 feet.

The Scott Creek damsite (13-2365+20) near mile 17.3, sec. 5, T. 10 N., R. 7 E., has a drainage area of 194 square miles. This site is assumed to be developed by a dam that would raise the water surface 360 feet from altitude 4,740 to altitude 5,100 feet approximately where the crest of the dam would be about 1,200 feet long.

The Cloverleaf site (13-2365+30) would have a reregulation and diversion dam immediately downstream from the Scott Creek site at altitude 4,740 and the water would be carried to the powerhouse site near mile 3, sec. 17, T. 9 N., R. 7 E., at the backwater limit (altitude 3,875 feet) on the Deadwood River of the Oxbow Bend site on the South Fork Payette River. The conduit would be about 12 miles long, or about two miles shorter than the course of the stream.

The Scott Creek and Cloverleaf sites as outlined would replace many possible developments of smaller capacity. The Bureau of

Reclamation-Corps of Engineers study cited above considered a project in the Scott Creek site area that would be effected by a 3.3 mile power tunnel from Deadwood Dam for power head. The Cloverleaf site of the Bureau-Corps plan was in sec. 8, T. 9 N., R. 7 E., where a tunnel half a mile long would develop a head of 200 feet and, in fact, such a development does not seem too unlikely. A dam at the Cloverleaf site in the NW¼ of sec. 8 that would raise the water surface from its present 4,240 feet to an altitude of 4,500 feet would be about 700 feet long at the crest. The 4,000-foot contour crosses the river less than three-fourths of a mile airline from the damsite so that a gross head of 500 feet could be created together with a substantial reservoir for controlling the releases from the Deadwood River and the inflow in the intervening reach.

The Oxbow Bend site (13-2365+50) as described here includes the Lowman site of the Bureau of Reclamation-Corps of Engineers 1961 report cited above. The damsite is assumed to be in the bend at mile 104.7 (mile 31.7 of the 1925 river survey), sec. 32, T. 9 N., R. 7 E., where it would have a crest length of about 400 feet at altitude 3,875 feet. An 800-foot-long tunnel through the narrow neck of the Oxbow would create an additional 30 feet of head (the altitude of the water surface at the damsite is about 3,660 feet). The powerhouse site is at mile 103.6, sec. 31. The backwater limit of the Oxbow Bend site determines the tailrace altitude of the Cloverleaf site on the Deadwood River, the Clear Creek site on Clear Creek, and the Steep Creek site on the South Fork Payette River. Drainage area at the damsite is 680 square miles.

Big Pine Creek site (13-2365+60) with damsite in sec. 33, T. 9 N., R. 6 E., mile 97, (mile 24 of the 1925 river survey), would develop the head between the tailwater altitude of the Oxbow Bend site, 3,630 feet, and the backwater limit of the Garden Valley reservoir site, altitude 3,335 feet. The Pine Flat site is included in this reach. Drainage area at the Big Pine Creek damsite is 715 square miles.

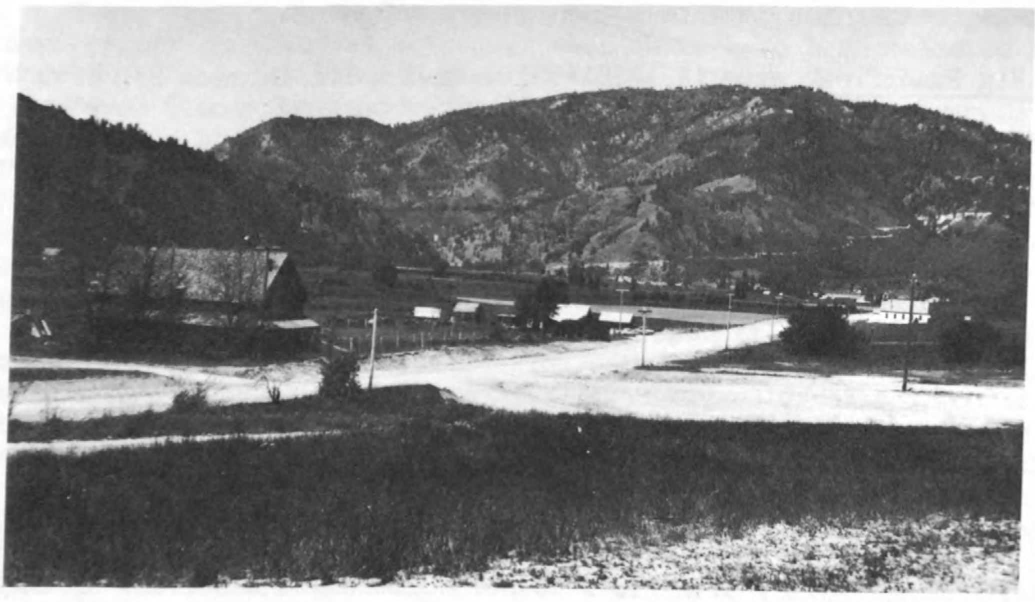
The Boiling Springs site (13-2375+50) would develop head between altitude 4,200 and altitude 3,750 at a powerhouse site in sec. 9, T. 11 N., R. 5 E., on the Middle Fork Payette River, at the backwater limit from the Rocky Canyon reservoir site. The drainage area at the diversion point, sec. 21, T. 12 N., R. 5 E., is 88 square miles. Two hundred feet of this head would be developed by the Boiling Springs dam and 250 feet in a four-mile-long conduit to the mouth of Silver Creek.

The Peace Valley site (13-2375+60) would use the Boiling Springs powerhouse site, would store 13,000 acre-feet of water in the Peace Valley reservoir site on Silver Creek (sec. 1, T. 11 N., R. 5 E.), and develop the head between the reservoir site altitude 4,600 feet and the powerhouse site altitude 3,750 feet in a three-mile-long conduit. Drainage area is 35 square miles.

The Rocky Canyon site (13-2375+70) with powerhouse near mile 17, sec. 29, T. 11 N., R. 5 E., and a drainage area of 180 square miles, includes site 12 GH 23 as studied by Hoyt (1935) and by the Bureau of Reclamation and Corps of Engineers (1961). A dam 700 feet long near the corner of secs. 20, 21, 28 and 29 in the same township would raise the water surface from its altitude of about 3,600 feet to altitude 3,750 feet. A conduit about three-fourths of a mile long would reach the powerhouse site at altitude 3,335 feet, the backwater limit of the Garden Valley reservoir site.

The Bureau of Reclamation-Corps of Engineers report cited above also investigated site 12 GH 24, a dam and reservoir, in sec. 32, T. 11 N., R. 5 E., on the Middle Fork Payette River. This site would have developed head between altitudes 3,200 and 3,300 feet but it will be flooded by the Garden Valley reservoir. The Bureau of Reclamation-Corps of Engineers report passed it over because of high unit cost and because of the superiority of the Garden Valley site.

The Gooseberry Creek site (13-2375+80) would utilize water by diversions from a drainage area of 53 square miles above 4,000 feet on Lightning, Pyle, and Anderson Creeks in a powerhouse site on Little Gooseberry Creek, sec. 2, T. 9 N., R. 4 E. The site is chosen to conform with the projected altitude of the Garden Valley reservoir as now planned.



Garden Valley reservoir site
and one of several possible damsites, Payette R., June 4, 1960

The Garden Valley reservoir site (13-2377+90), sec. 26, T. 9 N., R. 3 E., at mile 76.6 of the Payette River (mile 3.6 on the 1925 river survey) would control a drainage area of 1,195 square miles of the South and Middle Forks of the Payette River. The Bureau of Reclamation-Corps of Engineers' plan to divert water by way of Scriver Creek is used and the discharges from the North and Middle Forks are increased by the proposed diversion. The drainage area does not include any North Fork drainage. According to the Bureau of Reclamation-Corps of Engineers study (1961, v. 1, p. 7-139), the Garden Valley and Scriver Creek facilities would be multiple-purpose for future irrigation, power production at site and downstream therefrom, flood control, and recreation. Also included would be fish passage facilities for the protection of present runs and the re-establishment of anadronmous fish in the various Payette River tributaries.

The study contemplated the installation of 175 MW at the Garden Valley dam. The 1,940,000 acre-foot active capacity of Garden Valley reservoir would be achieved by raising the water surface from its present elevation of about 2,900 feet to an altitude of 3,335 feet. The gross head of 415 feet is between altitudes 3,335 and 2,920 feet, the backwater limit of the reregulating reservoir. According to the study, the Garden Valley plants would contribute about one-fourth of the energy produced by the powerplants included in the Payette Basin plan and the repayment of capital costs beyond the ability of irrigators to repay would benefit importantly from Garden Valley power. Garden Valley dam is to be a concrete arch 435 feet above the streambed with a crest length of 1,400 feet.

The Garden Valley reregulating dam (13-2380) sec. 28, T. 9 N., R. 3 E., at mile 73.5 (mile 0.5 on the 1925 river survey) will have a drainage area of 1,200 square miles. The Bureau of Reclamation-Corps of Engineers report cited above plans an installation of 36 MW at the concrete gravity dam which will be 130 feet above the streambed and will be 435 feet long. It will develop head between an altitude of about 2,800 feet and 2,920 feet.

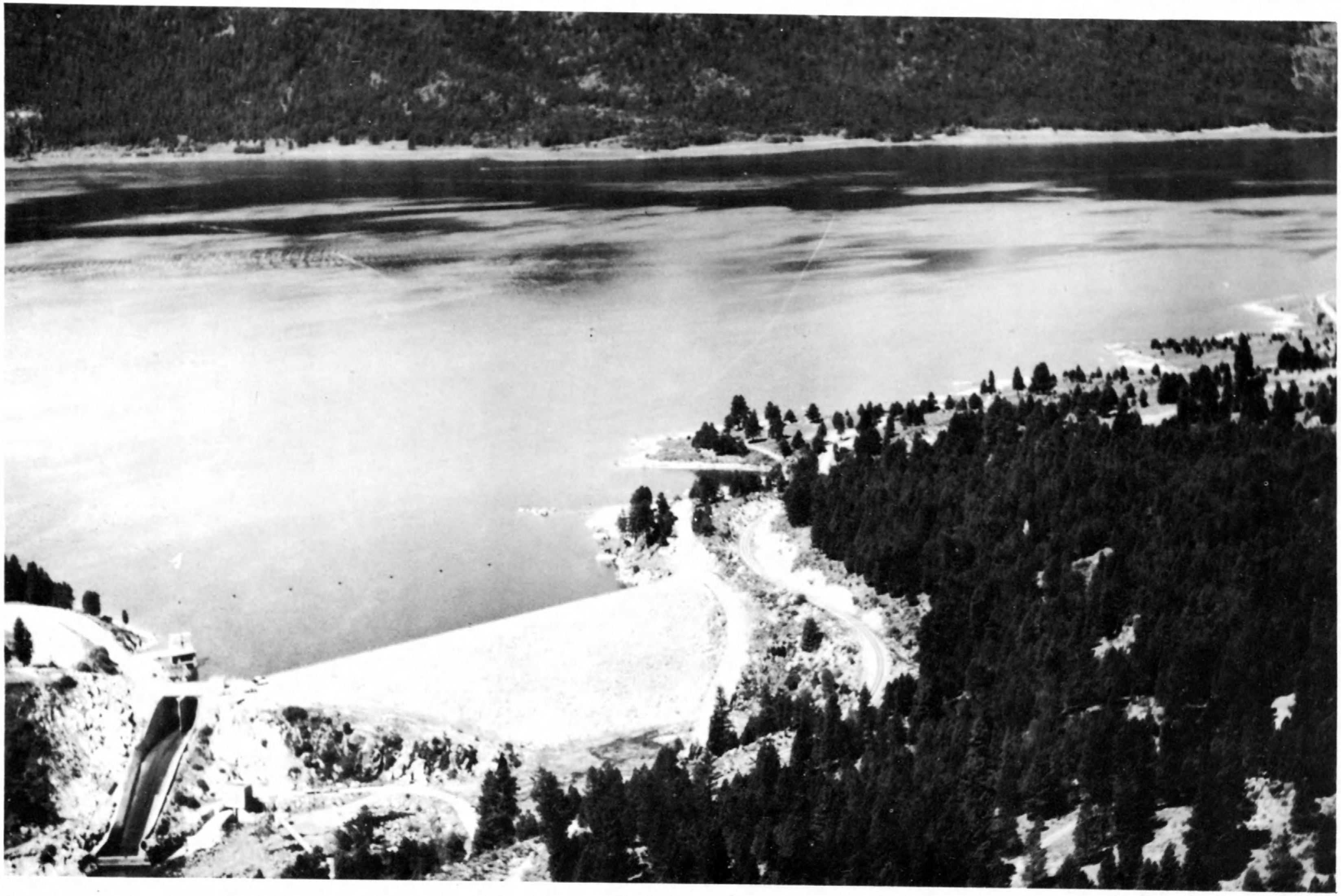
The Upper Lake project (13-2380+90) with a powerhouse site near mile 84 of the North Fork Payette River in sec. 35, T. 20 N., R. 3 E., utilizes the water from 66 square miles including right bank tributaries upstream from Fisher Creek (sec. 26, T. 20 N., R. 3 E.) at an altitude of 5,650 feet or higher. Raising the water surface of the lake from altitude 5,555 to 5,650 feet would impound 49,000 acre-feet of water. The conduit would be about six or seven miles long on the right bank between Upper Payette Lake and the powerhouse site and would pick up Deep and Fisher Creek water enroute. The Bureau of Reclamation-Corps of Engineers study (1961) eliminated the Upper Lake site in favor of Garden Valley and because of unfavorable geology at the damsite.

*** Payette Lake (13-2385) has been controlled since 1921 at mile 75.4 of the North Fork Payette River where the drainage area is 144 square miles. The dam, in sec. 8, T. 18 N., R. 3 E., as rebuilt in 1943 by the Lake Reservoir Company increases the capacity of the lake by 35,000 acre-feet and controls the lake between altitudes of about 4,983 and 4,990 feet. Lack of powersites and demands on Payette Lake water for irrigation eliminate the lake and the river between the lake and Cascade Reservoir from the potential power inventory.

Cascade Dam and Reservoir, N. F. Payette R., Sept. 19, 1961

*** The existing Cascade Plant (13-2445), sec. 26, T. 14 N., R. 3 E., at mile 40.8 of the North Fork Payette River probably is not in operation at this time. Cascade Dam completed in 1949 by the Bureau of Reclamation is an earthfill structure 170 feet in structural height with a crest length of 785 feet and a volume of dam of 395,000 cubic yards. The drainage area is 620 square miles. The powerhouse site might extend into sec. 25, where the former powerhouse is located. The reservoir stores 704,100 acre-feet of water (653,000 active) for irrigation, power, and flood control. The reservoir has become an important recreational facility. The potential power of the site assumes development between altitudes 4,735 feet and 4,828 feet at the damsite and would utilize the water measured at the gaging station at Cascade.

The Bogus Creek site (13-2450+80) would utilize the head created by a dam at mile 19.8 of the North Fork Payette River, sec. 2, T. 11 N., R. 3 E., at water surface altitude 4,528 feet, the backwater limit of the Upper Scriver Creek diversion reservoir. The drainage



Cascade Dam

USBR Photo

area is 869 square miles and the site, developing fall between altitudes 4,528 and 4,710 feet, leaves 25 feet undevelopable in Long Valley downstream from the Cascade tailrace.

The Bogus Creek site as described here replaces the Cabarton site and part of the Smith's Ferry section of the North Fork Payette River as described for possible development by Hoyt (1935, p. 283). About 10 miles of Union Pacific Railroad track would have to be relocated as would about two miles of State Highway 15. State Highway 15 is on the right bank of the river and leaves the river by way of Round Valley Creek. For the first six miles upstream from the damsite, the railroad follows the left bank of the river then crosses to the right bank for the remaining four miles of the reach that would require relocation. The railroad relocation will involve very extensive rock work if it is to be raised above the reservoir. There is a possibility, however, that the railroad, like Highway 15, might be removed from the river and, if right-of-way costs are not too high, be relocated at less expense. The reservoir would be about 10 miles long but would have a capacity of only 33,000 acre-feet because of the narrowness of the canyon throughout the reach.

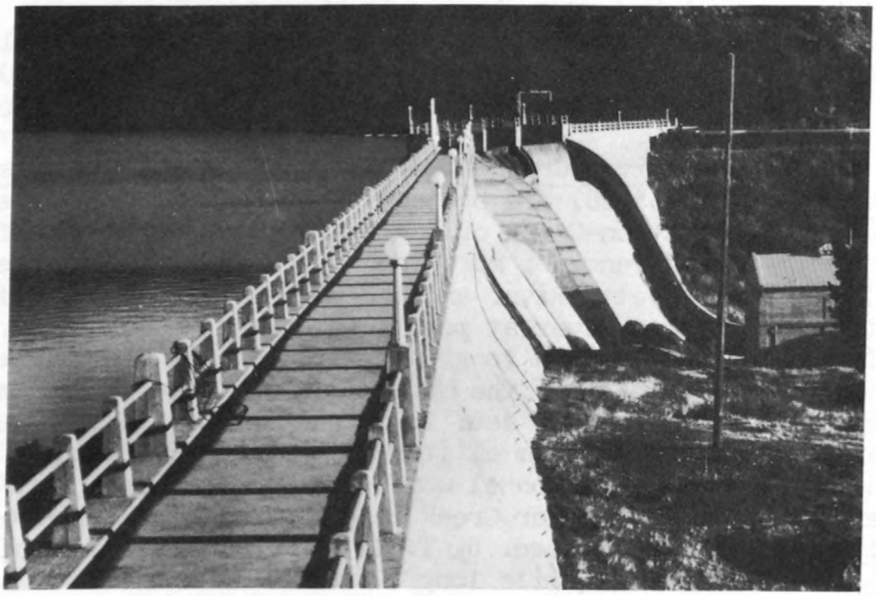
The Upper Scriver Creek site (13-2455+10) and the Lower Scriver Creek site (13-2455+20) are projects suggested in the above cited Bureau of Reclamation-Corps of Engineers study. They are feasible because of a difference of more than 1,200 feet in altitude between the North Fork Payette River and the Garden Valley reach of the Middle Fork Payette River at points which can be connected by a conduit about seven miles long, six miles of which would be in tunnel. The diversion of the North Fork would be at the Smith's Ferry damsite, mile 15.7, sec. 26, T. 11 N., R. 3 E., where the water would be raised from altitude 4,500 to 4,528 feet. From this point a four-mile-long tunnel would lead to the Upper Scriver Creek powerhouse site on Scriver Creek in the Middle Fork Payette basin at altitude 4,088 feet in sec. 8, T. 10 N., R. 4 E. A reregulating dam and reservoir and a 1½-mile long tunnel would connect this site to the Lower Scriver Creek site in sec. 21, T. 10 N., R. 4 E., at the backwater limit of the proposed Garden Valley reservoir, altitude 3,335 feet.

In addition to the power generated at the upper and lower Scriver Creek sites the water is to be passed through the generating units at the proposed Garden Valley and Garden Valley reregulating developments already described.

Between the Scriver Creek diversion site and the backwater limit of the Horseshoe Bend site which is determined by the tailwater elevation of the Garden Valley reregulating dam, the North Fork Payette River falls 1,700 feet in about 15 miles. The power potential of this reach will be much reduced if the river is diverted to Scriver Creek as proposed. The diversion plan is assumed, therefore, to measure the potential of the reach.

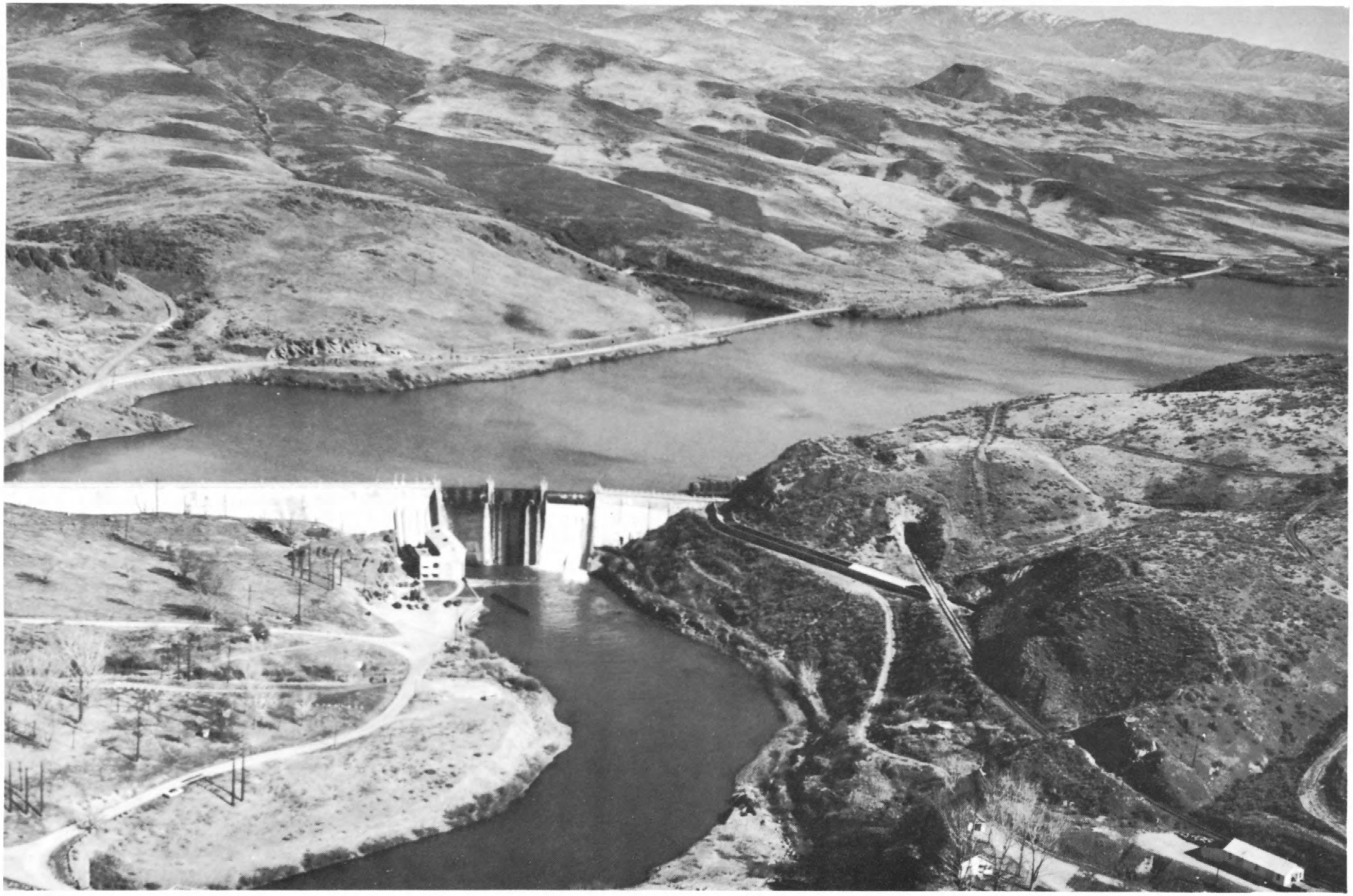
The Horseshoe Bend site (13-2475+10) with a dam on the Payette River at mile 52.4, sec. 31, T. 7 N., R. 2 E., drainage area 2,352 square miles, would develop head between altitude 2,550 feet and 2,800 feet, the Garden Valley reregulating tailrace. This development would flood the Lower Banks 80-foot power head development described in the above-mentioned Bureau of Reclamation-Corps of Engineers study for which the dam would be in sec. 17, T. 8 N., R. 3 E. The Horseshoe Bend site would have all of the right-of-way problems due to the railroad, highway, and towns that have made the Lower Banks site infeasible at this time.

The Montour Valley site (13-2475+20) would develop, by diversion and conduit along the left bank, the head remaining between the Horseshoe Bend tailrace site at 2,550 feet and the existing Black Canyon Reservoir at 2,497 feet.



Black Canyon Dam, Payette R., Idaho 10/1/59

*** Black Canyon Dam (13-2495) is a gravity-arch dam at mile 38.7, sec. 22, T. 7 N., R. 1 W., where the drainage area is 2,680 square miles. The dam was built in 1924 by the Bureau of Reclamation. It is 183 feet in structural height, 1,040 feet long at the crest, contains 81,204 cubic yards of concrete, and has a reservoir with a capacity of 44,100 acre-feet for irrigation and power. The powerplant has an installed capacity of 8 MW.



Black Canyon Dam USBR Photo

Weiser River

Weiser River drains about 1,700 square miles of west-central Idaho. It flows generally southwest from the headwaters in Price Valley and empties into the Snake River at Weiser. Much of the land drained is in the Payette National Forest. Altitudes in the basin range from 2,110 feet at the mouth of the river to about 6,000 feet on the mountains in its headwaters. The annual precipitation ranges from 11 to 40 inches. There was one powersite developed in the basin--the 160 kilowatt Rush Creek Plant which was abandoned in 1946.

The basin is primarily agricultural and is supported by extensive irrigation and there are no known plans to develop waterpower either on the main stem or on its tributaries. The Bureau of Reclamation-Corps of Engineers study (1961) included recommendations concerning potential water resource-development sites in the basin and did not recommend any waterpower development in connection with the suggested projects. A modest amount of potential waterpower is available. Data on the principal reservoirs, reservoir sites, and powersites in the Weiser River basin are summarized in table 11.

The Tamarack reservoir site (13-2515), is on the Weiser River in sec. 30, T. 19 N., R. 1 E., mile 95, where the drainage area is 36 square miles. A dam to raise the water from altitude 4,100 feet to 4,160 feet would have a crest length of about 1,300 feet. The reservoir would store 40,600 acre-feet of water and the top 20 feet would contain about 26,000 acre-feet which could provide a uniform flow of about 35 cfs. Downstream from the reservoir site the river falls 1,100 feet in 18 miles, running through a relatively narrow canyon in which there is little, if any, irrigation. Small power developments in this reach would be of local interest only, none being large enough to be included in the inventory. The urgent need for storage in the Weiser River basin may eventually make it necessary to develop a reservoir at this site. Possible values are storage for irrigation, domestic supplies, conservation, and recreation.

The Lost Valley Reservoir (13-2540) with a dam in sec. 28, T. 19 N., R. 1 W., where Lost Valley Creek drainage area is 29 square miles, was constructed in 1910 and rebuilt in 1929 by the Lost Valley Reservoir Company. It is an earthfill dam with a structural height of 34 feet and a crest length of 260 feet. The Lost Valley Reservoir stores 9,670 acre-feet of water for irrigation. The Bureau of Reclamation-Corps of Engineers study (1961 p. 7-156) proposes to raise the dam 50 feet which would enlarge the reservoir to 50,500 acre-feet for irrigation and flood control. The Q50 discharge would not be sufficient, it is estimated, to make a powersite large enough to be included in the inventory. ***

The Goodrich-B site (13-2575+80) with a dam on Weiser River at mile 53.6, sec. 20, T. 15 N., R. 2 W., was the only large reservoir site located in the basin by the Bureau of Reclamation-Corps of Engineers study. This site would store 250,000 acre-feet of water, including 50,000 acre-feet for conservation purposes, behind a dam 168 feet above streambed and having a crest length of about 1,200 feet. The study did not contemplate any waterpower development. The potential power development is based on the estimated discharges of the stream before regulation and assumes a maximum pool at altitude 2,860 feet, three feet higher than the Bureau-Corps recommendation and a tailrace altitude of 2,690 feet. Drainage area at the damsite is 593 square miles.

The Cambridge site (13-2585+90) with a powerhouse site in sec. 15, T. 14 N., R. 3 W., would divert the tailwater of the Goodrich-B plant and would have the same drainage area as Goodrich-B. Irrigation requirements make this development seem very unlikely.

The Cold Spring Ridge site (13-2605) on the Little Weiser River would divert water from Little Weiser River in sec. 17, and from Anderson Creek in sec. 21, T. 14 N., R. 2 E., to a powerhouse site in sec. 27, T. 14 N., R. 1 E. The conduit would be about eight miles in total length with approximately one mile of tunnel. The combined drainage areas total 30 square miles and the gross head developed is between altitudes 4,650 and 3,650 feet.

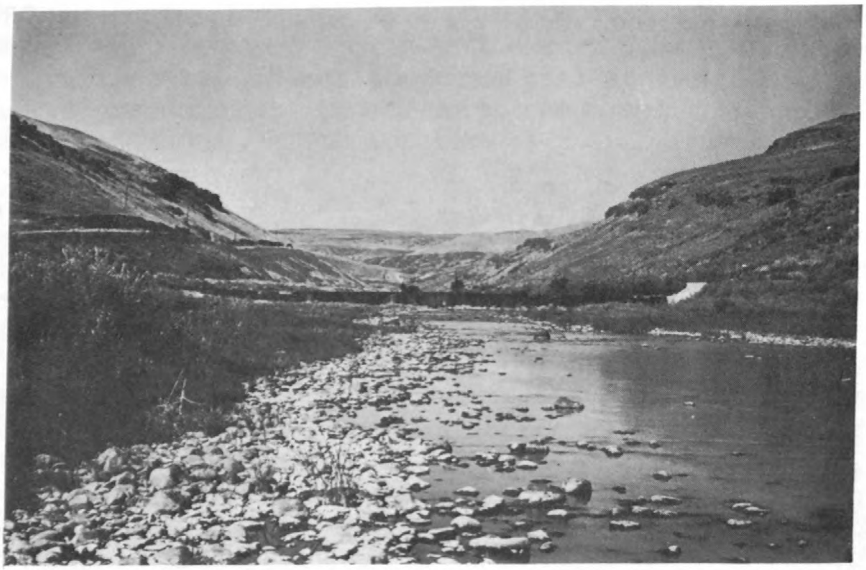
*** The Crane Creek Reservoir (13-2640) was constructed in 1910 and rebuilt in 1920 by the Crane Creek Reservoir Administration Board. The dam is in sec. 19, T. 12 N., R. 2 W., where the drainage area is 242 square miles. It is an earthfill structure 60 feet in structural height and 1,400 feet long. The capacity of the reservoir is 51,700 acre-feet. The small amounts of waterpower potential represented are not likely of being developed unless additional water is diverted from the Little Weiser River or from the Payette River. A diversion from Little Weiser River was considered at one time and an application for a Federal power project made. Introduction of water from the Payette River basin would increase the potential power of the site by an amount proportional to the water diverted and could be quite considerable since head available for development could include the 840 feet between altitudes 3,200 and 2,360 feet at a powerhouse site in sec. 7, T. 11 N., R. 3 W., and the 360 feet of head suggested for development in the Galloway site.

The Galloway site (13-2655+20) at mile 14 on the Weiser River, sec. 25, T. 11 N., R. 4 W., where the drainage area is 1,473 square miles, is assumed to be capable of developing head between altitudes 2,560 and 2,200 feet, combining Galloway and Concrete reservoir sites to give a storage capacity of 1,300,000 acre-feet. Although this dam has not been considered up to the present time, it may be found desirable to construct it, possibly to a lower altitude, in the future for irrigation, power, flood control, conservation, recreation, and municipal water supply. A large reservoir would make power operations very flexible, and if used only six hours per day could produce large blocks of peaking power.

Table 11.--Developed and potential storage, gross theoretical waterpower, and potential power with regulation, Weiser River basin, Idaho.

Powersite	Powerhouse or damsite location Sec.	T.	R.	Storage (acre-feet) Existing	Potential	Gross Head (feet)	Gross theoretical power in MW with gross head and 100% efficiency and flows at Q 95	Q 50	Mean	Potential power in MW of regulated stream at 80% efficiency*
Tamarack	30	19 N	1 E	-	26,000	60	-	-	-	-
Lost Valley	28	19 N	1 W	10,000	49,000	80	-	-	-	-
Upper South Hornet	20	17 N	3 W	213	213	-	-	-	-	-
Lower South Hornet	20	17 N	3 W	157	157	-	-	-	-	-
Johnson Park	31	17 N	2 W	-	1,500	-	-	-	-	-
Goodrich-B	20	15 N	2 W	-	250,000	170	.14	2.28	8.97	4.50
Cambridge	15	14 N	3 W	-	-	90	.07	1.2	4.7	2.00
Cold Spring Ridge	27	14 N	1 E	-	-	1000	1.27	2.12	3.83	1.1
King Hill Creek	28	14 N	1 E	-	40,000	-	-	-	-	-
Ben Ross Res.	27	14 N	1 W	7,800	12,450	26	-	-	-	-
Monday	8	14 N	1 W	-	13,000	-	-	-	-	-
Dixie	25	14 N	3 W	U	-	-	-	-	-	-
+Concrete	22	12 N	4 W	-	+	+	+	+	+	-
Grovner	6	12 N	1 W	280	280	-	-	-	-	-
Unnamed	33	13 N	2 W	U	-	-	-	-	-	-
Hog Creek Butte	19	13 N	1 W	U	-	-	-	-	-	-
Unnamed	34	10 N	2 W	U	-	-	-	-	-	-
Star Butte	16	12 N	3 W	U	-	-	-	-	-	-
#Crane Cr. Reservoir	7	11 N	3 W	51,700	92,000	840	.14	1.43	5.36	4.00
Little Crane Cr.	14	12 N	3 W	U	-	-	-	-	-	-
+Galloway	25	11 N	4 W	-	1,300,000	360	.7	7.65	27.2	15.23
Spangler	32	11 N	4 W	-	13,000	740	-	-	-	-
Barton	34	12 N	5 W	3,050	3,050	-	-	-	-	-
Totals				73,200	1,800,650		2.32	14.68	50.06	26.83

*Utilizing all potential storage at upstream sites.
+Concrete Res. (140,000 ac-ft, 270-foot head, .5 MW, 5.4 MW, and 19 MW) is included in Galloway Res. site.
#Crane Creek dam is an earthfill structure 60 feet high in sec. 19, T. 12 N., R. 2 W.
U Existing storage unknown.



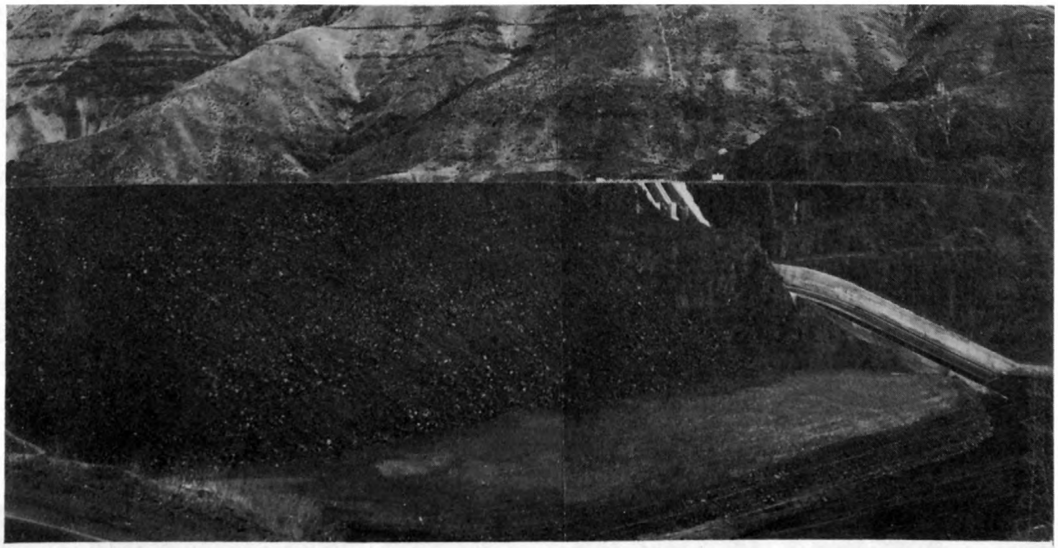
Galloway Diversion Dam and possible site for high dam, Weiser River, Aug. 13, 1963

Weiser River to Salmon River

In the reach of the Snake River between Baker and the mouth of the Salmon River, waterpower development will be limited to sites on the main stem except for a few high developments using little water on streams draining the western slopes of the Seven Devils Mountains. This entire reach is now either developed or the projects are under construction. The reach of river is about 160 miles long and falls 1,162 feet or approximately 7.2 feet per mile from the Brownlee Reservoir pool altitude of 2,077 feet to the proposed High Mountain Sheep tailrace altitude of 915 feet.

*** Brownlee Dam and Reservoir (13-2897), Federal Power Project 1971 licensed to Idaho Power Company is in sec. 2, T. 17 N., R. 5 W., at mile 285, where the drainage area is 72,590 square miles, is the largest power project so far completed on the Snake River. The dam, completed in 1958, is rockfill with a structural height of 395 feet, a crest length of 1,320 feet, and contains 6,000,000 cubic yards of fill. The reservoir has a capacity of 1,470,000 acre-feet, of which 984,500 acre-feet are principally for power. It is also drawn down when necessary to provide space for storing floodwater.

A historic effort was made at the Brownlee Dam to provide for migrating fish. It was planned to trap both the upstream and downstream-bound fish and transport them in tank trucks over the Brownlee,

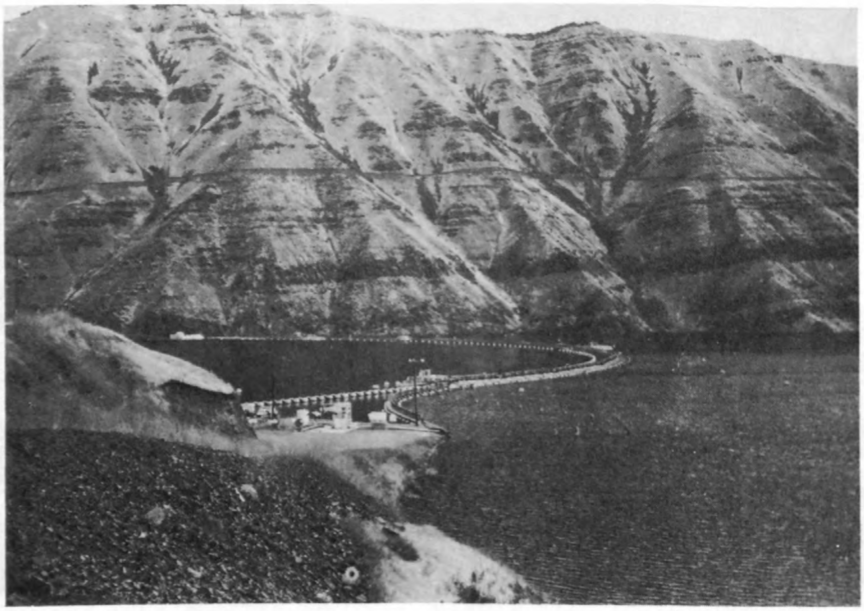


Brownlee Dam, Snake River, Sept. 10, 1960

Oxbow, and Hells Canyon Dams as they were constructed. Upstream-bound fish were lured into a trap at the Oxbow plant tailrace and freed in the Brownlee Reservoir. A screen was placed in the Brownlee Reservoir a short distance upstream from the dam in an attempt to prevent downstream migrants from passing through the turbines. Skimmer devices at the top of the screen were to pick up the fish which were then transported by tank truck to the Snake River downstream from the Oxbow Dam. The plan was to transport the fish to a point on the Snake River downstream from Hells Canyon Dam after it was constructed and to trap the upstream-bound fish at Hells Canyon. The screen was judged to be a failure and abandoned in 1963.

Wildhorse River empties into the Snake River a short distance downstream from Brownlee Dam. Its drainage area is about 180 square miles and its course is generally southwest from its course high on the southwestern slopes of the Seven Devils Mountains, approximately parallel to the Snake River, which it enters in the Oxbow Reservoir near Brownlee Dam. The river flows quite gently across the top of a high plateau for 10 or 15 miles, then leaves the plateau and cuts a deep canyon the rest of the way to its mouth.

Bear Creek Falls site (13-2897+10) could use water from a reservoir with a dam near the junction of Bear and Lick Creeks in sec. 15, T. 9 N., R. 3 W., (77 square miles) and a dam on the Crooked River in sec. 26, of the same township (20 square miles). The conduit from



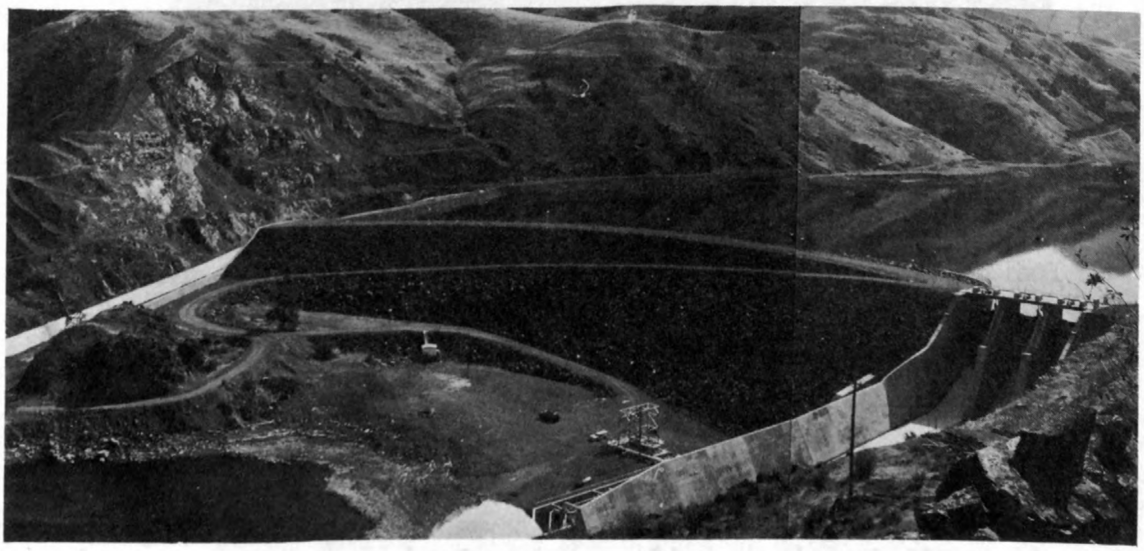
Fish skimmer above Brownlee Dam, Snake R., Sept. 10, 1960

the Bear Creek site would be about 2½-miles long and the one on the Crooked River about 2 3/4 miles long. Bear Creek Falls would develop head between altitude 4,240 feet and 3,360 feet at a powerhouse site in sec. 29, T. 19 N., R. 3 W. Bear Creek reservoir might be constructed for one or more of several values. It would have great value for stream regulation, conservation, and recreation. If fully developed the site would have the capacity to store more than three times the average yield of water and probably could completely regulate the stream at the reservoir outlet. It would make an ideal nesting and resting location for waterfowl and would improve the fish and wildlife values of the area. The Seven Devils Mountains will become more and more important as a tourist attraction and the reservoir would be very beneficial to the tourist industry.

It would be possible, for example, by skirting the high plateau, or by means of a six-mile tunnel to bring the water to the Snake River near Oxbow and develop all head between an altitude of 4,200 feet and the tailwater altitude of the Oxbow project, 1,683 feet. The tunnel would surface in the headwaters of Scorpion Creek in sec. 22, T. 19 N., R. 4 W., and could be connected with the toe of Oxbow Dam, altitude 1,683 feet, by means of a 1½-mile-long penstock, surface or underground. This would develop a gross head of 2,517 feet which could also be utilized as a pumped-storage project of almost any desired capacity.

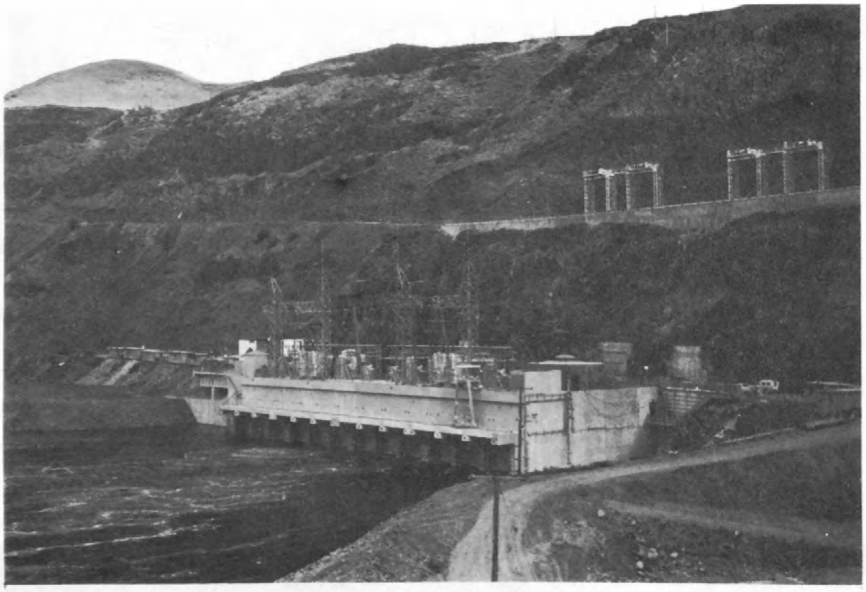
Emery Creek site (13-2897+20) would divert water from the Wildhorse River at the Bear Creek Falls tailrace site, downstream from the mouth of the Crooked River, sec. 29, T. 19 N., R. 3 W., drainage area 115 square miles. A five-mile conduit would develop the head between altitudes 3,360 and 2,800 feet at a powerhouse site in sec. 24, T. 18 N., R. 4 W.

The Wildhorse site (13-2897+30) would divert the Wildhorse River water from a drainage area of 149 square miles in sec. 24, T. 18 N., R. 4 W. The water could be carried to an alternative powerhouse site in a 2½-mile tunnel and a one-mile conduit and penstock. This powerhouse site near Williamson Creek on Oxbow Reservoir is in sec. 8, T. 18 N., R. 4 W. Or, the conduit route could follow the right bank of the Wildhorse River about 5½ miles and the water dropped in a distance of about half a mile to the Oxbow Reservoir near Brownlee Dam in sec. 36, T. 18 N., R. 5 W.



Oxbow Dam, Sept. 1963

Oxbow Dam (13-2900) was completed in 1961 at mile 273 on the Snake River, sec. 21, T. 19 N., R. 4 W., Boise Meridian. A tunnel connects the reservoir to the powerhouse in sec. 9, T. 7 S., R. 48 E., Willamette Meridian, Oregon. The drainage area is 72,800 square miles. Head between altitudes 1,805 and 1,683 feet is developed and the 52,500 acre-foot reservoir, 13 miles long, provides some storage in addition to reregulating Brownlee releases. The dam is rockfill with a structural height of 205 feet, a crest length of 725 feet, and a volume of 1,300,000 cubic yards. For the purpose of this report, which is to assign potential waterpower geographically, one-half of the Brownlee and Oxbow potentials are assigned to the State of Idaho. ***



Oxbow Powerplant, Snake River, Sept. 20, 1961.
Water is diverted from reservoir by a tunnel.

The Cuprum site (13-2900+10) is visualized as having a diversion on Indian Creek in sec. 19, T. 20 N., R. 4 W., where the drainage area is 25 square miles, and a one-mile tunnel to a powerhouse site in sec. 14, T. 20 N., R. 4 W., on the Snake River at the projected backwater altitude from the Hells Canyon project of Idaho Power Company which is now under construction.

The Deep Creek site (13-2902+05) with a powerplant in the Hells Canyon Powerhouse in sec. 15, T. 22 N., R. 3 W., would be served by water from a 22-square-mile area of Oxbow and Deep Creeks. A diversion at 4,400 feet in sec. 13, on Oxbow Creek, and sec. 36 of the same township on Deep Creek, would require a total length of conduit of about six miles. The tailrace altitude of 1,510 feet is the same as that authorized for Hells Canyon and the backwater limit of the High Mountain Sheep project.

*** The Hells Canyon project (13-2902+10) is now under construction by the Idaho Power Company under authority of Federal Power Project 1971 in sec. 15, T. 22 N., R. 3 W., mile 247, where the drainage area is 73,300 square miles. A recent change approved by the Federal Power Commission will permit moving the dam 500 feet upstream to a more favorable site for a concrete-gravity dam; changing from a rockfill-type dam to a concrete-gravity dam to effect a saving; and raising the normal water surface elevation of the reservoir from 1,683 to 1,688 feet. The tailrace altitude is 1,510 feet. This latter change will encroach five feet upon the low water tailrace of the Oxbow project as described above. The dam will, it is said, have a crest length of 994 feet. The initial installation will be 370 MW in three units of 123.3 MW each, and an ultimate capacity of 493 MW (four units of 123.3 MW each) is planned.

Snake River from Kleinschmidt Grade
in Hells Canyon Reservoir site

The Granite Creek site (13-2902+30) assumes the accumulation at a powerhouse site in sec. 26, T. 23 N., R. 3 W., of the runoff from 22 square miles of Granite Creek and its principal tributaries all draining the west side of Seven Devils Mountains, including 9,393-foot-high He Devil Peak. The diversions would be at an altitude of 4,400 feet and about eight miles of conduit, including a one-mile-long penstock, a one-mile inverted siphon, and several short tunnels. The tailrace would be at altitude 1,510 feet, the maximum pool elevation authorized for the High Mountain Sheep project.

The Old Timer site (13-2902+40) would divert Sheep Creek at an altitude of 3,800 feet near Old Timer Creek in sec. 13, T. 24 N., R. 2 W., where the drainage area is 20 square miles. A three-mile-long conduit, which might be shortened somewhat by tunneling, and a one-mile penstock would reach the powerhouse site in sec. 3 of the same township on the Snake River at the backwater altitude of High Mountain Sheep Reservoir, 1,510 feet. Appendix, Rock Island, Gem, Sheep, and Shelf Lakes in the headwaters of West Fork Sheep Creek should have an equalizing effect upon the discharge available during the dry season.

The High Mountain Sheep Dam (13-2920+30) at mile 188.9, sec. 14, T. 29 N., R. 4 W., Boise Meridian, Idaho, sec. 11, T. 4 N., R. 48 E., Willamette Meridian, Oregon, was recently authorized to Pacific Northwest Power Company under an application for Federal Power Project No. 2243. The dam will be a concrete arch with a structural height of 670 feet and will form a reservoir capable of storing 3,600,000 acre-feet of water. Two outdoor powerhouses, one on each side of the river, will have a combined capacity of 1,750 MW. Water will be raised to the Hells Canyon tailrace (1,510 feet) some 58 miles upstream from the damsite. The High Mountain Sheep tailrace is 915 feet.

The High Mountain Sheep damsite is on the Snake River eight-tenths of a mile upstream from the mouth of the Salmon River. This site has been selected over an alternative, the Nez Perce project, in which the dam would have been constructed downstream from the mouth of the Salmon River. The problem of getting anadromous fish, now spawning in the Salmon River, over Nez Perce dam was a principal factor in deciding in favor of High Mountain Sheep which can be built now. Nez Perce dam would also have been an arch with a structural height of 715 feet. It would have stored 6,600,000 acre-feet of water, about twice as much as the High Mountain Sheep reservoir, and 3,200 MW of generating equipment was planned for its powerhouse, also nearly twice as much as High Mountain Sheep. Depending upon a satisfactory solution to the fish-passage problem the undeveloped portion of the Nez Perce reservoir site probably will be utilized by constructing a dam at the Lower Canyon site on the Salmon River immediately upstream from its mouth.

Salmon River

If you will place a sheet of tracing paper over a small-scale map of the State of Idaho, trace the course of the main stem of the Salmon River from its headwaters to its mouth, lift your pencil and draw a small circle over the Snake River between that point and the mouth of the Grande Ronde River, lift your tracing paper by its lower right-hand corner and look through it from the reverse side, you may note that you have made a squiggle that resembles a large question mark. The past history of the Salmon River is well known. Its future is an unknown like the squiggle. The native Indians described it to the Lewis and Clark party as the "river of no return". This probably meant that one attempting to go down the river would never return for the reason that he would never reach his downstream destination, or could never get back. To several important species of anadromous fish, however, the Salmon River has been the river of return and it has become known as the most productive spawning area in the conterminous States for these fishes.

The basin has at times made important contributions to the mineral wealth of Idaho and has always been a valuable livestock producing area, being favorably endowed for both cattle and sheep raising. The higher lands are suited to grazing only, but there are level valleys

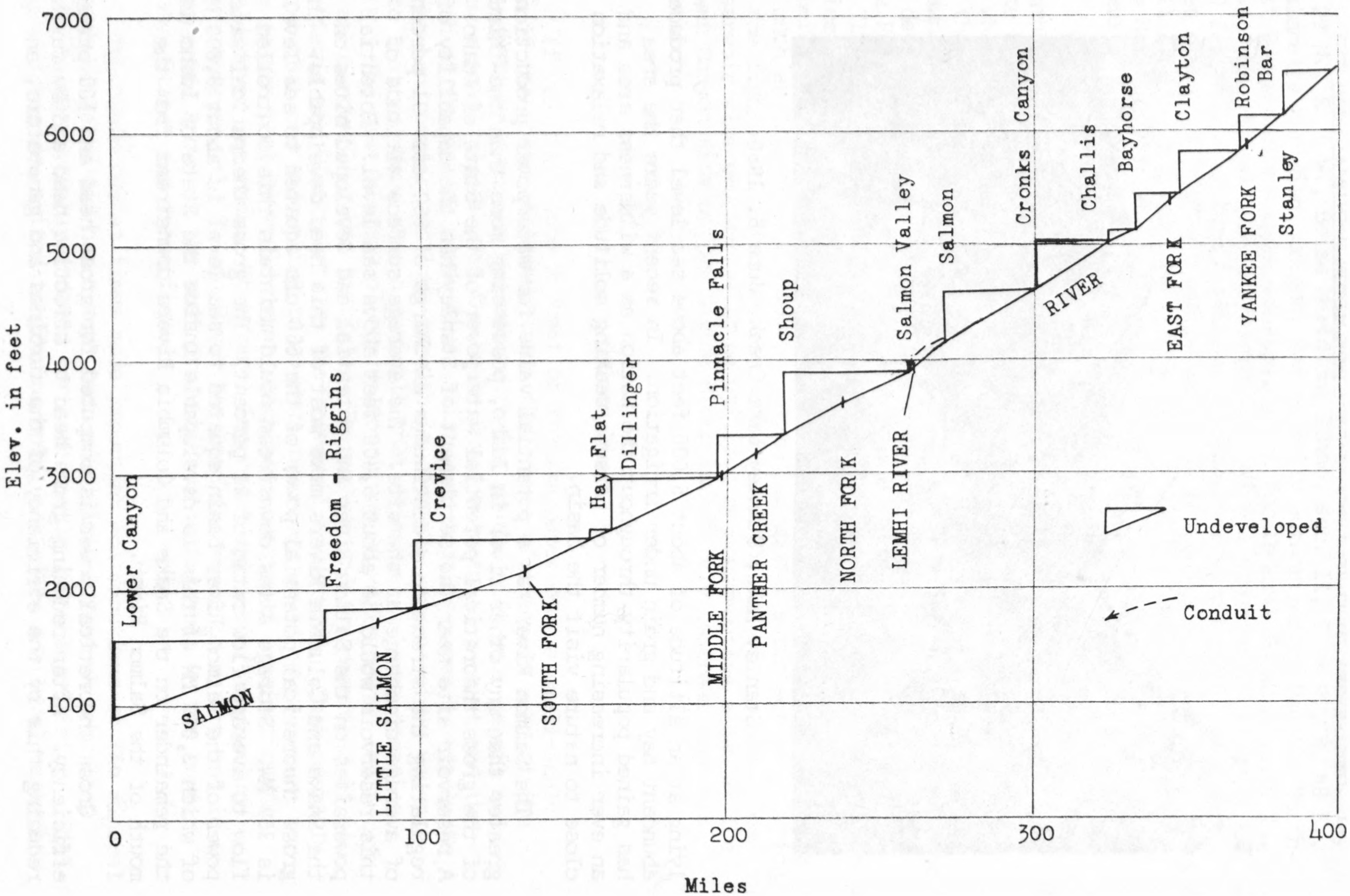
Stanley Lake, Stanley Lake Creek, June 6, 1960

lying at an altitude of about 5,000 feet above sea level that produce abundant hay and grain under irrigation. In recent years the area has gained popularity throughout the Nation as a wilderness area and an ever increasing number of persons seeking solitude and relaxation close to nature visit the basin.

The Salmon River has a potential value for waterpower production greater than any other river in Idaho, possessing more than one-third of the gross theoretical potential waterpower of the State of Idaho. A reservoir site near the settlement of Stanley has the capability of regulating the stream to a continuous discharge of 660 cfs--91 percent of average discharge at the site. The average surface altitude of this reservoir would be about 6,400 feet above sea level. Potential powersites on the Salmon River and potential and developed sites on the Snake and Columbia Rivers make most of this head developable. The gross theoretical potential power of the 660 cfs equated to sea level is 359 MW. Storage sites downstream could maintain this controlled flow to average flow ratio of 91 percent. The gross theoretical waterpower of the Salmon River basin equated to sea level is about 3,800 MW, of which 3,000 MW of this is developable inside the State of Idaho and the remainder on the Snake and Columbia Rivers downstream from the mouth of the Salmon River.

Gross theoretical power is computed for gross head and 100 percent efficiency. After reducing gross head to effective head and by further reducing this by the efficiency of the turbines and generators, an

FIGURE 9.--PROFILE OF SALMON RIVER SHOWING UNDEVELOPED POWERSITES ON MAIN STEM



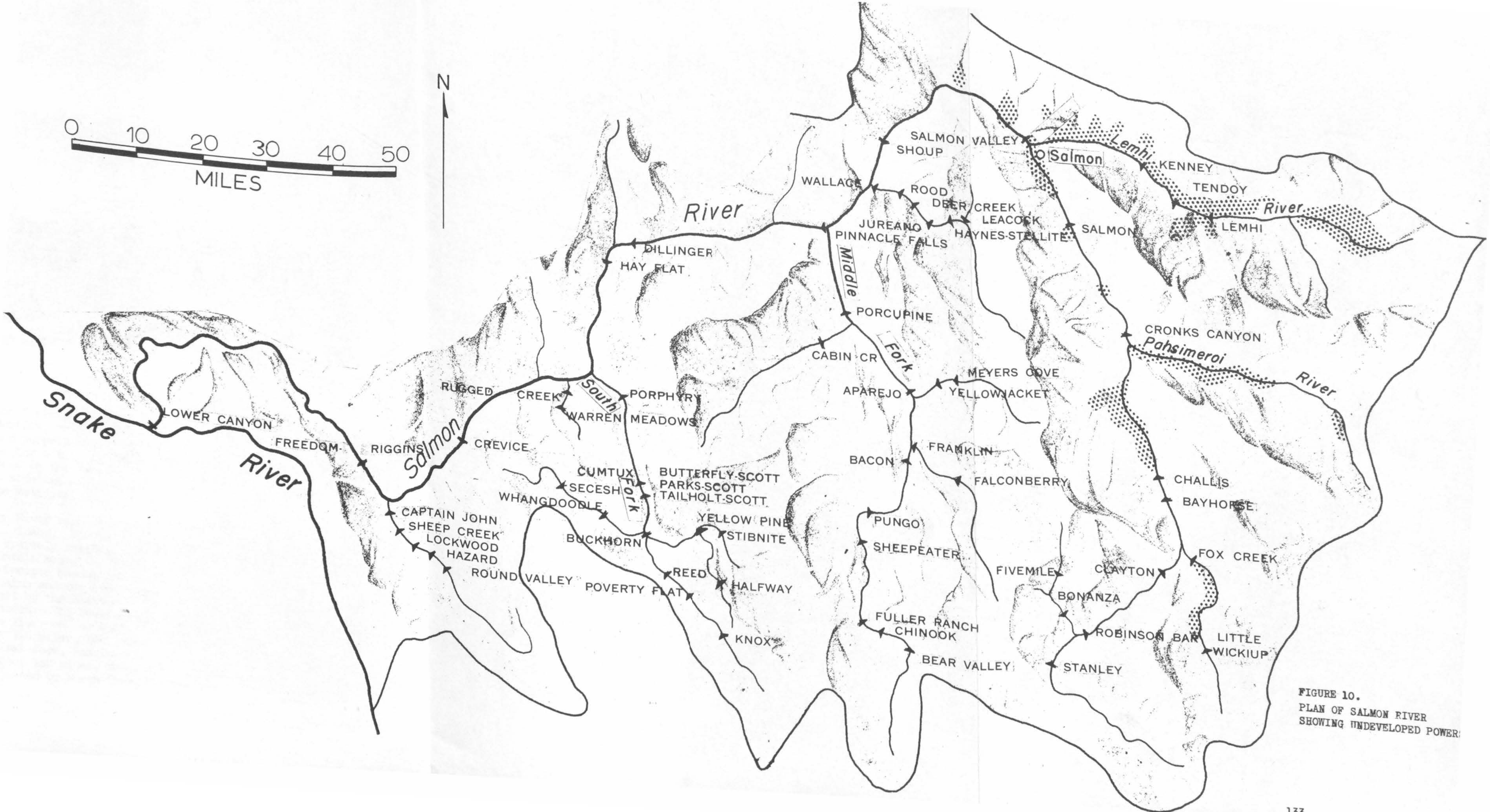
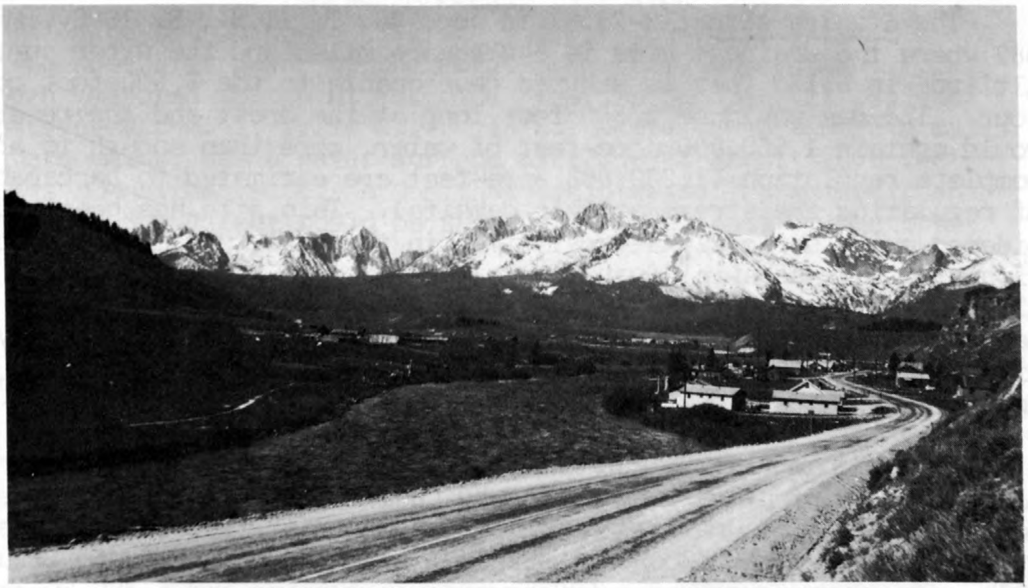


FIGURE 10.
PLAN OF SALMON RIVER
SHOWING UNDEVELOPED POWERS

overall efficiency of 70 percent might be achieved. Applying this to the 3,000 MW available in Idaho, a continuous capacity of 2,100 MW of firm power could be made available at plants in the Salmon River basin. To allow for appropriate daily and seasonal variations in demand, the plants probably would have a total installed capacity of at least 4,000 MW.



Stanley, in Stanley reservoir site, Salmon R., June 5, 1960

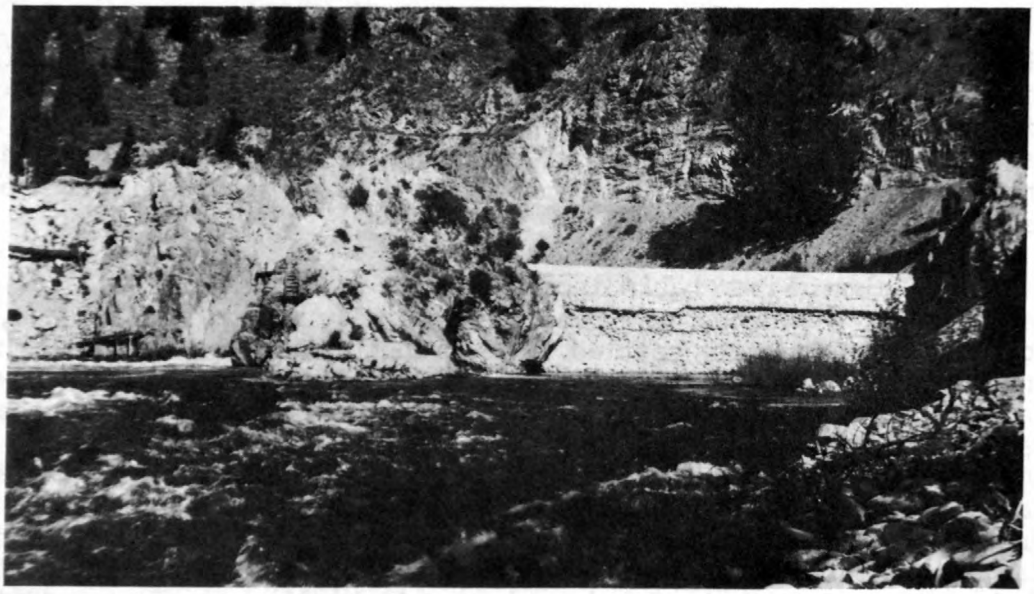
It would be fortunate for all concerned if fish life, recreation, livestock production, minerals, and waterpower values could be utilized concurrently and perpetuated to the fullest. The Salmon River basin offers a locale for a test of the sincerity and reasonableness of all parties concerned in the various values present and it may well be that the final solution will provide for a very high realization of each basin-wide multiple use.

The Salmon River basin includes about 14,000 square miles of the central part of Idaho. The basin is generally rough, mountainous, forested, and sparsely settled. Its principle character is a high and rugged mountain mass, its southern border dominated by the Sawtooth Range. The principle headwaters of the main stem originate in these Sawtooth mountains and the river flows northeastward until turned north and finally west by the Bitterroot Range on the east and Clearwater Range on the north. The Seven Devils Mountains divide the Salmon Basin from the Snake River on the west. While flowing northeasterly a distance of about 150 miles, the Salmon River is joined by its tributaries Yankee Fork, East Fork, Pahsimeroi, and Lemhi Rivers. In an additional distance of about 150 miles, while flowing north, northwest, and west, the river is joined by North Fork, Middle Fork, South Fork, and Little

Salmon Rivers. At the mouth of the Little Salmon River, the Salmon turns sharply northward to follow a continuing narrow valley for another 40 miles, then swings west to enter the Snake River near the lower end of the Middle Snake River canyon. Figure 9 is a longitudinal profile showing main stem powersites and figure 10 is a planimetric map of the basin showing all of the powersites used to determine the potential power of the basin.

The Stanley site (13-2955) in sec. 36, T. 11 N., R. 13 E., mile 382 where the drainage area is 540 square miles and the water surface altitude is 6,153 feet is assumed developable to the 6,500-foot contour. The dam would be 1,500 feet long at the crest and the reservoir would contain 1,560,000 acre-feet of water, more than enough to afford complete regulation (1,200,000 acre-feet are estimated to be capable of regulating the stream at this damsite). This site has been considered quite seriously several times in the past, usually in connection with a transbasin diversion to the Boise or Payette Rivers. Like all projects on the Salmon River, little mention or consideration has been given to it for many years. A large reservoir at the Stanley site could add the necessary ingredient to turn the Stanley Basin area into one of the world's famous recreation areas.

*** Sunbeam Dam (13-2955+30) in sec. 19, T. 11 N., R. 15 E., diverted water for a powerplant constructed by Custer Slide Mining and Development Company. The drainage area is 616 square miles. The dam was constructed in 1913 and blocked the salmon from migrating beyond it until 1934. The powerplant had a 500 horsepower turbine and a 300 kw generator although the potential power of the site was greater than this.

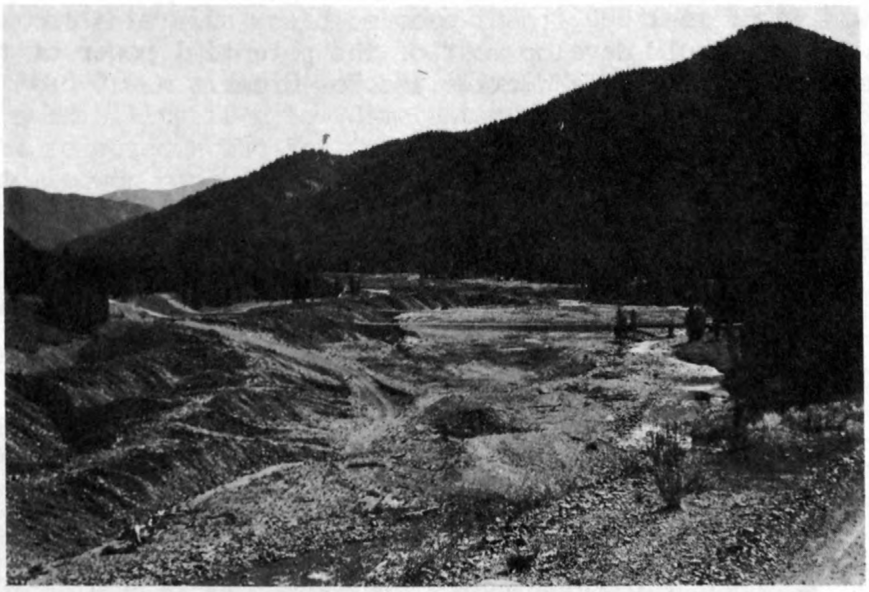


Sunbeam Dam, Salmon River, June 5, 1960

According to Hoyt (1920, p. 213) the plant was sold to Love and von Brecht in June 1920. A Federal Power Commission license for 20 years was issued in July 1921. A concrete section of the dam still remains in place. This site is included in the reach of river here assumed to be developable in the Robinson Bar site.

Yankee Fork-East Fork area

The potential power of the right-bank tributary, Yankee Fork, has been measured at two sites. The Fivemile damsite (13-2955+80) in unsurveyed sec. 2, T. 12 N., R. 15 E., where the drainage area is 74 square miles, has a water surface altitude of about 6,660 feet near its downstream side. A dam that would raise the water to an altitude of 6,940 feet would be about 2,000 feet long at the crest if the dam were placed at the narrowest section. The reservoir would have a capacity of 93,000 acre-feet. A diversion-conduit 3½ miles long would reach a powerhouse site in sec. 17 of the same township at altitude 6,390 feet, the backwater limit of the Bonanza site reservoir. The Eightmile site (13-2955+70) in unsurveyed sec. 30, T. 13 N., R. 16 E., is an alternative for the Fivemile site.



Bonanza reservoir site, Yankee Fork, Sept. 8, 1960

The Bonanza site (13-2955+90) is assumed to develop head between altitude 6,153 feet, the Robinson Bar site backwater limit, and altitude 6,390 feet, the Fivemile site tailrace altitude. The damsite is in unsurveyed sec. 32, T. 12 N., R. 15 E., about four miles above the mouth of the Yankee Fork where the drainage area is 170 square miles.

Topographic maps of the area are not suitable for measuring the dimensions of the dam and the storage capacity of the reservoir site.

The Robinson Bar site (13-2965+10) on the Salmon River at mile 368, sec. 27, T. 11 N., R. 15 E., where the drainage area is 852 square miles would develop head between altitude 6,153 feet, the Stanley tailrace site, and altitude 5,810 feet. The reservoir would have a capacity of 300,000 acre-feet. The Robinson Bar site as described here includes the reach of river formerly described as being developable at the Elkhorn Creek site, sec. 28, T. 11 N., R. 14 E.; the American Creek site, sec. 24, T. 11 N., R. 14 E.; the Yankee Fork site, sec. 19, T. 11 N., R. 15 E., half a mile above Yankee Fork; the abandoned Sunbeam plant; and the Muley Creek site, sec. 28, T. 11 N., R. 15 E., immediately above the mouth of Muley Creek.

Clayton site (13-2965+30) is on the Salmon River at mile 348.3 where the drainage area is 1,145 square miles. A dam in sec. 26, T. 11 N., R. 17 E., that would raise the water from its present altitude of 5,450 feet to altitude 5,810 feet would be about 1,300 feet long and the reservoir formed would have a storage capacity of about 600,000 acre-feet. The Clayton site includes the Badger Creek site, sec. 28, T. 11 N., R. 16 E.; the Holman Creek site, sec. 25, T. 11 N., R. 16 E.; and the Sullivan Hot Springs site, sec. 27, T. 11 N., R. 17 E.

Two sites would develop most of the potential power of the East Fork Salmon River--Little Wickiup and Fox Creek.

Little Wickiup dam and reservoir site area
E.F. Salmon River, July 19, 1960

The Little Wickiup site (13-2975+55) with a dam on the East Fork Salmon River, sec. 4, T. 8 N., R. 17 E., mile 22.5, where the drainage area is 153 square miles and the water surface is about 6,280 feet, would develop 190 feet of head by backing water to the Bowery damsite tailrace, altitude 6,470 feet and, in addition, would develop 280 feet of head in a five-mile long conduit along the right bank of the East Fork Salmon River. The powerhouse site would be in sec. 11, T. 9 N., R. 17 E., mile 16.5, at an altitude of 6,000 feet.

The Fox Creek to mouth site (13-2980+20) designates a nine-mile long section that presents several damsites, principal of which are the Fox Creek and Road Creek sites. The potential power is measured by assuming a dam immediately upstream from Fox Creek at mile 11.5, sec. 3, T. 9 N., R. 18 E., at altitude 5,780 feet that would be capable of raising the water surface to the Little Wickiup site tailrace, altitude 6,000 feet. Head between the damsite, altitude 5,780 and 5,450 feet could be developed by an eight-mile-long conduit along the left bank of the river to a powerhouse site at the Bayhorse site backwater at mile 2.5 in sec. 35, T. 11 N., R. 18 E. The Fox Creek damsite appears on the Zeigler Basin 7½-minute topographic quadrangle map to be superior topographically for a dam to the height described above. At an altitude of 6,000 feet the Fox Creek dam would have a crest length of 1,420 to 1,450 feet. At altitude 5,800 feet the Road Creek dam would have a crest length of about 600 feet. A dam to altitude 5,850 feet at this site would be more than 1,500 feet long, however.

The Road Creek site in sec. 24, T. 10 N., R. 18 E., appears to be the best possibility if a low dam (altitude 5,660 to altitude 5,800) were to be selected. The Fox Creek damsite is chosen because it gives the maximum power capability. The value of the bottomlands on the East Fork for grazing and for raising feed probably would limit the height of the reservoirs as well as their number unless the need for power developments becomes very acute.

Challis Creek-Panther Creek reach

Bayhorse site (13-2985) with a damsite in sec. 6, T. 12 N., R. 19 E., mile 333 on the Salmon River, has a drainage area of 1,800 square miles. A dam that would raise the water from its existing altitude of 5,125 feet to an altitude of 5,450 feet would be about 550 feet long at the crest. The reservoir at altitude 5,450 feet would have a capacity of about 550,000 acre-feet.

The Challis site (13-2985+10) in sec. 21, T. 13 N., R. 19 E., would develop head between altitudes 5,025 and 5,125 feet. The reservoir at this altitude would have a capacity of 26,000 acre-feet. The damsite is at mile 329 and the drainage area is 1,825 square miles. The Challis site described here is upstream from the town of Challis and the valley around the mouth of Challis Creek. The Challis reservoir site described by Hoyt (1935, p. 112) is now usually called

McNabbs Point which is included in the reach of river here assumed to be developable at the Cronks Canyon damsite.

The Cronks Canyon site (13-3020+20) with a damsite in secs. 17 and 18, T. 16 N., R. 21 E., is at mile 300 where the drainage area is 3,290 square miles. The reservoir as here presented would develop head between altitudes 4,590 and 5,025 feet, the new Challis site tailrace and would have a capacity of 4,750,000 acre-feet as measured from the existing 15-minute quadrangle maps of the area. This would include the McNabbs Point site (at old Challis site) which has been studied in the past for developing head and storage by a dam in sec. 35, T. 15 N., R. 19 E., water surface altitude 4,800 feet on the 1924 survey by the U. S. Geological Survey. The backwater of that site was limited to 5,000 feet and the capacity of the reservoir site was given as 614,000 acre-feet (Hoyt 1935, p. 112). For the purpose of measuring the gross theoretical power of the river the additional 25 feet (to altitude 5,025 feet) is assumed. At this altitude excessive flooding of hay and pastureland might occur in the valley near Challis.

The Salmon site (13-3020+90) at mile 271.8, sec. 36, T. 20 N., R. 21 E., has a drainage area of 3,642 square miles. This site appears to be capable of supporting a dam that would raise the water from its present altitude of 4,130 feet to the Cronks Canyon site tailrace altitude of 4,590 feet. The full reservoir would store about 1,200,000 acre-feet of water. The Salmon site is downstream from the Twelvemile Creek site and includes, in downstream order, McKims Creek site, site 12JA16, Rattlesnake Creek site, Camp Creek site, and Twelvemile Creek site.

Lemhi River is a right-bank tributary to the Salmon River which joins it just downstream from the town of Salmon. The Lemhi flows northwestward between the Continental Divide in the Bitterroot Range reach on its east and north side, and the Lemhi Range of the Sawtooth Mountains on its south and west side. The river flows in a valley that is as much as ten miles wide in places and, although it falls rapidly, a heavy stand of grass has prevented the stream from cutting a channel in the gravel which fills the entire riverbed. This large gravel bed has a great equalizing effect upon the river and it is thus a very even flowing stream. Throughout its length the Lemhi is diverted to irrigate the bottomlands in the valley, and this practice, while reducing the total flow to some extent, increases the uniformity of discharge of the remaining water because the return irrigation waste water travels slowly through the gravel.

The development of head for waterpower, if it is undertaken, probably will be by means of conduit. This is principally due to the steep gradient and the absence of damsites. Three diversion-conduit type developments could utilize a total head of 945 feet.

The Lemhi site (13-3050+10) would divert water in sec. 33, T. 17 N., R. 25 E., and carry it about nine miles along the left bank of the river to sec. 33, T. 18 N., R. 24 E., at mile 32. The drainage area is about 600 square miles and the fall between altitudes 5,215 and 5,600 feet would be developed. The drainage area also includes most of Hayden Creek which would be diverted at altitude 5,600 feet and carried to the Lemhi powerhouse site.

The Tendoy site (13-3050+20) would divert at the Lemhi tailrace altitude of 5,215 feet and carry the water along the right bank of the Lemhi River a distance of about four miles to a powerhouse site in sec. 4, T. 18 N., R. 24 E., at mile 26.5. The drainage area is 830 square miles.

The Kenney site (13-3050+30) would redivert the Lemhi River at the Tendoy tailrace, altitude 5,000 feet, and carry it about 10 miles along the right bank to a point near Kenney Creek. The powerhouse site is at mile 19, sec. 31, T. 20 N., R. 24 E., at altitude 4,660 feet, and the drainage area is 890 square miles, the same as the gaging station which is near the diversion point.

The Lemhi River joins the Salmon River at Salmon at an altitude of about 3,900 feet, a total fall of 760 feet in the lower 19 miles. Irrigation demands on the water are high during the low water season and no powersite with the required Q50 potential seems possible.

The Salmon Valley site (13-3050+70) could utilize water from the Salmon River, diverted at the once-considered Salmon damsite tailrace altitude of 4,130 feet and carry the water along the right bank near that altitude and across the Lemhi River from which the return flow from irrigation and excess water could be picked up and added to the Salmon River water. The powerhouse site at altitude 3,900 feet is on the Salmon River near the old powerplant that used Lemhi River water in sec. 32, T. 22 N., R. 22 E., at Salmon River mile 259. The Salmon River drainage is 5,030 square miles without considering the drainage area or any water diverted from the Lemhi River. The site is judged to be undevelopable by means of a dam because of the flooding that would result at the town of Salmon and in the surrounding valley.

The Shoup site (13-3060+30) with a dam at mile 218, sec. 30, T. 24 N., R. 19 E., where the drainage area is 5,684 square miles has been considered for development but probably never to the height suggested here. A dam that would raise the water from its present altitude of 3,337 feet to 3,900 feet, the tailrace site of the Salmon Valley plant site just described, would have a crest length of approximately 600 feet and would create a reservoir with a capacity of 2,500,000 acre-feet.

Panther Creek

Panther Creek is a left-bank tributary to the Salmon River, joining it about seven miles downstream from the bridge at Shoup. Panther Creek drains an area of about 540 square miles of rugged, mountainous terrain between the city of Salmon on the east and the Middle Fork Salmon River on the west. Running between these ridges and the Bitterroot Range along the Continental Divide, the Salmon River turns from a northward to a westward flowing stream. Panther Creek and its tributaries fall rapidly from such peaks as Taylor Mountain (9,700 feet), Black Mountain (9,550 feet), Lake Mountain (9,274 feet, Baldy Mountain (9,149 feet), Haystack Mountain (8,840 feet), Blackbird Mountain (9,000 feet), Indian Point (8,453 feet), and Mount McGuire (10,052 feet). Small waterpower plants could be established almost anyplace and many such plants have been put in operation by the various mining companies in the past. Most, if not all, of these have now been abandoned. The area is extensively mineralized yielding lead, silver, copper, cobalt, and a variety of "rare" earth substances.

The potential power of Panther Creek basin has been measured by assuming development at six sites of which the Leacock powersite (13-3060+40) is farthest upstream. This site with a dam at mile 3 on Napias Creek, sec. 13, and a powerhouse at mile 19.7 on Panther Creek, sec. 22, T. 21 N., R. 19 E., would develop a 258-square-mile drainage area including 72 square miles on Napias Creek and 186 square miles by a multiple-diversion system from other tributaries from altitudes higher than 5,800 feet. The conduit would be along the right bank to Panther Creek at the Leacock Ranch, altitude 4,820 feet.

*** The small Haynes-Stellite (13-3060+45) developed site could be enlarged by raising the forebay to the Leacock site tailrace, altitude 4,820 feet, sec. 22, T. 21 N., R. 19 E., and retaining the tailrace altitude of 4,556 feet at the present plant at mile 17 in unsurveyed sec. 8 of the same township. The drainage area at the diversion point is 325 square miles. A development that would utilize 234 feet of head was suggested for this site by Hoyt (1935, p. 317).

Jureano site (13-3060+50) would develop the next 316 feet of head along Panther Creek by a diversion dam at mile 16.4. The water would be raised to the Haynes-Stellite tailrace altitude of 4,556 feet and carried 3.5 miles to a powerhouse site at mile 13.2 near the mouth of Deer Creek, altitude 4,240 feet. The canyon walls are steep and rocky and a pipeline might be necessary. The drainage area is 340 square miles.

The Deer Creek site (13-3060+60) would be developed by a dam at mile 12.7 immediately downstream from Big Deer Creek that would raise the water surface to an altitude of 4,240 feet and a conduit to a powerhouse site near mile 9.8 where the water surface altitude is 3,780 feet. A pipeline or lined canal probably would be necessary. The drainage area is 402 square miles.

The Rood powersite (13-3060+70) would redivert the Deer Creek tailrace at mile 9.7, raising the water as necessary to reach altitude 3,780 feet. A lined canal or pipeline down the right bank of Panther Creek about four miles long would reach the powerhouse site above the mouth of Beaver Creek at mile 6, where the water surface altitude is 3,480 feet. The creeks entering Panther Creek in this reach are flowing at very low rates during the late summer and early fall months. The drainage area is 418 square miles.

The Wallace site (13-3060+90) might be developed by a dam at mile 5.5 and a conduit along the left bank to a powerhouse site near mile 2.2 in unsurveyed sec. 31, T. 23 N., R. 18 E. The diversion is at altitude 3,480 feet and the powerhouse site has been chosen to conform with the backwater limit of the Pinnacle Falls reservoir site on the Salmon River, 3,337 feet. The drainage area is 510 square miles.

The powersites in the Panther Creek basin are examples of small blocks of power that may be economically developable on many small streams in the Salmon River basin. The potential power available would be sufficient for the operation of mines and the lighting of associated communities. Only sites having a potential of 1 MW at Q50 discharge have been included here. There are, however, a large number of sites for smaller developments.

Middle Fork

Bear Valley and Marsh Creeks are the principal headwater tributaries to the Middle Fork Salmon River. These creeks join to form the Middle Fork about 106 miles by river channel upstream from its mouth. Bear Valley Creek, and to some extent Marsh Creek, drains a large region comprised principally of meadows or parks all lying at altitudes between 6,300 and 7,000 feet. The Middle Fork itself, on the otherhand, flows generally in a canyon throughout. The most inaccessible part is the downstream 25 or 30 miles which is known as "impassable canyon" and is as remote and inaccessible as any other canyon in the northwest. The Middle Fork basin is all in national forest and is well supplied with trails. Proposals to develop waterpower on the Middle Fork will be as unpopular as are those to develop the main stem of the Salmon River. A considerable power potential is available, however, and might be developed at the sites hereinafter described.

The Bear Valley site (13-3090+10) would be developed by a dam at mile 105.4 on the Middle Fork Salmon River, probably in unsurveyed sec. 24, T. 13 N., R. 10 E., where the drainage area is 333 square miles. A dam from the water surface altitude of 6,135 feet to raise the water to altitude 6,425 feet would have a crest length of less than 1,000 feet and would store 400,000 acre-feet of water. This would afford a high degree of regulation at the site. This site has received some consideration in the past, together with the Stanley

Basin site, in connection with plans to divert Salmon River water to the Payette or Boise Rivers.

The Chinook powersite (13-3090+20) would consist of a reregulating and diversion dam on the Middle Fork Salmon River at mile 105.3. The drainage area would be 333 square miles, the same as for the Bear Valley reservoir. A conduit six miles long would reach a powerhouse site at an altitude of 5,800 feet at mile 98.7, about half a mile downstream from Chicken Creek. The conduit would include tunneling at several locations. The site would become quite valuable if regulation were afforded by the Bear Valley reservoir site.

Headwaters of Bear Valley Creek, June 4, 1960

The Fuller Ranch site (13-3090+30) is at mile 92.4 in sec. 12, T. 14 N., R. 9 E., where the Middle Fork Salmon River has a drainage area of 450 square miles. The water surface at the damsite is assumed to be 5,480 feet but it might be desirable to move the dam downstream where the canyon is somewhat narrower. A dam that would raise the water to an altitude of 5,800 feet, the Chinook powersite tailrace, would have a crest length of between 1,500 and 1,800 feet depending upon the section chosen. The reservoir created at this altitude would have a capacity of 262,000 acre-feet.

The Sheepeater site (13-3090+40) would divert at the Fuller Ranch site tailrace altitude of 5,480 feet, possibly by a dam about 0.4 mile downstream at mile 92 in sec. 1, T. 14 N., R. 9 E. The drainage area would be 450 square miles, the same as for Fuller Ranch. The powerhouse site would be at mile 77.3 in sec. 32, T. 16 N., R. 11 E., water surface altitude 4,900 feet. The conduit length could be shortened to about 11 miles by including four or five miles of tunnel. It might be desirable to include such tunneling because of the difficulty of anchoring other types of conduit. The powerhouse site is about 0.3 mile upstream from the mouth of Rapid River. The Sheepeater site as described here includes the Deer Horn, Sheepeater and Steelhead powersites which would have developed approximately the same reach of river by three diversion-conduit-fed powerplants (Hoyt, 1935, p. 321).

The Pungo site (13-3090+50) would create head by a dam in sec. 6, T. 16 N., R. 12 E., near the mouth of Teapot Creek, mile 65.5, where the drainage area is 900 square miles. The water surface elevation at the damsite is 4,515 feet and a dam that would raise the water to an altitude of 4,900 feet (the Sheepeater site tailrace described above) would have a crest length of 900 to 1,000 feet according to the topographic maps available, and the reservoir would have a capacity of 337,000 acre-feet. The plan differs from previous suggestions for developing this reach of the Salmon River in that the dam is higher and the 2½-mile conduit eliminated. The head that would have been developed in the conduit (Hoyt, 1935, p. 322) is now suggested for development in the downstream Bacon reservoir site. The higher dam at the Pungo damsite would inundate the Risley powersite which had been suggested for a diversion dam at mile 72.6 and a powerhouse site at mile 67.6.

The Bacon site (13-3090+60) is also suggested to be developed by a dam on the Middle Fork Salmon River. The damsite is in sec. 28, T. 17 N., R. 13 E., mile 50.4, just downstream from Bacon Creek where the drainage area is 1,110 square miles. The reservoir site has a capacity of 364,000 acre-feet between altitudes 4,115 and 4,515 feet at the Pungo site tailrace, and the dam would have a crest length of about 1,400 feet. This development would inundate the sections of river formerly suggested for development in the Voller site, which would have developed 110 feet of head by a dam and tunnel near mile 57.3, and part of the Mahoney powersite which would have developed the fall between mile 56.5 and 49.7 by means of diversion and conduit.

The Falconberry site (13-3090+70) could develop 310 square miles of Loon Creek drainage by a dam on Loon Creek at mile 9.2, in unsurveyed sec. 20, T. 16 N., R. 14 E., and a 1.2-mile-long conduit to a powerhouse site in sec. 18 of the same township and range, mile 7.7. The dam would be at altitude 4,750 feet and would raise the water to a maximum altitude of 5,000 feet. The drainage area is 310 square miles. An additional 110 feet would be developed in the conduit as the powerhouse site has a tailrace altitude of 4,640 feet. At an altitude of 5,000 feet, the dam would have a crest length of a little less than 500 feet. The Warm Springs powersite described by Hoyt (1935, p. 326) is included in the Falconberry site as described here. The excellent damsite on Falconberry Creek would make a higher dam than Hoyt suggested possible.

The Franklin site (13-3090+80) could develop the remaining fall along Loon Creek (altitudes 4,640 and 4,115 feet, the Aparejo site backwater limit) in a 5½-mile-long conduit along the right bank of Loon Creek to the powerhouse site at mile 1.3 in unsurveyed sec. 19, T. 17 N., R. 14 E. The diversion would be in unsurveyed sec. 7, T. 16 N., R. 14 E., where the drainage area is 320 square miles. The site diverts at the same altitude as suggested formerly but, by utilizing a longer conduit it develops more head at a lower powerhouse site. The Ramey powersite on Loon Creek is included in the lower end of the Franklin site and the higher altitudes of the Aparejo reservoir site and is thus eliminated.

The Meyers Cove site (13-3090+85) would store the water from 222 square miles of Camas Creek drainage in a reservoir behind a dam in unsurveyed sec. 36, T. 18 N., R. 16 E., mile 12.2, and a conduit would develop head at a powerhouse site at mile 8.2 near the junction of Forge and Camas Creeks. The water surface altitude at the damsite is 5,060 feet at mile 12, and the water would be raised to an altitude of 5,260 feet by a dam that would have a crest length of 900 feet to form a reservoir with a storage capacity of 44,000 acre-feet. The water surface elevation at the powerplant site is about 4,760 feet.

The Yellowjacket site (13-3090+90) on Camas Creek could develop the head between altitudes 4,760 (Meyers Cove tailrace) and 4,115 feet (Aparejo reservoir site) by means of conduit along the right bank of Camas Creek between miles 8.2 and 3.0. The water from 100 square miles of Yellowjacket Creek would be added by a 1½-mile conduit along the right bank of that creek. The two conduits would be joined for about three-fourths of a mile and use a common penstock. The total drainage area controlled would be 340 square miles and the regulating effects of the Meyers Cove reservoir would be beneficial to this site also. The Woodtick and Yellowjacket powersites have been combined in this plan and the tailrace raised 105 feet (from altitude 4,010 to 4,115 feet) to eliminate interference with the Aparejo site as now conceived.

The Aparejo site (13-3090+95) is at mile 32.5 on the Middle Fork Salmon River in unsurveyed sec. 3 or 10, T. 18 N., R. 14 E., where the drainage area is 1,953 square miles. A dam to raise the water surface from its present altitude of 3,700 feet to an altitude of 4,115 feet is suggested. The capacity of the reservoir to this altitude would be 333,000 acre-feet. The site develops the head between the Bacon site tailrace and the Porcupine site backwater limit. By constructing the dam to the height suggested, all of the White powersite and the lower end of the Mahoney powersite are included in the Aparejo site.

A rearranged Cabin Creek site (13-3100) with a dam on Big Creek at mile 12, sec. 36, T. 21 N., R. 12 E. (water surface altitude 3,950 feet), and a conduit to mile 4.3, sec. 1, T. 20 N., R. 13 E., (water surface altitude 3,700 feet) is suggested for developing all of the power on Big Creek. The drainage area is 470 square miles.

The reservoir would have a storage capacity of 191,000 acre-feet at altitude 4,300, about one-third of the average annual discharge. The powerhouse has been selected to conform with the current suggestion of constructing the dam at the Porcupine site on the Middle Fork Salmon River high enough to back water to an altitude of 3,700 feet. This plan includes Garden Creek and upper part of Soldier Bar sites as suggested by Hoyt (1935, p. 328).

The Porcupine site (13-3100+70) would develop the head between the Aparejo site tailrace and the Pinnacle Falls site backwater limit at a damsite near mile 15 on the Middle Fork Salmon River, on unsurveyed land for which no land net has been projected. The drainage area at the damsite is 2,650 square miles. By raising the water from its present altitude of 3,337 feet to an altitude of 3,700 feet, a reservoir with a capacity of 253,000 acre-feet would be created.

Middle Fork to South Fork

Pinnacle Falls site (13-3102+20) with a damsite on the Salmon River in unsurveyed sec. 29, T. 23 N., R. 16 E., where the drainage area is 9,325 square miles (mile 197.5) would create a 435,000 acre-foot reservoir between altitudes 2,995 and 3,337 feet (the tailrace of the Shoup site). The damsite is 1.25 to 1.4 miles downstream from the mouth of the Middle Fork Salmon River. The exact location would be governed by the height of dam. For example, Hoyt (1935, p. 308) shows a site at water surface altitude 2,996 feet, where a dam capable of raising the water surface to altitude 3,090 feet would have a crest length of 350 feet.

The present suggested development differs from that planned by Hoyt in that the Shoup site is moved downstream to develop part of the head formerly suggested in the Big Sheepeater site which is located about 2,500 feet downstream from the mouth of Big Sheepeater Creek where the water surface altitude is about 3,280 feet. The Pinnacle Falls site as here described would develop the remaining head in the Big Sheepeater site together with all of the head suggested for development at the Long Tom site. The Long Tom site was to have developed the head between altitudes 3,040 and 3,318 feet by a dam at a point two miles upstream from the Middle Fork where a dam capable of raising the water surface to an altitude of 3,318 feet would have a crest length of about 450 feet.

The Dillinger site (13-3102+30) with a damsite at mile 163.3 on the Salmon River in unsurveyed sec. 4, T. 25 N., R. 11 E., where the drainage area is 10,100 square miles would develop head between altitudes 2,550 and 2,995 feet by means of a dam that would have a crest length of about 1,100 feet. The reservoir, which would back water to the Pinnacle Falls site, would have a capacity of about 700,000 acre-feet and would flood the Proctor Falls site (altitudes 2,960 to 3,038 feet), the Horse Creek site (proposed for altitudes

2,853 to 2,958 feet), Rainier Rapids (altitudes 2,788 to 2,848 feet), and Black Canyon site (2,660 to 2,788 feet) (Hoyt, 1935, p. 309-310).

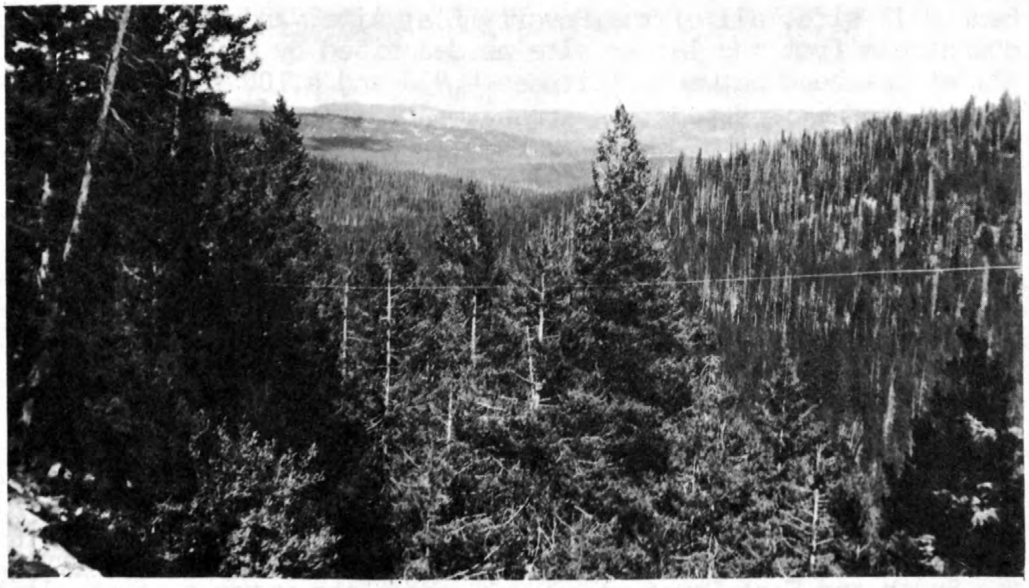
The Hay Flat site (13-3102+40) with a damsite at mile 155.5, Salmon River, in unsurveyed sec. 32, T. 26 N., R. 10 E., where the drainage area is 10,260 square miles would develop head between altitudes 2,445 and 2,550 feet. The reservoir created would have a capacity of about 20,000 acre-feet. The site would develop the head remaining downstream from the Dillinger site tailrace and upstream from the projected backwater altitude of the Crevice site. The Hay Flat site would occupy the reach of river originally considered to be developed by the Rattlesnake site (altitudes 2,513 to 2,553 feet) and part of the Growler site (considered to develop altitudes 2,353 to 2,548 feet)(Hoyt, 1935, p. 311).

South Fork

Warm Lake, Warm Lake Creek, South Fork Salmon R., Aug. 17, 1960

The South Fork Salmon River originates in the Sawtooth Mountains east of Cascade Reservoir and runs generally parallel to the North Fork Payette River but in the opposite direction. A north-south trending trough in the mountains appears to carry the Middle Fork Payette River southward and the South Fork Salmon River northward.

The river flows northward for about 100 miles joining the Salmon River 134 river miles above its mouth. The headwaters are in the open parks of Stolle Meadows (altitude 5,300 feet) and a wide mountain valley around Warm Lake and Knox. The principal tributaries are the East Fork South Fork which joins the South Fork 37 miles above its mouth and the Secesh River which enters from the left bank (west) about three-fourths of a mile below the East Fork. Downstream from the Secesh River the South Fork flows in a rugged canyon with only occasional narrow terraced valleys near the mouths of the larger tributary creeks. The headwaters of Johnson Creek, a tributary to East Fork South Fork Salmon River, drain one of the highest mountain plateaus in Idaho. This is the area surrounding the settlement of Landmark all of which has an altitude of 6,000 feet or higher.



Headwaters of Johnson Creek, E.F. South Fork Salmon

A sampling of peaks in the basin having altitudes higher than 8,000 feet includes Rocky Peak 8,200 feet, Rice Peak 8,696 feet, Chilcoot Mtn. 8,995 feet, Missouri Ridge 8,126 feet, Profile Peak about 8,600 feet, and Parks Peak 8,817 feet. The mountains are high on both sides of the South Fork from its headwaters to its mouth. Sheepeater Mtn. within six miles of the Salmon River has an altitude of 8,471 feet. Burgdorf Summitt overlooking the junction of the South Fork and Salmon is more than 8,000 feet in altitude. The tributaries to the South Fork Salmon River, like other small streams draining the mountain south of the Salmon River, have many small powersites. Those that are estimated to be capable of producing more than 1,000 kw at discharge available 50 percent or more of the time are briefly described here.

The Knox site (13-3105+20) at mile 68.2, sec. 26, T. 16 N., R. 6 E., where the drainage area is 140 square miles could develop head between altitudes 4,930 and 5,200 feet by a dam that would have a crest length of about 1,700 feet. The principal difference between the present suggestion and previous proposals for this site is that the dam here is somewhat higher. The site appears to be a favorable location for the construction of a rockfill dam. The powerplant is assumed to be at the damsite.

The Poverty Flat site (13-3105+30) would divert water at the Knox tailrace, drainage area 140 square miles, and carry it in a 12-mile-long conduit along the right bank of the South Fork to a point about one mile upstream from Fourmile Creek where it would be dropped to the powerhouse site near mile 53.5, sec. 35, T. 18 N., R. 6 E. The Poverty Flat site as described includes all of the Bear Hill site, all of the Poverty Flat site, and 65 feet of head downstream from the latter site as described by Hoyt (1935, p. 330). All of the head between altitudes 4,930 and 4,100 feet is developed in one conduit and penstock arrangement.

The Reed site (13-3105+40) would be a development by dam at mile 47.2, sec. 15, T. 18 N., R. 6 E., where the drainage area is 266 square miles. A rockfill dam that would raise the water surface 170 feet would have a crest length of 470 feet and would contain some 300,000 cubic yards of material. The spillway could be located at either end of the dam in solid rock. The altitude of the water surface at the damsite is 3,930 feet and a reservoir to an altitude of 4,100 feet would store between 63,000 and 64,000 acre-feet of water.

The Buckhorn site (13-3105+50) would have a diversion dam at mile 47.1 that would raise the water surface to the Reed site tailrace altitude of 3,930 feet (about 10 feet) and a nine-mile conduit to a powerhouse site immediately downstream from the junction of the South and East Forks at mile 37 where the water surface altitude is 3,620 feet. The drainage area is the same as Reed, 266 square miles.

The Stibnite site (13-3115+10) with powerhouse site in sec. 25, T. 19 N., R. 8 E., would be a diversion-conduit development on East Fork South Fork between altitudes 6,000 feet (mile 26.5) and 5,200 feet (mile 20.1). The diversion dam is on unsurveyed land and the powerhouse site is near the junction of the East Fork South Fork and Profile Creek. The drainage area is 70 square miles of the East Fork South Fork, Sugar Creek, Tamarack Creek, and Profile Creek above altitude 6,000 feet. An alpine-type water gathering arrangement and conduits totaling about 15 miles in length would be necessary.

The Landmark reservoir site (13-3125+50) would be developed at a damsite at mile 23.5 on Johnson Creek, sec. 31, T. 16 N., R. 8 E., where the water surface is 6,580 feet. A dam that would raise the water to altitude 6,700 feet would be about 1,300 feet long and the resulting reservoir would have a capacity of about 147,000 acre-feet, more than twice the average annual discharge. The site has no value for waterpower in itself, but a reservoir developed to a somewhat smaller capacity may some day be desirable as a multiple-purpose project having as one of its purposes the generation of waterpower at downstream sites.

Two sites downstream from the Landmark reservoir site measure the potential power of Johnson Creek at sites large enough to be included in the inventory. The Halfway site (13-3125+60) assumes a diversion at mile 14.8, drainage area 88 square miles, where the water surface is at an altitude of about 5,600 feet. The powerhouse site is at mile 11.8 in sec. 8, T. 17 N., R. 8 E., at water surface altitude 5,200 feet. It develops the head in Lunch Creek and Rustican sites suggested by Hoyt (1935, p. 334).

The Yellow Pine site (13-3130+10) would divert water at the Stibnite tailrace on the East Fork South Fork, mile 20.2, drainage area 95 square miles, and at the Halfway site tailrace on Johnson Creek, mile 11.8, 120 square miles. Head development would be between altitudes 5,200 and 4,660 feet. By two separate diversion routes the water would be carried to a powerhouse site at Landmark, mile 15 of the East Fork South Fork. The diversion routes would be about 11 miles for Johnson Creek and five miles for the East Fork South Fork. The Yellow Pine site develops heads suggested by Hoyt (1935, p. 335) for Hansen Creek and Riordan sites.

The Parks-Scott site (13-3130+20) would divert water at the Yellow Pine site tailrace near mile 15 of the East Fork South Fork, secs. 20 and 29, T. 19 N., R. 8 E., where the drainage area is 342 square miles. A five-mile tunnel would carry the water under Williams Peak, which causes the East Fork South Fork and the South Fork combined to make a horseshoe bend. The tunnel would surface in sec. 29, T. 20 N., R. 7 E., on Sheep Creek from which point the water could be carried five miles along the right bank of the South Fork to the powerhouse site at mile 26.4, sec. 4, T. 20 N., R. 7 E. This arrangement develops the head between altitude 4,660 and 3,260 feet. The Parks-Scott powerhouse site is shared with the Butterfly-Scott and Tailholt-Scott sites. These three develop the head proposed by Hoyt (1935, p. 334) to be developed by the Parks, Reagan, and Deadman powersites on the East Fork; the Butterfly and the Oom Paul sites on the Secesh River; and by the Buckhorn, Tailholt, Bear Creek, and Jeanott sites on the South Fork.

The Secesh site (13-3135+10) at mile 18.8 on the Secesh River, sec. 35, T. 22 N., R. 5 E., where the drainage area is 115 square miles is suggested for development of head between altitudes 5,900 and 5,640 feet by means of a dam that would have a crest length of about 600 feet. The reservoir at altitude 5,900 feet would have a storage capacity of about 236,000 acre-feet.

The Whangdoodle site (13-3135+20) would have a diversion dam at mile 18.6 in unsurveyed sec. 2, T. 21 N., R. 5 E., drainage area 115 square miles (same as Secesh site). The water would be carried about six miles, possibly along the right bank of the Secesh River in order to pick up Loon Creek water enroute, to a powerhouse site near mile 9.1, sec. 5, T. 20 N., R. 6 E. Head development would be between altitudes 4,700 and 5,640 feet. The Loon Creek water is not considered used in the discharge amounts estimated. Most of the head suggested for development in the Enos site by Hoyt (1935, p. 336) is included in the Whangdoodle site as described here.

The Butterfly-Scott site (13-3135+40) would divert water at the Whangdoodle tailrace, mile 9.1, sec. 5, T. 20 N., R. 6 E., and carry it by means of a seven-mile tunnel to the above-described Parks-Scott powerhouse site on the South Fork, mile 26.4, sec. 4, T. 20 N., R. 7 E. The drainage area is 175 square miles. The head developed (altitudes 3,260 and 4,700 feet) includes head formerly assigned to the Oom Paul site.

The Tailholt-Scott site (13-3135+50) would be a combination dam and conduit head development. A dam on the South Fork Salmon River at mile 33.2, sec. 25, T. 20 N., R. 6 E., where the drainage area is about 1,010 square miles, to raise the water from altitude 3,500 to 3,620 feet, would have a crest length of about 300 feet. The conduit along the left bank of the river would be a combination tunnel and closed conduit about five miles long to the combined Parks-Scott, Butterfly-Scott, and Tailholt-Scott powerhouse site at mile 26.4, sec. 4, T. 20 N., R. 7 E. The diversion altitude, after the water is raised 100 feet, is 3,620 feet, the Buckhorn site tailrace, and the powerhouse site is at altitude 3,260 feet. This site includes the Bear Creek site described by Hoyt (1935, p. 332) and, in fact, the cost of developing the entire 360 feet of fall by means of a dam at the Bear Creek site would have to be measured against the cost of the conduit. In either case the Scott powerhouse site could be utilized for the three developments.

The Cumtux site (13-3140+10) is at mile 19.5 on the South Fork Salmon River, sec. 11, T. 21 N., R. 7 E., where the drainage area is 1,165 square miles, would develop head between altitude 3,260 feet (the Scott powerhouse tailrace site) and altitude 2,905 feet by means of a dam that would have a crest length of about 405 feet. The reservoir formed would have a storage capacity of 125,000 acre-feet. The Cumtux site as described includes the head suggested for development in the Jeanott site, as well as part of the Carey site, as described by Hoyt (1935, p. 332).

The Porphyry site (13-3140+20) is suggested for developing the head remaining between the Cumtux tailrace and the backwater from the Crevice site on the Salmon River. The Crevice dam is planned to back water to an altitude of 2,445 feet which would back about seven miles up the South Fork Salmon River. In this reach of river, and continuing upstream to mile 11, the South Fork is in a 3,000-foot deep canyon with towering granite walls. Damsites are everywhere throughout this stretch and it is suggested that the head be developed by a dam at mile 10.3 where the drainage area is 1,260 square miles, 0.3 mile upstream from Porphyry Creek, that would raise the water from its present altitude of 2,585 feet to an altitude of 2,905 feet (320 feet). From the dam a tunnel two miles long across a bend in the river would lead to the powerhouse site at the Crevice backwater limit, mile 7. Drainage area at the damsite is 1,260 square miles. The dam would have a crest length of about 450 feet. The site includes the Carey, Rattlesnake, Porphyry, and part of the Raines powersites suggested by Hoyt for developing this reach of river (1935 p. 332). The remaining part of the Raines powersite and the Burgdorf powersite suggested by Hoyt are included in the Crevice reservoir.

South Fork to mouth

The high Sawtooth Mountain ridges continue west of the South Fork Salmon River and have turned the Secesh River southwestward from their southern slopes in its course toward the South Fork. The north slopes of the ridges are drained by creeks that offer numerous small waterpower development sites. Warren Creek, one of the larger of these creeks, drains a high plateau and valley and then descends rapidly to the main Salmon River which it enters at mile 129.6, 5.4 miles downstream from the South Fork. Warren Creek drains 93 square miles and two sites, Warren Meadows and Rugged Creek are used to measure its gross theoretical waterpower.

The Warren Meadows site (13-3145+10) would develop head between altitudes 5,840 and 4,840 feet by means of a dam in sec. 11, T. 23 N., R. 6 E., where the water surface altitude is estimated to be about 5,700 feet, and a 2½-mile conduit to the powerhouse site in sec. 11, T. 23 N., R. 6 E. The drainage area is about 70 square miles.

The Rugged Creek site (13-3145+20) is so named because the water would be carried out of the Warren Creek basin to a powerhouse site on Rugged Creek. The diversion site is in sec. 11, T. 23 N., R. 6 E., where the water surface would be raised 80 feet to altitude 4,840 feet. A five-mile conduit and penstock would reach the powerhouse site on the Crevice site backwater limit in Rugged Creek, altitude 2,445 feet, sec. 20, T. 24 N., R. 7 E. In order to obtain maximum amount of water, diversions from about five square miles each of Richardson Creek (a Warren Creek tributary) and Rapid Creek (an independent tributary of the Salmon River) have been included in the 85-square-mile drainage area. A two-mile-long conduit would be required for the Richardson Creek diversion, including an inverted siphon, and about three miles of conduit would bring the Rapid Creek water to the powerhouse site in an independent penstock.

Crevice site (13-3150+10) with damsite at mile 99.7, sec. 20, T. 24 N., R. 3 E., where the drainage area is 12,460 square miles has been considered the most desirable initial development on the Salmon River. The site is no longer being considered for immediate development because of the possible effect on the salmon runs in the basin. The gross head to be developed by Crevice dam is between altitudes 2,445 and 1,845 feet, and at the former altitude the reservoir would have an area of more than 10,000 acres and would store about 2,250,000 acre-feet of water. The site as presented here would include part of the Growler site and all of the Painted Rock, Castle, Crooked Bar, and Rheims sites as described by Hoyt (1935, p. 311).

The headwaters of the Weiser River flowing southward and those of the Little Salmon River flowing northward are in a wide trough which has an altitude of only 4,200 feet in the connecting pass in contrast to the usual 6,000 to 7,000-foot passes that divide the northward and southward draining areas to the east. The headwaters of the Little Salmon River are in open valleys and parks but fall in the stream increases as it passes between the Seven Devils Mountains on the west and the Sawtooth ridges on the east as both mountain ranges increase in height near the Salmon River. Rapid River which joins the Little Salmon near its mouth drains the eastern side of the seven Devils Mountains and is the principal tributary.

The Round Valley site (13-3160+50) with a damsite on the Little Salmon River in sec. 25 or 26, T. 21 N., R. 1 E., mile 25, is below a valley where a reservoir site is available that could store as much as 6,000,000 acre-feet of water, or any lesser amount desired. It is estimated that a dam to raise the water from altitude 3,700 (in the SW¼ of sec. 25) to altitude 3,900 feet would create a reservoir with a capacity of more than 700,000 acre-feet, which is three times the average annual runoff. An even smaller reservoir is expected because flooding would occur in the town of New Meadows at an altitude of about 3,850 feet. The Indian Mountain 7½-minute quadrangle map indicates that the dam would have a crest length of 550 feet at altitude 3,850 feet and would be about 650 feet long at altitude 3,900 feet. The drainage area is 208 square miles.

The Hazard site (13-3160+60) would develop head between altitudes 3,700 and 3,200 feet by a conduit from a point near the Round Valley site tailrace, sec. 25, T. 21 N., R. 1 E., to the powerhouse site at mile 20, sec. 11, T. 21 N., R. 1 E. The drainage area is 208 square miles and the conduit would be between four and five miles long.

The Lockwood site (13-3160+70) would redivert the water at the Hazard site tailrace, sec. 11, T. 21 N., R. 1 E., where the drainage area is 300 square miles. A seven-mile-long conduit to mile 12.9, sec. 9, T. 22 N., R. 1 E., would develop the head between altitudes 3,200 and 2,600 feet. Stable water conditions would be assured if Round Valley reservoir were developed.

The Sheep Creek site (13-3160+80) assumes diversion of the water at the Lockwood site tailrace, sec. 9, T. 22 N., R. 1 E., where the drainage area is 333 square miles. A conduit six miles long would carry the water, possibly along the right bank of the Little Salmon River to the powerhouse site at mile 6.7, sec. 8, T. 23 N., R. 1 E., and would develop the head between altitudes 2,600 and 2,140 feet.

The Captain John site (13-3160+90) would develop the remaining head upstream from the Freedom-Riggins site (the tailrace altitude of the Crevice site) by means of a diversion at altitude 2,140 feet in sec. 8, T. 23 N., R. 1 E., on the Little Salmon River, and in sec. 6 of this same township on Rapid River. The conduit on the Little Salmon River would be about five miles long and an additional two-mile-long conduit including an inverted siphon would join the Rapid River water near the mouth of Captain John Creek at mile 2.2, sec. 28, T. 24 N., R. 1 E. The tailrace altitude would be 1,845 feet and the drainage area would be 554 square miles.

The Freedom-Riggins site (13-3165+70) with damsite on the Salmon River in sec. 1, T. 26 N., R. 1 E., utilizes a damsite within the suggested maximum backwater limit of the Lower Canyon reservoir site (altitude 1,575 feet). To raise the water surface from its present altitude of 1,558 feet to the Crevice site tailrace altitude, 1,845 feet, a dam with a crest length of about 800 feet would be required. Head development would be between altitudes 1,575 and 1,845 feet. The drainage area is 13,320 square miles and the site is at river mile 69.3. If water is raised to this altitude, the town of Riggins would have to be relocated. The existence of the reservoir near the relocated town would be beneficial, however, and there are suitable relocation sites, possibly around the bay formed where the reservoir entered the Little Salmon River canyon, or at Shorts Bar a short distance up the main Salmon River from the present location.

The Lower Canyon site (13-3170+10) at mile 0.5, secs. 13 and 14, T. 29 N., R. 4 W., where the drainage area is 14,100 square miles is arranged to have the same tailrace altitude as High Mountain Sheep so that the China Gardens site may develop all of the head in both the Salmon and Snake Rivers. The maximum water surface altitude of Lower Canyon is 1,575 feet, the tailrace altitude of the Freedom-Riggins site. At altitude 1,575 feet the dam would have a crest length of about 2,100 feet. The Federal Power Commission (1964) mentions possibilities for developments of the lower Salmon River that will result from development of the High Mountain Sheep project on the Snake River upstream from the mouth of the Salmon River. The Lower Canyon dam is mentioned as being located at either mile 0.5 or at mile 3.7. A dam at mile 3.7 would have a crest length of less than 1,000 feet for a dam to altitude 1,575 feet. Possibility of a higher dam at Lower Canyon has also been mentioned.

Salmon River to Lewiston-Clarkston

The China Gardens site (13-3170+20) is at mile 172.5 on the Snake River where the drainage area is about 88,000 square miles. The damsite is in sec. 11, T. 31 N., R. 5 W., Boise Meridian, Idaho, and sec. 32, T. 7 N., R. 47 E., Willamette Meridian, Washington. A dam that would raise the water from its present altitude of about 832 feet above sea level to the High Mountain Sheep tailrace altitude of 915 feet (planned normal pool altitude is 910 feet) would be about 1,200 feet long at the crest. The tailrace will be limited to altitude 842.5 feet (845 feet for our purposes) by backwater from the planned Asotin reservoir. The Corps of Engineers' plan suggests a plant at the dam with an installed capacity of 180 MW. The site is 16 miles downstream from the mouth of the Salmon River.

The Asotin site (13-3340+10) at mile 146.8, sec. 36, T. 35 N., R. 6 W., Boise Meridian, and sec. 22, T. 10 N., R. 46 E., Willamette Meridian, Washington, where the drainage area is 93,100 square miles could develop the head between altitudes 735 feet at the damsite and 845 feet (842.5 feet according to the Corps of Engineers' plan) at the China Gardens site tailrace. The dam planned will be about 2,900 feet long, including the embankment section. Power installations ultimately will be 540 MW according to present plans. This is the most downstream powersite on the main stem of the Snake River from which potential waterpower is allotted to the State of Idaho. The project has been authorized for construction by the Corps of Engineers.

Clearwater River

The drainage area of the Clearwater River is about 9,600 square miles. This is 68 percent of the area drained by the Salmon River (14,100 square miles). Comparison of the average annual discharge of the two streams gives an approximately inverse ratio. Discharge records show the Salmon at Whitebird, drainage area 13,550 square miles, averaging 10,900 cfs for a 48-year period ending with water year 1960. This is 71 percent of the Clearwater River discharge at Spalding, drainage area 9,570 square miles, for a 38-year period ending in 1960, 15,260 cfs. Salmon River runoff per square mile is about 50 percent of that for the Clearwater River. The principal tributaries of the Clearwater River are the Selway River, its tributary Lochsa River, Middle Fork Clearwater River, North Fork Clearwater River, and Potlatch River. With the exception of the Potlatch these streams head near the summit of the Bitterroot Range and flow generally westward. The Selway Basin is adjacent to the Salmon River on the south and the North Fork Clearwater Basin is adjacent to the St. Joe River basin on the north. The Bitterroot River and the Clark Fork and their tributaries drain the opposite (eastern) slopes of the Bitterroot Mountains adjacent to the Clearwater River headwater streams.

The eastern portion of the Clearwater River basin is composed of rugged, heavily timbered mountains in which the various tributary streams have eroded deep canyons. The western part of the basin is generally barren and untimbered. The high benchlands are often adaptable to dry-farm wheat raising and the valleys, often irrigated from the creeks or by pumping from the river, produce hay and grain for livestock, as well as potatoes, many kinds of fruit, sugar beets, and so on.

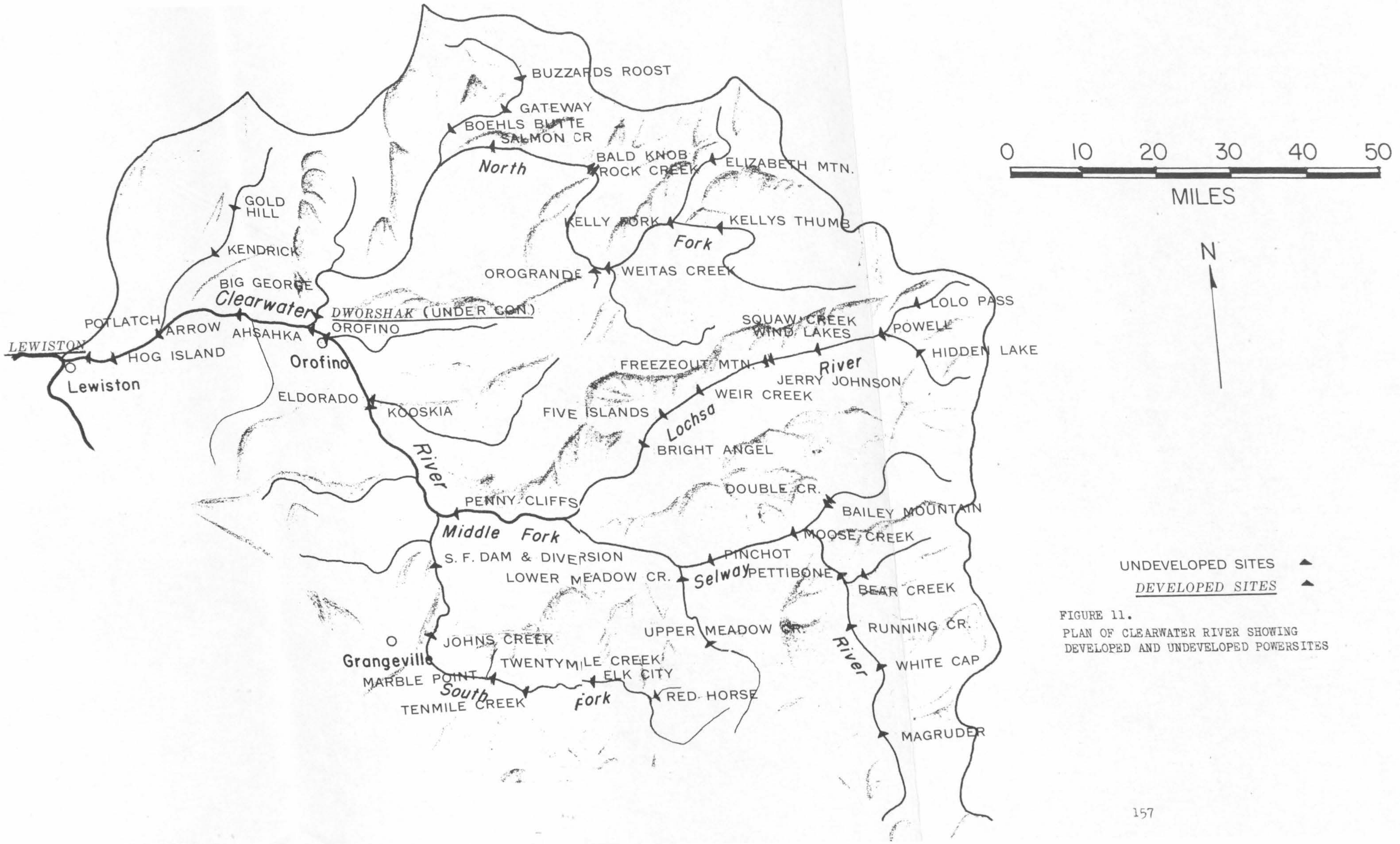


FIGURE 11.
PLAN OF CLEARWATER RIVER SHOWING DEVELOPED AND UNDEVELOPED POWERSITES

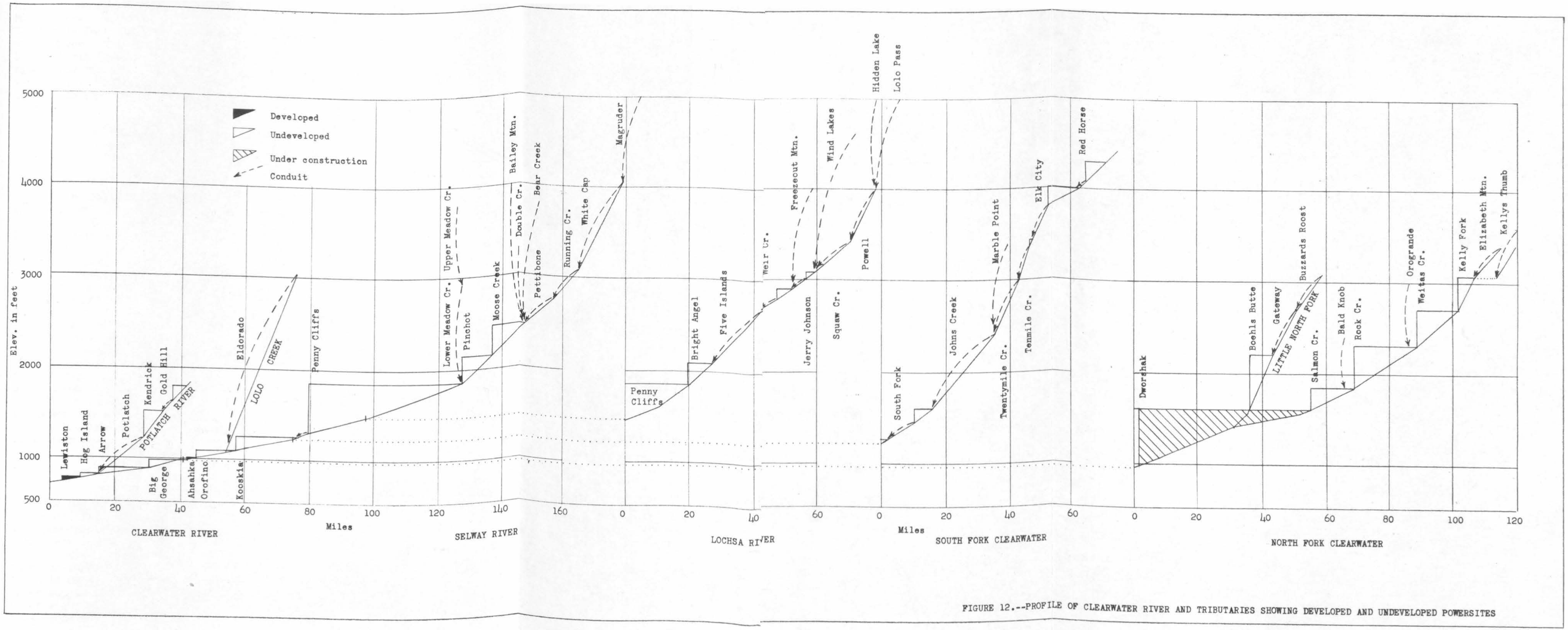


FIGURE 12.--PROFILE OF CLEARWATER RIVER AND TRIBUTARIES SHOWING DEVELOPED AND UNDEVELOPED POWERSITES

The timber on the South Fork is often lodgepole pine but timber quality improves to the northward being mainly yellow pine, fir, and tamarack in the Selway River basin, and white pine, cedar, spruce, hemlock, and fir in the Lochsa and North Fork basins. The Selway River is considered to be the main headwater stream and becomes the Middle Fork Clearwater River at its junction with the Lochsa River. The Middle Fork and South Forks join at Kooskia to form the Clearwater River. The Clearwater River flowing northwestward is joined by the North Fork, flowing southwestward, at a point about 40 river miles from the mouth. At this junction the Clearwater turns westward to its confluence with the Snake River at Lewiston. The following tabulation shows the relative size of the principal tributaries:

Selway River	2,000	square miles	
Lochsa River	1,180	do	do
S.F. Clearwater River	1,150	do	do
N.F. Clearwater River	2,440	do	do
Potlatch River	650	do	do

The Potlatch River heads at an elevation of about 5,000 feet and its drainage basin is principally in the barren western section just described. The river and its main tributaries have cut deep canyons in the basalt underlying the area.

The climate within the basin is influenced by the warm moisture-laden air moving eastward from the Pacific Ocean which causes heavy precipitation as it rises over the Bitterroot Mountains. Average annual precipitation varies between approximately 15 inches at the western edge of the basin to more than 70 inches in the mountains. The average for the basin is about 40 inches distributed throughout the year in a pattern similar to the Pacific Coast area, wet in winter and dry in summer. It would be very desirable to include storage with all waterpower developments undertaken in the basin and there are some good storage sites. Generally, however, the streams fall rapidly in deep narrow canyons and very high dams will be required to effect significant amounts of storage. Figure 11 is a planimetric map showing powersite locations and figure 12 contains longitudinal profiles showing the powersites used for determining the potential power of the Clearwater River basin.

Selway River

The Magruder site (13-3360+10) is planned to develop power from the runoff from 145 square miles of the Selway River headwater streams at a powerhouse at mile 179. The Selway River, Wilderson Creek, and Deep Creek are assumed to be divertible at an altitude of 5,000 feet and the water carried along the right bank of the Selway River to the Magruder ranger station where the altitude is 4,050 feet. The drainage basin is dotted with glacial (?) lakes and it is believed that the water supply would be relatively good during the low water period. About eight miles of conduit from Sweet and Wilderson Creeks and five miles from Deep Creek would be necessary.

The White Cap site (13-3360+20) on the Selway River, at mile 164.5, is at the diversion site given by Hoyt (1935, p. 346). The plan shown assumes diversion at the Magruder site tailrace on the Selway River where the drainage area is 280 square miles, and at altitude 4,050 feet on White Cap Creek where the drainage area is about 100 square miles--380 square miles in all. There is a reservoir site at the diversion point on White Cap Creek, and it would be necessary to raise the water surface 100 feet to establish the 1,000 feet of gross head. The conduit along the Selway River would be about 16 miles long and could pick up water from Indian Creek. The White Cap tailrace altitude of 3,050 feet is 15 feet higher than the present water surface to permit creation of a small pond at the Running Creek diversion site.

The Running Creek site (13-3360+30) consists of a powerhouse site on the Selway River at mile 157 where the water surface is 2,750 feet, and water would be carried to it from the White Cap site tailrace altitude of 3,050 feet in a seven-mile-long conduit. A diversion dam at mile 164.5 would raise the water surface from 3,035 to 3,050 feet. An additional three-mile-long conduit would add water from about 100 square miles of area drained by Running Creek. The total drainage area is 607 square miles.

The Bear Creek site (13-3360+40) with a powerhouse site at mile 3.6 on Bear Creek where the water surface altitude is about 2,750 feet would utilize water diverted at an altitude of 3,750 feet from Bear, Paradise, and Cub Creeks. A diversion about six miles long would be required on Bear Creek and an additional four-mile-long diversion would suffice for the Cub Creek and Paradise Creek diversions. The total drainage area is 140 square miles.

The Pettibone site (13-3360+50) would utilize a dam at about mile 147 to create head. The water surface altitude at the damsite is about 2,450 feet and a dam that would raise the water surface to an altitude of 2,750 feet would have a crest length of about 1,450 feet according to the 1924 river survey map prepared by the U. S. Geological Survey. The reservoir would largely replace the Goat Creek diversion and conduit development suggested by Hoyt (1935, p. 347). The drainage area is 915 square miles.

The Double Creek site (13-3360+70) shows head and potential power amounts that would accrue from the diversion of East Fork Moose Creek at mile 6.5, altitude about 3,300 feet, a short distance upstream from Battle Creek, and carrying the water in a conduit along the left bank of Moose Creek to a point about one mile downstream from Double Creek, at the backwater altitude of the Moose Creek reservoir site, 2,450 feet. The drainage area is 103 square miles. The conduit would be about seven miles long and would be shortened by three miles if the dam and reservoir were substituted. Approximately the same potential power with a storage reservoir added could be realized by constructing a dam downstream from the mouth of Elbow Creek to raise the water to the 3,300-foot contour altitude. The drainage area could be increased to 147 square miles as it would include 44 square miles from Battle, Elbow, and Monument Creeks. The diversion-conduit plan is used here because the Moose Creek reservoir site immediately downstream may make another storage reservoir unnecessary.

The developed Moose Creek Ranch powersite (13-3360+72) (Federal Power Project 2353) in unsurveyed sec. 25, T. 33 N., R. 12 E., was formerly licensed as Project 1996. The project consists of a concrete diversion dam 6 feet high and 108 feet long, a 97-foot flume, a frame powerhouse, and a 33 horsepower wheel operating a 24 kva generator. Altitudes and drainage area were not given. ***

The Bailey Mountain site (13-3360+75) would divert North Fork Moose Creek at an altitude of about 4,000 feet near the mouth of West Moose Creek and carry the water about six miles along the left bank of North Fork Moose Creek to the backwater limit of the Moose Creek reservoir site, 2,450 feet. The powerhouse could be on North Fork Moose Creek or, by a very short tunnel addition to the conduit, a single powerhouse could serve both the Moose Creek and Double Creek plants. The drainage area is 58 square miles and could be increased to 108 square miles by a four-mile-long conduit and inverted siphon to bring water from Wounded Doe and Lizard Creeks.

The Moose Creek site (13-3360+80) assumes the construction of a dam on the Selway River about 0.4 mile downstream from Divide Creek, at mile 137, where the drainage area is 1,200 square miles and the water surface is 2,150 feet. At altitude 2,450 feet water would back about five miles up Moose Creek and 10 miles up the Selway River to form a reservoir with a capacity of 222,000 acre-feet. The dam would have a crest length of about 800 feet. The Hopewood Creek and Goat Mountain sites suggested by Hoyt (1935, p. 347) are in this section of river.

The Pinchot site (13-3360+87) on the Selway River at mile 127, where the drainage area is 1,330 square miles, is planned to develop the head between the Moose Creek site tailrace altitude of 2,150 feet and the Penny Cliffs site backwater limit altitude of 1,855 feet. The Pinchot site is in the original Jim Creek reservoir site that had a dam planned at altitude 1,840 feet, which is now included in the Penny Cliffs reservoir site. The Jim Creek reservoir site upstream from the Penny Cliffs backwater limit is included in the reservoir that would be formed by constructing the dam near Pinchot Creek. The 1924 river survey indicates that the best cross section would be about 1,000 feet upstream from the creek where the dam would have a crest length of about 1,000 feet at altitude 2,150.

The Upper Meadow Creek site (13-3360+90) with a powerhouse site on Meadow Creek at about mile 19, would utilize water diverted from Meadow Creek at an altitude of 3,800 feet by means of a conduit about eight miles long along the right bank of Meadow Creek to altitude

2,900 feet. The drainage area is 90 square miles and water from an additional 23 square miles could be added by means of a diversion from streams draining the south side of Little Copper Butte in a three-mile-long conduit to the above-described powerhouse site.

The Lower Meadow Creek site (13-3360+95), by diverting Meadow Creek at the Upper Meadow Creek site tailrace altitude of 2,900 feet and a 10-mile-long conduit along the right bank of Meadow Creek to the backwater limit from the Penny Cliffs site, 1,855 feet, could develop the head remaining on Meadow Creek. The powerhouse site is at mile 2.4 and the drainage area is 177 square miles.

Lochsa River

The Lolo Pass site (13-3365+10), with a powerhouse site near the junction of Brushy Fork and Boulder Creek, sec. 5, T. 37 N., R. 15 E., would utilize water diverted at an altitude of about 5,000 feet from 38 square miles of Brushy Fork and Spruce Creek drainage and 42 square miles of Boulder Creek and Crooked Creek drainage, 80 square miles in all. About 20 miles of conduit, altogether, would be required and it probably would be desirable to include several miles of tunnels. Head would be developed between altitudes 5,000 and 4,000 feet.

The Hidden Lake site (13-3365+20) would develop power from 132 square miles of White Sand Creek headwaters by diverting water at an altitude of about 5,000 feet from White Sand Creek and its tributary Big Sand Creek and carrying it along the left bank of White Sand Creek to the powerhouse site in sec. 10, T. 36 N., R. 15 E., at an altitude of about 4,000 feet. It appears from the available topographic maps that reasonably sized reservoirs could be created by dams at the diversion points. Hidden Lake and Big Sand Lake and the surrounding valleys should have an equalizing effect upon the stream in its natural condition.

The Powell site (13-3365+30) with a powerhouse site near the Powell Ranger Station, sec. 26, T. 37 N., R. 14 E., mile 70, would utilize water from a drainage area of 370 square miles by diverting from the Lolo Pass site tailrace on Crooked Fork and from the Hidden Lake site on White Sand Creek. A conduit about six miles long on the left bank of Crooked Fork and about five miles long on the left bank of White Sand Creek would lead to separate penstock sites near the junction of the Lochsa River and White Sand Creek. Head would be developed between altitudes 4,000 feet and 3,440 feet.

The Squaw Creek site (13-3365+40) with a powerhouse site on the Lochsa River at mile 59 would require a conduit about 10 miles long on the left bank of the river to connect the Powell site tailrace, altitude 3,440 feet, to the backwaters from the Jerry Johnson reservoir site, altitude 3,100 feet. The Squaw Creek site and the Wind Lakes site, next described, might use a common powerhouse site. The

Squaw Creek powerhouse site has been moved upstream from the one described by Hoyt (1935, p. 349) to make room for a small storage basin at the mouth of Warm Springs Creek and the diversion point has been moved upstream to increase head.

The Wind Lakes site (13-3365+50) with a powerhouse site on the Lochsa River at mile 59, near or in common with the Squaw Creek site, would utilize water from a drainage area of 50 square miles of Warm Springs Creek. A diversion about six miles long would connect the diversion site, altitude 4,600 feet, with the powerhouse site, altitude 3,100 feet. The diversion would probably follow the right bank of Warm Springs Creek.

The Jerry Johnson site (13-3365+60) with a powerhouse site at mile 51.8 assumes a development by a 100-foot dam at mile 55.5, just downstream from the junction of Warm Springs Creek where the drainage area is 588 square miles, and a 3½-mile conduit along the right bank of the Lochsa River to the powerhouse site. Head between altitudes 3,100 and 3,000 feet would be developed by the dam, and head between 3,000 and 2,900 feet would be developed in the conduit.

The Freezeout Mountain site (13-3365+70) with a powerhouse site on the Weir Creek reservoir site, Lochsa River, at the mouth of Lake Creek, would utilize water from 43 square miles of Lake Creek drainage. Diversion would be at altitude 4,000 feet and tailrace at altitude 2,900 feet. A conduit about four miles long would be necessary. The conduit could follow either bank of the creek.

The Weir Creek site (13-3365+80) would utilize water from 695 square miles of Lochsa River drainage at a powerhouse site in unsurveyed T. 36 N., R. 11 E., mile 42.8. Of the 200-foot head, 95 feet would be developed by a dam at mile 47.5 and 105 feet in a five-mile-long conduit (altitudes 2,805 feet to 2,700 feet). The crest length of the dam would be about 300 feet.

The Five Islands site (13-3365+90) as described here includes the Lost Creek site described by Hoyt (1935, p. 350). Water would be diverted at mile 42.8, the tailrace of the Weir Creek site and carried in a conduit that would be somewhat shorter than the river channel to the powerhouse site at mile 27.6, altitude 2,100 feet.

The Bright Angel site (13-3369+10) might be located on the Lochsa River at mile 19.2 where the present water surface is about 20 feet lower than the projected Penny Cliffs backwater, or at one of several possible locations upstream to mile 20.8 where the water surface is about 20 feet higher than Penny Cliffs backwater limits. A dam at one of the sites in this 1.6-mile reach would have a crest length of about 1,000 feet at altitude 2,100 feet. The drainage area is 967 square miles. The tailrace altitude is 1,855 feet to accomodate the Penny Cliffs backwater. The power developments suggested will force the relocation of the Lewis and Clark Highway up on the side of the canyon. It is believed that a rockfill or a concrete dam will be feasible.

The Penny Cliffs site (13-3370+20) as studied by the Corps of Engineers would have a dam located at mile 79 on Middle Fork Clearwater River where the drainage area is 3,310 square miles. A dam that would raise the water from its present altitude of 1,285 feet to an altitude of 1,855 feet would have a crest length of about 1,800 feet. This site would include the Three Devils site as well as the Jim Creek, Meadows, Selway Falls, and Rock Cliff sites on Selway River as well as the Split Creek site on the Lochsa River (Hoyt, 1935, p. 348). The plan and profile of the Middle Fork Clearwater River surveyed in 1924 shows the water surface altitude at the damsite to be about 1,285 feet above sea level. Head to altitude 1,260 feet would be developable by means of a tunnel and penstock system through the left abutment, or by a means of a re-regulating dam and separate powerplant at the Kooskia site backwater limit, altitude 1,260 feet. The tailwater might be as low as 1,245 feet in an actual development in order to limit flooding in Kooskia by the next downstream site.

South Fork

The Red Horse site (13-3370+30) might be developed by means of a dam on the Red River at altitude 4,100 feet in unsurveyed sec. 7, T. 28 N., R. 9 E., where the drainage area is 135 square miles, to raise the water surface to an altitude of 4,300 feet, and a conduit four or five miles long to altitude 4,000 feet in sec. 3, T. 28 N., R. 8 E. The project would be entirely on the Red River which, together with American River, forms the South Fork Clearwater River at a point about 1½ miles downstream from the powersite and about the same distance southwest of Elk City. The site should be investigated for its upstream storage possibilities as there are few reservoir sites on the South Fork, which flows principally in a narrow canyon that must also be used for a road from Elk City to its mouth. The damsite would be located in the section of Red River upstream from Red Horse Creek. Topographic maps of the area are not suitable for determining the capacity of the reservoir site.

The Elk City site (13-3375+10) would also be a combination dam and conduit developing 200 feet by a dam at an altitude of about 3,800 feet in sec. 28, T. 28 N., R. 7 E., where the drainage area is 341 square miles. A conduit about five miles long on the right bank of the South Fork would carry the water to the powerhouse site near the mouth of Tenmile Creek (mile 47). The water surface at the powerhouse site is at an altitude of 3,420 feet and, according to the land net on the Nez Perce National Forest map, the powerhouse site would be in unsurveyed sec. 35, T. 28 N., R. 6 E.

The Tenmile Creek site (13-3375+20) with a diversion dam at mile 46.5, where the drainage area is 496 square miles, would raise the water surface from its present altitude of about 3,400 feet to the Elk City site tailrace altitude of 3,420 feet and develop the remaining head to altitude 3,000 feet in a conduit a little less than five miles long. The powerhouse site would be at the mouth of Twentymile Creek, mile 42.8, in unsurveyed sec. 31, T. 28 N., R. 6 E., as shown on the Nez Perce National Forest map.

The Twentymile Creek site (13-3375+50) is visualized as having a diversion dam at mile 42.5 near the tailrace of the Tenmile Creek site, drainage area 532 square miles, and a conduit 7½-miles long to mile 35, unsurveyed sec. 30, T. 29 N., R. 5 E. Head would be developed between altitude 3,000 and 2,400 feet. Hoyt (1935, p. 352) suggests a flume down the right bank connecting the above points. It probably would also be worthwhile to collect low-water discharges from several tributary creeks in that reach of river during low-water periods.

The Marble Point site (13-3375+60) would utilize water from 85 square miles of Johns Creek drainage. The diversion would be approximately in unsurveyed sec. 31, T. 28 N., R. 5 E., and a 6½-mile-long conduit would lead to the powerhouse site at the mouth of Johns Creek, mile 35 on South Fork Clearwater River in unsurveyed sec. 30, T. 29 N., R. 5 E. Head would be developed between an altitude of 3,400 and 2,400 feet. Perhaps the powerhouse for Twentymile Creek site could be shared.

The Johns Creek site (13-3375+80), because of difficulty in locating a conduit on the canyon walls and because of a large bend in the river, is suggested for development by a diversion dam at the mouth of Johns Creek, mile 35, where the drainage area is 728 square miles, and an eight-mile-long tunnel to a balancing reservoir site on Lightning Creek from which the water would be dropped in a 1½-mile-long penstock to a powerhouse site at altitude 1,615 feet, mile 15.6, sec. 9, T. 30 N., R. 4 E. As described here the Johns Creek site includes the Sheep Bridge site as well as a reach of river formerly developed by the Grangeville plant as suggested by Hoyt (1935, p. 532).

The Grangeville site (13-3380) would not be redeveloped. The Grangeville Plant of the Washington Water Power Company was constructed in 1917 and used until recent years. The company surrendered the Federal Power Commission license and dismantled the dam and plant in 1963. This reach is now included in the Johns Creek site just described.

The South Fork site (13-3380+10) might be developed by means of a dam at mile 9.4, sec. 17, T. 31 N., R. 4 E., where the water surface altitude is 1,435 feet. A dam that would raise the water to an altitude of 1,615 feet would have a crest length of about 700 feet. An eight-mile conduit on the right bank of the South Fork would carry the water to the Kooskia site backwater limit altitude of 1,260 feet. The South Fork as described here probably would best be developed in two units; a powerhouse at the South Fork dam and rediversion of the water to a powerhouse at the Kooskia site backwater limits at mile 1.3, sec. 8, T. 32 N., R. 4 E.

South Fork to North Fork

The Kooskia damsite (13-3390+10) is suggested for development at mile 57.2, on the Clearwater River, sec. 36, T. 35 N., R. 2 E., where the Clearwater River drainage area is 4,944 square miles. The site as here proposed would have a backwater limit of 1,260 feet, the Penny Cliffs tailrace. A lower backwater limit might be desirable (refer to the Penny Cliffs discussion). The water surface at the damsite is about 1,086 feet. At altitude 1,260 feet the highway, railroad, and town of Kamiah will have to be relocated. There will also be some relocation expense in and around Kooskia. The Penny Cliffs-Kooskia arrangement for developing this reach of river seems to be necessary because of the location of the town of Kooskia. The Kooskia damsite is suitable topographically and geologically for a dam that would raise the water to an altitude of 1,600 feet and form a reservoir with a storage capacity of 5,670,000 acre-feet. Opposition from the affected area made it evident that the site has social and economic infeasibility and it has been eliminated from the Corps of Engineers 308 report. A dam to altitude 1,600 feet would have had a crest length of about 1,350 feet. At an altitude of 1,260 feet the crest length is reduced to about 550 feet.

The Eldorado site (13-3390+50) might divert Lolo Creek near Eldorado Creek, sec. 18, T. 34 N., R. 8 E., where the drainage area is 144 square miles, and carry the water along the right bank about 18 miles to a point near the abandoned Lolo Creek Plant site. The powerhouse site is about one mile above the mouth of Lolo Creek in sec. 13, T. 35 N., R. 2 E., and the tailrace altitude is estimated to be 1,120 feet. The diversion altitude is 3,020 feet to make an even 1,900 feet of gross head.

*** The Lolo Creek Plant (13-3395+10) built about 1900 was owned in order by California Pacific Utilities, Pacific Power and Light Co., and Washington Water Power Co. located at mile 54 on the Clearwater River, sec. 14, T. 35 N., R. 2 E., and was abandoned about 1922.

The Orofino site (13-3395+80) is located at mile 45.4, a short distance upstream from Orofino and the mouth of Whiskey Creek, sec. 18, T. 36 N., R. 2 E., drainage area 5,375 square miles, would raise the river from its altitude of 1,000 feet to altitude 1,086 feet by means of a dam about 700 feet long at the crest. The river is about 400 feet wide at the water surface. Water would back to the Kooskia damsite tailrace and would require considerable road and railroad relocations throughout the 12-mile reach of river, but the damsite located upstream from Orofino would make full development of the fall in the Clearwater River feasible without too much interference at Orofino.

The Ahsahka site (13-3400+10) at mile 42, sec. 2, T. 36 N., R. 1 E., where the drainage area is 5,590 square miles, would develop head between the damsite, altitude 974 feet and the Orofino tailrace, altitude 1,000 feet without too much interference with the town of Orofino, the railway, or the highway along a three-mile reach of river.

North Fork

In a distance of 103.5 miles, from Kelly Creek to the mouth, the North Fork Clearwater River falls 1,770 feet, an average rate of only 17 feet per mile. Fall is less than 10 feet per mile near the mouth. There are no wide valleys which might be used for storage sites, but the low rate of fall increases the storage capacity of the river canyon and several head developments by means of dams will be feasible. Twelve powersites have been selected for measuring the gross theoretical potential. Five of these sites are on the main river and seven on tributaries. The North Fork tributaries ordinarily fall very rapidly and could furnish economical power in small blocks.

The Elizabeth Mountain powersite (13-3400+20) would divert the North Fork Clearwater River in unsurveyed sec. 6, T. 40 N., R. 11 E., at an altitude of about 3,400 feet and carry the water to a powerhouse site on unsurveyed land about 10 miles downstream at mile 107 where the water surface altitude is 3,100 feet. The drainage area is 152 square miles.

The Kellys Thumb site (13-3400+30) would be an elaborate, alpine-type water-gathering development that would utilize the gross head between altitudes 3,600 feet and 3,100 feet. Seven separate intakes and about 12 miles of conduit would be necessary to collect the water at a powerhouse site on unsurveyed land near the Kelly Creek Ranger Station on Kelly Creek. A dam 200 feet high on Cayuse Creek, where the drainage area is 166 square miles and the water surface altitude abour 3,400 feet, would raise that stream to the necessary altitude. Additional water collected from Kelly Creek, Little Moose Creek, Swamp Creek, and some Swamp Creek tributaries would contribute water from an additional drainage area of 152 square miles, total area 318 square miles.

The Kelly Fork site (13-3400+40) with a damsite at mile 102.3, where the drainage area is 582 square miles, is planned to develop head between altitudes 3,100 and 2,720 feet. The 380-foot-high dam would have a crest length of about 1,250 feet and is thus almost certainly too costly for early development. The reservoir capacity cannot be determined from existing maps but it appears that the principal storage area would be in Kelly Creek basin. The dam would be at a site formerly considered as the Fisher Creek diversion damsite.

The Weitas Creek damsite (13-3400+50) is at mile 88.3 on the North Fork Clearwater River about 1½ miles downstream from the mouth of Weitas Creek. The drainage area is 980 square miles and a dam that would raise the water from its present altitude of about 2,310 feet to altitude 2,720 feet would have a crest length of 1,200 to 1,300 feet. The Weitas Creek site would develop by a high dam the reach of river suggested by Hoyt to be developed by the Fisher Creek diversion and would add 100 feet of head downstream from the Fisher Creek powerhouse site suggested by Hoyt (1935, p. 355).

The Orogrande site (13-3400+60) is suggested for development by diverting Orogrande Creek at an altitude of about 3,000 feet in sec. 33, T. 38 N., R. 7 E., where the drainage area is 63 square miles. A conduit about six miles long on the left bank of Orogrande Creek would lead to the powerhouse site at mile 0.5, sec. 18, T. 38 N., R. 8 E., where the present water surface altitude is 2,310 feet. The powerhouse site has been moved upstream from the altitude suggested by Hoyt (1935, p. 355) to provide room for the Rock Creek site backwater as described hereafter.

The Rock Creek site (13-3405+20) with a damsite at mile 68.7, sec. 8, T. 40 N., R. 8 E., where the drainage area is 1,126 square miles, could create a head of 460 feet by means of a dam with a crest length of about 950 feet. The head developed would be between altitudes 2,310 and 1,850 feet or between the Weitas Creek and Cabin Creek sites. The reservoir would have a storage capacity of about 380,000 acre-feet. The Washington Creek site described by Hoyt (1935, p. 356) is included in the Rock Creek site as described here.

The Bald Knob site (13-3405+30) would utilize water from a drainage area of 113 square miles diverted from Grizzly, Cougar, Swift, and Collins Creeks at an altitude of about 2,400 feet. A total length of about 11 miles of conduit would be required to carry the water to the powerhouse site at the mouth of Skull Creek, mile 65.5 of the North Fork Clearwater River. About two-thirds of the drainage is from Skull and Collins Creeks and a storage reservoir with a capacity of 8,000 acre-feet could be created at the junction of these streams by a dam 160 feet high and 650 feet long at the crest. The damsite is at an altitude of about 2,220 feet and would raise the water to 2,400 feet.

The Salmon Creek site (13-3405+40) with a damsite at mile 55, sec. 28, T. 41 N., R. 6 E., where the drainage area is about 1,400 square miles, would create a reservoir with a storage capacity of 113,000 acre-feet by raising the water from its existing water surface altitude of 1,600 feet (Dworshak backwater limit) to 1,850 feet. The dam would have a crest length of about 1,200 feet. The Lost Pete site described by Hoyt (1935, p. 356) is included in the Salmon Creek site as described here.

The Buzzards Roost site (13-3405+50) with a powerhouse site at mile 20 of the Little North Fork Clearwater River, sec. 12, T. 42 N., R. 6 E., at altitude 2,700 feet, would utilize water diverted at an altitude of about 3,100 feet from a drainage area of 137 square miles at separate diversion points on the Little North Fork and on Canyon Creek. Two separate conduits, each about three miles long, would be required to carry the water to the powerhouse site.

The Gateway site (13-3405+60) with a powerhouse site at mile 12 of the Little North Fork, sec. 5, T. 41 N., R. 6 E., where the drainage area is 178 square miles, would divert water at the Buzzards Roost tailrace at altitude 2,700 feet in sec. 12, T. 42 N., R. 6 E., and carry it in an eight-mile-long conduit, probably on the left bank, to the powerhouse site. The fall between altitude 2,700 feet and 2,200 feet would be developed.

The Boehls Butte site (13-3405+70) with a powerhouse site at mile 6, sec. 17, T. 41 N., R. 5 E., would redivert at the Gateway site tailrace, where the drainage area is 234 square miles, and carry the water about seven miles on the left bank of the Little North Fork. Head would be developed between altitudes 2,200 and 1,600 feet. The latter is the backwater limit of the Dworshak Reservoir now under construction.

The Dworshak site (13-3410), formerly Bruces Eddy, is now under construction at a damsite two miles above the mouth of the North Fork Clearwater River, sec. 26, T. 37 N., R. 1 E., where the drainage area is 2,440 square miles. The reservoir will occupy the section of river suggested for development by Hoyt in the Benton, Big Island, Cranberry Creek, and Elk Berry sites as suggested in past investigations. The water surface altitude at the damsite is 974 feet and will be raised to a maximum of 1,600 feet by a concrete-gravity dam 707 feet high (640 feet above the streambed), 3,200 feet long at the crest, and containing about 6,000,000 cubic yards of concrete. The powerplant initially will have an installed capacity of 345,000 kilowatts and ultimately that will be doubled. At normal full pool the reservoir will extend 53 miles upstream, will have a surface area of 17,000 acres, and a storage capacity of 3,453,000 acre-feet, 2,000,000 of which will be usable for flood control and general storage purposes. The site is interesting because of the facilities being included for migrating fish. Upstream-bound fish are to be collected above the draft tube and taken by ladder to twin elevators which lift them over the dam. Special gates which are capable of taking water between elevations 1,600 to 1,415 will enable the fish to pass through the turbines on their way downstream.

North Fork to mouth

The Big George site (13-3410+40) with a damsite on the Clearwater River at mile 30, sec. 36, T. 37 N., R. 2 W., where the drainage area is 8,300 square miles, would develop head between altitudes 974 and 890 feet. About 10 miles of road and railroad between the mouth of the North Fork and the damsite would have to be relocated. The site developed as described here replaces the Peck site and part of the Eddy site described by Hoyt (1935, p. 359). The dam would be about 550 feet long at the crest.

The Arrow site (13-3410+50), mile 15, sec. 7, T. 36 N., R. 3 W., would back the water from its present altitude of 800 feet to the Big George tailrace altitude of 890 feet by means of a dam with a crest length of 1,100 to 1,200 feet. The drainage area is 8,486 square miles. Several miles of road and railroad would have to be relocated.

Three developments on the Potlatch River appear to be feasible. The Gold Hill site (13-3414+90) with a powerhouse site at mile 20.4, sec. 11, T. 38 N., R. 2 W., would be developed by a dam at altitude 1,600 feet in sec. 2, of this township, where the drainage area is 199 square miles. The water surface could be raised to an altitude of 1,800 feet by a dam with a crest length of about 1,750 feet, and the reservoir would have a capacity of 18,000 acre-feet. A tunnel three-fourths of a mile long would carry the water to the powerhouse site at altitude 1,500 feet, the backwater limit from the Kendrick reservoir site.

The Kendrick site (13-3414+95) would be developed by a dam at Kendrick, mile 14, sec. 19, T. 38 N., R. 2 W., where the Potlatch River has a drainage area of 424 square miles. The water surface at the damsite is 1,220 feet in altitude and a dam that would raise it to an altitude of 1,500 feet would have a crest length of nearly 2,000 feet. The reservoir would back about six miles up the Potlatch River and about three miles up Big Bear Creek and have a capacity of 137,000 acre-feet. Narrower sections could be found for the dam location but they would be inside the town of Kendrick.

Although the valley is wider and the reservoir sites would have a greater capacity, the Potlatch River is judged to be not developable by reservoir in the reach downstream from Kendrick because of the value of the existing cultural improvements as compared with the small amount of waterpower available.

The Potlatch site (13-3415) would develop the remaining fall of the Potlatch River by means of a diversion dam inside the town of Kendrick, mile 13.5, sec. 24, T. 38 N., R. 2 W., at water surface altitude 1,200 feet that would raise the water surface to the Kendrick site tailrace altitude of 1,220 feet and a conduit that would be about 12 miles long, if located on the left bank of the Potlatch River, to the Arrow powerhouse site at altitude 800 feet on the Clearwater River near the mouth of the Potlatch River. The diversion dam would form a stable pool inside the town at altitude 1,200 feet. It probably would be desirable to include two or three tunnel sections in the conduit because of the roughness of the terrain in the canyon. The drainage area and discharge amounts are the same for the Potlatch and Kendrick sites. The Potlatch powerhouse site is in sec. 7, T. 36 N., R. 3 W., and is combined with the Arrow powerhouse site. A somewhat shorter penstock would be required if the powerhouse were located at the 1,200-foot altitude on the Potlatch River but the advantages of combining the powerhouses under one roof would probably outweigh the saving in the shorter penstock. The drainage area is 425 square miles.

The Hog Island site (13-3415+40) with a damsite at mile 9, on the Clearwater River, sec. 19, T. 36 N., R. 4 W., where the drainage area is 9,583 square miles, would develop head between the Arrow site tailrace altitude of 800 feet, and the backwater limit from the constructed Lewiston Plant of the Washington Water Power Company, altitude 766 feet. The Spalding Memorial Park and several miles of road and railroad would have to be relocated to accomodate the reservoir.

The Lewiston Plant (13-3425+20) with powerplant in sec. 28, T. 36 N., R. 5 W., mile 3.7, where the drainage area is 9,640 square miles, develops head between altitudes 766 and 730 feet by means of a dam in sec. 27, mile 4.6. There are conflicting data on the altitude of the forebay. The plant data sheet shows normal pool of 764 feet. This plant was constructed in 1927, has 10,000 kilowatts installed and utilizes 2,340 acre-feet of pondage for power purposes. The reservoir serves as a logging pond in addition to creating the power head. Only a small part of the water is used in the plant and the site has a considerably greater capability than the present development. In 1960 the plant factor was 65.

Palouse River

There are sites in the mountainous headwater areas of the Palouse River basin where small waterpower plants may be developed, but none of the sites are large enough to be included in the Geological Survey inventory.

Tabulation of powersites

Developed powersites, showing their gross theoretical power and installed capacity of present plant, and undeveloped sites, showing their gross theoretical power are shown in table 12. Developed reservoirs are classified as developed sites with installed capacity equal to zero. This is done so that all developed storage can be taken into account. Also, in Idaho a considerable amount of water from flood-control and irrigation reservoirs without connected powerplants is used on a controlled release basis at downstream powerplants.

Table 12.--Developed powersites, showing gross theoretical power of sites and installed capacity of present plant; and undeveloped sites, showing gross theoretical power, State of Idaho.

STATE AND BASIN TOTALS	No. of plants	Storage, thousands of acre-feet	Gross theoretical power, with gross head, 100 percent efficiency and flows at			Installed capacity MW	Average annual generation MWH
			Q 95 MW	Q 50 MW	Mean MW		
STATE TOTALS							
Developed	44	9,739.5				1,025.1 1/	5,721,010
Potential at developed sites			522.8	1,002.5	1,396.5		9,772,500
Potential at undeveloped sites			2,379.4	4,700.2	9,278.9		64,973,650
Potential at developed and undeveloped sites			2,902.2	5,702.7	10,675.4		74,746,150
BEAR RIVER BASIN	6	1,443				96.9	229,500
Potential at developed sites			6.7	15.9	33.0		231,200
Potential at undeveloped sites			3.4	9.2	17.4		121,900
Potential at developed and undeveloped sites			10.1	25.1	50.4		353,100

1/ Approximately adjusts to the Federal Power Commission report of 1,250.7 MW installed in Idaho (for 1960) by adding 1/2 of Cabinet Gorge (100 MW), 1/2 of Palisades (57 MW), and 1/2 of Brownlee (180.2 MW), and deducting 1/2 of Oxbow (110 MW). The Federal Power Commission assigns all installed capacity to the State in which the powerhouse is located, whereas the Geological Survey divides it equally when two States are affected.

COLUMBIA RIVER BASIN (upstream from Snake River)							
Developed	5.5	1,401.4				156.5	902,600
Potential at developed sites			57.9	133.4	201.6		1,412,000
Potential at undeveloped sites			63.2	204.1	430.5		3,013,700
Potential at developed and undeveloped sites			121.1	337.5	632.1		4,425,700
SNAKE RIVER BASIN							
Developed	31.5	6,895.1				771.7	4,588,910
Potential at developed sites			458.2	853.2	1,161.9		8,129,300
Potential at undeveloped sites			2,312.8	4,486.9	8,831.0		61,838,050
Potential at developed and undeveloped sites			2,771.0	5,340.1	9,992.9		69,967,350

Table 12.--continued. (Developed sites)

Basin index number and basin / Stream / Site	Powerhouse location: Latitude °	Latitude '	Longitude °	Longitude '	Gross head (feet)	Storage, thousands of acre-feet	Gross theoretical power, with gross head, 100 percent efficiency and flows at: Q 95 MW	Q 50 MW	Mean MW	Installed capacity MW	Average annual generation MWH
Bear River basin											
10-H Bear River											
Paris Cr., Paris	42	14	111	26	346		-	-	-	.7	2,900
Soda Cr., Soda Springs	42	41	111	36	90		-	-	-	.7	3,600
Bear River, Soda	42	38	111	42	79	1,432 2/	.8	2.0	4.0	14.0	26,000
Grace	42	32	111	48	524	1,432 2/	4.5	8.5	16.9	44.0	120,000
Cove	42	31	111	48	98	1,432 2/	1.0	1.7	3.5	7.5	24,000
Oneida	42	16	111	44	145	1,443 2/	.4	3.7	8.6	30.0	53,000
Developed (6 plants)						1,443				96.9	229,500
Potential at developed sites (BEAR RIVER)							6.7	15.9	33.0		231,200
Kootenai River basin											
12-A Moyie River											
Moyie R., Moyie No. 2	48	44	116	11	200	Pondage	1.7	5.35	16.0	2.0	19,300
Moyie No. 1	48	44	116	11	168		-	-	-	.4	1,600
Developed (2 plants)										2.4	20,900
Potential at developed sites (MOYIE RIVER)							1.7	5.35	16.0		112,000

2/ Bear Lake storage utilized.

IDAHO-MONTANA											
Pend Oreille River basin											
12-D Clark Fork River											
Clark Fork R., Cabinet Gorge	48	05	116	03	97	42.8	61.5	125.7	183.3	200	1,158,900
Developed (1 plant)						42.8				200	1,158,900
Potential at developed sites (CLARK FORK RIVER)							61.5	125.7	183.3		1,283,000
IDAHO											
12-D Pend Oreille River											
Pend Oreille R., Albeni Falls	48	11	117	00	28	1,155	20.2	47.8	65.0	42.6	230,000
Developed (1 plant)						1,155				42.6	230,000
Potential at developed sites (PEND OREILLE RIVER)							20.2	47.8	65.0		455,000
PEND OREILLE RIVER BASIN, IDAHO											
Developed (1.5 plants, 1/2 of Cabinet Gorge)						1,176.4				142.6	800,000
Potential at developed sites							51	110.3	156.6		1,097,000

Table 12.--continued.

Basin index number and basin Stream Site	Powerhouse location Latitude °	'	Longitude °	'	Gross head (feet)	Storage, thousands of acre-feet	Gross theoretical power, with gross head, 100 percent efficiency and flows at Q 95 MW	Q 50 MW	Mean MW	Installed capacity MW	Average annual generation MWH
Spokane River basin											
12-E Coeur d'Alene River											
Canyon Cr., Hecla Mine	47	31	115	49	256		-	-	-	.25	700
Developed (1 plant)										.25	700
12-E Spokane River											
Spokane R., Post Falls	47	42	116	58	56	225	5.19	17.7	29.0	11.25	81,000
Developed (1 plant)										11.25	81,000
Potential at developed sites (SPOKANE RIVER)							5.19	17.7	29.0		203,000
Developed (2 plants)										11.5	81,700
Potential at developed sites (SPOKANE RIVER BASIN)						225	5.19	17.7	29.0		203,000
IDAHO AND WYOMING											
12-G Snake River, headwaters to Henrys Fork											
Snake R., Palisades	43	20	111	12	245	1,402	32.2	76.9	132.3	114	~~532,200~~ 508,000
Developed						1,402				114	~~532,200~~ 508,000
Potential at developed sites							32.2	76.9	132.3		926,000

IDAHO

Developed (1/2 Palisades)						701				57	~~266,100~~ 254,000
Potential at developed sites (SNAKE R., HEADWATERS TO HENRYS FORK)							16.1	38.45	66.15		463,000
12-G Snake River, Henrys Fork											
Henrys Fork, Henrys Lake	44	36	111	22	15	79	-	-	-	0	0
Island Park	44	25	111	23	72	127	.05	2.78	3.36	0	0
Buffalo R., Ponds Lodge	44.	26	111	24	100	17	1.23	1.44	1.57	.2	10
Henrys Fork, Ashton	44	04	111	30	150	Pondage	6.4	13.5	17.3	5.8	31,000
Henrys Fork, St. Anthony	44	58	111	41	40	0	1.44	1.73	3.91	.5	3,600
Teton R., Felt	43	55	111	17	535	Pondage	7.50	12.50	17.74	2.1	9,000
Developed (4 plants)						223				8.6	43,610
Potential at developed sites (HENRYS FORK)							16.62	31.95	43.88		306,700
12-G Snake R., Henrys Fork to Oregon line											
Snake R., Idaho Falls (#2)	43	33	112	03	21	Pondage	2.95	6.43	9.04	2.4	16,000
Idaho Falls (#1)	43	30	112	02	42		5.9	12.8	18.1	2.0	14,000
Idaho Falls (#4)	43	28	112	03	32		4.5	9.8	13.8	3.	20,000
Blackfoot R., Blackfoot Marsh	43	00	111	43	150	413	1.19	1.92	2.3	0	0
Portneuf R., Portneuf Res.	42	53	111	57	100	24	-	-	-	0	0
Birch, Marsh Cr., Malad City	42	21	112	15	510		-	-	-	.2	1,500
Snake R., American Falls	42	46	112	52	117	1,700	7.16	55.7	66.8	27.5	148,000
Minidoka (Lake Walcott)	42	40	113	29	50/	222	3.33	27.4	32.7	13.4	98,000
Goose Cr., Oakley	42	12	113	55	136	74.4	-	-	-	0	0
Snake R., Milner Lake	42	32	114	00	85	80	.09	4.98	13.3	0	0
Wilson Lake (offstream)	42	46	114	10		18.5	-	-	-	0	0
Dry Cr., Murtaugh Lake	42	28	114	09	161	12	-	-	-	0	0
Snake R., Twin Falls	42	36	114	21	145	.8	5.36	23.9	39.4	13.5	58,900
Shoshone Falls	42	36	114	24	226	.8	8.65	38.0	63.0	10.88	92,000

Table 12.--continued.

Basin index number and basin / Stream / Site	Powerhouse location: Latitude °	'	Powerhouse location: Longitude °	'	Gross head (feet)	Storage, thousands of acre-feet	Gross theoretical power, with gross head, 100 percent efficiency and flows at: Q 95 MW	Q 50 MW	Mean MW	Installed capacity MW	Average annual generation MWH
12-G Snake R., Henrys Fork to Oregon line (cont'd.)											
Clear Lakes, Clear Lakes	42	40	114	47	80		2.38	2.72	3.16	2.5	18,000
Salmon Falls Cr. Sal.Falls Cr.	42	13	114	44	225	182.7	-	-	-	0	0
Cedar Cr., Cedar Cr.	42	13	114	53	210	26	-	-	-	0	0
Springs, Thousand Springs	42	45	114	50	182		7.0	8.0	9.0	8.0	40,000
Snake R., Upper Salmon "B"	42	46	114	54	37	1.2	17.2	23.5	27.3	16.5	145,000
Upper Salmon "A"	42	46	114	56	44		20.5	28.0	32.5	18.0	165,000
Lower Salmon Falls	42	50	114	54	59	5.2	27.5	37.5	43.5	60.0	260,000
Big Lost, Sink, Mackay Res.	43	57	113	40	100	44.5	.55	1.27	2.38	0	0
Big Wood, Malad, Magic Res.	43	15	114	22	125	191.5	.05	1.27	4.57	0	0
Little Wood, Little Wood	43	25	114	00	200	30	.60	1.19	2.38	0	0
Malad R., Upper Malad	42	52	114	53	129		8.17	9.26	13.1	7.2	64,000
Lower Malad	42	52	114	54	145		11.0	12.3	18.4	13.5	105,000
Snake R., Bliss	42	55	115	04	70	1.2	36.4	48.6	54.6	75.0	369,200
Long Tom Cr., Long Tom Res.	43	17	115	35		5.	-	-	-	0	0
Rattlesnake Cr., Mountain Home	43	10	115	40	45	5.6	-	-	-	0	0
Snake R., C. J. Strike	42	57	115	58	88	166.	53.1	71.1	75.5	82.8	433,000
Swan Falls	43	14	116	22	23	2.3	see undeveloped Guffey			10.3	96,000
Developed (18 plants)						3,206.7				366.68	2,139,600
Potential at developed sites (Henrys Fork to Oregon line)							223.58	425.64	544.83		3,812,300
12-H Boise River											
Little Camas Cr., Little Camas	43	19	115	23		22.3	-	-	-	0	0
S.F. Boise R., Anderson Ranch	43	21	115	27	330	423	6.30	7.17	17.5	27	~~136,900~~ 139,000

Boise R., Arrowrock	43	36	115	55	156	286.6	11.1	20.0	33.1	0	0
Lucky Peak	43	32	116	03	240	307	20.4	36.7	60.6	0	0
Boise Diversion	43	32	116	06	44		3.74	6.73	11.1	1.5	~~7~~5,000
Barber *(Plant dismantled)*	43	34	116	08	23		.98	1.57	3.53	1.0	5,000
Deer Flat (Lake Lowell)	43	35	116	44	31	190.1	.53	1.32	2.63	0	0
Developed (3 plants)						1,229.0				29.5	148,900
Potential at developed sites (BOISE RIVER)							43.05	73.49	128.46		899,200
12-H Payette River											
Clear Creek, Lowman	44	05	115	37			–	–	–	.03	1,000
Deadwood R., Deadwood Lodge	44	28	115	35	720	Pondage	.61	1.0	1.53	.15	700
Deadwood Res.	44	18	115	39	141	161.9	–	–	–	0	0
N.F. Payette R., Payette Lk.	44	52	116	08	7	35	–	–	–	0	0
Cascade *(Plant dismantled)*	44	32	116	03	93	704.1	1.97	4.9	7.9	1.5	0
Payette R., Black Canyon	44	56	116	26	92	44.1	3.91	14.1	23.1	8	~~40~~62,000
Developed (4 plants)						945.1				9.68	41,700
Potential at developed sites							6.49	20.0	32.53		225,700
12-H Weiser River											
Lost Cr., Lost Valley	44	58	116	28	30	10	–	–	–	0	0
Little Weiser R., Ben Ross Res.	44	32	116	27	26	7.8	–	–	–	0	0
Crane Cr., Crane Cr. Res.	44	18	116	44	840	51.7	.14	1.43	5.36	0	0
Potential at developed sites (WEISER RIVER)						69.5	.14	1.43	5.36		37,500

Table 12.--continued.

Basin index number and basin Stream Site	Powerhouse location Latitude °	'	Longitude °	'	Gross head (feet)	Storage, thousands of acre-feet	Gross theoretical power, with gross head, 100 percent efficiency and flows at Q 95 MW	Q 50 MW	Mean MW	Installed capacity MW	Average annual generation MWH
12-H Snake R., Brownlee to High Mtn. Sheep											
Snake River, Brownlee	44	50	116	54	272	984.5	201.14	332.9	404.6	360.4	2,674,000
Oxbow	44	58	116	51	122	52.5	90.7	150.4	183.4	220.	1,108,000
Developed (2 plants)						1,037.0				580.4	3,782,000
Potential at developed sites (BROWNLEE - HIGH MTN. SHEEP)							291.84	483.30	588.0		4,116,000
Developed (1/2 Brownlee & 1/2 Oxbow = 1 plant)						518.5				290.2	1,891,000
Potential at developed sites (BROWNLEE - HIGH MTN. SHEEP)							145.92	241.65	294.0		2,058,000
12-K Clearwater River											
N.F. Moose Cr., Moose Cr. Ranch	46	10	114	53		-	-	-	-	.024	0
Clearwater R., Lewiston	46	26	116	58	36	2.3	6.3	20.6	46.7	10	58,000
Developed (2 plants)						2.3				10.024	58,000
Potential at developed sites (CLEARWATER RIVER)							6.3	20.6	46.7		326,900

Table 12.--continued. (Undeveloped sites)

Basin index number and basin / Stream / Site	Powerhouse location: Latitude ° '	Powerhouse location: Longitude ° '	Gross Head (feet)	Gross theoretical power, with gross head, 100 percent efficiency, and flows at Q 95 MW	Q 50 MW	Mean MW	Estimated average annual generation MWH
Bear River basin							
10-H Bear River							
Bloomington Cr., Bloomington	42 12	111 29	1000	1.5	2.5	3.0	21,000
Bear River, Lava	42 37	111 42	99	1.1	2.5	5.0	35,000
Mink (Oneida Narrows)	42 12	111 47	115	.5	2.9	6.8	47,700
Mink Creek, Mink Cr.	42 14	111 44	400	.3	1.3	2.6	18,200
Potential at undeveloped sites				3.4	9.2	17.4	121,900
Potential at developed sites (from developed waterpower summary)				6.7	15.9	33.0	231,200
Potential at developed and undeveloped sites (BEAR RIVER)				10.1	25.1	50.4	353,100
Kootenai River basin							
IDAHO AND MONTANA							
12-A Kootenai River							
Kootenai R., Low Katka	48 42	116 09	125	32.6	77.1	155.3	1,087,000
IDAHO							
12-A Moyie River							
Moyie R., Meadow Creek	48 49	116 08	330	2.52	7.85	24.8	173,600
Eileen	48 45	116 10	255	2.17	6.72	20.4	142,800
Potential at undeveloped sites				4.69	14.57	45.2	316,400

Table 12.--continued.

Basin index number and basin / Stream / Site	Powerhouse location: Latitude °	'	Longitude °	'	Gross head (feet)	Gross theoretical power, with gross head, 100 percent efficiency, and flows at Q 95 MW	Q 50 MW	Mean MW	Estimated average annual generation MWH
Potential at undeveloped sites (includes 1/2 Low Katka)						20.99	53.12	122.85	859,900
Potential at developed sites (from developed waterpower summary)						1.7	5.35	16.0	112,000
Potential at developed and undeveloped sites (KOOTENAI RIVER BASIN)						22.69	58.47	138.85	971,900
Pend Oreille River basin									
12-D Priest River									
Priest R., New Outlet Control	48	27	116	54	85	1.51	4.54	9.0	63,000
Priest No. 4	48	25	116	55	48	.94	2.81	5.34	37,400
Priest No. 6	48	14	116	52	175	4.66	13.5	23.7	166,000
Priest River	48	12	116	54	62	1.84	5.27	8.75	61,300
Potential at undeveloped sites (PRIEST RIVER)						8.95	26.12	46.79	327,700
PEND OREILLE RIVER BASIN									
Potential at undeveloped sites						8.95	26.12	46.79	327,700
Potential at developed sites (from developed waterpower summary)						51.0	110.3	156.6	1,097,000
Potential at developed and undeveloped sites						59.95	136.42	203.39	1,424,700
Spokane River basin									
12-E Coeur d'Alene River									
Coeur d'Alene R., Teddy Creek	47	47	116	04	243	.93	5.87	13.8	97,000
Leland Glen	47	39	116	02	293	3.36	15.9	33.1	232,000

Enaville	47	34	116	15	161	3.08	13.7	27.4	191,800
Potential at undeveloped sites (COEUR D'ALENE RIVER)						7.37	35.47	74.3	520,800
12-E St. Joe River									
St. Joe R., Simmons	47	08	115	24	320	1.63	5.3	11.8	82,600
Niagara Creek	46	11	115	27	280	1.9	6.43	14.3	100,000
Prospector	47	14	115	36	280	3.09	9.52	21.2	148,400
Avery	47	15	115	48	320	5.71	17.7	39.4	275,800
Fitzgerald-Falls	47	19	116	17	330	10.4	32.1	71.5	500,500
Potential at undeveloped sites (ST. JOE RIVER)						22.73	71.05	158.2	1,107,300
12-E St. Maries River									
St. Maries R., No. 2	47	18	116	31	380	1.45	8.4	11.1	77,000
No. 1	47	15	116	38	370	1.72	10.0	17.3	121,000
Potential at undeveloped sites (ST. MARIES RIVER)						3.17	18.4	28.4	198,000
SPOKANE RIVER BASIN									
Potential at undeveloped sites						33.27	124.92	260.9	1,826,100
Potential at developed sites (from developed waterpower summary)						5.19	17.7	29.0	203,000
Potential at developed and undeveloped sites						38.46	142.62	289.9	2,029,100
12-G Snake River, headwaters to Henrys Fork									
Palisades Cr., Palisades Lakes	43	23	111	15	1245	2.65	3.17	4.23	29,600
Pine Cr., Poison Cr.	43	32	111	18	400	.85	1.19	1.53	10,700
Lower Pine Cr.	43	30	111	22	300	.9	1.1	1.6	12,000
Snake R., Lynn Crandall	43	36	111	29	270	29.8	93.4	154.4	1,080,000
Lower Rush Beds	43	36	111	39	75	8.41	26.3	43.5	304,500
Potential at undeveloped sites						42.61	125.16	205.26	1,436,800
Potential at developed sites (from developed waterpower summary)						16.1	38.45	66.15	463,000
Potential at developed and undeveloped sites (HDW. TO HENRYS FORK)						58.71	163.61	271.41	1,899,800

Table 12.--continued.

Basin index number and basin / Stream / Site	Powerhouse location: Latitude ° '		Longitude ° '		Gross head (feet)	Gross theoretical power, with gross head, 100 percent efficiency, and flows at Q 95 MW	Q 50 MW	Mean MW	Estimated average annual generation MWH
12-G Snake River, Henrys Fork									
Henrys Fork, Lookout Butte	44	12	111	23	300	10.2	19.1	22.2	155,000
Mesa Falls	44	11	111	19	320	11.7	22.0	25.8	180,600
Warm R., Partridge Cr.	44	14	111	15	270	1.38	2.07	3.44	24,000
Warm River Butte	44	09	111	17	320	1.90	2.99	4.62	32,300
Robinson Cr. (Warm) Fish Cr.	44	07	111	17	320	.8	1.4	2.2	15,000
Henrys Fork, Warm River	44	22	111	20	230	12.7	27.2	28.2	197,000
Falls R., Sheep Falls	44	04	111	07	400	5.8	9.4	14.6	102,000
Boone Cr. (Falls) Boone Cr.	44	04	111	07	560	1.66	2.62	4.05	28,400
Falls R., Squirrel	44	03	111	12	140	3.75	5.65	8.87	62,100
Anderson	44	04	111	20	260	6.96	10.5	16.5	115,500
Teton R., Victor	43	37	111	05	400	1.02	1.87	3.4	23,800
Tetonia	43	52	111	15	140	1.96	3.27	4.64	32,500
N. Fk. Teton, Judkins	43	56	111	19	475	1.41	3.23	5.65	39,600
Canyon Cr., (Teton) Canyon Creek	43	53	111	26	675	.29	2.00	2.87	20,000
Teton R., Fremont	43	55	111	32	295	7.52	12.4	17.8	125,000
Potential at undeveloped sites						69.05	116.30	164.84	1,152,800
Potential at developed sites (from developed waterpower summary)						16.62	31.95	43.88	306,700
Potential at developed and undeveloped sites (HENRYS FORK)						85.67	148.25	208.72	1,459,500
12-G Snake R., Henrys Fork to Oregon line									
Willow Cr., Tex Creek	43	27	111	43	325	.69	1.52	5.38	37,700
Ririe (Meadow Creek)	43	32	111	44	180	.46	1.00	3.29	23,000
Snake R., Bennett Bridge	43	25	112	07	30	4.26	9.32	13.1	91,500
Woodville	43	24	112	09	15	2.13	4.65	6.55	45,800
Monroe	43	20	112	10	27	3.84	8.4	11.8	82,600

Firth	43	19	112	11	10	1.42	3.12	4.36	30,000
Blackfoot R., Graves Cr.	43	03	111	55	210	2.07	3.36	4.02	28,100
Brush Cr.	43	07	111	54	290	3.15	5.12	6.10	42,700
Spring Cr.	43	10	111	59	300	2.12	5.53	6.63	46,400
Blackfoot (Boise), Alridge	43	11	112	00	320	2.34	6.09	7.26	50,800
Blackfoot R., Wolverine Cr.	43	16	112	04	260	1.44	5.19	7.67	53,700
Snake R., Ferry Butte	43	07	112	31	25	1.70	6.50	8.33	58,300
Portneuf R., Lava Hot Springs	42	37	112	04	350	2.92	4.76	5.74	40,200
Blackrock	42	48	112	21	470	4.6	7.8	9.4	65,800
Pocatello	42	56	112	32	115	1.12	1.91	2.30	16,100
Snake R., Eagle Rock	42	42	112	57	53	3.08	25.2	30.1	210,700
Bickel	42	32	114	11	320	6.94	30.7	51.0	357,000
Kimberly	42	34	114	20	220	4.86	21.5	35.5	248,000
Rock Cr., West Fork	42	24	114	18	800	.54	1.36	2.52	17,600
Perrine	42	36	114	24	1052	.8	2.23	3.76	26,000
Snake R., Clear Lakes	42	40	114	43	198	10.25	45.5	75.0	525,000
Salmon Falls Cr., Balanced Rock	42	34	114	55	420	2.61	2.96	3.71	26,000
Lucerne	42	40	114	53	430	2.74	3.11	3.84	27,000
Snake R., Lower Thousand Springs	42	44	114	51	72	30.6	42.8	48.9	342,300
Medicine Lodge Cr., Medicine Lodge	44	15	112	24	500	.85	1.49	2.12	14,900
Birch Cr., Sink, Reno	43	56	112	46	1300	3.31	5.52	8.28	58,000
Little Lost, Sink, Howe	43	58	113	14	300	1.66	1.96	2.09	14,600
E.F. Big Lost, Castle Cr.	43	54	114	03	400	1.02	2.04	5.10	35,700
Big Lost, Garden Cr.	43	59	114	04	300	1.53	2.55	7.14	50,000
Bartlett Point	44	02	113	55	300	1.53	2.55	7.14	50,000
Big Wood, Malad, Baker Cr.	43	47	114	33	400	1.46	2.21	4.76	33,300
Boulder Flats	43	47	114	28	240	1.02	1.63	3.46	24,000
Lake Cr.	43	44	114	24	360	2.54	3.83	8.11	56,800
Ketchum	43	39	114	21	300	2.42	3.70	7.80	54,600
Hailey	43	31	114	19	400	3.23	4.93	10.4	72,800
Bellevue	43	26	114	15	240	2.75	4.08	8.57	60,000
Little Wood, Malad, Upper L'l Wood	43	28	114	03	600	.76	1.53	3.06	21,000
Carey	43	17	113	57	200	.68	1.36	2.21	15,500
Malad, Tuttle	42	52	114	52	288	0	2.45	5.63	39,000
Snake R., High Bliss	42	55	114	59	84	43.5	58.1	65.4	457,800
Pasture	42	58	115	14	94	49.0	65.4	73.5	514,500

Table 12.--continued.

Basin index number and basin Stream Site	Powerhouse location: Latitude °	'	Longitude °	'	Gross head (feet)	Gross theoretical power, with gross head, 100 percent efficiency, and flows at: Q 95 MW	Q 50 MW	Mean MW	Estimated average annual generation MWH
Snake R., Indian Cove	42	57	115	37	35	19.3	25.9	29.1	204,000
Bruneau R., Jarbidge	42	20	115	39	300	.51	2.3	4.46	31,000
Sheep Cr.	42	30	115	35	300	.76	3.7	7.4	52,000
The Forks	42	35	115	38	220	.75	3.0	6.27	44,000
Bruneau Canyon-Hot Springs	42	47	115	43	580	2.22	8.87	18.2	127,400
Snake R., Guffey	43	18	116	33	117	71.1	96.5	101.	707,000
Marsing	43	30	116	47	30	18.4	24.7	26.0	182,000
Blackjack-Butte (OREGON-IDAHO)	43	41	117	05	40	30.6	39.4	45.6	319,200
Potential at undeveloped sites						358.09	620.22	820.34	5,740,300
Potential at undeveloped sites (includes 1/2 Blackjack-Butte)						342.79	600.52	797.54	5,580,700
Potential at developed sites (from developed waterpower summary)						223.58	425.64	544.83	3,812,300
Potential at developed and undeveloped sites (HENRYS FORK TO OREGON LINE)						566.37	1,026.16	1,342.37	9,393,000
12-H Owyhee River									
E.F. Owyhee R., Juniper Canyon	42	12	116	30	400	1.08	4.59	10.2	71,400
S.F. Owyhee R., Red Canyon	42	17	116	56	450	1.91	4.78	20.8	145,600
Potential at undeveloped sites (OWYHEE RIVER)						2.99	9.37	31.0	217,000
12-H Boise River									
M.F. Boise R., Yuba Dam & Res.	43	48	115	12	500	1.06	1.91	4.46	31,200
Bald Mtn.	43	49	115	18	400	2.48	4.25	10.1	70,700
King	43	46	115	30	590	4.51	7.51	18.5	130,000

Alexander Flats	43	46	115	33	110	1.23	2.24	3.27	22,900
N.F. Boise R., Graham	43	55	115	19	250	.64	1.17	2.93	20,500
Trail Creek	43	53	115	25	600	2.04	3.82	9.28	65,000
Big Owl	43	53	115	30	415	2.12	3.88	9.39	65,700
Lost Creek	43	51	115	32	135	.81	1.44	3.51	24,600
Barber Flats	43	46	115	37	500	4.89	8.92	21.6	151,200
Boise R., Twin Springs	43	41	115	41	405	10.3	18.9	46.0	322,000
Slide Gulch	43	39	115	46	180	4.66	8.57	20.7	145,000
S.F. Boise R., Johnson Creek	43	39	114	54	900	1.07	1.91	4.21	29,000
Little Smoky	43	34	114	50	410	.87	1.57	3.13	21,900
Big Smoky	43	36	114	56	270	3.21	4.12	9.62	67,300
Boardman Cr.	43	36	115	04	400	4.59	6.80	16.0	112,000
Bascum Flats	43	37	115	08	200	2.81	4.08	9.86	69,000
Featherville	43	36	115	13	150	2.16	3.16	7.68	53,800
Casey Ranch	43	31	115	18	280	5.47	8.09	19.4	135,800
Casey to Anderson	43	29	115	19	102	1.99	2.95	7.07	49,500
Lime Cr., Lime Cr.	43	25	115	16	800	1.02	2.38	5.78	40,500
Fall Cr., Sawmill	43	25	115	23	800	.68	1.22	3.54	24,800
Indian Point	43	21	115	32	98	3.08	3.5	8.5	59,500
Raspberry	43	28	115	40	295	10.0	11.5	27.9	195,300
Long Gulch	43	33	115	44	259	9.57	10.9	26.4	184,800
Potential at undeveloped sites						81.26	124.79	295.56	2,092,000
Potential at developed sites (from developed waterpower summary)						43.05	73.49	128.46	899,200
Potential at developed and undeveloped sites (BOISE RIVER)						124.31	198.28	424.02	2,991,200

12-H Payette River

S.F. Payette R., Elk Lake	44	06	115	09	1200	3.06	4.59	7.14	50,000
Baron Creek	44	10	115	12	960	1.63	2.45	5.71	40,000
Grand Jean	44	10	115	12	260	1.65	2.54	5.30	37,000
Canyon Cr., S.F. Payette, Fogus	44	10	115	15	985	1.26	1.67	3.35	23,500
S.F. Payette R., Canyon Creek	44	10	115	15	225	1.91	2.86	5.73	40,000
Warm Springs Cr., Bull Trout Lake	44	07	115	24	2625	2.23	3.35	7.81	54,700
S.F. Payette R., Casner Cr.	44	07	115	24	440	5.98	8.60	17.6	123,000

Table 12.--continued.

Basin index number and basin / Stream / Site	Powerhouse location: Latitude °	'	Longitude °	'	Gross head (feet)	Gross theoretical power, with gross head, 100 percent efficiency, and flows at Q 95 MW	Q 50 MW	Mean MW	Estimated average annual generation MWH
Payette River (continued)									
Eight Mile Cr., Eight Mile	44	07	115	24	625	.53	1.06	2.39	16,700
S.F. Payette R., Archie Cr.	44	04	115	32	375	7.49	11.2	22.8	159,500
Steep Cr.	44	05	115	35	125	2.55	3.82	7.86	55,000
Clear Cr., Clear Creek	44	05	115	37	1125	3.15	3.82	7.65	53,600
Whitehawk Cr. (Deadwood) Whitehawk	44	17	115	38	500	1.06	1.36	2.98	20,900
Deadwood R., Scott Creek	44	13	115	38	360	1.37	6.12	10.4	72,800
Cloverleaf (Upper & Lower)	44	07	115	40	865	3.31	14.7	25.0	175,000
S.F. Payette R., Ox Bow Bend	44	04	115	40	245	7.07	13.1	29.7	207,900
Big Pine Creek	44	04	115	45	295	8.95	16.7	37.6	263,200
M.F. Payette R., Boiling Springs	44	18	115	52	450	1.34	2.37	5.06	35,400
Silver Cr. (M.F.) Peace Valley	44	18	115	52	850	1.08	1.81	3.83	26,800
M.F. Payette R., Rocky Canyon	44	16	115	53	415	2.54	4.48	9.60	67,200
Lightning-Anderson Crks. Gooseberry Creek	44	08	115	57	665	1.02	1.81	2.99	20,900
Payette R., Garden Valley	44	05	116	04	415	24.2	68.8	108.2	757,400
Garden Valley Reregulating	44	05	116	06	120	6.99	19.9	31.3	219,100
N.F. Payette R., Upper Lake	45	02	116	03	650	.83	2.21	8.84	62,000
Bogus Cr.	44	18	116	04	182	3.25	13.1	18.6	130,200
Scriver Creek (Upper)	44	12	116	00	440	8.23	33.7	48.6	340,200
Scriver Creek (Lower)	44	12	115	59	753	16.3	40.3	65.3	457,000
Payette R., Horseshoe Bend	43	54	116	16	250	15.5	40.4	71.8	502,600
Montour Valley	43	55	116	20	53	3.29	8.57	15.2	106,400
Potential at undeveloped sites						137.77	335.39	588.34	4,118,000
Potential at developed sites (from developed waterpower summary)						6.49	20.0	32.53	225,700
Potential at developed and undeveloped sites (PAYETTE RIVER)						144.26	355.39	620.87	4,343,700

12-H Weiser River									
Weiser R., Goodrich B	44	38	116	36	170	.14	2.28	8.97	63,000
Cambridge	44	33	116	42	90	.07	1.2	4.7	32,900
L. Weiser R., Cold Spring Ridge	44	31	116	19	1000	1.27	2.12	3.83	26,800
Weiser R., Galloway	44	15	116	46	360	.7	7.65	27.2	190,400
Potential at undeveloped sites						2.18	13.25	44.70	313,100
Potential at developed sites (from developed waterpower summary)						.14	1.43	5.36	37,500
Potential at developed and undeveloped sites (WEISER RIVER)						2.32	14.68	50.06	350,600
12-H Snake R., Brownlee to High Mountain Sheep									
Bear Cr. (Wildhorse) Bear Cr. Falls	44	58	116	44	880	.75	3.74	7.48	52,400
Wildhorse R., Emery Creek	44	53	116	46	560	.48	2.62	5.24	36,700
Wildhorse	44	51	116	53	995	1.27	5.92	12.7	88,900
Indian Cr., Cuprum	45	04	116	47	1917	.81	2.44	4.89	34,200
Deep Cr., Deep Creek	45	15	116	42	2890	1.23	3.68	7.37	51,600
Snake R., Hells Canyon (ID.-OREG.)	45	15	116	42	173	132.3	214.6	264.6	1,852,000
Granite Creek, Granite Creek	45	18	116	40	2890	1.23	3.68	7.37	51,600
Sheep Creek, Old Timer	45	27	116	34	2290	.97	2.92	5.84	41,000
Snake R., High Mountain Sheep (I-O)	45	51	116	47	595	556.6	759.	936.1	6,553,000
Potential at undeveloped sites (Brownlee - High Mtn. Sheep)						695.64	998.6	1,251.59	8,761,400
Potential at undeveloped sites (includes 1/2 High Mtn. Sheep and Hells Canyon)						351.19	511.80	651.24	4,558,900
Potential at developed sites (from developed waterpower summary)						145.92	241.65	294.0	2,058,000
Potential at developed and undeveloped sites (BROWNLEE - HIGH MTN. SHEEP)						497.11	753.45	945.24	6,616,900
12-J Salmon River									
Salmon R., Stanley	44	15	114	53	347	7.23	11.5	21.2	148,400
Yankee Fork, Fivemile	44	23	114	43	550	.70	1.17	3.74	26,200

Table 12.--continued.

Basin index number and basin Stream Site	Powerhouse location		Gross head (feet)	Gross theoretical power, with gross head, 100 percent efficiency, and flows at			Estimated average annual generation
	Latitude ° '	Longitude ° '		Q 95 MW	Q 50 MW	Mean MW	MWH
12-J Salmon River (continued)							
Yankee Fork, Bonanza	44 19	114 43	237	.80	1.10	3.72	26,000
Salmon R., Robinson Bar	44 15	114 41	343	8.73	13.7	30.6	214,200
Clayton	44 16	114 25	360	11.0	19.3	36.7	256,900
E.F. Salmon R., Little Wickiup	44 08	114 25	470	1.40	2.00	4.79	33,500
Fox Creek to mouth	44 15	114 18	550	3.27	4.67	10.5	73,500
Salmon R., Bayhorse	44 24	114 15	325	10.1	17.8	40.	280,000
Challis	44 27	114 13	100	4.25	6.80	12.4	86,800
Cronks Canyon	44 43	114 00	435	17.6	31.2	67.8	474,600
Salmon	45 01	113 55	460	19.5	34.6	75.3	527,100
Lemhi R., Lemhi	44 51	113 37	385	1.14	5.56	6.54	45,800
Tendoy	44 55	113 38	215	.64	3.29	3.84	26,900
Kenney	45 01	113 39	340	1.01	5.49	6.36	44,500
Salmon R., Salmon Valley	45 11	113 53	230	11.7	20.7	45.0	315,000
Shoup	45 22	114 17	563	32.5	57.4	124.3	870,100
Napias, Panther Crks., Leacock	45 08	114 13	980	4.17	7.08	15.4	107,800
Panther Cr., Haynes-Stellite	45 10	114 15	264	1.81	3.20	6.94	48,600
Jureano	45 11	114 19	316	2.29	4.04	8.79	61,400
Deer Creek	45 14	114 19	460	3.71	6.61	14.3	100,000
Rood	45 16	114 20	300	2.55	4.49	9.77	68,400
Wallace	45 18	114 23	143	1.33	2.35	5.11	35,800
M.F. Salmon R., Bear Valley	44 27	115 14	290	3.80	5.27	13.6	95,200
Chinook	44 31	115 14	335	4.39	6.10	15.7	109,900
Fuller Ranch	44 34	115 18	320	5.03	7.15	18.4	128,800
Sheepeater	44 41	115 09	580	9.12	12.9	33.3	233,100
Pungo	44 45	115 02	385	10.5	14.9	38.3	268,000
Bacon	44 46	114 53	400	12.4	17.7	45.6	319,200
Loon Cr., M.F., Falconberry	44 43	114 48	360	3.89	5.54	14.2	99,400

Franklin (Biggs Ranch)	44 48	114 48	525	5.89	8.34	21.4	149,800
Camas Cr., M.F., Meyers Cove	44 53	114 35	500	3.87	5.52	14.1	98,700
Yellowjacket	44 53	114 40	645	5.48	9.32	21.9	153,300
M.F. Salmon R., Aparejo	44 55	114 44	415	19.8	28.2	72.2	505,400
Big Cr., M.F., Cabin Creek	45 06	114 48	600	11.4	16.1	41.3	289,100
M.F. Salmon R., Porcupine	45 07	114 43	363	23.7	33.6	86.2	603,400
Salmon R., Pinnacle Falls	45 18	114 36	342	45.7	80.9	176.0	1,232,000
Dillinger	45 32	115 07	445	75.6	133.8	291.0	2,037,000
Hay Flat	45 32	115 14	105	18.1	31.9	69.6	487,200
S.F. Salmon R., Knox	44 42	115 42	270	.82	1.47	5.13	35,900
Poverty Flat	44 52	115 42	830	2.54	4.51	15.8	110,600
Reed	44 54	115 43	170	.98	1.74	6.13	42,900
Buckhorn	45 01	115 43	310	1.79	3.18	11.2	78,400
E.F., S.F., Salmon R., Stibnite	44 58	115 25	800	1.36	2.38	5.78	40,500
Johnson Cr., E.F., S.F., Halfway	44 49	115 31	400	.78	1.39	4.86	34,000
Yellow Pine	44 58	115 31	540	2.75	4.59	13.7	95,900
E.F., S.F., Salmon R., Parks-Scott	45 06	115 37	1400	10.6	18.9	66.4	464,800
Secesh R., S.F., Secesh	45 12	115 49	260	.64	1.15	4.07	28,500
Whangdoodle	45 06	115 45	940	2.32	4.15	14.7	102,900
Butterfly-Scott	45 06	115 37	1440	5.51	9.79	34.3	240,000
S.F. Salmon R., Tailholt-Scott	45 06	115 37	360	7.44	13.2	46.5	325,500
Cumtux	45 11	115 35	355	8.15	14.5	48.3	338,000
Porphyry	45 17	115 28	460	11.7	19.5	66.5	465,500
Warren Cr., Sal. R., Warren Meadows	45 22	115 41	1000	2.12	4.25	7.65	53,600
Rugged Creek	45 24	115 38	2395	4.07	12.2	22.4	156,800
Salmon R., Crevice	45 24	116 07	600	124.4	220.3	479.4	3,355,800
Little Salmon R., Round Valley	45 07	116 17	200	1.38	2.41	5.27	36,900
Hazard	45 11	116 19	500	3.44	6.03	13.2	92,400
Lockwood	45 16	116 20	600	5.92	10.5	22.8	159,600
Sheep Creek	45 20	116 21	460	6.14	10.9	23.6	165,200
Captain John	45 24	116 20	295	5.02	8.78	20.1	140,700
Salmon R., Freedom-Riggins	45 37	116 17	270	63.7	112.7	245.	1,715,000
Lower Canyon	45 52	116 47	660	160.4	283.9	617.	4,320,000
Potential at undeveloped sites (SALMON RIVER)				840.07	1,453.71	3,325.69	23,280,400

Table 12.--continued.

Basin index number and basin Stream Site	Powerhouse location Latitude °	'	 Longitude °	'	Gross head (feet)	Gross theoretical power, with gross head, 100 percent efficiency, and flows at Q 95 MW	 Q 50 MW	 Mean MW	Estimated average annual generation MWH
IDAHO AND WASHINGTON									
12-H China Gardens to Clarkston									
(I-W) Snake R., China Gardens	46	02	116	56	70	77.3	136.8	178.5	1,250,000
(I-W) Snake R., Asotin	46	20	117	02	110	121.5	215.0	280.5	1,963,500
Potential at undeveloped sites (China Gardens to Clarkston)						198.8	351.8	459.0	3,213,500
Potential at undeveloped sites (CHINA GARDENS TO CLARKSTON) (includes 1/2 of China Gardens and Asotin)						99.4	175.9	229.5	1,606,750
12-K Clearwater River									
Selway R., Magruder	45	43	114	43	950	3.23	8.08	24.2	169,400
White Cap	45	52	114	45	1000	8.5	23.0	65.5	458,500
Running Creek	45	56	114	49	300	3.83	11.0	31.1	217,700
Bear Cr., Bear Creek	46	02	114	46	1000	3.40	8.5	23.8	166,600
Selway R., Pettibone	46	02	114	50	300	5.87	16.6	21.4	149,800
E.F. Moose Cr. (Selway) Double Cr.	46	12	114	52	850	1.81	5.42	15.2	106,400
N.F. Moose Cr., Bailey Mountain	46	12	114	52	1550	2.63	15.8	54.0	378,000
Selway R., Moose Creek	46	07	114	57	300	7.65	21.4	29.3	205,100
Pinchot	46	05	115	08	295	8.25	23.2	66.2	463,400
Meadow Cr.(Selway) Upper Meadow Cr.	45	55	115	15	900	1.91	5.35	13.8	96,600
Lower Meadow Creek	46	02	115	17	1045	4.00	11.1	32.0	224,000
Crooked Fork Cr.,(Lochsa) Lolo Pass	46	35	114	36	1000	2.12	6.8	17.0	119,000
White Sand Cr.(Lochsa) Hidden Lake	46	28	114	34	1000	3.4	11.1	28.1	196,700
Lochsa R., Powell	46	31	114	39	560	5.71	16.2	42.8	299,600
Squaw Creek	46	28	114	52	340	3.76	11.6	29.5	206,500

Warm Springs Cr.(Lochsa) Wind Lks.	46	28	114	52	1500	1.91	6.37	16.6	116,200
Lochsa R., Jerry Johnson	46	28	114	58	200	3.06	9.18	24.6	172,200
Lake Cr. (Lochsa) Freezeout Mtn.	46	28	114	59	1100	1.40	4.67	11.2	78,400
Lochsa R., Weir Creek	46	26	115	05	200	3.57	10.7	29.6	207,200
Five Islands	46	21	115	18	600	11.2	34.2	90.3	632,100
Bright Angel	46	17	115	23	245	5.82	17.9	48.0	336,000
M.F. Clearwater, Penny Cliffs	46	09	115	56	595	43.5	127.	354.2	2,479,400
Red R., (S.F. Clearwater) Red Horse	45	48	115	28	300	.38	1.27	3.57	25,000
S.F. Clearwater R., Elk City	45	48	115	41	580	1.97	5.67	16.8	117,600
Tenmile Creek	45	48	115	46	420	2.14	6.07	17.5	122,500
Twentymile Creek	45	50	115	53	600	3.31	9.18	27.0	189,000
Johns Cr. (S.F.) Marble Point	45	50	115	53	1000	.85	2.55	7.23	50,600
S.F. Clearwater R., Johns Creek	45	58	115	58	785	6.00	16.3	48.0	336,000
South Fork	46	08	115	59	355	2.87	8.00	23.6	165,200
Clearwater R., Kooskia	46	20	116	08	174	18.3	54.3	146.4	1,024,800
Lolo Cr. (Clearwater) Eldorado	46	22	116	09	1900	5.65	16.1	46.8	327,600
Clearwater R., Orofino	46	28	116	15	86	9.79	27.8	70.9	496,300
Ahsahka	46	30	116	18	26	3.09	8.62	22.1	154,700
N.F. Clearwater, Elizabeth Mtn.	46	45	115	14	300	1.53	4.59	9.69	67,800
Kelly Cr. (N.F.) Kellys Thumb	46	43	115	05	500	5.31	16.1	33.6	235,200
N.F. Clearwater R., Kelly Fork	46	43	115	17	380	7.43	22.6	46.8	327,600
Weitas Creek	46	38	115	28	410	13.6	39.3	81.8	572,600
Orogrande Cr. (N.F.) Orogrande	46	38	115	30	690	1.19	4.1	8.79	61,500
N.F. Clearwater R., Rock Creek	46	48	115	28	460	17.2	48.9	103.2	722,400
Skull & Quartz Crks. Bald Knob	46	50	115	29	550	2.10	6.07	12.6	88,200
N.F. Clearwater R., Salmon Cr.	46	52	115	40	250	11.9	33.4	70.1	490,700
Little N.F., Buzzards Roost	46	59	115	40	400	1.7	5.44	10.9	76,300
Gateway	46	56	115	44	500	2.97	8.92	17.8	124,600
Boehls Butte	46	54	115	52	600	4.6	14.3	28.6	200,200
N.F. Clearwater R., Dworshak (Bruces Eddy)	46	31	116	18	626	50.5	143.6	302.2	2,115,400
Clearwater R., Big George	46	30	116	31	84	12.4	40.9	94.8	663,600
Arrow	46	28	116	46	90	13.6	45.3	104.	728,000

Table 12.--continued.

Basin index number and basin / Stream / Site	Powerhouse location: Latitude °	'	Longitude °	'	Gross head (feet)	Gross theoretical power, with gross head, 100 percent efficiency, and flows at Q 95 MW	Q 50 MW	Mean MW	Estimated average annual generation MWH
12-K Clearwater River (continued)									
Potlatch R., Gold Hill	46	40	116	32	300	.13	1.28	5.10	35,700
Kendrick	46	37	116	39	280	.21	2.28	10.2	71,400
Potlatch	46	28	116	46	420	.32	3.43	15.2	106,400
Clearwater R., Hog Island	46	27	116	52	34	5.92	19.2	43.7	305,900
Potential at undeveloped sites						343.49	1,020.74	2,497.38	17,481,600
Potential at developed sites (from developed waterpower summary)						6.30	20.6	46.7	326,900
Potential at developed and undeveloped sites (CLEARWATER RIVER)						349.79	1,041.34	2,544.08	17,808,500

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