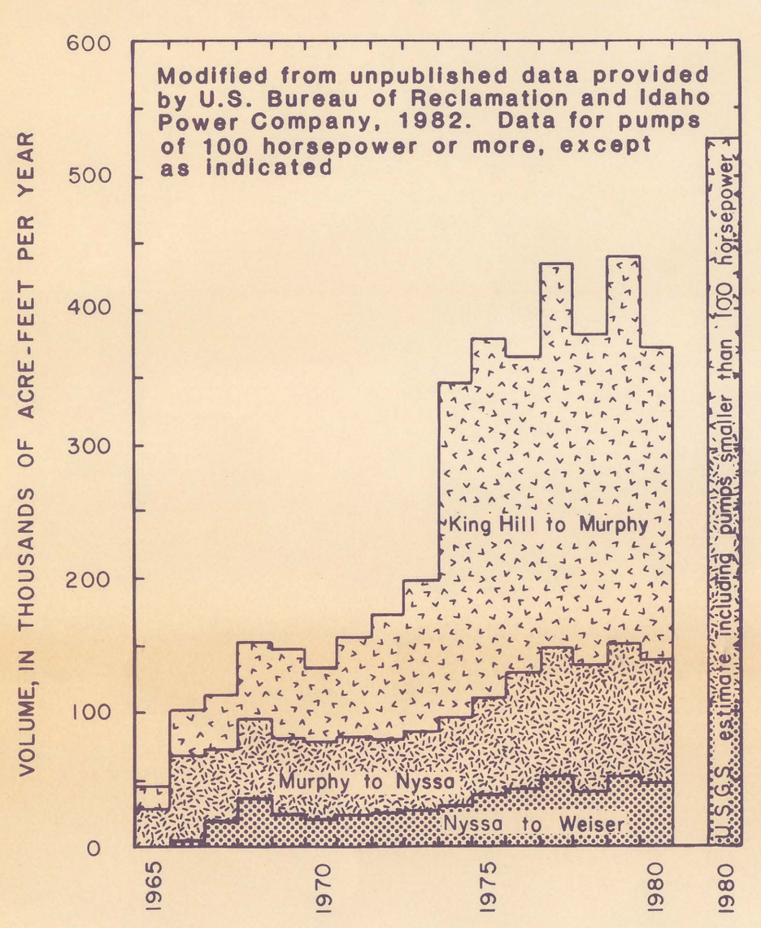
SURFACE WATER

SURFACE-WATER DEVELOPMENT

Pumpage from rivers and reservoirs is an important source of irrigation water, especially on the western plain. Early gravity diversions of surface water were concentrated on the eastern plain and in the Boise River valley. The first pumping stations withdrew water from rivers to supplement gravity diversions to canal networks; by 1935, pumping plants on the Snake River helped irrigate about 80,000 acres (Hoyt, 1935). In the late 1950's, pumpage from rivers became economically more attractive as a result of improved pump technology and availability of low-cost power. By that time, most surface water on the eastern plain was appropriated and networks of canals served by gravity diversions were already in place. Consequently, most river pumps added after the 1950's were on the western plain.

PUMPAGE FROM SNAKE RIVER BELOW KING HILL



After 1960, pumpage from the Snake River between King Hill and Weiser increased steadily. River pumping facilities made water in entrenched river reaches available for irrigation of adjacent uplands. From 1965 to 1975, pumpage from the Snake River between King Hill and Weiser increased about eightfold. Since 1975, annual pumpage from this reach has been fairly uniform.

METHOD OF ESTIMATING PUMPAGE

The estimation technique for surface-water pumpage is essentially the same as described for ground-water pumpage (see sheet 1). Pumpage was estimated for each river pumping station by using the equation shown below:

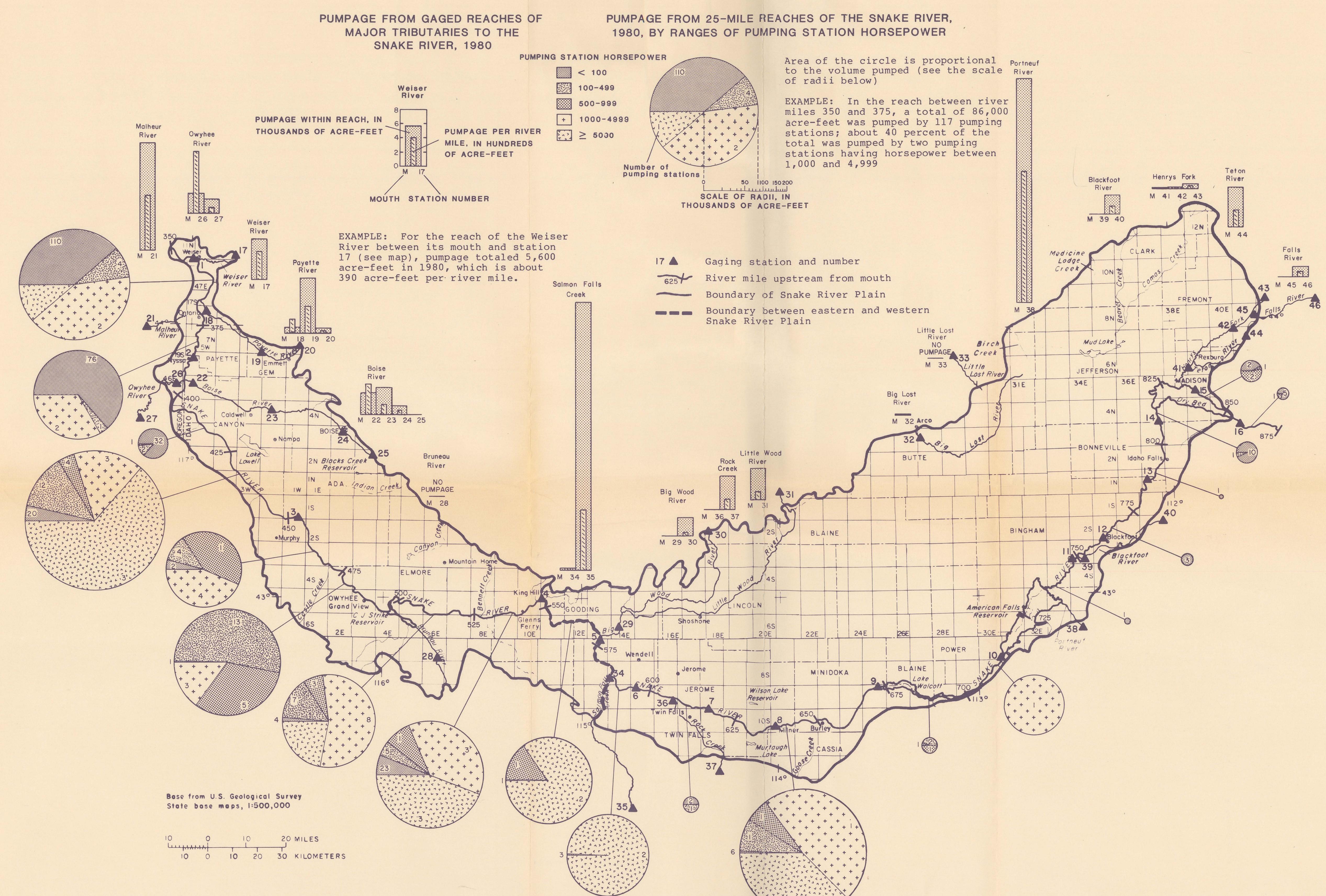
$$Q = (kWh)/[(K)(TH)] \qquad (3)$$

where terms are as defined on sheet 1. Power consumption for each plant was supplied by utility companies. The K factor of 1.69 and estimated irrigation system pressure heads are the same as those used for ground-water estimates. Pumping lift is altitude at the point of discharge minus altitude of the river stage at the point of withdrawal. All altitudes were interpolated from topographic maps. Most river pumps were observed in the field to verify location and type of distribution system.

Estimates of pumpage from the Snake River were summed over 25-mi reaches and between U.S. Geological Survey gaging stations. Estimates of pumpage from major tributaries were summed between gaging stations.

ESTIMATED SURFACE-WATER PUMPAGE

EXPLANATION



An estimated 940,000 acre-ft of water were withdrawn for irrigation by 621 electrical pumping stations on the Snake River and its major tributaries in 1980. The following statements summarize 1980 river pumpage:

- --Pumpage on the eastern plain was 210,000 acre-ft; pumpage on the western plain was 730,000 acre-ft.
- --Reported types of distribution systems supplied by pumping on the Snake River were: 60 percent gravity, 1 percent center pivot sprinkler, and 39 percent other types of sprinkler.
- --Seventy-three percent of the electrical pumps on the Snake River were less than 100 hp and accounted for about 12 percent of total pumpage.
- --Small pumps (less than 100 hp) commonly irrigate land adjacent to rivers where lifts are low and terrain is relatively level. For example, along the reach from Nyssa (station number 2) to Weiser (station number 1), 96 percent of the pumps have lifts of 50 ft or less. About 83 percent of the pumps discharge to gravity irrigation systems.
- --Most electrical pumping stations larger than 1,000 hp supply water to uplands along reaches where the river is deeply entrenched. Large pumping stations typically have several pumps that discharge water into a common penstock and lift it to a canal system at the top of the canyon. The largest has 15 pumps powered by motors totaling 21,600 hp.
- --Gravity diversions and a dense network of canals preclude the need for major river pump diversions above American Falls Reservoir.
- --Surface-water pumpage and gravity diversions combine to irrigate 2 million acres on the plain. About 70 percent of surface-water pumpage was withdrawn on the western plain.

SNAKE RIVER PUMPAGE BY GAGED REACH

Station No. on map	Gaging station number	Number of pumping plants	Total pumpage during irrigation season (acre-feet)	Pumpage as a percentage of total diversions 1/	Pumpage as a percentage of total flow at upstream gage (May 1 through September 30) 2/
	Study area boundary				
		32	10,100	--	--
1	13269000				
		153	112,800	100	3
2	13213100				
		116	176,800	100	6
3	13172500				
		88	256,800	80	8
4	13154500				
		6	53,000	100	2
5	13135000				
		5	46,900	100	3
6	13094000				
		3	1,400	0	<.5
7	13090000				
		0	0	0	0
8	13088000				
		10	114,900	5	3
9	13081500				
		4	1,940	<.5	<.5
10	13077000				
		2	24,800	34	1
11	13069500				
		3	1,120	2	<.5
12	13062500				
		1	80	<.5	<.5
13	13060000				
		0	0	0	0
14	13057150				
		12	4,040	1	<.5
15	13038500				
		10	3,420	1	<.5
16	13037500				
Total		445	808,100	--	--
Average		--	--	15.8	--

1/Kjelstrom (U.S. Geological Survey, written commun., 1982).

2/U.S. Geological Survey (1981).

Pumpage accounts for about 90 percent of total irrigation diversions (pumped plus gravity) from the Snake River on the western plain and about 3 percent on the eastern plain. Gravity diversions are the principal means of surface-water withdrawals on the eastern plain. Both the history of surface-water development for irrigation and the amount of river entrenchment account for differences in the importance of pumpage on various reaches of the Snake River.

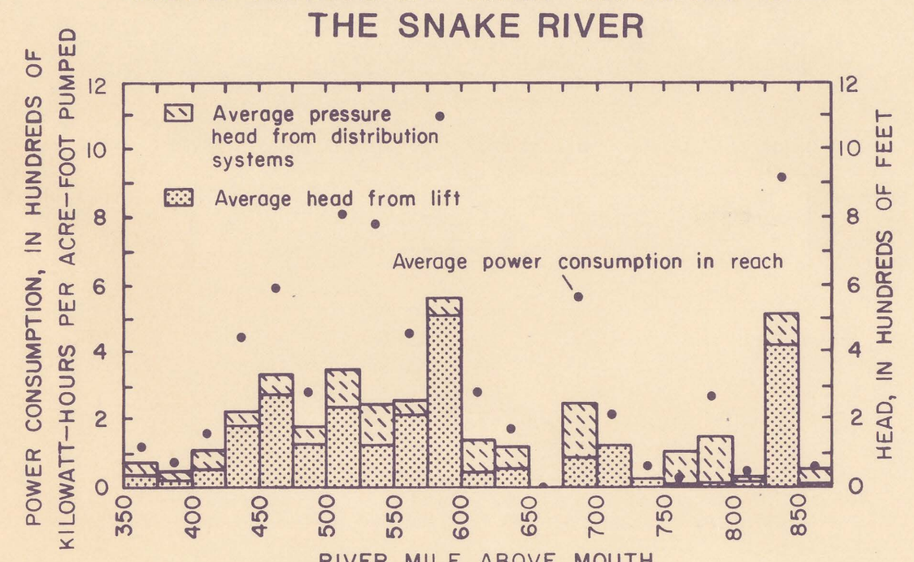
With two exceptions, pumped withdrawals for irrigation were less than 10 percent of the total volume flowing into each reach during the irrigation season (May 1 through September 30). The exceptions were the Portneuf River and the upper reach of Rock Creek where pumpage exceeded 25 percent of total flow.

TRIBUTARY PUMPAGE BY GAGED REACH

Station number on map	Gaging station number	Number of pumping plants	Total pumpage during irrigation season (acre-feet)	Pumpage as a percentage of total flow at upstream gage (May 1 through September 30) 1/
Weiser River	Mouth			
		16	5,640	2
17	13266000			
Payette River	Mouth			
		4	800	1
18	13251000			
		12	7,750	1
19	13250000			
		5	660	<.5
20	13249500			
Total		21	9,210	
Malheur River	Mouth			
		27	15,100	(2)
21	13233300			
Owyhee River	Mouth			
		13	2,690	4
22	13184000			
		12	1,890	2
23	13183000			
Total		25	4,580	
Boise River	Mouth			
		12	2,940	<.5
24	13213000			
		13	3,690	(2)
25	13210050			
		2	1,220	<.5
26	13205500			
		0	0	0
27	13202000			
Total		27	7,850	
Bruneau River	Mouth			
		0	0	0
28	13168500			
Big Wood River	Mouth			
		0	0	0
29	13152500			
		3	2,590	1
30	13142500			
Total		3	2,590	
Little Wood River	Mouth			
		6	5,170	5
31	13148500			
Big Lost River	Mouth			
		1	7	<.5
32	13132500			
Little Lost River	Mouth			
		0	0	0
33	13119000			
Salmon Falls Creek	Mouth			
		1	160	<.5
34	13108150			
		6	37,800	(2)
35	13106500			
Total		7	37,960	
Rock Creek	Mouth			
		0	0	0
36	13093095			
		8	4,700	27
37	13092000			
Total		8	4,700	
Portneuf River	Mouth			
		2	31,400	29
38	13075500			
Blackfoot River	Mouth			
		0	0	0
39	13068500			
		8	2,620	2
40	13066000			
Total		8	2,620	
Henrys Fork	Mouth			
		1	100	<.5
41	13056500			
		2	150	<.5
42	12050500			
		1	500	1
43	13046000			
Total		4	750	
Teton River	Mouth			
		5	5,100	1
44	13055000			
Falls River	Mouth			
		0	0	0
45	13049500			
		16	1,440	<.5
46	13047500			
Total		16	1,440	

1/ U.S. Geological Survey (1981).
(2) Insufficient data.

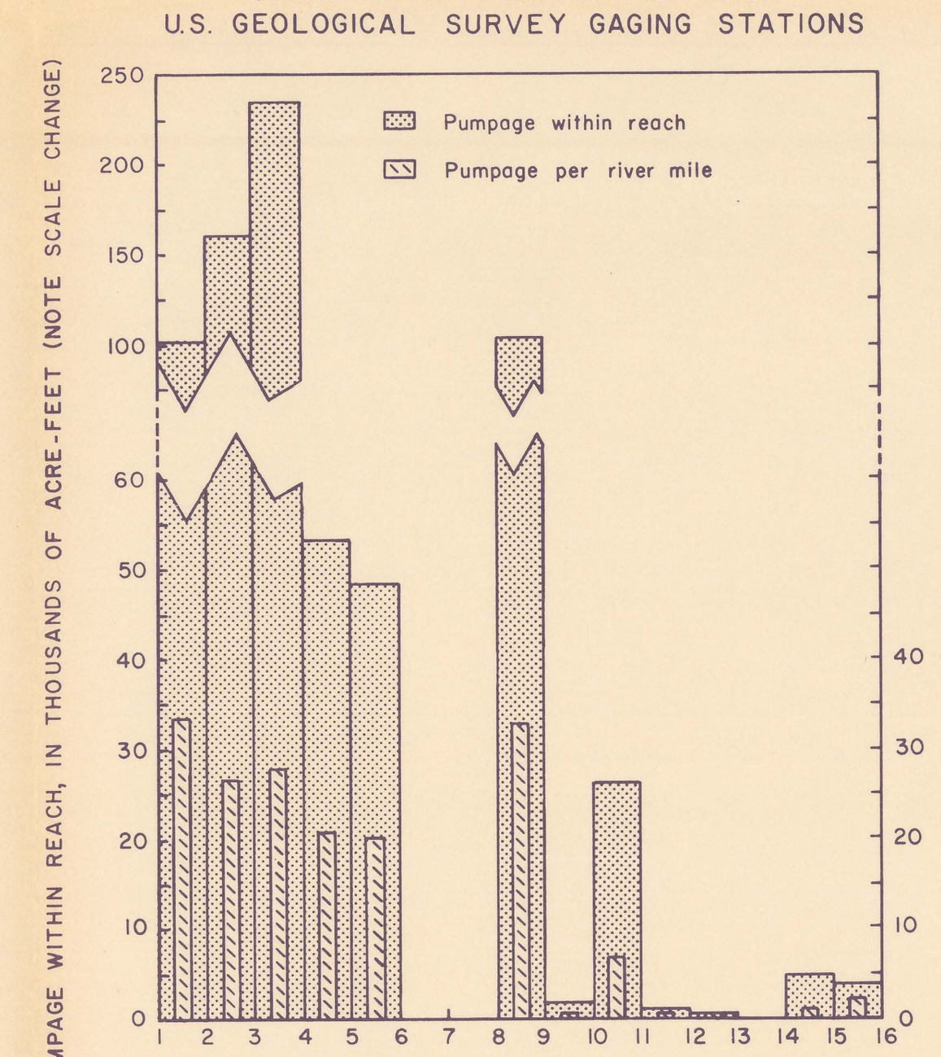
AVERAGE POWER CONSUMPTION AND HEAD ALONG 25-MILE REACHES OF THE SNAKE RIVER



Total head for river pumps consists of head from pumping lift and pressurized distribution systems. Lift varies with depth of river entrenchment. Between river miles 575 and 600, the Snake River is entrenched up to 650 ft, and lift accounts for most of the total head of pumping from this reach. Along less entrenched reaches, operating pressures of distribution systems are the largest part of total head. Most pumps between river miles 750 and 775 supply water to pressurized irrigation systems.

Pumps with high total head consume more power per acre-foot of water withdrawn than pumps with low total head. Between river miles 575 and 600, total head averages about 550 ft and power consumption averages more than 1,000 kWh for each acre-foot pumped. In contrast, between river miles 375 and 400, total head averages less than 100 ft and power consumption averages about 100 kWh for each acre-foot pumped.

SNAKE RIVER PUMPAGE BETWEEN U.S. GEOLOGICAL SURVEY GAGING STATIONS



Seventy percent of surface-water pumpage on the Snake River Plain is from the Snake River between the U.S. Geological Survey gaging stations near Buhl (station number 6) and at Weiser (station number 1). Topography varies from steep canyon walls surmounted by plateaus one hundred to several hundred feet above the river to gently rolling land that rises gradually from the river. River pumping is particularly important along deeply entrenched reaches where gravity diversions are not possible.

SUMMARY

Ground- and surface-water pumpage for irrigation in 1980 on the Snake River Plain was estimated from electrical power consumption data to provide input for ground-water flow models and data for water managers. An estimated 2.3 million acre-ft of ground water were pumped from about 5,300 wells to irrigate 1.0 million acres on the plain. More than 80 percent of ground-water pumpage was on the eastern plain. Ground-water pumpage equals about one-fifth of total annual recharge to the ground-water system.

An estimated 940,000 acre-ft of water were withdrawn from the Snake River and its major tributaries by 621 river pumping stations. Surface-water pumpage and gravity diversions combined to irrigate 2.0 million acres on the plain. About 70 percent of pumped surface-water withdrawals were on the western plain.

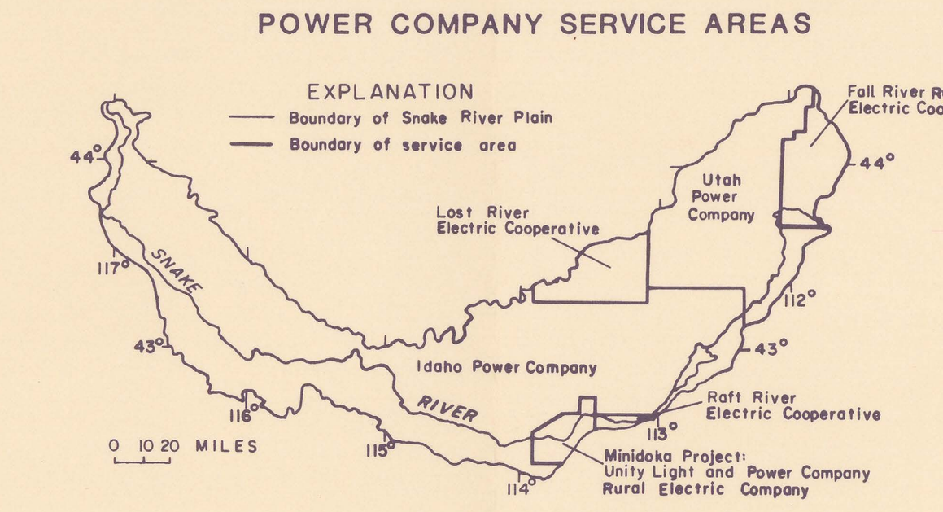
Pumps powered by electrical motors of less than 100 hp accounted for about 12 percent of total surface-water pumpage on the plain. Previous surface-water pumpage estimates did not include pumpage from these pumping stations.

ACKNOWLEDGMENTS

We express our appreciation to well owners who provided basic data for this study and to the following organizations whose cooperation made this study possible:

Bonneville Power Administration
Fall River Rural Electric Cooperative, Inc.
Idaho Department of Water Resources
Idaho Power Company
Lost River Electric Cooperative, Inc.
Raft River Electric Cooperative, Inc.
Rural Electric Company
Utah Power Company
U.S. Bureau of Reclamation
Unity Light and Power Company
Numerous irrigation districts
Other State and Federal agencies

POWER COMPANY SERVICE AREAS



REFERENCES

Diamond, Jonathan, and Williamson, A. K., 1983, A summary of ground-water pumpage in the Central Valley, California, 1961-77: U.S. Geological Survey Water-Resources Investigations Report, in press.

Hoyt, W. G., 1935, Water utilization in the Snake River basin: U.S. Geological Survey Water-Supply Paper 657, 379 p.

Idaho Department of Water Resources, 1978, Water-related land use-1975: Boise, Idaho, scale 1:126,720, 16 county map sheets.

Idaho Power Company, 1981, Irrigated acreage and number of pumps in Idaho Power Company service area: Unpublished data, 1950-80, on file in Boise, Idaho, office of Idaho Power Company.

Johnson, G. S., Brockway, C. E., and Luttrell, S. P., 1982, Application of a numerical ground-water flow model to the Mud Lake area in southeastern Idaho: Moscow, University of Idaho, unpublished M.S. thesis, 58 p.

Kjelstrom, L. C., 1984, Flow characteristics of the Snake River and water budget for the Snake River Plain, Idaho and eastern Oregon: U.S. Geological Survey Open-File Report 84-052, scale 1:1,000,000, 2 sheets.

Lindholm, G. F., 1981, Plan of study for the regional aquifer system analysis of the Snake River Plain, Idaho and eastern Oregon: U.S. Geological Survey Open-File Report 81-689, 21 p.

Lindholm, G. F., Garabedian, S. P., Newton, G. D., and Whitehead, R. L., 1983, Configuration of the water table, March 1980, in the Snake River Plain regional aquifer system, Idaho and eastern Oregon: U.S. Geological Survey Open-File Report 82-1022, map scale 1:500,000.

Mundorff, M. J., Crosthwaite, E. G., and Kilburn, Chabot, 1964, Ground water for irrigation in the Snake River basin in Idaho: U.S. Geological Survey Water-Supply Paper 1654, 224 p.

Nace, R. L., West, S. W., and Mower, R. W., 1957, Feasibility of ground-water features of the alternate plan for the Mountain Home Project, Idaho: U.S. Geological Survey Water-Supply Paper 1376, 121 p.

Norvitch, R. F., Thomas, C. A., and Madison, R. J., 1969, Artificial recharge to the Snake Plain aquifer; an evaluation of potential and effect: Idaho Department of Reclamation, Water Information Bulletin no. 12, 59 p.

Solley, W. B., Chase, E. B., and Mann, W. B. IV, 1983, Estimated use of water in the United States in 1980: U.S. Geological Survey Circular 1001, 56 p.

U.S. Bureau of Reclamation, 1980, Irrigated acreage in Idaho in 1979: Unpublished maps compiled for the Pacific Northwest River Basins Commission, on file in Boise, Idaho, office of U.S. Bureau of Reclamation, scale 1:250,000.

U.S. Bureau of Reclamation and Idaho Power Company, 1982, Snake River depletion by pumpage for irrigation: Unpublished data, 1965-80, on file in Boise, Idaho, office of U.S. Bureau of Reclamation.

U.S. Geological Survey, 1981, Water resources data for Idaho: U.S. Geological Survey Water-Data Reports ID-80-1, 375 p., and ID-80-2, 380 p.

_____1982, Irrigation water use: Unpublished data, 1980, on file in Boise, Idaho, office of U.S. Geological Survey.

Whitehead, R. L., 1984, Geohydrologic framework of the Snake River Plain, Idaho and eastern Oregon: U.S. Geological Survey Open-File Report 84-051, scale 1:1,000,000, 3 sheets.

Young, H. W., and Harenberg, W. A., 1971, Ground-water pumpage from the Snake Plain aquifer, southeastern Idaho: Idaho Department of Water Administration, Water Information Bulletin no. 23, 28 p.

WATER WITHDRAWN FOR IRRIGATION IN 1980 ON THE SNAKE RIVER PLAIN, IDAHO AND EASTERN OREGON

By
B.B.Bigelow, S.A.Goodell, and G.D.Newton

1984