FERC-0062

APPRAISAL REPORT

WATER RESOURCES APPRAISAL FOR HYDROELECTRIC LICENSING

CLARK FORK—PEND OREILLE RIVER BASIN

MONTANA, IDAHO, WASHINGTON

FEDERAL ENERGY REGULATORY COMMISSION

OFFICE OF ELECTRIC POWER COMMISSION

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PREFACE

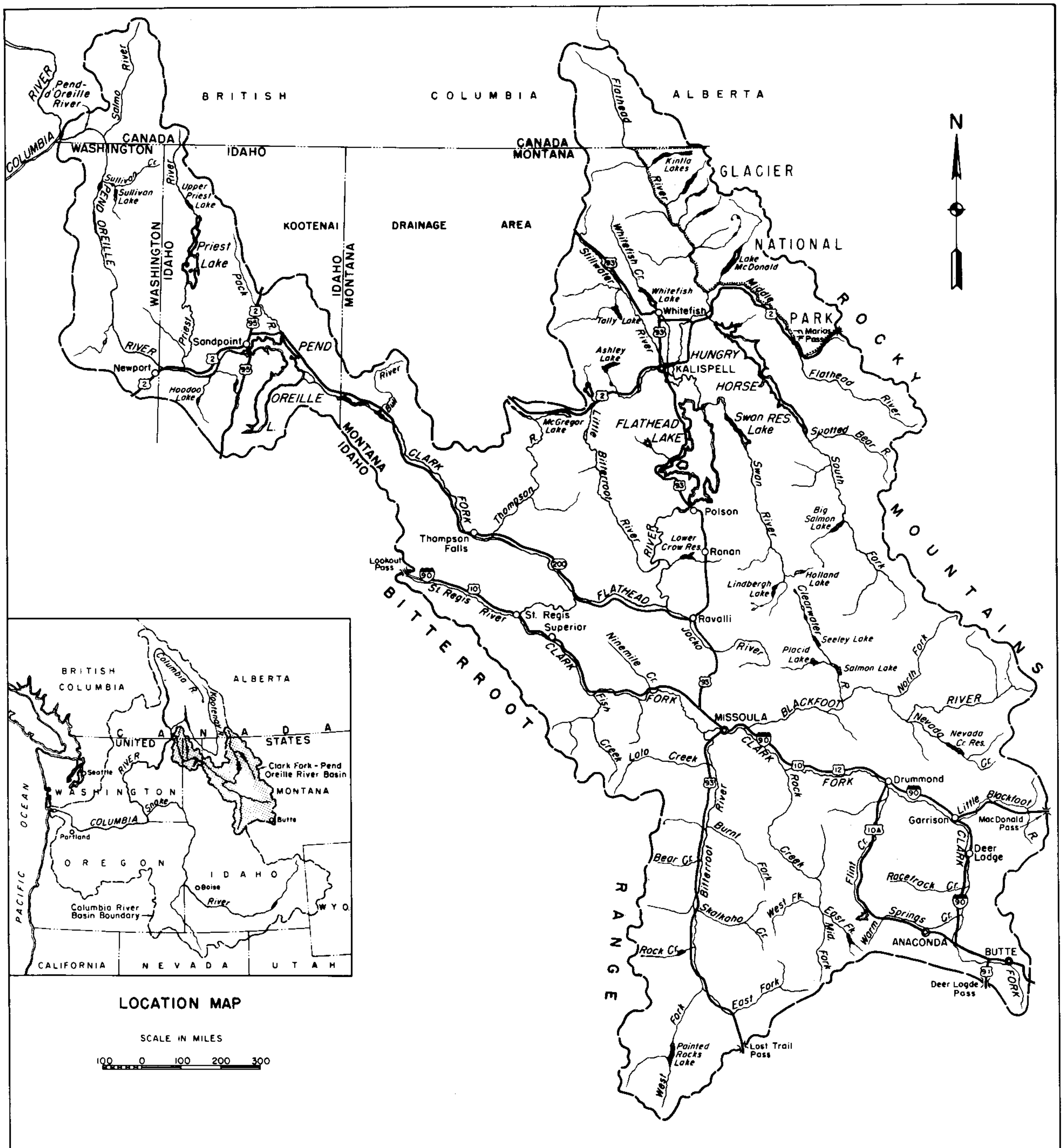
The Federal Power Act, as amended, authorized the Federal Power Commission to undertake investigations of the water resources of any region to be developed; to cooperate with the executive departments and other agencies of Federal and State governments in water resources planning; and to issue licenses to non-Federal interests for the construction, operation, and maintenance of dams, powerhouses, and appurtenances for hydroelectric power development and other purposes. The Act reserves to the United States the right to take over a non-publicly owned project upon expiration of the license after paying to the licensee the net investment costs, not to exceed fair value of the property taken and severance damages, if any. Projects to be licensed or relicensed must, in the judgment of the Commission, be best adapted to a comprehensive plan for improving waterways for the benefit of interstate commerce, for hydroelectric power development, and for other beneficial public uses, including recreation.

On October 1, 1977, pursuant to the provisions of the Department of Energy Organization Act (DOE Act), Public Law 95-91, 91 Stat. 565 (August 4, 1977) and Executive Order No. 12009, 42 Fed. Reg. 46267 (September 15, 1977), the Federal Power Commission ceased to exist and its functions and regulatory responsibilities were transferred to the Secretary of Energy and the Federal Energy Regulatory Commission (FERC) which, as an independent commission within the Department of Energy, was activated on October 1, 1977. On December 23, 1977, the Secretary issued an order amending DOE Delegation Order No. 0204-1 further delegating to the FERC the authority, under section 4(a) of the Federal Power Act, to continue its activities as they relate to river basin appraisals.

For the purposes of this report, all references to the "Commission" when used in the context of an action taken prior to October 1, 1977, refer to the Federal Power Commission; when used otherwise, the reference is to the Federal Energy Regulatory Commission.

This report on the Clark Fork-Pend Oreille River basin, Montana, Idaho, and Washington, has been prepared by the staff of the Federal Energy Regulatory Commission as part of a program of Water Resources Appraisals for Hydroelectric Licensing. It is intended primarily to provide information which the Commission and its staff may use or build upon, as appropriate, when considering matters related to hydroelectric licensing, relicensing, or recommendation for Federal takeover. The report is a staff study which was not prepared for adoption or approval by the Commission and does not commit or prejudge later Commission action.

Much of the material in the report is based on reconnaissance-type information, but more precise data have been used where available. The basic material used in preparing the report has largely been abstracted from previous reports of Federal, State, and local entities. Several agencies and individuals have participated in discussions pertaining to the information in the report and have provided useful background data or suggestions. However, the plans presented do not necessarily carry the endorsement of any agency or group.



GENERAL MAP

CLARK FORK - PEND OREILLE RIVER BASIN

WASHINGTON - IDAHO - MONTANA

1980

SCALE IN MILES

10 0 10 20 30 40 50

FERC - Water Resources Appraisal for Hydroelectric Licensing **Figure 1**

SUMMARY

The Clark Fork-Pend Oreille[1/] River basin, a major component of the Columbia River basin, drains western Montana, the panhandle region of northern Idaho, the northeastern corner of Washington, and 1,203 square miles in southern British Columbia, Canada. The river, from source to mouth, is about 420 miles long and has a drainage area of 25,800 square miles. Clark Fork rises near Butte, Montana and with few deviations, flows northwesterly to enter the easterly side of Pend Oreille Lake in Idaho. Major tributaries are the Flathead, Blackfoot, Bitterroot, and St. Regis Rivers. Pend Oreille River is the outlet stream for Pend Oreille Lake. It flows westerly from the lake at Sandpoint, Idaho, crosses into Washington, then flows north to join the Columbia River 16 miles north of the boundary.

The climate is greatly affected by the elevation and topographic features. A climatic barrier, a nearly continuous chain of mountains, divides the basin approximately at the boundary between Idaho and Montana. Westerly winds drop much of their moisture content in crossing the barrier, resulting in greater precipitation on the west side than on the east at comparable elevations. Also, temperatures are more extreme on the drier eastern side. Although the prevailing winds are westerly, the basin is subject to continental as well as oceanic-influence. The precipitation varies widely with season, elevation, and location. The average annual precipitation varies from 10 inches in sections of western Montana to nearly 100 inches along the west slopes of the Glacier National Park Rocky Mountains. Precipitation over the basin averages about 28 inches.

The source of most of the streamflow is the snow which falls in the higher forested mountain areas. Practically, all of the high mountain ranges contribute from 30 to 50 inches of runoff annually. The Clark Fork-Pend Oreille River system, one of the major tributaries of the Columbia River, contributes over 13 percent of the annual streamflow of the Columbia River at The Dalles, Oregon.

The economy of the basin is based on mining, agriculture, lumbering, and production of metals. Mining and production of metals are the most important economic activities in the Butte-Anaconda area, and agriculture is the basic industry in the remainder of the basin. The basin area is served by various railroads; interstate, State, and local highways; and several airports. The basin contains over half of Glacier National Park and is surrounded by scenic mountain ranges. The tourist industry is an increasingly important element of the economy.

Development of the rivers has long been a key factor in the utilization of the basin's natural resources. The rivers are now largely controlled by dams that provide electric generation, irrigation, flood protection, and opportunities for recreation. There are 13 hydroelectric generating plants in the United States' portion of the basin. Nine of these plants are licensed by the Federal Energy Regulatory Commission. Total installed capacity for the 13 plants is 1,743,000 kilowatts. The expiration dates of two of the licenses were December 31, 1975, for Thompson Falls, FERC Project No. 1869, and May 22, 1980, for Kerr, FERC Project No. 5. These two projects are described in detail in this report. On December 28, 1979, a new major 40-year license was issued to the Montana Power

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Company, authorizing continued operation of the 30,000-kilowatt Thompson Falls project, Project No. 1869, located on the Clark Fork River in Sanders County, Montana.

The Thompson Falls project has an installed capacity of 30,000 kilowatts. It is located on the Clark Fork River in the town of Thompson Falls, Montana. The falls made it a naturally favorable site for the development of power. The principal project works consist of 3 separate structures forming the closure across the river: the Main Dam, the Dry Channel Dam, and the intake structure to the powerhouse; a power canal; 6 main steel penstocks and 2 smaller steel penstocks for the 2 water-powered exciters; a powerhouse containing 6 generating units, each rated at 5,000 kilowatts; and a switchyard. The gross head on the plant is 60 feet, and the average annual generation is 310,000,000 kilowatt-hours. The project works were constructed during the period 1913-1916.

The Kerr project, licensed to the Montana Power Company, has an installed capacity of 168,000 kilowatts and 1,217,000 acre-feet of usable power storage capacity. It is located on the Flathead River and Flathead Lake about 5 miles downstream from Polson, Montana. The principal project works consist of a 200-foot high concrete arch dam with intakes on the left bank admitting water to 3 tunnels extending through a rock cliff, a distance of about 800 feet, to three 56,000-kilowatt rated generating units located in the powerhouse. The plant operates under a gross head of 187 feet and has an average annual generation of 1,174,000,000 kilowatt-hours. Flathead Lake covers 189 square miles and is one of the United States' largest natural freshwater lakes. Kerr Dam controls the lake between elevations 2,883 feet and 2,893 feet, all within the natural fluctuations of lake levels existing before the dam was built. Lake elevations under high flows are not controlled by the dam but by the river channel between the lake and the dam. Included in the project as presently licensed are two transmission circuits to Thompson Falls. The dam was closed off in 1938 and the first hydroelectric unit went into service in 1939, followed by the installation of two additional units in 1949 and 1954.

The Kerr Project No. 5 is currently licensed to Montana Power Company (MOPO). The Montana Power Company has filed an application for new license for the Kerr project. The Confederated Salish and Kootenai Tribes of Montana have filed a competing application for license for the Kerr project. The Tribes' application has been docketed as Project No. 2776. Review of the competing application is going forward.

The Kerr project is currently operating under an annual license since MOPO's licensed for Project No. 5 expired on May 22, 1980.

The Kerr project is maintained, in good condition, and is capable of being operated efficiently for the foreseeable future. The continued operation of the project is economically justified. Having been in existence for a period of 42 years, the projects' impact on the modified reservoir-river ecosystem appears to be well established. The alternatives to the continued operation of the project would require generation of equivalent power from some other source, probably thermal, which would consume irreplaceable fuel and water and could pollute air and water.

The basin has a wide range of opportunities to meet water and related land resource needs. The two major benefits to be derived from development of the basin would be power and flood control. While water is normally plentiful, there are many localized areas that experience seasonal shortages requiring a dependable water supply. Nearly all water-short areas are located in the Montana portion of the basin.

Many studies have been made of the future development and utilization of the water and related land resources of the basin. These studies have been made by Federal, State, and local agencies and by electric utilities. The principal purposes of the developments studied would be to provide hydroelectric power, water conservation for irrigation and municipal supply, and flood control. Other purposes include fish and wildlife management, water-quality control, and water-oriented recreation.

There are 13 potential conventional hydroelectric power projects discussed in this report. Possible additions to existing hydroelectric projects include the Kerr, Thompson Falls, Boundary, Cabinet Gorge, and Hungry Horse projects. These additions are discussed in this report. Optimum development of these projects could provide up to about 1,000,000 acre-feet of additional storage capacity which would increase power benefits at existing downstream developments. Waneta - the only project in the Canadian portion of the basin, Boundary, Box Canyon, and Albeni Falls (plants below Priest River) and Cabinet Gorge, Noxon Rapids, and Thompson Falls (plants below the Flathead River) would receive most of the benefits. Kerr and Hungry Horse plants would only benefit from storage upstream in the Flathead drainage and Milltown from storage on the Blackfoot River. Recent declaration of the main stem (North Fork), Middle, and South Forks of the Flathead River, as part of the National Wild and Scenic Rivers System, has eliminated a potential of 684,000 kilowatts of hydroelectric power in the basin. In addition, 67 miles of the Priest River, Idaho are under consideration for inclusion in the National Wild and Scenic Rivers System.

A cursory economic analysis of potential hydroelectric resources in the basin indicates favorable energy economics at the Quartz Creek, Buffalo Rapids Nos. 2 and 4 (alternatives to High Buffalo Rapids), Sloan Bridge (alternative to Buffalo Rapids No. 2), and the Sullivan Creek sites. In addition, the development of the additional capacity at the existing Boundary, Cabinet Gorge, Thompson Falls, and Kerr projects seems to warrant further consideration.

The Corps of Engineers has prepared an inventory of potential pumped storage sites for the area but did not recommend any sites for further consideration.

The Kerr project is in good physical condition and is capable of providing an economical source of power for an extended period; therefore, abandonment of the project would serve no useful purpose. Preliminary studies of the Kerr project have indicated that adding an additional generating unit to the Kerr project is economical and requires further study. None of the potential projects mentioned in this Appraisal Report would have a serious adverse effect on the Kerr project. There appears to be no significant benefits to takeover of the project by the Federal Government for non-hydroelectric water resources purposes.

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CHAPTER I

DESCRIPTION OF THE CLARK FORK-PEND OREILLE RIVER BASIN

Location and Drainage Area

The Clark Fork-Pend Oreille River basin, a major component of the Columbia River basin, drains western Montana, excluding a small area tributary to the Kootenai River in the northwest corner, a portion of the panhandle region of northern Idaho, most of Pend Oreille County in the northeastern corner of Washington, and two areas totaling 1,203 square miles in British Columbia, Canada. The basin is bounded by the main range of the Rocky Mountains on the east and south, by the Bitterroot Range of Idaho on the west, and by the Kootenai drainage and Canada on the north. See figure 1 for a general map of the region. The river, from source to mouth, is about 420 miles long and has a drainage area of 25,800 square miles.

The Clark Fork, which, with Flathead River its principal tributary, drains the 22,287 square miles of basin area upstream from Pend Oreille Lake, rises near Butte, Montana and with few deviations, flows northwesterly to enter the easterly side of Pend Oreille Lake in Idaho. Other important tributaries are the Blackfoot, Bitterroot, and St. Regis Rivers. The Flathead, which joins the Clark Fork about 26 miles downstream from St. Regis, Montana, drains the northern two-fifths of the basin, comprising approximately 9,100 square miles. It rises in the northeast extremity of the basin in British Columbia, Canada, thence, flows generally south for most of its length, passing through Flathead Lake en route, to Dixon, Montana, where it turns abruptly and flows west to join the Clark Fork. The principal tributaries of the Flathead are the Middle and South Forks, two north-flowing streams, which join the main stream 53 and 44 miles, respectively, upstream from Flathead Lake.

Pend Oreille River is the outlet stream for Pend Oreille Lake. It flows westerly from the Lake at Sandpoint, Idaho, crosses into Washington, then flows north to the international boundary. After entering Canada, the stream turns west again and flows 16 miles to join the Columbia River just north of the boundary. The principal tributary of the Pend Oreille is Priest River.

Clark Fork, from its source near Butte to Pend Oreille Lake, falls with a gradually decreasing slope a total of about 3,500 feet. This fall is characterized by a succession of steep and moderate slopes. Pend Oreille River from Pend Oreille Lake to the brink of Metaline Falls has a relatively flat gradient, broken at Albeni Falls, where the low-water falls is about 7 feet, and at Box Canyon, where the stream drops 8 feet in three-quarters of a mile. At Metaline Falls the slope changes abruptly, and in the 27-mile reach from the falls to the Columbia, the Pend Oreille falls 645 feet, of which 390 feet are in the last 16 miles in Canada. The Pend Oreille joins the Columbia at the head of Franklin D. Roosevelt Lake, the reservoir created by Grand Coulee Dam, at about elevation 1,300 feet.

A multitude of natural lakes and many small, man-made reservoirs are situated in the basin. The largest of the lakes are Flathead Lake on Flathead River, Pend Oreille Lake at the mouth of Clark Fork, and Priest Lake on Priest River. Some of the large man-made reservoirs in the basin are the Hungry Horse Reservoir on the South Fork of the Flathead River, Noxon Rapids on the Clark Fork, and Boundary on the Pend Oreille River. The storage in these natural and artificial reservoirs materially regulates the flow in the river basins.

Physiography and Geology

Northwestern Montana, northern Idaho, and eastern British Columbia are occupied by several groups of mountains and two conspicuous linear depressions. The eastern depression, known as the Rocky Mountain Trench, only 60 miles west of the Great Plains, is one of the greatest of its kind in the world. It extends 800 miles northwestward from Flathead Lake in Montana.

A similar depression, known as the Purcell Trench, crosses the International Boundary near Porthill, Idaho, about 65 miles west of the Rocky Mountain Trench. The two trenches are nearly parallel but intersect about 200 miles north of the International Boundary. The floor of the Purcell Trench is aggraded or thickly covered with alluvium, and contains the outlet arm of Pend Oreille Lake as well as parts of the Kootenai River.

West of the Purcell Trench, which bounds the eastern portion of the Pend Oreille basin, is a succession of mountain ranges and valleys. The Priest Range, a part of the overall Selkirk Range, attains elevations of 7,000 feet and has glaciated peaks rising scenically above Priest Lake, which partially occupies the valley on the west. West of Priest Lake and the Priest River valley is the Kaniksu Range. It is lower and has fewer peaks than the Priest Range but contains several mineralized areas and numerous active mines near the Canadian border.

Mountains in the Continental Divide generally range from 7,000 to 10,000 feet. Two very important geologic events have determined that overall drainage pattern. The first event, which determined the main lines of drainage, was the early structural growth of the mountain ranges and valleys brought about by periods of folding and faulting, with intervening periods of erosion. The second event, which directly or indirectly altered many of the minor details of the drainage, was the advance of glaciers during the Pleistocene.

Five major groups of rock are represented. They are the Belt Series (a thick sequence of metasedimentary rocks occupying the largest area), recent valley and terrace deposits, granite and related intrusive rocks, Paleozoic sediments, and volcanic extrusives.

Climate and Hydrology

The climate is greatly affected by the elevation and topographic features. A climatic barrier divides the basin approximately at the boundary between Idaho and Montana. This barrier is a nearly continuous chain of mountains represented by the Bitterroot, Coeur d'Alene, and Selkirk Mountains. Westerly winds drop much of their moisture content in crossing the barrier, resulting in greater precipitation on the west side than on the east at comparable elevations. Also, temperatures are more extreme on the drier eastern side. Although the prevailing winds are westerly, the basin is subject to continental as well as oceanic influence.

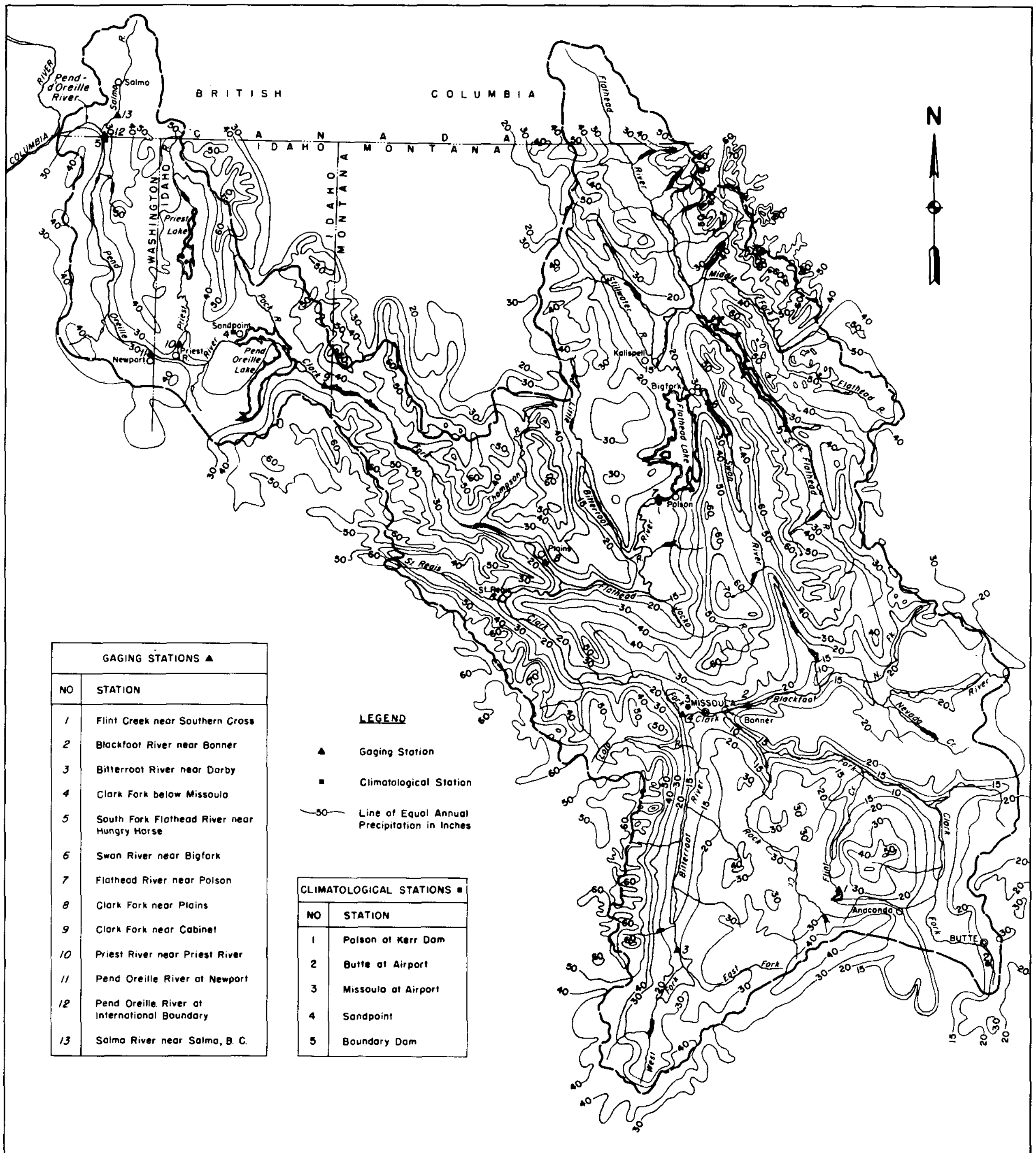
The seasonal range in temperatures is somewhat greater east of the climatic divide, and the transition from winter to summer is less gradual. Pacific modifying (warming) influences are at a maximum during winters in the northwest section of the basins where Arctic cold invasions occur only about oncc a winter and at a minimum in the Butte-Deer Lodge area where cold continental air may penetrate several times in a winter. In the lower elevations from the northwest into the Thompson Falls area of Montana, highest temperatures of record run near 110 degrees Fahrenheit, while Butte and Deer Lodge have reached 100 degrees Fahrenheit. On the cold end of the scale, differences in extremes are greater; from about -50 degrees Fahrenheit in the Deer Lodge Valley to around -20 degrees Fahrenheit in much of northeastern Washington. The normal mean temperatures for selected stations representative of local conditions at various elevations are shown in table 1. The location of each station is shown on figure 2. The frost-free period varies from 126 days to less than 30 days depending on the elevation. The longest growing season between dates of freezing temperature is 126 days at Boundary Dam in Washington. That for Kerr Dam in Montana is almost as long at 118 days, whereas the growing seasons near Hungry Horse Dam and Butte, Montana, are 96 and 76 days, respectively.

Table 1

Average Monthly and Annual Temperatures
At Representative Climatological Stations
Clark Fork-Pend Oreille River Basin

Station	Polson, MT (Kerr Dam)	Butte, MT (Airport)	Missoula, MT (Airport)	Sandpoint, ID	Boundary Dam, WA
Elevation in feet (msl)	2,730	5,526	3,190	2,100	2,600
Years of Record	22	75	39	63	4
Month					
January	22.5	15.1	19.2	25.6	20.8
February	29.1	19.5	25.0	29.2	29.5
March	40.0	26.3	33.7	36.0	37.1
April	40.8	38.5	44.3	45.8	45.9
May	52.4	47.3	52.6	53.8	54.1
June	60.1	54.3	58.5	59.3	59.3
July	63.6	62.7	67.0	65.3	66.7
August	67.1	60.3	64.8	63.4	66.5
September	52.0	51.2	55.4	56.1	56.3
October	42.2	41.6	44.0	46.1	44.5
November	35.4	27.7	30.5	34.9	32.0
December	22.5	20.1	23.5	29.7	31.4
Annual	44.0	38.7	43.2	45.4	45.3

Source: U.S. Department of Commerce, National Oceanic and Atmospheric Administration, Environmental Data Service; Montana, Annual Summary 1974, Volume 77, No. 13; Idaho, Annual Summary 1974, Volume 77, No. 13; Washington, Annual Summary 1974, Volume 78, No. 13.



NO	GAGING STATIONS ▲ STATION
1	Flint Creek near Southern Cross
2	Blackfoot River near Bonner
3	Bitterroot River near Darby
4	Clark Fork below Missoula
5	South Fork Flathead River near Hungry Horse
6	Swan River near Bigfork
7	Flathead River near Polson
8	Clark Fork near Plains
9	Clark Fork near Cabinet
10	Priest River near Priest River
11	Pend Oreille River at Newport
12	Pend Oreille River at International Boundary
13	Salmo River near Salmo, B. C.

NO	CLIMATOLOGICAL STATIONS ■ STATION
1	Polson at Kerr Dam
2	Butte at Airport
3	Missoula at Airport
4	Sandpoint
5	Boundary Dam

HYDROLOGIC MAP
CLARK FORK - PEND OREILLE RIVER BASIN
WASHINGTON - IDAHO - MONTANA
1980
SCALE IN MILES
10 0 10 20 30 40 50

FERC - Water Resources Appraisal for Hydroelectric Licensing **Figure 2**

Precipitation varies widely with season, elevation, and location. The southwestern slopes of all mountain ranges have many Pacific precipitation features, but these characteristics diminish northwest to southeast. In general, the wettest areas are to the north, but substantial moisture falls over most of the area with the exception of some "rain shadow" sections such as the Butte-Deer Lodge-Drummond Valley and a small area southwest of Flathead Lake. Annual average totals increase rapidly, but not uniformly, eastward into the mountains. Several places in northern Idaho and extreme northeastern Washington have annual precipitation of 50 inches or more, and along the western slopes of the Rocky Mountains in Glacier National Park annual precipitation is near 100 inches. The mountain "shadowed" sections of western Montana, however, have annual average precipitation as low as 10 inches. Table 2 gives the average annual and monthly precipitation at representative climatological stations in the basin. The location of each station and lines of average annual precipitation are shown on figure 2.

Table 2

Average Monthly and Annual Precipitation
At Representative Climatological Stations
Clark Fork-Pend Oreille River Basin

Station	Polson, MT (Kerr Dam)	Butte, MT (Airport)	Missoula, MT (Airport)	Sandpoint, ID	Boundary Dam, WA
Elevation in feet (msl)	2,730	5,526	3,190	2,100	2,600
Years of Record	23	80	39	64	4
Month			Inches		
January	1.19	0.42	2.42	4.49	2.59
February	1.63	0.44	2.34	3.30	0.86
March	0.97	0.65	2.57	2.97	1.83
April	0.64	0.90	1.60	1.97	1.19
May	1.71	1.74	0.81	2.05	1.71
June	1.21	2.42	1.19	2.33	1.27
July	0.88	1.20	0.91	0.63	0.60
August	0.58	1.03	0.72	0.83	0.61
September	1.62	1.04	1.91	1.71	1.72
October	0.67	0.67	0.76	2.37	3.09
November	0.55	0.49	0.51	4.21	6.01
December	1.48	0.48	1.69	4.88	7.06
Total	13.13	11.48	17.43	31.74	28.54

Source: U.S. Department of Commerce, National Oceanic and Atmospheric Administration, Environmental Data Service; Montana, Annual Summary 1974, Volume 77, No. 13; Idaho, Annual Summary 1974, Volume 77, No. 13; Washington, Annual Summary 1974, Volume 78, No. 13.

In the northwestern parts of the basin, a large proportion of the annual precipitation occurs during the cold season. At the southeastern edge of the basin, however, the picture is almost exactly reversed. For example, 73 percent of Butte's annual precipitation occurs during the April-September warm season. The change in seasonal maximum precipitation is fairly gradual northwest to southeast. Particularly over the mountains, most winter moisture falls as snow, and it is much heavier in all cases than over valley bottoms.

Streamflow

The source of most of the streamflow is the snow which falls in the higher forested mountain areas. Practically all of the high mountain ranges contribute from 30 to 50 inchdes of runoff annually. The valley and foothill areas generally receive so little precipitation that their contribution to streamflow is negligible. Streamflow at selected long-term gaging stations are given in table 3.

The Clark Fork-Pend Oreille River basin contributes over 13 percent of the annual runoff of the Columbia River measured at The Dalles, Oregon. That portion of the system in Montana, the Clark Fork basin, provides most of this water with an average annual runoff of 15,750,000 acre-feet at the Idaho-Montana State line, or 10 percent of the runoff of the Columbia River at The Dalles.

Table 3

Streamflow Data
Clark Fork Basin

(Records through Water Year 1973)

Gaging Station Location	Elevation (ft)	Drainage Area (sq mi)	Period of Record (yrs)	Discharge (cubic feet per second)		
				Average	Maximum	Daily Minimum
Flint Creek near Southern Cross, MT	5,630	53	35	28	174	0
Blackfoot River near Bonner, MT	3,345	2,290	39	1,636	19,200	200
Bitterroot River near Darby, MT	3,943	1,049	37	918	11,500	71
Clark Fork below Missoula, MT	3,090	9,003	46	5,395	52,800	388
South Fork Flathead River near Hungry Horse, MT	3,575	1,160	11	2,370	28,300	156
Swan River near Bigfork, MT	3,063	671	53	1,154	8,400	193
Flathead River near Polson, MT	2,693	7,096	68	11,730	82,800	5
Clark Fork River near Plains, MT	2,449	19,958	65	19,890	134,000	3,200
Clark Fork River near Cabinet, ID	2,060	22,067	47	22,350	195,000	270
Priest River near Priest River, ID	2,090	902	47	1,673	10,500	165
Pend Oreille River at Newport, WA	2,000	24,200	61	25,990	136,000	1,280
Pend Oreille River at International boundary	1,700	25,200	60	26,000	171,300	109
Salmo River near Salmo, B.C.	1,720	476	26	1,121	16,300	50

Source: U.S. Geological Survey.

CHAPTER II

PRIOR REPORTS AND CURRENT INVESTIGATIONS

Many published reports and studies pertaining to development of water and related land resources of the Clark Fork-Pend Oreille River basin have been examined during the investigation leading to this report. In addition, information was utilized which was furnished informally by organizations directly concerned with specific fields of development.

Prior Reports

Several reports having a direct and important bearing on the basin's water resources development are discussed briefly below.

"The Columbia River," a report of the Bureau of Reclamation (now, the Water and Power Resources Service), published in 1947 as House Document No. 473, 81st Congress, 2nd Session, suggested a plan for use as a general guide for further investigation and development of the water resources of the Columbia River basin. The Bureau listed 11 projects in the Clark Fork-Pend Oreille basin with a potential hydroelectric capacity of 1 million kilowatts.

"Review Report on the Columbia River and Tributaries" (House Document No. 531, 81st Congress, 2nd Session, 1948), a report of the Corps of Engineers, contains an appendix on the Clark Fork-Pend Oreille basin. This review report proposed an integrated system of 12 projects, for flood control and/or for hydroelectric power, and identified 19 other projects worthy of future study.

"A Special Report of Multi-purpose Storage Possibilities - Clark Fork Basin," 1953, is a Bureau of Reclamation report providing a summary of analyses of storage possibilities in the Clark Fork basin drawn largely from previous investigations but supplemented by some additional reconnaissance studies. This report cited 17 sites for storage with multi-purpose use, mostly flood control and power.

"Special Report on Fishery Resources, Project No. 2141, Priest River, Idaho," was prepared by the U.S. Fish and Wildlife Service in 1959.

"Clark Fork Basin, Montana," prepared by the Bureau of Reclamation in 1959, is a reconnaissance report primarily oriented to irrigation and water development sites.

The Corps of Engineers prepared a report entitled, "Columbia River and Tributaries," published as House Document No. 403, 87th Congress, 2nd Session, 1962. This report updated House Document No. 531 and presented the Army's latest concept of regional development of the Columbia River basin, characterized as the "Major Water Plan." Two projects in the Clark Fork-Pend Oreille basin were selected for inclusion in this plan -- Flathead Lake Outlet Improvement, and Knowles -- and were recommended by the Corps of Engineers for construction. Twelve other projects in the basin, including eight run-of-river plants, were listed for possible future development.

"A Preliminary Survey of Fish and Wildlife Resources of Pend Oreille River Basin, Idaho and Washington," was prepared in 1963 by the U.S. Fish and Wildlife Service.

"Pend Oreille River Basin, Idaho-Washington," prepared by the Bureau of Reclamation in 1964, is a reconnaissance report. Among its conclusions were that irrigation development at that time lacked economic justification, and that hydroelectric power potential in the basin was almost fully developed.

The Federal Power Commission in 1965 published a planning status report entitled, "Clark Fork-Pend Oreille River Basin, Montana, Idaho, Washington,"

The Corps of Engineers in 1967 prepared a "Memorandum Report on Clark Fork Basin, Montana, for the Federal Power Commission," in three volumes: Main Report, Appendix A - Report Drawings, and Appendix B - Power. This report was an updating of system power and flood control studies and project costs presented in House Document No. 403, 87th Congress. A principal change was the consideration of Canadian storage in the system power studies.

The Idaho Water Resources Board in 1969 prepared "Idaho Economic Base Study for Water Requirements" in two volumes.

A report "Columbia - North Pacific Region Comprehensive Framework Study" in 17 volumes was prepared by State and Federal agencies under the aegis of the Pacific Northwest River Basins Commission, an organization established under authority of the Water Resources Planning Act of 1965. The study contains an appraisal of natural resources, projects, future requirements and associated problems, and provides broad framework plans and programs for management and development of resources to the year 2020 and the intermediate years 1980 and 2000. Also included is a general estimate of costs and a program of implementation. The Clark Fork-Pend Oreille basin forms the major portion of 1 of the 12 subregions studied as entities in the report. This Type I study was initiated in Fiscal Year 1966 and completed in Fiscal Year 1973.

"Land Use and Water Quality in the Flathead Drainage" is a staff report of the University of Montana Biological Research Station prepared in 1974.

The Idaho Department of Water Resources in 1974 conducted a study of alternative methods for operating the active storage in Priest Lake to meet recreation uses in conjunction with downstream flow objectives.

The Bureau of Reclamation has also written several reports on specific projects, all in the State of Montana. These are the Bitterroot Valley project, Kalispell project, Blackfoot River project (Ninemile Prairie and McNamara projects), and the Flathead River project (Spruce Park project).

The U.S. Fish and Wildlife Service has prepared several reports for specific areas in the basin: Priest River, McNamara project on the Blackfoot River, Flathead Lake, and Cabinet Gorge project on the Clark Fork River.

The Corps of Engineers has expanded its inventory of pumped storage sites in the Pacific Northwest to include this basin. It has also conducted a review of previous reports on flood control for the Clark Fork-Flathead River basin for the purpose of determining if Corps' assistance is justified at this time. An interim report on flood control improvements near Kalispell has recently been completed. Other areas will be studied during future phases of the basin study. The final report was completed in 1979.

The Bob Marshall Wilderness was evaluated by the U.S. Geological Survey (USGS) and the U.S. Bureau of Mines for its potential mineral resources. The area includes the upper reaches of the Flathead River. A mineral resource report was published in 1975 by the USGS.

As part of the Comprehensive Coordinated Joint Plan of the Pacific Northwest River Basins Commission, the Montana State study team, a State-Federal interagency group, completed a Level B study of the Flathead River basin. The following recommendations for future studies were made: (1) study the feasibility of Hungry Horse Reregulation Dam, (2) study the feasibility of Buffalo Rapids Nos. 2 and 4, (3) study the feasibility of modifying the operation of Hungry Horse Dam, and (4) study the feasibility of installing a variable intake structure at Hungry Horse Dam.

Recent studies in the basin include the Clark Fork-Flathead River basin study being conducted by the U.S. Army Corps of Engineers. This study was authorized to review previous reports to determine whether any modification should be made for flood control or other purposes. In participation with the Bureau of Reclamation, the Corps' Seattle District prepared a report on potential storage sites. The report was forwarded to the Federal Power Commission in 1967 for its use in considering a license request for power dams on the lower Flathead River. In 1974, an interim report was completed recommending levee protection for developed areas near Kalispell and flood plain zoning for the remainder of the upper Flathead River flood plain.

A study of the Upper Clark Fork and Flathead Rivers was authorized by Congress in 1976 but was suspended in September 1979 after Congress suspended funds for continuation of the study. In all, the Corps studied 19 potential hydropower alternatives in various combinations of conventional and storage reservoir alternatives. The Corps suggested there is strong local opposition to hydro development and that adverse socio-economic and environmental impacts could occur with hydropower development.

Current Investigations

The U.S. Army Corps of Engineers is currently conducting a detailed assessment of the Nation's hydroelectric resources as part of the National Hydroelectric Power Study authorized by section 167 of the Water Resources Development Act of 1976 (Public Law 94-587). The study is designed to provide a current and comprehensive estimate of the potential for incremental or new generation at existing dams and other water resource projects, as well as for undeveloped sites in the United States.

The Federal Energy Regulatory Commission's Office of Electric Power Regulation, Division of River Basins, is preparing a river and site coding system including mapping for hydropower resources assessment. The system has been designed for use in maintaining an updated computer file, with reference maps, of developed and undeveloped hydropower in the United States. Publication of the assessment and reference maps is expected near the end of 1980.

CHAPTER III

THE ECONOMY OF THE BASIN

General

The Clark Fork-Pend Oreille basin is an extremely scenic, rural area encompassing all or parts of 10 counties in western Montana, Bonner County in the Idaho panhandle, and Pend Oreille County in the northeastern corner of Washington State (table 4). These 12 counties constitute the economic study area. In 1970, the population of these 12 counties totaled 225,243. Major industries within the basin include mining, lumbering, livestock and grain farming, and tourism. The area's fastest growing economic sectors, however, are trade and services. These are expanding to serve retirees and other persons who recently have been migrating to the area.

Table 4

Population Trends
Clark Fork-Pend Oreille Basin Economic Area

State and County	Total Population			
	1950	1960	1970	1975
Idaho				
Bonner	14,853	15,587	15,560	19,775
Montana				
Deer Lodge	16,553	18,640	15,652	15,101
Flathead	31,495	32,965	39,460	44,604
Granite	2,773	3,014	2,737	2,729
Lake	13,835	13,104	14,445	17,086
Mineral	2,081	3,037	2,958	3,499
Missoula	35,493	44,663	58,263	65,090
Powell	6,301	7,002	6,660	7,569
Ravalli	13,101	12,341	14,409	18,460
Sanders	6,983	6,880	7,093	8,063
Silver Bow	48,422	46,454	41,981	43,034
Washington				
Pend Oreille	7,413	6,914	6,025	7,361
TOTAL BASIN	199,303	210,601	225,243	252,371

Source: U.S. Department of Commerce, Bureau of the Census, Census of Population, 1950, 1960, and 1970. Also, Bureau of Census, Current Population Reports, Series, P-25 Numbers 674, 695, and 660.

Population

During the 1950-1960 decade, the population of the area increased by 11,298 (5.7%). With the exception of Missoula County, the counties within the area experienced either small population gains or losses (see table 4). These resulted from the out-migration of unemployed and underemployed workers and their dependents to Spokane, Boise, Portland, and other metropolitan areas. Missoula County's population growth resulted from the expansion of its lumber and wood products industry, particularly its particle board and plywood manufacturing plants.

During the 1960's, the area's population increased by 14,642 (7%). Population losses in Deer Lodge, Silver Bow, Granite, and Powell Counties resulted primarily from the out-migration of unemployed Anaconda Copper Company workers due to strikes and reduced production at both Anaconda's large open pit copper mine near Butte in Silver Bow County and smelting plant in Deer Lodge County.

Population estimates for 1975 published by the Bureau of the Census indicate that, during the first half of the 1970-1980 decade, the population of the area expanded by 27,128. This was almost four times the average annual population gain experienced in the 1960's. Government officials in the basin indicate that the area's recent growth has resulted from the immigration of retired persons and "back-to-nature types" from California's heavily populated metropolitan areas. The area is sparsely populated with an estimated 1975 population density of 10.4 persons per square mile. The area's low population density causes many problems. School districts have few students; hospitals must serve extensive areas; and specialized public services and equipment are difficult for small communities to afford.

Employment and Personal Income

In 1977, the area's economy generated 96,870 full- and part-time jobs. These produced $770,828,000 in total personal income, as shown in table 5. Per capita personal income in 1974 ranged from $3,362 in Granite County to $4,866 in Silver Bow County. As shown in table 6, these represented, respectively, 61.7 percent and 89.3 percent of the national average.

From 1970 to 1974, total employment within the area increased by 14.8 percent. The industries which experienced the largest employment and real income gains were trade and services. The growth in tourism and increased pace of population growth undoubtedly were the primary factors behind the expansion of these sectors.

The economic development of the basin depends on wood products manufacturing, tourism, mining, and agriculture.

Employment opportunities and income generated by these basic sectors provide the major market support for local-oriented industries, such as banks, public utilities, personal and maintenance services, and local government. The area's four basic sectors are discussed in the following paragraphs.

Wood Products Manufacturing

The area contains large reserves of Douglas fir, ponderosa pine, larch, Englemann spruce, and lodgepole pine. The smaller size of the area's trees and its steeper slopes have made logging there less profitable than in other areas of the West. Until recently, when the demand for lumber increased nationally and supplies began to dwindle in other areas, the basin's timber resources were not fully utilized.

Table 5

Employment and Personal Income by Major Industry Group
Clark Fork-Pend Oreille Economic Area 1977

Industry	Employment		Personal Income	
	Number	Percent	Amount ($000)	Percent
Agriculture 1/	6,422	6.6	13,281	1.7
Non-farm proprietors	9,993	10.3	3/	3/
Manufacturing 2/	11,284	11.7	121,065	15.7
Mining 2/	3,670	3.8	49,964	6.5
Contract Construction	3,766	3.9	51,683	6.7
Wholesale and Retail Trade	17,492	18.0	133,705	17.4
Finance, Insurance, and Real Estate 2/	2,620	2.7	25,075	3.3
Transportation, Communications, and Public Utilities	5,618	5.8	72,975	9.5
Services 2/	14,189	14.7	100,485	13.0
Other Industries 2/	233	0.2	1,519	0.2
Civilian Federal Gov't.	3,889	4.0	51,019	6.6
Military	137	0.1	6,253	0.7
State and Local Gov't.	14,555	15.0	109,816	14.3
Totals Available	93,868	96.8	736,840	95.6
Actual	(96,870)	100.0	(770,828)	100.0

Source: Regional Economics Information System, Bureau of Economic Analysis, U.S. Department of Commerce, 1977.
1/ Includes farm employees and farm proprietors.
2/ Data withheld for some industries to avoid disclosure, but included in totals.
3/ Included by industry; primary source of non-farm wages, ES-202 Covered Wages-Montana Employment Security Commission.

Most of the area's timber is processed locally into lumber, pulp, paper, and plywood. Approximately 46 percent of the output is sold to buyers in the Midwest. Missoula is the basin's most important logging and lumber processing county.

Tourism and Recreation

Recreation is one of the major industries in the area. Each year over two million visitors are attracted to the recreation facilities within the basin. Although most recreation activity takes place in the warm summer months, the

Table 6

Per Capita Personal Income in the Economic Study Area and the United States, 1970 and 1974

State and County	Per Capita Income 1/ 1970	1974	Change, 1970-74 Amount	Percent	Percent of U.S. 1970	1974
Idaho						
Bonner	$2,533	$3,501	$ 968	38.2	63.9	64.3
Montana						
Deer Lodge	2,997	4,227	1,230	41.0	75.6	77.6
Flathead	3,181	4,506	1,325	41.7	80.2	82.7
Granite	2,533	3,362	829	32.7	63.9	61.7
Lake	2,530	3,462	932	36.8	63.8	63.6
Mineral	2,788	3,785	997	35.8	70.2	69.5
Missoula	3,324	4,548	1,324	39.8	83.8	83.5
Powell	2,973	4,089	1,116	37.6	75.0	75.0
Ravalli	2,782	3,369	587	21.0	70.0	61.8
Sanders	2,608	4,020	1,412	54.1	65.8	73.7
Silver Bow	3,476	4,866	1,390	40.0	87.6	89.3
Washington						
Pend Oreille	3,001	3,976	975	32.5	75.6	73.0
Study Area	2,895	3,646	751	25.9	73.0	66.9
United States	3,966	5,449	1,483	37.4	100.0	100.0

Source: U.S. Department of Commerce, Bureau of Economic Analysis, Regional Economics Information System, 1977.

1/ Defined as the total personal income received by county residents divided by the county's total population. Personal income includes: wages and salaries; other labor income; proprietor's income; dividends, interest, and rent; net social security receipts; unemployment insurance, pensions, and welfare assistance.

increasing popularity of winter sports and the development of ski resorts within the basin are making recreation a year-round business.

Glacier National Park is the number one attraction for recreationists. Flathead Lake and Lake Pend Oreille are the next most popular centers of recreation activity offering opportunity for picnicking, camping, hiking, fishing, hunting, and sightseeing.

The existing public and private recreation facilities adequately accommodate the large influx of visitors, but additional recreation facilities are planned to keep pace with estimated increases in visitors. Several summer home developments exist around Flathead Lake and along the Pend Oreille River.

Portions of the Kaniksu, Kootenai, Lolo, Flathead, Deerlodge, and Bitterroot national forests lie within the basin. These national forests provide unlimited opportunities for most recreational pursuits. The Bob Marshall Wilderness is located southeast of Flathead Lake. In 1974, 39,400 visitor-days were recorded on the 710,000 acres of the wilderness within the basin.

There are three major lakes in the basin: Flathead, Priest, and Pend Oreille. Ownership of tourist-related facilities at the three lakes is divided among various State and Federal agencies. Detailed attendance figures are not readily available, however, the National Park Service does collect data for Glacier National Park, located near the eastern border of the basin approximately 30 miles northeast of Kalispell, Montana. Attendance at that facility has increased dramatically from 1,051,000 visitor-days in 1969 to 1,662,000 visitor-days in 1976. According to Park Service officials, the upward trend in visitation at this major national park is typical of western Montana and Idaho.

Mining and Minerals

The basin is a major mineral producing area. Copper mining is concentrated in the Butte area, Silver Bow County, Montana. Most of this copper is produced by the Anaconda Copper Company, which operates, among other holdings, a huge open-pit copper mine near Butte and a smelter in the City of Anaconda, Deer Lodge County.

The copper reserves in the Butte area are sufficient to maintain production at 100,000 tons per year for many years. Mining employment in Silver Bow County in 1974 was approximately 3,570 people. Reduced copper production has generally resulted from lower copper prices.

Significant oil and gas fields are thought to exist on the western slope of the Rockies along the Overthrust Belt. Large resources have been found in similar geological features in Utah and Wyoming. Exploration and production in Montana may be somewhat hampered by Federal lands protection.

In addition to copper, the basin produces various other minerals, including silver, gold, zinc, antimony, limestone, sand, and gravel.

Agriculture

The basin's major agricultural products include livestock and grain. The value of livestock and crop production for the Montana counties of the basin in 1975 are displayed in table 7.

During the 1970-1974 period, there was a severe drop in farm income within the area. According to the Montana Department of Agriculture, the sale of wheat to Russia in early 1974 was one of the causes of this decline. The large foreign sale of wheat led to over-production in the summer of 1974 and an increase in the amount of wheat in storage. Currently, the volume of grain storage in Montana is at an all time high, and prices are low. In addition, the rise in fuel prices since 1973 has added greatly to farm expenses.

Electric Utility Systems

More than a dozen Federal, private, and public electric utility systems operate in the Clark Fork-Pend Oreille River basin. However, the basin is served primarily by the Bonneville Power Administration (BPA), Pacific Power & Light Company (PAPL), and the Montana Power Company (MOPO) operating within the basin as shown on the Principal Electric Facilities Map, figure 3. The map shows power supply and transmission lines within the Clark Fork-Pend Oreille River basin.

Table 7

Agricultural Sales by County, 1975
Montana Counties of the Clark Fork-Pend Oreille Basin

County	Livestock	Crops
Deer Lodge	$ 888,100	$ 325,800
Flathead	7,659,600	6,867,700
Granite	3,206,400	905,200
Lake	12,074,200	6,677,600
Mineral	242,200	122,700
Missoula	2,612,700	1,048,100
Powell	6,786,100	1,734,900
Ravalli	9,587,700	2,327,400
Sanders	3,084,600	1,227,100
Silver Bow	500,900	248,800
Total	$46,642,500	$21,485,300

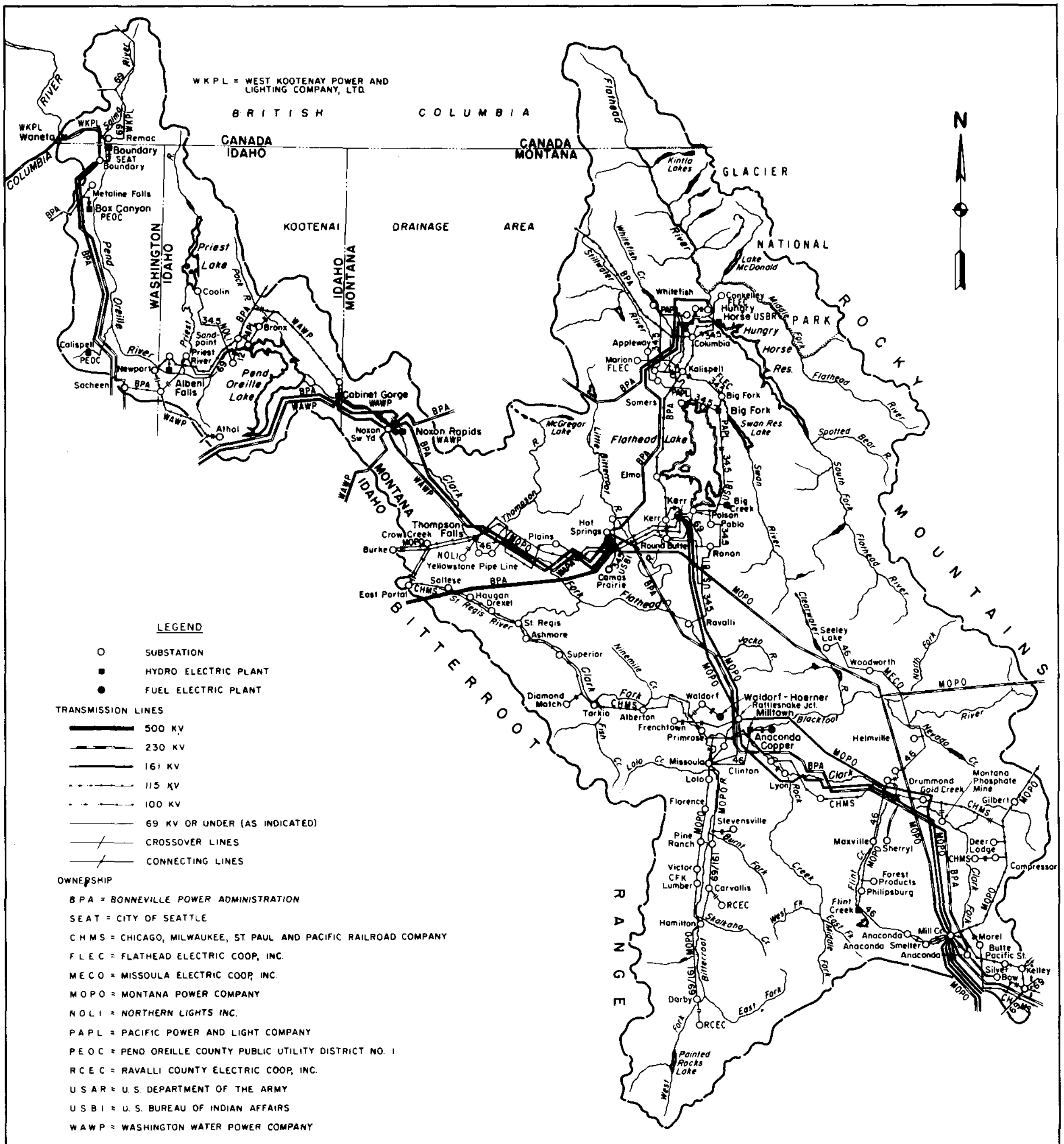
Source: Montana Agricultural Statistics, 1974 and 1975, Montana Department of Agriculture and U.S. Department of Agriculture State Research Service, 1976.

The total installed generating capacity in the basin is approximately 1,765,000 kilowatts. Two industrial steam plants comprise 7,100 kilowatts of this total. The bulk of the total, 1,743,000 kilowatts, is generated by 13 existing hydroelectric plants in the United States portion of the basin owned by 8 separate utility systems. A tabulation and description of the plants is contained in the Hydroelectric Power section of chapter 4 of this report.

The Montana Power Company is a participant in the Western Systems Coordinating Council, a voluntary council of bulk power suppliers in 14 western States. The expressed purpose of this council is to promote the reliable operation of interconnected bulk power systems in the western region. It is 1 of 9 electric reliability councils which include most of the 48 contiguous States.

Transportation

The Clark Fork-Pend Oreille River basin is serviced by surface and air transportation with important junctions at Butte, Missoula, and Helena, Montana and at Spokane, Washington.



PRINCIPAL ELECTRIC FACILITIES

CLARK FORK - PEND OREILLE RIVER BASIN

WASHINGTON - IDAHO - MONTANA

1980

SCALE IN MILES

10 0 10 20 30 40 50

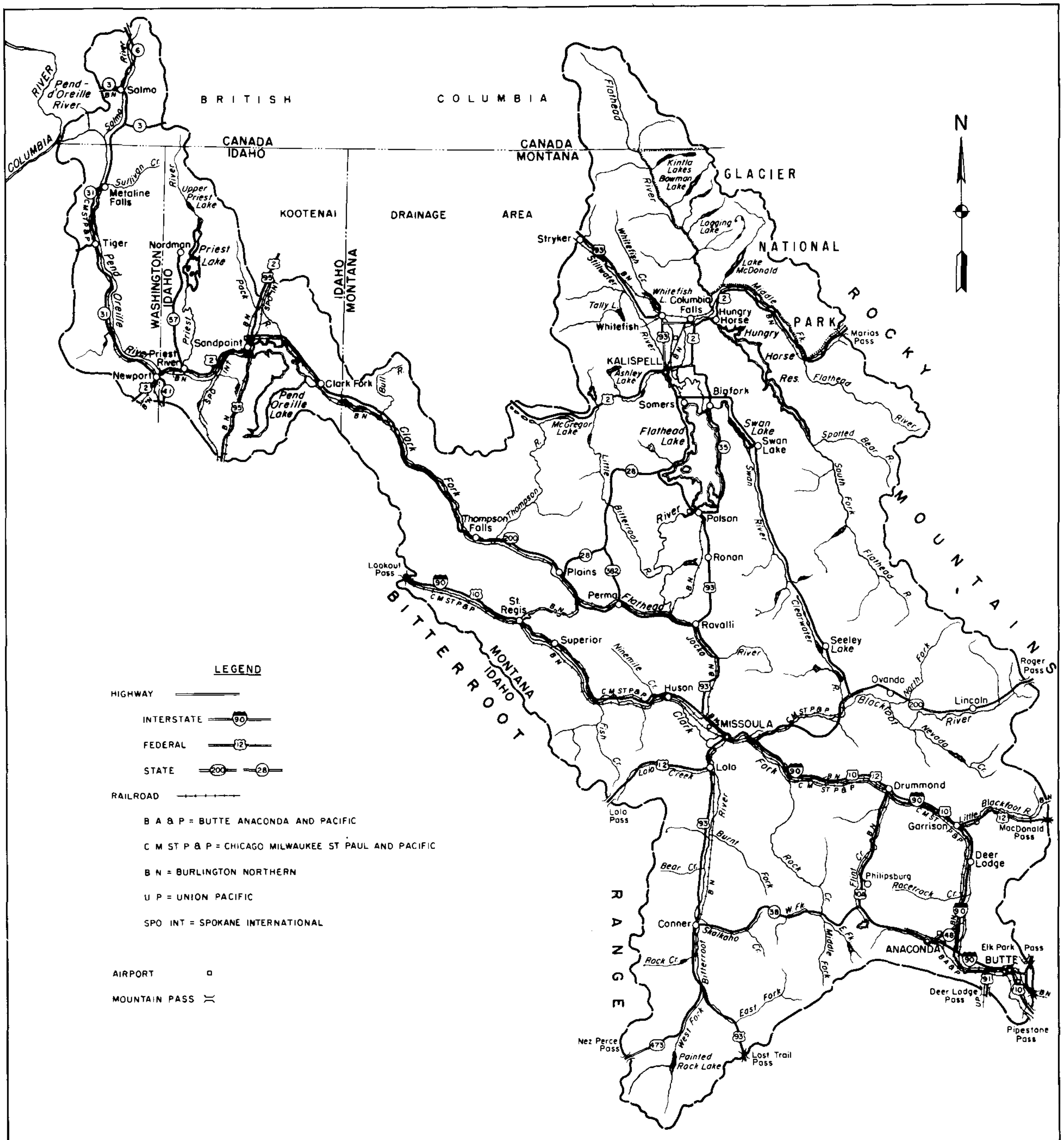
FERC - Water Resources Appraisal for Hydroelectric Licensing **Figure 3**

Spokane, although outside the river basin, is a hub for major transportation arteries to the basin. Interstate Highway 90 and U.S. Highway 10 heads southeast from Spokane across the Idaho Panhandle and enters the river basin in Montana forming a main route through Missoula to Butte. U.S. Highway 12 follows most of this route but turns to Helena instead of Butte. Federal Highway 2 from Spokane traverses the northwest section of the basin and turns southeast to Kalispell, Montana, and Glacier National Park. U.S. Highway 2 connects in Idaho with Montana State Route 200, which parallels the Clark Fork River, bisecting the northwest arm of the basin and ultimately heading southeast to the town of Ravalli, Montana, where it connects with a main north-south route, U.S. Highway 93. Highway 93 spans the main body of the basin to the north along Flathead Lake and beyond Kalispell, and south through Missoula and along the Bitterroot River. U.S. Highway 91 and Interstate Highway 15 connects Butte to points north of the basin including Helena, Great Falls, and south Idaho Falls, Idaho.

Airports within the basin are generally small and access is limited to a certain extent by the mountainous terrain. Airports handling commercial carriers within the area include Silver Bow County Airport in the Butte-Anaconda area, Glacier Park International Airport near Kalispell, and Missoula Airport. Smaller airports for private plane use are located throughout the area. International service is available at the Spokane International Airport located outside the basin.

The Burlington Northern is the major rail system in the river basin. Burlington's main line from the east through Butte and Missoula branches northward through Sandpoint, Idaho. This line is augmented by a network of lines connecting points in and around the basin. Another Burlington main line, emanating from Spokane, crosses northern Montana near Glacier Park and then heads eastward. The Chicago Milwaukee St. Paul and Pacific (CMSP&P) line in Montana has been discontinued.

In addition to rail service, the agriculture, lumber, mining, and other area industries are served by regularly scheduled freight truck lines which provide daily trans-continental service to and from the area. Figure 4 shows details of the transportation system network.



TRANSPORTATION SYSTEM

CLARK FORK - PEND OREILLE RIVER BASIN

WASHINGTON - IDAHO - MONTANA

1980

SCALE IN MILES

10 0 10 20 30 40 50

FERC - Water Resources Appraisal for Hydroelectric Licensing **Figure 4**

CHAPTER IV

EXISTING WATER AND RELATED LAND RESOURCES DEVELOPMENT

General

The waters of the Clark Fork are subject to the provisions of the Boundary Waters Treaty, 1910, and the Columbia River Treaty, 1964, insofar as the treaties affect the Columbia basin. Basin-wide planning of water and related land resources is coordinated through the Pacific Northwest River Basins Commission, established by the President in 1967, at the request of the States and the Water Resources Council.

Development of the river systems has long been a key factor in the utilization of the basin's natural resources. The rivers are now largely controlled by dams that provide power generation, irrigation, flood protection, and opportunities for recreation. Various water resource developments in the basin are shown on figure 5, Development Map and figure 6, Profile Map.

Irrigation

Irrigation development is generally concentrated in three areas -- the Flathead, Upper Clark Fork, and the Bitterroot. The remaining irrigated land occurs as smaller, scattered tracts throughout the Lower Clark Fork and Pend Oreille basins.

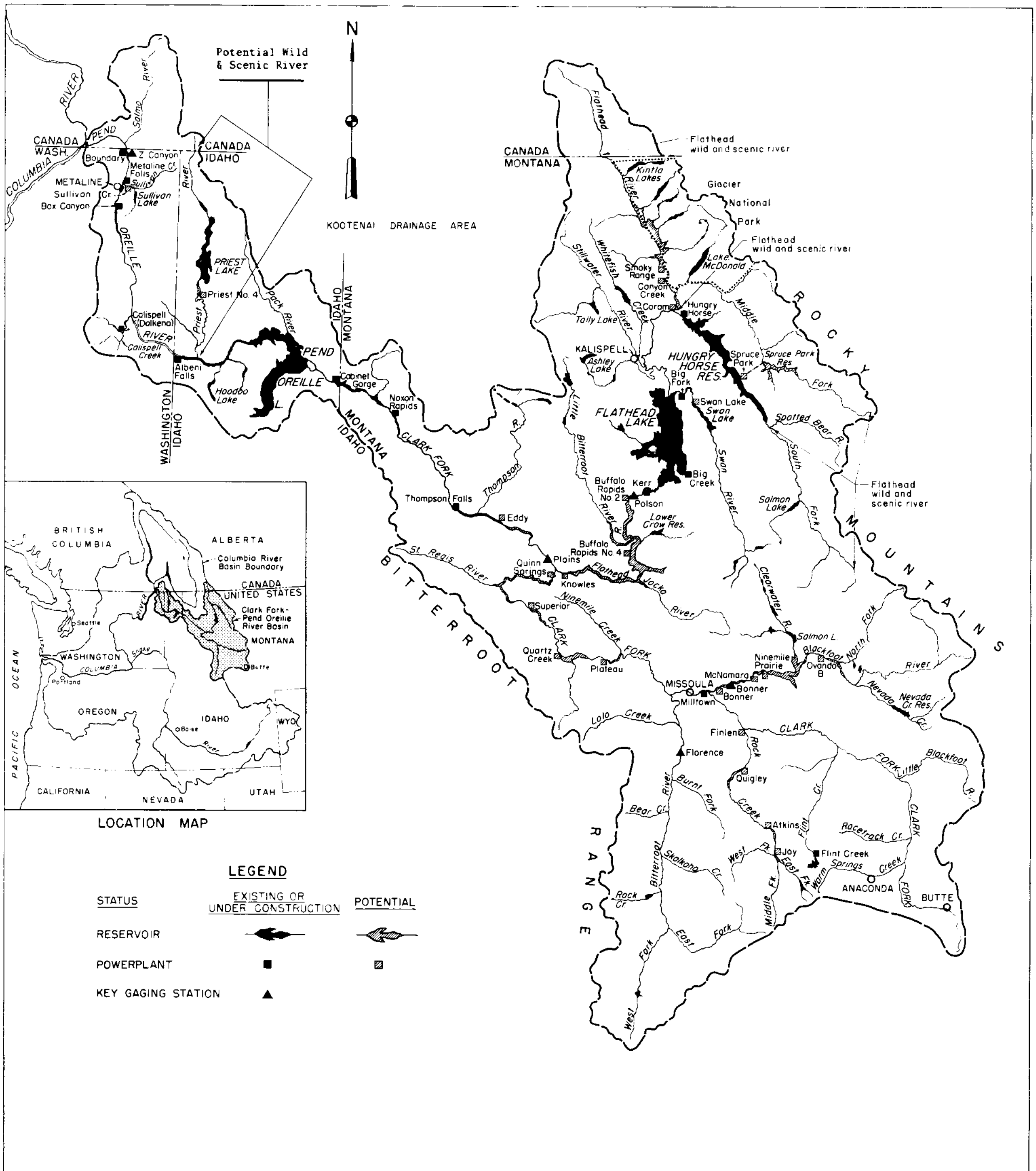
The irrigation of agricultural land accounts for the largest use of water in the Flathead basin. About 153,000 acres are presently irrigated, 143,000 acres from surface water, and 10,000 acres from groundwater. The Flathead Irrigation Project, located entirely within the Flathead Indian Reservation, serves 114,000 acres and is the region's largest single irrigation development. Significant development has also taken place around the city of Kalispell.

The Upper Clark Fork area contains several substantial blocks of irrigated land and smaller scattered developments that total approximately 131,000 acres. The larger irrigated blocks are located along the main stem of the Clark Fork and Blackfoot Rivers with the remainder located along tributary streams. There are 109,000 acres of irrigated land in the Bitterroot subarea.

About 70 percent of the irrigated acreage in the Clark Fork-Pend Oreille River basin is served by private irrigation systems and the remainder from Federally constructed facilities. Some 423,000 acres are irrigated from surface sources and 15,000 acres from groundwater development.

Flood Control

Major floods in the basin result from melting of the winter accumulated snowpack augmented by heavy rain during the months of May and June. In only a few areas in the Clark Fork basin do floods cause appreciable damage. However, flood flows of the Clark Fork, in general, coincide with flood flows from the other major tributaries of the Columbia River, contributing substantially to the tremendous damage in the more highly populated and developed areas along the lower Columbia.



BASIN MAP

CLARK FORK - PEND OREILLE RIVER BASIN

WASHINGTON - IDAHO - MONTANA

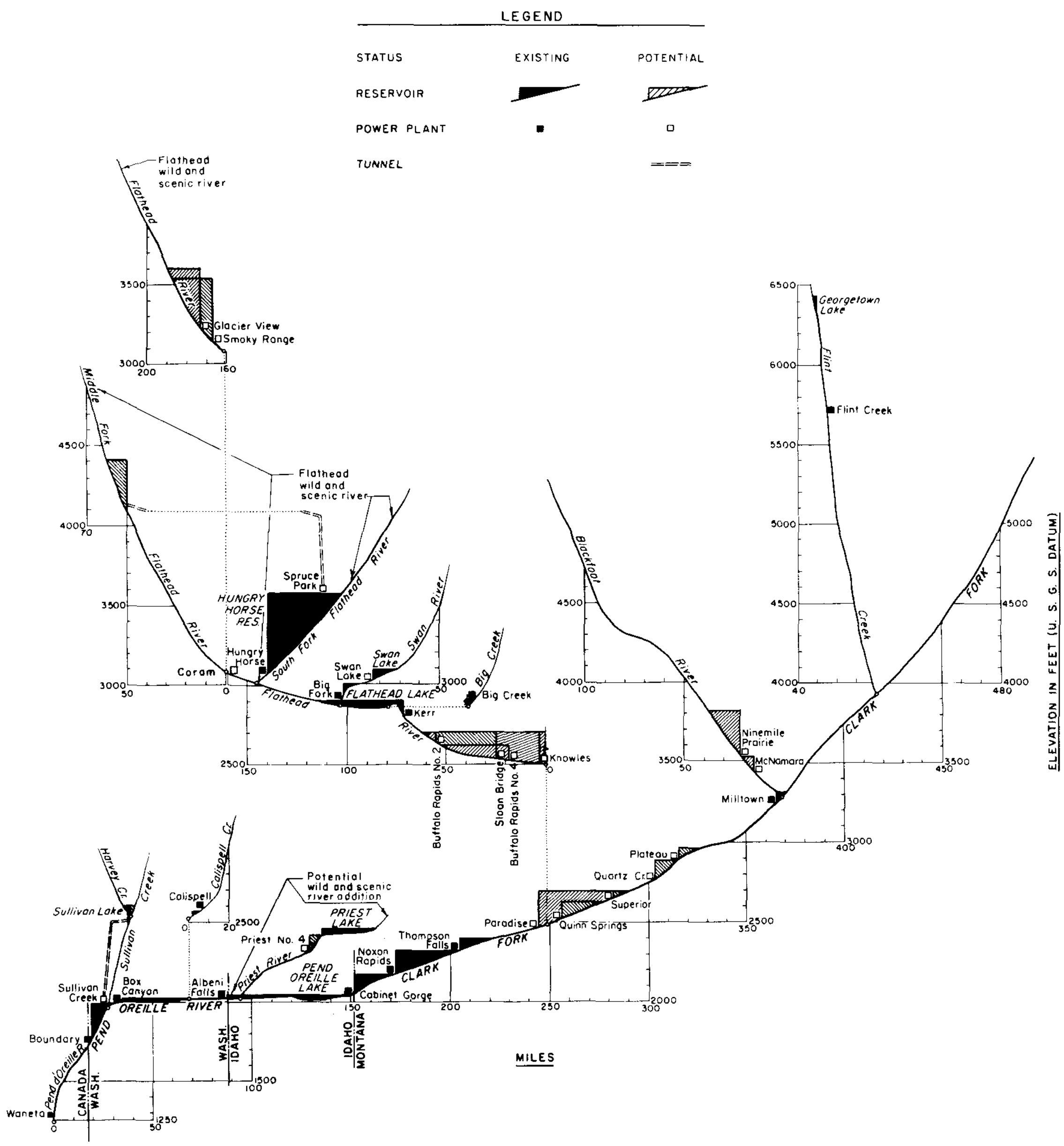
1980

SCALE IN MILES

10 5 0 10 20 30 40 50

FERC– Water Resources Appraisal for Hydroelectric Licensing

FIGURE 5



PROFILE

CLARK FORK - PEND OREILLE RIVER BASIN

WASHINGTON - IDAHO - MONTANA

1980

FERC - Water Resources Appraisal for Hydroelectric Licensing — Figure 6

The areas subject to flood damage in the basin are scattered, occurring largely at the relatively few locations where the valleys widen and low-lying agricultural lands are located. The principal area subject to this type of flood damage is Flathead valley above Flathead Lake where up to 30,000 acres have been inundated during major floods. Table 8 lists the numerous storage reservoirs in the basin.

Table 8

Existing Storage Reservoirs
Clark Fork-Pend Oreille River Basin

Name	Stream	Drainage Area (sq mi)	Owner	Storage Capacity usable (ac-ft)	Storage Capacity total (ac-ft)	Use 1/
Sullivan Lake	Harvey Creek	51.8	POC PUD No. 1 3/		15,400	P
Priest Lake	Priest River	572	State of Idaho	82,000		N,R
Pend Oreille Lake 4/	Pend Oreille River	22,900	Corps of Engineers	1,155,100	1,561,300	C,F,N,P,R
Cabinet Gorge	Clark Fork River	21,840	Wash. Wtr. Power	43,500		P
Noxon Rapids	Clark Fork River	21,833	Wash. Wtr. Power	334,600	495,600	P,R
Thompson Falls	Clark Fork River	20,968	Mont. Power Company	14,970		P,R
Lower Crow	Crow Creek		Bur. of Ind. Affairs	10,350	10,350	I,R
Hubbart	Lt. Bitterroot River	114	Bur. of Ind. Affairs	12,100	12,100	I
Lt. Bitterroot Lake	Lt. Bitterroot River	31.8	Bur. of Ind. Affairs	26,400	26,400	I,R
Flathead Lake	Flathead River	7,086	Mont. Power Company	1,219,000		F,I,P,R
Ashley Lake	Judith River 2/		Ash. Irr. District	20,000		I
Hungry Horse	S. Fk. Flathead	1,654	Bur. of Reclamation	2,982,000	3,468,000	F,I,P
Lake Como	Rock Creek	54.6	Bitt. Irr. District	34,890	34,890	I,R
Georgetown Lake	Flint Creek	50.1	Mont. Power Company	31,040		P,R,W

1/ *P-power; N-navigation; R-recreation; C-conservation; F-flood control; I-irrigation; W-industrial.*
2/ *Diversion from Judith River.*
3/ *POC - Pend Oreille County.*
4/ *Albeni Falls Dam.*

The most serious flood control problems in the Pend Oreille basin occur along the Pend Oreille River between Albeni Falls and Metaline Falls. Presently developed upstream storage and local levees limit severe flood damage.

Hungry Horse Reservoir, with complete control of the South Fork Flathead River, has lessened the probability of flooding in this area except during the larger floods. Other lands subject to agricultural damage occur in scattered areas along major tributaries. Damage to urban developments occur principally in the area of Missoula.

The Albeni Falls Dam and Pend Oreille Lake is a multi-purpose project on the Pend Oreille River between Priest River, Idaho, and Newport, Washington. Major functions of the project are power generation at site and regulation of streamflow for downstream hydroelectric projects, while flood control, conservation, and recreation are other important functions.

In addition to its hydroelectric power operations, the Montana Power Company operates Flathead Lake for flood control through its Kerr project, Project No. 5. This operation is discussed in chapter 5 of this report.

Navigation

There is currently no commercial navigation in the Clark Fork-Pend Oreille River basin, and variations in flow have little effect on navigation in the Columbia River. During the low-water season, storage releases from the Albeni Falls Reservoir aid navigation on the lower Columbia River by maintaining higher river stage conditions.

Hydroelectric Power

The advantage of water stored in the form of abundant snow and glaciers in the higher elevations and the presence of several natural lakes have led to the development of 13 hydroelectric generating plants in the United States' portion of the basin and 1 hydroelectric plant in the Canadian portion. These plants also provide storage for flood control and additional energy generation at downstream plants on the Columbia River. Development of the hydro sites progressed concurrently with the development of the area, and the plants provided power for early mining, electric railroads, municipal and rural uses, and more recently for power export to other areas.

The 6 owners/operators of the 13 existing American hydroelectric plants and the total capacity of each are as follows:

Owner	Number of Plants	Installed Capacity (MW)
The City of Seattle	1	551
The Montana Power Company	4	202
The Washington Water Power Company	2	597
United States Government	3	328
Pend Oreille County PUD #1	2	61
Pacific Power & Light Company	1	4
Totals	13	1,743

Data on the individual plants, including year installed, are shown in table 9.

Nine of the plants are licensed by the Federal Energy Regulatory Commission. The Thompson Falls development's license expired September 30, 1975. On December 28, 1979, a new major license was issued to the Montana Power Company, authorizing continued operation of the 30,000-kilowatt Thompson Falls project, Project No. 1869. The Kerr project's license expired May 22, 1980. Both projects are licensed to the Montana Power Company, and their detailed descriptions are given in chapter 5 of this report.

Brief descriptions of the other hydroelectric projects in the basin are given in the following paragraphs. The powerplant in the Canadian portion of the basin is also described.

Boundary Project

This 551-megawatt hydroelectric project was completed in 1967 by Seattle City Light. It is located in the State of Washington on the Pend Oreille River

Table 9

Existing Hydroelectric Powerplants
Clark Fork-Pend Oreille River Basin in USA

Plant Name	Stream	Owner and/or Operator	Drainage Area (sq mi)	Gross Head (ft)	Installed Capacity (kW)	Average Annual Generation (GWH)	Year Installed	FERC Project No.	License Expiration Date
Boundary	Pend Oreille River	Seattle City Light	25,200	261	551,000	3,997	1967	2144	9-30-2011
Box Canyon	Pend Oreille River	Pend Oreille PUD No. 1	24,940	42	60,000	508.5	1955	2042	1-31-2002
Sullivan Creek	Sullivan Creek	Pend Oreille PUD No. 1	NA	605	2/	2/	1931,1923	2225	9-30-2008
Calispell	Calispell Creek	Pend Oreille PUD No. 1	57	309	560	2.3	1920	--	--
Albeni Falls	Pend Oreille River	Corps of Engineers	24,200	29	42,600	210	1955	-- 1/	--
Cabinet Gorge	Clark Fork River	Washington Water Power Company	22,000	97	200,000	1,088.5	1952	2058	2-28-2001
Noxon Rapids	Clark Fork River	Washington Water Power Company	21,833	152	396,880	1,880	1959	2075	4-30-2005
Thompson Falls	Clark Fork River	Montana Power Company	20,940	60	30,000	310	1915	1869	12-31-2015
Kerr	Flathead River	Montana Power Company	7,000	187	168,000	1,060	1938	5	5-22-1980
Big Creek	Big Creek	Bureau of Indian Affairs		585	360	2	1916	-- 1/	--
Big Fork	Swan River	Pacific Power & Light Company	730	105	4,150	31	1910	2652	4-30-1990
Hungry Horse	S.F. Flathead River	Bureau of Reclamation	1,640	477	285,000	820	1952	-- 1/	
Milltown	Clark Fork River	Montana Power Company	6,040	29	3,040	20	1906	2543	12-31-1993
Flint Creek	Flint Creek River	Montana Power Company	52	717	1,100	8	1901	1473	6-30-1988
			Total Existing Project		1,742,690	9,941.3			

1/ Federally owned plant.
2/ Project now provides storage only.
3/ New license issued December 28, 1979. Original license expired December 31, 1975.

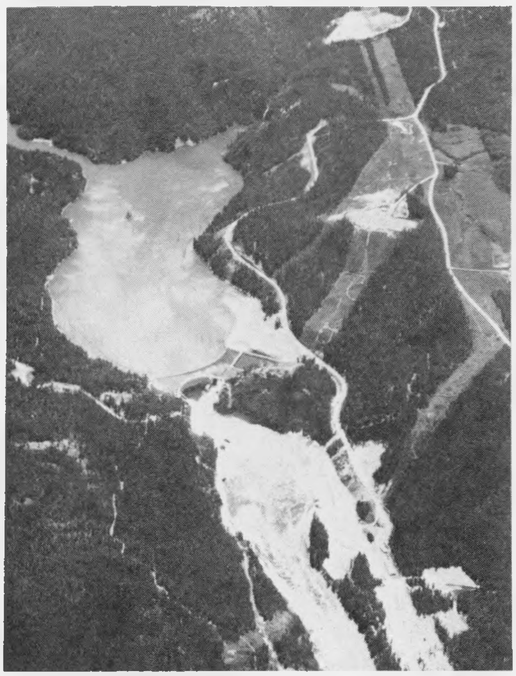


Figure 7. The Boundary Project has an underground powerhouse.

within a mile of the Canadian border. It was licensed by the Federal Power Commission as project No. 2144 effective March 10, 1961, for a period of 50 years. Project works consist of a concrete arch dam 385 feet high, backing water upstream 17.4 miles through Metaline Falls to the Box Canyon project; an underground powerplant containing four, 138-megawatt units; and 3,000 feet of 4-circuit, 230-kilovolt transmission line connecting directly to the BPA-Boundary substation (see figure 7). The Metaline Falls project, Project No. 1393, owned by Pend Oreille Mines & Minerals, was retired May 14, 1967, because it was inundated by the Boundary project.

Sullivan Creek

Sullivan Creek and Mill Pond downstream are parts of an abandoned power development on Sullivan Creek near Metaline Falls, Washington. Both reservoirs are included in Project No. 2225, under license issued November 25, 1958, to Public Utility District (PUD) No. 1 of Pend Oreille County. The license terminates September 30, 2008. Sullivan Creek is a concrete gravity dam, 210 feet long by 30 feet high. It provides 15,400 acre-feet of usable storage capacity in a natural lake and increases the lake's area to 1,293 acres. Sullivan Creek stores spring runoff which is released after September 20 each year to provide for additional power generation in downstream powerplants. This project was originally operated under a U.S. Forest Service permit. Only the two 1920's era dams and their reservoirs are licensed. The powerplant, conduit, penstock, and a diversion dam are not included in the license, their use having been discontinued prior to licensing. The reservoirs are used solely for impounding and releasing water for maximum utilization at Boundary on the Pend Oreille and downstream Columbia River plants. The licensee receives remuneration for the storage benefits the project provides. The redevelopment of Sullivan Creek for power purposes has been under study for some time, but a feasible plan has not yet been formulated.

Box Canyon Project

This 60-megawatt low-head hydroelectric project was completed in 1955 by PUD No. 1 of Pend Oreille County. It was licensed by the Federal Power Commission effective February 11, 1952, for a period of 50 years as Project No. 2042. It is located on the Pend Oreille River 17.4 miles upstream of the Boundary project and 55.5 miles downstream of Albeni Falls Dam. The project consists of a concrete gravity dam, 260 feet long and 104 feet high, with 4 spillway gates, 40 feet wide and 62 feet deep; a forebay channel to the left of the dam 700 feet long; a semi-outdoor-type powerhouse containing four, 15-megawatt generating units operating under a head of 46 feet or less, depending on flow conditions. When the streamflow increases to 80,000 cubic feet per second, the available head decreases to about 13 feet due to tailwater rise, and the plant ceases production. The project reservoir extends upstream from the dam about 55 miles.

Calispell Powerplant

The Calispell powerplant, constructed in 1920, is located on Calispell Creek, a tributary to the Pend Oreille River near Usk, Washington. It is a 2-unit powerplant with a total capacity of 560 kilowatts. It is owned and operated by PUD No. 1 of Pend Oreille County.

Albeni Falls Project

The construction of Albeni Falls Dam, on the Pend Oreille River in northern Idaho, was authorized for construction by Congress in May 1950. The U.S. Army Corps of Engineers constructed the project during the period 1951 to 1955. It is 25 miles downstream from the outlet of Pend Oreille Lake, one of the West's largest natural lakes. The dam provides regulation of lake levels within the limits of its natural variations. The lake surface area at normal full pool is 147.8 square miles at elevation 2,062.5 feet. The dam provides 1,153,000 acre-feet of usable storage by lowering Pend Oreille Lake 12.8 feet below this elevation for firming up low flows on the Columbia River in addition to generating

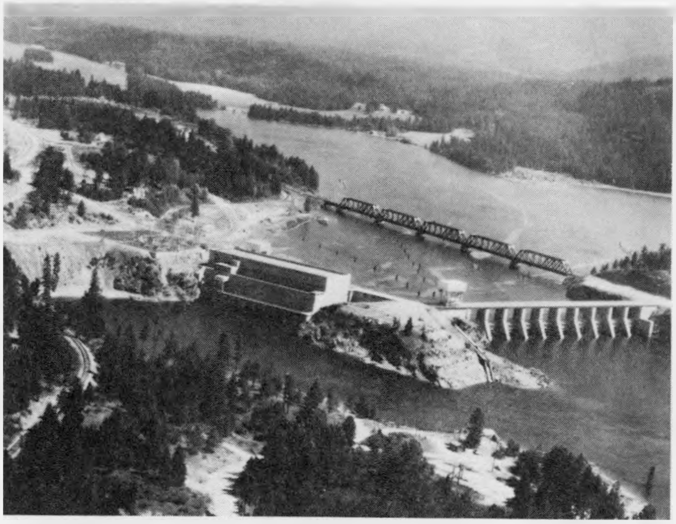


Figure 8. This aerial view of the Albeni Falls project shows the spillway dam at right, the powerhouse at center, and switchyard at left.

power at the site. The Albeni Falls Dam consists of two dams separated by an island as shown on figure 8. The gated spillway dam on one side of the island is a concrete gravity section 755 feet long and 90 feet high. The powerhouse section of the dam is 350 feet long and contains three, 14,200-kilowatt generating units. The units were placed in service in 1955.

The Albeni Falls powerplant, like the Box Canyon plant, 55.5 miles downstream, goes out of production during periods of high runoff.

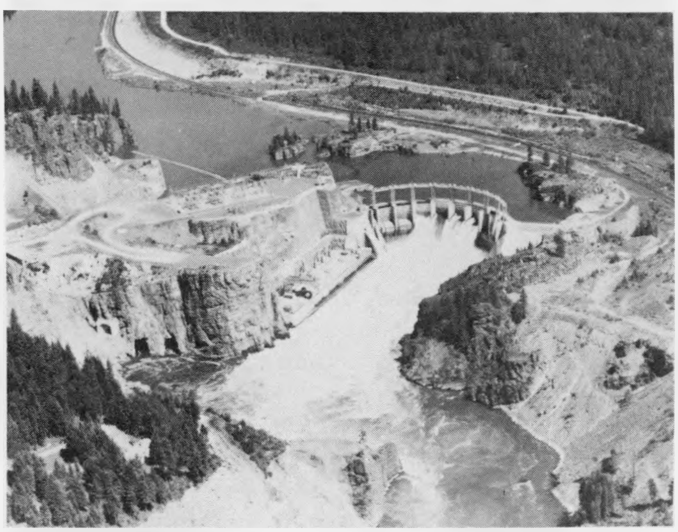


Figure 9. Cabinet Gorge project has an outdoor type powerplant.

Cabinet Gorge Project

This 200-megawatt hydroelectric project is located on the Clark Fork 10.9 miles upstream from Pend Oreille Lake. It was licensed by the Federal Power Commission as Project No. 2058 effective March 10, 1951, for a period of 50 years. It was completed in 1952 by The Washington Water Power Company. The reservoir, with a surface area of 3,200 acres, is narrow and extends about 20 miles upstream to the Noxon Rapids project. The concrete arch dam, with gravity abutment sections, is 375 feet long and 140 feet high. As shown on figure 9, the dam is surmounted by eight vertical lift spillway gates. The outdoor-type powerplant, about 300 feet downstream, contains 4 turbine-generator units, each of 50-megawatt capacity. The reservoir is maintained full, or nearly full, at all times.

Noxon Rapids Project

Figure 10. The Noxon Rapids project before fifth unit was installed.

This hydroelectric project is immediately upstream from Cabinet Gorge Reservoir. It is owned and operated by The Washington Water Power Company. This development, Project No. 2075, was licensed by the Federal Power Commission effective May 12, 1955, for a period of 50 years. It went into service in 1959. The dam is 4,910 feet long and 180 feet high and consists of 3 segments. The central segment is a concrete gravity section with a gated spillway and power intake, and the two abutting segments are earth embankments as shown on figure 10. An application was filed November 18, 1974, seeking approval for the installation of a fifth unit with a capacity of 114 megawatts. The application was approved October 10, 1975, by the Federal Power Commission and the fifth unit was installed in 1977. The powerplant now contains five turbine generator units with a total nameplate capacity of 397 megawatts.

Milltown Project

The Milltown project is located on the Clark Fork upstream from Missoula, Montana. It was originally constructed in 1906-1907 with four, 600-kilowatt generating units. A fifth unit of 640-kilowatt capacity was added in 1926 making a total present plant capacity of 3,040 kilowatts. This is a low-head development with the powerhouse forming a section of the dam (see figure 11). The spillway portion of the dam is a 216-foot long rockfill timber crib structure. A sluice section and a gravity wall section complete the dam which creates a small reservoir backing water up both the Clark Fork and the Blackfoot Rivers. The reservoir is heavily silted, and its reduced storage capacity is approximately 300 acre-feet. The project was licensed by the Federal Power

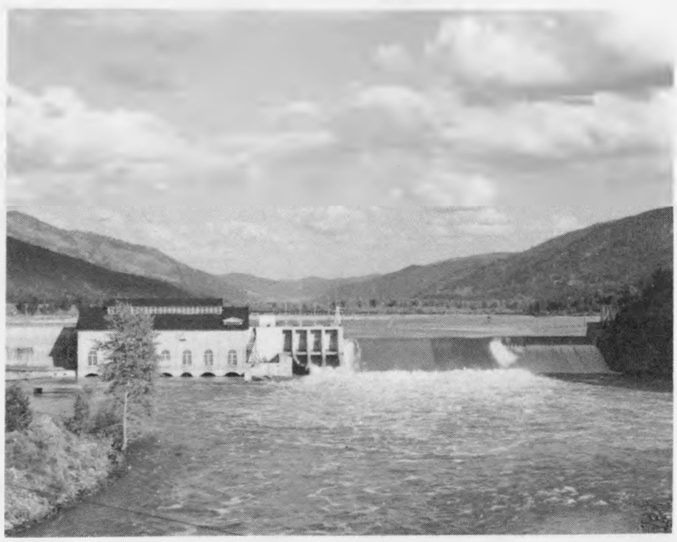


Figure 11. The Milltown powerhouse forms a portion of the dam.

Commission as Project No. 2543 effective May 1, 1965, for a period terminating December 31, 1993.

Big Fork

The Big Fork hydroelectric develop ment is located on the Swan River, in and adjacent to the town of Big Fork, Flathead County, Montana. The power project was originally constructed in the early 1900's but has been modified several times since that date. Two larger units installed in 1924 and 1929 have brought its generating capacity to 4,150 kilowatts. Pacific Power & Light Company, the present owner and generator of the plant, filed an application for license for this project, Project No. 2652, on July 13, 1967, and was issued a license September 24, 1976. The project's concrete dam, with an uncontrolled spillway, diverts water through a mile-long conduit to the forebay and power intake. The water then travels via steel penstocks to the three units housed in a brick powerhouse (see figure 12). The 2 larger units are vertical-shaft Francis turbines each rated at 2,400 horsepower under a hydraulic head of 105 feet.

Figure 12. Big Fork powerplant houses three units.

Hungry Horse Project

The Hungry Horse project, located on the South Fork of the Flathead River in northwestern Montana, was constructed by the Bureau of Reclamation (now, the Water and Power Resources Service) and put in service in 1952. Hungry Horse Dam is a concrete curved gravity structure 564 feet high with a crest length of 2,115 feet. The powerhouse, located directly downstream from the dam, contains 4 generating units of 71,250-kilowatt capacity each. The reservoir, about 34 miles long, has a capacity of 3,468,000 acre-feet of which 2,982,000 acre-feet are active storage capacity and a surface area of 23,800 acres (see figure 13). The Hungry Horse project plays an important role in Pacific Northwest power

Figure 13. Hungry Horse Dam, reservoir, and powerhouse.

generation and flood control operations. It contributes to irrigation and navigation, and the reservoir is a valuable recreation area.

The potential for enlarging Hungry Horse powerplant was given preliminary evaluation in the Bureau of Reclamation's 1977 Western Energy Expansion Study. Based on that analysis, the benefits from additional hydropower generating capacity at Hungry Horse would exceed costs, and beneficial environmental effects from a new reregulating pool or different stream operation could occur. Powerplant enlargements up to 200 megawatts are also being evaluated by the Water and Power Resources Service. The U.S. Forest Service provides and maintains recreational developments along the reservoir shoreline. Controlled release of storage at Hungry Horse increases power production at 19 downstream powerplants in the Columbia River system, 8 of which are located in the Clark Fork-Pend Oreille River basin.

Flint Creek

Flint Creek, Project No. 1473, is a high-head plant of 1,100-kilowatt capacity using Georgetown Lake as its forebay. It is located on Flint Creek 38.8 miles upstream from the confluence of Flint Creek, a tributary of the Clark Fork. The project was originally constructed by the Anaconda Copper Mining Company, which still uses a portion of the Georgetown Lake water for mining and municipal purposes in Anaconda, Montana. Georgetown Lake is a shallow lake having a surface area of over 2,000 acres. It is formed by a masonry dam which has been raised and reinforced with earthfill. A penstock, consisting of 1.2 miles of 52-inch wood-stave conduit, a 60-foot high surge tank, and a quarter-mile of steel pipeline supply the two 1,500 horsepower units (housed in the powerhouse shown on figure 14). The project was acquired by The Montana Power Company to which it was licensed effective July 1, 1938, for a period of 50 years.

Figure 14. Flint Creek powerhouse is the building to the left.

Waneta

The single Canadian hydroelectric power project in the basin, Waneta, is located on the Pend Oreille River at its confluence with the Columbia River. It is operated for the Consolidated Mining and Smelting Company, Limited, now referred to as Cominco Ltd., by the West Kootenay Power and Light Company, Limited. The availability of Waneta's hydroelectric power output is a key factor in the growth of Cominco's mining, metallurgical, and chemical fertilizer operations in the Kootenay district of British Columbia. The dam is a concrete structure 250 feet in height and with a crest length of 950 feet. There are four, 90,000-kilowatt units in the powerplant with a design head of 210 feet. It is possible that in the future when peaking capacity is of greater value, the head developed by the existing dam could be used to provide an additional 150,000 kilowatts of capacity. The project works were constructed during the period 1951-1966.

Cominco entered into a long-term equi-change agreement in 1964 under which the Waneta plant was inter-tied with the Bonneville Power Administration system. Under the agreement Cominco may borrow energy from the United States to supplement its own power output during low water periods, then return the borrowed energy within a year.

The Waneta project created a reservoir extending 800 feet from the International Boundary up Cedar Creek, a tributary of Pend Oreille River, in the State of Washington, as a part of the main reservoir behind Waneta Dam. A minor-part license authorizing the flooding of a little over 2 acres of Federal land in Cedar Creek Valley at the International Boundary was issued by the Federal Power Commission as Project No. 2103 on August 1, 1952, for a period of 50 years to Montana Phosphate Products Company, a subsidiary of Cominco Ltd.

Recreation

Hydroelectric power developments within the basin provide additional recreation opportunities. The most popular development is Hungry Horse, which had over 240,000 visitors in 1973. Thompson Falls, Noxon Rapids, Cabinet Gorge, Box Canyon, and Boundary Dams all form reservoirs and provide recreation opportunities on the Clark Fork and Pend Oreille Rivers.

Flathead Lake, the largest natural body of freshwater in the western conterminous United States, offers a variety of recreation activities and facilities. There are eight State recreation areas and many private developments on the lake. More than half a million tourists visit the lake annually.

Lake Pend Oreille is situated on the Clark Fork in Idaho. The lake is popular for fishing, boating, camping, and picnicking. Farragut State Park is situated at the southern end of the lake. Other recreation facilities are provided by local government agencies and private developers.

The Corps of Engineers has constructed six recreation areas to meet rapidly increasing recreational demand along Lake Pend Oreille. A swimming beach, boat launching ramp, and picnic and camping facilities at Springy Point, 3.5 miles downstream from Sandpoint, were made available to the public in the summer of 1962. Additional camping facilities were constructed in 1968. Further day-use improvements are programmed for this area. Complete facilities for picnicking, camping, boating, and swimming were constructed in 1959 at Albeni Cove, 2 miles east of Newport, Washington, and near the south end of Albeni Falls Dam. The following summer similar recreation facilities were made available at Priest River Park at the mouth of Priest River on the eastern edge of the town of Priest River, Idaho.

Fish and Wildlife

Big game species in the basin include elk, moose, mountain lion, whitetail and mule deer, bighorn and white sheep, black and grizzly bear, and mountain goat.

Native game birds in the basin include three species of forest grouse: blue, ruffed, and spruce. The Montana Department of Fish and Game has introduced pheasant, Hungarian partridge, chuckers, and turkey.

There are four national wildlife refuges for migratory waterfowl in the basin. The Pablo and Ninepipe refuges are located south of the Flathead Lake within the Flathead Indian Reservation. In 1974, over 1,000,000 waterfowl visited those 2 refuges. The Ravalli National Wildlife Refuge is south of Missoula, and the Swan River National Wildlife Refuge is located east of Flathead Lake.

The National Bison Range is located 50 miles south of Flathead Lake west of the town of St. Ignatius. The 19,000-acre wildlife refuge was established in 1908 to protect the few remaining American bison or buffalo. Small display herds of bison, elk, whitetail and mule deer, bighorn sheep, and a few long-horned cattle can be seen in these exhibition pastures.

Native fish in the basin include Yellowstone and west slope cutthroat trout, Dolly Varden, lake trout, Kamloops rainbow trout, and whitefish. Brown, brook, and rainbow trout have been introduced. Kokanee salmon exist in Flathead Lake and Lake Pend Oreille. A small number of bass and northern pike have been introduced into the basin.

Steam-Electric Power

Presently, there are no utility-owned fossil-fueled or nuclear steam-electric plants operating in the basin, and no known plants are planned for the foreseeable future.

CHAPTER V

THOMPSON FALLS AND KERR PROJECTS

The license for Kerr, Project No. 5, owned and operated by The Montana Power Company, expired May 22, 1980, but is currently operated under an annual license issued pursuant to section 15(a) of the Federal Power Act, 16 U.S.C. §808(2). On December 28, 1979, a new major license was issued authorizing continued operation of The Montana Power Company's 30,000-kilowatt Thompson Falls project.

Thompson Falls, Project No. 1869

History

Thompson Falls Dam was the first dam built on the Clark Fork downstream from Missoula, Montana (figure 15). The falls made it a naturally favorable site for the development of power. However, the size of the investment required and the uncertainty of finding a market for the power delayed the development many years.

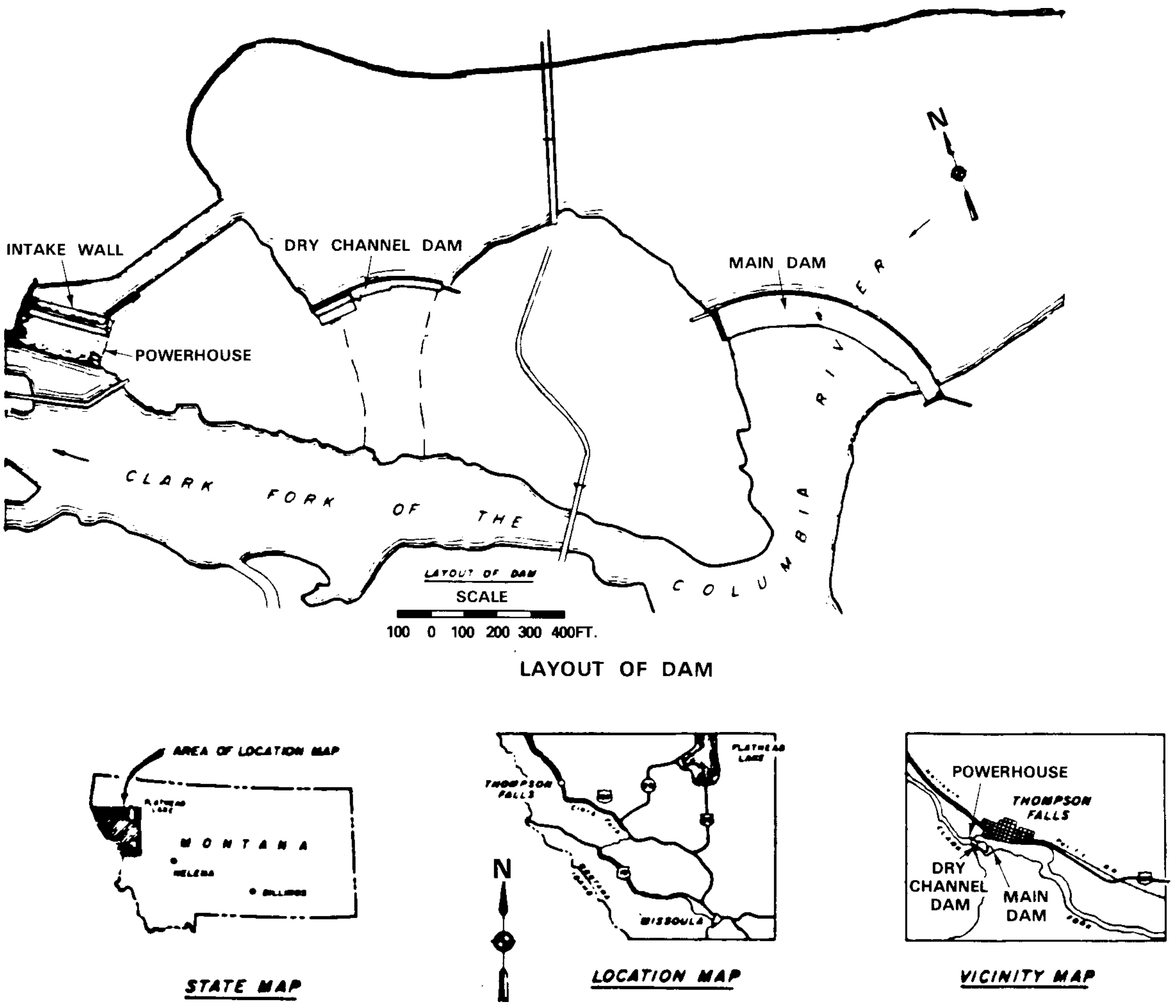
Edward Donlan of Missoula, Montana, and other individuals commenced to appropriate water rights and acquire lands necessary for development of the project as early as 1905. Those individuals formed a corporation on Septemter 26, 1907, known as the Northwestern Development Company. They conveyed to this corporation the lands, rights, and interests which they had acquired for the proposed project. Then the Thompson Falls Power Company, a corporation organized under the laws of Montana, acquired by deed, dated February 12, 1913, all of the water rights, lands, and properties of the Northwestern Development Company.

The Thompson Falls Power Company on February 11, 1913, concluded negotiations with the Chicago, Milwaukee & St. Paul Railway Company and contracted to furnish power for the electrical operation of the railroad between Deer Lodge, Montana, and Avery, Idaho, for a period of 99 years. The Thompson Falls Power Company also contracted with the Federal Mining and Smelting Company and other interests to furnish electric power for mining operations in the Coeur d'Alene Mining District of Northern Idaho. These contracts assured the necessary market for the power from the proposed development.

The Thompson Falls Power Company then undertook the construction of the Thompson Falls project commencing in early May 1913. The first 6,250 kilovolt-ampere generating unit was in service July 1, 1915, and the next three units were operating by July 21, 1915. The last two units of the six-unit plant were completed by May 1917.

The Thompson Falls Power Company continued to own and operate the Thompson Falls project until March 29, 1929, at which time the property was acquired by The Montana Power Company, the present owner and operator of the project.

No major changes have been made to the project, and there has been no change in its mode of operation. Generation has increased, however, as a result of more storage and streamflow regulation provided by the construction and operation of dams upstream (Kerr in 1938 and Hungry Horse in 1951).



THOMPSON FALLS DEVELOPMENT
PROJECT NO. 1869
GENERAL PLAN
1980

The project affects the Clark Fork River, a navigable water of the United States, and also the lands of the United States in Lolo National Forest. There is, however, currently no commercial navigational traffic on the river.

Project Description

The Thompson Falls hydroelectric project has an installed capacity of 30,000 kilowatts and principally consists of: (1) a main dam, a concrete gravity structure about 1,016 feet long and 54 feet maximum height (see figure 16); (2) a smaller dam, of the same type, about 449 feet long and 45 feet high located to the right of the main dam in the so-called Dry Channel; (3) a reservoir extending 12 miles upstream and having a usable storage capacity of 15,000 acre-feet; (4) a power canal about 450 feet and 80 feet wide cut through rock; (5) 6 main steel penstocks, 14 feet in diameter and about 40 feet long, and 2 smaller steel penstocks, 6.67 feet in diameter, for the 2 water-powered exciters; and (6) a steel-framed and masonry powerhouse containing 6 generating units, each rated at 5,000 kilowatts.

Figure 16. The main dam for Thompson Falls project.

Pertinent Data for the Thompson Falls project are shown in table 10.

Main Dam

The main dam forms the closure across the main channel of the Clark Fork. It is a concrete gravity structure, curved in plan. The greater part of the dam is an overflow spillway, with an overall length of 913 feet and an average height of 18 feet above the riverbed rock on which it is founded. It is divided into 38 bays by concrete piers or permanent steel frames which support flashboards. Most of these bays are identical and are formed by permanent steel frames on 24-foot centers. Five vertical removable steel beams on 4-foot centers provide supports for flashboards stacked 16 feet high above the spillway crest elevation 2,380 to normal operating level of 2,396. Two of the 38 bays are combined for a single 48-foot trash passing sluiceway. Of the 37 piers, 14 are of concrete, and the remaining 23 are structural steel frame. The flashboards are removed as required to pass spring runoff and are replaced after excessive flows have passed. A track mounted crane and truck are used to handle and transport flashboards. Flashboards are removed for runoff and replaced not more than once a year.

Table 10

Pertinent Data
Thompson Falls Project
Project No. 1869

General	
River	Clark Fork
Drainage area, sq mi	20,940
Average river flow, cfs	20,010
Primary purpose	power
Year of initial operation	1915
Dam	
Type	Concrete Gravity
Height (maximum), ft	54
Length of spillway section, ft	913
Total length, feet main dam	1,016
Reservoir	
Full pool water surface elevation, ft msl.	2,396
Storage capacity for hydroelectric power, ac-ft	15,000
Powerplant	
Number of units	6
Installed capacity, kW	30,000
Design head, ft	60.0
Hydraulic capacity, cfs	11,120
Average annual generation, kWh	310,000,000
Potential additional installed capacity	35,000

Dry Channel Dam

This dam closes off a natural flood by-pass channel located some 900 feet to the right of the main dam and completes the closure of the Clark Fork at the Falls. This dam is also a concrete gravity structure curved in plan and consisting of two distinct portions. The right side portion is a nonoverflow wall, 122 feet long and 38 feet high, containing 10 sluiceways controlled by slide gates. These gates have not been in regular use since 1945. Three sluiceways have been closed by timber bulkheads to reduce leakage through the slide gates. The left side portion of the dam is an overflow spillway with an ogee crest. It is 289 feet long and has an average height of 17 feet above the streambed. The spillway crest elevation is at elevation 2,384, or four feet higher than the crest of the main dam. Spillway discharges are controlled by 12 bays of flash-boards like those of the main dam except stacked 12 feet instead of 16 feet high.

Power Facilities

The steel-framed masonry powerplant (figure 17), housing six generating units with a rated capacity of 5,000 kilowatts each, is located along the right bank of the river about 1,000 feet downstream of the Dry Channel. A forebay channel cut in rock from the reservoir to the power intake is 450 feet long and 80 feet wide (figure 18). The intake wall, which lies at the end of this channel, is a concrete gravity structure 258 feet long and 40 feet high, with a wing wall angled off at each end. There are six 14-foot diameter main unit steel penstocks and two 6.67-foot diameter exciter-turbine penstocks leading from the forebay to the powerhouse, a distance of 40 feet.

Figure 17. Thompson Falls powerhouse.

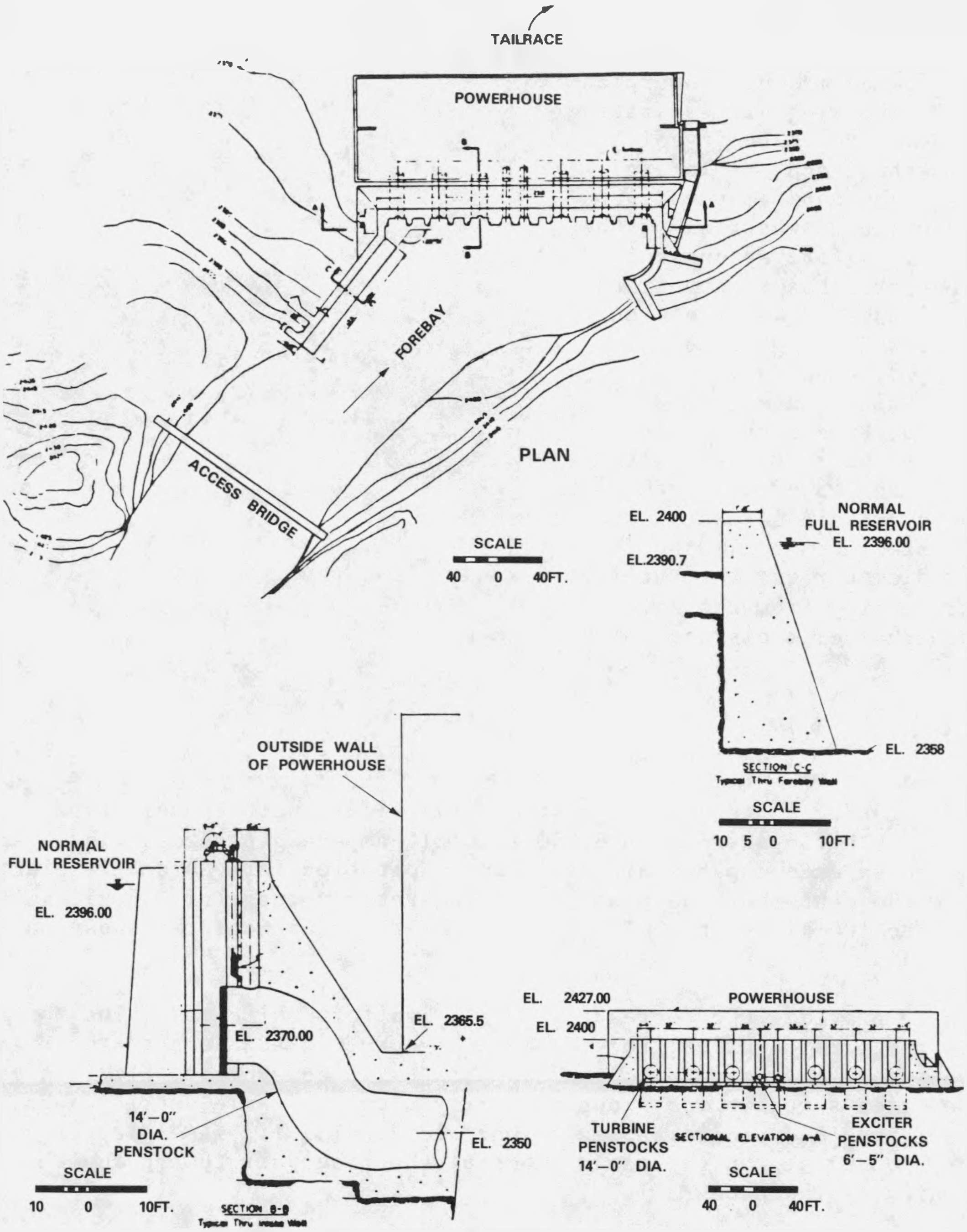
The six generating units each consist of a vertical shaft Francis-type turbine rated at 9,350 horsepower and a 6,250 kilovolt-ampere generator. Three water wheel exciters, each capable of furnishing excitation for the entire plant, are located in the center of the plant. The generator voltage of 6.6 kilovolts is stepped up to 100 kilovolts. The interior of the powerhouse is shown on figure 19.

The licensee provides two recreation facilities for public use. The Montana Power Company park, a block from the main highway, is adjacent to the right shore of the reservoir on the road to the Thompson Falls powerhouse. It is a grassed and shaded area suitable for group or family picnics. An electric range, hot and cold water, and five picnic tables are provided. The licensee also provides and maintains a boat ramp on the north shore of the reservoir toward the east end of the community of Thompson Falls.

Project Operation

The plant is an integral part of The Montana Power Company system and is used to carry base loads. It is considered a run-of-river plant, and the generation at any time depends upon the natural flow available. The 15,000 acre-feet of storage capacity at the site would not normally be utilized since the resultant large draw down of the reservoir would decrease the effective head available and, therefore, reduce the capacity of the plant.

At present, reservoir level and spill are controlled by adding and removing flash-boards at the main and dry channel dams. These boards cannot be removed under



THOMPSON FALLS DEVELOPMENT
PROJECT NO. 1869
FOREBAY AND INTAKE
PLAN ELEVATION
1980

FERC—Water Resources Appraisal For Hydroelectric Licensing — Figure 18

Figure 19. Thompson Falls powerhouse has six units.

more than 4 feet of water. Therefore, each spring before the flood season, it is necessary to remove all of the boards down to crest on the main dam. These boards cannot be replaced until the river returns to its normal summer flow. Therefore, up to 13 feet of head is lost at this project for two to three months.

Furthermore, the river flow at Thompson Falls is highly variable. Without gates at Thompson Falls, it is usually necessary to operate the reservoir from 1 to 2 feet below full pool elevation to allow for this variable flow. This condition results in some loss of head for most of the other 9 to 10 months of the year.

The applicant, The Montana Power Company, has proposed to modify the project works by installing two 40-foot by 18-foot, remotely operated, tainter gates in the space presently occupied by bay Nos. 16, 17, 18, and 19 on the main dam. The applicant also has proposed to replace the top eight feet of the existing flashboard systems, on both dams, with timber drop panels and convert the existing flashboards stanchions to a trippable type. The proposed modifications would allow the applicant to hold the reservoir at its normal full level during a greater portion of the year than is presently possible with the existing flashboard arrangement, and as a result, it will increase power production by an estimated 32 million kilowatt-hours.

Production expenses for Project No. 1869, as reported by the Company in their FERC Form 1 Annual Report, totaled $216,000 or 0.73 mills per kilowatt-hour for the year 1978. The depreciated original cost, as of the time of license expiration, was estimated to be $2,405,413. An economic analysis based on this cost, an interest rate of 10.5 percent (private financing), production expenses, and power benefits (dependable capacity and average annual energy generation) indicates continued operation of the project appears to be economical.

Safety

Overflow sections of the main dam and the Dry Channel Dam were strengthened in 1967 by tying the structure into bedrock with post-tensioned anchors. Stress analysis showed that the anchors stabilized the structures sufficiently so that no significant tension develops under maximum loads. Stability studies performed by staff show that the stresses under normal hydrostatic plus earthquake loadings and maximum hydrostatic loading are within acceptable limits and the dams are safe against sliding and overturning.

The Federal Energy Regulatory Commission's San Francisco Regional Office staff inspected the project on June 21, 1979, and found the project works to be well maintained and in good operating condition.

The applicant's engineering consultant report, dated February 1977, did not disclose any deficiencies or hazardous conditions and concluded that no factors were found that would reduce the safety of the dams or the related structures. The applicant has filed an emergency action plan which has been approved by FERC staff.

Spillway Adequacy

The main dam is principally a concrete overflow ogee spillway divided into 38 bays and surmounted by removable timber flashboards. The flashboards maintain the normal operating reservoir elevation and are removed in spring prior to flood flows. The Dry Channel Dam is a concrete gravity structure consisting of an overflow spillway and nonoverflow section. The spillway is divided into 12 bays and gated by timber flashboards. The spillway discharge capacity of the project is 459,600 cubic feet per second. The probable maximum flood is 450,000 cubic feet per second.

Licensing Action

Based on the Commission orders, issued November 1, 1961, (Project No. 1869) and November 29, 1976, (Project No. 5), none of the four transmission lines emanating from the Thompson Falls project are considered primary lines as defined in section 3 (11) of the Federal Power Act. The transmission lines therefore, are not subject to the Commission's jurisdiction.

On December 28, 1979, the Commission issued a major license to The Montana Power Company (MOPO) of Butte, Montana, under part I of the Federal Power Act, for a period effective December 1, 1979, and terminating December 31, 2015.

The original license for the project expired December 31, 1975. MOPO has requested that a new license be issued for a term of 50 years. MOPO's proposed modification of project works, involving the installation of taintor gates and the replacement of existing flashboards with drop panels, was a significant modification of the project. It did not, however, constitute the kind of extensive redevelopment of a project that would warrant the Commission's issuing a new license for a full 50-year period. In accordance with the Commission policy as stated in The Montana Power Company, Project No. 2301, "Order Issuing New License (Major)" (October 5, 1976), MOPO's proposed modification of project works constitute substantial new construction for which a 40-year license period was appropriate.

Kerr, Project No. 5

History

The Kerr project (Project No. 5) was licensed to the Rocky Mountain Power Company on May 23, 1930. Poor economic conditions of the early 1930's delayed construction. The dam was closed off in April 1938, and the first 56,000-kilowatt generating unit went into commercial service May 20, 1939, followed by a second unit of the same capacity in 1949.

The license for this project was amended and transferred from the Rocky Mountain Power Company to The Montana Power Company on August 8, 1938.

In 1945, the license was amended to include two sections of a transmission line extending from the licensee's Thompson Falls plant via Kerr to the licensee's substation at Anaconda, Montana.

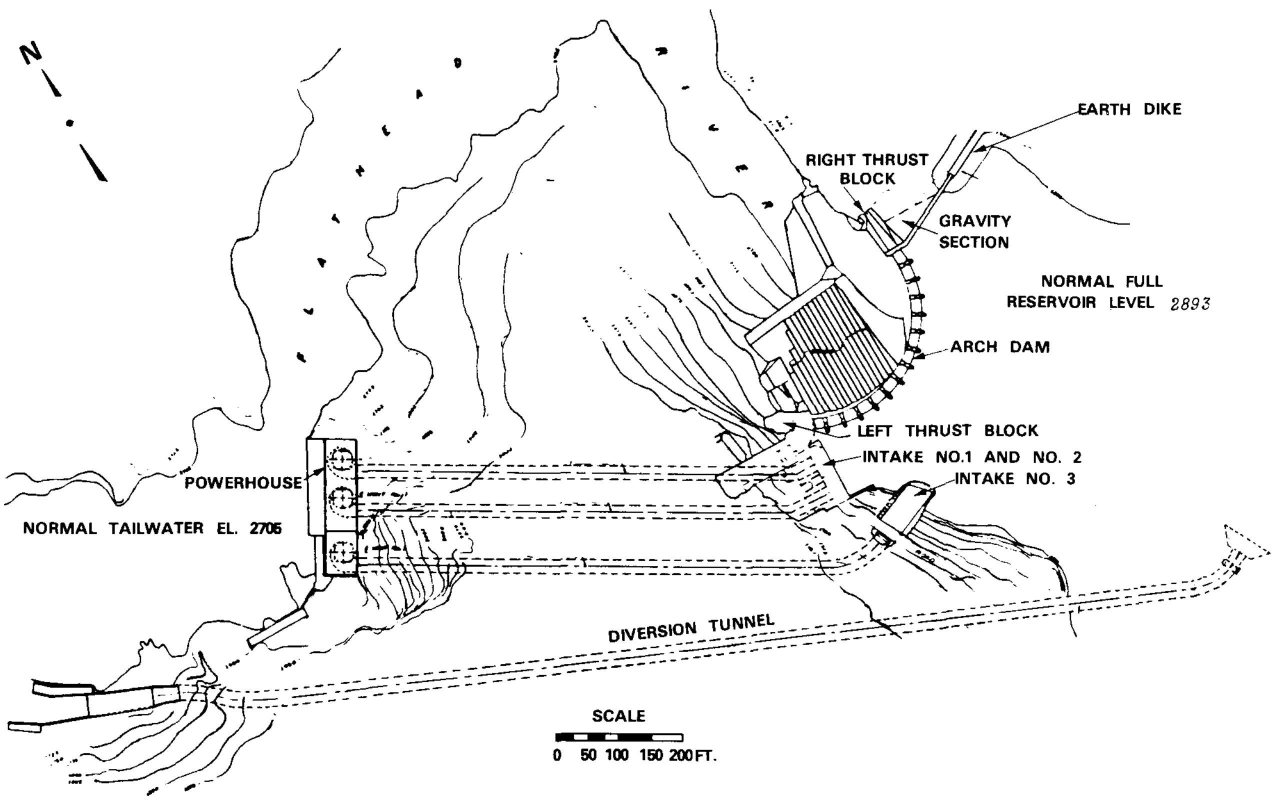
The third generating unit also of 56,000-kilowatt capacity went into service on December 5, 1954, increasing the total plant capacity to 168,000 kilowatts.

Project Description

The Kerr Project is located on Indian Tribal Lands held in trust for the Confederated Salish and Kootenai Tribes of the Flathead Reservation, State of Montana, pursuant to the Treaty of Hell Gate of July 16, 1855, 12 Stat. 975, and reserved for power purposes under the Act of March 3, 1909, 35 Stat. 781, 796, section 22.

Project No. 5, which has an installed capacity of 168,000 kilowatts and controls 1,217,000 acre-feet of water storage capacity, is located in the Flathead River basin on the Flathead River and Flathead Lake about 5 miles downstream from Polson in Flathead and Lake Counties, Montana. An aerial view of the development is given on figure 20, and figure 21 is the general plan of the project.

Figure 20. Kerr project with the dam on the left, the powerplant in the lower centers, and the operator's colony on the right.



KERR HYDROELECTRIC DEVELOPMENT
PROJECT NO. 5
GENERAL PLAN
1980

FERC—Water Resources Appraisal For Hydroelectric Licensing **Figure** 21

Pertinent data for the Kerr project is shown in table 11.

Table 11

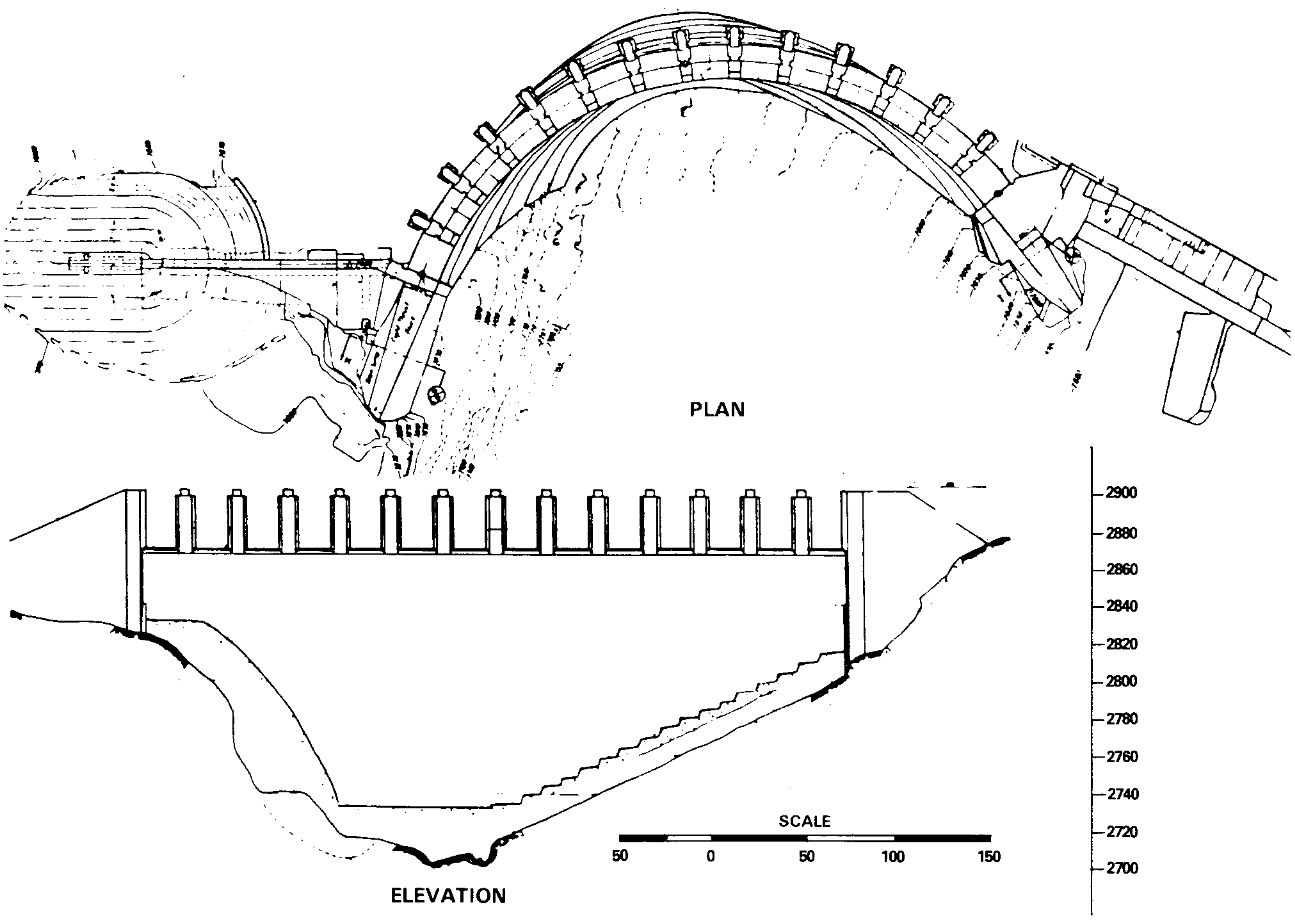
Pertinent Data
Kerr Project
Project No. 5

General	
River	Flathead
Drainage area, sq mi	7,000
Average river flow, cfs	11,730
Primary purpose	Power
Year of initial operation	1938
Dam	
Type	concrete arch
Height (maximum), ft	200
Length of spillway section, ft	179
Total length, ft	381
Reservoir	
Full pool water surface elevation, ft msl	2,893
Maximum drawdown, ft	10
Total storage capacity, ac-ft 1/	1,217,000
Storage capacity for hydroelectric power, ac-ft	1,217,000
Area at normal pool, ac 1/	126,000
Powerplant	
Number of units	3
Installed capacity, kW	168,000
Design head, ft	187
Hydraulic capacity, cfs	14,346
Average annual generation, kWh	1,173,840,000
Overload capability, kW	179,928
Plant factor (average)	.75
Potential additional installed capacity, kW 2/	64,000
Ultimate installed capacity, kW	232,000

1/ *Kerr controls the releases of the Flathead Lake, a large natural body of water with 126,000 acres of surface area and an active storage of up to 1,219,000 acre-feet (with a total capacity of 1,826,000 acre-feet at elevation 2,893).*

2/ *Potential installed capacity ranges from 60 to 80 megawatts.*

Kerr Dam is a variable radius concrete arch, 381 feet long and 200 feet high, with a radius of 179 feet at the top (see figure 22). Fourteen gated spillway bays,



KERR DAM
PROJECT NO. 5
DAM PLAN & ELEVATION

each 21 feet wide, are in the top of the dam and can spill 170,000 cubic feet per second without overtopping the structure. Outflow is over the top of the wheeled gates, which are lowered by individual hoists to control the discharge (see figure 23).

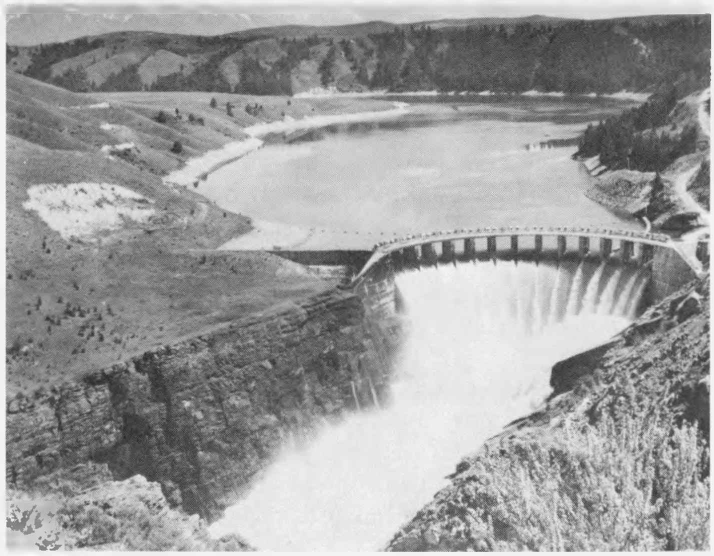


Figure 23. Kerr Dam and reservoir.

The dam is located in a box canyon four miles below Flathead Lake on the Flathead River. Flathead Lake is a large natural body of water some 126,000 acres in area when full. Kerr Dam controls the lake between elevations 2,883 and 2,893 feet, all within the natural fluctuations of lake levels existing before the dam was built. In fact, the lake is said to have reached elevation 2,900 feet in June 1894, and the U.S. Geological Survey estimates the maximum discharge at that time was 110,000 cubic feet per second, less than spillway capacity of 170,000 cubic feet per second.

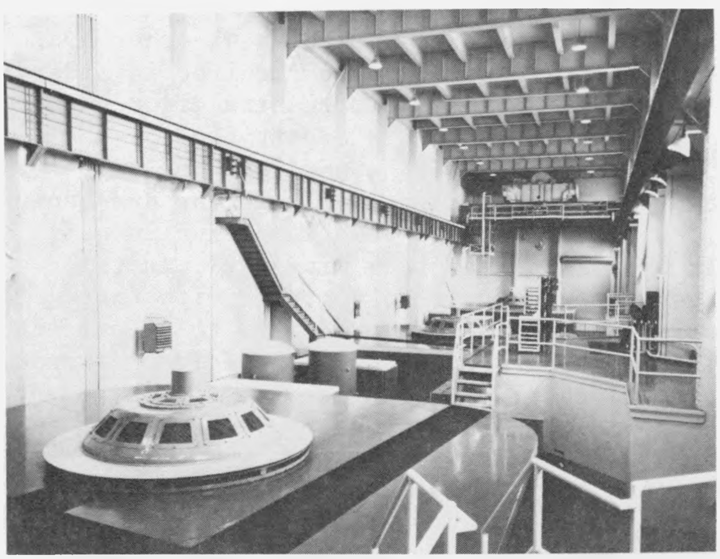


Figure 24. The Kerr powerplant houses three 56,000-kilowatt generating units.

Lake elevations under high flows are not controlled by the dam but by the river channel between the lake and the dam. The natural flow and lake level regime were first changed when water storage began April 11, 1938. It was again altered when Hungry Horse Dam, upstream from the lake, was closed in September 1951.

Three penstock tunnels serve the three 56,000-kilowatt generating units located in a powerhouse about 800 feet downstream from the power intake structures. These tunnels are located to the left of the dam and take advantage of the river bending to the left at the dam site. The power conduits are concrete lined tunnels 23.3 feet in diameter with trashracks and individual intake gates for closure. The units operate under a gross head about 187 feet. They are vertical shaft Francis-type turbines with 2 rated at 77,000 horsepower and 1 rated at 78,500 horsepower, at at 189-foot head and each directly drives a 56,000-kilowatt generator (see figure 24). A 250-ton bridge crane is provided for handling units. Units, crane, and control room are all in a steel-framed reinforced concrete powerhouse. The main transformers are 18,666 kilovolt-ampere single phase, 13,200/115,000 and 13,800/115,000 volts. These are mounted outside of the powerhouse on a concrete deck directly over the draft tube outlets. Power is transmitted from the transformers downstream about 1,600 feet to the project switchyard.

The powerhouse service road is through and along the canyon wall between the operator's village and the plant and includes road tunnels and bridges.

Included in the project, as presently licensed, is a transmission circuit to Thompson Falls. Adjacent to the project switchyard, Bonneville Power Administration has a substation tied to the 115-kilovolt line to the Hungry Horse powerplant.

The operator's village with 11 permanent cottages is located adjacent to and upstream from the switchyard.

Recreation facilities provided by the licensee are located on project land. The facilities are limited to a visitor overlook area above the dam and powerhouse and visitor facilities and explanatory exhibits within the powerhouse.

Project Operation

The structures and equipment for the entire Kerr project are satisfactorily maintained and are in good condition. The Consultant's safety inspection was made in 1978 by Ebasco Services, Incorporated, and submitted June 12, 1979. The report was based on an investigation of the overall safety of the project, except for transmission lines and generating equipment. Recommendations were made only in regard to surveillance.

Operation of Kerr hydroelectric development is coordinated with that of other hydro resources of the Northwest Power Pool. Coordinated operation is required in order to produce the maximum power consistent with the demands of irrigation, flood control, and recreation. To accomplish these ends, Applicant is a party to the Pacific Northwest Coordination Agreement of September 1964. Coordination for power production is accomplished pursuant to the Coordination Agreement, giving due consideration to legitimate non-power uses. Draft on storage usually begins in mid-September and reaches maximum drawdown at the end of March or mid-April. In this period, use of storage releases from Hungry Horse Reservoir, together with those from Flathead Lake, makes generation possible at a plant factor of 75 to 80 percent. During the remaining months of the year, generation depends upon the volume of runoff available in excess of that required to refill reservoirs. In many years, the plant continues to operate at high plant factor through May and June.

In most years, spring runoff produces a volume of water which not only is sufficient to refill reservoirs, but also causes a continuous discharge over the dam spillway for a month or longer. This has proved to cause some erosion of apron concrete but is not a safety hazard if the apron is repaired before the underlying rock is exposed.

In 1962, the Montana Power Company, licensee for the Kerr project, executed a memorandum of understanding with the Corps of Engineers which set forth principles and procedures for the regulation of Flathead Lake in the interests of flood control. The agreement, as approved by the Federal Power Commission, provides in general that (1) the licensee and the Corps of Engineers will cooperate in exchanging data and coordinating operations for flood control; (2) conditions permitting, the lake will be drawn down to elevation 2,890 feet by May 30, and to elevation 2,893 feet, the maximum level under license, by June 15; (3) when the lake reaches elevation 2,885 feet, in a moderate or major flood year, the licensee will gradually open its spill-gates to maintain free flow and will not close the gates until after the danger of exceeding elevation 2,893 feet has passed.

The amended agreement has been endorsed by both the Flathead Lakers, Inc., an association of lakeside residents who are interested in having the lake level brought up to the maximum under license as soon in the recreation season as possible, and the Upper Flathead Valley Flood Control Association, an organization of farm owners at the upper end of the lake who are interested in having the lake level kept down to prevent inundation of their lands by late floods.

Production expenses for Project No. 5, as reported by the Company in their FERC Form 1 Annual Report, totaled $3,885,000 in 1978. This total includes $3,492,000 for rental use of Indian lands and $139,000 headwater benefit payment to the Federally-owned Hungry Horse Dam. The depreciated original cost, at the time of license expiration, is estimated to be $17,311,196. An economic analysis based on , an interest rate of 10.5 percent (private financing), production expenses, and power benefits (dependable capacity and average annual energy generation) indicates continued operation of the project appears to be economical.

Licensing Action

The Kerr project is currently operating under an existing license which expired May 22, 1980. In order to authorize the continued operation and maintenance of the project, pending Commission action on Licensee's application, an annual license to the Montana Power Company was issued.

The annual license to the Montana Power Company will be in effect for the period May 23, 1980, to May 22, 1981, or until Federal takeover, or until issuance of a new license for the project, whichever comes first, for the continued operation and maintenance of Project No. 5, subject to the terms and conditions of the original license. If Federal takeover, or issuance of a new license, does not take place on or before May 22, 1981, a new annual license will be in effect each year thereafter, effective May 23 of each year, until such time as Federal takeover takes place, or a new license is issued, without further notice being given by the Commission.

Competing License Application Project No. 2776

The Confederated Salish and Kootenai Tribes of the Flathead Indian Reservation, where the Kerr project is located, have filed a competing application for a major license for the Kerr Project. The tribe's application has been docketed as FERC Project No. 2776.

The Confederated Salish and Kootenai Tribes of the Flathead Reservation claim rights to all waters arising upon, flowing through, or bordering the Flathead Indian Reservation and are currently attempting to determine the extent of those waters and their use upon the reservation. However, there are significant legal questions concerning the full extent of the Indians' rights which remain to be answered. 1/

1/ *The Flathead River Basin, Level B Study of Water and Related Lands, September 1976, prepared by the State of Montana and the Pacific Northwest River Basin Commission.*

CHAPTER VI

NEEDS FOR FURTHER DEVELOPMENT OF WATER AND RELATED LAND RESOURCES

General

The basin has a wide range of opportunities to meet water and related land resource needs. The two major benefits to be derived from development of the basin would be power and flood control. While water is normally plentiful, there are many localized areas that experience seasonal shortages which make a supplemental water supply necessary. Nearly all watershort areas are located in the Montana portion of the basin.

Flood Control Requirements

The only significant flood control storage effective in the Clark Fork-Pend Oreille River basin is on the South Fork of the Flathead River at Hungry Horse Dam and Kerr Dam on the main stem of the Flathead. Most of the storage capacity is at Hungry Horse Dam with Kerr Dam permitting somewhat more efficient use of the natural storage in Flathead Lake. Flathead Lake and Lake Pend Oreille help in controlling flow of the lower Columbia River.

Along the main stem of the Clark Fork, three major problem areas are apparent. Although much of Missoula now is protected by levees, development in several areas not protected could proceed at a faster rate than projected. Pend Oreille Lake has a growing resort and summer home flood problem which is tied to control of the lake elevation. Although the construction of Albeni Falls Dam and the improvement of the outlet channel between the lake and the dam have made it possible to achieve a degree of control of the lake surface elevation, control is lost at about an 18-year frequency flood, and the growing development adjacent to the lake is creating a situation in which significant flood damages will occur. Downstream, there are large agricultural losses along the Pend Oreille River which will demand attention as farm production increases in value.

Several tributaries have expanding flood problems. The wide Flathead River valley has perhaps the greatest requirement for flood control in the region.

The city of Kalispell is building out onto the flood plain, and valley lands have a large agricultural potential if the river can be confined to its channel. Recreational development of the Swan Lake shoreline, not far from Kalispell, is expected to continue steadily. The increasing value of lake frontage will emphasize the need for control of the lake level. Flooding of agricultural land on Calispell Creek is related to flow in the Pend Oreille River and operation of Box Canyon Dam for power.

Measures to satisfy flood control needs include storage, channel and levee works, watershed improvements, and nonstructural measures such as improved land management practices and zoning. Flood plain zoning can be particularly important in this basin because alternative large-scale structural measures do not appear warranted in many of the problem areas.

The Flathead River has several sites where large storage projects could be developed, but the Middle Fork and main river (North Fork) above Columbia Falls has been included in the National Wild and Scenic Rivers System. Potential projects eliminated by this designation are Glacier View, Smokey Range, Spruce Park, and Coram.

There are three sites on the main stem of the Flathead River below Flathead Lake that are alternatives for developing that reach of the river. The Knowles site near the mouth would require extensive railroad and highway relocations and would inundate 47,000 acres of cultivated and grazing land. Also, the reservoir would inundate a portion of the National Bison Range. High Buffalo Rapids, 34 miles upstream, has few of the problems associated with the Knowles sites, and is generally preferable. The Sloan Bridge site, still farther upstream, would be a less efficient development, and the principal advantage would be lower development cost. It may, however, be precluded by private construction of Buffalo Rapids Nos. 2 and 4.

The Buffalo Rapids proposals are run-of-river dams and would not form large pools or inundate upstream lands. However, construction of these and High Buffalo, Sloan Bridge, or Knowles Dams, located on the Flathead Indian Reservation, would preclude construction of facilities upstream as far as Kerr Dam.

Irrigation Water Needs

The primary need for irrigation water centers around the development of water storage and distribution systems to supply more water to existing development and new water to potential development.

Most of the streams supplying water for irrigation originate in the high mountains. Spring snowmelt results in peak flows during April, May, and June. Streamflows drop off fast after the spring snowmelt is over, causing irrigation water shortages during July and August, particularly on the smaller streams. A need exists for identification of all feasible upstream storage sites to assure adequate supplies of irrigation water.

Opportunities to irrigate new lands exist in many areas. These lands need to be identified, a water source determined, and the effect of overall water supplies evaluated. An estimate was made in the Columbia-North Pacific Region Comprehensive Framework Study that there are about 1,360,000 acres of potentially irrigable land in the Clark Fork-Pend Oreille River basin. An estimated 3,300,000 acre-feet of water would be needed at the farm to meet the irrigation needs in 2020 for the potential irrigable land.

Water Supply Requirements

The principal factors that will determine future water needs in the region are population growth and industrial expansion, particularly in primary metals and pulp and paper production. As these increase, the need for water will likewise increase. Municipal, industrial, and rural-domestic water uses are projected to more than double by the year 2020.

While the steadily mounting need for water will not strain the abundant water resources in the region, localized supply difficulties are certain to emerge. Although the total supply of water is capable of meeting the needs well into the next century, storage capacity must be developed to assure that the supply is available at the required time and place.

Treatment of wastes must be improved throughout the area, including both mine wastes and domestic and industrial wastes. As municipal systems are expanded and replaced in the future, communities will have to shift to complete treatment of surface-water supplies. Where quality of groundwater cannot be controlled, treatment will also be required, although the quality of the groundwater can be controlled to some degree by improving agricultural practices.

Water Quality problems include groundwater contamination, point and non-point surface water pollution, temperature and flow fluctuations below storage reservoirs, inadequate municipal waste treatment, and low streamflows.

There are several water quality problems besides municipal and industrial wastes. One is nutrient and sediment discharges from logging, grazing, livestock feedlots, summer homes, and road construction. Irrigation return flows from the Flathead Irrigation project also carry sediments and other pollutants into the tributaries of the lower Flathead River. Another problem is flow and temperature fluctuations below Hungry Horse Dam, which adversely affect fisheries, recreation, and water quality downstream.

Industrial pollution of the Clark Fork near Butte and Anaconda from mining and milling wastes has been brought largely under control. But there remain problems of spillover from settling ponds during windstorms and of keeping pollution control equipment operating during copper industry strikes. Wastes from wood and paper plants near Missoula also cause some water pollution problems. In addition, attention has recently been turned to agricultural sources of pollution, particularly in connection with feedlots and fertilizers and to contamination from various chemical sprays.

Streams within the basin are generally fast moving, well-aerated streams with dissolved oxygen levels near saturation. However, during the summer months when streamflows are low and seasonal waste loadings are high, oxygen levels are depressed in Ashley Creek from Kalispell to the mouth and in Silver Bow Creek from Butte to Warm Springs.

Controlling pollution in the Clark Fork-Pend Oreille River basin, in order to provide water quality sufficient to serve adequately the river system's functions, will require a coordinated program of waste reduction, flow regulation, application of waste-controlling techniques, and development of a system of cooperative management of the watershed for pollution control.

Future coal, oil, and gas exploration on the North and South forks of the Flathead River, as well as Canadian coal development, are potential threats to water quality. These threats would involve sediments, nutrients, and altered flows caused by road construction, mining, and population growth.

Electric Power Needs

Future resources and requirements of electric energy in the basin are virtually impossible to isolate from the Pacific Northwest Area since the basin is only a relatively small constituent of a vastly larger integrated system of Federal, private, and public entities. This, therefore, necessitates an investigation of the future power needs of the entire Northwest Power Pool area since the basin's future is dependent upon many circumstances.

The Northwest Power Pool systems serve a large geographical area in all or parts of the States of Oregon, Washington, Idaho, Utah, Montana, Wyoming, California, and the Province of British Columbia. Hydroelectric power projects in the Clark Fork-Pend Oreille River basin contribute approximately 6.5 percent of the capacity of the U.S. portion of the Northwest Power Pool. The major systems serving customers in Oregon, Washington, Northern Idaho, Western Montana, and Northern California are parties to the Pacific Northwest Coordination Agreement and comprise the Coordinated System within the Northwest Power Pool.

The Northwest Power Pool is a pronounced winter peaking load area which results in high capacity reserve margins during the summer peak load period. Reserve margins vary from 12.6-18.4 percent at the time of the winter peak load responsibility and from 23.0-34.2 percent for the summer peak. Some of the summer excess capacity will be used in generating energy to serve secondary markets and interruptible loads.

The U.S. portion of the Pool will have the tightest capacity during the 1981-83 period. Table 12 indicates the projected reserve margins and those deemed desirable based on WSCC's criteria.

Table 12

U.S. Portion of Northwest Power Pool

	U.S. Portion of Northwest Power Pool				
	1979-80	1980-81	1981-82	1982-83	1983-84
Est. Firm Peak Load (January) - MW	31,560	33,427	34,988	36,720	38,382
Net Resources and Firm Transfers - MW	35,197	36,673	37,826	39,212	42,416
Reserve Margin - MW	3,637	3,246	2,838	2,499	4,034
Desired Reserve Margin - MW	2,741	2,832	2,889	3,077	3,210
Surplus/Deficiency in Reserve Margin - MW	896	414	-51	-578	824

Reference: WSCC "Coordinated Bulk Power Supply Program" 1978-1988, April 1, 1980.

The Northwest Power Pool is basically a hydro-oriented system with about 75 percent of its resources made up of hydro as of January 1980. A unique feature of a hydro system is that while peak resources may be sufficient, the energy supply can be deficient. Because of slippages of major thermal units, adverse hydro conditions would produce an energy deficiency in the U.S. portion of the Pool. This deficiency could range from about 11,744 gigawatt-hours in 1980 to a high of about 28,150 gigawatt-hours in 1984 during the 5-year period.

Electrical energy demand, according to the WSCC 1980 "Coordinated Bulk Power Supply Program," will have increased in the Northwest Power Pool from (in gigawatt-hours)

173,193 in 1979, to 297,700 in 1990 and 435,700 in 2000, or a 151.6 percent increase over the twenty-year time period. Therefore, one can conclude that the demand for electricity will increase substantially in the future.

According to the Bonneville Power Administration (BPA), a plan has been engineered to transmit power to Northwest load centers from two generating units being constructed at Colstrip in eastern Montana. The final environmental impact statement for the transmission project was filed in July, 1979. Colstrip units 3 and 4 -- each with generating capacity of 700 MW -- are tentatively scheduled to come on line in late 1983 and 1984. They are being financed by a group of five privately-owned Northwest utilities. Sixty percent of the power produced by Colstrip units 3 and 4 and 50 percent of Colstrip units 1 and 2 is to go to West Group utilities of the Northwest Power Pool. Much of this power must be transmitted almost 1,000 miles to the Puget Sound and Willamette Valley load centers.

A relatively small portion of the increase in requirements will be met by hydroelectric projects. The major share of the load increase not met by hydroelectric development will necessarily come from thermal-electric power. Another possible, but unlikely, source of electric power is surplus power from other regions via interties. It can be concluded that the load-power supply situation in the Pacific Northwest area for future years will require sizeable additions to the existing supply for all project requirements to be satisfied.

Recreation Needs

Recreation use is expected to increase gradually in the basin. Out-of-state visitation has been decreasing due to increased fuel costs, but use by local residents is compensating for this decrease. Recreation use by Idaho and Montana residents increased substantially over previous years. It is expected that the construction of new recreation facilities will keep pace with the estimated increase in recreation use. New recreation developments should be planned for minimal adverse effects on the environment.

Fish and Wildlife Needs

Fish and wildlife are important resources in the basin. Research is being conducted by Federal and State agencies to improve habitat and increase wildlife populations. In recent years, land use changes have caused a decline in suitable habitat, and increased fishing and hunting pressures have reduced wildlife populations.

The Idaho Department of Fish and Game is concentrating research efforts on Lake Pend Oreille. Overfishing and loss of spawning areas have caused a decline in fish populations. Commercial fishing on the lake is now prohibited. The Montana Department of Fish and Game is studying the fishery in Flathead Lake. Study results will be used to improve the existing fishery. In 1963, the U.S. Fish and Wildlife Service completed a study on the Pend Oreille River basin.

The Montana Department of Fish and Game is continuing its studies of the elk, wolverine, whitetail deer, and ring-necked pheasant. In Glacier National Park, the National Park Service is conducting additional wildlife studies. The University of Montana has studied the grizzly bear in the basin. The U.S. Forest Service has conducted several terrestrial wildlife studies in the national forests. The U.S. Fish and Wildlife Service has studied migratory waterfowl on wildlife refuges within the basin.

The results of these studies will provide information on wildlife species, populations and habitats. Planners will be able to use this information to make decisions for enhancement of fish and wildlife.

CHAPTER VII

FUTURE DEVELOPMENT OF WATER AND RELATED RESOURCES

General

Two of the three Federal Energy Regulatory Commission licenses to Montana Power Company in the Clark Fork-Pend Oreille River basin have expired. The license for Thompson Falls Project No. 1869 expired December 31, 1975, and the license for the Kerr Project No. 5 expired on May 22, 1980. A new major license was issued by the Commission on December 1, 1979, for the Thompson Falls project. The expiration date of the third license, for Flint Creek, Project No. 1473, is June 30, 1988. The Commission, under the Federal Power Act, must decide whether to issue a new license to the original licensee or to a new licensee or to recommend takeover by the Federal Government. This report has been prepared to make information available to the Commission, its staff, Federal and State agencies, and the general public that will aid in making decisions relating to these matters. Development plans of several agencies were reviewed, and additional studies were made by staff for future development and utilization of the water resources of the basin. See figure 5, page 22, for the location of potential hydroelectric power projects reviewed.

The potential water resource projects considered are those that could provide the opportunity for future development of the basin's resources and help to meet the increasing needs of the basin. The principal purposes of the projects considered would be hydroelectric power production, irrigation, flood control, navigation, fish and wildlife conservation, recreation, and water quality control.

The report does not include formulation of a plan for basin development or a program for implementing such a plan. The studies are of a reconnaissance level and denote type, complexity, and a general economic evaluation of the individual projects considered. Further detailed studies would be required to determine the optimum basin plan.

Developments Considered

Many sites in the Clark Fork-Pend Oreille River basin have been investigated for the possible development of hydroelectric power as well as for other purposes. Studies of sites have been made by the Corps of Engineers, Water and Power Resources Service, electric utilities, and other organizations. Although the potential projects would have hydroelectric power as a principal purpose, most would also provide benefits from flood control, irrigation, recreation, and fish and wildlife enhancement.

Possible future developments in the basin described herein include additions at 5 existing plants, 13 conventional hydroelectric power projects, and 2 representative pumped storage projects. Table 13 lists the projects under these classifications.

Paradise reservoir on the Clark Fork would inundate the Quinn Springs and Superior sites just upstream and the Knowles site, all the Buffalo Rapids sites, and the Sloan Bridge site on the Flathead. High Buffalo Rapids would be an alternative to Buffalo Rapids Nos. 2 and 4 and to Sloan Bridge, while Buffalo Rapids No. 2 and Sloan Bridge are alternatives to each other. An application for license to

Table 13

Possible Future Hydroelectric Development Clark Fork - Pend Oreille River Basin

Project	River	Gross Head (ft)	New Gross Power Storage Capacity (ac-ft)	Installed Capacity (kW)	Average Annual Generation 1,000 kWh
Possible Conventional Additions to Existing Projects					
Kerr, Unit 4	Flathead	187	0	64,000	-
Thompson Falls	Clark Fork	60	0	35,000	100,000
Boundary, Unit 5, 6	Pend Oreille	275	0	275,500	425,000
Hungry Horse	S.Fk. Flathead	477	0	295,000 6/	114,000
Cabinet Gorge	Clark Fork	97	0	100,000	545,000
Priest No. 4 1/	Priest	109	0	[27,300]	[66,000]
	Total			769,000	1,184,000
Conventional Hydroelectric Power Projects				Ultimate Installed Capacity (kW)	
Sullivan Creek	Pend Oreille	605	28,000	25,000	60,400
Paradise 8/	Clark Fork	241	6,500,000	1,191,600	2,505,000
Knowles 2/	Flathead	230	4,959,000	796,000	1,620,000
High Buffalo Rapids 3/ 8/	Flathead	160	868,000	516,000	1,104,000
Buffalo Rapids, No. 4	Flathead	80	(pondage)	276,000	587,000
Buffalo Rapids, No. 2	Flathead	80	(pondage)	276,000	561,000
Sloan Bridge 8/	Flathead	130	(512,000)	412,000	832,000
Quinn Springs	Clark Fork	120	(pondage)	124,000	455,000
Superior	Clark Fork	40	(pondage)	31,500	131,000
Quartz Creek	Clark Fork	130	(pondage)	120,000	438,000
Plateau	Clark Fork	50	(pondage)	46,000	157,000
McNamara 7/	Blackfoot	118	(pondage)	44,000	88,000
Ninemile Prairie 7/	Blackfoot	285	1,000,000	92,000	254,000
Painted Rocks	Bitteroot	50	U	5,200	16,070
Eddy 4/	Clark Fork	55	U	192,000	580,000
Bonner 4/	Blackfoot	165	U	22,000	86,000
Ovando B 4/	Blackfoot	250	9,500	19,000	75,000
Finlen 4/	Rock Creek	210	1,240	14,000	55,000
Quigley 4/	Rock Creek	240	780	14,000	56,000
Atkins 4/	Rock Creek	174	2,480	9,000	85,000
Joy 4/	Rock Creek	234	2,520	10,000	41,000
Swan Lake 4/	Swan	54	2,340	5,000	26,000
Spruce Park 5/	M.Fk. Flathead	860	4,000	[380,000]	[420,000]
Coram 5/	Flathead	108	U	[114,000]	[290,000]
Smoky Range 5/	N.Fk. Flathead	350	15,100	[190,000]	[510,000]
Glacier View 5/	N.Fk. Flathead	222	15,100	[325,000]	[367,000]
Canyon Creek 5/	N.Fk. Flathead	154	-	[16,000]	[260,000]
			total	4,240,000	9,812,000
Potential Pumped Storage Projects					
Boulder Creek	Boulder			1,000,000 or	-
Upper South Fork	Crk.			4,000,000	
Station Creek	Station Crk.			1,000,000 or	-
				4,000,000	

Note: [ ] indicates development prohibited due to National Wild and Scenic River Designation. Not reflected in totals.

U - Usable power capacity is less than 5,000 acre-feet.

1/ Located upstream from potential Wild and Scenic River, Section 5A, PL 90-542.

2/ Conflicts with Buffalo Rapids Nos. 2 and 4, and Sloan Bridge projects.

3/ Alternative to Buffalo Rapids Nos. 2 and 4 projects.

4/ Sites formerly listed in Clark Fork - Pend Oreille Planning Status report but not currently found to be suitable for development, and no longer have support. Changing energy economics may again bring interest to some of the sites.

5/ Located on Flathead Wild and Scenic River Section 3A, PL 90-542. Development precluded.

6/ Includes potential 200-megawatt powerplant (would require reregulation) and 95-megawatts from powerplant uprating.

7/ Project appears to be not economically justified or environmentally desirable.

8/ Project would require large relocations, currently opposed by local interests.

construct Buffalo Rapids Nos. 2 and 4, FPC Project No. 2507, was dismissed in 1977 by this Commission, the dismissal was without prejudice to the filing of another application in the future. The Smoky Range and Glacier View dam sites would be mutually exclusive in the reach above Flathead Lake. The dam and reservoir sites of each potential project are shown in profile on figure 6. Project data used in the cursory economic analysis come from previous U.S. Army Corps of Engineers' studies and the "Comprehensive Framework Study of Water and Related Lands" prepared by the Pacific Northwest River Basins Commission, June 1977.

Developments Considered

In evaluating potential projects, the staff derived investment costs based on estimates contained in available reports. These costs were reviewed, modified, and updated to mid-1979 price levels using Engineering News Record Construction costs indexes.

The Water Resources Council has adopted new Principles and Standards requiring comparability of Federally-financed hydroelectric power with Federally-financed alternative power generation (combustion turbine, combined-cycle, or coal-fired steam-electric power generation). Each cost-benefit analysis performed for potential hydroelectric developments compare (1) Federally-financed hydroelectric power to Federally-financed alternatives, (2) privately-financed hydroelectric power to privately-financed alternatives.

The annual costs used in the benefit-cost analyses include fixed charges, operation and maintenance expenses, and administration and general expenses. The annual fixed charges with Federal and private financing are shown in table 14.

Our estimates of the generalized value of power from hydroelectric projects are based on the cost of producing power at modern alternative electric generating plants, using the methodology described in "Hydroelectric Power Evaluation" (DOE/FERC 0031, dated August 1979). The total value is composed of a "capacity component" which corresponds to the fixed capital charges and fixed operating costs of the alternative electric plant and transmission facilities, and an "energy component" which closely correlates with the price of fuel and other operating expenses which are variable in nature and generally dependent upon the number of kilowatt-hours generated.

The present FERC procedure is to develop generalized power values assuming a 7-1/2 percent plant factor for combustion turbine units, 25 percent for combined cycle units, and 55 percent for coal-fired units. These plant factors are assumed to be the equivalent average lifetime plant factor of the unit-type in question.

Table 14

Estimated Annual Fixed Charges,
as a Percent of Gross Plant Investment,
January 1, 1979

Period of Analysis (years)	100
<u>Private Financing</u>	
Cost of money	10.50
Depreciation 1/	0.07
Insurance	0.10
Taxes	
Federal income	
Federal miscellaneous	
State and local	
Total taxes	4.37
Total fixed charges	15.04
<u>Federal Financing</u>	
Interest	7.125
Amortization	0.007
Total fixed charges	7.132

Note: For the purposes of this evaluation report, it is assumed that each economic life selected properly reflects the weighted service life of each plant component, and, therefore, as stated in DOE/FERC 0031, an interim-replacement allowance is not required.

1/ 50-year sinking fund.

Generalized unadjusted power values used in the cursory project economic evaluations are as follows:

Generalized Power Values for Western Montana, January 1979

Hydro Capacity Factor %	Alternative Type	Alternative Plant Factor %	Capacity Value Estimated ($/kW) Private Financing	Capacity Value Estimated ($/kW) Federal Financing	Energy Value (mills/kWh)
0-20	Combustion Turbine	7.5	36	22	50
30-40	Combined Cycle	25.0	77	50	30
50-100	Coal-Fired	55.0	169	98	6

For Federal financing, adjustments were made to those capacity values determined for privately-financed alternatives to reflect the lower capital cost due to interest during construction and the substantial difference in fixed charges. Energy values reflect March 1979 prices. The resultant values of energy also reflect a hydro-steam adjustment to the at-market estimated costs. Substantial rises in petroleum costs since March 1979 and the likelihood of future price increases seem to indicate these power values are conservative.

The preliminary economic evaluations are summarized in table 30. The projects' monetary benefits and costs should be used only to serve as a screening of the relative economic feasibility of the individual projects.

In order to properly assess the feasibility of the potential projects, additional studies are needed to reflect consideration for non-economic factors such as social and environmental impacts.

Installation of Additional Generating Capacity to Existing Projects

A number of opportunities exist for additional power development at the existing projects. Uprating existing hydroelectric generators and turbine units at the powerplants may be one of the most immediate, cost effective, and environmentally acceptable means of developing additional power. The enlargements of the present powerplants are also an attractive means of developing additional electrical power and energy.

The possibilities are briefly discussed as follows:

Addition to Thompson Falls

Thompson Falls, Project No. 1869, feasibility studies, undertaken by the Applicant for the proposed ultimate scheme of development of the Thompson Falls projects, led to three options: (1) install taintor gates and replace existing flashboards with drop panels to maintain head during high discharge periods (otherwise lost due to removal of existing boards); (2) install two additional 17,000 to 12,500-kilowatt units; and (3) increase the height of the dam by 2 feet. Table 15 summarizes project data. Table 30 displays preliminary economic cost and benefits for options 1 and 2.

Based on our cursory analysis, it appears that options 1 and 2 have benefit/cost ratios greater than 1. The licensee has been required to study the options.

The staff's review of the water discharge records, for a period of 67 years starting on October of 1910, has revealed that the average flow of the Clark Fork River near Plains, Montana, is about 20,010 cubic feet per second, which exceeds the hydraulic capacity of the project. Records also indicate the project has historically operated at the equivalent or greater than its installed capacity continuously. It appears that the optimum development of the hydroelectric power potential at the Thompson Falls project would include a combination of options (1) and (2), thereby providing additional capacity and energy making more economic and operationally efficient use of the site's hydropower potential. The inclusion of Article 45 to the license requires the licensee to, within six months from the date of issuance of the license (time period was extended to December, 1980), prepare and file with the Commission a feasibility analysis of installing additional generating capacity at the Thompson Falls project, taking into account, to the extent reasonable, all benefits that

Table 15

Thompson Falls Project
Project Data

River mile	Clark Fork
Drainage area, sq mi	20,940
Mean Flow, cfs	20,010
Reservoir Data	
Top of normal pool, ft-msl	2,396
Storage capacity, ac-ft	15,000
Power Data	
No. of additional units	2
Possible additional Installed capacity, kW	35,000
Avg. ann. gen., MWh	100,000
Head-Feet	
Max. gross usable for power, ft	60

would be derived from the installation, including any contribution to the conservation of nonrenewable natural resources. If the study shows additional capacity to be economically feasible, the licensee shall simultaneously file a schedule for filing an application to amend its license to install that capacity.

Additions to Boundary Project

The Boundary powerplant is underground and consists of four units each having a nameplate rating of 137,750 kilowatts and an overload capability of 162,500 kilowatts. Space has been provided for two more similarly sized units. The location of the Boundary project is shown on figure 5. Project data are summarized in table 16. The Boundary hydroelectric project is located in the northeast corner of Washington on the Pend Oreille River, with the dam and powerplant about 1 mile south of the Canadian border. The project (Project No. 2144) was constructed by the City of Seattle Department of Lighting in the period from 1963 to 1967. The reservoir extends upstream for 17.5 miles to the base of Box Canyon Dam.

A preliminary economic analysis of adding two units to the Boundary hydroelectric development is given in table 30. In adding the additional capacity to the project, there would be no new joint use facilities, and all of the new investment would be for specific power facilities. Likewise, no non-power benefits would accrue. The favorable economics indicate that this addition would be a desirable one at any time the additional capacity could be absorbed into the system.

Hungry Horse Powerplant Enlargement and Reregulating Reservoir

This proposal of the Water and Power Resources Service's Western Energy Expansion Study is for a study of a potential 200-megawatt powerplant (four 50-megawatt units)

Table 16

Boundary Project, Units 5 and 6
Project Data

River mile, Pend Oreille				17
Drainage area, sq mi				25,200
Mean flow, cfs				27,010
<u>Reservoir Data</u>	<u>Elevation</u> (ft-msl)	<u>Area</u> (ac)	Storage <u>Capacity</u> (ac-ft)	
Top of normal pool, ft msl	1,990	1,668		
Minimum power pool	1,950			
Tailwater elevation, ft msl, maximum	1,729			
Usable storage, existing			43,000	
<u>Power Data</u>				
No. of additional units				2
Length of conduit, feet, varies				53 to 216
Possible additional installed capacity, kW, Units 5 and 6 (nameplate)				275,500
Average annual generation, MWh				425,000
<u>Head - feet</u>				
Maximum gross usable for power				261

which would be located on the left bank of the South Fork of the Flathead River just below existing Hungry Horse powerplant approximately 20 miles from Kalispell, Montana. A new 18-foot penstock would be constructed through the existing Hungry Horse Dam. A new switchyard and 7 miles of 230-kilovolt transmission line would be included. Net average annual generation would be approximately 114 gigawatt-hours. A new 60-foot high reregulating dam would be located about 2-1/2 miles downstream from Hungry Horse Dam.

Also proposed for further study is the Hungry Horse powerplant uprating. This proposal is to study the potential increase in capacity and generation through rewinding existing generators and uprating existing turbines at Hungry Horse powerplant. The present rated capacity of the 4 units is 285 megawatts. The existing turbines are capable of producing 30 percent more power than the generator capacity since they were rated for lower head conditions than those that normally exist throughout the year. To take advantage of this turbine capacity, the capacity of the generators, transformers, and the 13.8-kilovolt bus would be increased. This would increase plant capacity by about 95 megawatts and cost about $11,800,000 or $124/kilowatt.

A study of the Hungry Horse Dam and Reservoir operation was recommended by the Flathead Level "B" study to find a method of reducing reservoir drawdowns and downstream flow fluctuations. Recreational opportunities both on the reservoir and downstream as far as Flathead Lake would thereby be enhanced. However, reduction of downstream flow fluctuations without a reregulating dam would inevitably reduce the potential of Hungry Horse as a producer of peaking power, as a forced-outage reserve, and as an emergency standby for firm generation. Limiting drawdown of the reservoir would also reduce the present potential of selling provisional energy to industry. This provisional energy has often eliminated the necessity of shutting down aluminum potlines at Columbia Falls, Montana, during the beginning of the drawdown season.

Additions to Cabinet Gorge

The installation of 100,000 kilowatts additional capacity, with an additional average annual energy generation of 545,000,000 kilowatt-hours, appears to be currently economical using January 1979 construction costs and power values. A cursory economic analysis, given in table 30, assuming a total investment cost of $45,000,000 for the additional two 50-megawatt units and private financing, resulted in a benefit-cost ratio greater than one. Although the total investment assumed does not include possibly significant structural modifications, the potential addition of 100,000 kilowatts to Cabinet Gorge seems to warrant further investigation.

Additions to the Kerr project are discussed at the end of this report.

Potential Conventional Hydroelectric Power Projects

There are a number of sites in the basin for new hydroelectric facilities. However, proposals to develop much of this potential have met with public opposition. In addition, Federal laws prevent new projects in Glacier National Park, wilderness areas, and at the Three Forks of the Flathead River due to their inclusion into the National Wild and Scenic Rivers System.

According the "Flathead Level B Study," there is public opposition to enlarging the outlet channel of Flathead Lake, which would enhance the power and flood control operation at both Kerr and Hungry Horse Dams, and development of a large dam on the Flathead River below Kerr Dam may also face strong opposition. Potential run-of-river projects at Buffalo Rapids 2 and 4 sites, which do not involve large impoundments, have received less opposition than large storage projects at recent public meetings.

The 13 potential conventional hydroelectric power projects studied are described below. Of these, five are on the main stem of the Clark Fork-Pend Oreille River, and the rest are on the Flathead River, the Blackfoot River, or other tributaries of the main stem. The locations of these potential conventional projects are shown on figures 5 and 6. In addition, there are 13 other sites in the basin, 1 of which is in Canada, which are briefly mentioned but are not currently under active consideration.

Sullivan Creek Project

The Sullivan Creek project would be located in the northeast corner of the State of Washington, a few miles upstream from the Canadian border. It would utilize the waters of both Outlet Creek and Sullivan Creek near the town of Metaline Falls. Application for license for the project (Project No. 2526) was made on June 14, 1965, by Public Utility District No. 1 of Pend Oreille County, and was dismissed on January 24, 1975, without prejudice to subsequent filing of application which conform with Commission regulations.

The project would consist of an earth and rockfill dam having a water surface elevation of 2,594 feet, providing about 61,600 acre-feet of storage capacity and a powerhouse containing 25,000 kilowatts installed capacity. The project would replace the existing but non-operating Sullivan Lake (Project No. 2225) which is presently used only for storage. The location and major features of the Sullivan Creek project are shown on figure 25. Table 17 gives pertinent data on the project.

Table 17

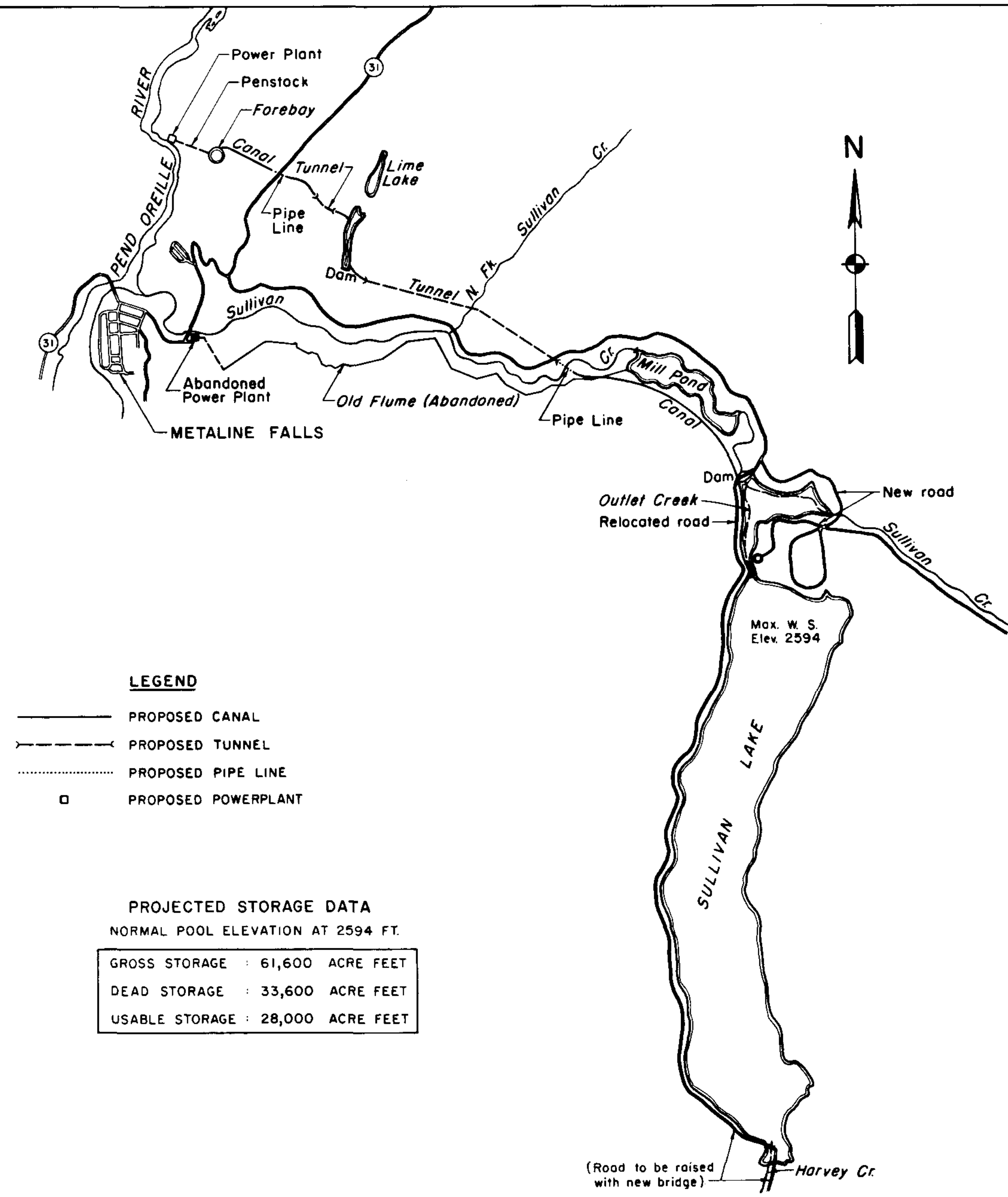
Sullivan Creek Project
Project Data

River mile, Pend-Oreille River	26
Drainage area, square miles	122
Mean flow, cfs	170
Reservoir Data	Usable Storage Capacity (ac-ft)
Elevation (ft msl)	2,594
Top of normal pool	61,600
Minimum power pool	33,600
Storage	28,000
Power Data	
No. of units	2
Installed capacity, kW	25,000
Average annual generation, MWh	60,400
Head	
Maximum gross usable for power, ft	605

The project appears to be economically favorable when based on at-site power benefits with this size installation. Some minor additional benefits for irrigation, flood control, downstream power, and recreation could also be assigned.

Paradise Project

The Paradise project would be one of several alternatives for the development of the head above Thompson Falls. Located on Clark Fork about 4 miles downstream from the mouth of the Flathead River (see figure 26), Paradise Dam would consist of a 270-foot high zoned embankment on the main channel and a smaller embankment on a side channel on the left bank. The powerhouse and spillway would be placed on the rock ridge separating the two channels. Paradise Reservoir with a normal pool elevation of 2,700 feet would back water on the Flathead River to the base of Kerr Dam and 46 miles up the Clark Fork. The reservoir would have a gross



PROJECTED STORAGE DATA
NORMAL POOL ELEVATION AT 2594 FT.

GROSS STORAGE	:	61,600 ACRE FEET
DEAD STORAGE	:	33,600 ACRE FEET
USABLE STORAGE	:	28,000 ACRE FEET

SULLIVAN CREEK PROJECT

CLARK FORK - PEND OREILLE RIVER BASIN

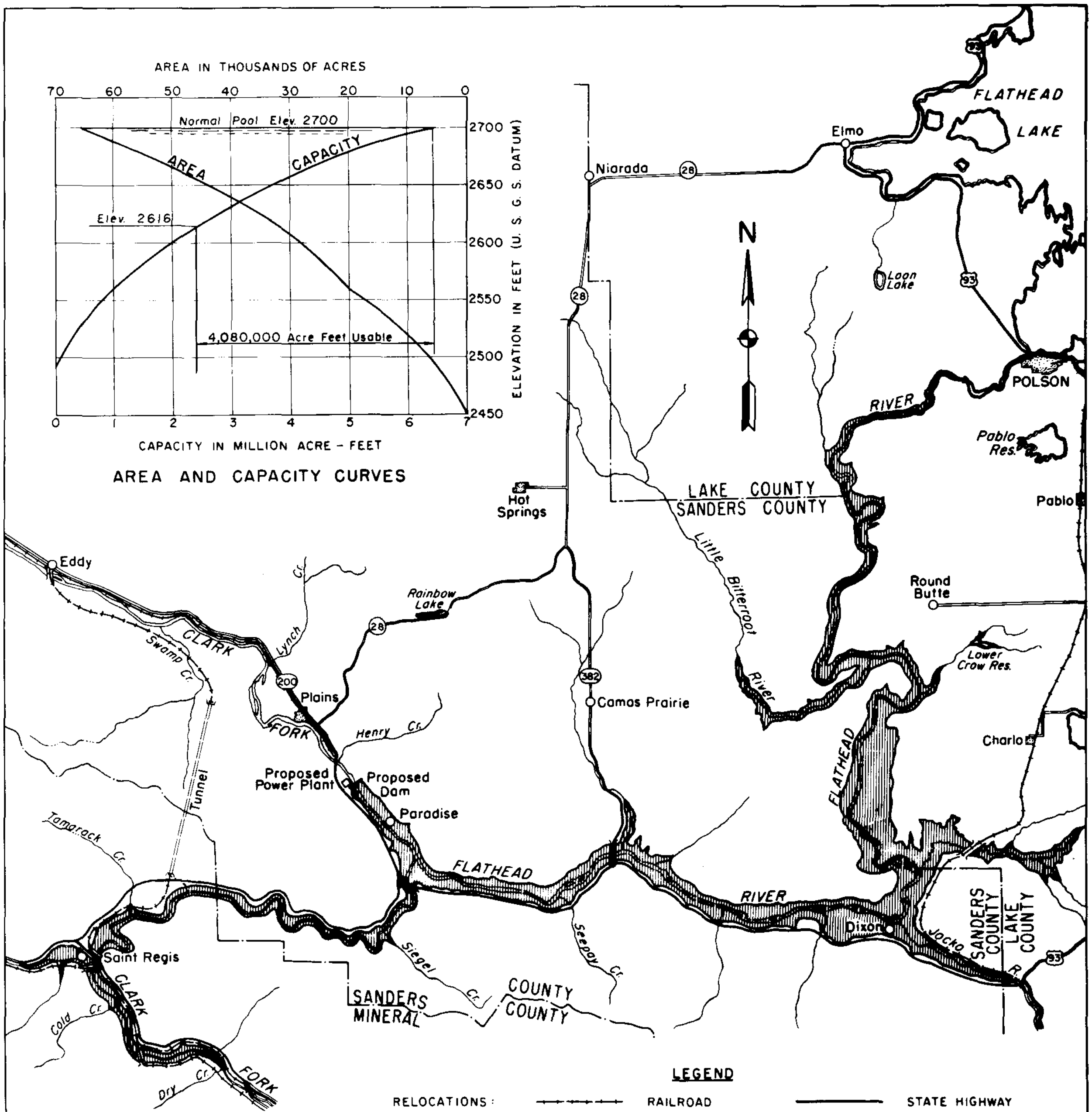
WASHINGTON

1980

SCALE IN MILES

1 0 1 2

FERC - Water Resources Appraisal for Hydroelectric Licensing — Figure 25



PARADISE PROJECT

CLARK FORK - PEND OREILLE RIVER BASIN

MONTANA

1980

SCALE IN MILES

FERC - Water Resources Appraisal for Hydroelectric Licensing — **Figure 26** storage capacity of 6,500,000 acre-feet, of which 4,080,000 acre-feet would be useful for hydroelectric power, flood control, and possible irrigation. Twelve 99,300-kilowatt units would give a total installed capacity of 1,191,600 kilowatts. Table 18 gives pertinent project data.

Table 18

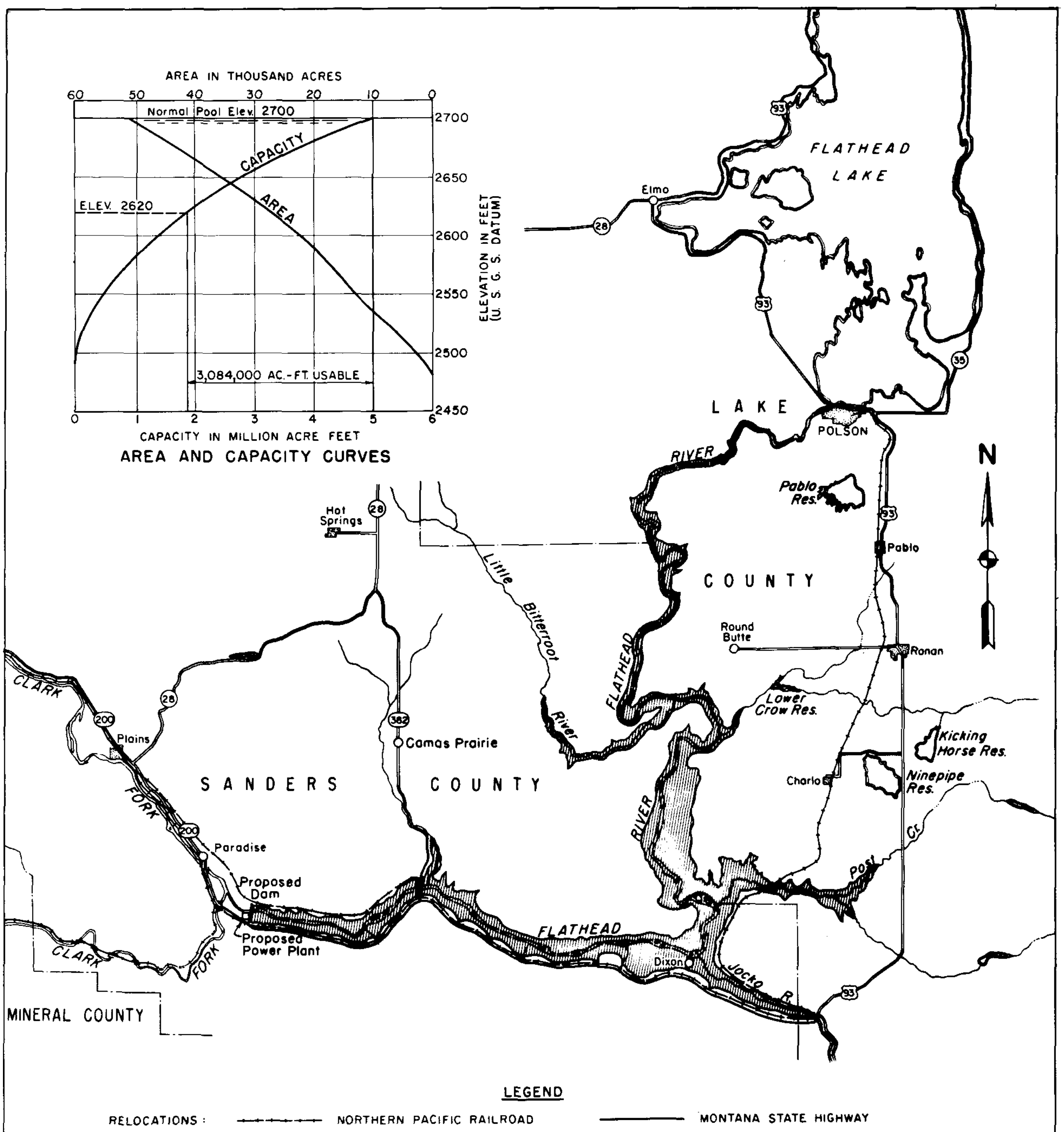
Paradise Project
Project Data

River mile, Clark Fork-Pend Oreille Rivers			241.0
Drainage area, sq mi			20,000
Mean flow, cfs			19,900
<u>Reservoir</u>	<u>Elevation</u> (ft msl)	<u>Area</u> (ac)	Usable Storage <u>Capacity</u> (ac-ft)
Top of normal pool	2,700	66,130	6,500,000
Minimum power pool	2,616	32,500	2,420,000
Tailwater elevation	2,459		
Storage			4,080,000
<u>Power Data</u>			
Number of units			12
Installed capacity, kW			1,191,600
Average annual generation, MWh			2,505,000
<u>Head</u>			
Maximum gross usable for power, ft			241

Table 30 gives monetary costs and benefits. The project does not appear to be economically favorable. Due to the extensive railway and highway relocation, the investment cost would be quite excessive. Benefits are derived mainly from at-site power, plus some local recreation and flood control and other flood control downstream. No further consideration of the Paradise project should be given as long as the costly relocation work is necessary.

Knowles Project

The Knowles project would be a multi-purpose development entirely on the Flathead River. Located nearly 3 miles upstream from the confluence of the Flathead with Clark Fork (see figure 27), Knowles dam would consist of a 266-foot high zoned earthfill embankment across the main channel and a gated concrete spillway and powerhouse on the side channel. Knowles Reservoir with a normal pool of 2,700 feet would back water up to the base of Kerr Dam. The reservoir would have a gross storage capacity 4,959,000 acre-feet of which 3,084,000 acre-feet would be useful for hydroelectric power, flood control, and possible irrigation. Eight



KNOWLES PROJECT

CLARK FORK - PEND OREILLE RIVER BASIN

MONTANA

1980

SCALE IN MILES

5 0 5 10

FERC - Water Resources Appraisal for Hydroelectric Licensing **Figure 27**

99,500-kilowatt units would give a total installed capacity of 796,000 kilowatts. Table 19 gives pertinent project data.

Table 19

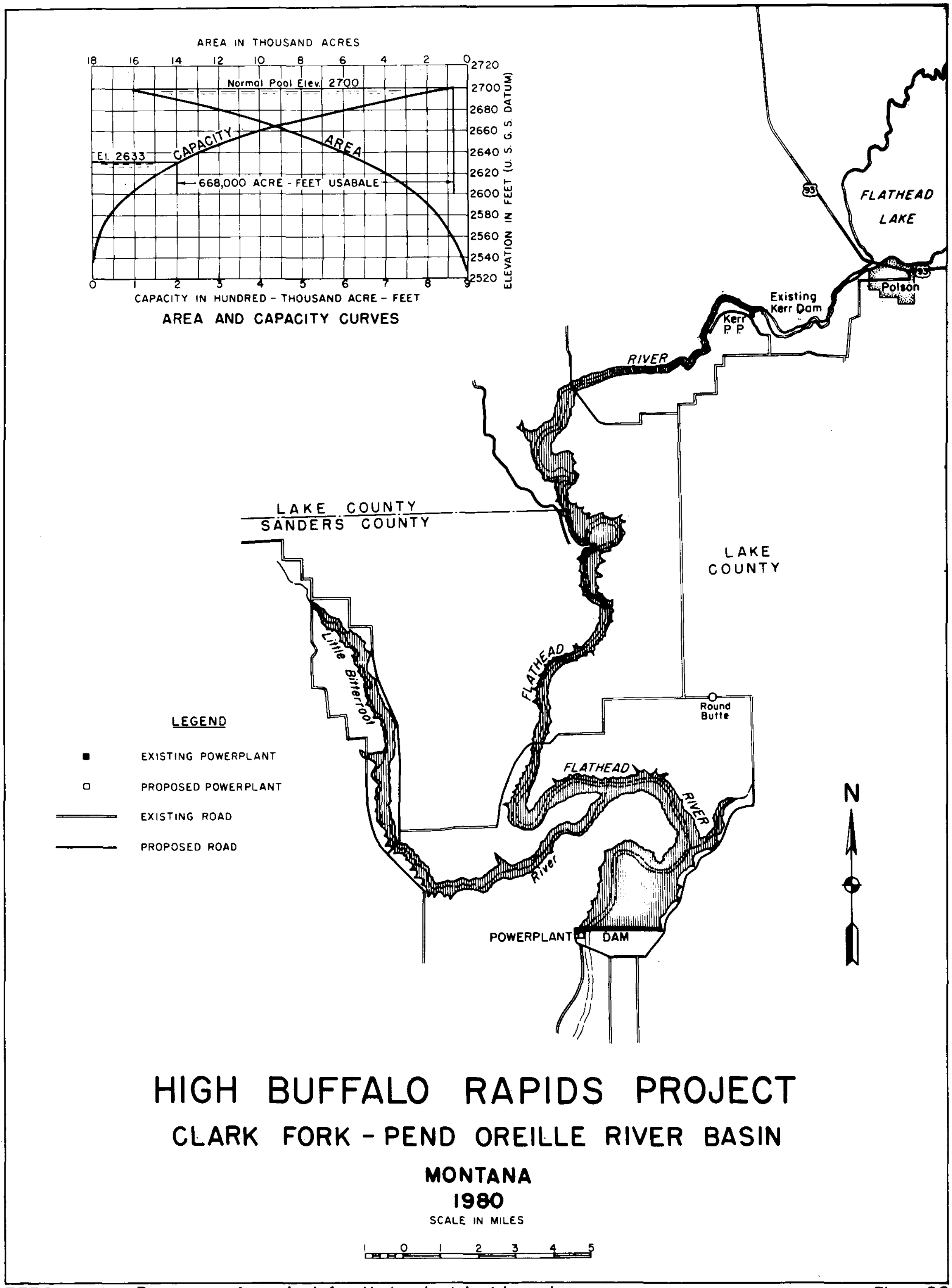
Knowles Project
Project Data

River mile, Flathead River			2.7
Drainage area, sq mi			9,000
Mean flow, cfs			12,600
Reservoir Data	Elevation (ft msl)	Area (ac)	Usable Storage Capacity (ac-ft)
Top of normal pool	2,700	51,500	4,959,000
Minimum power pool	2,620	27,500	1,875,000
Tailwater elevation, maximum	2,470		
Storage			3,084,000
Power Data			
No. of units			8
Installed capacity, kW			796,000
Average annual generation, MWh			1,620,000
Head			
Maximum gross usable for power, ft			230

Table 30 gives monetary costs and benefits. With private financing, the project is economically submarginal. Because considerable railway and road relocation would be required by the reservoir, the investment cost would be excessive. Benefits are derived mainly from at-site power plus some local recreation and flood control and other flood control downstream. But little further consideration should be given to Knowles project as long as costly relocation work is necessary.

High Buffalo Rapids Project

The High Buffalo Rapids project would be an alternative to Buffalo Rapids Nos. 2 and 4 and the Sloan Bridge projects for developing the Flathead River below Kerr Dam (see figure 28). At a site 36-1/2 miles upstream from the Clark Fork, the 160-foot dam would consist of an earth embankment from the left bank and a gated concrete spillway and powerhouse section from the right bank. High Buffalo Rapids reservoir with a normal pool elevation of 2,700 feet would back water for 36 miles on the Flathead River. The reservoir would have a gross capacity of 868,000 acre-feet of which 668,000 acre-feet would be usable for hydroelectric power, flood control, and possible irrigation. Eight 64,500-kilowatt units would give a total installed capacity of 516,000 kilowatts. Table 20 gives pertinent project data.



FERC - Water Resources Appraisal for Hydroelectric Licensing — Figure 28

Table 20

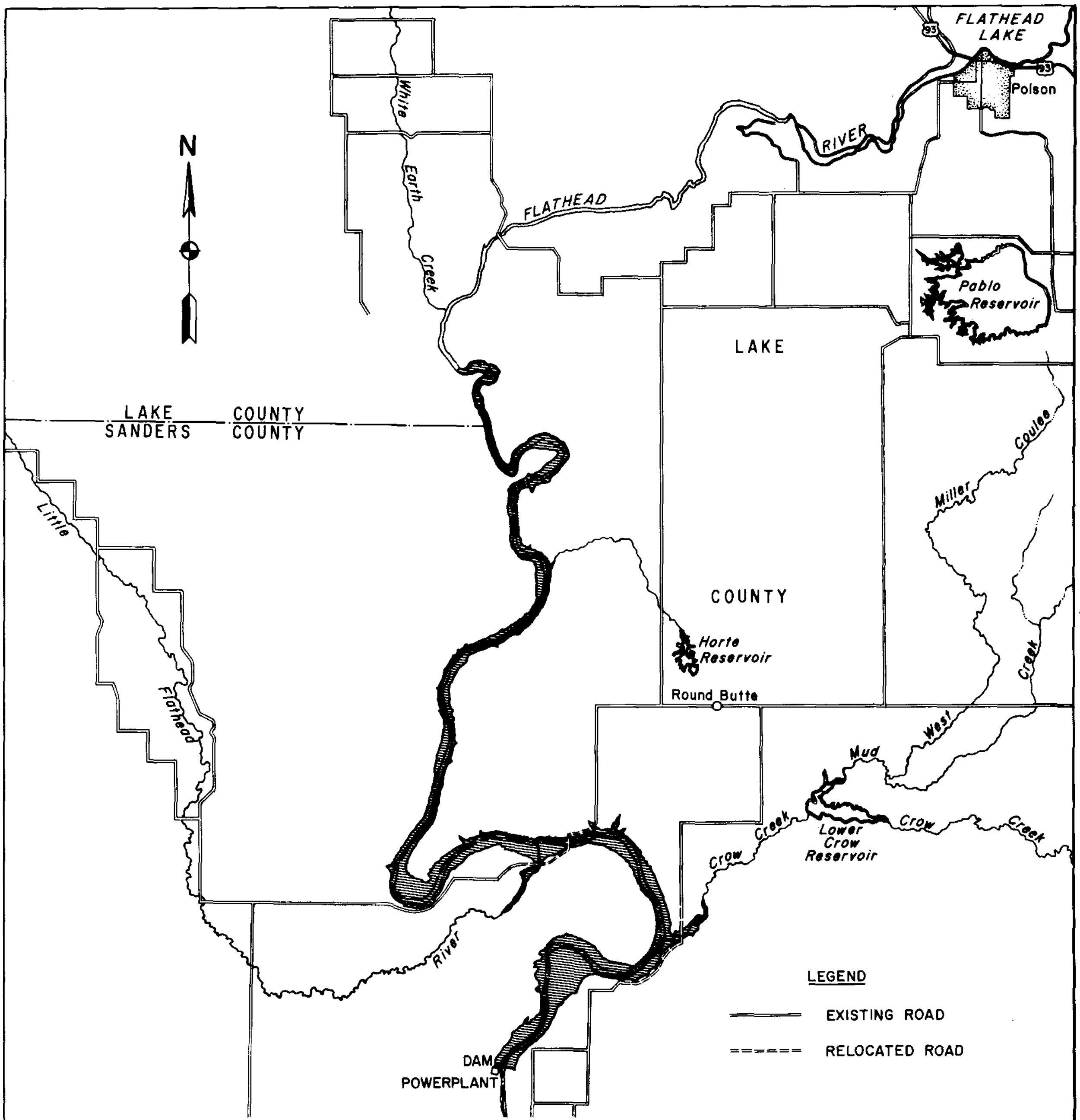
High Buffalo Rapids Project
Project Data

River mile, Flathead			36.5
Drainage area, sq mi			8,075
Mean flow, cfs			12,100
Reservoir Data	Elevation (ft msl)	Area (ac)	Usable Storage Capacity (ac-ft)
Top of normal pool	2,700	16,500	868,000
Minimum power pool	2,633	5,000	
Tailwater elevation, maximum	2,540		
Tailwater elevation, minimum	2,536		
Storage			668,000
Power Data			
No. of units			8
Installed capacity, kW			516,000
Average annual generation, MWh			1,104,000
Head			
Maximum gross usable for power, ft			160

Table 30 gives monetary costs and benefits for High Buffalo Rapids project. At January 1979 construction prices and power values, the project is economical with Federal financing. The only relocations are secondary roads and utilities. Benefits are derived mainly from at-site power with some local recreation and flood control, plus downstream flood control and minor power benefits downstream. With changing value of benefits, future study of this project may be desirable.

Buffalo Rapids No. 4 Project

The Buffalo Rapids No. 4 project in conjunction with Buffalo Rapids No. 2 would be an alternative development to the High Buffalo Rapids project or to the Sloan Bridge project. At a site 36-1/2 miles upstream from the Clark Fork (see figure 29), the project would consist of an 80-foot zoned earth embankment, a powerhouse, and a gated concrete gravity spillway on the right abutment. The reservoir at Buffalo Rapids No. 4 project with a normal pool elevation of 2,620 feet would back water on the Flathead River 25 miles to the Buffalo Rapids No. 2 site, but the storage would be limited to use as pondage for hydroelectric power purposes. Four 69,000-kilowatt units would give a total installed capacity of 276,000 kilowatts. Table 21 gives pertinent project data.



BUFFALO RAPIDS NO. 4 PROJECT

CLARK FORK - PEND OREILLE RIVER BASIN

MONTANA

1980

SCALE IN MILES

1 0 1 2 3 4

Table 21

Buffalo Rapids No. 4 Project
Project Data

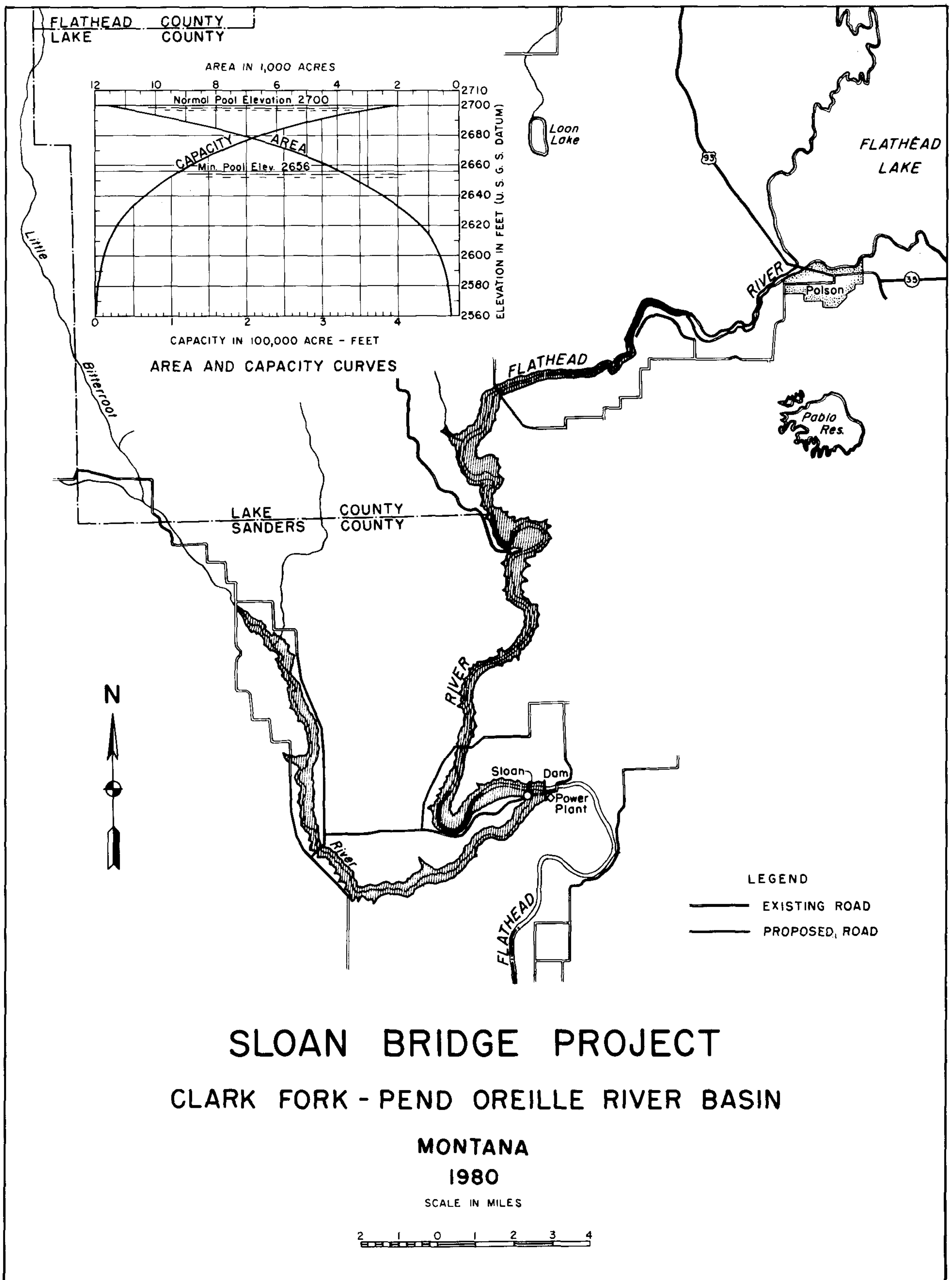
River mile, Flathead River			36.5
Drainage area, sq mi			8,075
Mean flow, cfs			12,100
Reservoir Data	Elevation (ft msl)	Area (acs)	
Top of normal pool	2,620	3,370	
Tailwater elevation, maximum	2,540		
Tailwater elevation, minimum	2,536		
Storage is limited to pondage			
Power Data			
No. of units			4
Installed capacity, kW			276,000
Average annual generation, MWh			587,000
Head			
Maximum gross usable for power			80

Table 30 gives monetary costs and benefits. The project is economical based on January 1979 construction costs and power values with Federal financing. Benefits are limited almost entirely to at-site power but include a small amount of local recreation. With changing value of benefits, future study of this project, in conjunction with Buffalo Rapids No. 2, may be desirable.

Sloan Bridge Project

The Sloan Bridge project would be an alternative to the High Buffalo Rapids project, or to the combination of Buffalo Rapids Nos. 4 and 2. At a site 44.7 miles upstream from the Clark Fork, the dam would consist of a zoned earthfill embankment with a concrete gated spillway and powerhouse in a side channel on the right bank (see figure 30). Sloan Bridge Reservoir with a normal pool elevation of 2,700 feet would back water 27 miles on the Flathead River to Kerr Dam. The reservoir would have a gross capacity of 512,000 acre-feet of which 400,000 acre-feet would be useful for hydroelectric power, flood control, and possible irrigation. Eight 51,500-kilowatt units would give a total installed capacity of 412,000 kilowatts. Table 22 gives pertinent project.

Table 30 gives monetary costs and benefits. At January 1979 construction costs and power values, the project is economical with Federal financing. Benefits are derived mainly from at-site power with some local recreation and flood control, plus downstream flood control and minor power benefits downstream. With changing value of benefits, future study of the Sloan Bridge project may be desirable.



FERC - Water Resources Appraisal for Hydroelectric Licensing — Figure 30

Table 22

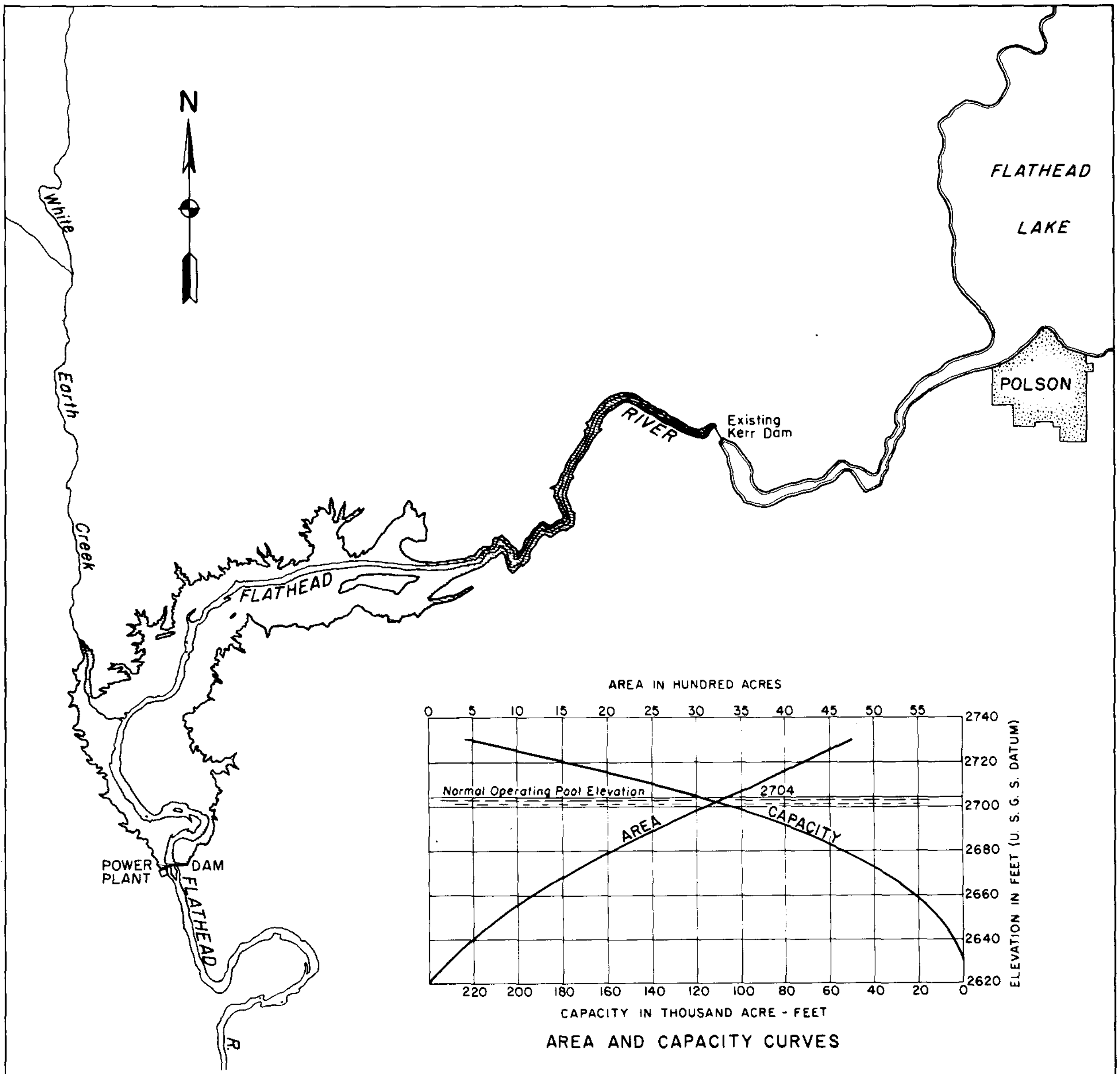
Sloan Bridge Project
Project Data

River mile, Flathead River			44.7
Drainage area, sq mi			7,745
Mean flow, cfs			11,600
Reservoir Data	Elevation (ft msl)	Area (ac)	Usable Storage Capacity (ac-ft)
Top of normal pool	2,700	12,500	512,000
Minimum power pool	2,656	4,000	112,000
Tailwater elevation	2,570		
Storage			400,000
Power Data			
No. of units			8
Installed capacity, kW			412,000
Average annual generation, MWh			832,000
Head			
Maximum gross usable for power, ft			130

Buffalo Rapids No. 2 Project

Buffalo Rapids No. 2 project in conjunction with Buffalo Rapids No. 4 would be an alternative development to the High Buffalo Rapids project or to the Sloan Bridge project. At a site 60.7 miles upstream from the Clark Fork, the dam would consist of a zoned earth embankment with a concrete gated spillway and a powerhouse on the right bank (see figure 31). The reservoir at Buffalo Rapids No. 2 project with a normal pool elevation of 2,700 feet would back water on the Flathead River 11.8 miles to Kerr Dam, but the storage would be limited to use as pondage for hydroelectric power purposes. Four 69,000-kilowatt units would give a total installed capacity of 276,000 kilowatts. Table 23 gives pertinent project data.

Table 30 gives monetary costs and benefits of the Buffalo Rapids No. 2 project. With January 1979 construction costs and power values, the project is economical with Federal financing. Benefits are limited almost entirely to at-site power, but include a small amount of local recreation. With changing value of benefits, future study of this project, both with and without Buffalo Rapids No. 4, may be desirable.



BUFFALO RAPIDS NO. 2 PROJECT

CLARK FORK - PEND OREILLE RIVER BASIN

MONTANA

1980

SCALE IN MILES

1 0 1 2 3

FERC - Water Resources Appraisal for Hydroelectric Licensing **Figure 31**

Table 23

Buffalo Rapids No. 2 Project
Project Data

River mile, Flathead River			60.7
Drainage area, sq mi			7,100
Mean flow, cfs			11,060
Reservoir Data	Elevation (ft msl)	Area (acs)	
Top of normal pool	2,700	3,350	
Tailwater elevation	2,620		
Storage is limited to pondage			
Power Data			
No. of units			4
Installed capacity, kW			276,000
Average annual generation, MWh			561,000
Head			
Maximum gross usable for power, ft			80

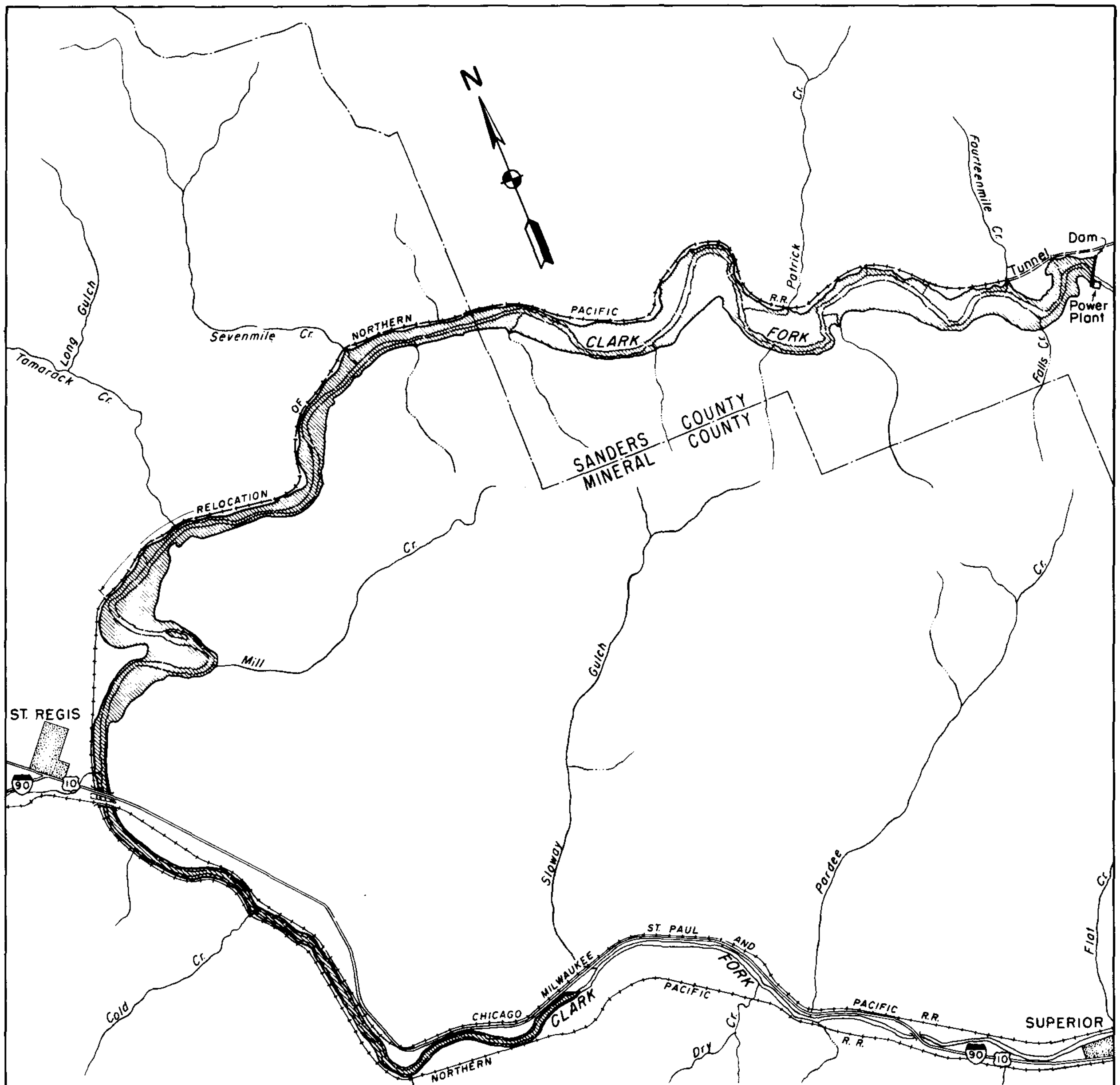
Quinn Springs Project

Quinn Springs project would be a single-purpose hydroelectric power development on the Clark Fork 251 miles upstream from the Columbia River. At a site 6.5 miles upstream from the confluence of the Clark Fork and Flathead Rivers, Quinn Springs Dam would be a 140-foot high concrete gravity structure, 1,600 feet long with a gated spillway and integral powerhouse. Quinn Springs Reservoir with a normal pool elevation of 2,630 feet would back water up the Clark Fork a distance of 24 miles (see figure 32), but the storage would be limited to pondage with a drawdown of about 2 feet, which would allow some at-site recreation benefits. The powerplant would include four 31,000-kilowatt units with a total installed capacity of 124,000 kilowatts. Table 24 gives project data for Quinn Springs project.

Table 30 gives the monetary costs and benefits of Quinn Springs project. This development is economically submarginal at January 1979 construction costs and power values. Due to costly railway and other relocation required by the reservoir, the investment cost would be quite large. Benefits are derived from at-site power and some local recreation.

Superior Project

Superior Dam and Reservoir would be a single-purpose hydroelectric power development on the Clark Fork 281 miles upstream from the Columbia River. At a site 36.5 miles upstream from the confluence of the Clark Fork and Flathead Rivers, Superior Dam would be a 60-foot high concrete gravity dam, 500 feet long with a gated spillway



QUINN SPRINGS PROJECT

CLARK FORK - PEND OREILLE RIVER BASIN

MONTANA

1980

SCALE IN MILES

1 0 1 2 3

FERC - Water Resources Appraisal for Hydroelectric Licensing Figure 32

Table 24

Quinn Springs Project
Project Data

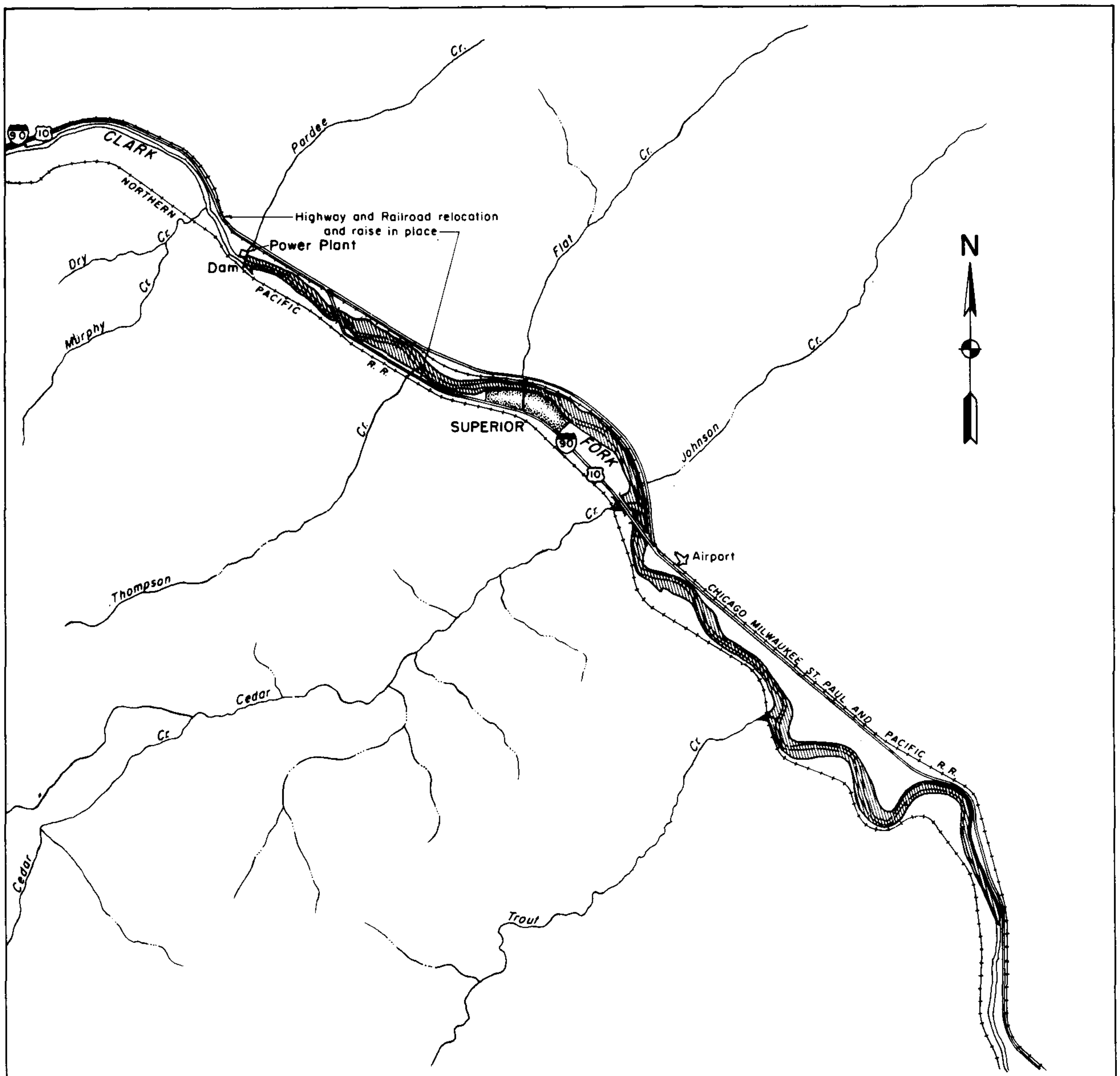
River mile, Clark Fork-Pend Oreille River		251.0
Drainage area, sq mi		10,828
Mean flow, cfs		7,584
Reservoir	Elevation (ft msl)	
Top of normal pool	2,630	
Minimum power pool	2,628	
Tailwater elevation	2,510	
Storage limited to pondage		
Power Data		
No. of units		4
Installed capacity, kW		124,000
Average annual generation, MWh		455,000
Head		
Maximum gross usable for power, ft		120

and integral powerhouse. Superior Reservoir, with a normal pool elevation of 2,700 feet, would back water on Clark Fork a distance of 10 miles (see figure 33), but the storage would be limited to pondage with a drawdown of about 2 feet, allowing at-site recreation benefits. The powerplant would include three 10,500-kilowatt units, giving a total installed capacity of 31,500 kilowatts.

Table 30 gives the monetary costs and benefits of Superior project. This development is not economically favorable at January 1979 construction costs and power values. Some road and railroad lines would have to be relocated. Benefits would consist of at-site power plus a fair amount of local recreation. However, no further consideration should be given to the Superior project development because of the unfavorable economics at present prices and values.

Quartz Creek Project

Quartz Creek project would be a single-purpose hydroelectric development on the Clark Fork 301 miles upstream from the Columbia River. At a site 56.5 miles above the confluence of the Clark Fork with Flathead River, Quartz Creek Dam would consist of a 180-foot high concrete gravity structure, 600 feet long with a gated spillway. The concrete powerhouse would be on the right bank immediately downstream (see figure 34). Quartz Creek Reservoir, with a normal pool elevation of 2,895 feet, would back water on Clark Fork a distance of 10 miles, but storage would be limited to pondage with a drawdown of about 2 feet, allowing at-site recreation benefits.



SUPERIOR PROJECT

CLARK FORK - PEND OREILLE RIVER BASIN

MONTANA

1980

SCALE IN MILES

1 0 1 2 3

FERC - Water Resources Appraisal for Hydroelectric Licensing — Figure 33

Table 25

Superior Project
Project Data

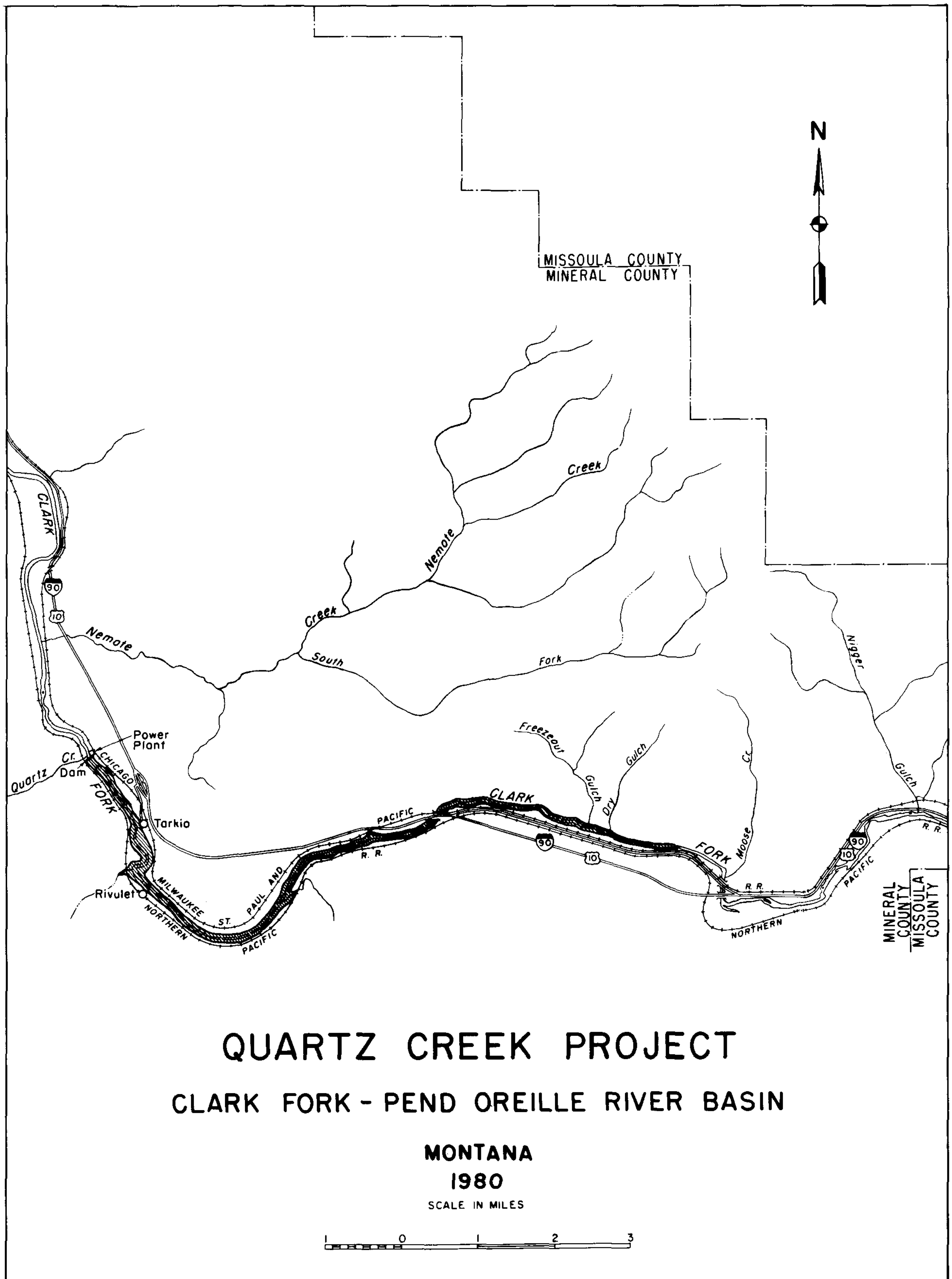
River mile, Clark Fork-Pend Oreille River	281.0
Drainage area, sq mi	10,130
Mean flow, cfs	6,540
Reservoir Data	Elevation (ft msl)
Top of normal pool	2,700
Minimum power pool	2,698
Tailwater elevation	2,660
Storage limited to pondage	
Power Data	
No. of units	3
Installed capacity, kW	31,500
Average annual generation, MWh	131,000
Head - feet	
Maximum gross usable for power	40

The powerplant would contain four 30,000-kilowatt units, giving a total installed capacity of 120,000 kilowatts. Table 26 gives the project data for Quartz Creek project.

Table 30 gives monetary costs and benefits of Quartz Creek project. The project is economically favorable with January 1979 construction costs and power values. Several short stretches of road and railroad would have to be relocated. Benefits would be mainly at-site power plus a fair amount of local recreation. Further consideration of the Quartz Creek project may be warranted.

Plateau Project

Plateau project would be a single-purpose hydroelectric development on the Clark Fork, 313.6 miles upstream from the Columbia River. At a site 68.6 miles above the confluence of the Clark Fork with Flathead River, Plateau Dam would be an 87-foot high concrete gravity structure about 700 feet long with a gated spillway and integral powerhouse. Plateau Reservoir, with a normal pool elevation of 2,955 feet, would back water on the Clark Fork a distance of 8.5 miles (see figure 35), but storage would be limited to pondage with a drawdown of about 2 feet. The powerplant would include four 11,500-kilowatt units, giving a total installed capacity of 46,000 kilowatts. Table 27 gives the project data for Plateau project. Table 30 gives monetary costs and benefits for the project.



FERC - Water Resources Appraisal for Hydroelectric Licensing — Figure 34

Table 26

Quartz Creek Project
Project Data

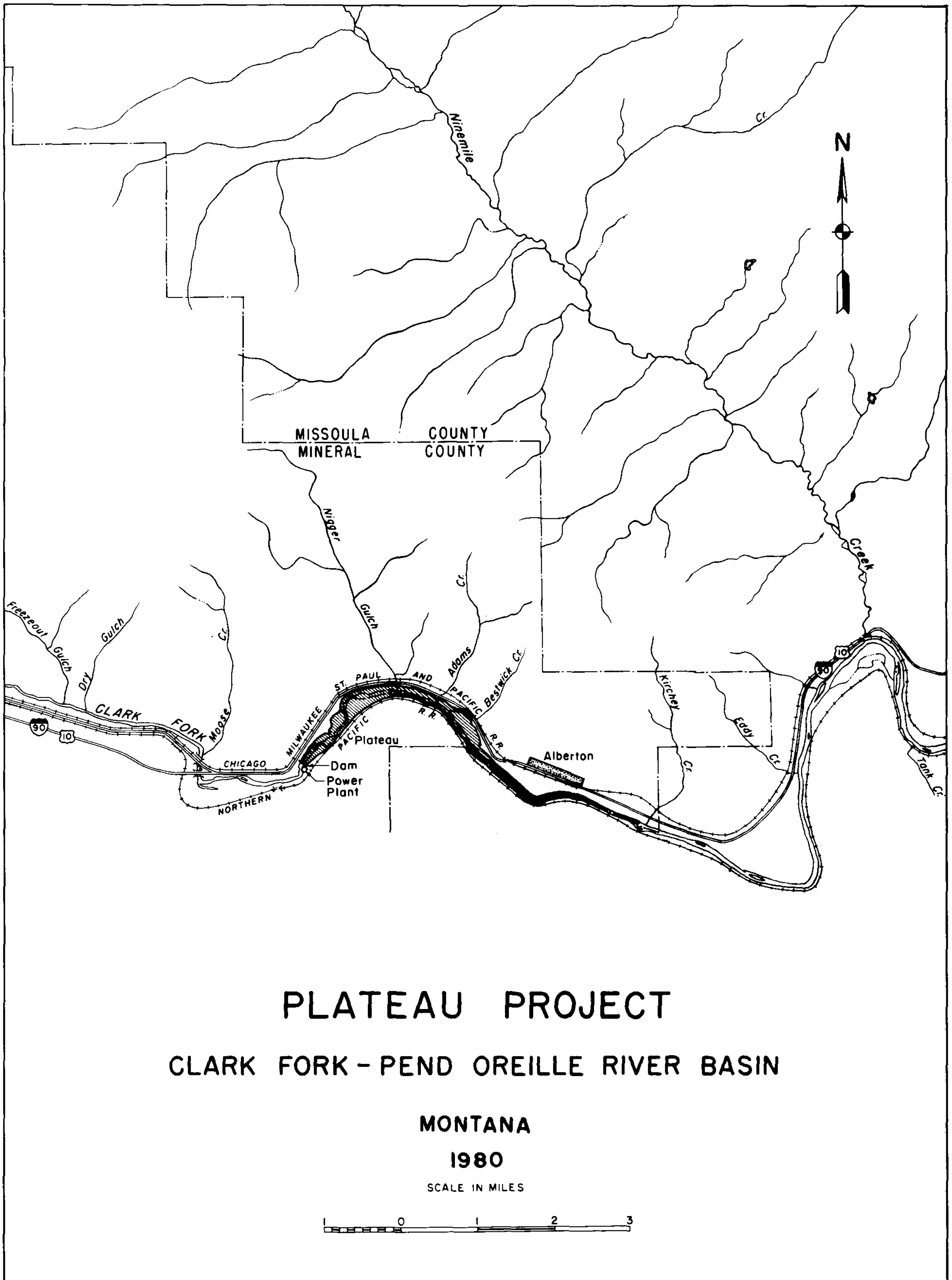
River mile, Clark Fork-Pend Oreille River	301.0
Drainage area, sq mi	9,883
Mean flow, cfs	6,130
<u>Reservoir Data</u>	<u>Elevation</u> (ft msl)
Top of normal pool	2,895
Minimum power pool	2,893
Storage limited to pondage	2,765
<u>Power Data</u>	
No. of units	4
Installed capacity, kW	120,000
Average annual generation, MWh	438,000
<u>Head - feet</u>	
Maximum gross usable for power	130

With Federal financing, hydroelectric power development at the project appears to be marginally economically favorable at January 1979 construction costs and power values; however, when railroad and road relocations are considered, the development appears to be uneconomical. Benefits would be almost exclusively at-site power with a very small amount of local recreation.

<u>McNamara Project</u>

McNamara project would be a single-purpose hydroelectric project on the Blackfoot River 13.5 miles upstream from the Clark Fork. McNamara Dam would be a 133-foot high earth and rockfill structure with a 750-foot crest, a gated spillway on the right bank, and tunnel through the left abutment supplying a powerhouse immediately downstream (see figure 36). McNamara Reservoir, with a normal pool elevation of 3,535 feet, would be limited to pondage with a drawdown of about 2 feet. The powerplant would include four 11,000-kilowatt units, giving a total installed capacity of 44,000 kilowatts. Table 28 gives the project data for McNamara project.

Table 30 gives monetary costs and benefits of McNamara project. With Federal financing, the project is economically marginal at January 1979 construction costs and power values. The major purposes of the project would be to reregulate the flows below the Ninemile Prairie development and the at-site production of power, together with a very small amount of local recreation. Further consideration should be given to this project as an afterbay for the Ninemile Prairie project.



FERC - Water Resources Appraisal for Hydroelectric Licensing — Figure 35

Table 27

Plateau Project
Project Data

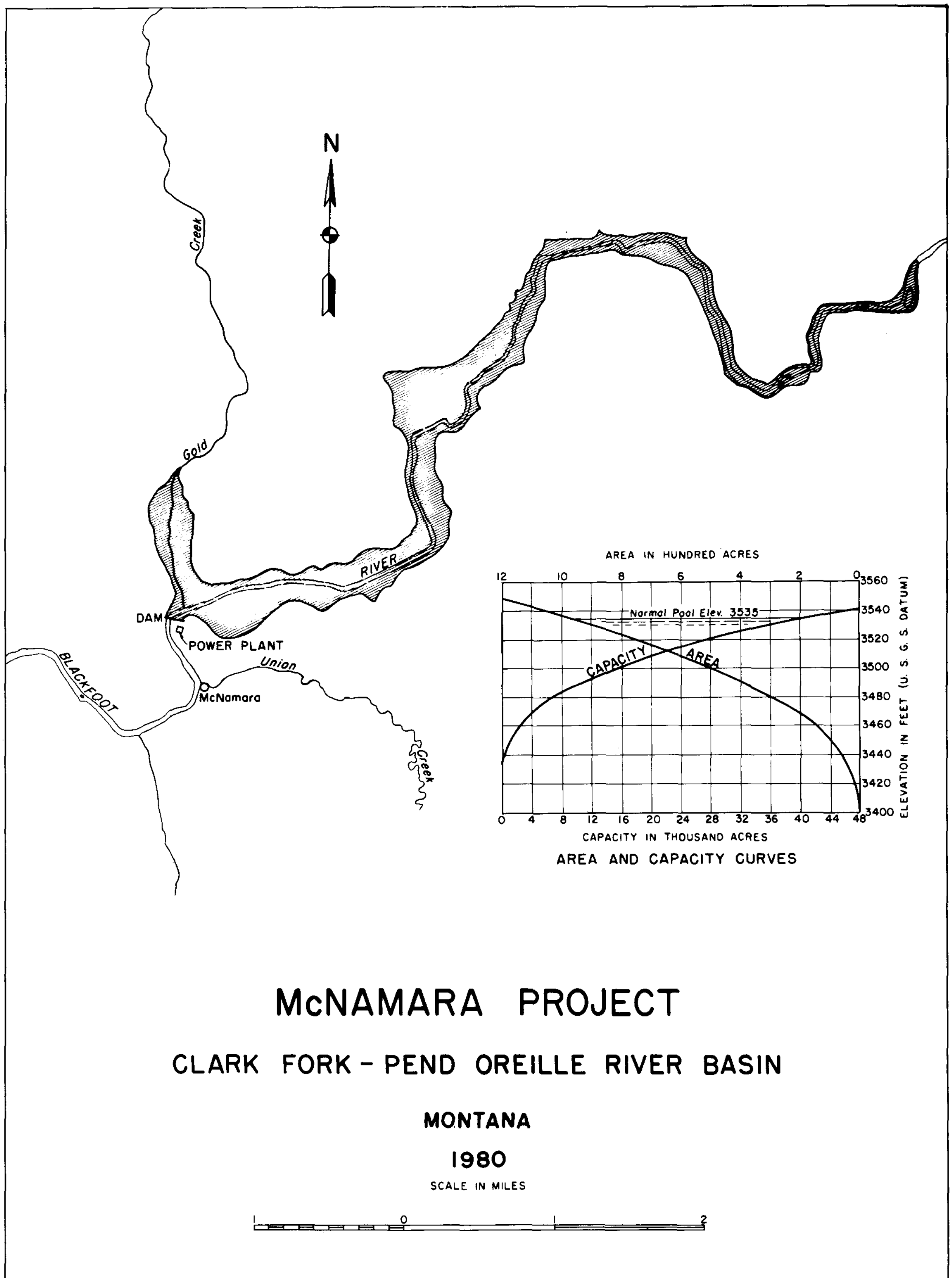
River mile, Clark Fork-Pend Oreille	313.6
Drainage area, sq mi	9,558
Mean flow, cfs	5,730
Reservoir Data	Elevation (ft msl)
Top of normal pool	2,955
Minimum power pool	2,953
Tailwater elevation	2,905
Storage limited to pondage	
Power Data	
No. of units	4
Installed capacity, kW	46,000
Average annual generation, MWh	157,000
Head - feet	
Maximum gross usable for power	50

Ninemile Prairie Project

Ninemile Prairie project would be a multi-purpose development on the Blackfoot River 22 miles up from the confluence with the Clark Fork. Ninemile Prairie Dam would be a 300-foot high earth and rockfill structure with a 1,700-foot crest, with side spillway and powerplant at the left abutment (see figure 37). Ninemile Prairie Reservoir, with a normal pool elevation of 3,819 feet, would back water on the Blackfoot River for 14 miles. The reservoir would have a gross storage capacity of 1,000,000 acre-feet of which 885,000 acre-feet would be useful for hydroelectric power, flood control, and possible irrigation. The water surface area of 11,450 acres would support fish and wildlife benefits and create recreational opportunities. The powerplant would contain four 23,000-kilowatt units, giving a total installed capacity of 92,000 kilowatts. Table 29 gives the project data for the Ninemile Prairie project.

Table 30 gives monetary costs and benefits of Ninemile Prairie project. The project is submarginally feasible with Federal or private financing at January 1979 construction costs and power values. Benefits are derived from both at-site and downstream power and flood control, local fish and wildlife, and recreation.

Should benefits be substantially increased through irrigation use of increased values, then further consideration should be given to the Ninemile Prairie development and the McNamara project.



FERC - Water Resources Appraisal for Hydroelectric Licensing Figure 36

Table 28

McNamara Project
Project Data

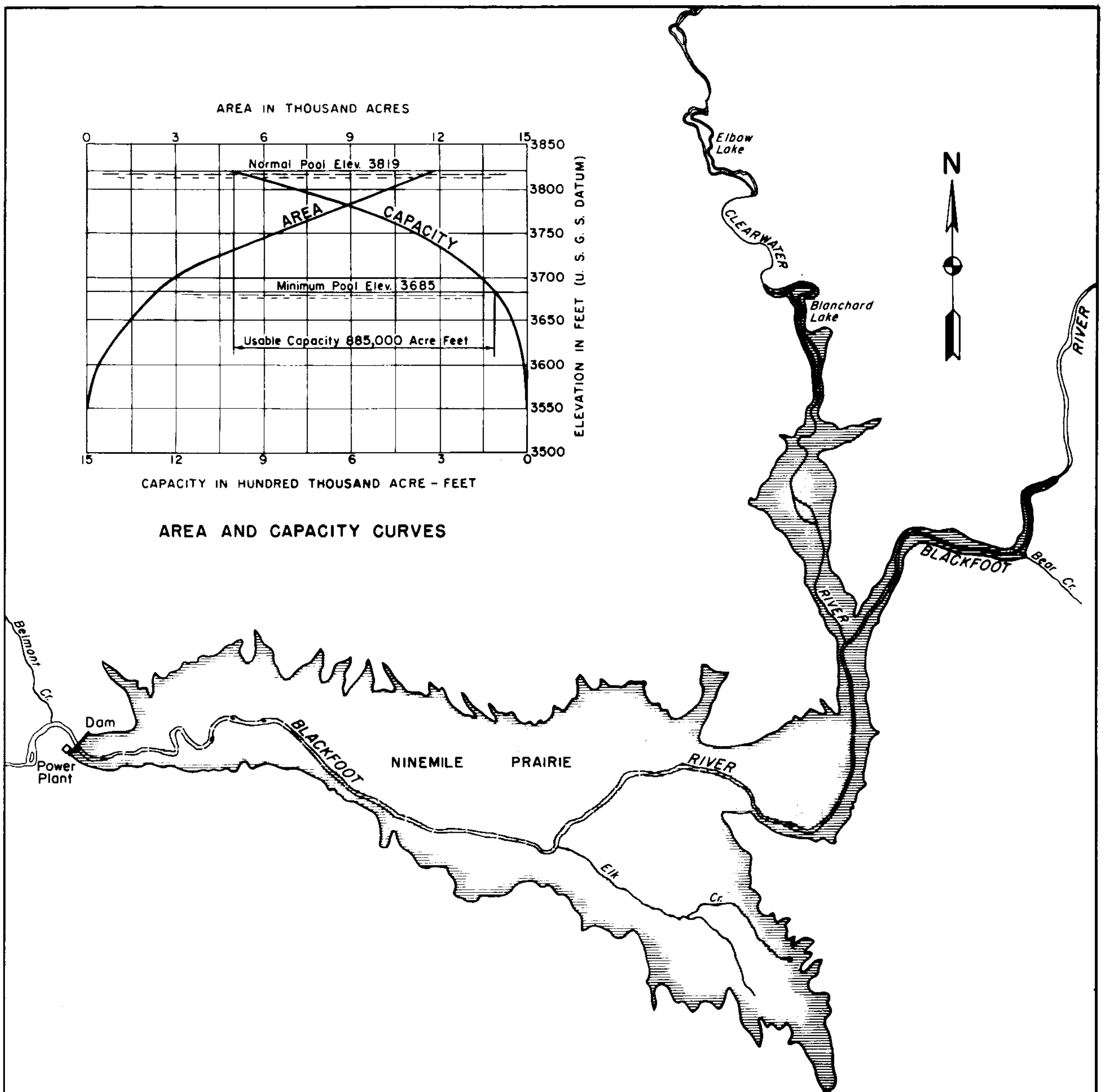
River mile, Blackfoot River	13.5
Drainage area, sq mi	2,000
Mean flow, cfs	1,220
Reservoir Data	Elevation (ft msl)
Top of normal pool	3,535
Minimum power pool	3,533
Tailwater elevation	3,417
Storage limited to pondage	
Power Data	
No. of units	4
Installed capacity, kW	44,000
Average annual generation, MWh	88,000
Storage limited to pondage	
Head	
Maximum gross usable for power, ft	118

Pumped Storage Potential

There is a large potential for the development of pumped storage hydroelectric capacity in the Clark Fork-Pend Oreille River basin due to its rugged topography. An inventory of potential pumped storage sites in the Pacific Northwest was prepared by the North Pacific Division of the U.S. Army Corps of Engineers in the January 1976 publication, "Pumped Storage in the Pacific Northwest, an Inventory." Fourty-four sites were listed for the Clark Fork-Pend Oreille River basin.

A Phase II study by the Corps completed in August 1977 reduced the number of sites under consideration to two, the Boulder Creek-Upper South Fork and the Station Creek projects. Both projects are located in the Mission Mountain range on the east side of the Flathead Lake. Both projects propose to use the Flathead Lake as a lower reservoir with upper reservoirs located in the Flathead Indian Reservation.

Boulder Creek-Upper South Fork site, located on a stream of the same name, proposal would have a 2,830-foot head with possible installed capacity of either 1,000 or 4,000 megawatts depending upon operation. Station Creek, located on a stream of the same name, would have a 2,780-foot head with installed capacities of either 1,000 or 4,000 megawatts. Both projects are not located near major load centers, and the Phase II study did not recommend the sites for further consideration, however, this does not preclude future development of pumped storage if the need arises.



NINEMILE PRAIRIE PROJECT

CLARK FORK - PEND OREILLE RIVER BASIN

MONTANA

1980

FERC- Water Resources Appraisal for Hydroelectric Licensing — Figure 37

Table 29

Ninemile Prairie Project
Project Data

	Elevation (ft msl)	Area (ac)	Usable Storage Capacity (ac-ft)
River mile, Blackfoot River			22.0
Drainage area, sq mi			2,044
Mean flow, cfs			1,140
Reservoir Data			
Top of normal pool	3,819	11,450	1,000,000
Minimum power pool	3,685	2,370	115,000
Tailwater elevation	3,534		
Storage			885,000
Power Data			
No. of units			4
Installed capacity, kW			92,000
Average annual generation, MWh			254,000
Head			
Maximum gross usable for power, ft			285

Wild and Scenic Rivers

With the enactment of the Wild and Scenic Rivers Act on October 2, 1965, Public Law 90-542, segments of the Flathead and Priest Rivers in the basin were designated for study of possible inclusion into the National system. The study function was performed within the Department of Interior by the Heritage, Conservation and Recreation Service (formerly the Bureau of Outdoor Recreation).

Two hundred-nineteen miles of the Flathead River were added to the National system on October 12, 1976, by Public Law 94-486. The reach of the river involved is as follows:

> The North Fork from the Canadian border downstream to its confluence with the Middle Fork; the Middle Fork from its headwaters to its confluence with the South Fork; and the South Fork from its origin to Hungry Horse Reservoir.

Section 5A of the National Wild and Scenic Rivers (NWSR) Act placed the entire main stem of the Priest River, Idaho (67 miles) under study for possible inclusion in the wild and scenic rivers system. The desirability of retaining the Priest River

Table 30

Summary of Monetary Costs and Benefits
Clark Fork - Pend Oreille River Basin
1979

Project	Investment Cost 3/ $(million)	Federal Financing 1/ Annual Costs $(million)	Federal Financing 1/ Annual Benefits $(million)	B/C	Private Financing 2/ Annual Costs $(million)	Private Financing 2/ Annual Benefits $(million)	B/C
Additions to Existing Projects							
Boundary	69.0				10.8	53.0	4.9
Cabinet Gorge	45.0				6.8	20.0	2.9
Kerr	15.0				2.6	12.0	4.6
Thompson Falls 4/							
Option 1	.65				.098	.19	1.9
Option 2	32.0				5.0	6.0	1.2
Potential Projects							
Sullivan Creek	19.0	1.8	3.0	1.7	3.0	4.0	1.3
Paradise 5/	2,600.0	190.0	160.0	0.8	400.0	180.0	0.5
Knowles	1,300.0	98.0	100.0	1.0	200.0	110.0	0.6
High Buffalo Rapids 5/	640.0	48.0	67.0	1.4	98.0	74.0	0.8
Buffalo Rapids No. 4	340.0	26.0	35.0	1.3	52.0	39.0	0.8
Sloan Bridge 5/	490.0	37.0	51.0	1.4	76.0	57.0	0.8
Buffalo Rapids No. 2	290.0	22.0	34.0	1.5	45.0	38.0	0.8
Quinn Springs	280.0	20.0	19.0	1.0	43.0	22.0	0.5
Superior	101.0	8.0	4.0	0.5	16.0	6.0	0.4
Quartz Creek	120.0	10.0	19.0	1.9	19.0	22.0	1.2
Plateau	80.0	7.0	7.0	1.0	13.0	8.0	0.6
McNamara 6/	60.0	5.0	5.0	1.0	10.0	6.0	0.6
Ninemile Prairie 6/	200.0	15.0	14.0	0.9	32.0	17.0	0.5

1/ *Approximate costs and benefits, using 7-1/8% interest rate.*
2/ *Approximate costs and benefits, using 10.5% interest rate.*
3/ *Based on project data stated in this report.*
4/ *License requires detailed economic study, expected in December 1980.*
5/ *Would require large relocations, opposed by local interests.*
6/ *Project appears to be not economically feasible or environmentally desirable.*

Note: This table is a preliminary screening of the numerous potential projects in the basin. Detailed studies may be required to determine the full benefits and costs.

in a relatively undeveloped state has been studied by the Forest Service under the National Wild and Scenic Rivers Act, and is being considered by Congress. President Carter's 1979 Environmental Message recommended the Priest River for Federal designation. Table 31 displays the NWSR system legislation's effect on potential and existing electric power facilities on the Flathead and Priest Rivers.

Canadian Development

In Canada, the Pend Oreille River flows about 16 miles northwesterly from the international boundary to its confluence with the Columbia River. The Seven-Mile project, presently under construction, consists of a concrete gravity dam with gated spillway and a powerplant 6 miles above the confluence near the upstream end of the existing Waneta Reservoir. The Seven-Mile powerplant will have an initial installation of

Table 31

Hydroelectric Power Resources, Developed & Undeveloped, Affected by Existing and Potential Wild & Scenic River Legislation

Project	River	Capacity (MWh)	Average Generation (MWh)	Gross Head (ft)	Comment
Section 5A - Priest River Potential Wild & Scenic River					
Priest No. 4	Priest	27.3	66.0	109	1/
Albeni Falls	Pend Oreille	42.6 2/	248.0	29	Potential addition to existing facilities. 2/
Section 3A - Flathead Wild & Scenic River					
Spruce	Middle Fk.	38.0	42.0	860	
Coram	Flathead	114.0	290.0	160	
Smoky Range	North Fork	190	510.0	350	
Glacier View	North Fork	325	367.0	222	3/

1/ *Priest Lake contains 82,000 acre-feet of storage capacity usable for power downstream.*

2/ *Although the Federally-owned Albeni Falls dam and powerplant is located on the Pend Oreille River, the reservoir backs up the Priest, therefore, project operation or expansion may be adversely affected by NWSR designation.*

3/ *Alternative to Smoky Range.*

three 202,500-kilowatt units operating under a gross head of about 200 feet, with structural provisions for adding a fourth 202,500-kilowatt unit. First power is scheduled for 1980. The ultimate installation would be 810,000 kilowatts with an average annual generation of about 3,150 million kilowatt-hours. The drainage area would be 25,800 square miles. At a normal pool elevation of 1,710 feet, the reservoir would contain 65,000 acre-feet and extend about 9 miles to the international boundary.

The Waneta development with an existing installation of 90,000 kilowatts could be expanded to an ultimate installation of 150,000 kilowatts.

Effects of Potential Developments on Existing Projects

Optimum development of potential conventional hydroelectric projects in the Clark Fork-Pend Oreille River basin could provide up to about 1 million acre-feet of additional storage capacity depending on which alternative sites were developed. This additional storage would increase power benefits at existing downstream developments. Plants on the Columbia River would be benefitted least by this additional storage. Waneta, the only project in the Canadian portion of the basin, Boundary, Box Canyon, and Albeni Falls plants below Priest River, and Cabinet Gorge, Noxon Rapids, and Thompson Falls plants below the Flathead River would receive most of the benefit from this storage. Kerr and Hungry Horse plants would only benefit from storage upstream in the Flathead drainage and Milltown from storage in the Blackfoot River basin. The potential storage capacity would have no effect on the output of Calispell, Big Creek, Big Fork, or Flint Creek powerplants.

Studies of Alternative Plans for Future Use of Project No. 5

The Montana Power Company has filed an application with the Federal Energy Regulatory Commission for a new major license for the Kerr project, Project No. 5. The expiration date for the original license was May 22, 1980. In addition, the Confederated Salish and Kootenai Tribes have filed a competing application for license for the Kerr project.

The Montana Power Company currently has no definite plans for further development of the project at the present time and proposes to continue to store water from the Flathead River drainage in its Flathead Lake reservoir to be released as required for the Kerr hydroelectric project.

To comply with provisions of the Federal Power Act, the Commission must decide whether to relicense the Kerr project or to recommend other alternatives, including takeover by the Federal Government, continued operation of the present plant, abandonment, licensing to other applicants, and the installation of additional generating capacity.

The staff has reviewed available plans of Federal, State, and local agencies and the local power companies as they relate to power production and related purposes in the Clark Fork-Pend Oreille River basins such as flood control, municipal and industrial water supply, water-oriented recreation, and fish and wildlife enhancement.

This water resources appraisal report does not formulate a plan for the basin development or a program for implementing such a plan but instead identifies what plans have been made and how they are related to Project No. 5. The project plans presented herein are of a reconnaissance level and denote the type, complexity, and general economic feasibility of individual projects considered. Detailed planning would be required to determine the final features, scope, and economic justification.

Continued Operation of the Project

Kerr, Project No. 5, first operated with 1 unit in 1938, with additional units added in 1949 and 1954. Each of the 3 units has a capacity of 56,000 kilowatts. The project is connected to the transmission and distribution systems of the licensee, serving customers in the Montana Power Company system. The structures and equipment of this project are in good condition at present and are well maintained. This project is operating adequately.

The Kerr project is capable of continuing to produce power for a number of years. Economic analysis indicates that continued operation of this project is favorable.

Installation of Additional Generating Capacity

A number of opportunities exist for additional power development at the Kerr project. Uprating existing hydroelectric generators and turbine units at the powerplants may be one of the most immediate, cost effective, and environmentally acceptable means of developing additional power. The enlargements of the present powerplants are also an attractive means of developing additional electrical power and energy.

The possibilities are briefly discussed as follows:

There is no provision in the present plant for an additional unit, but the original diversion tunnel could be rehabilitated, the building extended, and a new turbine and generator set south of Unit No. 3. Installing a fourth unit at Kerr would be expected to supply additional peaking capacity of 60 to 80 megawatts. There is also a possibility that the existing units at Kerr could be modernized and upgraded to increase present capacity by possibly 25 to 35 percent. Project data are summarized in table 32 for the Kerr project.

Table 32

Kerr Project, Unit 4
Project Data

River mile, Flathead River			72.0
Drainage area, sq mi			7,096
Mean flow, cfs			11,730
Reservoir Data	Elevation (ft msl)	Area (ac)	Usable Capacity (ac-ft)
Top of normal pool, ft msl	2,893	126,109	-
Minimum power pool	2,883	-	-
Tailwater elevation	2,706	-	-
Storage capacity, ac-ft			1,217,000
Power Data			
No. of additional units			1
Possible additional installed capacity, kW			64,000
Avg. ann. gen., MWh			15,000
Head-Feet			
Max. gross usable for power, ft			187

Table 30 gives cursory monetary costs and benefits of the addition to Kerr project. Based on power benefits only, the addition is economically favorable. There would be no non-power benefits and no additional power generated downstream.

Under existing conditions, the Kerr Dam provides approximately 1,200,000 acre-feet of usable storage capacity in Flathead Lake, 1 possible development is to increase the usable storage capacity in Flathead Lake by 1,000,000 acre-feet, which would increase the installed capacity at the Kerr plant where a head of 180 feet is now available. If the hydraulic capacity of Flathead Lake's outlet were increased from the current 5,000 cubic feet per second to 30,000 cubic feet per second (at lake elevation 2,883), flood flows could be moved through the lake much faster -- alleviating upstream flood damages, and possibly providing power generation benefits. Such a project, as previously proposed by the Corps of Engineers, would involve excavation of channel restrictions in the 2-mile reach from Polson to a point approximately 3 miles above Kerr Dam. The high point in the existing channel would be lowered about 2 feet to elevation 2,876. Lake lowering and refill would be substantially improved, with full condition (elevation 2,893) reached earlier in the year than now is possible, and recreation benefits would result. This earlier filling to full pool, however, could cause higher water tables at the north end of the lake. It would also be possible to further increase storage by raising the water surface of the lake.

The additional continuous streamflow provided by this project would increase the firm output downstream.

The outlet improvement project was determined to be not currently economically feasible in a Corps of Engineers' Study 2/; the project may become feasible in the future due to rising electricity values. However, it is opposed by a number of lakeshore property owners, who are fearful that the lake could then be lowered below the natural minimum elevation of 2,883.

Takeover by the Federal Government

Section 14 of the Federal Power Act (16 U.S.C. 807(a)), as amended, reserves the right of the United States Government to take over, operate, etc., a non-publicly-owned project upon the expiration of the license after paying the current licensee's net investment in the project, not to exceed fair value of the property taken, plus severance damages, if any.

Takeover of operations of the projects by the Federal Government for other purposes would deprive the licensee of an economical source of hydroelectric energy for its customers which probably would have to be replaced by other non-renewable power alternatives such as steam-electric power generation, either produced or purchased by Montana Power. Local counties in which the projects are located, Flathead and Lake Counties, Montana, would lose annual property taxes from the licensee, the State would lose taxes levied for the support of the University system, and the Federal Government would lose licensing fees and headwater benefit payments. In addition, the United States Government would have to assume the annual cost of operation and maintenance of the Kerr Project.

If the United States does not, at the expiration of the original license, exercise its right to takeover, maintain, and operate any project of the license, Section 15 of the Act, as amended, authorizes the Commission to issue, under the terms and conditions of the Act, a new license to the original licensee, to issue a new license to a new licensee, or to issue a license for non-power use provided that the licensed project no longer be used for power purposes in accordance with the comprehensive water resource development plan.

Considering the need for power and the project's important and beneficial role in the region's water resource development plan, the non-power use is not a practical option for the Kerr project.

2/ *Public Brochure, Flathead River Flood Control Study, U.S. Army Corps of Engineers, Seattle, February 1973.*

The project is best used for the generation of hydroelectric power; there are no apparent reasons for Federal takeover of an economical source of hydropower for other water resources purposes.

The Federal Government could possibly, however, operate the plants and system and provide power to the same customers at a somewhat lower price since taxes would not be paid. However, the lost taxes would be replaced by the taxpayer.

Abandonment

One alternative would be to abandon the project. The loss of the controlled water surface of Flathead Lake, resulting from abandonment, would change the long established fisheries, land uses, and related recreational service opportunities. Therefore, the abandonment of this project would have an adverse economic impact on the basin. In addition to creating an adverse economic effect on the licensee and its ratepayers, the abandoned generation would have to be supplied by other means, probably steam-electric, to meet the needs of the licensee and its customers. In addition, the annual fees paid by the licensee to the Federal Government would be forefeited. There appears to be no benefits to abandonment since the current and future operation of the project is economically feasible.

Environmental Considerations

Continued operation of this project, as is, would have no significant additional adverse effects on the quality of the environment for the following reasons: (1) The Montana Power Company currently plans no additional construction of power facilities; and (2) the existing facility has been in operation for some 42 years, and initial environmental disruption has long since been established. Staff concludes that relicensing of existing Project No. 5 would not significantly adversely affect the quality of the environment.

The existing hydroelectric projects in the Clark Fork-Pend Oreille River basin play a major role in the recreational activities of the basin. All of the potential projects which would involve dams and reservoirs would alter stream characteristics and runoff patterns and would affect fish and wildlife habitats. Construction of reservoirs would inundate stream fisheries but would create replacement lake fisheries. Some of the potential reservoirs could provide an improved setting for water-oriented recreational opportunities.

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