

1978. Under the pumping plan of irrigation there will be eliminated from the irrigable area some 320,000 acres of good land lying on the eastern border of the area. This is to be regretted, as the land would, if it could be irrigated economically, form an asset to the State. But it is an integral part of the gravity plan, which is infeasible, and only a small part of it can be included in the pumping plan at any reasonable cost per acre.

1979. The pumping plan, with the high dam at the Coulee, is the system which permits of the maximum amount of potential and commercial power being developed on the river and its tributaries, and has that further advantage over the gravity plan as an offset to the reduction in area.

1980. Comparisons of the potential power available under various schemes of regulation and of irrigation have been made earlier in the report. Under the pumping plan of irrigating the Columbia Basin irrigation project from the high Grand Coulee Dam there would be 323,000 kilowatts (case 8) less commercial power available 100 percent of the time at that dam than would be available under the gravity plan (case 4). However, if Z Canyon and all the sites on the main river above the Snake be considered, plan 4 (pumping) would still show an excess of 103,000 kilowatts in commercial power available 100 percent of the time over plan 2-A (gravity). With Columbia River Reservoir regulated to produce the maximum commercial power in the river system, and considering the tributaries in the United States and the main stream above the Snake, plan 4 (pumping) would produce 295,000 kilowatts more than would plan 2-A (gravity).

1981. While the foregoing discussion shows that the high dam is to be preferred in the combined irrigation and power development, when interest on the cost is considered, it should be stated that if the irrigation of the Columbia Basin irrigation project is to be effected under a plan whereby no interest is charged, the low dam might be preferred. Under such a plan, if the land were settled at the rate of 50,000 acres per year, and if \$2.50 per acre were repaid on the principal each year, the subsidy to irrigation at the end of the settlement period would be many millions of dollars.

#### IV. COMPREHENSIVE PLAN

##### A. ELEMENTS OF THE PLAN

*(Pls. nos. 146 and 147)*

1982. A general plan for the most effective improvement of Columbia River above the Snake for the purposes of navigation, and the prosecution of such improvement in combination with the most efficient development of the potential water power, the control of floods, and the needs of irrigation, is as follows:

1983. This plan is set up as a guide to future operations on Columbia River above the Snake. It is not contemplated that any of the elements are for immediate construction or that any will necessarily be undertaken by the United States. It is believed that if the plan be followed that the best use of the waters of the river will result and that the natural resources will be conserved to the fullest possible extent.

## (1) MOUTH OF SNAKE TO FOOT OF PRIEST RAPIDS

1984. Work in this section would be limited to improvements for navigation which will not be required for many years and could be constructed at any time when the navigable condition of the sections below and above require the improvement of this stretch.

1985. The work would consist of locks and lateral dams at miles 15 and 40 above the Snake. These locks would be used only at the lower river stages. The estimates of cost of these improvements are:

Mile 15 (see par. 456)-----	\$800, 000
Mile 40 (see par. 456)-----	950, 000

## (2) PRIEST RAPIDS

(Pl. nos. 97 and 101) <sup>2</sup>

1986. The potential power at these rapids can best be developed by the construction of a dam at the lower end of the rapids to maintain an upper pool level at an elevation of about 540 feet, which would back the water to Rock Island Rapids. Navigation would be improved by the construction of locks through the dam on the right bank. The estimated cost is:

Dam and power development (table no. 139)-----	\$60, 500, 000
Navigation locks (par. 1649)-----	5, 400, 000
Total-----	<u>65, 900, 000</u>

## (3) ROCK ISLAND RAPIDS

(Pl. no. 81) <sup>2</sup>

1987. A power company is now constructing a dam and power plant at these rapids and provision has been made for the construction of locks by the United States when conditions warrant. The estimated cost of constructing the locks through the dam is (par. 1650) \$1,800,000.

## (4) ROCKY REACH AND CHELAN

(Pl. nos. 75 and 69) <sup>2</sup>

1988. Plans are submitted for power developments at these points, and these plants will be needed to fully develop the potential power on the river between Rock Island and Foster Creek. These sites are believed to be the most favorable within this particular stretch. While not as desirable as are other sites where the foundation conditions are better, they can be developed to produce energy at a reasonable cost, and properly form part of a comprehensive plan for the full utilization of the power of the stream. The plans submitted also indicate how locks could be constructed through the dams although navigation structures are not included in the comprehensive plan for points above Rock Island. Estimates of cost of lock construction are given in paragraphs 1652 and 1654. The estimated costs of the power developments only are:

The Rocky Reach (table no. 129)-----	\$38, 000, 000
Chelan (table no. 126)-----	39, 000, 000

<sup>2</sup> Not printed.

## (5) FOSTER CREEK

(Pl. no. 61) <sup>2</sup>

1989. The plan calls for a dam with pool elevation of 928.6 feet, which would back the water to the Grand Coulee Dam site. The plate shows the location of possible locks, although locks are not included in the plan of improvement. The estimated cost of the power development is (table no. 123) \$48,300,000.

## (6) GRAND COULEE

(Pl. no. 57, p. 746)

1990. A high dam is proposed in the Columbia opposite the head of Grand Coulee for the generation of power for the general market and for use in connection with the irrigation of the Columbia Basin irrigation project. This dam would hold the water at elevation 1,287.6 and would back the water to the international boundary. A location for locks is shown on the plans, although none are contemplated for inclusion in the comprehensive plan.

1991. The estimated cost of the dam, power house, and machinery with 4 percent money is \$171,200,000. The pumping station is included in the cost of the irrigation of the Columbia Basin irrigation project (see par. 1996).

## (7) REGULATION OF STORAGE

1992. Prime power on the main stream and on the Clark Fork can be greatly increased by regulation of upstream storage. The comprehensive plan for improvement, therefore, includes such regulation.

1993. *i. Hungry Horse Reservoir.*—This includes a dam for impounding water in the interest of power and flood control. The water-supply studies assumed regulations below elevation 3,435 feet, giving a useful storage of 1,110,000 acre-feet. Further study would be necessary for a determination of the exact height of dam.

1994. *ii. Flathead Lake.*—The plan proposed is to regulate 1,540,000 acre-feet below elevation 2,893 and is the same plan as that proposed by the Rocky Mountain Power Co. (to whom license has been issued by the Federal Power Commission), except that the storage here proposed is the total storage between the ultimate limits suggested by the license to the power company.

1995. *iii. Pend Oreille Lake.*—It is proposed to store 1,610,000 acre-feet in this lake and regulate it below elevation 2,066.8, United States Coast and Geodetic Survey datum. Regulation would be accomplished by a dam at Albany Falls or possibly by a power dam on Clark Fork at Z Canyon. No estimates of cost were made for storage with dam at Z Canyon. The estimated cost of a dam and power development at Albany Falls is \$6,470,000.

## (8) COLUMBIA BASIN IRRIGATION PROJECT

1996. A portion of the water required for the Columbia Basin irrigation project would be pumped from the forebay of the high Grand Coulee Dam in Columbia River, and the remainder from the upper

<sup>2</sup> Not printed.

pool formed by the high Priest Rapids Dam, this scheme constituting the principal elements of plan 4-A as discussed in the irrigation section of chapter II.

1997. The estimated cost is (including pumping stations) \$207,400,000, or \$177 per acre. This is divided as follows:

Area to be irrigated by pumping from Grand Coulee Dam—1,034,000 acres at a cost of \$192,300,000.  
Area to be irrigated by pumping from Priest Rapids—140,000 acres at a cost of \$15,100,000.

## (9) IRRIGATION OF OTHER AREAS

1998. Irrigation of areas adjacent to the river than can be served by pumping from the river or by gravity diversion is part of the plan for the use of the waters of the Columbia. No special areas are included in the comprehensive plan, nor have special and detailed estimates been prepared. The areas are isolated and will be developed independently of each other and when conditions warrant.

## (10) FLOOD CONTROL

1999. No provision is made for the control of floods on the Columbia above the Snake as none is required.

## (11) SUMMARY OF COMPREHENSIVE PLAN

2000. The comprehensive plan includes navigation improvements in connection with power dams as far upstream as Wenatchee when conditions justify.

2001. *i. Navigation structures.*—Cost of navigation structures are as follows:

(a) Lock and lateral dam at Richland.....	\$800,000
(b) Lock and lateral dam at mile 40.....	950,000
(c) Locks at Priest Rapids.....	5,400,000
(d) Locks at Rock Island Rapids.....	1,800,000
Total.....	8,950,000

2002. *ii. Power development.*—Power developments at Priest Rapids, Rock Island, Rocky Reach, Chelan, Foster Creek, and Grand Coulee: Each dam to back water to next dam upstream. Dam at Grand Coulee to back water to boundary. Total prime power with regulation, 2,790,000 kilowatts.

(a) Priest Rapids.....	\$60,500,000
(b) Rock Island Rapids (being built).....	38,000,000
(c) Rocky Reach.....	39,000,000
(d) Chelan.....	48,300,000
(e) Foster Creek.....	171,200,000
(f) Grand Coulee (high dam).....	357,000,000
Total, for power.....	357,000,000

2003. Regulation of storage in—

	<i>Acre-feet approximately</i>
Hungry Horse Reservoir.....	1,100,000
Flathead Lake.....	1,540,000
Pend Oreille Lake.....	1,610,000

2004. *iii. Flood control.*—No plans for control of floods on Columbia are given as none are necessary.

2005. *iv. Irrigation.*—The irrigation plan includes the irrigation of lands marginal to the river by pumping, and the irrigation of Columbia Basin irrigation project by pumping from pool above high dam at Grand Coulee of 10,370 second-feet and by pumping 1,390 second-feet from above Priest Rapids Dam. Area to be irrigated is about 1,175,000 acres.

(a) Columbia Basin irrigation project, \$207,400,000.

2006. *v. Items included in plan for which estimates have not been prepared*—

- (a) Hungry Horse Dam and power house.
- (b) Control works at outlet of Flathead Lake.
- (c) Irrigation of lands marginal to the river.

2007. *vi. Items that may at some future time form part of the comprehensive plan but are not at present included*—

- (a) Control of 569,000 acre-feet of storage in Priest Lake.
- (b) Control of storage in Pend Oreille Lake by dam at Z-Canyon.
- (c) Control of 430,000 acre-feet of storage in Coeur d'Alene Lake.
- (d) Construction of locks at Rocky Reach, Chelan, Foster Creek, and Grand Coulee.
- (e) Irrigation of Rathdrum Prairic.

#### B. ECONOMIC ANALYSIS

2008. The complete canalization of the Columbia River above the Snake, to permit direct traffic from Portland to the Canadian line, is physically possible. The cost of such work, however, would be out of all proportion to the benefits secured.

2009. Navigation between Snake River and points below Wenatchee can be made physically possible, in connection with power development, by the construction of locks through the dams at Priest Rapids and Rock Island Rapids and by the improvement of the river channel between Priest Rapids and Snake River. The economic feasibility of such work would depend upon the amount of traffic that would pass through the locks. If this traffic amounted to 250,000 tons annually, the water rate, to cover all costs including interest on the investment at 4 percent, would be approximately equal to the rail rate. An analysis of the potential traffic indicates that river commerce would never exceed 250,000 tons annually and it is, therefore, concluded that improvement of the upper river for navigation would not be justifiable on economic grounds under present conditions or under predictable future conditions.

2010. The analysis of costs of river transportation above the Snake indicate that if 500,000 tons were available for river commerce at some future time, there would be a saving of approximately \$1 per ton for the 500,000 tons as compared to the present rail rates in the State of Washington. If future development of production along the river indicated that 500,000 tons traffic would be available for river commerce, the Federal Government might be justified in participating in the cost of constructing locks through dams across the river below Wenatchee as an aid to navigation provided rates for rail and motor truck transportation remained as at present.

2011. A complete utilization of the water of the Columbia for power development, between the international boundary and the mouth of Snake River, can be secured by the construction of a high dam at

Grand Coulee and by dams at Foster Creek, Chelan, Rocky Reach, Rock Island Rapids, and Priest Rapids. These developments, with regulation of storage, would ultimately permit the development of 2,790,000 kilowatts of prime power at a very low cost per kilowatt-hour, and will be economically feasible when there is a demand for the power. Construction of these dams would provide pools which would reach upstream to the toe of the dam above, in each case, thus utilizing most of the grade in the river for power development.

2012. The construction of a high dam at Grand Coulee would submerge the site at Kettle Falls and, at the same time, would form a barrier to complete canalization of the river in the interest of navigation. On the other hand the construction of a high Grand Coulee Dam would create sufficient revenue from the sale of power to provide a satisfactory subsidy for irrigation development under the pumping plan at Grand Coulee. A low dam at this point would not provide sufficient power to subsidize irrigation development, although it would permit the development of power at Kettle Falls. The total ultimate power development at the high dam at Grand Coulee, however, would be greater than the combined power developed from a low dam at Grand Coulee and a dam at Kettle Falls and Fish Hawk site on Spokane River and the construction of a high dam at Grand Coulee would, therefore, represent the best plan for the complete utilization of the water of Columbia River from the standpoint of power development.

2013. The Columbia River carries sufficient water to supply all irrigable lands adjacent to the river, without materially reducing the volume of water available for power development. This is particularly true under plan no. 4-A where the water used in irrigation of lands in the southern end of the Columbia Basin irrigation project would be available for power development at all sites above Priest Rapids.

2014. An analysis of the benefits to local and regional interests resulting from irrigation development clearly shows that the value of these benefits exceeds the cost of construction with interest under the pumping plan. This balancing of costs and benefits establishes the economic feasibility of the pumping project under either plan 4 or 4-A. A similar attempt to balance costs and benefits under plans for delivery of water to the upper Columbia Basin by gravity show that the costs exceed the benefits and that gravity plans for water delivery are, therefore, infeasible.

2015. The analysis of the economic feasibility of irrigation development under plans nos. 4 and 4-A is based upon an assumption that cheap secondary power will be available for pumping. Without such power development, irrigation under any plan would cost more than the value of the benefits to be derived and could not be justified under any consideration.

2016. The returns from the sale of water alone would not be sufficient to meet the cost of irrigation construction with interest. A combined use of the revenue from the sale of water to farmers and from the sale of power to the public would pay all construction costs with interest.

2017. It is apparent that a combined development of irrigation and power would be desirable since such combined development would represent a more complete utilization of the water of the Columbia

River than would be provided by power development alone. Such a combination is necessary if irrigation is to be provided, since cheap secondary power is essential to economic feasibility and combined revenue is necessary to meet construction costs.

2018. The use of revenue from the sale of power as a subsidy for irrigation development by the pumping plan is justified on the following grounds: First, irrigation development alone, when judged from the standpoint of the local and regional values which it creates, is economically feasible. Second, the establishment of a primary industry, such as agriculture, represents an expansion in the wealth producing capacity of the Nation and creates opportunity for productive activity that is available to any citizen of the United States. Third, increased production due to irrigation development would reduce the cost of farm produce to the consumer in the Northwest, provided production was sufficient to exclude marginal supplies of produce now imported from distant points.

2019. Government participation in irrigation development, either by a loaning of credit or by providing interest-free money, may be justified on a basis of the second and third classes of benefits named above. Participation of business interests, both local and regional, through assessments imposed by a large district organization, may be justified on the basis of the first class of benefits named above. A combined revenue from the sale of water and power and from an assessment of benefits, created by the irrigation development, would provide better security for repayment and would permit repayment in a shorter period than would be possible where revenue is secured from the sale of water and power alone.

## V. CONCLUSIONS AND RECOMMENDATIONS

### A. CONCLUSIONS

2020. The purpose of this investigation and report is to produce a comprehensive plan for the use of the waters of the Columbia River above the Snake—a plan which could be used as a guide to all future construction on the river.

2021. Such a plan is given in chapter IV. Future conditions now unforeseen may dictate some modifications, such as slight changes in locations and heights of dams; but the general plan is believed sound. It should not be modified, except in detail, without mature consideration.

2022. It is not to be understood that the particular designs of the structures, such as dams and power plants, are essential to the comprehensive plan. The designs are submitted to indicate what could be done and to furnish data on which to estimate the cost as a basis for the economic study. The comprehensive plan is the general method of using the waters of the stream—it sets forth a principle rather than a specific design.

2023. Navigation on the Columbia above the Snake is not and probably never will be important. Some local traffic connecting with the nearest railway points may develop in quiet stretches of the river and in the pools above power dams. Although future traffic on the river will probably never be important, provision should be made in all plans of power dams for future construction of navigation locks should commerce develop to a point where the expenditure would be justified.