State of
Washington

Department
of Ecology

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D R A F T

– P O L I C Y –

SNAKE RIVER (MAIN STEM) IN WASHINGTON

JANUARY 1974

OLYMPIA, WASHINGTON

A STATE POLICY FOR MANAGEMENT OF THE WATERS OF THE SNAKE RIVER (MAIN STEM) IN WASHINGTON

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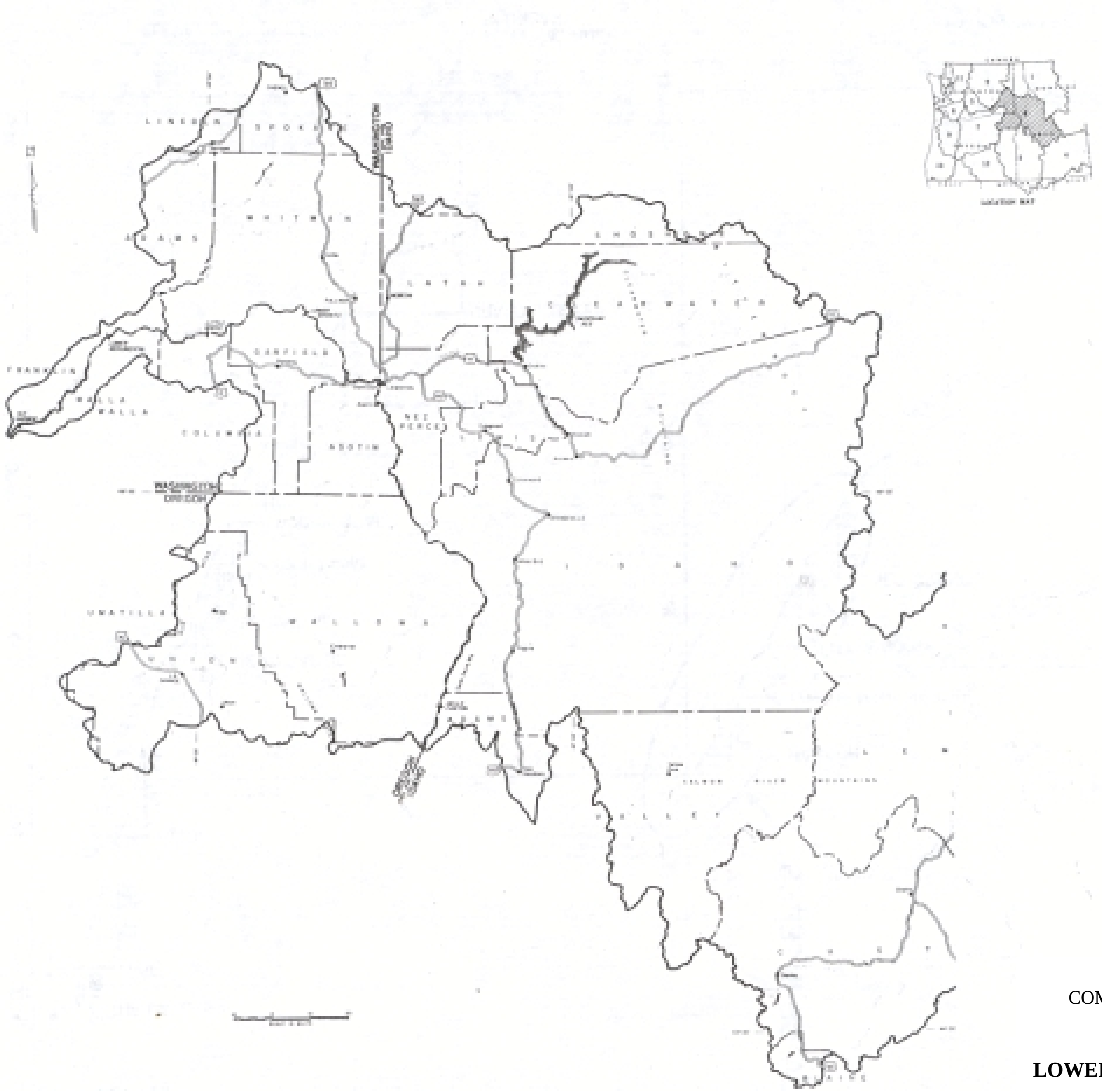
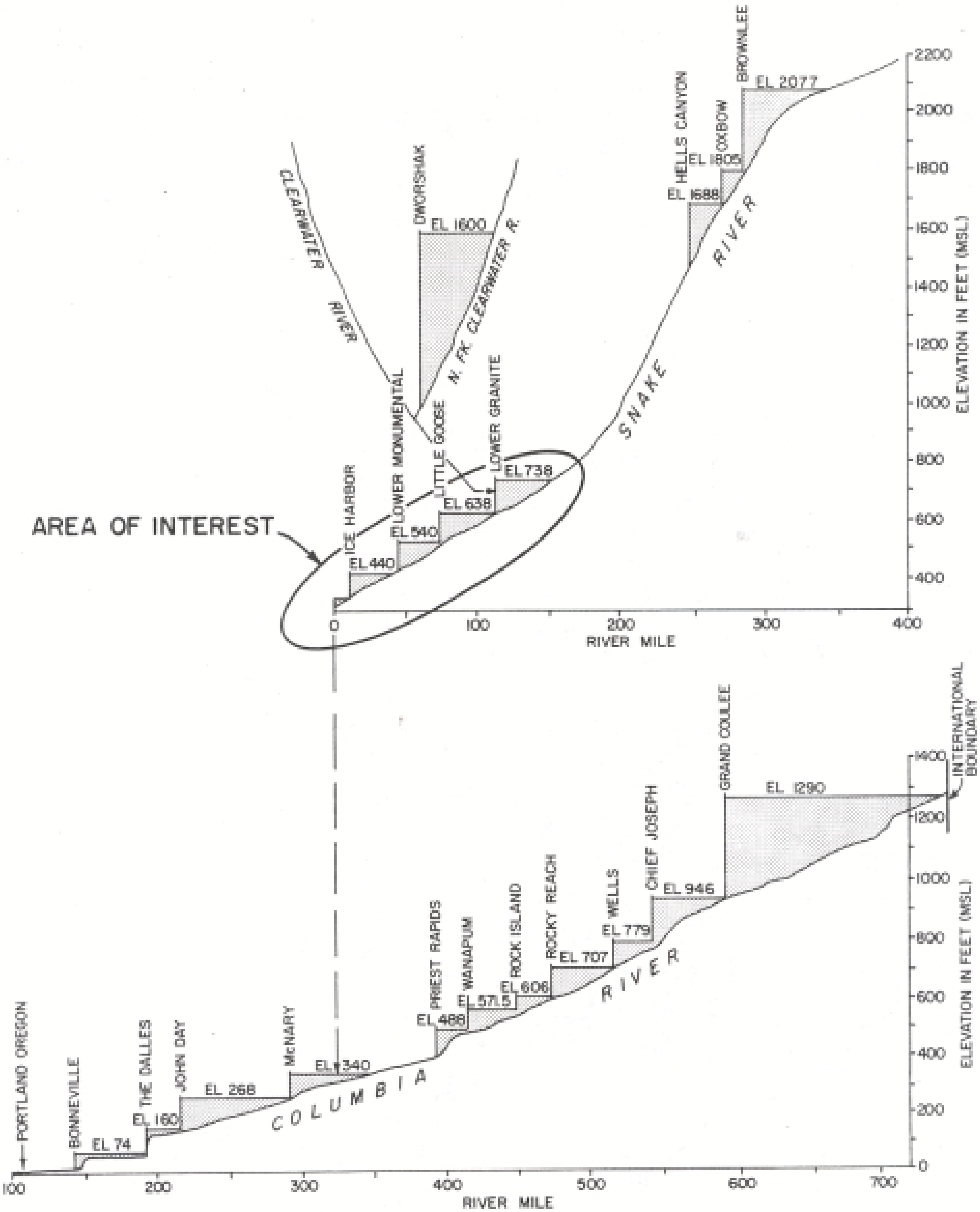


COLUMBIA-NORTH PACIFIC
COMPREHENSIVE FRAMEWORK STUDY

LOWER SNAKE



COLUMBIA AND LOWER SNAKE RIVER PROJECTS

C O N T E N T S

Appendices

A STATE POLICY FOR MANAGEMENT OF THE WATERS OF THE SNAKE RIVER (DRAIN STEM) IN WASHINGTON

SUMMARY

The policy recommended herein results from an assessment of the land capability and river flow characteristics within the Snake River area of Washington. The demands on the flow were investigated as to both instream and out-of-bank requirements, based on the water resource system modified to 1970 use conditions.[3] Out of the assessment came a prioritization on the allocation of water to the major use categories, that is, preservation (12,000 cubic feet per second) first priority, consumptive uses (2,000 cubic feet per second-primarily irrigation) second priority yet firm, minimum flow, i.e., enhancing instream uses (8,000 cubic feet per second) third priority allocation and power (remaining flow) as the fourth priority.

The policy recommended provides a maximum firm monthly diversion of 122,000 acre-feet, whereas "diverted water causes a loss only for power generation, except for diversions on the order of 400,000 acre-feet or more monthly in low-flow years."[4] The power loss is documented and recognized, as is power consumption necessitated by diversion.

The recommended policy allocates all waters of the Snake River system in Washington approximately 95 percent of the time now and 98 percent of the time at the ultimate installed hydroelectric power generating level.

Water rights on a firm basis will continue to be issued until the 2,000 cubic feet per second block is allocated.

The State will work towards the implementation of actions which further the policy adopted.

*All references are noted in attached Appendix L.

RECOMMENDATION

As a result of the analysis presented and information referenced in Appendices A through M, the following policy recommendations are made:

It is the policy of the Department of Ecology to protect an instream flow of 12,000 cubic feet per second[15] in the Snake River in Washington; to allocate a maximum of 2,000 cubic feet per second (554,000 acre feet per year) firm supply for irrigation[18] and allied consumptive uses; to protect an additional 8,000 cubic feet per second to assure a minimum flow of 20,000 cubic feet per second[12]; and, to recognize that the remaining waters are required for power production on the Snake and Columbia Rivers.[4]

This policy sets forth the following prioritization for Snake River waters in Washington:

Priority	Quantity	Purpose
1	12,000 cubic feet per second	Preservation of instream values including navigation
2	2,000 cubic feet per second	Consumptive uses
3	8,000 cubic feet per second	Minimum flow
4	Remainder (95% to 98% of time)	Power

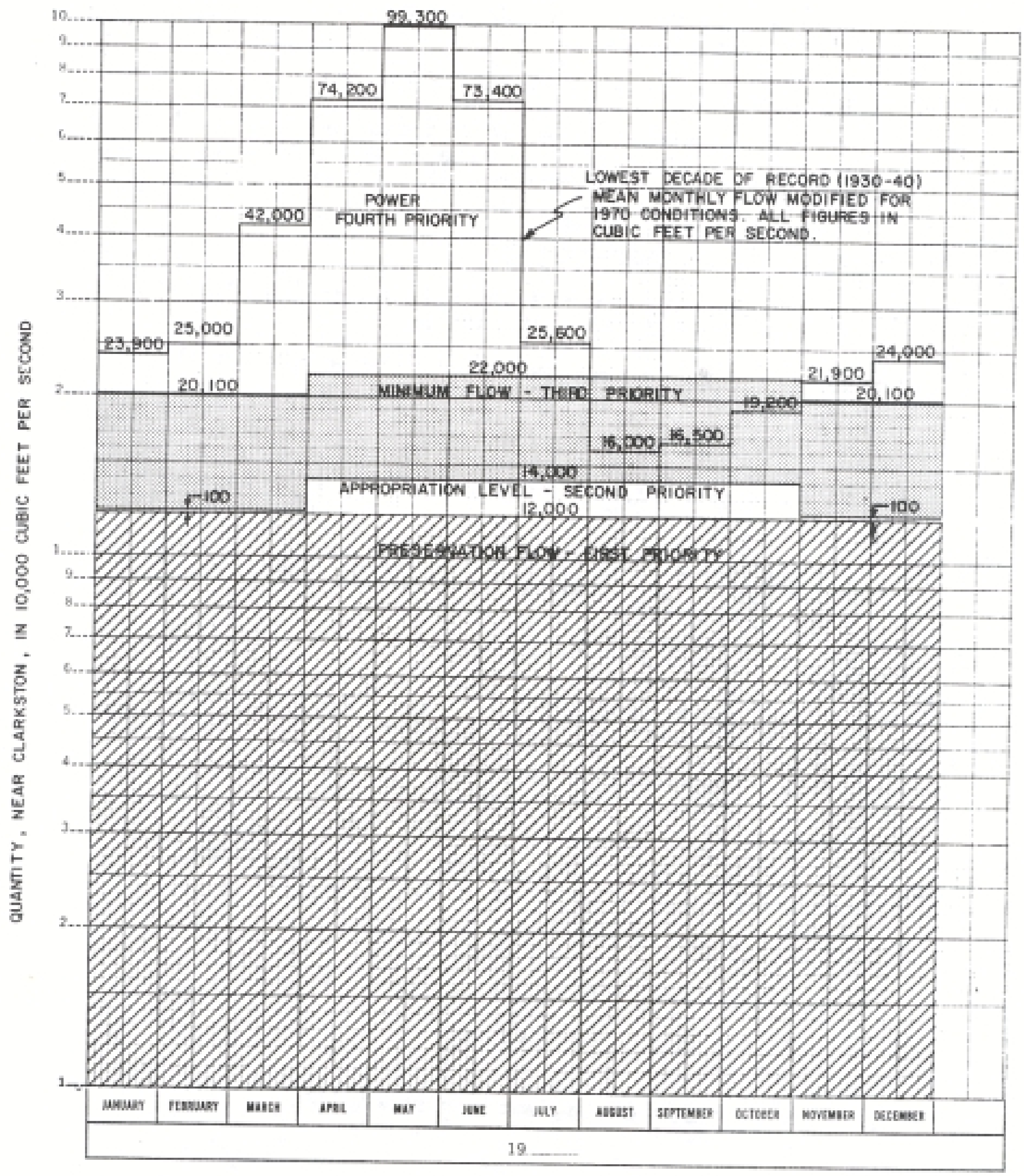
Annual minimum flows were used for both the preservation and enhancement flows recommended.

Variable flows were allocated to the out-of-bank uses to reflect their seasonal use patterns.

The Department of Ecology shall require the use of groundwater and/or the conjunctive use of surface and groundwater when drainage conditions warrant.

FIGURE 1

The following graph depicts the relationship between priority uses and the average flows modified for 1970 conditions in detail:



RESOURCE BASE

The water flow in the Snake River was analyzed on the basis of modified flows for the period of record 1928 to 1968 for a 1970 level of development in Washington, Oregon and Idaho.[3] The 7-day, 10-year flow was developed from 1915 through 1950,[28] for the system as modified during that time. See Figure 1 and the referenced appendices for further information.

The land resource base was analyzed by classes and irrigability criteria. The most likely irrigable area amounts to 136,000 acres[18] under assumed market conditions.[19]

RESOURCE USE

Currently within the Snake River Basin within Washington the following uses are made of flows available:

1. Irrigation – 540 cubic feet per second for approximately 40,000 acres.
2. Navigation – 400 cubic feet per second (Lockage requirement only) FPC License, Brownlee, Art. 43, sets a 13,000 cubic feet per second instream flow 95% of time.
3. Power – 66,000 cubic feet per second (105,000 cubic feet per second after construction completed at Ice Harbor).
4. Recreation – Unknown.[12, 27]
5. Fisheries – Unknown (300 cubic feet per second required for operation of fish passage facilities).
6. Municipal and Industrial – Less than 10 cubic feet per second.

An apparent ultimate likely development of the Lower Snake area in Washington would indicate the following potentials:

1. Irrigation – 2,000 cubic feet per second for 140,000 acres.
2. Navigation – 400 cubic feet per second lockage.
3. Power – 132,000 cubic feet per second maximum installed capacity.
4. Recreation – 12,000 cubic feet per second.[12]
5. Fisheries – Unknown (300 cubic feet per second for ladders). Note: A flow is provided of 12,000 cubic feet per second firm plus 8,000 cubic feet per second less an amount not to exceed 2,000 cubic feet per second during the irrigation season when the river flow near Clarkston falls below 22,000 cubic feet per second.

6. Municipal, Domestic and Industrial – 100 cubic feet per second maximum.

The above paragraphs present the current and ultimate resource use within the Lower Snake River area in Washington. The following is a discussion of the resource use recommended:

A. The preservation flow, i.e., an instream flow of 12,000 cubic feet per second, is highest priority and is a fixed quantity from where the Snake River enters Washington above Rogersburg (Snake River Mile 175) to Ice Harbor Dam (Snake River Mile 9.7). The 12,000 cubic feet per second is the rounded 7-day, 10-year low flow based on the period of record from water year 1918 through 1950 near Clarkston (U.S.G.S. Gage No. 13-3435 at River Mile 132.9 below the confluence of the Clearwater River).[28] The State of Washington has a state-wide regulation under RCW 90.54.020(a) setting forth the criteria for said preservation flow. The preservation flow is measured as the inflow to Lower Granite Pool; therefore, provisions in water rights must be referenced thereto.[24] The constant 12,000 cubic feet per second is routed on the basis that the river system is totally impounded through Lower Granite, Little Goose, Lower Monumental, and Ice Harbor reservoirs.

The preservation flow is 1,000 cubic feet per second less than the 13,000 cubic feet per second provided in Art. 43, F.P.C. license for Brownlee Dam and is the same as the 12,000 cubic feet per second-recommended minimum flow by the Pacific Northwest River Basin's Commission report of 1973.[12]

B. The out-of-bank allocation of a maximum of 2,000 cubic feet per second (554,000 acre-feet per year) as a firm supply for irrigation and allied consumptive uses is very high priority, but lower in priority than the preservation flow. There is a small probability of infringement upon the 2,000 cubic feet per second in the reaches of maximum diversion, i.e., Ice Harbor pool; however, the 2,000 cubic feet per second would be specifically subject to the 12,000 cubic feet per second preservation flow.

A firm supply is defined as a supply being no less than 90% of the water demand in any 10-year period and not less than 50% in any one year. The 2,000 cubic feet per second allocated to out- of-bank uses is on a firm supply basis.

The out-of-bank allocated water is generally distributed among consumptive uses as follows:

Use	Quantity	Comment
Irrigation	1,900 cfs (up to 517,000 A.F.)	A gross duty of 3.8 A.r./ac/yr. is used.[25]
Allied purposes (Domestic Municipal and Industrial)	100 cfs (up to 37,000 A.F.)	An assumed use factor of 50% is used.

The irrigation demand is distributed as follows:

Month	Range in Percent of Total	Average (Percent)	Average monthly Division (Acre-feet)
April	0 – 10	5	25,900
May	10 – 17	13	67,200
June	18 – 26	23	118,900
July	18 – 35	23	118,900
August	12 – 28	23	118,900
Sept.	5 – 15	10	51,700
Oct.	0 – 7	3	15,500

The allied demands are distributed evenly over the entire year.

It is not contemplated that the breakdown within this consumptive class be rigidly held.

A regulation under RCW 90.54.050 will be used to effect such allocation in the form of a reservation for future use.

Since the depletion base year is 1970, all allocations since 1970 are part of the 1,900 cubic feet per second allocated to irrigation. To tabulate the current charge against the 1,900 cubic feet per second, figures from all outstanding permits, and any certificate issued subsequent to January 1, 1971, were used. These appropriations or potential appropriations amount to approximately 750 cubic feet per second (up to 155,000 A.F.) and are tabulated in Appendix F.

C. Minimum flows for the Snake River below Clarkston have been recommended by the Columbia River Fishery Advisory Group. The minimum of the minimum flows is 20,000 cubic feet per second and is the flow recommended by the group for all but four months of the year. The policy of the Department of Ecology should be responsive to instream values as well as out-of-bank and power uses. Hence, the policy of the Department of Ecology is to work towards a minimum flow of 20,000 cubic feet per second to instream uses so that maximum feasible protection is given in stream values. These values include aesthetics, fisheries, recreation, and any other use compatible with the public's use of this system.

This quantity would benefit by the 12,000 cubic feet per second preservation flow, but, when flows at Clarkston are below 22,000 cubic feet per second during the irrigation season, would lose by the depletion portion of the higher priority 2,000 cubic feet per second out-of-bank uses.

The 20,000 cubic feet per second is a constant figure throughout the year and will be protected under the Minimum Flow Act (RCW 90.22).

The probability of water being available beyond the 22,000 cubic feet per second (20,000 cubic feet per second adjusted with the 2,000 cubic feet per second depletion) level is less than 50% at Lower Granite.

IMPLEMENTATION

The primary tools to be utilized in the continuing development and implementation of the recommended policy follow:

1. Regulations:
    - A. To formalize the recommended 12,000 cubic feet per second preservation flow, the state-wide, 7-day, 10-year preservation flow regulation is being promulgated under RCW 90.54.020(a).
    - B. To assure the block of 2,000 cubic feet per second to irrigation and related consumptive uses, the Water Resources Act, Reservation Section (RCW 90.54.050) will be utilized.
    - C. To enhance certain instream uses, the Minimum Flow Act (RCW 90.22) will be followed.
2. To assure that Washington State interests are preserved vis-a-vis Oregon and Idaho an interstate compact may be investigated.
3. The water resource information system can be used to compile information on this basin. Supporting information noted in Appendix L is available through the information system.
4. The manpower necessary for coordination of the various interests having concerns over the impact of the presented policy will be available.

There are several constraints to implementation of the policy as recommended by this investigation. Constraints appear to include:

1. The possibility that relevant statutes, federal or state, regarding such things as license or authorization provisions (power, etc.) may hamper or modify implementation of the recommended policy.
2. The navigation, fisheries, and power flows have been assessed as to impact, rather than as objectives to be met, thereby bringing up potential use conflicts.
3. A minimum of coordination has been attempted as between the several entities having a primary interest in the type of policy presented. Therefore, certain disputes with other interests are expected to arise. Such disputes may take the following form:
   (a) The Corps of Engineers may state that no consideration was given to their navigation and power requirements and invoke the federal-state relationship relative to such matters.
   (b) The Bonneville Power Authority and Federal Power Commission may consider their power flow requirements or system operations to be unacceptably impacted.
   (c) Various fisheries interests may object to their interests not being provided with 100% of their demands on the system. This may result from the fact that a 20,000 cubic feet per second or higher flow level was not selected as the required preservation flow.
4. The physical constraint of the current system operation and upstream usage.
5. The possible conflicts with Oregon and Idaho.
6. The public acceptance has not been tested.
7. The environmental impacts have not been fully assessed as of this writing.

APPENDIX A

State of Washington Department of Ecology

STATE WATER PROGRAM

COLUMBIA AND SNAKE RIVER STUDY AREA

<u>Water Supply of the Snake River in Washington</u>

In order to allocate the waters of the Snake River in Washington among competing potential uses of the water, it is important that the water supply available for allocation be known. The purpose of this paper is to present an analysis of the availability of water in the Snake River in Washington.

The Snake River at the Washington-Oregon-Idaho border contains waters that have escaped from the intensively irrigated Snake River Plain in Idaho and from other irrigated areas in Idaho, Oregon, and Wyoming. Irrigation development occurred in the Snake River Basin prior to 1870 and there was a rapid growth in irrigation acreage developed using surface water between 1870 and 1920 with about 2,400,000 acres of land irrigated using surface water in 1920. Between 1920 and 1966, the increase in the use of surface water for irrigation was not as rapid and about 3,100,000 acres were irrigated by 1966 from surface water sources.

The annual flow of the Snake River near Clarkston has varied from 20,000,000 acre-feet (27,600 cfs) in 1931 to 54,300,000 acre-feet (74,940 cfs) in 1971 during the period of record from 1910 to 1973. The minimum daily flow was 9,320 cfs in September 1958. The minimum 7-day flow in 1958 was 10,100 cfs.

A diagram showing the average flow for the period of record is given in Figure 1. In order to evaluate the impact of upstream development, hydrologic years 1931 through 1940 has been used as a base period. The average flow during 1930 through 1940 was 29,100,000 acre-feet compared to a period of record average of 35,900,000 acre-feet. The monthly average flow for the 1931 through 1940 water year (in cubic feet per second) is:

October	November	December	January	February	March
18,200	21,400	24,100	24,200	24,100	44,300

April	May	June	July	August	September
79,700	106,700	79,500	26,700	15,300	15,700

In May 1957, the Water Management Subcommittee of the Columbia Basin Inter-Agency Committee issued a report on stream flow depletion in the Columbia Basin. This report contains information on the flows that would exist in the Snake River if the conditions of development projected for 2010 existed during the period of record. In February 1973, a report was issued by the Columbia River Water Management Group which contained information on the flows which would have occurred with the 1970 level of development.

Information on the three conditions is given in Table 1. These data indicate the annual depletion has increased by 1,400,000 acre-feet between 1930 and 1970 and will increase by an additional 400,000 acre-feet if and when the development projected for 2010 occurs. Of concern to an allocation of water in Washington is the change in level of the minimum flows. The average monthly flows for the 1931-40 period are given in Figure 1 for the measured data and for the projected 2010 conditions. The diagram indicates the low flows will not be reduced by additional development in Idaho and Oregon. A frequency analysis has been made of the low monthly flow in the Snake River near Clarkston. The data are given in Figure 3. The 1 in 10 year flows is 13,000 cfs. The year with a flow close to 13,000 cfs was 1934. The low 7-day flow was 12,400 cfs in 1934.

Assuming water is available for allocation up to the nine in ten year monthly average flow level, a total of 20,700 cfs of water is available for allocation. The 7-day, 9 in 10 year flow is in the order of 20,000 cfs.

On the basis of the analysis above, the water available for allocation among competing uses is 7,600 cfs during the low flow period. The 1 in 10 year flow of 12,400 cfs is for a highly modified system. The natural flows of the Snake River are not known, nor is an estimate of the natural low flows readily available. The average annual depletion during the 1930's was 5,900 cfs. The total consumptive use was about 1,000,000 acre-feet (16,000 cfs) but most of this was from storage. Until additional information is available, the modified 1 in 10 year 7-day low flow should be used as the preservation flow.

In order to check the 1 in 10 year 7-day low flow developed in the analysis given above, the U.S. Geological Survey was asked to analyze the data they have available and to develop an estimate of the 1 in 10 year, 7-day low flow. The results are given below.

Time Period (Climatic Year)	Number of Years	1 in 10 year, 7-day low flow
1918-22, 30-40	14	11,000 cfs
1918-22, 30-50	24	11,700 cfs
1918-22, 30-60	34	11,800 cfs
1918-22, 30-71	45	11,700 cfs

The 1 in 10 year, 7-day low flow for about the same period as the previous analysis (1916-1950) is 11,700 cfs.

The preservation flow is the 1 in 10 year, 7-day low flow which is 12,000 cfs to the nearest 1,000 cfs. As stated previously, this is for a highly modified system.

TABLE 1 – Flow in the Snake River During 1931-40 with Different Conditions of Development

Month	Measure	1970 Conditions	2010 Conditions
October	18,200	19,200	19,700
November	21,400	21,900	24,900
December	24,100	24,000	23,600
January	24,200	23,900	23,600
February	24,100	25,000	22,900
March	44,300	42,000	41,200
April	79,700	74,000	69,000
May	106,700	99,000	94,800
June	79,500	73,400	70,600
July	26,700	25,600	23,700
August	15,300	16,000	14,600
September	15,700	16,500	17,100
Annual (cfs)	40,000	37,700	36,500
(acre-feet)	29,100,000	27,700,000	27,300,000

Monthly average flows in cubic feet per second (cfs)

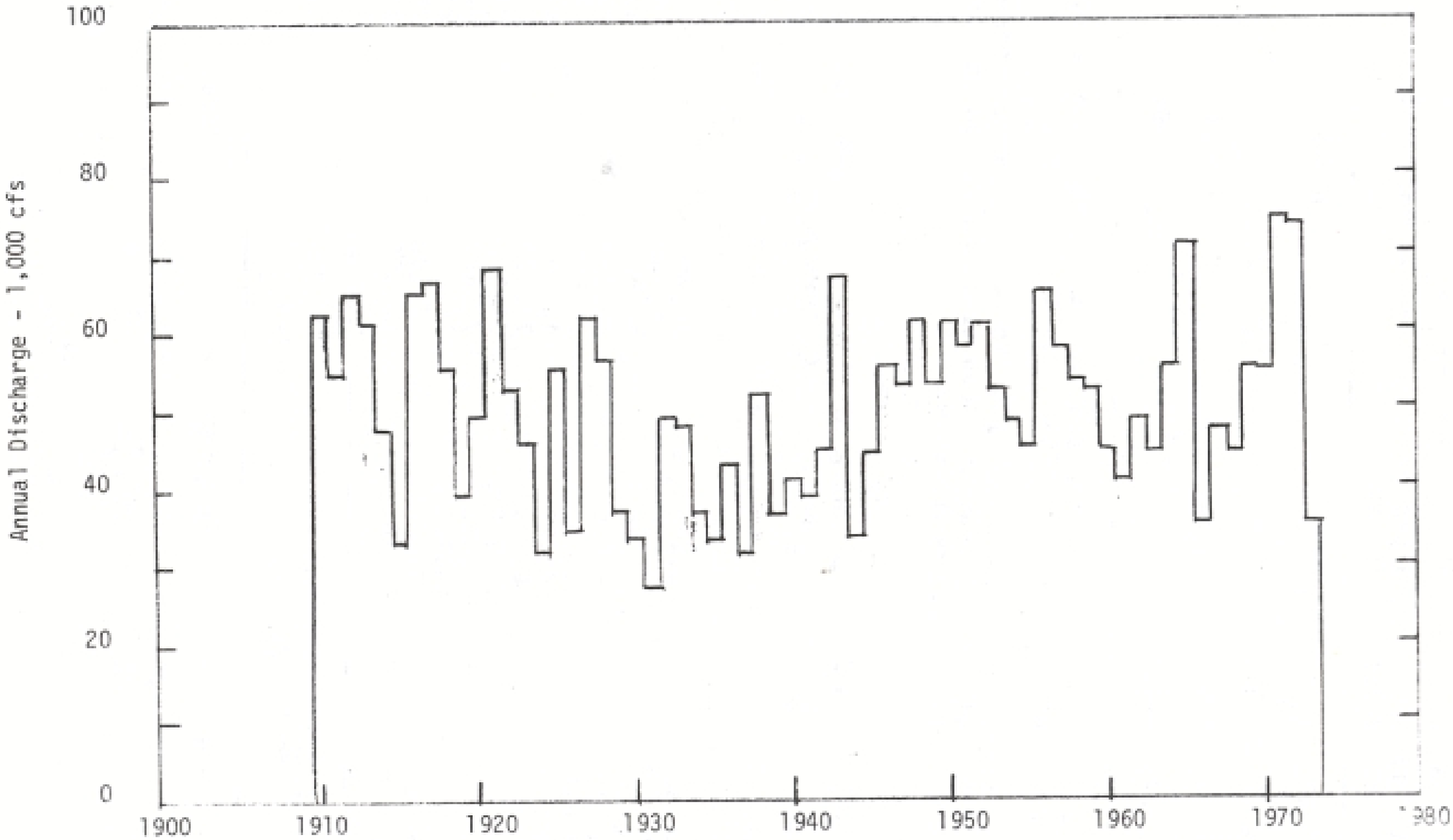


Figure 1: Annual Discharge of the Snake River at the Gaging Station near Clarkston, Washington

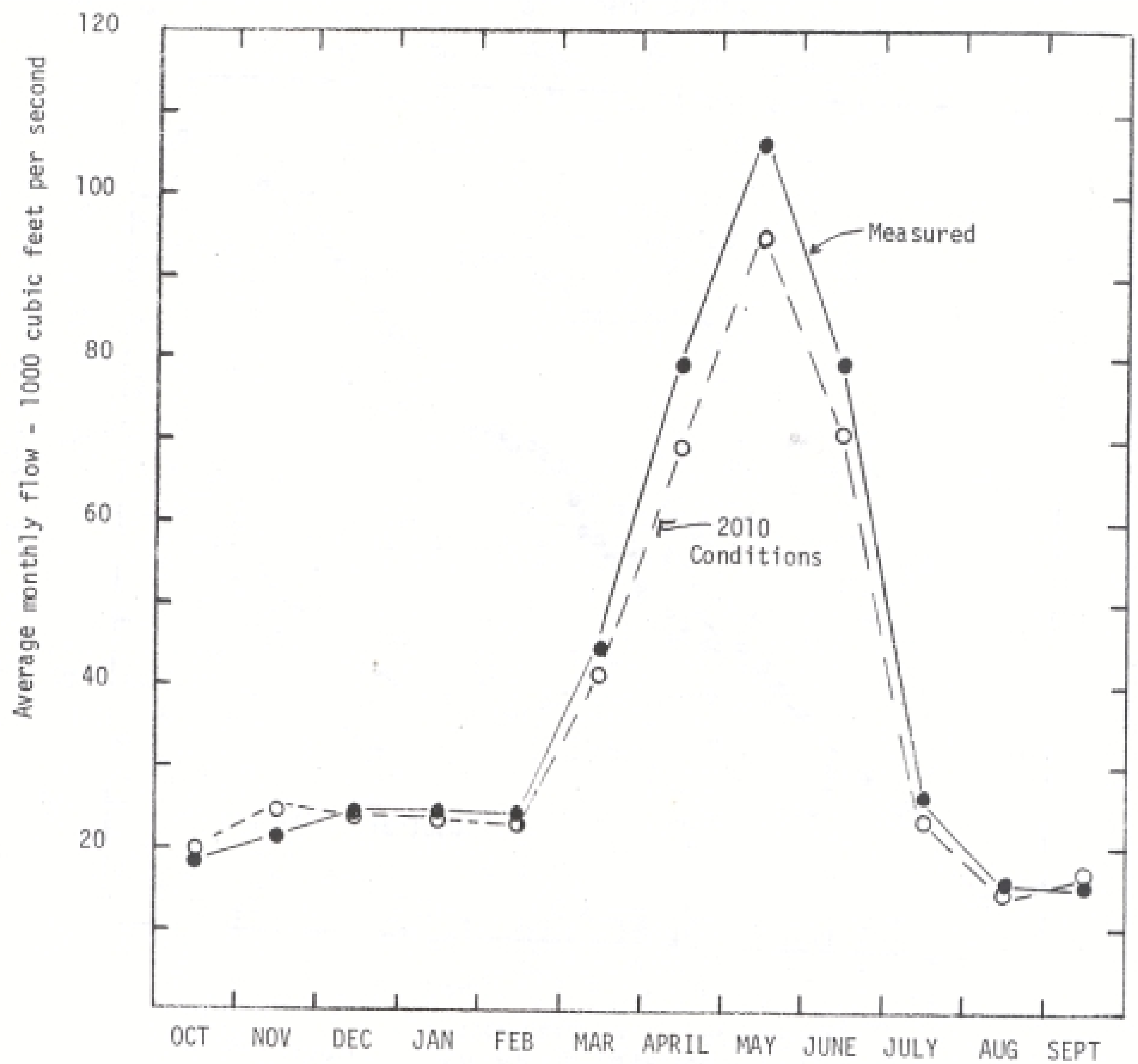


Figure 2: Average Monthly Flows in the Snake River near Clarkston - 1931 to 1940

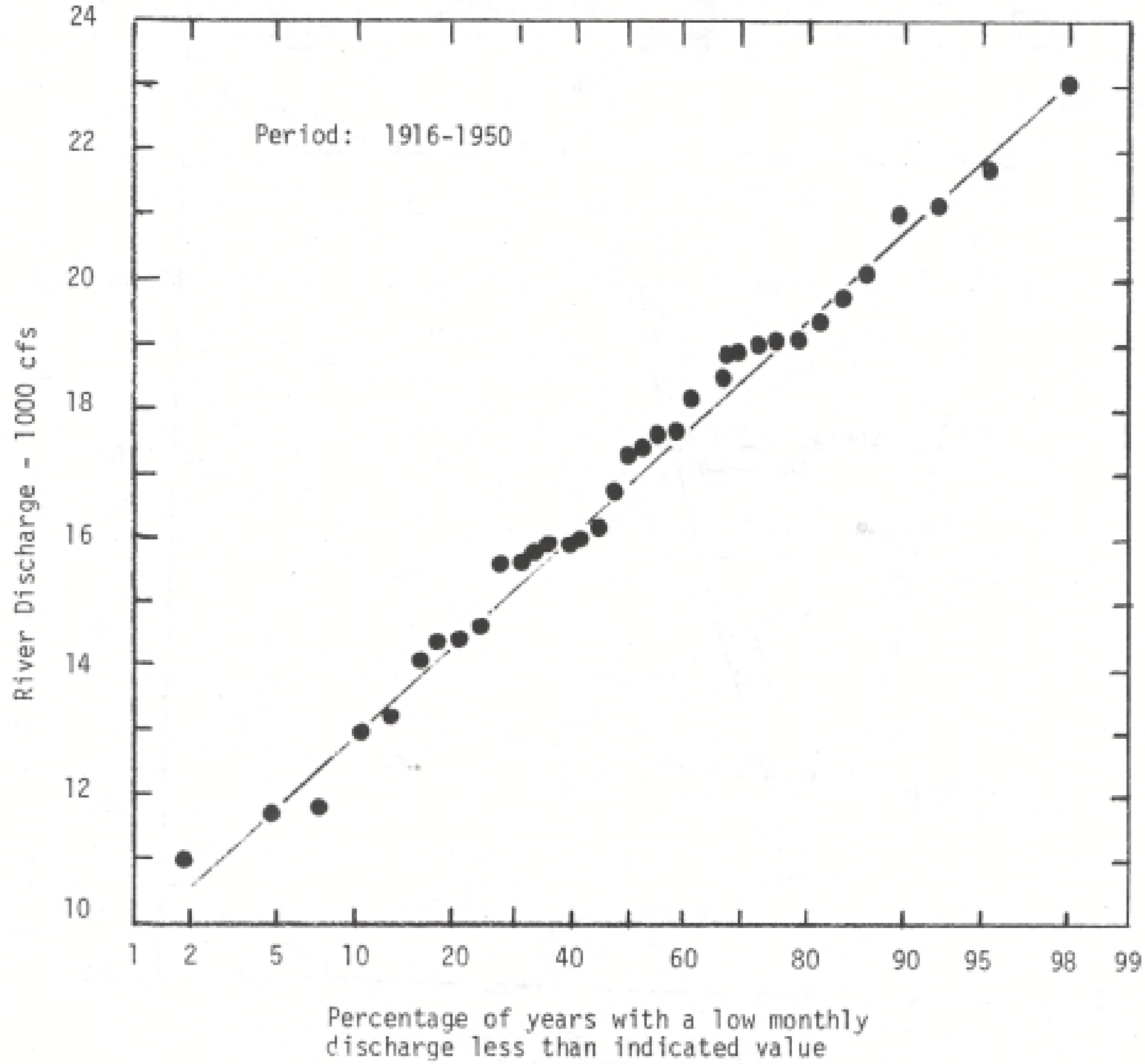


Figure 3: Exceedence Curve for the Snake River near Clarkston, Washington

APPENDIX B

State of Washington Department of Ecology

STATE WATER PROGRAM

WASHINGTON STATE WATER PROGRAM

COLUMBIA AND SNAKE RIVER STUDY AREA

<u>Possible Impact of Developments in Oregon and Idaho on Water Available from the Snake River in Washington</u>

On the basis of analysis of the information developed by the Columbia River Water Management Group, it was concluded that developments in Oregon and Idaho would have little impact on water available from the Snake River in Washington. One question remaining is the possible impacts of developments close to the Washington border.

In Table 1 are the August flows of the Snake River. The table shows that most of the river is diverted at Milner, Idaho. Most of the irrigated area in Idaho is irrigated by water from above Milner, or diverted from the Boise River. The irrigated land in Oregon is principally irrigated from the Malheur and Owyhee rivers. Land is available, but water is not available without storage, hence the impact on low flows into Washington of future irrigation development upstream will be small.

The water available in Washington comes from the highly irrigated area in Oregon and Idaho above the Snake River Canyon, the Salmon, the Grande Ronde, and the Clearwater.

Information on the relative importance of these is given in Table 2. The information in Table 2 indicates that there could be problems if the waters of the Salmon and/or Clearwater were diverted for irrigation. The CNP Irrigation Appendix (No. IX) has the following statement:

> "<u>Clearwater and Salmon Rivers</u> The Salmon and Clearwater drainages contain over 1 million acres of potentially irrigable land. Just over 250,000 acres of this land are located in the upper reaches of the Salmon River and its tributaries. The remaining lands are in the lower reaches of the Salmon and Clearwater basins. The vast and rugged area between the upper drainages and the lower reaches of the Salmon River has virtually no potentially irrigable land. Likewise, none of the upper

Clearwater River or its tributary basins contain potentially irrigable land. Parts of these upper drainages are included in primitive areas and reaches of several streams have been designated as wild rivers or potential wild rivers.

"Irrigation season flows of the upper Salmon River tributaries are already heavily used, and many irrigated lands experience water shortages. New development would require storage facilities on the smaller tributaries where the potentially irrigable lands are located.

"Difficulties in obtaining a water supply and the success of the existing dryfarm operations will also restrict new irrigation development in the lower Salmon and Clearwater River drainages. The best land potential is probably the Palouse-like Camas Prairie area around the towns of Grangeville and Cottonwood, much of which has class 1 or 2 lands. However, developing a water supply for this area from either the Clearwater or the Salmon River would require pump lifts of approximately 2,000 feet."

Another impact on the flows of the Snake River in Washington will occur from the operation at Dworshak Dam. The Walla Walla District Corps of Engineers was contacted for information on how the reservoir will be operated. On the basis of the information obtained, it was concluded that, at most, Dworshak will reduce the flows of the Snake River below Clarkston by 500 cfs during low flow periods in August. The dam was constructed by the Corps of Engineers and was filled during 1972. Hence, data for 1970 conditions in the Snake River Basin does not include the impact of the reservoir.

The Corps will try to maintain a stable pool or pass inflow during August and drawdown (hence Q (out) > Q (in)) during September.

There are two criterion possible for late July and August. These are:

1. Q (out) >, 1000 cfs

2. Q (out) > Q (in)

The second criteria will not impact flows below Clarkston but the first will. In the attached table are the flows in the North Fork of the Clearwater at the dam site in 1961 (a dry year), as well as on the Clearwater just above the junction with the Snake. A release of 1000 cfs would reduce the flows at Spalding from 2652 to 2333 cfs during August. The flow in Snake below Clarkston was actually 16,260 cfs and would have been 15,940 cfs with Dworshak Dam, according to the criteria above.

During 1973 the flows of the Snake were low and Dworshak was in existence. The actual operation of the reservoir caused a substantial increase in the flow of the Snake River below Clarkston. The minimum 7-day flow was actually 17,300 cfs with the reservoir, but would have been about 15,500 cfs if the reservoir had not been constructed. Weekly data for the Snake River at Clarkston, both with and without Dworshak, are given in Figure 1.

The information above supports the conclusion that future developments in Oregon and Idaho will have little impact on the water available from the Snake River in Washington, except that Dworshak may increase the flow of the Snake River below Clarkston.

Construction of large power dams on the Snake, Clearwater, or Salmon could have an impact on the flow pattern, but the State will be able to have an impact on the Reservoir Operation Rules prior to construction.

TABLE 1 - August Flows in the Main Stem of the Snake River Drainage

Gage Number	Location	Drainage Area (sq. mi.)	1934	1961	1973*
0375	Heise, Idaho	5,752	–	8,552	9,981
0770	Neeley, Idaho	13,600	5,660	8,920	NA
0815	Minidoka, Idaho	15,700	5,190	7,344	NA
0880	Milner, Idaho	17,180	7	3	9
0900	Kimberly, Idaho	–	409	384	NA
0940	Buhl, Idaho	–	–	2,082	NA
1350	Hagerman, Idaho	–	5,111	5,993	6,126
1545	King Hill, Idaho	35,800	6,416	6,947	NA
1725	Murphy, Idaho	41,900	6,562	6,838	NA
2690	Weiser, Idaho	69,200	7,389	9,004	10,390
2902	Oxbow, Oregon	73,150	7,424	8,381	10,600
2905	Joseph, Idaho	73,800	–	8,664	NA
3435	Clarkston, Wash.	103,200	12,930	16,260	18,480

*Preliminary

TABLE 2 - August 1961 Flows of the Lower Snake System

Gage Number	River	Location	Area sq.mi	Flow - cfs Aug.	Sept.	Annual
13-3425	Clearwater	Spaulding, ID	9,570	2,652	3,122	15,110
13-3330	Grande Ronde	Troy, OR	3,275	653	762	2,703
13-3170	Salmon	White Bird, ID	13,550	3,497	3,985	9,019
13-2905	Snake	Joseph, ID	73,800	8,664	11,370	13,070
- Total of	Subbasins above Clarkston		100,195	15,466	19,239	39,962
13-3435	Snake	Clarkston	103,200	16,260	19,950	41,430

TABLE 3 Stream Flows in the Clearwater River during the 1961 water year

Month	Clearwater at Spalding	North Fork at the Clearwater
October	2,983	1,493
November	5,193	2,531
December	4,007	1,791
January	4,583	2,077
February	19,330	9,076
March	16,350	7,284
April	26,360	11,590
May	51,300	19,610
June	40,550	13,860
July	6,524	2,842
August	2,652	1,319
September	3,122	1,372
Annual	15,170	6,202

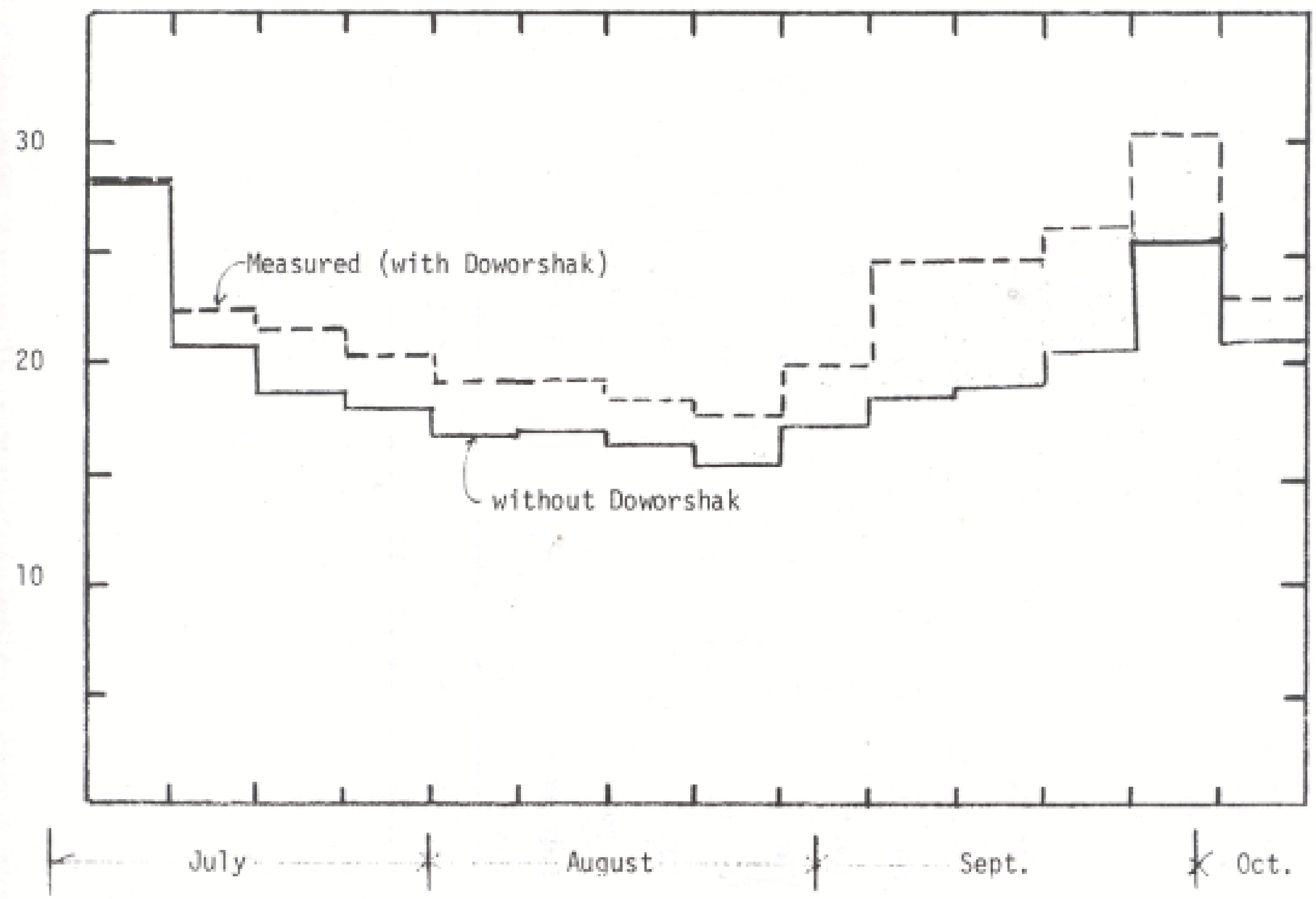


Figure 1. Weekly Flow in the Snake River at Clarkston, Washington (July 4 to October 9, 1973)

APPENDIX C

State of Washington Department of Ecology

STATE WATER PROGRAM

WASHINGTON STATE WATER PROGRAM

COLUMBIA AND SNAKE RIVER STUDY AREA

<u>Minimum Flows on the Snake River in Washington</u>

Minimum flows on the Snake River have not been formally established. The purpose of this paper is to review the available information on recommended minimum flows.

In 1972, the Department of Ecology received a set of tables from the Columbia Basin Fishery Technical Committee, which specified the recommended minimum flows at Clarkston and at each of the four dams downstream.

These recommendations are given in Table 1.

Table 1 - Minimum Flows Recommended by the Columbia Basin Fishery's Technical Committee for the Snake River

Time Period	Clarkston	Little Goose	Ice Harbor
March 1 - April 30	27,000	27,000	28,000
May 1 - June 30	75,000	75,000	76,000
July 1 - August 31	20,000	20,000	21,000
Sept. 1 - Nov. 30	20,000	20,000	21,000

All flow in cubic feet per second (cfs)

In March 1973, an intensive study was made of the Hells Canyon Reach of the Snake River and minimum flows have been recommended for the river below Brownlee Dam.

The recommended flows are given in the table below:

Table 2. Recommended Minimum and Optimum Flows for the Hells Canyon of the Snake River

Time Period	Minimum Flow	Optimum Flows
October 1 – October 31	12,000	12,000
November 1 – November 30	15,050	23,425
December 1 – March 31	14,250	22,000
April 1 – June 30	15,050	23,425
July 1 – July 31	14,250	23,425
August 1 – September 30	12,000	12,000

All flow in cubic feet per second (cfs)

The maximum flows required for lockage and for operation of the fish passage facilities on the four Lower Snake dams is about 700 cfs. The ultimate hydraulic capacity will be 132,000 cfs at Lower Granite, Little Goose, and Lower monumental. The ultimate hydraulic capacity at Ice Harbor will be 105,000 cfs.

The operation of the Lower Snake reservoirs for power results in a constant fluctuation in discharge in the Snake River at any given point. During the period of August 16 to 31, 1971, the average flow was 21,600 cfs, with a range in daily average flows of 12,800 cfs to 29,900 cfs, as measured below Ice Harbor Dam. The range in hourly flows is given below.

Table 3. Range in Hourly Flows Below the Lower Snake River Dam, August 16 – 31, 1971.

Dam	Minimum	Maximum
Ice Harbor	7,500	45,000
Lower Monumental	7,000	47,000
Little Goose	5,000	44,000
Lower Granite	Under Construction	

All flows in cubic feet per second (cfs)

During the period August 16 through 31, the flow near Clarkston was 22,300 cfs; with a range in mean daily flow from 20,000 to 23,200 cfs. The operation of the reservoirs has a significant impact on the flows of the Snake River at its mouth.

If the recommended minimum flows for the Hells Canyon Reach of the Snake River are established, it is reasonable to assume these flows should also be applicable for the Lower Snake. It is also reasonable to use as a target minimum flow, the flows recommended by the Columbia Basin Fishery Technical Committee.

A summary of the minimum flows and target minimum flows is given in Table 4.

Table 4. Recommended Minimum Flows for the Lower Snake River

Month	Minimum Flow (Hells Canyon Report)	Desired Minimum Flow (Fisheries Agencies)
October	12,000	20,000
November	15,050	20,000
December	14,250	20,000
January	14,250	20,000
February	14,250	20,000
March	14,250	27,000
April	15,050	27,000
May	15,050	75,000
June	15,050	75,000
July	14,250	20,000
August	12,000	20,000
September	12,000	20,000

All flows in cubic feet per second (cfs)

The control point for diversion should be the U.S.G.S. gage near Clarkston or the gage below Lower Granite, corrected for change in storage at Lower Granite. In other words, flows in the Lower Snake River are highly variable because the operation of the hydroelectric power dams has a significant impact on the flows.

A diagram of the average monthly flows in the 30's, under 1970 conditions of upstream development is given in Figure 1, as are the desired minimum flows and the recommended minimum flows.

The preservation flow has been determined to be 14,000 cfs, which is in reasonable agreement with the minimum flows given in Table 4.

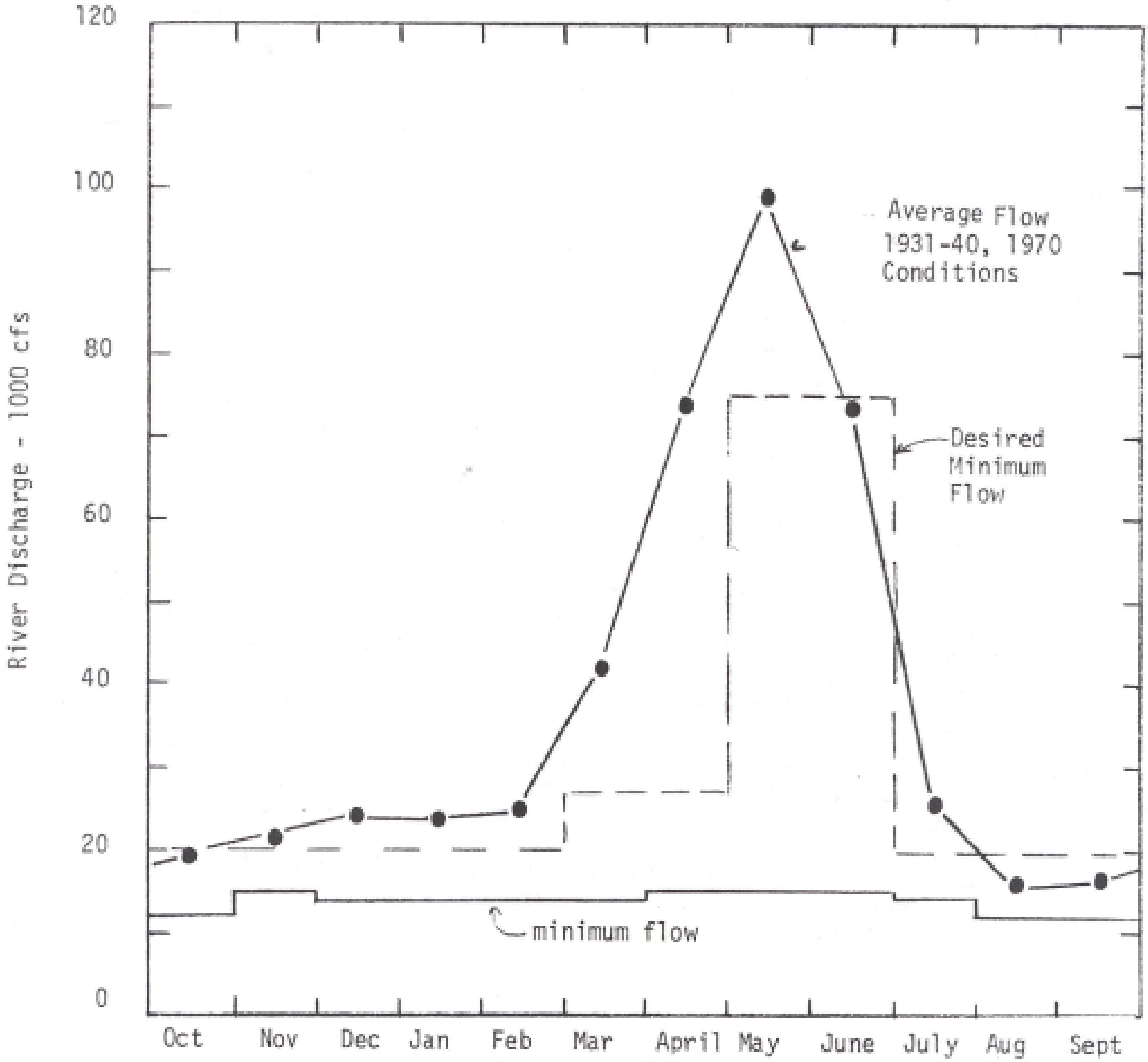


Figure 1. Average Montly Discharge of the Snake River near Clarkston and Recommended Minimum Flows

APPENDIX D

State of Washington Department of Ecology

STATE WATER PROGRAM

WASHINGTON STATE WATER PROGRAM

COLUMBIA AND SNAKE RIVER STUDY AREA

<u>Lands Irrigable from the Lower Snake River</u>

The maximum total diversion from the Lower Snake River for irrigation is the amount of water required to irrigate all irrigable land which can economically be reached by pumping.

The maximum area economically reachable will depend on the pump lift, the distance from the river, and the size of the unit being irrigated. Very preliminary information indicates that lands within the 600 foot contour above the elevation of the reservoir level is about the maximum lift which can be pumped and still transport the water a few miles. The normal surface elevation of the Lower Snake River reservoirs is given in Table 1 as is the maximum elevation of land which can be irrigated from the reservoir assuming a maximum lift of about 600 feet. The economic lift for Ice Harbor is assumed to be 560 feet because of the distance from the river to potential irrigable lands, and 660 feet for the other three reservoirs because the elevation increases rapidly near the river above the dams.

The U. S. Bureau of Reclamation has made a study of the Lower Snake Basin. Using the results of this study and the information in Table 1, it was determined that all of the land which can be economically irrigated is in the Lower Snake area below the mouth of the Palouse River. The USBR estimate of irrigable lands in the area below the Palouse is given as Table 2. Using this table, the total area which could be irrigated in the future is 355,300 acres. This includes lands in the Walla Walla Basin as well as the Lower Snake. The USBR estimates that 3.8 acre-feet/acre would have to be diverted in order to irrigate lands in the Lower Snake area. The return flows would be about 1.2 acre-feet/acre. The return flows would probably reach the Snake River below Ice Harbor Dam or the Walla Walla River. It is estimated that the maximum monthly diversion would occur in August and be 23 percent of the total diversion. Hence, the potential diversion if all irrigable lands were irrigated is 310,000 acre-feet in August. This is an average flow of 5,060 cfs.

Not all of the potential irrigable lands are economical to irrigate from the Snake River because of pump lifts and distance from the river. Information in the USBR study indicates that all of the lands in the Eureka Flats area are likely to be economical to irrigate from the Snake River. Using the information Figure 35 of the CNP Irrigation Appendix, it is estimated that all of the Class 1 and 2 lands north of the Snake River, as well as half of the Class 3 lands, are economical to irrigate from the Snake River. The area of potential irrigable lands which can be economically irrigated from the Snake River is given in Table 3.

The total economically irrigable area is 209,000 acres which would need a total diversion of 2,980 cfs (say 3,000 cfs). Except for about 3,000 acres, all of the lands could be irrigated by water from Ice Harbor reservoir. The 3,000 acres could be irrigated from Lower Monumental.

Much of the lands north of the Snake could be irrigated from the Columbia Basin Project or from ground water sources. A rough estimate of the lands to be irrigated from the Snake River is given in Table 4. The total land area is 136,000 acres and would require a total diversion of 1,940 cfs (say 2,000 cfs). The diversions according to class of land and the type of estimate is given in Table 5.

In the May 1957 report on depletions in the Columbia River system, the following areas were estimated as potentially irrigable from the Snake River in Washington.

Eureka Flats		86,500	acres
Burbank		7,000	acres
Lower Snake		29,000	acres
Additional area in Washington		20,000	acres
Additional area in Washington (Walla Walla)		60,000	acres
	Total	202,500	acres

The estimates in Tables 2 through 4 include lands irrigable from the Snake but in the Walla Walla Basin. The 202,500 acres given above agrees well with the 209,000 acres in Table 3. Correcting for lands likely to be irrigated from sources other than the Snake River would probably result in the amount shown in Table 4.

The most likely demand for irrigation water from the Snake River will be 2,000 cfs with a possible upper limit of 3,000 cfs. The total for Class 1 and 2 lands would likely be 1,200 cfs.

Subsequent to the analysis given above, it was determined the economical pump lifts are as given in the following table for the various classes of soil and a risk premium of $20 per acre per year.

Economical Pump Lifts from the Snake River

	Distance in Miles from River				
Soil Class	1	2	5	7	10
I	>2000	>2000	1440	720	0
II	640	780	0	0	0
III	640	0	0	0	0

Pump lifts in feet.

The data given above indicates that the economical pump lift for Class I and II soils is greater than used above. A review of the location of the Class I and II lands indicates the most likelihood estimate is not sensitive to the change and remains the same.

In the U.S.B.R. Lower Snake River Basin Report, a possible project with total pump lifts up to 715 feet and transmission distances of up to about 10 miles was given as a potential project with a benefit cost ratio of 0.82 to 1 on the basis of direct benefits and an interest rate of 5-1/8%. The project was for the Eureka Flats area. This information suggests that whole of Eureka Flats will not be developed by private capital and that the economical pump lifts used in this report are justifiable.

TABLE 1 - Elevation of lands which can be reached by water from Lower Snake Reservoirs

Location	Pool or River Elevation (feet)	Reachable Land Elevation (feet)
Below Ice Harbor	340	900
Ice Harbor Reservoir	440	1,000
Lower Monumental Reservoir	540	1,200
Little Goose Reservoir	638	1,300
Lower Granite Reservoir	738	1,400

Table 2 – Arable lands, Lower Main Stem Area (U.S. Bureau of Reclamation) (Sprinkler Classification)

AREA	CLASS 1		CLASS 2		CLASS 3		TOTAL ARABLE			TOTAL
	Irrig.	Dry	Irrig.	Dry	Irrig.	Dry	Irrig.	Dry	TOTAL	Rounded
North of Snake River										
Columbia Basin lands	2,000[4/]	21,900	700[4/]	40,000	300[4/]	74,800	3,000[4/]	136,700	139,700	140,000
Other				300		12,000		12,300	112,300	12,000
Total	2,000	21,900	700	40,300	300	86,800	3,000	149,000	152,000	152,000
South of Snake River										
Eureka Flat		26,000		44,700		35,200		105,900	105,900	106,000[2/]
Columbia Basin lands		200	100	2,400	1,200	3,800	1,300	6,400	7,700	8,000
Other	4,000[3/]	3,400	7,300[3/]	1,300	4,800[3/]	85,800	16,100[3/]	90,500[1/]	106,600	106,000
Total	4,000	29,600	7,400	48,400	6,000	124,800	17,400	202,800	220,200	220,000
TOTAL Lower Main Stem	6,000	51,500	8,100	88,700	6,300	211,600	20,400	351,800	372,200	372,000

[1/] Determined from Columbia-North Pacific land inventory.

[2/] LeGrow area classified in detail, balance reconnaissance grade.

[3/] Estimated arable acreage within the areas planned for development by University Land Company and K2H Farms. About 12,600 acres of these were irrigated during the 1970 season.

[4/] Private developments within the Columbia Basin Project boundary.

TABLE 3 Estimated Area of Dry Lands which can be Economically Irrigated from the Snake River in Washington

Area	Class 1	Class 2	Class 3	Total
North of Snake River	21,900	40,000	37,400	99,300
South of Snake River				
Eureka Flat	26,000	44,700	35,200	105,900
Other	1,100	1,600	1,100	3,800
Total	49,000	86,300	73,700	209,000

All areas in acres.

TABLE 4 "Most Likelihood" Estimate of Lands to be Irrigated from the Snake River in Washington

Area	Class 1	Class 2	Class 3	Total
North of Snake River	10,000	2,000	15,000	27,000
South of Snake River	27,000	46,000	36,000	109,000
Total	37,000	48,000	51,000	136,000

TABLE 5 Water Required to Irrigate the Land Irrigable from the Snake River in Washington

	Total Irrigable		Total Economical Irrigable Area		"Most Likelihood" Irrigable Area	
Land Class	Annual Diversion (ac-ft)	Diversion Capacity (cfs)	Annual Diversion (ac-ft)	Diversion Capacity (cfs)	Annual Diversion (ac-ft)	Diversion Capacity
1	199,000	750	186,000	700	141,000	530
2	343,000	1,290	328,000	1,230	182,000	680
3	808,000	3,030	280,000	1,050	194,000	730
Total	1,350,000	5,070	794,000	2,980	517,000	1,940

MEMORANDUM
January 15, 1974

TO: Bob Milhous, Kris Kauffman

FROM: Bill Lin

RE: Economic Aspects of Determining Irrigable Lands in Lower Snake River Areas.

Enclosed please find the summary in regard to the economic aspects of determining irrigable lands in Lower Snake River Areas as per your request of January 8, 1974.

As you are all aware, my work was primarily directed to the determination of economically feasible level of pump lift and length of transfer line from the River, for each soil class. To do this, the following assumptions were made:

1. Farm Size: 1,000 acres.
2. Cropping pattern:
    1) Dryland Farming: Wheat - Summer fallow rotation
    2) Irrigated Farming:

Potatoes	300	acres
Sugar Beets	300	"
Alfalfa Hay	200	"
Wheat	100	"
Dry Peas	100	"

3. Yield and Price

Type of operation	Crops	Yield			Price
		Soil A	Soil B	Soil C	
Dryland Farming	Winter Wheat	50 bu	40	32	$ 3.25
Irrigated	Potatoes	30 ton	25	20	28.00
Farming	Sugar Beets	30 ton	25	20	16.00
	Wheat	100 bu	85	70	3.25
	Alfalfa Hay	7.5 ton	6	4	26.00
	Dry Peas	30 cwt	22	16	10.00

4. Cost of Production: Similar to that in Yakima River Basin.

5. Pump Cost: See Fig. 1 (the lower bound regression line was used).

6. Pipe Cost: $130,000/mile from river and 20 years life were assumed (See Fig. 2).

7. Discount Rate: 7%.

The above assumptions, which have their sources of reference shown in Appendix A, all tend to maximize feasible irrigability. I then proceeded with the calculations of return to management on a per acre basis for both the dryland farming and irrigated farming operations. The differences of total farm returns for the two types of operations are compared with pipe cost, which is a function of the distance of transfer line from the river. If the potential gain of irrigated farming exceeds the cost of pipe construction, then it pays the farm to extend the pipe length until the point where the potential gain can no longer more than offset the pipe cost. Otherwise, it does not pay the farm to construct transfer line.

Differences of return to management between dryland farming and irrigated farming operations are shown in Table 1, 2, and 3 in accordance with soil class A, B, and C. Of course, if a difference of return to management is positive, it indicates that it pays the farm to go for irrigated farming; otherwise, it indicates dryland farming is a better alternative.

In light of the possible consideration of risk premium in producers' production decisions, a set of breakeven curves for various risk premiums were presented in Fig. 3. It is believed, however, that the $100,000 risk premium is likely to be the upper limit for a 1,000 acre farm.

BL:je

Enclosures

CC: M. L. Vialle

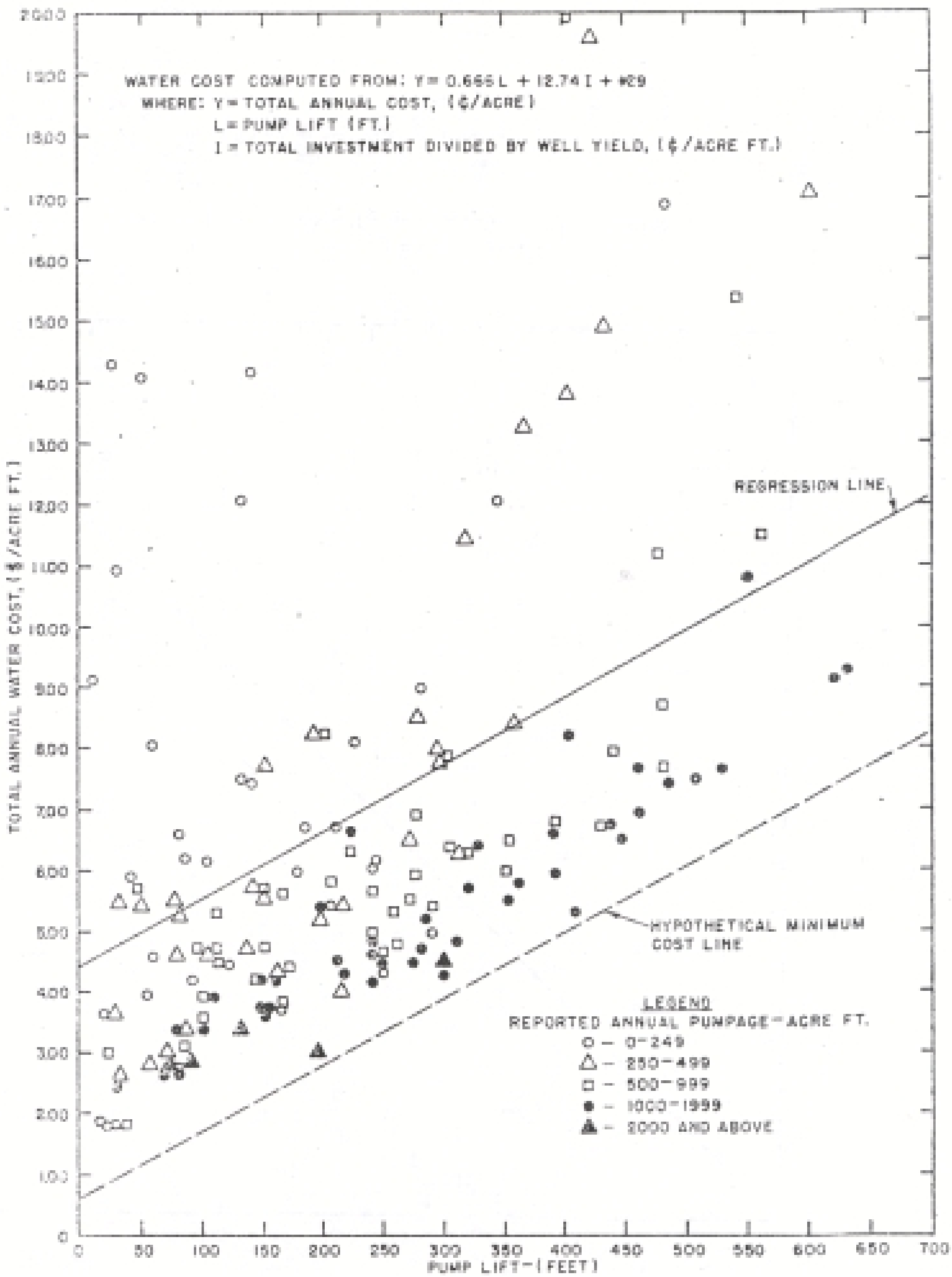


Figure 1. Relationship of pumping cost to pumping lift (all questionnaire data used)

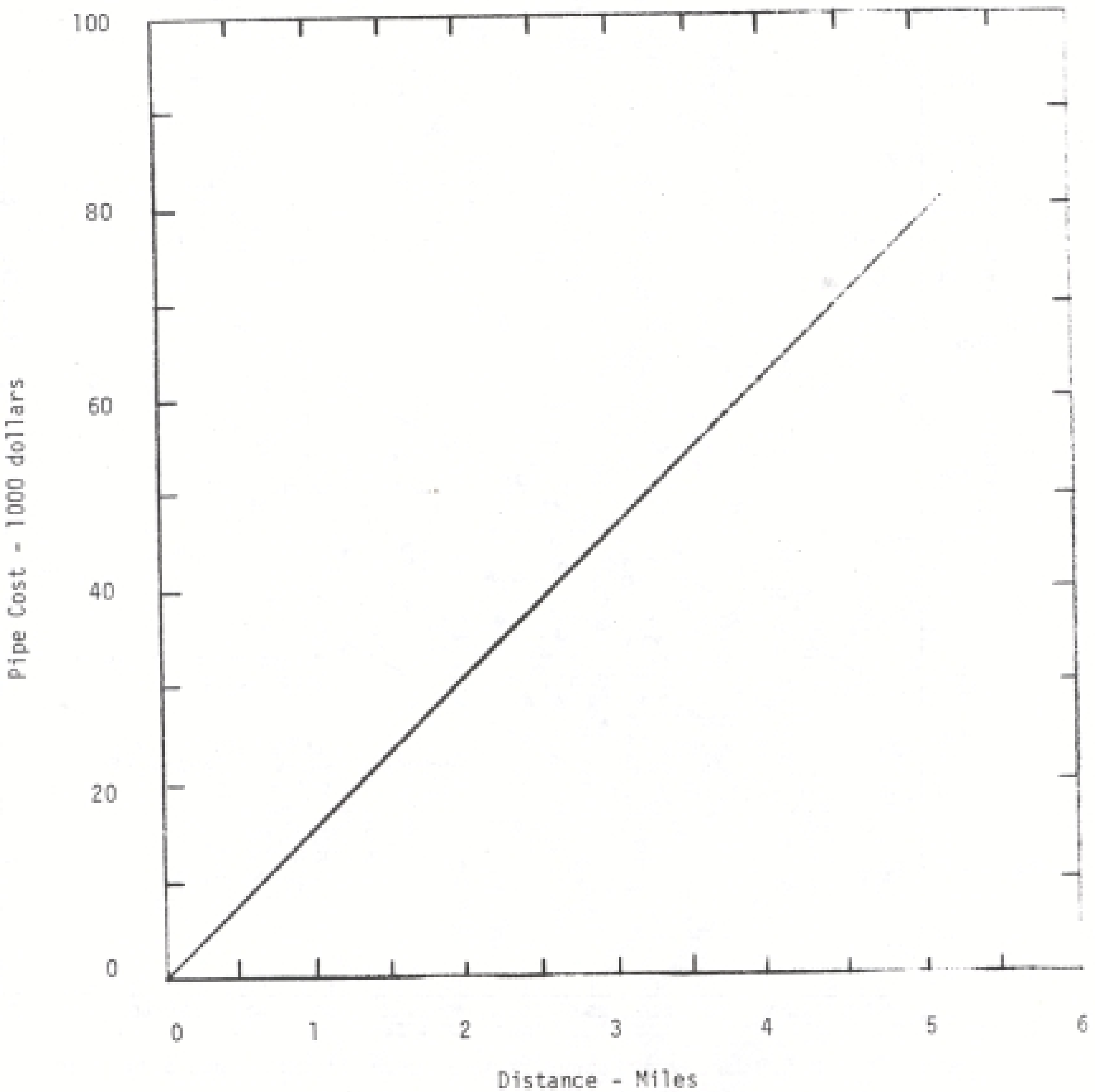


Figure 2. Relationship of Pipe Cost to Distance from the Snake River

Table 1. Differences of Return to Management Between Dryland Farming and Irrigated Farming Operations: Soil Class A.

Pump Lift / Distance of Transfer Line	500'	600'	700'	800'	900'	1,000'	1,500'	2,000'
Mile 1	119,886	117,786	114,210	111,010	107,590	103,110	97,210	91,210
2	104,286	102,186	98,610	95,410	91,990	87,510	81,610	75,610
3	88,686	86,586	83,010	79,810	76,390	71,910	66,010	60,010
4	73,086	70,986	67,410	64,210	60,790	56,310	50,410	44,410
5	57,486	55,386	51,810	48,610	45,190	40,710	34,810	28,810
6	41,886	39,786	36,210	33,010	29,590	25,110	19,210	13,210
7	26,286	24,186	20,610	17,410	13,990	9,510	3,610	-2,390
8	10,686	8,586	5,010	1,810	-1,610	-6,090	-11,990	-17,990
9	-4,914	-7,014	-10,590	-13,790	-17,210	-21,690	-27,590	-33,590
10	-20,514	-22,614	-26,190	-29,390	-32,810	-37,290	-43,190	-49,190

Table 2. Differences of Return to Management Between Dryland Farming and Irrigated Farming Operations: Soil Class B.

Pump Lift / Distance of Transfer Line	500'	600'	700'	800'	900'	1,000'	1,500'	2,000'
Mile 1	76,000	73,000	69,690	66,150	62,570	59,030	53,150	47,150
2	60,400	57,400	54,090	50,550	46,970	43,430	37,550	31,550
3	44,800	41,800	38,490	34,950	31,370	27,800	21,950	15,950
4	29,200	26,200	22,890	19,350	15,770	12,230	6,350	350
5	13,600	10,600	7,290	3,750	170	-3,370	-9,250	-15,250
6	-2,000	-5,000	-8,310	-11,850	-15,430	-18,970	-24,850	-30,850
7	-17,600	-20,600	-23,910	-27,450	-31,030	-34,570	-40,450	-46,450
8	-33,200	-36,200	-39,510	-43,050	-46,630	-50,170	-56,050	-62,050
9	-48,800	-51,800	55,110	-58,650	-62,230	-65,770	-71,650	-77,650
10	-64,400	-67,400	-70,710	-74,250	-77,830	-81,370	-87,250	-93,250

Table 3. Differences of Return to Management Between Dryland Farming and Irrigated Farming Operations: Soil Class C.

Pump Lift / Distance of Transfer Line (Mile)	500'	600'	700'	800'	900'	1,000'	1,500'	2,000'
1	24,357	21,357	17,780	14,270	10,670	7,070	1,070	-4,930
2	8,757	5,757	2,180	-1,330	-4,930	-8,530	-14,530	-20,530
3	-6,843	-9,843	-13,420	-16,930	-20,530	-24,130	-30,130	-36,130
4	-22,443	-25,443	-29,020	-32,530	-36,130	-39,730	-45,730	-51,730
5	-38,043	-41,043	-44,620	-48,130	-51,730	-55,330	-61,330	-67,330
6	-53,643	-56,643	-60,220	-63,730	-67,330	-70,930	-76,930	-82,930
7	-69,243	-72,243	-75,820	-79,330	-82,930	-86,530	-92,530	-98,530
8	-84,843	-87,843	-91,420	-94,930	-98,530	-102,130	-108,130	-114,130
9	-100,443	-103,443	-107,020	-110,530	-114,130	-117,730	-123,730	-129,730
10	-116,043	-119,043	-122,620	-126,130	-129,730	-133,330	-139,330	-145,330

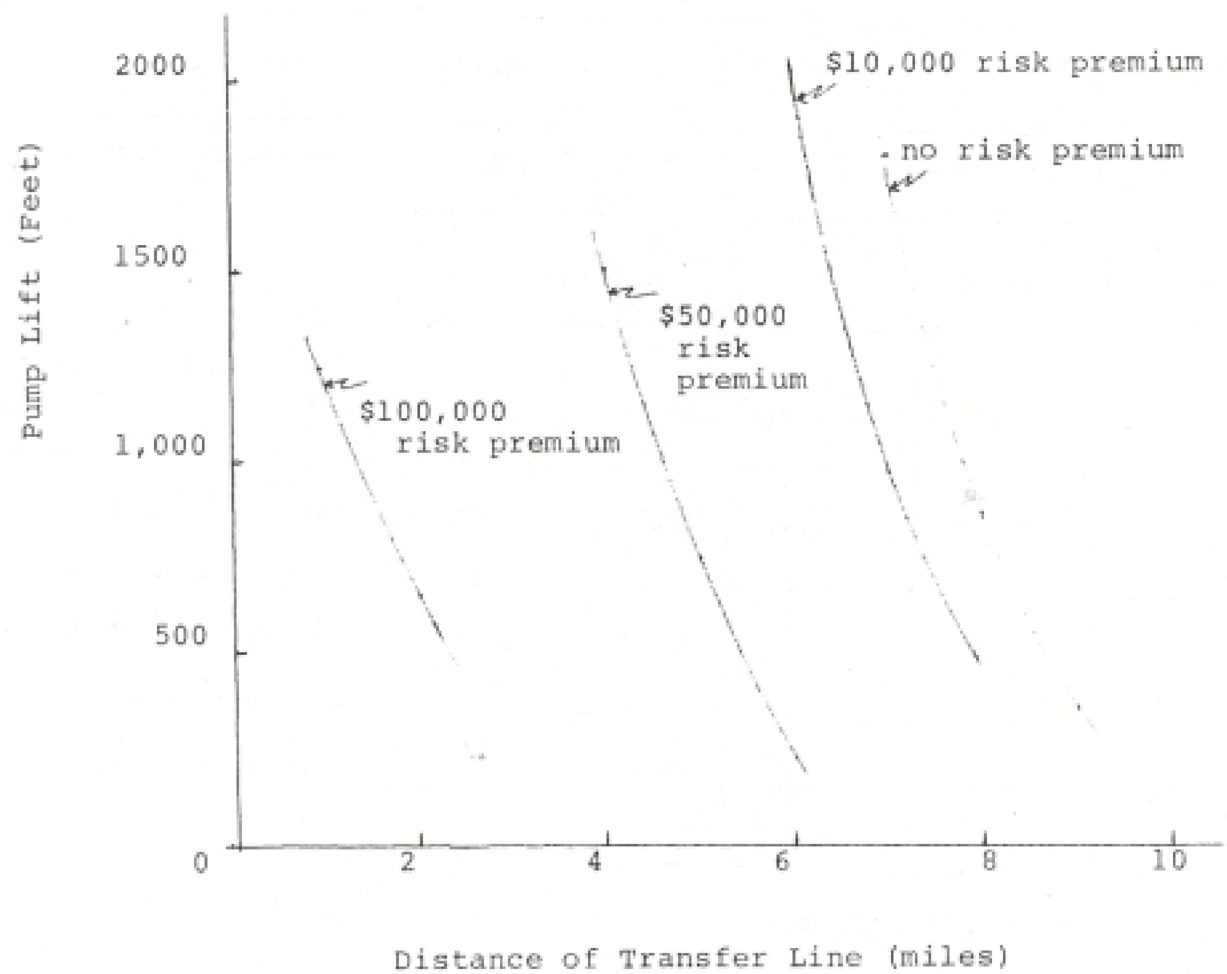


Figure 3. "Break-even" Curves for Various Risk Premiums; Soil Class A

APPENDIX A. SOURCES OF REFERENCES FOR ASSUMPTION

Assumption or Estimation	Sources of Reference
Farm Size	• Departmental staff • Cooperative Extension Service, WSU
Cropping Pattern	• Departmental staff • Cooperative Extension Service, WSU DNR
Yield and Price	• Cooperative Extension Service, WSU • USDA, Crop & Statistical Reporting Services • DNR
Cost of Production	• Agricultural Research Center, WSU "Land Development & Water Use, Yakima River Basin, WA," Appendix A 4-1, "Crop Budgets for Currently Irrigated Land," Pullman, April, 1972.
Pump Cost	• Norman C. Young & Dale R. Ralston, "reasonable Pumping Lifts for Idaho," Water Information bulletin No. 21, Idaho Dept. of Water Admin., February, 1971.
Pipe Cost	• Departmental staff • Consultants, E.N.R.
Discount Rate	• Current approximate federal discount rate. • Current approximate DNR discount rate.

APPENDIX F

State of Washington Department of Ecology

STATE WATER PROGRAM

WASHINGTON STATE WATER PROGRAM

COLUMBIA AND SNAKE RIVER STUDY AREA

Water Use from the Snake River Main Stem

The water of the Snake River Main Stem in Washington is used primarily for:

1. Power
2. Navigation
3. Fish Passage
4. Fish Production
5. Irrigation

At the present time, municipal and industrial water is not taken directly from the Snake River but from tributaries and wells. The total M & I use in the Lower Snake Basin (CNP Region 6) is about 60 cfs at the present time and is projected to be about 110 cfs by 2020. The demand for M & I water from the Snake River in Washington will not exceed 50 cfs in the foreseeable future.

After all turbines are installed in the Lower Snake dams, up to 132,000 cfs can be used to produce power. The operation of the navigation facilities will require a daily average of about 350 cfs, depending on traffic. The fish passage facilities require about 400 cfs. It is not known what daily average flow is needed in order to maintain an adequate water quality in the reservoirs.

The use of water from the Snake River in Washington for irrigation has increased significantly in the last 10 years. Information on irrigation usage is given in Table 1.

Table 1 Irrigation Water Right Priorities for Water from Snake River in Washington

Year	Water Rights With Priority dates Earlier or in year (cfs)	Area Irrigation (Acres)
1950	9.8	590
1955	21.17	1,451
1960	26.55	1,773.5
1965	81.95	4,953.5
1970	536.36	39,434.1
1973	824.82	52,887.45

The water right priorities with dates past 1970 total 288.46 cfs

Information on the individual water rights for flows greater than 1.0 cfs are attached.

It is assumed that if a certificate is issued after January 1, 1971 the water was put to use after 1970. The quantity of water certified after January 1, 1971 is 747.84 cfs, which is used, or will be used, to irrigate 48,048.35 acres.

The "most likelihood" estimate of lands which were not irrigated but likely to be irrigated in 1970 was 136,000 acres. The lands which will still be developed after development of the 48,000 acres is about 88,000 acres.

Recorded Water Appropriations of Plus 1.000 cubic feet per second On Snake River Above Ice Harbor Dam to the Idaho Line

Application	Permit	Certificate	Priority Date	Name of Applicant	Point of Diversion	cubic feet per second	acre-feet	acres
S3-21045	S3-21045P		4/17/73	Jausaud Tenants in common	NE¼SE¼, Sec. 24, T. 9 N., R. 31 E. W.M.	59.40	10,320	2219.35
20260	14942	11862	5/25/67	Modie J. Spiegel	Gov't Lot 6, Sec. 19, T. 9 N., R. 32 E.W.M.	62.54		3979.00
18108	13332	9729	8/22/63	Snake River Land Co.	Gov't Lot 6, Sec. 19, T. 9 N., R. 32 E.W.M.	55.00	17,640	3160.00
21411	15616	11864 11865 11866	1/15/69	Modie J. Spiegel	Gov't Lot 6, Sec. 19, T. 9 N., R. 32 E.W.M.	13.81 18.36 2.15	9,997 13,292 1,558	2993.00 3979.00 466.00
21921	16172		12/1/69	Lee J. Brickey	SE¼SE¼, Sec. 8, T. 9 N., R. 32 E. W.M.	3.00	814	155.00
20311	14921		5/22/67	Dept. Natural Resources	SE¼ SE¼SE¼, Sec.8, T. 9 N., R. 32 E.W.M.	12.80	2,560	640.00
19723	14572		6/20/66	G. C. Walkley		12.00		4500.00
20910	15482	S3-00335C	4/18/68	K2H Farms	SW¼ SW¼SW¼, Sec.16, T. 10 N., R. 32 E.W.M.	125.00	21,000	7000.00
22633	S3-00395P		10/21/70	Walla Walla Water Power	Lot 4, Sec. 1, T. 9 N., R. 32 E.W.M.	110.00	27,546	5924.00
S3-20371	S3-20371P		8/23/72	K2H Farms	SW¼ SW¼SW¼, Sec.36, T. 10 N., R. 32 E.W.M.	170.00	27,360	7880.00
21557	15820	S3-00334C	4/22/69	K2H Farms	SW¼ SW¼SW¼, Sec.36, T. 10 N., R. 32 E.W.M.	8.00	1,185	395.00
S3-20916			3/15/73	Dept. Natural Resources	SW¼ SW¼SW¼, Sec.36, T. 10 N., R. 32 E.W.M.	10.00	1,955	420.00
10094	7270	6539	1/29/51	Klicker Bros.	Gov't Lot 5, Sec. 19, T. 12 N., R. 34 E.W.M.	3.60	1,600	400.00
21609	16509		5/26/69	Mervin Deruwe	Gov't Lot 4, Sec. 19, T. 13 N., R. 36 E.W.M.	17.00	4,100	1111.00

Recorded Water Appropriations of Plus 1.000 cubic feet per second On Snake River Above Ice Harbor Dam to the Idaho Line

Application	Permit	Certificate	Priority Date	Name of Applicant	Point of Diversion	cubic feet per second	acre-feet	acres
20277	14874		5/31/67	Lyle H. McNeff	Gov't Lot 8, Sec. 18, T. 9 N., R. 32 E.W.M.	60.00	6,700	3250.00
11879	8743	5701	12/4/52	W. G. Harder	Gov't Lot 2, Sec. 25, T. 13 N., R. 34 E.W.M.	1.60		90.00
9316	6388	6414	1/10/50	G. Poston	Gov't Lot 5, Sec. 12, T. 13 N., R. 39 E.W.M.	2.70		150.00
10725	8271	5459	9/14/51	E. Klevans	Gov't Lot 9, Sec. 7, T. 11 N., R. 45 E.W.M.	1.34		85.00
9996	6977	5137	11/20/50	A. Ohrus	Gov't Lot 4, Sec. 21, T. 11 N., R. 45 E.W.M.	1.60		80.00
16264	11968	8039	8/11/60	Wash. Water Power	Gov't Lot 2, Sec. 20, T. 11 N., R. 46 E.W.M.	1.78	370	92.5
20237	15121		5/08/67	DNR		4.0	1200	300
20238	15122		5/08/67	A & L Henniyar		1.8	364	91.0
21108	6359	11847	7/25/68	L. Kuykendall	Gov't Lot 7, Sec. 3, T. 13 N., R. 40 E.W.M.	3.92	490	196.0
13693	10280	6546	1/4/56	C. Delegans	Gov't Lot 4, Sec. 23, T. 14 N., R. 41 E.W.M.	3.00	800	200.0
10940	8028	4670	12/27/51	J. Pring	Gov't Lot 10, Sec. 18, T. 11 N., R. 45 E.W.M.	2.00		125.0
10765	7694	4628	10/1/51	O. Parker	Gov't Lot 2 and 4, Sec. 14, T. 11 N., R. 45 E.W.M.	2.00		110.0
9290	6373	5055	12/30/49	W. Wilson	Gov't Lot 2, Sec. 19, T. 11 N., R. 46 E.W.M.	1.50		
S3-21433	S3-21433P		7/26/73	Jack Hsieh	Gov't Lot 4, Sec. 21, T. 9 N., R. 31 E.W.M.	46.0	7687	2300.0
S3-05346			11/27/40			4.0		250.0

APPENDIX G

State of Washington Department of Ecology

STATE WATER PROGRAM

COLUMBIA AND SNAKE RIVER STUDY AREA

Water Quality Considerations of Diversion from the Snake River in Washington

In allocating the waters of the Snake River among competing uses one of the potential conflicts is between use of the water out of stream and the use of the water to maintain water quality instream. The purpose of this appendix is to examine the impact of diverting 2,000 cfs from the Snake River on the water quality of the Snake River in Washington.

It is expected that all most all of the 2,000 cfs allocated to diversion will be diverted from the Ice Harbor Reservoir with some from Lower Monumental Reservoir; almost no water will be diverted from Lower Granite or Little Goose Reservoirs. Consequently, the possible impact of diversions on the water quality will be confined to Ice Harbor Reservoir and to the Snake River Arm of McNary pool.

Information on the four Snake River reservoirs is given in Table 1.

Table 1 - Capacity of Reservoirs on the Lower Snake River

Name	Total Storage (Acre-feet)	Active Storage (Acre-feet)	Surface Area (Acres)	Average Depth
Lower Granite	484,000	44,000	8,000	54
Little Goose	565,000	49,000	10,000	56
Lower Monumental	376,000	20,000	6,590	57
Ice Harbor	406,000	25,000	9,000	45

All of the reservoirs are run-of-river reservoirs and the active capacity is small (total of 138,000 acre-feet) although the total storage is reasonably large (1,831,000 acre-feet).

The recommended preservation flow of the Snake River in Washington is 12,000 cfs (23,760 acre-feet/day), the average detention time of the reservoirs when the flow is at the preservation level (12,000 cfs) and when the flow is 14,000 cfs are shown in Table 2.

TABLE 2 - Detention Time in Lower Snake Reservoirs

	Detention Time in Days		
Reservoir	@ 12,000 cfs	@14,000 cfs	@ 16,000 cfs
Lower Granite	20.3	17.5	15.3
Little Goose	23.8	20.4	171.8
Lower Monumental	15.8	13.6	11.9
Ice Harbor	17.1	14.6	12.8
Total	77.0	66.1	55.1

If the flow into the reach is 14,000 cfs and 2,000 cfs is removed at the head of Ice Harbor pool, the total detention time will be increased by 2.5 days for a total of 68.6 days, an increase of 3.8 percent over the case of no diversions. Information on the nutrient load of the Snake River is contained in the U.S.G.S. water supply papers and in Part II of Water Resources Data for Washington. The data indicates the concentrations are sufficiently large, that algal blooms could be a problem in the Snake River reservoirs.

In the Corps of Engineers, Walla Walla District report on water quality in the Lower Granite pool area, the following statement is made:

> "Relatively high blue-green algal growth develops in the Little Goose pool in late August and September. Downstream reservoirs, Lower Monumental and Ice Harbor, do not show the numbers of blue-greens found in Little Goose. Growth of these algal forms will be shifted to the Lower Granite Lake after dam closure with levels of blue-green algal production in the Lower Granite Lake comparable to those observed in the Little Goose pool. Bacterial quality of waters improve as the Snake River is detained in the reservoirs and passes into the downstream pools. Sphaerotilus bacteria are present below the (Snake-Clearwater) confluence during summer low flows, but in Lower Granite Lake are not expected to achieve nuisance proportions."

A water quality problem from the fisheries standpoint is likely to exist during low flows if the reservoirs are stratified. The Walla Walla District makes the following statement:

> "High recreation rates in the Snake River below Lewiston maintain dissolved oxygen in the free-flowing river at about 70 percent saturation, while dissolved oxygen concentrations in the Little Goose reservoir, the next downstream impoundment, did not drop below 65 percent saturation

> during the study. Likewise, thermal stratification did not develop in any of the down-river reservoirs and it is not expected to occur in the Lower Granite project. For these reasons, hydrogen sulfide accumulation is not expected in the Lower Granite pool."

Based on the information given above and on the fact that the acreage detention times would only be increased by 4 percent, the conclusion is made that the diversion of an additional 2,000 cfs will not change the water quality of the Lower Snake River a measurable amount. Irrigation return flows are probably into the Walla Walla and Columbia Rivers.

APPENDIX H

State of Washington Department of Ecology

STATE WATER PROGRAM

COLUMBIA AND SNAKE RIVER STUDY AREA

Energy Impact of Diverting 2,000 cfs from Ice Harbor Reservoir

The impact on energy will be of two types: (1) energy not generated because the water is consumed by crop and (2) energy used to pump the water from Ice Harbor port to the land.

In the first case all 2,000 cfs are lost from generation at Ice Harbor but some of the water is returned to the Columbia and Walla Walla rivers. Using information in Dutton and Millham, the total loss will be 144 million Kilowatt-hours per year. This is about 1,000 kilowatt-hours for each acre irrigated.

In the second case, energy which could be used elsewhere in the economy of the northwest is used to pump water from the Snake River for irrigation. Assuming an average hydraulic head of 600 feet and a pumping efficiency of 0.80, the pumping energy would be 410 million kilowatt-hours per year which is about 2,900 kilowatt-hours/acre/year.

The total energy cost of an acre irrigated from the Snake River is 3,900 kilowatt-hours/year.

APPENDIX I

State of Washington Department of Ecology

STATE WATER PROGRAM

COLUMBIA AND SNAKE RIVER STUDY AREA

Permit Provisions for Water Rights from the Lower Snake River

The control point for the Lower Snake River will be the gage on the Snake River near Clarkston, or the flow into Lower Granite Reservoir. The use of an upstream control point requires that each water right issued after the adoption of a regulation establishing a preservation flow be subject to a changing quantity of flow below which water cannot be diverted. The equation to use in calculating the specific quantity for a specific permit is:

$$Qm = 12{,}000 + \quad Qpi$$

Where 12,000 is the desired preservation flow and Qpi is the flow of a water right with a priority earlier than the specific permit being considered, all prior water rights for which certificates dated past 1970 must be included in the summation. The minimum flow required the next permit, when and if issued, would be:

$$Qm = 12{,}000 \text{ cfs} + 746.84 = 12{,}746.84$$

The 746.84 cfs results from the fact that water rights certificates or permits have been issued for 746.84 cfs since January 1, 1971. If the permit issued is for 100 cfs, then the permit must have the provision that diversions stop when the flow is less than 12,746.84 cfs as measured at Clarkston. The summation would continue until the total is 14,000 cfs - at which time water is not available for future appropriation.

The number of days in which flows were less than the preservation and the minimum flows are given in the following table.

Water Year	Number of Days Flow Was Less Than 12,000	14,000	16,000	22,000
1961	0	0	12	59
1962	0	0	0	31
1963	0	0	0	8
1964	0	0	0	3
1965	0	0	0	0
1966	0	0	7	55
1967	0	0	1	41
1968	0	0	0	16
1969	0	0	0	18
1970	0	0	0	10
1971	0	0	0	0
1972	0	0	0	1
1973	0	0	1	47

If 1934 flows were to occur again, the sum of the diversions (Qpi) -would cease for up to 45 days, because the flows were less than 14,000 cfs - 1934 was a year with the 1 in 10 year minimum flow.

APPENDIX J

State of Washington Department of Ecology

STATE WATER PROGRAM

COLUMBIA AND SNAKE RIVER STUDY AREA

<u>Potential Resources Problem in the Lower Snake River Area</u>

The following list of potential resource problems was prepared by staff of the Eastern Regional Office (DOE). These should be addressed in the environmental assessment by the Department of Ecology.

Wind erosion of bare cultivated land

Instability of sidewalls in excavations

Pollution of ground water by fertilizers
Pollution of ground water by pesticides
Pollution of ground water by herbicides

Effect of low water level on pumping plants
Waste treatment plant effluent effect on water at low flow

Runoff due to over-irrigation
Siltation of river due to runoff

Minimum flow to sustain fish life and wildlife
Minimum flow for navigation
Minimum flow for fish ladder operation
Minimum flow for power generation

Farming flood plains

Effect of low flows on water access for recreation
Effect of low flows on water in harbors
Reservoir eutrophication at low flow

River pollution from surface runoff, feed lots, return flow

Aesthetic impact of low flow – unsightly shorelines and abandoned structures

Thermal pollution

Slope stability at low flow – landslides

APPENDIX K

State of Washington Department of Ecology

STATE WATER PROGRAM

COLUMBIA AND SNAKE RIVER STUDY AREA

<u>Ground Water in the Lower Snake Area</u>

Ground water use in the Snake River area of Washington has been small. The purpose of this report is to take a very preliminary look at ground water use and the potential for ground water use in the area near the main stem of the Snake River.

In 1966, the ground water permits in Water Resources Inventory Areas 33 and 35 were for a total of 124.2 cfs. Much of the use in WRIA 35 is away from the main stem area. The uses in each WRIA are given in Table 1.

Table 1 - Summary of Ground Water Rights, Lower Snake, 1966

WRIA No.	Name	Municipal	Irrigation	Total
33	Snake-Low	–	33.5	45.7
35	Snake-Tucannon	43.9	33.0	78.5
	Total	43.9	66.5	124.2

all flows in cfs

Little information is available on the ground water in the area of irrigable lands nor in the Eureka Flats area. On the north side of the Snake River ground water may be available at reasonable depths because of irrigation in the Columbia Basin. On the south side, little water is available at this time except very near the river. In Washington Department of Water Resources Monograph No. 1, the following comment on ground water in the Eureka Flats area is made:

Eureka Flat

> Water levels beneath Eureka Flat are similarly very deep. In years past the water for household use of individual farmsteads in the area had to be hauled and stored in cisterns. Many homes subsequently were abandoned, or the owners resorted-to costly drilling of deep wells which were equipped with windpowered machinery. These wells usually are 6 inches in diameter and reach depths to over 1,000 feet to obtain yields of 10-15 gpm. The few wells scattered across the area generally penetrate 50 to 150 feet, or a little more, of fine loessal silt and sand striking the basalt which generally is barren of water for several hundred feet more. An apparent anomally exists in some areas where reported water levels place the main water table below the level of Lake Sacajawea. Actual water-level measurements, difficult to obtain in some older wells, or test drilling will be necessary to provide more accurate information in these areas. According to the memories of some people contacted during this 1963 study, some sand and gravel is found to depths of over 200 feet beneath Eureka Flat near Eureka (well 10/34-31J). These buried deposits probably represent the alluvial materials along an ancient course of the Snake River across the Eureka Flat area. One driller (Harold Yager) reported that in the Clyde area domestic wells are drilled 800-900 feet deep to obtain 10-20 gpm of water. The wells penetrate about 200 feet of unconsolidated deposits before reaching the basalt. The basalt may contain several semiperched water-bearing zones which are drained during drilling to deeper zones. Generally, information on the few wells canvassed on Eureka Flat is scanty. A seismic survey will be required to more clearly define the nature of the basalt surface and of the depth and extent of the coarser unconsolidated deposits which underlie the fine loess that mantles the area.

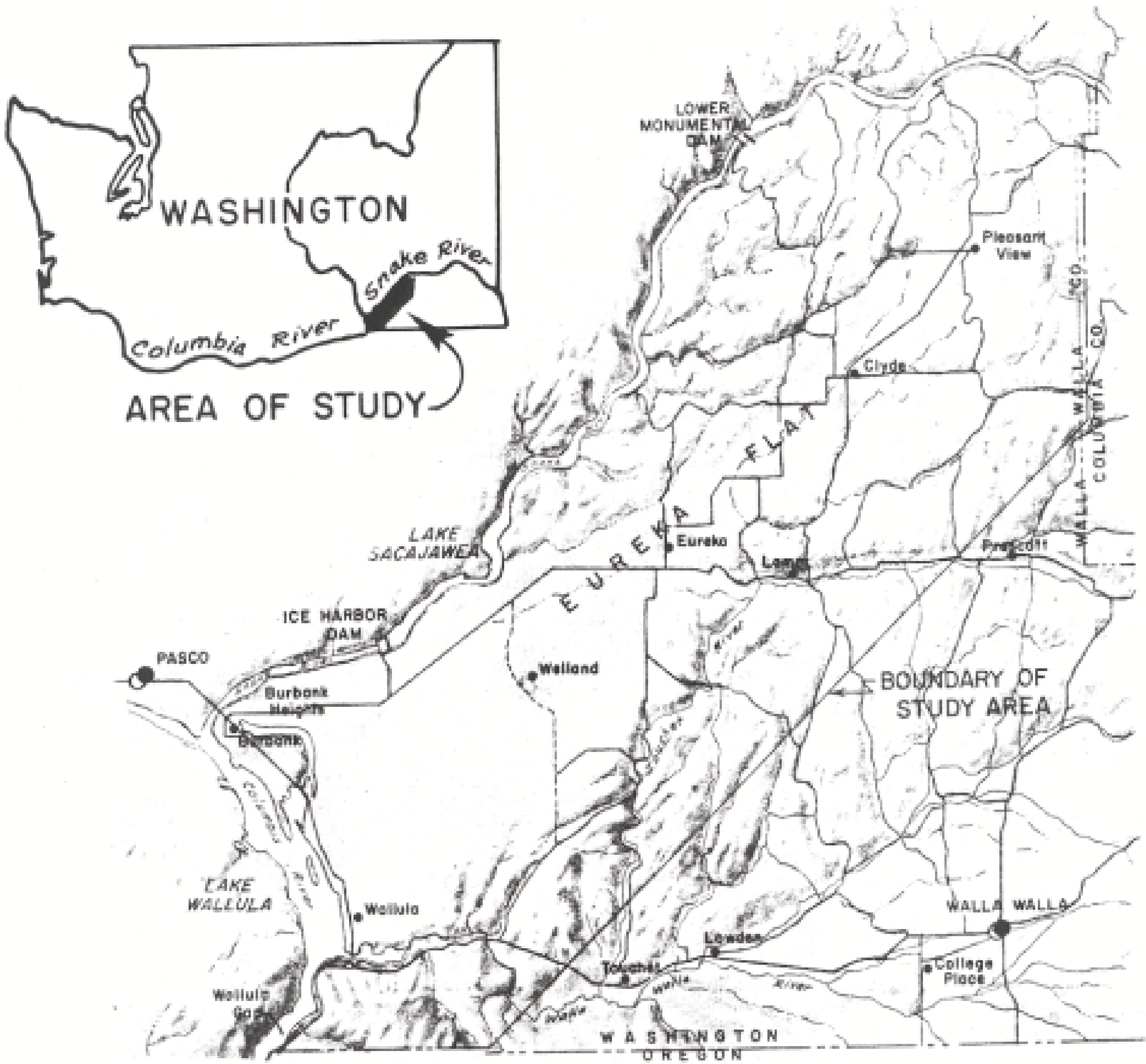
If the Eureka Flats area is irrigated, the near surface material may be saturated, and with time recharge the basalt aquifer. Drainage could be a problem in the Eureka Flats area and the possibility of conjunctive use management of surface and ground waters should be investigated.

Ground water problems which may occur as a result of irrigation of the Eureka Flats area are:

1. Nutrient pollution of the ground water.

2. Drainage.

3. Landslides in the Snake River Canyon resulting from saturation of the slopes.


WASHINGTON
Snake River
Columbia River
AREA OF STUDY
LOWER MONUMENTAL DAM
Pleasant View
Clyde
EUREKA FLAT
Eureka
Prescott
LAKE SACAJAWEA
ICE HARBOR DAM
PASCO
Burbank Heights
Burbank
Wallula
LAKE WALLULA
Touchet
Lowden
WALLA WALLA
College Place
BOUNDARY OF STUDY AREA
WALLA WALLA CO.
COLUMBIA CO.
WASHINGTON
OREGON

APPENDIX L

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WRIS Information Bulletin No. 13

SNAKE RIVER MAIN STEM

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APPENDIX M

State of Washington Department of Ecology

STATE WATER PROGRAM

WASHINGTON STATE WATER PROGRAM

COLUMBIA AND SNAKE RIVER STUDY AREA

<u>Natural Flows in the Snake River</u>

An attempt was made to estimate the natural flow of the Snake River on an annual basis and for August. The results are given below. They can only be considered to be very rough estimates of the natural flow.

I. Annual Flows (1961)

Stream	Measured	Depletions	Natural
Snake above Salmon	13,300	7,100	20,400
Salmon	9,000	280	9,300
Grand Ronde	2,700	260	3,000
Clear Water	15,200	15	15,200
Minor (and error)	1,200	--	1,200
Total (Clarkston)	41,400	7,655	49,100

II. August Flows (1961)

Stream	Measured	Depletions	Natural
Snake above Salmon	8,700	1,600	10,300
Salmon	3,500	980	4,500
Grand Ronde	650	930	1,600
Clear Water	2,650	50	2,700
Minor (and error)	800	--	800
Total	16,000	3,560	19,900

III. Natural 1 in 10, 7-day, Low Flow

Average Depletion prior to 1950: 4,200,000 acre feet (5,800 cfs)

During August, Depletion is: (5,800 cfs) (0.46) = 2,700

Measured 1 in 10, 7-day, low flow: 12,400 cfs

Natural 1 in 10, 7-day, low flow: 15,100 cfs