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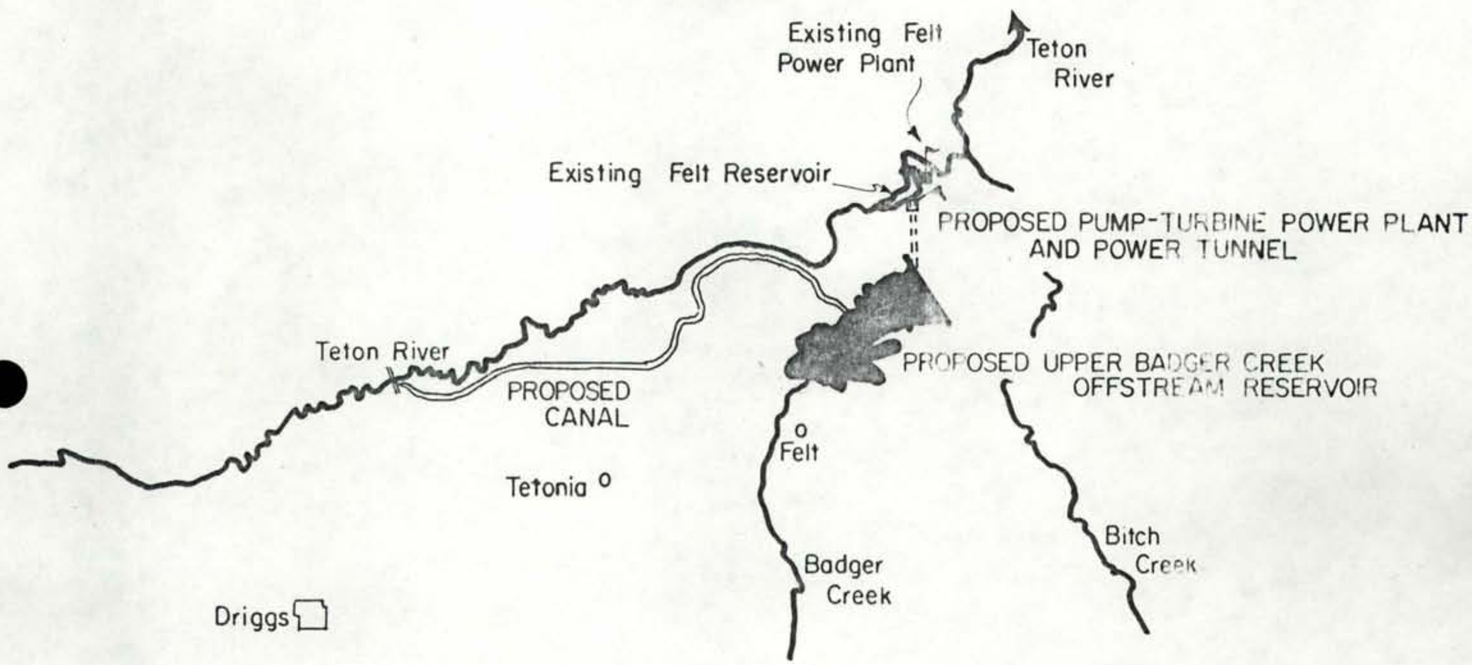
A PRELIMINARY APPRAISAL OF OFFSTREAM RESERVOIR SITES FOR MEETING WATER STORAGE REQUIREMENTS IN THE UPPER SNAKE RIVER BASIN



IDAHO WATER AND ENERGY RESOURCES
RESEARCH INSTITUTE

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Research Technical Completion Report

A PRELIMINARY APPRAISAL OF OFFSTREAM RESERVOIR SITES FOR MEETING WATER STORAGE REQUIREMENTS IN THE UPPER SNAKE RIVER BASIN

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ABSTRACT

This report presents an appraisal of the value and possibility of utilizing offstream reservoirs as water and related land resource developments. It follows a Phase I effort that merely inventoried potential sites in the Upper Snake Riber Basin of Idaho upstream from Weiser, Idaho. The study reports on the assessment that was made of the availability of water for storage on offstream reservoirs in the various drainages, allowing for extensive use of interbasin transfer of water and for pumping to sites from water sources that appear to have not been completely allocated. Likely future uses of the storage water that could be impounded in offstream reservoirs are reported on and estimates are made of the value of water in those uses under Idaho conditions now prevailing. Over 200 offstream reservoir sites were considered and a subjective screening has identified by basin thirteen of the most promising sites.

A methodology for making an assessment of the social, political, and environmental acceptability of these offstream reservoir sites was developed and suggestions made of how to conduct the appraisal of a particular offstream reservoir site. Conclusions indicate that the possibility of offstream water storage developments will be rather marginal in a cost effective sense. Particular attention was given to determining how augmentation of flows for fishery enhancement might be benefited by offstream reservoir development. Hydropower development appears to offer promise of positive benefits. More detailed reservoir operational studies and economic feasibility evaluations are recommended on the more promising reservoir sites to determine future value and acceptability.

ACKNOWLEDGEMENT

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Special thanks is extended to A.C. Robertson of the Idaho Department of Water Resources for his advice on water availability and related hydrologic consideration. Recognition is made of the use and the contribution of studies on fish flow-water storage studies by Peter Hengeste, of the North Pacific Division Office of the U.S. Corps of Engineers. Appreciation is expressed for the contribution of Richard J. Fisher, James Nee, and George Harrison of the Ecological Services Division of the U.S. Fish and Wildlife Service at Boise, Idaho, who helped in the environmental and fishery enhancement components of the study.

Thanks is also extended to M.L. Hall, P.J. Vance, and C. Eguia, civil engineering students who helped on calculations and preparation of graphic material for the report. A sincere thanks is also given for the secretarial assistance of Judy Kidd, Catherine Evans, and Gloria Hall, who so willingly made a superb effort in getting the report prepared.

INTRODUCTION

The purpose of this research study was to make an appraisal of a detailed inventory of offstream reservoir sites to determine the value of the offstream impoundment of water in meeting possible water storage requirements in the Upper Snake River Basin in Idaho. "Offstream" as used in this report means that approximately half or more of the water needed to fill the reservoir is imported from another drainage. The detailed inventory of sites was performed in an earlier phase of this research (Kirkland, Warnick, and Heitz, 1979), and was added to in the earlier stages of this phase.

The specific objectives of the research were as indicated below:

1. Evaluate the availability of water at the best offstream reservoir sites located in the Inventory.

2. Study the validity of pump lift criterion used in the original survey.

3. Study the utilization of two or more source streams and "other basin" transfers that might provide storable water.

4. Reconsider sites found in the Inventory with less than 35,000 acre-feet capacity, using minimum capacity limit of 20,000 acre-feet.

5. Evaluate the most likely uses of stored water at identified sites in the Inventory and give particular emphasis to conservation goals and fishery enhancement.

6. Make additional literature search, researcn and assessment of costs of dams and conveyance systems and methods of expressing the value of stored water for various purposes.

7. Reduce the list of potential sites to the best 6 to 10 sites by a systematic screening process.

8. Make a preliminary assessment of social, political and environmental acceptability of the selected sites, particularly stressing methodology.

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AVAILABILITY OF WATER FOR THE VARIOUS OFFSTREAM RESERVOIRS

In planning this research it was decided that a detailed year-by-year operations and water-balance study was not justified. It was recognized that the experience of the Hydrology Section of the Idaho Department of Water Resources should be used to give a cursory evaluation for regions or basins where more detailed assessments would need to be conducted. The staff of this research project in conferences with A. C. Robertson, Chief of the Hydrology Section of the Idaho Department of Water Resources has made this assessment. The principal basis for the decisions is a reach-gain river model study that was made by the Idaho Department of Water Resources. The particular model that was considered was Study No. 54 which used 1977 levels of water use development. This means that a simulation of river flows and reservoir contents on a monthly basis from 1928 through 1977 was made, assuming the 1977 level of water use and storage. This simulation was made to generate an accounting of all storage changes in reservoirs and gains or losses in river reaches caused by natural inflows, return flows and stream diversions. The accounting was done using the historical record period 1928 through 1977. Thus the model generates flow data and storage contents as if all dams, irrigation releases, power releases, flow augmentation and water losses were in operation from 1928 through 1977. An example printout sheet is shown in the Appendix for the Snake River operational flows immediately below Milner Dam (Appendix Table A-1-1).

A comment needs to be made about the accuracy of the accounting. Accurate Data are lacking on return flows in some reaches. Diversion data in early years were not as accurate and well-documented as today. Where the computer printout indicates a flow in the Snake River of 11,036 cfs it might actually be between 8,000 and 14,000 cfs. Another extremely important factor is the 10 to 12 years in the 1930's and 1940's which indicate an unusual sequence of low flows. How typical is that sequence? Is it a once in 50-year event or is it a once in 1000-year event? In the absence of more information, like tree ring correlation studies, the known record must be the basis for making a rather conservative evaluation.

The simulation model results are reviewed moving downstream from Palisades Reservoir to the Weiser Basin in the following paragraphs. The model indicates that there is very limited firm water available for new development above Milner Dam. That is, the model indicates that the reservoirs above Milner did not consistently fill, especially in the dry 1930's, given the 1977 level of river development and water use. Twelve out of 14 years between 1930 and 1943 Palisades did not fill. However, only 9 other times in the 1928 to 1977 period was there a shortfall, and in 4 of these years the reservoirs were close to full. The American Falls Reservoir filled even fewer times in this period.

The model is saying that, based on current development and management and diversion practices, there is no firm water available for consumptive use above Milner, and this includes water for the Bruneau Plateau area, which would be diverted above Milner. Thus a project would need to be justified primarily on the basis of the non-consumptive benefits provided such as flood control, hydroelectric power, fish and wildlife, recreation, and local low-flow augmentation (as opposed to irrigation augmentation or main stream flow augmentation). It must also be shown that the present system of reservoirs cannot provide the same benefits as cheaply as additional water storage projects.

A small amount of water is allowed to pass Milner to meet contractual agreements the U.S. Water and Power Resources Service (Bureau of Reclamation) has with

Idaho Power Company, related to American Falls Reservoir. There is also some leakage as it is impossible to completely stop the river flow.

The model did not consider the Lost River system, Birch Creek, Medicine Lodge Creek, or Camas Creek. For the Lost River, the same principle as above can be applied to Mackay Reservoir. That is, if it is not being regularly filled, there is little point in seeking additional consumptive water storage. USGS records show that Mackay Reservoir was filled less than 50 percent of the years 1919 to 1950.

The Wood River would be short of water to a considerable extent were it not for the Snake River diversions through the Milner-Gooding Canal which supply much of the lower Little and Big Wood drainage with supplemental water. The filling of Magic Reservoir provides the basic check point in the Wood River system for determining whether there is a basis for additional storage, especially consumptive use water that would be supplied from storage. USGS records indicate that Magic Reservoir did not fill over 50 percent of the years between 1909 and 1950.

Below Thousand Springs there is water in the Snake River which could be utilized but its location at the bottom of the canyon makes it essentially inaccessible for offstream storage. Bruneau River water is similarly unavailable.

In the Boise River Basin it is again necessary to consider reservoir capacity and annual fillings to determine whether there is any firm water available if there is a need for additional storage. This consideration should also evaluate whether raising Lucky Peak would not be more beneficial than building new storage, if additional storage is justified. Flood control, especially for Boise, is becoming an increasingly important factor to consider, as is low flow augmentation to counter the increasing river load of secondary treatment sewage effluent. There is still 116,000 acre-feet of uncommitted capacity in Lucky Peak Reservoir which needs evaluation in any consideration of new storage for consumptive uses.

The Payette River system clearly has surplus firm water in the lower reaches. The North Fork must be viewed from the standpoint of the operations output for Cascade Reservoir, which is not always filled and which has some uncommitted storage. The Weiser River Basin has no significant storage; therefore, it is open to storage development which will provide flood control and consumptive use benefits as well as nonconsumptive benefits like hydropower development and augmented flows for enhancement of fish migration. Later in this report information is presented on some possible planning schemes that could provide some likely uses of the waters of the Payette and Weiser Rivers.

Modified System Operation

The evaluation based on reach-gain analysis of present modes of operation of the many reservoirs and river diversions is predicated upon many longstanding irrigation practices and is limited by the customary exercise of existing water rights. These make the use of river waters somewhat less than optimum. As a planning effort it is desirable to define some scenarios that would determine what water might be available if diversions were changed and more water were retained in the river system. More water would then be available for storage all along the Snake River.

This study did an example analysis to show, for future planning purposes, the possibility of obtaining storage water for new offstream reservoirs through changes in existing irrigation diversion patterns. The main stem of the Henrys Fork River above its mouth was chosen to make the "what if" analysis. This river was chosen primarily because of the rather high irrigation diversions that it serves and the fact that only two reservoirs were operative. Thus the analysis was made rather simple and straight-forward. Figure 1 is a schematic diagram of the Henry's Fork drainage showing existing reservoirs, the river systems, the canal diversions, and the relative location of potential off-stream reservoirs.

In this case, the Reach-Gain River study Model No. 54 by the Idaho Department of Water Resources was used to obtain the basic data for the analysis. An "average year" flow study was made of water requirements to meet the demands for irrigation. The year 1951 was chosen as a real time analysis period because the model showed essentially no difference in reservoir carry-over from beginning of year to end of year and because it had 424,000 acre-feet of run-off at the outlet to Island Park Reservoir as compared to the long-term average runoff of 422,000 acre-feet. Real time analysis in this case means the operational studies were made on a monthly flow basis starting with October as the beginning of a water year and following through in a sequential pattern month by month. A study of reductions in irrigation diversions that might be attainable by improving overall irrigation system efficiency was made. This was based on published reports by (1) U.S. Soil Conservation Service, (2) U.S. Bureau of Reclamation and (3) Claiborn and Brockway. These studies estimated that overall irrigation efficiency could be improved from 30% to 42%. The savings in water that could be achieved through improved irrigation efficiency while still meeting commitments was then calculated. At the same time a minimum instream flow release was estimated for the reach of the Henrys Fork River immediately below Island Park Reservoir. The minimum flow that was to be maintained was taken as the minimum historical flow in the channel before any dams were built. Following this a study was made as to whether water savings could be made while serving the storage demands that are normally placed on the river. This study revealed that in an average year a total of 67,700 acre-feet of water would be available immediagely below Island Park Reservoir for new off-stream storage. The details of this study and a brief statement of assumptions

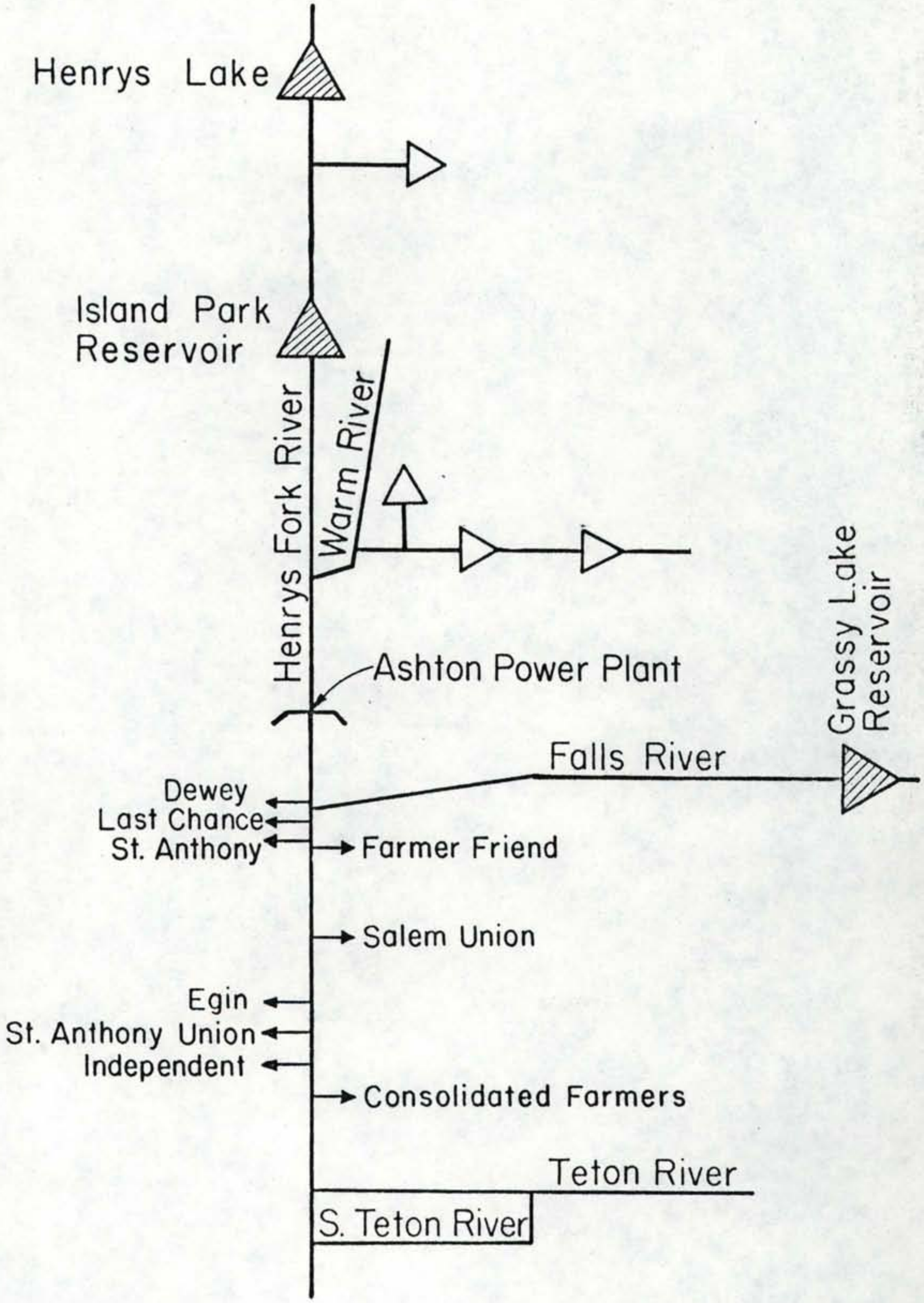


Figure 1. Schematic Diagram of Henrys Fork River Reservoirs, Diversions, Potential Offstream Sites, and Principal River Inflows.

are in the Appendix (Henrys Fork Snake River Water Availability Analysis). This example of flow regulations on the main stem of the Henrys Fork of the Snake River shows that there is potential for water storage upstream of Milner Dam if changes in diversion patterns could be implemented. Further detailed study of the possibilities for securing additional waters through increased irrigation efficiency is needed all the way down the Snake River system, and particularly in the system down to Milner Dam on the Snake River.

Studies by the Soil Conservation Service and by M. Ali, a graduate student in Agricultural Economics at the University of Idaho, show that above Milner Dam a reduction in irrigation diversion to some reasonably attainable efficiency might result in additional storage water of about 1.2 million acre-feet per year. This is a preliminary figure. The true potential for reduction in diversion needs to be studied very carefully because of the many water right problems and institutional problems that might be involved. A note of caution is expressed here concerning the possibility that reductions in diversions will impact groundwater flows into American Falls reservoir and flows of the springs in the Snake River reach from Milner Dam to Bliss, Idaho.

For planning design of offstream reservoir developments in the Payette River and the Weiser River drainages, a brief operational study was made to estimate the amount and time availability of water in the Payette River. This was done using monthly estimates of flow for the Payette River at Horseshoe Bend and estimates of irrigation demands within the Payette River system.

A special study made by the Payette River Watermaster in 1977 indicated 146,295 acres were irrigated in 1977. A study of the irrigation water requirements for this acreage using the consumptive requirements published by Sutter and Corey and the 26% overall irrigation efficiency (that being attained at present) revealed the following monthly diversion requirements for an average year condition:

Table 1. Estimated Irrigation Diversion Requirements in the Payette River below Horseshoe Bend (Acre-feet)

Month	April	May	June	July	Aug.	Sept.	Oct.
Diversion	25,716	170,783	314,268	360,607	296,264	93,935	23,233

Yearly Total = 1,284,800

A true-time study based on 1964 data was made to identify the amount and timing of water availability using the measured flow at Horseshoe Bend and reservoir contents and the change of contents at Cascade and Deadwood Reservoirs. From this an unregulated flow record was generalized. Using this, a tabular study was then made to determine the amount and timing of water availability. In this operational study of an average year it was decided to maintain a minimum flow that was as large as the historical unregulated minimum flow in the stream below Horseshoe Bend. This was 36,000 acre-feet per month. Figure 2 illustrates the availability of water. This shows that 2,196,000 acre-feet of water was available in 1964. The water needed for irrigation with 26% overall irrigation system efficiency was computed to be 1,284,800 acre-feet. This indicates that there would be 620,470 acre-feet of water for use after meeting present (1977) irrigation and low flow demands. The time availability of the water is shown in the monthly hydrograph plots of Figure 2. A similar study was done for the very dry year of 1977 and the results are shown graphically in Figure 3. This dry year study shows that there would be no excess water. Further study was made by assuming that farm operations could achieve improved overall irrigation efficiency. An attainable efficiency was chosen as 44 percent, as reported in the study by the Bureau of Reclamation and the Bureau of Indian Affairs. This shows that in a dry year there would only be 162,600 acre-feet of water available for new storage reservoirs using 44% efficiency. Using the current 26% efficiency, there would be no additional water. Other years of operational studies were made with different degrees of efficiency and with higher runoff yield for the water years. These results are shown in the Appendix to this report (Payette River Water Availability Analysis).

Additional analysis of the hydrographs and the records of reservoir operation shows that in the true-time operation for 1959 (a near-average year) with minimal carryover in the upstream reservoirs, a total of 144,000 acre-feet of storage would be necessary to meet the normal month-by-month irrigation requirements for the irrigation system below Horseshoe Bend assuming 44% irrigation efficiency. That requirement could be stored in the 161,900 acre-feet of space that is available in Deadwood Reservoir. However, under the overall 26% system efficiency existing at the present time, 446,400 acre-feet would need to be stored. Of this, 161,900 acre-feet could be stored in Deadwood Reservoir, while the remaining 284,500 acre-feet of water would need to be stored in Cascade Reservoir or in new storage sites on the South Fork of the Payette River. This information is graphically illustrated in Figure 4. It assumes, as before explained, an overall irrigation efficiency of 44%. This information is used later in illustrating possible schemes for using newly developed water storage in offstream reservoirs.

Data and supporting information for these studies were supplied by the Idaho Department of Water Resources through the cooperative effort of Alan Robertson.

In further conferences with Alan Robertson of the Idaho Department of Water Resources, the researchers on this project learned of a water supply study made by Peter Henegested of the Power Section of the North Pacific

PAYETTE RIVER WATER AVAILABILITY

AVERAGE YEAR

26% IRRIGATION EFFICIENCY

- - Water diversions needed for system efficiency of 26.

—— Unregulated flows = 2,916,000 acre-ft.

Water available for uses other than irrigation either above or below Black Canyon Reservoir = 620,470 acre-ft.

Water available for uses other than irrigation below Black Canyon Reservoir = 203,050 acre-ft.

Shortage

Water to compensate for shortage.

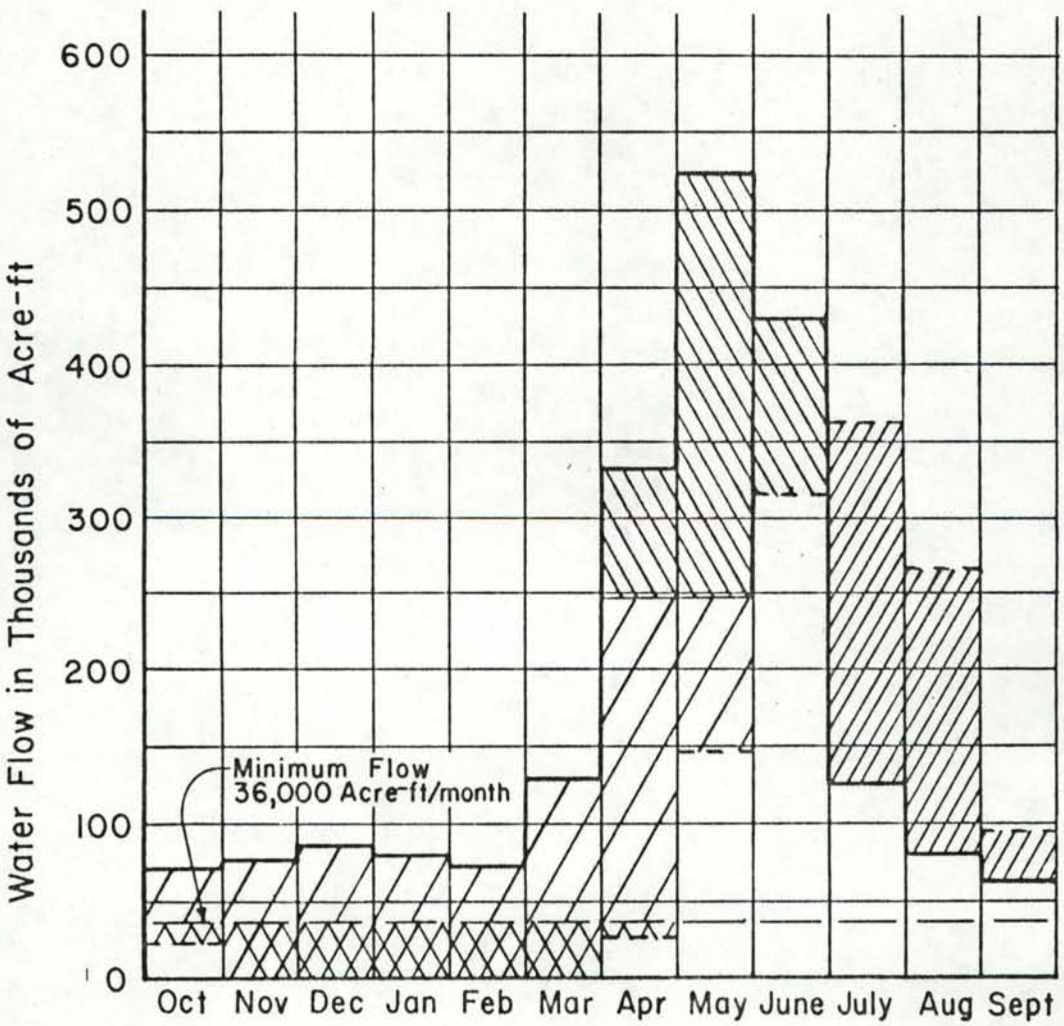


Figure 2. Graphical Presentation of the Availability of Payette River Water at Horseshoe Bend (1964 average year with 26% irrigation efficiency).

PAYETTE RIVER WATER AVAILABILITY

DRY YEAR

26% IRRIGATION EFFICIENCY

--- Water diversions needed for system efficiency of 26% (1,284,000 acre-ft).

—— Unregulated flow = 1,121,000 acre-ft.

(cross-hatched) Water available for uses other than irrigation below Black Canyon Dam.

(hatched) Shortage.

(reverse hatched) Water to compensate for shortage.

Net Shortage of Water Needed For Irrigation at 26% Efficiency Plus Water For Minimum Flow = 375,000 Acre-ft.

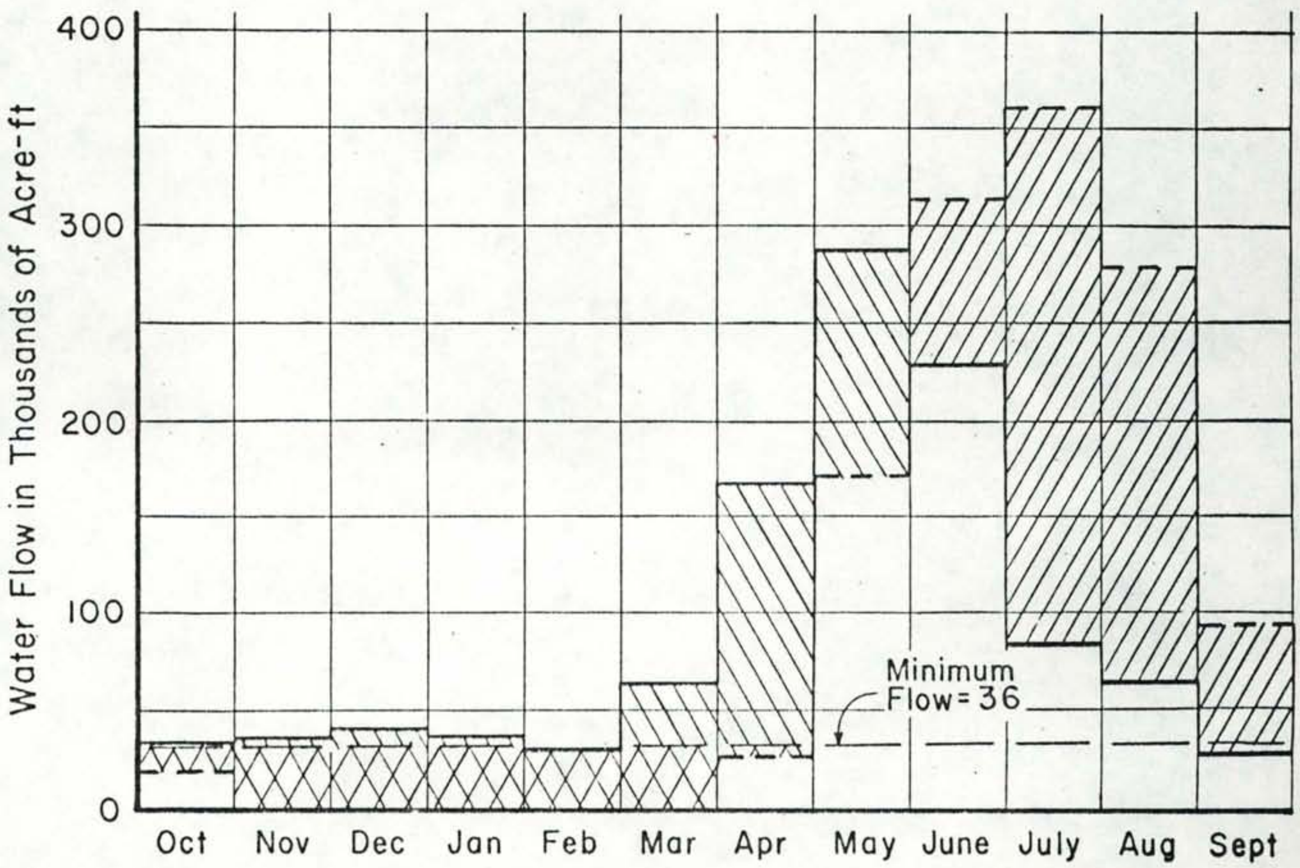


Figure 3. Graphical Presentation of the Availability of Payette River Water at Horseshoe Bend (1977 Dry Year with 26% Irrigation Efficiency).

PAYETTE RIVER WATER AVAILABILITY

AVERAGE YEAR

44% IRRIGATION EFFICIENCY

--- Water diversions needed for system efficiency of 44% (760,240 acre-ft)

—— Unregulated flow = 2,107,000 acre-ft.

Minimum flow = 36,000 acre-ft/month (600 cfs).

Shortage.

Water to compensate for shortage.

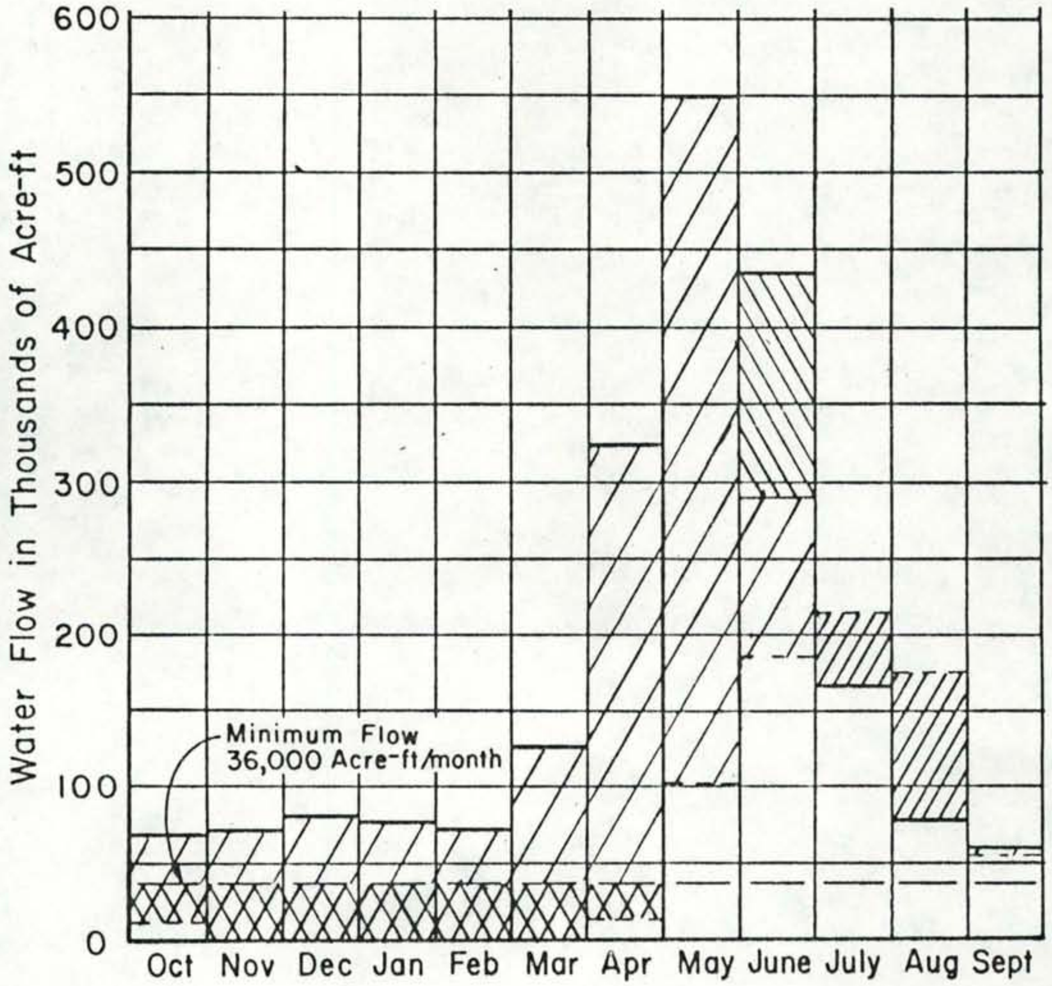


Figure 4. Graphical Presentation of the Availability of Payette River Water at Horseshoe Bend (1959 Average Year With 44% Irrigation Efficiency).

Division Office of the Corps of Engineers. This study has not been published but operational study sheets of the river and reserviors were obtained for consideration on this project. The purpose of that Corps of Engineers study was to determine how much the flows of Lower Snake River below Lower Granite Dam could be increased at certain times of the year to expedite migrating young Salmon and Steelhead proceeding down the river. A total of eight proposed on-stream reservoirs were assumed to be in operation, and simulated operating studies were conducted for the period 1928 to 1969. For purpose of comparison and use in this research only the four proposed storage projects on the Snake River and tributaries above the mouth of the Weiser River were used. These proposed reservoirs are, with the indicated live reservoir storage, as follows (see Figure 5):

1. Lynn Crandall (1,420,000 acre-feet),
2. Thousand Springs (490,000 acre-feet),
3. Twin Springs (300,000 acre-feet), and
4. Garden Valley (1,940,000 acre-feet).

An average year was studied to determine how much the Snake River flow could be altered below Brownlee Reservoir. Brownlee Reservoir is the last existing reservoir on the Snake River above Hells Canyon Dam that could be used to alter the flow. Figure 6 shows a group of monthly hydrographs of releases from Brownlee Reservoir for the 1964 water year, a year in which runoff was near the long time historical average. First is shown the reconstituted natural flow of the Snake River; second, the flow as projected by the Idaho Department of Water Resources simulation Run No. 59 that represents the river as it would have been operated under 1977 degree of depletions and upstream irrigation use; third, is the Corps of Engineers projection of operational flows as they would have existed under 1995 degree of development; and fourth, a regulated flow in

MIGRATORY FISH FLOW AUGMENTATION

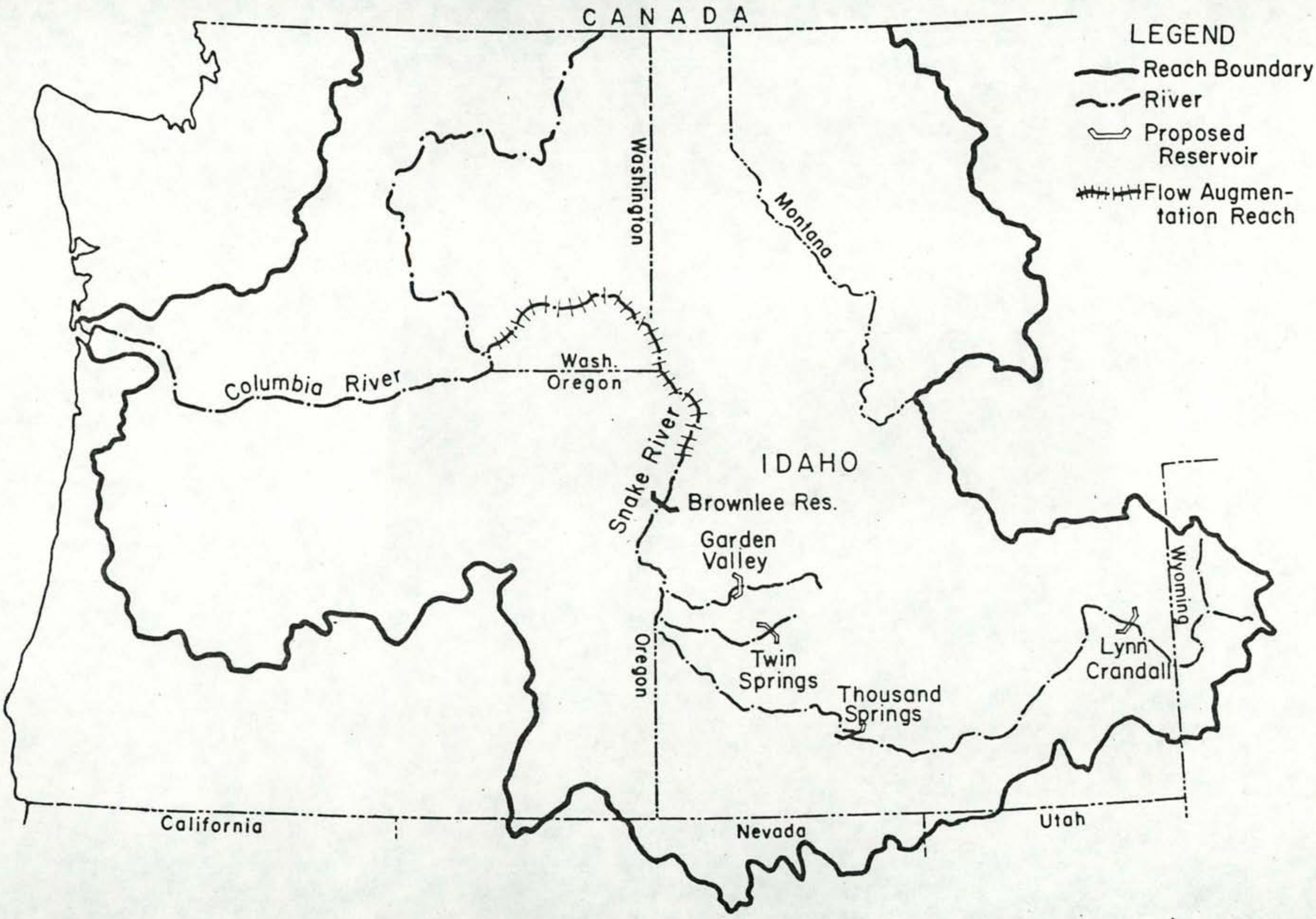


Figure 5. Map Showing Proposed New Onstream Reservoirs Utilized in Corps of Engineers (Hengesteg Study) Operational Plan to Augment River Flows for Fish Enhancement.

which normal power operations and irrigation demands are met, and as much flow is released in the last half of the month of April as possible to benefit downward migration of fish. This average year shows that mean daily flow in the Snake River in the critical river reach below Brownlee Dam could be increased from 22,545 cfs to 38,963 cfs during the last 15 days of April. The true-time water year 1964 was used for this Corps of Engineers operational study, starting in October 1963 and ending in September 1964. That year the operational studies confirmed that all reservoirs filled. Thus the 4,150,000 acre-feet of new storage would have been used and necessary to accomplish the augmentation of flow for fish enhancement by using a carryover from the 1963 water year of 3,727,300 acre-feet. In that average year of 1964 all the reservoirs ended up at the end of September with a total of 4,029,600 acre-feet.

In the case of a very dry year (1931 water year) results of Corps of Engineer's study showed that the mean daily flow in the last 15 days of April was increased from 5153 C.F.S. to 36,083 C.F.S. Figure 7 gives a graphic representation of the four operational studies. Only 780,300 acre-feet of storage was shown to have been generated as increase in storage in the four hypothetical reservoirs and Brownlee Reservoir. To accomplish this required carrying over a total of 987,400 acre-feet from the 1930 water year. At the end of September 1931 the operational studies showed no storage left in any of the four hypothetical reservoirs.

In a wet year no real advantage to augmenting fish flows in the Lower Snake River can be ascribed to having the additional storage because natural seasonal flood flows will satisfy the fish flow demands. Hence, one might observe that the 4,150,000 acre-feet of proposed new water storage represents an upper limit of the amount of water storage that might be sought in offstream reservoir sites. Later use is made of these data in Figure 6 and 7 to estimate values of this storage water in the single purpose use for fish enhancement.

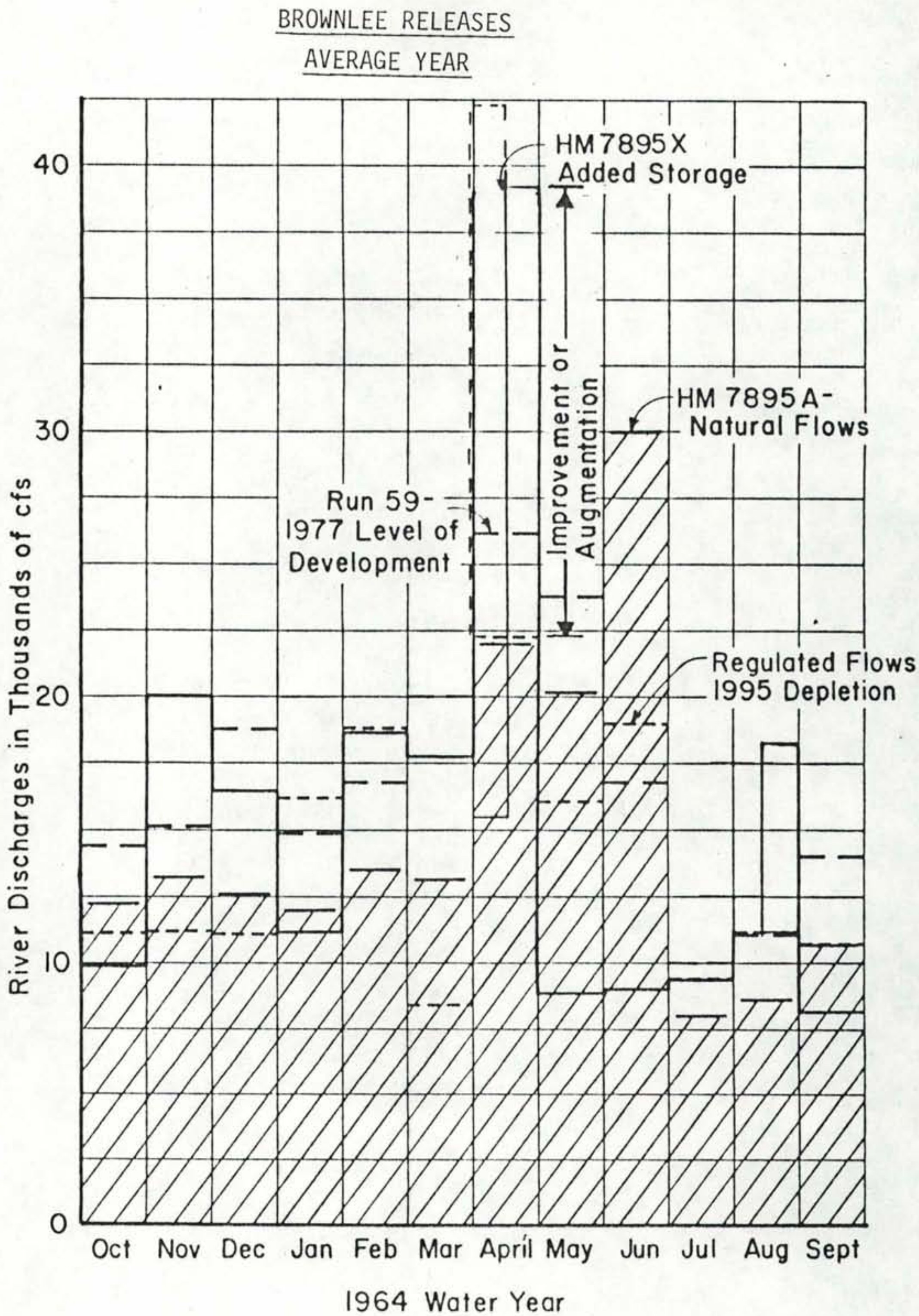


Figure 6. Hydrographs of River Discharges from Brownlee Reservoir, Snake River, Idaho Showing Operational Releases for Corps of Engineers. Hypothetical Plan to Augment River Flow for Enhancement of Fishery (1964 Average Year).

BROWNLEE RELEASES

DRY YEAR

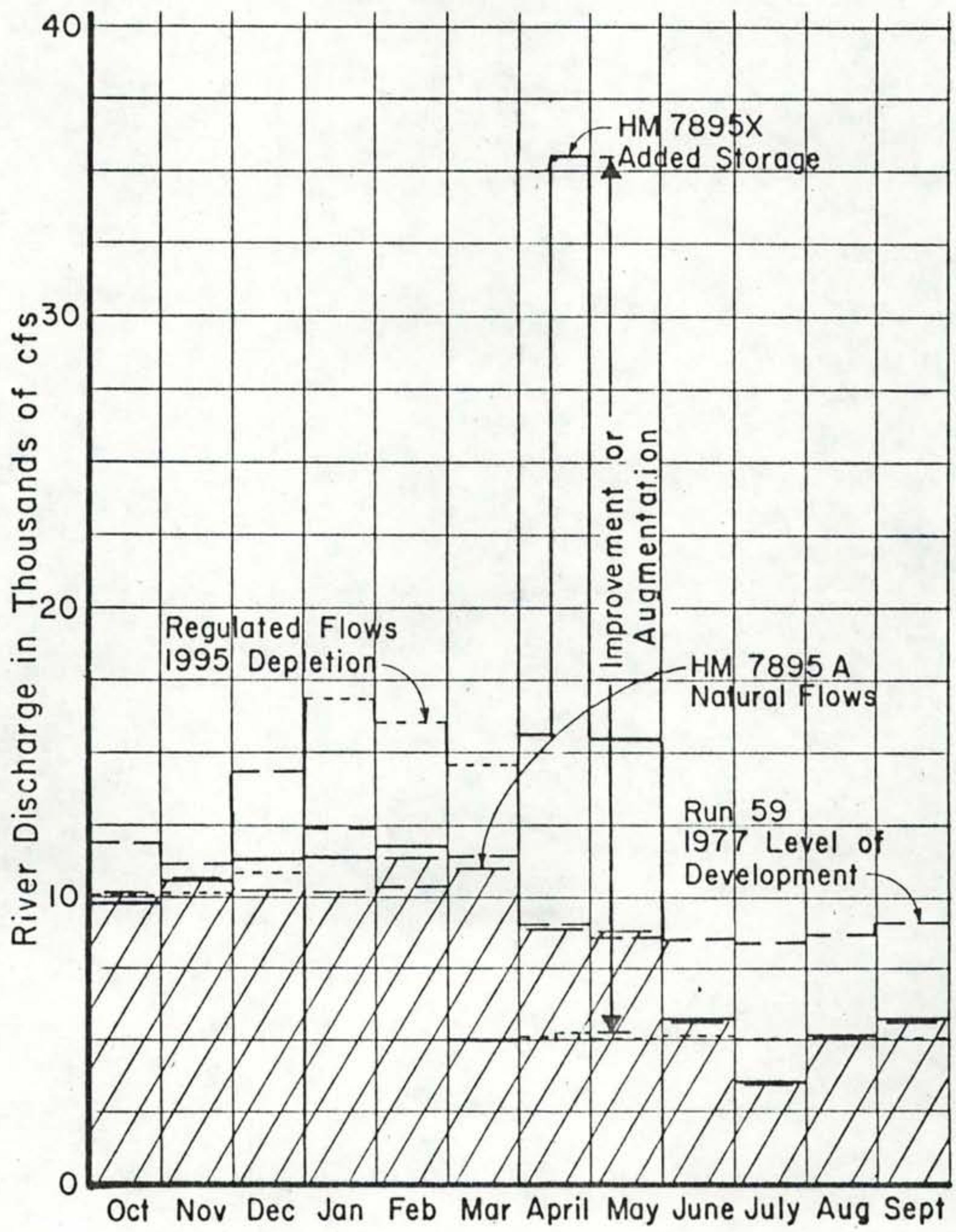


Figure 7. Monthly Hydrographs Showing Operational Characteristics of Snake River Releases From Brownlee Reservoir for Corps of Engineers Hypothetical Plan to Augment River Flows for Fishery Enhancement (1931 Dry Year).

VALUE OF STORAGE WATER AND COSTS OF OFFSTREAM RESERVOIR STORAGE

This section of the report responds to the contract objective of assessing what value offstream storage water might have in various potential uses in the Southern Idaho area where an inventory has been made of offstream reservoir sites. It was also important to determine the relationship of the costs of water storage in offstream reservoirs to the water values in various uses.

Irrigation Use Values

Because much past use of Snake River water has been for irrigation development, the value of this use is considered important as a possible future use of new storage water. Three recent reports were used to make the assessment of irrigation water values: the work of Allen and Brockway (1979), the Ph.D. dissertation of Ali (1978) and the draft environmental impact study of new land development by the Bureau of Land Management (1979). The study by Allen and Brockway (1979) indicates that the Bell Rapids Project in Twin Falls County grossed $590 per irrigated acre in 1977. This mutual irrigation company involves 25,520 acres of land. Nearly half of the acreage is in potatoes, a very high-valued crop. A study by M. Ali (1978) shows that costs of producing irrigated crops in the Upper Snake region was $250 per acre which is for a slightly different cropping pattern than the Bell Rapids Project. Thus the net revenue or value added from the irrigation operation is about $340 per acre. In this case there is also an additional cost of supplying the water: $25.08/acre-foot. The average rate of diversion on this project in 1977 was 2.62 acre-feet per acre, thus the value of the water might be assigned a maximum gross unit amount of about $105/acre-foot. This is giving all the net revenue value to water, which may be too liberal, because the irrigation manager should be credited with a portion of that net benefit. This project is probably one of the most efficiently run projects in the area because the application of water is by sprinklers and the farms are large, new, and in general, well managed. Likewise, this analysis of the Bell Rapids Project utilizes the benefits from farming with a high percentage of the land cropped with a high valued crop of potatoes. In the long run the net value added cannot be expected to be as high as here calculated. Average gross crop value obtained from use of the irrigation water from Allen and Brockway's 17 projects is far lower than the Bell Rapids Project. The gross crop values range from $167 per acre to the high for Bell Rapids of $590 per acre and average approximately $166 per acre.

The recent study by Bureau of Land Management is more theoretical but nevertheless useful in assessing the value of irrigation water. The study assumes 320-acre farms operating with a 350-ft lift and an energy cost of 16.65 mills per KWH, which is about one third the marginal cost of new energy production in the Pacific Northwest. With normalized conditions, accounting for different crops and prices for the year 1977 the net return per acre was reported as $55.67. If a diversion rate similar to the Bell Rapids Project is considered then the net value added per acre-foot of water would be $21.25/ acre-foot.

A later study by Kevin (1979) gives net returns to irrigation projects of $103.92 per acre, or, if we use the same water diversion rate as was used on the Bell Rapids Project of 2.62 acre-feet per acre, the return would be 103.92/ 2.62 = $39.66 per acre-foot. Barranco (1978) gives net returns of $90.48 and $59.55 per acre. This would indicate a net value added per acre-foot of $34.66 and $22.73, respectively, based on a diversion rate of 2.62 acre-feet per acre. In all these cases the values were based on high lift pumping in areas of Southern Idaho where farm sizes were relatively large, and with a diversified, rotational irrigated agriculture.

Certainly the value added is in the range of $20 to $100 per acre-foot but that full amount cannot justifiably be assigned and used as a basis for justifying a water storage project. This then shows a limit of the annual cost that can be incurred in developing new storage water that would be used in irrigated agriculture. In the Weiser River drainage it is quite obvious that the type of irrigated agriculture there could not earn such high net returns from irrigation (U.S. Bureau of Reclamation, Wrap-Up Report, 1972).

Hydropower Use Values

For purposes of comparison and to obtain some kind of limit as to the value of storage water for hydropower, a study was made of the simple scheme to utilizing the Milner Dam diversion and the Twin Falls Canal to develop hydroelectric energy by dropping the excess and new storage flows back into the Snake River Canyon at a point where the canal comes very close to the canyon rim. This allows for development of 440 feet of hydraulic head and would utilize storage water during periods when the canal had unused capacity throughout the year. Figure 8 shows the hydrology and water release schedules that could be developed. Based on that water used from storage a computation was made of the energy that could be produced from this so called new storage water. The result shows 254,154,794 KWH produced with 231,400 acre-feet of storage water from an average year's operation. If the power was valued at 40 mills per KWH the value of the power would be

$$\frac{254{,}154{,}794 \text{ KWH} \times \$0.04}{231{,}400 \text{ acre-feet}} = \$43.93 \text{ per acre-foot}$$

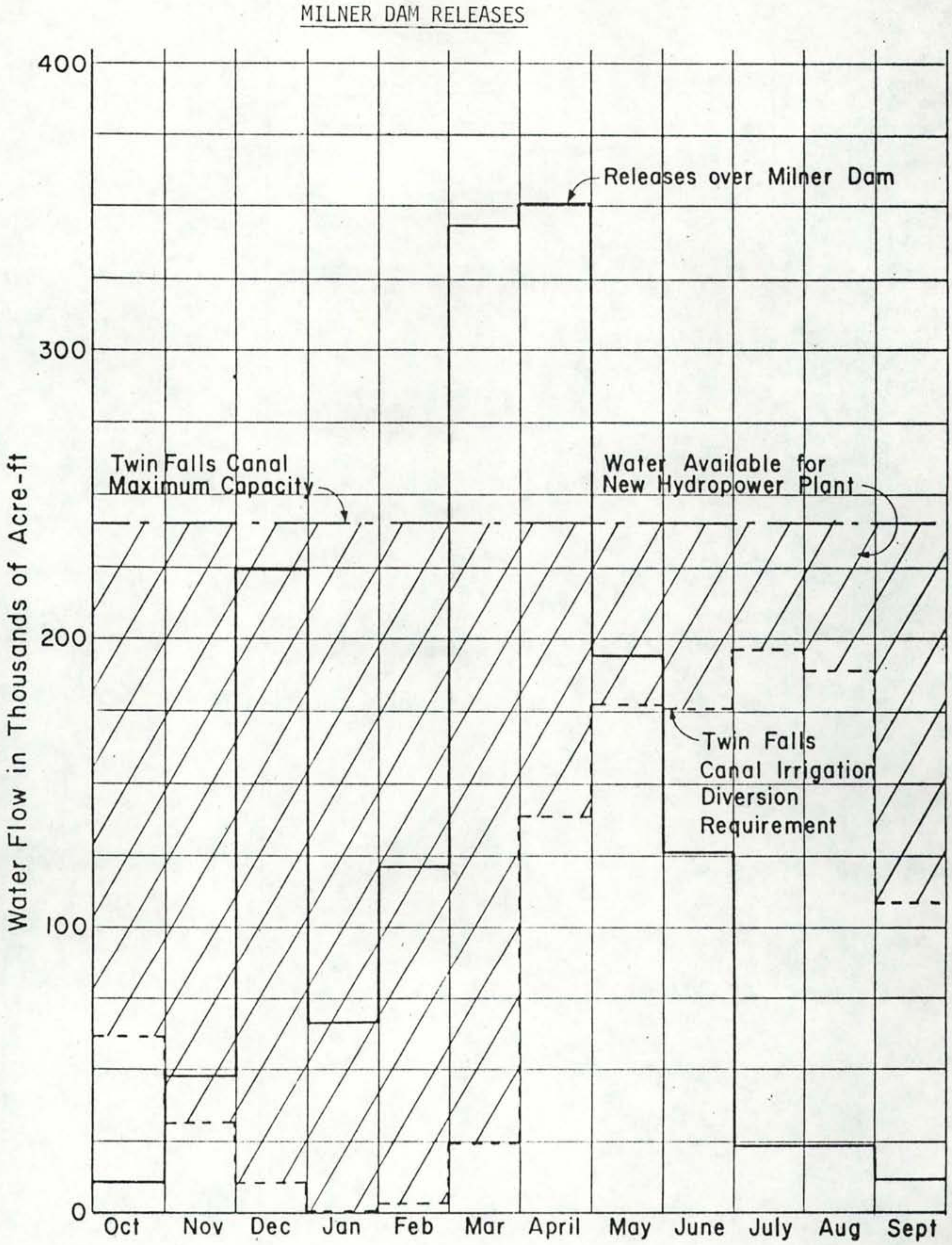


Figure 8. Monthly Hydrograph of Possible Water Release at Milner Dam on the Snake River for Possible Power Development.

This does not account for the full value of this water for power because some of this water will generate peaking benefits and all the water will generate additional KWH's in power plants on down the Snake and Columbia Rivers. On the negative side, the production of the energy requires the installation of a power plant. The amortized capital and operating cost of such a power plant would need to be subtracted from the power revenue to obtain a net value of the water in this use. The development of such a power scheme is mentioned as one of several scenarios for likely uses of water and as part of a comprehensive alternative for water development in the Upper Snake River basin. A computational table illustrating how the water use and power calculations were obtained is presented in the Appendix of this report as Table A-1.

Fishery Enhancement Values

Reconnaissance level studies by the U.S. Fish and Wildlife Service (1980) furnished to the researchers of this study by the Walla Walla district of the Corps of Engineers have been used to determine a value of offstream water for enhancement of flows for fish runs in the Snake River below Hells Canyon Dam. That study considered using new storage reservoirs in the Weiser River drainage. To accomplish the following analyses, the Corps of Engineers operational studies of Brownlee Reservoir mentioned in the Availability of Water section of the report were used, in which the Corps of Engineers North Pacific Division considered new reservoirs upstream of Weiser on the Snake River. The reservoir operational study was conducted to provide as high as possible flows in the last half of the month of April to expedite the downstream migration of chinook salmon and steelhead smolt.

In the 1964 average year operation, the North Pacific Division Study (HM 7895X-ADDED STORAGE) shows that it was possible to increase the flow below Brownlee Reservoir in the last half of April from 22,545 cfs to 38,963 cfs, or a net increase equal to 16,418 cfs. The U.S. Fish and Wildlife (USFWS) study, Delivery Order No. DACW-68-80-F-0234 dated August 20, 1980, shows in USFWS Table 7, the April flow in an average year (according to USFWS for 1978) at Ice Harbor Dam to be 106,000 cfs. The above increase from a hypothetical operation of four additional reservoirs would make it possible for the flow to be 122,418 cfs. In Table 7, line 8 shows a flow of 122,800 cfs, which is significantly close to the 122,418 cfs to justify use of subsequent data in the USFWS tables. The number of chinook salmon smolts by this flow is 2,082,900 from column 2, Table 9 resulting in a projected net escapement of chinook salmon of 62,487 (column 4, Table 9). Monitary benefit due to this increased escapement of chinook salmon is shown to be $18,371,200 in Column 6, Table 9. Similar reasoning and computational effort shows a monetary benefit due to the increased escapement of steelhead to be $13,437,300. If these benefits to both chinook salmon and steelhead can be added then the total benefits would amount to $31,808,500 for an average year. Assuming this required 4,150,000 acre-feet of storage to accomplish the fishery enhancement the value of storage water would be $7.66/acre-foot.

In a low-flow year the flow at Ice Harbor Dam is considered to be 40,000 CFS during the critical fish migration season. The Corps of Engineers, North Pacific Division, Study HM 7895X shows that with the four new reservoirs and Brownlee Reservoir operating, an increase in the flow at Brownlee Reservoir from 5153 cfs to 36,083 cfs can be during the last 15 days of April. This resulting increase of 30,930 cfs causes an estimated flow of 70,930 cfs at Ice Harbor. This is only slightly less than the value of 73,600 cfs appearing in Table 7, Column 3, Line 16 of the USFW's Study. Therefore, the same value of increased escapement is used for the 70,930 cfs as for the 73,600 cfs. This escapement is shown to be 41,118 chinook salmon (column 4, USFWS, Table 9) and is assigned a monetary value of $12,088,700. Similar reasoning and computational interpolation for steelhead gives a monetary value of $10,345,400 and a total benefit of $22,434,000. The water availability analysis made on the 1931 low-flow year for the Corps of Engineers, North Pacific Division study shows that this was accomplished with a maximum amount of storage that year of 780,300 acre-feet. If one were to rate the value of the storage water on that actually available and used in such a dry year the value would be at least $28.75/acre-foot. However, based on total live storage capacity the value per acre foot of storage would be $5.41/acre-foot.

It should be recognized that these higher values are not possible when smaller amounts of storage are envisioned.

Flood Control Values

In all planning for water storage development there is a value of storage space or storage volume of water that accrues by virtue of the damage prevented through flood control operations which hold back the flood flows and reduce flooding. Information recently provided in reconnaissance studies by the Walla Walla District of the Corps of Engineers on the proposed on-stream Galloway Dam are pertinent to assessing the value of water storage for flood control. This information was obtained through personal correspondence with Paul C. Fredericks of the Basin and Urban Studies Section. Examples reported are from studies being conducted on the Weiser River. One example is the Lost Valley Dam.

Lost Valley Dam lies 16 miles North of Council, Idaho, on Lost Creek, a tributary to the West Fork of the Weiser River. A 20,000-acre-foot enlargement at Lost Valley Dam has been studied. The present (1980) value of annual flood reduction benefits for the 20,000-acre-foot enlargement, incidental to filling for irrigation, was estimated to be $3,850 and will increase to

$4,790 over a 100-year project life. Based on the 20,000-acre-foot storage volume enlargement, this gives a value of $0.19/acre-foot. If an additional 2,600 acre-feet of additional flood control storage were added, this would increase flood control benefits by less than one percent.

For a 35,000-acre-feet Monday Gulch alternative, one of the off-stream sites proposed in this study, the present value of annual flood control benefits, incidental to filling for irrigation use, was estimated to be $3,640, and would increase to $4,530 over the 100-year project life. On the basis of planned active storage capacity of 35,000 acre-feet, the present annual value of flood control is slighty more than $0.10/acre-foot of water stored. An additional 4,000 acre-feet of exclusive flood control storage would reportedly increase these benefits by about 4%.

A potential Middle Fork Dam on the Middle Fork of the Weiser River four miles upstream from its confluence has been studied for a 20,000-acre-foot capacity. The present value (1980) of annual flood control benefits, incidental to reservoir filling for irrigation, was estimated to be $11,820 and will increase to $14,710 over a 100-year project life. This amounts to a value of $0.59/acre-foot of capacity. An additional 12,400 acre-feet of exclusive flood control space would reportedly increase the benefits by 30% but the study shows that the incremental cost increases make this option economically infeasible.

A potential Price Valley (Mosquito Flats) Dam located on the main Weiser River two miles upstream from the town of Tamarack, has been planned for a 30,000-acre-foot live capacity. Present value of annual flood reduction benefits, incidental to reservoir filling for irrigation, are estimated to be $4,510 increasing to $5,610 over a 100-year project life. This amounts to a value of $0.15/acre-foot of capacity. Because the drainage area upstream from this site is quite small compared to the total area upstream from the zones of greatest flood damage potential, additional exclusive flood control storage would provide minimal increases in flood reduction benefits.

A proposed Goodrich Dam located on the main Weiser River between Council and Cambridge was projected to have exclusive flood control storage amounts of 10,000 to 36,000 acre-feet of capacity. The Corps of Engineers estimates for the flood reduction benefits for the different amounts of exclusive storage to be as shown below.

Exclusive Storage (acre-feet)	Present Annual Benefit for Flood Reduction	Annual Benefit Considering Economic Development over 100-yr Life
10,000	$32,780	$40,800
20,000	45,670	56,840
30,000	52,120	64,870
36,000	53,730	66,880

The lower capacity which gives the maximum flood control benefits would be $0.33/acre-foot of water storage capacity. This is reported as 1979 dollar values.

A recent proposal for Galloway Dam upstream from the present Galloway diversion and downstream from Midvale has reportedly maximum annual flood reduction benefits in that reach of the river of $57,610 at 1979 price levels, increasing to $71,700 over a 100-year project life. No estimate of flood level of capacity was made. The capacity has been studied for capacities ranging from 419,000 acre-feet to 1,220,000 acre-feet. If it is assumed that 50% of capacity were for exclusive flood control then the value could be as high as 57,610/209,500 = $0.27/acre-foot. The cost of railroad relocation makes this a difficult site to develop.

These examples indicate a range of values for offstream storage for flood control purposes which is less than $0.60/acre-foot. Other rivers given a preliminary screening in the inventoried area are likely to have a lesser relative value than those reported above except perhaps the Boise River which is heavily developed.

In the Upper Snake River Area the value of flood control benefits on the Teton River would have some value but that was not investigated at this stage of the research.

Costs of Offstream Reservoirs

In order to judge the comparative advantage of the many reservoir sites inventoried in the (project) study, it was necessary to make a very preliminary assessment of the cost of developing particular offstream reservoirs. It was decided to consider as the main variables the cost of the dam, the spillway, and the conveyance works, and neglect at this early stage the costs of land clearing, land acquisition, and engineering contingencies. To determine such costs would require more time and funding than could be justified in this project. The cost estimating curves of the U.S. Water and Power Resources Service and the U.S. Corps of Engineers were used to develop a basic cost of dam development for most of the sites inventoried. The basic curves for these are shown in the Appendix (Offstream Reservoir Cost Analysis) with an example of how they were applied to the inventoried sites.

As a further part of the cost it was recognized that offstream sites would require pumping or gravity conveyance of water to achieve full storage. A series of curves were developed for this purpose. Figure 9 is a nomograph that has combined several of the canal and pumping cost estimating curves and nomographs.

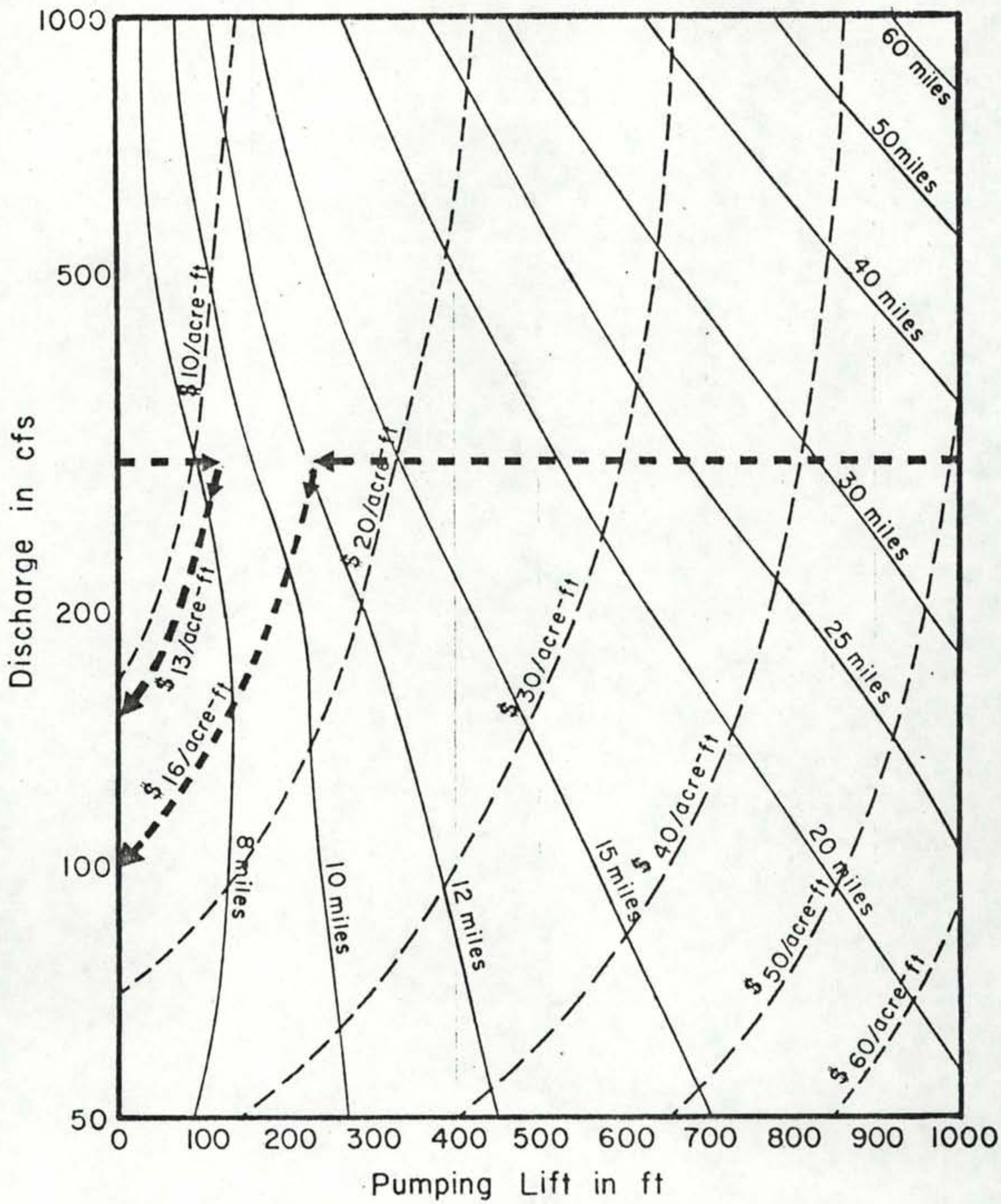
To make the evaluation such that comparisons could be made, some simplifying assumptions were made. The pumping costs were assumed to consist of the cost of the pumps and prime movers, structures and improvements, switchyard, accessory and miscellaneous equipment, and an assumed 1 mile of penstock, operation and maintenance, 7 3/4% interest, and 50-year life. The pumping plant is assumed to be unattended. Normally pumping would be during a 4-month period of relatively high runoff flows and relatively low power demand. The cost of energy was figured for only 4 months of the year and at 15 mill/KWH.

The alternative method to pumping water to the offstream reservoir would be developing a high capacity gravity-fed canal. The curves of Figure 9 are marked to show how the nomograph might be used. Figure 10 shows an example sketch of how each offstream site was studied, giving the suggested scheme for providing a water source and the information necessary to make the somewhat streamlined preliminary cost of storage estimates. An example calculation and graphic representation of how an offstream reservoir site was evaluated for the cost component of the analyses is shown in the Appendix (Cost Analysis Example for Offstream Reservoir Sites).

For purpose of comparison, a search was made for cost data on some proposed onstream reservoirs in the same general area of Idaho. For example, the once-proposed Garden Valley Dam on the Middle Fork of the Payette River shows a basic storage dam cost of $50,805,000 (USBR, 1966). If this figure is converted to annual cost using a discount rate of 7 3/4% and project life of 50 years, the annual cost would be $4,033,917. This was reported as a 1965 cost, updating it to 1980 dollars gives an annual cost of $11,049,424. Since the Garden Valley Site was projected to have a live storage of 2,400,000 acre-feet, the cost of providing on-stream storage based on the live storage capacity is shown to be $4.60/acre-foot.

A review of the once-proposed Twin Springs Dam on the Boise River shows a single high dam and a reregulating dam to have a basic dam cost of

CONVEYANCE COST ESTIMATING NOMOGRAPH



ASSUMPTIONS

July 1980 Cost estimates, 50-year life, 7 3/4% interest.

Pumping costs include pumps and prime movers, structures and improvements, switchyard, accessory and miscellaneous equipment, operation and maintenance, 1 mile of penstock, and power at 15 mills.

4 months of diversion.

EXAMPLE: 300 cfs and 12 miles of canal give approximately $16/acre-ft.
300 cfs and 150 ft of pump lift give approximately $13/acre-ft.

Figure 9. Nomograph Used In Estimating Conveyance Components of Cost.

$30,258,000 (U.S. Corps of Engineers, 1972). Converting to a 1980 annual cost using a discount rate of 7 3/4% and a project life of 50 years gives a 1980 annual reservoir cost of $5,877,924. Using a live storage of 490,000 acre-feet, the cost of on-stream storage would then be $12.00/acre-foot.

Information furnished by Paul C. Fredricks of the Walla Walla District of the Corps of Engineers provides further insight as to the comparative cost of on-stream reservoir storage. The basic reservoir cost for the Galloway Dam on the lower Weiser River was extracted from recent studies to compare with information generated in this research on offstream reservoir costs. The costs compared are the construction costs for the embankment, the spillway and the outlet works. Galloway Dam figured for a 419,000-acre-foot capacity reservoir shows a basic dam cost in 1980 dollars of $53,390,000. Using a discount rate of 7 3/4% and a 50-year life gives an equivalent annual cost of $4,239,166. This amounts to a cost of $10.12/acre-foot of storage capacity. It should be noted that this does not include railroad relocation, which could double or triple the cost, depending on criteria.

A brief appraisal of the crude estimation of costs of the many offstream reservoirs studied on this project indicates that the basic dam and conveyance costs exceed $40/acre-foot for many of the sites.

PUMPING TO SUPPLY WATER TO OFFSTREAM RESERVOIRS

In Phase I of this study of offstream reservoirs a rather arbitrary limit was placed on using pumping of water only if the pumping lift was 25 ft or less. This present phase of the study asked for a re-evaluation of that limit. The result was that the feasibility depends on the cost of the alternative system of conveying and filling the storage. The nomograph developed for assessment of storage and conveyance costs, Figure 9, is useful to show how pumping should be limited.

One of the more promising sites in Phase I study so far as physical conditions are concerned was the Monday Gulch site in the Weiser drainage. This site was reassessed and definitive alternatives were selected for supplying water to the reservoir. One alternative was to provide water through an 11-mile canal, diverting water from the Little Weiser River at a point high enough in elevation that the canal could provide a gravity supply of water. This diversion point would be located in Section 36,T 14 N, R 1 W_1 upstream of the existing C. Ben Ross Reservoir diversion. Figure A-5-5 shows that a 200 cfs canal would provide approximately 48,000 acre-feet of Little Weiser River water in an average year.

As an alternative to canal diversion, water could be pumped from the Little Weiser from a point in section 9 downstream of the community of Indian Valley. Most of the water would be pumped over a 3-month period at approximately 260 cfs due to the relatively high and narrow-duration runoff period. Although Figure 9 has been developed for 4 months of diversion, it can be used in this example to evaluate relative costs. Using Figure 9, an 11-mile, 200 cfs canal would cost about $17/acre-foot of Monday Gulch storage and a 260 cfs, 110/ft capacity pumping plant would cost about $15/acre-foot. Costs for 3 months of diversion would be somewhat greater due to the less efficient time use of capital. Using the data from Table A-5-1, the canal costs can be estimated to be about $20/acre-foot as compared to the $17/acre-foot from Figure 9. In this example, thus, pumping appears to be a reasonable alternative to the 11-mile canal, especially with the installation of reversible pump-turbine units.

Other main costs of the Monday Gulch project would be the embankment, spillway, and outlet works costs. These costs were calculated to be in the $12 to $15/acre-foot range, making the total project cost in excess of $30/acre-foot. A sample calculation and illustration of this Monday Gulch site has been included in the Appendix of the report to show how the analyses were used in assessing the viability of different sites (Monday Gulch Example Cost Analysis).

Although this simplistic and generalizing approach can be seen to have many problems and uncertainties, it is still considered to be a useful way of screening the relative worth and viability of the different offstream sites that have been inventoried. Thus a preliminary analysis has been conducted on many of the inventoried off-stream sites to identify in a very preliminary way the economic viability of the different sites.

During the course of this study it was seen that no simple, definite limit of lift could be assigned to the pumping of water to offstream reservoirs. This can be seen in Figure 9. In fact, with the use of reversible pump-turbines as in pumped storage applications, higher heads are often more desirable.

An example of a potential offstream reservoir site utilizing pumping is the fairly promising Coyote Butte Site south of Boise. The Coyote Butte site is discussed in more detail under Boise River Basin Offstream Reservoir Alternatives later in the report. The Coyote Butte Site would utilize a 165-ft pump lift from the Mora Canal to the Reservoir Site. Boise River water would be pumped from the canal during the offseason of irrigation water use and when the seasonal demand for power is relatively low. Pumped water stores in the Coyote Butte Reservoir would then be released when needed for power through a 645-ft drop into the Snake River or returned through the 165-ft drop to the Mora Canal irrigation system. The Coyote Butte Site, one of many illustrations as to why pumping lift should not be arbitrarily limited.

UTILIZATION OF TWO OR MORE SOURCE STREAMS AND INTERBASIN TRANSFER FOR DEVELOPMENT OF WATER SUPPLY FOR OFFSTREAM STORAGE

The consideration of utilizing several small streams to accumulate more flow for filling offstream reservoirs was studied. The previous data on the high costs of the conveyance rendered pooling of small flows uneconomic in most cases. An example of such a site is Howell Ranch (No. 186). Most of the effort was devoted to study of interbasin transfer of water in the Weiser and Payette River drainages where the water availability study indicated that this was a promising possibility. The conceptual schemes of these interbasin transfers centered on the possibility of developing hydraulic head for power production and the moving of water to storage that could be regulated to meet fishery enhancement flows below Hells Canyon Dam on the Snake River. Table 2 gives a summary of the various schemes that were identified to have transbasin diversion possibilities for developing hydropower. In a later section a few of the more promising schemes for these offstream storage interbasin transfer schemes are reported in more detail. A complete inventory of offstream reservoirs studied in both Phase I and Phase II has been developed and will be bound in a separate volume and is summarized in this report in a single tabulation, (Table A-7-1). An example of how these data are reported is presented here as Figure 10. Over two hundred potential reservoir sites were identified and catalogued.

CONSIDERATION OF OFFSTREAM RESERVOIRS SMALLER THAN 35,000 ACRE-FEET

This study concentrated the search for smaller reservoirs in the Weiser, Payette, and the Boise River drainages. In general the smaller reservoirs were found to have the disadvantages of: 1) of very little economic viability for development of power at the dam site; 2) a poor relation of live storage to dead storage; 3) in some cases a questionable length of life due to the hazard of filling with erosion sediments; 4) lack of ability to provide enough flow for significant low flow augmentation; and 5) relatively higher cost per acre-foot of water stored. The tabulation in Table 3 gives a summary of small offstream reservoir sites identified in this study. Figure 10 shows an example of such a site. Limited attention was given for sites in the portion of the Snake River above Swan Falls Dam on the Snake River because of the unfavorable water availability conditions.

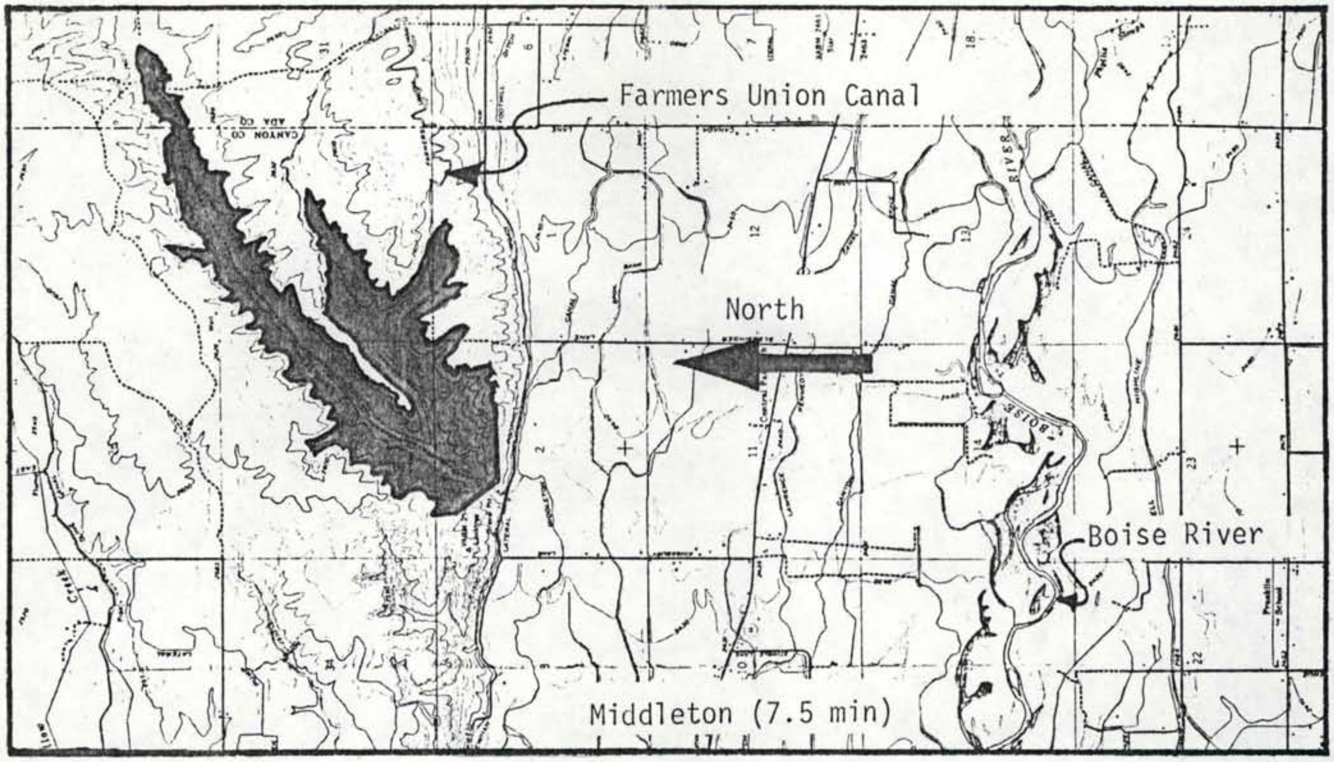
Table 2 Summary of Offstream Reservoirs with Significant Hydropower Potential.

Site No.	Site Name	Water Source	Head (ft)	Capacity (MW)
2	Deadman Gulch	N.F. Payette R., Crane Cr.	660	-
	Deadman Tunnel	N.F. Payette R.	1480	200.0
3	Sugarloaf	N.F. Payette R., Crane Cr.	620	111.0
	Sugarloaf Tunnel	N.F. Payette R.	1480	200.0
4	Granger Butte	N.F. Payette R., Crane Cr.	170	-
	Granger Butte Tunnel	N.F. Payette R.	1415	-
6	Riley Butte	N.F. Payette R., Crane Cr.	200	-
	Riley Butte Tunnel	N.F. Payette R.	1215	-
8	South Fork Crane Creek	N.F. Payette R.,	200	-
	Crane Creek Tunnel	N.F. Payette R.	1350	-
11	Indian Valley	N.F. Payette R.,Little Weiser R.	210	-
	Indian Valley Tunnel	N.F. Payette R.	1850	-
23	Black Canyon Enlargement	Payette R.	177	-
34	Squaw Creek (Lower)	N.F. Payette R.,Squaw Cr.	320	57.5
	Squaw Creek-Lower Tunnel	N.F. Payette R.	1500	215.0
35	Squaw Creek (Upper)	N.F. Payette R., Squaw Cr.	500	90.0
	Squaw Creek Upper Tunnel	N.F. Payette R.	1300	200.0
54	Middle Fork Payette River	N.F.,M.F., and S.F. Payette R.	440	139.9
	North Fork to Middle Fork Tunnel	N.F. Payette R.	1060	72.0
	South Fork to Middle Fork Tunnel	S.F. Payette R.	200	29.0
55	Lower Scriver Creek	N.F. Payette R., Scriver Cr.	360	-
	Lower Scriver Creek Tunnel	N.F. Payette R.	900	-
58	Pidgeon Flat	S.F. Payette R., Deadwood R.	500	-
80	Dunnigan Creek	Mores Cr., Grimes Cr.	400	4.8
106	Coyote Butte	Boise R.	645	46.0
108	Larrys Lake	Boise R.	395	-
132	Rock Creek Ranch	Big Wook R., Rock Cr.	165	-
177	Lane Lake	Bitch Cr., Conant Cr.	510	20.0
178	Bitch Creek	Teton R., Bitch Cr.	475	11.0
180	Upper Badger Creek	Teton R., Badger Cr.	440	6.0
184	Ashton Dam Enlargement	Henrys Fork Snake R.	95	-
185	Robinson Creek	Fans R., Robinson Cr.	300	-
*22	Lost Valley Enlargement	Weiser R.	500	-
*36	High Valley	N.F. Payette R.	1500	-
	High Valley	Squaw Cr.	2000	-
*39	Dry Buck	N.F. Payette R.	1800	-
	Dry Buck	Squaw Cr.	1600	-
*40	Tripod Creek	N.F. Payette R.	700	-
*42	Grassy Flat	N.F. Payette R.	1000	-
*59	Warm Spring Creek	S.F. Payette R.	600	-
*83	Placerville	S.F. Payette R.	1700	-
*84	Pioneerville	S.F. Payette R.	1600	-
*86	Meadow Creek	N.F. Boise R.	1800	-
*87	Rabbit Creek	N.F. Boise R.	1250	-

Table 2 Summary of Offstream Reservoirs with Significant Hydropower Potential (Cont.).

Site No.	Site Name	Water Source	Head (ft)	Capacity (MW)
*93	Trapper Flat	S.F. Payette R.	2600	-
*96	Krall Mountain	S.F. Boise R.	700	-
*97	Dixie Creek	S.F. Boise R.	900	-
*98	Cat Creek	S.F. Boise R.	880	-
*100	Moores Flat	S.F. Boise R.	1200	-
*106	Coyote Butte	Snake River	645	-
*115	Long Tom Creek	S.F. Boise R.	1000	-
*131	Water Holes	S.F. Boise	1200	-
*150	Fish Creek	Portnuef R.	665	-
*168	Birch Creek	Snake River	960	-
*177	Lane Lake	Teton River	510	-
*180	Upper Badger Creek	Teton River	440	-

* Potential Pumped Storage Sites



LANKTREE GULCH

Site No. 73

Location: Sec 2 T 4 N R 2 W Middleton Quadrangle (7.5 min)

Elevation (ft-MSL)	Area (acres)	Storage (acre-ft)	Dam Height (ft)	Crest Length (ft)
2400	--	--	--	--
2500	62	1,000	50	--
2550	410	11,000	100	--
2560	510	16,000	110	--
2570	640	22,000	120	3620

Offstream Water Source: Boise River.

Diversion Type: Canal (existing Farmers Union Canal empties into reservoir area).

Impoundment Impacts: Little development in area.

Acceptability Classification: B-B-B

Figure 10. Example sheet of Sketch Map with Location and Capacity Information for Inventoried Offstream Reservoir Sites.

Table 3 Summary of Offstream Reservoir Sites with Maximum Capacities Less than 35,000 Acre-Feet.

Site No.	Site Name	Max Capacity (acre-feet)	Dam[1] Height (ft)	Crest[2] Length (ft)
5	Upper Crane Creek	33,500	70	1000
15	Upper Grizzly Creek	22,000	210	1330
18	Jackson Creek	23,000	195	1660
31	Haw Creek	33,000	190	1500
32	Lower Shafer Creek	34,000	260	1660
42	Grassy Flat	32,000	160	1860
48	Green Mountain	24,000	110	2140
62	Homestead Gulch	21,000	110	1350
63	Sebree	30,000	130	5000
65	Chadre	24,000	50	3200
67	Magello	27,000	85	3800
69	West Harley Gulch	31,000	70	4700
70	Middleton	29,000	75	4900
72	Upper Willow Creek	31,000	100	3020
73	Lanktree Gulch	22,000	120	3620
74	Little Gulch[3]	16,000	105	1300
75	Woods Gulch	26,000	115	3120
83	Placerville	21,000	145	1200
101	Lower Feather River	24,000	200	1560
129	Tuana Gulch	25,000	80	3800
160	Grizzly Creek	26,000	50	1550
171	Swan Valley	32,000	380	1500
176	Spring Creek	32,000	165	1000
186	Howell Ranch	32,000	130	3650

[1]Not including freeboard.
[2]At maximum water surface elevation.
[3]Studied in conjunction with the Big Gulch Site.

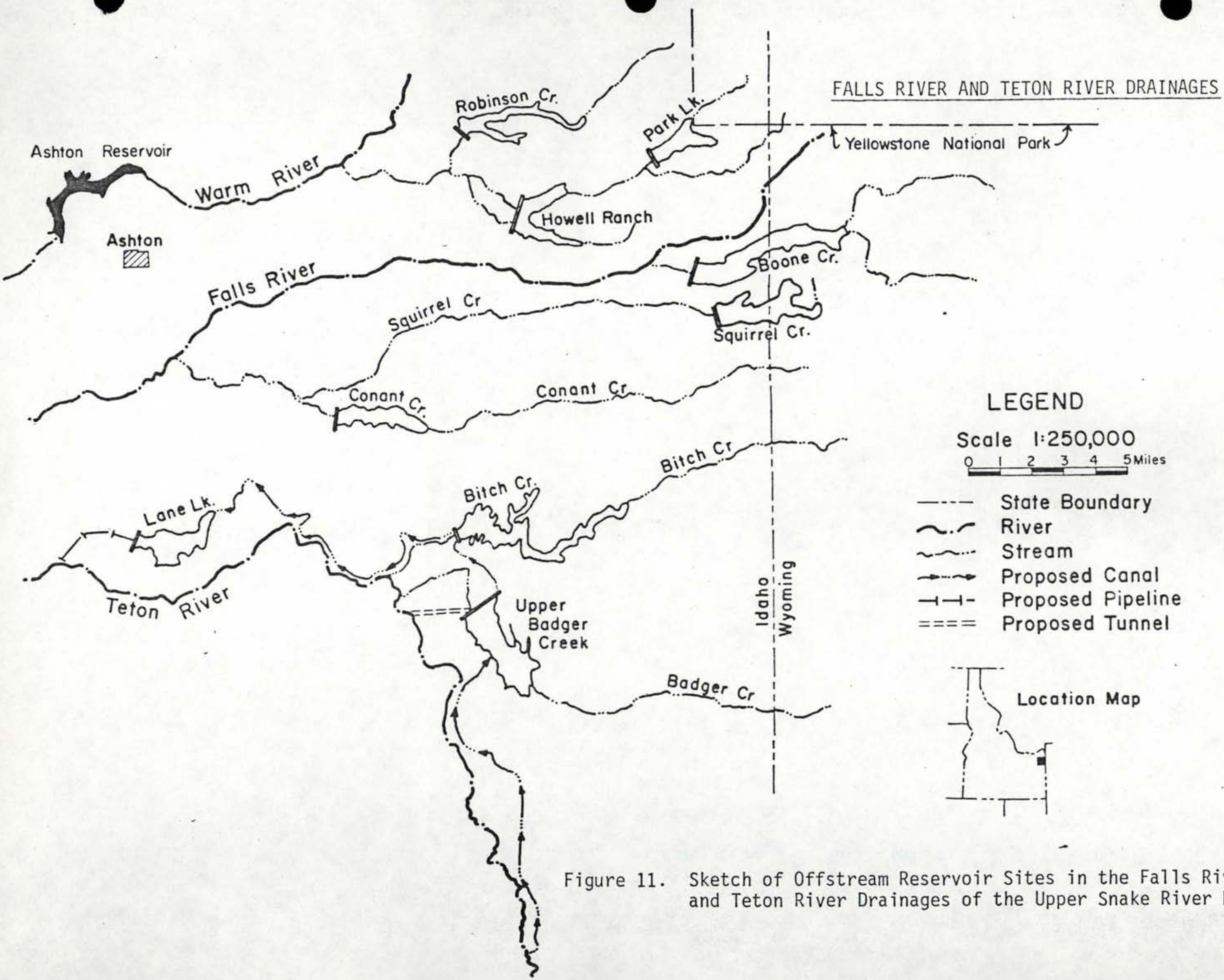


Figure 11. Sketch of Offstream Reservoir Sites in the Falls River and Teton River Drainages of the Upper Snake River Basin.

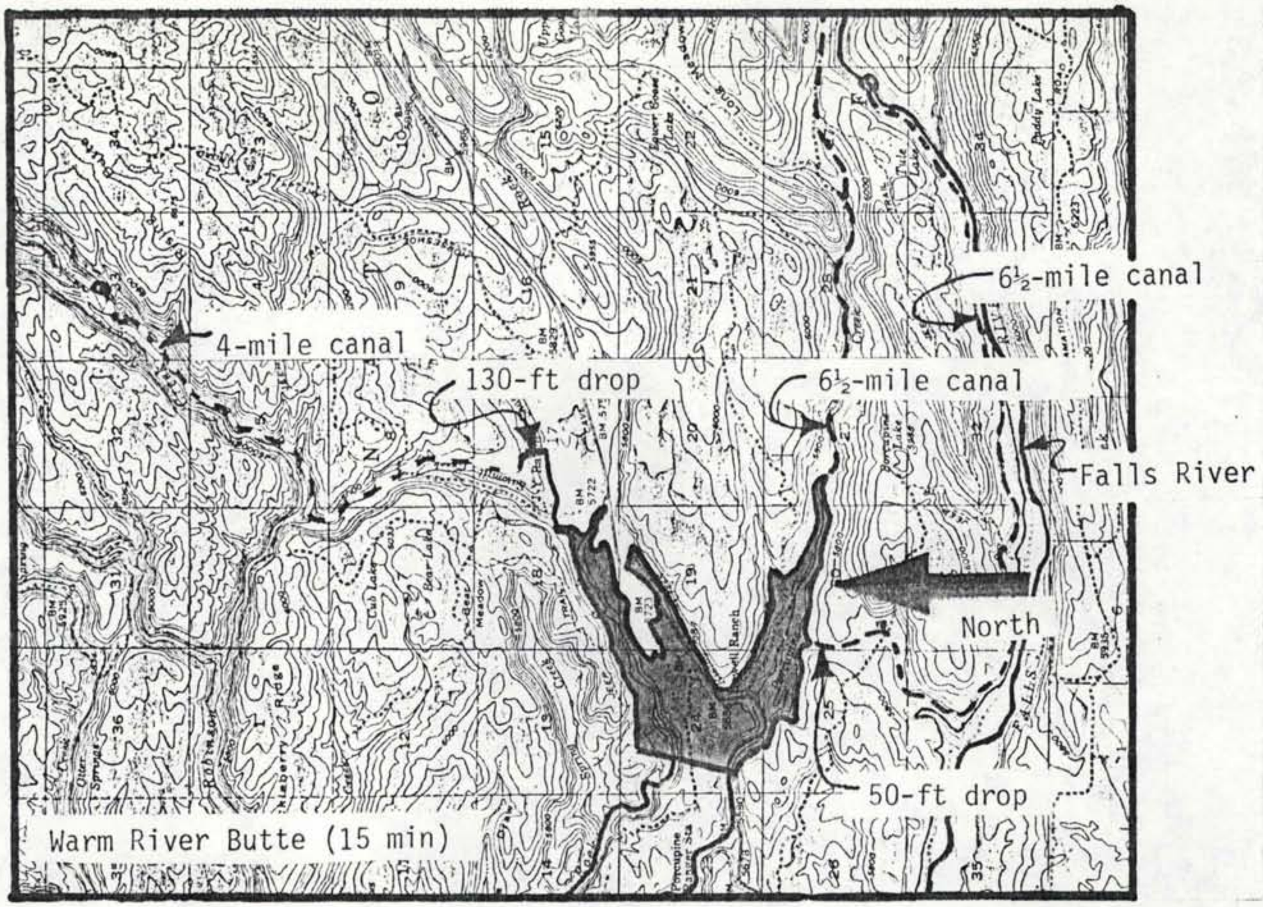
LIKELY USES OF STORAGE WATER AND COMPREHENSIVE DEVELOPMENT ALTERNATIVES BY BASINS

The section on values of water defined three major present day uses of storage water that have potential economic benefits in the context of offstream storage situations: (1) irrigation water supply; (2) hydroelectric power development; and (3) augmented river flows for fishery enhancement. Limited potential for municipal and industrial water supply appeared to be possible. Flood control in both the Weiser River and the Payette River was shown to have rather low annual benefit. The uses of water for recreation, wildlife enhancement, and water quality control were not studied to any extent. In this study it became apparent that very few offstream reservoir sites would in a limited single purpose use, show a favorable benefit-to-cost ratio. Limited time and unavailability of operational studies make it difficult in this preliminary study to analyze how flow would be regulated to meet comprehensive multipurpose development of possible uses of storage water, such as combining irrigation use with local hydropower development, flood control, or enhancement of fish flows. In each basin an attempt was made to choose possible development schemes that would use offstream storage and interbasin transfers to make viable water resource development projects. On that basis the most likely development alternatives studied under this research contract are presented in this section.

Upper Snake River Basin Reservoir Alternatives

In the Upper Snake River basin above Milner Dam the most promising sites for development are the Howell Ranch Site (No. 186) on Porcupine Creek, the Lane Lake Site (No. 177) on a tributary to the Teton River, the Upper Badger Creek Site (No. 180) on Badger Creek, and the Bitch Creek Site (No. 178) on Bitch Creek. Figure 11 is a map of the area showing the location of these various offstream reservoir sites. The Boone Creek Site indicated on the map of Figure 11 was not considered in any great detail because a diversion would need to be made out of Yellowstone Park for offstream water. All of these offstream storage possibilities were analyzed with the idea in mind that any storage water would be so regulated as to still meet downstream demands for irrigation. The benefits of hydroelectric power development at or near a site would be of a non-consumptive use. Each of these four offstream reservoir sites are discussed here to present the conceptual idea of how the reservoir would function.

1. The Howell Ranch Site. This site replaces Phase I Site No. 128 known as Rock Creek Site. Figure 12 is a sketch map of the proposed reservoir site showing the outline of the maximum inundated area, the two source streams for filling the reservoir with offstream diversions, and comments on inpoundment impact. A very brief analysis of flows in Robinson Creek indicated that 10,000 acre-feet could be diverted during the high flow season and still leave a minimum flow of 27 cfs in Robinson Creek. An alternative might be to supply storage water from the Falls River with a 6-1/2 mile, 50-cfs canal that could operate most of the year and divert 30,000 acre-feet of water from the Falls River and still maintain a 95-cfs flow. There is possibility of developing a small amount of power at the site by dropping diverted water into the reservoir from either of the canals used to furnish offstream water. Detailed costs were not completed on this site, but compared with similar sites that were analyzed for cost, this site will have rather marginal economic viability. Storage at this site may improve regulation for irrigation water that is now being proposed for a pressure piping system on the irrigated areas near Ashton, Idaho as served by the Marysville and the Yellowstone Canals.



HOWELL RANCH

Site No. 186

Location: Sec 24 T 9 N R 44 E Warm River Butte Quadrangle (15 min)

Elevation (ft-MSL)	Area (acres)	Storage (acre-ft)	Dam Height (ft)	Crest Length (ft)
5590	--	--	--	--
5600	19	62	10	--
5640	112	2,400	50	--
5680	320	10,700	90	--
5720	760	32,000	130	3650

Offstream Water Source: Falls River or Robinson Creek.

Diversion Type: 6½ miles of new canal from Falls River or 4 miles of new canal from Robinson Creek.

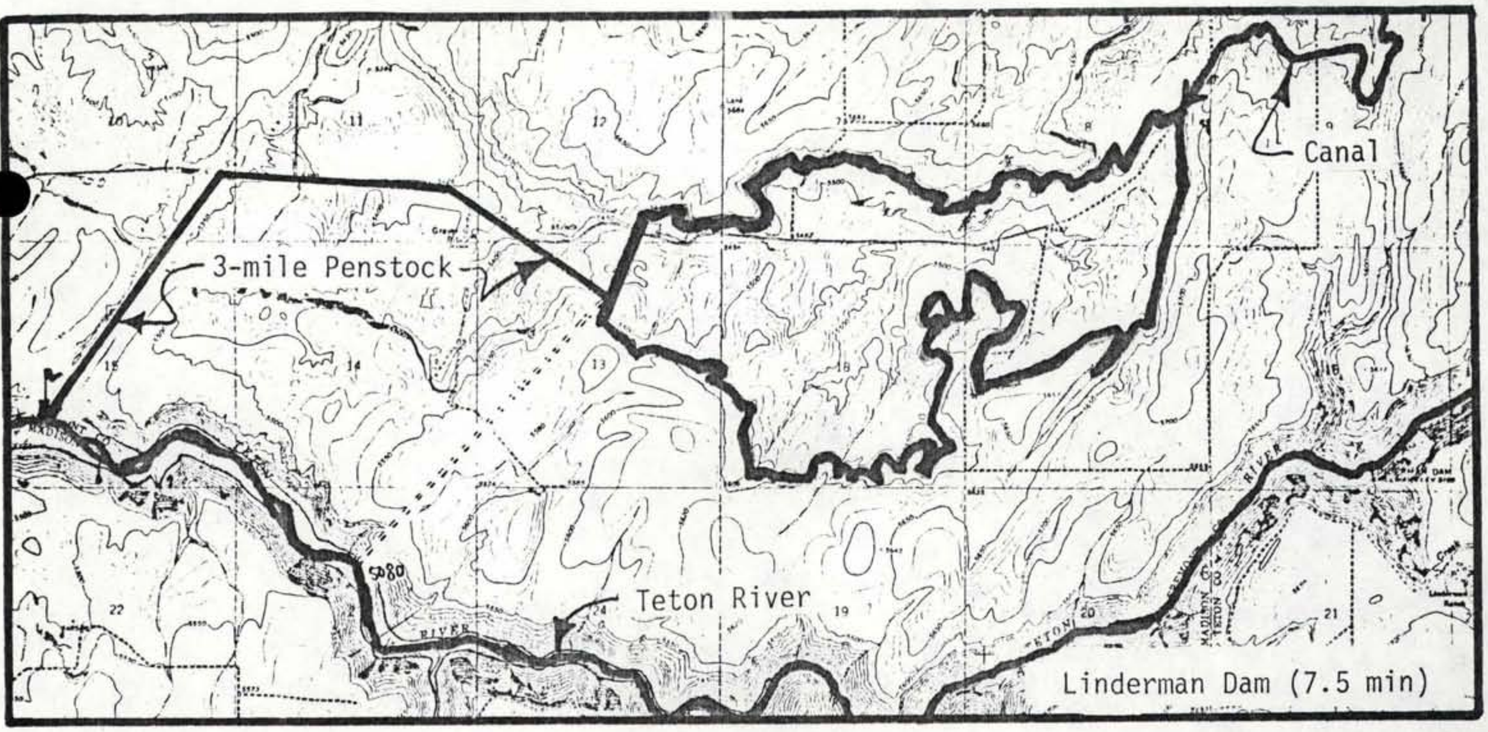
Impoundment Impacts: Inundation of uninhabited Howell Ranch and some roads.

Acceptability Classification: B-B-B

Figure 12. Sketch Map and Characteristics of the Howell Ranch Offstream Reservoir Site (Warm River drainage).

2. The Lane Lake Site. This is a site that was thus not identified on the Phase I inventory. Figure 13 is a sketch map of the proposed reservoir site showing the outline of the maximum inundated area, the source of water and possible penstock location for a hydropower development that would drop the water into a new power plant on the Teton River. A brief analysis of the hydrology of the streams in the area indicates that approximately 75,000 acre-feet of water could, in an average year, be diverted out of Bitch Creek and still maintain a minimum flow of 26 cfs at the diversion point. A 17-mile canal having a 210-cfs capacity for seasonal diversion would permit the delivery to the Lane Lake Offstream reservoir of 70,000 acre-feet in an average year.

An alternative source of water was considered through the possibility of diverting water from Conant Creek, tributary to the Falls River. Allowing a 13-cfs minimum flow to remain in Conant Creek, a 16.5-mile, 100-cfs canal should be able to deliver a flow of 32,000 acre-feet annually. A smaller, 75-cfs, canal should be able to deliver approximately 28,000 acre-feet annually. Canal capacities would be relatively large to accomodate the unregulated spring runoffs. Very preliminary estimates of the basic cost of the storage dam and conveyance canals indicate an annual cost of this storage to be in the range between \$30 to \$40/acre-foot. The net value of the hydropower energy generated would help in paying off that cost but would still leave \$20 to 25/acre-foot of storage water to be paid for by other possible uses. These uses would require an operation study of flood control operations, downstream irrigation diversions, and downstream power enhancement to determine the enegineering feasibility. This site might be considered as a water storage source for the proposed offstream development of a



LANE LAKE

Site No. 177

Location: Sec 13 T 7 N R 42 E Linderman Dam Quadrangle (7.5 min)

Elevation (ft-MSL)	Area (acres)	Storage (acre-ft)	Dam Height (ft)	Crest Length (ft)
5450	--	--	--	--
5460	10	34	10	--
5470	47	300	20	--
5480	115	1,080	30	--
5490	230	2,900	40	900
5500	390	5,900	50	1130
5510	570	10,700	60	2200
5520	750	17,300	70	2250
5530	900	26,000	80	2300
5540	1030	35,000	90	2360
5550	1100	46,000	100	2400
5560	1170	57,000	110	2460
5570	1240	69,000	120	2520

Offstream Water Source: Bitch Creek, Conant Creek.

Diversion Type: 17-mile canal from Bitch Creek, 16½-mile canal from Conant Creek.

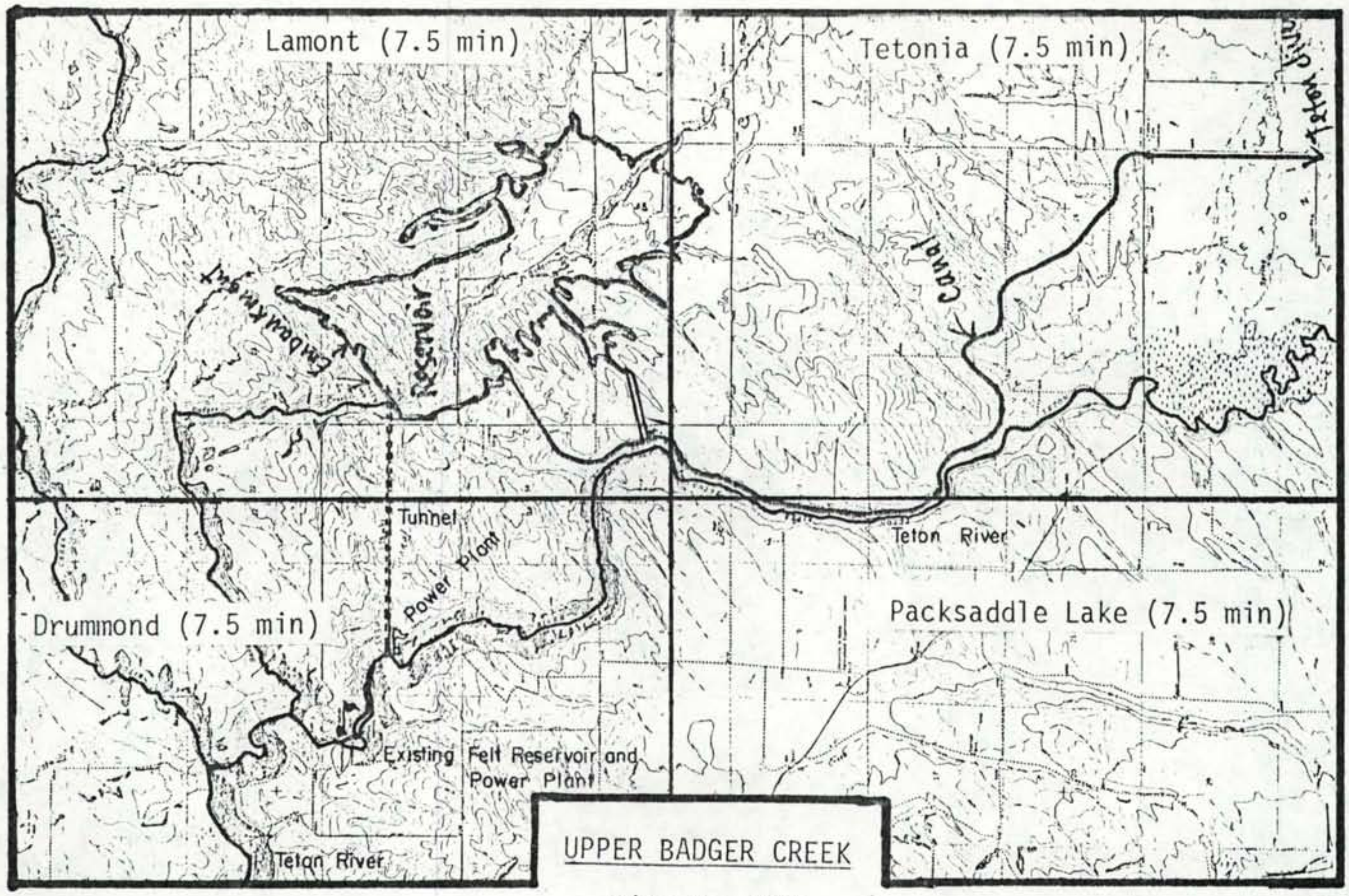
Impountment Impacts: Inundation of some roads, agricultural development and limited habitation.

Acceptability Classification: A-B-B

Figure 13. Sketch Map and Characteristics of the Lane Lake Offstream Reservoir Site (Teton River Drainage).

Twin Falls Canal power release back into the Snake River downstream from Milner Dam.

3. The Upper Badger Creek Site. This site, located on Badger Creek, could store a maximum of 49,000 acre-feet. Figure 14 is a sketch map of the proposed site showing the outline of the maximum inundated area, a canal diversion from Teton River, and the possibility of a tunnel to serve as a penstock to a hydroelectric power development on the Teton River slightly upstream of the present Felt Power Plant. A brief analysis of the hydrology of the Teton River indicates that 87,000 acre-feet of water in an average year could be diverted through a 380-cfs canal to the Upper Badger Creek Reservoir, leaving a minimum flow of 150 cfs in the Teton River. An 1.8-mile from the Upper Badger Creek to the existing Felt Reservoir would provide approximately 440 ft. of head for hydroelectric power development. In addition, a hydroelectric power benefit could accrue to the Felt Power Plant downstream by having more sustained flows in the Teton River through the storage regulation of the Upper Badger Creek Reservoir.
4. The Bitch Creek Site. This site was inventoried in the Phase II portion of the study of offstream reservoirs. The Bitch Creek site would require a 475-ft high, 1400-ft long dam across the Bitch Creek Valley. With on-stream flows and a transbasin diversion from the Teton River through an 18-mile canal, it appears possible to develop an 11-MW hydroelectric power plant. Figure 15 is a sketch map of the proposed site showing the outline of the maximum inundated area and brief characteristics of the site. The Bitch Creek site would cause flooding of some sections of a highway, and cause problems at a railroad bridge. The high cost of a long diversion canal cut makes it less attractive economically that the Lane Lake site.



Site No. 180

Offstream Phase I No. 135

Location: Sec 26 T 7 N R 44 E Lamont Quadrangle (7.5 min)

Elevation (ft-MSL)	Area (acres)	Storage (acre-ft)	Dam Height (ft)	Crest Length (ft)
5840	--	--	--	--
5890	27	480	50	--
5900	62	910	60	280
5910	157	1,970	70	--
5920	310	4,300	80	--
5930	440	8,000	90	--
5940	760	14,000	100	--
5950	1030	23,000	110	1800
5960	1300	34,000	120	2200
5970	1600	49,000	130	2600

Offstream Water Source: Teton River.

Diversion Type: 12 miles of new canal and/or pumped storage from Felt Reservoir.

Impoundment Impacts: Limited farmstead development.

Acceptability Classification: A-B-B

Figure 14. Sketch Map and Characteristics of the Upper Badger Creek Offstream Reservoir Site (Teton River Drainage).

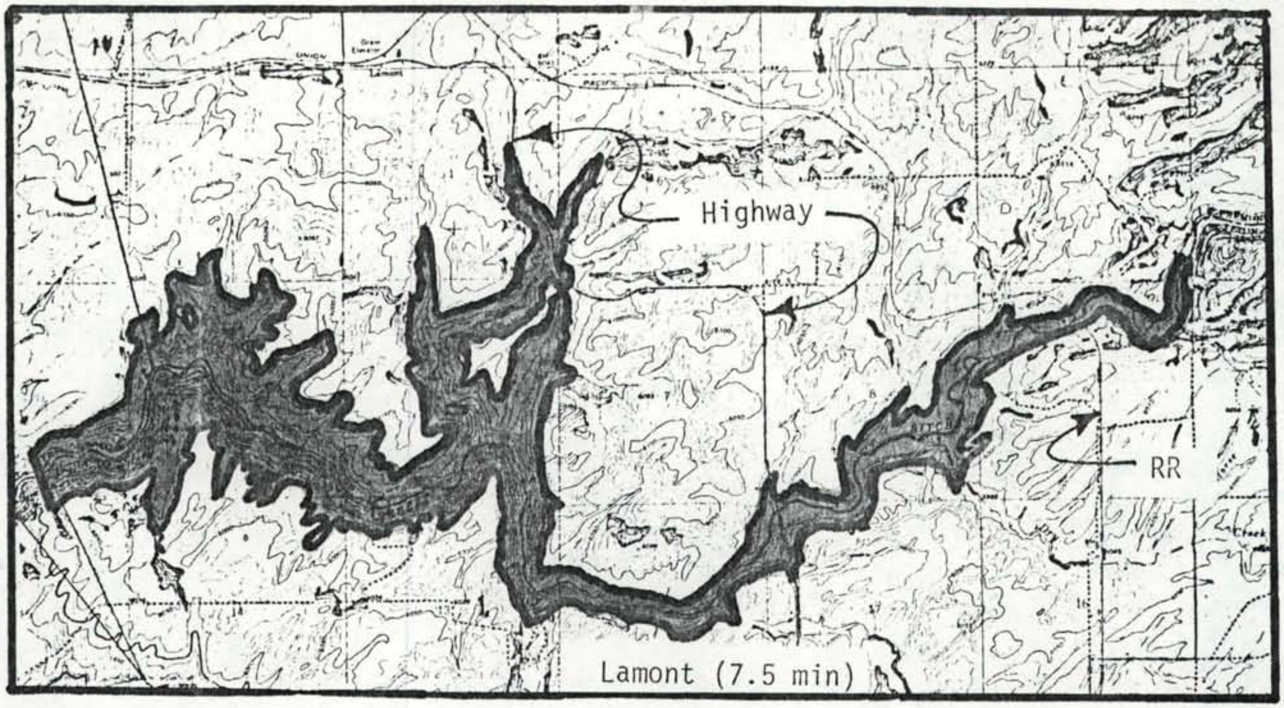
The Twin Falls Canal Power Site

This site is partially discussed under "Value of Storage Water" and is an offstream use of water that would utilize the present Twin Falls Main Canal to divert flows that now spill over Milner Dam to develop hydropower at a site where the main canal comes close to the Snake River Canyon rim. At this point there is 440 feet of hydraulic head available and a 4000-cfs canal capacity. Figure 16 is a sketch map showing the plan arrangement for such a scheme. Utilizing the full 4000 cfs to define flow capacity of the power plant, a 126-MW power plant could be developed. The hydrologic analysis of flows available for discharge through the plant on an average year indicate that 636 million KWH of energy could be produced at the site. To accomplish this would require modification of present irrigation practices upstream and new storage to ensure proper releases of water at Milner Dam. No economic analysis was done on this site but the simplicity of the power installation would tend to justify a more refined study. Without upstream storage it is estimated that, in an average year, 370 million KWH of energy would be available at the Twin Falls Canal power site.

Boise River Basin Offstream Reservoir Alternatives

Twenty offstream reservoir sites were identified in the Boise River system or adjacent areas in the Phase I, 1979 study. These sites, along with 27 new Phase II sites, are summarized in Table 4. The most promising of these sites is the Coyote Butte site that has been previously proposed by the Idaho Department of Water Resources as a pumped storage site.

1. The Coyote Butte Site. This offstream site would require four separate embankments and have a maximum impoundment capacity of 260,000 acre-feet. Two alternatives for filling it have been suggested. One by a pump lift diverting water below the Mora Drop on the Mora Canal



BITCH CREEK

Site No. 178

Location: Sec 10 T 7 N R 44 E Lamont Quadrangle (7.5 min)

Elevation (ft-MSL)	Area (acres)	Storage (acre-ft)	Dam Height (ft)	Crest Length (ft)
5495	--	--	--	--
5500	1	2	5	--
5550	22	460	55	--
5800	280	32,000	305	702
5900	630	76,000	405	1000
5950	1060	117,000	455	1200
5970	1390	142,000	475	1360

Offstream Water Source: Teton River.

Diversion Type: 18 miles of new canal from Teton River in the Teton Basin near Tetonia.

Impoundment Impacts: Limited development and habitation in Bitch Creek Canyon. Reservoir would inundate Lamont-Tetonia Highway. Reservoir headwaters would reach Union Pacific Railroad Bridge over Bitch Creek, at Water Surface elevation 5930.

Acceptability Classification: A-B-C

Figure 15. Sketch Map and Characteristics of Bitch Creek Offstream Reservoir Site (Teton River Drainage).

THE TWIN FALLS CANAL POWER SITE

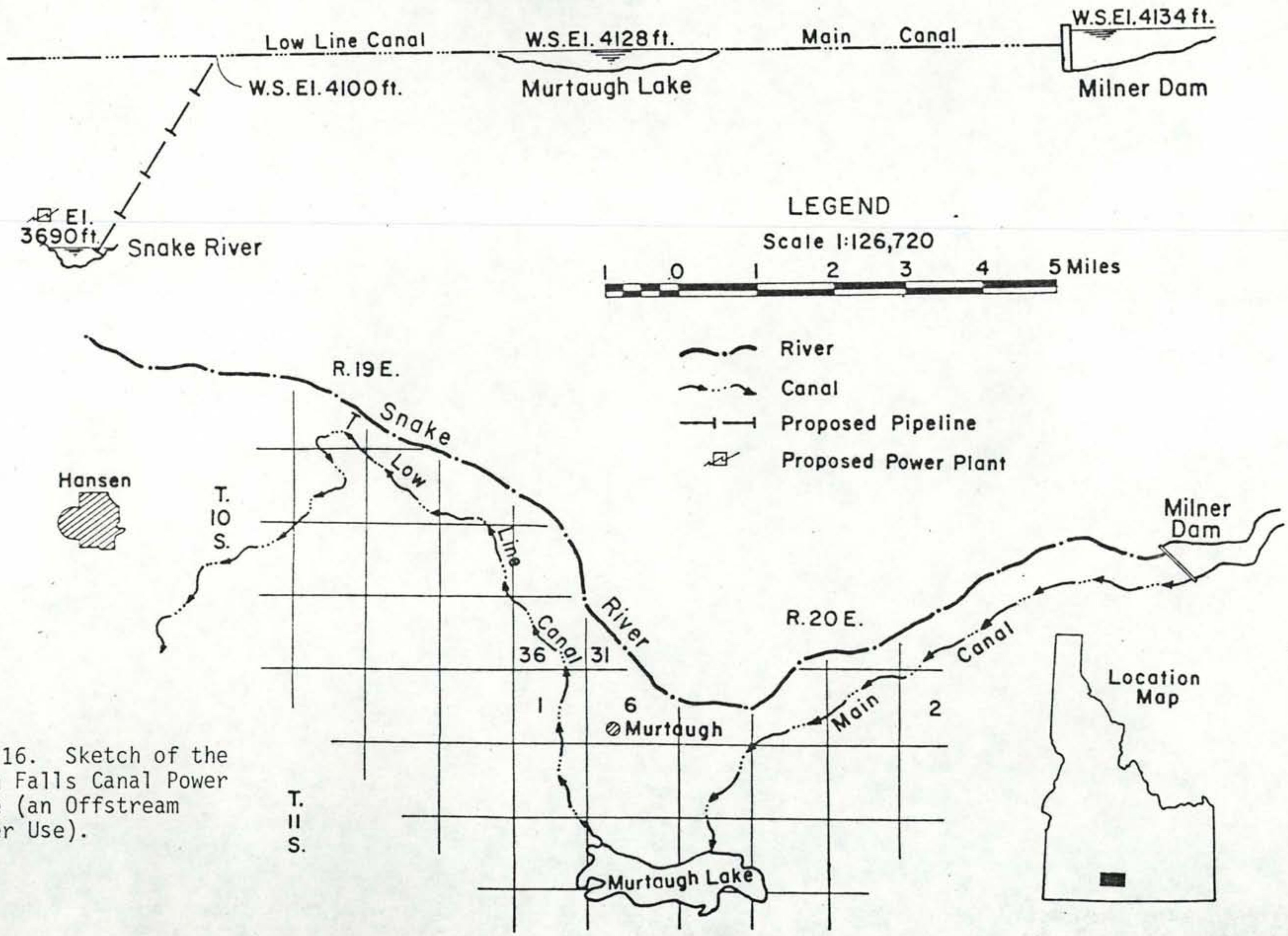


Figure 16. Sketch of the Twin Falls Canal Power Site (an Offstream Water Use).

Table 4. Summary of Offstream Reservoir Sites in the Boise River Drainage

Site No.	Site Name	Water Source	Maximum Capacity (acre-ft)
60	Hurd Gulch	Payette or Snake River	35,000
61	Ashlock Gulch	Payette or Snake River	72,000
62	Homestead Gulch	Payette River	21,000
63	Sebree	Payette or Boise Rivers	30,000
64	Sand Run Gulch	Payette River	54,000
65	Chadre	Payette River	24,000
66	Conswello	Payette River	56,000
67	Magello	Payette River	27,000
68	Sand Hollow Creek	Payette River	41,000
69	West Hartley Gulch	Boise and Payette Rivers	31,000
70	Middleton	Payette River	29,000
71	Firebird	Payette River	67,000
72	Upper Willow Creek	Payette River	31,000
73	Lanktree Gulch	Boise River	22,000
74	Big and Little Gulches	Boise River	52,000(total)
75	Woods Gulch	Boise River	26,000
76	Horseshoe Bend Road	Boise River	100,000
77	Lower Dry Creek	Boise River	43,000
78	Dry Creek	Boise River	53,000
79	Stuart Gulch	Boise River	37,000
80	Dunnigan Creek	Mores Cr and/or S Fk Payette R	240,000
81	Grimes Creek	South Fork Payette River	1,500,000
82	Granite Creek	South Fork Payette River	48,000
83	Placerville	South Fork Payette River	21,000
84	Pioneerville	South Fork Payette River	58,000
85	Elk Creek	Mores Creek	41,000
86	Meadow Creek	Crooked and/or N Fk Boise Rivers	44,000
87	Rabbit Creek	Crooked and/or N Fk Boise Rivers	152,000
88	Lower Crooked River	N Fk Boise and/or S Fk Payette River	250,000
89	Crooked River West	N Fk Boise and/or S Fk Payette River	119,000
90	Crooked River East	South Fork Payette River	37,000
91	Upper Crooked River	S Fk Payette River	49,000
92	Archie Mountain	S Fk Payette River	49,000
93	Trapper Flat	S Fk Payette River	178,000
94	Bear River	N Fk Boise River and/or Crooked Rivers	93,000
95	Blacks Creek Road	S Fk Boise River	44,000
96	Krall Mountain	S Fk Boise River	121,000
97	Dixie Creek	S Fk Boise River	46,000
98	Cat Creek	S Fk Boise River	93,000
99	Trinity Mountain	S Fk Boise River	104,000
100	Moores Flat	S Fk Boise River	52,000
101	Lower Feather River	S Fk Boise River	24,000
102	Upper Feather River	S Fk Boise River	70,000
103	Lower Little Smoky Creek	Big Smoky Creek, S Fk Boise River	76,000
104	Upper Little Smoky Creek	Big Smoky Creek, S Fk Boise River	87,000
105	Indian Creek-Mayfield	S Fk Boise River	52,000
106	Coyote Butte	Boise River	260,000

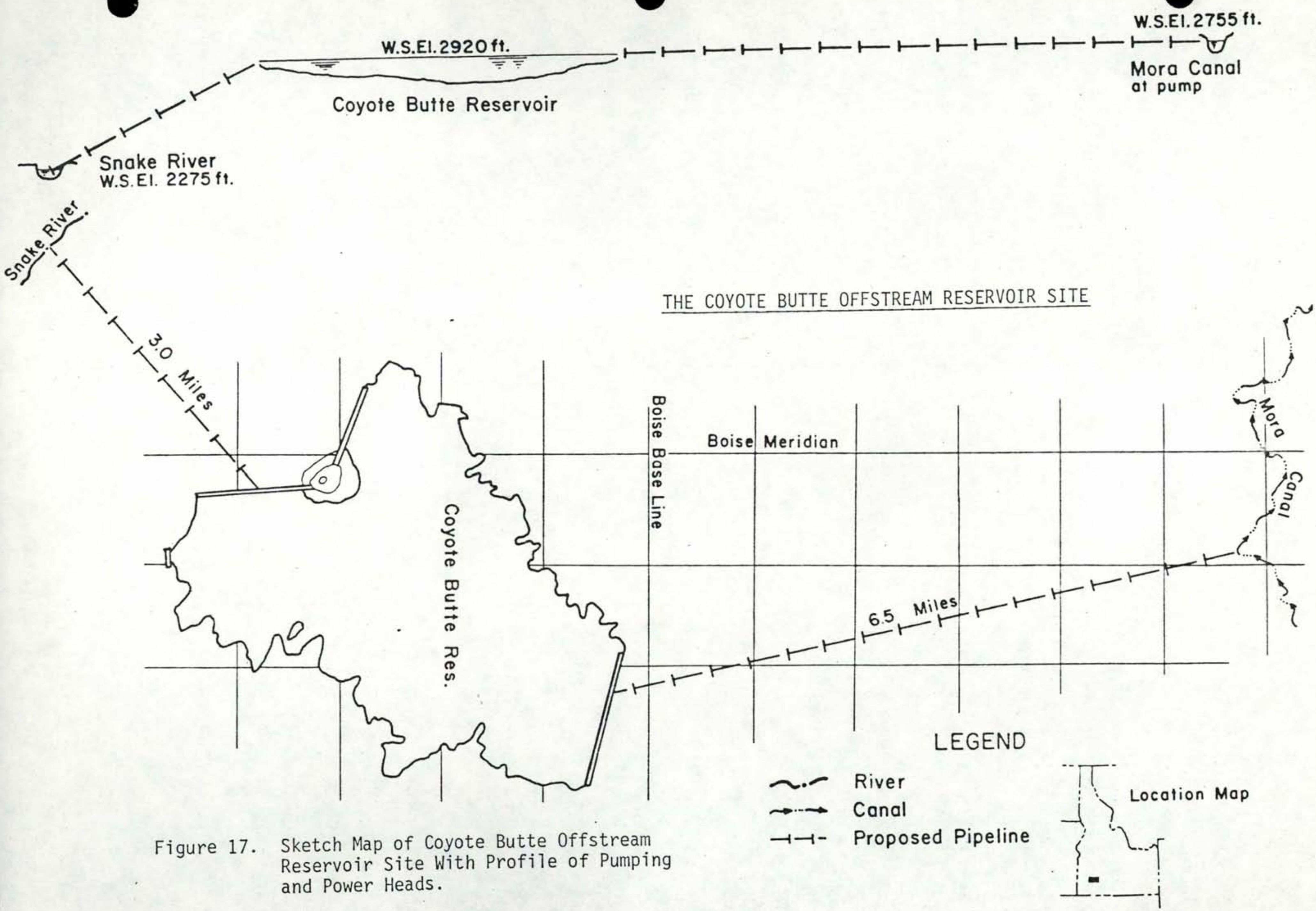
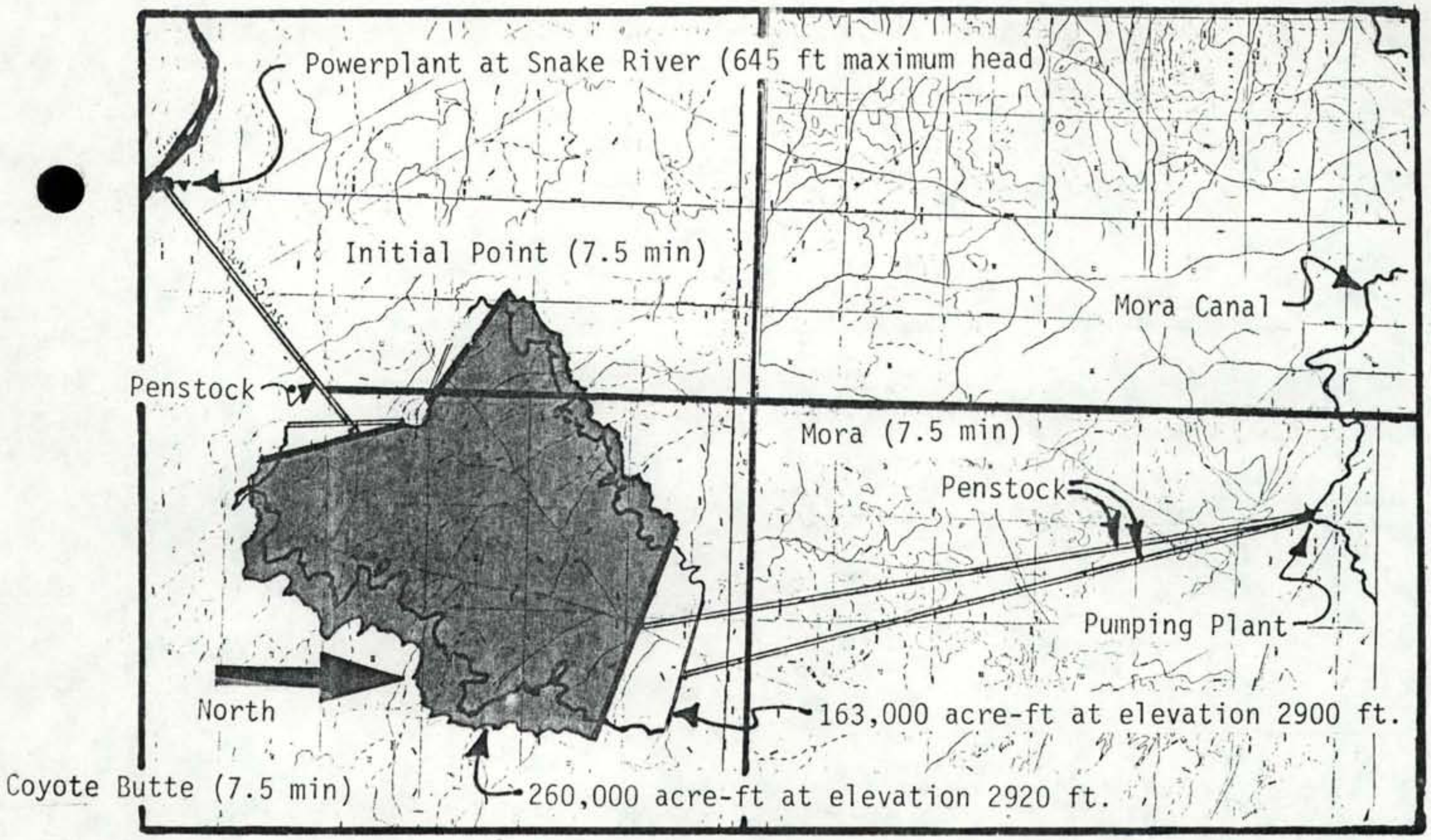


Figure 17. Sketch Map of Coyote Butte Offstream Reservoir Site With Profile of Pumping and Power Heads.



COYOTE BUTTE

Site No. 106

Location: Sec 20 T 1 S R 1 E Coyote Butte Quadrangle (7.5 min)

Elevation (ft-MSL)	Low Dams (3) Area (acres)	Low Dams (3) Storage (acre-ft)	High Dams (4) Area (acres)	High Dams (4) Storage (acre-ft)
2823	--	--	--	--
2840	153	865	111	480
2860	560	7,900	520	6,300
2870	2,700	23,000	2,400	20,000
2880	4,400	59,000	3,800	50,000
2900	6,200	163,000	5,400	142,000
2920	--	--	6,600	260,000

Offstream Water Source: Boise River.

Diversion Type: 165-ft pump lift (to elevation 2920 ft) from existing Mora Canal.

Impoundment Impacts: New transmission line in area; proposed powerplant located in existing Birds of Prey Natural Area.

Acceptability Classification: B-A-A

Figure 18. Sketch Map and Characteristics of the Coyote Butte Offstream Reservoir (Boise River Drainage).

and another by a pump lift from the Mora Canal upstream of the Drop. Figure 17 presents a sketch map of the Coyote Butte Site showing the water source and elevation information for the development. A considerable pumping lift is required but recovery of power is envisioned by dropping the water through a hydraulic head of 645 feet into the Snake River near the existing Swan Falls power plant. Storage-water could also be released back into the Mora Canal irrigation system with the use of a reversible pump-turbine in the event of an unexpected irrigation water shortage. Figure 18 gives details of the Coyote Butte offstream Reservoir Site along with the characteristics of the reservoir.

A very brief analysis was made of using Boise River runoff flows diverted during the non-irrigation season into the Mora Canal to determine the practicality of filling and using the maximum storage capacity at the site. Details on the water availability analysis are presented in the Appendix. Brief preliminary analyses of costs and benefits indicate this site has reasonable economic possibility.

2. The Dunnigan Creek Site. This offstream reservoir site is proposed as a possibility for developing storage upstream from Lucky Peak Dam. It would require a canal diversion from Mores Creek and would use on-stream flows in Grimes Creek. There is also the option of a very high-head pumped storage interchange with the South Fork of the Payette River. A brief economic costs appraisal indicates only a fair economic possibility.

Payette River Basin Offstream Reservoir Alternatives

Thiry-six offstream reservoir sites in the Payette River drainage were inventoried in Phase I and Phase II of this research study. In Phase II the principal effort was devoted to looking at rather large interbasin transfers that might develop extensive hydraulic head for hydroelectric developments. Table 5 summarizes the various sites considered. The most promising sites are discussed below:

1 & 2. The Squaw Creek Sites. This development idea involves two different reservoir sites alternatives. The first alternative, designated as Squaw Creek (Lower) Site No. 34, involves a 253,00-acre-foot reservoir. The water supply for this would come from a 12-mile tunnel diversion from the North Fork of the Payette River at Smiths Ferry. This would be an alternative to the North Fork Payette River power development proposed by the Idaho Power Company, now in the licensing process. Figure 19 is a sketch map of the overall scheme. Figure 20 shows a detailed sketch map showing reservoir characteristics of the lower site. This particular scheme proposes development of 1500 feet of hydraulic head for power purposes in the transbasin diversion from Smiths Ferry on the Payette River to Squaw Creek. It allows for minimal inundation of valuable land areas in the Squaw Creek drainage, and provides storage for downstream irrigation demands in the Payette River basin below existing Black Canyon Reservoir. A brief economic analysis of costs indicates that power revenues should be greater than the costs of the dam, power plant, and tunnel development.

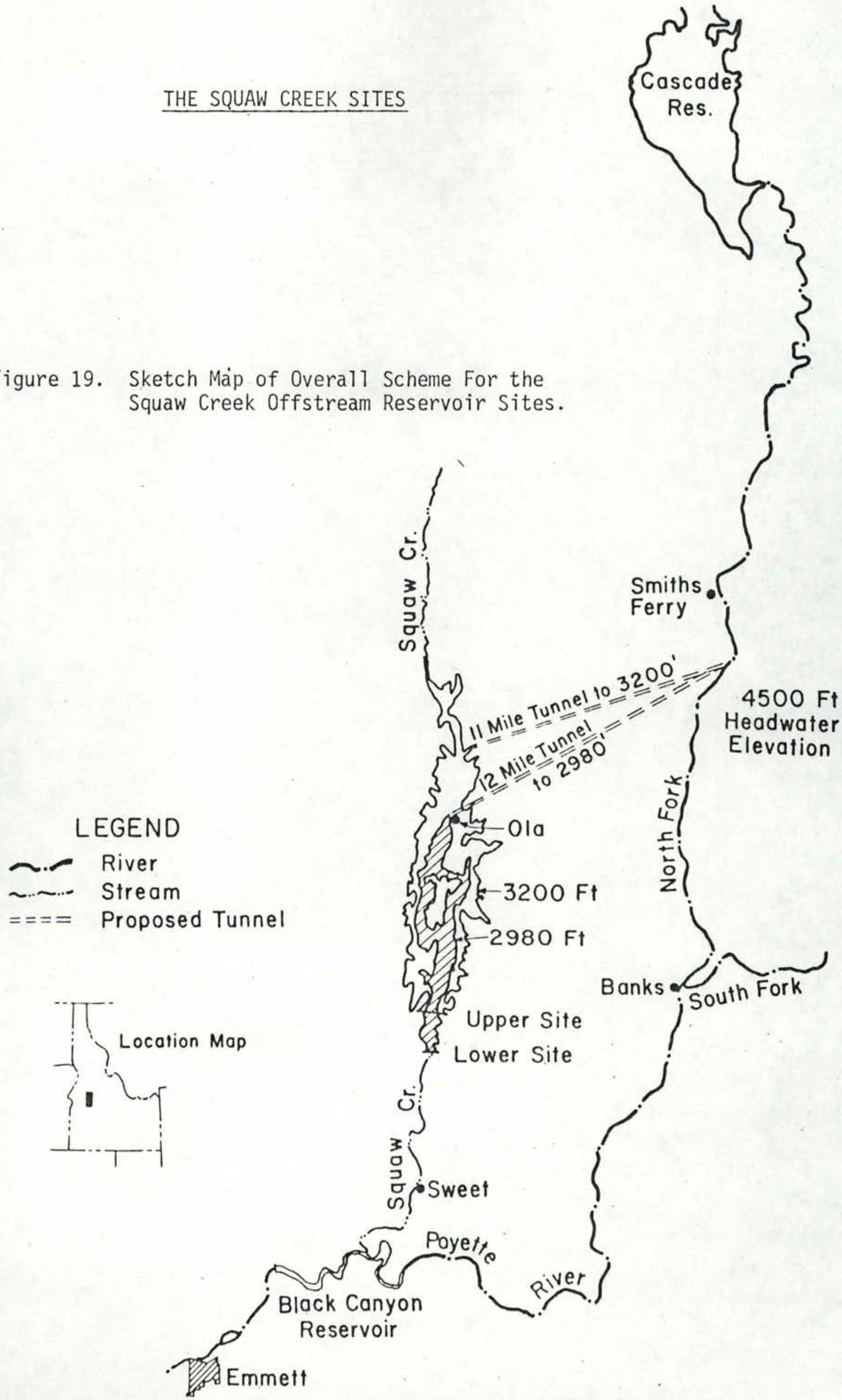
Squaw Creek (Upper) Site No. 35 would consider a much larger reservoir (2,060,000 acre-feet of storage capacity) and is illustrated in Figure 21. This would flood the Ola, Idaho area. The added storage could provide for much more flexibility in high flow years. Power plants would be located at the tunnel outlet from the Smiths Ferry

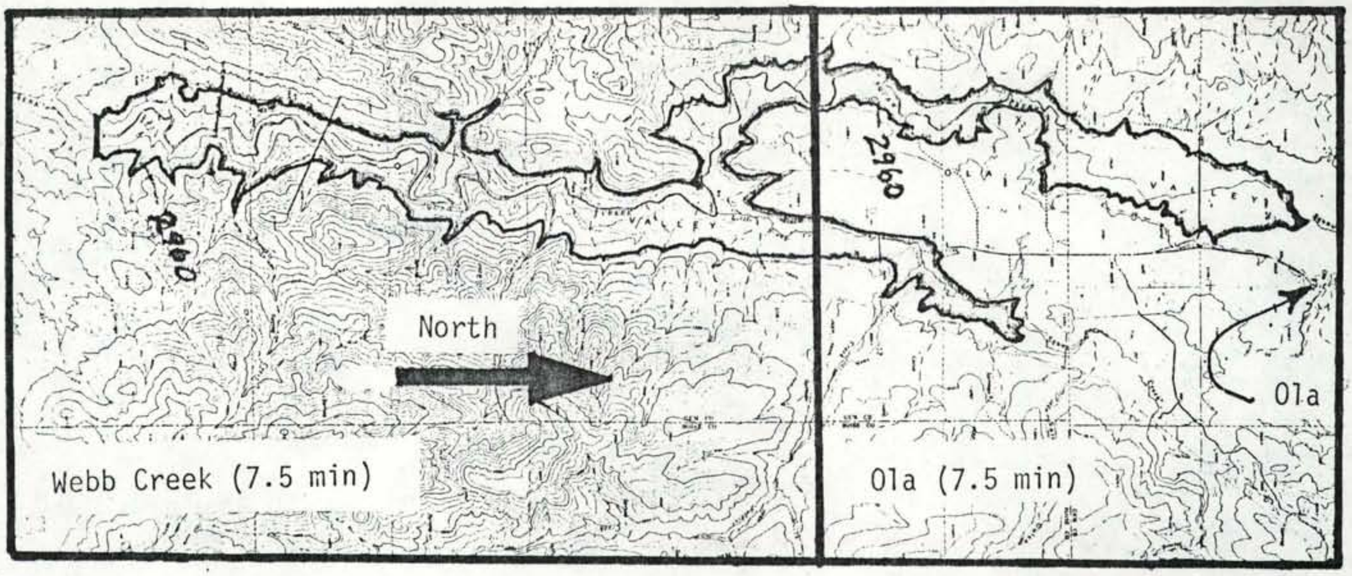
Table 5 Summary of Offstream Reservoir Sites in the Payette River Drainage

Site No.	Site Name	Water Source	Maximum Storage
24	Crystal School	Payette or Snake River	91,000
25	Little Willow Creek	Payette River	85,600
26	Birding Island	Payette River	175,000
27	Big Willow Creek	Weiser and Payette Rivers	310,000
28	Upper Big Willow	N Fk Payette or Little Weiser R	350,000
29	Sand Hollow	Payette River	145,000
30	Bissel Creek	Payette River	187,000
31	Haw Creek	Payette River	33,000
32	Black Canyon Enlargement	Payette River	180,000
33	Sweet	Payette River	148,000
34	Squaw Creek (Lower)	N Fk Payette River	550,000
35	Squaw Creek (Upper)	N Fk Payette River	2,600,000
36	High Valley	N Fk Payette River	1,760,000
37	Lower Shafer Creek	Payette River	34,000
38	Upper Shafer Creek	Payette River	93,000
39	Dry Buck	Payette River	380,000
40	Tripod Creek	N Fk Payette River	54,000
41	Round Valley	N Fk Payette River	430,000
42	Grassy Flat	N Fk Payette River	32,000
43	Big Creek	N Fk Payette River	400,000
44	Horsethief Basin	Big Creek	75,000
45	Scott Valley	N Fk Payette and/or Gold Fork R	131,000
46	Gold Fork	N Fk Payette River	930,000
47	Kennally Creek	Gold Fork R, Boulder Creek	330,000
48	Green Mountain	Rapid Creek	24,000
49	Boulder Creek	Lake Fork Creek	93,000
50	Little Payette Lake	Lake Fork Creek	37,000
51	Browns Pond	N Fk Payette River	92,000
52	Slick Rock	Lake Fork Creek tributaries	35,000
53	Upper Payette Lake	Summit Creek	98,000
54	Middle Fork Payette R.	N Fk & M Fk Payette River	1,600,000
55	Lower Scriver Creek	N Fk & M Fk Payette River	44,000
56	Anderson Creek	S Fk Payette River	51,000
57	Wash Creek	S Fk Payette River	55,000
58	Pidgeon Flat	S Fk Payette River	490,000
59	Warm Spring Creek	S Fk Payette River	61,500

THE SQUAW CREEK SITES

Figure 19. Sketch Map of Overall Scheme For the Squaw Creek Offstream Reservoir Sites.





SQUAW CREEK
(Lower Site)

Site No. 34

Location: Sec 10 T 8 N R 1 E Webb Creek Quadrangle (7.5 min)

Elevation (ft-MSL)	Area (acres)	Storage (acre-ft)	Dam Height (ft)	Crest Length (ft)
2660	--	--	--	--
2680	20	135	20	--
2720	95	2,250	60	400
2760	187	7,780	100	600
2800	346	18,300	140	740
2840	530	35,700	180	900
2880	851	63,100	220	1060
2920	1459	109,000	260	1260
2960	2710	191,000	300	1360
2980	3550	253,000	320	1440
3000	4420	333,000	340	1520
3040	6520	550,000	380	1720

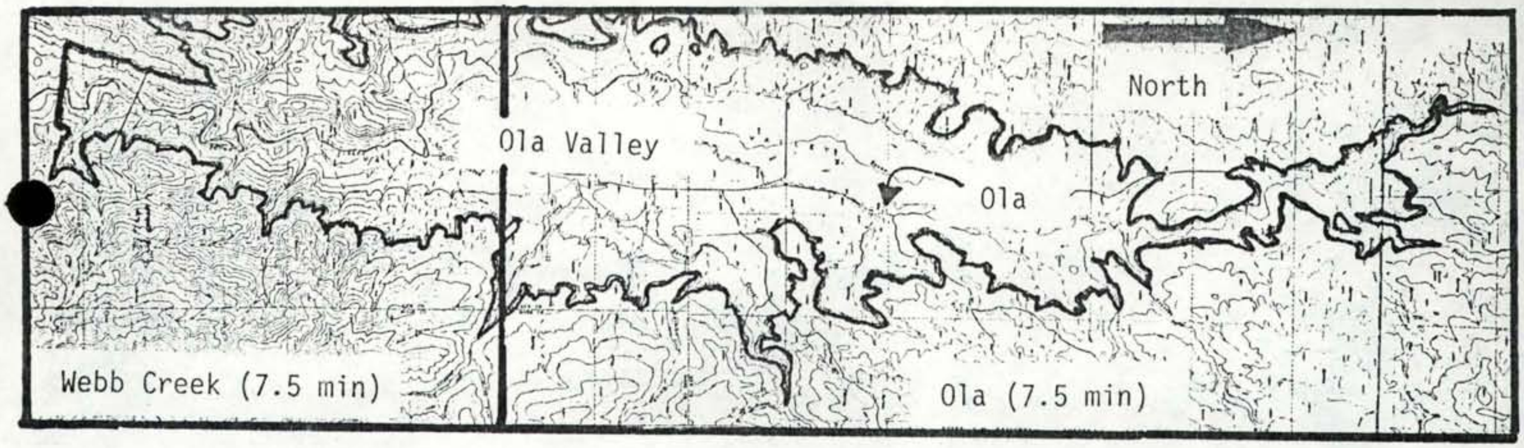
Offstream Water Source: North Fork Payette River.

Diversion Type: 12-mile hydroelectric power tunnel (1500-ft head).

Impoundment Impacts: Agricultural development and residences near Ola. (Ola at 3000-ft elevation).

Acceptability Classification: A-A-B

Figure 20. Sketch Map and Characteristics of Squaw Creek (Lower) Offstream Reservoir Site (Payette River Drainage).



SQUAW CREEK
(Upper Site)

Site No. 35

Location: Sec 3 T 8 N R 1 E Webb Creek Quadrangle (7.5 min)

Elevation (ft/MSL)	Area (acres)	Storage (acre-ft)	Dam Height (ft)	Crest Length (ft)
2700	--	--	--	--
2800	204	7,200	100	--
2880	656	38,100	180	--
2960	2,450	147,000	260	--
2980	3,290	204,000	280	1840
3000	4,121	278,000	300	2100
3040	6,194	483,000	340	2300
3080	8,160	769,000	380	2800
3120	10,100	1,130,000	420	3200
3200	13,000	2,060,000	500	3800
3240	15,100	2,600,000	540	4140

Offstream Water Source: North Fork Payette River.

Diversion Type: 12-mile hydroelectric power tunnel (1300-ft head)

Impoundment Impacts: Inundation of town of Ola (elevation 3000 ft) and surrounding agricultural lands.

Acceptability Classification: A-A-C

Figure 21. Detailed Sketch Map and Characteristics of the Squaw Creek (upper) Offstream Reservoir Site (Payette River Drainage).

diversion and at the Squaw Creek Dam. The tunnel diversion could be expected to have a hydraulic head of 1300 feet with a power plant having 187-MW capacity. The power plant at the upper Squaw Creek Dam could have an average hydraulic head at the dam of 460 feet and plant capacity of 90 MW. This would have a capacity of 2500 cfs to give opportunity to utilize high seasonal releases in the North Fork Payette River from existing Cascade Reservoir.

3. The Middle Fork Payette River Site. This site envisions a high dam on the Middle Fork of the Payette River above Garden Valley, Idaho. A schematic layout of the development is shown in Figure 22. It should be noted that it would involve two tunnels, an 8-mile tunnel from Smith Ferry on the North Fork of the Payette River, developing a hydraulic head of 1100 to 1200 feet, and another tunnel of 15-mile length that would permit development of 200 feet of head. Both the existing Cascade Reservoir and the existing Deadwoood Reservoir would provide storage regulation for the power flows. Regulation for downstream irrigation and other uses could be accomplished at the Middle Fork offstream reservoir. Figure 23 gives detailed information about the site and the reservoir characteristics. A serious problem is the flooding of campgrounds and summer homes in the Middle Fork Valley. A brief study of reservoir costs indicate that the power revenues would more than pay for the costs involved in such a project.

Other possible sites of smaller size that might have need for more study are the Bissel Creek Site and the Horsethief Basin Site.

Weiser River Basin Offstream Reservoir Alternatives

Because the Weiser River is presently less regulated than rivers in any of the other drainages investigated, more effort was extended to study offstream

THE MIDDLE FORK OF THE PAYETTE RIVER OFFSTREAM RESERVOIR SITE

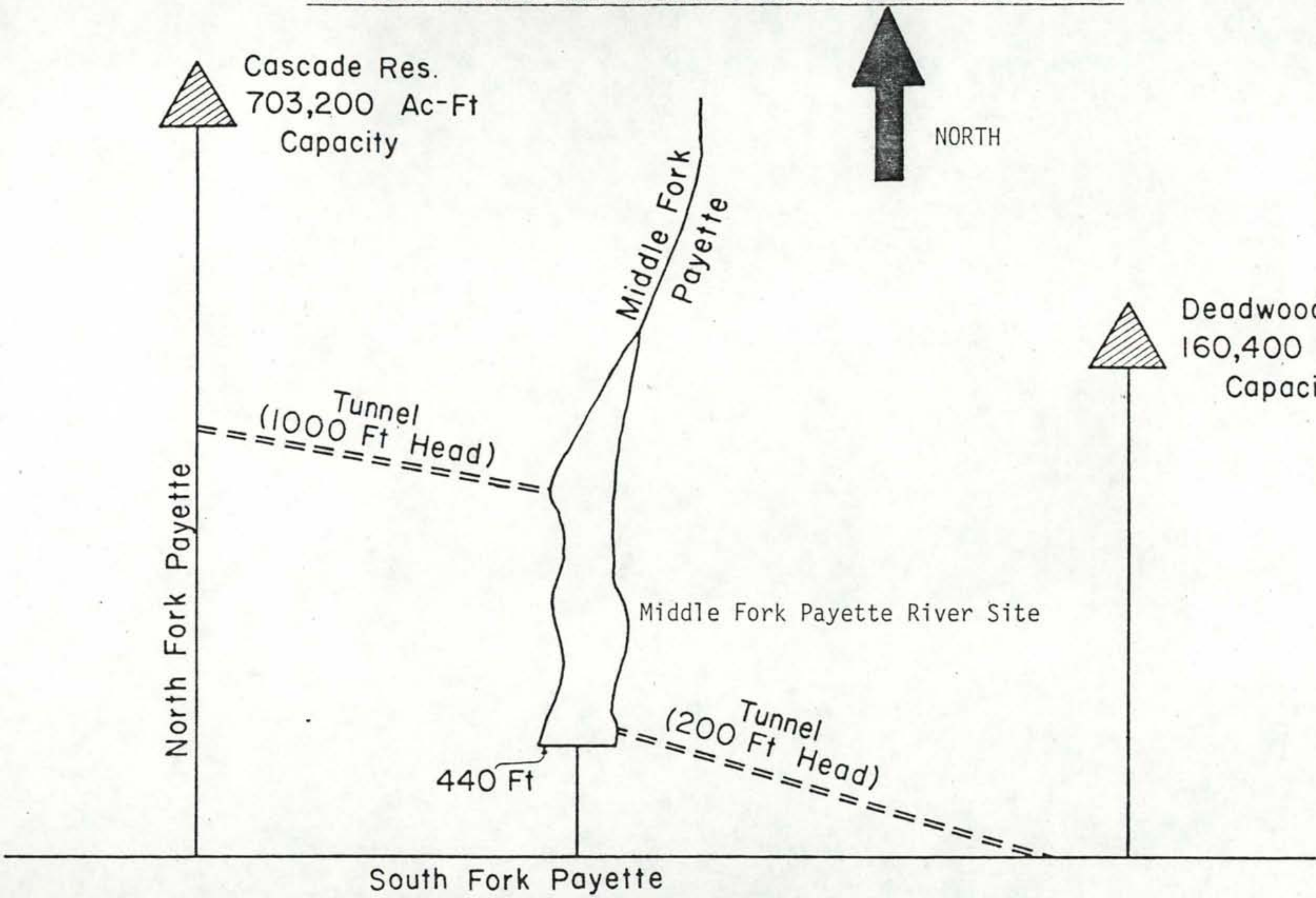
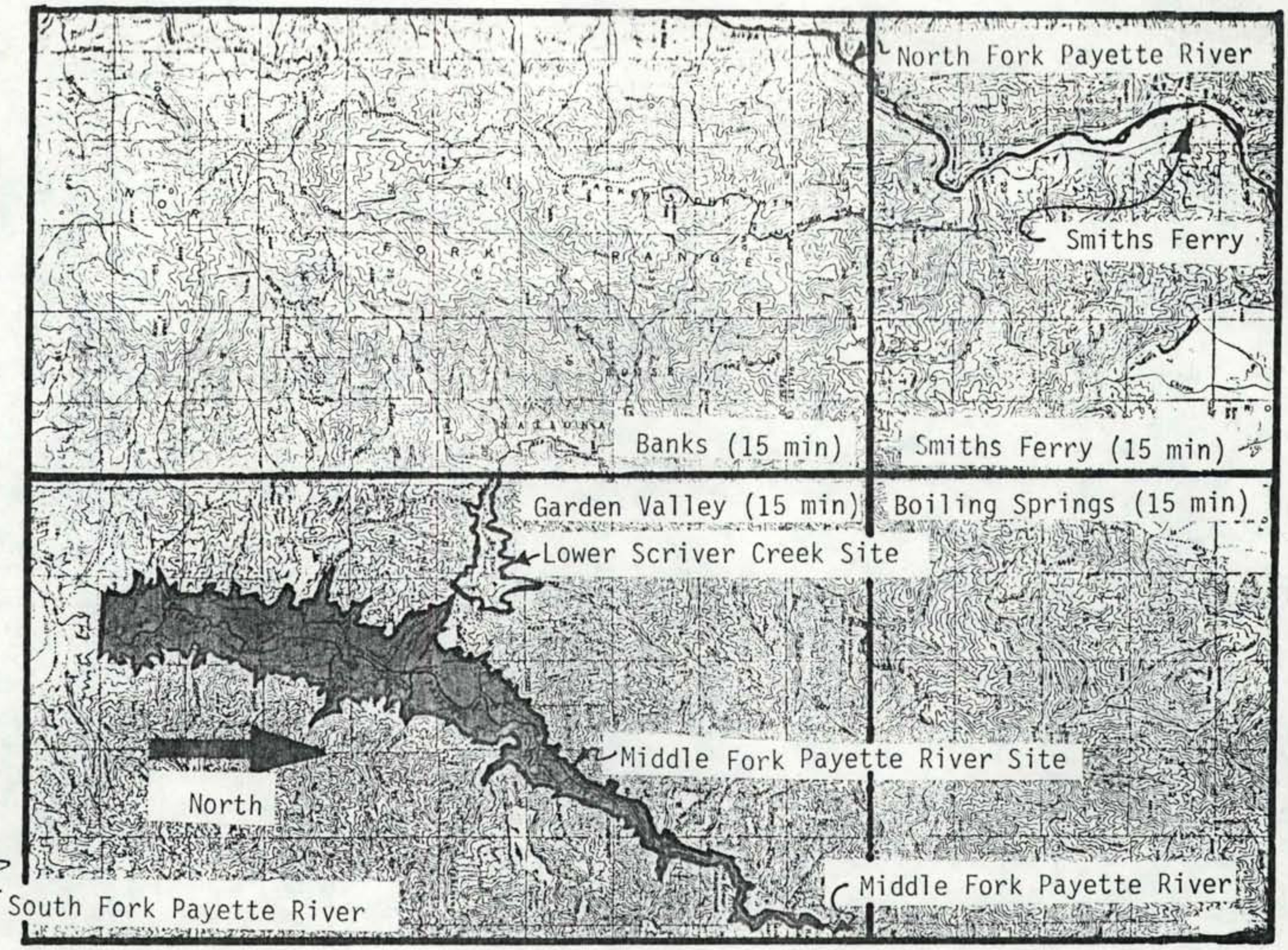


FIGURE 22. Schematic Diagram of the Proposed Middle Fork Payette River Offstream Reservoir Site (Payette River Drainage).



MIDDLE FORK PAYETTE RIVER

Site No. 54

Location: Sec 10 T 9 N R 4 E Garden Valley Quadrangle (15 min)

Elevation (ft-MSL)	Area (acres)	Storage (acre-ft)	Dam Height (ft)	Crest Length (ft)
3000	--	--	--	--
3040	420	5,600	40	--
3120	1900	91,000	120	2200
3200	3300	300,000	200	3400
3280	4650	610,000	280	4800
3360	6200	1,040,000	360	6300
3440	7400	1,600,000	440	8600

Offstream Water Source: North and South Forks of Payette Rvier.

Diversion Type: 8-mile hydroelectric power tunnel from North Fork Payette River near Smiths Ferry (1100-ft head) and/or 15-mile tunnel from South Fork Payette River below the mouth of the Deadwood River.

Impoundment Impacts: Inundation of habitation, roads, and campgrounds along Middle Fork Payette River Valley.

Acceptability Classification: A-A-C

Figure 23. Sketch Map and Characteristics of Middle Fork Payette River Offstream Reservoir Site.

storage sites in that drainage. Table 6 summarizes the various sites considered. The most promising sites are discussed below:

1. The Sugarloaf Reservoir Site. This proposed development located on Crane Creek would inundate the existing Crane Creek Reservoir. The maximum storage capacity would be approximately 600,000 acre-feet. Figure 24 presents a graphical sketch of the proposed project and Figure 25 gives more details of the project characteristics. The main offstream water source would be an 18-mile tunnel diversion of the North Fork of the Payette River from the existing Cascade Reservoir. Leaving a minimum flow for instream needs, approximately 635,000 acre-feet could be diverted on an average year from the Payette River system. In addition, a 10-mile canal from the Little Weiser River could be made that would furnish 52,000 acre-feet of water on an average year to the Sugarloaf Reservoir.

   This would require a very high, 625-ft dam. A 200-MW hydropower plant at the tunnel exit could utilize 1400 feet of hydraulic head. A power plant of about 110 MW could utilize the varying head at the Sugarloaf Dam. There might be need to provide storage on the South Fork of the Payette River to replace storage water now used at such operations as the Black Canyon Dam and the Black Canyon Irrigation District. Development of an onstream reservoir at the Galloway Site on the lower Weiser River would benefit by the increased storage and interbasin transfer of water. The 600,000-acre-feet storage capacity would allow for flexible control of water in the North Fork of the Payette River. With the large capacity of the two reservoirs and the high capacity discharge of the tunnel, power could be produced as

Table 6 Summary of Offstream Reservoir Sites in the Weiser River Drainage

Site No.	Site Name	Water Source		Max. Capacity (acre-feet)
1	Cove Creek	Weiser R, Crane Cr, or N Fk Payette R		78,000
2	Deadman Gulch	Little Weiser, N Fk Payette Rivers		400,000
3	Sugarloaf	N Fk Payette, Little Weiser Rivers		600,000
4	Granger Butte	North Fork Payette River		375,000
5	Upper Crane Creek	Little Weiser River		33,500
6	Riley Butte	North Fork Payette River		310,000
7	Big Flat	Little Weiser River		52,000
8	South Fork Crane Creek	North Fork Payette River		680,000
9	Hog Creek Butte	Little Weiser River		48,000
10	Lower Sage Creek	Keithly Creek		69,000
11	Indian Valley	Middle Fork Weiser River		554,000
12	Monday Gulch	Little Weiser River		40,000
13	Lower Monday Gulch	Little Weiser River		107,000
14	Rush Creek	Goodrich, Cow and Grizzly Creeks		42,500
15	Upper Grizzly Creek	Rush, Cow, Goodrich Crs, Weiser R		22,000
16	Bacon Creek	Middle Fork Weiser River		45,500
17	Johnson Creek	Hornet Creek		50,000
18	Jackson Creek	Johnson or Hornet Creek		23,000
19	Hornet Creek	Weiser, West Fork Weiser Rivers		360,000
20	North Hornet Creek	Hornet Cr, North Fork Weiser R		80,000
21	West Fork Weiser River	Weiser River		94,000
22	Lost Valley Enlargement	Lost Creek	Add'l.	25,000
23	Price Valley	Lost Creek, Weiser River		352,000

THE SUGARLOAF PROPOSED OFFSTREAM RESERVOIR AND HYDROELECTRIC POWER DEVELOPMENT

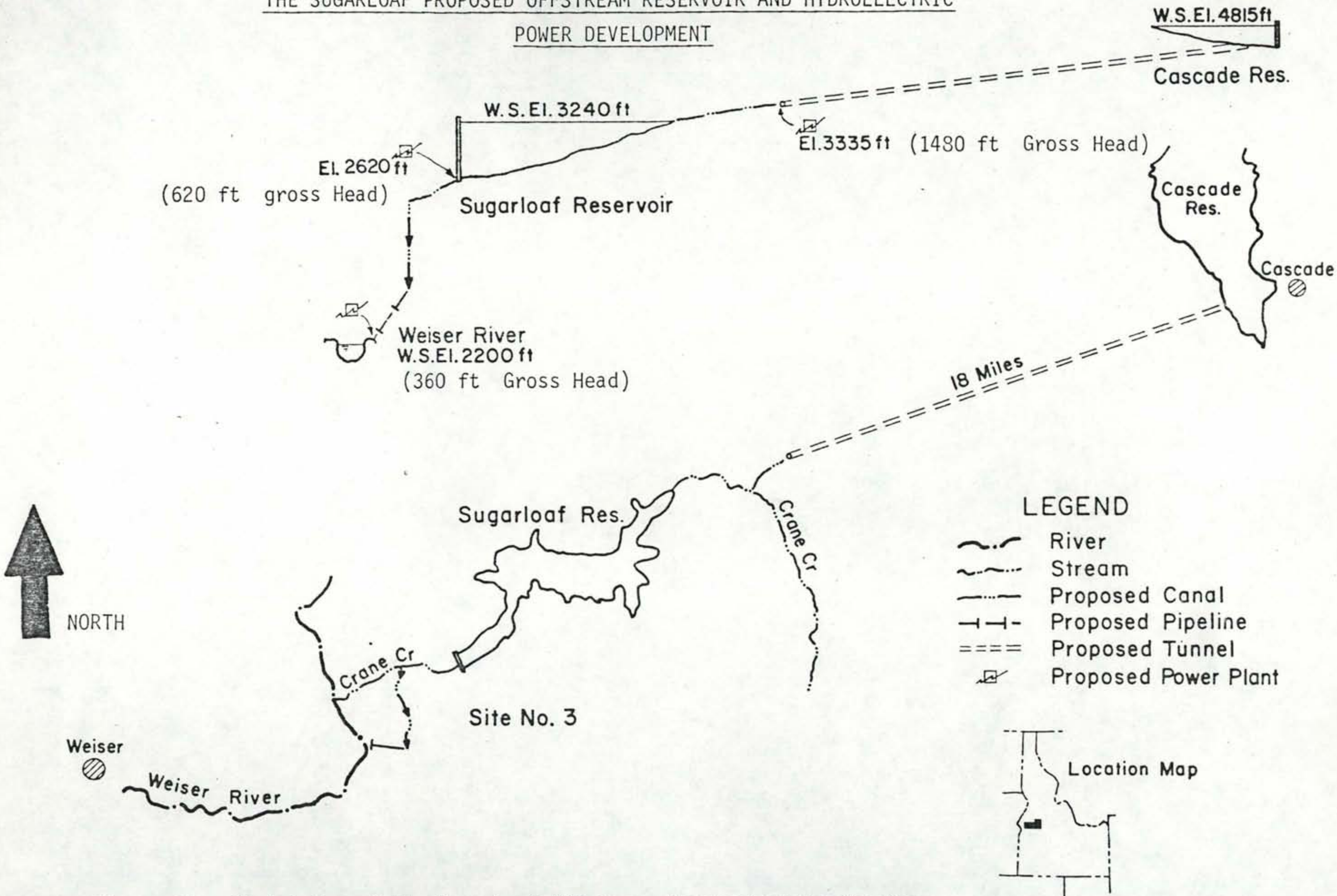
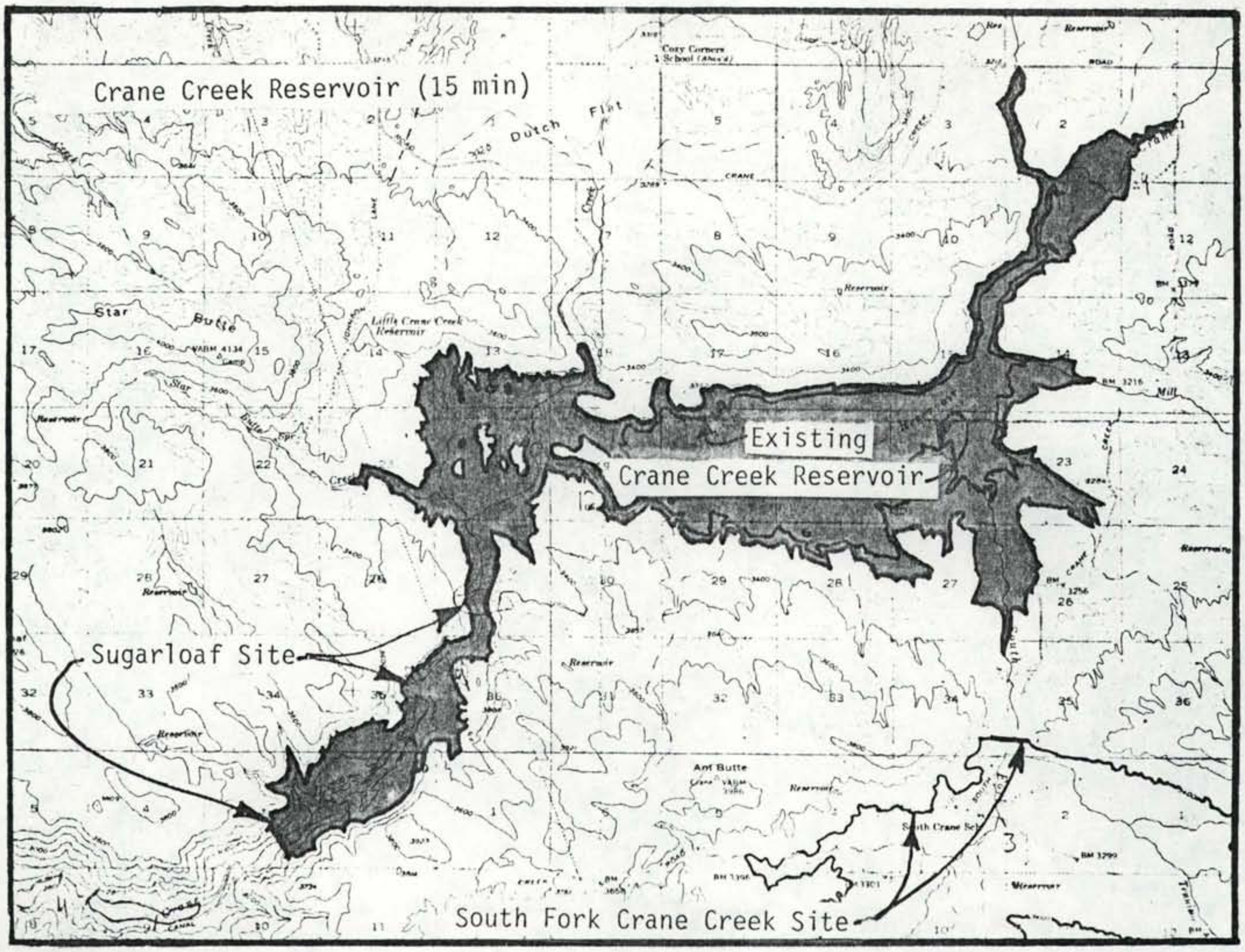


Figure 24. Sketch Map of the Sugarloaf Offstream Reservoir Site Showing Water Source and Profile Information (Weiser River Drainage).



SUGARLOAF

Site No. 3

Location: Sec 3 T 11 N R 3 N Crane Creek Reservoir Quadrangle (15 min)

Elevation (ft-MSL)	Area (acres)	Storage (acre-ft)	Dam Height (ft)	Crest Length (ft)
2620	--	--	--	--
3000	293	37,300	380	1300
3120	934	105,000	500	1560
3160	1,430	152,000	540	1670
3200	5,810	287,000	580	1800
3220	7,500	424,000	600	1820
3240	10,100	600,000	620	1930

Offstream Water Source: North Fork Payette River.

Diversion Type: 16-mile hydroelectric power tunnel from Cascade Reservoir Crane Creek (1400 ft head).

Impoundment Impacts: Water surface elevations greater than 3150 would flood considerable agricultural lands and the existing Crane Creek Reservoir (3191 ft MSL).

Acceptability Classification: A-A-B

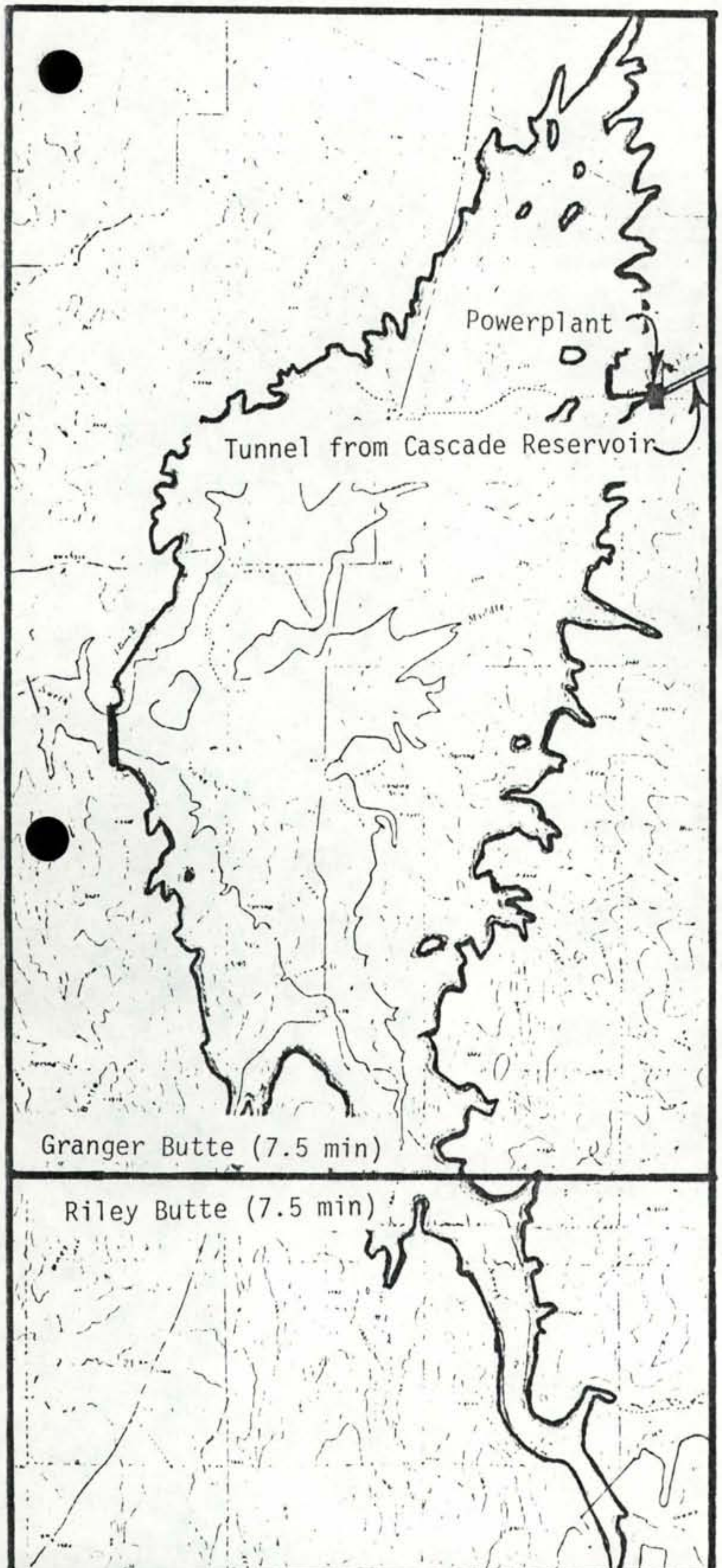
Figure 25. Sketch Map and Characteristics of the Sugarloaf Offstream Reservoir Site.

seasonal peaking power. Preliminary economic analyses indicate development costs could be more than paid for by power revenues.

2. The Granger Butte Site. This proposed site located in an essentially undeveloped region of the Weiser River drainage, is envisioned to have a maximum storage of 375,000 acre-feet. Figure 26 presents a sketch map and characteristics of the site. This proposal would require a 17-mile power diversion tunnel from Cascade Reservoir. This would require a lower dam than the Sugarloaf Site but would not necessarily plan for power development at the reservoir dam site. There would be less opportunity to have carryover storage and less flexibility in release schedules for power use, fish enhancement and other uses. No cost analysis was made of this scheme but it is not likely that it would be as cost effective as the Sugarloaf site.

3. The Monday Gulch Site. This proposed site is one that has been frequently mentioned as a likely site for offstream storage because of the natural dam site and the nature of the bowl-shaped basin. Figure 27 presents a sketch map of the site and reservoir characteristics. Throughout this report this site has been used as an example study site. In an earlier section it is shown that pumping may be a relatively economical means of filling this reservoir compared to a long, gravity-fed canal. A later section of the report on assessment of social, political and environmental acceptibility uses the Monday Gulch site as an example showing a proposed methodology to be used for planning such water developments. The Monday Gulch site appears to be

rather expensive and storage water is likely to cost more than $30/acre-foot. The proposed water uses are releases for supplemental



GRANGER BUTTE

Site No. 4

Location: Sec 4 T 12 N R 1 W
Granger Butte Quadrangle (7.5 min)

Elevation (ft-MSL)	Area (acres)	Storage (acre-ft)	Dam Height (ft)
3230	--	--	--
3240	22	73	10
3260	270	2,540	30
3280	730	12,200	50
3300	1400	33,500	70
3320	2200	69,700	90
3340	2960	121,000	110
3360	3740	188,000	130
3380	4660	272,000	150
3400	5640	375,000	170

Crest Length (elevation 3400): 3450 ft.

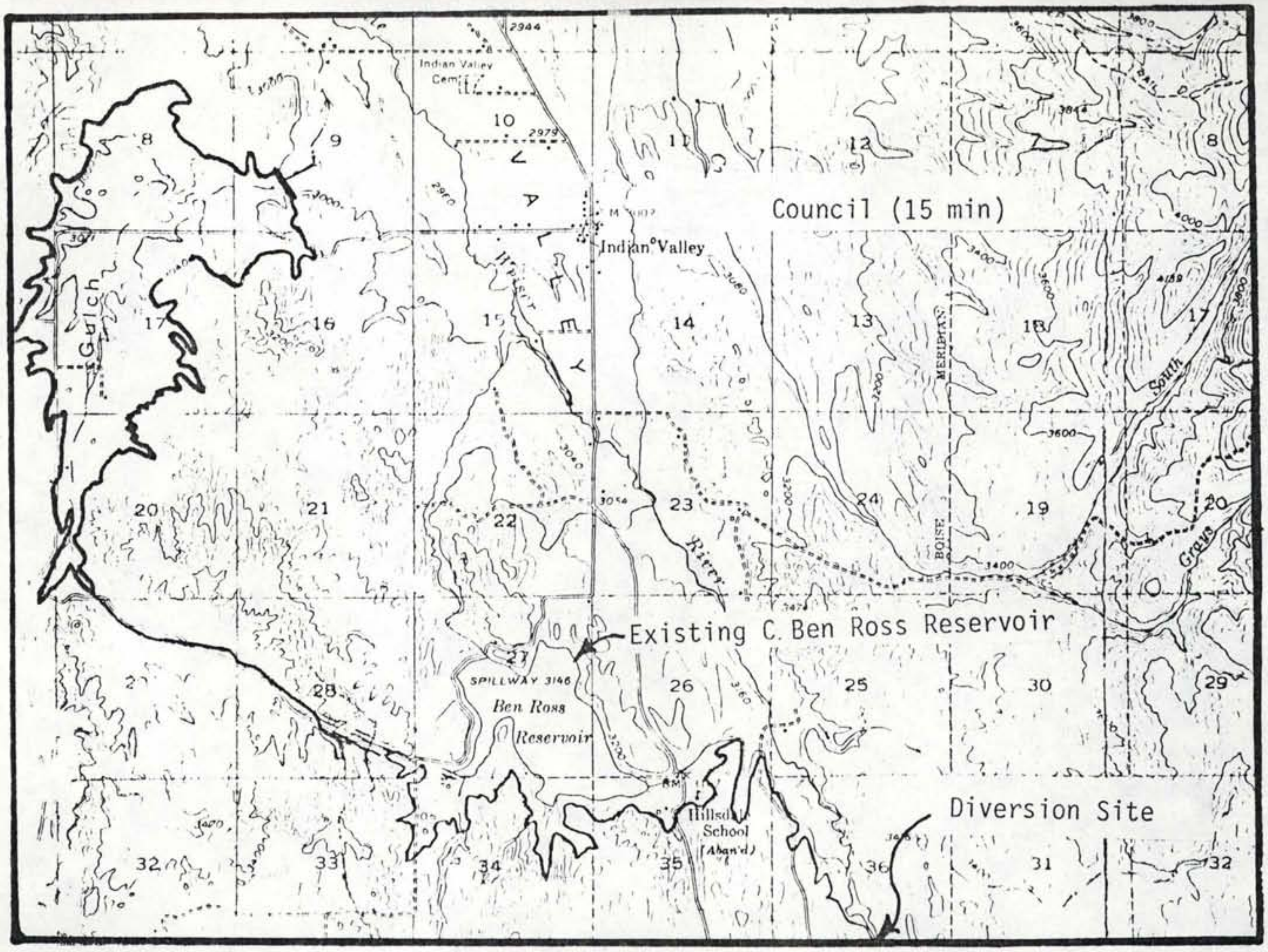
Offstream Water Source: North Fork Payette River.

Diversion Type: 17-mile hydroelectric power tunnel from Cascade Reservoir. (Payette Drainage). (1400 ft. head).

Impoundment Impacts: Agricultural Development, habitation, and roads.

Acceptability Classification: A-A-B

Figure 26. Sketch Map and Characteristics of Granger Butte Offstream Reservoir Site (Weiser River Drainage).



MONDAY GULCH

Site No. 12

Offstream Phase I No. 002

Location: Sec 9 T 14 N R 1 W Council Quadrangle (15 min)

Elevation (ft-MSL)	Area (acres)	Storage (acre-ft)	Dam Height (ft)	Crest Length (ft)
2915	--	--	--	--
2960	67	1,000	--	--
3000	426	9,830	85	--
3040	1160	40,400	125	750

Offstream Water Source: Little Weiser River.

Diversion Type: 11 miles new canal.

Impoundment Impacts: Limited farming and habitation.

Acceptability Classification: B-B-A

Figure 27. Sketch Map and Characteristics of the Monday Gulch Offstream Reservoir Site (Weiser River Drainage).

irrigation water and fishery enhancement flows. These uses are not at this time expected to have benefits equal to $30/acre foot unless worked into an integrated water resource development, like the Sugarloaf site development, with an onstream development at Galloway site on the lower portion of the Weiser River. A more comprehensive appraisal needs to be made of such a possibility.

ASSESSMENT OF SOCIAL, POLITICAL, AND ENVIRONMENTAL ACCEPTABILITY

by

H. S. Duncombe

Professor of Political Science

Proposed System of Evaluating the Political Feasibility of Alternative Impoundment Sites

In meeting this portion of the research studies objectives a preliminary effort has been initiated to develop a system for evaluating the political feasibility of alternative water impoundment sites.

The objective of this proposed system is to reduce the cost of preparing detailed engineering studies of impoundments that would generate so much political opposition that it would be unlikely that the plans would be approved by Congress, the Idaho Water Resources Board, Idaho Public Utilities Commission, Federal Energy Regulating Commission, or other government bodies. The proposed system would also focus attention on sites which appear most politically feasible so that government agencies and utilities could concentrate their engineering studies on the sites most likely to be approved.

The proposed system includes two measures of political feasibility. It consists of a compilation of the ratings of a diverse group of 20-40 knowledgeable people on perceived impacts of the proposed impoundment. This measure is intended to determine the political support or opposition the proposed site will engender before Congress, the Idaho Water Resources Board, Idaho Public Utilities Commission, Federal Energy Regulatory Commission and other government bodies.

The second measure is entitled "Prediction of Agency Action." These are separate estimates of action that will be taken on the proposed site by government decision making agencies such as the Idaho Water Resources Board, Idaho Public Utilities Commission, and Federal Energy Regulating Commission. The estimates will be based partly on the "Profile of General

Political Acceptability" of the site and partly on a study of the voting behavior of members of the decision making boards and commissions and decision-making of agency executives.

Profile of General Political Acceptability - The profile would list a series of factors which are politically significant in generating support or opposition for most impoundments. The political importance of each factor would be judged on those rating the ipoundments so that if a factor was not applicable for a particular impoundment the raters would indicate not applicable on the form. The standard factors to be used for rating are:

1. Power
2. Flood control
3. Irrigation
4. Navigation and boating (includes power boating, water skiing, rafting, canoeing, kayaking, etc.)
5. Property bax base
6. Fishing (lake and stream)
7. Wildlife and Hunting
8. Parks
9. Municipal or industrial water supply
10. Archeology and historical sites
11. Scenic values
12. Land flooded or disturbed by site
13. Transportation
14. Water Quality
15. Wilderness

The standard factors would be listed vertically on a sheet of paper with those factors not pertinent to a particular project omitted. Attachment A is a sample rating form with Figure 28 showing information needed for the evaluation. The "Profile of General Political Acceptability" would then be sent to a diverse group of 20-40 people knowledgeable about the general area of the site. The panel would vary from site to site although several proposed sites in the same area would be judged by the same panel. The panel would be asked to do two things:

1. Indicate the importance of each factor on a 5 point scale.
2. Indicate the political impact of the factor (from +5 to -5).

A +5 in political impact would indicate the rater felt that an impoundment site would have a highly favorable impact. For example, irrigators might strongly support the site as an additional, much-needed source of water. A -5 impact would indicate the rater's view that the proposed site would produce strong political opposition.

After the rating is completed a total rating could be produced by multiplying the importance of the factor (the weight) times the rating. For example, Rater A might give a 4 rating for the importance of power and a +3 rating for its political impact. The result would be a +12 rating which would be combined with the other ratings given by Rate A to give his total rating for the site. Adding the total ratings given by each rater and dividing by the number of ratings would give a general political acceptability rating. While this rating of general political acceptability might be used in a manner similar to a cost-benefit ratio, the writer cautions against its over-use. The profile itself built from the ratings will probably prove more valuable than any single overall figure for a particular site.

2. We would contact officials in the area of the impoundment such as a local banker, newspaperman, or county commissioner to learn the names of individuals who could represent the views of other affected groups. For example, we know the impoundment would provide water for downstream farmers. From contacts with a prominent county commissioner who lives in the area we could get the name of a farmer who knows the views of farmers in the area and might be a leader in making known these views. We would then contact the farmer and ask that he be one of the raters.

In making the final selection of raters, we will try to eliminate persons whoses biases on the impoundment are so strong they could not be reasonably fair in their rating. We would not want, for example, an opponent of a dam who would rate every one of the factors a -5 or a supporter who would rate every factor a +5. We anticipate that many of the raters will have strong feelings for or against some aspect of the dam (i.e. irrigation water, effects on fishing, etc.) but want raters who can be objective on most factors. For a particular site, the following people might be selected.

1. An irrigation district official in the area of the impoundment.
2. A power company official.
3. Several farmers who would represent both upstream and downstream interests.
4. A downstream city official (this would be particularly important if flood control or municipal water supply were involved).
5. A county commissioner from a district including the site or affeected by the site.
6. A property owner in an area to be flooded or disturbed by the project.
7. A fisheries biologist selected by the Fish and Game Department from the region affected by the site.
8. A game management specialist selected by the Fish and Game Department from the region affected by the impoundment.
9. A Transportation Department official knowledgeable about the affect of the site on roads.

10. One or two Idaho Water Resources Department officials.

11. A Department of Parks and Recreation Department officials.

12. A member of the Idaho Whitewater Association familiar with freeflowing streams in the area.

13. A member of the Idaho Conservation League from the area.

14. A member of the Idaho Wildlife Federation from the area.

15. An official of the Associated Taxpayers of Idaho who would be familiar with the tax impact on the project and affect on local business and property owners.

16. An official of the State Historical Values who could rate the archeological and historic values of the project.

17. A water quality specialist from the Department of Health and Welfare.

18. A farmer or rancher suggested by the Idaho Farm Bureau or other farm organization powerful in the area.

19. A realtor in the area affected by the site.

20. A member of the Sierra Club in the area.

21. A consumer group official.

22. A banker in the area affected by the site.

23. An official of the Army Corps of Engineers who knows the area.

24. A county cooperative extension agent and/or ASCS executive.

25. State legislator(s) living near the area affected by the impoundment.

Some raters (particularly those representing state agencies) may wish to rate a project on only a few criteria in their area of expertise. For example, a fishers biologist might only wish to give a rating on the effect of the impoundment on fishing and water quality. If the evaluator and planner pressed these raters to give rating in other areas they might refuse to rate at all or give only perfunctary attention to other items.

Therefore, the writer in his judgement would ask the raters to give ratings to as many of the 15 criteria as they feel knowledgeable about. This will reduce the total number of items rated but would not interfere with the computation of a numeric indext. All of the raters will be asked to fill out one page form containing a structured questionnaire on the front side and open-ended questions on the reverse side. A copy of the proposed form may be found in Attachment A.

This project study has tested out the methodology of selecting raters by having one of the researchers contact state and interest group officials in Boise to select raters for the Monday Gulch proposed impoundment in Adams County. The researcher drove to the site of the impoundment, contacted persons in the Weiser, Cambridge, Indian Valley and Council areas, and selected an additional list of local raters. The tentative list of persons selected is shown in Attachment B.

Prediction of Agency Action - The "Profile of General Political Acceptability" will not, of course, predict how a particular decision-making body will vote on a proposed impoundment. It will give an indication of which groups will testify in the hearing of the project and the intensity and direction of their testimony. This testimony will have some impact on the decision.

The knowledge and values of the members of decision making boards and commissions will also have an important impact on their decisions. From interviews, it is hoped that a profile of this knowledge and views can be built. From analysis of past votes of board or commission members as well as a knowledge of their current views, we are hopeing to be able to predict the votes of individual commissioners on particular projects. For example, we are confident we would have been able to predict a 3-0 or 2-1 in the Idaho Public Utilities Commission against the South Fork of the Payette Hydro Development Project and would have been able to predict a favorable vote for the North Fork project.

The writer would propose to make a detailed study of the voting and values of the members of:

1. The Idaho Public Utilities Commission
2. The Idaho Water Resources Board
3. The Idaho State Board of Health and Welfare
4. The Idaho Fish and Game Commission
5. The Federal Energy Regulatory Commission

In addition, the writer would hope to provide a methodology for the general prediction of the action that might be taken by federal or state landowning agencies on particular sites.

The end product of the project would be a "Prediction of Political Action" sheet for each proposed impoundment or water development site which would predict whether the site would receive the necessary approvals for the project to be completed.

ATTACHMENT A

Proposed Rating Form for the Profile of Political Acceptability

Attached is a one page summary of the proposed ____________________ impoundment. We are asking you to give your opinions of the acceptability of this project to you and the people you know. We are asking that you identify yourself on this form so that we understand where you live and your connection with the proposed impoundment.

Name ______________________________ Telephone (home) ___________ (office) _________

Address ______________________ ______________________ ___________ ___________
Street or Route City or Post Office County Zip code

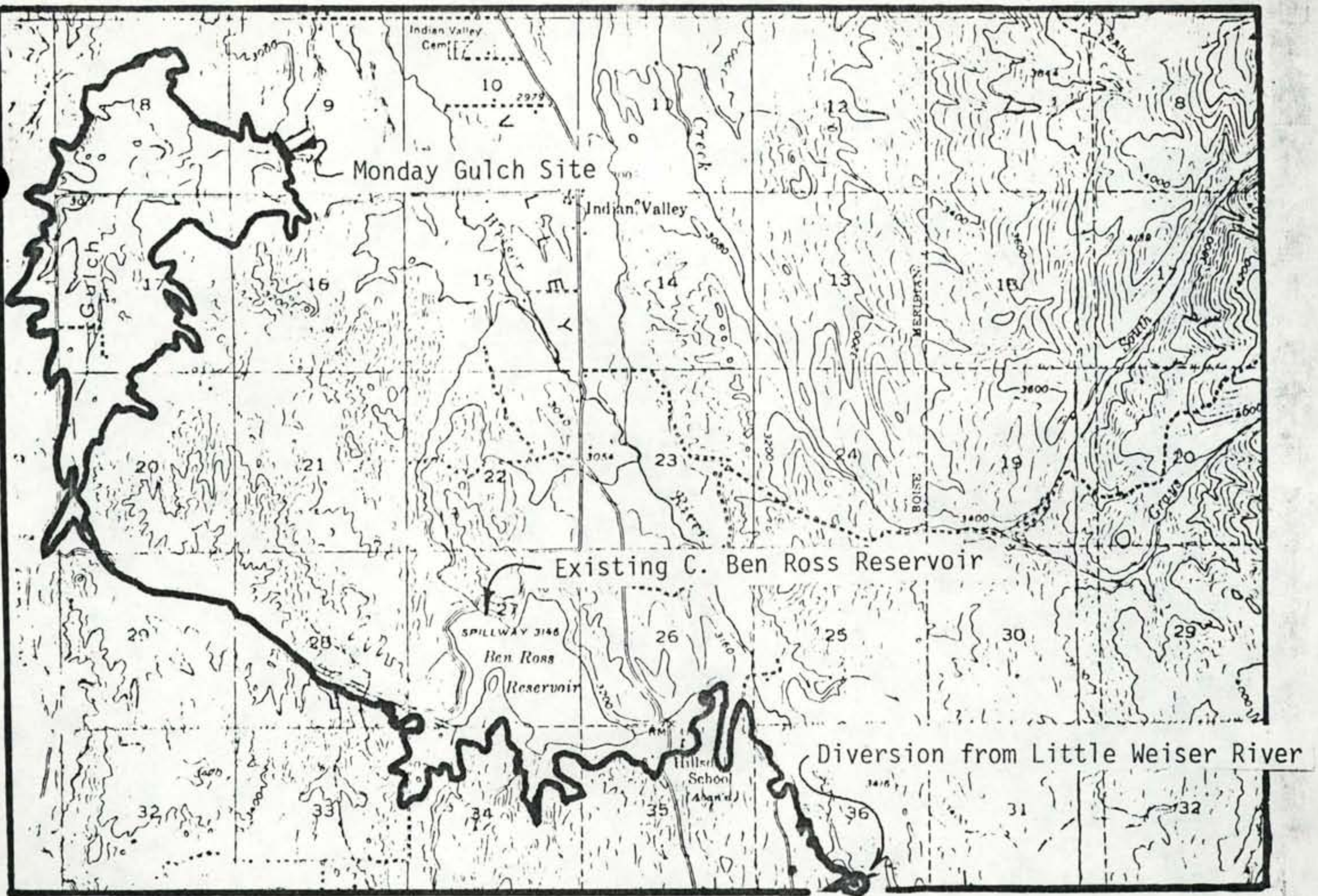
Occupation ____

How do you feel about the proposed impoundment described on the attached page?

How do you think others feel about the proposed impoundment?

Please rate the proposed impoundments on as many of the following factors as you feel knowledgeable about. Please rate first the importance of the factor. A factor of no importance, for example, should receive a 0 rating while a factor of very great importance would receive a +5 rating. Then rate the factors on their political impact. A +5 rating would indicate a highly favorable response and a -5 a highly unfavorable.

Factor	Importance of Factor: Very Important 5	4	3	2	1	Of no Important 0	Political Impact of Factor: Highly Favorable +5	4	3	2	1	Neutral 0	-1	-2	-3	-4	Highly Unfavorable -5
Power																	
Flood control																	
Irrigation																	
Navigation and Boating																	
Property Tax Base																	
Fishing																	
Wildlife & Hunting																	
Parks																	
Water Supply																	
Archeological & Historical Sites																	
Scenic Values																	
Land Flooded or Disturbed by Site																	
Transportation																	
Water Quality																	
Wilderness																	
Your overall Rating of Political Impact																	



Monday Gulch Proposed Offstream Storage Site - SITE No. 12

LOCATION	
County:	Adams
Section, Township, Range:	Sec 9, T 14 N, R 1 W
River Basin:	Weiser River
RESERVOIR CHARACTERISTICS	
Maximum Pool Elevation:	3040 ft
Dam Height:	125 ft
Crest Length:	750 ft
Maximum Surface Area:	1160 ft
Gross Storage Content:	40,000 acre-feet
WATER SOURCE	
Source Name:	Little Weiser River
Location of Diversion Point:	T 14 N, R 1 W
Type of Diversion:	Canal
Diversion Distance:	11 miles
IMPOUNDMENT IMPACT	
Unimproved Road to be Relocated:	
Grazing Lands:	
Limited Farmstead Development:	
COST ESTIMATE	
Live Storage Cost:	$31.86/acre-feet

Based on the Conveyance and Basic Dam Costs.

Figure 28. Descriptive Sketch and Engineering Data Necessary to Familiarize A Rater With Features of a Water Reservoir Development.

ATTACHMENT B

A Test of the Selection of Raters for the Profile of Political Acceptability

One of the most difficult tasks in establishing a "Profile of Political Acceptability" for a particular off-stream storage project is the selection of a panel of people who can provide a broad spectrum of interest and knowledge on a particular project. To gain insight on the best means of selecting ing persons who could best evaluate the project, one of the researchers tested this process on the Monday Gulch project in Adams County, Idaho. The researcher used a two step approach in selecting a list of names of people who could evaluate the project from many different points of views:

1. The research spent two days in Boise contacting key interest groups and state agencies. Officials were asked to supply the names of local or regional people who could best evaluate the project and fill in the rating form we have developed.

2. The researchers spent a day in the Weiser River Valley and interviewed a number of people in Weiser, Cambridge, Indian Valley and Council to select other prople who could also serve as raters.

The research contacted some, but not all, of the proposed raters. A final list of raters can only be compiled after all raters have been contacted. In some cases two or more persons from the same organization would cooperate in the rating process. There is at least one person in the following tentative list of raters familiar with each of the 15 rating factors, but very few (if any) of the raters are very knowledgeable about the effect of the Monday Gulch impoundment on all of the factors. The tentative raters are:

1. Mr. Ross Strawn, President of the Weiser Irrigation District. Mr. Strawn was suggested by Mr. Sherill Chapman, Director of the Idaho Water Resources Association.

2. Mr. Robert J. O'Connor, Executive Vice-President and Chief Operations Officer of the Idaho Power Company. Mr. O'Connor would probably delegate the responsibility to someone else in his company.

3. Mr. Verl King and Mr. Bill Gosset of the Idaho Water Resources Dept. Mr. Verl King is familiar with power potential of projects and Mr. Gosset flood control projects.

4. Mr. Vic Armacost , Army Corps of Engineers, Walla Walla Office.

5. Mr. Dale Christiansen, Director of Idaho Department of Parks and Recreation. Mr. Christiansen would undoubtedly seek assistance from Mr. Don Denton on the impact of the impoundment on park planning. He would also seek advice from Jim Paulsen on the effect on power boating and from Todd Graff on the effect on canoes and kayacking.

6. Mr. Ken Horowitz, Idaho Whitewater Association.

7. Mr. Will Reid, fisheries biologist of Region 3 of the Department of Fish and Game. He would probably be the person selected by the Dept. of Fish and Game as most knowledgeable on the fisheries impact of the project.

8. Mr. Charles Jensen, game management specialist of Region 3 of the Fish and Game Department.

9. Mr. Russ Westerberg, Director of the Associated Taxpayers of Idaho. He would delegate the rating to one of his staff who would visit the area and confer with local businessmen and property owners. Mr. Westerberg states he could develop a tax profile of the project and accurately guage the public feeling on the project.

10. Mr. Tom Green, State Historical Society. Mr. Green would make a preliminary assessment on the archeological and historic values of the site by going to the file to see if the impoundment would cover known historic or archeological sites and would estimate whether a more thorough study would uncover any sights. However, after a site is selected he would need to make (or contract for) a more thorough study.

11. Mr. Al Murray, Environmental Control Section, Department of Health and Welfare. Mr. Murray might have Mr. Bill Clark and John Wroten of the Boise Field Office to make some field surveys on the environmental impact of the impoundment on water. Dick Rogers who worked on the Idaho Water Survey might be involved in assessing the impact on municipal water supplies.

12. Mr. Dean Tisdale, Chief of Management and Planning, Idaho Department of Transportation. Mr. Tisdale could quickly determine if the proposed impoundment would affect any state highway or local road. If it does have an effect on a road or source of aggregate, one of his staff would explore further.

13. Mr. J. H. Daniels, Idaho Conservation League member from Weiser. He was suggested by Mr. Pat Ford, an official of the Idaho Conservation League.

14. Dr. Sam Monger, Council. He is an active member of the Idaho Wildlife Federation suggested by Mr. Bruce Bowler, official of the Idaho Wildlife Federation.

15. Mr. Cliff Keppinger, County Commissioner of Adam County. He owns a farm in the area to be flooded by the impoundment and surveyed the area in the 1940's.

16. Mr. Lawson Howland, County Commissioner of Washington County, he is a farmer who represents an area of his county which may receive irrigation benefits from the impoundment.

17. Mr. Jim Bumgarner, a cattle farmer who is an official of the Weiser Flood Control District and Weiser Irrigation District.

18. Mr. Dale Castagno, a farmer suggested by Mr. John Hatch, Director of Public Affairs of the Idaho Farm Bureau Federation. Mr. Castagno runs cattle in the area of the impoundment.

19. Dennis Baird, an official of the Sierra Club, and President of the Idaho Environmental Council.

20. Mr. Ottis Peterson, retired Bureau of Reclamation official working with the Idaho Consumer Affairs, Inc.

21. Realtor, Karen Hollis of Payette selected by Mr. Mark Donn of the Idaho Association of Realtors and/or Realtor Ferd Dunn of Council.

22. Mr. John Sachtjen, farmer in the Cambridge area who farms near the Little Weiser below the project.

23. Mr. Dawson Gaertner, farmer at Midvale.

24. Mr. George Danielson, owner and manager of a large general merchandise store at Cambridge. Mr. Danielson is a member of the Idaho House of Representatives and very knowledgeable about the political views of the people of Cambridge and the surrounding area.

25. Mr. Malcolm Hewet - a Director of the Little Weiser Irrigation District that operates the Benn Ross impoundment close to Monday Gulch.

26. Mr. Don Wood, Adams County Assessor and President of the Council Chamber of Commerce.

27. Mr. Chad Gibson, Adams County Agent, Council.

28. Mr. Ken Schwartz, Agricultural Stabilization and Conservation Service executive stationed in Council.

29. Mr. Steve Shumway, Council farmer who would understand the feelings of farmers upstream from the project on the Weiser River.

30. State Senator Larry Craig, who operates a cattle ranch in the Midvale area.

31. Mr. Harry Nelson, retired former owner of the Weiser, Signal-American, who as a newspaper publisher has taken an active interest in Weiser River water projects for 25 years.

32. Mr. Keith Alsager, President of the Cambridge Chamber of Commerce and Manager of the branch of the First Security Bank in Cambridge.

The preceeding list of people includes persons from the affected state agencies, representatives from key interest groups, and people representing the following areas in the Weiser Valley - Weiser, Cambridge, the Indian Creek area, and the Council area. Upstream and downstream farm interests are represented.

While we did not select a final list of raters for the Monday Gulch project, the test was very useful in showing that it is possible to select an excellent group of raters with a wide range of perspective on the project.

CONCLUSIONS AND RECOMMENDATIONS

Conclusions

In this assessment, over 200 offstream reservoir sites were considered. Most of them were visited but the principal information gained is from preliminary map studies. The following conclusions are made from this research.

1. The study of the availability of water indicates, with present practices, that little water is available for new storage development in the Snake River System upstream from Milner Dam, or in the Big Lost and Little Lost River systems and the Wood River drainage. The Boise River appears to have some uncontracted storage and existing reservoirs tend to fill most years, indicating offstream reservoirs could be used to store spring flood flows on most years. This additional storage could provide flexibility and, hopefully, resource uses that would have positive net benefits. The Payette River with modification in system operation likewise appears to offer some potential for development of offstream reservoirs. Because the Weiser River has rather small amounts of existing storage there appears to be a definite justification for seeking both onstream and offstream reservoir storage in that drainage.

2. The assessment of costs of reservoir development and value of water shows that irrigation use may have values ranging from \$20/acre-foot up to a high of \$100/acre-foot. Hydropower developments may have gross values under Idaho conditions of greater than \$40/acre foot. Since the value of electric power is increasing rapidly, the value of water in hydroelectric use will be changing and will make many now economically questionable sites worth developing. The downstream

gross value or value added for fishery enhancement appear to range from \$4 to \$26/acre-foot. Flood control benefits on the Weiser River were found to be less than \$1/acre-foot. Rarely will all of these water use benefits be additive because the uses conflict as to when releases from storage will need to be met. Preliminary cost analysis on a range of offstream reservoir sites indicate that basic costs of just the dams, spillways, outlet works and water conveyance systems will in most cases exceed \$40 per acre foot. On that basis it has been shown by this study that only the very best offstream reservoir sites are apt to be cost effective under present economic conditions.

3. A study of the limitation to pumping height indicates that it is not possible to assign a limit to pumping lift for offstream reservoirs. The Coyote Butte Site shows that if a recovery of the pumping lift can be made with a much higher hydropower head it may be wise to have higher pumping lifts. Several offstream reservoir sites of that type were inventoried in the process of this study.

4. Small reservoir sites of less than 35,000 acre-feet capacity were inventoried and preliminary analysis of feasibility studied. Few if any will have costs of less than \$50/acre foot if conveyance channels, pumping lifts, or supply tunnels of any reasonable length are included in the cost. These smaller sites have been separately identified for future reference. Limited search for these small reservoirs was conducted in the Snake River system upstream of Swan Falls Dam except for a few possible sites in the Henrys Fork drainage.

5. This study points to the most likely water uses for offstream storage as being for hydropower development, for some types of high-valued-crop irrigation, for augmentation of instream flows for fishery enhancement and for flood control in special cases. Because of the

rising value of hydropower considerable time was devoted to seeking out schemes that would include transbasin diversion for hydropower development. A brief review of how onstream reservoirs might benefit fish migration on the Lower Snake River indicates some possibility for favorable benefits, but a more detailed study with smaller operational time increments than monthly flow data are needed to verify the reality of the advantages of fish flow augmentation.

A brief study of conservation in the magnitude of diversions made for irrigation in the Henrys Fork River was an effort to meet the objective of identifying uses of water and conservation goals that might result from offstream reservoir development. That evaluation indicates, with reduction in the amounts of given irrigation diversions, that the average year hydrologic condition would provide opportunity for water for offstream reservoirs. Much caution in using these early findings should be exercised because of the many physical, environmental and institutional restraints that are involved in the real world of water management.

6. In an attempt to screen and indicate a priority for future study of offstream storage sites for water development, a cataloguing and a subjective ranking has been made of all the sites, Table A-7-1. The subjective ranking has developed a comprehensive evaluation based on three principal considerations; 1) water availability, 2) economic viability, and 3) environmental impact. The analysis has indicated that it is wise to consider the potential in terms of specific drainages. In the Upper Snake Region, sites that show reasonable promise are the Howell Ranch Site in the Warm River drainage, the Lane Lake Site, the Badger Creek Site and the Bitch Creek Site all in the Teton River drainage. A unique site that needs future study is an offstream

hydropower site on the Twin Falls Canal Company main canal. This would involve a need for upstream offstream storage to develop the full potential at the hydropower site.

In the Boise River and the adjacent area along the main stem of the Snake River, the Coyote Butte Site No. 106 has unique possibilities, especially if existing canals can be used for conveyance of flood flows of the Boise River. This might likewise have potential to serve as a dry year irrigation water supply source for Boise Project Board of Control lands. Another possibility in the Mores Creek area of the Boise River is the Dunnigan Creek Site No. 80.

The Payette River water availability analysis and search for offstream storage sites indicates that rather large water resource developments utilizing interbasin tranfers by tunnels could provide offstream reservoir possibilities. The most promising are two sites on Squaw Creek, designated Squaw Creek (Lower Site) Offstream Reservoir, Site No. 34, Squaw Creek (Upper Site) Offstream Reservoir Site No. 35, and Middle Fork Payette River Offstream Reservoir Site No. 54. Smaller sites that would have unique possibilities are Bissel Creek Offstream Reservoir Site No. 30 and Horsethief Basin Offstream Reservoir Site No. 44.

In the Weiser River basin twenty-three sites were investigated and the most promising are: The Sugarloaf Offstream Reservoir Site (No. 3), the Granger Butte Offstream Reservoir (Site No. 4), and the Monday Gulch Offstream Reservoir (Site No. 12). The first two will involve complicated water transfer from the existing Cascade Reservoir, possible integration with storage in existing Crane Creek Reservoir, and possible diversion from Weiser River sources.

7. Dr. Duncombe has studied the problem of assessing the social, political and environmental acceptibility of offstream reservoirs as water resource development alternatives. A methodology for developing a profile of general political acceptability has been developed and a "prediction of agency action" as a measure to be used for more cost effective water resource planning has been suggested. An example of how to develop and who might be used to develop a profile of general political acceptability has been presented using the Monday Gulch Offstream Reservoir Site. This utilizes systematized rating and weighing of considerations that can be identified as important in the decision making process.

Recommendations

The research in Phase II of offstream reservoirs sites for water resource development opened up many questions especially as to viability of interbasin transfers and as such opened up opportunity for much conflict and misunderstanding of intent as to how water might be used. These recommendations are made with the reservation that these schemes are merely conceptual and should not be taken as advocating the actual development of any scheme. Thus the following are specific recommendations:

1. On the more promising sites additional studies in more detail should be made of water availability in the form of operational hydrologic studies covering a series of years that would allow opportunity to determine how the water storage and release would function in a sequential time period. In particular, studies should be made of the Upper Snake River, attempting to determine, with additional storage available, more precisely the impact of reductions in irrigation diversions

and the compatibility of new uses of the water resource, particularly including instream flow needs. Specific sites that would merit effort as additional studies are sites such as the Howell Ranch Site, the Upper Badger Creek Site, and the Power site on the Twin Falls Cnala (dropping water back into the Snake River). Numerous assumptions were made in the progress of research on the minimum flows that should be maintained. More attention needs to be given, in river and reservoir operational studies, to minimum flows and restraints required by existing water rights and contractual water supply agreements.

2. On the more promising offstream sites detailed cost and benefit studies should be undertaken. This could include again sites like Upper Badger Creek, the Coyote Butte Site, and sites in the Weiser River drainage.

3. The conceptual schemes for developing offstream reservoirs with trans-basin diversions in the Payette and Weiser River basins for high head, high capacity hydropower plants, should be studied in more depth. Specific sites that should be investigated are the Monday Gulch site, the Sugarloaf Site, the Squaw Creek Sites, and the Midle Fork of the Payette River Site. More on-site inspection should be made of feasibility level studies. There are several of these schemes that have been suggested by this research. Initial reaction from special interest groups may be a problem. The methodology suggested by Dr. Duncombe for developing profiles of general political acceptability might be applied to a group of these offstream reservoir developments even before extensive funding for site investigations, like drilling and specific project formulation, is undertaken.

4. A more thorough effort needs to be made to develop comprehensive and integrated uses of the water resource rather than just consider a single offstream reservoir. This should include trying to utilize both offstream and onstream reservoirs rather than restricting the study to offstream possibilities alone.

5. The assessment of how reservoir operational studies might be undertaken with regard to enhancing fishery through special flow regulation is relatively new and more research is needed on that subject. Studies could be extended to other basins, like the Salmon River Basin within the state. Future effort should focus on more defined project operational studies, even on smaller scale projects or planning schemes.

6. A Phase III study was anticipated by the team that conducted this investigation. A more refined appraisal of how to determine the public acceptability of particular offstream reservoir and water resource development possibilites is recommended for a definitive and creative research effort. This should include more detailed operational studies of the manner in which storage releases could be made to enhance the fishery.

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APPENDIX

Table A-1-1. Example Printout from Study No. 54 of the Idaho Department of Water Resources River and Reservoir Simulation Model -- Snake River at Milner Dam.

UPPER SNAKE STUDY 54. DISCHARGE, SNAKL RIVER AT MILNER (CFS)

W-YR	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEPT	CFS-MONTHS
28	2000	3968	6627	8299	12097	7344	12774	1661	1902	330	330	200	57532
29	200	3823	3391	1486	1592	4432	5926	70	30	330	170	200	21702
30	200	651	3307	1037	935	3009	150	70	30	140	170	200	9900
31	200	300	1710	823	500	300	150	70	30	10	10	10	4132
32	200	300	400	509	517	300	150	70	30	140	23	10	2640
33	200	300	400	634	500	300	150	70	10	10	10	10	2594
34	200	300	400	500	582	300	150	70	10	10	10	10	2542
35	200	300	400	503	500	300	150	70	10	10	10	10	2463
36	200	300	400	631	937	602	150	70	30	234	170	200	3924
37	200	300	1631	815	604	300	223	70	30	10	10	10	4202
38	200	300	400	727	542	300	150	70	30	330	170	200	3419
39	200	340	2036	855	551	537	1725	70	30	140	170	10	6606
40	200	300	1770	950	701	300	873	70	30	10	10	10	5223
41	200	300	400	966	697	300	150	70	30	10	10	10	3143
42	200	300	610	621	521	300	150	70	30	140	10	10	2962
43	200	300	1020	1064	790	5877	13999	70	30	330	330	200	24210
44	856	3627	3332	4869	4005	4094	4602	70	30	330	170	200	26184
45	200	318	2807	883	607	1639	4469	70	30	330	330	200	11884
46	200	2686	3469	3264	6650	8227	9071	70	100	330	170	200	34437
47	200	3654	3304	1544	4278	6516	5816	924	30	330	170	200	26965
48	200	478	3354	1208	4580	6374	4606	1819	3242	330	170	200	26561
49	200	2685	3304	1037	794	8781	3609	4497	30	330	170	200	25638
50	200	553	3551	1189	5828	7668	12776	70	30	330	330	1000	33525
51	2072	3670	7822	8090	12354	11953	9064	4319	30	330	170	200	60074
52	200	3080	3352	6932	9597	8296	11009	3414	1063	330	170	200	47644
53	200	300	3321	1441	4447	4490	2371	70	1642	330	170	200	18983
54	200	336	3447	1011	962	5392	8047	1801	30	330	170	200	21927
55	200	458	2050	917	587	417	5356	70	30	140	170	200	10595
56	200	388	2548	932	6430	12355	10468	70	134	330	210	200	34264
57	200	3326	3472	3507	9335	7286	11142	5024	30	330	330	200	44181
58	200	1266	3326	1335	5188	4455	3974	2902	30	330	170	200	23375
59	200	416	3236	997	500	338	390	70	30	140	170	200	6687
60	200	300	3299	863	560	971	3682	70	30	10	10	10	10006
61	200	300	400	699	686	300	150	70	30	10	10	131	2987
62	200	934	1973	790	634	2577	4587	1791	30	330	330	200	14376
63	200	300	2525	1037	713	4274	3646	70	5320	330	170	200	18785
64	200	813	3656	987	2208	5587	5890	3170	2128	330	330	200	25499
65	200	2948	3949	7070	9064	10334	11862	70	30	330	330	1000	47187
66	2000	2907	7960	6505	4397	4741	282	70	30	140	170	200	29402
67	200	932	1954	1020	535	1304	1637	70	124	330	330	200	8637
68	200	2037	3591	1177	4203	5092	2751	70	30	330	330	225	20036
69	1257	3399	3543	5374	11706	9417	3363	1048	30	330	170	200	39836
70	200	300	3572	1397	4199	5849	2959	4013	2467	330	330	200	25816
71	200	3391	4379	16898	13912	11761	14115	8985	3303	3256	330	1000	81531
72	2000	10552	10338	17779	12811	15817	9947	3284	3491	330	330	1000	87678
73	3091	4429	9482	7024	5000	6342	4878	1215	30	330	170	200	42190
74	200	3663	3557	10334	9914	10554	16699	3196	3613	330	330	496	62886
75	2000	3165	6132	8498	9240	9200	9880	9288	501	4647	330	1000	63880
76	2000	4756	9479	11568	10888	13195	13147	11757	30	330	330	1000	78480
77	2440	3277	5983	5561	4473	2932	150	70	30	10	10	10	24945
AVG	554	1760	3328	3283	4077	4868	5068	1526	601	382	184	255	25887

2. HENRYS FORK RIVER EXAMPLE WATER AVAILABILITY ANALYSIS

Assumptions and definition of analysis

This analysis was made to show an example of how decreases in irrigation diversion rates might provide in-channel water that could be used for offstream storage development. The following assumptions were made:

1. The main stem canals shown in Figure 1 will be supplied with water from the Henrys Fork River and the two reservoirs will be filled to meet water deliveries in effect as of 1977 degree of development.
2. The theoretical water demand will be based on farm requirement for alfalfa at Ashton using the 80 percentile of irrigation requirements reported by Sutter and Corey. (Sutter and Corey, 1968).
3. One analysis will consider the overall irrigation efficiency of 30%.
4. An attainable irrigation efficiency of 42% will be used to estimate water savings that might be used to fill new storage.
5. Average year conditions will be studied and to make it a more realistic true-time sequence, water year 1951 will be used for the operational study.
6. A minimum flow release below Island Park Reservoir will be equal to the record minimum flow of 17,200 acre-feet (March 1932). The total yearly flow that year was 302,000 acre-feet as compared to the 1928-1977 average flow of 422,700 acre-feet.

MAIN STEM HENRYS FORK SNAKE RIVER

AVERAGE YEAR

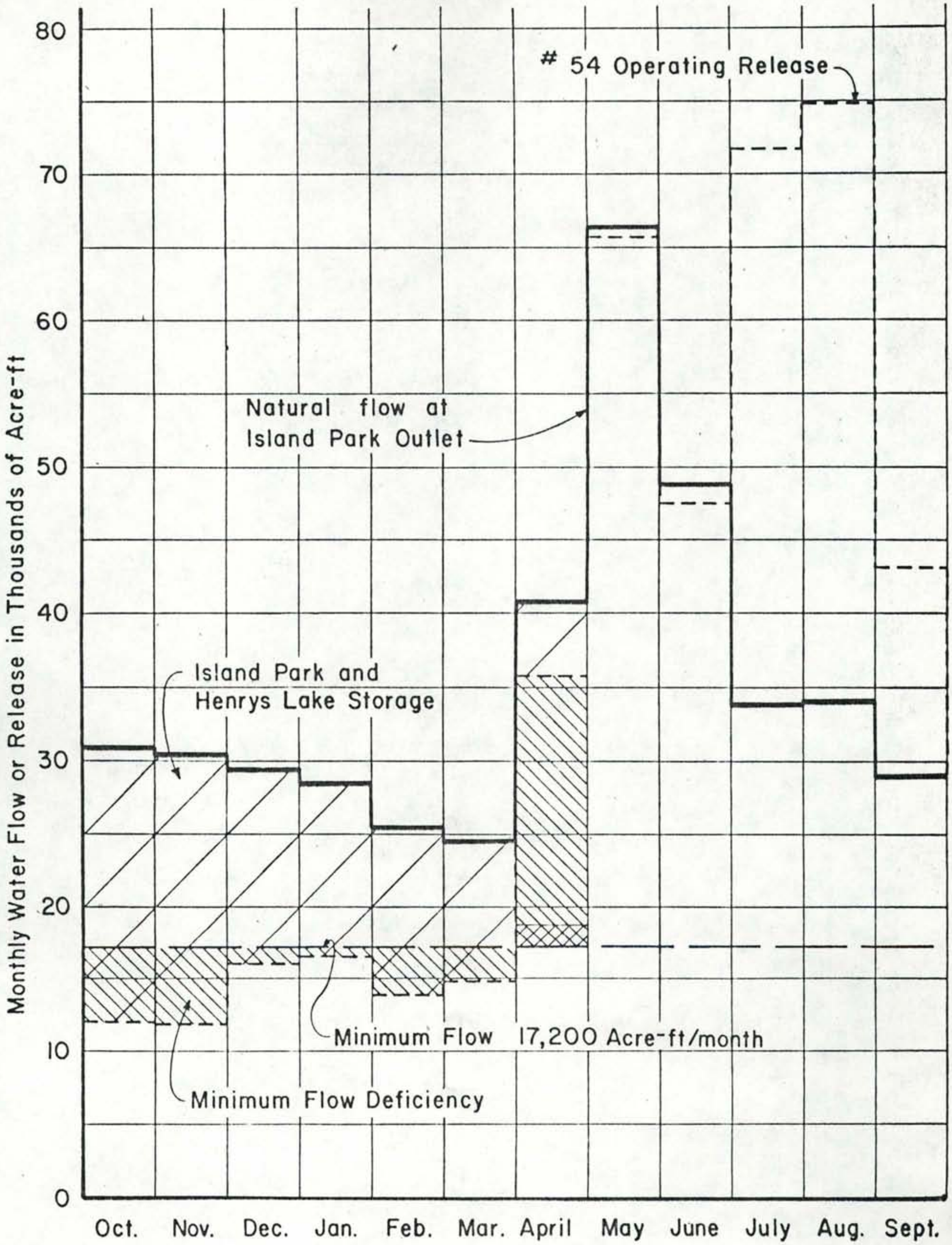

Figure A-2-1. Graphical Study of Storage Water Availability - Main Stem Henrys Fork Snake River - 1951 - Average Year Condition.

MAIN STEM HENRYS FORK SNAKE RIVER WATER AVAILABILITY AND IRRIGATION DEMANDS

1951 AVERAGE YEAR

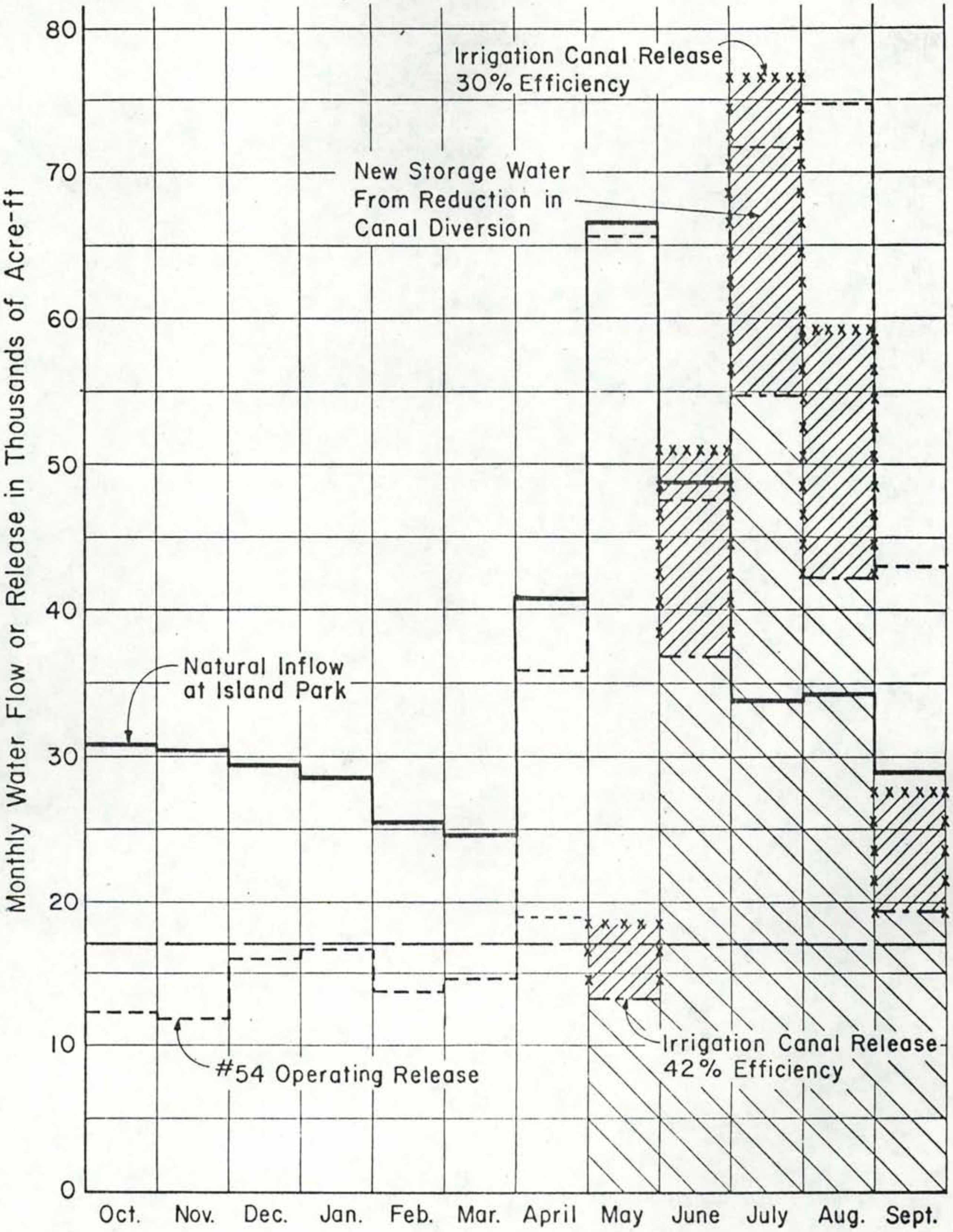

Figure A-2-2. Graphical Study Comparing Water Availability and Irrigation Demands for Main Stem Henrys Fork Snake River - 1951 Average Year Condition.

HENRYS FORK SNAKE RIVER WATER AVAILABILITY

AVERAGE YEAR

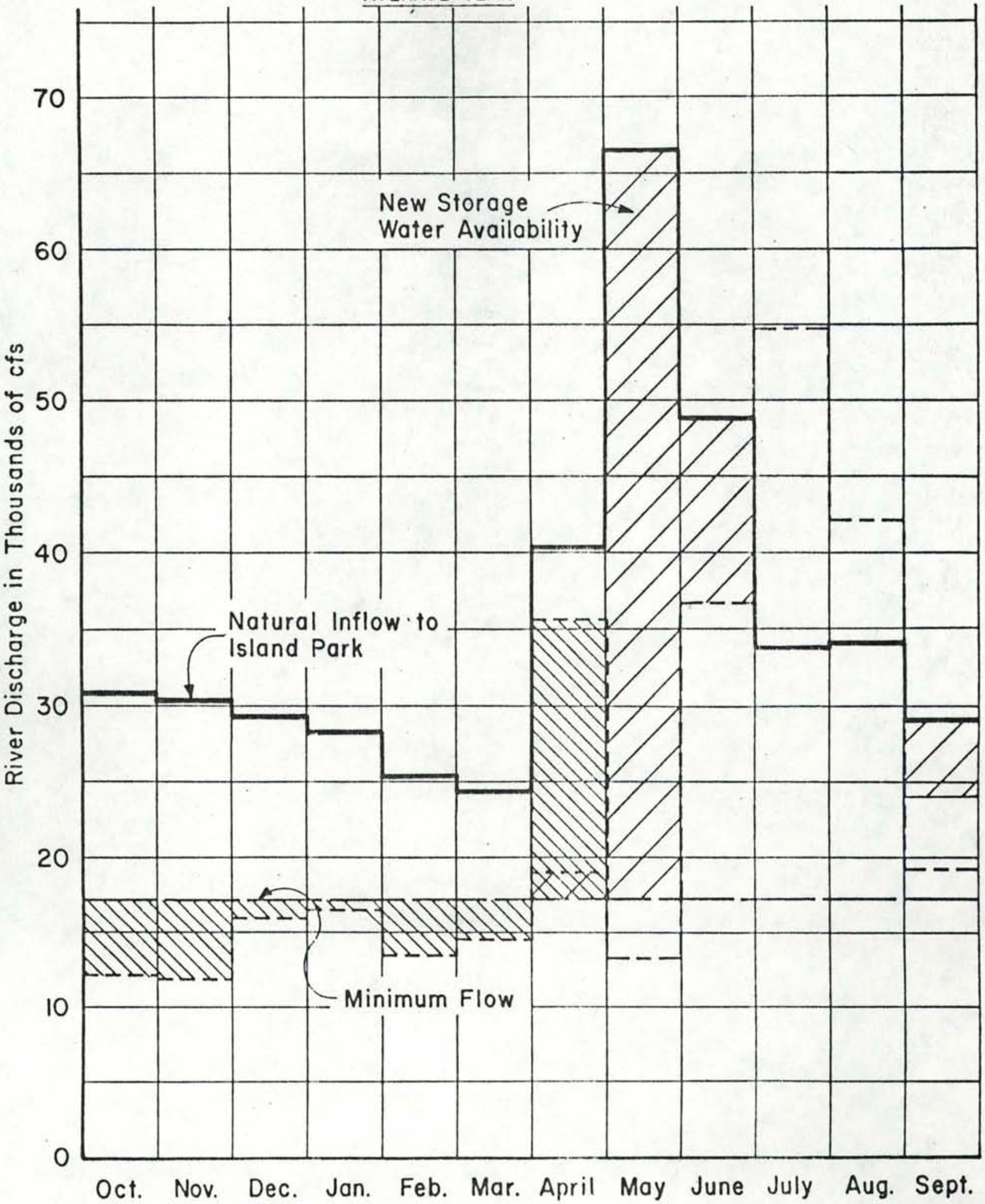

Figure A-2-3. Graphical Study Showing When New Storage Operations Would Occur-Main Stem Henrys Fork Snake River - 1951 Average Year Conditions.

3. PAYETTE RIVER WATER AVAILABILITY ANALYSIS

Assumptions and definition of analysis

This analysis was made to show how water in the Payette River drainage might be made available to offstream reservoirs throughout different years with different stream flows, different irrigation efficiencies, and different demands for irrigation releases. Figure A-3-1 shows schematically the various key gaging stations and reservoir locations. The following assumptions were made:

1. A pattern of irrigation demands and cropping was chosen as similar to that of the Boise Project which has been studied extensively by Warnick and Brockway, 1974.
2. A reported actual 1977 irrigation diversion record was used but missing data on unmeasured months was extrapolated on the basis of average year conditions.
3. A series of irrigation diversion requirements were estimated based on comsumptive use data from Corey and Sutter (1970), and on 1977 reported irrigated acreage. The reported irrigation efficiency of 26% and reported attainable efficiency of 44% were taken from the U.S. Department of Interior 1978 publication.
4. The operational information generated is shown in Tables A-3-1 and Table A-3-2.

Personal Communication from A.C. Robertson presented flow data and acreage data that was collected for the 1977 water year.

PAYETTE AND WEISER RIVER SYSTEMS

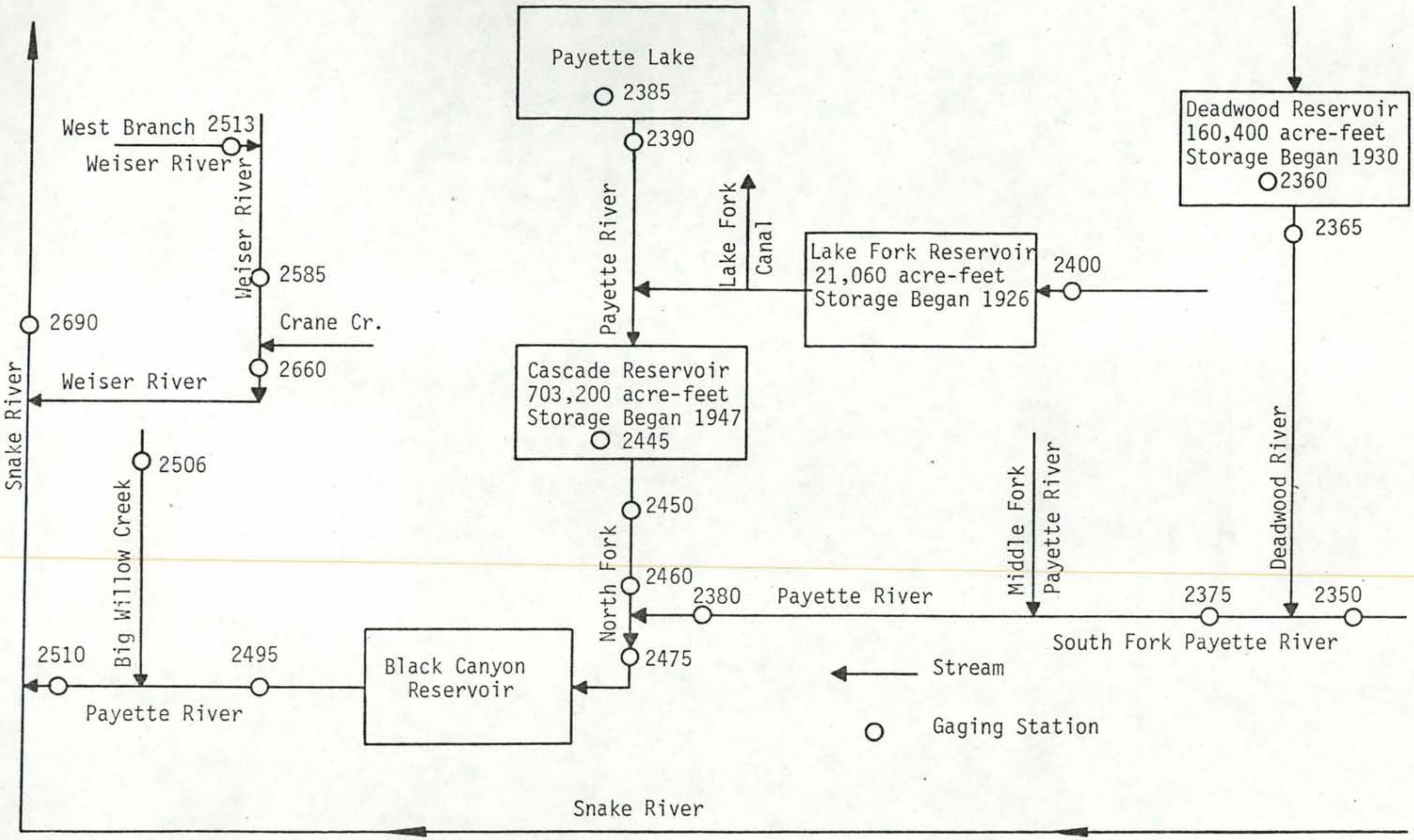

Figure A-3-1. Schematic Diagram of Payette and Weiser River Systems Showing Gaging Stations and Reservoir Locations.

Table A-3-1. Estimated Irrigation Diversion Requirements in the Payette River Below Horseshoe Bend for 44% and 26% System Efficiencies.
(1000's Acre-Feet)

System Efficiency = 44%

Crop	April	May	June	July	Aug.	Sept.	Oct.	Total
Corn	116.4	10396	25058	31691	27386	8534	--	103181
Grain	7203	27816	45159	38233	28592	--	--	147003
Hay	--	31916	57100	72726	60258	33246	11220	266466
Pasture	4821	19394	32193	41558	31473	11858	1884	143181
Potatoes	1197	4678	15785	23722	14144	--	--	59526
Vegetables	1879	5137	7581	1463	--	--	--	16060
Orchard	--	1718	3081	3984	3452	1945	643	14823
	15216	101055	184957	213377	165304	55583	13747	750240

System Efficiency = 26%

Crop	April	May	June	July	Aug.	Sept.	Oct.	Total
Corn	197	17569	42348	53588	45282	14422	--	173376
Grain	12173	47009	76319	64614	48320	--	--	248435
Hay	--	53938	96499	122907	101836	56186	18962	450328
Pasture	8147	32776	55406	70233	53266	20040	3184	242052
Potatoes	2023	7906	2667	40090	23903	--	--	100599
Vegetables	3176	8682	12812	2472	--	--	--	27142
Orchard	--	2903	5207	6733	5834	3287	1087	25051
	25716	170783	314268	360607	278441	93935	23233	1266983

Table A-3-2. Unregulated Flows in Payette River at Horseshoe Bend for Some Representative Wet, Dry, and Average Years. (1000's of Acre-feet)

Year	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Total
1951	99.74	104.92	118.04	110.11	102.18	180.87	469.40	794.53	692.52	241.26	112.85	86.62	3,050,000
1959	68.90	72.48	81.54	76.06	70.58	124.95	324.27	548.87	434.88	166.66	77.96	59.84	2,107,000
1964	71.86	75.54	84.95	79.28	73.56	130.22	337.96	572.06	453.25	173.70	81.25	62.37	2,196,000
1977	36.66	38.56	43.38	40.47	37.55	66.48	172.52	292.02	231.37	88.67	41.48	31.48	1,121,000
1928 to 1977 Average	76.03	79.98	89.98	83.94	77.89	137.88	357.83	605.69	479.90	183.92	86.03	66.03	2,325,100
%*	3.27	3.44	3.87	3.61	3.35	5.93	15.39	26.05	20.64	7.91	3.70	2.84	100.00

* Time distribution percentage of total. Example Flow for March of 1951 = 0.593 x 3,050,000 = 180.87

PAYETTE RIVER WATER AVAILABILITY

DRY YEAR

ACTUAL DIVERSIONS

-- Actual Irrigation Water Diversions = 862,368 acre-feet.

— Unregulated flow = 1,121,000 acre-feet.

Water available for uses other than irrigation below Black Canyon Dam.

Shortage = 513,128 acre-feet.

Water to compensate for shortage.

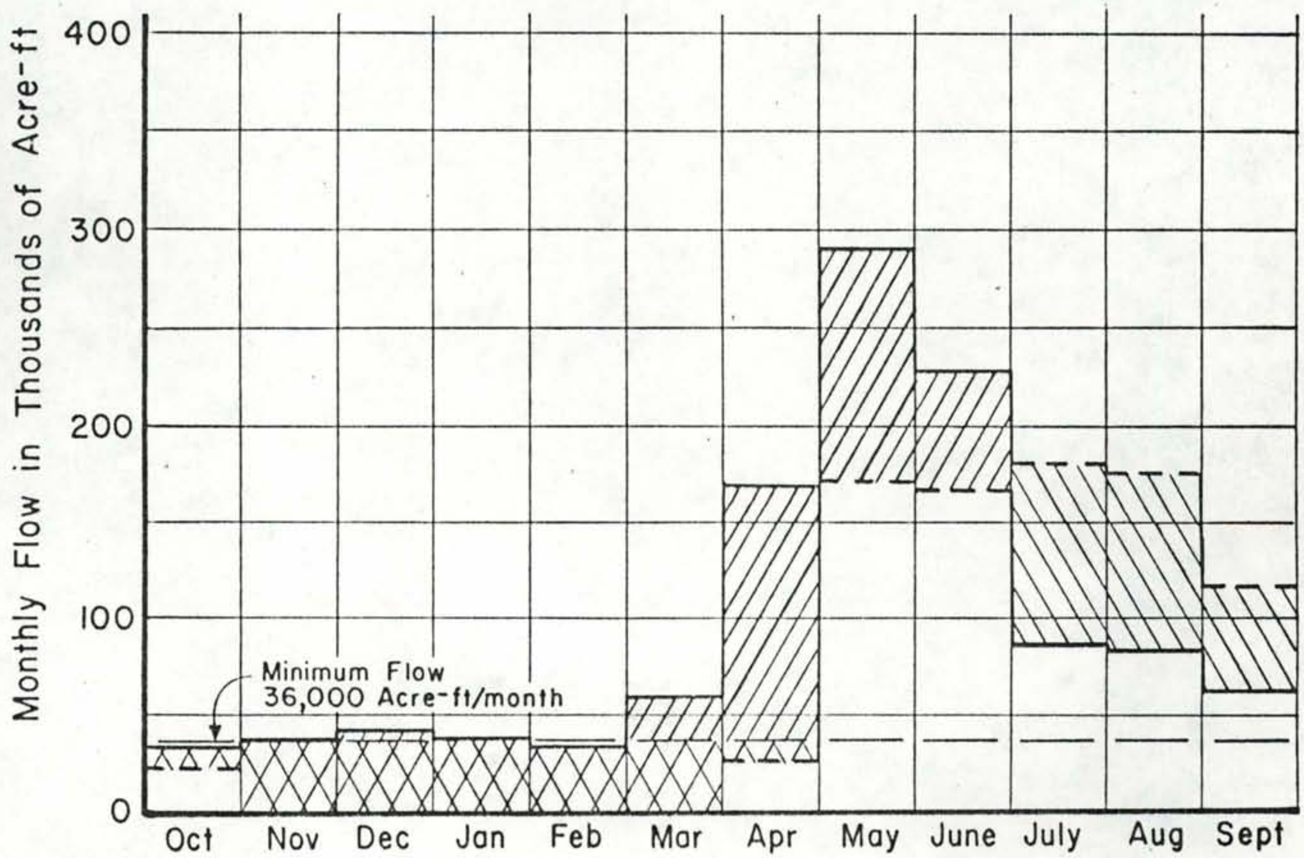

Figure A-3-2. Graphical Presentation of the Availability of Payette River Water at Horseshoe Bend (Dry Year 1977 With Actual Diversions).

PAYETTE RIVER WATER AVAILABILITY

AVERAGE YEAR

44% IRRIGATION EFFICIENCY

-- Water diversions needed for system efficiency of 44%.

— Unregulated flow = 2,196,000 acre-feet.

Water available for uses other than irrigation either above or below Black Canyon Dam = 1,210,630 acre-feet.

Water available for uses other than irrigation below Black Canyon Dam 223,030 acre-feet.

Shortage.

Water to compensate for shortage.

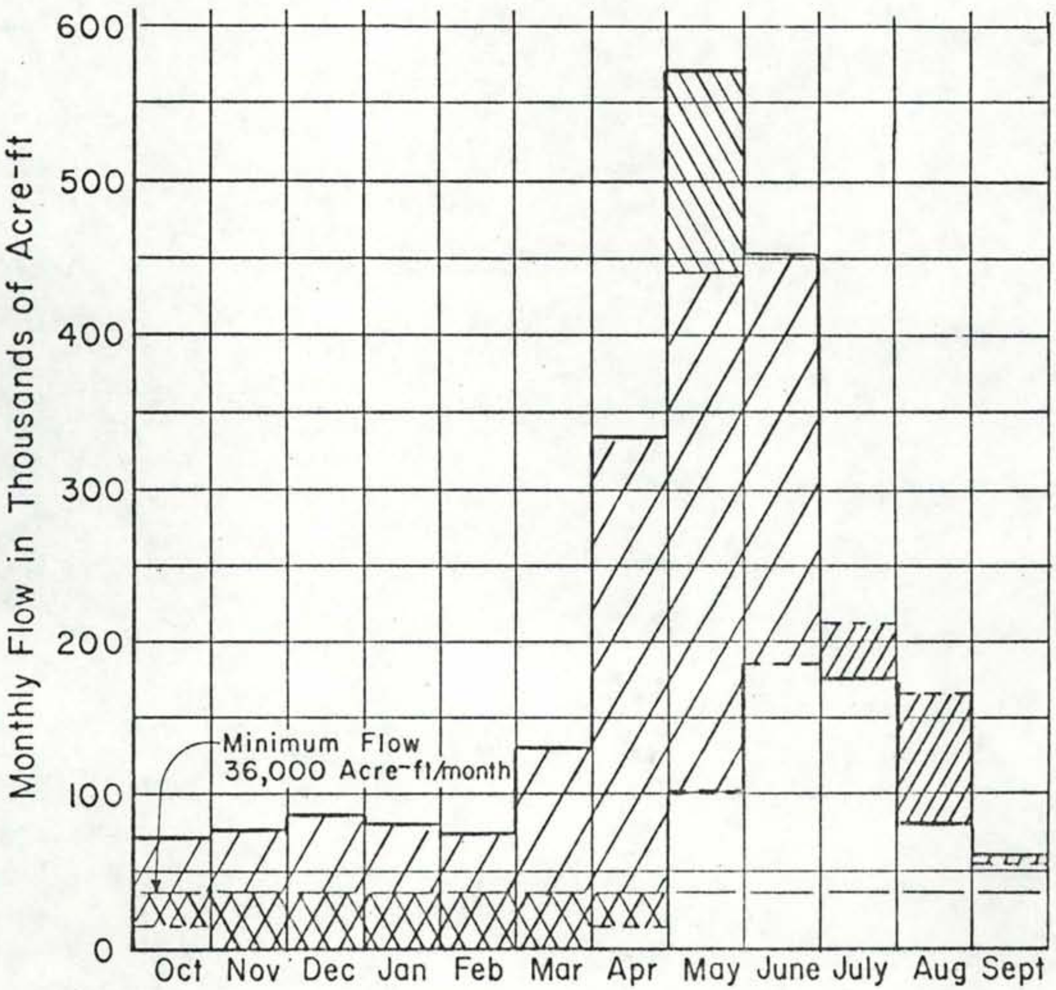

Figure A-3-3. Graphical Presentation of the Availability of Payette River Water at Horseshoe Bend (1964 Average Year with 44% Irrigation Efficiency).

PAYETTE RIVER WATER AVAILABILITY

DRY YEAR

44% IRRIGATION EFFICIENCY

-- Water needed for system efficiency of 44%.

— Unregulated flow = 1,121,000 acre-ft.

Water available for uses other than irrigation either above or below Black Canyon Dam

Water available for uses other than irrigation below Black Canyon Dam.

Shortage.

Water to compensate for shortage.

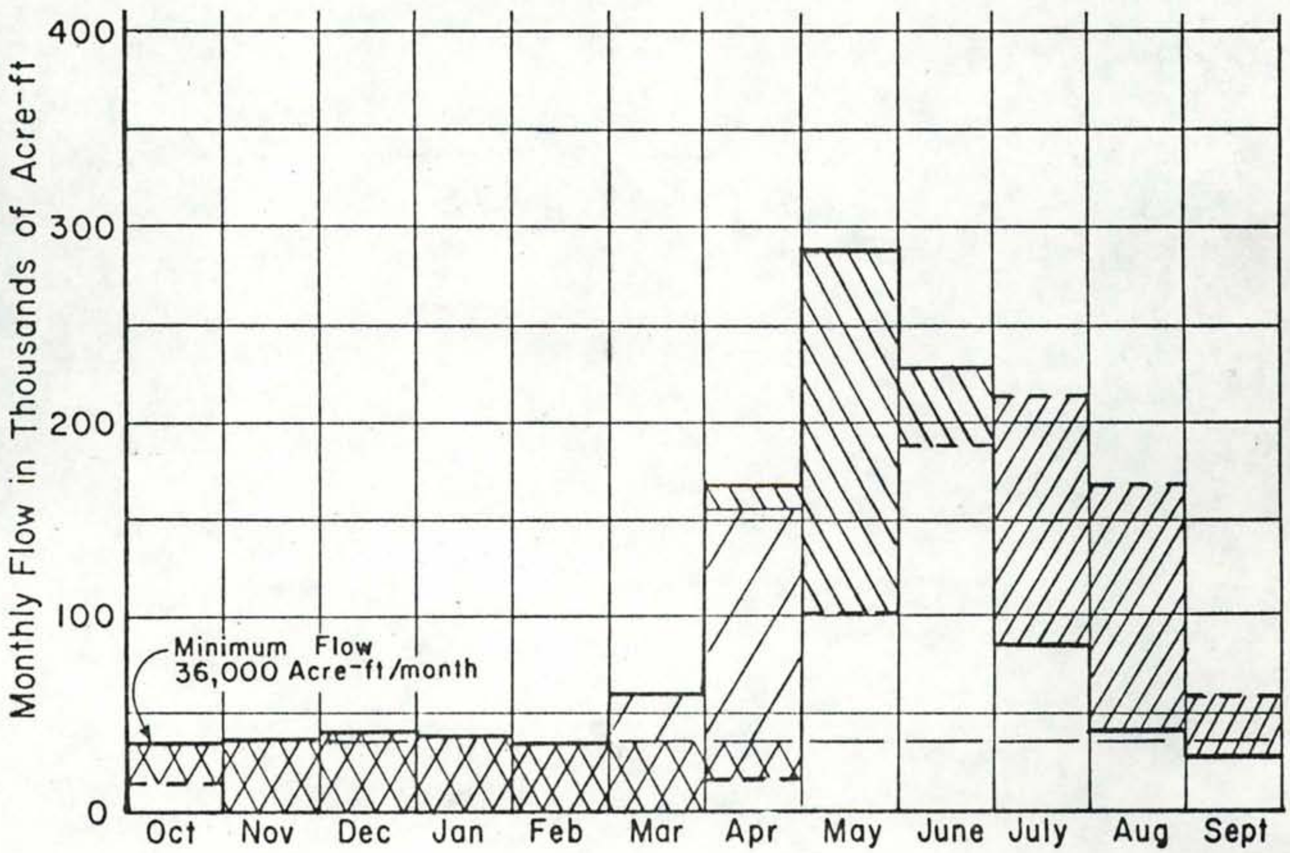

Figure A-3-4. Graphical Presentation of the Availability of Payette River Water at Horseshoe Bend (Dry Year 1977 with 44% Irrigation Efficiency).

PAYETTE RIVER WATER AVAILABILITY - AVERAGE YEAR - 26% IRRIGATION EFFICIENCY

- - - Water diversions needed for system efficiency of 26%.

—— Unregulated flow = 2,107,000 acre-feet.

Water available for uses other than irrigation either above or below Black Canyon Dam = 624,000 acre-feet.

Water available for uses other than irrigation below Black Canyon Dam = 204,050 acre-feet.

Shortage.

Water to compensate for shortage.

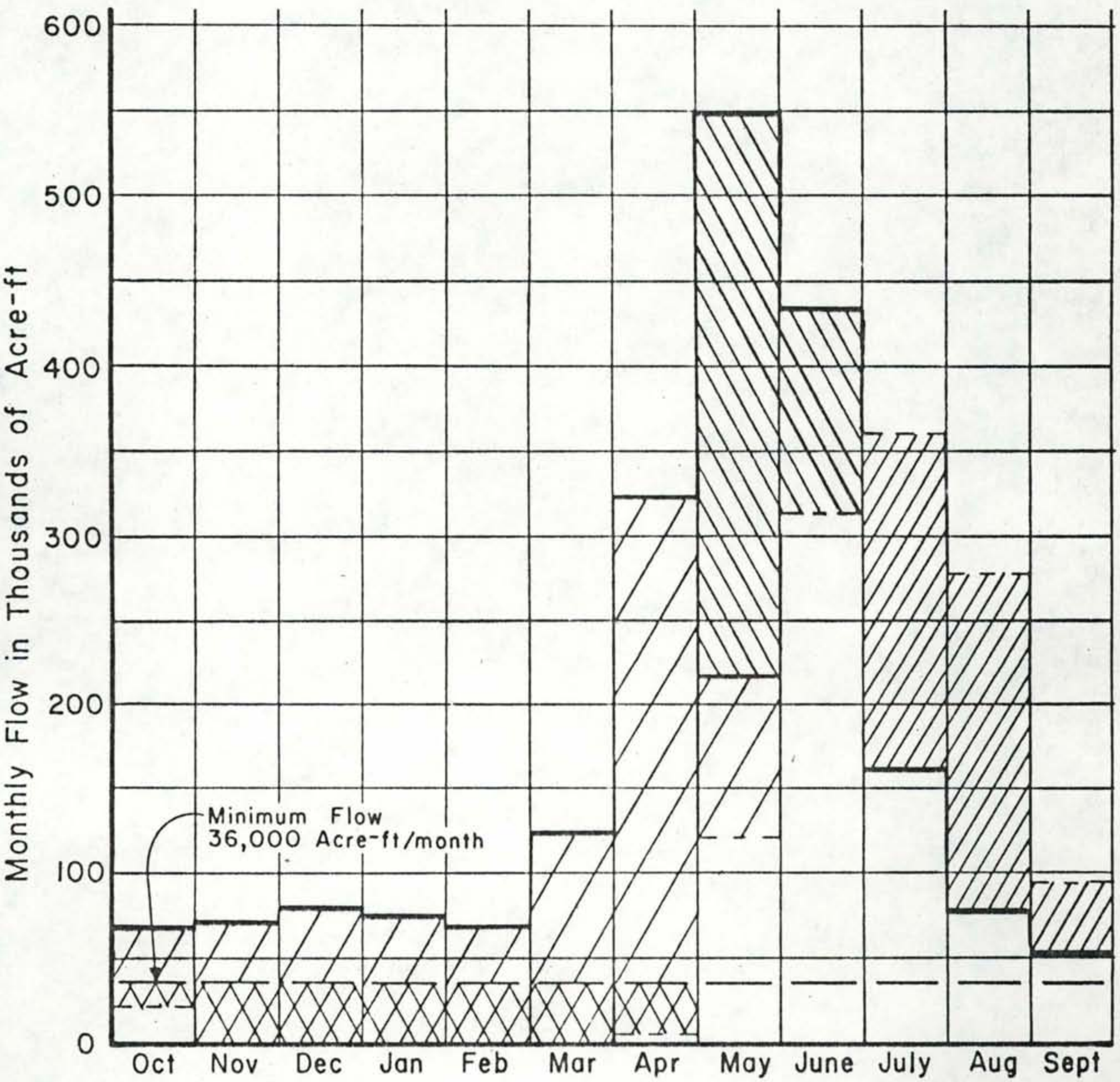

Figure A-3-5. Graphical Presentation of the Availability of Payette River Water at Horseshoe Bend (1959 Average Year with 26% irrigation efficiency).

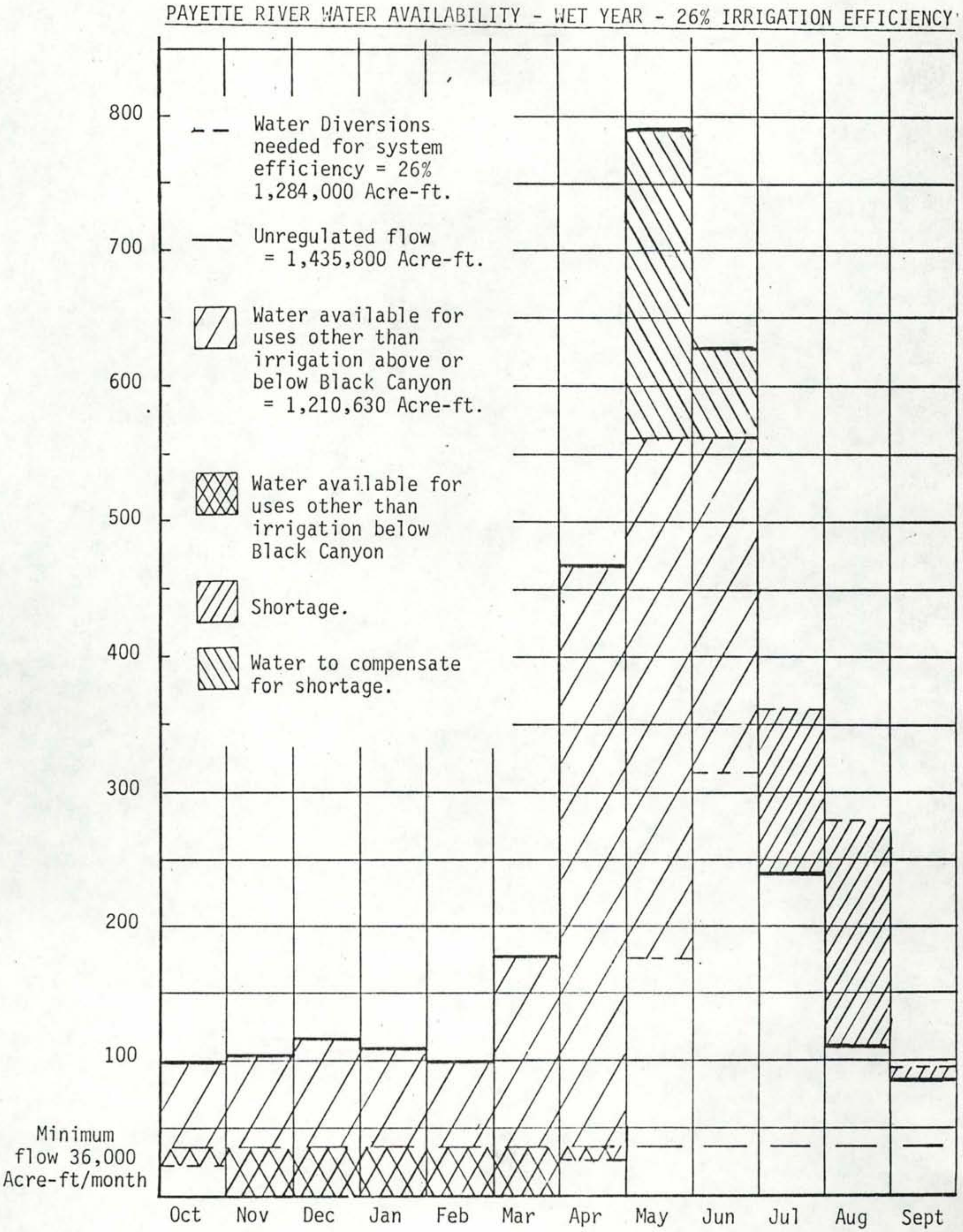

Figure A-3-6. Graphical Presentation of the Availability of Payette River Water at Horseshoe Bend (Wet Year 1951 with 26% Irrigation Efficiency).

PAYETTE RIVER WATER AVAILABILITY - WET YEAR - 44% IRRIGATION EFFICIENCY

- - - Water diversions needed for system efficiency of 44% = 750,240 acre-feet.

——— Unregulated flow = 3,050,000 acre-feet.

Water available for uses other than irrigation either above or below Black Canyon Dam = 2,016,680 acre-feet.

Water available for uses other than irrigation below Black Canyon Dam = 223,030 acre-feet.

Shortage.

Water to compensate for shortage.

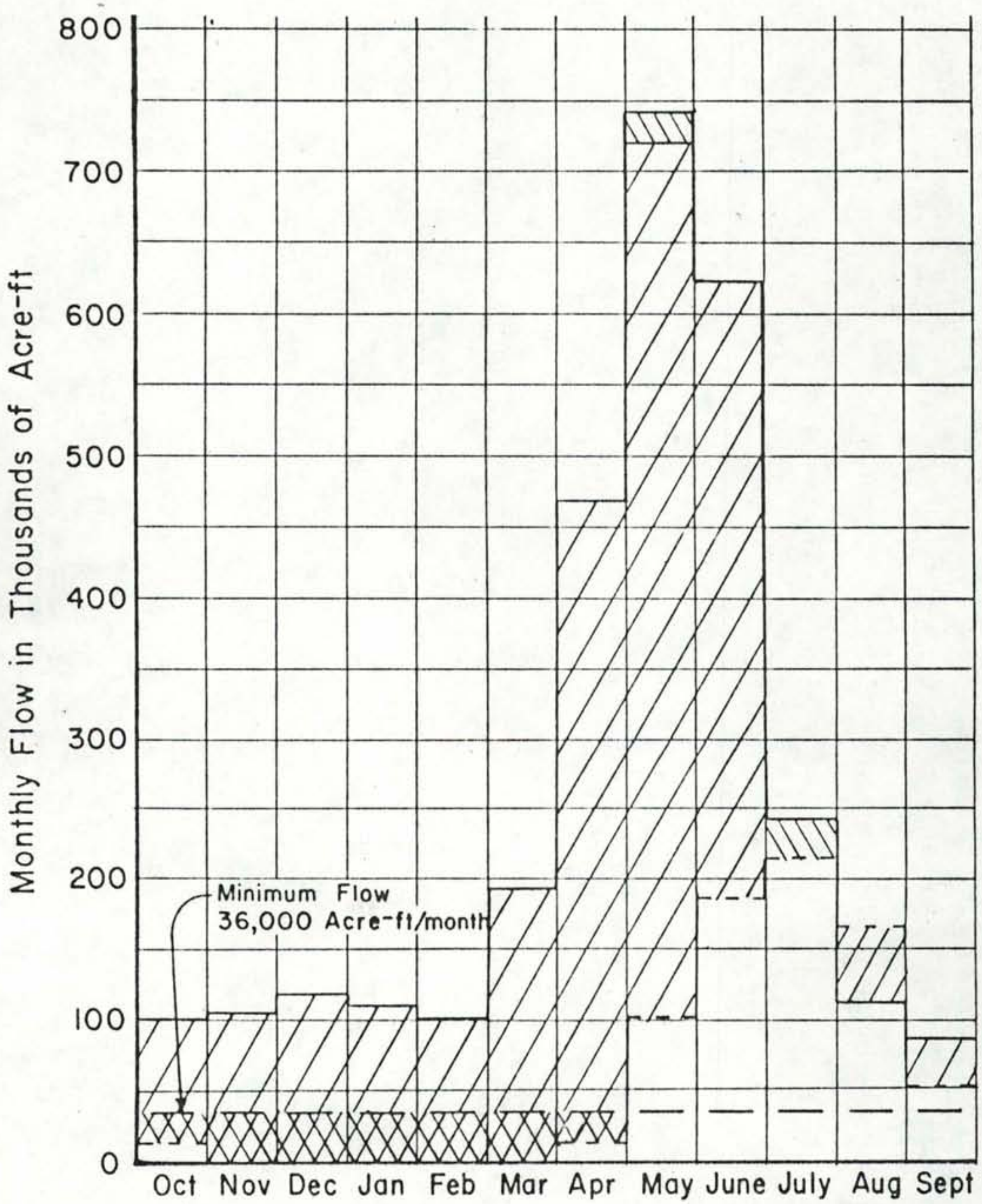

Figure A-3-7. Graphical Presentation of the Availability of Payette River Water at Horseshoe Bend (Wet Year 1951 with 44% Irrigation Efficiency).

4. WATER AVAILABILITY ANALYSIS OF TWIN FALLS CANAL POWER DEVELOPMENT

Assumptions and definition of analysis.

The basic premise was stated that the full capacity of the Twin Falls main canal could be used to convey water to a new power plant at a point where the main canal comes to the canyon rim and a hydraulic head might be developed for hydropower. The following assumptions were made:

1. All flows past Milner Dam on the Snake River would be routed to pass through the Twin Falls Canal.
2. The channel capacity would be limited to the present 4000 cfs and it would be maintained at full discharge at all times and serve both irrigation and power releases.
3. The irrigation relations were the historical releases for the year studied.
4. The water flow that was deficient in availability to keep the Twin Falls Canal full as shown in the year studied would be furnished by new offstream storage and improvement in irrigation efficiency by decreasing farm diversion requirements.

The following computational table shows details as to how the water availability was computed and the way energy output was computed. Figure A-4-1 shows how much so called new storage water would be needed in an average year.

Table A-4-1 Computational Table for the Water Supply and Power Development Analysis at the Twin Falls Canal Power Site below Milner Dam

Item Description			Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
1974-75 Milner Releases	AF	1	12,300	218,000	218,700	635,400	550,600	649,000	993,700	196,500	215,000	20,300	20,300	29,500
	cfs	2	200	3,663	3,557	10,334	9,914	10,554	16,699	3,196	3,613	330	330	496
Storage Water Needed or Spill (3=9-1)	AF	3	131,100	+12,700	-9,500	-395,800	+310,600	+409,000	+794,300	+153,800	+160,200	+19,000	+13,100	-32,700
1934-35 Milner Release	AF	4	12,300	17,900	24,600	30,900	27,800	18,400	8,900	4,300	600	600	600	600
	cfs	5	200	300	400	503	500	300	150	70	10	10	10	10
		6												
1947-48 Milner Releases	AF	7	12,300	159,800	203,200	63,800	44,100	539,900	214,800	276,500	1,800	20,300	10,500	11,900
	CF	8	200	478	3,354	1,208	4,580	6,374	4,606	1,819	3,242	330	170	200
Canal Capacity Full Flow	AF	9	240,000	240,000	240,000	240,000	240,000	240,000	240,000	240,000	240,000	240,000	240,000	240,000
		10												
1963-64 Milner Releases (Average Year)	AF	11	12,300	48,400	224,800	60,700	127,000	343,500	350,500	194,900	126,600	20,300	20,300	11,900
Storage Need (M=9-11) Total 231,400	AF	12	-165,300	-161,500	-5,200	-179,300	-109,100	+133,300	+249,100	+17,400	+62,700	-23,200	-30,700	-19,600
1935 Milner Releases (Min. Year)	AF	13	12,300	17,900	24,600	30,700	32,300	18,400	8,900	4,300	600	600	600	600
Storage Need (14=9-13) Total - 1,485,700	AF	14	165,200	-192,000	-205,400	-209,300	-203,800	-191,800	-902,500	-58,200	-63,300	-42,900	-50,400	-30,900
		15												
		16												
1948 Twin Falls Canal Diversions	AF	17	96,600	34,700	11,800	400	0	0	40,600	197,300	185,200	238,700	232,800	177,800
Available T.F. Canal Capacity (18=9-17)	AF	18	143,400	205,300	228,200	239,600	240,000	240,000	199,400	42,700	54,800	-1,300	7,200	62,200
$AF/60 = \overline{Q}_n = 18/60 = 19\ \overline{Q}_n$	cfs	19	2,390	3,422	3,803	3,993	4,000	4,000	3,233	712	913	22	120	1,037.
$\overline{P}_m = \overline{Q}_m \times \frac{He\ 0.746}{550} = \overline{Q}_n 31.65\ P_m$	KW	20	76,643	108,306	120,365	126,378	126,600	126,600	102,324	22,535	28,896	696	3,798	32,821
1964 Twin Falls Canal Diversions	AF	21	51,800	37,000	35,100	32,200	28,600	26,400	84,400	202,200	194,600	215,000	222,700	150,200
Available T.F. Canal Capacity 22=9-21	AF	22	188,200	203,000	204,900	207,800	211,400	213,600	155,600	37,800	45,400	25,000	17,300	89,800
		23												
		24												
		25												
1977 Twin Falls Canal Diversions	AF	26	62,500	30,100	10,000	0	3,900	29,800	13,800	177,500	176,100	196,500	189,000	108,500
Available T.F. Canal Capacity (27=9-26)	AF	27	177,500	209,900	230,000	240,000	236,100	210,200	101,400	62,500	63,900	43,500	51,000	31,500
$AF/60$ = Flow through turbine $\overline{Q}_m$	cfs	28	2,958	3,498	3,833	4,000	3,935	3,503	1,690	1,041	1,062	725	850	525
$\overline{P}_m = 31.65\ \overline{Q}_m$ = Power	KW	29	93,621	110,712	121,314	126,600	124,542	110,870	53,489	32,948	33,612	22,946	26,903	16,616
Energy $= \overline{E} = \overline{P}_m t_{hrs}$ Total= 636,271	MWH	30	69,654	79,713	90,258	94,190	83,692	82,488	38,512	24,513	24,201	17,072	20,016	11,964
		31												
		32												
Q'_m = Storage water used in Average Year	cfs		2,755	2,692		2,988	1,818					387	512	327
P'_m = Power produced w/storage water	KW	34	87,196	85,202		94,570	57,540					12,249	16,205	10,350
$E_m = P'_m t$, Total= 254,154	MWH	35	64,874	61,345		70,360	38,667					9,113	12,057	7,452

$\overline{Q}_m$ = Average Monthly Discharge through Turbines - CFS
$\overline{P}_m$ = Average Monthly Power Output KW
E_m = Average Monthly Energy Output KWH
AF = Acre-feet

5. OFFSTREAM RESERVOIR COSTS ANALYSIS

Assumptions and definition of analysis

This analysis has utilized a group of published cost curves to give preliminary information as to the economic viability of the various offstream reservoir sites studied. The curves shown in this appendix were for different time periods and information taken from them has been updated to July 1980 costs. The following assumptions were made:

1. The dam, embankment, spillway, outlet works, and known hydroelectric plants sizes were the unique costs and an accounting for these would give a suitable cost value to make related costs comparisons.
2. A sample calculation of costs is presented as Table A-5-1. In order to accomplish this it was necessary to make an estimate of divertable water. Figure A-5-5 presents a graphical representation of the estimate of diversion capacity for the Monday Gulch Offstream Reservoir Site and how the water would be obtained.

Table A-5-1. Computational Table for Monday Gulch Cost Study.

MONDAY GULCH

Site No. 12

Cost Estimates (1)

Embankment (2)

Dam Height = 131 ft (125 ft + 6-ft freeboard)

Crest Length = 800 ft Shape Factor (K_s) = 1.00

Total Cost = $[30 + 2/3(131)(2.5)]\ \frac{131 \times 800}{54}\ (K_s)\ (\$/cy) =$

$= \underline{480{,}000\ cy} \times 1.00 \times 6.96\ \$/cy \times 0.90^{(3)} \times 2.52/2.11^{(4)} =$

= $3,600,000.00 — $3,600,000.00

Spillway (5)

Estimated capacity = 1000 cfs

Spillway Head = 125 ft

$125\sqrt{1000} = 3953$ which gives (curve): $410,000 x 3.02/1.04 (4) =

= $1,190,000.00 — $1,190,000.00

Outlet Works (6)

Design Capacity (3 month release) = $\frac{40{,}400\ \text{acre-feet}}{3\ \text{month}\ (60\ \text{acre-feet/cfs-month})} = 223\ \text{cfs}$

$125\sqrt{223} = 1867$ which gives (curve): $470,000 x 3.11/1.03 (4)

= $1,420,000.00 — $1,420,000.00

Canal (7)

Estimated Capacity = 200 cfs

Length = 11 miles

Cost = $160/ft x 0.90 (3) x 2.78/2.27 (4) = $176.35/ft

or $176.35/ft x 5280 ft/mile x 11 miles = $10,000,000.00

Total Capital Cost	$16,210,000.00
Annual Cost (8)	$ 1,287,000.00
Cost per acre-foot of Storage capacity (40,400 acre-feet)	$ 31.86

(1) July 1980 Price Level.

(2) Figures.

(3) Geographic Cost Adjustment Factor for Idaho.

(4) Cost Indexes.

(5) Figure A-5-2.

(6) Figure A-5-3.

(7) Figure A-5-4.

(8) 7 3/4% interest, 50-year life.

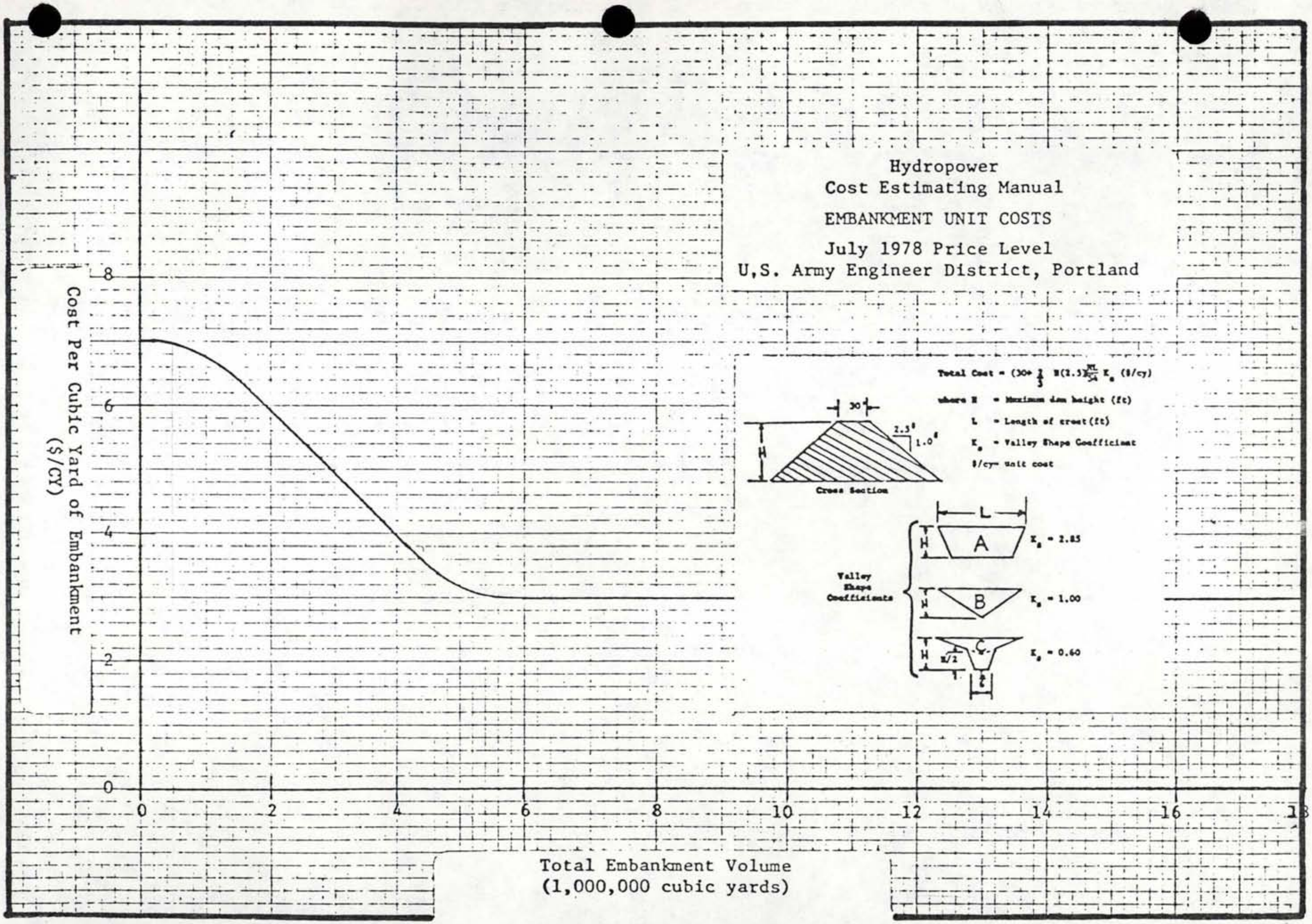

Figure A-5-1. Embankment Cost Estimating Curve. Source: Hydropower Cost Estimating Manual, U.S. Army Corps of Engineers, 1979.

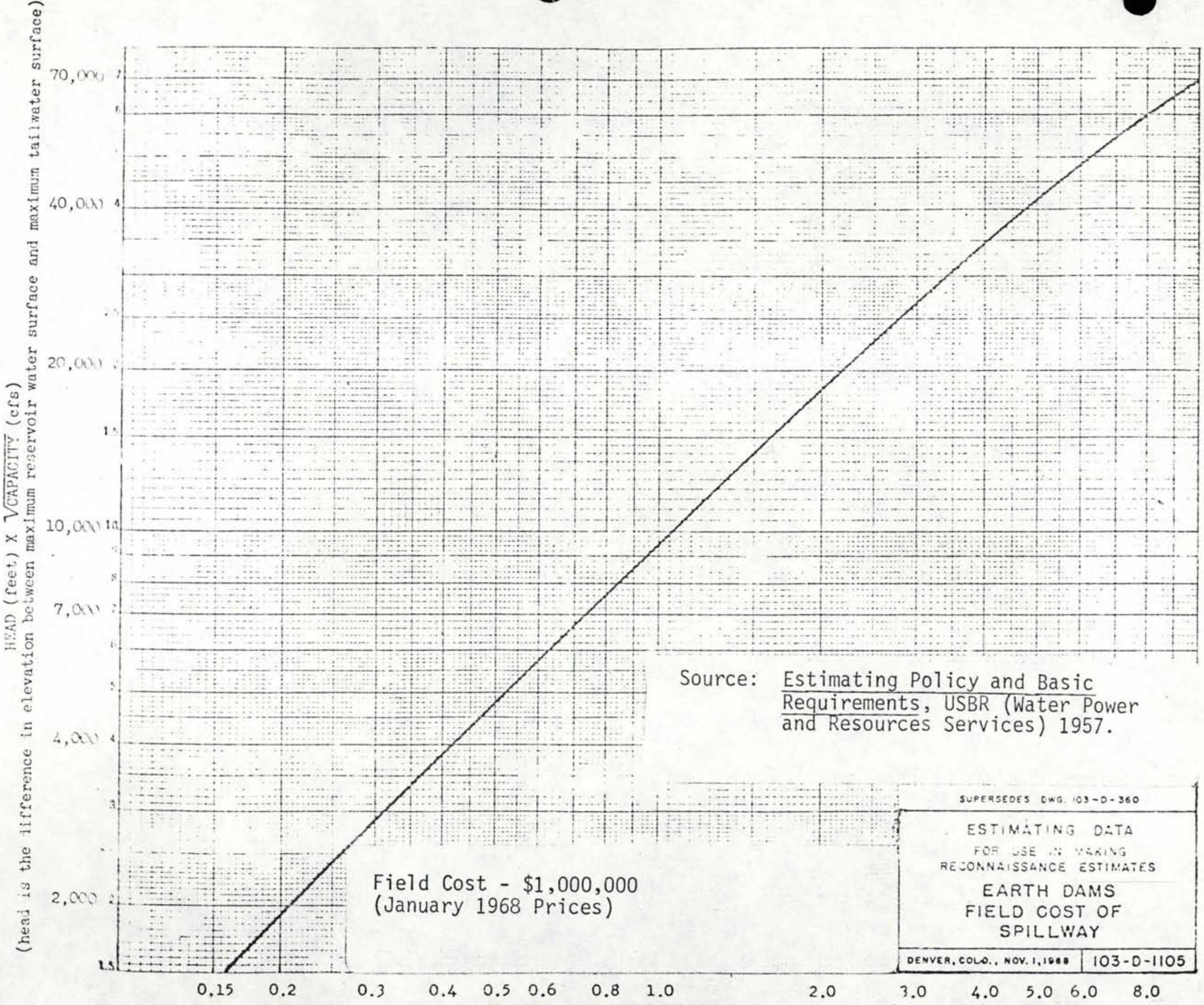

Figure A-5-2. Spillway Cost Estimating Curve.

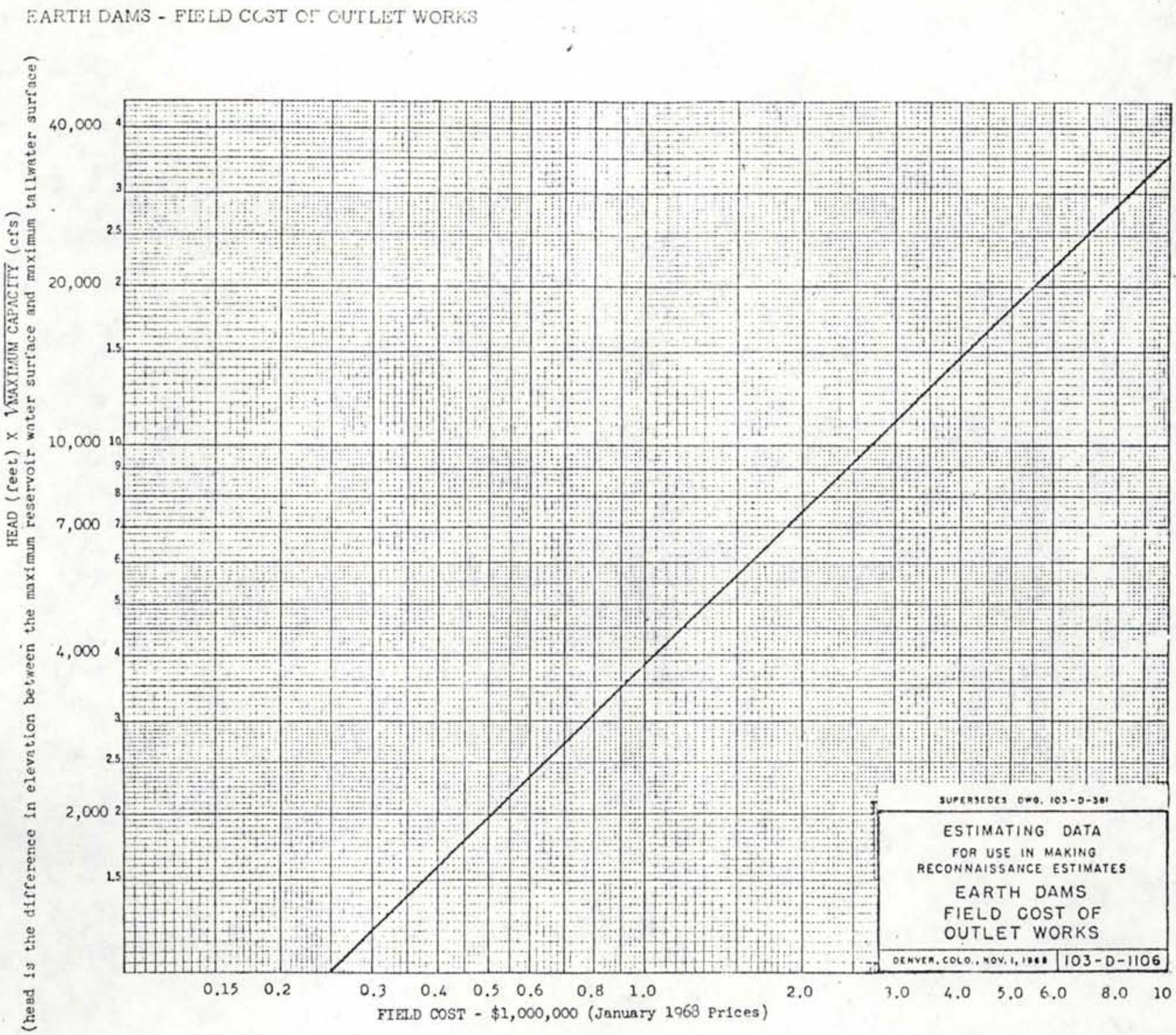

Figure A-5-3. Outlet Works Cost Estimating Curve.

Source: Estimating Policy and Basic Requirements, USBR (Water Power and Resources Services) 1957.

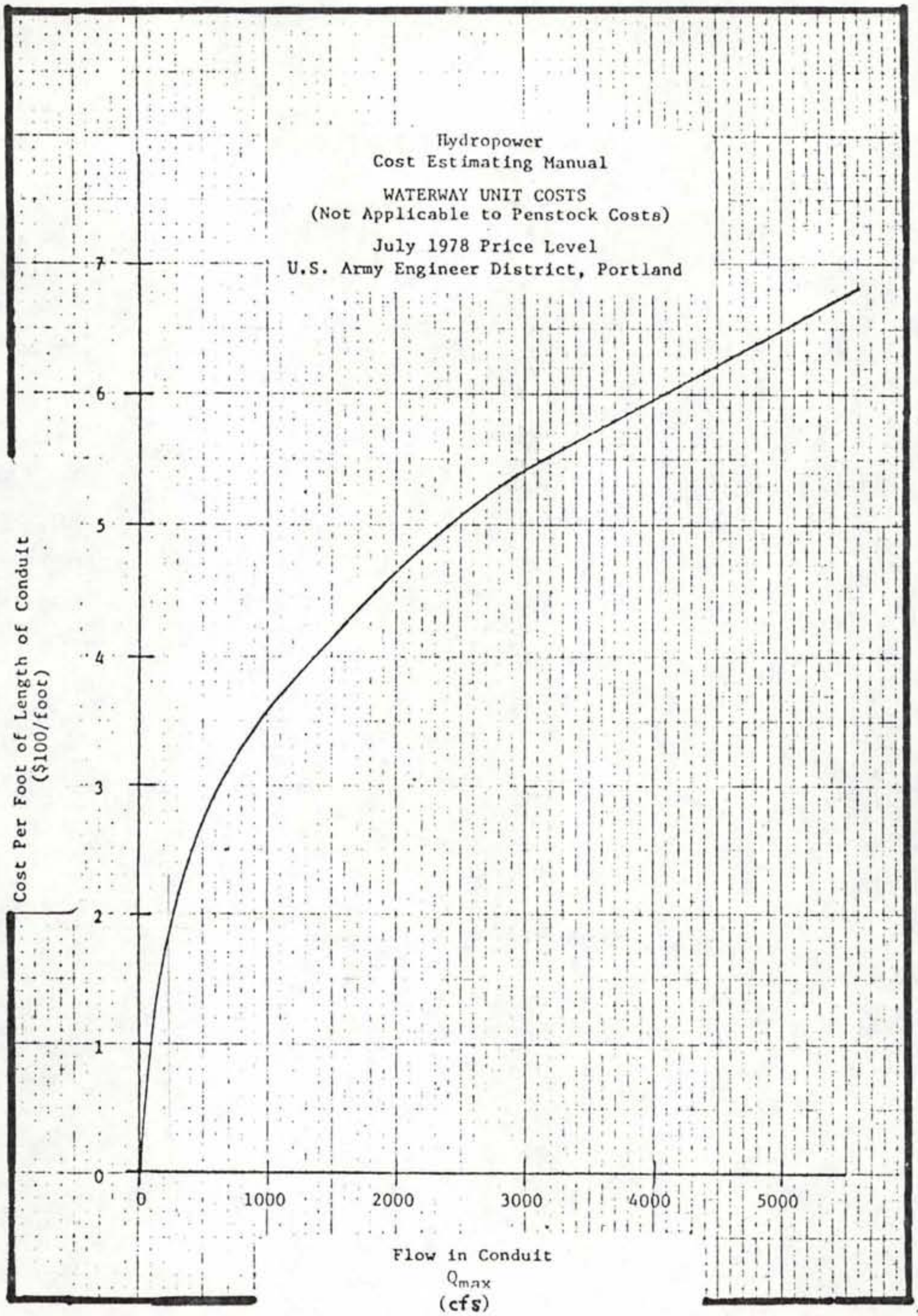

Figure A-5-4. Waterway Cost Estimating Curve.

Source: Hydropower Cost Estimating Manual, U.S. Army Corps of Engineers.

LITTLE WEISER RIVER WATER AVAILABILITY

AVERAGE YEAR

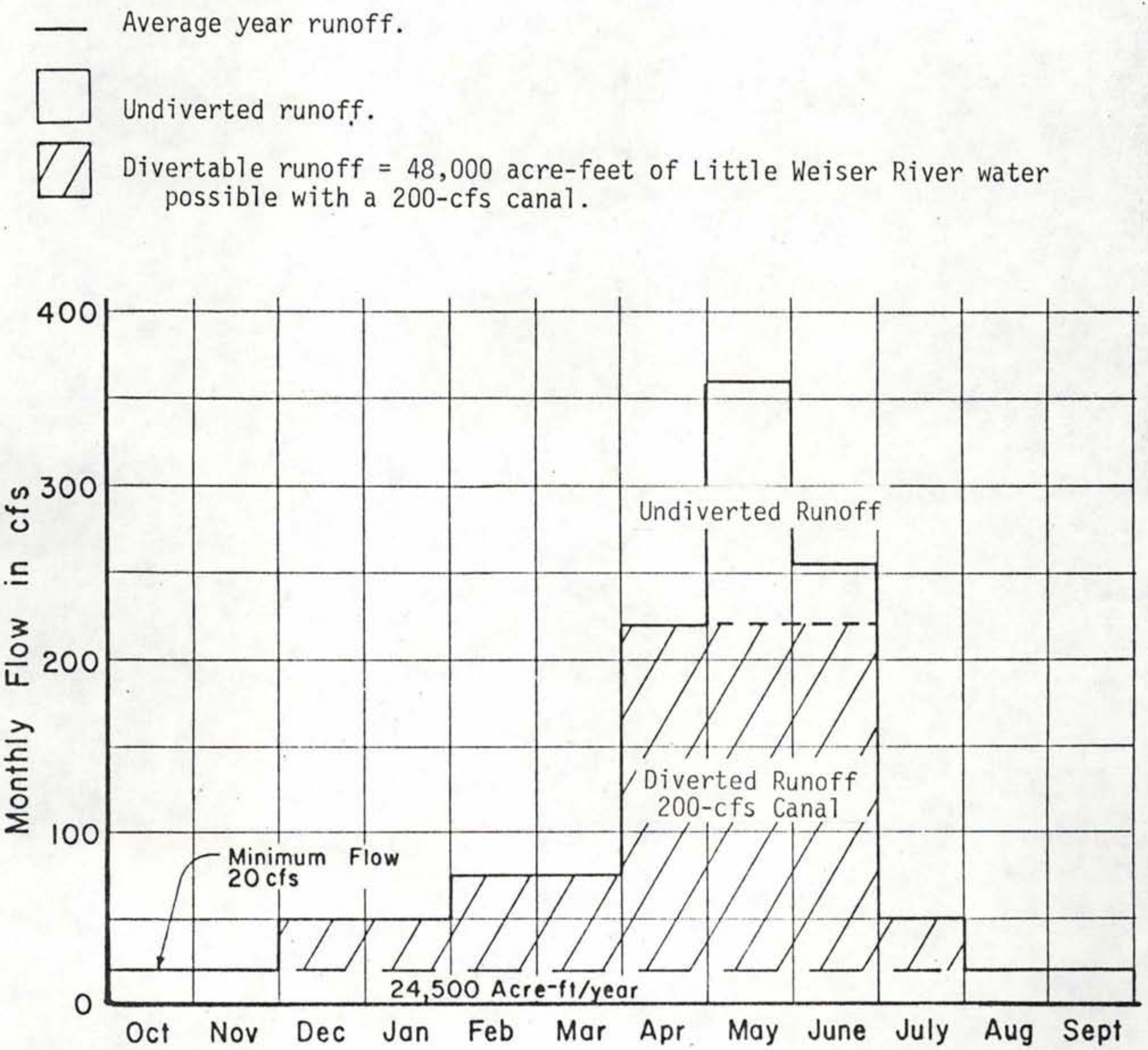

Figure A-5-5. Water Availability for Diversion From the Little Weiser River to the Monday Gulch Offstream Reservoir Site (Average Year).

6. WATER AVAILABIITY ANALYSIS FOR COYOTE BUTTE OFFSTREAM RESERVOIR

Assumptions and definition of analysis

This analysis was made to show how in an average year the water for storage in an offstream reservoir at the Coyote Butte Site might be made available. The following assumptions were made:

1. That the diversions for water to be stored in Coyote Butte Reservoir would come from the Boise River at Diversion Dam and be carried in existing canals and pumped from Mora Canal to the reservoir site.
2. The water flows would be those in excess of present irrigation requirements.
3. Storage regulation at Lucky Peak Reservoir and other Boise River reservoirs would provide flexibility to be able to capture most of the flood flow in the Boise River.
4. Tables A-6-1 and A-6-2 show how the assessment of flow might be analysed (no true-time operational release study was made.)
5. The Birds of Prey natural area would not be enlarged and cause conflict with developing the required water impoundment.
6. Power releases could be made at times to meet the greatest peaking needs and serve a high-valued load.
7. Water stored in the Coyote Butte Offstream reservoir could be returned to the Mora Canal to meet unexpected irrigation needs.

Table A-6-1. Computational Table Showing Justification of Availability of Water for Coyote Butte Offstream Reservoir (1964 Average Year)

Location or Station		Diversions or Drains (acre-feet)	Net Computational Flow (acre-feet)
BOISE RIVER AT BOISE (Gage=677,300)			(677,330)
Settlers Canal	-	52,500	624,800
Drain No. 3	+	6,200	631,000
Thurman Ditch	-	11,100	619,900
Farmer Union Canal	-	76,000	543,900
Boise Sewer	+	5,400	549,300
New Dry Creek Canal	-	23,900	525,400
Ballentyne Canal	-	6,500	518,900
Eagle Drain	+	21,200	540,100
Middleton Canal	-	48,400	491,700
Thurman Drain	+	6,000	497,700
Little Pioneer Canal	-	11,800	485,900
Phyllis Canal	-	133,200	352,700
Canyon County Canal	-	24,900	327,800
Caldwell Highline Canal	-	21,700	306,100
Five Mile Creek	+	37,400	343,500
North and South Middleton Drain	+	45,900	389,400
Willow Creek	+	7,800	397,200
Mason Drain and Creek	+	45,900	443,100
Riverside Canal	-	82,200	360,900
Hartley Drain	+	25,800	386,700
Sebree Canal	-	97,500	289,200
Campbell Canal	-	9,800	279,400
Siebenberg Canal	-	3,400	276,000(minimum)
Indian Creek	+	75,800	351,800
Eureka No. 2 Canal	-	32,400	319,400
Upper Center Point Canal	-	6,300	313,100
Lower Center Point Canal	-	8,700	304,400
BOISE RIVER AT NOTUS (Gage=726,800)			(726,800)

The calculated available water at Diversion Dam using Siebenberg flow while leaving a 150-cfs(108,700 acre-feet/year) minimum is 276,000 - 108,700 or 167,300 acre-feet.

The calculated available water of 167,300 acre-feet does not include the additional water available from unaccounted-for returns between Boise and Notus of 726,800 - 304,400 or 422,400 acre-feet.

Table A-6-2. Computational Table Showing Justification of Availability of Water for Coyote Butte Offstream Reservoir (1952 Wet Year)

Location or Station		Diversions or Drains (acre-feet)	Net Computational Flow (acre-feet)
BOISE RIVER AT BOISE (Gage=1,764,000)			(1,764,000)
Settlers Canal	-	54,600	1,709,400
Drain No. 3	+	7,000	1,716,400
Thurman Ditch	-	10,000	1,706,300
Farmer Union Canal	-	71,400	1,634,900
Boise Sewer	+	4,600	1,639,500
New Dry Creek Canal	-	21,900	1,617,600
Ballentyne Canal	-	5,400	1,612,200
Eagle Drain	+	19,300	1,631,500
Middleton Canal	-	53,800	1,577,700
Thurman Drain	+	8,900	1,586,600
Little Pioneer Canal	-	12,200	1,574,400
Phyllis Canal	-	129,400	1,445,000
Canyon County Canal	-	25,600	1,419,400
Caldwell Highline Canal	-	14,100	1,405,300
Five Mile Creek	+	36,100	1,441,400
North and South Middleton Drain	+	46,100	1,487,500
Willow Creek	+	12,400	1,499,900
Mason Drain and Creek	+	50,500	1,550,400
Riverside Canal	-	96,900	1,453,500
Hartley Drain	+	24,300	1,477,800
Sebree Canal	-	113,300	1,364,500
Campbell Canal	-	6,600	1,357,900
Siebenberg Canal	-	3,400	1,354,500 (minimum)
Indian Creek	+	73,700	1,428,200
Eureka No. 2 Canal	-	26,900	1,401,300
Upper Center Point Canal	-	6,300	1,395,000
Lower Center Point Canal	-	6,200	1,388,800
BOISE RIVER AT NOTUS (Gage=1,832,800)			(1,832,800)

The calculated available water at Diversion Dam using Siebenberg flow while leaving a 150-cfs(108,700 acre-feet/year) minimum is 1,354,500-108,700 or 1,245,800 acre-feet.

The calculated available water of 1,245,800 acre-feet does not include the additional water available from unaccounted-for returns between Boise and Notus of 1,832,800-1,388,800 or 440,000 acre-feet.

7. OFFSTREAM RESERVOIR SITE SUMMARY AND RANKING

Table A-7-1 which follows is a subjective tabulation of all offstream reservoir sites studied under both Phase I and Phase II of this contract research. The number, name, and maximum storage is reported for each site. A rating in the form of an acceptability classification was made of the availability of water, the economic viability, and the freedom from adverse impact resulting from impoundments and construction features of the water resource development.

Guidelines for rating the availability of water

The availability of water rating was somewhat subjectively but based on studies made during the progress of the research. The guidelines are:

1. Evidence of flow magnitudes in source streams that will permit filling the reservoirs when average year conditions prevail.
2. Evidence that water diversions for storage will not disrupt present water uses.
3. Evidence that dry years will still provide some storage water and have beneficial releases for new or future uses.

An entry of A was made in the table if all three criteria appear to be adequately met. An entry of B was made if only two criteria were met. An entry of C was made if all three criteria were not adequately met.

Guidelines for making rating for economic viability

The economic viability rating does not imply that an economic analysis was done on each site but that subjective appraisals were made, knowing that costs would be greater or less on given sites than those on which preliminary economic analysis were made. The guidelines are:

1. Evidence that the annual cost of dam, spillway and outlet works would be less than $30/acre-foot of storage.

   Evidence that water use benefits would include several purposes and be nearly equal to the dam, spillway and outlet works annual costs.

3. Evidence that the conveyance costs would not be unreasonable with respect to the dam, spillway, and outlet works costs.

An entry of A was made in the table if all three criteria were adequately met. An entry of B was made if only two criteria were met and one of them appears to be relatively adverse. An entry of C was made if only one of the criteria was met and there was a very strong adverse economic cost apparent in either of the three categories.

Guideline for rating the impoundment impacts.

The impoundment impact evaluation indicates a subjective appraisal of those considerations which might influence acceptability such as displacement of habitation and utilities, disruption of highly developed agricultural activity, and serious environmental degradation or obvious institutional or legal problems. The guidelines are:

1. Evidence that minimal displacement of habitation, utilities and commercial developments would result.
2. Evidence that very little highly developed agriculture would be displaced.
3. Evidence that there would be little environmental degradation, minimal adverse impact on fish and wildlife, minimal impairment of recreational use activities, or adverse impacts on known archeaological and historical sites.
4. Evidence that there is a minimum of institutional or legal problems.

An entry of A was made in the table if three of the four criteria were adequately met. An entry of B was made if two of four criteria were adequately met and no serious negative impacts were obvious. An entry of C was made if only two of the criteria was met and there was evidence of a serious problem in any one of the four criteria.

As a further rating action in the acceptability classification, an unacceptable rating was designated as an X in the space of any entry if it was considered that the site had such negative possibilities due to any one of the rating considerations that it was not worth further investigative time.

Table A-7-1. Offstream Reservoir Site Summary and Acceptability Classification

Site No.	Site Name	Maximum Capacity	Water Availability	Economic Viability	Impoundment Impacts
		Acre-feet	Availability Classification		
1	2	3	4	5	6
		Weiser River Drainage			
1	Cove Creek	78,000	A	C	B
2	Deadman Gulch	400,000	A	B	B
3	Sugarloaf	600,000	A	A	B
4	Granger Butte	375,000	A	A	B
5	Upper Crane Creek	33,500	B	C	C
6	Riley Butte	310,000	A	B	B
7	Big Flat	52,000	B	C	B
8	South Fork Crane Creek	680,000	A	C	B
9	Hog Creek Butte	48,000	B	C	C
10	Lower Sage Creek	69,000	C	B	B
11	Indian Valley	554,000	B	B	X
12	Monday Gulch	40,000	B	B	A
13	Lower Monday Gulch	107,000	C	C	A
14	Rush Creek	42,500	C	C	B
15	Upper Grizzly Creek	22,000	B	C	A
16	Bacon Creek	45,500	B	C	B
17	Johnson Creek	50,000	B	C	A
18	Jackson Creek	23,000	A	C	A
19	Hornet Creek	360,000	C	C	C
20	North Hornet Creek	80,000	C	C	B
21	West Fork Weiser River	94,000	B	C	C
22	Lost Valley Enlargement	Add'l 25,000	B	B	A
23	Price Valley	350,000	B	C	C
		Payette River Drainage			
24	Crystal School	91,000	A	C	B
25	Little Willow Creek	85,000	A	C	C
26	Birding Island	175,000	A	C	C
27	Big Willow Creek	310,000	A	X	C
28	Upper Big Willow	350,000	B	X	B
29	Sand Hollow	145,000	A	C	B
30	Bissel Creek	187,000	A	C	A
31	Haw Creek	33,000	A	C	B
32	Black Canyon Enlargement	Add'l. 180,000	A	B	X
33	Sweet	148,000	A	B	X
34	Squaw Creek (Lower)	550,000	A	A	B
35	Squaw Creek (Upper)	2,600,000	A	A	C

Table A-7-1. Offstream Reservoir Site Summary and Acceptability Classification (cont.)

1	2	3	4	5	6
		Payette River Drainage (Cont.)			
36	High Valley	1,760,000	B	C	C
37	Lower Shafer Creek	34,000	A	X	B
38	Upper Shafer Creek	93,000	A	X	C
39	Dry Buck	380,000	A	C	C
40	Tripod Creek	54,000	B	C	C
41	Round Valley	430,000	B	C	X
42	Grassy Flat	32,000	A	B	C
43	Big Creek	400,000	C	C	C
44	Horsethief Basin	75,000	B	B	C
45	Scott Valley	131,000	C	C	C
46	Gold Fork	930,000	C	C	C
47	Kennally Creek	330,000	C	C	C
48	Green Mountain	24,000	B	B	B
49	Boulder Creek	93,000	B	B	C
50	Little Payette Lake	Add'l. 37,000	A	B	C
51	Browns Pond	92,000	B	X	C
52	Slick Rock	35,000	B	B	C
53	Upper Payette Lake	Add'l. 98,000	B	B	C
54	Middle Fork Payette R.	1,600,000	A	A	C
55	Lower Scriver Creek	44,000	A	B	A
56	Anderson Creek	51,000	A	C	A
57	Wash Creek	55,000	A	C	B
58	Pidgeon Flat	490,000	A	C	B
59	Warm Spring Creek	61,500	B	C	A
		Boise River Drainage			
60	Hurd Gulch	35,000	A	C	C
61	Ashlock Gulch	72,000	A	C	C
62	Homestead Gulch	21,000	A	C	B
63	Sebree	30,000	A	C	B
64	Sand Run Gulch	54,000	A	B	C
65	Chadre	24,000	A	B	X
66	Conswello	56,000	A	C	B
67	Magello	27,000	A	C	C
68	Sand Hollow Creek	41,000	A	B	C
69	West Hartley Gulch	31,000	A	C	C
70	Middleton	29,000	A	C	C
71	Firebird	67,000	A	X	X
72	Upper Willow Creek	31,000	A	X	C
73	Lanktree Gulch	22,000	B	B	B
74	Big and Little Gulches	52,000(total)	B	C	B
75	Woods Gulch	26,000	B	C	C
76	Horseshoe Bend Road	100,000	B	X	X
77	Lower Dry Creek	43,000	B	C	C
78	Dry Creek	53,000	B	X	C
79	Stuart Gulch	37,000	B	X	C
80	Dunnigan Creek	240,000	B	C	C
81	Grimes Creek	1,500,000	C	C	C

Table A-7-1. Offstream Reservoir Site Summary and Acceptability Classification (cont.)

1	2	3	4	5	6
	Boise River Drainage (Cont.)				
82	Granite Creek	48,000	A	C	C
83	Placerville	21,000	A	C	B
84	Pioneerville	58,000	A	C	C
85	Elk Creek	41,000	B	C	B
86	Meadow Creek	44,000	B	C	A
87	Rabbit Creek	152,000	B	C	A
88	Lower Crooked River	250,000	C	C	A
89	Crooked River West	119,000	B	C	C
90	Crooked River East	37,000	A	C	B
91	Upper Crooked River	49,000	A	X	B
92	Archie Mountain	49,000	A	X	B
93	Trapper Flat	178,000	A	C	B
94	Bear River	93,000	B	X	A
95	Blacks Creek Road	44,000	B	C	B
96	Krall Mountain	121,000	C	C	B
97	Dixie Creek	46,000	B	C	C
98	Cat Creek	93,000	B	C	C
99	Trinity Mountain	104,000	C	X	C
100	Moores Flat	52,000	B	C	B
101	Lower Feather River	24,000	B	C	B
102	Upper Feather River	70,000	C	C	B
103	Lower Little Smoky Creek	76,000	B	C	B
104	Upper Little Smoky Creek	87,000	B	C	B
105	Indian Creek-Mayfield	52,000	B	C	B
106	Coyote Butte	260,000	B	A	A
	Snake River Drainage				
107	Sands Basin	115,000	C	C	B
108	Larrys Lake	61,000	A	C	A
109	Reynolds Basin	950,000	C	X	X
110	Sinker Butte	70,000	A	X	C
111	Corder Creek	41,000	C	X	B
112	Jack Creek	40,000	A	C	B
113	Crater Rings	16,400 and 23,000	C	X	B
114	Syrup Creek	141,000	B	C	B
115	Long Tom Creek	450,000	C	C	B
116	Browns Creek	47,000	C	C	C
117	Reverse	36,000	C	C	B
118	Sailor Creek	320,000	B	C	C
119	Blue Butte	360,000	B	C	A
120	Crows Nest	134,000	B	C	A

Table A-7-1. Offstream Reservoir Site Summary and Acceptability Classification (cont.)

1	2	3	4	5	6
	Snake River - Southwest Idaho Basin (Cont.)				
121	Twin Buttes	380,000	B	C	A
122	Notch Butte	125,000	B	C	A
123	Upper Sailor Creek	70,000	B	C	B
124	Deadman Creek	148,000	B	C	C
125	Blue Gulch	380,000	B	C	C
126	Rosevear Gulch	1,320,000	B	C	C
127	Clover Creek	56,000	C	C	C
128	Deer Gulch	49,000	B	C	B
129	Tuana Gulch	25,000	C	C	C
130	Camas Prairie	210,000	C	C	X
131	Water Holes	41,000	C	C	B
132	Rock Creek Ranch	98,000	B	B	B
133	Deer Creek	139,000	C	C	C
134	Greenhorn Gulch	101,000	C	C	C
135	Elkhorn Gulch	117,000	C	C	X
136	Triumph	166,000	C	C	C
137	Baugh Creek	49,000	C	C	C
138	Birch Glenn	270,000	C	C	C
	Upper Snake River Basin				
139	Marsh Creek	320,000	C	C	C
140	Lanes Gulch	46,000	C	C	B
141	Rockland Valley	181,000	C	C	C
142	Bannock Creek	102,000	C	C	X
143	Rattlesnake Creek	220,000	C	C	X
144	Upper Rattlesnake Creek	158,000	C	C	X
145	Moonshine Creek	36,000	C	C	X
146	Blackrock Canyon	119,000	C	C	C
147	Hawkins Creek	44,000	C	C	C
148	Hawkins Basin	47,000	C	C	C
149	Marsh Valley	78,000	B	C	C
150	Fish Creek	145,000	C	C	C
151	Monroe Canyon	81,000	C	C	A
152	Portneuf River	41,000	C	C	X
153	Lone Pine Canyon	80,000	C	C	X
154	Lincoln Creek	72,000	B	B	X
155	Miner Creek	45,000	C	C	B
156	Rawlins Creek	230,000	C	C	C
157	Paradise Valley	71,000	C	C	C
158	High Basin	42,000	C	C	C
159	Supon Creek	101,000	C	C	X
160	Grizzly Creek	26,000	C	C	C

Table A-7-1. Offstream Reservoir Site Summary and Acceptability Classification (cont.)

1	2	3	4	5	6
	Snake River - Southwest Idaho Basin (Cont.)				
161	Ozone	105,000	C	C	C
162	Willlow Creek Lava Field	52,000	C	C	C
163	Hell Creek	270,000	C	C	B
164	Jumpoff Hill	153,000	C	C	C
165	King Creek	86,000	C	C	C
166	Brockman Creek	151,000	C	C	C
167	Indian Fork	41,000	C	C	C
168	Birch Creek	43,000	C	C	B
169	Fall Creek	58,000	B	C	C
170	Fall Creek Falls	94,000	B	C	C
171	Swan Valley	32,000	B	C	C
172	Gibson Creek	240,000	B	C	C
173	Rainey Creek	250,000	B	C	C
174	Palisades Creek	41,000	B	C	X
175	Moody Creek	46,000	B	C	B
176	Spring Creek	32,000	B	C	B
177	Lane Lake	69,000	A	B	B
178	Bitch Creek	142,000	A	B	C
179	Lower Badger Creek	73,000	A	C	A
180	Upper Badger Creek	49,000	A	B	B
181	Conant Creek	40,000	A	C	C
182	Squirrel Creek	126,000	A	C	B
183	Boone Creek	83,000	A	C	X
184	Ashton Dam Enlargement	29,000	A	C	C
185	Robinson Creek	70,000	B	C	C
186	Howell Ranch	32,000	B	B	B
187	J Y Ranch	49,000	B	C	X
188	Park Lake	37,000	B	C	X
189	Moose Creek	60,000	B	C	C
190	Appendicitis	104,000	C	C	B
191	Dry Fork	108,000	C	C	B
192	Antelope Creek	41,000	C	C	C
193	Alder Creek	147,000	C	C	B
194	Chilly	81,000	C	C	B
195	Pass Creek	90,000	C	C	B
196	Cedarville Canyon	109,000	C	C	B
197	Chandler Canyon	60,000	C	C	B
198	Blue Creek	35,000	C	C	B
199	Deep Creek	35,000	C	C	B
200	Medicine Lodge	700,000	C	C	B
201	Rocky Creek	104,000	C	C	B

Table A-7-1. Offstream Reservoir Site Summary and Acceptability Classification (cont.)

1	2	3	4	5	6
		Snake River - Southwest Idaho Basin (Cont.)			
202	Middle Creek	194,000	C	C	C
203	Beaverhead	62,000	C	C	C
204	Pleasant Valley	58,000	C	C	C
205	Cow Camp	39,000	C	C	C
206	Camas Creek	41,000	C	B	C
207	Upper Camas Creek	134,000	C	C	B