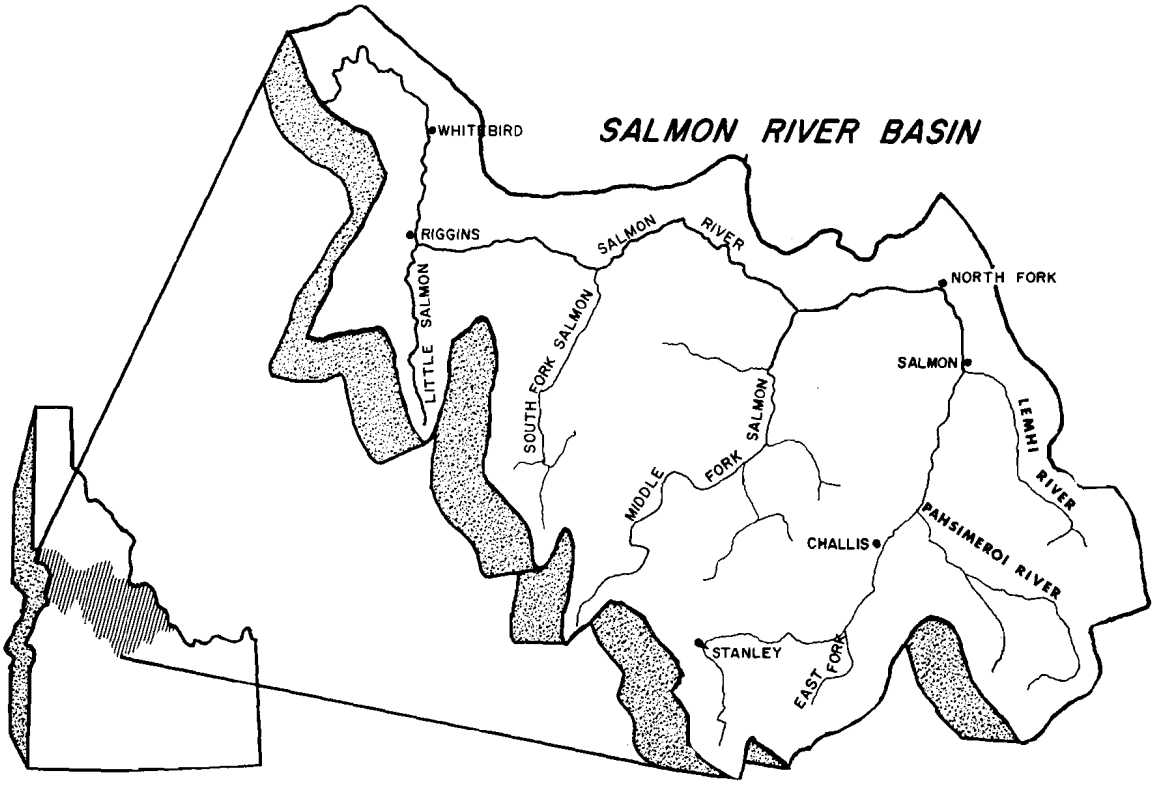
A Methodology Study To Develop Evaluation Criteria For Wild And Scenic Rivers



Report of

Water For Municipal And Industrial Use Subproject

by
Fred J. Watts

Water Resources Research Institute
University of Idaho
Moscow, Idaho
September, 1970

A METHODOLOGY STUDY TO DEVELOP EVALUATION CRITERIA FOR WILD AND SCENIC RIVERS

Report of
WATER FOR MUNICIPAL AND INDUSTRIAL USE SUBPROJECT

by
Fred J. Watts

Water Resources Research Institute
University of Idaho
Moscow, Idaho
August, 1970

ACKNOWLEDGMENTS

This report was prepared by the Idaho Water Resources Research Institute, University of Idaho, under a contract agreement with the Idaho Water Resources Board and the Office of Water Resources Research. Acknowledgment is accorded to Mr. Warren Reynolds of the Idaho Water Resource Board for his constructive review of this report.

CONTENTS

LIST OF TABLES

PAGE

PAGE

WATER FOR MUNICIPAL AND INDUSTRIAL USE

Introduction

Public Law 90-542 provides for a National Wild and Scenic Rivers System. The purpose of the law is to protect for the enjoyment and benefit of the people of the United States certain rivers which in conjunction with lands bordering the waters possess outstanding scenic, recreational, fish and wildlife, geologic land forms, and other such desirable features.

Two categories of rivers are specified by the Act. "Instant Rivers" are authorized for immediate inclusion in the National Wild and Scenic Rivers System. The Middle Fork of the Salmon River and The Middle Fork of the Clearwater River are the two rivers located in Idaho included in this category. The second category "Study Rivers" includes rivers which are to be studied for possible inclusion in the Wild and Scenic Rivers System. The main stem of the Salmon, and the Bruneau, St. Joe, Priest, and Moyie Rivers are the five Idaho rivers placed in the second category.

The Act specifies three classes of wild rivers: wild, scenic, and recreational. A "wild river" refers to a river free from impoundments, with non-polluted water and essentially primitive shorelines. A "Scenic river" is free from impoundments with shorelines and watersheds still essentially primitive and undeveloped but which is accessible in places by roads. A "recreational river" is readily accessible by roads and railroads, may have development along the shorelines and may have undergone some impoundment or diversion in the past. Public Law 90-542 specifies a ten-year time limit on classification studies after which recommendations on the disposition of study rivers are to be made to the Congress.

There is little valid criteria available for evaluating rivers for wild or scenic classification. For this reason the Water Resources Research Institute of the University of Idaho has organized a Scenic

Rivers Study Unit for the purpose of developing methodology to evaluate wild rivers. The goal of this study is to establish criteria which can be used to identify and determine the economic, aesthetic, and scenic and other values of wild rivers.

The Salmon River in Idaho has been selected as the study river. This river originates in central Idaho and flows about 410 miles generally through precipitous undeveloped canyon country and discharges into the Snake River 49 miles above Lewiston. The average annual discharge of the Salmon River at its mouth is about 8,000,000 acre feet.

The portion of the Salmon from its mouth to the town of North Fork has been designated as a "study river". However, for the methodology study the entire Salmon drainage basin will be studied. There are two reasons for this. First, because any economic development--impoundments, diversions, mining, paper, industry, logging, etc.,--would affect the main stem wild river section. Second, because it is more convenient and is more meaningful to include all the activities in a river basin. The hydrologic basin unit (the Salmon drainage basin) was used for some portions of the Idaho Economic Base Study for Water Requirements (1[a]) and in the Idaho Water Resources Inventory (2).

The purpose of the methodology study is to develop information pertinent to decision-making and planning as it pertains to the selection, use, and management of wild and scenic river systems. The methodology study has four broad objectives:

1. Inventory present quantities and qualities of natural resources in the river basin area, and estimate future quantities and qualities of these resources, establishing their values in both situations.
2. Identify, describe, and quantify, where possible, benefits from scenic beauty, personal enrichment, and other aesthetic experiences derived from the river.
3. Develop a series of models to evaluate or determine the resource use pattern consistent with a wild rivers system, and the resource use pattern which would exist under various levels of development in the river basin area.

---

[a]Number in parenthesis refers to reference number at the end of the report.

4. Present recommendations for alternative uses of resources for the entire river basin area, recommend restrictions if classification is applicable, and describe the economic and social ramifications of each of the alternatives considered.

The plan for the methodology study is to divide the research work into a series of subprojects, each covering an important economic activity related to the river. These subprojects consist of eleven resource and service functions:

1. Forest and range resources
2. Minerals
3. Outdoor recreation
4. Commercial fisheries
5. Irrigation
6. Water for municipal and industrial use
7. Water quality control
8. Hydroelectric power
9. Flood control
10. Navigation
11. Transportation and access

Each of these eleven resource and service functions will be examined on an individual basis at their present level of development and at projected levels of development. For this municipal and industrial subproject, projections from reference 1 were used. When applicable an inventory of the resource (timber, minerals, etc.) will be included in the respective subreports.

Once the above subprojects have been completed, a series of economic models will be developed which will make relatively accurate estimates of costs and benefits for each of the resources included in the subprojects. This will permit comparisons of potential costs and benefits of alternative resource uses. The technique will be modified and extended to the years 2000 and 2020, consistent with the time projections of the Columbia-North Pacific Region Comprehensive Framework Study.

It is at this stage of the analysis that one purpose of the methodology study will be realized. This purpose is to make an

economic evaluation of the Salmon River in its natural state. The evaluation will be made consistent with the present levels of resource use indicated by the subprojects. This evaluation at the current level of resource use will then be compared with simulated levels of development on the river, and within the river basin area. At this stage of the analysis it will be possible to include in the study certain general considerations such as population, and economic growth, and the demand for recreation, electricity, timber, minerals and other resources in the area in the future.

Two general evaluations of the river resource base can then be made. First, the current and projected levels of economic activity based on the status quo. Second, a determination of the benefits foregone, (if this turns out to be the case) as a result of maintaining the river in its natural free-flowing state. Efforts throughout the study will be to try to identify and quantify the aesthetic and personal enhancement values for which the expressed national desire is to protect and conserve.

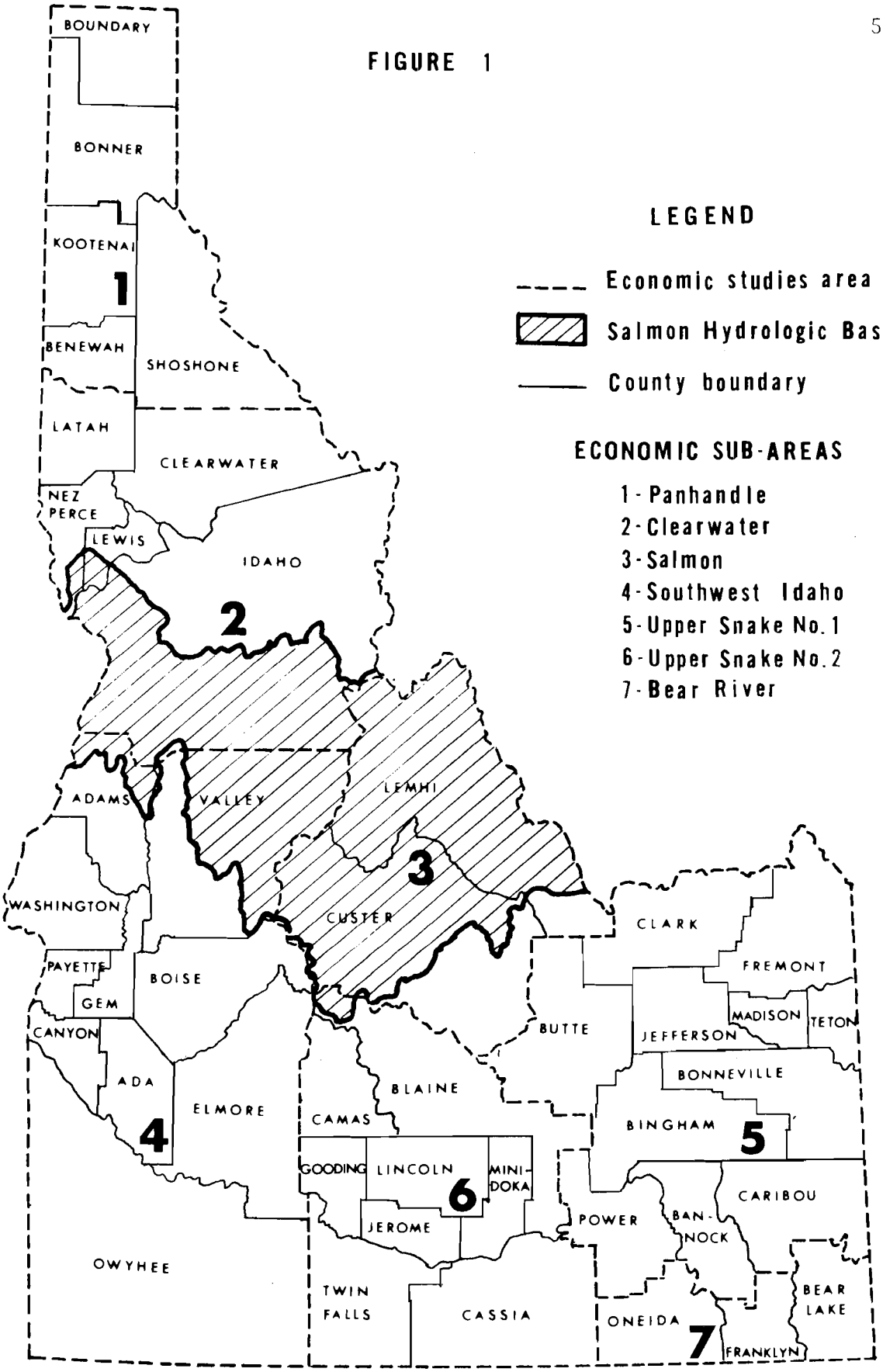
The purpose of this subproject is to catalogue information concerning municipal and industrial water use, present and future, in the Salmon Hydrologic unit and to briefly explain the methodology which was used to derive the data. Boundaries of the hydrologic unit and the economic study units discussed in the report are shown in figure 1.

The objectives of this study are:

1. To determine water needs for municipal and industrial use in the Salmon River Basin.
2. To assign a value to the water that might be used for municipal and industrial use in the Salmon River Basin.
3. To determine the impact on the present and future use of water for municipal and industrial purposes on the Salmon River if the entire system is classified as a wild river or if only certain segments are so designated. At the present stage of investigation it is not possible to quantify the third objective.

The principal sources of information for this study is reference 1, "Idaho Economic Base Study for Water Requirements", Idaho Water Resources Board, 1969. This report is one of a series of planning reports which summarizes water resource needs in Idaho both present and future. The data were assembled for the expressed purpose of providing information required to prepare the Idaho State Water Plan.

FIGURE 1


BOUNDARY
BONNER
KOOTENAI
1
BENEWAH
SHOSHONE
LATAH
CLEARWATER
NEZ PERCE
LEWIS
IDAHO
2
ADAMS
VALLEY
LEMHI
3
WASHINGTON
CUSTER
CLARK
FREMONT
PAYETTE
BOISE
GEM
CANYON
BUTTE
MADISON
TETON
JEFFERSON
ADA
BONNEVILLE
BLAINE
ELMORE
4
CAMAS
BINGHAM
5
GOODING
LINCOLN
6
MINI-DOKA
CARIBOU
POWER
BAN-NOCK
JEROME
OWYHEE
TWIN FALLS
CASSIA
ONEIDA
7
FRANKLYN
BEAR LAKE
LEGEND
Economic studies area
Salmon Hydrologic Basin
County boundary
ECONOMIC SUB-AREAS
1 - Panhandle
2 - Clearwater
3 - Salmon
4 - Southwest Idaho
5 - Upper Snake No. 1
6 - Upper Snake No. 2
7 - Bear River

Because this municipal and industrial report is primarily a summarizing report, much of the information is quoted directly from the above reference. In general, direct quotes are inset. The procedure used to determine water requirements both present and future is outlined in detail in reference 1. The resource base of the state was examined and the water requirements needed to develop this resource base assuming that it continues to develop at the same rate and in the same direction as in the past was then determined. This was accomplished by (a) examining historical changes in population and employment; (b) examining the resource base of the state by considering the potential for agricultural, mining, and forest products; (c) analyzing the relationship between basic employment and population then utilizing this relationship for projection purposes; (d) surveying by questionnaire the present municipal and industrial water use patterns; and (e) projecting the municipal and industrial water requirements which are likely to accompany the development of the resource base described in (b) above.

The state was sub-divided into seven economic study areas made up of groups of counties. Certain data were available only by county, thus groups of counties in integrated trade areas separated geographically from other trade areas were the logical study unit. After completion of the study, data prepared for the economic study areas were adjusted to hydrologic drainage areas by shifting both population and employment when these factors were amenable to such adjustment. Details of the adjustment procedure were not reported. The methodology for accomplishing the objectives outlined above is described next.

Employment Projections and Population Projections

The employment base model was used to project employment and population in the economic studies areas. The model rests on the assumptions that: (1) Population in a given region is primarily a function of employment opportunities; (2) Employment opportunities in a given region are primarily a function of jobs in industries which are engaged in the export of commodities outside the region (basic employment jobs); (3) Employment can be separated into two types (a) basic employment and (b) dependent or service employment and these two types of employment can be used to generate a base ratio for projection purposes.

Fundamental to the base ratio approach is the assumption that economic activities within communities may be divided into two classes which are different both with respect to the forces which activate them and with respect to the contributions which they make to the urban economy. The first class is composed of base or town building activities which export goods beyond the boundary of the study area. The second class is composed of service or "town filling" activities (non-exporting) which are local in nature. They complement the base industries and therefore, for purposes of analysis, the base industries are the more significant.

To implement the base model for a study area it is necessary to:

1. Determine which industries are basic industries and project employment in these;

2. Examine historical relationships between basic employment and service employment and project the relationships;

3. Construct total employment projections by adding basic employment, service employment, and unemployment projections; and

4. Examine historical labor force participation rates, extend these and combine them with employment projections to obtain population projections.

The relationships were obtained for the census years 1940, 1950, and 1960 for each of the seven economic study areas. Based on variables determined for these three periods, future employment and population figures were projected for the years 1980, 2000, and 2020.

Basic to the model is the assumption that population is directly dependent on job opportunities available in basic (exporting) industries in a given region.

Population and employment by economic study areas in Idaho for 1940, 1950, 1960 and projectionsfor 1980-2020 are shown in Table 1.

TABLE 1

POPULATION AND EMPLOYMENT BY

ECONOMIC STUDIES AREAS IN IDAHO

FOR 1940, 1950, 1960 AND

PROJECTIONS FOR 1980-2020

Regions	1940	1950	1960	1980	2000	2020
I. Panhandle						
Basic Employment	12,680	13,327	11,470	12,681	13,531	14,688
Dependent Employment	8,877	12,477	14,160	15,851	17,590	19,829
Labor Force	25,687	28,095	28,308	29,721	32,418	35,955
Population	72,499	74,687	77,864	82,558	90,050	99,875
II. Clearwater						
Basic Employment	10,997	11,572	11,485	13,832	15,503	17,374
Dependent Employment	8,760	12,101	14,460	17,982	20,929	24,324
Labor Force	23,087	24,408	28,232	33,140	37,950	43,435
Population	63,277	67,477	74,749	87,211	99,868	114,303
III. Salmon						
Basic Employment	2,096	2,081	1,572	1,982	2,787	3,284
Dependent Employment	1,006	1,368	1,493	1,982	2,878	3,284
Labor Force	3,513	3,675	3,207	4,129	5,806	6,842
Population	10,070	9,596	8,812	11,469	16,128	19,006
IV. Southwest Idaho						
Basic Employment	23,081	26,061	27,995	37,338	47,664	57,548
Dependent Employment	21,233	37,362	47,550	67,208	95,328	126,606
Labor Force	49,459	67,085	83,766	112,587	152,587	195,464
Population	140,241	175,060	212,604	281,348	381,468	448,660
V. Upper Snake #1						
Basic Employment	19,780	21,525	23,645	32,950	44,066	55,736
Dependent Employment	16,038	25,977	35,242	52,720	79,519	111,472
Labor Force	39,151	49,666	62,026	89,240	128,526	174,175
Population	124,636	140,636	171,373	241,189	347,368	470,743

Regions	1940	1950	1960	1980	2000	2020
VI. Upper Snake #2						
Basic Employment	16,185	17,052	16,571	26,571	34,971	44,696
Dependent Employment	12,121	18,457	20,938	34,171	48,959	67,044
Labor Force	30,729	36,941	39,101	62,975	87,427	116,396
Population	90,745	99,293	102,814	165,724	230,071	306,305
VII. Bear River						
Basic Employment	3,621	3,623	3,142	3,976	4,903	5,773
Dependent Employment	2,247	3,010	3,025	4,175	5,393	6,350
Labor Force	6,525	6,947	6,454	8,491	10,725	12,628
Population	23,557	21,088	19,208	25,830	32,500	38,267
Total Population	525,025	587,837	667,424	895,329	1,197,453	1,537,159

Source: Idaho Economic Base Study for Water Requirements, Vol. I, Idaho Water Resource Board, Boise, Idaho.

Municipal, Urban and Rural Water Withdrawal

In order to understand the breakdown of data presented in the following sections, the following definitions are essential.

Gross municipal water withdrawal includes amounts supplied by municipalities for industrial uses, domestic uses, irrigation of lawns, gardens and parks; for retail service-related functions that are normally associated with population centers; and the quantity of water lost in the process of delivering.

Industrial water withdrawal is defined as that withdrawal made by productive facility (basic industry) that is an intensive user of water. This category excludes service types of industries, i.e. this category applies only to those industries which manufactureor process an exportable product.

Rural water withdrawal is defined as that withdrawal made by a dwelling place not located in an incorporated area. Domestic use, irrigation of small lawns and gardens and livestock watering are included.

Urban gross water withdrawal is the gross municipal water withdrawal minus the water supplied by a given municipality to intensive water-using industries. Note that the total water used by basic industries is the sum of industrial water withdrawals and the difference in Gross municipal water withdrawal and Urban gross water withdrawal.

Method of Obtaining Water Withdrawal

The primary source of information for this study was the responses to questionnaires which were mailed to intensive water using industrial plants and to each municipality located in the State of Idaho. A third short-form questionnaire was mailed to selected industrial firms late in the study. The purpose of this short-form questionnaire was to determine more accurately certain characteristics of firms with fewer than 50 employees. Specifically, the researcher hoped that

determining these characteristics would add to the coverage of gross water withdrawals and help to delineate more accurately the source of supply for the smaller firm.

The non-respondents were generally assumed to possess the same characteristics as the respondent in the same category. Accordingly, data for municipalities which did not respond to the questionnaire, or which were unable to provide useful information, were estimated by multiplying the average daily water withdrawal per capita for the state as a whole times 365 times the estimated non-surveyed municipal population. The same basic technique was used for non-surveyed industrial employment. In this case, the critical factor was the withdrawal per employee within the specific industrial classification.

Non-surveyed urban as well as rural populations were derived by adjusting 1960 U.S. Bureau of Census figures. The first step involved estimated 1966 total population for each Idaho county. This was achieved by . . . estimating the student migration ratio age 1-9 and 2-10, using 1960 as a base year. Also included was natural increase. Second, urban population was estimated by applying the average annual urban growth rate of census years 1950 through 1960 to the 1960 urban census population figure. The result was total urban population. Rural population was derived by subtracting estimated urban population from the total population estimated for each county.

Non-surveyed industrial employment was determined by matching each industrial questionnaire against detailed listings of employers and the number of employees.

In some cases respondents to industrial and municipal questionnaires were unable to provide actual measurements of gross water intake, but did provide estimates of the volume of water involved. The use of these estimates was much more prevalent, however, in the case of municipal respondents. In either situation these estimates were accepted or rejected on a judgement basis. . . .

For purposes of estimating municipally supplied water for non-surveyed intensive employment the character of the respondent and the non-respondent were assumed to be identical. Significant differences were found, however, both with respect to the number of employees and to the specific types of industrial classification. Firms that had an average of less than 50 employees were municipally supplied with 20 percent of their total withdrawal. For those firms with more than 50 employees the equivalent figure was 6 percent.

TABLE 2

WATER WITHDRAWAL RATES IN IDAHO - 1966[a]

	Idaho	Salmon Economic Study Area		Salmon Hydrologic Study Area[b]	
	10^6 gallons	10^6 gallons	% of total for state	10^6 gallons	% of total for state
1. Daily Gross Municipal Water Withdrawal	117	.6	.5	0.6	.5
Annual Gross Municipal Water Withdrawal	42,606	213	.5	201	.5
2. Daily Industrial Water Withdrawal	455	1	.3	1.0	.3
Annual Industrial Water Withdrawal[c]	166,000	41	.3	395	.3
3. Daily Urban Gross Water Withdrawal	111	.6	.5	.6	.5
Annual Urban Gross Water Withdrawal	40,440	208	.5	297	.5
4. Daily Rural Gross Water Withdrawal	58.0	1.0	1.8	1.0	1.7
Annual Rural Gross Water Withdrawal	21,200	382	1.8	360	1.7
5. Daily Gross Water Withdrawal Used by Basic Industries[d]	461	1.0	.3	1.0	.2
Annual Gross Water Withdrawal Used by Basic Industries	168,000	424	.3	399	.2

[a]Based on the following estimated populations for 1966: Urban 474,869; Rural 248,844.

[b]Extrapolated using ratio obtained from table 9 and 13 for the year 1980.

[c]Includes 80 billion gallons of water withdrawn for trout farms in the Snake No. 2. region.

[d]The sum of Daily Industrial Water Withdrawal plus Daily Gross Municipal Water Withdrawal minus the Daily Urban Gross Water Withdrawal.

[e]Hydrologic and Economic Study areas are dilineated in Figure 1

Source: Idaho Economic Base Study For Water Requirements, Vol. I, Idaho Water Resource Board, Boise, Idaho.

Municipal Water Withdrawal

During 1966, Idaho's municipalities contained an estimated urban population of 474,869 and made an average daily gross municipal water withdrawal of approximately 117 million gallons. The annual total gross municipal water withdrawal is currently estimated at 42,606,451,000 gallons.

Water withdrawal rates are depicted in Table 2.

Applying the percentage shown in Table 2, the annual total gross municipal water withdrawal for the Salmon economic study area is about 213,200,000 gallons.

Gross Municipal Water Withdrawal Per Capita Per Day

The range in average daily withdrawals per capita reported by those Idaho municipalities providing usable questionnaire responses ran from a low of 45.1 gallons to a high of 1,320 gallons. The low, which was based on a fully metered water supply system, was reported by Oakley; the high was reported by Inkom. The latter figure represents an estimate provided by Inkom authorities rather than a metered volume. Middleton recorded the highest withdrawal per capita per day for a municipality with a fully metered water supply system (807 gallons). The average gross withdrawal, of all the Idaho municipalities providing usable questionnaire responses was 247 gallons per capita per day.

The factors responsible for the variations in municipal water withdrawal are numerous and complex and are discussed in detail in reference 1.

Urban Water Withdrawal

To eliminate double counting of water withdrawal, it is necessary to determine and/or estimate the volume of water supplied by municipalities in intensive water using industries.

Inspection of both municipal and industrial survey questionnaires has made it possible to identify intensive water-using industrial establishments with an aggregate 1966 gross water withdrawal of 1,408,636,000 gallons that were municipally supplied. Virtually all of the municipally-supplied establishments fell within one of the food and kindred products classifications. The tendency, on the other hand, of intensive water using industries to be municipally-supplied was inversely related to size. In effect then: the smaller the number of employees utilized by a firm the greater the probability that it would be

> municipally supplied, and vice versa. The application of these two factors to the estimated gross water withdrawal of non-surveyed intensive water-using industries resulted, . . . in an increment of 757,717,000 gallons to the amount estimated to have been municipally-supplied. This bought the 1966 withdrawal of municipally-supplied water by intensive water-using industries to 2,166,353,000 gallons.
>
> The total 1966 gross municipal water withdrawal in Idaho was estimated at 42,606,453,000 gallons. By subtracting estimated gross withdrawal by intensive water-using industries of municipally-supplied water from the 1966 gross municipal water withdrawal, a total estimated gross urban water withdrawal of 40,440,100,000 gallons may be calculated. This figure represents an average gross withdrawal of approximately 233 gallons per capita per day . . . .

Rural Water Withdrawal

> The amount of water used in dwellings not supplied by a municipal water system presents a problem that is unsolvable within the confines of this study. There is no method by which actual data on rural water withdrawal can be derived. Accordingly, it is assumed that the average gross water withdrawal per day per rural resident is the same as the average urban gross water withdrawal per capita per day found in the state as a whole. . . .
>
> The 1966 total rural population for Idaho was estimated to be 248,844.

Based on the assumed per capita per day gross water withdrawal of 233 gallons, the total daily rural gross water withdrawal was 58,000,000 gallons. The annual withdrawal was 21,170,000,000 gallons.

Industrial Water Withdrawal

> During 1966, Idaho's intensive water using industries employed 34,567 individuals and made an average daily gross water withdrawal of slightly more than 455 million gallons. The annual gross water withdrawal was 166 billion gallons.

Table 2 summarizes water withdrawal data discussed in this chapter.

Table 3, Monthly Water Demand Characteristics for Idaho Industries 1966 - Table 4, Composition of Water-Intensive Industrial Employment and Gross Water Withdrawal for the State of Idaho, 1966 -- Table 5, Average Annual Gross Water Withdrawal per Employee-- and Table 6, Water Intake per Employee for Intensive Water Using Industries

in Idaho in 1966 are presented for possible use in economic simulation models of the Salmon River unit.

TABLE 3
MONTHLY WATER DEMAND CHARACTERISTICS
FOR IDAHO INDUSTRIES 1966
(Index - Average Month = 100)

January	108	May	109	September	99
February	101	June	91	October	108
March	96	July	86	November	106
April	100	August	93	December	102

Source: Idaho Economic Base Study for Water Requirements, Vol. I, Idaho Water Resource Board, Boise, Idaho.

TABLE 4
COMPOSITION OF WATER INTENSIVE INDUSTRIAL EMPLOYMENT & GROSS WATER WITHDRAWAL FOR THE STATE OF IDAHO

Classification	Percent of Water Intensive Employment	(thousands of gallons) Gross Water Withdrawal	99.9% of Total Gross Water Withdrawal
Fresh & Frozen Fish	0.2	80,289,394	48.3
Frozen Fruits & Veg.	17.0	10,950,683	6.6
Beet sugar	3.4	5,812,827	3.5
Dehydrated Foods	6.1	3,257,804	2.0
Dairy Products	6.0	3,174,892	1.9
Meat Products	3.4	1,845,356	1.1
Canned Fruit & Veg.	1.7	237,549	0.1
Other Food Products	6.2	1,234,142	0.7
Total Food & Kindred	44.0	106,802,647	64.3
Sawmills & Planning	21.7	25,830,860	15.5
Paper, Allied, Other Lumber	16.7	16,375,405	9.8
Total Lumber, Paper, etc.	38.4	42,206,265	25.3
Chemical & Allied Prod.	4.3	5,699,930	3.4
Primary Metals & Metal Mining	11.2	9,297,407	5.6
National Reactor Testing Station	NA	1,978,509	1.2
Mining and Quarring	2.1	313,152	0.2

NA: Not Available

Source: Idaho Economic Base Study for Water Requirements, Vol. I, Idaho Water Resource Board, Boise, Idaho.

TABLE 5

AVERAGE ANNUAL GROSS WATER WITHDRAWAL PER EMPLOYEE

(Thousands of gallons)[a]

Industrial Classification	National 1964	Surveyed Employment State 1966
Fresh & Frozen Fish	NA	1,029,351
Frozen Fruit & Vegetables	1,268	1,867
Beet sugar	4,882	4,985
Dehydrated Foods	773	1,538
Dairy Products	762	1,537
Meat Products	635	1,553
Canned Fruits & Vegetables	625	410
Other Food	NA	572
Sawmills & Planing Mills	1,581	3,446
Paper and other Lumber, Paperboard Mills	NA	2,838
Chemical & Allied Products	6,389	3,920
Primary Metals & Metal Mining	NA	2,406
Mining & Quarrying (except metals)	NA	427

[a]These data do not include the withdrawals recorded for steam electric power generation.

NA: Not Available

Source: Idaho Economic Base Study for Water Requirements, Vol. I, Idaho Water Resource Board, Boise, Idaho.

TABLE 6

WATER INTAKE PER EMPLOYEE FOR
INTENSIVE WATER USING INDUSTRIES
IN IDAHO IN 1966
(thousands of gallons)

Industrial Group	Water Intake Per Employee
Paper	
Paper except building	3,272.73
Paperboard	15,333.33
Other paper, allied	960.00
Pulp[n]	205.48
Building paper, board[n]	33.00
Lumber	
Saw, planing mills	3,445.95
Other lumber, wood	641.07
Primary metals & metal mining	2,460.16
Mining & Quarrying except metal	426.64
Fabricated metals[n]	148.00
Machinery, except electrical[n]	186.00
Electrical mach. equip.[n]	112.00
Motor Vehicles & M.V. equip.[n]	229.00
Transportation equip. ex. M.V.	168.00
Meat Products	1,553.33
Dairies	1,536.73
Canned Fruit & Veg.	409.57
Dehydrated foods	1,538.15
Frozen fish	1,029,351.20
Frozen fruit, veg.	1,867.12
Beat sugar	4,985.27
Other food	571.89
Textile Mill Products[n]	383.00
Apparel & fabricated T.M. Prods.[n]	340.19
Inorganic Chemicals	4,048.74
Fertilizers	3,846.15
Other Chem. & Allied	5.00

[n]Denotes national average from 1963 Census of Manufacturers.

Source: Idaho Economic Base Study for Water Requirements, Vol. I, Idaho Water Resource Board, Boise, Idaho.

Salmon Region

> The total estimated gross municipal water withdrawal in the Salmon Region, during 1966, amounted to 213,167,000 gallons, with an estimated 4,699,000 gallons of this total diverted to intensive water-using industries. This results in an urban gross water withdrawal of 208,498,000 gallons. The City of Salmon, which includes 66 percent of the region's urban population, provided the only usable questionnaire responses. The gross urban water withdrawal per capita per day for Salmon, Idaho, amounted to 82 gallons. This withdrawal per capita per day provided an average per day per capita withdrawal of 128 gallons for the Salmon Region. Lemhi County, in 1966, accounted for 45.7 percent of the total estimated gross municipal water withdrawal; the remainder went to Custer County.
>
> It is estimated that 418,724,000 gallons were withdrawn by the Salmon Region's intensive water using industries during 1966. Of this amount 94.3 percent was attributable to the forest and wood products classification, the remainder to food and kindred products. . . .

The combined total of municipal water withdrawal and industrial water withdrawal for intensive water using industries was 423,400,000 gallons during 1966.

Projected Municipal and Industrial Water Use

Projected municipal and industrial water use may be separated into the two parts of industrial water and non-industrial water. Non-industrial water includes a rural domestic water use and water delivered by public water supply systems except that delivered to firms engaged in mining and manufacturing. Industrial water includes water used by mining and manufacturing firms (except steam electric generation and printing and publishing).

Methodology

Water data may be examined according to its sources of supply or its uses. . . . The municipal water systems were surveyed to determine publicly supplied water: the industrial water use was subtracted from total publicly-supplied water to obtain gross urban domestic water use. This figure was divided by the population to determine the urban per capita water use.

The industrial water use was divided by employment in order to determine water use per employee.

Urban per capita water use and water use per employee provide the base figure for making the projections. Appropriate water quantities were obtained by multiplying per capita water use or adjusted water use per employee by projected population or employee estimates. . . .

Non-Industrial Water Use for Economic Studies Areas

Non-industrial water includes: (1) total publicly-supplied water less any publicly-supplied industrial water; and (2) rural domestic water.

Rural domestic water use data have not been collected, inasmuch as the costs of collecting such data are prohibitive. The complete non-industrial water use picture is obtained by assuming that per capita rural water use is the same as per capita publicly-supplied non-industrial water use. Per capita rural water use is usually considered to be lower than publicly-supplied per capita non-

industrial water. With the relatively large livestock industry in Idaho, however, the addition of livestock watering to rural domestic water use tends to negate the differences between the two. The main advantages of applying per capita water use to total population are: (1) assurance that water intake for all persons in each region is completely accounted and (2) assurance that double counting is minimized.

The per capita non-industrial water use among Idaho's regions in 1966 varied from a low of 82 gallons in the Salmon Region to 484 gallons in the Bear River Region. The comparable average for the State of Idaho was 233 gallons. Per capita non-industrial water use is expected to increase in the future based upon historical trends. In the case of the Bear River Region, the relatively high per capita figure of 484 gallons is expected to decrease in the future as population advances and competing water uses come into being. In all other regions per capita water use is expected to increase as follows: (1) 10 gallons from 1966 - 1980; (2) 10 gallons from 1980 - 2000; and (3) 10 gallons from 2000 - 2020.

The projections of non-industrial water use for each of the regions have been obtained by applying the adjusted water use per capita to the population projections. See Tables 7 and 8 for a summary of these projections.

Industrial Water Use for Economic Studies Areas

The employment projections have been used to estimate industrial water use in coordination with estimates by individual firms. An adjusted water use per employee for each intensive water-using industry has been multiplied by the employment in that specific industry group.

Water use per unit of product is expected to remain relatively constant. Attempts to determine water use per unit of product, however, have been only moderately successful; allocation of water to joint products is especially difficult. An alternative approach of utilizing water use per employee has been used. Productivity per employee is expected to increase with changes in technology. With a relatively constant water use per unit of product, a significant increase in water use per employee is expected.

Based on changes in productivity and historical trends in water use patterns, increases in water use per employee are expected to be as follows: (1) 1966 - 1980 -- 10 percent; (2) 1966 - 2000 -- 35 percent; (3) 1966 - 2020 -- 40 percent.

TABLE 7

PROJECTIONS OF NON-INDUSTRIAL WATER USE IN IDAHO
BY ECONOMIC STUDIES AREA FOR SELECTED YEARS, 1980 - 2020
(Thousands of Gallons)

Economic Studies Area	1980	2000	2020
Salmon	385,129.0	600,445.4	776,965.3
Panhandle	8,045,689.9	9,104,505.2	10,462,405.6
Clearwater	6,907,547.2	8,274,563.1	9,887,781.0
Southwest Idaho	20,127,635.9	28,682,578.9	38,525,954.4
Upper Snake No. 1	25,705,923.6	38,290,374.6	53,608,212.8
Upper Snake No. 2	12,944,701.6	18,810,605.0	26,161,510.0
Bear River	4,451,547.3	5,504,200.0	6,341,224.6
STATE TOTAL	78,568,174.5	109,267,272.2	145,764,053.7

Source: Idaho Economic Base Study for Water Requirements, Vol. I, Idaho Water Resource Board, Boise, Idaho

TABLE 8

PROJECTIONS OF NON-INDUSTRIAL WATER USE IN IDAHO BY ECONOMIC STUDIES AREA, FOR SELECTED YEARS, 1980 - 2020

(Thousands of acre feet)

Economic Studies Area	1980	2000	2020
Salmon	1,18	1.84	2.38
Panhandle	24.69	27.94	32.11
Clearwater	21.20	25.39	30.34
Southwest Idaho	61.77	88.02	118.23
Upper Snake No. 1	78.89	117.51	164.52
Upper Snake No. 2	39.72	57.73	80.29
Bear River	13.66	16.89	19.46
STATE TOTAL	241.11	335.32	447.33

Source: Idaho Economic Base Study for Water Requirements, Vol. I, Idaho Water Resource Board, Boise, Idaho.

The water intake per employee figures for the State of Idaho were shown in Table 6. In order to obtain projected industrial water use, adjusted water use per employee figures in Table 6 have been multiplied by the projected employment in each region for each industrial group. The projections for economic studies areas are shown in Tables 9 - 10.

Non-Industrial and Industrial Water Use for Hydrologic Drainage Basins

> Because data by hydrologic drainage basin are not collected by the U. S. Census Bureau or the Idaho Department of Employment, adjustments to hydrologic drainage basins must be considered crude. Data for economic studies areas have been adjusted to hydrologic drainage basins by shifting both population (with respect to non-industrial water) and employment (with respect to industrial water) when these factors have been amenable to such an adjustment.
>
> Differences in population densities within counties contained within economic studies units have been taken into consideration in attempting to determine the projections for hydrologic drainage basins.

The projections of non-industrial water use by hydrologic drainage basin are shown in Table 11 and 12, the projections of industrial water use by hydrologic drainage basin are shown in Tables 13 and 14.

Summary

> Projections of non-industrial and industrial water have been derived and set forth. For convenience in utilizing figures, the projections have been given in both thousands of gallons and acre-feet.

The total municipal and industrial water requirements for economic studies areas are shown in Tables 15 and 16. The similar figure for hydrologic drainage basins are shown in Tables 17 and 18.

TABLE 9
PROJECTIONS OF INDUSTRIAL WATER REQUIREMENTS
FOR IDAHO BY ECONOMIC STUDIES AREA
FOR SELECTED YEARS 1980 - 2020
(Thousands of Gallons)

REGION	1980	2000	2020
Salmon	1,228,116.12	2,964,763.88	4,831,655.56
Panhandle	8,635,745.39	9,911,651.53	9,224,975.02
Clearwater	25,329,794.15	28,414,426.85	27,197,265.25
Upper Snake No. 1	13,901,054.94	27,933,630.29	38,660,496.59
Upper Snake No. 2	8,541,451.02	19,920,573.56	31,527,076.12
Southwest Idaho	20,448,620.16	30,173,251.05	40,987,760.93
Bear River	3,993,458.53	8,235,455.32	10,355,816.05
TOTAL	82,078,240.31	127,553,752.48	162,785,045.52

Source: Idaho Economic Base Study for Water Requirements, Vol. I, Idaho Water Resource Board, Boise, Idaho.

TABLE 10

PROJECTIONS OF INDUSTRIAL WATER REQUIREMENTS FOR IDAHO BY ECONOMIC STUDIES AREAS FOR SELECTED YEARS 1980 - 2020
(Thousands of acre feet)

REGION	1980	2000	2020
Salmon	3.76	9.09	14.82
Panhandle	26.50	30.41	28.31
Clearwater	77.73	87.20	83.46
Upper Snake - 1	42.66	85.72	118.64
Upper Snake - 2	26.21	61.13	96.75
Southwest Idaho	62.75	92.59	125.78
Bear River	12.25	25.27	31.78
TOTAL	251.86	391.41	499.54

Source: Idaho Economic Base Study for Water Requirements, Vol. I, Idaho Water Resource Board, Boise, Idaho.

TABLE 11

PROJECTIONS OF NON-INDUSTRIAL WATER REQUIREMENTS
FOR IDAHO BY HYDROLOGIC DRAINAGE BASIN
FOR SELECTED YEARS, 1980 - 2020
(Thousands of Gallons)

HYDROLOGIC DRAINAGE BASIN	1980	2000	2020
Salmon	363,234.8	576,171.4	750,311.0
Panhandle	8,045,689.9	9,104,505.2	10,462,405.6
Clearwater	6,907,547.2	8,274,563.1	9,887,781.0
Southwest Idaho	20,127,635.9	28,682,578.9	38,525,954.4
Upper Snake No. 1	24,879,441.0	38,140,485.2	53,449,811.6
Upper Snake No. 2	12,944,701.6	18,810,605.0	26,161,510.0
Bear River	5,299,924.1	5,678,363.4	6,526,279.6
STATE TOTAL	78,568,174.5	109,267,272.2	145,764,053.2

Source: Idaho Economic Base Study for Water Requirements, Vol. I, Idaho Water Resource Board, Boise, Idaho.

TABLE 12

PROJECTIONS OF NON-INDUSTRIAL WATER REQUIREMENTS
FOR IDAHO BY HYDROLOGIC DRAINAGE BASIN
FOR SELECTED YEARS, 1980 - 2020
(Thousands of acre feet)

HYDROLOGIC DRAINAGE BASIN	1980	2000	2020
Salmon	1.11	1.77	2.30
Panhandle	24.69	27.94	32.11
Clearwater	21.20	25.39	30.34
Southwest Idaho	61.77	88.02	118.23
Upper Snake No. 1	76.35	117.05	164.03
Upper Snake No. 2	39.73	57.73	80.29
Bear River	16.12	17.43	20.03
TOTAL	240.97	335.33	447.33

Source: Idaho Economic Base Study for Water Requirements, Vol. I, Idaho Water Resource Board, Boise, Idaho.

TABLE 13

PROJECTIONS OF INDUSTRIAL WATER REQUIREMENTS
FOR IDAHO BY HYDROLOGIC DRAINAGE BASIN
FOR SELECTED YEARS 1980 - 2020
(Thousands of Gallons)

HYDROLOGIC DRAINAGE BASIN	1980	2000	2020
Salmon	1,158,297.72	2,796,217.05	4,556,975.94
Panhandle	8,635,745.39	9,911,651.53	9,224,975.02
Clearwater	25,399,612.55	28,582,973.68	27,471,944.87
Southwest Idaho	20,448,620.16	30,173,251.05	40,987,760.93
Upper Snake No. 1	13,142,297.82	26,368,893.78	36,692,891.54
Upper Snake No. 2	8,541,451.02	19,920,573.56	31,527,076.12
Bear River	4,752,215.65	9,800,191.83	12,323,421.10
TOTAL	82,078,240.31	127,553,752.48	162,794,045.52

Source: Idaho Economic Base Study for Water Requirements, Vol. I, Idaho Water Resource Board, Boise, Idaho.

TABLE 14

PROJECTIONS OF INDUSTRIAL WATER REQUIREMENTS
FOR IDAHO BY HYDROLOGIC BASINS
FOR SELECTED YEARS, 1980 - 2020
(Thousands of acre feet)

HYDROLOGIC DRAINAGE BASIN	1980	2000	2020
Salmon	3.55	8.57	13.98
Panhandle	26.50	30.41	28.30
Clearwater	77.94	87.72	84.31
Southwest Idaho	62.75	92.60	125.78
Upper Snake No. 1	40.33	80.92	112.60
Upper Snake No. 2	26.20	61.13	96.74
Bear River	14.72	30.07	37.81
TOTAL	251.99	391.42	499.52

Source: Idaho Economic Base Study for Water Requirements, Vol. I, Idaho Water Resource Board, Boise, Idaho.

TABLE 15

PROJECTIONS OF TOTAL MUNICIPAL AND INDUSTRIAL WATER REQUIREMENTS FOR IDAHO BY ECONOMIC STUDIES AREA FOR SELECTED YEARS 1980-2020

(Thousands of gallons)

REGION	1980	2000	2020
Salmon	1,613,245.12	3,565,209.28	5,608,620.86
Panhandle	16,681,435.29	19,016,156.73	19,687,380.62
Clearwater	32,237,341.35	36,688,989.95	37,085,046.25
Southwest Idaho	40,576,256.06	58,855,829.95	79,513,715.33
Upper Snake - 1	39,606,978.54	66,224,004.89	92,268,709.39
Upper Snake - 2	21,486,152.62	38,731,178.56	57,688,586.12
Bear River	8,445,005.83	13,739,655.32	16,697,040.65
STATE TOTAL	160,646,414.81	236,821,024.68	308,549,099.22

Source: Idaho Economic Base Study for Water Requirements, Vol. I, Idaho Water Resource Board, Boise, Idaho.

TABLE 16

PROJECTIONS OF TOTAL MUNICIPAL AND INDUSTRIAL WATER REQUIREMENTS FOR IDAHO BY ECONOMIC STUDIES AREA FOR SELECTED YEARS, 1980 - 2020

(Thousands of acre feet)

REGION	1980	2000	2020
Salmon	4.95	10.94	17.21
Panhandle	51.19	58.35	60.41
Clearwater	98.93	112.59	113.80
Southwest Idaho	124.52	180.62	244.01
Upper Snake No. 1	121.53	203.23	283.15
Upper Snake No. 2	65.93	118.86	177.03
Bear River	25.91	42.16	51.24
TOTAL	492.96	726.75	946.85

Source: Idaho Economic Base Study for Water Requirements, Vol. I, Idaho Water Resource Board, Boise, Idaho.

TABLE 17

PROJECTIONS OF TOTAL MUNICIPAL AND INDUSTRIAL WATER REQUIREMENTS FOR IDAHO BY HYDROLOGIC DRAINAGE BASINS FOR SELECTED YEARS 1980 - 2020

(Thousands of gallons)

REGION	1980	2000	2020
Salmon	1,521,532.52	3,372,388.45	5,307,286.94
Panhandle	16,681,435.29	19,016,156.73	19,687,380.62
Clearwater	32,307,159.75	36,857,536.78	37,359,725.87
Southwest Idaho	40,576,256.06	58,855,829.95	79,513,715.33
Upper Snake - 1	38,021,738.82	64,509,378.98	90,142,703.14
Upper Snake - 2	21,486,152.62	38,731,178.56	57,688,586.12
Bear River	10,052,139.75	16,326,471.43	18,849,700.70
TOTAL	160,646,414.81	236,821,024.68	308,588,098.72

Source: Idaho Economic Base Study for Water Requirements, Vol. I, Idaho Water Resource Board, Boise, Idaho.

TABLE 18

PROJECTIONS OF TOTAL MUNICIPAL AND INDUSTRIAL WATER REQUIREMENTS FOR IDAHO BY HYDROLOGIC DRAINAGE BASINS FOR SELECTED YEARS, 1980 - 2020

(Thousands of acre feet)

HYDROLOGIC DRAINAGE BASIN	1980	2000	2020
Salmon	4.66	10.34	16.28
Panhandle	51.19	58.35	60.41
Clearwater	99.14	113.11	114.65
Southwest Idaho	124.52	180.62	244.01
Upper Snake No. 1	116.68	197.97	276.63
Upper Snake No. 2	65.93	118.86	177.03
Bear River	30.84	47.50	57.84
TOTAL	492.96	726.75	946.85

Source: Idaho Economic Base Study for Water Requirements, Vol. I, Idaho Water Resource Board, Boise, Idaho.

Value of Municipal and Industrial Water

The combined maintenance and operating costs for municipal water supplies in the Salmon economic study area during 1966 was $144 per million gallons withdrawn (1). The ratio of revenue divided by combined maintenance and operating costs for cities, 10,000 and over in United States for the year 1945, 1950, 1955, and 1960 was 1.9 (4). On the assumption that municipalities operate without a profit motive, the revenue dollar is considered the value of municipal and industrial water.

A 2 1/2% annual growth rate of combined maintenance and operating costs is assumed. Reference 4 documents 3 to 3 1/2% increase for the years 1945 through 1960, years of above average growth rate.

The value of municipal and industrial water were obtained by multiplying 1.9 times the annual combined maintenance and operating costs assuming a 2 1/2% annual growth rate of maintenance and operating costs and applying these values to the quantities of water withdrawn in 1966 and to the water requirements projections shown in Table 18. A summary of this information is shown in Table 19.

TABLE 19

ANNUAL VALUE OF MUNICIPAL AND INDUSTRIAL WATER WITHDRAWN IN THE SALMON HYDROLOGIC DRAINAGE BASIN AND IN IDAHO FOR SELECTED YEARS 1966 - 2020

YEAR	Annual Value per acre foot (dollars/acre ft)	Annual Projected Municipal and Industrial Water Use (thousands of acre feet)[1]		Annual Value (millions of dollars)	
		Salmon Hydrologic drainage basin	Idaho[2]	Salmon Hydrologic drainage basin	Idaho
1966	89.1	1.83	394	0.163	35.1
1980	126.0	4.66	493	0.587	62.1
2000	206.5	10.3	727	2.13	150.
2020	338.0	16.3	947	5.50	320.

[1]Source: Idaho Economic Base Study for Water Requirements, Vol. I, Idaho Water Resource Board, Boise, Idaho.

[2]Quantities for Idaho do not include water for trout farms in the Snake No. 2 study region.

Conclusions

The projections obtained in Reference 1 rest on the following assumptions:

1. There will be no wars of such severity as to materially affect long-term economic growth patterns. Conversely, it may be expected that there will be no appreciable cessation of cold war activities.
2. The Federal Government, as a matter of national policy, will actively support programs designed to stimulate economic growth.
3. State and regional demand for basic products will be primarily a function of national demand.
4. The unemployment rate will be approximately 4 percent of the labor force.
5. Continued technological changes will support a steady growth in annual average productivity per man hour.
6. During the period 1967 to 1990, population in the United States will grow as projected by the U. S. Department of Commerce Series C projections; thereafter, the population of the United States will grow at the 1990 rate with immigration holding constant at 400,000 persons per year.
7. Water will not be a constraint to industrial growth.
8. In the future, conventional agriculture will provide a share of man's food supply not too different from that provided in the past.
9. There will be sufficient power available in the State of Idaho for the development or expansion of large power-using industries. Additional power loads will be supplied primarily from thermal fuel plants.
10. The rate of substitution of new products will not greatly lessen the demand for forest and wood products.
11. There will be no government legislation, or changes in criteria for classifying forest land as commercial, that will signi-

ficantly lessen the amount of timber that can be grown and/or harvested.

12. The base-ratio model is an adequate tool for projecting historical performance into the future.

If significant changes in the population growth rate occur or if a radical change in food production occurs (mass production of crops by hydrophilic processes as an example) then projections utilized in this report may be far too high. On the other hand, a dynamic statewide or Federal program to stimulate economic growth within the state could swing the pendulum the other way. In any event it will be necessary in the decision-making process to keep the assumptions fundamental to projections in mind and to adjust accordingly when these assumptions are not realized.

The impact on the present and future use of water for municipal and industrial purposes in the Salmon River Hydrologic area with the Middle Fork of the Salmon designated a Wild River will probably not be significant. Water Quality Standards as established by law will have more influence; however, the laws will in all likelyhood be applied uniformly and therefore the competitive position of the Salmon region may not change.

Over 75% of the projected water withdrawal will be utilized for exporting industries. For this reason additional information on projected resource development for individual segments of the Salmon will be necessary before assessing the impact of classifying additional segments of the Salmon as a wild river.

REFERENCES

1. Idaho Economic Base Study for Water Requirements, Idaho Water Resource Board, 1969.

2. Idaho Water Resources Inventory; Idaho Water Resource Board, 1968.

3. Report of Flood Control Subproject, edited by J. J. Peebles, Water Resources Research Institute, University of Idaho, 1970.

4. Seidel, H. F., Cleasby, J.L., "A statistical analysis of water works data for 1960," AWWA Journal, Vol. 58, December, 1966, No. 12, p. 1507.