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WATER RESOURCES PLANNING REPORT
HENRYS FORK BASIN

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C.E. 524

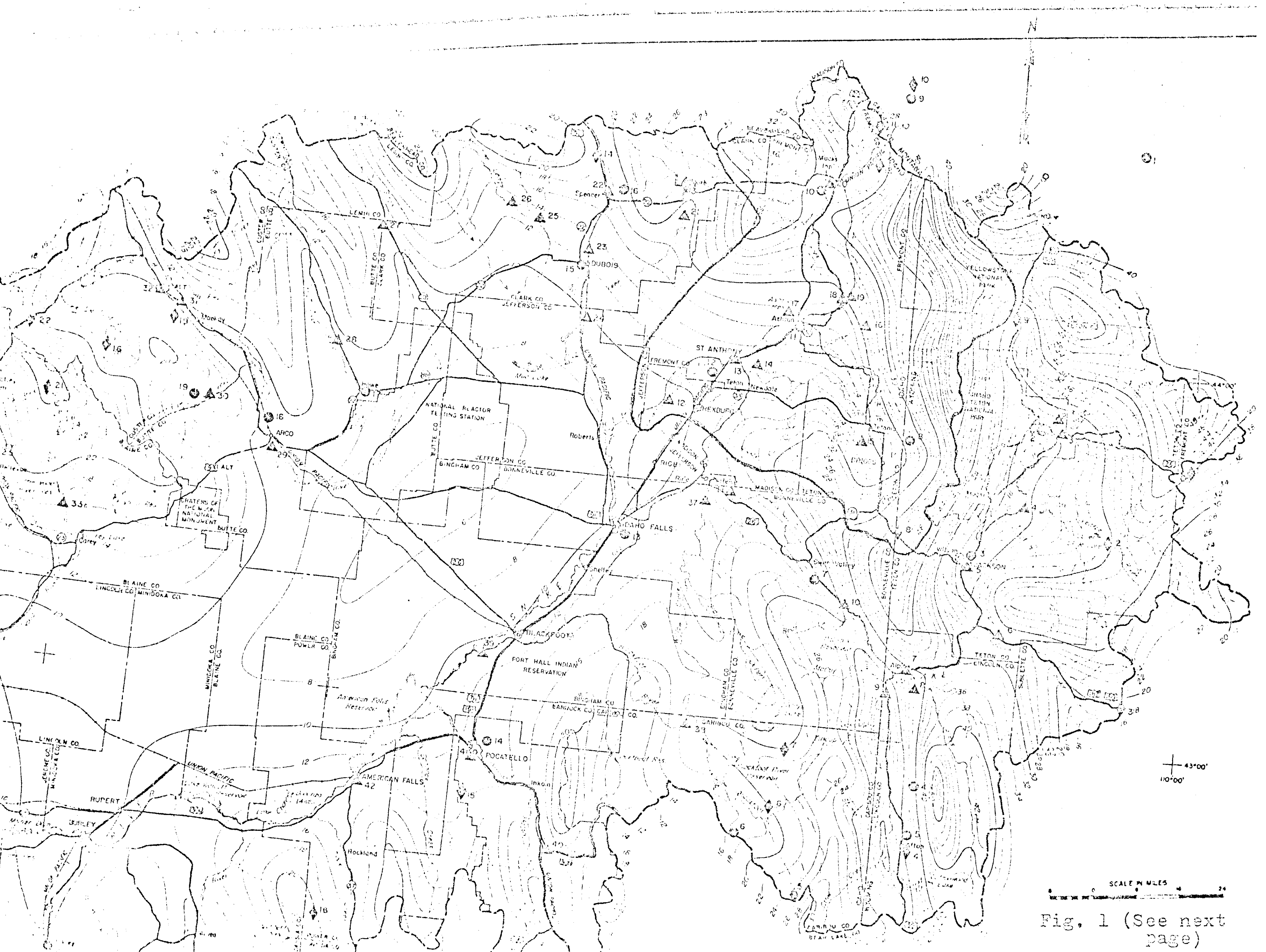
1. Basin description: physical features, climatological data and economic development.

The Henrys Fork Basin is, in general, a high elevation area but it also includes a small part of the Snake River Plains. It is one of the major tributaries areas of Upper Snake River Basin (Figure 1).

Henry's Fork rises near the Continental Divide in the Centennial Mountains west of Yellowstone National Park. The somewhat box-shaped 3,010 square mile area (Figure 2) lies in eastern Idaho and extreme western Wyoming. A high mountain range borders the basin on the east and a lateral range comprises the northern part of the basin. Lands in the basin range from an elevation of about 5,000 feet near Rexburg to over 13,000 feet in the Grant Teton Mountains.

Except in the lower elevations, the basin climate is characterized by cool summers and a prolonged cold winter season. In general, precipitation increases with an increase in elevation. Table 1 summarizes records of representative climatological stations in the area. Briefly summarized from these data the mean annual temperatures in valley areas approximates 41 degrees. July and January average temperatures in the valleys are about 64 and 16 degrees, respectively. The mean annual precipitation averaged over the basin is 26 inches, with variations from about 10 inches near Rexburg to 60 inches in the mountains. The annual precipitation is distributed with 9 to 12 percent per month in October through February, May and June; about 5 percent per month occurs in July and August; and 6 to 8 percent per month occurs in March, April, and September. Precipitation in individual years varies from about 50 to 170 percent of the annual mean.

A considerable amount of the annual precipitation, particularly at higher elevations, occurs as snowfall. Snow accumulates on the ground during the cooler months and is melted by increasing temperatures during



Fig, 1 (See next page)

LEGEND

NORMAL ANNUAL PRECIPITATION ISOHYETS

STREAM GAGING STATIONS

CLIMATOLOGICAL STATIONS

SNOW COURSES

STREAM GAGING STATIONS

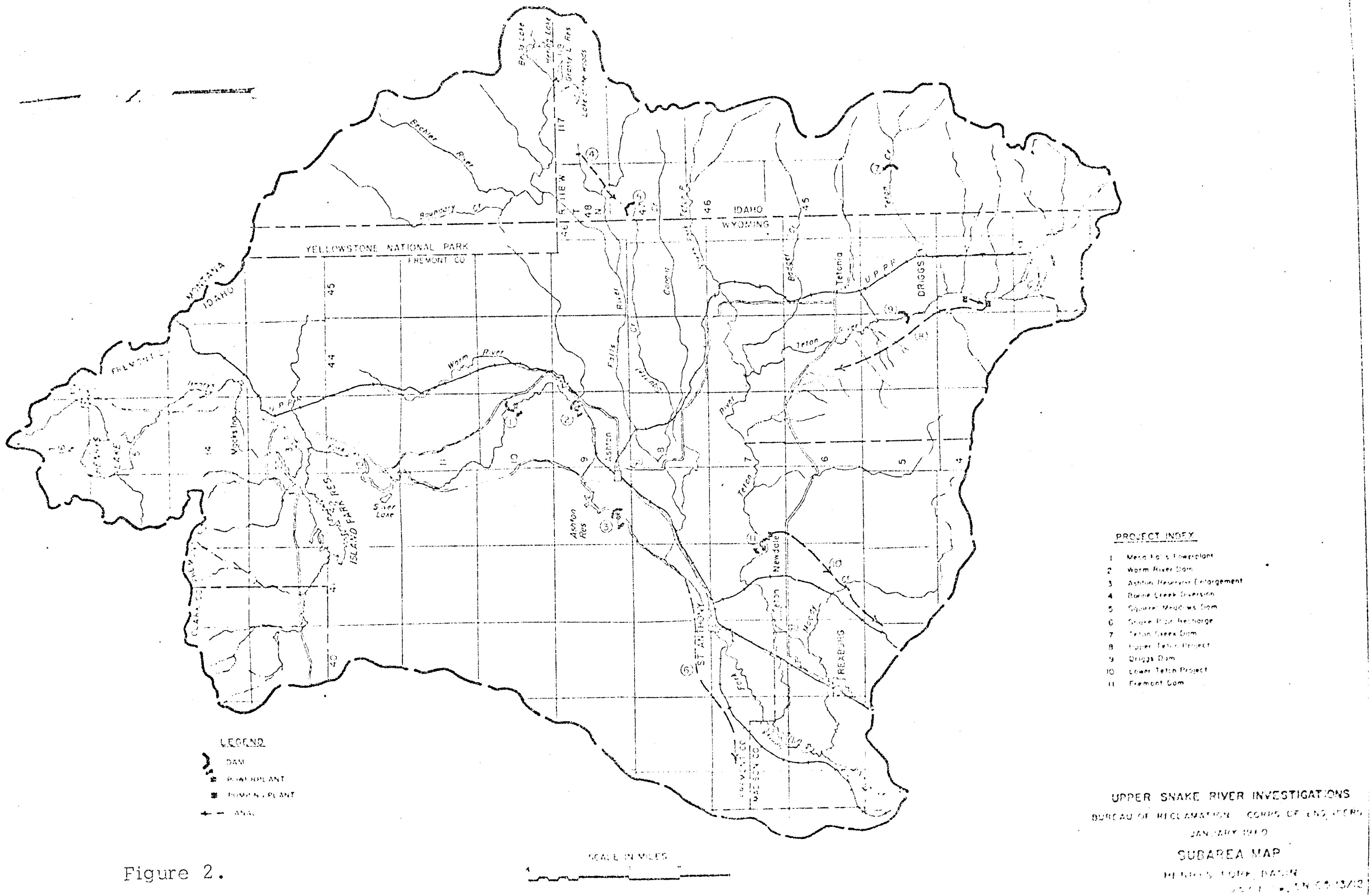
Sta. No.	Stream	Location	Drainage Area Square miles
12	Henrys Fork	Near Rexburg	2,920
13	Henrys Fork	At St. Anthony	1,770
14	Teton River	Near St. Anthony	890
15	Teton River	Near Driggs	303
16	Fall River	Near Squirrel	351
17	Henrys Fork	Near Ashton	1,040
18	Henrys Fork	At Warm River	656
19	Warm River	At Warm River	178
20	Henrys Fork	Near Island Park	481

CLIMATOLOGICAL STATIONS

Sta. No.	NAME OF STATION	ELEVATION FEET
8	Alta	6,411
9	West Yellowstone	6,662
10	Island Park Dam	6,300
11	Ashton	5,220
12	Sugar	4,890

SNOW COURSES

Sta. No.	COURSE	ELEVATION FEET
8	State Line	6,400
9	Snake River Station	6,780
10	West Yelloestone	6,700
11	Valley View	6,500
12	Big Spring	6,500



IDAHO
WYOMING
MONTANA
YELLOWSTONE NATIONAL PARK
FREMONT CO
Bechler River
Boundary Cr
Warm River
Falls River
Teton
DRIGGS
Tetonia
ASHTON
Ashton Res
ST ANTHONY
Newdale
REXBURG
ISLAND PARK RES
Silver Lake
LEGEND
DAM
PROJECT INDEX
1 Mesa Falls Powerplant
2 Warm River Dam
3 Ashton Reservoir Enlargement
4 Boone Creek Diversion
5 Squirrel Meadows Dam
6 Snake Plain Recharge
7 Teton Creek Dam
8 Upper Teton Project
9 Driggs Dam
10 Lower Teton Project
11 Fremont Dam
SCALE IN MILES
UPPER SNAKE RIVER INVESTIGATIONS
BUREAU OF RECLAMATION - CORPS OF ENGINEERS
SUBAREA MAP
HENRYS FORK BASIN

Figure 2.

TABLE 1

SUMMARY OF TEMPERATURE, PRECIPITATION & SNOW DATA
REPRESENTATIVE LOCATIONS, HENRYS FORK BASIN

Station 1/	Elevation Ft. M.S.L.	Records2/ Years	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ye
			Average temperatures - Degree F												
West Yellowstone	6,662	29	11.7	16.1	22.4	34.5	43.9	51.0	59.5	57.0	48.2	38.0	22.8	14.9	35
Island Park Dam	6,300	21	12.8	16.8	23.8	36.5	46.4	52.6	61.2	59.6	51.4	42.7	26.7	19.5	37
Ashton	5,220	51	18.2	21.7	28.5	41.0	50.2	57.4	64.8	63.2	54.4	44.4	31.8	20.6	41
Sugar	4,890	32	16.6	20.4	30.0	43.0	51.9	59.5	66.7	63.1	54.6	44.5	31.7	20.2	41
Alta	6,411	46	18.1	21.5	27.0	37.9	47.1	53.9	63.0	61.4	53.2	43.7	29.5	22.3	39
			Average precipitation - Inches												
West Yellowstone	6,662	29	2.20	1.79	1.94	1.38	2.01	2.55	1.28	1.19	1.17	1.59	1.78	2.27	21.
Island Park Dam	6,300	20	3.08	3.24	2.48	1.81	2.37	3.56	0.77	1.32	1.70	2.42	3.09	2.92	28.
Ashton	5,220	51	1.88	1.52	1.21	1.16	1.71	1.66	0.94	0.79	1.12	1.28	1.30	1.64	16.
Sugar	4,890	46	1.20	0.92	0.68	0.79	1.25	1.26	0.63	0.52	0.97	1.01	0.69	1.10	11.
Alta	6,411	48	1.51	1.43	1.51	1.37	2.07	2.34	1.04	1.10	1.29	1.53	1.37	1.56	18.

Snow depths and water depths - Inches

Course	Elevation Ft. M.S.L.	Records Years	Averages of records: Jan 1 3/ Snow depth	Jan 1 3/ Water depth	Feb 1 3/ Snow depth	Feb 1 3/ Water depth	Mar 1 3/ Snow depth	Mar 1 3/ Water depth	Apr 1 3/ Snow depth	Apr 1 3/ Water depth	May 1 3/ Snow depth	May 1 3/ Water depth	Maximum recor: Snow depth	Water depth	Mt
West Yellowstone	6,700	25	23.3	5.0	32.6	7.9	37.6	10.4	37.0	11.8	-	-	62.0	19.0	Ap
Valley View	6,500	23	26.9	5.3	40.5	9.7	48.1	13.0	48.7	15.4	-	-	81.0	30.0	Ap
Big Springs	6,500	23	33.8	7.3	50.1	13.1	61.3	18.7	61.4	21.7	35.2	15.5	91.0	34.7	Ap
State Line	6,400	23	27.4	5.9	39.9	9.9	46.2	13.2	47.2	16.1	24.0	9.7	74.0	27.9	Ap

Notes: 1. Station locations shown on figure 1.
2. Record years are overall. Data are sometimes for shorter periods.
3. Approximate survey date.

April through June. Table 1 shows also snow depths and water equivalent at representative locations.

The major tributary in the subbasin is the Teton River of about 890 square miles. Agriculture is the basic economic resource of Teton River basin. The extent of development, however, differs significantly in each of three regions: The upper and lower Teton valleys and the canyon stretch between them.

The upper Teton Valley is primarily dependent on livestock and small grain production, with dairying and potato production of somewhat less importance. Full development of this basin has been restricted because of a shortage of late-season irrigation water compounded by a high water table which affects some 14,000 to 20,000 acres on the right bank of the river. Even without these limitations, however, the short growing season would prevent intense cultivation of many new crops. The population of the upper Teton basin, which totaled 3,101 in the 1960 census, is about equally divided between farm residents and those living in the rural communities of Driggs, Victor, and Tetonia. These latter communities provide the immediate consumer markets and farm trading facilities for the valley, though major needs are satisfied at Rexburg, 40 miles downstream in the lower valley, or at Idaho Falls, some 65 miles west on Snake River.

In the vicinity of the village of Tetonia, Teton River leaves the upper valley and enters a deep narrow canyon. Little or no development has taken place in the canyon proper although the benchlands on either side are devoted to dryland grain farming.

Some 30 miles further downstream, near the community of Teton in Fremont County, Teton River leaves the canyon and enters the lower valley leading to its confluence with Henrys Fork. Here the agricultural development has been intensified to a degree far beyond that elsewhere in the basin. The rich soil, under irrigation, produces abundant yields of such crops as potatoes and sugar beets, as well as hay, grain and pasture in support of high quality dairy herds.

Consumer marketing and farm trading facilities are available at Rexburg and St. Anthony. Other rural communities are Sugar City, population 584, and Teton, population 399. The economy of these centers is directly related to the agricultural development of the area.

The Union Pacific Railroad provides connections throughout Teton Basin. U. S. Highway 20 - 191 traverses the lower valley, with State Highway 33 providing access to the upper Teton region. Both gravel and hard-surfaced farm-to-market roads serve the area. Power and telephone facilities are available to the majority of the residents of Teton Basin.

The Henrys Fork Basin itself is a region that varies from primitive, timbered, mountain areas in upper Henrys Fork Basin to highly developed agricultural lands near the mouth of Henrys Fork. Above St. Anthony, agriculture is generally limited to hay and pasture in support of beef production. In the reach below, to Snake River, are many diversified farms producing row crops, hay and grain as well as milk from farm dairy herds. In this lower reach, an intricate system of irrigation canals and ditches provides vital supplies of water from Henrys Fork and Teton River to the land. Urban centers which supply the needs of the area are St. Anthony, Fremont, County seat, (1960 population, 2700) and Rexburg, Madison County seat, (1960 population, 4767). Other towns and villages which provide for immediate farm needs are Ashton, population 1,242; Newdale, population 272; Teton and Sugar City. Major shopping and trading facilities are found at Idaho Falls on Snake River some 25 miles southwest of the area.

The main transportation facilities of Henrys Fork Basin include also a branch of the Union Pacific Railroad, U. S. Highway 20-191, and State Highways 32, 33, and 47. A good system of farm-to-market roads traverses the area. Power and telephone facilities are available to the majority of residents.

2. Present Water Uses

Irrigation development in this area commenced in the late 1800's. At the present time, there are about 170,000 acres irrigated from surface water and about 5,000 acres irrigated from ground water.

Teton River Basin is the only Henrys Fork tributary area containing any large irrigated areas, and there are some 45,000 acres of land in the Upper Teton Valley under irrigation. The growing seasons are short because of the high altitude and hardy crops are grown such as hay, pasture, and grain. Frost has been known to occur during every month of the year. Dairying is the principal farm enterprise. Some beef is pastured on the subirrigated "bottom" land, but most beef pastured in the basin is wintered on irrigated farms of the Snake River Plain. A few potatoes are grown in the area.

That part of the Henrys Fork Valley considered a part of Snake Plain roughly begins at Ashton and extends to the mouth of Henrys Fork. It includes the lower Teton Basin and areas near the mouth of Fall River. The growing season is longer than at higher elevations in the basin, and row crops, such as potatoes and sugar beets are grown. An estimated 115,000 acres of irrigated land are on Snake Plain in the Henrys Fork Basin. Hay and grain are also raised and used to feed livestock which are important in the area.

Irrigation has been developed on about 15,000 acres in small blocks of land along minor streams tributary to Henrys Fork, of which there are about 3,000 irrigated acres above Ashton in the vicinity of Squirrel and Drummond. Hay, grain and a few potatoes are grown on these lands, but the short growing season and the lack of late-season water limit yields.

There are three storage reservoirs in the basin with a combined total usable capacity of 221,700 acre-feet. Henrys Lake Reservoir, located in the headwaters of the Henrys Fork River, was constructed in 1923 by the North Fork Reservoir Company, an organization of water users on the Henrys Fork. The reservoir was formed by a concrete dam at the outlet of Henrys Lake which raised the lake surface some 15 feet. The reservoir has a usable capacity of 79,300 acre-feet. Floodwaters of Dry Creek were diverted into Henrys Lake from 1924 until 1943; since 1943 very little water has been diverted from Dry Creek to Henrys Lake.

Island Park Reservoir, located on the Henrys Fork about 15 miles below Henrys Lake Reservoir, built by the United States, was completed in the fall of 1938. The reservoir has a total capacity of 127,600 acre-feet, of which 127,200 acre-feet are active.

Grassy Lake Reservoir, located on Grassy Lake Creek, a small tributary of Fall River, was constructed by the United States and completed in the fall of 1939. The reservoir was formed by an earthfill, rockface dam at the outlet of Grassy Lake. The dam raised the original lake surface some 75 feet to provide a total capacity of 15,500 acre-feet, some 15,200 acre feet of which are active. A feeder canal with a capacity of 220 cubic feet per second was constructed to divert water from Cascade Creek, an adjoining tributary of Fall River into Grassy Lake Reservoir.

Provision was made to deliver stored water to the canals diverting from the lower Teton River by constructing a feeder canal from the Henrys Fork. The Cross Cut Canal was built under the United States Reclamation program and started operating in 1938. It diverts from the Henrys Fork just below the mouth of Fall River and empties into Teton River a short distance above the upper canal diversion in the lower Teton River area. Water can also be delivered through this canal to about 5,000 acres under the lower canals diverting from Fall River.

The Utah Power and Light Company have hydroelectric powerplants on Henrys Fork at Ashton and at St. Anthony, both of which started operating about 1915. The Ashton plant has an installed capacity of 5,800 kilowatts and an average operating head of about 46 feet. The St. Anthony plant has an installed capacity of 500 kilowatts and operates under a 15-foot head. Both of these plants are located above the points of diversion to most of the Henrys Fork Canals. At the time Island Park Reservoir was constructed, an agreement was reached whereby the beginning of the storing season at Island Park would be delayed until November 15 each year in order to maintain the power production at the Ashton plant during the fall when the lowest runoff occurs. This operation schedule causes no reduction in storage in the Island Park Reservoir, because in wet years there is always sufficient inflow after November 15 to fill the reservoir, and in dry years the water is required downstream to fill prior storage rights of American Falls Reservoir.

There are several large land areas in the Henrys Fork Basin that are now subirrigated. One such area of about 28,000 acres on the west side of Henrys Fork for about 20 miles downstream from St. Anthony is locally known as "Egin Bench." In the early stages of development, the settlers built a canal from the Henrys Fork near St. Anthony and attempted to surface irrigate the land on Egin Bench in the usual manner. The water percolated into the porous soil and subsoil so fast, however, that the farm ditches became dry on very short runs. After several years of continued attempts to surface irrigate a few scattered tracts, it was noted that the water table was rising rapidly under the upstream portion of the bench near St. Anthony and had reached the surface in a few places near the main canal. The flourishing crops and native vegetation in these seeped areas immediately proved that subirrigation was more beneficial to plant growth than surface irrigation. Greater efforts were then made to raise the water table to the surface over a larger area by providing ponding areas, by operating the main canal all winter, and by keeping water in the distribution system throughout the ice-free period. Additional canals were constructed to divert Henrys Fork water at and above St. Anthony. The canal systems were extended the full length of the bench, and the water table was eventually raised in the summer to ground surface throughout the area. Subirrigation has been successfully practiced in this areafor over 50 years. Other large land areas in the Henrys Fork Valley are irrigated in a similar manner. This method of water application results in high average water deliveries to the lands. In 1958, over 975,000 acre-feet of water were diverted to the 114,000 acres in the Henrys Fork Valley irrigated with surface water supplies.

The increase in the water supply in the Mud Lake area since 1900 has long been attributed by inhabitants of the region to the underground movement of water used in irrigation of Egin Bench. According to the early residents of the area, Mud Lake was a more or less intermittent pond prior to 1900, and there were no springs in the vicinity of the lake. About 1900, approximately 5 years after irrigation began on Egin Bench, water was noted standing in pools along the railroad near Hamer, and from then on the water levels in the wells around Mud Lake rose steadily. Ground-water studies in the Henrys Fork Basin indicate that Henrys Fork probably was a losing stream above the Rexburg gaging station before the high water tables were built up on both sides of the river by irrigation.

However, the large applications of water in the Henrys Fork Valley and the resultant raising of the water tables has increased the losses from Henrys Fork Valley.

3. Assessment of the water supply

Surface Water Supply

Streamflow Characteristics

Henrys Fork and most of its tributaries are fed largely by snowmelt, and therefore have quite regular patterns of low flows during late summer, fall, winter, and early spring months, and high flows during the later spring and early summer months. Annual runoff volumes vary with seasonal precipitation, and temperature variations control to a large extent the rates of discharge during the high spring runoff season. To the extent that runoff is caused by snowmelt, the seasonal runoff volumes can be forecasted with reasonable accuracy based on seasonal precipitation, water content of the snow on the ground, antecedent runoff, and other factors that can be evaluated prior to the high runoff season. Streams draining the eastern part of the area tend to have the most sustained flows because of the large area of high mountains in which abundant snowfall occurs. The Henrys Fork Basin is unique in that an important tributary, Warm River and one branch of the Main Stem near its headwaters appear as large, continually flowing springs. Rainstorms are not a highly important cause of high runoff, but occasional periods of unseasonably warm temperature in the early spring do create some early high flows.

Streamflow Data

Table 2 summarizes recorded runoff at selected gaging stations in the Henrys Fork Basin. Although the streamflow records reflect storage regulation and effect of diversions for irrigation, the table does show the relative contribution of tributary streams and the main stem at key locations in the basin.

Ground-Water Supply

In the Upper Teton Basin, depths to water range from less than one foot in the water-logged area along Teton River to more than 200 feet near the east and west margins of the basin. The depth to water depends partly on topography and partly on local recharge and discharge. During the spring and fall, water levels may vary as much as 100 feet along the east side of the basin. The water table is lowest during early spring and rises rapidly during May, June, and July as the snow in the surrounding mountains melts and the water is carried into the valley by streams. During the latter

TABLE 2

DISCHARGE DATA

Representative Gaging Stations
Henrys Fork River Basin

		Record Period Discharges 1/					Annual Water Supply	
							Mean	
Stream	Location	Area Sq. Mi.	Period Water Yrs.	Avg. Cfs	Max. Cfs	Min. Cfs	1000 AF	Inches
Henrys Fork	Near Island Park	481	33-69 3/	567	2,770	1 4/	411	16.1
Henrys Fork	At Warm River	656	10-15,18-52	998	3,540	217 4/	701	20.0
Warm River	At Warm River	178	12-15,18-33	229	900	123	155	16.3
Henrys Fork	Near Ashton	1,040	02-09,26-69	1,387	6,220	53	1,005	18.2
Fall River	Near Squirrel	351	02-09,18-69	755	6,440	72	547	30.0
Henrys Fork	At. St. Anthony	1,770	19-69 3/	1,692	9,030	118 4/	1,226	13.0
Teton River	Near Driggs	335	61-69	373	2,050	75	272	15.2
Teton River	Near St. Anthony	890	03-69 3/	770	11,000	214	560	11.8
Henrys Fork	Near Rexburg	2,920	09-69	1,911	11,000	183 5/	1,370	8.8

Notes: 1/ Data from U.S.G.S., Water Resources Data for Idaho (1969).

3/ Records incomplete.

4/ Regulated by upstream reservoirs.

5/ Large effects due to upstream regulation and irrigation diversions.

part of July, August, and September, the water table drops rapidly as the water is discharged to Teton River from water-logged lower parts of the valley. In this respect, the valley acts as an under ground storage reservoir which is recharged largely during the late spring and early summer. Discharge from the reservoir is continous throughout the year. An unknown amount of ground water leaves the valley by under flow toward the north, some of which enters Teton River through springs discharging several miles below Tetonia.

The alluvium yields adequate supplies of water for domestic and stock use and is capable of yielding amounts sufficient for irrigation to properly constructed and developed wells. A test well was drilled 3.5 miles southeast of Driggs and pumping tests made. It was concluded from these tests that properly constructed wells in the area would yield up to 5 cubic feet per second with only a small amount of drawdown. From chemical analyses made of the ground water, it was concluded this source of water is of satisfactory quality for irrigation use.

Downstream from Ashton, the Henrys Fork is above the main water table and water is lost by percolation from the channel between Ashton and the mouth of Henrys Fork. The main water table is about 100 feet below the surface in the vicinity of St. Anthony and Parker and a perched water table has developed in the area because of the large diversion, particularly on the north side of the river on the Egin Bench. The perched and main water tables converge toward the west and merge a few miles west of Egin Bench.

Water Available for Future Use

Surface Water

The gaging station on Henrys Fork at Rexburg measures the quantity of water leaving the Henrys Fork Basin. The runoff during the period 1928 through 1957 ranged from 601,000 acre-feet to 1,921,000 acre-feet a year and averaged about 1,290,000 acre-feet. Studies were made to determine the effect present development would have on the quantity of water leaving the basin. It has been estimated that with present development in the Henrys Fork Basin, Henrys Fork River and tributaries would contribute about 1,270,000 acre-feet a year on the average to Snake River. It is estimated the runoff would range between 606,000 acre-feet and 1,923,000 acre-feet.

Even though large quantities of water now leave the Henrys Fork Basin unused only in those years when water is wasting past Milner Dam could additional water be used in the Henrys Fork Basin without conflict with downstream irrigation water rights.

Ground Water

One area that holds promise as a source of ground-water supply is the Upper Teton River Basin. Studies made by the U. S. Geological Survey indicate that ground water is available at reasonable depths and in sufficient quantities on the east side of Teton River to make it a prospective source of water supply for future irrigation development. It has been estimated that up to 25,000 acre-feet of water a year could be pumped without an excessive lowering of the water table.

Ground-water studies also show the water table in this area is tributary to Teton River. Therefore, ground-water pumping in the area would result in some reduction in flow of Teton River. Because of prior downstream water rights, some source of replacement supply and exchange arrangements would be necessary to permit development of the ground-water resources for future irrigation in upper Teton River Basin.

4. Projection of needs

Among the needs in the conventional functional uses of water three must be emphasized in this basin.

Flood problems in Henrys Fork Basin are found along Henrys Fork from the vicinity of St. Anthony to the mouth and along lower Teton River. These same reaches are also subject to bank erosion. Relief might be afforded by storage and/or channel works. Flood control should therefore be considered as a main objective.

Existing irrigation in the basin total over 170,000 acres in area, served by three reservoirs. Investigations have established the desirability of extending irrigation facilities to new lands. Supplemental water and additional storage for further development are important objectives too.

Besides, this subarea ranks high in hydroelectric power potential. Therefore it is imperative that full consideration be given to development of that potential.

Flood Control

Floods in this subarea are important on the lower reaches of Henrys Fork and the lower reaches of Teton River. The following paragraphs describe separately for the both areas the flood characteristics, channel capacities, past floods, existing regulation, flood frequencies and flood damages.

Henrys Fork

Floods

Floods in this stream result largely from snowmelt runoff. Flood flows occur annually in the late spring and early summer; with peaks occurring among a series of high fluctuating discharges of several days to several weeks duration. Peaks are related to seasonal runoff volumes, but the precipitation and temperatures that occur during the flood runoff season influence the concentration of high flows and the date and magnitude of the peaks.

Inadequate capacity for high flood flows exists in the lower 22 miles of Henrys Fork. The bankfull capacity of this reach approximates 5,000 cubic feet per second; a flow of 9,000 cubic feet per second causes general inundation along the stream.

Floods exceeding bankfull capacity have occurred in a majority of the years of record since 1909. The 1894 flood, estimated peak 11,600 cubic feet per second, is the largest historical flood in the stream. The 1927, 1964, and 1968 floods were the largest floods of actual record, with discharges exceeding 8,500 cubic feet per second. Table 3 lists annual flood peaks for Henrys Fork near Ashton and Rexburg. The location of these stations is shown on Figure 1.

A number of upstream reservoirs and large irrigation diversions at the upper end of the lower valley modify the magnitude of natural flood peaks. Peaks also reflect effects of sizable upstream irrigation diversions. These diversions are of reasonably uniform magnitude, but are so complex that it is not practical to derive peaks without them.

Frequencies of maximum annual flood peaks in Henrys Fork near Rexburg, representative of conditions in the critical flooding reach in the lower stream, are shown in the following tabulation for existing conditions and for conditions without upstream regulation:

Exceedence Probability Percent	Exceedence Frequency Years	Discharges Equalled or Exceeded	
		Actual c.f.s.	Unregulated c.f.s.
50	2	6,250	6,400
20	5	7,600	8,000
10	10	8,350	8,600
5	20	9,200	9,200
2	50	10,300	10,300
1	100	11,200	11,200

Extent and Character of Flooded Areas

For convenience of analysis, the Henrys Fork flood plain has been divided into 5 reaches: the Source to St. Anthonys, St. Anthony to North Branch Teton River, North Branch to South Branch Teton River, and South Branch Teton River to the mouth of Henrys Fork. Above St. Anthony, the flood plain includes only undeveloped brush, pasture and timber land. Through St. Anthony, the flooded area is restricted to a deep rock channel in which little development has occurred. Even below St. Anthony, the flood plain is generally restricted to a strip of brush and pasture on either side of the river. It is only below North Branch Teton River that the flood plain encompasses a significant amount of cropland; yet, even here, narrow belts of undeveloped brush pasture stretch along both sides of Henrys Fork to the mouth. The flood plain of a discharge similar to that of 1894, 11,600 cubic feet per second, includes a total of 9,000 acres, consisting of 5,300 acres of brush pasture, 1,800 acres of hay, 1,200 acres of small grain and 700 acres of row crops. Improvements in the flood plain include roads and bridges, minor irrigation structures and several groups of farm buildings in the lower reach near Snake River.

Flood Damages

Due to the nature of development in the flood plain, as noted above, flood damages on Henrys Fork occur only downstream from North Branch Teton River. Inundation results in damage to roads, bridges, irrigation works, farmsteads and crops and pasture land. Analysis of these flood damages were based on field damage surveys, correlated with studies of maps, photographs and hydrologic data. Damages for floods of several discharges were then developed. The following table presents damages at 1959 price levels and development by various classification for three representative flows:

Flow at Gage near Rexburg Year of Historical Peak Flow	5,430 cfs 1944 FLD	7,560 cfs 1918 FLD	11,600 cfs 1894 FLD
Class of Property			
Agricultural			
Crops	$3,200	$76,200	$180,000
Other than Crops	1,800	40,300	143,000
Residential	-	4,400	36,000
Public Properties	-	500	3,000
Transportation Facilities	-	14,400	30,000
Flood Fight	200	1,000	20,000
TOTALS	$5,200	$136,800	$412,000

Teton River

Floods

Floods in Teton River and tributaries are primarily snowmelt floods, but some difficulties result also from rainstorms in the tributary streams and also ice formation in both Teton River and its tributaries. As on Henrys Fork, the snowmelt floods occur as a series of high flows for prolonged periods of several days to several wekks in the late spring and early summer. Teton River and several of its tributaries overflow in the early spring from ice jams when temperatures moderate suddenly, following prlonged periods of subfreezing temperatures. The ice accumulates at

TABLE 3

OBSERVED ANNUAL FLOOD PEAKS IN HENRYS FORK

Water Year	Near Ashton 1040 sq.mi. Cfs	Date	Water Year	Near Rexburg 2920 sq.mi. Cfs	Date	Water Year	Near Ashton 1040 sq.mi. Cfs	Date	Water Year	Near Rexburg 2920 sq.mi. Cfs	Date
1890	6000	5/8	1894	11,600 1/		1939	3630	5/4	1939	5060	5/2
1891	2910	5/6	1909	7,680	6/6	1940	2950	4/26	1940	4350	6/9
			1910	6,810	4/30	1941	2380	7/20	1941	3540	5/29
			1911	6,650	6/17	1942	3050	5/26	1942	4580	6/11
1903	3970	5/8	1912	7,200	6/11	1943	4290	6/2	1943	7040	6/3
1904	5370	5/20	1913	6,720	5/29	1944	2510	8/12	1944	5430	6/12
1905	2280	4/24	1914	7,050	6/6	1945	4580	6/8	1945	7910	6/11
1906	3030	4/29	1915	6,200	6/4	1946	5060	4/27	1946	7130	4/28
1907	3750	5/12	1916	6,490	5/8	1947	4140	5/4	1947	6370	6/11
1908	4000	6/6	1917	8,750	5/31	1948	3370	5/8	1948	6740	5/23
1909	4250	5/29	1918	7,560	6/25	1949	3740	5/22	1949	7650	5/24
			1919	5,930	4/30	1950	3630	5/16	1950	6570	6/9
1920	5130	5/16	1920	6,350	5/19	1951	3330	5/7	1951	5210	5/14
1921	4140	5/5	1921	8,300	6/2	1952	5040	5/21	1952	7820 2/	5/6
1922	4370	5/8	1922	6,470	5/22	1953	3190	6/5	1953	5880	6/9
1923	3760	5/7	1923	5,000	5/28	1954	3650	8/29	1954	5100	5/23
1924	2220	5/3	1924	1,800	10/20	1955	3400	7/19	1955	4000	6/5
1925	6220	5/7	1925	8,980	5/23	1956	3240	5/8	1956	5930	5/30
1926	3560	4/21	1926	4,950	4/23	1957	5040	5/21	1957	8680	5/22
1927	5220	5/17	1927	9,490	6/29	1958	3400	5/12	1958	5210	5/27
1928	3440	5/11	1928	7,700	5/14	1959	3300	7/11	1959	4070	6/28
1929	3230	5/17	1929	6,230	6/19	1960	2680	8/1	1960	4150	4/11
1930	2880	4/11	1930	3,030	4/15	1961	2930	8/7	1961	2470	5/31
1931	1630	4/20	1931	2,280	5/17	1962	3880	5/9	1962	7100	2/14
1932	4060	5/12	1932	7,060	6/18	1963	2890	5/9	1963	5430	5/16
1933	2760	5/18	1933	4,980	6/16	1964	3960	6/12	1964	11000	6/20
1934	1740	4/9	1934	1,790	11/21	1965	4620	5/12	1965	8610	6/28
1935	2450	5/11	1935	3,620	6/3	1966	2890	5/11	1966	3810	5/12
1936	3170	5/1	1936	5,700	5/17	1967	4400	5/30	1967	7130	5/31
1937	2920	5/9	1937	4,040	6/14	1968	3130	5/6	1968	8840	6/15
1938	4040	5/1	1938	6,220	5/3	1969	4840	5/8	1969	6760	4/25

NOTES: 1/ Estimated from records on Snake River
2/ Unregulated peak estimated to have been 10,100 c.f.s.

constrictions and, despite relatively low discharges, raises water surface devations to flood heights locally. Also, although not experienced frequently, rainstorms have caused out-of-bank flows during the spring months, principally in the smaller drainage areas.

The channel capacities of the lower 33 miles of Teton River and also a reach between miles 67 and 99 are inadequate to contain high flows. Nominal bankfull capacity in the lower reach is 2,000 cubic feet per second and general inundation occurs with a discharge of 4,000 cubic feet per second. In the upper reach, flows in excess of 1,800 cubic feet per second cause flooding of adjacent lands. The effects of icing are such that in a recent year there was considerable flooding in the lower reach of Teton River with a discharge of about 400 cubic feet per second. Moody Creek in its lower reaches has an estimated channel capacity approximating 200 cubic feet per second.

In Teton River, large floods in the period of record occurred is 1890, 1892, 1893, 1909, 1921, 1925, 1927, 1928, 1950, 1956, 1957, 1958, 1959, 1962, 1963, 1964 and 1967. The 1894 and 1918 floods probably were as large as any of those listed above, but their peak discharges on the stream have not been estimated. Table 4 lists annual peak discharges of record for Teton River near St. Anthony, representative of discharges in the lower reach of the river. Figure 1 shows this stream gage location. There are no records of flood peaks on Moody Creek. In general, floods on Moody Creek probably vary approximately with peaks on Teton River.

With the exception of a few very small reservoirs and some fairly large irrigation diversions, floods on Teton River are unregulated. Some help in flood times has been given to the lower valley by intentional excessive diversions in the upper valley and temporary floods of the extensive pasture lands which have porous subsoils and high percolation rates. On the tributaries, the floods are uncontrolled or unregulated.

Frequencies for existing conditions, determined from streamflow records, are shown below for Teton River near St. Anthony and near Tetonia. For Moody Creek, frequencies in the following tabulation have been estimated from adjacent streams and a regionalized study.

TABLE 4

OBSERVED ANNUAL FLOOD PEAKS IN FALL RIVER AND TETON RIVER

Water Year	Fall River near Squirrel 351 sq.mi.		Teton River near St. Anthony 1/ 890 sq.mi.		Water Year	Fall River near Squirrel 315 sq. mi.		Teton River near St. Anthony 1/ 890 sq. mi.	
	Cfs	Date	Cfs	Date		Cfs	Date	Cfs	Date
1890	-	-	4440	5/29	1939	2670	5/17	2270	5/18
1891	-	-	2360	5/8	1940	3950	6/1	2040	5/14
1892	-	-	5410	6/21	1941	2490	5/28	2390	5/28
1893	-	-	5830	6/13	1942	2950	6/9	3550	6/10
1903	-	-	3080	6/9	1943	3320	5/29	3280	5/30
1904	-	-	3950	5/24	1944	2640	6/9	2830	6/28
1905	2710	6/10	1760	6/3	1945	2940	6/6	3270	6/9
1906	2580	6/6	3300	6/14	1946	2700	6/6	2320	4/27
1907	3130	6/8	3040	5/29	1947	3500	6/10	2680	5/9
1908	2970	6/19	4250	6/17	1948	3690	6/8	3560	5/29
1909	4160	6/4	5230	6/5	1949	3710	5/17	3660	5/17
1918	5380	6/14	-	-	1950	3310	5/24	4010	4/2
1919	4730	5/29	-	-	1951	3200	5/29	3490	5/29
1920	2900	6/12	3040	6/12	1952	3560	6/9	3180	5/5
1921	3560	6/12	4390	6/13	1953	3450	6/19	3270	6/19
1922	3980	6/22	3300	5/26	1954	2710	6/10	2950	5/22
1923	2630	6/13	3410	5/26	1955	3420	6/23	2070	6/13
1924	1920	5/21	1580	5/18	1956	3890	6/2	3790	6/2
1925	3650	5/23	4230	5/21	1957	4080	6/6	4660	6/6
1926	2520	5/25	2370	5/6	1958	3640	5/26	3680	5/24
1927	6440	6/27	4100	6/14	1959	3830	6/15	3790	4/3
1928	4330	5/27	4350	5/13	1960	4750	6/4	2300	5/13
1929	3540	6/30	3220	5/25	1961	2890	5/31	2130	5/27
1930	2300	6/12	1780	4/3	1962	3000	5/10	11000	2/12
1931	3120	5/17	1260	5/16	1963	3180	6/15	7280	2/3
1932	5600	6/17	3390	6/17	1964	3900	6/18	5000	6/19
1933	4960	6/15	2560	6/15	1965	3610	6/26	3080	6/12
1934	1780	5/9	862	5/7	1966	2560	5/11	2510	5/11
1935	4040	6/1	3990	5/15	1967	4240	5/29	4150	6/23
1936	4040	6/1	3990	5/15	1968	4300	6/13	3560	6/14
1937	3010	6/23	2020	5/19	1969	2850	5/28	2440	5/13
1938	3050	6/8	3940	4/19					

Note: 1/ Reflects some diversion of water for irrigation.

Exceedence Probability Percent	Exceedence Frequency Years	Discharge Equalled or Exceeded: Teton R nr Tetonia c.f.s.	Teton R nr St. Anthony c.f.s.	Moody Cr nr Mouth c.f.s.
50	2	1,450	3,050	200
20	5	1,760	4,170	340
10	10	1,940	4,950	440
5	20	2,080	5,650	560
2	50	2,260	6,800	720
1	100	2,380	8,700	840

Extent and Character of Flooded Areas

Flooding is of economic significance only in the lower Teton Valley since high water tables also plague the areas subject to flooding as in the upper basin; therefore, this discussion will be limited to the lower basin. The flood plain that would result from a discharge similar to that of 1894, 5,830 cubic feet per second, consists of 5,700 acres of agricultural land, including 1,900 acres of small grains, 370 acres of raw crops, 2,730 acres of pasture and 700 acres of brush. The characteristics of development vary throughout the valley. Almost immediately after the river flows into the valley, it enters a highly developed agricultural area where lands have been cultivated right up to the banks. From here to Rexburg and the Rexburg-St. Anthony highway, cropland, hay land and seeded pastures have been developed on each bank of both the North Branch and South Branch Teton River. Below the main highway, the development on the riverbanks becomes less extensive until, near Henrys Fork, relatively little land has been cleared for crop production because of frequent inundation. Other improvements in the flood plain include roads, bridges, railroads, irrigation structures and farm houses and buildings.

Flood Damages

Inundation results in damages to transportation facilities, irrigation works, farmsteads, crops and pasture lands. Analysis of these damages was based on field damage surveys, correlated with study of maps, photographs and hydrologic data. Damages for floods of several discharges were then developed. The following table presents damages at 1959 price levels and development by various classification for three representative flows:

Class of Property	9,000 c.f.s.	5,830 c.f.s.	3,660 c.f.s.
Agricultural			
Crops	$ 443,100	$138,000	$22,250
Other than Crops	388,130	112,460	24,850
Commercial	85,900	7,600	
Public Properties	27,600	11,200	4,150
Transportation Facilities	240,470	39,550	2,000
Flood Fight	45,750	11,400	1,220
	$1,230,950	$320,210	$54,470

The damages for these three flows were used to develop a discharge-damage curve for Teton River in the lower basin. On the basis of this curve and the average annual damage table, average annual damages in the lower Teton Valley are estimated to be $98,950 for 1959 price levels and developments.

Hydroelectric power

Greatly increased demands are predicted by private utilities and public agencies concerned with power development for future power requirements in the Snake Basin area. The Federal Power Commission estimated that the projected energy requirements for 1980 will be 15.6 billions of kwh, an increase of 7.3 billions of kwh when compared with requirements in 1967.

Power demand is expanding as a result of many factors, including unprecedented growth of irrigation pumping, population increases, increased per capita power consumption, industrial expansions, and greater variety of domestic uses.

It is strongly apparent that the hydroelectric potential of the Henrys Fork Basin will be utilized as rapidly as it can be developed under any presently foreseeable schedule, unless there is complete stagnation of economic growth and resource utilization and populations do not continue to increase, which is highly unlikely.

Future power loads for the Upper Snake River Basin, from which the Henrys Fork Basin is one of the major tributaries, are based on requirements of the southern and eastern Idaho, a part of eastern Oregon service areas, and a small area in western Wyoming.

Future irrigation expansion in Snake Basin of any magnitude would be accomplished only with pumping. The opportunities for gravity diversions to serve major land areas were converted to functioning irrigation developments many years ago. Pump diversions are necessary, not only to lift water from major water courses but in many circumstances additional pumping in the form of exchange or replacement water is essential so that a divertible supply is available where needed. From any engineering and physical viewpoint, there is a foreseeable future irrigation potential of the Upper Snake involving some 1,130,000 acres of new land and 1,100,000 acres requiring a supplemental water supply. Irrigation of about 95 percent of the new land areas would require pumping to deliver a water supply or pumping to provide an exchange or replacement water supply or both. Much less pumping would be required to provide the supplemental water supplies. Total anticipated irrigation pumping loads probably would be about four times as great as present pumping power requirements. Existing hydroelectric powerplants and potential hydroelectric power sites in Henrys Fork Basin are listed in Table 5. Full hydroelectric power capabilities should be realized at all projects where feasible.

Agricultural water use

The 184,000 acres of arable land resource of the Henrys Fork Basin, which excludes a considerable area of timbered lands, occur in the Island Park region, in the Teton and Fall River drainages, and along the foothills that border the Henrys Fork on the southeast from Warm River to the valley of the Main Stem of the Snake River. At the higher elevations in Henrys Fork Basin the soils have a greater organic matter content than in the drainage basin of the South Fork of the Snake River. Soils are dark in color, more friable, and nitrogen deficiencies are not so great when compared to the soils formed under arid conditions on the Snake Plain. In lower Henrys Fork Basin and in parts of the Teton and Fall River drainages, much of the arable lands has been dry-farmed for many years.

Fall River Area

Some 38,500 acres of arable lands are within the unforested part of the Fall River Basin. They occur mostly on a rolling upland area with loessal soils of varying depths over basalt. There is a well-defined surface drainage pattern. Internal drainage characteristics of these lands probably are adequate for much of the area. However, in locations where the underlying basalt may be impermeable, undesirable drainage conditions from perched water tables could be expected with irrigation development. The mineral fertility is considered very good, but nitrogen and organic matter are needed to bring the soils to the highest productivity level.

TABLE 5

EXISTING HYDROELECTRIC POWERPLANTS AND POTENTIAL HYDROELECTRIC POWER SITES IN HENRYS FORK BASIN

Name	Nameplate rating1/ Killowatts	Stream or Location	Owner or Operator	Initial Operation
Ashton	5,800	Henrys Fork	Utah Power & Light Co.	1917
St. Anthony	500	Henrys Fork	Utah Power & Light Co.	1915
Felt	1,870	Teton River	Teton Valley Power & Mill.	1921
Mesa Falls	15,000	Henrys Fork		Project
Warm River Dam & Reservoir	30,000	Henrys Fork		Project
Reconstruction of Ashton Dam & Reservoir	12,000	Henrys Fork		Project
Lower Teton	22,000	Teton River		Project

1/ Peaking capability is different, in most cases, than rated capacity shown.

Teton River Area

Arable lands of Teton Basin total some 77,500 acres. They occur in fairly large blocks bordering both sides of the Teton River valley. Lands along the east side of the Upper Teton Basin lie on well-defined alluvial fans that merge into each other and out into the Teton River valley floor. These fans have been built up of outwashed materials by the side tributary streams originating in the Grant Teton Mountains. The soils are largely alluvial in origin and contain a high proportion of coarse, gravelly material. The natural stream deposition process has had a sorting action with the results that the finer soil materials are on the more outward margins of the alluvial fans terminating along the Teton River.

North of the Teton River, arable lands are on a rolling upland with a thick covering of windlaid material over basalt. This area is now mostly dry-farmed and merges with the Fall River loessal uplands. The surface drainage pattern is well-defined, and the adequacy of sub-surface drainage would depend upon the transmissibility of the underlying volcanic rocks. South of the Teton River there are many square miles of rolling uplands with deep, loessal soils over basalt. There is adequate moisture for dry farming and where not too steep for tillage these lands produce excellent dry-farm crops of wheat. The native vegetative cover probably ranged from low brush to moderate-sized timber. The mineral fertility is good, and external drainage characteristics are adequate. Internal drainage may be a problem in limited areas, should irrigation water be applied.

Foothills East of Henrys Fork Valley

The rolling upland areas that border the Henrys Fork Valley between Ashton and the valley of the Snake River below Heise contain many thousand acres of high-quality arable lands. The land areas east of the river are nearly all dry-farmed and, with adequate moisture, are very productive for wheat. The upland areas previously described for the Teton and Fall River areas merge into these foothills and all are very much alike. Deep, loessal soils overlie bedrock mostly of volcanic origin.

The water-holding capacity and fertility of these lands is very good, and the external drainage characteristics are very favorable for removalbe or surface waste waters. However, because of steepness in some localities, erosion could become accelerated under irrigation. There may be locations where depths to impermeable rocks are shallow or where understrata are quite tight. Under such circumstances, internal drainage characteristics are unfavorable, and drainage problems should occur with irrigation.

Detailed information about irrigation projects appears in section 5.

Other water uses

The full use of the water resources of any basin involves a diversity of applications in addition to irrigation, flood control, and power, such as municipal and industrial supplies, stock water, pollution abatement, recreation, and fish and wildlife enhancement.

Municipal and Industrial water

The present economy of the Henrys Fork Basin centers upon its natural resources: timber, agriculture, and recreational offerings as well as livestock.

Adequate surface water supplies are not uniformly available throughout Upper Snake River Basin. In general, those areas yielding the greatest supplies have the least demand. A good example is the Henrys Fork Basin which according to statistics released by the Idaho Statistical Abstract (1960) has only a population of about 21,000 inhabitants. Almost all of the population within the Upper Snake River Basin is located in the areas of well developed irrigated agriculture in souther and eastern Idaho.

In Henrys Fork Basin there is not an area which is expected to be a "focal" point of growth. At the same time it is probable that the scarce industry of the basin will not experience expansion unless a pulp or paper plant were established.

However we have to consider the expansion of rural developments. Stock and other rural requirements aside from irrigation are at present largely met from individual sources such as wells or ponds. Based upon growth projections, the demand by the year 2010 will be on the order of 45,000 acre-ft. per year which amount probably will be mostly obtained through ground-water development.

If irrigation is substantially increased in the valleys industries allied with it may develop a basically stable and prosperous economy in the basin. In such case municipal and industrial water supply will have to be considered as an important factor.

Water quality control

At present, pollution is not a serious problem in Henrys Fork Basin. However, if a pulp or paper plant is expected to be installed proper precautions towards pollution potentials should be considered.

Provision of minimum flows to protect the quality of water should also be a policy matter mainly in cases where the use of dilution water is used to abate pollution and conserve water quality in the absecne of complete sewage treatment.

The first known quality of water analyses that have been made of surface water in the Henrys Fork Basin were those made by the Agriculture Experiment Station of the University of Idaho from April, 1948 to October, 1949. Since 1964 there are two water-quality stations in the basin, one in the Teton River near St. Anthony which at the same provides thermograph data and the other one in the Henrys Fork near Rexburg.

The results of these analyses show this water to be of excellent quality for irrigation use. Tables 6 and 7 from water year October, 1966 to September, 1967 confirm the aforementioned statement.

Navigation

With the exception of a very limited log-floating operation on several streams of the basin and some boat service in rather isolated sections, there is no commercial navigation on the Henrys Fork Basin. On the numerous lakes and reservoirs of the area small motor launches and row boats are operated for recreation and pleasure during the summer season.

Recreation, Fish and Wildlife, and Scenic Rivers

Even if one were to hurriedly scan the basin, he could not fail to notice its outstanding scenic, geologic, biologic, and recreational resources. If the recreation seeker is interested in the less trenous types of recreation such as photography, nature study, or simply viewing the magnificant scenery, it is there for his inspriation and enjoyment. If, on the other hand, he is looking for diversion and challenge in hiking, skiing, mountain climbing, hunting, fishing, water skiing, or river boating, these too are available.

Much of the present recreation development has been carried out by the Federal Government, but the States and private industry are shouldering some of the responsibility.

TABLE 6

13-0550. TETON RIVER NEAR ST. ANTHONY, IDAHO

LOCATION.--Lat 43°55'40", long 111°36'55", temperature recorder at gaging station on right bank, 0.5 mile upstream from railroad bridge, 4 miles southeast of St. Anthony, Fremont County, and at mile 22.
DRAINAGE AREA.--890 square miles, approximately.
RECORDS AVAILABLE.--Water temperatures: April 1964 to September 1967.
EXTREMES, 1966-67.--Water temperatures: Maximum, 68°F July 18-20; minimum, freezing point on many days during December and January.
EXTREMES, 1964-67.--Water temperatures: Maximum, 71°F July 18, 19, 24, Aug. 2, 1966; minimum, freezing point on many days during winter months.

Chemical analyses, in parts per million, water year October 1966 to September 1967

Date of collection	Mean discharge (cfs)	Silica (SiO_2)	Iron (Fe)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO_3)	Carbonate (CO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Boron (B)	Dissolved solids (residue at 180°C) Parts per million	Dissolved solids Tons per acre-foot	Dissolved solids Tons per day	Hardness as $CaCO_3$ Calcium, Magnesium	Hardness as $CaCO_3$ Noncarbonate	Sodium adsorption ratio	Specific conductance (micromhos at 25°C)	pH
June 5, 1967.....	1960	10		22	5.6	2.3	1.2	92	0	4.8	1.0	0.2	0.5	0.04	95	0.13		78	2	0.1	157	7.9

Temperature (°F) of water, water year October 1966 to September 1967

Month	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	Average
October																																
Maximum	52	51	49	48	50	51	51	51	51	49	48	49	46	43	42	42	42	42	43	43	43	42	42	44	45	45	46	46	45	44	45	46
Minimum	49	49	46	45	46	48	49	49	48	46	46	45	43	40	40	40	41	41	40	42	42	39	39	42	43	43	44	44	43	43	44	43
November																																
Maximum	45	42	40	39	39	40	41	41	39	36	36	39	41	42	42	41	41	39	39	40	40	40	38	37	37	37	36	36	38	40	--	39
Minimum	47	40	39	38	39	39	40	38	36	36	36	36	39	41	41	41	39	39	39	39	40	38	37	37	37	36	36	36	36	38	--	38
December																																
Maximum	40	40	40	40	39	37	35	35	33	33	33	33	34	35	35	35	33	33	32	32	33	33	33	33	33	33	33	32	32	33	33	34
Minimum	40	40	40	39	37	35	35	33	33	33	33	33	33	24	35	33	33	32	32	32	33	32	32	32	33	33	32	32	32	32	33	33
January																																
Maximum	33	33	33	33	33	33	33	33	33	33	33	32	32	32	32	32	32	32	32	32	34	36	36	35	34	34	37	38	38	38	37	33
Minimum	33	33	33	33	33	33	33	33	33	32	32	32	32	32	32	32	32	32	32	32	32	34	35	33	33	34	34	37	38	37	36	33
February																																
Maximum	36	36	36	37	37	36	34	33	35	35	35	37	38	38	36	33	36	36	36	34	34	34	36	36	36	38	38	37	--	--	--	35
Minimum	35	34	36	36	36	34	33	33	33	35	34	34	37	36	33	33	33	35	34	33	33	33	34	35	36	36	36	36	--	--	--	34
March																																
Maximum	36	36	36	36	35	35	34	35	39	39	40	40	38	38	40	40	43	42	42	41	42	45	45	43	43	43	43	44	44	41	40	39
Minimum	36	36	36	34	33	34	33	33	35	39	38	37	37	37	37	35	39	[illegible]	[illegible]	39	39	42	43	41	39	41	40	42	41	38	37	37
April																																
Maximum	43	43	46	48	48	45	45	47	47	47	47	48	51	51	47	45	48	52	52	46	45	48	48	48	49	49	49	49	46	44	--	47
Minimum	39	40	40	44	43	41	43	45	45	44	45	44	45	47	44	43	44	46	46	43	41	42	45	45	45	46	47	46	43	41	--	43
May																																
Maximum	46	48	48	50	51	54	57	60	59	57	51	48	50	52	55	60	60	59	57	54	55	55	55	54	53	50	53	52	50	47	48	53
Minimum	42	45	45	45	45	47	50	53	54	51	45	44	44	46	49	51	54	55	54	51	52	54	51	50	48	47	50	49	47	46	47	48
June																																
Maximum	49	50	51	51	51	49	49	50	50	50	50	50	53	53	54	56	56	56	57	57	57	54	54	53	57	57	57	56	59	60	--	53
Minimum	48	49	49	51	48	48	48	49	50	49	49	50	50	51	52	53	54	53	55	55	53	52	52	50	53	56	55	53	56	58	--	51
July																																
Maximum	60	60	60	60	60	60	59	58	59	62	64	65	65	65	62	64	64	62	66	66	66	66	67	67	66	66	66	66	65	67	67	63
Minimum	58	58	59	58	58	58	57	56	54	57	58	59	60	60	57	59	60	56	60	60	60	61	62	63	63	61	60	60	61	61	62	59
August																																
Maximum	67	67	67	66	67	65	65	65	65	66	66	67	67	67	67	67	67	68	68	68	65	66	66	67	67	67	67	67	65	64	66	66
Minimum	61	61	61	62	61	61	60	58	58	59	60	61	62	62	61	61	61	62	62	62	62	59	59	61	62	61	63	62	61	59	59	60
September																																
Maximum	66	64	65	65	66	65	65	64	63	63	60	54	50	54	55	55	56	56	55	58	59	58	59	59	60	59	58	59	59	59	--	59
Minimum	59	60	59	58	59	61	60	59	59	55	54	50	48	53	51	51	52	53	53	53	54	55	54	55	56	56	54	55	55	57	--	55

TABLE 7

13-0565. HENRYS FORK NEAR REXBURG, IDAHO

LOCATION.--Lat 43°49'35", long 111°54'12" at bridge on State Highway 88, 200 feet upstream from gaging station, 6 miles west of Rexburg, Madison County, and at mile 9.3.

DRAINAGE AREA.--2,920 square miles, approximately.

RECORDS AVAILABLE.--Chemical analyses: October 1965 to September 1967.

Chemical analyses, in parts per million, water year October 1966 to September 1967

Date of collection	Mean discharge (cfs)	Silica (SiO_2)	Iron (Fe)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO_3)	Carbonate (CO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Boron (B)	Dissolved solids (residue at 180°C) Parts per million	Tons per acre-foot	Tons per day	Hardness as $CaCO_3$ Calcium, Magnesium	Noncarbonate	Sodium adsorption ratio	Specific conductance (micromhos at 25°C)	pH
Oct. 13, 1966....	909	26	--	24	7.9	14	2.1	131	0	4.8	5.0	1.6	0.5	0.10	150	0.20		92	0	0.6	219	7.5
Nov. 18..........	1730	28	0.14	19	5.1	16	2.6	106	0	4.8	6.5	2.0	.4	.17	130	.18		68	0	.8	199	7.5
Dec. 22..........	1740	7.6	.06	18	6.2	17	2.2	110	0	5.2	6.5	2.0	2.5	.06	134	.18		70	0	.9	210	7.3
Jan. 30, 1967....	1610	33	--	18	4.9	17	2.9	102	0	4.8	7.0	1.9	1.0	.12	136	.18		65	0	.9	202	7.3
Feb. 24..........	1310	34	.26	19	5.0	19	2.7	110	0	4.8	7.0	2.0	.4	.14	142	.19		68	0	1.0	213	7.8
Apr. 3...........	1140	29	--	24	6.9	15	3.0	130	0	5.2	6.5	1.7	1.0	.04	155	.21		88	0	.7	242	7.7
May 11...........	2590	27	--	13	3.7	12	2.6	75	0	4.4	5.0	1.5	.8	.11	111	.15		48	0	.8	153	7.3
July 26..........	882	26	--	25	7.4	10	2.1	128	0	4.4	4.5	1.3	.9	.05	141	.19		93	0	.5	226	7.8
Aug. 28..........	1450	26	--	22	6.5	11	2.2	114	0	4.6	4.0	1.6	.8	.01	132	.18		82	0	.5	197	7.5

The Forest Service has provided numerous campgrouns, picnic areas, and facilities for water sports on land under its jurisdiction throughout the basin. Within the National forests and extending into the Henrys Fork Basin are the Teton Wilderness Area in Wyoming and the Targhee National Forest in Idaho. The Grand Teton National Park is also within the boundaries of the basin. In addition, a sizable portion of Yellowstone National Park is situated west of the Continental Divide and is in the basin.

Skiing, a very popular winter activity in the basin, is mostly provided by private investment. In the Henrys Fork Basin we have the Teton Pass Area in Idaho.

Some of the more famous points of interest in the basin include the scenic Mesa Falls, about 15 miles by road northeast of Ashton, Idaho; the Henrys Lake, in the upper part of the basin; and of course, Yellowstone National Park.

Visitation at reservoirs is also very common. The transition from stream and river use to reservoirs takes place as the public becomes aware of the extensive and diversified recreation potentialities of a reservoir.

For the sportsman, Henrys Fork Basin offers incomparable fishing and hunting. Henrys Lake is an exceptional region for trout. The large rainbow and cutthroat trout in Henrys Lake have attracted national attention for a great many years. Island Park Reservoir and Upper Mesa Falls are also noted trout fishing places enjoyed by thousands of people each year.

The basin area by modern standards is a hunter's paradise. Elk are found in the mountains of eastern Idaho and the Wyoming portion of the basin. The National Elk Refugee in Wyoming is administered by the Bureau of Sport Fisheries and Wildlife. Permit hunting for antelope and moose takes place in some locations. Black bear and deer are widely distributed through out the basin.

When considering the basin as a whole, recreation pressures are not usually great; there is, however, a locally overused facility: Yellowstone National Park.

5. Suggested projects

Table 8 is a summary of the projects to be considered in this basin. Locations of these projects are shown in Figure 3.

MESA FALLS PROJECT, IDAHO

The Mesa Falls Project would be located on the Henrys Fork of the Snake River in Fremont County, Idaho, about 15 miles by road northeast of Ashton, Idaho. See Project Index, Figure 3.

The project would consist of facilities to utilize the head created by Upper and Lower Mesa Falls to produce electric power. These power facilities would be a part of the new production needed to meet the anticipated expansion in irrigation pumping power requirements. Under the considered project plant, a 15,000 - kilowatt powerplant would be constructed adjacent to Lower Mes Falls.

However, the project would destroy the present high scenic attractiveness of the Mes Falls. Mesa Falls Project would not appear favorable for early development because of recreational disadvantages.

WARM RIVER DAM AND RESERVOIR

Warm River Dam and Reservoir would be located on Henrys Fork of Snake, 1,200 feet downstream from the confluence of Henrys Fork and Warm River, about 8 miles northeast of Ashton, Idaho. See Project Index, Figure 3.

The project would be multiple-purpose, providing 140,000 acre-feet total capacity with 75,000 acre-feet of usable storage capcity for flood control and power generation, created by a rockfill dam 265 feet high above foundation level. The project lies almost entirely within the Targhee National Forest.

The project would develop a site with excellent water supply and power potential and provide much needed flood control regulation to the reach of river extending from Ashton to Rexburg, in particular.

There is also a possibility of a future use in the project as a source of supplemental water supply. The fish and wildlife and recreational aspects will require careful consideration.

Table 8

HENRYS FORK

Project	Total Res. Capacity Ac.-ft.	Active Res. Capacity Ac.-ft.	Powerplant Capacity Kilowatts	Area Served New Acres	Area Served Supp. Acres	Exchange Water Ac.-ft.	Source of Water Supply Stream	Construction Cost Dollars	Remarks
Mesa Falls Proj.	-	-	15,000	-	-	-	Henrys Fork	6,120,000	
Warm River Dam & Res.	140,000	75,000	30,000	-	-	-	Henrys Fork	23,474,000	
Reconstruction of Ashton Dam & Res.	48,700	40,000	12,000	-	-	-	Henrys Fork	7,428,000	Rebuild & enlarge existing dam & p.p.
Squirrel Meadows Project	10,470	10,000	-	3,100	3,000	-	Squirrel Cr.	2,145,000	
Snake Plain Recharge Project	Diversion of floodflows up to 1,500 cfs maximum from Henrys Fork or Snake River from St. Anthony to about Shelley.								
Upper Teton Proj.	50,000	35,000	-	15,200	27,800	-	G.W. & Teton Riv.	14,237,000	Pump 25,000 AF from G.W. for 27,800 acs eastside lands.
Alta Proj.	3,420	3,400	-	-	3,400	-	Teton Creek		Small project sponsorship.
Lwr. Teton Proj.	315,000	200,000	22,000	39,000	30,000	-	Teton River	39,615,000	
	Flood-control objective of 6,000 cfs max. discharge of Henrys Fork at Rexburg Gage.								
TOTALS	567,590	363,400	79,000	57,300	64,200			93,019,000	

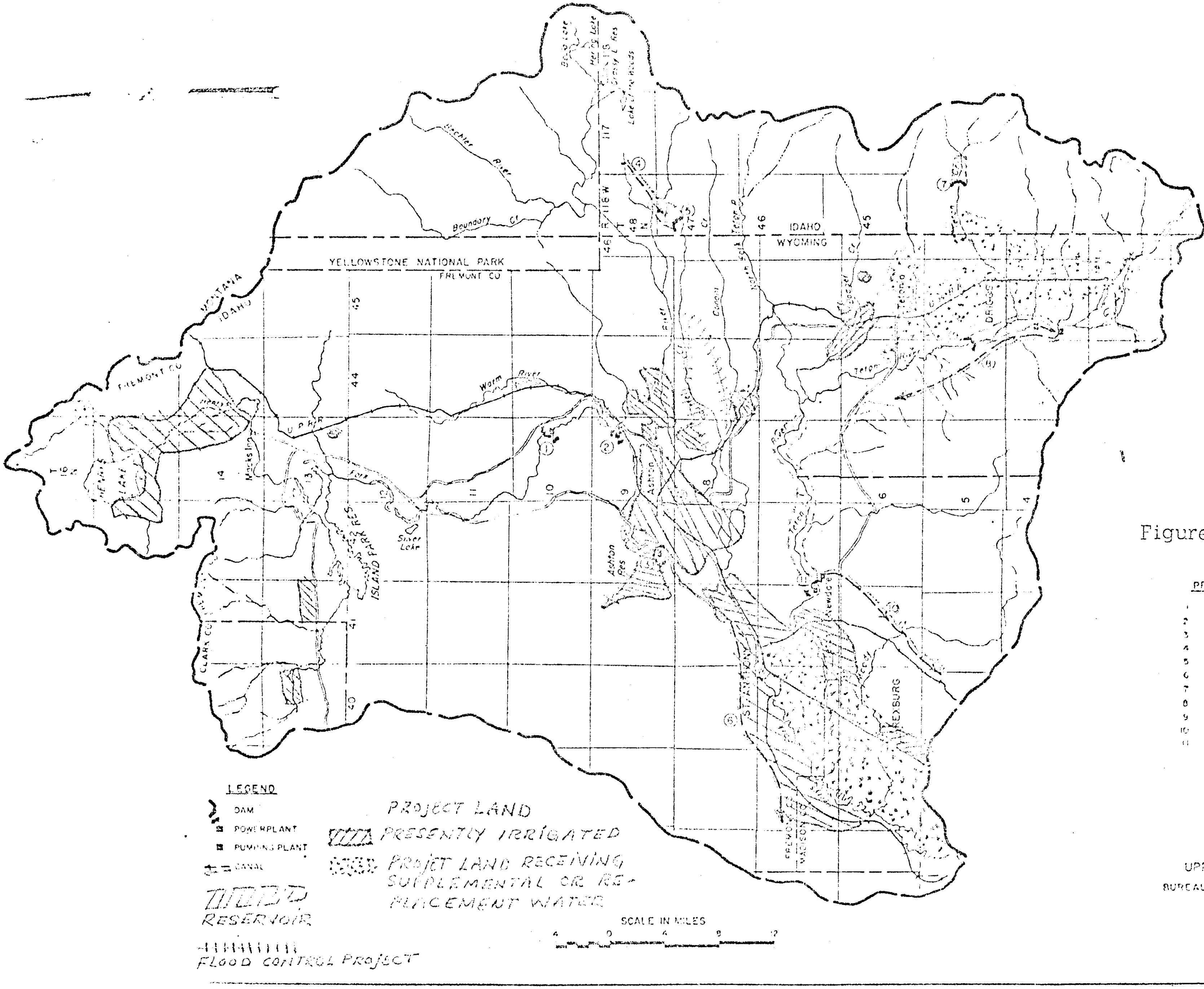


Figure 3.

PROJECT INDEX

1. Mesa Falls Powerplant
2. Warm River Dam
3. Ashton Reservoir Enlargement
4. Bypne Creek Diversion
5. Squirrel Meadows Dam
6. Snake Plain Recharge
7. Teton Creek Dam (Alta Project)
8. Upper Teton Project
9. Driggs Dam
10. Lower Teton Project
11. Fremont Dam

UPPER SNAKE RIVER INVESTIGATIONS

BUREAU OF RECLAMATION CORPS OF ENGINEERS

JANUARY 1960

SUBAREA MAP

HENRYS FORK BASIN

U S C E Dwg SN-05-13/12

PLATE IV-14

RECONSTRUCTION OF ASHTON DAM AND RESERVOIR

The existing Ashton hydroelectric project is located on Henrys Fork of Snake River in Fremont County, Idaho, approximately two miles west of the town of Ashton. See Project Index, Figure 3. The dam was constructed in 1917, rehabilitated in 1925, and is now owned by Utah Power and Light Company.

The reconstructed project would be multiple-purpose in character providing flood control storage, power generation, and incidental recreation. The project plan provides a total storage capacity of 48,700 acre-feet, 40,000 acre-feet being active capacity for flood control and power. The dam will be located approximately 400 feet downstream and rise about 50 feet higher than the presetn dam with a power installation of 12,000 kilowatts.

This project is economically justified by a benefit-cost ratio of 1.5 to 1.0 on an amortization period of 100 years. It is an excellent site with a good water supply.

Reconstruction of Ashton Dam would fully develop the hydroelectric water potential of the site to meet increasing demands for power and for needed flood control on Henrys Fork and Snake River, particularly in heavy runoff years. This project would be operated jointly with the Warm River Project as a regulating dam for both power generation and flood control.

SQUIRREL MEADOWS PROJECT

Squirrel Meadows Project is in Fremont County, Idaho, about 9 miles southeast of Ashton near the community of Drummond. See Project Index, Figure 3.

The project area is characterized by dry, farily warm summer days, cool nights, and cold winters. The irrigators now experience water shortages after about the first of July each year. Irrigation of new lands and the provision of supplemental water to irrigated lands would meet needs for economic expansion and stabilization in the area.

The objective of the Squirrel Meadows development is to furnish a water supply to 3,100 acres of presently dry-farmed land and a supplemental supply for about 3,000 acres of presently irrigated land. The water supply would be provided by storage of flows from Boone Creek and the North Fork of Squirrel Creek. A diversion dam on North Fork of Boone Creek and feeder canal from the North Fork to Squirrel Meadows Reservoir would allow storage of flows from the North, Middle and South Forks of Boone Creek. Water released from the Squirrel Meadows Reservoir would be delivered to the project lands down the natural channel of Squirrel Creek, a distance of about 7 miles. Enlargement and extension of the existing distribution system and drainage facilities are required to develop the area.

Squirrel Meadows Dam would create a reservoir with a total capacity of 10,470 acre-ft., some 10,000 acre-feet of which would be active. Additional water used by this project during a dry period would have to be replaced because of prior rights downstream.

Although soil quality in the project lands is quite high, the topography of much of the new land area is too steep for gravity irrigation. Sprinkler irrigation is a very satisfactory alternative, but would add to the irrigation expense.

SNAKE PLAIN RECHARGE PROJECT

The Snake Plain aquifer provides an unusally good opportunity for artificial recharging operations. At many places, the irregular, broken surface of the lava takes water readily, and large fractures and other openings permit rapid percolation of water to the water table. A very large storage space is available; a water-level rise of 10 feet over the entire area of the aquifer would represent an increase of perhaps 5 million acre-feet of water in storage. Because of the very great coefficient of transmissibility of the aquifer, the recharge wave will spread rapidly, and large amounts of water can be recharged at one place without building the ground-water mound to excessive heights.

There are three areas in the Snake River Plain where the U.S. Geological Survey, Ground Water Branch, has indicated that recharge may be accomplished.

The first of these lies west of St. Anthony and recharge diversion would be from Henrys Fork. See Project Index, Figure 3. Based on very generalized observation of daily flows available for recharge, it would appear that a diversion works of approximately 1,500 cubic feet per second capacity from Henrys Fork might be an economical size for recharging the St. Anthony area.

During low floods, the Snake Plain Recharge diversion could reduce floodflows in lower Henrys Fork and Snake River below Henrys Fork by 1,500 cubic feet per second at all times that a flow of 1,500 cubic feet per second plus downstream irrigation diversion requirements exist at the diversion point. The diversion would be effective for the entire range of potential floods except as limited by possible emergencies.

The proposed diversion would contribute to the reduction of flood damages in downstream areas on Henrys Fork, lower Columbia River, and in a minor way, on Snake River from Henrys Fork to American Falls.

UPPER TETON PROJECT

The Upper Teton Project is located in Teton Basin, a high mountain valley at the west base of the Teton Mountains of Wyoming. Lands of the project are situated on the basin floor and along both sides of Teton River in Teton County, Idaho. See Project Index, Figure 3.

The area considered for irrigation in this project comprises approximately 43,000 acres. This total includes 27,800 acres of presently irrigated land lying on the east side of Teton Basin and in need of supplemental water and 15,200 acres now dry farmed on the west side for which a surface water supply would be provided.

The irrigated area on the east side is located along five principal tributaries to Teton River. Ground water would be used to supplement the natural flow of these tributary streams. The U. S. Geological Survey, Ground Water Branch, has estimated that up to 25,000 acre-feet per season can be safely pumped from ground water in this area.

The plan to serve the west side area involves storage on Teton River, at Driggs Reservoir site and pumping from the reservoir to serve about 15,200 acres. Driggs Reservoir would also provide flood control on Teton, Henrys Fork, and Snake Rivers.

Provision of supplemental water would greatly improve the economic condition of farmers throughout the area that have had extreme water shortages in the past and shortage of late-season water is a problem at present.

The extension of irrigation to new lands bordering the present irrigated areas in the Teton Basin would have a stabilizing effect on the economy of the area and expand the existing economic and tax base.

ALTA PROJECT, WYOMING

The Alta Project is located along both sides of Teton Creek in a high mountain valley at the west base of the Teton Range in Teton County, Wyoming. Teton Creek heads in the Teton Mountains and flows west out of Wyoming into Idaho to its confluence with Teton River, about 3 miles southwest of Driggs, Idaho. See Project Index, Figure 3.

Objective of the Alta Project development is to furnish a supplemental water supply to 3,400 acres of presently irrigated land. The water supply would be obtained from storage of flows in Teton Creek. Existing diversions from Teton Creek, canals, and laterals are considered adequate for continued use.

Teton Creek Dam would create a reservoir with a total capacity of 3,424 acre-feet, of which 3,400 acre-feet would be active storage. The project development would allow effective local use of a water resource which at the present time, without the benefit of storage, is in excess of local needs in the early part of the irrigation season and inadequate to meet the needs in the latter part of the season.

Forage and feed would continue to be the most important crops of the area, although the acreages of seed potatoes probably would increase. Dairy herds would increase in size and would use most of the hay, grain, and pasture produced. Additional winter feed would provide insurance against unusally severe winters and the stored water would alleviate critical water shortages during dry years.

LOWER TETON PROJECT

Lower Teton Project constitutes the long-range plan of water resource development for the lower basin of the Teton River. See Project Index, Figure 3.

A major multi-purpose dam (Fremont Dam) and reservoir with a total storage capacity of about 315,000 acre-feet, is required to develop the full potentials of the stream for flood control, power, and recreation, and provide the necessary elevation and storage for a large unit of irrigation development in Madison County.

The area of new land considered for development lies on the Rexburg Bench and totals about 39,000 acres. Supplemental water equivalent to a supply for 30,000 acres within the Fremont-Madison Irrigation District would also be provided. Water would be pumped from the reservoir pool to supply the new land area. Supplemental needs of the presently irrigated area downstream would be met from storage released into the stream and diverted into existing canals serving the area.

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[illegible] signature of his department head and dean. The forms are then sent to the Graduate Office together with two copies of the proposal for University files plus the number of copies required to be signed in the original before mailing. University regu[illegible]

Deadline date is

1. Title of Project: Environmental Survey of the Teton River and Henry's Fork of the Snake River
2. Application to (agency): U.S. Corps of Engineers Amount $ 7900.00
3. Duration of Project: from (date) 1 May 1972 to (date) 30 September 1972
4. Present facilities, space allocations and staff (ARE)(ARE NOT) adequate. If not, a statement as to what additional facilities or staff must be provided to adequately conduct this project may be attached.
5. The proposed time distribution of the applicant (presumed to be the principal investigator) is:

Appointment basis (as on file in President's Office)		Distribution of time (itemize all research activity including other grants.)	
Teaching	%	Instruction	25 %
Research	%	This request	0.25
Other	%		75 %
Total	100%	Total	100%

Administration time 0.25% on this item

Attach appointment and time distribution statements for additional personnel who are contributing to the project.

[signature] Applicant (signature) Date

Other (signature) Date 21 April 1970

Head of Department (signature) Date

Dean of College (signature) Date