TECHNICAL MEMORANDUM

SUBJECT: **Snake/Salt River Basin Plan**
Basin Water Use Profile - Agriculture

PREPARED BY: Sunrise Engineering, Inc.

DATE: August 23, 2002

Introduction:

Agricultural water uses consume more water than any other use in the Snake/Salt River basin. Agricultural uses mainly consist of irrigation of crops by either flood or sprinkler irrigation. The vast majority of irrigation water is diverted from surface water sources, although there are small areas served by groundwater sources.

History of Agriculture in the Basin:

The first homestead was built in Jackson Hole in 1884, and by 1900 the cattle industry dominated the area. Settlement in the Star Valley area began in the late 1870's and 1880's, with many of the early settlers interested in raising beef cattle. Prior to that time, the area had been used as summer range for cattle from the Bear Lake area. The first approved water right in the Star Valley area was on Spring Creek, a tributary of Crow Creek, in 1885. Rights were filed on for many of the tributaries in Star Valley soon afterward. The rise of the dairy industry soon followed, and the first creamery in Star Valley was established in 1900.

Flood irrigation was initially utilized for forage production for farm animals. Initially, water was generally diverted out of the smaller tributaries, as opposed to the main stems of rivers. This was due to the varied locations of the tributaries, as well as the difficulty associated with diverting from a large river. Irrigated cropland developed more rapidly downstream in Idaho than it did in the Snake/Salt River basin, mainly due to the longer growing season. As a result, conflicts on water use arose between irrigators in the two states. These conflicts resulted in the Roxanna Decree in 1941, which governs the use of Teton Creek and South Leigh Creek on the west side of the Teton Range. Soon afterward in 1950 the Snake River Compact was agreed upon by the two states as well as by Federal agencies.

Grand Teton National Park was initially created in 1929, consisting of approximately 100,000 acres. The Park was later enlarged to over 300,000 acres in 1950. While provisions were made to accommodate existing private homesteads located within the Park, much of the land located within the Park that had been irrigated in the past is no longer irrigated or used for agricultural purposes. Also, the relative lack of land under private ownership in the Jackson Hole area, there is great pressure to convert agricultural lands to residential use.

Gravity flow sprinkler systems were established in many areas of Star Valley in the 1960's and 1970's, which increased irrigation application efficiency. This increase in efficiency resulted in an increase in the productivity of the farmland. Several hundred dairy farms were in operation in Star Valley up until the early 1980's, when market prices and new regulations prompted many to sell their cows and leave the business. Presently less than 50 dairies are still in operation, however they tend to have larger herds than the dairies of the past.

Methodology:

While attempting to quantify the use of water for agricultural uses in the Snake/Salt River basin, it was discovered that there are very few diversion records available that would indicate the actual use of water. Records generally consist of spot records on a specific ditch, with sometimes only one spot reading being made in a particular year. Many diversions do not have any records as to the diverted flow. This situation is mainly due to the method of regulation currently used in the basin. Generally, irrigators do not call upon the State to regulate the flow of water in irrigation diversions. In locations where water becomes scarce later in the season (generally the tributaries), canal companies or irrigation districts have been formed in order to run the irrigation facilities more efficiently. These companies or districts regulate the flow of water to the irrigators on the system, and commonly distribute the water equally among all irrigators regardless of priority. In some cases, the irrigation district or company is essentially the only irrigator on a particular tributary.

When regulation is required, flows are read and the water distributed by Water Division IV of the Board of Control. This is the source of the majority of flow records available. However, these readings are generally only made on an as-needed basis, thus the records on regulated streams are very often sparse. The major exception to this is on Teton Creek, which is a tributary to the Teton River. This creek is governed by the Roxanna Decree, and so water must be divided between users in Wyoming and Idaho as part of that ruling.

There has been very little use of stored water for irrigation in the basin. The large reservoirs that are located in the basin, such as Jackson Lake and Grassy Lake, serve farmland that is located downstream in Idaho. Palisades Reservoir, which is located partially in Wyoming, also serves Idaho irrigation interests. At this point, there are essentially no storage reservoirs used for irrigation of Wyoming lands located within the Snake/Salt River basin. Because of this fact, flow records from these reservoirs have no bearing on irrigation diversion flows in the basin.

Typical Crops:

Alfalfa is the most extensive crop grown in the Salt River basin. Much of the alfalfa grown in Star Valley is used to feed local dairy and beef cattle. Small grains such as barley are also grown. There is also a significant amount of acreage used for native hay or pasture. The Snake River portion of the basin produces native hay almost exclusively. Nearly all of this crop is flood irrigated. The Teton River basin has a mix of crops, with alfalfa being the most predominant.

Also, a significant amount of small grains are produced, as well as pasture. A small amount of potatoes are grown in the Teton basin.

The distribution of crops throughout the basin was determined as part of the technical memorandum entitled "Cropping Patterns in the Basin". This information was generally obtained by producers throughout the basin, with additional input from those working with various agencies involved in the farming and ranching industry. The resulting distribution of crops by sub-basin is shown in **Table 1**.

Table 1. Crop Type Distribution by Sub-Basin

Sub-Basin	Alfalfa	Grain	Pasture	Mtn. Meadow
Upper Salt River	49%	18%	24%	8%
Lower Salt River	58%	25%	12%	4%
Upper Snake River	0%	0%	0%	100%
Lower Snake River	0%	0%	2%	98%
Teton River	40%	30%	30%	0%

Consumptive Use:

According to Pochop et al., Consumptive Use (CU) is the water use of a well-watered crop under optimum growing conditions, and is considered to be the maximum use of water by the specified crop with the given conditions. This consumptive use must be met either through precipitation or irrigation. Consumptive Irrigation Requirement (CIR) is the CU of a crop minus the precipitation. In other words, CIR is the irrigation water required to fulfil the consumptive use of a crop.

Data regarding CU and CIR for this basin study were obtained from the publication Consumptive Use and Consumptive Irrigation Requirements in Wyoming written by Pochop et al. Background data regarding this report were also collected from the author for use in this basin plan. Data associated with the various data sites within the basin were used. These sites included Afton, Bedford, Jackson, Moran, and Alta. Consumptive use data for alfalfa, grass hay, mountain meadow hay, and grains were collected at the various sites in the Snake/Salt River basin.

As part of the technical memorandum entitled "Surface Water Data Collection and Study Period Selection", indicator gages were selected for the basin plan. These indicator gages were used to determine which years to classify as average, wet, or dry for each climate station used for CU/CIR data. Once the years were classified as average, wet, or dry, the results from the CU/CIR study were used to create representative figures for each scenario at each climate station. There were adequate climate stations in the CU/CIR study to enable the various sub-basins in the study to utilize a climate station within its area. For example, Afton was used for the Upper Salt, Moran for Upper Snake, and so forth. The process of obtaining representative CIR information was completed for each crop type. The CIR results for each location, broken into wet, dry, and average years, were then applied to the sub-basin depending upon the distribution of crops grown in that area. The resulting CIR number was weighted based upon the percentage of each crop grown in the sub-basin. This weighted CIR number was used to determine the amount of water consumed by the crops in a particular sub-basin by applying the irrigation requirement over the period of days irrigated. The weighted CIR values are shown in **Appendix A**, with both monthly and seasonal totals given.

Irrigation Days:

Consumptive use of crops assumes well watered crops under optimum growing conditions. Field conditions rarely represent optimum growing conditions due to factors such as inefficient irrigation methods, climate, soil conditions, topography, and so forth. Due to this fact, much of the water diverted from the rivers and streams is not consumed by agricultural crops. However, much of this unconsumed water returns to the system through groundwater augmentation and return flows. Thus, aside from losses through evaporation and so forth, this water can be used at a later time, and is not depleted from the system.

In order to quantify the water used for crop irrigation, the number of days in which crops are irrigated was determined for each sub-basin. Due to the lack of irrigation water use records in the basin, other methods were used to estimate how many days of each month in the growing season in which irrigation typically occurs. This was done using the data obtained for the "Irrigation Diversion Operation and Description" technical memorandum. However, the main source of data for irrigation days was conversations with Water Division III Hydrographer-Commissioners. Their input was vital in determining the irrigation days to be used for the average, wet, and dry scenarios.

By estimating the number of days in which irrigation is taking place in the basin, the effects of being short of water in a particular sub-basin are taken into account. Also, the period of time in which irrigation is stopped in order to harvest crops is included. For example, fields under flood irrigation must have the water shut off of the field for a number of days in order to let the ground dry up enough to allow harvest. However, areas under sprinkler irrigation experience very little down time, as many will have the sprinklers back on one side of the field before the harvest is completed on the other. Irrigation days for the various sub-basins within the Snake/Salt River basin are shown in **Appendix A**.

Agricultural Depletion Estimate:

Agricultural depletions consist of the water supplied by artificial means that is consumed by irrigated crops. This is water required by the plants beyond natural precipitation. The determination of agricultural depletions consisted of taking the weighted monthly CIR for each sub-basin, and multiplying that value by the number of irrigated acres. This monthly result was then adjusted based on the number of days irrigated for each month, resulting in the agricultural depletion. This was conducted for average, wet, and dry year scenarios. Agricultural depletion results are shown in **Appendix A**.

References:

Beesley, Conan, Hydrographer-Commissioner, Wyoming State Engineer's Office, Telephone Interview, August 21, 2002.

Bruce, Ed, Hydrographer-Commissioner, Wyoming State Engineer's Office, Personal Interview, August 20, 2002.

Pochop, Larry, Travis Teegarden, Greg Kerr, Ronald Delaney, and Victor Hasfurther, Consumptive Use and Consumptive Irrigation Requirements in Wyoming, University of Wyoming Cooperative Extension Service and Wyoming Water Research Center, WWRC Publication #92-06, 1992

Star Valley Conservation District, Star Valley Conservation District's Long Range Plan 1995-2000, 1995.

Wyoming State Engineer's Office, Wyoming Water Planning Program, Report No. 12, Water & Related Land Resources of the Snake River Basin, Wyoming, December 1972.

Sunrise Engineering, Inc., Cropping Patterns in the Basin, Technical Memorandum, Snake/Salt River Basin Plan, 2002.

Sunrise Engineering, Inc., Irrigation Diversion Operation and Description, Technical Memorandum, Snake/Salt River Basin Plan, 2002.

Wight, Jermy B., Make This Valley Full of Ditches, 2001.

Wilson, Jim, Hydrographer-Commissioner, Wyoming State Engineer's Office, Telephone Interview, August 21, 2002.

Appendix A

Basin Water Use Profile – Agriculture

Table 1. Consumptive Irrigation Requirement (inches) by Crop Distribution Zones

Zone	Climate Station	Alfalfa Weight	Grain Weight	PGH Weight	MMH Weight		Apr	May	Jun	Jul	Aug	Sep	Oct	Total
Upper Salt River	Afton	0.49	0.18	0.24	0.08	N	0.00	2.12	4.12	5.03	3.23	0.22	0.00	14.73
						D	0.15	0.87	4.81	4.31	2.41	0.42	0.00	12.97
						W	0.00	2.09	4.63	5.08	3.03	0.23	0.00	15.05
Lower Salt River	Bedford	0.58	0.25	0.12	0.04	N	0.00	1.66	3.98	5.43	2.62	0.13	0.00	13.82
						D	0.03	0.62	5.09	4.43	2.32	0.47	0.00	12.96
						W	0.01	1.29	4.78	3.51	1.55	0.00	0.00	11.13
Snake River below Moose	Jackson	0.00	0.00	0.02	0.98	N	0.08	2.44	5.07	6.34	4.28	0.25	0.00	18.46
						D	0.19	2.52	6.33	6.01	4.59	0.31	0.00	19.95
						W	0.04	2.71	4.70	6.27	4.42	0.20	0.00	18.34
Snake River above Moose	Moran	0.00	0.00	0.00	1.00	N	0.00	1.29	4.59	5.76	4.09	0.38	0.00	16.11
						D	0.00	2.10	5.84	5.57	4.60	0.76	0.00	18.87
						W	0.00	1.42	4.34	5.86	4.42	0.36	0.00	16.39
Teton River	Alta	0.40	0.30	0.30	0.00	N	0.00	1.17	3.72	4.39	3.08	1.04	0.00	13.39
						D	0.00	1.14	4.47	4.66	3.76	1.44	0.00	15.48
						W	0.00	1.15	3.09	4.53	3.41	0.72	0.00	12.90

Table 2. Snake/Salt River Basin Irrigation Days

Upper Salt

Month	Days Diverted	Percent Available Wet	Percent Available Average	Percent Available Dry	Irrigation Days Wet	Irrigation Days Average	Irrigation Days Dry
April	5	100%	100%	100%	5	5	5
May	22	100%	100%	100%	22	22	22
June	30	100%	100%	90%	30	30	27
July	31	100%	80%	70%	31	25	22
August	31	70%	60%	40%	22	19	12
September	30	60%	50%	30%	18	15	9
October	24	50%	40%	20%	12	10	5

Lower Salt

Month	Days Diverted	Percent Available Wet	Percent Available Average	Percent Available Dry	Irrigation Days Wet	Irrigation Days Average	Irrigation Days Dry
April	0	100%	100%	100%	0	0	0
May	12	100%	100%	100%	12	12	12
June	30	100%	100%	90%	30	30	27
July	31	100%	80%	70%	31	25	22
August	31	70%	60%	40%	22	19	12
September	15	60%	50%	30%	9	8	5
October	12	50%	40%	20%	6	5	2

Upper & Lower Snake

Month	Days Diverted	Percent Available Wet	Percent Available Average	Percent Available Dry	Irrigation Days Wet	Irrigation Days Average	Irrigation Days Dry
April	0	100%	100%	100%	0	0	0
May	25	100%	100%	100%	25	25	25
June	30	100%	100%	100%	30	30	30
July	26	100%	100%	100%	26	26	26
August	26	100%	100%	100%	26	26	26
September	20	100%	100%	100%	20	20	20
October	15	100%	100%	100%	15	15	15

Teton

Month	Days Diverted	Percent Available Wet	Percent Available Average	Percent Available Dry	Irrigation Days Wet	Irrigation Days Average	Irrigation Days Dry
April	0	100%	100%	100%	0	0	0
May	0	100%	100%	100%	0	0	0
June	30	100%	100%	100%	30	30	30
July	31	100%	100%	65%	31	31	20
August	31	100%	65%	30%	31	20	9
September	30	60%	30%	20%	18	9	6
October	10	30%	20%	15%	3	2	2

Note: Diversions in October and part of September are for stock water, soil moisture, etc.

Table 3. Agricultural Depletions

Sub-Basin	Irrigated Acreage	Wet Year Depletions (acre-ft)							
		April	May	June	July	August	September	October	Total
Upper Salt	31,774	0	3,923	12,262	13,438	5,614	363	0	35,601
Lower Salt	33,810	0	1,403	13,454	9,884	3,052	0	0	27,793
Upper Snake	6,813	0	650	2,465	2,788	2,102	134	0	8,140
Lower Snake	22,027	0	4,007	8,628	9,653	6,803	246	0	29,337
Teton	4,647	0	0	1,198	1,752	1,322	166	0	4,439
						Wet Year Basin Total (ac-ft) =			**105,310**

Sub-Basin	Irrigated Acreage	Average Year Depletions (acre-ft)							
		April	May	June	July	August	September	October	Total
Upper Salt	31,774	0	3,990	10,916	10,660	5,127	295	0	30,987
Lower Salt	33,810	0	1,812	11,213	12,244	4,427	90	0	29,785
Upper Snake	6,813	0	588	2,605	2,744	1,947	145	0	8,029
Lower Snake	22,027	0	3,619	9,307	9,764	6,586	300	0	29,577
Teton	4,647	0	0	1,441	1,699	774	121	0	4,036
						Average Year Basin Total (ac-ft) =			**102,413**

Sub-Basin	Irrigated Acreage	Dry Year Depletions (acre-ft)							
		April	May	June	July	August	September	October	Total
Upper Salt	31,774	64	1,634	11,470	7,984	2,558	337	0	24,047
Lower Salt	33,810	0	677	12,917	8,746	2,610	197	0	25,146
Upper Snake	6,813	0	963	3,314	2,652	2,190	288	0	9,407
Lower Snake	22,027	0	3,728	11,619	9,246	7,072	377	0	32,042
Teton	4,647	0	0	1,731	1,173	437	112	0	3,452
						Dry Year Basin Total (ac-ft) =			**94,095**