SUPPLEMENTAL REPORT

ENVIRONMENTAL PROGRAMS

— 1977 —

WHITE RIVER SHALE PROJECT

Federal Prototype Oil Shale Leases

Ua and Ub

January 1979

WHITE RIVER SHALE PROJECT
1315 WEST HIGHWAY 40
VERNAL, UTAH 84078
(801) 789-0571

February 23, 1979

Mr. Henry O. Ash
Executive Director
Oil Shale Environmental Advisory Panel
U. S. Department of Interior
Office of the Secretary
Denver Federal Center, Rm. 820-A, Bldg. 67
Denver, Colorado 80225

Re: "Supplemental Report -- Environmental Programs"

Dear Mr. Ash:

Enclosed for your use are two copies of the subject report. This report contains data collected by the U. S. Geological Survey during the 1977 water year. This information was not available at the time the WRSP 1977 Environmental Progress Report was published and copies sent to you in July 1978.

Please contact me if you have any questions concerning this report or our project.

Sincerely,

Rees C. Madsen

Rees C. Madsen
Manager

RCM/nh

Enclosure

SUPPLEMENTAL REPORT

ENVIRONMENTAL PROGRAMS

- 1977 -

WHITE RIVER SHALE PROJECT

FEDERAL PROTOTYPE OIL SHALE LEASES

U-a and U-b

January 1979

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF TABLES (Continued)

SUPPLEMENTAL WATER RESOURCES REPORT

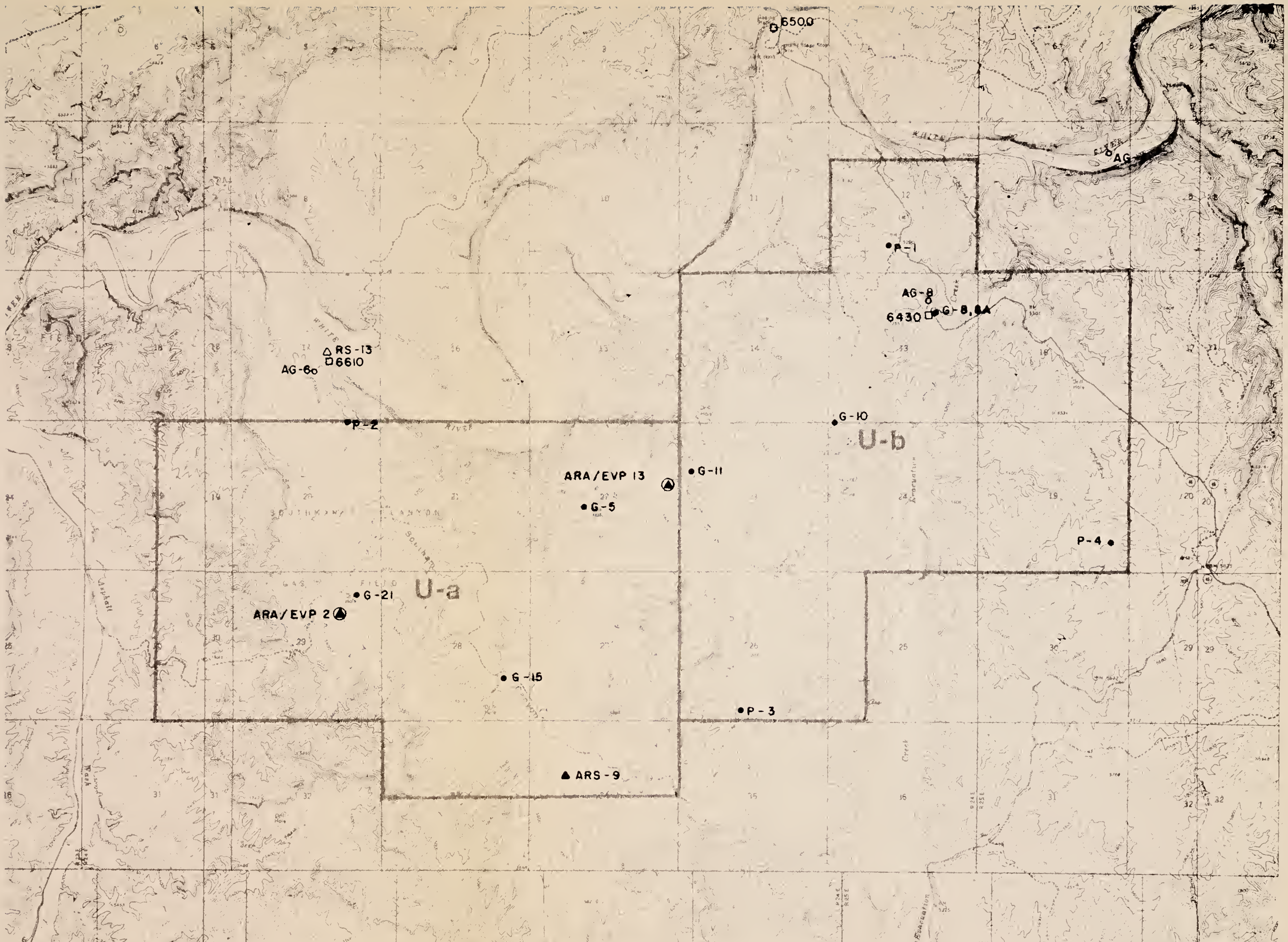
The annual WRSP progress report for the Interim Environmental Monitoring Program covering the 1977 water year (October 1, 1976 through September 30, 1977) was published in July 1978. At that time, some 1977 data that had been collected by the United States Geological Survey (USGS) were not available. These data have been received from the USGS and are presented in this supplemental report to the 1977 annual report. The anlayses of these data are also presented.

Some additional analyses of the data presented in the 1977 annual report have been done since that report was published. These analyses are included within the conclusions of the Surface Water, Alluvial Ground Water and Precipitation/Evaporation sections. No additional analyses were done on the data from Deep Ground Water.

The analyses were performed and this report prepared by VTN Colorado Inc. for the White River Shale Project (WRSP). The White River Shale Project is a joint venture of Phillips Petroleum Company, Sohio Natural Resources Company and Sunoco Energy Development Company. WRSP was formed to develop two Federal oil shale leases (Tracts Ua and Ub) located in Uintah County, Utah.

The locations of the water resources monitoring sites are shown in Figure 1. All supporting data are shown in the figures and tables of the text and in the field data section. All USGS data in this report are preliminary and subject to revision.

WATER RESOURCES MONITORING SITES



6700 ▫ ◦ AG-3

LEGEND

- ▫ SURFACE WATER
- • DEEP AQUIFER WATER
- ◦ ALLUVIAL WATER
- ▲ PRECIPITATION (AUTOMATIC)
- △ PRECIPITATION (STORAGE)
- Ⓐ PRECIPITATION (AUTO)/EVAPORATION PAN

UTAH

N

1 0 1

SCALE IN MILES

FIGURE 1

1.0 Surface Water

This section presents the data collected by the USGS that were unavailable at the time that the 1977 annual report for the Interim Monitoring Period was written. The analysis of these data, as well as additional analyses of the previously presented data are included in this section.

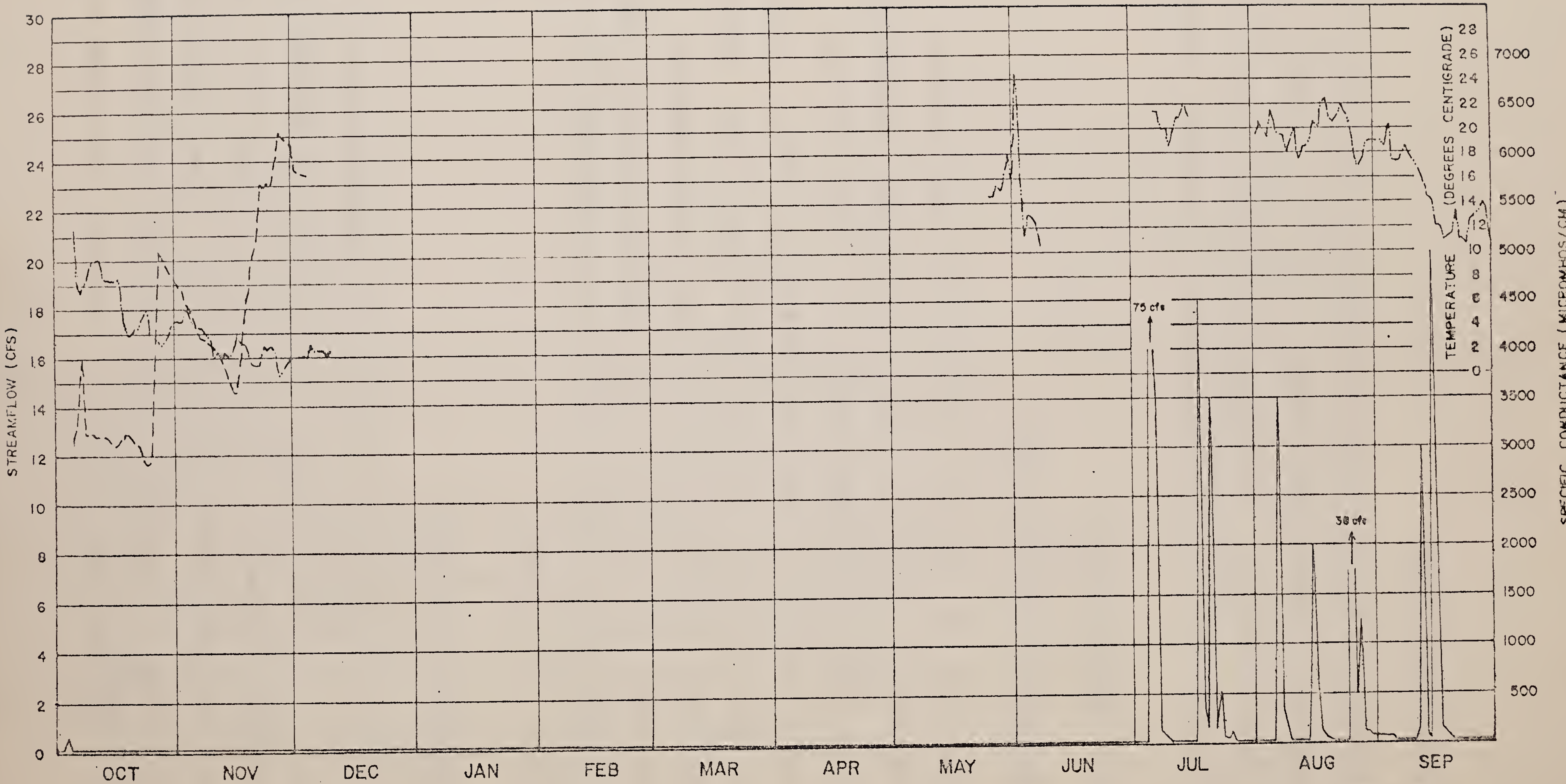
1.1 Results to Date

Streamflow: Evacuation Creek

During the 1977 water year the maximum mean daily streamflow at station 09306430 was 2.12m^3/sec (75 cfs). The peak flows occurred during July, August and September and were due to thunderstorm runoff. The surface runoff was of short duration but very intense. It accounted for almost all of the volume of runoff during the year. The minimum mean daily streamflow at this station was 0.0003 m^3/sec (0.01 cfs). The mean daily streamflow at station 09306430 is shown in Figure 2. The annual total volume of runoff at station 09306430 was 60.3 hectare-meters (489 acre-feet).

Streamflow: Dry Washes

In Hell's Hole Canyon at the mouth (station 09306405) there were eight days of flow during the year. In Asphalt Wash near the mouth (station 09306625) there were six days of flow during the year. All of these flow events were due to thunderstorm runoff. The mean daily streamflow for the days of flow during the 1977 water year at stations 09306405 and 09306625 are shown in Table 1. The annual total volume of runoff



MEAN DAILY STREAMFLOW, TEMPERATURE AND SPECIFIC CONDUCTANCE

EVACUATION CREEK NEAR MOUTH, NEAR WATSON (09306430)

OCTOBER 1976 – SEPTEMBER 1977

FIGURE 2

TABLE 1

MEAN DAILY STREAMFLOW
HELL'S HOLE CANYON AND ASPHALT WASH
OCTOBER 1976 - SEPTEMBER 1977

	Date	Mean Daily Streamflow (cfs)
Hell's Hole Canyon at Mouth (Station 09306405)		
	10/02/76	0.53
	7/04/77	0.26
	7/05/77	7.00
	7/17/77	0.08
	7/19/77	5.10
	7/20/77	0.20
	7/23/77	5.20
	7/24/77	6.80
Asphalt Wash near Mouth (Station 09306625)		
	10/02/76	0.01
	10/03/76	0.28
	8/17/77	3.10
	8/18/77	0.61
	8/25/77	0.07
	9/16/77	0.15

was 6.17 hectare-meters (50 acre-feet) at station 09306405 and 1.04 hectare-meters (8.4 acre-feet) at station 09306625.

Water Quality: White River

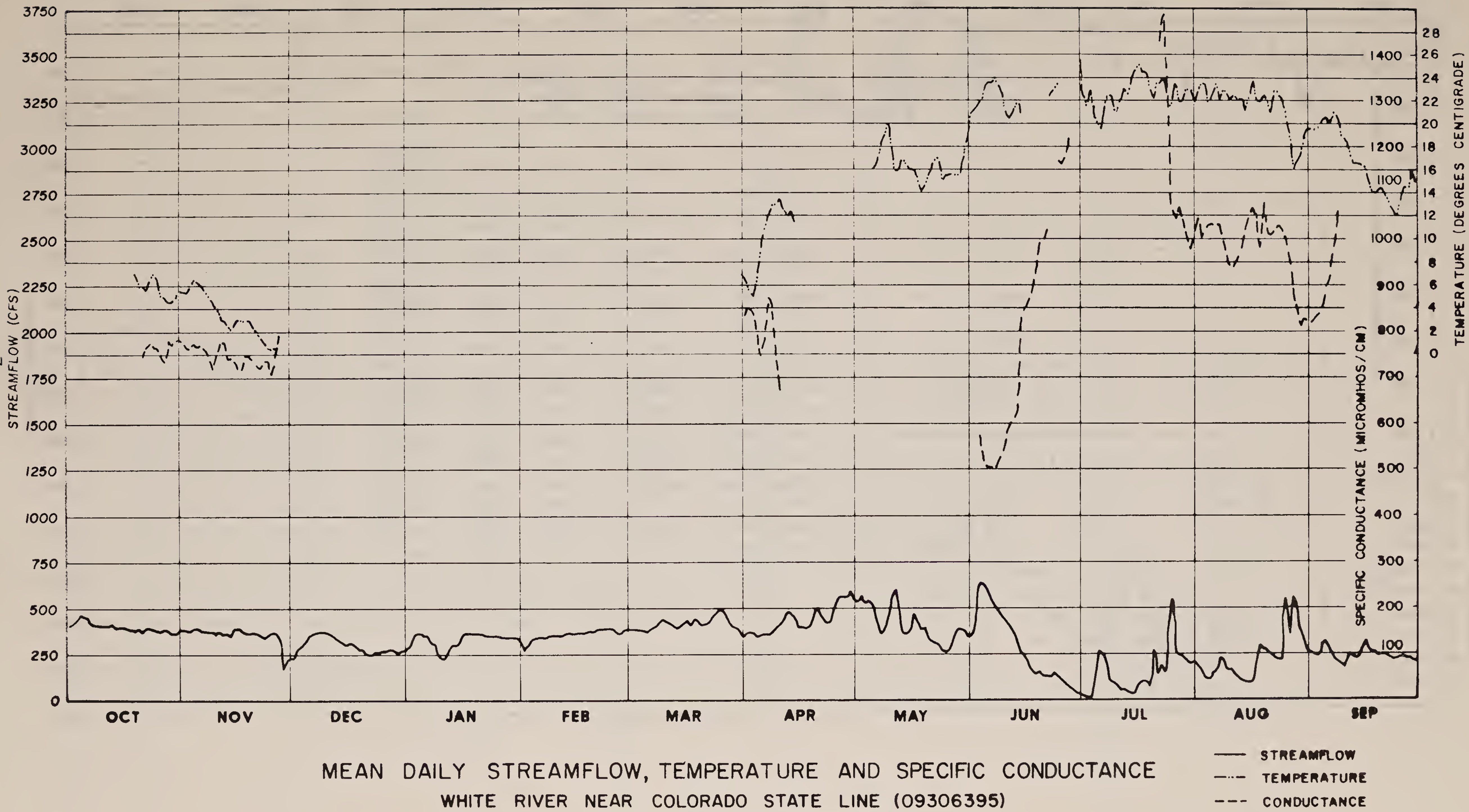
Temperature and specific conductance during the 1977 water year at stations 09306395 and 09306500 are shown in Figures 3 and 4 , respectively. Temperature followed an annual sinusoidal pattern, and specific conductance followed an inverse relationship to streamflow. This was similar to the Baseline period.

The 1977 records of suspended sediment concentration and discharge at stations 09306395 and 09306700 are shown in Tables 2 and 3 , respectively. The 1977 record was the first year of record at station 09306395. Suspended sediment concentration at both stations followed the direct relationship to streamflow that was established in the Baseline study.

Water Quality: Evacuation Creek

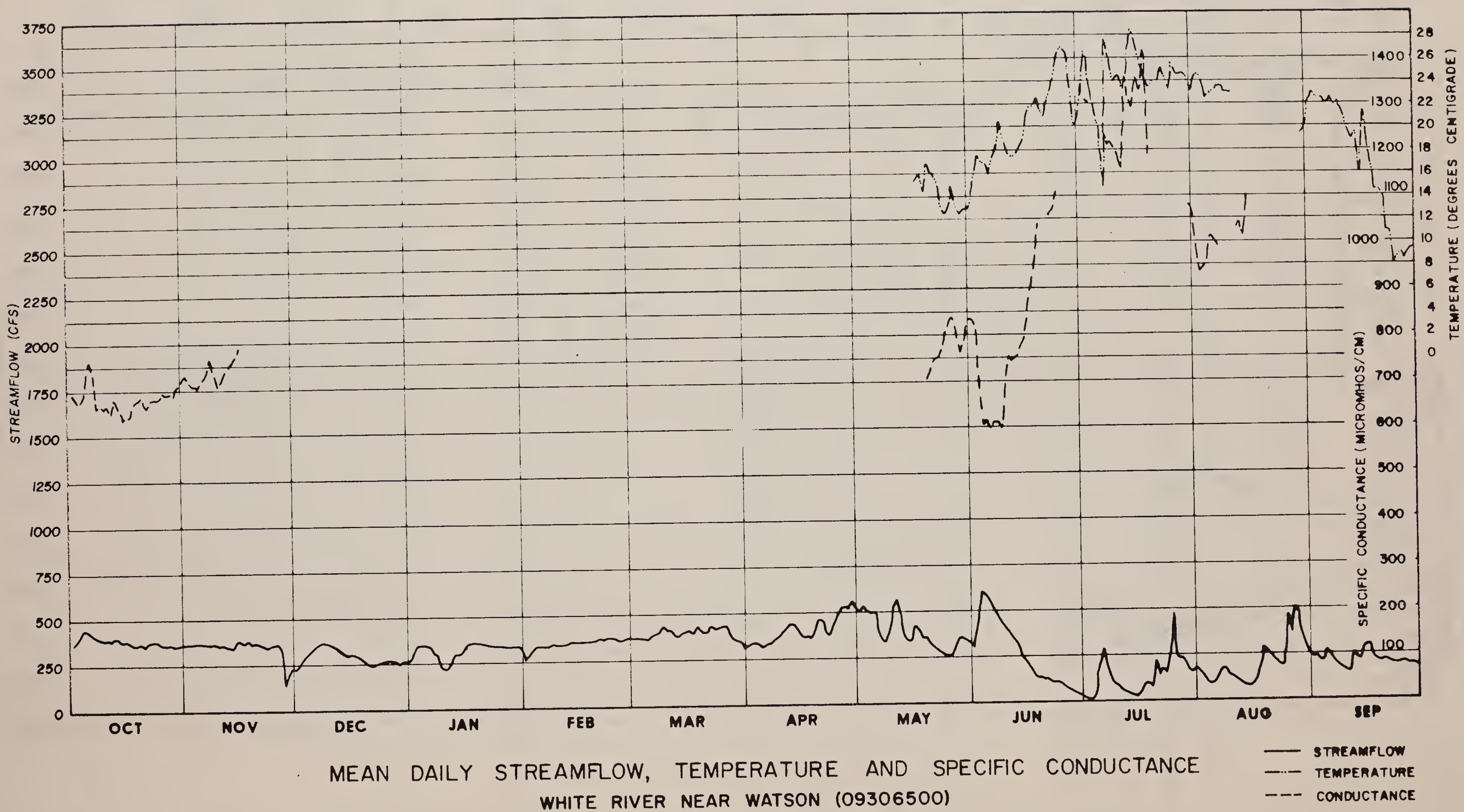
Temperature and specific conductance during the 1977 water year for Evacuation Creek near the mouth (station 09306430) are shown in Figure 2 .

Suspended sediment concentration and discharge data for station 09306430 are shown in Table 4 . The maximum mean daily suspended sediment discharge was 35,700 tons/day on July 5, 1977. The total annual discharge was 89,052 tons. The high values of mean daily suspended sediment were due to thunderstorm runoff. The values of



MEAN DAILY STREAMFLOW, TEMPERATURE AND SPECIFIC CONDUCTANCE
WHITE RIVER NEAR COLORADO STATE LINE (09306395)
OCTOBER 1976 - SEPTEMBER 1977

FIGURE 3



MEAN DAILY STREAMFLOW, TEMPERATURE AND SPECIFIC CONDUCTANCE
WHITE RIVER NEAR WATSON (09306500)
OCTOBER 1976 - SEPTEMBER 1977

FIGURE 4

TABLE 2

UNITED STATES DEPARTMENT OF INTERIOR - GEOLOGICAL SURVEY
09306395 - WHITE R. NR. COLO. STATE LINE, UT.

PROCESS DATE 11/2.
DISTRICT CODE 49

PARTICLE-SIZE DISTRIBUTION OF SUSPENDED SEDIMENT

DATE	TIME	STREAM-FLOW, INSTAN-TANEOUS (CFS)	TEMPER-ATURE (DEG C)	SEDI-MENT, SUS-PENDED (MG/L)	SEDI-MENT DIS-CHARGE, SUS-PENDED (T/DAY)	SED. SUSP. FALL DIAM. % FINER THAN .002 MM	SED. SUSP. FALL DIAM. % FINER THAN .004 MM
OCT , 1976							
15...	1600	397	13.0	95	102	--	--
JAN , 1977							
05...	1245	350	.0	121	114	--	--
FEB							
01...	1400	266	.0	81	58	--	--
MAR							
24...	1545	460	4.0	1040	1290	27	40
29...	1415	404	4.5	407	444	--	--
APR							
06...	1300	360	13.0	195	190	--	--
27...	1215	564	17.0	624	950	--	--
MAY							
13...	1320	347	16.0	127	119	--	--
JUN							
02...	1300	538	22.5	272	395	--	--
14...	1030	241	20.0	111	72	--	--
21...	1300	135	14.0	95	34	--	--
JUL							
07...	1450	166	24.5	12900	5780	62	84
13...	1200	40	25.0	194	21	--	--
AUG							
25...	1030	642	21.0	23200	40200	33	47
31...	1115	261	18.0	851	600	43	53
SEP							
07...	1410	207	24.0	709	396	--	--
14...	1100	224	--	2800	1690	51	71

TABLE 2 (continued)

UNITED STATES DEPARTMENT OF INTERIOR - GEOLOGICAL SURVEY
09306395 - WHITE R. NR. COLO. STATE LINE, UT.

PROCESS DATE 09/29/78
DISTRICT CODE 49

Unpublished Records
Subject to Revision

SUSPENDED SEDIMENT DISCHARGE

DATE	SUS. SED. FALL DIAM. % FINER THAN .016 MM	SUS. SED. FALL DIAM. % FINER THAN .031 MM	SUS. SED. FALL DIAM. % FINER THAN .062 MM	SUS. SED. FALL DIAM. % FINER THAN .125 MM	SUS. SED. FALL DIAM. % FINER THAN .250 MM	SUS. SED. FALL DIAM. % FINER THAN .500 MM
OCT , 1976						
15...	--	--	--	--	--	--
JAN , 1977						
05...	--	--	--	--	--	--
FEB						
01...	--	--	--	--	--	--
MAR						
24...	62	88	89	93	99	100
29...	--	--	--	--	--	--
APR						
06...	--	--	--	--	--	--
27...	--	--	--	--	--	--
MAY						
13...	--	--	--	--	--	--
JUN						
02...	--	--	--	--	--	--
14...	--	--	--	--	--	--
21...	--	--	--	--	--	--
JUL						
07...	99	100	--	--	--	--
13...	--	--	--	--	--	--
AUG						
25...	78	96	99	100	--	--
31...	71	90	95	99	100	--
SEP						
07...	--	--	--	--	--	--
14...	95	99	100	--	--	--

TABLE 3

SEDIMENT DISCHARGE
STATION 09306700

	OCTOBER 1976			NOVEMBER 1976			DECEMBER 1976		
	MEAN DISCHARGE (cfs)	MEAN CONCENTRATION (mg/l)	SEDIMENT DISCHARGE (tons/day)	MEAN DISCHARGE (cfs)	MEAN CONCENTRATION (mg/l)	SEDIMENT DISCHARGE (tons/day)	MEAN DISCHARGE (cfs)	MEAN CONCENTRATION (mg/l)	SEDIMENT DISCHARGE (tons/day)
1	384	- -	- -	354	- -	- -	202	- -	- -
2	398	- -	- -	349	- -	- -	250	- -	- -
3	416	- -	- -	349	- -	- -	280	- -	- -
4	435	- -	- -	356	* 238	229	305	- -	- -
5	430	- -	- -	361	- -	- -	335	- -	- -
6	415	509	570	354	- -	- -	345	- -	- -
7	392	* 380	402	352	- -	- -	355	- -	- -
8	384	- -	- -	348	- -	- -	360	- -	- -
9	383	307	317	350	220	208	360	- -	- -
10	380	240	246	338	168	153	355	- -	- -
11	378	307	313	344	212	197	340	- -	- -
12	372	- -	- -	337	200	182	330	- -	- -
13	384	489	507	332	165	148	310	* 183	153
14	366	- -	- -	323	153	133	300	- -	- -
15	362	251	245	359	247	239	290	- -	- -
16	365	209	206	369	200	199	295	- -	- -
17	354	193	184	351	* 145	137	295	- -	- -
18	346	210	196	361	176	172	280	- -	- -
19	347	- -	- -	343	164	152	265	- -	- -
20	349	* 180	170	357	181	174	250	- -	- -
21	336	- -	- -	348	203	191	240	- -	- -
22	351	- -	- -	338	167	152	240	- -	- -
23	366	239	236	319	218	188	245	- -	- -
24	362	- -	- -	321	257	223	250	- -	- -
25	354	- -	- -	326	270	238	250	- -	- -
26	349	- -	- -	340	455	418	260	- -	- -
27	347	- -	- -	310	- -	- -	265	- -	- -
28	353	- -	- -	150	- -	- -	255	* 176	121
29	339	- -	- -	200	- -	- -	240	- -	- -
30	339	- -	- -	220	- -	- -	250	- -	- -
31	346	- -	- -	- -	- -	- -	255	- -	- -

Note: The symbol, *, indicates that a suspended sediment measurement was taken manually using the EDI method. The symbol, S, indicates that the day was subdivided using the mean interval method to calculate sediment discharge.

TABLE 3 (Continued)

SEDIMENT DISCHARGE
STATION 09306700

	JANURAY 1977			FEBRUARY 1977			MARCH 1977		
	MEAN DISCHARGE (cfs)	MEAN CONCENTRATION (mg/l)	SEDIMENT DISCHARGE (tons/day)	MEAN DISCHARGE (cfs)	MEAN CONCENTRATION (mg/l)	SEDIMENT DISCHARGE (tons/day)	MEAN DISCHARGE (cfs)	MEAN CONCENTRATION (mg/l)	SEDIMENT DISCHARGE (tons/day)
1	275	- -	- -	260	- -	- -	370	- -	- -
2	330	- -	- -	290	- -	- -	370	- -	- -
3	345	- -	- -	320	- -	- -	370	- -	- -
4	345	- -	- -	330	- -	- -	365	- -	- -
5	340	- -	- -	330	- -	- -	360	- -	- -
6	335	- -	- -	330	- -	- -	375	- -	- -
7	295	- -	- -	330	- -	- -	385	- -	- -
8	290	- -	- -	335	* 368	333	387	- -	- -
9	220	- -	- -	340	- -	- -	383	* 586	606
10	210	- -	- -	340	- -	- -	405	- -	- -
11	215	* 114	66	340	- -	- -	408	- -	- -
12	265	- -	- -	345	- -	- -	361	- -	- -
13	290	- -	- -	350	- -	- -	353	- -	- -
14	290	- -	- -	350	- -	- -	368	- -	- -
15	315	- -	- -	350	- -	- -	371	- -	- -
16	345	- -	- -	350	- -	- -	402	- -	- -
17	350	- -	- -	350	- -	- -	391	- -	- -
18	350	- -	- -	355	- -	- -	415	- -	- -
19	350	- -	- -	360	- -	- -	398	- -	- -
20	345	- -	- -	360	- -	- -	404	- -	- -
21	340	- -	- -	370	- -	- -	381	- -	- -
22	340	- -	- -	365	* 291	287	419	- -	- -
23	340	- -	- -	370	- -	- -	453	- -	- -
24	340	* 343	315	370	- -	- -	446	- -	- -
25	335	- -	- -	370	- -	- -	446	- -	- -
26	330	- -	- -	360	- -	- -	460	- -	- -
27	330	- -	- -	360	- -	- -	413	- -	- -
28	330	- -	- -	365	- -	- -	386	- -	- -
29	330	- -	- -	- -	- -	- -	373	- -	- -
30	330	- -	- -	- -	- -	- -	370	- -	- -
31	315	- -	- -	- -	- -	- -	323	- -	- -

Note: The symbol, *, indicates that a suspended sediment measurement was taken manually using the EDI method. The symbol, S, indicates that the day was subdivided using the mean interval method to calculate sediment discharge.

TABLE 3 (Continued)

SEDIMENT DISCHARGE
STATION 09306700

	APRIL 1977			MAY 1977			JUNE 1977		
	MEAN DISCHARGE (cfs)	MEAN CONCENTRATION (mg/l)	SEDIMENT DISCHARGE (tons/day)	MEAN DISCHARGE (cfs)	MEAN CONCENTRATION (mg/l)	SEDIMENT DISCHARGE (tons/day)	MEAN DISCHARGE (cfs)	MEAN CONCENTRATION (mg/l)	SEDIMENT DISCHARGE (tons/day)
1	335	- -	- -	510	846	1170	307	- -	- -
2	351	- -	- -	542	504	738	444	- -	- -
3	361	- -	- -	550	623	925	624	* 1310	2210
4	340	- -	- -	489	- -	- -	606	- -	- -
5	330	* 277	247	536	477	690	587	- -	- -
6	344	- -	- -	458	* 424	524	560	* 612	925
7	353	- -	- -	363	366	359	503	- -	- -
8	366	- -	- -	352	251	239	475	- -	- -
9	388	- -	- -	369	229	228	450	- -	- -
10	405	- -	- -	506	358	489	418	- -	- -
11	433	- -	- -	579	276	431	390	- -	- -
12	471	1010	1280	538	- -	- -	345	- -	- -
13	475	835	1070	390	- -	- -	314	- -	- -
14	445	605	727	363	* 204	200	261	* 183	129
15	404	485	529	341	- -	- -	222	- -	- -
16	386	408	425	430	- -	- -	192	- -	- -
17	394	389	414	424	* 305	349	159	- -	- -
18	376	312	317	381	* 232	239	131	112	40
19	421	352	400	374	* 177	179	124	104	35
20	465	* 445	559	341	182	168	123	* 109	36
21	477	587	756	313	- -	- -	101	79	22
22	412	474	527	300	- -	- -	111	112	34
23	390	260	274	274	- -	- -	100	73	20
24	430	234	272	255	* 57	39	111	90	27
25	478	510	658	247	- -	- -	94	91	23
26	516	516	719	264	* 119	85	78	64	13
27	550	664	986	313	- -	- -	64	72	12
28	535	627	906	357	- -	- -	47	62	7.9
29	563	1430	2170	374	- -	- -	44	* 60	7.1
30	558	949	1430	352	- -	- -	38	72	7.4
31	- -	- -	- -	348	- -	- -	- -	- -	- -

Note: The symbol, *, indicates that a suspended sediment measurement was taken manually using the EDI method. The symbol, S, indicates that the day was subdivided using the mean interval method to calculate sediment discharge.

TABLE 3 (Continued)

SEDIMENT DISCHARGE
STATION 09306700

	JULY 1977			AUGUST 1977			SEPTEMBER 1977		
	MEAN DISCHARGE (cfs)	MEAN CONCENTRATION (mg/l)	SEDIMENT DISCHARGE (tons/day)	MEAN DISCHARGE (cfs)	MEAN CONCENTRATION (mg/l)	SEDIMENT DISCHARGE (tons/day)	MEAN DISCHARGE (cfs)	MEAN CONCENTRATION (mg/l)	SEDIMENT DISCHARGE (tons/day)
1	29	88	6.9	164	583	258	245	1150	761
2	22	44	2.6	128	- -	- -	235	3480	2210
3	17	28	1.3	114	- -	- -	226	- -	- -
4	50	22	3.0	91	* 216	53	200	- -	- -
5	220	2910	1730	88	- -	- -	308	- -	- -
6	254	48500	33300	124	- -	- -	260	3780	2640 S
7	180	23800	11600	138	- -	- -	216	* 7550	4320 S
8	122	1020	336	181	- -	- -	196	591	313
9	96	712	185	134	- -	- -	177	434	207
10	89	268	64	131	- -	- -	160	292	126
11	70	346	65	123	- -	- -	154	254	106
12	53	290	41	102	* 134	37	216	5240	3060
13	40	320	35	83	- -	- -	247	31300	20900
14	27	153	11	76	- -	- -	220	12200	7250
15	25	* 134	9.0	73	- -	- -	249	* 4840	3250
16	27	108	7.9	90	- -	- -	376	21200	21500
17	66	186	33	88	- -	- -	234	23000	14500
18	88	272	65	286	- -	- -	214	2010	1160
19	72	- -	- -	305	14900	11800 S	201	- -	- -
20	163	* 318	140	226	6120	3520 S	201	- -	- -
21	146	- -	- -	230	9870	5760 S	205	- -	- -
22	145	- -	- -	209	1506	850	197	- -	- -
23	140	- -	- -	193	877	457	193	- -	- -
24	281	- -	- -	186	1140	573	192	- -	- -
25	461	- -	- -	406	1810	1980	194	- -	- -
26	235	- -	- -	487	- -	- -	203	- -	- -
27	225	* 5550	3370	501	15400	20800	200	- -	- -
28	218	3300	1940	600	27600	44700	189	- -	- -
29	168	1120	508	441	* 11300	13500	188	* 181	92
30	155	853	357	332	3480	3120	169	- -	- -
31	164	586	259	276	1760	1310	- -	- -	- -

Note: The symbol, *, indicates that a suspended sediment measurement was taken manually using the EDI method. The symbol, S, indicates that the day was subdivided using the mean interval method to calculate sediment discharge.

TABLE 4

UNITED STATES DEPARTMENT OF INTERIOR - GEOLOGICAL SURVEY PROCESS DATE IS 09-29-78

STATION NUMBER 09306430 EVACUATION CR NR MOUTH NR WATSON,UT STREAM SOURCE AGENCY USGS
LATITUDE 395704 LONGITUDE 1090931 DRAINAGE AREA 284.00 DATUM 5080.00 STATE 49 COUNTY 047

Unpublished Records
Subject to Revision

SUSPENDED-SEDIMENT DISCHARGE (TONS/DAY), WATER YEAR OCTOBER 1976 TO SEPTEMBER 1977
MEAN VALUES

DAY	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP
1	.02	.00	.00	.00	.01	.01	.01	.01	.01	.01	.40	6.0
2	.01	.00	.00	.00	.01	.02	.01	.01	.01	.01	.50	4.0
3	.10	.00	.00	.00	.01	.02	.01	.01	.02	.01	.50	3.0
4	.01	.00	.00	.00	.01	.02	.01	.01	.02	.01	.60	2.0
5	.02	.00	.00	.00	.02	.02	.01	.01	.02	35700	.60	.50
6	.00	.00	.00	.00	.02	.02	.01	.01	.02	4480	4000	.30
7	.00	.00	.00	.00	.02	.02	.01	.01	.02	60	250	.20
8	.00	.00	.00	.00	.03	.02	.01	.01	.02	32	6.0	.10
9	.00	.00	.00	.00	.03	.02	.01	.01	.02	22	3.0	.08
10	.00	.00	.00	.00	.03	.02	.01	.02	.02	7.0	1.0	.06
11	.00	.00	.00	.00	.03	.02	.01	.01	.02	1.2	.50	127
12	.00	.00	.00	.00	.02	.02	.01	.01	.02	.70	.20	3250
13	.00	.00	.00	.00	.02	.02	.01	.02	.02	.10	.10	25
14	.00	.00	.00	.00	.02	.02	.01	.01	.02	.06	.50	11
15	.00	.00	.00	.00	.02	.02	.01	.01	.02	.01	2000	6000
16	.00	.00	.00	.00	.02	.02	.01	.01	.01	.01	450	1200
17	.00	.00	.00	.00	.02	.02	.00	.01	.01	7950	46	48
18	.00	.00	.00	.00	.03	.02	.00	.01	.01	330	27	36
19	.00	.00	.00	.00	.02	.02	.01	.01	.01	61	16	10
20	.00	.00	.00	.00	.01	.02	.01	.01	.01	3260	7.0	3.0
21	.00	.00	.00	.00	.01	.01	.01	.01	.01	58	6.0	1.0
22	.00	.00	.00	.00	.02	.01	.00	.01	.01	670	6.0	.30
23	.00	.00	.00	.00	.02	.01	.00	.01	.01	34	5.0	.10
24	.00	.00	.00	.00	.02	.01	.00	.01	.01	1.2	9.0	.09
25	.00	.00	.00	.00	.01	.01	.00	.01	.01	2.9	17100	.08
26	.00	.00	.00	.00	.02	.01	.00	.01	.01	.70	410	.09
27	.00	.00	.00	.01	.01	.01	.01	.01	.01	.20	1200	.06
28	.00	.00	.00	.01	.02	.01	.01	.01	.01	.10	50	.05
29	.00	.00	.00	.01	---	.58	.01	.01	.01	.03	35	.04
30	.00	.00	.00	.01	---	.01	.01	.02	.01	.03	11	.03
31	.00	---	.00	.01	---	.01	---	.02	---	.20	8.0	---
TOTAL	0.16	0.00	0.00	0.05	0.53	1.07	0.23	0.35	0.43	52671.48	25649.90	10728.08
MEAN	.01	.00	.00	.00	.02	.03	.01	.01	.01	1700	827	358
MAX	.10	.00	.00	.01	.03	.58	.01	.02	.02	35700	17100	6000

WTR YR 1977 TOTAL 89052.28 MEAN 244 MAX 35700

TABLE 4 (continued)

UNITED STATES DEPARTMENT OF INTERIOR - GEOLOGICAL SURVEY PROCESS DATE 11/15/78
09306430 - EVACUATION CR NR MOUTH NR WATSON,UT DISTRICT CODE 49

PARTICLE-SIZE DISTRIBUTION OF SUSPENDED SEDIMENT

DATE	TIME	STREAM-FLOW, INSTAN-TANEOUS (CFS)	TEMPER-ATURE (DEG C)	SEDI-MENT, SUS-PENDED (MG/L)	SEDI-MENT DIS-CHARGE, SUS-PENDED (T/DAY)	SED. SUSP. FALL DIAM. % FINER THAN .002 MM	SED. SUSP. FALL DIAM. % FINER THAN .004 MM	SED. SUSP. FALL DIAM. % FINER THAN .016 MM	SED. SUSP. FALL DIAM. % FINER THAN .031 MM	SED. SUSP. FALL DIAM. % FINER THAN .062 MM	SED. SUSP. FALL DIAM. % FINER THAN .125 MM	SED. SUSP. FALL DIAM. % FINER THAN .250 MM
DEC , 1976												
13...	1230	.02	3.0	46	<.01	--	--	--	--	--	--	--
JAN , 1977												
18...	1630	.02	2.5	13	<.01	--	--	--	--	--	--	--
FEB												
07...	1650	.02	4.0	348	.02	--	--	--	--	--	--	--
MAY												
03...	1315	.02	16.0	142	.01	--	--	--	--	--	--	--
JUL												
05...	2045	456	16.0	178000	219000	27	38	60	78	84	95	100
05...	2130	247	16.0	164000	109000	28	39	64	82	90	98	100
06...	1700	1.5	26.0	69700	282	68	90	99	100	--	--	--
15...	1300	<.01	28.0	91	<.01	--	--	--	--	--	--	--
20...	1200	7.8	26.5	125000	2630	49	70	97	100	--	--	--
24...	1300	.18	28.0	1940	.94	93	97	100	--	--	--	--
AUG												
16...	1145	4.0	25.5	65900	712	56	77	99	100	--	--	--
19...	1230	.19	29.0	31800	16	76	98	100	--	--	--	--

suspended sediment concentration were within the range of values during the Baseline period.

Water Quality: Dry Washes

No water quality data were obtained during the 1977 water year at Hell's Hole Canyon at the mouth (station 09306405) and Asphalt Wash near the mouth (station 09306625).

1.2 Conclusions

The December 1976 Work Plan presented two hypotheses to be tested. The first hypothesis is:

> There are no significant differences in chemical or physical composition of the surface water between stations 09306395, 09306400, 09306500 and 09306700.

Concurrent data for temperature and specific conductance at stations 09306395 and 09306400 were tested to determine the correlation coefficient and the standard error of estimate using simple linear regression. The criteria to be met were set in the Work Plan. These were: the correlation coefficient should be greater than or equal to 0.9 and the standard error of estimate should be less than or equal to 10%. Also, the analyses should be based on daily values from baseflow and highflow periods.

The results of the analyses for temperature are shown in Table 5. The standard error of estimate with station 09306400 as the dependent

TABLE 5

RELATIONSHIP OF TEMPERATURE MEASUREMENTS
BETWEEN STATIONS 09306395 and 09306400

Independent Variable (X)	Dependent Variable (Y)	Time Period	Correlation Coefficient	Standard Error of Estimate in Percent
09306395	09306400	10/19/76-11/22/76	0.96	11.8
09306400	09306395	10/19/76-11/22/76	0.96	9.6
09306395	09306400	5/5/77-6/9/77	0.89	7.9
09306400	09306395	5/5/77-6/9/77	0.89	7.9

variable during baseflow is slightly greater than 10% (11.8%), while the correlation coefficient is 0.96. During highflow the correlation coefficient is slightly less than 0.9 (0.89) while the standard error of estimate in both cases is 7.9%.

The results of the analyses for specific conductance are shown in Table 6. The relationship of each station to station 09306500 is also included to determine whether the data may be erroneous at either station. The correlation coefficients among all three stations during baseflow are well below 0.9. Also, the correlation coefficient between stations 09306395 and 09306500 during highflow is below 0.9 (0.75). In all of the cases the standard error of estimate is less than 10%.

The correlation coefficient is a mathematical definition of the association between samples of two variables. The standard error of estimate is a measure of the reliability of a regression. The relationship between the correlation coefficient and the standard error of estimate is:

$$r = [1 - (S_e/S_y)^2]^{1/2}$$

where r is the correlation coefficient, S_e is the standard error of estimate, and S_y is the standard deviation of the dependent variable. (See: "Some Statistical Tools in Hydrology", Techniques of Water Resources Investigations of the United States Geological Survey, Book 4, Chapter A1, 1968.)

The correlation coefficients for the relationships of specific conductance during baseflow among the three stations are well below 0.9, while the standard error of estimate is well below 10%. A major

TABLE 6

RELATIONSHIP OF SPECIFIC CONDUCTANCE MEASUREMENTS
AMONG STATIONS 09306395, 09306400 and 09306500

Independent Variable (X)	Dependent Variable (Y)	Time Period	Correlation Coefficient	Standard Error of Estimate in Percent
09306395	09306400	10/21/76-11/23/76	0.25	3.3
09306400	09306395	10/21/76-11/23/76	0.25	2.6
09306395	09306400	6/3/77-6/9/77	0.91	4.6
09306400	09306395	6/3/77-6/9/77	0.91	2.2
09306395	09306500	10/21/76-11/16/76	0.46	4.1
09306500	09306395	10/21/76-11/16/76	0.46	2.2
09306395	09306500	6/3/77-6/9/77	0.75	2.8
09306500	09306395	6/3/77-6/9/77	0.75	3.5
09306400	09306500	10/1/76-11/16/76	0.46	4.8
09306500	09306400	10/1/76-11/16/76	0.46	5.0
09306400	09306500	5/20/77-6/9/77	0.93	4.9
09306500	09306400	5/20/77-6/9/77	0.93	8.7

factor involved is that the ranges of the data values during baseflow at each of the three stations is quite small. Because of this, the standard deviation of the dependent variables is quite small (less than 10% of the mean of the dependent variables, for all cases). As the relationship given previously indicates, the correlation coefficient will be small for such cases, even though the standard error of estimate does not exceed 10%. When the range of data values is small in comparison to the mean value, the standard error of estimate expressed as a percentage of the mean of the dependent variable is the more reliable indicator of the relationship between two stations.

It is planned that operation of station 09306400 will be permanently discontinued. Continuous monitoring of streamflow, temperature and specific conductance at station 09306395 will adequately replace the same at station 09306400.

The records of suspended sediment concentration and discharge at stations 09306395 and 09306700 are shown in Tables 2 and 3 , respectively. The record at station 09306395 was prepared by the USGS, and the record at station 09306700 was prepared by WRSP. The data is similar for most of the cases that are comparable; i.e., when the suspended sediment concentration values represent similar points on the streamflow hydrograph. It should be noted that the suspended sediment discharge values are based on instantaneous streamflow for station 09306395, and mean daily streamflow for station 09306700 (except where it is indicated that the day was subdivided).

The comparability of reported water quality data was determined by F tests using the analysis of variance (ANOVA) approach. The 90 percent confidence level was used for the F tests.

The results of the ANOVA tests for significant differences in the 1977 data among the White River stations are shown in Table 7. There were two failures out of 37 parameters tested for the baseflow period. These were iron and aluminum. For the lower basin runoff period, there were no failures out of 23 parameters tested. For the upper basin runoff period, one parameter, boron, failed out of 16 tests. The results of the tests show a very high success ratio. The failures which did occur are attributed to levels near detection limits of the analytical procedures, or a limited amount of data being available for the ANOVA test. The conclusion drawn from the results of the ANOVA tests is that there are no significant differences in chemical composition of the surface water between stations 09306395, 09306500 and 09306700 on the White River.

The second hypothesis to be tested is:

> There are no significant differences in chemical or physical composition of the surface water between comparable data from the two-year Baseline and Interim periods.

<u>White River:</u>

The comparison of streamflow and suspended sediment at the White River stations was discussed in the 1977 annual report. In view of the

TABLE 7

RESULTS OF ANOVA TESTS FOR SIGNIFICANT DIFFERENCE WHITE RIVER WATER QUALITY

Parameters		AMONG STATIONS DURING 1977			BETWEEN BASELINE AND 1977		
		Baseflow	Lower Basin Runoff	Upper Basin Runoff	Baseflow	Lower Basin Runoff	Upper Basin Runoff
Total Alkalinity as $CaCO_3$	(mg/l)			--			
Dissolved Solids	(mg/l)				x		
Hardness as Ca, Mg	(mg/l)			--			
Noncarbonate Hardness	(mg/l)			--	x	x	
pH				--			
Specific Conductance	(umhos/cm)				x		
Streamflow	(cfs)				x	x	x
Temperature	(°C)						
Turbidity	(JTU)		--	--			
Color	(PCU)		--	--			
Calcium	(mg/l)				x		x
Magnesium	(mg/l)				x	x	
Potassium	(mg/l)				x		x
Sodium	(mg/l)				x		
Sodium Adsorption Ratio				--			
Percent Sodium				--			
Strontium	(ug/l)		--	--	x		
Bicarbonate	(mg/l)						
Carbonate	(mg/l)						
Chloride	(mg/l)				x		x
Sulfate	(mg/l)				x		
Sulfide	(mg/l)	--	--	--		x	
Fluoride	(mg/l)				x		
Bromide	(mg/l)	--	--	--			
Dissolved Oxygen	(mg/l)						
Chemical Oxygen Demand	(mg/l)		--	--	x		
Dissolved Organic Carbon	(mg/l)	--	--	--		--	
Chlorophyll A	(ug/l)		--	--			--
Chlorophyll B	(ug/l)		--	--			--
Ammonia as N	(mg/l)		--	--			
Nitrite as N	(mg/l)		--	--			
Nitrate as N	(mg/l)		--	--			
Kjeldahl Nitrogen as N	(mg/l)		--	--	x		
Total Phosphorus as P	(mg/l)		--	--		x	
Diss. Ortho Phosphate as PO_4	(mg/l)			--		x	x
Boron	(ug/l)			x		x	x
Copper	(ug/l)	--	--	--			
Iron	(ug/l)	x	--	--			
Manganese	(ug/l)		--	--	x		
Zinc	(ug/l)	--	--	--			x
Molybdenum	(ug/l)	--	--	--			x
Silica	(mg/l)				x		
Aluminum	(ug/l)	x	--	--			
Barium	(ug/l)	--	--	--			
Cadmium	(ug/l)	--	--	--			
Chromium	(ug/l)	--	--	--			x
Lead	(ug/l)	--	--	--	x		
Lithium	(ug/l)		--	--			
Mercury	(ug/l)	--	--	--			
Selenium	(ug/l)	--	--	--			
Vanadium	(ug/l)	--	--	--			x
Arsenic	(ug/l)	--	--	--	x		
MBAS	(mg/l)	--	--	--			--
Phenols	(ug/l)	--	--	--			
Pesticides	(ug/l)	--	--	--		--	--
Herbicides	(ug/l)	--	--	--		--	--
DDE in Bottom Material	(ug/l)	--	--	--	--	--	--
DDT in Bottom Material	(ug/l)	--	--	--	--	--	--
Other Pesticides in Bottom Material	(ug/l)	--	--	--	--	--	--
Herbicides in Bottom Material	(ug/l)	--	--	--	--	--	--
Gross Alpha as U-nat.	(ug/l)	--	--	--			
Gross Beta as Sr90	(pCi/l)	--	--	--			
Gross Beta as Ce137	(pCi/l)	--	--	--			

LEGEND:

x indicates failure of Analysis of Variance (one-way) test with α=0.1 (90% confidence level)

-- indicates that test could not be made due to lack of data

conclusion for the first hypothesis, the 1977 water quality data from the White River stations was grouped together for each streamflow period. The statistical summary of this data is shown in Table 8 . The results for each streamflow period during the 1977 water year were then compared to the results from the Baseline period using the ANOVA testing procedure previously described. The results of the ANOVA tests are shown in Table 7 . There were 18 failures out of 59 tests for the baseflow period. Most of these failures were caused by the data from the July water quality samples, which were taken at extremely low streamflow. Many of the parameters that are related to streamflow had values outside of the ranges from the Baseline period. For the lower basin runoff period there were 7 failures out of 56 tests. For the upper basin runoff period there were 10 failures out of 54 tests. Many of the parameters for these two streamflow periods failed due to a limited amount of data being available during the 1977 water year. The value for zinc (420 ug/l) during the 1977 upper basin runoff period was unusally high and appears to be anomalous.

Although the relatively high failure rates indicate that there are significant differences for some water quality parameters between the Baseline and Interim periods, these differences are attributed to differences in climatic conditions rather than changes in the hydrologic system.

The balance and distribution of major ions for streamflow periods during the 1977 water year is shown in Figure 5 . Only the baseflow period of mid-June through September 1977 shows significant differences from comparable streamflow periods during the Baseline period. There

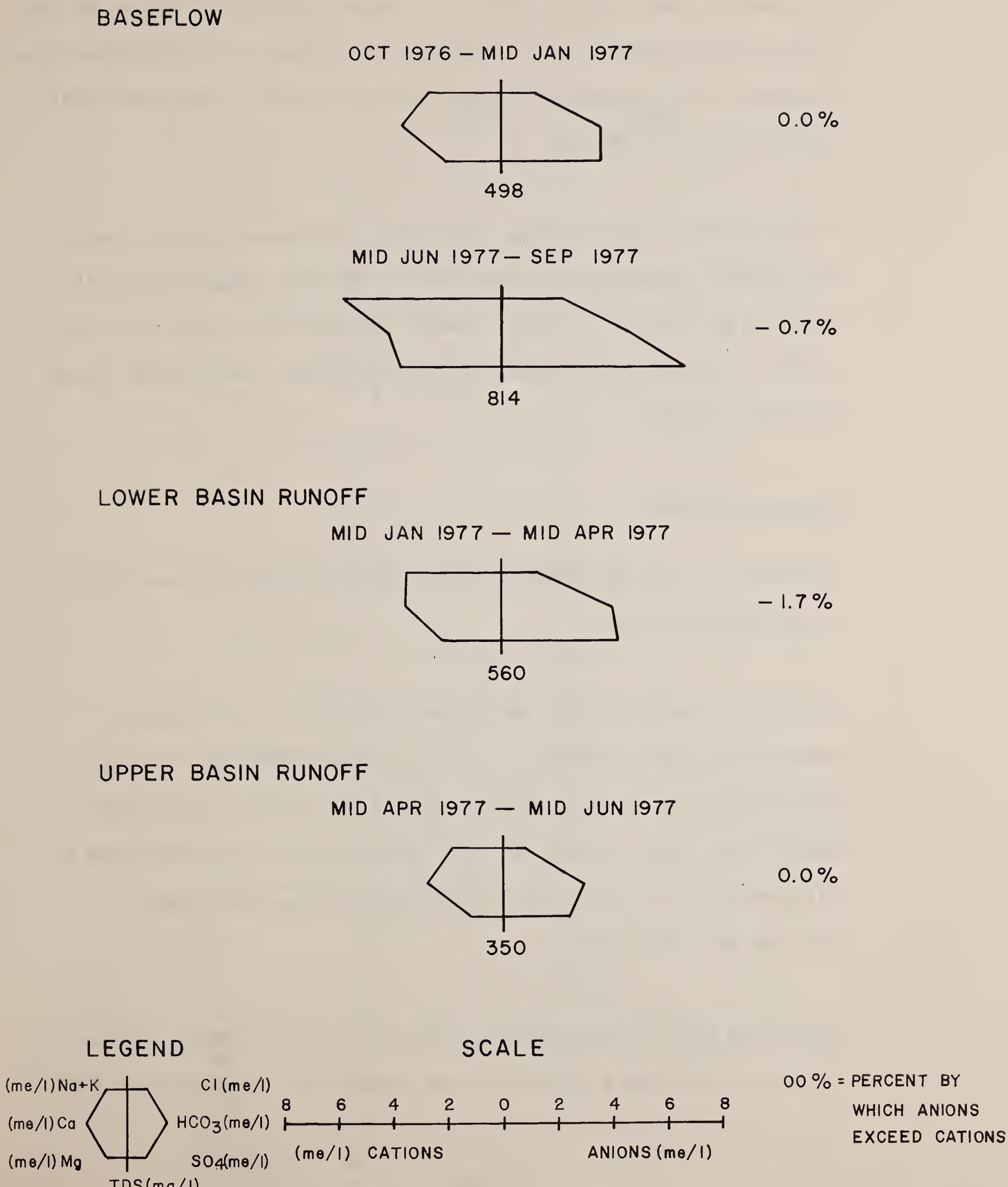
TABLE 8

SUMMARY OF WHITE RIVER WATER QUALITY
OCTOBER 1976 - SEPTEMBER 1977

Parameters		BASEFLOW					LOWER BASIN RUNOFF					UPPER BASIN RUNOFF				
		No. of Samples	Mean	Stan. Dev.	Max.	Min.	No. of Samples	Mean	Stan. Dev.	Max.	Min.	No. of Samples	Mean	Stan. Dev.	Max.	Min.
Total Alkalinity as $CaCO_3$	(mg/l)	13	202	31	260	167	4	199	6	204	190	2	125	21	140	110
Dissolved Solids	(mg/l)	13	619	170	908	479	4	560	21	592	545	3	350	65	397	275
Hardness as Ca, Mg	(mg/l)	10	295	25	340	270	4	288	5	290	280	2	195	21	210	180
Noncarbonate Hardness	(mg/l)	10	105	14	130	89	4	90	9	100	78	2	65	3	67	63
pH		11	8.2	0.3	8.5	7.4	4	8.0	0.5	8.4	7.3	2	7.85	0.2	8.0	7.7
Specific Conductance	(umhos/cm)	13	929	244	1425	700	4	825	37	870	790	3	564	124	693	445
Streamflow	(cfs)	13	269	148	432	40	4	356	21	376	328	3	424	95	520	330
Temperature	(°C)	13	11.5	10.8	26.0	0.0	4	7.5	8.5	16.5	0.0	3	19.0	3.1	22.5	16.6
Turbidity	(JTU)	9	55	68	210	7	2	80	0	80	80	1	220	--	220	220
Color	(PCU)	9	15	12	35	3	2	19	9	25	12	1	8	--	8	8
Calcium	(mg/l)	13	77	8	95	70	4	71	3	76	69	3	56	8	64	48
Magnesium	(mg/l)	13	32	11	50	22	4	27	2	29	25	3	16	3	19	14
Potassium	(mg/l)	13	2.8	1.4	4.9	1.6	4	1.9	0.2	2.1	1.7	3	2.4	1.1	3.7	1.7
Sodium	(mg/l)	13	88	38	150	54	4	80	7	87	72	3	41	8	45	32
Sodium Adsorption Ratio		10	1.8	0.5	2.8	1.4	4	2.0	0.2	2.2	1.8	2	1.2	0.3	1.4	1.0
Percent Sodium		10	33	4	43	29	4	38	2	39	35	2	30	3	32	28
Strontium	(ug/l)	9	1059	191	1400	800	2	990	0	990	990	1	660	--	660	660
Bicarbonate	(mg/l)	13	245	38	320	203	4	240	8	249	230	3	177	40	220	140
Carbonate	(mg/l)	12	0.33	1.15	4	0	4	0	0	0	0	3	0	0	0	0
Chloride	(mg/l)	13	55	21	89	33	4	45	3	47	41	3	26	3	29	24
Sulfate	(mg/l)	13	230	80	360	160	4	203	19	230	190	3	112	32	130	75
Sulfide	(mg/l)	3	0.2	0.4	0.7	0.0	2	0.7	0.1	0.8	0.6	1	0.2	--	0.2	0.2
Fluoride	(mg/l)	13	0.4	0.5	2.0	0.2	4	0.38	0.05	0.4	0.3	3	0.27	0.15	0.4	0.1
Bromide	(mg/l)	3	0.1	0.0	0.1	0.1	2	0.1	0.0	0.1	0.1	1	0.1	--	0.1	0.1
Dissolved Oxygen	(mg/l)	14	8.3	2.6	13.3	5.4	5	9.6	2.0	11.6	7.0	4	6.9	1.4	8.0	5.0
Chemical Oxygen Demand	(mg/l)	9	37	29	90	5	2	22.5	5.0	26	19	1	25	--	25	25
Dissolved Organic Carbon	(mg/l)	2	7.2	0.4	7.4	6.9	0	--	--	--	--	1	3.9	--	3.9	3.9
Chlorophyll A	(ug/l)	8	3.2	4.8	13.5	0.000	1	0.000	--	0.000	0.000	0	--	--	--	--
Chlorophyll B	(ug/l)	8	1.7	3.1	7.35	0.000	1	0.000	--	0.000	0.000	0	--	--	--	--
Ammonia as N	(mg/l)	9	0.01	0.02	0.06	0.00	2	0.01	0.01	0.02	0.00	1	0.01	--	0.01	0.01
Nitrite as N	(mg/l)	9	0.0044	0.0053	0.01	0.00	2	0.00	0.00	0.00	0.00	1	0.00	--	0.00	0.00
Nitrate as N	(mg/l)	9	0.09	0.10	0.22	0.00	2	0.02	0.00	0.02	0.02	1	0.10	--	0.10	0.10
Total Kjeldahl Nitrogen as N	(mg/l)	9	0.53	0.35	1.1	0.16	2	0.45	0.06	0.49	0.41	1	0.80	--	0.80	0.80
Total Phosphorus as P	(mg/l)	9	0.10	0.05	0.19	0.04	2	0.085	0.007	0.09	0.08	1	0.24	--	0.24	0.24
Diss. Ortho Phosphate as PO_4	(mg/l)	13	0.05	0.05	0.18	0.00	3	0.31	0.20	0.52	0.12	2	0.08	0.06	0.12	0.03
Boron	(ug/l)	13	84	38	140	50	4	60	0	60	60	3	63	11	70	50
Copper	(ug/l)	3	4	4	7	0	2	0.5	0.7	1	0	1	5	--	5	5
Iron	(ug/l)	9	32	23	80	10	2	50	14	60	40	1	20	--	20	20
Manganese	(ug/l)	9	12	10	30	0	2	5	7	10	0	1	0	--	0	0
Zinc	(ug/l)	3	10	10	20	0	2	5	7	10	0	1	420	--	420	420
Molybdenum	(ug/l)	3	1	0	1	1	2	1	0	1	1	1	0	--	0	0
Silica	(mg/l)	13	14.2	1.5	16	12	4	13.5	1.9	16	12	3	12.7	1.5	14	11
Aluminum	(ug/l)	9	13	15	40	0	2	5	7	10	0	1	0	--	0	0
Barium	(ug/l)	3	0	0	0	0	2	0	0	0	0	1	0	--	0	0
Cadmium	(ug/l)	3	0	0	0	0	2	0.5	0.7	1	0	1	0	--	0	0
Chromium	(ug/l)	3	0	0	0	0	2	5	7	10	0	1	<10	---	<10	<10
Lead	(ug/l)	3	0	0	0	0	2	2.5	3.5	5	0	1	0	--	0	0
Lithium	(ug/l)	9	17	10	30	0	2	20	0	20	20	1	10	--	10	10
Mercury	(ug/l)	3	0.0	0.0	0.0	0.0	2	0.0	0.0	0.0	0.0	1	0.0	--	0.0	0.0
Selenium	(ug/l)	3	1	0	1	1	2	1	0	1	1	1	1	--	1	1
Vanadium	(ug/l)	3	1.9	0.3	2.1	1.6	2	1.85	0.07	1.9	1.8	1	2.8	--	2.8	2.8
Arsenic	(ug/l)	3	0.67	0.58	1	0	2	1	0	1	1	1	1	--	1	1
MBAS	(mg/l)	2	0.00	0.00	0.00	0.00	2	0.00	0.00	0.00	0.00	1	0.00	--	0.00	0.00
Phenols	(ug/l)	3	2.33	0.58	3	2	2	1.5	0.7	2	1	1	3	--	3	3
Pesticides	(ug/l)	2	0.0	0.0	0.0	0.0	0	--	--	--	--	0	--	--	--	--
Herbicides	(ug/l)	2	0.0	0.0	0.0	0.0	0	--	--	--	--	0	--	--	--	--
DDE in Bottom Material	(ug/l)	2	0.4	0.14	0.5	0.3	0	--	--	--	--	0	--	--	--	--
DDT in Bottom Material	(ug/l)	2	0.1	0.14	0.2	0.0	0	--	--	--	--	0	--	--	--	--
Other Pesticides in Bottom Material	(ug/l)	2	0.0	0.0	0.0	0.0	0	--	--	--	--	0	--	--	--	--
Herbicides in Bottom Material	(ug/l)	2	0.0	0.0	0.0	0.0	0	--	--	--	--	0	--	--	--	--
Gross Alpha as U-nat.	(ug/l)	3	7.9	1.7	<9.7	<6.4	2	9.7	3.3	12	<7.3	1	5.5	--	5.5	5.5
Gross Beta as Sr90	(pCi/l)	3	1.7	0.3	2.1	<1.5	2	2.7	1.5	3.7	<1.6	1	2.8	--	2.8	2.8
Gross Beta as Cs137	(pCi/l)	3	2.0	0.4	2.5	1.7	2	3.4	1.9	4.7	<2.0	1	3.5	--	3.5	3.5

FIGURE 5

BALANCE AND DISTRIBUTION OF MAJOR IONS
WHITE RIVER STATIONS



was an increase in the concentration of all major ions, but sodium and sulfate replaced calcium and bicarbonate as the dominant cation and anion, respectively. This situation is similar to the distribution of ions during lower basin runoff. The change in the distribution of ions during the mid-June through September 1977 period was probably due to an increase in the proportion of baseflow contributed by the lower basin (below Meeker, Colorado).

In conclusion, there are some significant differences in the chemical and physical composition of the water of the White River between the Baseline and Interim periods. However, these differences are attributed to differences in climatic conditions rather than changes in the hydrologic system.

Evacuation Creek:

Streamflow at station 09306430 during the 1977 water year was similar to the Baseline period.

A summary of water quality during the 1977 water year at station 09306430 is shown in Table 9 . The results of ANOVA tests for significant differences in water quality between the Baseline and Interim periods are shown in Table 10. For the baseflow period there were 10 failures out of 57 tests. For the highflow period there were 16 failures out of 22 tests.

During the 1977 baseflow period, the data for pH, fluoride and dissolved orthophosphate were within the range of values during the Base-

SUMMARY OF EVACUATION CREEK WATER QUALITY
OCTOBER 1976 - SEPTEMBER 1977

Parameters		BASEFLOW No. of Samples	BASEFLOW Mean	BASEFLOW Stan. Dev.	BASEFLOW Max.	BASEFLOW Min.	HIGHFLOW No. of Samples	HIGHFLOW Mean	HIGHFLOW Stan. Dev.	HIGHFLOW Max.	HIGHFLOW Min.
Total Alkalinity as $CaCO_3$	(mg/l)	3	443	11	450	430	2	204	150	310	98
Dissolved Solids	(mg/l)	3	3817	347	4211	3560	2	1236	557	1630	842
Hardness as Ca, Mg	(mg/l)	2	1150	71	1200	1100	2	375	177	550	250
Noncarbonate Hardness	(mg/l)	2	715	50	750	680	2	195	64	240	150
pH		5	7.7	0.2	7.8	7.4	2	7.15	0.07	7.2	7.1
Specific Conductance	(umhos/cm)	5	4540	623	5300	3600	2	1530	113	1610	1450
Streamflow	(cfs)	5	0.05	0.08	0.2	0.01	1	1.5	--	1.5	1.5
Temperature	(°C)	5	13.8	12.8	31.0	2.0	2	21.0	7.1	26	16
Turbidity	(JTU)	3	8.3	2.1	10	6	0	--	--	--	--
Color	(PCU)	3	8.3	4.2	13	5	0	--	--	--	--
Calcium	(mg/l)	3	180	10	190	170	2	95	50	130	60
Magnesium	(mg/l)	3	177	6	180	170	2	39	21	54	24
Potassium	(mg/l)	3	8.4	1.6	9.8	6.7	2	7.7	2.6	9.5	5.9
Sodium	(mg/l)	3	810	79	900	750	2	255	92	320	190
Sodium Adsorption Ratio		2	9.75	0.35	10	9.5	2	5.6	0.6	6.0	5.2
Percent Sodium		2	59.0	1.4	60	58	2	58.5	5.0	62	55
Strontium	(ug/l)	3	3867	153	4000	3700	0	--	--	--	--
Bicarbonate	(mg/l)	3	539	17	550	520	2	250	184	380	120
Carbonate	(mg/l)	3	0	0	0	0	0	--	--	--	--
Chloride	(mg/l)	3	60	9	70	54	2	16.5	6.4	21	12
Sulfate	(mg/l)	3	2300	265	2600	2100	2	690	297	900	480
Sulfide	(mg/l)	1	0.7	--	0.7	0.7	0	--	--	--	--
Fluoride	(mg/l)	3	0.97	0.15	1.1	0.8	2	0.6	0.0	0.6	0.6
Bromide	(mg/l)	1	0.1	--	0.1	0.1	0	--	--	--	--
Dissolved Oxygen	(mg/l)	5	5.9	1.1	7.6	4.8	0	--	--	--	--
Chemical Oxygen Demand	(mg/l)	3	43	8	49	34	0	--	--	--	--
Dissolved Organic Carbon	(mg/l)	1	11	--	11	11	0	--	--	--	--
Chlorophyll A	(ug/l)	1	0.000	--	0.000	0.000	0	--	--	--	--
Chlorophyll B	(ug/l)	1	0.000	--	0.000	0.000	0	--	--	--	--
Ammonia as N	(mg/l)	3	0.04	0.06	0.11	0.00	0	--	--	--	--
Nitrite as N	(mg/l)	3	0.00	0.00	0.00	0.00	0	--	--	--	--
Nitrate as N	(mg/l)	3	0.03	0.04	0.07	0.00	0	--	--	--	--
Kjeldahl Nitrogen as N	(mg/l)	3	0.61	0.28	0.89	0.34	0	--	--	--	--
Total Phosphorus as P	(mg/l)	3	0.017	0.012	0.03	0.01	0	--	--	--	--
Diss. Ortho Phosphate as PO_4	(mg/l)	3	0.02	0.01	0.03	0.01	0	--	--	--	--
Boron	(ug/l)	3	2300	300	2600	2000	2	344	122	430	257
Copper	(ug/l)	1	2	--	2	2	0	--	--	--	--
Iron	(ug/l)	3	57	29	90	40	2	298	279	495	100
Manganese	(ug/l)	3	183	49	240	150	2	235	21	240	210
Zinc	(ug/l)	1	110	--	110	110	0	--	--	--	--
Molybdenum	(ug/l)	1	49	--	49	49	0	--	--	--	--
Silica	(mg/l)	3	11.4	2.4	14	9.2	2	10.5	0.8	11	9.9
Aluminum	(ug/l)	3	17	12	30	10	0	--	--	--	--
Barium	(ug/l)	1	0	--	0	0	0	--	--	--	--
Cadmium	(ug/l)	1	0	--	0	0	0	--	--	--	--
Chromium	(ug/l)	1	0	--	0	0	0	--	--	--	--
Lead	(ug/l)	1	1	--	1	1	0	--	--	--	--
Lithium	(ug/l)	3	147	12	160	140	0	--	--	--	--
Mercury	(ug/l)	1	0.0	--	0.0	0.0	0	--	--	--	--
Selenium	(ug/l)	1	0	--	0	0	0	--	--	--	--
Vanadium	(ug/l)	1	0.2	--	0.2	0.2	0	--	--	--	--
Arsenic	(ug/l)	1	1	--	1	1	0	--	--	--	--
MBAS	(mg/l)	1	0.10	--	0.10	0.10	0	--	--	--	--
Phenols	(ug/l)	1	4	--	4	4	0	--	--	--	--
Pesticides	(ug/l)	0	--	--	--	--	0	--	--	--	--
Herbicides	(ug/l)	0	--	--	--	--	0	--	--	--	--
Gross Alpha as U-nat.	(ug/l)	1	<53	--	<53	<53	0	--	--	--	--
Gross Beta as Sr90	(pCi/l)	1	25	--	25	25	0	--	--	--	--
Gross Beta as Cs137	(pCi/l)	1	32	--	32	32	0	--	--	--	--

TABLE 10

RESULTS OF ANOVA TESTS FOR SIGNIFICANT DIFFERENCE EVACUATION CREEK WATER QUALITY (station 09306430) BASELINE PERIOD VERSUS 1977

Parameters		Baseflow	Highflow
Total Alkalinity as $CaCO_3$	(mg/l)		x
Dissolved Solids	(mg/l)		x
Hardness as Ca, Mg	(mg/l)		x
Noncarbonate Hardness	(mg/l)		x
pH		x	x
Specific Conductance	(umhos/cm)		x
Streamflow	(cfs)		
Temperature	(°C)		
Turbidity	(JTU)		--
Color	(PCU)		--
Calcium	(mg/l)		x
Magnesium	(mg/l)		x
Potassium	(mg/l)		
Sodium	(mg/l)		x
Sodium Adsorption Ratio			x
Percent Sodium			
Strontium	(ug/l)		--
Bicarbonate	(mg/l)		x
Carbonate	(mg/l)		--
Chloride	(mg/l)		x
Sulfate	(mg/l)		x
Sulfide	(mg/l)	x	--
Fluoride	(mg/l)	x	x
Bromide	(mg/l)	x	--
Dissolved Oxygen	(mg/l)	x	--
Chemical Oxygen Demand	(mg/l)	x	--
Dissolved Organic Carbon	(mg/l)		--
Chlorophyll A	(ug/l)		--
Chlorophyll B	(ug/l)		--
Ammonia as N	(mg/l)		--
Nitrite as N	(mg/l)		--
Nitrate as N	(mg/l)		--
Kjeldahl Nitrogen as N	(mg/l)		--
Total Phosphorus as P	(mg/l)		--
Diss. Ortho Phosphate as PO_4	(mg/l)	x	--
Boron	(ug/l)		
Copper	(ug/l)		--
Iron	(ug/l)		x
Manganese	(ug/l)	x	x
Zinc	(ug/l)	x	--
Molybdenum	(ug/l)		--
Silica	(mg/l)	x	
Aluminum	(ug/l)		--
Barium	(ug/l)		--
Cadmium	(ug/l)		--
Chromium	(ug/l)		--
Lead	(ug/l)		--
Lithium	(ug/l)		--
Mercury	(ug/l)		--
Selenium	(ug/l)		--
Vanadium	(ug/l)		--
Arsenic	(ug/l)		--
MBAS	(mg/l)		--
Phenols	(ug/l)		--
Pesticides	(ug/l)	--	--
Herbicides	(ug/l)	--	--
Gross Alpha as U-nat.	(ug/l)		--
Gross Beta as Sr90	(pCi/l)		--
Gross Beta as Cs137	(pCi/l)		--

LEGEND:

x indicates failure of Analysis of Variance (one-way) test with $\alpha = 0.1$ (90% confidence level)
-- indicates that test could not be made due to lack of data

line period; the data for bromide and dissolved oxygen had some values below the minimum values during the Baseline period; and, the data for sulfide, COD, manganese, zinc and silica had some values above the maximum values during the Baseline period. The causes for these differences are unknown.

The balance and distribution of major ions during 1977 baseflow and highflow at station 09306430 is shown in Figure 6. The balance and distribution of major ions for the 1977 baseflow period is similar to comparable data during the Baseline period. During highflow the concentrations of all of the major ions were reduced due to the dilution effect of thunderstorm runoff. Although sodium and sulfate were still the dominant ions, potassium, calcium and bicarbonate showed the least reduction proportionally.

In conclusion, there are significant differences in the chemical composition of the water of Evacuation Creek between the Baseline and Interim periods. However, these differences probably do not represent a change in the hydrologic system. It is more likely that they represent natural variations attributable to climatic variations and extreme surface runoff from thunderstorms. Therefore, the 1977 data should be included with the Baseline period data to further define variations of the water quality of Evacuation Creek near the mouth.

Dry Washes:

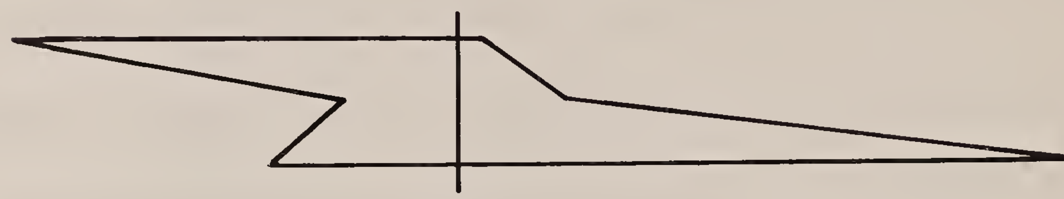
Streamflow measured at the gaging stations in Hell's Hole Canyon, Southam Canyon and Asphalt Wash during the 1977 water year was similar

FIGURE 6

BALANCE AND DISTRIBUTION OF MAJOR IONS
EVACUATION CREEK—STATION 09306430

BASEFLOW

OCT 1976 – JUN 1977, MID JUL 1977 – SEP 1977

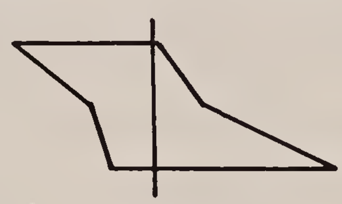


– 1.0 %

3817

HIGHFLOW

EARLY JULY 1977

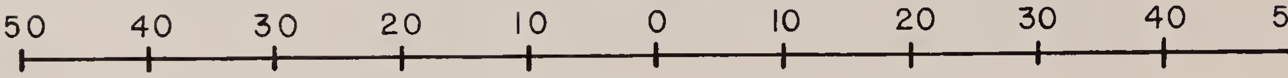


– 1.0 %

1236

SCALE

50 40 30 20 10 0 10 20 30 40 50



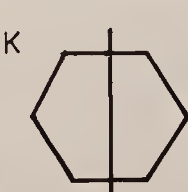
(me/l) CATIONS ANIONS (me/l)

LEGEND

(me/l) Na K Cl (me/l)

(me/l) Ca HCO_3 (me/l)

(me/l) Mg SO_4 (me/l)



TDS
(mg/l)

0.0 % = PERCENT BY WHICH ANIONS EXCEED CATIONS to data from the Baseline period. Flow events were due to runoff from thunderstorms.

No water quality samples were collected from the stations in these dry washes during the 1977 water year.

2.0 Alluvial Water

This section expands on the conclusions presented in the 1977 annual report for the Interim Monitoring Period. The statistical analyses presented are based upon data from water quality samples analyzed by USGS laboratories. A comparison of nomenclature is presented in Table 11.

2.1 Conclusions

The December 1976 Work Plan presented three hypotheses to be tested. The first hypothesis is:

> There are no significant differences in water level and chemical composition between comparable data from the two-year Baseline and Interim periods.

The static water levels of wells in the White River alluvium and the Evacuation Creek alluvium during the Interim period were similar to the static water levels during the Baseline period. The static water levels of the wells in the alluvium of the dry washes (Asphalt Wash, Southam Canyon and Hell's Hole Canyon) remained steady through the Interim period at levels close to the lowest levels during the Baseline period. The decline of the lowest static water level between the two periods of time ranged from 0.09 to 0.27 meter (0.3 to 0.9 feet) for these wells.

TABLE 11

COMPARISON OF NOMENCLATURE

ALLUVIAL WELLS

WRSP Nomenclature	USGS Nomenclature	Nomenclature for Report
AG-1 Lower	AG-1 #1	AG-1 #1
AG-1 Upper	AG-1 #2	AG-1 #2
AG-3 Lower (USGS)	White River Alluvium #1	AG-3 #1
AG-3 Upper (USGS)	White River Alluvium #2	AG-3 #2
AG-3 Upper (WRSP)	White River Alluvium #3	AG-3 #3
AG-4	AG-4	AG-4
AG-6 Lower	Southam Canyon #1	AG-6 #1
AG-6 Upper	Southam Canyon #2	AG-6 #2
AG-8	AG-8	AG-8
Evacuation Creek Near Park Canyon, Lower	Evacuation Creek Near Park Canyon #1	Evacuation Creek Near Park Canyon #1
Evacuation Creek Near Park Canyon, Upper	Evacuation Creek Near Park Canyon #2	Evacuation Creek Near Park Canyon #2
Evacuation Creek Above Missouri Creek, Lower	Evacuation Creek Above Missouri Creek #1	Evacuation Creek Above Missouri Creek #1
Hell's Hole Canyon, Lower	Hell's Hole Canyon #1	Hell's Hole Canyon #1
Hell's Hole Canyon, Upper	Hell's Hole Canyon #2	Hell's Hole Canyon #2

The results of statistical tests for significant differences in water quality for the alluvial wells between the Baseline and Interim periods are shown in Table 12. A statistical summary of the data from the Baseline and Interim periods for each of these wells is shown in Tables 13 through 15. All of the alluvial wells except AG-6 #1 and #2 have no significant difference between the Baseline and Interim periods for most of water quality parameters.

The distribution of major cations and anions based on the water quality samples from the alluvial wells during the Interim period are shown in Figures 7 through 9. The distribution of major cations and anions is also similar for each of the wells, except AG-6 #1 and #2, between the Baseline and Interim periods. At AG-6 #1 there were 11 failures out of 24 Analysis of Variance tests. At AG-6 #2 there were 13 failures out of 21 tests.

The trend of specific conductance and dissolved solids with respect to time during the Baseline and Interim periods for these two wells is shown in Figures 10 and 11. The dissolved solids concentration and specific conductance for both wells show a decrease from January 1976 to May 1977, and then are relatively steady from May 1977 through September 1977. Both wells also show differences in the distribution of major cations and anions between the Baseline and Interim periods. At AG-6 #1, calcium and magnesium decreased proportionally more than sodium did, and bicarbonate did not decrease while chloride and sulfate did.

The differences in chemical composition at AG-6 #1 and #2 are probably due to a decreasing effect in time of the upstream discharges that occurred at the P-2 wells earlier. It appears that the effects of these discharges have passed by May 1977, because the specific conductance is relatively stable from May through September 1977 at both wells.

TABLE 12

RESULTS OF ANOVA TESTS FOR SIGNIFICANT DIFFERENCE
ALLUVIAL WATER QUALITY
1976 VERSUS 1977

Parameters		AG-1 #1	AG-3 #1	AG-3 #2	AG-3 #3	AG-8	Evac. Cr. Near Park Canyon #1	Evac. Cr. Near Park Canyon #2	Evac. Cr. Above Missouri Creek #1	AG-6 #1	AG-6 #2	AG-4	Hell's Hole Canyon #1	Hell's Hole Canyon #2
Total Alkalinity as $CaCO_3$	(mg/l)										x			
Dissolved Solids	(mg/l)					x				x	x			
Hardness as Ca, Mg	(mg/l)				x					x	x			
Noncarbonate Hardness	(mg/l)			x						x	x			
pH					x		x							
Specific Conductance	(umhos/cm)									x	x			
Temperature	(°C)													
Calcium	(mg/l)								x	x	x			
Magnesium	(mg/l)			x	x					x				
Potassium	(mg/l)						x				x			
Sodium	(mg/l)				x				x		x			
Sodium Adsorption Ratio														
Percent Sodium										x	x			
Strontium	(ug/l)	--	--	--	--	--	--	--	--	--	--	--	--	--
Bicarbonate	(mg/l)										x		x	
Carbonate	(mg/l)													
Chloride	(mg/l)									x	x			
Sulfate	(mg/l)					x				x	x			
Sulfide	(mg/l)	--	--	--	--	--	--	--	--	--	--	--	--	--
Fluoride	(mg/l)												x	
Bromide	(mg/l)	--	--	--	--	--	--	--	--	--	--	--	--	--
Dissolved Organic Carbon	(mg/l)	--	--	--	--	--	--	--	--	--	--	--	--	--
Carbon Dioxide	(mg/l)	--	--	--	--	--	--	--	--	--	--	--	--	--
Ammonia as N	(mg/l)	--	--	--	--	--	--	--	--	--	--	--	--	--
Nitrite and Nitrate as N	(mg/l)								x	x	x			
Total Kjeldahl Nitrogen as N	(mg/l)	--	--	--	--	--	--	--	--	--	--	--	--	--
Total Phosphorus as P	(mg/l)	--	--	--	--	--	--	--	--	--	--	--	--	--
Diss. Ortho Phosphorus as P	(mg/l)										--			
Diss. Ortho Phosphate as PO_4	(mg/l)		--	--			--	--	--	--	--		--	--
Boron	(ug/l)				x	x								
Copper	(ug/l)	--	--	--	--	--	--	--	--	--	--	--	--	--
Iron	(ug/l)	x	--	--			--	--	--		--		--	--
Manganese	(ug/l)		--	--			--	--	--	x	--		--	--
Zinc	(ug/l)	--	--	--	--	--	--	--	--	--	--	--	--	--
Molybdenum	(ug/l)	--	--	--	--	--	--	--	--	--	--	--	--	--
Silica	(mg/l)	x												

NOTE: The trace metals, trace non-metals, radioactive constituents and all other parameters not shown cannot be tested due to lack of data

LEGEND:

x indicates failure of Analysis of Variance (one-way) test with α=0.1 (90% confidence level)
-- indicates that test could not be made due to lack of data

TABLE 13

SUMMARY OF ALLUVIAL WATER QUALITY
WHITE RIVER ALLUVIUM
JANUARY 1976 - SEPTEMBER 1977

	Parameters		AG-1 #1					AG-1 #2					AG-3 #1					AG-3 #2					AG-3 #3				
			No. of Samples	Mean	Stan. Dev.	Max.	Min.	No. of Samples	Mean	Stan. Dev.	Max.	Min.	No. of Samples	Mean	Stan. Dev.	Max.	Min.	No. of Samples	Mean	Stan. Dev.	Max.	Min.	No. of Samples	Mean	Stan. Dev.	Max.	Min.
GENERAL CHARACTERISTICS	Total Alkalinity as $CaCO_3$	(mg/l)	5	346	42	416	318	2	319	63	363	274	6	470	18	497	445	5	384	14	401	367	7	486	39	550	424
	Dissolved Solids	(mg/l)	5	633	21	649	597	2	951	42	980	921	6	3340	344	3630	2680	6	1852	51	1900	1770	7	2796	383	3650	2570
	Harndess as Ca, Mg	(mg/l)	5	78	6	89	73	2	425	35	450	400	6	1388	237	1600	930	5	562	23	590	530	7	1084	187	1500	990
	Noncarbonate Hardness	(mg/l)	5	0	0	0	0	2	106	91	170	41	6	935	253	1200	470	5	180	33	210	140	7	609	218	1100	480
	Oil and Grease	(mg/l)	1	6	--	6	6	1	4	--	4	4	1	3	--	3	3	0	--	--	--	--	1	2	--	2	2
	pH		5	8.0	0.3	8.2	7.5	3	7.9	0.2	8.1	7.7	5	7.8	0.2	8.0	7.6	5	7.7	0.2	8.0	7.5	7	7.9	0.3	8.3	7.4
	Specific Conductance	(umhos/cm)	5	964	106	1150	900	3	1467	247	1750	1300	5	4132	365	4400	3490	5	2660	115	2800	2500	8	3394	336	3800	2800
	Temperature	(°C)	5	9.8	1.7	11.7	7.4	3	11.2	3.9	14.7	7.0	6	10.8	1.7	13.5	9.0	5	11.0	2.4	13.5	8.5	8	10.6	1.7	12.6	8.3
	Turbidity	(JTU)	1	450	--	450	450	1	450	--	450	450	0	--	--	--	--	0	--	--	--	--	1	130	--	130	130
	Color	(PCU)	5	82	103	200	20	2	25	7	30	20	1	5	--	5	5	0	--	--	--	--	5	12	5	20	7
MAJOR CATIONS	Calcium	(mg/l)	5	13	2	16	11	2	105	7	110	100	6	238	43	280	160	5	73	6	80	65	7	187	33	260	170
	Magnesium	(mg/l)	5	11.2	0.5	12	11	2	39	3	41	37	6	195	35	230	130	5	93	3	97	90	7	151	27	210	130
	Potassium	(mg/l)	5	2.5	0.3	3.0	2.2	2	5.8	0.3	6.0	5.6	6	4.8	0.7	5.5	3.8	5	3.4	0.5	3.7	2.6	7	4.2	0.8	5.6	3.5
	Sodium	(mg/l)	5	204	5	210	200	2	155	7	160	150	6	572	25	600	540	5	418	16	440	400	7	533	39	610	500
	Sodium Adsorption Ratio		5	10.1	0.5	11	9.7	2	3.3	0.0	3.3	3.3	6	6.7	0.5	7.7	6.1	5	7.7	0.4	8.1	7.2	7	7.0	0.2	7.3	6.8
	Percent Sodium		5	85	1	85	83	2	44	0	44	44	6	48	4	56	44	5	62	2	64	59	7	51	2	53	47
	Strontium	(ug/l)	3	430	26	460	410	2	1500	0	1500	1500	1	3400	--	3400	3400	0	--	--	--	--	5	2380	164	2500	2200
MAJOR ANIONS	Bicarbonate	(mg/l)	5	399	19	433	388	2	388	76	442	334	6	573	23	606	542	5	468	17	489	448	7	593	47	670	517
	Carbonate	(mg/l)	4	0	0	0	0	2	0	0	0	0	5	0	0	0	0	4	0	0	0	0	6	0	0	0	0
	Chloride	(mg/l)	5	52	2	55	51	2	96	21	110	81	6	173	19	190	140	5	101	14	110	79	7	144	21	190	130
	Sulfate	(mg/l)	5	115	17	130	85	2	340	42	370	310	6	1850	243	2100	1400	5	912	47	940	830	7	1457	294	2100	1300
	Sulfide	(mg/l)	3	9.1	5.5	14	3.2	2	0.0	0.0	0.0	0.0	1	0.0	--	0.0	0.0	0	--	--	--	--	5	0.7	1.3	3.0	0.0
	Fluoride	(mg/l)	5	2.5	0.2	2.7	2.3	2	0.65	0.07	0.7	0.6	6	0.4	0.2	0.7	0.2	5	1.1	0.1	1.2	0.9	7	0.6	0.1	0.7	0.4
	Bromide	(mg/l)	1	0.3	--	0.3	0.3	1	0.3	--	0.3	0.3	1	0.6	--	0.6	0.6	0	--	--	--	--	1	0.5	--	0.5	0.5
BIO-CHEM. CONST.	Chemical Oxygen Demand	(mg/l)	1	52	--	52	52	1	92	--	92	92	1	91	--	91	91	0	--	--	--	--	1	76	--	76	76
	Carbon Dioxide	(mg/l)	0	--	--	--	--	0	--	--	--	--	2	13	3	15	11	2	21	4	23	18	2	23.9	27.1	43	4.7
	Dissolved Organic Carbon	(mg/l)	3.	10.5	5.2	16	5.6	2	33	8	39	27	1	4.9	--	4.9	4.9	0	--	--	--	--	4	23	2	25	21
MACRONUTRIENTS	Ammonia as N	(mg/l)	3	0.29	0.04	0.32	0.25	2	0.54	0.03	0.56	0.52	1	0.62	--	0.62	0.62	0	--	--	--	--	5	0.67	0.08	0.74	0.54
	Nitrite as N	(mg/l)	3	0.003	0.006	0.01	0.00	2	0.01	0.00	0.01	0.01	1	0.00	--	0.00	0.00	0	--	--	--	--	5	0.03	0.07	0.16	0.00
	Nitrate as N	(mg/l)	3	0.08	0.06	0.14	0.02	2	0.24	0.03	0.26	0.22	0	--	--	--	--	0	--	--	--	--	5	0.08	0.08	0.22	0.01
	Nitrite and Nitrate as N	(mg/l)	5	0.07	0.05	0.14	0.03	2	0.25	0.03	0.27	0.23	5	0.04	0.03	0.07	0.00	4	0.035	0.021	0.06	0.00	6	0.10	0.14	0.38	0.01
	Total Kjeldahl Nitrogen as N	(mg/l)	3	1.16	0.42	1.6	0.77	2	6.1	5.2	9.8	2.4	1	1.7	--	1.7	1.7	0	--	--	--	--	5	2.6	1.3	4.6	1.1
	Total Phosphorus as P	(mg/l)	3	0.32	0.16	0.48	0.17	2	3.11	3.95	5.9	0.31	1	0.09	--	0.09	0.09	0	--	--	--	--	5	1.11	0.53	1.9	0.48
	Diss. Ortho Phosphorus as P	(mg/l)	5	0.08	0.02	0.10	0.05	2	0.005	0.007	0.01	0.00	5	0.016	0.012	0.03	0.00	4	0.020	0.008	0.03	0.01	6	0.010	0.006	0.02	0.00
	Diss. Ortho Phosphate as PO_4	(mg/l)	5	0.23	0.07	0.31	0.15	2	0.015	0.021	0.03	0.00	1	0.03	--	0.03	0.03	1	0.03	--	0.03	0.03	6	0.03	0.02	0.06	0.00

TABLE 13 (continued)

	Parameters		AG-1 #1					AG-1 #2					AG-3 #1					AG-3 #2					AG-3 #3				
			No. of Samples	Mean	Stan. Dev.	Max.	Min.	No. of Samples	Mean	Stan. Dev.	Max.	Min.	No. of Samples	Mean	Stan. Dev.	Max.	Min.	No. of Samples	Mean	Stan. Dev.	Max.	Min.	No. of Samples	Mean	Stan. Dev.	Max.	Min.
MICRONUTRIENTS	Boron	(ug/l)	5	1340	182	1500	1100	2	265	35	290	240	6	4017	2032	6900	1200	5	3280	1580	6000	2000	7	3097	2084	6900	1700
	Copper	(ug/l)	3	2.3	1.5	4	1	2	3.5	0.7	4	3	1	2	--	2	2	0	--	--	--	--	5	4.0	4.1	11	1
	Iron	(ug/l)	4	128	129	320	40	2	30	14	40	20	2	50	28	70	30	1	80	--	80	80	6	245	259	650	20
	Manganese	(ug/l)	4	20	8	30	10	2	425	64	470	380	2	380	0	380	380	1	280	--	280	280	6	410	65	460	300
	Zinc	(ug/l)	3	13	15	30	0	2	10	0	10	10	1	860	--	860	860	0	--	--	--	--	5	40	24	80	20
	Molybdenum	(ug/l)	3	0	0	0	0	2	38	3	40	36	1	18	--	18	18	0	--	--	--	--	5	15	5	21	10
	Silica	(mg/l)	5	21	2	23	19	2	13.5	0.7	14	13	6	17.7	1.4	20	16	5	16.4	1.1	18	15	7	17.6	1.1	19	16
TRACE METALS	Aluminum	(ug/l)	3	37	32	60	0	2	25	21	40	10	1	0	--	0	0	0	--	--	--	--	5	22	15	40	0
	Barium	(ug/l)	3	100	100	200	0	2	150	212	300	0	1	0	--	0	0	0	--	--	--	--	5	0	0	0	0
	Cadmium	(ug/l)	3	0.3	0.6	1	0	2	0	0	0	0	1	0	--	0	0	0	--	--	--	--	5	0.4	0.6	1	0
	Total Chromium	(ug/l)	3	30	10	40	20	2	350	424	650	50	1	10	--	10	10	0	--	--	--	--	5	64	21	80	30
	Lead	(ug/l)	3	1.0	1.7	3	0	2	0	0	0	0	1	8	--	8	8	0	--	--	--	--	5	2.4	3.9	9	0
	Lithium	(ug/l)	3	60	0	60	60	3	30	0	30	30	1	130	--	130	130	0	--	--	--	--	5	100	7	110	90
	Mercury	(ug/l)	2	0.15	0.21	0.3	0.0	1	0.2	--	0.2	0.2	1	0.1	--	0.1	0.1	0	--	--	--	--	5	0.14	0.15	0.3	0.0
	Selenium	(ug/l)	2	0	0	0	0	1	0	--	0	0	1	0	--	0	0	0	--	--	--	--	5	0	0	0	0
	Vanadium	(ug/l)	3	2.0	2.2	4.4	0.2	2	4.8	1.7	6.0	3.6	1	1.4	--	1.4	1.4	0	--	--	--	--	5	2.5	0.9	3.7	1.4
TRACE NON-METALS	Arsenic	(ug/l)	2	0.5	0.7	1	0	1	5	--	5	5	1	1	--	1	1	0	--	--	--	--	5	6	2	8	4
	Cyanide	(mg/l)	3	0.00	0.00	0.00	0.00	2	0.00	0.00	0.00	0.00	1	0.00	--	0.00	0.00	0	--	--	--	--	5	0.002	0.004	0.01	0.00
	Phenols	(ug/l)	1	1	--	1	1	1	1	--	1	1	1	2	--	2	2	0	--	--	--	--	1	0	--	0	0
	Pesticides	(ug/l)	0	--	--	--	--	0	--	--	--	--	0	--	--	--	--	0	--	--	--	--	1	0	--	0	0
	Herbicides	(ug/l)	0	--	--	--	--	1	0	--	0	0	0	--	--	--	--	0	--	--	--	--	1	0	--	0	0
RADIOACTIVE CONST.	Gross Alpha as U-nat.	(ug/l)	1	<8.5	--	<8.5	<8.5	1	<12	--	<12	<12	0	--	--	--	--	0	--	--	--	--	1	<35	--	<35	<35
	Gross Beta as Sr 90	(pCi/l)	1	4.3	--	4.3	4.3	1	7.9	--	7.9	7.9	0	--	--	--	--	0	--	--	--	--	1	<7.3	--	<7.3	<7.3
	Gross Beta as Ce 137	(pCi/l)	1	5.1	--	5.1	5.1	1	9.8	--	9.8	9.8	0	--	--	--	--	0	--	--	--	--	1	<9.0	--	<9.0	<9.0
	Potassium 40	(pCi/l)	1	1.7	--	1.7	1.7	1	4.3	--	4.3	4.3	0	--	--	--	--	0	--	--	--	--	1	3.0	--	3.0	3.0
	Radium 226, radon method	(pCi/l)	1	0.07	--	0.07	0.07	0	--	--	--	--	1	0.12	--	0.12	0.12	0	--	--	--	--	1	0.07	--	0.07	0.07
	Diss. Uranium, dir. fluorometric	(ug/l)	1	0.5	--	0.5	0.5	0	--	--	--	--	1	2.2	--	2.2	2.2	0	--	--	--	--	1	1.5	--	1.5	1.5

TABLE 14

SUMMARY OF ALLUVIAL WATER QUALITY EVACUATION CREEK ALLUVIUM JANUARY 1976 - SEPTEMBER 1977

	Parameters		AG-8					EVAC. CREEK NEAR PARK CANYON #1					EVAC. CREEK NEAR PARK CANYON #2					EVAC. CREEK ABOVE MISSOURI CREEK #1				
			No. of Samples	Mean	Stan. Dev.	Max.	Min.	No. of Samples	Mean	Stan. Dev.	Max.	Min.	No. of Samples	Mean	Stan. Dev.	Max.	Min.	No. of Samples	Mean	Stan. Dev.	Max.	Min.
GENERAL CHARACTERISTICS	Total Alkalinity as $CaCO_3$	(mg/l)	7	427	49	456	320	5	463	55	508	369	5	461	6	470	455	5	423	22	450	395
	Dissolved Solids	(mg/l)	7	3877	122	4010	3650	5	3416	168	3540	3130	5	3804	101	3950	3710	5	3316	45	3350	3240
	Harndess as Ca, Mg	(mg/l)	7	1171	76	1300	1100	5	1176	173	1300	880	5	1380	45	1400	1300	5	762	41	800	710
	Noncarbonate Hardness	(mg/l)	7	747	62	860	690	5	718	192	850	380	5	894	49	930	810	5	338	52	390	260
	Oil and Grease	(mg/l)	1	19	--	19	19	0	--	--	--	--	0	--	--	--	--	0	--	--	--	--
	pH		8	7.9	0.3	8.4	7.4	5	7.7	0.3	8.1	7.4	5	7.7	0.3	8.2	7.4	5	7.8	0.2	8.1	7.5
	Specific Conductance	(umhos/cm)	8	4550	650	5200	3100	5	4336	181	4500	4060	5	4580	133	4690	4370	5	4366	159	4600	4190
	Temperature	(°C)	7	12.3	2.5	14.4	8.3	5	10.9	2.4	14.0	7.5	5	11.4	4.5	18.0	7.5	5	11.1	2.9	13.0	6.0
	Turbidity	(JTU)	1	4500	--	4500	4500	0	--	--	--	--	0	--	--	--	--	0	--	--	--	--
	Color	(PCU)	5	32	36	90	0	0	--	--	--	--	0	--	--	--	--	0	--	--	--	--
MAJOR CATIONS	Calcium	(mg/l)	7	171	12	190	160	5	166	5	170	160	5	200	12	210	180	5	81	6	88	75
	Magnesium	(mg/l)	7	180	16	210	160	5	186	43	210	110	5	208	4	210	200	5	136	11	150	120
	Potassium	(mg/l)	7	9.4	1.8	12	7.0	5	6.4	0.5	7.1	5.7	5	7.2	1.0	8.3	5.8	5	9.0	2.1	12	6.3
	Sodium	(mg/l)	7	819	25	850	780	5	672	11	680	660	5	726	15	740	700	5	806	9	820	800
	Sodium Adsorption Ratio		7	10.4	0.6	11	9.6	5	8.6	0.8	10	8.0	5	8.6	0.3	8.9	8.2	5	12.8	0.5	13	12
	Percent Sodium		7	60	2	63	57	5	56	4	63	53	5	54	1	55	53	5	69	1	71	68
	Strontium	(ug/l)	5	3680	638	4300	3000	0	--	--	--	--	0	--	--	--	--	0	--	--	--	--
MAJOR ANIONS	Bicarbonate	(mg/l)	7	520	60	556	390	5	563	67	619	450	5	562	6	570	555	5	516	27	550	481
	Carbonate	(mg/l)	7	0	0	0	0	4	0	0	0	0	4	0	0	0	0	4	0	0	0	0
	Chloride	(mg/l)	7	64	13	93	54	5	53	2	54	50	5	50	4	53	43	5	37	4	43	31
	Sulfate	(mg/l)	7	2357	98	2500	2200	5	2040	152	2200	1800	5	2280	84	2400	2200	5	1980	45	2000	1900
	Sulfide	(mg/l)	5	0.7	0.1	1.1	0.9	5	1.64	0.05	1.7	1.6	0	--	--	--	--	0	--	--	--	--
	Fluoride	(mg/l)	7	1.0	0.1	1.1	0.9	5	1.64	0.05	1.7	1.6	5	1.7	0.1	1.8	1.6	5	0.98	0.15	1.2	0.8
	Bromide	(mg/l)	1	0.2	--	0.2	0.2	0	--	--	--	--	0	--	--	--	--	0	--	--	--	--
BIO-CHEM. CONST.	Chemical Oxygen Demand	(mg/l)	1	79	--	79	79	0	--	--	--	--	0	--	--	--	--	0	--	--	--	--
	Carbon Dioxide	(mg/l)	0	--	--	--	--	2	30	10	37	23	2	25	16	36	14	2	22	8	28	16
	Dissolved Organic Carbon	(mg/l)	5	16.6	0.6	17	16	0	--	--	--	--	0	--	--	--	--	0	--	--	--	--
MACRONUTRIENTS	Ammonia as N	(mg/l)	5	0.094	0.038	0.14	0.04	0	--	--	--	--	0	--	--	--	--	0	--	--	--	--
	Nitrite as N	(mg/l)	5	0.016	0.030	0.07	0.00	0	--	--	--	--	0	--	--	--	--	0	--	--	--	--
	Nitrate as N	(mg/l)	5	0.130	0.037	0.17	0.07	0	--	--	--	--	0	--	--	--	--	0	--	--	--	--
	Nitrite and Nitrate as N	(mg/l)	6	0.13	0.07	0.24	0.04	4	0.09	0.09	0.17	0.01	4	10.7	0.6	11	9.9	4	0.12	0.04	0.14	0.06
	Total Kjeldahl Nitrogen as N	(mg/l)	5	18.5	29.1	70	1.5	0	--	--	--	--	0	--	--	--	--	0	--	--	--	--
	Total Phosphorus as P	(mg/l)	5	2.87	3.17	7.4	0.21	0	--	--	--	--	0	--	--	--	--	0	--	--	--	--
	Diss. Ortho Phosphorus as P	(mg/l)	6	0.007	0.005	0.01	0.00	4	0.010	0.008	0.02	0.00	4	0.013	0.013	0.03	0.00	4	0.010	0.008	0.02	0.00
	Diss. Ortho Phosphate as PO_4	(mg/l)	6	0.020	0.015	0.03	0.00	1	0.03	--	0.03	0.03	1	0.03	--	0.03	0.03	1	0.03	--	0.03	0.03

TABLE 14 (continued)

	Parameters		AG-8					EVAC. CREEK NEAR PARK CANYON #1					EVAC. CREEK NEAR PARK CANYON #2					EVAC. CREEK ABOVE MISSOURI CREEK #1				
			No. of Samples	Mean	Stan. Dev.	Max.	Min.	No. of Samples	Mean	Stan. Dev.	Max.	Min.	No. of Samples	Mean	Stan. Dev.	Max.	Min.	No. of Samples	Mean	Stan. Dev.	Max.	Min.
MICRONUTRIENTS	Boron	(ug/l)	6	2850	1701	6100	1300	5	2560	182	2800	2300	5	1940	134	2100	1800	5	198	38	220	130
	Copper	(ug/l)	5	3.2	1.5	5	1	0	--	--	--	--	0	--	--	--	--	0	--	--	--	--
	Iron	(ug/l)	6	50	28	100	20	1	40	--	40	40	1	40	--	40	40	1	30	--	30	30
	Manganese	(ug/l)	6	780	303	1200	470	1	510	--	510	510	1	30	--	30	30	1	160	--	160	160
	Zinc	(ug/l)	5	10	10	20	0	0	--	--	--	--	0	--	--	--	--	0	--	--	--	--
	Molybdenum	(ug/l)	5	43	12	55	25	0	--	--	--	--	0	--	--	--	--	0	--	--	--	--
	Silica	(mg/l)	7	10.8	0.7	12	9.8	5	8.9	0.6	9.9	8.3	5	13	1	14	12	5	11.4	1.1	13	10
TRACE METALS	Aluminum	(ug/l)	5	24	5	30	20	0	--	--	--	--	0	--	--	--	--	0	--	--	--	--
	Barium	(ug/l)	5	40	55	100	0	0	--	--	--	--	0	--	--	--	--	0	--	--	--	--
	Cadmium	(ug/l)	5	0	0	0	0	0	--	--	--	--	0	--	--	--	--	0	--	--	--	--
	Total Chromium	(ug/l)	5	176	186	500	60	0	--	--	--	--	0	--	--	--	--	0	--	--	--	--
	Lead	(ug/l)	5	0	0	0	0	0	--	--	--	--	0	--	--	--	--	0	--	--	--	--
	Lithium	(ug/l)	5	148	13	160	130	0	--	--	--	--	0	--	--	--	--	0	--	--	--	--
	Mercury	(ug/l)	5	0.2	0.2	0.4	0.0	0	--	--	--	--	0	--	--	--	--	0	--	--	--	--
	Selenium	(ug/l)	5	0.2	0.5	1	0	0	--	--	--	--	0	--	--	--	--	0	--	--	--	--
	Vanadium	(ug/l)	5	0.9	0.5	1.3	0.2	0	--	--	--	--	0	--	--	--	--	0	--	--	--	--
TRACE NON-METALS	Arsenic	(ug/l)	5	2	1	3	1	0	--	--	--	--	0	--	--	--	--	0	--	--	--	--
	Cyanide	(mg/l)	5	0.002	0.004	0.01	0.00	0	--	--	--	--	0	--	--	--	--	0	--	--	--	--
	Phenols	(ug/l)	1	3	--	3	3	0	--	--	--	--	0	--	--	--	--	0	--	--	--	--
	Pesticides	(ug/l)	1	0	--	0	0	0	--	--	--	--	0	--	--	--	--	0	--	--	--	--
	Herbicides	(ug/l)	1	0	--	0	0	0	--	--	--	--	0	--	--	--	--	0	--	--	--	--
RADIOACTIVE CONST.	Gross Alpha as U-nat.	(ug/l)	1	<45	--	<45	<45	0	--	--	--	--	0	--	--	--	--	0	--	--	--	--
	Gross Beta as Sr 90	(pCi/l)	1	15	--	15	15	0	--	--	--	--	0	--	--	--	--	0	--	--	--	--
	Gross Beta as Ce 137	(pCi/l)	1	18	--	18	18	0	--	--	--	--	0	--	--	--	--	0	--	--	--	--
	Potassium 40	(pCi/l)	1	8.0	--	8.0	8.0	0	--	--	--	--	0	--	--	--	--	0	--	--	--	--
	Radium 226, radon method	(pCi/l)	1	0.07	--	0.07	0.07	0	--	--	--	--	0	--	--	--	--	0	--	--	--	--
	Diss. Uranium, dir. fluorometric	(ug/l)	1	20.0	--	20.0	20.0	0	--	--	--	--	0	--	--	--	--	0	--	--	--	--

TABLE 15

SUMMARY OF ALLUVIAL WATER QUALITY
DRY WASHES ALLUVIUM
JANUARY 1976 - SEPTEMBER 1977

			AG-6 #1					AG-6 #2					AG-4					HELL'S HOLE CANYON #1					HELL'S HOLE CANYON #1				
	Parameters		No. of Samples	Mean	Stan. Dev.	Max.	Min.	No. of Samples	Mean	Stan. Dev.	Max.	Min.	No. of Samples	Mean	Stan. Dev.	Max.	Min.	No. of Samples	Mean	Stan. Dev.	Max.	Min.	No. of Samples	Mean	Stan. Dev.	Max.	Min.
GENERAL CHARACTERISTICS	Total Alkalinity as $CaCO_3$	(mg/l)	10	284	9	305	274	5	296	21	323	271	7	483	47	556	428	5	846	119	980	721	5	782	70	900	712
	Dissolved Solids	(mg/l)	10	6222	469	6710	5310	5	3506	788	4490	2420	7	1259	272	1680	975	5	1626	33	1680	1600	5	1718	130	1910	1550
	Harndess as Ca, Mg	(mg/l)	10	3060	384	3500	2300	5	1760	445	2300	1100	7	240	89	380	150	5	107	25	150	91	5	100	17	130	86
	Noncarbonate Hardness	(mg/l)	10	2760	360	3200	2100	5	1428	477	2000	740	7	0	0	0	0	5	0	0	0	0	5	0	0	0	0
	Oil and Grease	(mg/l)	1	2	--	2	2	0	--	--	--	--	1	2	--	2	2	0	--	--	--	--	0	--	--	--	--
	pH		8	7.8	0.2	8.1	7.7	4	7.6	0.2	7.8	7.4	7	7.9	0.2	8.2	7.5	4	8.9	0.5	9.5	8.5	5	9.0	0.3	9.4	8.7
	Specific Conductance	(umhos/cm)	10	6536	464	7250	5600	5	4260	798	5000	3000	7	1831	457	2600	1370	5	2505	212	2750	2250	5	2680	135	2850	2500
	Temperature	(°C)	10	12.0	1.0	13.5	10.0	5	12.2	1.4	13.5	10.0	7	12.3	1.0	13.9	11.0	5	12.2	1.5	14.0	11.0	5	12.5	1.7	14.0	10.0
	Turbidity	(JTU)	0	--	--	--	--	0	--	--	--	--	1	85	--	85	85	0	--	--	--	--	0	--	--	--	--
	Color	(PCU)	4	0.8	1.5	3	0	0	--	--	--	--	5	22	16	40	5	0	--	--	--	--	0	--	--	--	--
MAJOR CATIONS	Calcium	(mg/l)	10	637	89	790	510	5	350	91	440	210	7	17.4	6.2	26	9.9	5	10.8	7.9	24	5.0	5	8.2	2.1	11	6.1
	Magnesium	(mg/l)	10	354	40	390	260	5	210	58	290	130	7	48	18	77	30	5	20	1	21	18	5	20	4	27	17
	Potassium	(mg/l)	10	7.1	1.1	8.7	5.5	5	6.8	1.0	7.7	5.2	7	2.1	0.6	2.9	1.2	5	3.8	1.0	5.2	2.5	5	3.3	0.5	3.8	2.5
	Sodium	(mg/l)	10	789	45	850	730	5	460	53	520	380	7	371	59	460	300	5	570	14	590	550	5	594	29	630	550
	Sodium Adsorption Ratio		10	6.3	0.5	6.8	5.5	5	4.9	0.2	5.1	4.7	7	10.4	0.5	11	10	5	24	2	26	21	5	26	1	27	24
	Percent Sodium		10	36	3	40	32	5	37	4	44	33	7	77	4	82	72	5	92	2	93	89	5	92	1	93	91
	Strontium	(ug/l)	4	7225	2985	11000	4500	0	--	--	--	--	5	874	231	1200	610	0	--	--	--	--	0	--	--	--	--
MAJOR ANIONS	Bicarbonate	(mg/l)	10	346	11	372	334	5	361	25	394	330	7	588	58	678	522	5	931	98	1080	825	5	875	82	960	764
	Carbonate	(mg/l)	7	0	0	0	0	3	0	0	0	0	6	0	0	0	0	4	62	74	168	0	4	48	24	66	13
	Chloride	(mg/l)	10	238	26	280	190	5	113	24	130	73	7	51	9	69	42	5	70	62	180	39	5	84	45	150	42
	Sulfate	(mg/l)	10	3970	330	4400	3400	5	2160	577	2900	1400	7	437	140	650	280	5	424	131	560	230	5	524	150	730	380
	Sulfide	(mg/l)	4	0.0	0.0	0.0	0.0	0	--	--	--	--	5	0.6	1.4	3.2	0.0	0	--	--	--	--	0	--	--	--	--
	Fluoride	(mg/l)	10	0.4	0.3	1.0	0.2	5	0.3	0.0	0.3	0.3	7	4.5	1.8	5.8	0.7	5	6.2	0.7	6.9	5.0	5	5.3	0.7	5.9	4.3
	Bromide	(mg/l)	1	0.7	--	0.7	0.7	0	--	--	--	--	1	0.2	--	0.2	0.2	0	--	--	--	--	0	--	--	--	--
BIO-CHEM. CONST.	Chemical Oxygen Demand	(mg/l)	1	36	--	36	36	0	--	--	--	--	1	35	--	35	35	0	--	--	--	--	0	--	--	--	--
	Carbon Dioxide	(mg/l)	1	6.9	--	6.9	6.9	1	15	--	15	15	3	8.3	0.4	8.6	7.9	1	5.1	--	5.1	5.1	2	1.6	0.9	2.2	0.9
	Dissolved Organic Carbon	(mg/l)	4	8.5	2.1	11	6.0	0	--	--	--	--	5	13.2	4.2	19	9.0	0	--	--	--	--	0	--	--	--	--
MACRONUTRIENTS	Ammonia as N	(mg/l)	4	0.08	0.05	0.14	0.01	0	--	--	--	--	5	0.03	0.02	0.07	0.01	0	--	--	--	--	0	--	--	--	--
	Nitrite as N	(mg/l)	4	0.30	0.10	0.38	0.16	0	--	--	--	--	5	0.022	0.027	0.06	0.00	0	--	--	--	--	0	--	--	--	--
	Nitrate as N	(mg/l)	0	--	--	--	--	0	--	--	--	--	5	5.4	2.9	9.3	2.3	0	--	--	--	--	0	--	--	--	--
	Nitrite and Nitrate as N	(mg/l)	10	6.6	1.3	8.7	4.8	5	1.43	0.49	2.0	0.92	6	5.2	2.7	9.3	2.3	4	0.038	0.075	0.15	0.00	4	0.035	0.051	0.11	0.00
	Total Kjeldahl Nitrogen as N	(mg/l)	4	1.67	1.22	3.3	0.63	0	--	--	--	--	5	1.66	0.57	2.3	0.98	0	--	--	--	--	0	--	--	--	--
	Total Phosphorus as P	(mg/l)	4	2.89	3.89	8.7	0.46	0	--	--	--	--	5	0.37	0.18	0.57	0.18	0	--	--	--	--	0	--	--	--	--
	Diss. Ortho Phosphorus as P	(mg/l)	10	0.020	0.013	0.04	0.00	2	0.025	0.007	0.03	0.02	6	0.025	0.010	0.04	0.01	4	0.14	0.18	0.40	0.03	4	0.053	0.043	0.10	0.00
	Diss. Ortho Phosphate as PO_4	(mg/l)	3	0.070	0.046	0.12	0.03	2	0.075	0.021	0.09	0.06	6	0.072	0.030	0.12	0.03	1	0.18	--	0.18	0.18	1	0.12	--	0.12	0.12

TABLE 15 (continued)

	Parameters		AG-6 #1					AG-6 #2					AG-4					HELL'S HOLE CANYON #1					HELL'S HOLE CANYON #1				
			No. of Samples	Mean	Stan. Dev.	Max.	Min.	No. of Samples	Mean	Stan. Dev.	Max.	Min.	No. of Samples	Mean	Stan. Dev.	Max.	Min.	No. of Samples	Mean	Stan. Dev.	Max.	Min.	No. of Samples	Mean	Stan. Dev.	Max.	Min.
MICRONUTRIENTS	Boron	(ug/l)	10	544	279	1300	250	5	366	48	440	320	7	2014	1319	3700	540	5	1800	224	1900	1400	5	1760	313	1900	1200
	Copper	(ug/l)	4	10	7	18	3	0	--	--	--	--	5	18	7	30	12	0	--	--	--	--	0	--	--	--	--
	Iron	(ug/l)	5	28	11	40	20	0	--	--	--	--	6	32	23	70	10	1	90	--	90	90	1	100	--	100	100
	Manganese	(ug/l)	5	2120	377	2500	1500	0	--	--	--	--	6	13	8	30	10	1	0	--	0	0	1	10	--	10	10
	Zinc	(ug/l)	4	3700	949	4600	2500	0	--	--	--	--	5	16	15	40	0	0	--	--	--	--	0	--	--	--	--
	Molybdenum	(ug/l)	4	3	4	7	0	0	--	--	--	--	5	426	123	530	230	0	--	--	--	--	0	--	--	--	--
	Silica	(mg/l)	10	19.9	1.0	21	18	5	19.2	1.1	21	18	7	12.9	0.7	14	12	5	10.3	0.7	11	9.7	5	9.1	0.7	10	8.3
TRACE METALS	Aluminum	(ug/l)	4	20	8	30	10	0	--	--	--	--	5	32	18	50	10	0	--	--	--	--	0	--	--	--	--
	Barium	(ug/l)	4	100	200	400	0	0	--	--	--	--	5	40	55	100	0	0	--	--	--	--	0	--	--	--	--
	Cadmium	(ug/l)	4	1.8	1.7	4	0	0	--	--	--	--	5	0.6	0.9	2	0	0	--	--	--	--	0	--	--	--	--
	Total Chromium	(ug/l)	4	158	112	320	70	0	--	--	--	--	5	34	21	60	10	0	--	--	--	--	0	--	--	--	--
	Lead	(ug/l)	4	3.3	4.0	9	0	0	--	--	--	--	5	2.0	3.5	8	0	0	--	--	--	--	0	--	--	--	--
	Lithium	(ug/l)	4	40	0	40	40	0	--	--	--	--	5	174	37	230	140	0	--	--	--	--	0	--	--	--	--
	Mercury	(ug/l)	4	0.28	0.21	0.5	0.0	0	--	--	--	--	5	0.24	0.29	0.7	0.0	0	--	--	--	--	0	--	--	--	--
	Selenium	(ug/l)	4	38	15	55	18	0	--	--	--	--	5	5.8	5.1	11	0	0	--	--	--	--	0	--	--	--	--
	Vanadium	(ug/l)	4	4.3	1.2	5.4	2.8	0	--	--	--	--	5	8.0	3.4	13	3.9	0	--	--	--	--	0	--	--	--	--
TRACE NON-METALS	Arsenic	(ug/l)	4	1.3	1.0	2	0	0	--	--	--	--	5	7.8	2.2	11	5	0	--	--	--	--	0	--	--	--	--
	Cyanide	(mg/l)	4	0.00	0.00	0.00	0.00	0	--	--	--	--	5	0.002	0.004	0.01	0.00	0	--	--	--	--	0	--	--	--	--
	Phenols	(ug/l)	1	1	--	1	1	0	--	--	--	--	1	1	--	1	1	0	--	--	--	--	0	--	--	--	--
	Pesticides	(ug/l)	0	--	--	--	--	0	--	--	--	--	1	0	--	0	0	0	--	--	--	--	0	--	--	--	--
	Herbicides	(ug/l)	0	--	--	--	--	0	--	--	--	--	1	0	--	0	0	0	--	--	--	--	0	--	--	--	--
RADIOACTIVE CONST.	Gross Alpha as U-nat.	(ug/l)	0	--	--	--	--	0	--	--	--	--	1	<50	--	<50	<50	0	--	--	--	--	0	--	--	--	--
	Gross Beta as Sr 90	(pCi/l)	0	--	--	--	--	0	--	--	--	--	1	5.3	--	5.3	5.3	0	--	--	--	--	0	--	--	--	--
	Gross Beta as Ce 137	(pCi/l)	0	--	--	--	--	0	--	--	--	--	1	6.4	--	6.4	6.4	0	--	--	--	--	0	--	--	--	--
	Potassium 40	(pCi/l)	0	--	--	--	--	0	--	--	--	--	1	1.3	--	1.3	1.3	0	--	--	--	--	0	--	--	--	--
	Radium 226, radon method	(pCi/l)	0	--	--	--	--	0	--	--	--	--	1	0.09	--	0.09	0.09	0	--	--	--	--	0	--	--	--	--
	Diss. Uranium, dir. fluorometric	(ug/l)	0	--	--	--	--	0	--	--	--	--	1	15	--	15	15	0	--	--	--	--	0	--	--	--	--

FIGURE 7

BALANCE AND DISTRIBUTION OF MAJOR IONS
ALLUVIAL WATER QUALITY — WHITE RIVER
OCTOBER 1976—SEPTEMBER 1977

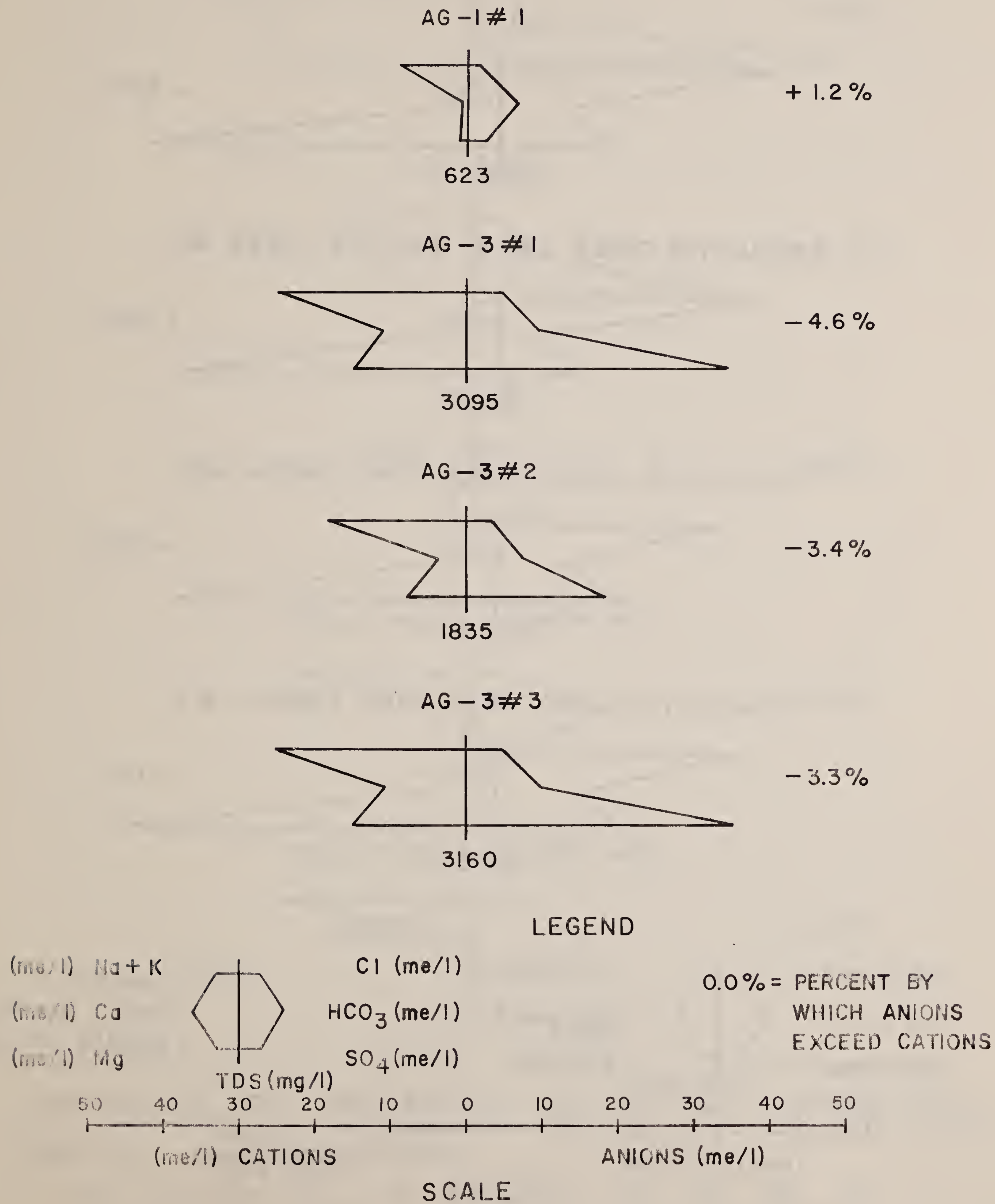


FIGURE 8

BALANCE AND DISTRIBUTION OF MAJOR IONS
ALLUVIAL WATER QUALITY — EVACUATION CREEK
OCTOBER 1976—SEPTEMBER 1977

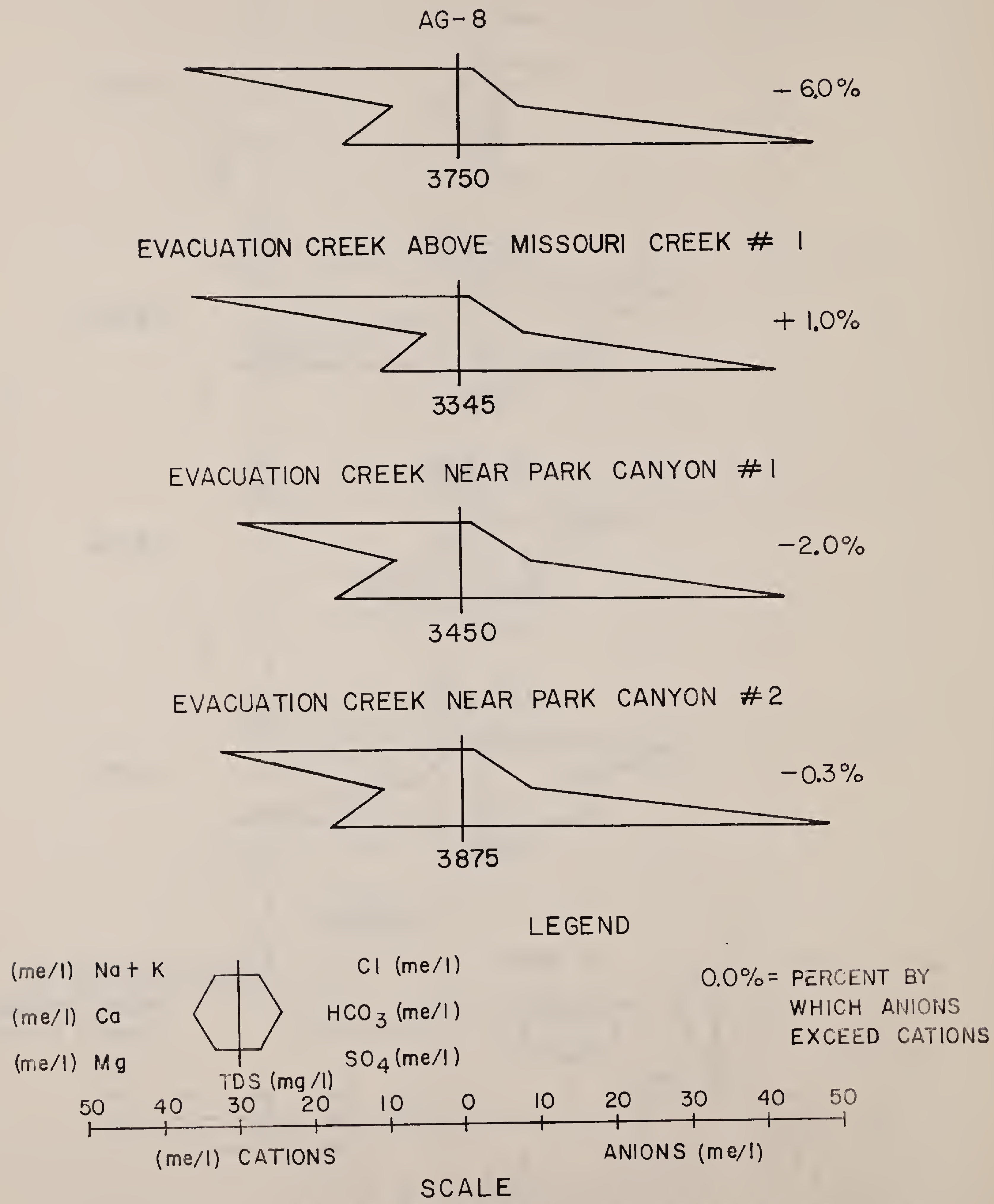
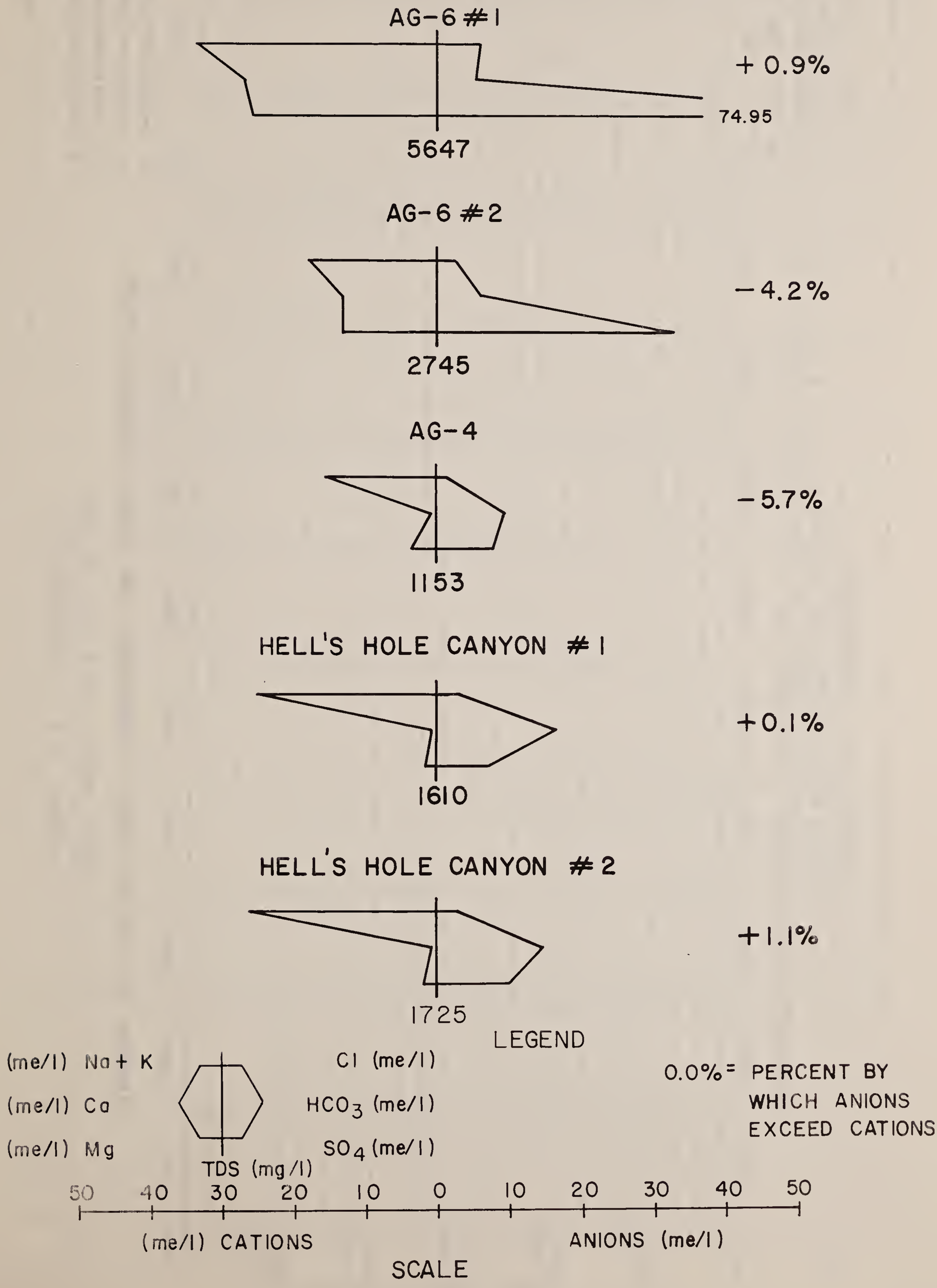
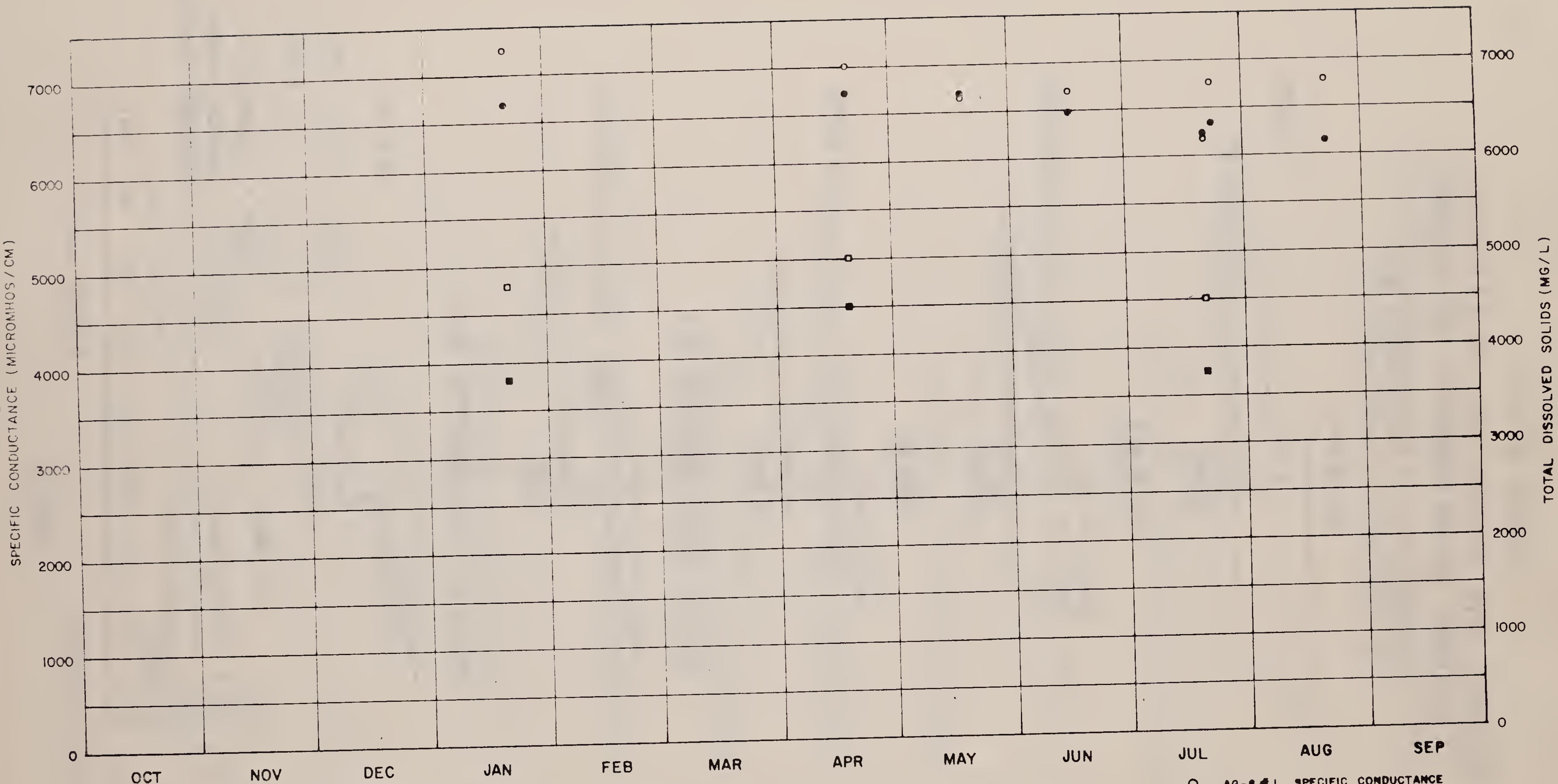


FIGURE 9

BALANCE AND DISTRIBUTION OF MAJOR IONS
ALLUVIAL WATER QUALITY — DRY WASHES
OCTOBER 1976 — SEPTEMBER 1977





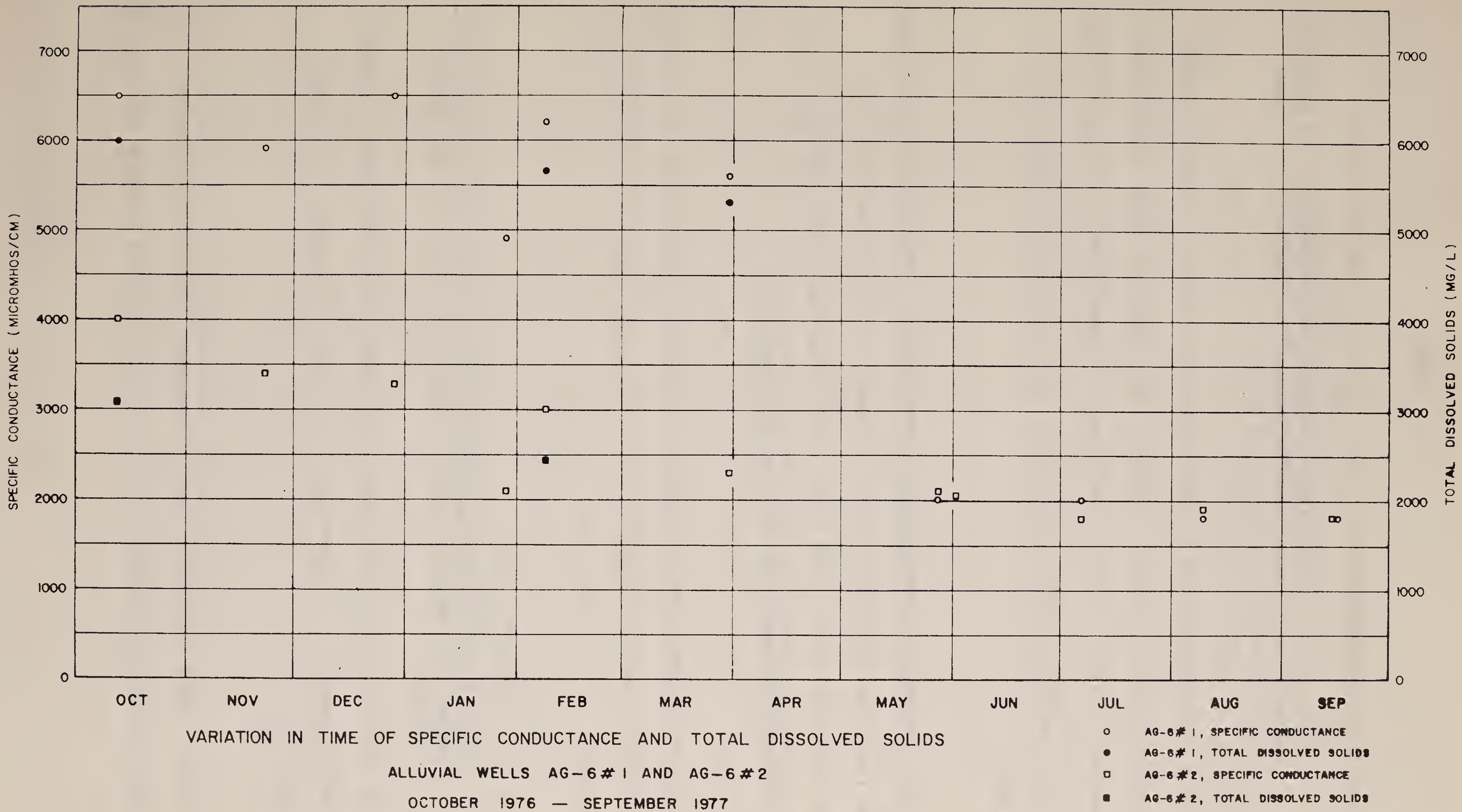
VARIATION IN TIME OF SPECIFIC CONDUCTANCE AND TOTAL DISSOLVED SOLIDS

ALLUVIAL WELLS AG-6 # 1 AND AG-6 # 2

OCTOBER 1975 — SEPTEMBER 1976

○ AG-6 # 1, SPECIFIC CONDUCTANCE
● AG-6 # 1, TOTAL DISSOLVED SOLIDS
□ AG-6 # 2, SPECIFIC CONDUCTANCE
■ AG-6 # 2, TOTAL DISSOLVED SOLIDS

FIGURE 10



VARIATION IN TIME OF SPECIFIC CONDUCTANCE AND TOTAL DISSOLVED SOLIDS

ALLUVIAL WELLS AG-6 # 1 AND AG-6 # 2

OCTOBER 1976 — SEPTEMBER 1977

FIGURE 11

The second hypothesis is:

> There are no significant differences in water level and chemical composition between comparable data from the two White River alluvial well sites (AG-1 and AG-3).

The fluctuation of static water level with respect to time at these two locations is similar. However, the ranges of these fluctuations are not similar. At AG-1 the range is approximately 1.22 meters (four feet), whereas at AG-3 the range is approximately 0.30 meter (one foot).

There are obvious differences in the chemical composition of the water at these two locations. This is shown in Table 13 and Figure 7. Of the major cations and anions, only bicarbonate does not show large differences between the AG-1 and AG-3 locations.

Possible explanations for these differences in water level and chemical composition were discussed in the 1977 annual report for the Interim Period.

The third hypothesis is:

> There are no significant differences in water level and chemical composition between lower and upper well points at any specific location.

The results of statistical tests for significant differences in water quality parameters between lower and upper well points are shown in Table 16.

At AG-1, there are significant differences in 26 out of 48 water quality parameters tested. Also, the distribution of major cations and

TABLE 16

RESULTS OF ANOVA TESTS FOR SIGNIFICANT DIFFERENCE
ALLUVIAL WATER QUALITY
LOWER VERSUS UPPER ALLUVIAL WELLS
JANUARY 1976 - SEPTEMBER 1977

Parameters		AG-1 #1 (Lower) vs. AG-1 #2 (Upper)	AG-3 #1 (Lower) vs. AG-3 #2 (Upper)	AG-3 #1 (Lower) vs. AG-3 #3 (Upper)	Evac. Cr. Near Park Canyon #1 (Lower) vs. Evac. Cr. Near Park Canyon #2 (Upper)	AG-6 #1 (Lower) vs. AG-6 #2 (Upper)	Hell's Hole Canyon #1 (Lower) vs. Hell's Hole Canyon #2 (Upper)
Total Alkalinity as $CaCO_3$	(mg/l)		x				
Dissolved Solids	(mg/l)	x	x	x	x	x	
Hardness as Ca, Mg	(mg/l)	x	x	x	x	x	
Noncarbonate Hardness	(mg/l)	x	x	x	x	x	
Oil and Grease		--	--	--	--	--	--
pH						x	
Specific Conductance	(umhos/cm)	x	x	x	x	x	
Temperature	(°C)						
Turbidity	(JTU)	--	--	--	--	--	--
Color	(PCU)		--		--	--	--
Calcium	(mg/l)	x	x	x	x	x	
Magnesium	(mg/l)	x	x	x		x	
Potassium	(mg/l)	x	x				
Sodium	(mg/l)	x	x	x	x	x	
Sodium Adsorption Ratio		x	x			x	
Percent Sodium		x	x	x			
Strontium	(ug/l)	x	--	x	--	--	--
Bicarbonate	(mg/l)		x				
Carbonate	(mg/l)						
Chloride	(mg/l)	x	x	x		x	
Sulfate	(mg/l)	x	x	x	x	x	
Sulfide	(mg/l)	x	--	x	--	--	--
Fluoride	(mg/l)	x	x	x			x
Bromide	(mg/l)	--	--	--	--	--	--
Chemical Oxygen Demand	(mg/l)	--	--	--	--	--	--
Carbon Dioxide	(mg/l)	--				--	
Dissolved Organic Carbon	(mg/l)	x	--	x	--	--	--
Ammonia as N	(mg/l)	x	--		--	--	--
Nitrite as N	(mg/l)		--		--	--	--
Nitrate as N	(mg/l)	x	--	--	--	--	--
Nitrite and Nitrate as N	(mg/l)				x	x	
Total Kjeldahl Nitrogen as N	(mg/l)	x	--		--	--	--
Total Phosphorus	(mg/l)		--		--	--	--
Diss. Ortho Phosphorus as P	(mg/l)	x					
Diss. Ortho Phosphate as PO_4	(mg/l)	x	--		--		--
Boron	(ug/l)	x			x		
Copper	(ug/l)		--		--	--	--
Iron	(ug/l)				--	--	--
Manganese	(ug/l)	x	x		--	--	--
Zinc	(ug/l)		--	x	--	--	--
Molybdenum	(ug/l)	x	--		--	--	--
Silica	(mg/l)	x			x		x
Aluminum	(ug/l)		--		--	--	--
Barium	(ug/l)		--		--	--	--
Cadmium	(ug/l)		--		--	--	--
Total Chromium	(ug/l)		--	x	--	--	--
Lead	(ug/l)		--		--	--	--
Lithium	(ug/l)	x	--	x	--	--	--
Mercury	(ug/l)		--		--	--	--
Selenium	(ug/l)		--		--	--	--
Vanadium	(ug/l)		--		--	--	--
Arsenic	(ug/l)		--	x	--	--	--
Phenols	(ug/l)	--	--	--	--	--	--
Cyanide	(mg/l)		--		--	--	--
Pesticides	(ug/l)	--	--	--	--	--	--
Herbicides	(ug/l)	--	--	--	--	--	--
Gross Alpha as U-nat.	(ug/l)	--	--	--	--	--	--
Gross Beta as Sr90	(pCi/l)	--	--	--	--	--	--
Gross Beta as Ce137	(pCi/l)	--	--	--	--	--	--
Potassium 40	(pCi/l)	--	--	--	--	--	--
Radium 226, radon method	(pCi/l)	--	--	--	--	--	--
Diss. Uranium, dir. fluorometric	(ug/l)	--	--	--	--	--	--

LEGEND:

x indicates failure of the Anlysis of Variance (one-way) test with α=0.1 (90% confidence level)
-- indicates that test could not be made due to lack of data

anions is not similar between the lower and upper wells. Differences in chemical composition may be influenced by the depth of alluvium that the water percolates through. Also, the lower well may be influenced by leaching from the bedrock surface.

There are significant differences in 16 out of 25 water quality parameters tested between AG-3 #1 and AG-3 #2. There are significant differences in 16 out of 48 water quality parameters tested between AG-3 #1 and AG-3 #3. The distribution of major cations and anions is similar between all three wells. There is no clear explanation for this condition. A possible cause might be that water reaching the lower well has had more opportunity to dissolve minerals from the alluvium than water reaching the other two upper well points.

At Evacuation Creek near Park Canyon, 10 out of 23 water quality parameters have significant differences between the lower and upper wells. Inspection of Table 14 indicates that only nitrite and nitrate as nitrogen and silica show large differences between the means. The other eight parameters failed because the standard deviations were quite small compared to the difference in means. The distribution of major cations and anions is similar between the lower and upper wells.

At the AG-6 location, 12 out of 23 water quality parameters showed significant differences between the lower and upper wells. This situation is changing with respect to time, as shown in Figures 10 and 11 . From May 1977 through September 1977, the specific conductance is similar between the lower and upper wells. This leads to the conclusion that water quality samples taken after May 1977 will show much less difference between the lower and upper wells. Future data will indicate whether this conclusion is correct or not.

At the Hell's Hole Canyon location there was little difference in chemical composition between the lower and upper wells.

3.0 Precipitation/Evaporation

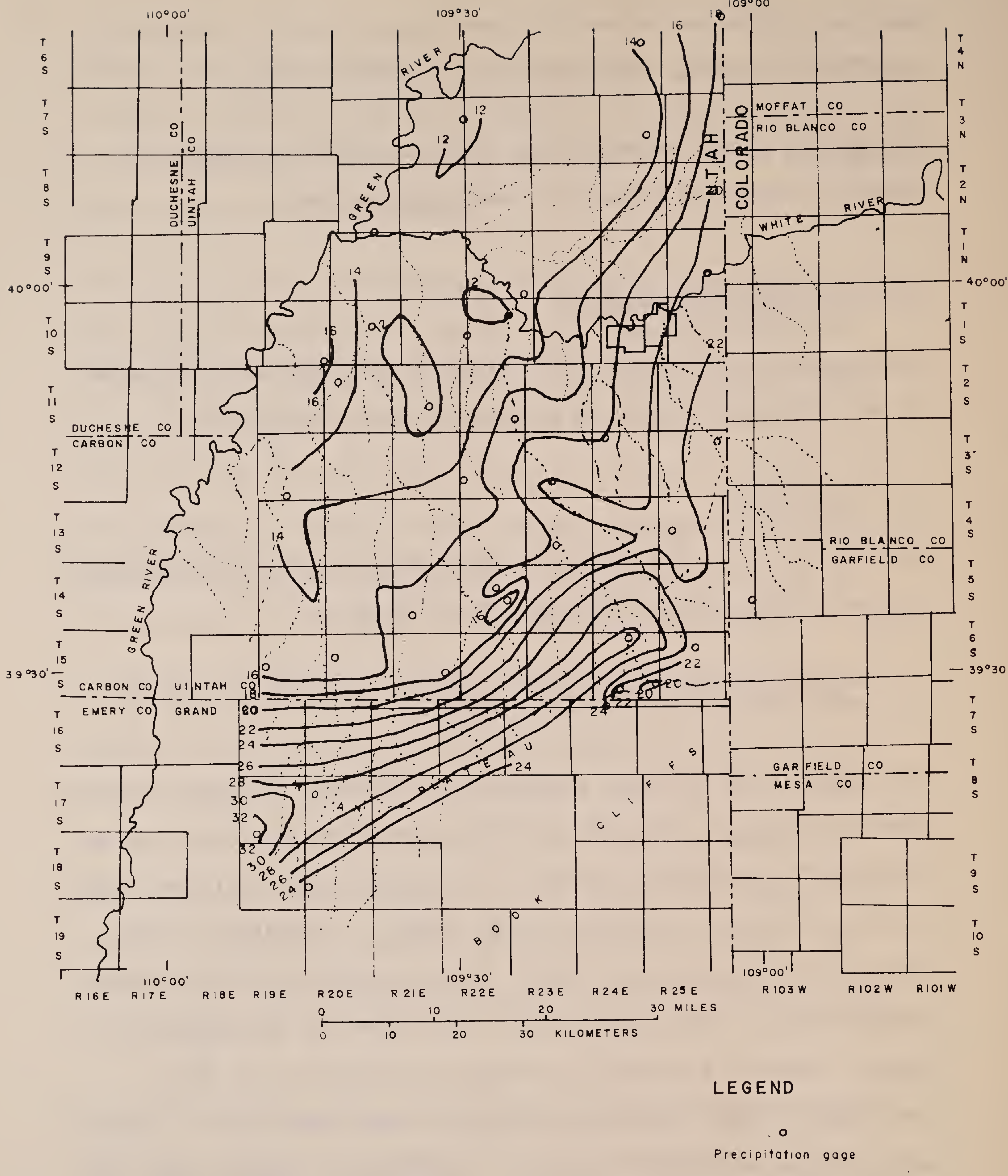
The purpose of this section is to expand on the conclusions presented in the 1977 annual report for the Interim Monitoring Period.

3.1 Conclusions

Specifically, this section will be concerned with the second hypothesis presented in the December 1976 Work Plan, which is:

> The existing USGS precipitation network is adequate to predict precipitation levels on Tracts Ua/Ub.

The isohyetal map of annual precipitation during the 1977 water year is shown in Figure 12. This map is based on data from the gages involved in the USGS precipitation network. This network does not include any of the precipitation gages maintained by WRSP. A comparison of the 1977 annual precipitation at ARA-2, ARS-9 and ARA-13 with the regional isohyetal map is shown in Figure 13. The record for ARS-9 during January, February and March was estimated from the data at ARA-2. The results of the comparison of measured versus predicted 1977 annual precipitation are shown in Table 17. These results indicate that the predictions from the isohyetal map of 1977 annual precipitation for the USGS network of gages is within 25 percent of the measured values at the three WRSP automatic precipitation gages.



ANNUAL PRECIPITATION IN CM.

OCTOBER 1976 — SEPTEMBER 1977

USGS REGIONAL NETWORK

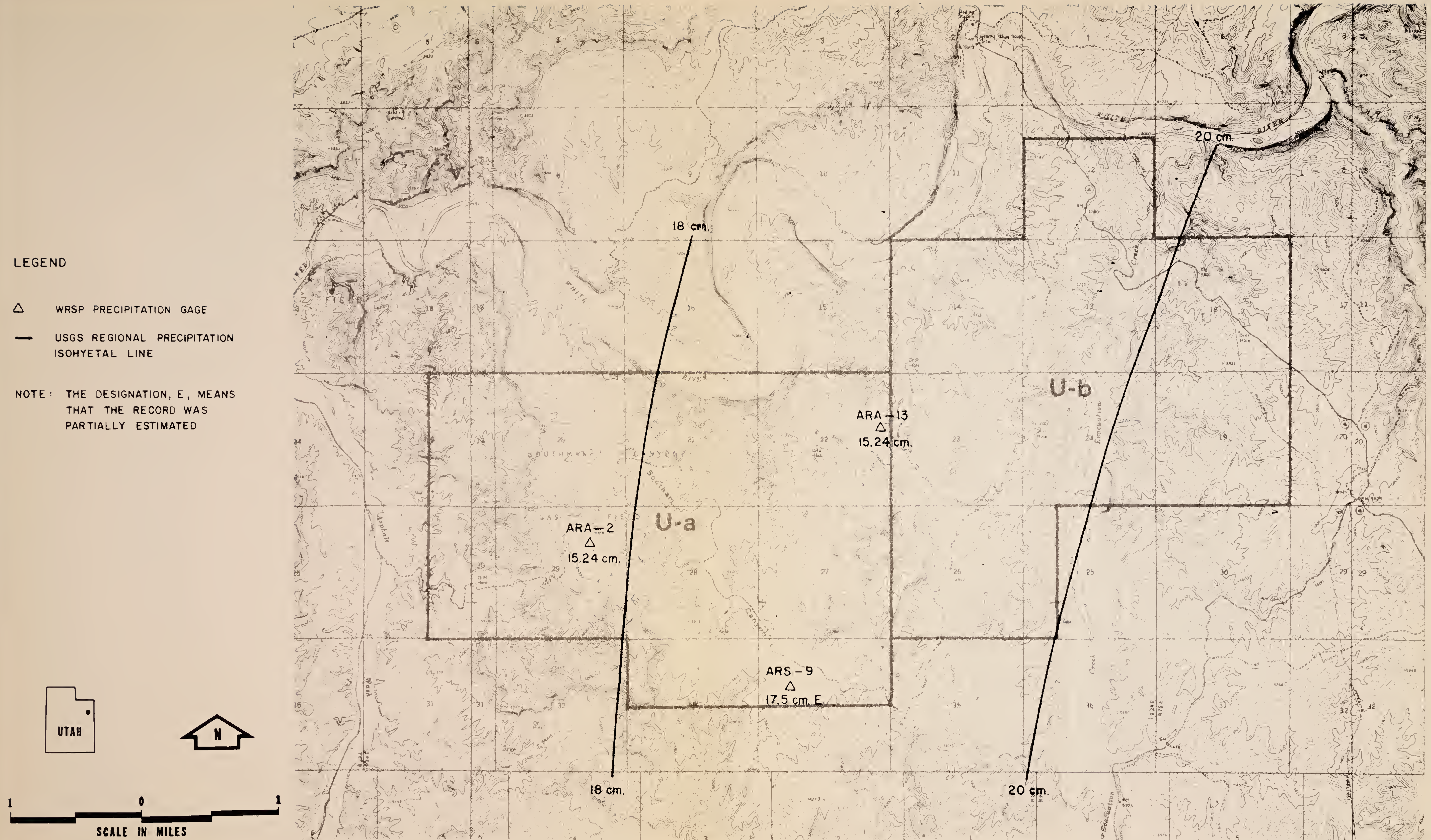
FIGURE 12

LEGEND

△ WRSP PRECIPITATION GAGE

— USGS REGIONAL PRECIPITATION ISOHYETAL LINE

NOTE: THE DESIGNATION, E, MEANS THAT THE RECORD WAS PARTIALLY ESTIMATED



COMPARISON OF WRSP PRECIPITATION GAGES
TO USGS REGIONAL PRECIPITATION NETWORK
OCTOBER 1976 — SEPTEMBER 1977

FIGURE 13

TABLE 17

COMPARISON OF MEASURED PRECIPITATION
WITH PREDICTED VALUE FROM ISOHYETAL MAP

STATIONS ARA-2, ARS-9 and ARA-13

OCTOBER 1976 - SEPTEMBER 1977

Station	Measured 1977 Annual Precipitation in Centimeters	Predicted 1977 Annual Precipitation in Centimeters	Percent Difference of Prediction from Measurement
ARA-2	15.24	18	+18
ARS-9	17.5 E	19	+ 9
ARA-13	15.24	19	+25

Note: The designation, E, means that part of the record was estimated.

This type of prediction may be considered accurate for some purposes; however, the regional precipitation network is not likely to accurately predict precipitation on Tracts Ua/Ub from an intense localized thunder storm. This was discussed in the 1977 annual report. The conclusion for the second hypothesis will not change considering the analysis discussed in this section; i.e., the existing USGS precipitation network is not completely adequate to predict precipitation levels on Tracts Ua/Ub.