APPENDIX 7-58

SUMMARY OF HYDRO LOGIC BASELINE INFORMATION,

SOUTH CRANDALL LEASE

INCORPORATED
APR 15 2005
DIV OF OIL GAS & MINING

1/23/95 revised 4/97

SEP 16 2005

PETERSEN HYDROLOGIC

14 September 2003

Mr. Dave Shaver
GENWAL Resources, Inc.
P.O. Box 1077
Price, Utah 84501

Dave,

This appendix summarizes the baseline water monitoring activities in the South Crandall Lease area. Baseline monitoring locations are shown on Figure 1. Discharge and major-ion water quality data from seeps, springs, and streams in the South Crandall Lease area are presented in Table 1. Trace metal and nutrient water quality measurements are presented in Table 2.

Historic monitoring of seeps, springs, and creeks in the South Crandall Lease area has been performed by several entities. The sources from which the hydrologic data in the table were obtained are listed in Tables 1 and 2.

GENWAL Resources, Inc. has collected a large amount of hydrologic data from springs, seeps, and streams in the South Crandall Lease and surrounding area. Beginning in 1985 and continuing to the present, GENWAL has performed a series of spring and seep surveys in the South Crandall Lease and surrounding area. In conjunction with scientific investigations conducted at the Crandall Canyon Mine, GENWAL has also collected a substantial amount of discharge, solute, and isotopic data in the region. Over the past several years, GENWAL also performed baseline monitoring of springs, seeps, and streams in the South Crandall Lease area.

Beaver Creek Coal Company, as part of hydrologic monitoring at the Huntington Canyon #4 Mine, monitored seeps, springs, and streams in the South Crandall Lease and surrounding area. This included monitoring of Little Bear Spring.

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The Castle Valley Special Service District operates Little Bear Spring as part of a water supply system that supplies municipal water to adjacent municipalities. In conjunction with these activities, the Castle Valley Special Service District performs routine monitoring of Little Bear Spring. The CVSSD measures monthly average discharge from Little Bear Spring and performs periodic water quality measurements. The monthly average discharge at the spring for the period 1982 to the present is presented in Table 3.

2695 N. 600 E. LEHI, UTAH 84043 (801) 766-4006

Water quality and discharge data from Little Bear Spring collected by the CVSSD are included in Tables 1 and 2.

Data from the South Crandall Lease area has also been collected by governmental agencies. The United States Geologic Survey, in conjunction with various investigations in the Huntington Canyon area, has performed periodic measurements of discharge and water quality from streams, seeps, and springs in the area, including Little Bear Spring. The Utah Department of Health has also monitored water quality at Little Bear Spring. Water quality measurements performed by the USGS and the Utah Department of Health are included in Tables 1 and 2. Discharge data from Little Bear Spring collected by the USGS and CVSSD prior to 1982 are presented in Table 4.

Also included in this appendix is a plot of the Palmer Hydrologic Drought Index. A plot of the PHDI for Utah Region 4 (which includes the South Crandall Lease area) is presented in Figure 2. The PHDI is a monthly value generated by the National Climatic Data Center using a variety of hydrologic parameters that indicates wet and dry spells. The PHDI is calculated from several hydrologic parameters including precipitation, temperature, evapotranspiration, soil water recharge, soil water loss, and runoff. Consequently, it is a useful tool for evaluating the relationship between climate and groundwater and surface water discharge data. The PHDI is useful for determining whether variations in spring and stream discharge rates are the result of climatic variability or whether they are the result of other factors.

As indicated by the PHDI (Figure 2), during the past 20 years, the region has experienced periods of extreme drought and periods of extreme wetness in addition to periods of near normal climatic conditions. The climatic conditions the area was experiencing during baseline monitoring activities at the South Crandall Lease area are important to consider when evaluating the data in this appendix.

Please feel free to contact me should you have any questions in this regard.

Sincerely,

Erik C. Petersen, M.S., P.G.
Principal Hydrogeologist
Utah PG No. 5373615-2250

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	Date	Data source	Flow (gpm)	T (C°)	pH (s.u.)	Cond. (µS/cm)	TDS (mg/l)	Ca^{2+} (mg/l)	Mg^{2+} (mg/l)	Na^{+} (mg/l)	K^{+} (mg/l)	HCO_3^{-} (mg/l)	CO_3^{2-} (mg/l)	SO_4^{2-} (mg/l)	Cl^{-} (mg/l)	DO (mg/l)	Turbidity (NTU)	Hard. (mg/l)	Acidity (mg/l)	Alkalinity (mg/l CaCO3)	O&G (mg/l)	TSS (mg/l)	Tritium (TU)	^{14}C (pmC)	$\delta^{13}C$ (‰)	δ2H (‰)	$\delta^{18}O$ (‰)	$\delta^{34}S$ (‰)
								Major Ions																Isotopes				
SP-74																												
(Blackhawk Formation)	Jun-85	Genwal	seep	---	---	---																						
	Oct-85	Genwal	dry	---	---	---																						
	Jun-93	Genwal	dry	---	---	---																						
	30-Jun-03	Genwal	dry	---	---	---																						
	25-Aug-03	Genwal																										
SP-75	Jun-85	Genwal	seep																									
(Blackhawk Formation)	Oct-85	Genwal	dry																									
	Jun-93	Genwal	dry																									
	30-Jun-03	Genwal	dry	---	---	---																						
	25-Aug-03	Genwal																										
SP-76	Jun-85	Genwal	1	10	7.48	960																						
(Blackhawk Formation)	Oct-85	Genwal	1	5	8.35	850																						
	30-Jun-03	Genwal	dry	---	---	---																						
	25-Aug-03	Genwal	dry																									
SP-77	Jun-85	Genwal	seep	---	---	---																						
(Blackhawk Formation)	Oct-85	Genwal	dry	---	---	---																						
	30-Jun-03	Genwal	dry	---	---	---																						
	25-Aug-03	Genwal	dry																									
SP-78	Jun-85	Genwal	seep	---	---	---																						
(Star Point Sandstone)	Oct-85	Genwal	dry	---	---	---																						
	Jun-93	Genwal	dry	---	---	---																						
	30-Jun-03	Genwal	seep	---	---	---																						
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SP-79	Jun-85	Genwal	seep	---	---	---																						
(Star Point Sandstone)	Oct-85	Genwal	dry	---	---	---																						
	Jun-93	Genwal	dry	---	---	---																						
	30-Jun-03	Genwal	0.395	8.9	7.71	870											7.9											
	25-Aug-03	Genwal	0.353	10.7	7.84	1,006																						
Little Bear Spring	3-Oct-57	Utah Dept. of Health					305	75	25			341	1.67	14	7.4					282								
(Star Point Sandstone)	25-Jun-70	CVSSD	399																									
(upper Little Bear Spring)	8/75 to 2/79 av.	USFS mean	449	5.8	8.9									56.7	3.7					244								
(upper Little Bear; 4-1-W)	16-Jul-76	Beaver Ck. Coal			9.3									15.9	3.7													
	18-Aug-76	USGS, 1981	121	8.3	7.6	530	332	67	38	7.1	1.5	346		35	5.3					284								
	18-Aug-76	USGS, 1981	117																									
	27-Apr-78	USGS, 1981	426																									
	29-Aug-78	USGS, 1981	292																									
(upper Little Bear; 4-1-W)	15-Sep-78	Beaver Ck. Coal	180		7.10	720	470							28.0	14												1.00	
	13-Oct-78	USGS, 1981	256																									
	8-Nov-78	USGS, 1981	188																									
	4-Nov-77	Utah dept of Health			7.7	492	315	66	36	6	2	346		32	2					274								
(upper Little Bear; 4-1-W)	15-Jun-79	Beaver Ck. Coal			8.4									97.5														
(upper Little Bear; 4-1-W)	11-Oct-79	Beaver Ck. Coal			7.80		330							58.0	8												1.00	
(upper Little Bear; 4-1-W)	25-Aug-80	Beaver Ck. Coal			7.20	490	350							33.0	14												9.00	
(upper Little Bear; 4-1-W)	6-Nov-80	Beaver Ck. Coal			7.20	500	350							21.0	0.65												1.00	
(upper Little Bear; 4-1-W)	4-Jan-81	Beaver Ck. Coal			6.80	557	390							18.0	4.49												8.00	
(upper Little Bear; 4-1-W)	3-Feb-81	Beaver Ck. Coal			7.80	530	350							18.0	12.3												1.00	
(upper Little Bear; 4-1-W)	4-Mar-81	Beaver Ck. Coal			7.40	520	310								9.00												1.00	
(upper Little Bear; 4-1-W)	9-Apr-81	Beaver Ck. Coal			8.40	580	380							24.0	14.00												2.00	

	Date	Data source	Flow (gpm)	T (C°)	pH (s.u.)	Cond. (µS/cm)	TDS (mg/l)	Major Ions: Ca^{2+} (mg/l)	Mg^{2+} (mg/l)	Na^{+} (mg/l)	K^{+} (mg/l)	HCO_3^{-} (mg/l)	CO_3^{2-} (mg/l)	SO_4^{2-} (mg/l)	Cl^{-} (mg/l)	DO (mg/l)	Turbidity (NTU)	Hard. (mg/l)	Acidity (mg/l)	Alkalinity (mg/l CaCO3)	O&G (mg/l)	TSS (mg/l)	Isotopes: Tritium (TU)	^{14}C (pmC)	$\delta^{13}C$ (‰)	δ2H (‰)	$\delta^{18}O$ (‰)	$\delta^{34}S$ (‰)
	28-Apr-81	Utah dept of Health			8.0	535	308	53	36	12	1	320		35	4					262								
(upper Little Bear; 4-1-W)	13-May-81	Beaver Ck. Coal			7.9	540	350							37.5	12							9.0						
(upper Little Bear; 4-1-W)	11-Jun-81	Beaver Ck. Coal		10	7.7	530	345							36	10							2.0						
(upper Little Bear; 4-1-W)	10-Dec-81	Beaver Ck. Coal			7.6	560	375							18	4.24							14.0						
(upper Little Bear; 4-1-W)	14-Jan-82	Beaver Ck. Coal	265	7	7.2	500	325							30	2.9							4.0						
(upper Little Bear; 4-1-W)	17-Feb-82	Beaver Ck. Coal	269	10	7.8	450	286							6.0	4.6							1.0						
(upper Little Bear; 4-1-W)	Mar-82	Beaver Ck. Coal	265	8	7.4	400	260							27.0	3.8							2						
(upper Little Bear; 4-1-W)	22-Apr-82	Beaver Ck. Coal	305		7.5	590	390							30.0	2.40							14.0						
(upper Little Bear; 4-1-W)	26-May-82	Beaver Ck. Coal			7.6	520	350							24.0	9.9													
(upper Little Bear; 4-1-W)	23-Jun-82	Beaver Ck. Coal			7.7	560	367							21.0	10.1							4.0						
(upper Little Bear; 4-1-W)	21-Jul-82	Beaver Ck. Coal		16.0	1.7	415	276							6.0	13.0							4.0						
(upper Little Bear; 4-1-W)	24-Aug-87	Beaver Ck. Coal					315	52	46	7	2		0	36	5			319	281									
	18-Sep-90	CVSSD			7.20		236	61.8	38.25	6.87	1.70	362	<0.10	34.2	4.3		0.61	430		297		5						
	24-Nov-92	CVSSD			7.4	405	312	48.2	38.2	7.25	1.86	331	0.4	34.9	4.52		0.50	173		272								
	10/95 and 9/96	CVSSD		8.9	7.6	556																	22.0	71.12	-9.7	-124	-17	7
	3-Feb-97	Genwal		8.9	7.6	556	306	62	37	7	1	341	<5	29	7			307		279		<5						
	30-Jun-03	Genwal		8.8	7.37	511	315.0	67.5	35.0	6.74	1.39	340.0	<5	35	4		1.0	313.0	17.0	279		6						
Streams																												
Little Bear Canyon Creek	6/25/1970	CVSSD	126																									
	9-Jul-70	CVSSD	126																									
	24-Aug-70	CVSSD	36																									
	6-Oct-70	CVSSD	40																									
	15-Apr-71	CVSSD	27																									
	27-May-71	CVSSD	90																									
	13-Oct-78	USGS, 1981	108																									
	30-Oct-79	USGS, 1981	108																									
	30-Sep-98	Genwal	49	8.4	8.4	560																						
	2-Nov-98	Genwal	73.2	3.9	8.0	470																						
	30-Jun-03	Genwal	dry																									
	24-Aug-03	Genwal	dry																									
Section 4 Creek	30-Jun-03	Genwal	dry																									
	25-Aug-03	Genwal	dry																									
Section 5 Creek	30-Jun-03	Genwal	0.97	14.7	8.42	462	293	47.7	35.9	6.8	1.61	254	<5	59	5	7.82	1.7	267	<5	215	<2	<5						
	25-Aug-03	Genwal	1.07	10.6	8.12	510	322	47.3	39.9	6.99	1.6	273	<5	57	5	7.04	3.1	282	<5	230	<2	24						
Sec 5. U. Right Creek	30-Jun-03	Genwal	0.233	11.0	8.25	521										6.83	12.1											
	25-Aug-03	Genwal	0.210	13.6	8.40	585										7.09	17.2											
Sec 5 U. Left Creek	30-Jun-03	Genwal	1.55	10.0	8.40	428										7.61	3.1											
	25-Aug-03	Genwal	1.21	10.2	8.28	435										7.55	9.0											
IBC-1	30-Sep-98	Genwal	7.1	7.7	8.3	480	390	49	42	6	2	333	28	50	6													
	2-Nov-98	Genwal	8.93	2.5	8.3	420																						
	30-Jun-03	Genwal	3.26	8.0	8.19	481	330	55.0	39.2	6.61	1.47	299	<5	55	4	8.36	1.2	299	18	249	<2	<5						
	25-Aug-03	Genwal	0.405	9.3	7.89	599	382	63.0	47.2	7.37	1.85	353	<5	61	4	7.85	3.1	352	<5	289	<2	<5						

Table 2 South Crandall Lease baseline monitoring summary

Petersen Hydrologic 14 Sep 03

	Date	Data source	Flow (gpm)	T (C°)	pH (s.u.)	Cond. (µS/cm)	TDS (mg/l)	Nutrients NH_4 (mg/l N)	NO_3^- (mg/l N)	NO_2^{2-} (mg/l N)	PO_4 (mg/l P)	Trace Constituents Ag (mg/l)	Al (mg/l)	As (mg/l)	Ba (mg/l)	B (mg/l)	Cd (mg/l)	Cr (t) (mg/l)	Cr(VI) (mg/l)	Cu (mg/l)	Cn (mg/l)	F- (mg/l)	Fe(t) (mg/l)	Fe(d) (mg/l)	Hg (mg/l)	Mn (t) (mg/l)	Mn (d) (mg/l)	Mo (mg/l)	Ni (mg/l)	Pb (mg/l)	Se (mg/l)	Si (mg/l SI02)	Sr (mg/l)	Tl (mg/l)	Zn (mg/l)
Springs																																			
LB-1	1993	Genwal	1	6	7.95	478																													
(Castlegate Sandstone)	30-Jun-03	Genwal	dry																																
	24-Aug-03	Genwal	dry																																
LB-2	1993	Genwal	2	4	7.95	495																													
(Castlegate Sandstone)	1994	Genwal	5	7	8.12	375																													
	Jun 24-27,96	Genwal			7.78	415																													
	7-Aug-97	Genwal	10	4.9	8.10	312	290																<0.1	<0.1		<0.1									
	30-Jun-03	Genwal	2	5.4	7.93	487	307.0	<0.1	0.08	<0.03	<0.05		0.011	<0.005		0.017	<0.003			<0.01			<0.02	<0.005	<0.0002	<0.005	<0.005	<0.005		<0.005	0.014				<0.005
	24-Aug-03	Genwal	2.15	9.9	8.09	401	275	<0.1	<0.03	<0.03	<0.05		<0.010	<0.005		0.019	<0.003			<0.010			0.02	<0.005	<0.0002	<0.005	<0.005	<0.005		<0.005	0.017				<0.005
LB-5	1993	Genwal	1	7	7.73	425																													
(Blackhawk Formation)	30-Jun-03	Genwal	seep																																
	24-Aug-03	Genwal	dry																																
LB-5A	1993	Genwal	Seep	---	---	---																													
(Blackhawk Formation)	Jun 24-27,96	Genwal	15	7	7.98	436																													
	7-Aug-97	Genwal	7	8	8.10	535	480																<0.1	<0.1											
	30-Jun-03	Genwal	1.95	8.0	7.56	699	482.0	<0.1	0.3	<0.03	<0.05		<0.010	<0.005		0.023	<0.003			<0.010			0.033	<0.005	<0.0002	<0.005	<0.005	<0.005		<0.005	0.014				<0.005
	24-Aug-03	Genwal	2.01	8.9	8.02	682	477	0.3	0.3	<0.03	<0.05		<0.010	<0.005		0.015	<0.003			<0.010			0.102	<0.005	<0.0002	<0.005	<0.005	<0.005		<0.005	0.017				<0.005
LB-11	1981	Beaver Ck. Coal	5	9.9	8.1	559																													
(Star Point Sandstone)	30-Jun-03	Genwal	5																																
	24-Aug-03	Genwal	4.69	10.0	8.09	556																													
LB-13	1982	Beaver Ck. Coal	1.5		7.95	291																													
(Castlegate Sandstone)	30-Jun-03	Genwal	dry																																
	24-Aug-03	Genwal	dry																																
LB-14	25-Aug-80	Beaver Ck. Coal			7.6	520	370		0.03															0.136			0.032								
(Castlegate Sandstone)	22-Jul-81	Beaver Ck. Coal	1	20	8.3	620	405		0.33															0.22			0 03								
	1982	Beaver Ck. Coal	22		7.45	333																													
	30-Jun-03	Genwal	dry																																
	24-Aug-03	Genwal	dry																																
LB-15	1980	Beaver Ck. Coal			7.2	495																													
(Alluvium)	1981	Beaver Ck. Coal			7.65	548																													
	1982	Beaver Ck. Coal	300	16	7.56	491																													
	25-Aug-03	Genwal	0.1	18.2	7.44	1,441																													
LB-16	1980	Beaver Ck. Coal			7.4	500																													
(Star Point Sandstone)	1981	Beaver Ck. Coal			8.76	559																													
	1982	Beaver Ck. Coal	5		7.8	488																													
	30-Jun-03	Genwal	seep																																
	24-Aug-03	Genwal	seep																																
SP-73	Jun-85	Genwal	seep	---	---	---																													
(Blackhawk Formation)	Oct-85	Genwal	dry	---	---	---																													
	Jun-93	Genwal	10	5	8.26	417																													
	30-Jun-03	Genwal	dry	---	---	---																													
	25-Aug-03	Genwal	dry																																
SP-74																																			
(Blackhawk Formation)	Jun-85	Genwal	seep	---	---	---																													
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	Date	Data source	Flow (gpm)	T (C°)	pH (s.u.)	Cond. (µS/cm)	TDS (mg/l)	Nutrients NH_4 (mg/l N)	NO_3^- (mg/l N)	NO_2^{2-} (mg/l N)	PO_4 (mg/l P)	Trace Constituents Ag (mg/l)	Al (mg/l)	As (mg/l)	Ba (mg/l)	B (mg/l)	Cd (mg/l)	Cr (t) (mg/l)	Cr(VI) (mg/l)	Cu (mg/l)	Cn (mg/l)	F- (mg/l)	Fe(t) (mg/l)	Fe(d) (mg/l)	Hg (mg/l)	Mn (t) (mg/l)	Mn (d) (mg/l)	Mo (mg/l)	Ni (mg/l)	Pb (mg/l)	Se (mg/l)	Si (mg/l SI02)	Sr (mg/l)	Tl (mg/l)	Zn (mg/l)
	30-Jun-03	Genwal	dry	---	---	---																													
	25-Aug-03	Genwal	dry																																
SP-78	Jun-85	Genwal	seep	---	---	---																													
(Star Point Sandstone)	Oct-85	Genwal	dry	---	---	---																													
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	30-Jun-03	Genwal	seep	---	---	---																													
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Little Bear Spring	3-Oct-57	Utah Dept. of Health					305		0.16																										
(Star Point Sandstone)	25-Jun-70	CVSSD	399																			0.7	0.25									3.9			
(upper Little Bear Spring)	8/75 to 2/79 av.	USFS mean	449	5.8	8.9				0.185			0.0017		0.002	0.0236			0.0018		0.0051		0.15	0.0914		0.0002		0.017			0.0015	0.0023				0.0099
(upper Little Bear; 4-1-W)	16-Jul-76	Beaver Ck. Coal			9.3				0.180														0.003				0.002								
	18-Aug-76	USGS, 1981	121	8.3	7.6	530	332									0.03						0.1		0.04								5.6	0.26		
	18-Aug-76	USGS, 1981	117																																
	27-Apr-78	USGS, 1981	426																																
	29-Aug-78	USGS, 1981	292																																
(upper Little Bear; 4-1-W)	15-Sep-78	Beaver Ck. Coal	180		7.10	720	470		0.08														0.210												
	13-Oct-78	USGS, 1981	256																																
	8-Nov-78	USGS, 1981	188																																
	4-Nov-77	Utah dept of Health			7.7	492	315		0.09						0.04	0.08						0.12	0.17	0.05			0.002					6			0.005
(upper Little Bear; 4-1-W)	15-Jun-79	Beaver Ck. Coal			8.4				0.06														0.182				0.014								
(upper Little Bear; 4-1-W)	11-Oct-79	Beaver Ck. Coal			7.80		330		0.08														0.010				0.035								
(upper Little Bear; 4-1-W)	25-Aug-80	Beaver Ck. Coal			7.20	490	350		0.19														0.022				0.015								
(upper Little Bear; 4-1-W)	6-Nov-80	Beaver Ck. Coal			7.20	500	350		0.26														0.025				0.01								
(upper Little Bear; 4-1-W)	4-Jan-81	Beaver Ck. Coal			6.80	557	390		0.12														0.040												
(upper Little Bear; 4-1-W)	3-Feb-81	Beaver Ck. Coal			7.80	530	350		0.10														0.020				0.002								
(upper Little Bear; 4-1-W)	4-Mar-81	Beaver Ck. Coal			7.40	520	310		0.13																		0.01								
(upper Little Bear; 4-1-W)	9-Apr-81	Beaver Ck. Coal			8.40	580	380		0.13																										
	28-Apr-81	Utah dept of Health			8.0	535	308		0.15		0.20	0.002		0.001	0.06	0.05		0.005		0.01		0.12	0.03		0.0001		0.01		0.01	0.005	0.001	6			0.035
(upper Little Bear; 4-1-W)	13-May-81	Beaver Ck. Coal			7.9	540	350		0.19														0.02				0.01								
(upper Little Bear; 4-1-W)	11-Jun-81	Beaver Ck. Coal		10	7.7	530	345		0.15														0.01				0.001								
(upper Little Bear; 4-1-W)	10-Dec-81	Beaver Ck. Coal			7.6	560	375		0.27														0.01				0.015								
(upper Little Bear; 4-1-W)	14-Jan-82	Beaver Ck. Coal	265	7	7.2	500	325		0.19														0.001				0.011								
(upper Little Bear; 4-1-W)	17-Feb-82	Beaver Ck. Coal	269	10	7.8	450	286		0.01														0.03				0.001								
(upper Little Bear; 4-1-W)	Mar-82	Beaver Ck. Coal	265	8	7.4	400	260		0.09														0.02				0.01								
(upper Little Bear; 4-1-W)	22-Apr-82	Beaver Ck. Coal	305		7.5	590	390		0.16														0.12												
(upper Little Bear; 4-1-W)	26-May-82	Beaver Ck. Coal			7.6	520	350																0.05				0.005								
(upper Little Bear; 4-1-W)	23-Jun-82	Beaver Ck. Coal			7.7	560	367		0.14														0.09				0.005								
(upper Little Bear; 4-1-W)	21-Jul-82	Beaver Ck. Coal		16.0	1.7	415	276		0.18														0.10				0.007								
(upper Little Bear; 4-1-W)	24-Aug-87	Beaver Ck. Coal					315																	0.18			<0.02								
	18-Sep-90	CVSSD			7.20		236	<0.03	0.22	<0.02		<0.005		<0.001	0.080		<0.010	<0.010		<0.01		0.09	<0.03		<0.0003		<0.01			<0.002	<0.001				<0.01
	24-Nov-92	CVSSD			7.4	405	312	<0.05	0.34	<0.01	<0.10	<0.01		<0.002	0.061	<0.01	<0.004	<0.03	<0.005	<0.03	<0.050	<0.10	0.06	<0.03	<0.0005		<0.002		0.04	<0.001	<0.002	5.96		0.19	0.022
	10/95 and 9/96	CVSSD		8.9	7.6	556																	<0.1	<0.1		<0.1									
	3-Feb-97	Genwal		8.9	7.6	556	306																0.023	<0.005	<0.0002	<0.005	<0.005	<0.005		<0.005	0.017				<0.005
	30-Jun-03	Genwal		8.8	7.37	511	315.0	<0.1	0.015	<0.03	<0.05		0.012	<0.005		0.017	<0.003			<0.010																
Streams																																			
Little Bear Canyon Creek	6/25/1970	CVSSD	126																																
	9-Jul-70	CVSSD	126																																
	24-Aug-70	CVSSD	36																																
	6-Oct-70	CVSSD	40																																
	15-Apr-71	CVSSD	27																																
	27-May-71	CVSSD	90																																
	13-Oct-78	USGS, 1981	108																																
	30-Oct-79	USGS, 1981	108																																
	30-Sep-98	Genwal	49	8.4	8.4	560																													
	2-Nov-98	Genwal	73.2	3.9	8.0	470																													
	30-Jun-03	Genwal	dry																																
	24-Aug-03	Genwal	dry																																
Section 4 Creek	30-Jun-03	Genwal	dry																																
	25-Aug-03	Genwal	dry																																
Section 5 Creek	30-Jun-03	Genwal	0.97	14.7	8.42	462	293	<0.1	<0.03	<0.03	<0.05		0.015	<0.005		0.038	<0.003			<0.010			0.021	<0.005	<0.0002	<0.005	<0.005	<0.005		<0.005	0.014				<0.005
	25-Aug-03	Genwal	1.07	10.6	8.12	510	322	0.1	<0.03	<0.03	<0.05		<0.010	<0.005		0.028	<0.003			<0.010			0.096	<0.005	<0.0002	<0.005	<0.005	<0.005		<0.005	0.013				<0.005
Sec 5. U. Right Creek	30-Jun-03	Genwal	0.233	11.0	8.25	521																													
	25-Aug-03	Genwal	0.210	13.6	8.40	585																													
Sec 5 U. Left Creek	30-Jun-03	Genwal	1.55	10.0	8.40	428																													
	25-Aug-03	Genwal	1.21	10.2	8.28	435																													

	Date	Data source	Flow (gpm)	T (C°)	pH (s.u.)	Cond. (µS/cm)	TDS (mg/l)	Nutrients NH_4 (mg/l N)	NO_3^- (mg/l N)	NO_2^{2-} (mg/l N)	PO_4 (mg/l P)	Trace Constituents Ag (mg/l)	Al (mg/l)	As (mg/l)	Ba (mg/l)	B (mg/l)	Cd (mg/l)	Cr (t) (mg/l)	Cr(VI) (mg/l)	Cu (mg/l)	Cn (mg/l)	F- (mg/l)	Fe(t) (mg/l)	Fe(d) (mg/l)	Hg (mg/l)	Mn (t) (mg/l)	Mn (d) (mg/l)	Mo (mg/l)	Ni (mg/l)	Pb (mg/l)	Se (mg/l)	Si (mg/l SI02)	Sr (mg/l)	Tl (mg/l)	Zn (mg/l)
IBC-1	30-Sep-98	Genwal	7.1	7.7	8.3	480	390																0.1			<0.1									
	2-Nov-98	Genwal	8.93	2.5	8.3	420																													
	30-Jun-03	Genwal	3.26	8.0	8.19	481	330	<0.1	<0.03	<0.03	<0.05		<0.010	<0.005		0.030	<0.003			<0.010			<0.02	<0.005	<0.0002	<0.005	<0.005	<0.005		<0.005	0.017				<0.005
	25-Aug-03	Genwal	0.405	9.3	7.89	599	382	0.1	<0.03	<0.03	<0.05		<0.010	<0.005		0.040	<0.003			<0.010			<0.02	0.009	<0.0002	<0.005	<0.005	<0.005		<0.005	0.019				<0.005

Table 3 Little Bear Spring average monthly flow data from Castle Valley Special Service District 1982-2003.

Month	Flow (gpm)	Month	Flow (gpm)	Month	Flow (gpm)	Month	Flow (gpm)	Month	Flow (gpm)	Month	Flow (gpm)
Jan/1982	296	Jan/1986	326	Jan/1990	308	Jan/1994	286	Jan/1998	335	Jan/2002	287
Feb/1982	291	Feb/1986	319	Feb/1990	302	Feb/1994	275	Feb/1998	325	Feb/2002	279
Mar/1982	286	Mar/1986	317	Mar/1990	295	Mar/1994	262	Mar/1998	316	Mar/2002	274
Apr/1982	283	Apr/1986	304	Apr/1990	282	Apr/1994	268	Apr/1998	309	Apr/2002	263
May/1982	321	May/1986	380	May/1990	278	May/1994	231	May/1998	364	May/2002	257
Jun/1982	435	Jun/1986	400	Jun/1990	271	Jun/1994	229	Jun/1998	484	Jun/2002	250
Jul/1982	438	Jul/1986	383	Jul/1990	270	Jul/1994	218	Jul/1998	477	Jul/2002	240
Aug/1982	409	Aug/1986	356	Aug/1990	275	Aug/1994	218	Aug/1998	443	Aug/2002	232
Sep/1982	356	Sep/1986	339	Sep/1990	280	Sep/1994	223	Sep/1998	415	Sep/2002	237
Oct/1982	337	Oct/1986	331	Oct/1990	277	Oct/1994	218	Oct/1998	410	Oct/2002	234
Nov/1982	330	Nov/1986	330	Nov/1990	272	Nov/1994	219	Nov/1998	385	Nov/2002	228
Dec/1982	325	Dec/1986	331	Dec/1990	265	Dec/1994	212	Dec/1998	372	Dec/2002	231
Jan/1983	320	Jan/1987	326	Jan/1991	257	Jan/1995	208	Jan/1999	354	Jan/2003	227
Feb/1983	316	Feb/1987	322	Feb/1991	249	Feb/1995	204	Feb/1999	342	Feb/2003	195
Mar/1983	315	Mar/1987	321	Mar/1991	241	Mar/1995	199	Mar/1999	334	Mar/2003	217
Apr/1983	311	Apr/1987	315	Apr/1991	229	Apr/1995	198	Apr/1999	326	Apr/2003	214
May/1983	325	May/1987	320	May/1991	225	May/1995	209	May/1999	326	May/2003	210
Jun/1983	424	Jun/1987	380	Jun/1991	236	Jun/1995	282	Jun/1999	407	Jun/2003	255
Jul/1983	430	Jul/1987	388	Jul/1991	296	Jul/1995	418	Jul/1999	428	Jul/2003	284
Aug/1983	395	Aug/1987	364	Aug/1991	302	Aug/1995	436	Aug/1999	407	Aug/2003	271
Sep/1983	358	Sep/1987	345	Sep/1991	302	Sep/1995	402	Sep/1999	390		
Oct/1983	339	Oct/1987	345	Oct/1991	298	Oct/1995	371	Oct/1999	375		
Nov/1983	330	Nov/1987	328	Nov/1991	291	Nov/1995	345	Nov/1999	360		
Dec/1983	326	Dec/1987	321	Dec/1991	281	Dec/1995	328	Dec/1999	335		
Jan/1984	325	Jan/1988	313	Jan/1992	270	Jan/1996	315	Jan/2000	324		
Feb/1984	326	Feb/1988	311	Feb/1992	260	Feb/1996	304	Feb/2000	324		
Mar/1984	322	Mar/1988	309	Mar/1992	251	Mar/1996	292	Mar/2000	317		
Apr/1984	324	Apr/1988	304	Apr/1992	229	Apr/1996	285	Apr/2000	309		
May/1984	368	May/1988	308	May/1992	Broken pipe	May/1996	312	May/2000	298		
Jun/1984	423	Jun/1988	327	Jun/1992	Broken pipe	Jun/1996	427	Jun/2000	368		
Jul/1984	409	Jul/1988	340	Jul/1992	243	Jul/1996	443	Jul/2000	395		
Aug/1984	377	Aug/1988	327	Aug/1992	252	Aug/1996	412	Aug/2000	371		
Sep/1984	352	Sep/1988	345	Sep/1992	247	Sep/1996	378	Sep/2000	347		
Oct/1984	340	Oct/1988	366	Oct/1992	252	Oct/1996	356	Oct/2000	334		
Nov/1984	335	Nov/1988	366	Nov/1992	246	Nov/1996	318	Nov/2000	323		
Dec/1984	332	Dec/1988	307	Dec/1992	237	Dec/1996	323	Dec/2000	312		
Jan/1985	332	Jan/1989	256	Jan/1993	230	Jan/1997	314	Jan/2001	293		
Feb/1985	329	Feb/1989	356	Feb/1993	223	Feb/1997	293	Feb/2001	295		
Mar/1985	324	Mar/1989	363	Mar/1993	218	Mar/1997	291	Mar/2001	286		
Apr/1985	227	Apr/1989	363	Apr/1993	216	Apr/1997	286	Apr/2001	282		
May/1985	379	May/1989	341	May/1993	225	May/1997	321	May/2001	280		
Jun/1985	379	Jun/1989	333	Jun/1993	354	Jun/1997	444	Jun/2001	367		
Jul/1985	357	Jul/1989	332	Jul/1993	419	Jul/1997	447	Jul/2001	373		
Aug/1985	341	Aug/1989	330	Aug/1993	379	Aug/1997	421	Aug/2001	379		
Sep/1985	331	Sep/1989	340	Sep/1993	346	Sep/1997	398	Sep/2001	289		
Oct/1985	332	Oct/1989	334	Oct/1993	278	Oct/1997	388	Oct/2001	314		
Nov/1985	327	Nov/1989	326	Nov/1993	309	Nov/1997	344	Nov/2001	304		
Dec/1985	322	Dec/1989	319	Dec/1993	300	Dec/1997	350	Dec/2001	296		

Table 4 Little Bear Spring flow data 1970-1981

Date	Flow (cfs)	Flow (gpm)	Source
25-Jun-70	0.89	399	CVSSD
9-Jul-70	0.88	395	CVSSD
24-Aug-70	0.61	274	CVSSD
6-Oct-70	0.5	224	CVSSD
15-Apr-71	0.65	292	CVSSD
27-May-71	0.52	233	CVSSD
18-Aug-76	0.26	117	USGS
27-Apr-78	0.95	426	USGS
29-Aug-78	0.65	292	USGS
13-Oct-78	0.57	256	USGS
8-Nov-78	0.42	188	USGS

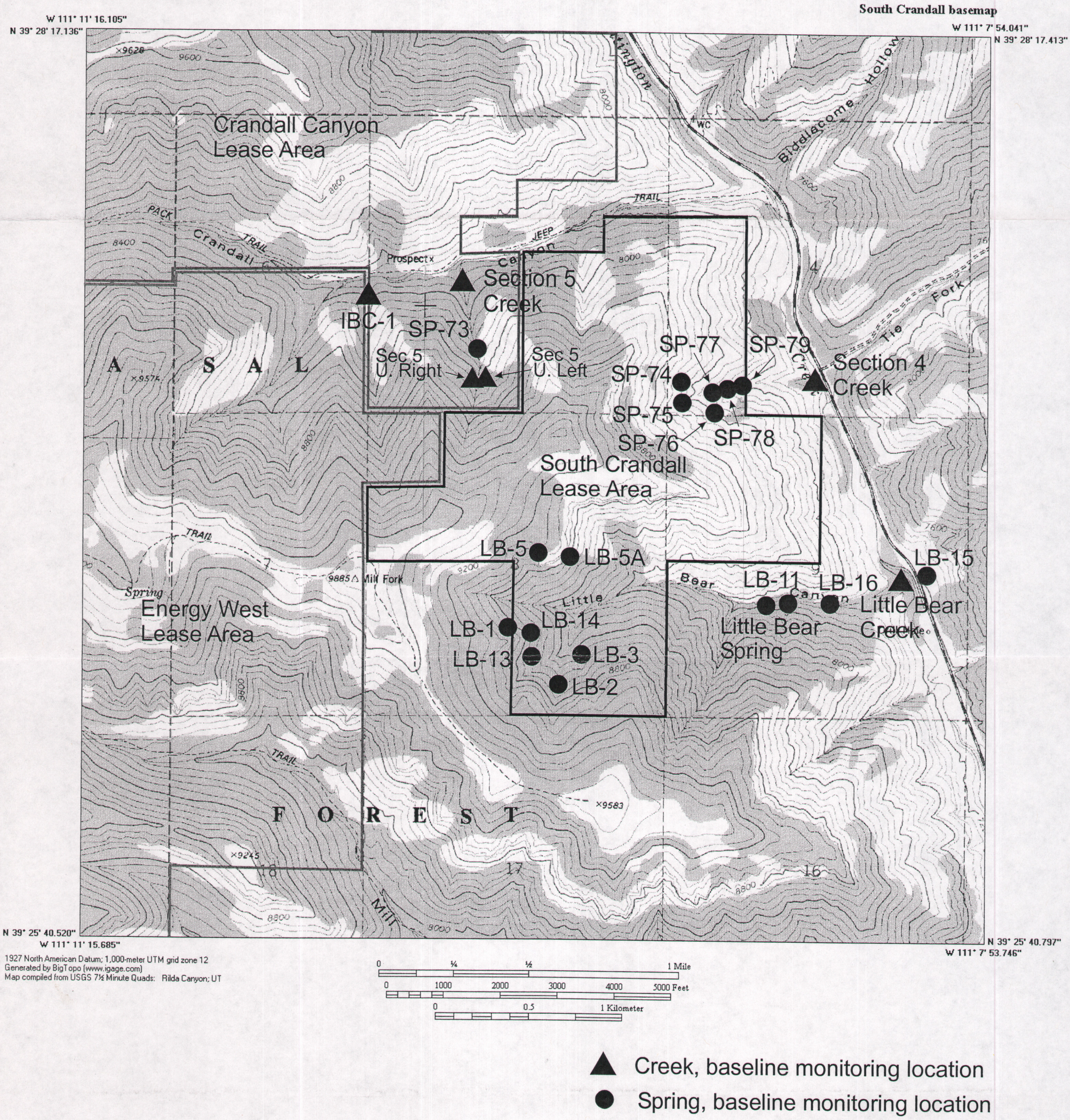
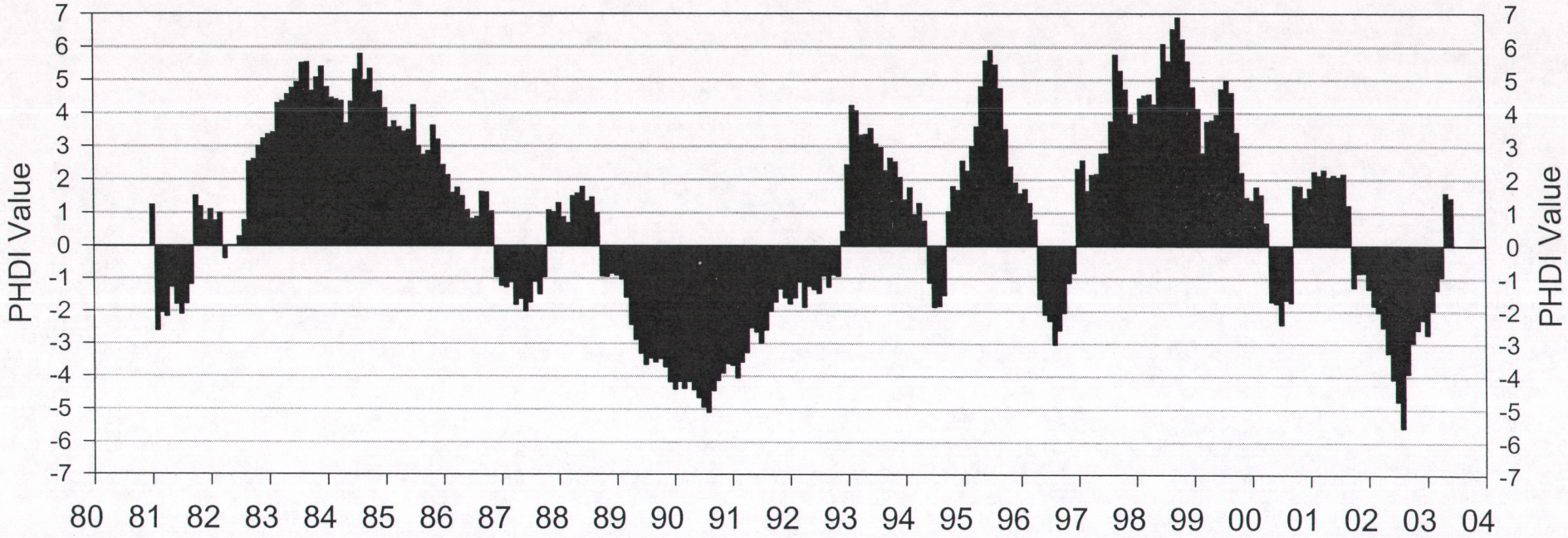


Figure 1 South Crandall Lease baseline monitoring locations



-1 to -2	Mild Drought	1 to 2	Mild Wet Spell
-2 to -3	Moderate Drought	2 to 3	Moderate Wet Spell
-3 to -4	Severe Drought	3 to 4	Severe Wet Spell
-4 to -5	Extreme Drought	4 to 5	Extreme Wet Spell

Figure 2 Plot of Palmer Hydrologic Drought Index for Utah Region 4.