TEMPERATURE PROFILES OF WATER MONITORING WELLS IN SNAKE VALLEY, TULE VALLEY, AND FISH SPRINGS FLAT, MILLARD AND JUAB COUNTIES, UTAH

by Robert E. Blackett

OPEN-FILE REPORT 578
UTAH GEOLOGICAL SURVEY
a division of
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Cover photo: A sinkhole developed in Paleozoic carbonate rocks along the west flank of the Confusion Range, Millard County, Utah.

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CONTENTS

ABSTRACT 1
INTRODUCTION 1
GEOLOGY AND GEOHYDROLOGY 1
Regional Setting 1
Paleozoic Carbonate Aquifer 3
Quaternary-Tertiary Basin-Fill Aquifer 3
GROUND-WATER MONITORING WELLS 3
Well Drilling Summary 3
Temperature Profiles 3
UGS PW01C – Garrison 6
UGS PW02B – Burbank 6
UGS PW03B – NE Garrison 6
UGS PW04B – N Hamblin Valley 9
UGS PW05C – SW Eskdale 9
UGS PW06D – NE Eskdale 10
UGS PW07B – NW Ferguson Valley 10
UGS PW08B – Mormon Gap 10
UGS PW09B – E Eskdale 10
UGS PW10A – E Cowboy Pass 10
UGS PW11E – The Cove 10
UGS PW12A – Little Valley 10
UGS AG13C – Garrison Ag 11
UGS AG14C – Eskdale 11
UGS AG15A – GPR Ag 11
UGS AG16C – Davies Ranch 11
UGS PW17C – Coyote Knolls 11
UGS PW18 – NW Middle Range 11
UGS PW19C – Table Knoll 11
UGS PW20A – Sand Pass 12
UGS SG21C – Fish Springs North 12
UGS SG24C – Twin Springs 12
UGS SG25C – Leland Harris Springs North 12
SUMMARY 12
ACKNOWLEDGMENTS 12
REFERENCES 13
APPENDIX A A-1

FIGURES

Figure 1. Location of monitoring wells, Snake Valley ground-water monitoring project 2
Figure 2. Generalized stratigraphic column for west-central Utah 7
Figure 3. Comparison of temperature profiles of deep (> 100 m) ground-water monitoring wells, Snake Valley Project 8
Figure 4. Comparison of temperature profiles of shallow (< 100 m) ground-water monitoring wells, Snake Valley Project 9

TABLES

Table 1. Summary of wells used for temperature-depth profiles, Snake Valley ground-water monitoring project 4
Table 2. Summary temperature-depth profiles, Snake Valley ground-water monitoring project 6

TEMPERATURE PROFILES OF WATER MONITORING WELLS IN SNAKE VALLEY, TULE VALLEY, AND FISH SPRINGS FLAT, MILLARD AND JUAB COUNTIES, UTAH

ABSTRACT

The Utah Geological Survey (UGS) established a network of 68 ground-water monitoring wells at 27 sites in several western Utah valleys primarily in Millard and Juab Counties from 2007 through 2009. In support of the UGS Snake Valley ground-water monitoring project, temperature logs were acquired from 23 of these monitoring wells using high-precision temperature logging gear. Wells were completed in a variety of geologic formations to test ground-water conditions within a Tertiary-Quaternary basin-fill aquifer and a deep carbonate-rock aquifer consisting mainly of fractured Paleozoic limestone and dolomite units. Well depths ranged from 67 ft (20 m) at Fish Springs to 1840 ft (561 m) near the community of Garrison. Maximum temperatures (bottom-hole temperatures, or BHTs) ranged from about 53°F (12°C) in a shallow, 180-ft (55 m) well completed in valley-fill deposits near Needle Point Spring on the south end of Snake Valley, to 117°F (47°C) measured in a 1000-ft (305 m) deep well on the northwest side of the Middle Range (Juab County), which was completed in the Devonian Guillmette Formation. Variations in thermal gradients are summarized in individual well descriptions and temperature-depth plots. Thermal gradients range from near zero (isothermal conditions) in well UGS PW03B (near Garrison) to a high of 6.72°F/100 ft (122.5°C/km) in well UGS PW18 (NW Middle Range).

INTRODUCTION

In 2007 the Utah State Legislature funded the UGS to establish a ground-water monitoring-well network in several of Utah's west desert valleys. The Snake Valley Ground-Water Monitoring Well Project was established in response to proposed water-development projects in east-central Nevada that could affect ground water resources in west-central Utah (Utah Geological Survey, 2010). Objectives of the Snake Valley Ground-Water Monitoring Well Project are to improve the understanding of the ground-water flow systems and resources, characterize baseline ground-water levels and chemistry, and measure future changes in these parameters.

The Snake Valley Ground-Water Monitoring Well Project is located in west-central Utah and east-central Nevada. Kirby and Hurlow (2005) describe the study region as a north-south trending hydrologic basin straddling the Nevada-Utah state line for 135 miles (217 km) in the east-central part of the Great Basin. Situated within the Basin and Range Province (BRP), Snake Valley is bounded by several north-south trending mountain ranges including the Snake Range and Deep Creek Range on the west, and the Confusion Range, Burbank Hills, and Mountain Home Range to the east-southeast. Snake Valley also extends northeastward, merging with the Great Salt Lake Desert and is bounded on the northeast by the Middle Range and the Fish Springs Range. Several monitoring wells were also installed northeast of Snake Valley in Tule Valley and Fish Springs Flat (figure 1).

The first phase of monitor-well drilling occurred from early July to early December 2007. The second phase occurred from late March to late May 2008. The third phase commenced in early June and ended in December 2008. The final phase of drilling ended in April of 2009. Standard geophysical logs were recorded from each well site, and lithologic descriptions were prepared from cutting samples. Monitoring wells were installed at 27 sites and included 51 boreholes with a total of 68 piezometers screened to test the various water-bearing units. This report summarizes down-hole temperature measurements recorded in 23 of these wells during the summer of 2008 and spring of 2009.

GEOLOGY AND GEOHYDROLOGY

Regional Setting

Kirby and Hurlow (2005) described geologic units of the Snake Valley study area and surrounding region. Their descriptions are paraphrased in the following paragraphs and illustrated on figure 2. Bedrock units primarily consist of Neoproterozoic to early Mesozoic strata up to 33,000 feet (10,058 m) thick (Gans and Miller, 1983). Paleozoic-age shelf carbonates dominate the middle and upper part of the sequence, while quartzites and clastic rocks of Early Cambrian and Proterozoic age dominate the lower part of the section.

Contractional deformation of these rocks began in the Late Jurassic and continued through the early Tertiary as east-directed thrust faults and north-south trending folds of the Sevier fold and thrust belt. Lower and mid-crustal metamorphism occurred during the emplacement of plutons during the Mesozoic and early Cenozoic in the northern and southern Snake Range (Gans and Miller, 1983; McGrew, 1993; Miller and others, 1999).

Extension, widespread volcanism, and crustal thinning began

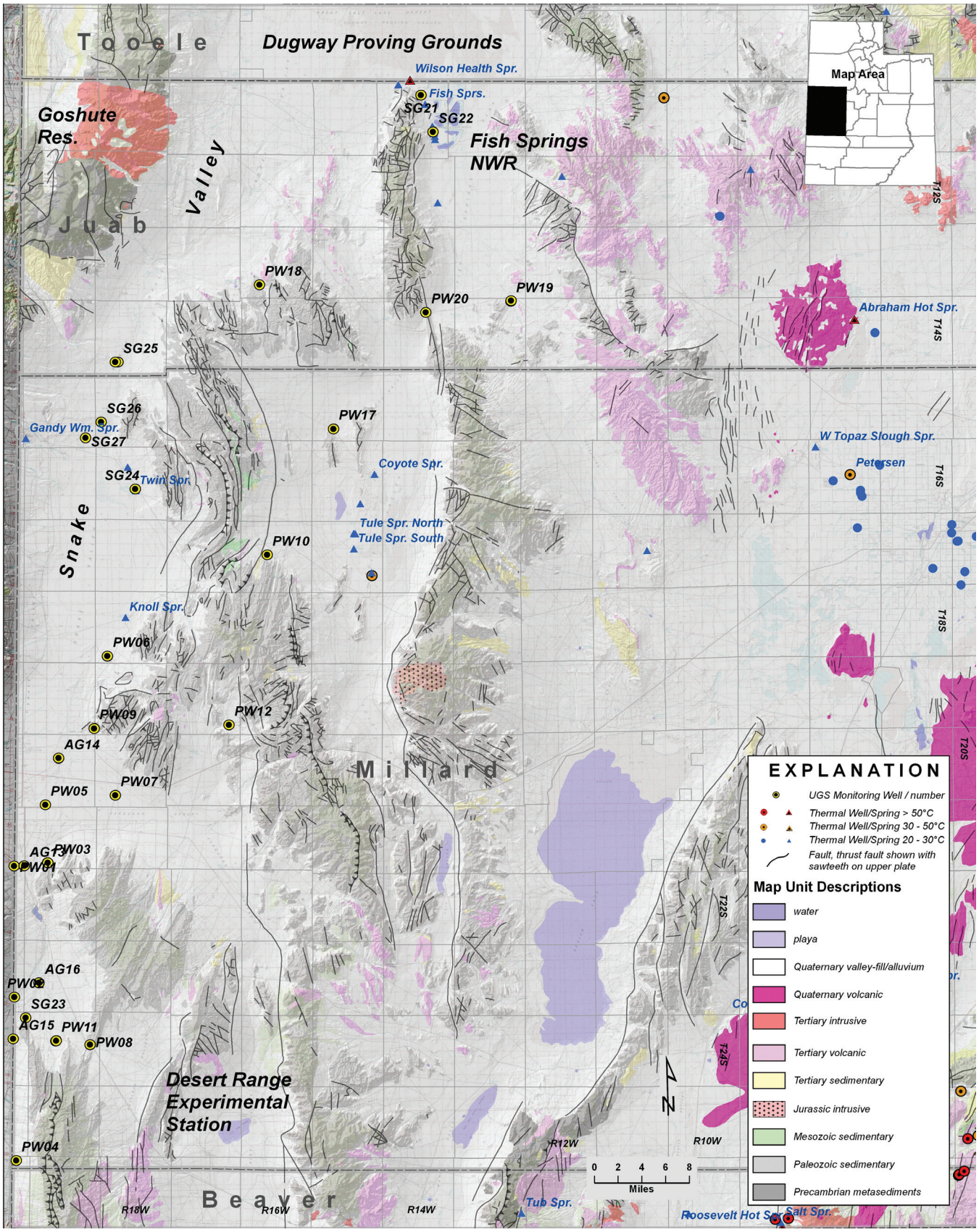

Figure 1. *Location of monitoring wells, Snake Valley ground-water monitoring project (geology from Hintze and others, 2000).*

during the latest Eocene and early Oligocene (Axen and others, 1993; Miller and others, 1999). Crustal thinning was accommodated along the Snake Range decollement (SRD), a regional, shallow east-dipping fault (low-angle detachment), imaged in the subsurface with estimated extension between 5 and 15 miles (8 and 24 km) east-southeastward across the southern Snake Range and adjacent Snake Valley (Allmendinger and others, 1983; Gans and Miller, 1983; Bartley and Wernicke, 1984; Shah Alam, 1990; McGrew, 1993). Footwall rocks (of the SRD) were thinned and metamorphosed to greenschist facies during extension (Miller and others, 1983; McGrew, 1993). A later period of extension involving slip on both the low-angle SRD and other high-angle faults to the north and south occurred in the Miocene; volcanic rocks and clastic basin fill were deposited and regional doming of the Snake Range occurred (Miller and others, 1999). Various aspects of the SRD have received much debate (Gans and Miller, 1983; Bartley and Wernicke, 1984).

Welch and others (2007) described the ground-water resources of the region as contained in three general categories of aquifers—shallow basin-fill aquifers, a deeper volcanic-rock aquifer, and an underlying carbonate-rock aquifer that forms the base of the regional ground-water flow system. Two aquifers in the Snake Valley hydrologic basin are important relative to this project. They include the regionally extensive carbonate aquifer, and the overlying basin-fill aquifer (Gates, 1987; Plume, 1996; Harrill and Prudic, 1998). Locally important aquifers may exist in the Early Cambrian and upper Proterozoic clastic parts of the section. Important aquitards include the Mesozoic to Tertiary-aged igneous and metamorphic rocks of the lower plate of the SRD (Plume, 1996).

Paleozoic Carbonate Aquifer

The Paleozoic shelf carbonate rocks throughout the region form an important aquifer underlying much of the eastern and southern parts of the Great Basin, referred to as the "Great Basin Carbonate-Rock Aquifer System." Permeability in the carbonate-rock aquifer is dominated by secondary dissolution along joints, fractures, and faults. Kirby and Hurlow (2005) cited data from oil and gas well drill-stem tests indicating a wide variance in horizontal hydraulic conductivity, likely representing fluid flow in highly fractured carbonate rocks versus unfractured rocks. They also assume that vertical hydraulic conductivity is equal to or less than horizontal hydraulic conductivity, depending on lithology, bedding, and fracture relationships.

Quaternary-Tertiary Basin-Fill Aquifer

Most ground water is developed from the basin-fill aquifers that, in the Snake Valley study area, comprise mostly clastic, fine-grained deposits derived from the surrounding mountain ranges. Total thickness of basin fill modeled from gravity and well data ranges between 0 and 2.4 miles (0–3.8 km) (Kirby and Hurlow, 2005). Seismic and gravity data, and well data show asymmetric basins with basin-fill deposits generally thickening westward toward the Snake Range (Almendinger and others, 1983; Shah Alam, 1990; McGrew, 1993). Basin-fill geometry is irregular north to south, defining several distinct pockets of thick basin fill. Primary permeability in the basin-fill aquifer is due to connected voids of the aquifer matrix (matrix permeability).

GROUND-WATER MONITORING WELLS

Well Drilling Summary

Monitor-well drilling was conducted in four phases beginning in December 2007, ending in April 2009. Fifty-one boreholes with 68 piezometers were installed at 27 well sites (figure 1, table 1). (A piezometer is a 1.0-inch [2.5 cm], 2.0-inch [5.1 cm], or 2.5-inch- [6.4 cm] diameter PVC pipe, slotted and therefore open to the aquifer over a limited depth range, but isolated from the rest of the aquifer by cement or "bentonite" grout.) Pressure transducers were installed in most of the wells to monitor long-term water levels. The U.S. Geological Survey's (USGS) Western Region Research Drilling Program (RDP) and Central Region RDP drilled the majority of the wells using mud rotary and direct-air techniques. "Geoprobe" and auger drilling methods were used by the USGS Central Region RDP at some shallow well sites near areas of ground-water discharge or "upwelling." Several wells installed near agricultural areas were drilled by a private contractor (Hurlow and Kirby, 2007). Data from these wells, along with other project information, can be accessed through an Internet website at http://geology.utah.gov/esp/snake_valley_project/index.htm. A general summary of well drilling and completion is shown in table 1.

Temperature Profiles

Temperature-depth profiles were recorded at 23 monitor-well sites throughout the Snake Valley project area using a high-precision thermistor probe and temperature logging equipment. The equipment consists of a thermistor probe linked to four-conductor cable on a cable reel with electrical connection to a volt-ohm meter. Probe resistance is read from the volt-ohm meter, manually recorded and converted to temperature using a probe-specific, polynomial expression determined by the manufacturer (Natural Progression Instruments, Olympia, Washington). Instrument characteristics and periodic calibrations result in a temperature measurement precision of 0.02°F (0.01°C). Temperatures were recorded at 23 monitoring well sites with a total of 15,519 ft (4730 m) of borehole length recorded. Bottom-hole temperatures ranged from 54.5 to 117°F (12.5 to 47°C) in boreholes ranging from 67 to 1840 ft (20 to 561 m) deep (table 2). The monitoring wells were completed in various geologic units ranging in age from Quaternary to Cambrian (table 2 and figure 2).

Temperature readings made above water levels (in air) require longer periods to reach equilibrium than those readings made

Table 1. *Summary of wells used for temperature-depth profiles, Snake Valley ground-water monitoring project.*

Map ID	Site Name	Borehole Name	Tsp, Rng, Sec	Longitude	Latitude	Completion Date	Borehole Diameter	Borehole Depth (ft)	Piezometer Name	Piezometer Depth (ft)	Screened Unit	Water Depth (ft)	Temp. Log
PW01	Garrison	UGS PW01ABC	T21S R20W 36	-114.04920	38.94121	21-Aug-07	11.0" to 340'	1840	UGS PW01A	260	QTs	97.38	
							7.88" 340-950'		UGS PW01B	965	QTs	98.19	
							6.0" to 1840'		UGS PW01C	1617	QTs	123.97	X
PW02	Burbank	UGS PW02AB	T23S R20W 25	-114.04747	38.78089	11-Oct-08	18" to 40'	998	UGS PW02A	425	Pa	33.32	
							12.25" to 394'		UGS PW02B	635	Pa	29.66	X
							6.0" to 620'						
							5.675 to 998'						
PW03	NE of Garrison	UGS PW03AB	T21S R19W 32	-113.99622	38.94546	9-Sep-07	12.25" to 8'	968	UGS PW03A	320	Dg	198.86	
							8.0" to 528'		UGS PW03B	860	Ds	194.39	X
							7.5" to 968'						
		UGS PW03Z	T21S R19W 32	-113.99664	38.94576	9-Aug-08	6.0" to 220'	220	UGS PW03Z	220	Dg	172.21	
		UGS PW03P	T21S R19W 32	-113.99664	38.94576	12-Sep-08	12" casing to 296'	845	UGS PW03P	845	Dg, Ds	181.2	
							12" to 845'						
PW04	N. Hamblin Valley	UGS PW04AB	T26S R20W 02	-114.04273	38.58115	30-Aug-07	11.0" to 118'	983	UGS PW04A	750	Tv	593.57	
							7.88" 118-720'		UGS PW04B	915	Tv	593.29	X
							7.0" to 983'						
PW05	SW of Eskdale	UGS PW05ABC	T20S R19W 32	-114.00123	39.01632	19-Jul-07	11.0" to 840'	1000	UGS PW05A	158	QTs	53.19	
							8.75" to 1000'		UGS PW05B	650	QTs	42.48	
									UGS PW05C	880	QTs	35.4	X
PW06	NE of Eskdale	UGS PW06ABC	T18S R18W 32	-113.90526	39.19877	12-Sep-07	11.0" to 197'	390	UGS PW06A	170	QTs	108.2	
							8.75" to 390'		UGS PW06B	335	QTs	107.96	
									UGS PW06C	390	Pa	107.7	
		UGS PW06D	T18S R18W 32	-113.90527	39.19885	7-Oct-07	12.25" to 360'	553	UGS PW06D	553	Pa	108.57	X
							5.5" to 553						
PW07	NW Ferguson Valley	UGS PW07A	T20S R18W 32	-113.89175	39.02857	31-Jul-07	11.0" to 20'	580	UGS PW07A	570	QTs	45.94	
							6.5" to 580'						
		UGS PW07B	T20S R18W 32	-113.89177	39.02858	5-Aug-07	11.0" to 1060'	1400	UGS PW07B	1285	QTs	47.95	X
							8.5" to 1400'						
PW08	Mormon Gap	UGS PW8A	T24S R19W 13	-113.92886	38.72331	31-Jul-08	6.0" to 160'	160	UGS PW8A	160	PIPMe	99.21	
		UGS PW8B	T24S R19W 13	-113.92884	38.72346	7-Aug-08	6.0" to 400'	400	UGS PW8B	400	PIPMe	98.84	X
PW09	East of Eskdale	UGS PW09A	T19S R19W 36	-113.92557	39.11032	30-Nov-07	11.0" to 20'	265	UGS PW09A	265	SI	175.94	
							6.0" to 265'						
		UGS PW09B	T19S R19W 36	-113.92541	39.11027	30-Nov-07	11.0" to 20'	880	UGS PW09B	720	SI	175.94	X
							6.0" to 880'						
PW10	E. of Cowboy Pass	UGS PW10AB	T17S R16W 16	-113.65508	39.32380	22-May-08	11.0" to 303'	748	UGS PW10A	669	PIPMe	542.81	X
							6.0" to 748'		UGS PW10B	738	PIPMe	521.1	
PW11	The Cove	UGS PW11A	T24S R19W 16	-113.98217	38.72778	4-Apr-08	7.0" to 255'	255	UGS PW11A	255	QTs	216.69	
		UGS PW11BC	T24S R19W 16	-113.98240	38.72773	15-Apr-08	11.0" to 470'	540	UGS PW11B	455	QTs	215.52	
							8.0" to 540'		UGS PW11C	539	PIPMe	214.92	
		UGS PW11DE	T24S R19W 16	-113.98176	38.72831	23-May-08	12.25" to 475'	1263	UGS PW11D	740	PIPMe	210.31	
							6.0" to 1263'		UGS PW11E	1159	PIPMe	210.31	X
		NPA-1B	T24S R19W 16	-113.98161	38.72792	6-May-08	10.0" to 520'	1340	NPA-1B	1340	PIPMe	216.67	X
							12.25" to 1340'						
PW12	Little Valley	UGS PW12A	T19S R17W 36	-113.71404	39.11545	20-May-08	11.0" to 20'	1645	UGS PW12A	1633	Dg	1428.56	X
							6.0" to 1645						

Table 1. *continued*

Map ID	Site Name	Borehole Name	Tsp, Rng, Sec	Longitude	Latitude	Completion Date	Borehole Diameter	Borehole Depth (ft)	Piezometer Name	Piezometer Depth (ft)	Screened Unit*	Water Depth (ft)	Temp. Log
AG13	Garrison Ag	UGS AG13BC	T21S R20W 36	-114.03377	38.94756	26-Jun-08	8.5" to 180'	320	UGS AG13B	158	QTs	72.3	
							6.0" to 320'		UGS AG13C	305		73.35	X
AG14	Eskdale Ag	UGS AG14A	T20S R19W 16	-113.98102	39.07357	14-Jun-08	6.0" to 65'	65	UGS AG14A	65	QTs	28.33	
		UGS AG14BC	T20S R19W 16	-113.98093	39.07379	18-Jun-08	8.5" to 180'	317	UGS AG14B	140	QTs	26.68	
							6.5" to 317'		UGS AG14C	280		20.59	X
AG15	GPR Ag	UGS AG15A	T24S R20W 14	-114.04902	38.72977	25-Jul-08	6.5" to 180'	180	UGS AG15A	179	QTs	82.16	X
AG16	Davies Ranch Ag	UGS AG16A	T23S R19W 20	-114.00929	38.79862	27-Jun-08	6.0" to 80'	80	UGS AG16A	60	QTs	20.64	
		UGS AG16BC	T23S R19W 20	-114.00935	38.79874	11-Jul-08	8.5" to 180'	317	UGS AG16B	100	QTs	19.9	
							6.5" to 317'		UGS AG16C	315		15.35	X
PW17	Coyote Knolls	UGS PW17A	T15S R15W 32	-113.55109	39.47797	12-Oct-08	11" to 16'	183	UGS PW17A	180	SI	84.52	
							6" to183'						
		UGS PW17BC	T15S R15W 32	-113.55101	39.47793	9-Oct-08	11" to 10'	590	UGS PW17B	245	Oes	83.97	
							6" to 590'		UGS PW17C	580		84.2	X
PW18	NW Middle Range	UGS PW18A	T13S R16W 32	-113.66857	39.65385	12-Nov-08	11" to 16'	1003	UGS PW18A	990	Dg	757.1	X
							6" to 1003'						
PW19	Table Knoll	UGS PW19AC	T14S R13W 02	-113.27123	39.63427	6-Nov-08	12" to 35'	460	UGS PW19A	280	Co	198.01	
							7.75" to 460'		UGS PW19C	460	Co	198.14	X
		UGS PW19B	T14S R13W 02	-113.27096	39.63489	6-Oct-08	10" to 32'	523	UGS PW19B	405	Co	195.33	
							5.88" to 523'						
PW20	Sand Pass	UGS PW20A	T14S R14W 10	-113.40560	39.62065	20-Oct-08	12.25" to 124'	760	UGS PW20A	565	Cpm	293.41	X
							5.88 to 668'						
							5.5 to 760'						
SG21	Fish Springs - North Spring	UGS SG21A	T11S R14W 03	-113.41334	39.38866	7-Dec-08	3.25" to 35'	35	UGS SG21A	24	QTs	7.79	
		UGS SG21B		-113.41339	39.88658	9-Dec-08	8.0" to 39'	39	UGS SG21B	38	QTs	7.67	
		UGS SG21C		-113.41337	39.88654	20-Apr-09	6" to 43'	67	UGS SG21C	66	SI?	3.87	X
							5.9" to 67'						
SG22	Fish Springs - Middle Spring	UGS SG22A	T11S R14W 23	-113.39445	39.84159	23-Oct-08	3.25" to 27'	27	UGS SG22A	24	QTs	5.52	
		UGS SG22B		-113.39455	39.84146	24-Oct-08	8.0" to 75'	75	UGS SG22B	61	QTs		
SG23	Needle Point Spring	UGS SG23B	T24S R20W 01	-114.02978	38.75581	16-Nov-08	8.0" to 65'	65	UGS SG23B	60	QTs	8.11	
SG24	Twin Springs	UGS SG24A	T16S R18W 22	-113.86311	39.40352	3-Nov-08	3.25" to 14'	19	UGS SG24A	19	QTs	5.71	
		UGS SG24B		-113.86309	39.40351	4-Nov-08	3.25" to 43'	48	UGS SG24B	48	QTs	4.02	
		UGS SG24C		-113.86301	39.40348	17-Nov-08	8.0" to 116'	116	UGS SG24C	115	QTs	2.19	X
SG25	Leland Harris Springs North	UGS SG25A	T14S R18W 32	-113.89177	39.55861	7-Nov-08	3.25" to 25'	25	UGS SG25A	25	QTs	4.98	
		UGS SG25B		-113.89167	39.55871	8-Nov-08	3.25" to 65'	65	UGS SG25B	65	QTs	4.78	
		UGS SG25C		-113.89172	39.55867	19-Nov-08	8.0" to 116'	116	UGS SG25C	115	QTs	2.19	X
		UGS SG25D		-113.89567	39.55860	3-Dec-08	3.25" to 45'	60	UGS SG25D	45	QTs	8.81	
SG26	Gandy Salt Marsh North	UGS SG26A	T15S R18W 19	-113.91753	39.48503	6-Dec-08	3.25" to 12'	12	UGS SG26A	12	QTs	3.6	
		UGS SG26B		-113.91752	39.48505	6-Dec-08	3.25" to 45'	45	UGS SG26B	45	QTs	4.58	
		UGS SG26C		-113.91750	39.48512	9-Dec-08	8.0" to 90'	90	UGS SG26C	90	QTs	3.6	
SG27	Gandy Salt Marsh	UGS SG27A	T15S R19W 36	-113.94269	39.46544	10-Dec-08	3.25" to 18'	18	UGS SG27A	18	QTs	8.15	

* See “Screened Unit” descriptions at the bottom of Table 2.

Table 2. Summary temperature-depth profiles, Snake Valley ground-water monitoring project.

Map ID	Site Name	Piezometer Name	Tsp, Rng, Sec	Longitude	Latitude	Completion Date	Temp Log Date	Borehole Diameter	Piezometer Depth (ft)	Screened Unit*	Water Depth (ft)	BHT** (°F)	BHT** (°C)	PD** (m)	PD** (ft)
PW01	Garrison	UGS PW01C	T21S R20W 36	-114.049200	38.941208	21-Aug-07	24-Sep-08	6.0" @ 1840'	1617	QTs	124.0	67.5	19.7	490.0	1607.6
PW02	Burbank	UGS PW02B	T23S R20W 25	-114.047470	38.780888	11-Oct-08	5-May-09	6.0" @ 620'	635	PIPMe	29.7	63.1	17.3	192.8	632.5
PW03	NE of Garrison	UGS PW03B	T21S R19W 32	-113.996220	38.945457	9-Sep-07	7-Aug-08	7.5" @ 968'	860	Ds	194.4	56.0	13.3	263.0	862.9
PW04	N. Hamlin Valley	UGS PW04B	T26S R20W 02	-114.042730	38.581146	30-Aug-07	23-Sep-08	7.0" @ 983'	915	Tv	593.3	60.7	15.9	278.0	912.1
PW05	SW of Eskdale	UGS PW05C	T20S R19W 32	-114.001230	39.016315	19-Jul-07	24-Sep-08	8.75" @ 1000'	880	QTs	35.4	61.4	16.3	294.2	965.2
PW06	NE of Eskdale	UGS PW06D	T18S R18W 32	-113.905270	39.198845	7-Oct-07	24-Sep-08	8.75" @ 390'	553	Pa	108.6	65.5	18.6	168.0	551.2
PW07	NW Ferguson Valley	UGS PW07B	T20S R18W 32	-113.891770	39.028576	5-Aug-07	7-Aug-08	8.5" @ 1400'	1285	QTs	48.0	62.6	17.0	390.0	1279.5
PW08	Mormon Gap	UGS PW8B	T24S R19W 13	-113.928840	38.723457	7-Aug-08	5-May-09	6.0" @ 400'	400	PIPMe	98.8	58.8	14.9	121.0	397.0
PW09	East of Eskdale	UGS PW09B	T19S R19W 36	-113.925410	39.110268	30-Nov-07	24-Sep-08	6.0" @ 880'	720	Sl	175.9	66.9	19.4	267.5	877.6
PW10	E. of Cowboy Pass	UGS PW10A	T17S R16W 16	-113.655075	39.323803	22-May-08	7-Aug-08	6.0" @ 748'	669	PIPMe	542.8	60.2	15.7	200.0	656.2
PW11	The Cove	UGS PW11E	T24S R19W 16	-113.981760	38.728310	23-May-08	5-May-09	6.0" @ 1263'	1159	PIPMe	210.3	65.8	18.8	350.8	1150.9
PW12	Little Valley	UGS PW12A	T19S R17W 36	-113.714040	39.115450	20-May-08	24-Sep-08	6.0" @ 1645	1633	Dg	1428.6	95.3	35.1	495.0	1624.0
AG13	Garrison Ag	UGS AG13C	T21S R20W 36	-114.033770	38.947560	26-Jun-08	5-May-09	6.0" @ 320'	305	QTs	73.4	54.6	12.5	96.0	315.0
AG14	Eskdale Ag	UGS AG14C	T20S R19W 16	-113.980930	39.073790	18-Jun-08	5-May-09	6.5" @ 317'	280	QTs	20.6	57.5	14.2	96.5	316.6
AG15	GPR Ag	UGS AG15A	T24S R20W 14	-114.049020	38.729767	25-Jul-08	5-May-09	6.5" @ 180'	179	QTs	82.2	52.7	11.5	54.6	179.1
AG16	Davies Ranch Ag	UGS AG16C	T23S R19W 20	-114.009346	38.798737	11-Jul-08	5-May-09	6.5" @ 317'	315	QTs	15.4	56.3	13.5	95.0	311.7
PW17	Coyote Knolls	UGS PW17C	T15S R15W 32	-113.551010	39.477930	9-Oct-08	6-May-09	6" @ 590'	580	Oes	84.2	66.4	19.1	175.0	574.1
PW18	NW Middle Range	UGS PW18A	T13S R16W 32	-113.668570	39.653854	12-Nov-08	6-May-09	6" @ 1003'	990	Dg	757.1	116.5	47.0	302.0	990.8
PW19	Table Knoll	UGS PW19C	T14S R13W 02	-113.271225	39.634266	6-Nov-08	6-May-09	7.75" @ 460'	460	Co	198.1	95.2	35.1	139.0	456.0
PW20	Sand Pass	UGS PW20A	T14S R14W 10	-113.405600	39.620647	20-Oct-08	6-May-09	5.88" @ 668'	565	Cpm	293.4	77.7	25.4	172.0	564.3
SG21	Fish Springs	UGS SG21C	T11S R14W 03	-113.413370	39.886540	20-Apr-09	6-May-09	5.9" @ 67'	66	Sl?	3.9	73.6	23.1	19.6	64.3
SG24	Twin Springs	UGS SG24C	T16S R18W 22	-113.863014	39.403480	17-Nov-08	6-May-09	8.0" @ 116'	115	QTs	2.2	61.4	16.4	34.7	113.8
SG25	Leland Harris Sprgs. N	UGS SG25C	T14S R18W 32	-113.891720	39.558666	19-Nov-08	6-May-09	8.0" @ 116'	115	QTs	2.2	58.5	14.7	35.5	116.5

* QTs - valley fill; Tv - volcanics; Pa - Arcturus Fm; PIPMe - Ely Ls; Dg - Guillmette Fm; Ds - Simonson Dol; Sl - Laketown Dol; Oes - Ely Springs Dol; Co - Orr Fm; Cpm - Prospect Mtn. Quartzite;
**BHT - Bottom-Hole Temperature; PD - Probe Depth

in water. For readings in water, the thermistor probe normally reaches thermal equilibrium within a few seconds. For readings in air, researchers often record time series of measurements for a given depth, resulting in extrapolation to an equilibrium temperature at infinite time using an established mathematical procedure. However, for the work on the Snake Valley project, since temperature measurements below water level were the focus of the effort, I opted to record resistance values above water levels (in air) for 12 minutes. (Typically, after 12 minutes, probe resistance would stabilize or fluctuate around a value rather than continue to drift up or down.) The following paragraphs, referenced to wells and figures 3 and 4 showing the graphic profiles, describe the observed temperatures in individual Snake Valley monitoring wells. Data for the individual temperature profiles of wells are listed in Appendix A.

UGS PW01C – Garrison

Well site UGS PW01 is located about 8 miles (13 km) due south of the intersection of U.S. Highway 6/50 and Utah SR-159 near the Utah-Nevada state line. The well is situated barely on the Utah side of the state boundary adjacent to the community of Garrison. The temperature profile indicates a thermal gradient of about 1.05°F/100 ft (19.2°C/km)—below the average (1.97°F/100 ft; 36°C/km) for the BRP. The well was drilled entirely in valley-fill sediments (QTs) with a bottom-hole temperature of 67.5°F (19.7°C).

UGS PW02B – Burbank

Well site UGS PW02 is located west of Big Springs Creek in Snake Valley just east of the Utah-Nevada state line. The temperature profile indicates a thermal gradient of about 1.36°F/100 ft (24.7°C/km). After spudding into young alluvium (Qa), the well penetrated the Arcturus Formation (Pa), and the Ely Limestone (PIPMe) below 591 ft (180 m). This borehole was drilled to 998 ft (304 m); however, temperatures were only recorded to a depth of 633 ft (193 m), the bottom of piezometer PW02B.

UGS PW03B – NE Garrison

Well site UGS PW03 is situated about 1.5 miles (2.4 km) east of Garrison along the northwest margin of the Burbank Hills at their juncture with Snake Valley. The well was spudded into

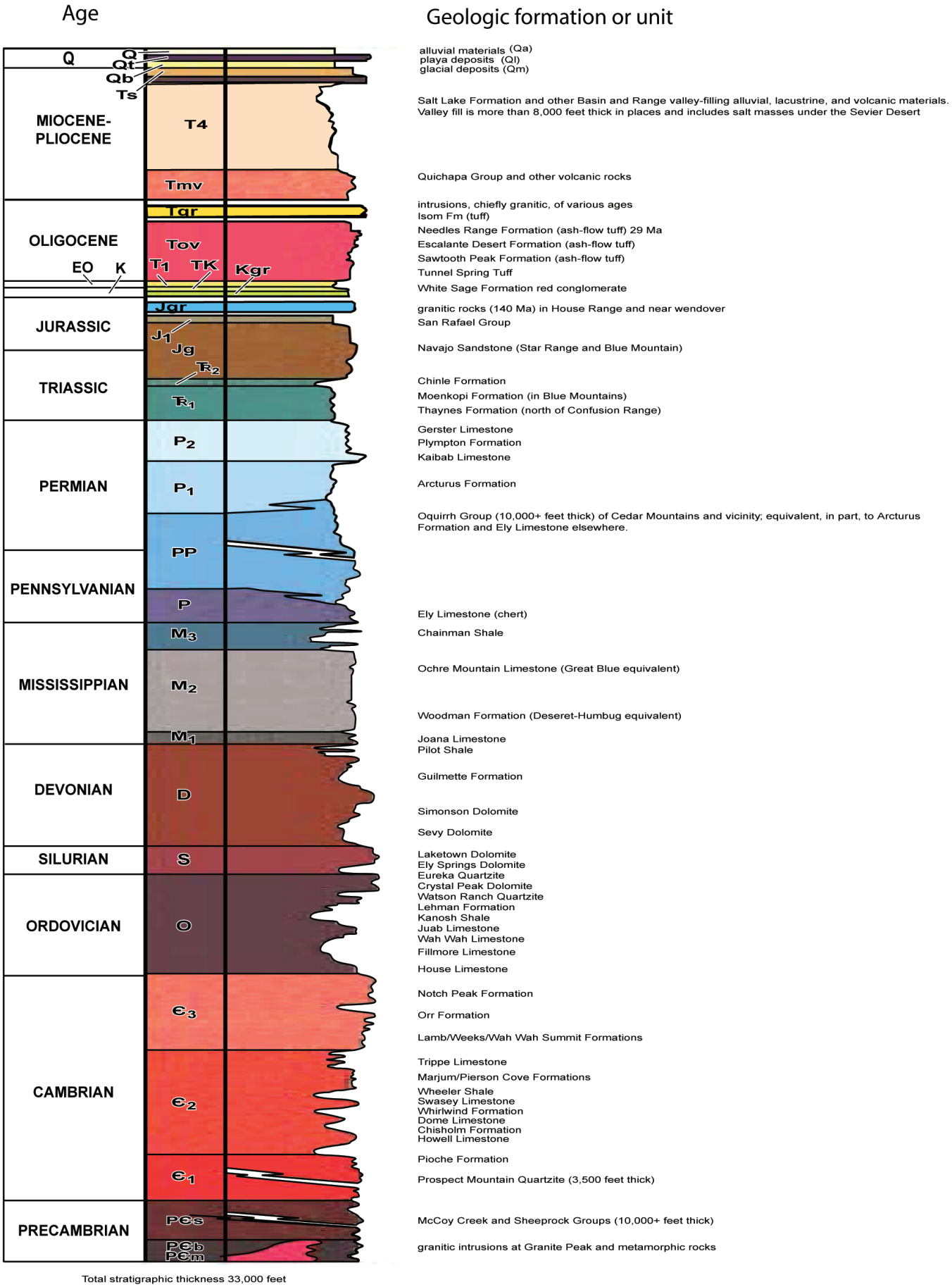

Figure 2. *Generalized stratigraphic column for west-central Utah. From Kirby and Hurlow (2005), modified from Hintze and others (2000).*

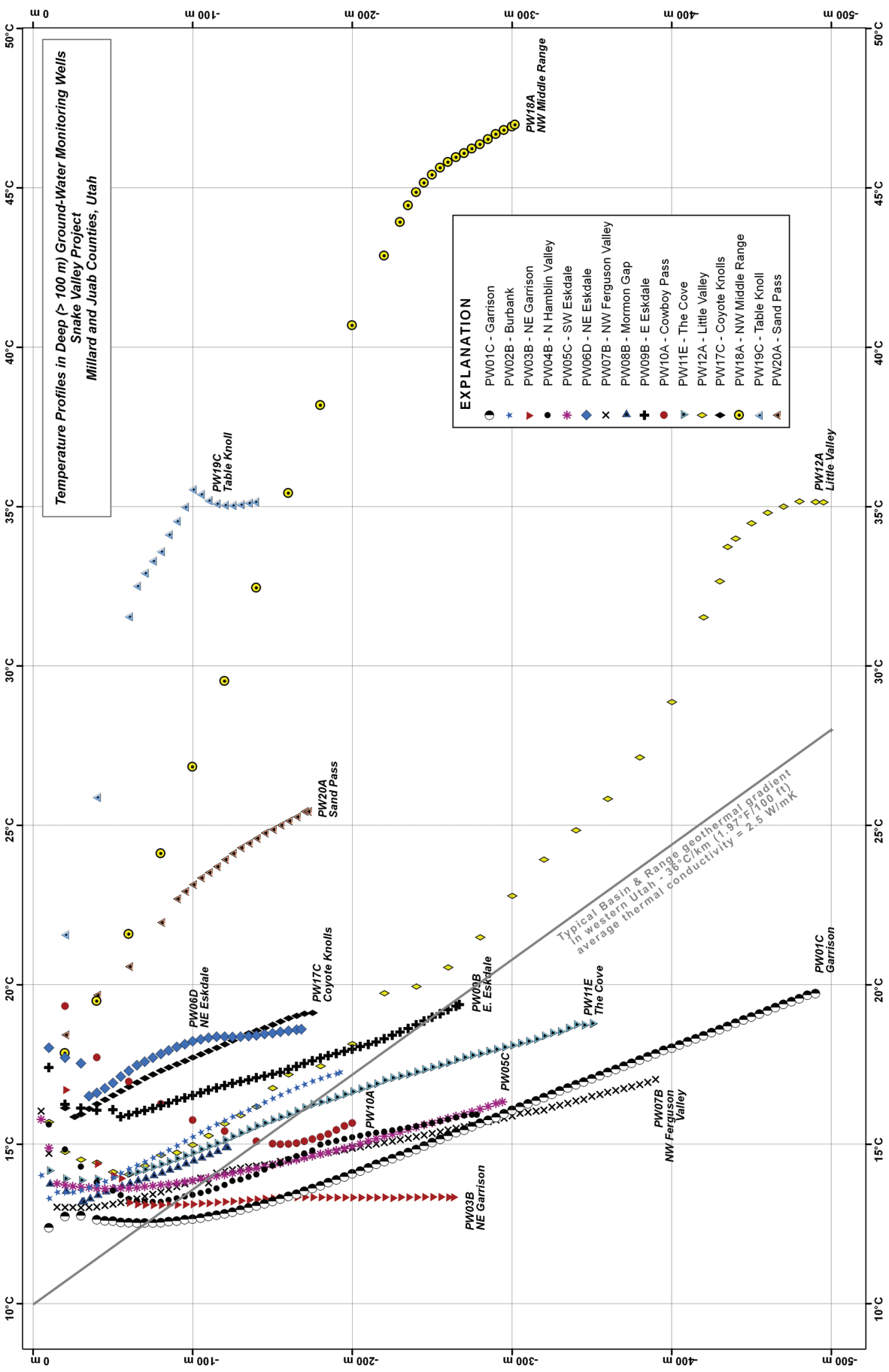

Figure 3. *Comparison of temperature profiles of deep (> 100 m) ground-water monitoring wells, Snake Valley Project (see figure 1 for well locations; typical BRP geothermal gradient [36°C/km] assumes a heat flow of 91 mWm^{-2} [from Henrikson, 2000] and an average thermal conductivity of 2.5 Wm^{-1}K).*

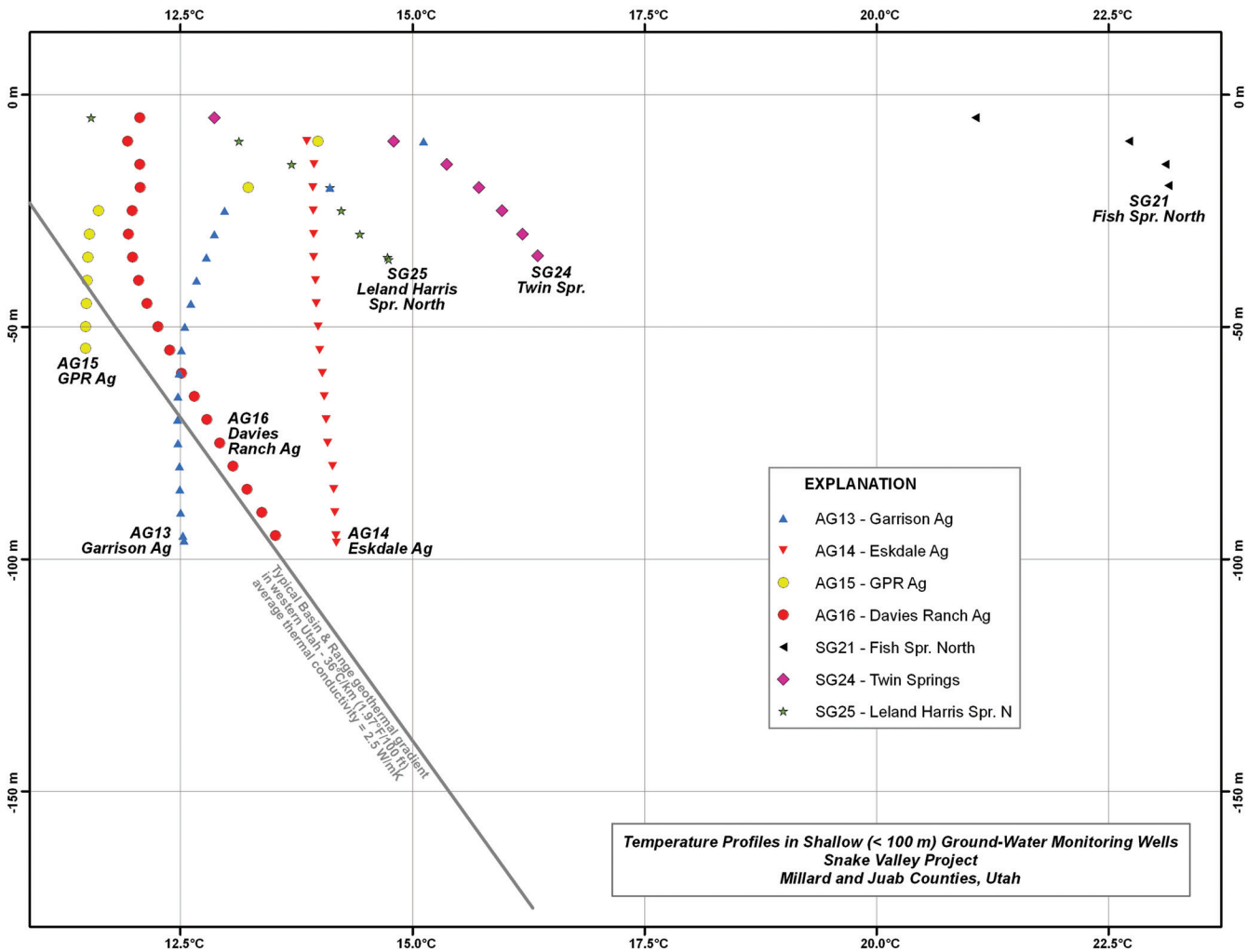

Figure 4. *Comparison of temperature profiles of shallow (< 100 m) ground-water monitoring wells, Snake Valley Project (see figure 1 for well locations; typical BRP geothermal gradient [36°C/km] assumes a heat flow of 91 mWm^{-2}[from Henrikson, 2000] and an average thermal conductivity of 2.5 Wm^{-1}K).*

the Guillmette Formation (Dg), and penetrated the Simonson Dolomite (Ds) below about 689 ft (210 m). The borehole was drilled to a depth of 968 ft (295 m), although temperatures were only recorded to a depth of 863 ft (263 m) in piezometer PW03B. Temperatures recorded above the water level in the well dropped rapidly to the water level. Below the water level, temperatures varied only slightly, giving a thermal gradient of nearly zero (isothermal) below the water level in the well (637.8 ft [194.4 m]).

UGS PW04B – N Hamblin Valley

Well site UGS PW04 is situated near the juncture of Hamblin Valley and the Mountain Home Range, on an alluvial fan extending westward down-slope from the Mountain Home Range. The well was spudded in alluvial fan material (Qa), soon penetrating volcanic rocks (Tv) below 66 ft (20 m) depth. The borehole was drilled to a total depth of 983 ft (300 m). Temperatures were recorded to a depth of 912 ft (278 m) in piezometer PW04B. The temperature profile shows a relatively continuous drop in temperature downward to about 250 ft (76 m), followed by relatively continuous increase in temperature to water level (594 ft [181 m]). The thermal gradient within this zone is about 1.1°F/100 ft (19.1°C/km). Below water level the overall gradient decreases to about 0.48°F/100 ft (8.8°C/km). Both of these values are well below the average thermal gradient for the BRP. At total probe depth (912 ft [278 m]) temperature was 60.7°F (15.9°C).

UGS PW05C – SW Eskdale

Well site UGS PW05 is located in Snake Valley about 2.5 miles (4 km) south of U.S. Highway 6/50 and about 2.5 miles (4 km) east of the Nevada-Utah border. The well was drilled in valley-fill material (QTs) to 1000 ft (305 m) and the deepest piezometer (PW05C) was completed to 880 ft (268 m). The temperature profile shows rapid decline from the surface down to the water level at 35.6 ft (10.8 m). Temperature declines continue, less pronounced, down to 197 ft (60 m) where a reversal occurs, followed by relatively constant increase to the total depth of the well. The overall gradient in the interval from 410 to 804 ft (125 to 245 m) is about 0.69°F/100 ft

(12.58°C/km), far below normal range for BRP geothermal gradients.

UGS PW06D – NE Eskdale

Well site UGS PW06 is situated about 7.5 miles (12 km) NNE of Eskdale along the east margin of Snake Valley where it is bounded by the Conger Range. The well site is on alluvial fan material shed westward from the Conger Range. Drilling penetrated valley-fill material (QTs) from the surface to 345 ft (105 m). Near this depth, bedrock (reportedly the Permian Arcturus Formation) was intersected. The well continued in the Arcturus to total depth of 553 ft (168.6 m). In piezometer PW06D, temperatures recorded in air decreased uniformly with a sharp drop to 61.7°F (16.5°C) at the water level (107.3 ft [32.7 m]). From borehole water level, thermal gradients increase almost constantly through the QTs section of the well (1.28°F/100 ft [23.33°C/km]). As the well crosses into the Arcturus Formation near 345 ft (105 m), gradient decreases markedly, becoming isothermal between 377 and 443 ft (115 and 135 m) followed by low temperature gradients to the bottom of the well (0.39°F/100 ft [7.14°C/km]).

UGS PW07B – NW Ferguson Valley

Well site UGS PW07 is located in the northwest part of the Ferguson Valley about one mile (1.6 km) south of U.S. Highway 6/50. The well was spudded in valley-fill material (QTs) and continued in QTs to total depth of 1400 ft (427 m). At the time of logging (piezometer B), water level was at 47.74 ft (14.55 m). Shallow temperature readings above the static water level decline in a steep, negative linear fashion to the water level. Temperature readings below static water then increase somewhat linearly to total depth, with a minor deviation at about 361 ft (110 m). The temperature gradient from 591 to 1214 ft (180 to 370 m) (depth of piezometer PW07B) is about 0.61°F/100 ft (11.05°C/km), much below the typical BRP thermal gradient.

UGS PW08B – Mormon Gap

Well site UGS PW08 was drilled at Mormon Gap located just south of SR-21 between the Mountain Home Range to the south and the Burbank Hills to the north. The well was spudded in the Permian-Pennsylvanian Ely Limestone and bottomed in the same unit at 400 ft (122 m) depth. Static water level was 98.1 ft (29.9 m). The temperature gradient measured (piezometer PW08B) between 115 and 394 ft (35 to 120 m) is 1.03°F/100 ft (18.82°C/km).

UGS PW09B – E Eskdale

Well site UGS PW09 is located about one mile (1.6 km) east of Eskdale at the western edge of the Conger Range. The well was spudded in the Silurian Laketown Dolomite, eventually bottoming in this unit at 880 ft (268 m). Static water level was at 175.2 ft (53.4 m). The temperatures with depth decrease somewhat erratically down to water level then increase in continuous fashion to total depth. Overall, the thermal gradient measured (piezometer PW09B) from 197 to 804 ft (60 to 245 m) is 0.87°F/100 ft (15.89°C/km).

UGS PW10A – E Cowboy Pass

Well UGS PW10A is located roughly 2 miles (3.2 km) east of Cowboy Pass in the Confusion Range. The pass separates Tule Valley to the east from Snake Valley to the west. The well was spudded in valley-fill material (QTs), penetrating Ely Limestone (PIPMe) at about 328 ft (100 m). The well continues in PIPMe to total depth at 748 ft (228 m). Static water level in the well is relatively deep at 544 ft (166 m). The temperature profile is unusual in that it displays a negative thermal gradient to about 500 ft (152 m) depth (recording in air). Below this depth, temperatures gradually rise to the bottom of the screened interval (piezometer PW10A) near 656 ft (200 m) yielding a thermal gradient of 0.91°F/100 ft (16.5°C/km). Bottom-hole temperature was 60.2°F (15.7°C) at 656 ft (200 m).

UGS PW11E – The Cove

Well site UGS PW11 is located in The Cove about 4 miles (6.4 km) east of the Utah-Nevada state line, due north of the north end of the Mountain Home Range and southwest of the Burbank Hills. Borehole UGS PW11E was spudded in valley-fill material (QTs), penetrating the Mississippian-Permian Ely Limestone (PIPMe) at about 480 ft (146 m), and continuing in PIPMe to TD at 1263 ft (385 m). Static water level was at 210 ft (64 m). The shallow temperature gradient is negative to about 98 ft (30 m), and then temperatures increase gradually with depth to the static water level. Overall, the temperature gradient from 213 to 1001 ft (65–305 m), below the water level, is fairly linear at about 0.91°F/100 ft (16.7°C/km). This gradient is well below the average gradient (1.37–1.92°F/100 ft [25–35°C/km]) for the BRP. There does not appear to be a change in thermal gradient across the QTs/PIPMe contact (480 ft [146 m]). Bottom-hole temperature (probe depth) was 65.8°F (18.8°C).

UGS PW12A – Little Valley

Well site UGS PW12 is located in Little Valley between the Conger Range to the west and the Confusion Range to the east. The well was both spudded and completed entirely within the Devonian Guillmette Formation, to a total depth of 1645 ft (501 m). Static water level is 1429 ft (436 m); temperature readings above the water level were, therefore, recorded in air, an extremely slow process. Initially from the surface downward, readings in air were recorded at 32.8 ft (10 m) intervals. Below 656 ft (200 m), readings were taken at intervals of 65.6 ft (20 m) due to limited time available for logging the well. Below the water level (1425 ft [434 m]), temperature readings at 32.8 ft (10 m) intervals were resumed to total depth. From the surface downward, the well displays near isothermal

conditions to about 197 ft (60 m). From this point, temperatures increase nearly linear (in air), at a rate of 3.33°F/100 ft (60.8°C/km) down to the static water level at 1425 ft (434 m). Below the water level, the temperature profile is nearly isothermal to the probe depth of 1624 ft (495 m). The intermediate thermal gradient (3.33°F/100 ft [60.8°C/km]) is above normal for the BRP. At the total probe depth (1624 ft [495 m]), temperature was 95.3°F (35.1°C).

UGS AG13C – Garrison Ag

Well site UGS AG13 is located on the north side of the community of Garrison, Utah, near the northwest corner of the junction of SR-21 and SR-159. The well location is less than one mile (< 1.6 km) east of the Nevada-Utah state line. The well was completed entirely within valley-fill sediments (QTs) of Snake Valley. Static water level was at 73.0 ft (22.3 m). From the surface downward, the first two readings were taken at 32.8 ft (10 m) intervals showing a rapid, negative, shallow temperature gradient to the static water level. From here, temperatures continue to drop gradually to 213.3 ft (65 m), becoming nearly isothermal from the water level to the total probe depth (315 ft [96 m]). Bottom-hole temperature (probe depth) was 54.6°F (12.5°C).

UGS AG14C – Eskdale

Well site UGS AG14 is located in Snake Valley about 2 miles (3.2 km) southwest of the town of Eskdale, about 1.5 miles (2.4 km) north of U.S. Highway 6/50, and about 2 miles (3.2 km) east of the Nevada-Utah state line. The well was completed entirely within valley-fill sediments (QTs) of Snake Valley. Static water level was at 18 ft (5.5 m). The first two temperature readings to 49 ft (15 m) suggest a somewhat high, shallow temperature gradient. However, from about 115 ft (35 m) to probe depth at about 317 ft (96.5 m), overall thermal gradient is very low at 0.22°F/100 ft (3.95°C/km). Bottom-hole temperature (probe depth) was 57.5°F (14.2°C).

UGS AG15A – GPR Ag

Well site UGS AG15 is located adjacent east of the Nevada-Utah state line midway between the south end of the Southern Snake Range (Nevada) and the north end of the Mountain Home Range (Utah). The site is about one mile (1.6 km) southwest of the hill known as Needle Point Mountain. The well was drilled entirely in valley-fill sediments (QTs) encountering static water at a depth of 78 ft (24 m). The temperature profile shows a shallow, negative gradient to 82 ft (25 m), becoming isothermal from this depth to the probe depth of 179 ft (54.6 m). Bottom-hole temperature (at probe depth) was 52.7°F (11.5°C).

UGS AG16C – Davies Ranch

Well site UGS AG16 is located in Snake Valley about 3.5 miles (5.6 km) northwest of Needle Point Mountain, 1.5 miles (2.4 km) west of SR-21, and 1.5 miles (2.4 km) east of the Nevada-Utah state line. The Burbank Hills lie about 6 miles (9.7 km) to the northeast. The well was drilled to 317 ft (96.6 m), entirely within valley-fill sediments (QTs). The shallow (< 100 ft [30.5 m]) temperature profile is erratic. Below 100 ft (30.5 m), temperature increases with depth at a gradient of about 1.51°F/100 ft (27.6°C/km). This value approaches the average for thermal gradients in the BRP. Bottom-hole temperature was 56.3°F (13.5°C).

UGS PW17C – Coyote Knolls

Well site UGS PW17 is located in the northern part of Tule Valley, at the northern end of the western knoll of Coyote Knolls. The Confusion Range lies about 10 miles (16 km) to the west and the House Range lies about 15 miles (24 km) to the east. The well was spudded in the Silurian Laketown Dolomite. The well reportedly intercepts the Ordovician Ely Springs Dolomite at 160 ft (49 m) depth, which continues to the total depth of the well at 590 ft (180 m). The temperature gradient measured from 197 to 509 ft (60 to 155 m) is 1.18°F/100 ft (21.5°C/km), slightly below average for the BRP. Bottom-hole temperature was 66.4°F (19.1°C).

UGS PW18 – NW Middle Range

Well site UGS PW18 is located on the northwest flank of the Middle Range, which forms part of the boundary of the northern part of Snake Valley to the northwest. The north limit of the Confusion Range lies about 6 miles (10 km) west-southwest of the well, while the Fish Springs Range lies about 12 miles (19 km) to the east-northeast. The well was spudded in the Devonian Guillmette Formation, bottoming within the same unit at the total depth of 1003 ft (305.7 m). The static water level is deep at 757 ft (231 m). The temperature profile measured in air down to the water level yields a thermal gradient of 6.81°F/100 ft (124°C/km), much above average for the BRP. Below water level, the gradient from 804 to 991 ft (245 to 302 m) is 1.75°F/100 ft (31.9°C/km), about average for the BRP. Bottom-hole temperature at 991 ft (302 m) was 116.5°F (47.0°C). The overall gradient for the well, using the bottom-hole temperature and estimating an ambient surface temperature of 10°C (50°F), is 6.72°F/100 ft (122.5°C/km).

UGS PW19C – Table Knoll

Well site UGS PW19 is located at the north end of Table Knoll southeast of Fish Springs Flat. Sand Pass, which separates the Fish Springs Range (north) from the House Range (south), lies about 7 miles (11 km) west-southwest. Two wells drilled at the site differ somewhat in the units they penetrated. Borehole PW19AC (temperature profile from piezometer UGS PW19C) was spudded in the alluvium/valley-fill unit, and then penetrated volcanic tuff at about 140 ft (43 m). The well penetrated the Cambrian Notch Peak Formation at 190 ft (58 m), then intercepted the Cambrian Orr Formation (?) at about 260 ft (79 m), bottoming in this unit at 460 ft (140 m). Static

water level was reported at 198 ft (60.4 m). Above the static water level, thermal gradients appear very high at 13.7°F/100 ft (249°C/km). Below the water level, the thermal gradient breaks into two slopes within the Orr Formation at about 328 ft (100 m). The gradient from 213 to 328 ft (65–100 m) is still high at 4.73°F/100 ft (86.3°C/km). The gradient from 328 ft (65 m) to probe depth at 456 ft (139 m) is negative, suggesting a change downward from a zone of lower to higher thermal conductivity, or a lateral flow of warmer water near the level of the change in gradient. Bottom-hole temperature is 95.2°F (35.1°C).

UGS PW20A – Sand Pass

Well site UGS PW20 is located at Sand Pass, the saddle between the Fish Springs Range on the north and the House Range to the south. Sand Pass overlooks Tule Valley to the southwest and Fish Springs Flat to the east and northeast. The well was spudded into alluvium and other valley-fill units (QTs), reportedly encountering bedrock (Cambrian Pioche Formation [Cpo]) at about 60 ft (18 m), and entering a fault zone between 75 and 95 ft (23–29 m). The well continued to penetrate Cpo to a depth of about 180 ft (55 m) where the well then intersected the Cambrian Prospect Mountain Quartzite (Cpm). Fault material was again described between 215 and 230 ft (65.5–70 m), below which the well penetrated the Cambrian Howell Formation. Fault zone material was suspected again between 255 and 278 ft (77.7–84.7 m), below which the well penetrated Cpm, continuing in this unit to total depth at 760 ft (232 m). Static water level was reported at 293 ft (89.4 m). The thermal gradient above the water level is 3.37°F/100 ft (61.4°C/km), which is above the average BRP gradient. Thermal gradient below the water level drops to 1.83°F/100 ft (33.3°C/km), about an average BRP gradient.

UGS SG21C – Fish Springs North

Well site UGS SG21 is located at the extreme northeast end of the Fish Springs Range where the range joins the northwest edge of Fish Springs Flat. The site is within the Fish Springs National Wildlife Refuge. The well, which is the deepest of three at the site, was spudded in QTs, intercepting bedrock (possibly Laktown Dolomite [Sl]) at 28 ft (8.5 m) depth. Total well depth was 67 ft (20.4 m). Static water was reported at 3.9 ft (1.2 m) depth. The shallow thermal gradient, using only two points, to 33 ft (10 m) is high at 17.6°F/100 ft (320°C/km), but the deeper gradient from 49 to 64 ft (15 to 20 m) is nearly isothermal. The bottom-hole temperature is 73.7°F (23.1°C).

UGS SG24C – Twin Springs

Well site UGS SG24 is located at Twin Springs in northern Snake Valley about 2 miles (3 km) west of the edge of the Confusion Range. The community of Gandy is about 7 miles (11 km) northwest from the well site. The well was spudded and completed in QTs material to a total depth of 116 ft (35.4 m). The initial, very-high, shallow temperature gradient yields to the deeper gradient measured from 66 to 114 ft (20–34.7 m) of 2.4°F/100 ft (43.5°C/km). This value is slightly higher than normal for the BRP. Bottom-hole temperature was 61.4°F (16.4°C).

UGS SG25C – Leland Harris Springs North

Well site UGS SG25 (Leland Harris) is located near the middle of the northern part of Snake Valley. The western edge of the Confusion Range is about 6 miles (10 km) to the east and the community of Gandy is about 9 miles (14 km) to the southwest. The well (piezometer UGS SG25C) was spudded and drilled to total depth of 116 ft (35.4 m) in QTs material. Static water level is near-surface at about 2.2 ft (0.67 m). The shallow, very-high thermal gradient gives way to a deeper gradient of about 2.8°F/100 ft (51°C/km), measured between 49 and 116 ft (15–35.5 m). This value is higher than average for the BRP.

SUMMARY

In support of the UGS' Snake Valley ground-water monitoring project, temperature logs were acquired from 23 of 27 monitoring well sites throughout the Snake Valley project area. Four shallow boreholes at well sites were not logged because they were inaccessible for various reasons at the time field studies were underway. Temperature-depth data were acquired for 23 monitoring wells using high-precision temperature logging gear. Well depths ranged from 67 ft (20 m) at Fish Springs to 1840 ft (561 m) near the community of Garrison. Maximum temperatures (bottom-hole temperatures, or BHTs) ranged from about 53°F (12°C) in a shallow, 180-ft (55 m) well completed in valley-fill deposits near Needle Point Spring on the south end of Snake Valley, to 117°F (47°C) measured in a 1000-ft (305 m) deep well on the northwest side of the Middle Range (Juab County), which was completed in the Devonian Guillmette Formation. Among other factors, thermal gradients vary with depth, water saturation, and the thermal conductivity of geologic material penetrated by the well. Variations in thermal gradients are summarized in individual well descriptions and temperature-depth plots (figures 3 and 4). The gradients range from near zero (isothermal conditions) to an overall high of 6.72°F/100 ft (122.5°C/km), considerably above typical values for the BRP, at well PW18 (NW Middle Range).

ACKNOWLEDGMENTS

Matt Affolter and Kevin Thomas of the UGS Ground Water and Paleontology Program, Taylor Boden of the UGS Energy and Minerals Program, and Rick Allis, UGS Director, assisted with down-hole temperature data collection and field logistics. Hugh Hurlow of the UGS Ground Water and Paleontology Program provided many helpful suggestions to the manuscript.

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APPENDIX A

Temperature-depth data for Snake Valley ground-water monitoring well sites.

Key to “LITH” column:

Tertiary-Quaternary

QTS:	undifferentiated valley-fill units
Tv:	undifferentiated volcanic units

Mississippian-Permian

Pa:	Arcturus Formation
PIPMe:	Ely Limestone

Devonian

Dg:	Guillmette Formation
Ds:	Simonson Dolomite

Ordovician-Silurian

Sl:	Laketown Dolomite
Oes:	Ely Springs Dolomite

Cambrian

Cnp:	Notch Peak Formation
Co:	Orr Formation
Ch:	Howell Limestone
Cpo:	Pioche Formation
Cpm:	Prospect Mountain Quartzite

FZ:	fault zone

Project:	**Snake Valley**	
Well:	**UGS PW01C - Garrison**	
Date Logged:	**24-Sep-08**	
Owner:	**Utah Geological Survey**	
Location:	**(C-21-20)36ccc**	
UTM.E:	**755750**	**NAD1983 Z11**
UTM.N:	**4314393**	**NAD1983 Z11**
Land Elev.	**5312.7 FT**	**1619.3 M**
Water Level:	**137.1 FT**	**41.8 M**

DEPTH (M)	DEPTH (FT)	T(°C)	T(°F)	LITH
10.0	32.8	12.4	54.3	QTs
20.0	65.6	12.8	55.0	"
30.0	98.4	12.8	55.0	"
40.0	131.2	12.6	54.8	"
45.0	147.6	12.6	54.7	"
50.0	164.0	12.6	54.7	"
55.0	180.4	12.6	54.6	"
60.0	196.9	12.6	54.6	"
65.0	213.3	12.5	54.6	"
70.0	229.7	12.5	54.6	"
75.0	246.1	12.6	54.6	"
80.0	262.5	12.6	54.6	"
85.0	278.9	12.6	54.7	"
90.0	295.3	12.6	54.7	"
95.0	311.7	12.7	54.8	"
100.0	328.1	12.7	54.8	"
105.0	344.5	12.7	54.9	"
110.0	360.9	12.7	54.9	"
115.0	377.3	12.8	55.0	"
120.0	393.7	12.8	55.1	"
125.0	410.1	12.9	55.2	"
130.0	426.5	12.9	55.3	"
135.0	442.9	13.0	55.4	"
140.0	459.3	13.1	55.5	"
145.0	475.7	13.1	55.7	"
150.0	492.1	13.2	55.8	"
155.0	508.5	13.3	55.9	"
160.0	524.9	13.4	56.1	"
165.0	541.3	13.5	56.2	"
170.0	557.7	13.5	56.4	"
175.0	574.1	13.6	56.5	"
180.0	590.6	13.7	56.7	"
185.0	607.0	13.8	56.9	"
190.0	623.4	13.9	57.0	"
195.0	639.8	14.0	57.2	"
200.0	656.2	14.1	57.4	"
205.0	672.6	14.2	57.5	"
210.0	689.0	14.3	57.7	"
215.0	705.4	14.4	57.9	"
220.0	721.8	14.5	58.0	"
225.0	738.2	14.6	58.2	"
230.0	754.6	14.7	58.4	"
235.0	771.0	14.8	58.6	"
240.0	787.4	14.9	58.7	QTs
245.0	803.8	15.0	58.9	"
250.0	820.2	15.1	59.1	"
255.0	836.6	15.2	59.3	"
260.0	853.0	15.3	59.5	"
265.0	869.4	15.4	59.7	"
270.0	885.8	15.5	59.8	"
275.0	902.2	15.6	60.0	"
280.0	918.6	15.7	60.2	"
285.0	935.0	15.8	60.4	"
290.0	951.4	15.8	60.5	"
295.0	967.8	16.0	60.7	"
300.0	984.3	16.1	60.9	"
305.0	1000.7	16.2	61.1	"
310.0	1017.1	16.3	61.3	"
315.0	1033.5	16.4	61.5	"
320.0	1049.9	16.5	61.7	"
325.0	1066.3	16.6	61.8	"
330.0	1082.7	16.7	62.0	"
335.0	1099.1	16.8	62.2	"
340.0	1115.5	16.9	62.4	"
345.0	1131.9	17.0	62.6	"
350.0	1148.3	17.1	62.7	"
355.0	1164.7	17.2	62.9	"
360.0	1181.1	17.3	63.1	"
365.0	1197.5	17.4	63.3	"
370.0	1213.9	17.5	63.4	"
375.0	1230.3	17.6	63.6	"
380.0	1246.7	17.7	63.8	"
385.0	1263.1	17.8	64.0	"
390.0	1279.5	17.9	64.1	"
395.0	1295.9	18.0	64.3	"
400.0	1312.3	18.0	64.5	"
405.0	1328.7	18.1	64.6	"
410.0	1345.1	18.2	64.8	"
415.0	1361.5	18.3	65.0	"
420.0	1378.0	18.4	65.2	"
425.0	1394.4	18.5	65.3	"
430.0	1410.8	18.6	65.5	"
435.0	1427.2	18.7	65.7	"
440.0	1443.6	18.8	65.9	"
445.0	1460.0	18.9	66.0	"
450.0	1476.4	19.0	66.2	"
455.0	1492.8	19.1	66.4	"
460.0	1509.2	19.2	66.6	"
465.0	1525.6	19.3	66.7	"
470.0	1542.0	19.4	66.9	"
475.0	1558.4	19.5	67.1	"
480.0	1574.8	19.6	67.2	"
485.0	1591.2	19.7	67.4	"
490.0	1607.6	19.7	67.5	"

Project:	**Snake Valley**	
Date Log:	**5-May-09**	
Well:	**UGS PW02B - Burbank**	
Owner:	**Utah Geological Survey**	
Location:	**(C-23-20)25ccc**	
UTM.E	**235275**	**NAD83 Z12**
UTM.N	**4296874**	**NAD83 Z12**
Land Elev:	**5459.3 FT**	**1664 M**
Water Level:	**28 FT**	**8.5 M**

DEPTH (M)	T(°C)	DEPTH (FT)	T(°F)	LITH
5.0	14.04	16.4	57.3	Qa
10.0	13.32	32.8	56.0	Pa
15.0	13.51	49.2	56.3	"
20.0	13.50	65.6	56.3	"
25.0	13.51	82.0	56.3	"
30.0	13.57	98.4	56.4	"
35.0	13.65	114.8	56.6	"
40.0	13.74	131.2	56.7	"
45.0	13.85	147.6	56.9	"
50.0	13.97	164.0	57.1	"
55.0	14.11	180.4	57.4	"
60.0	14.24	196.9	57.6	"
65.0	14.35	213.3	57.8	"
70.0	14.46	229.7	58.0	"
75.0	14.59	246.1	58.3	"
80.0	14.71	262.5	58.5	"
85.0	14.83	278.9	58.7	"
90.0	14.97	295.3	58.9	"
95.0	15.11	311.7	59.2	"
100.0	15.25	328.1	59.4	"
105.0	15.39	344.5	59.7	"
110.0	15.52	360.9	59.9	"
115.0	15.64	377.3	60.1	"
120.0	15.75	393.7	60.3	"
125.0	15.88	410.1	60.6	"
130.0	15.99	426.5	60.8	"
135.0	16.09	442.9	61.0	"
140.0	16.21	459.3	61.2	"
145.0	16.33	475.7	61.4	"
150.0	16.45	492.1	61.6	"
155.0	16.56	508.5	61.8	"
160.0	16.68	524.9	62.0	"
165.0	16.79	541.3	62.2	"
170.0	16.89	557.7	62.4	"
175.0	16.99	574.1	62.6	"
180.0	17.08	590.6	62.7	"
185.0	17.16	607.0	62.9	PIPMe
190.0	17.23	623.4	63.0	"
192.8	17.27	632.5	63.1	"

Project:	**Snake Valley**	
Date Log:	**7-Aug-08**	
Well:	**UGS PW03B – NE Garrison**	
Owner:	**Utah Geological Survey**	
Location:	**(C-21-19)32dad**	
UTM.E	**240327**	**NAD83 Z12**
UTM.N	**4314994**	**NAD83 Z12**
Land Elev:	**5325 FT**	**1623 M**
Water Level:	**47.7 FT**	**14.6 M**

DEPTH (M)	DEPTH (FT)	T(°C)	T(°F)	LITH
20	65.6	16.68	62.03	Dg
40	131.2	14.36	57.85	"
50	164.0	14.00	57.20	"
55	180.4	13.91	57.03	"
60	196.9	13.15	55.66	"
65	213.3	13.10	55.58	"
70	229.7	13.08	55.54	"
75	246.1	13.07	55.52	"
80	262.5	13.07	55.52	"
85	278.9	13.07	55.53	"
90	295.3	13.08	55.54	"
95	311.7	13.09	55.56	"
100	328.1	13.10	55.58	"
105	344.5	13.12	55.61	"
110	360.9	13.14	55.64	"
115	377.3	13.16	55.68	"
120	393.7	13.17	55.71	"
125	410.1	13.19	55.74	"
130	426.5	13.21	55.78	"
135	442.9	13.23	55.82	"
140	459.3	13.25	55.86	"
145	475.7	13.28	55.90	"
150	492.1	13.29	55.93	"
155	508.5	13.31	55.96	"
160	524.9	13.31	55.96	"
165	541.3	13.32	55.97	"
170	557.7	13.32	55.97	"
175	574.1	13.32	55.97	"
180	590.6	13.31	55.96	"
185	607.0	13.31	55.96	"
190	623.4	13.31	55.96	"
195	639.8	13.31	55.96	"
200	656.2	13.31	55.96	"
205	672.6	13.31	55.96	"
210	689.0	13.31	55.96	"
215	705.4	13.31	55.96	Ds
220	721.8	13.31	55.96	"
225	738.2	13.29	55.93	"
230	754.6	13.32	55.97	"
235	771.0	13.32	55.97	"
240	787.4	13.32	55.98	Ds
245	803.8	13.32	55.98	"
250	820.2	13.33	55.99	"
255	836.6	13.33	55.99	"
260	853.0	13.32	55.98	"
263	862.9	13.32	55.98	"

Project:	**Snake Valley**		
Date Log:	**23-Sep-08**		
Well:	**UGS PW04B – N. Hamblin V.**		
Owner:	**Utah Geological Survey**		
Location:	**(C-20-18)32aba**		
UTM.E:	**757603**	**NAD83 Z11**	
UTM.N:	**4274445**	**NAD83 Z11**	
Land Elev:	**6180 FT**	**1884 M**	
Water Level:	**593.8 FT**	**181.0 M**	

DEPTH (M)	DEPTH (FT)	T(°C)	T(°F)	LITH
10.0	32.81	15.64	60.14	Qa
20.0	65.62	14.85	58.73	"
30.0	98.43	14.31	57.76	Tv
40.0	131.23	13.82	56.87	"
50.0	164.04	13.56	56.40	"
55.0	180.45	13.41	56.15	"
60.0	196.85	13.30	55.95	"
65.0	213.25	13.25	55.85	"
70.0	229.66	13.22	55.79	"
75.0	246.06	13.21	55.78	"
80.0	262.47	13.21	55.77	"
85.0	278.87	13.27	55.88	"
90.0	295.28	13.32	55.97	"
95.0	311.68	13.38	56.08	"
100.0	328.08	13.42	56.16	"
105.0	344.49	13.48	56.27	"
110.0	360.89	13.54	56.38	"
115.0	377.30	13.63	56.53	"
120.0	393.70	13.74	56.73	"
125.0	410.10	13.86	56.95	"
130.0	426.51	13.90	57.03	"
135.0	442.91	13.99	57.19	"
140.0	459.32	14.07	57.32	"
145.0	475.72	14.21	57.59	"
150.0	492.13	14.35	57.82	"
155.0	508.53	14.42	57.96	"
160.0	524.93	14.55	58.19	"
165.0	541.34	14.64	58.35	"
170.0	557.74	14.72	58.50	"
175.0	574.15	14.81	58.67	"
180.0	590.55	15.00	59.01	"
185.0	606.96	15.06	59.12	"
190.0	623.36	15.12	59.22	"
195.0	639.76	15.18	59.32	"
200.0	656.17	15.23	59.42	"
205.0	672.57	15.28	59.51	"
210.0	688.98	15.33	59.59	"
215.0	705.38	15.37	59.67	"
220.0	721.78	15.41	59.74	"
225.0	738.19	15.45	59.81	"
230.0	754.59	15.49	59.88	"
235.0	771.00	15.53	59.95	"
240.0	787.40	15.57	60.03	"
245.0	803.81	15.62	60.12	"
250.0	820.21	15.68	60.22	"
255.0	836.61	15.73	60.32	"
260.0	853.02	15.79	60.42	"
265.0	869.42	15.85	60.53	"
270.0	885.83	15.91	60.65	"
275.0	902.23	15.93	60.68	"
278.0	912.07	15.93	60.68	"

Project:	**Snake Valley**		
Date Log:	**24-Sep-08**		
Well:	**UGS PW05C - SW Eskdale**		
Owner:	**Utah Geological Survey**		
Location:	**(C-20-19)32ddd**		
UTM.E:	**240219**		**NAD83 Z12**
UTM.N:	**4322669**		**NAD83 Z12**
Land Elev:	**5080**	**FT**	**1548 M**
Water Level:	**35.6**	**FT**	**10.8 M**

DEPTH (M)	DEPTH (FT)	T(°C)	T(°F)	LITH
5	16.40	15.80	60.44	QTs
10	32.81	14.90	58.82	"
15	49.21	13.78	56.81	"
20	65.62	13.74	56.73	"
25	82.02	13.70	56.65	"
30	98.43	13.67	56.61	"
35	114.83	13.66	56.59	"
40	131.23	13.64	56.55	"
45	147.64	13.62	56.52	"
50	164.04	13.63	56.53	"
55	180.45	13.64	56.55	"
60	196.85	13.63	56.54	"
65	213.25	13.65	56.58	"
70	229.66	13.69	56.63	"
75	246.06	13.72	56.69	"
80	262.47	13.74	56.73	"
85	278.87	13.77	56.78	"
90	295.28	13.80	56.84	"
95	311.68	13.84	56.91	"
100	328.08	13.88	56.98	"
105	344.49	13.92	57.06	"
110	360.89	13.96	57.14	"
115	377.30	14.01	57.22	"
120	393.70	14.06	57.31	"
125	410.10	14.11	57.40	"
130	426.51	14.16	57.49	"
135	442.91	14.21	57.58	"
140	459.32	14.26	57.67	"
145	475.72	14.31	57.77	"
150	492.13	14.37	57.86	"
155	508.53	14.42	57.96	"
160	524.93	14.48	58.06	"
165	541.34	14.53	58.16	"
170	557.74	14.59	58.26	"
175	574.15	14.65	58.37	"
180	590.55	14.71	58.47	"
185	606.96	14.77	58.58	"
190	623.36	14.82	58.68	"
195	639.76	14.88	58.79	"
200	656.17	14.95	58.92	"
205	672.57	15.03	59.05	"
210	688.98	15.11	59.20	QTs
215	705.38	15.19	59.34	"
220	721.78	15.26	59.47	"
225	738.19	15.33	59.59	"
230	754.59	15.40	59.71	"
235	771.00	15.48	59.86	"
240	787.40	15.55	59.99	"
245	803.81	15.62	60.12	"
250	820.21	15.69	60.24	"
255	836.61	15.76	60.37	"
260	853.02	15.83	60.49	"
265	869.42	15.90	60.62	"
270	885.83	15.96	60.72	"
275	902.23	16.03	60.86	"
280	918.64	16.11	61.00	"
285	935.04	16.20	61.15	"
290	951.44	16.29	61.32	"
294.2	965.22	16.34	61.41	"

Project:	**Snake Valley**	
Date Log:	**24-Sep-08**	
Well:	**UGS PW06D - NE Eskdale**	
Owner:	**Utah Geological Survey**	
Location:	**(C-18-18)32cbb**	
UTM.E:	**249111**	**NAD83 Z12**
UTM.N:	**4342857**	**NAD83 Z12**
Land Elev:	**5001 FT**	**1524 M**
Water Level:	**107.3 FT**	**32.7 M**

DEPTH (M)	DEPTH (FT)	T(°C)	T(°F)	LITH
10.0	32.8	18.0	64.5	QTs
20.0	65.6	17.7	63.9	"
30.0	98.4	17.6	63.6	"
35.0	114.8	16.5	61.7	"
40.0	131.2	16.6	61.9	"
45.0	147.6	16.8	62.2	"
50.0	164.0	16.9	62.5	"
55.0	180.4	17.1	62.8	"
60.0	196.9	17.3	63.2	"
65.0	213.3	17.5	63.5	"
70.0	229.7	17.6	63.7	"
75.0	246.1	17.7	63.9	"
80.0	262.5	17.8	64.1	"
85.0	278.9	18.0	64.3	"
90.0	295.3	18.1	64.5	"
95.0	311.7	18.2	64.7	"
100.0	328.1	18.2	64.8	"
105.0	344.5	18.3	64.9	Pa
110.0	360.9	18.3	65.0	"
115.0	377.3	18.4	65.1	"
120.0	393.7	18.4	65.1	"
125.0	410.1	18.4	65.1	"
130.0	426.5	18.4	65.1	"
135.0	442.9	18.4	65.1	"
140.0	459.3	18.4	65.2	"
145.0	475.7	18.5	65.2	"
150.0	492.1	18.5	65.3	"
155.0	508.5	18.5	65.4	"
160.0	524.9	18.6	65.4	"
165.0	541.3	18.6	65.5	"
168.0	551.2	18.6	65.5	"

Project:	**Snake Valley**	
Date Log:	**7-Aug-08**	
Well:	**UGS PW07B - NW Ferguson**	
Owner:	**Utah Geological Survey**	
Location:	**(C-20-18)32aba**	
UTM.E	**249677**	**NAD83 Z12**
UTM.N	**4323927**	**NAD83 Z12**
Land Elev:	**5023 FT**	**1531 M**
Water Level:	**47.74 FT**	**14.55 M**

DEPTH (M)	DEPTH (FT)	T(°C)	T(°F)	LITH
5.0	16.4	16.0	60.9	QTs
10.0	32.8	14.7	58.5	"
15.0	49.2	13.0	55.5	"
20.0	65.6	13.0	55.4	"
25.0	82.0	13.0	55.4	"
30.0	98.4	13.0	55.4	"
35.0	114.8	13.0	55.5	"
40.0	131.2	13.0	55.5	"
45.0	147.6	13.1	55.6	"
50.0	164.0	13.1	55.6	"
55.0	180.4	13.2	55.7	"
60.0	196.9	13.2	55.8	"
65.0	213.3	13.3	55.9	"
70.0	229.7	13.4	56.1	"
75.0	246.1	13.4	56.2	"
80.0	262.5	13.5	56.3	"
85.0	278.9	13.6	56.5	"
90.0	295.3	13.7	56.6	"
95.0	311.7	13.8	56.8	"
100.0	328.1	13.9	57.0	"
105.0	344.5	13.9	57.1	"
110.0	360.9	13.8	56.8	"
115.0	377.3	14.1	57.4	"
120.0	393.7	14.2	57.5	"
125.0	410.1	14.2	57.6	"
130.0	426.5	14.3	57.7	"
135.0	442.9	14.3	57.7	"
140.0	459.3	14.3	57.8	"
145.0	475.7	14.4	57.9	"
150.0	492.1	14.4	57.9	"
155.0	508.5	14.5	58.0	"
160.0	524.9	14.5	58.1	"
165.0	541.3	14.6	58.2	"
170.0	557.7	14.6	58.3	"
175.0	574.1	14.7	58.4	"
180.0	590.6	14.7	58.5	"
185.0	607.0	14.7	58.5	"
190.0	623.4	14.8	58.6	"
195.0	639.8	14.8	58.7	"
200.0	656.2	14.9	58.8	QTs
205.0	672.6	14.9	58.9	"
210.0	689.0	15.0	59.0	"
215.0	705.4	15.0	59.0	"
220.0	721.8	15.1	59.1	"
225.0	738.2	15.1	59.2	"
230.0	754.6	15.1	59.3	"
235.0	771.0	15.2	59.4	"
240.0	787.4	15.2	59.4	"
245.0	803.8	15.3	59.5	"
250.0	820.2	15.3	59.6	"
255.0	836.6	15.4	59.7	"
260.0	853.0	15.5	59.8	"
265.0	869.4	15.5	59.9	"
270.0	885.8	15.6	60.0	"
275.0	902.2	15.6	60.1	"
280.0	918.6	15.7	60.2	"
285.0	935.0	15.7	60.3	"
290.0	951.4	15.8	60.4	"
295.0	967.8	15.8	60.5	"
300.0	984.3	15.9	60.6	"
305.0	1000.7	16.0	60.8	"
310.0	1017.1	16.0	60.8	"
315.0	1033.5	16.0	60.9	"
320.0	1049.9	16.1	60.9	"
325.0	1066.3	16.2	61.1	"
330.0	1082.7	16.2	61.2	"
335.0	1099.1	16.3	61.3	"
340.0	1115.5	16.4	61.5	"
345.0	1131.9	16.4	61.6	"
350.0	1148.3	16.5	61.7	"
355.0	1164.7	16.6	61.8	"
360.0	1181.1	16.6	61.9	"
365.0	1197.5	16.7	62.1	"
370.0	1213.9	16.8	62.2	"
375.0	1230.3	16.8	62.3	"
380.0	1246.7	16.9	62.4	"
385.0	1263.1	17.0	62.5	"
390.0	1279.5	17.0	62.7	"

Project:	**Snake Valley**	
Date Log:	**5-May-09**	
Well:	**UGS PW08B – Mormon Gap**	
Owner:	**Utah Geological Survey**	
Location:	**(C-24-19)13cbd**	
UTM.E	**245378**	**NAD83 Z12**
UTM.N	**4290162**	**NAD83 Z12**
Land Elev:	**5727 FT**	**1746 M**
Water Level:	**98.1 FT**	**29.9 M**

DEPTH (M)	DEPTH (FT)	T(°C)	T(°F)	LITH
10.0	32.8	13.74	56.7	PIPMe
20.0	65.6	13.52	56.3	"
30.0	98.4	13.18	55.7	"
31.0	101.7	13.19	55.7	"
35.0	114.8	13.28	55.9	"
40.0	131.2	13.40	56.1	"
45.0	147.6	13.50	56.3	"
50.0	164.0	13.59	56.5	"
55.0	180.5	13.67	56.6	"
60.0	196.9	13.77	56.8	"
65.0	213.3	13.85	56.9	"
70.0	229.7	13.92	57.1	"
75.0	246.1	14.00	57.2	"
80.0	262.5	14.09	57.4	"
85.0	278.9	14.18	57.5	"
90.0	295.3	14.27	57.7	"
95.0	311.7	14.38	57.9	"
100.0	328.1	14.47	58.1	"
105.0	344.5	14.57	58.2	"
110.0	360.9	14.66	58.4	"
115.0	377.3	14.77	58.6	"
120.0	393.7	14.88	58.8	"
121.0	397.0	14.89	58.8	"

Project:	**Snake Valley**	
Date Log:	**24-Sep-08**	
Well:	**UGS PW09B - E Eskdale**	
Owner:	**Utah Geological Survey**	
Location:	**(C-19-19)36daa**	
UTM.E:	**247055**	**NAD83 Z12**
UTM.N:	**4333088**	**NAD83 Z12**
Land Elev:	**5126 FT**	**1562 M**
Water Level:	**175.2 FT**	**53.4 M**

DEPTH (M)	DEPTH (FT)	T(°C)	T(°F)	LITH
10.0	32.8	17.42	63.36	Sl
20.0	65.6	16.26	61.27	"
30.0	98.4	16.15	61.06	"
40.0	131.2	16.08	60.95	"
50.0	164.0	16.10	60.98	"
55.0	180.4	15.88	60.58	"
60.0	196.9	15.94	60.69	"
65.0	213.3	16.01	60.82	"
70.0	229.7	16.08	60.94	"
75.0	246.1	16.14	61.06	"
80.0	262.5	16.22	61.20	"
85.0	278.9	16.31	61.35	"
90.0	295.3	16.39	61.50	"
95.0	311.7	16.47	61.65	"
100.0	328.1	16.55	61.78	"
105.0	344.5	16.63	61.94	"
110.0	360.9	16.72	62.09	"
115.0	377.3	16.78	62.21	"
120.0	393.7	16.86	62.34	"
125.0	410.1	16.92	62.46	"
130.0	426.5	16.98	62.57	"
135.0	442.9	17.04	62.67	"
140.0	459.3	17.10	62.78	"
145.0	475.7	17.15	62.88	"
150.0	492.1	17.21	62.98	"
155.0	508.5	17.27	63.09	"
160.0	524.9	17.36	63.25	"
165.0	541.3	17.45	63.42	"
170.0	557.7	17.55	63.58	"
175.0	574.1	17.63	63.74	"
180.0	590.6	17.72	63.89	"
185.0	607.0	17.79	64.03	"
190.0	623.4	17.86	64.15	"
195.0	639.8	17.93	64.27	"
200.0	656.2	18.00	64.40	"
205.0	672.6	18.08	64.54	"
210.0	689.0	18.15	64.67	"
215.0	705.4	18.22	64.80	"
220.0	721.8	18.33	64.99	"
225.0	738.2	18.43	65.18	Sl
230.0	754.6	18.54	65.37	"
235.0	771.0	18.65	65.57	"
240.0	787.4	18.76	65.77	"
245.0	803.8	18.88	65.99	"
250.0	820.2	19.00	66.19	"
255.0	836.6	19.11	66.40	"
260.0	853.0	19.23	66.61	"
265.0	869.4	19.34	66.81	"
267.5	877.6	19.39	66.91	"

Project:	**Snake Valley**	
Date Log:	**7-Aug-08**	
Well:	**UGS PW10A - E Cowboy Pass**	
Owner:	**Utah Geological Survey**	
Location:	**(C-17-16)16cdc**	
UTM.E	**271128**	**NAD83 Z12**
UTM.N	**4356072**	**NAD83 Z12**
Land Elev:	**5266 FT**	**1605 M**
Water Level:	**544 FT**	**166 M**

DEPTH (M)	DEPTH (FT)	T(°C)	T(°F)	LITH
20.0	65.6	19.34	66.82	QTs
40.0	131.2	17.73	63.92	"
60.0	196.9	16.98	62.56	"
80.0	262.5	16.28	61.30	"
100.0	328.1	15.77	60.38	PIPMe
120.0	393.7	15.42	59.76	"
140.0	459.3	15.11	59.19	"
150.0	492.1	15.03	59.05	"
155.0	508.5	15.01	59.02	"
160.0	524.9	15.02	59.03	"
165.0	541.3	15.04	59.07	"
170.0	557.7	15.10	59.18	"
175.0	574.1	15.17	59.30	"
180.0	590.6	15.24	59.43	"
185.0	607.0	15.33	59.60	"
190.0	623.4	15.46	59.83	"
195.0	639.8	15.58	60.05	"
200.0	656.2	15.68	60.22	"

Project:	**Snake Valley**	
Date Log:	**5-May-09**	
Well:	**UGS PW11E - The Cove**	
Owner:	**Utah Geological Survey**	
Location:	**(C-24-19)16bdb**	
UTM.E	**240794**	**NAD83 Z12**
UTM.N	**4290850**	**NAD83 Z12**
Land Elev:	**5659 FT**	**1725 M**
Water Level:	**210 FT**	**64.1 M**

DEPTH (M)	DEPTH (FT)	T(°C)	T(°F)	LITH
10.0	32.8	14.2	57.5	QTs
20.0	65.6	13.9	57.0	"
30.0	98.4	13.8	56.9	"
40.0	131.2	13.9	57.0	"
50.0	164.0	14.0	57.1	"
60.0	196.9	14.1	57.3	"
65.0	213.3	14.1	57.4	"
70.0	229.7	14.2	57.5	"
75.0	246.1	14.3	57.7	"
80.0	262.5	14.4	57.8	"
85.0	278.9	14.4	58.0	"
90.0	295.3	14.5	58.2	"
95.0	311.7	14.6	58.3	"
100.0	328.1	14.7	58.5	"
105.0	344.5	14.8	58.7	"
110.0	360.9	14.9	58.8	"
115.0	377.3	15.0	59.0	"
120.0	393.7	15.1	59.2	"
125.0	410.1	15.2	59.4	"
130.0	426.5	15.3	59.6	"
135.0	442.9	15.4	59.8	"
140.0	459.3	15.6	60.0	"
145.0	475.7	15.6	60.2	"
150.0	492.1	15.7	60.3	PIPMe
155.0	508.5	15.8	60.5	"
160.0	524.9	15.9	60.7	"
165.0	541.3	16.0	60.8	"
170.0	557.7	16.1	61.0	"
175.0	574.1	16.2	61.2	"
180.0	590.6	16.3	61.3	"
185.0	607.0	16.4	61.5	"
190.0	623.4	16.4	61.6	"
195.0	639.8	16.5	61.8	"
200.0	656.2	16.6	61.9	"
205.0	672.6	16.7	62.1	"
210.0	689.0	16.8	62.2	"
215.0	705.4	16.9	62.4	"
220.0	721.8	17.0	62.6	"
225.0	738.2	17.1	62.7	"
230.0	754.6	17.1	62.8	"
235.0	771.0	17.2	62.9	PIPMe
240.0	787.4	17.2	63.0	"
245.0	803.8	17.3	63.2	"
250.0	820.2	17.4	63.3	"
255.0	836.6	17.5	63.4	"
260.0	853.0	17.5	63.6	"
265.0	869.4	17.6	63.7	"
270.0	885.8	17.7	63.9	"
275.0	902.2	17.8	64.0	"
280.0	918.6	17.8	64.1	"
285.0	935.0	17.9	64.2	"
290.0	951.4	18.0	64.3	"
295.0	967.8	18.0	64.4	"
300.0	984.3	18.1	64.5	"
305.0	1000.7	18.1	64.7	"
310.0	1017.1	18.2	64.8	"
315.0	1033.5	18.3	64.9	"
320.0	1049.9	18.4	65.1	"
325.0	1066.3	18.5	65.2	"
330.0	1082.7	18.5	65.3	"
335.0	1099.1	18.6	65.5	"
340.0	1115.5	18.7	65.7	"
345.0	1131.9	18.7	65.7	"
350.0	1148.3	18.8	65.8	"
350.8	1150.9	18.8	65.8	"

Project:	**Snake Valley**	
Date Log:	**24-Sep-08**	
Well:	**UGS PW12A - Little Valley**	
Owner:	**Utah Geological Survey**	
Location:	**(C-19-17)36bca**	
UTM.E:	**265351**	**NAD83 Z12**
UTM.N:	**4333096**	**NAD83 Z12**
Land Elev:	**5851 FT**	**1783 M**
Water Level:	**1425.0 FT**	**434.3 M**

DEPTH (M)	DEPTH (FT)	T(°C)	T(°F)	LITH
10.0	32.81	15.71	60.27	Dg
20.0	65.62	14.78	58.60	"
30.0	98.43	14.53	58.16	"
40.0	131.23	14.44	57.99	"
50.0	164.04	14.14	57.46	"
60.0	196.85	14.07	57.33	"
70.0	229.66	14.34	57.81	"
80.0	262.47	14.67	58.41	"
90.0	295.28	14.75	58.55	"
100.0	328.08	14.99	58.99	"
110.0	360.89	15.28	59.51	"
120.0	393.70	15.66	60.18	"
130.0	426.51	15.92	60.66	"
140.0	459.32	16.19	61.14	"
150.0	492.13	16.77	62.19	"
160.0	524.93	17.20	62.96	"
180.0	590.55	17.47	63.44	"
200.0	656.17	18.16	64.68	"
220.0	721.78	19.75	67.55	"
240.0	787.40	19.96	67.93	"
260.0	853.02	20.56	69.00	"
280.0	918.64	21.50	70.70	"
300.0	984.25	22.80	73.05	"
320.0	1049.87	23.94	75.09	"
340.0	1115.49	24.86	76.75	"
360.0	1181.10	25.84	78.52	"
380.0	1246.72	27.14	80.85	"
400.0	1312.34	28.88	83.98	"
420.0	1377.95	31.53	88.76	"
430.0	1410.76	32.66	90.80	"
435.0	1427.17	33.74	92.74	"
440.0	1443.57	34.00	93.20	"
450.0	1476.38	34.48	94.06	"
460.0	1509.19	34.81	94.66	"
470.0	1541.99	35.01	95.01	"
480.0	1574.80	35.17	95.30	"
490.0	1607.61	35.15	95.26	"
495.0	1624.02	35.14	95.25	"

Project:	**Snake Valley**	
Date Log:	**5-May-09**	
Well:	**UGS AG13C Garrison Ag**	
Owner:	**Utah Geological Survey**	
Location:	**(C-21-20)36ddd**	
UTM.E:	**757087**	**NAD83 Z11**
UTM.N:	**4314476**	**NAD83 Z11**
Land Elev:	**5262 FT**	**1604 M**
Water Level:	**73.0 FT**	**22.3 M**

DEPTH (M)	T(°C)	DEPTH (FT)	T(°F)	LITH
10.0	15.12	32.81	59.21	QTs
20.0	14.11	65.62	57.40	"
25.0	12.98	82.02	55.36	"
30.0	12.87	98.43	55.16	"
35.0	12.78	114.83	55.00	"
40.0	12.68	131.23	54.82	"
45.0	12.61	147.64	54.69	"
50.0	12.54	164.04	54.58	"
55.0	12.51	180.45	54.51	"
60.0	12.49	196.85	54.48	"
65.0	12.47	213.25	54.45	"
70.0	12.47	229.66	54.45	"
75.0	12.48	246.06	54.46	"
80.0	12.49	262.47	54.48	"
85.0	12.50	278.87	54.49	"
90.0	12.50	295.28	54.50	"
95.0	12.53	311.68	54.55	"
96.0	12.54	314.96	54.58	"

Project:	**Snake Valley**	
Date Log:	**5-May-09**	
Well:	**UGS AG14C Eskdale Ag**	
Owner:	**Utah Geological Survey**	
Location:	**(C-20-19)16aaa**	
UTM.E:	**242121**	**NAD83 Z12**
UTM.N:	**4329196**	**NAD83 Z12**
Land Elev:	**5010 FT**	**1527 M**
Water Level:	**18 FT**	**5.5 M**

DEPTH (M)	T(°C)	DEPTH (FT)	T(°F)	LITH
10.0	13.86	32.8	56.95	QTs
15.0	13.94	49.2	57.09	"
20.0	13.92	65.6	57.06	"
25.0	13.93	82.0	57.07	"
30.0	13.93	98.4	57.08	"
35.0	13.94	114.8	57.09	"
40.0	13.96	131.2	57.12	"
45.0	13.96	147.6	57.14	"
50.0	13.98	164.0	57.17	"
55.0	14.00	180.4	57.20	"
60.0	14.03	196.9	57.25	"
65.0	14.05	213.3	57.29	"
70.0	14.07	229.7	57.32	"
75.0	14.09	246.1	57.36	"
80.0	14.14	262.5	57.45	"
85.0	14.15	278.9	57.47	"
90.0	14.17	295.3	57.50	"
95.0	14.18	311.7	57.52	"
96.5	14.18	316.6	57.52	"

Project:	**Snake Valley**	
Date Log:	**5-May-09**	
Well:	**UGS AG15A GPR Ag**	
Owner:	**Utah Geological Survey**	
Location:	**(C-24-20)abd**	
UTM.E:	**756525**	**NAD 83 Z11**
UTM.N:	**4290924**	**NAD 83 Z11**
Land Elev:	**5528 FT**	**1685 M**
Water Level:	**78 FT**	**23.79 M**

DEPTH (M)	T(°C)	DEPTH (FT)	T(°F)	LITH
10	13.98	32.8	57.2	QTs
20	13.23	65.6	55.8	"
25	11.61	82.0	52.9	"
30	11.52	98.4	52.7	"
35	11.50	114.8	52.7	"
40	11.49	131.2	52.7	"
45	11.48	147.6	52.7	"
50	11.48	164.0	52.7	"
54.6	11.48	179.1	52.7	"

Project:	**Snake Valley**	
Date Log:	**5-May-09**	
Well:	**UGS AG16C Davies Ranch**	
Owner:	**Utah Geological Survey**	
Location:	**(C-23-19)20cac**	
UTM.E:	**759724**	**NAD83 Z11**
UTM.N:	**4298692**	**NAD83 Z11**
Land Elev:	**5415 FT**	**1651 M**
Water Level:	**14 FT**	**4.27 M**

DEPTH (M)	T(°C)	DEPTH (FT)	T(°F)	LITH
5	12.06	16.40	53.71	QTs
10	11.93	32.81	53.48	"
15	12.06	49.21	53.71	"
20	12.06	65.62	53.71	"
25	11.98	82.02	53.56	"
30	11.94	98.43	53.49	"
35	11.98	114.83	53.57	"
40	12.05	131.23	53.69	"
45	12.14	147.64	53.85	"
50	12.26	164.04	54.06	"
55	12.38	180.45	54.29	"
60	12.51	196.85	54.51	"
65	12.65	213.25	54.76	"
70	12.78	229.66	55.01	"
75	12.92	246.06	55.26	"
80	13.07	262.47	55.52	"
85	13.22	278.87	55.79	"
90	13.38	295.28	56.08	"
95	13.52	311.68	56.34	"

Project:	**Snake Valley**	
Date Log:	**6-May-09**	
Well:	**UGS PW17C Coyote Knolls**	
Owner:	**Utah Geological Survey**	
Location:	**(C-15-15)32aab**	
UTM.E	**280583**	**NAD83 Z12**
UTM.N	**4372921**	**NAD83 Z12**
Land Elev:	**4507 FT**	**1374 M**
Water Level:	**84 FT**	**25.6 M**

DEPTH (M)	T(°C)	DEPTH (FT)	T(°F)	LITH
20	16.15	65.6	61.07	Sl
26	15.87	85.3	60.57	"
30	15.95	98.4	60.72	"
35	16.12	114.8	61.02	"
40	16.27	131.2	61.29	"
45	16.41	147.6	61.54	"
50	16.55	164.0	61.78	Oes
55	16.68	180.4	62.02	"
60	16.82	196.9	62.27	"
65	16.95	213.3	62.51	"
70	17.08	229.7	62.74	"
75	17.20	246.1	62.97	"
80	17.32	262.5	63.17	"
85	17.42	278.9	63.36	"
90	17.52	295.3	63.54	"
95	17.62	311.7	63.72	"
100	17.73	328.1	63.92	"
105	17.83	344.5	64.10	"
110	17.94	360.9	64.28	"
115	18.04	377.3	64.47	"
120	18.15	393.7	64.67	"
125	18.26	410.1	64.88	"
130	18.38	426.5	65.09	"
135	18.49	442.9	65.29	"
140	18.57	459.3	65.43	"
145	18.66	475.7	65.58	"
150	18.76	492.1	65.77	"
155	18.86	508.5	65.96	"
160	18.96	524.9	66.13	"
165	19.04	541.3	66.27	"
170	19.11	557.7	66.39	"
175	19.13	574.1	66.44	"

Project:	**Snake Valley**	
Date Log:	**6-May-09**	
Well:	**UGS PW18A NW Middle Range**	
Owner:	**Utah Geological Survey**	
Location:	**(C-13-16)abb**	
UTM.E	**271050**	**NAD83 Z12**
UTM.N	**4392744**	**NAD83 Z12**
Land Elev:	**5185 FT**	**1580 M**
Water Level:	**757 FT**	**230.9 M**

DEPTH (M)	T(°C)	DEPTH (FT)	T(°F)	LITH
20	17.87	65.62	64.17	Dg
40	19.50	131.23	67.10	"
60	21.60	196.85	70.89	"
80	24.14	262.47	75.44	"
100	26.85	328.08	80.32	"
120	29.53	393.70	85.15	"
140	32.46	459.32	90.43	"
160	35.43	524.93	95.77	"
180	38.19	590.55	100.74	"
200	40.69	656.17	105.24	"
220	42.87	721.78	109.17	"
230	43.92	754.59	111.06	"
235	44.45	771.00	112.00	"
240	44.86	787.40	112.74	"
245	45.15	803.81	113.27	"
250	45.41	820.21	113.74	"
255	45.63	836.61	114.13	"
260	45.80	853.02	114.44	"
265	45.95	869.42	114.71	"
270	46.08	885.83	114.94	"
275	46.22	902.23	115.20	"
280	46.36	918.64	115.45	"
285	46.52	935.04	115.74	"
290	46.67	951.44	116.01	"
295	46.81	967.85	116.25	"
300	46.92	984.25	116.45	"
302	46.97	990.81	116.54	"

Project:	**Snake Valley**	
Date Log:	**6-May-09**	
Well:	**UGS PW19C Table Knoll**	
Owner:	**Utah Geological Survey**	
Location:	**(C-14-13)02adb**	
UTM.E	**305089**	**NAD83 Z12**
UTM.N	**4389630**	**NAD83 Z12**
Land Elev:	**4635 FT**	**1413 M**
Water Level:	**198 FT**	**60.4 M**

DEPTH (M)	T(°C)	DEPTH (FT)	T(°F)	LITH
20.0	21.56	65.62	70.81	QTs
40.0	25.87	131.23	78.57	QTs/Tv
60.0	31.53	196.85	88.75	Cnp
65.0	32.49	213.25	90.49	"
70.0	32.90	229.66	91.21	"
75.0	33.28	246.06	91.90	"
80.0	33.57	262.47	92.43	Co
85.0	34.11	278.87	93.39	"
90.0	34.52	295.28	94.14	"
95.0	34.97	311.68	94.94	"
100.0	35.51	328.08	95.93	"
105.0	35.37	344.49	95.66	"
110.0	35.17	360.89	95.31	"
115.0	35.07	377.30	95.13	"
120.0	35.03	393.70	95.05	"
125.0	35.02	410.10	95.04	"
130.0	35.04	426.51	95.08	"
135.0	35.09	442.91	95.17	"
139.0	35.13	456.04	95.24	"

Project:	**Snake Valley**	
Date Log:	**6-May-09**	
Well:	**UGS PW20A Sand Pass**	
Owner:	**Utah Geological Survey**	
Location:	**(C-14-14)10acb**	
UTM.E:	**293515**	**NAD83 Z12**
UTM.N:	**4388419**	**NAD83 Z12**
Land Elev:	**4717 FT**	**1438 M**
Water Level:	**89.4 M**	**293 FT**

DEPTH (M)	T(°C)	DEPTH (FT)	T(°F)	LITH
20.0	18.4	65.6	65.2	QTs/Cpo/FZ
40.0	19.7	131.2	67.4	Ch
60.0	20.6	196.9	69.0	Cpm
80.0	22.0	262.5	71.5	FZ
90.0	22.7	295.3	72.9	Cpm
95.0	22.9	311.7	73.3	"
100.0	23.2	328.1	73.7	"
105.0	23.4	344.5	74.0	"
110.0	23.5	360.9	74.4	"
115.0	23.7	377.3	74.7	"
120.0	23.9	393.7	75.1	"
125.0	24.1	410.1	75.4	"
130.0	24.3	426.5	75.8	"
135.0	24.5	442.9	76.0	"
140.0	24.6	459.3	76.3	"
145.0	24.8	475.7	76.6	"
150.0	24.9	492.1	76.8	"
155.0	25.0	508.5	77.0	"
160.0	25.2	524.9	77.3	"
165.0	25.3	541.3	77.5	"
170.0	25.4	557.7	77.8	"
172.0	25.4	564.3	77.8	"

Project:	**Snake Valley**	
Date Log:	**6-May-09**	
Well:	**UGS SG21C Fish Springs North**	
Owner:	**Utah Geological Survey**	
Location:	**(C-11-14)03dca**	
UTM.E:	**293644**	**NAD83 Z12**
UTM.N:	**4417952**	**NAD83 Z12**
Land Elev:	**4310 FT**	**1314 M**
Water Level:	**3.9 FT**	**1.2 M**

DEPTH (M)	T(°C)	DEPTH (FT)	T(°F)	LITH
5.0	21.1	16.4	69.9	QTs
10.0	22.7	32.8	72.9	Sl(?)
15.0	23.1	49.2	73.6	"
19.6	23.1	64.3	73.7	"

Project:	**Snake Valley**	
Date Logged:	**6-May-09**	
Well:	**UGS SG24C Twin Spring**	
Owner:	**Utah Geological Survey**	
Location:	**(C-16-18)22cab**	
UTM.E:	**253481**	**NAD83 Z12**
UTM.N:	**4365465**	**NAD83 Z12**
Land Elev:	**4820 FT**	**1469 M**
Water Level:	**2.2 FT**	**0.7 M**

DEPTH (M)	T(°C)	DEPTH (FT)	T(°F)	LITH
5.0	12.86	16.40	55.15	QTs
10.0	14.80	32.81	58.63	"
15.0	15.37	49.21	59.66	"
20.0	15.71	65.62	60.29	"
25.0	15.97	82.02	60.74	"
30.0	16.19	98.43	61.13	"
34.7	16.35	113.85	61.43	"

Note: adjacent pool temp 18°C (64°F),and other Twin spg overflow was 20°C (68°F)

Project:	**Snake Valley**
Date Log:	**6-May-09**
Well:	**UGS SG25C Leland Harris North Spr.**
Owner:	**Utah Geological Survey**
Location:	**(C-14-18)29ddd or (C-14-18)32aaa**
UTM.E:	**251562 NAD83 Z12**
UTM.N:	**4382770 NAD83 Z12**
Land Elev:	**4789 FT 1460 M**
Water Level:	**near surface**

DEPTH (M)	T(°C)	DEPTH (FT)	T(°F)	LITH
5	11.54	16.40	52.76	QTs
10	13.13	32.81	55.63	"
15	13.70	49.21	56.65	"
20	14.11	65.62	57.40	"
25	14.23	82.02	57.62	"
30	14.43	98.42	57.98	"
35	14.73	114.83	58.52	"
35.5	14.74	116.47	58.54	"