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SOUTHERN NEVADA WATER AUTHORITY

Water Resources Division

Delamar, Dry Lake, and Cave Valleys Stipulation Agreement Hydrologic Monitoring Plan Status and Historical Data Report

September 2009

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Executive Committee

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ACRONYMS

AR	Activity Ratio
BLM	Bureau of Land Management
BRT	Biological Resource Team
DDC	Delamar, Dry Lake, and Cave valleys
DOI	U.S. Department of the Interior
DRI	Desert Research Institute
EC	Executive Committee
EPA	U.S. Environmental Protection Agency
GMWL	global meteoric water line
GPS	Global Positioning System
HA	hydrographic area
JFA	Joint Funding Agreement
MCL	maximum contaminant level
NAD83	North American Datum of 1983
NAVD88	North American Vertical Datum of 1988
NDOW	Nevada Department of Wildlife
NDWR	Nevada Division of Water Resources
NOAA	National Oceanic and Atmospheric Administration
NRCS	Natural Resources Conservation Service
NSE	Nevada State Engineer
NWS	National Weather Service
SNOTEL	SNOwpack TELemetry
SNWA	Southern Nevada Water Authority
SR	State Route
TRP	Technical Review Panel
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
UTM	Universal Transverse Mercator

ABBREVIATIONS

°C	degrees Celsius
afy	acre-feet per year
amsl	above mean sea level
bgs	below ground surface

ABBREVIATIONS (CONTINUED)

cfs	cubic feet per second
cm	centimeter
ft	foot
ft^3	cubic foot
gal	gallon
gpm	gallons per minute
in.	inch
L	liter
m	meter
Ma	million years
mg	milligram
mi	mile
mi^2	square mile
mS	millisiemens
µg	microgram
µm	micrometer
µmho	micromho
µS	microsiemen
pmc	percent modern carbon

1.0 INTRODUCTION

The Southern Nevada Water Authority (SNWA) prepared this report to present the current status of each element of the Hydrologic Monitoring, Management and Mitigation Plan for Delamar, Dry Lake, and Cave Valley (DDC) hydrographic basins. This report also includes descriptions and historical data from the hydrologic monitoring network, which was revised and expanded in 2008. The first *Delamar, Dry Lake, and Cave Valley Stipulation Agreement Hydrologic Monitoring Plan Status and Data Report* (SNWA, 2008b) documented data collected in 2007 and historical data from selected DDC existing monitor wells.

1.1 Background

SNWA holds groundwater rights in DDC for municipal and domestic purposes under Permits 53987 through 53992 for the appropriation of groundwater resources in DDC. These permits were granted by the Nevada State Engineer (NSE) in Ruling Number 5875 (Ruling) issued on July 9, 2008. The total combined duty under Permits 53987 and 53988 located in Cave Valley is limited to 4,678 afy. The total combined duty under Permits 53989 and 53990 located in Dry Lake Valley is limited to 11,584 afy. The total combined duty under Permits 53991 and 53992 located in Delamar Valley is limited to 2,493 afy.

On January 7, 2008, prior to the water-right application hearing, a Stipulation for Withdrawal of Protests (Stipulation) was established between SNWA and the U.S. Department of the Interior (DOI), on behalf of the Bureau of Indian Affairs, the Bureau of Land Management (BLM), the National Park Service, and the U.S. Fish and Wildlife Service (USFWS) (collectively known as the DOI Bureaus). The Stipulation requires that SNWA implement a hydrologic monitoring, management, and mitigation plan, which is presented in Exhibit A of the Stipulation. The location of the DDC area of interest as presented in the Stipulation is presented in Figure 1-1. As part of the Stipulation, an Executive Committee (EC) was established to oversee its implementation. A Technical Review Panel (TRP), composed of representatives of parties to the agreement, was also established to develop and oversee the implementation of the hydrologic monitoring, management, and mitigation plan, review program data, and modify the plan, if necessary.

The TRP, in consultation with the NSE, developed a hydrologic monitoring program, which was finalized in January 2009, that meets the requirements of the Stipulation and Ruling. The program is summarized in this document. An annual DDC hydrologic monitoring plan status and data report is planned to be submitted each year in the future to the EC and NSE to meet the reporting requirements of the Stipulation and NSE.

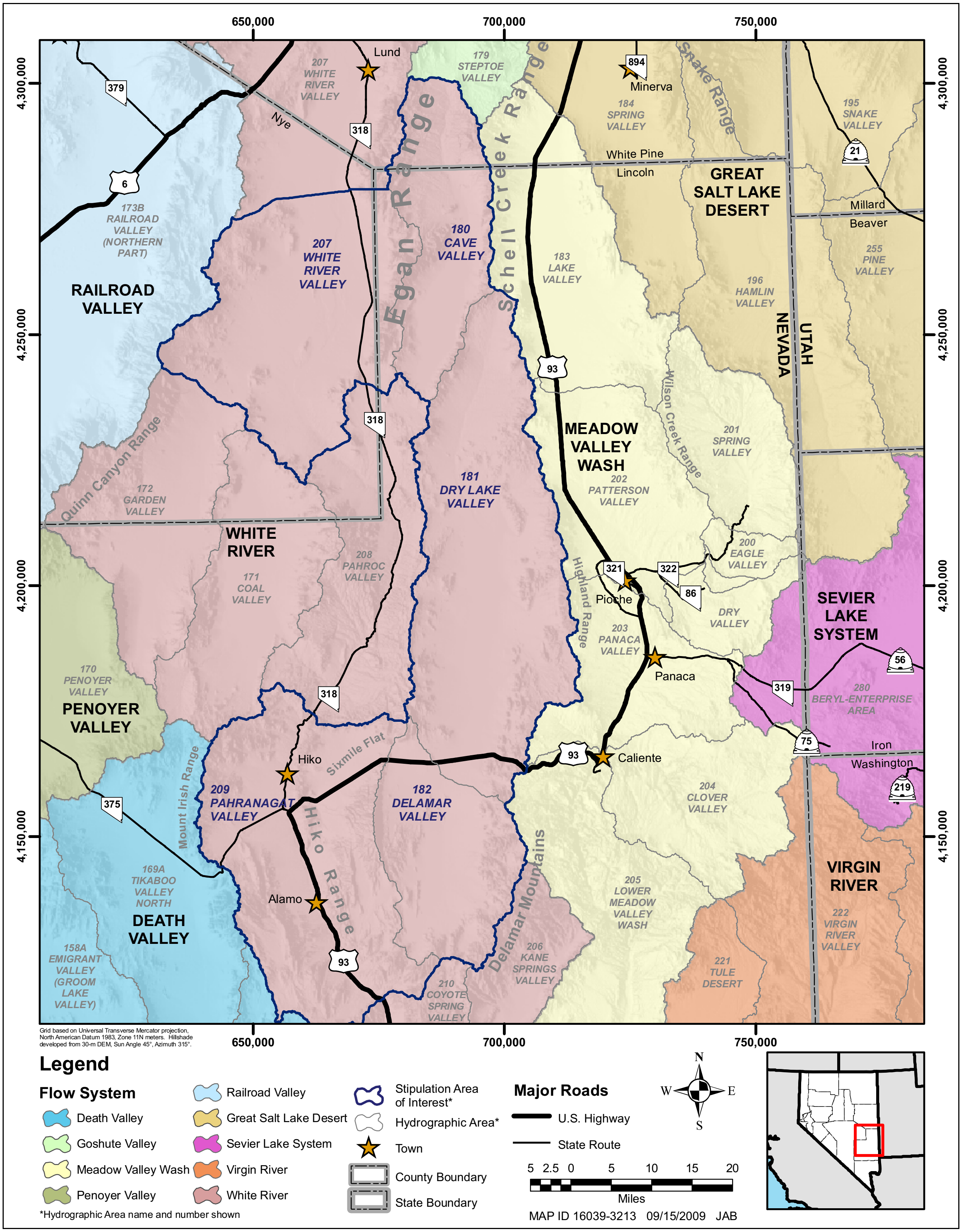


Figure 1-1
Stipulation Area of Interest

1.2 Hydrologic Monitoring Plan Requirements and Status

The Stipulation hydrologic monitoring plan's primary requirements and current status are presented below:

- Identify 15 existing wells to be monitored by SNWA, including groundwater-level data collection from nine existing wells quarterly and six existing wells continuously. The six monitor wells identified for continuous measurement will be equipped with data loggers and pressure transducer instrumentation as required. Existing wells were selected by the TRP, in consultation with the NSE, to meet this requirement. Appropriate site access will be requested for wells included in the network. Historical data on these wells are included in this report.

- Construct and equip up to four new monitor wells located in or around DDC and adjacent basins for the purpose of long-term monitoring. The TRP, in consultation with the NSE, selected two new and one contingency well site locations. The contingency site is dependent upon the results of an exploratory well (DEL4003X). Well DEL4003X may be used as a monitor well, depending upon the hydrogeologic conditions encountered. One additional new monitor well is being kept as a reserve and may be located, if needed, after the production network configuration is determined. Right-of-way access for the new sites is being requested through BLM.

- Continue spring discharge monitoring at five springs (Flag Springs Complex, Hot Creek, Moorman, Ash, and Crystal springs) currently being monitored through a cooperative Joint Funding Agreement (JFA) between SNWA, the U.S. Geological Survey (USGS), and the Nevada Division of Water Resources (NDWR). Future monitoring will be performed through the JFA or directly by SNWA. USFWS will monitor Cottonwood Spring and provide data to the TRP.

- Evaluate the technical feasibility and property access of three additional springs (Hiko, Hardy, and Maynard springs). SNWA installed a continuous recording flow meter on the pipeline from Hiko Spring in June 2009 to measure discharge. SNWA also installed a flume for biannual monitoring at Hardy Springs in August 2009. Maynard Spring will be observed and existing piezometers will be measured biannually by SNWA.

- Monitor biannually eight springs within DDC that were selected by the TRP, in consultation with the NSE. These springs consist of Grassy, Coyote, Big Mud, Littlefield, Cave, Parker Station, Lewis Well, and Silver King Well. Meloy Spring was identified as an alternate to Littlefield Spring if property access is obtained. Spring monitoring will begin in fall 2009.

- Perform a 72-hour constant-rate aquifer test on all future DDC production test wells.

- Perform two water-chemistry sampling events and analyze 10 locations per event. This process would be repeated every five years after groundwater extraction begins. The sampling event is anticipated to be performed after completion of the new monitor wells.

- Identify a precipitation station network in the vicinity of DDC. SNWA will compile and report data from the stations as made available by the owners/operators of the stations.

SNWA continues to collect continuous and periodic groundwater data from the existing monitor and exploratory well network, which began in mid-2007. The preliminary network was described in SNWA (2008b). The monitoring network was revised and expanded by the TRP to meet the Stipulation hydrologic monitoring plan's objectives and requirements. SNWA also established a shared data-repository website to provide TRP and NSE with updates on activities, reports, and data collected as part of the plan.

1.3 Report Scope

Section 2.0 of this report presents the groundwater monitoring network and historical water-level data collected to date. Section 3.0 contains a description of the spring monitoring network, physical setting, and historical discharge data. Section 4.0 describes the precipitation network and associated historical data. Section 5.0 presents water-chemistry data associated with the groundwater and spring monitoring networks. Section 6.0 lists activities associated with the monitoring plan anticipated to be performed in 2009 and 2010. Section 7.0 documents report references.

2.0 Monitor Well Network

Data collected under the Stipulation hydrologic monitoring plan provide representative hydrologic data on the regional and local DDC aquifer systems. The monitor well network was developed in consultation with the TRP and NSE to (1) serve as long-term monitoring points between SNWA's future production wells and existing water-right holders and Federal water rights and resources; (2) provide spatially distributed hydrologic data from basin-fill, carbonate-rock, and volcanic aquifers within DDC and adjacent hydrographic areas to analyze and produce annual groundwater-level contour and water-level drawdown maps; (3) provide groundwater flow model calibration observations; and (4) evaluate the effects of SNWA's groundwater withdrawals.

Monitor well locations were selected with consideration of hydrogeologic conditions at each location. Geologic reconnaissance, stratigraphic and structural field mapping, aerial photo analysis, surface geophysics, and existing hydrogeologic data review were performed to assist in well selection.

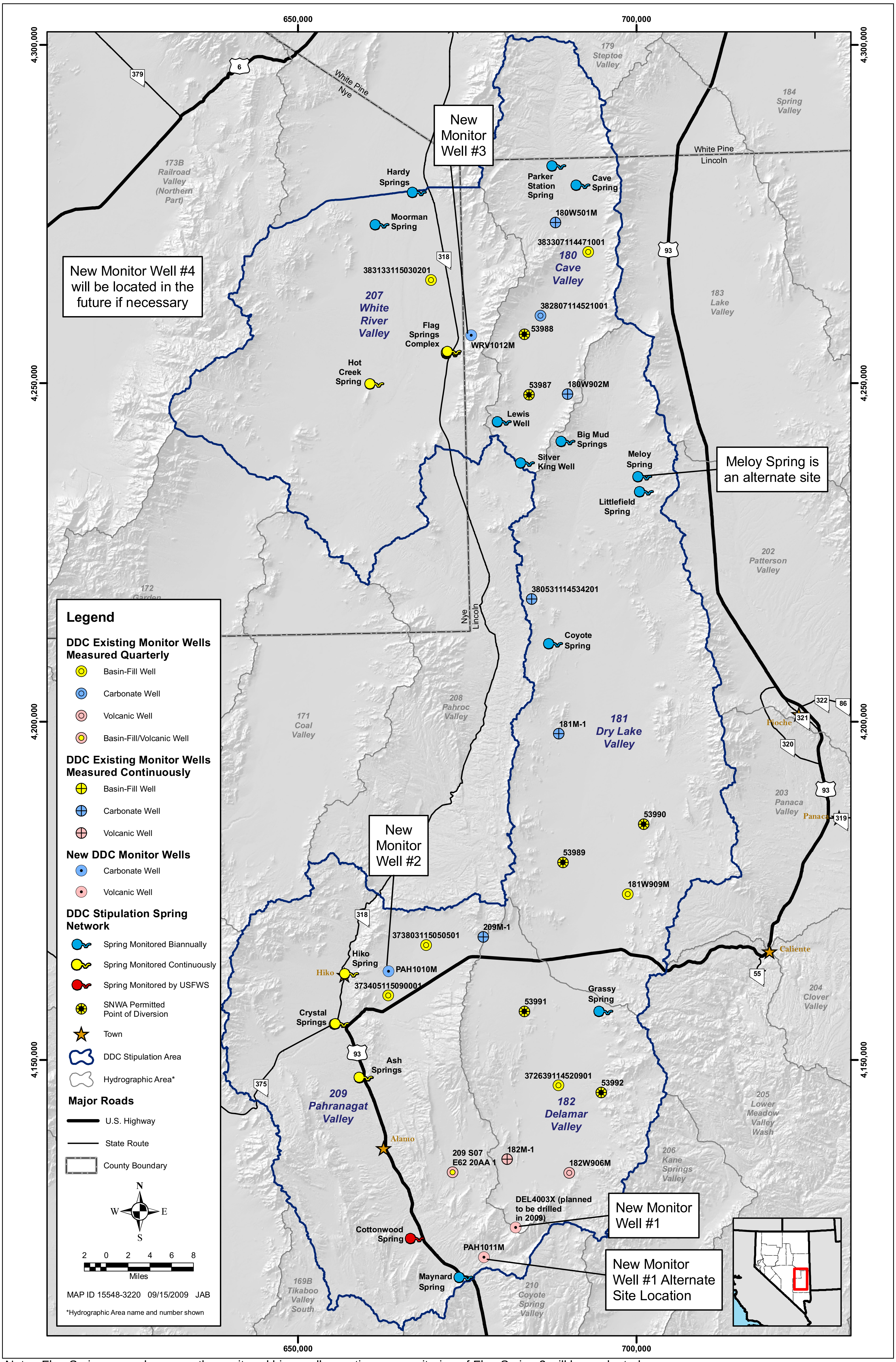
2.1 Regional Hydrogeologic Setting

The regional hydrogeologic framework and a summary of the results of previous studies have been presented in several reports. The primary reports presenting the regional hydrogeology related to the groundwater monitoring network include *Geology of White Pine and Lincoln Counties and Adjacent Areas, Nevada and Utah—The Geologic Framework of Regional Groundwater Flow Systems* (Dixon et al., 2007) and *Baseline Characterization Report for Clark, Lincoln, and White Pine Counties Groundwater Development Project* (SNWA, 2008a). These reports describe the regional hydrogeologic setting and present geologic cross sections and potentiometric surface maps of the study area.

2.2 Existing Monitor Well Network

The TRP modified and expanded the preliminary DDC monitor well network. The expanded network includes seven SNWA wells, three private wells, four USGS-MX wells, and one BLM well. SNWA will record periodic water levels quarterly in nine and continuously in six representative monitor wells in DDC and adjacent hydrographic areas. The locations of the monitor wells are shown on Figure 2-1. Well location coordinates, construction attributes, and monitoring frequency are presented in Table 2-1. A professional survey of location coordinates, ground-surface elevations, and top-of-casing measuring-point elevations of most of the wells was completed in 2008. Surveys of the remaining wells that compose the monitoring network will be performed after obtaining property access.

SNWA constructed its seven monitor wells associated with this program in 2005. These consist of four 6-in.-diameter and three 12-in.-diameter monitor wells in Delamar, Dry Lake, Cave, and



Note: Flag Springs complex currently monitored biannually; continuous monitoring of Flag Spring 2 will be evaluated.

Figure 2-1
DDC Monitor Well and Spring Network

Table 2-1
DDC Existing Well Monitoring Network

Site Number	Station Local Number	Location: UTM[a] Northing (m)	Location: UTM[a] Easting (m)	Surface Elevation (ft amsl)	Completion Date	Drill Depth (ft bgs)	Well Depth (ft bgs)	Well Casing Diameter (in.)	Screened Interval (ft bgs)	Open Interval (ft bgs)	Aquifer	Monitor Frequency
180W902M	180W902M	4,248,355.594	689,816.075	5,984.889	10/18/2005	915	903	12	196-882	77-915	Carbonate	Continuous
382807114521001	180 N07 E63 14BADD 1 USGS-MX	4,259,963.148	685,737.555	6,012.388	9/30/1980	460	460	10	210-250, 375-435	190-460	Carbonate[b]	Quarterly
383307114471001	180 N08 E64 15BCBC1 USBLM (Harris Well)	4,269,378.233	692,859.569	6,162.553	---	---	---	7	---	---	Basin Fill	Quarterly
180W501M	180W501M	4,273,712.794	687,971.032	6,428.634	9/25/2005	1,215	1,212	7	788-1,192	54-1,215	Carbonate	Continuous
182W906M	182W906M	4,133,304.570	690,065.209	4,796.956	9/2/2005	1,735	1,703	6	1,275-1,678	128-1,735	Volcanic	Quarterly
182M-1	182M-1	4,135,293.370	680,867.319	4,597.775	7/10/2005	1,345	1,331	12	1,007-1,290	58-1,345	Volcanic	Continuous
372639114520901	182 S06 E63 12AD 1 USGS-MX	4,146,220.241	688,472.411	4,706.299	5/10/1980	1,215	1,195	10	920-980, 1,040-1,180	10-1,215	Basin Fill	Quarterly[c]
181W909M	181W909M	4,174,462.589	698,676.168	4,799.409	10/17/2007	1,285	1,260	12	637-1,240	183-1,285	Basin Fill	Quarterly
181M-1	181M-1	4,198,199.898	688,534.985	4,963.074	8/30/2005	1,501	1,472	6	765-1,451	59-1,501	Carbonate	Continuous
380531114534201	181 N03 E63 27CAA 1 USGS-MX	4,218,085.093	683,720.322	5,456.348	1/1/1981	2,395	2,395	9	935-2,395	---	Carbonate	Continuous[c]
209 S07 E62 20AA 1[d]	209 S07 E62 20AA 1 (Dean Turley Well)	4,133,610.322	672,648.881	4,082.464	1/10/1981	695	695	8	600-695	55-695	Basin Fill/ Volcanic	Quarterly
373405115090001[d]	209 S04 E61 28CD 1	4,159,504.384	663,314.660	4,230.577	6/22/1965	1,314	980	12	---	52-1,143	Basin Fill/ Volcanic	Quarterly
373803115050501[d]	209 S04 E61 01AACB1	4,166,944.288	668,927.028	4,528.895	---	---	700	8	---	---	Basin Fill	Quarterly
209M-1	209M-1	4,168,065.785	677,323.461	5,097.298	8/4/2005	1,616	1,616	6	1,274-1,595	52-1,616	Carbonate	Continuous
383133115030201	207 N08 E62 30CD 1 USGS-MX	4,265,229.623	669,732.248	5,290.205	---	101	101	2	---	---	Basin Fill	Quarterly

[a]Professional survey complete on location and elevation. All coordinates are Universal Transverse Mercator, North American Datum, 1983, Zone 11.
[b]Carbonate bedrock was encountered at 265 ft bgs according to the well log.
[c]Well is monitored continuously by the USGS.
[d]Wells are pending property access approval.
Well-construction data are based upon best available information from well logs, MX Project Report (Ertec Western Inc., 1981), and direct field measurements.
Monitoring frequency agreed to by the TRP. Additional water-level data in the study area may be collected by SNWA or USGS and reported in future data reports.

Pahranagat valleys. Geologic analysis reports were completed for each of the seven SNWA monitor wells included in the network (Eastman, 2007a through g). Copies of the reports have been posted on the SNWA shared data-repository website.

Two additional SNWA wells, one 6-in.-diameter monitor well (CAV6002M2) and one 20-in.-diameter test well (CAV6002X), were installed in southern Cave Valley near Monitor Well 180W902M on October 13 and 28, 2007, respectively. Well-construction attributes of the additional SNWA wells are presented in Table 2-2 and Figure 2-2.

SNWA collected continuous water-level data at the seven SNWA monitor wells within the network between April and June 2007. Site visits are conducted approximately every six weeks to obtain periodic water-level measurements and download continuous pressure transducer data for processing and analysis. Measurements of water levels were compared to pressure transducer data to ensure proper function and calibration of the instrumentation.

USGS collects continuous data at two USGS-MX wells within the network [182 S06 E63 12AD 1 USGS-MX (Delamar Well) and 181 N03 E63 27CAA 1 USGS-MX (N. Dry Lake)]. USGS also collects continuous data at 181 S03 E64 12AC 1 USGS-MX (S. Dry Lake Well), which is not included in the network.

Historical, periodic water-level measurements collected by SNWA and USGS are presented in Appendix A. Hydrographs for the nine existing DDC network wells that are monitored quarterly are also presented in Appendix A. Water-level data collected by SNWA and USGS at the six continuously monitored wells are presented in Appendix B. Appendix B also includes tables presenting periodic and daily mean continuous water-level data as well as associated 2008 and historical hydrographs. SNWA continuous data were corrected for temperature. Historical USGS data are presented at the National Water Information System's website at http://waterdata.usgs.gov/nv/nwis/current/?type=gw.

Periodic water-level data and the associated hydrographs from the two additional SNWA well locations are presented in Appendix C.

2.2.1 New Monitor Wells

The installation of up to four new monitor wells are included in the Stipulation hydrologic monitoring plan. In 2009, the TRP, in consultation with the NSE, selected two new sites and one contingency site. The location of the fourth well, if needed, will be selected after more information is made available on the production well network configuration and baseline data are collected. New well-location coordinates, estimates of surface elevation, and depth-to-groundwater measurements are presented in Table 2-3, and the locations are presented in Figure 2-1.

The northernmost new monitor well, WRV1012M, is located on the west side of the Egan Range northeast of Flag Spring in White River Valley. This well is anticipated to be completed in the Ely Springs Dolomite. The location was selected as a monitoring point between Flag Springs Complex and southern Cave Valley. The new well and other existing monitor wells in Cave Valley will provide

Table 2-2
Additional SNWA DDC Wells

Site Number	Station Local Number	Location		Surface Elevation (ft amsl)	Completion Date	Drill Depth (ft bgs)	Well Depth (ft bgs)	Well Casing Diameter (in.)	Screened Interval (ft bgs)	Open Interval (ft bgs)	Aquifer	Monitor Frequency
		UTM[a] Northing (m)	UTM[a] Easting (m)									
CAV6002X	CAV6002X	4,248,307.582	689,819.008	5,987.966	10/28/2007	917	901	20	219-901	50-917	Basin Fill/ Carbonate	Quarterly
CAV6002M2	CAV6002M2	4,248,365.834	689,782.960	5,982.814	10/13/2007	893	885	6	159-882	50-893	Basin Fill/ Carbonate	Quarterly

[a]Professional survey complete on location and elevation. All coordinates are Universal Transverse Mercator, North American Datum, 1983, Zone 11.
Well-construction data are based upon best available information from well logs.

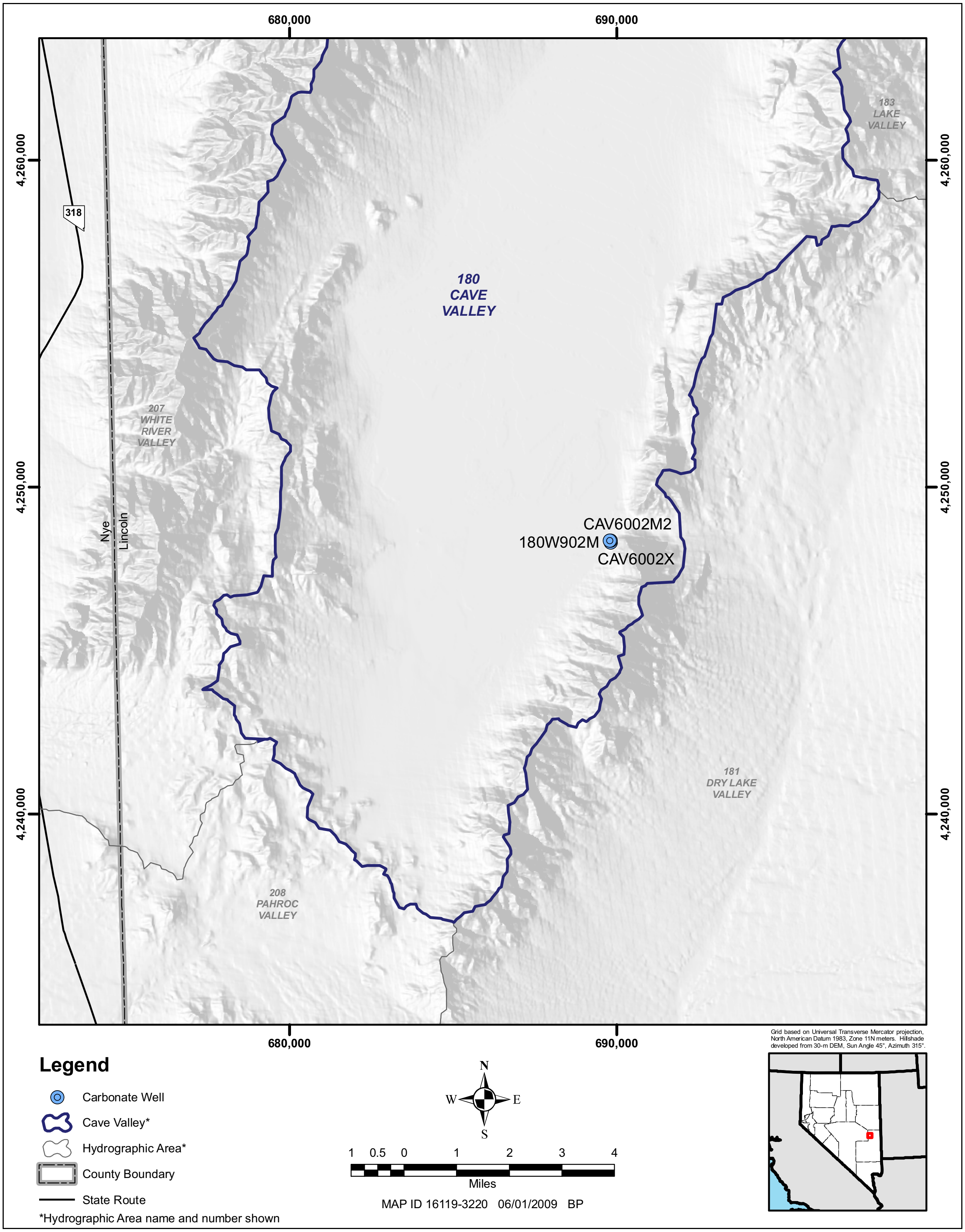


Figure 2-2
Additional SNWA DDC Wells

Table 2-3
New DDC Monitor Wells

Well Name	Location		Estimated Surface Elevation (ft amsl)	Estimated Depth to Water (ft)
	UTM Northing (m)	UTM Easting (m)		
WRV1012M	4,257,087	675,519	5,794	420
PAH1010M	4,163,098	663,576	4,380	700
DEL4003X	4,125,223	682,153	4,738	1,450
PAH1011M (alternate site)	4,121,019	677,508	3,727	635

baseline water-level data to evaluate the hydraulic gradient through Shingle Pass. The depth to groundwater is estimated to be approximately 420 ft bgs at this location.

The second new monitor well, PAH1010M, is located on the east side of the Hiko Range in Sixmile Flat in Pahranagat Valley. The site is located 3.5 mi east of Hiko Spring. The target completion zone is saturated fractured carbonate rocks within the middle to lower units of the Guilmette Formation and possibly the Simonson Dolomite. Carbonate bedrock is anticipated within 50 ft of land surface, and it is expected that rocks will be fractured at depth because of the movement along the range-front fault and local normal faults. The depth to water in this area is estimated to be approximately 700 ft bgs. Both WRV1012M and PAH1010M are located on BLM land, and National Environmental Policy Act (NEPA) right-of-way applications will be submitted to BLM to gain access to the sites.

The third new monitor well is the site of a proposed SNWA exploratory well, DEL4003X, which is located near the southern boundary of Delamar Valley within a structural feature in the Pahranagat Shear Zone. This well is anticipated to be completed in volcanic materials. If the hydrogeologic conditions encountered indicate that a future production well would not be viable at this location, the exploratory well would become the third DDC new monitor well. However, if the well were to be viable as a future production site, a contingent site, PAH1011M, also located along a major structural feature southwest of Well DEL4003X in the Pahranagat Shear Zone would be constructed. The right-of-way application has been submitted to BLM for both these locations.

In the Stipulation, the DOI Bureaus agreed to expedite the NEPA applications and other clearances, within the limits of applicable laws, to help meet the requirements of the hydrologic monitoring plan. The construction of the new monitor wells is contingent upon private property accessibility and issuance of appropriate rights-of-way by various Federal and State agencies.

2.3 Aquifer Testing

A constant-rate pumping test will be performed on each future production test well to evaluate aquifer properties. The tests results may also identify boundary conditions and provide information on aquifer heterogeneity. Aquifer-testing results would be used to assess well performance, provide aquifer-property data for the groundwater flow model, and evaluate long-term pumping influence.

Well-performance step tests and 72-hour constant-rate tests have been performed on SNWA Test Well CAV6002X and Monitor Well 180W902M located in Cave Valley. These locations and results are presented on Table 2-4. A Hydrologic Analysis Report, including hydrologic data, test analysis, and water-chemistry results, is currently being prepared for Test Well CAV6002X.

Table 2-4
Aquifer-Test Summary Data for SNWA DDC Test Well CAV6002X (Tested in 2007)

Test Well Number	Associated Observation Well	Distance from Test Well (ft)	Specific Capacity (gpm/ft)	Constant-Rate Test Duration (hours)	Constant-Rate Test Flow Rate (gpm)	Step-Test Range (gpm)	Drill Depth (ft bgs)	Well Depth (ft bgs)	Well Casing Diameter (in.)	Screened Interval (ft bgs)	Open Interval (ft bgs)	Drawdown at end of Constant-Rate Test (ft)
CAV6002X	CAV6002X	---	6.26	72	1,200	800 to 1,500	917	901	20	219 to 901	50 to 917	191.82
	180W902M	157	81[a]				915	903	12	196 to 882	77 to 915	6.96
	CAV6002M2	225	---				893	885	6	159 to 882	50 to 893	6.93
	180W501M[b]	16 miles	---				1,215	1,212	7	788 to 1,192	54 to 1,215	0
	382807114521001[b]	8 miles	---				460	460	10	210 to 250, 375 to 435	190 to 460	0

[a]Aquifer test conducted on the monitor well at 1,100 gpm after completing the aquifer test on the production well.
[b]Background well.

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3.0 SPRING MONITORING NETWORK

The four components of the spring monitoring network are described in Section C of Part II of Exhibit A in the Stipulation. These components consist of the following:

- Five named springs located in White River and Pahranagat valleys, which are currently monitored through the JFA between NDWR, SNWA, and USGS.
- Three spring sites located in White River and Pahranagat valleys that are to be investigated by the TRP and NSE for technical feasibility and property access for inclusion in the monitoring program.
- Cottonwood Spring, located in Pahranagat Valley, that is currently monitored by USFWS, which agreed to provide the discharge data to all parties.
- Up to eight additional springs, selected by the TRP, to be monitored biannually within DDC.

Historical hydrologic data for all network springs and previously prepared physical and geologic descriptions of selected springs are presented in this section. Additional descriptions of site geology in the vicinity of selected springs included in the program are presented in SNWA (2008a). A revised detailed description of each spring will be prepared after completion of a reconnaissance evaluation. Historical water-chemistry data from each spring are presented in Section 5.0. The spring discharge monitoring network locations and monitoring frequency are listed in Table 3-1 and presented in Figure 3-1.

3.1 Springs Currently Monitored in Adjacent Hydrographic Areas

Five springs adjacent to the DDC valleys that are currently being monitored were named in the Stipulation for inclusion in the program. These are Flag Springs Complex, Hot Creek, Moorman, Ash, and Crystal springs, all of which are currently being monitored through a JFA between SNWA, USGS, and NDWR. SNWA will continue funding or provide direct monitoring of these locations. During 2008, no changes were made to the monitoring frequency or list of springs being monitored as part of the stipulation under the JFA.

3.1.1 Flag Springs Complex

The Flag Springs Complex is located in Nye County at the Nevada Department of Wildlife (NDOW) Headquarters for the Wayne Kirsch Wildlife Management Area approximately 60 mi south of Ely, Nevada, along Nevada State Highway 318 (Figure 3-1). The three springs that compose the Flag Springs Complex discharge from coarse Quaternary alluvial gravels along a line approximately

Table 3-1
DDC Springs Monitoring Locations and Measurement Frequency

Basin Number	Station Number	Station Name	Elevation[a]	Location[b] UTM Northing (m)	UTM Easting (m)	Monitoring Frequency
180	1800101	Cave Spring	6,490	4,279,249	691,760	Biannual
	1800301	Parker Station Spring	6,490	4,282,096	688,179	
	381624114540302	USBLM Silver King Well	6,230	4,238,220	683,551	
	381943114562201	Lewis Well	6,260	4,244,297	680,106	
181	1810101	Meloy Spring[c]	6,180	4,236,201	700,888	Alternate
	1810301	Littlefield Spring	6,150	4,233,949	701,112	Biannual
	1810401	Coyote Spring	5,220	4,211,513	687,693	
	1810501	Big Mud Springs	6,430	4,241,387	689,547	
182	1820101	Grassy Spring	5,790	4,157,193	695,124	
207	2070501	Hot Creek Spring near Sunnyside, NV	5,230	4,249,926	661,290	Continuous
	2071101	Moorman Spring	5,300	4,273,440	662,053	Biannual
	2071501	Hardy Springs	5,350	4,278,196	667,553	
209	2090101	Hiko Spring	3,880	4,162,744	657,549	Continuous
	2090201	Cottonwood Spring	3,240	4,123,643	667,261	USFWS
	2090801	Maynard Spring	3,110	4,117,909	674,444	Biannual
Flag Springs Complex						
207	2071301	Flag Spring 3 (South)	5,290	4,254,416	672,579	Continuous[d]
	2071302	Flag Spring 2 (Middle)	5,280	4,254,570	672,576	
	2071303	Flag Spring 1 (North)	5,290	4,254,696	672,719	
Crystal Springs						
209	09415589	Crystal Springs Diversion near Hiko, NV	3,820	4,155,336	656,011	Continuous
	2090401	Crystal Springs near Hiko, NV	3,800	4,155,348	656,165	
Ash Springs						
209	09415639	Ash Springs Diversion at Ash Springs, NV	3,600	4,147,415	659,716	Continuous
	2090501	Ash Springs	3,600	4,147,460	659,684	

[a]All elevations are rounded to the nearest 10 ft, North American Vertical Datum of 1988 (NAVD88). High-resolution Global Positioning System (GPS) will be used to determine elevations at a later date.
[b]All coordinates are UTM North American Datum of 1983 (NAD83) Zone 11.
[c] Meloy Spring is an alternate site that will replace Littlefield Spring if property access is granted.
[d]Currently being monitored biannually. TRP will evaluate potential for continuous monitoring of the middle elevation spring.

1,200 ft long. From the source in the NDOW headquarters area, the Flag Springs discharge into Sunnyside Creek and then flow into the Adams-McGill Reservoir, where the water is used for livestock, wildlife, and recreation.

Monitoring at Flag Springs Complex currently consists of biannual monitoring of three spring orifices through the JFA between USGS, SNWA, and NDWR. SNWA plans to work with NDOW to evaluate expanding the current monitoring to include continuous discharge monitoring at one of the springs and periodic measurements at regular intervals at the other two springs at the complex.

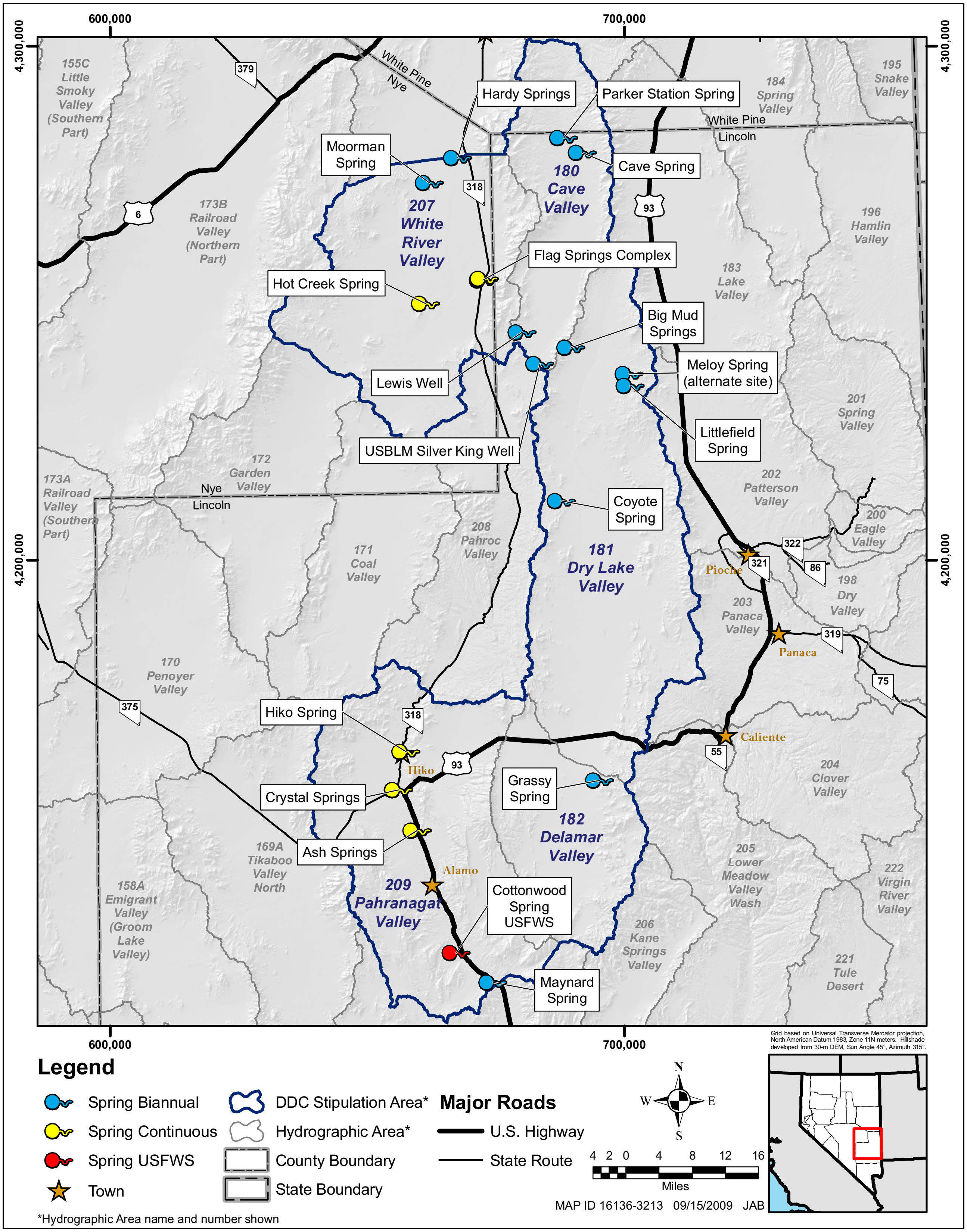


Figure 3-1
Location of Springs Associated with the DDC Stipulation Hydrologic Monitoring Plan

The earliest reported discharge measurement of 2.5 cfs was taken at Flag Spring No. 1 in 1949 (Maxey and Eakin, 1949). The USGS, beginning in 1982, measured the discharge of the three springs annually. During 1992, the discharge measurements were increased to a biannual frequency that continued through the end of 1994. No discharge measurements were reported between 1995 and 1996. During 1997, the springs were again measured by USGS biannually, which continued through 2008, as part of the JFA with SNWA and NDWR. Discharge measurements for 2008 are listed in Table 3-2, and historical data are displayed in Figure 3-2. Historical discharge measurements are provided in Appendix D.

Table 3-2
Discharge Measurement Summary of Flag Springs Complex

Spring Name	Average Discharge (cfs)	Minimum Discharge (cfs)	Maximum Discharge (cfs)	Standard Deviation (cfs)	May 2008 Discharge[a, b] (cfs)	September 2008 Discharge[a, b] (cfs)
Flag Spring 1 (north)	2.3	1.5	3.5	0.4	2.8	3.0
Flag Spring 2 (middle)	2.9	0.5	3.6	0.5	3.0	2.9
Flag Spring 3 (south)	2.2	1.1	3.7	0.5	2.2	2.2

[a]2008 Discharge measurements are average of two reported measurements.
[b]Source: USGS (2009)

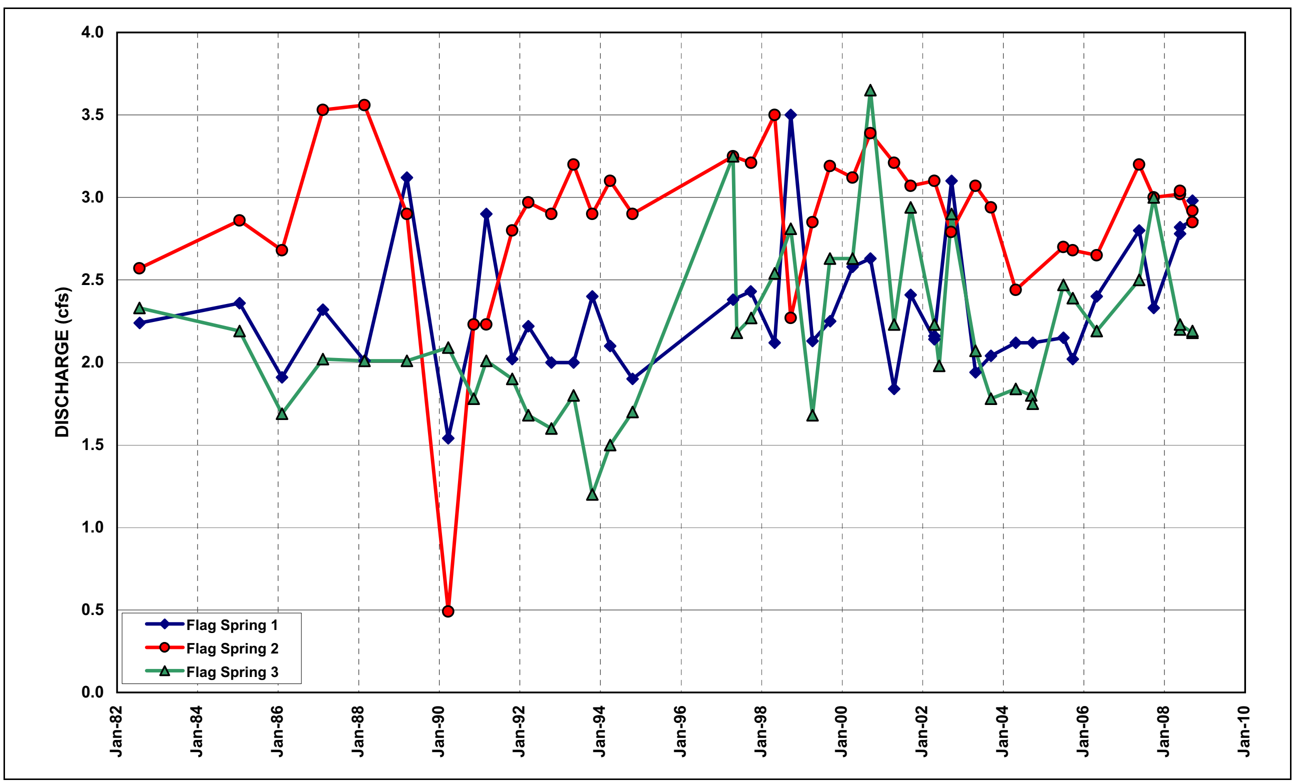


Figure 3-2
Discharge Measurements of the Flag Springs Complex

3.1.2 Moorman Spring

Moorman Spring is located in White River Valley approximately 20 mi southwest of Lund, Nevada, in Nye County (Figure 3-1). The spring discharges from the alluvium along a fault scarp. The spring forms a small pool, approximately 30 ft long and 15 to 20 ft wide, behind an old irrigation diversion structure. The discharge at Moorman Spring is currently measured biannually through the JFA between USGS, SNWA, and NDWR.

The pool is partially encircled by a man-made berm that appears to have been used to contain the spring flow in a reservoir. Dense grasses and sagebrush grow in and around the spring area, and the spring pool has moderate algal growth along the edges and bottom (Figure 3-3).

Figure 3-3
Orifice Pool of Moorman Spring, White River Valley, Nevada

The main orifice of the spring is in the southwest corner of the spring pool. Moorman Spring is diverted approximately 25 ft downstream of the orifice. A 1-ft-wide headgate and two aqueducts artificially control Moorman Spring's pool elevation. The aqueducts discharge northward then turn west and discharge to a large shallow reservoir. From the reservoir, the water discharges into an approximately 2-ft-wide channel that continues south for several miles. The system appears to have been designed to allow flow to the western aqueduct to be completely shut off, diverting the entire flow to the eastern aqueduct. Raising the headgate would allow the entire flow to be diverted to the large reservoir located several hundred yards to the west. From this reservoir, the discharge could be regulated from the earthen dam at the south end of the reservoir. The diversion structures in both the reservoir and the spring pool appeared in poor and possibly inoperable condition during the 2004 field investigation. Currently, the water appears to be used for livestock and wildlife.

Moorman Spring is situated in a highly dissected alluvial fan. The soils around the spring are fine-grained material that have little to no cementation. The Guilmette limestone formation of Devonian age is exposed approximately 2 to 3 mi west of the spring (Kleinhampl and Ziony, 1985). The site itself is a tufa mound cut by several northeast-trending faults. The mound is approximately 10 ft high and forms a subcircular shape around the spring complex. The fault that cuts the mound projects to the southwest along the spring channel for approximately 3 mi.

In 1935, the reported discharge was 0.22 cfs (100 gpm) (Stearns et al., 1937). The extremely low discharge was likely influenced by the extreme drought in the western United States during the mid-1930s. The same discharge measurement was again reported in Miller et al. (1953). Since 1935, the average discharge at Moorman Spring has been approximately 0.47 cfs (213 gpm), and the historical discharge measurements appear relatively constant. Discharge measurements made by USGS at Moorman Spring during the 2008 water year on May 22 and September 11 are presented in Table 3-3. The discharge data for Moorman Spring are displayed in Figure 3-4 and are listed in Appendix D.

Table 3-3
Discharge Measurement Summary of Moorman Spring

Spring Name	Average Discharge (cfs)	Minimum Discharge (cfs)	Maximum Discharge (cfs)	Standard Deviation (cfs)	May 2008 Discharge[a, b] (cfs)	September 2008 Discharge[a, b] (cfs)
Moorman Spring	0.47	0.22	0.69	0.10	0.33	0.32

[a]2008 Discharge measurements are average of two reported measurements.
[b]Source: USGS (2009)

3.1.3 Hot Creek Spring

Hot Creek Spring is located in southern White River Valley, approximately 36 mi southwest of Lund, Nevada, and 2 mi west of Adams-McGill Reservoir in Nye County (Figure 3-1). The spring discharge forms Hot Creek, which flows southeast to the Adams-McGill Reservoir. The spring and reservoir are located on the Wayne Kirch Wildlife Management Area, administered by NDOW. At one time, the flow of Hot Creek could be diverted to the Dacey Reservoir to the northeast. Spring discharge is currently being monitored continuously through the JFA between USGS, SNWA, and NDWR.

Hot Creek Spring forms a large, irregularly shaped pool approximately 65 ft wide by 75 ft long. An underwater photo of the main spring orifice is presented in Figure 3-5. At the orifice, the pool depth was measured at 22 ft. Hot Creek Spring is the only major spring in the study area that is undisturbed at the orifice. The spring discharge area is approximately 5 acres covered by dense grasses.

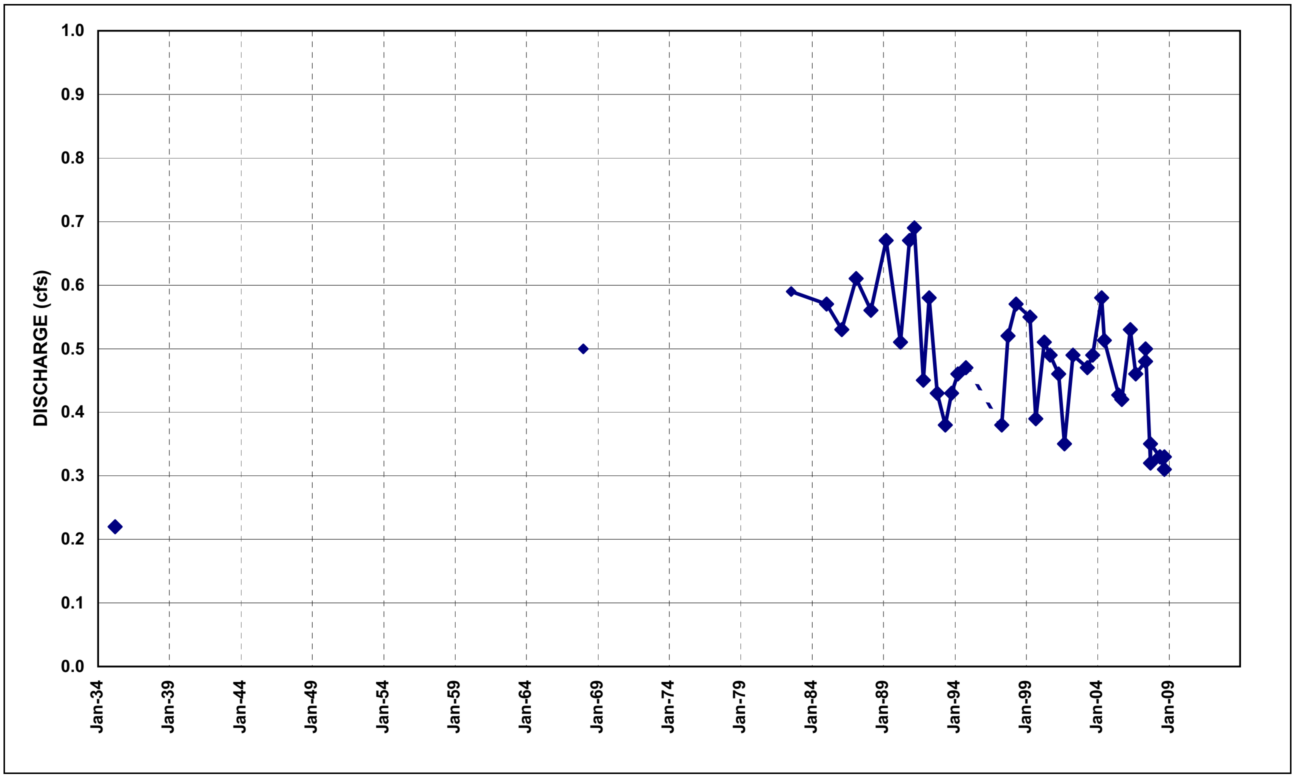
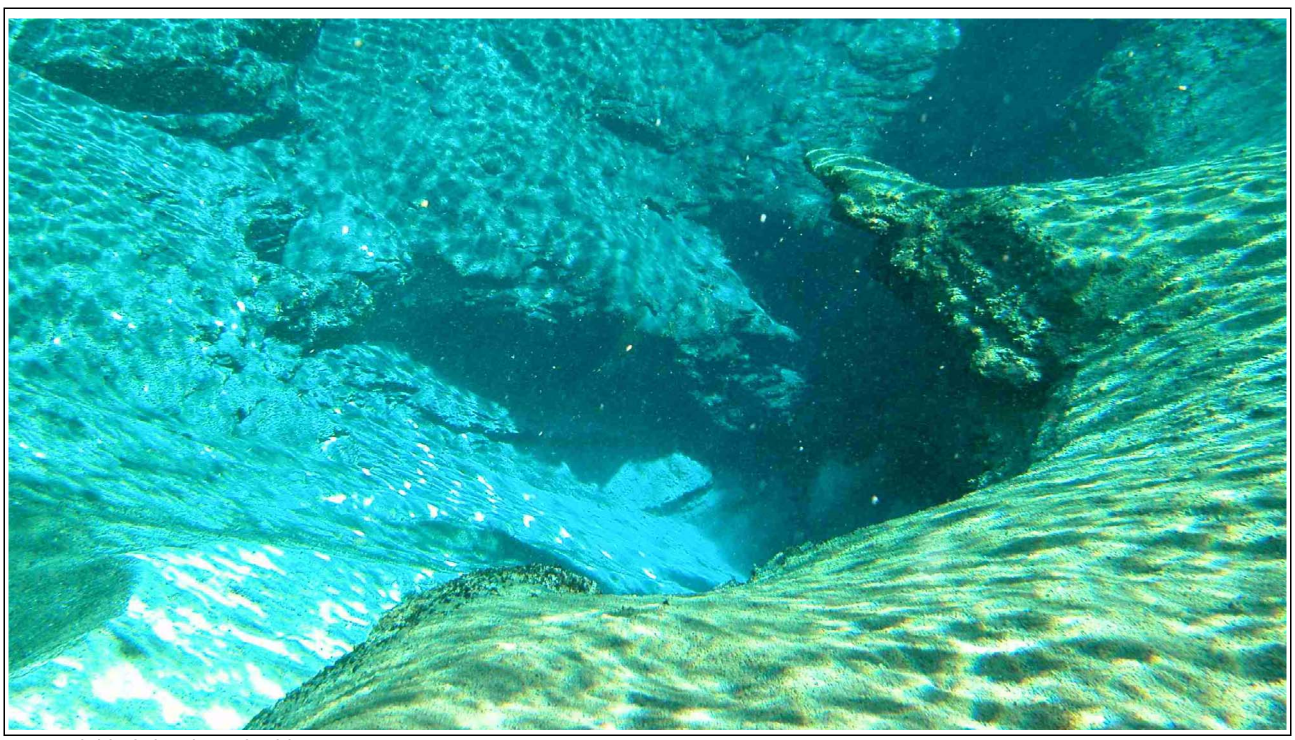


Figure 3-4
Historical Discharge Measurements at Moorman Spring



Note: Field of view is 20 ft wide.

Figure 3-5
Underwater View of the Hot Creek Spring Main Orifice

The Hot Creek Spring tufa mound is exposed to the northwest of the spring complex, which has been cut by northeast-trending faults. The area's most common feature is the large amount of tufa/travertine deposits. A prominent northeast-trending ridge of Paleozoic rocks is exposed to the southwest of the Hot Creek Spring complex. The oldest rock on the ridge is the Pogonip Limestone of Ordovician age, followed by the Eureka Quartzite and Ely Springs Dolomite of Ordovician age and the Sevy Dolomite of Devonian age. The rocks dip approximately 25 degrees to the east, striking north 10 degrees east. The ridge forms a prominent northeast-striking horst with distinctive faults flanking the horst. The fault with the greatest influence on Hot Creek Spring is on the east side of the horst and projects through the principal discharge area in the spring (Figure 3-6).

Only two discharge measurements were made at Hot Creek Spring before 1982. The first was on April 6, 1935, and the measured discharge was 15.3 cfs (6,955 gpm) (Maxey and Eakin, 1949). The second was on December 7, 1961, and the measured discharge was 13.4 cfs (6,090 gpm). From 1982 to 1989, annual discharge measurements were made by the USGS and are reported in USGS (2009). The discharge measurement data show what appears to be a large variability in the discharge. This variability likely reflects either diversions upstream of the measurement section or different measurement sections on the Hot Creek channel. In 1985, a discharge measurement of 25.5 cfs (11,590 gpm) was reported by the USGS. This measurement is approximately two times greater than what would be expected and is likely an error. From 1989 to 1994 and 1996 to 2006, the discharge was measured biannually by the USGS. In June 2006, the Hot Creek near Sunnyside, Nevada, stream gaging station was installed approximately 0.25 mi downstream of the orifice and was activated.

In 2008, after two years of developing the discharge rating, the USGS published three water years: 2006 (partial year), 2007, and 2008. A comparison of stream statistics is provided in Table 3-4. The measurements are listed in Appendix D. Discharge measurements prior to 2006 were measured below the current gage, 50 to 60 ft below the ponded swimming area shown in Figure 3-7. On February 25, 2009, USGS measured the discharge as 13.9 cfs (6,239 gpm). Water-quality data were collected by USGS as well as the Desert Research Institute (DRI) periodically from 1981 until 2005. During that time, conductivity and temperature values remained stable at 530 to 547 µmhos/cm and 30.9°C to 32.5°C, respectively. The miscellaneous discharge data from Hot Creek Spring from 1935 until 2008 are displayed in Figure 3-8. Historical data, which are possibly anomalous, are highlighted on the figure. The mean daily discharge data from 2006 to 2008 are displayed in Figure 3-9.

3.1.4 Ash Springs

Ash Springs is located in Ash Springs, Nevada, approximately 600 ft east of U.S. Highway 93 (Figure 3-1). The spring is used for irrigation, domestic supply, and recreation and is composed of many orifices that extend more than a quarter mile along the north-south-trending Hiko Fault. The spring area was developed in the 1970s and through the 1980s as a privately owned resort. The main orifice is on public land administered by the BLM and has a large picnic area and swimming pool (Figure 3-10). Ash Springs discharge and irrigation diversion is currently measured through a JFA between USGS, SNWA, and NDWR.

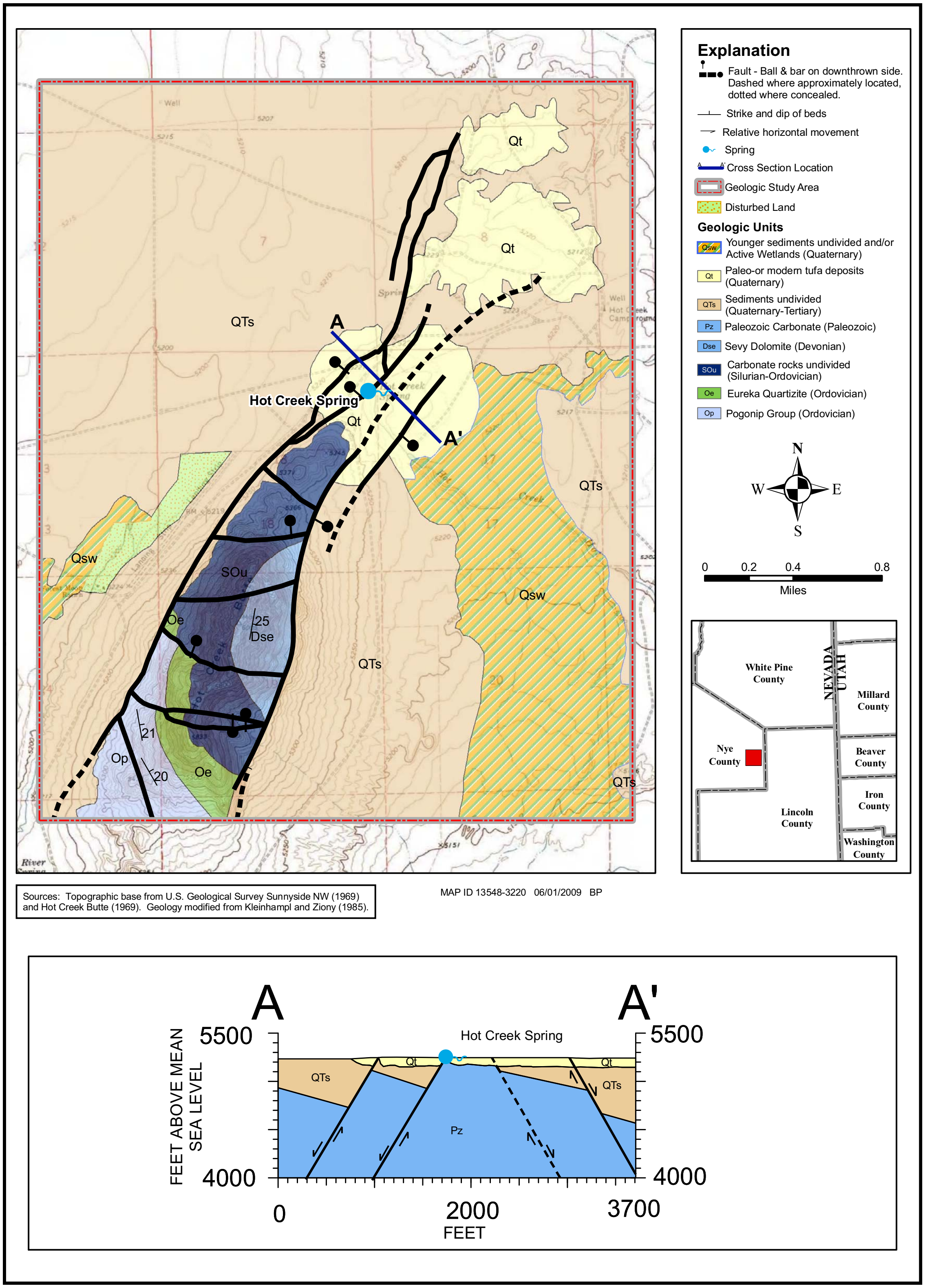


Figure 3-6
Generalized Geologic Map and Cross Section of Hot Creek Spring, White River Valley, Nevada

Table 3-4
Comparison of Discharge Measurement Statistics for Hot Creek Spring

Data Set	Average (cfs)	Minimum (cfs)	Maximum (cfs)	Standard Deviation (cfs)	Measurement Count (cfs)
All Discharge Measurements	12.1	1.10	24.5	3.36	63
Excluding Outliers and Diversions	13.8	11.0	15.6	1.13	38
Continuous Record 2006-2008	14.0	13	15.0	0.46	---

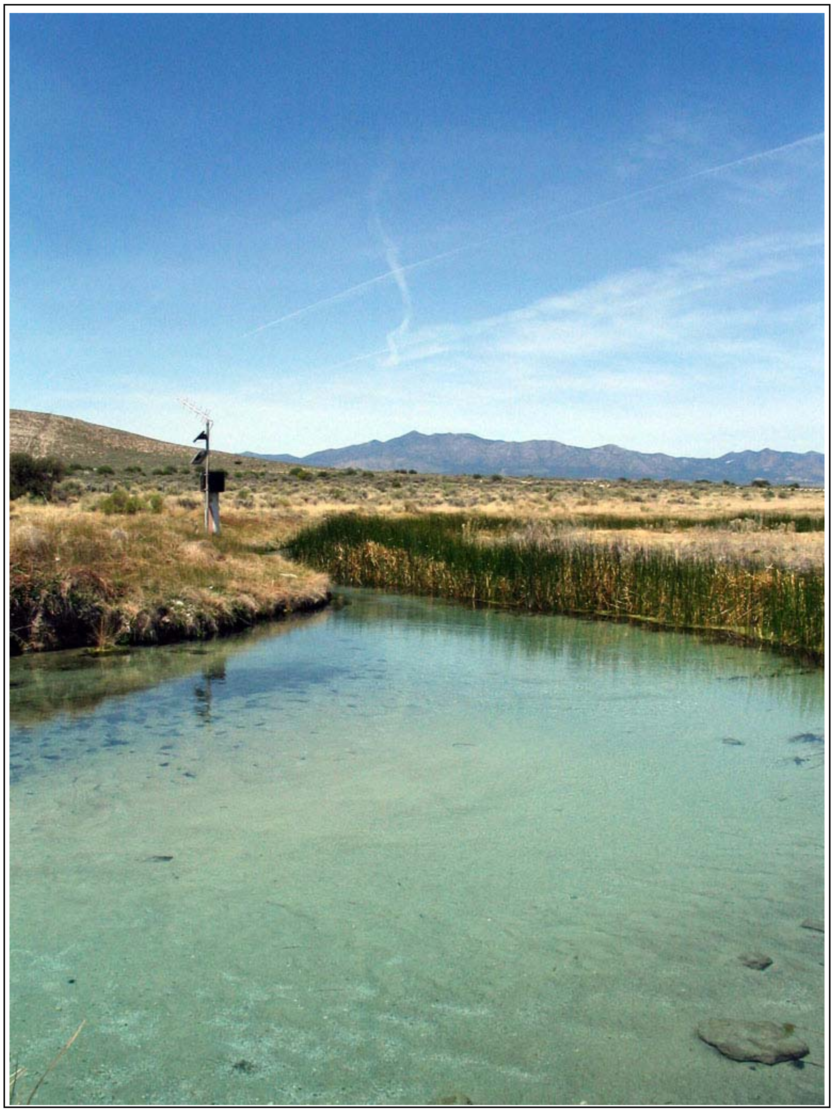


Figure 3-7
Hot Creek Spring Gaging Station

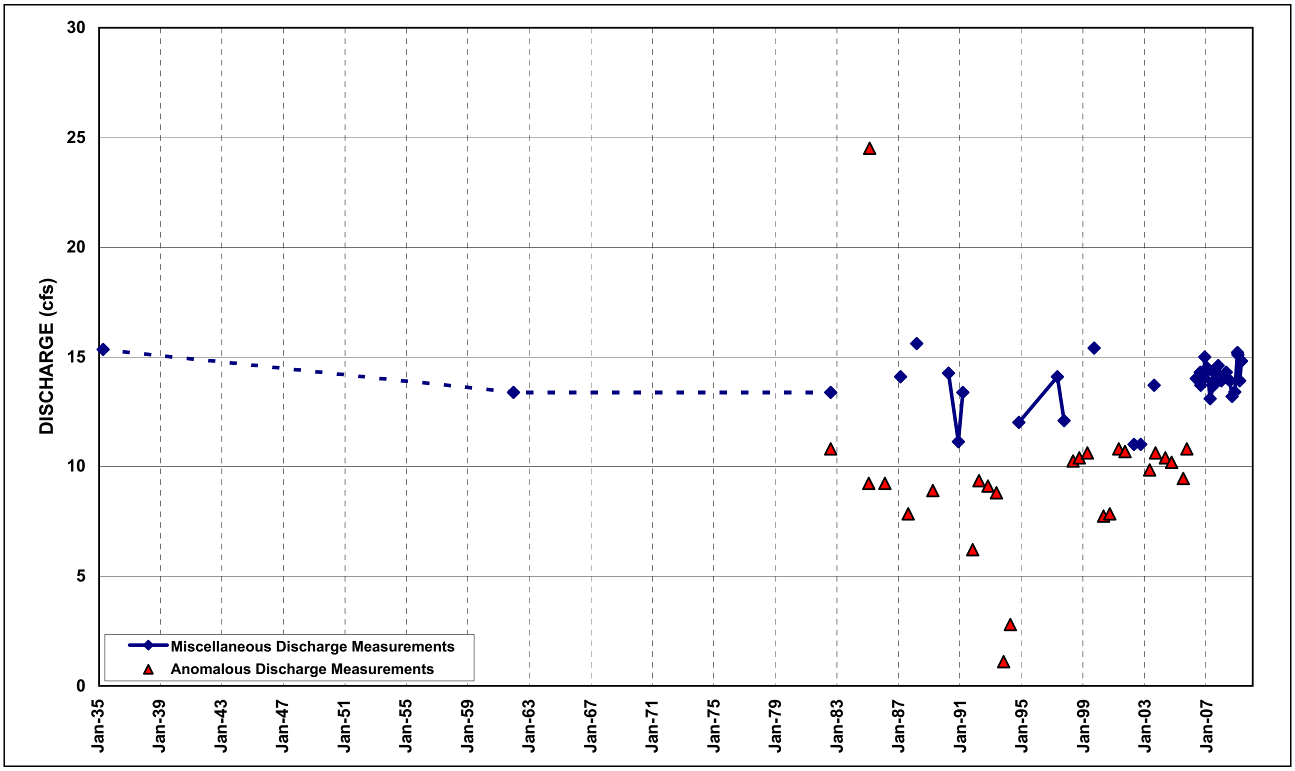


Figure 3-8
Hydrograph of Hot Creek Spring

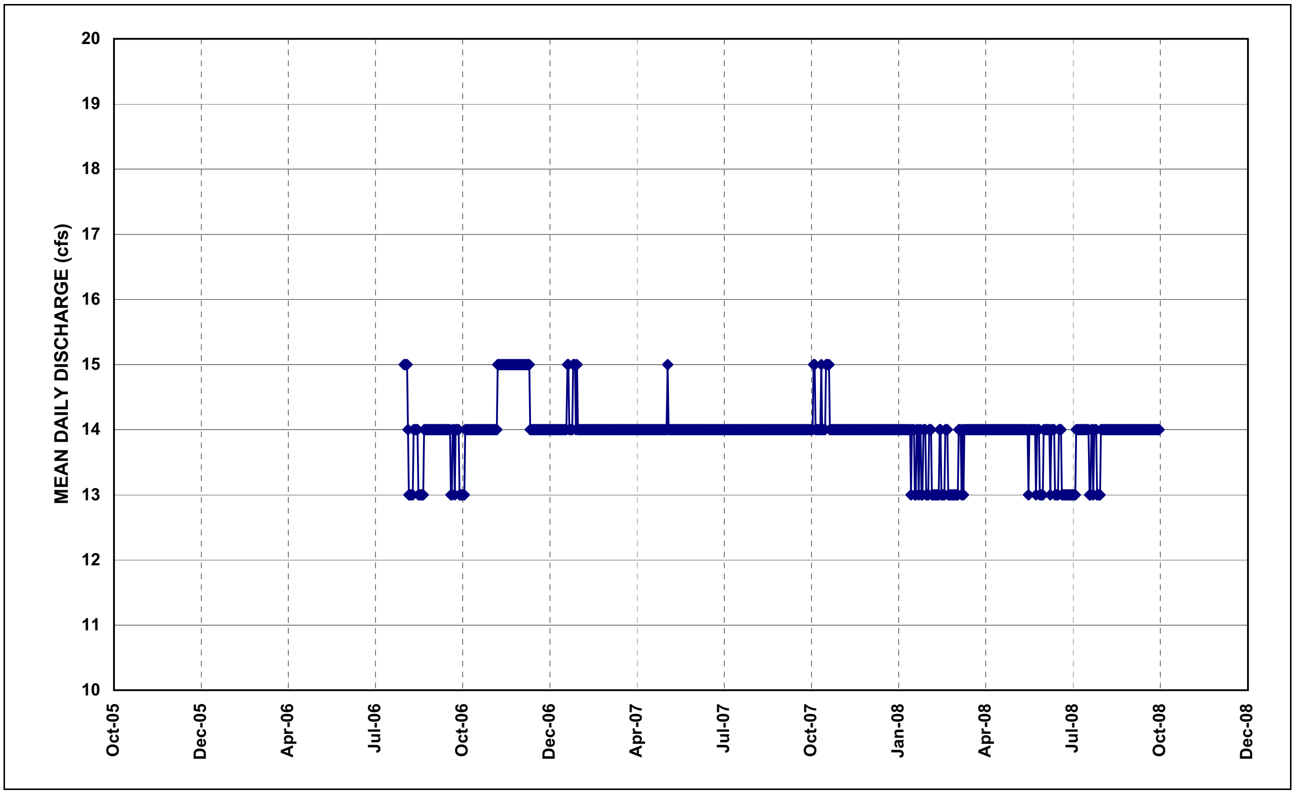


Figure 3-9
Mean Daily Discharge from Hot Creek Spring

Figure 3-10
Main Pool and Orifice of Ash Springs

3.1.4.1 Geologic Setting

The bedrock about 20 ft east of Ash Springs' main pool was mapped as the Devonian Sevy Dolomite (Tschanz and Pampeyan, 1970). The bedrock is a light-gray, resistant, fine-grained, well-bedded dolomite with an attitude of north 30 degrees east, 26 degrees west and forms a low, northeast-north-trending fault scarp along the springs. The local geology and structural features are shown on Figure 3-11. The faulting brecciated the bedrock along most of this scarp. Sitting on the dolomite just east of the main pool is an eroded mass of light-gray and tan, resistant, porous, spring carbonate, which is about 6 by 10 ft and likely early Pleistocene. Bedrock pieces and dikes of carbonate are scattered along most of the range front east of the springs. A spring mound of tufa deposits (about 30 ft high and at least 300 by 100 ft), presumably early Quaternary, lies just south of the spring complex. The low hills east and southeast of this spring mound consist of Hiko Tuff, an 18-Ma ash-flow tuff derived from the Caliente caldera complex to the east (Rowley et al., 1995). These volcanic rocks are faulted down against the Sevy Dolomite to the north along generally east-striking faults. The main fault passes through a small canyon to the east and through the large spring mound. A parallel fault to the north, with brecciated Sevy Dolomite and spring limestone north and south of the fault, has an attitude of north 80 degrees east. This fault was mapped in a small canyon just east of the Ash Springs bathhouse.

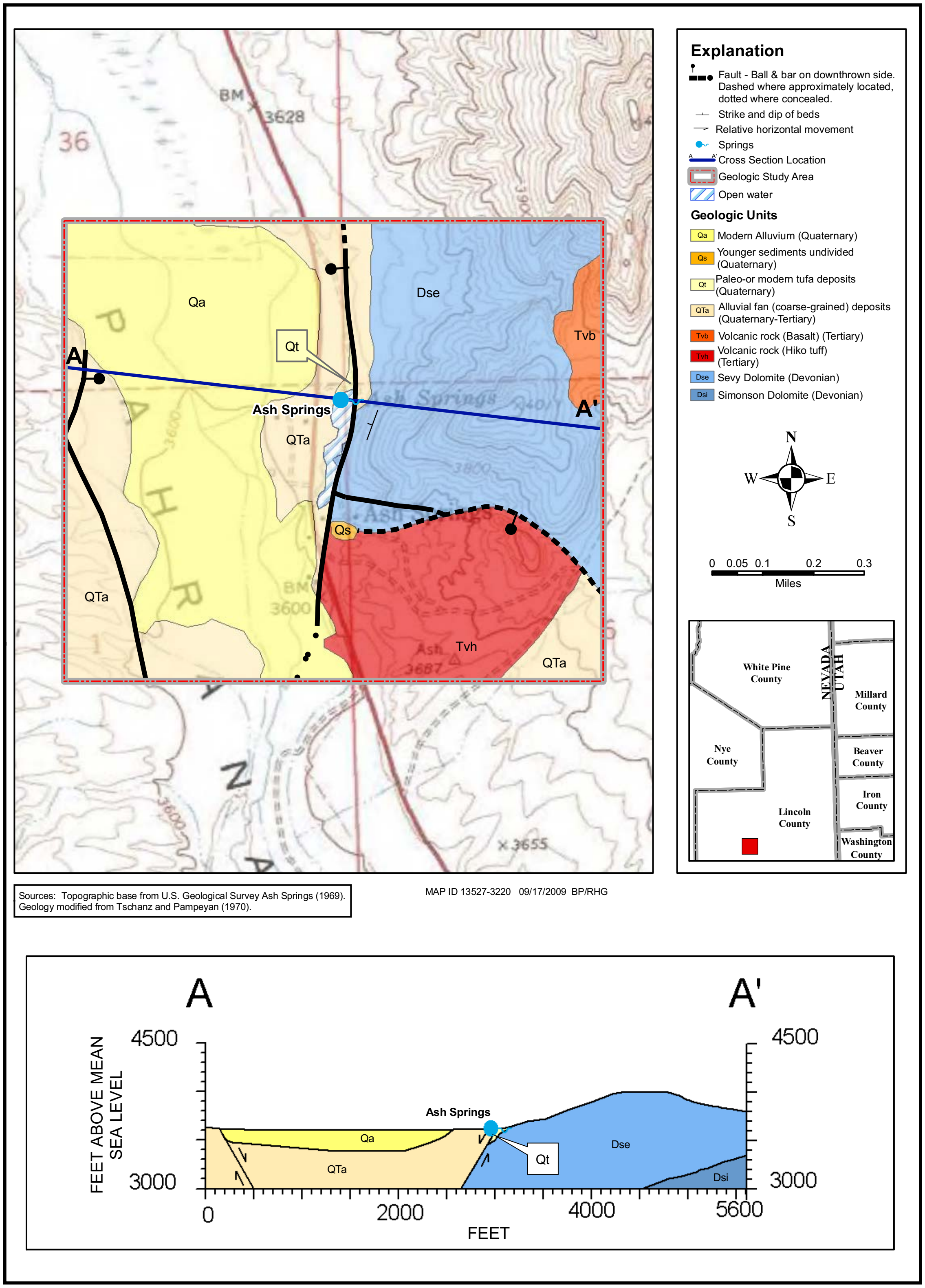
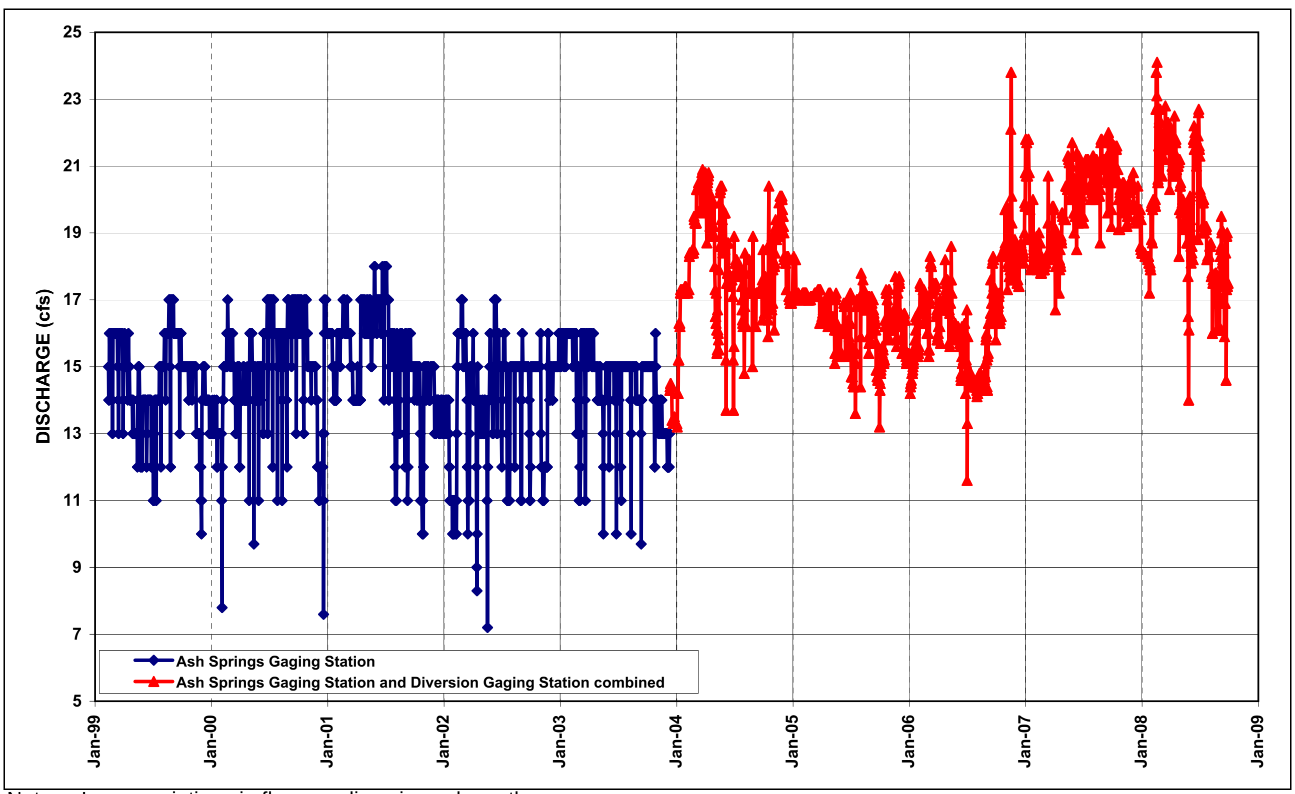


Figure 3-11
Generalized Geologic Map and Cross Section of Ash Springs, Pahranagat Valley, Nevada

3.1.4.2 Discharge

Discharge at Ash Springs has been measured intermittently since 1912, similar to the measurements at Hiko Spring and Crystal Springs. Prior to the 2004 water year, only the discharge in the main channel had been measured by USGS. Like the discharge record for Crystal Springs, the discharge record for Ash Springs consists only of a partial record because a portion of the flow was intermittently diverted above the gage for agricultural purposes. Currently, USGS operates gaging stations on both the main channel and on the diversion channel. Figure 3-12 illustrates the period of record of the Ash Springs gaging station from 1998 to 2008. Some natural variations occur in Ash Springs' discharge. A notable example of this variation was reported by Smith (1944) as described below.

Donald K. Perry, Water Commissioner for the Pahranagat Lake and Tributaries, reported that on July 4, 1943, the spring increased in discharge from 17.36 to 18.56 cfs (7,790 to 8,330 gpm) and remained at this discharge until he left the valley on September 3, 1943. He described this event as "very unusual" and stated that the spring had been known to decrease in discharge, but this was the first time it had shown any increase in discharge (Smith, 1944, p. 25). Measurements prior to the gage are not depicted in the hydrograph but consist of 30 measurements spanning 83 years. The minimum, maximum, and mean reported discharges during this period were 15.5 cfs, 22.9 cfs, and 17.7 cfs, respectively.

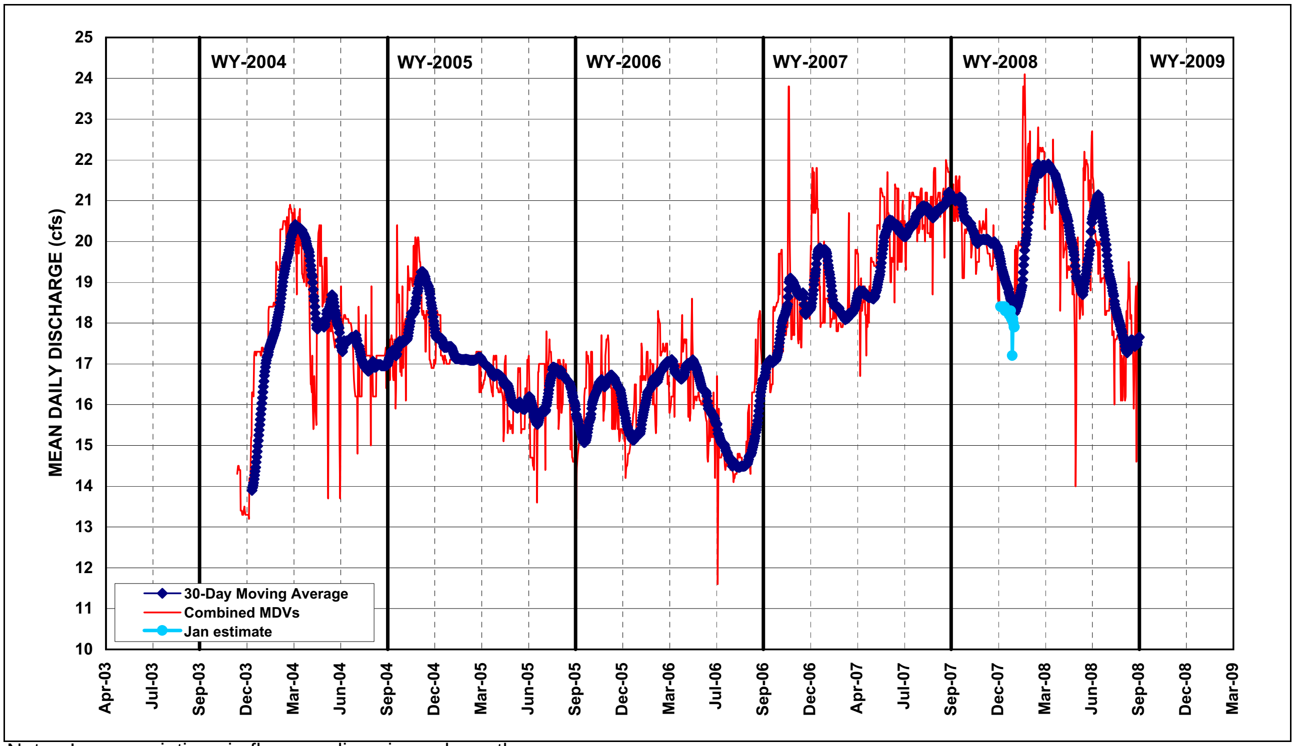


Note: Large variations in flow are diversions above the gage.

Figure 3-12
Mean Daily Discharge at Ash Springs 1998-2008

Compared to Crystal Springs, Ash Springs' record is more variable. The mean daily discharges are highly affected by the diversions. Because of the variability, a 30-day moving average was applied to the sum of the discharge records of the main gage and the diversion gage (Figure 3-13). This produces a hydrograph that has an average annual discharge of approximately 18 cfs since the installation of the supplemental gage on the diversion in 2003.

The temperature of Ash Springs discharge has been measured between 1966 and 2005 at 32°C to 36°C. The annual discharge data and statistics are summarized in Table 3-5.



Note: Large variations in flow are diversions above the gage.
MDVs = Mean Daily Values

Figure 3-13
Thirty-Day Moving Average of Mean Daily Discharge Values for Ash Springs 2003-2008

Table 3-5
Annual Discharges at Ash Springs

Water Year[a]	Ash Springs (09415640) Annual Discharge (afy)	Ash Springs (09415640) Average Annual Discharge (cfs)	Ash Springs Diversion (09415639) Annual Discharge (afy)	Ash Springs Diversion (09415639) Average Annual Discharge (cfs)	Total Combined Discharge (afy)	Average Annual Total Combined Discharge (cfs)	Days Diverted
2005	10,060	13.9	2,190	3.03	12,240	16.9	365
2006	8,760	12.1	2,810	3.88	11,580	16.0	365
2007	11,580	16.0	2,480	3.43	14,040	19.4	365
2008	11,760	16.2	2,600	3.58	14,370	19.8	365

[a]Data are from USGS Water Resources Data-Nevada water years 2005 through 2008 (USGS, 2006, 2007b, 2008). Period of record for Ash Springs diversion gage is December 12, 2003, to present. The 2004 water year is incomplete.

3.1.4.3 Diversions and Water Use

Ash Springs has been diverted to supply agricultural uses since the early 20th century, much like Crystal Springs and Hiko Spring. Currently, the springs supply water for the gas station east of U.S. Highway 93 and recreation, wildlife, and agricultural uses in the valley. Prior to the installation of the supplemental gage at the irrigation diversion site in late 2003, the discharge record was influenced by diversions. The domestic diversion for the gas station is still reflected in the discharge record.

3.1.5 Crystal Springs

Crystal Springs is located approximately a quarter mile west of the SR 318/SR 375 junction and a half mile west of the U.S. Highway 93/SR 318 junction in Lincoln County. Crystal Springs is approximately 4 mi south of Hiko, Nevada, and 5 mi north of Ash Springs, Nevada (Figure 3-1). This locale, used as a watering place and campsite, was the principal stopover on the Mormon Trail alternate route (State of Nevada, 2004a). Crystal Springs' main channel and irrigation diversion discharge is currently monitored through a JFA between USGS, SNWA, and NDWR.

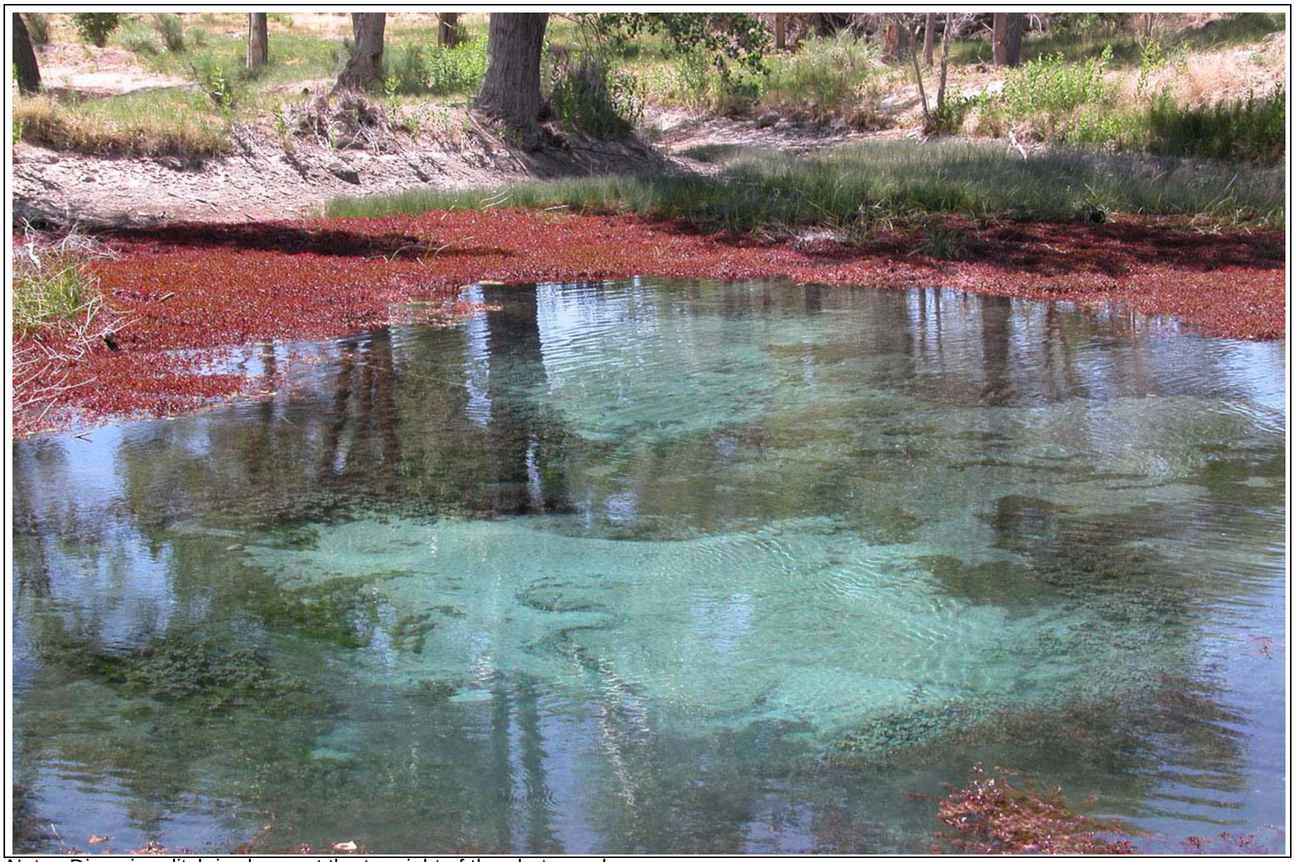
3.1.5.1 Geologic Setting

Crystal Springs is approximately 2 mi west of the Hiko Range. A photograph of the spring reservoir is presented in Figure 3-14. The main orifice discharges from bedrock on the east side of a small outcrop of limestone and sandstone. On the east side of the outcrop, the rock is largely a fault breccia in which blocks of westward-dipping rock protrude from a mass of breccia. The main fault that places the hill against alluvium to the east is assumed to strike north and underlie the spring complex east of the hill. The fault is shown as such on Figure 3-15. About a half mile to the east of Crystal Springs (just east of U.S. Highway 93), middle to early Pleistocene older fan deposits (Qfo) are cut by a fault that is downthrown on the west side and are overlain by young fan deposits (Qfy); thus, the fault is early to middle Pleistocene.

3.1.5.2 Discharge

The discharge at Crystal Springs has been documented with miscellaneous measurements since 1912 and with a continuous recording gage since late 1985 (Figure 3-16). The periods of record for the gaging station are from 1985 to 1988, 1990 to 1994, and 1998 to the present. Prior to 2004, the gaging station only accounted for water that was not diverted into an irrigation ditch. In 2004, the USGS installed a second gaging station on the irrigation diversion. The continuous record for the 2008 water year is depicted in Figure 3-17.

The Crystal Springs discharge measurements range from 1 to 14 cfs (450 to 6,280 gpm). This large difference occurs because the combined discharge from the main orifices is intermittently diverted to an irrigation ditch supplying agricultural uses to the south. The diversion structure and its operation are discussed in detail in the subsequent section. Except for leakage from the dam or flow seepage through the banks that contain the secondary spring orifice, the entire flow may be diverted for irrigation.



Note: Diversion ditch is shown at the top right of the photograph.

Figure 3-14
Reservoir and Orifice of Crystal Springs

The continuous record at Crystal Springs is variable because of the irrigation diversion located upstream of the primary gaging station. As a result of the diversion, the gage has not always recorded the entire flow. Therefore, the historical record may be misleading when trying to determine the spring's historical discharge. In 2004, a supplemental gage was installed on the Crystal Springs diversion channel to correct this problem, and in 2005, the first data from this gage were published by the USGS. Water years 1990 through 1993 and 1999 were not used in the analysis of Crystal Springs because data from water years 1990 and 1999 were incomplete years and daily diversions of water appear to have occurred from 1991 to 1993. An analysis of the mean daily values prior to October 6, 1991, shows that the undiverted mean daily discharge is 12 cfs (5,386 gpm). This discharge rate is not recorded again until October 19, 1993. In the period from 1991 through October 1993, the maximum daily discharge was 11 cfs (4,937 gpm) for a period of seven days in April 1993.

The mean daily discharge data collected at Crystal Springs near Hiko, Nevada, gaging station during the 2008 water year are problematic. For several days during the water year, the total discharge from the diversion channel and main channel does not equal 13 cfs (5,834 gpm) (Figure 3-17). Errors only occur during periods of diversion. The 2007 water year contained two days with similar issues, and the 2006 data set was relatively error free. USGS has been contacted to determine the source of these errors. The data from the 2005 through 2008 water years and the period of record are summarized in (Table 3-6).

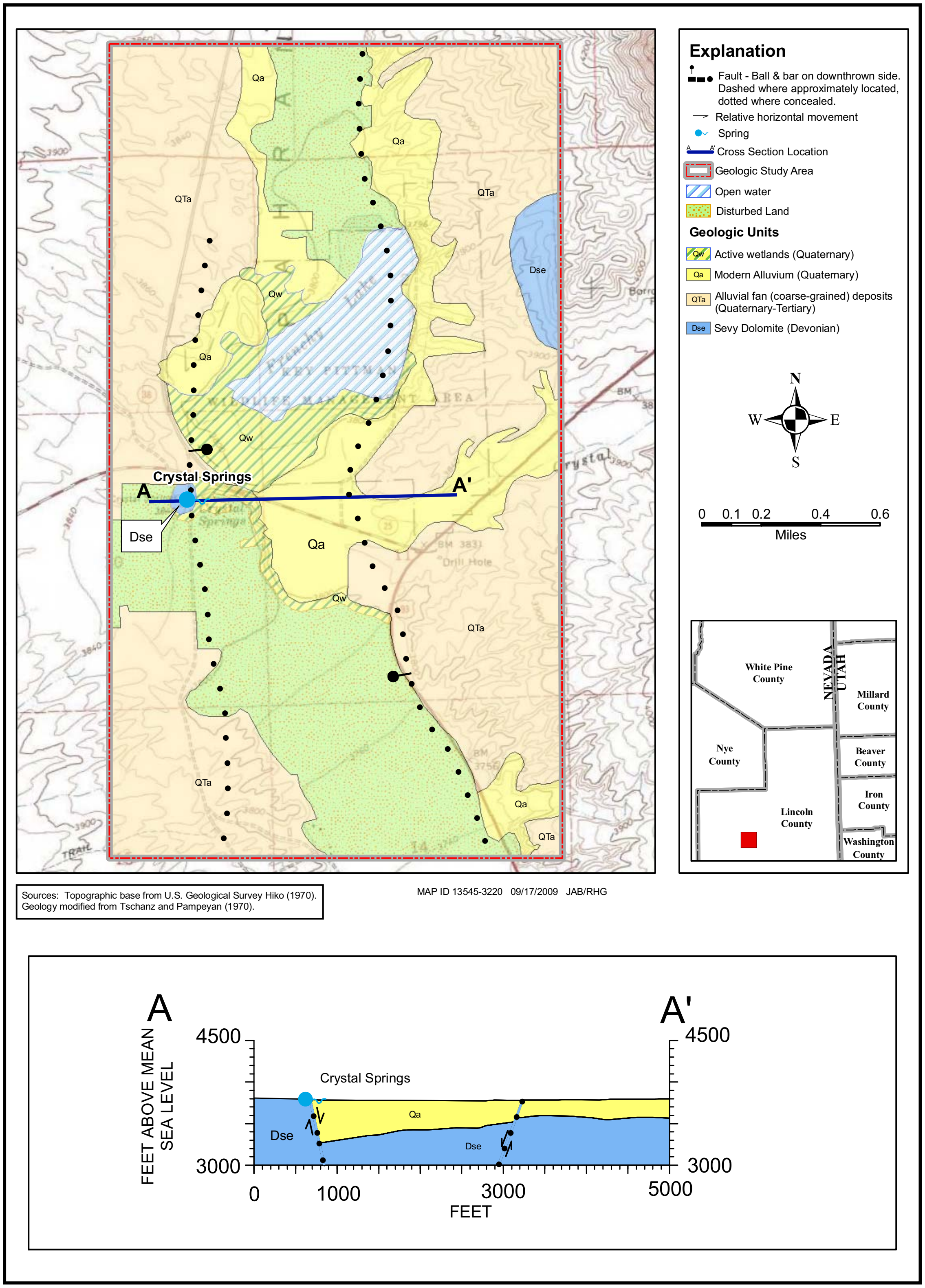


Figure 3-15
Generalized Geologic Map and Cross Section of Crystal Springs, Pahranagat Valley, Nevada

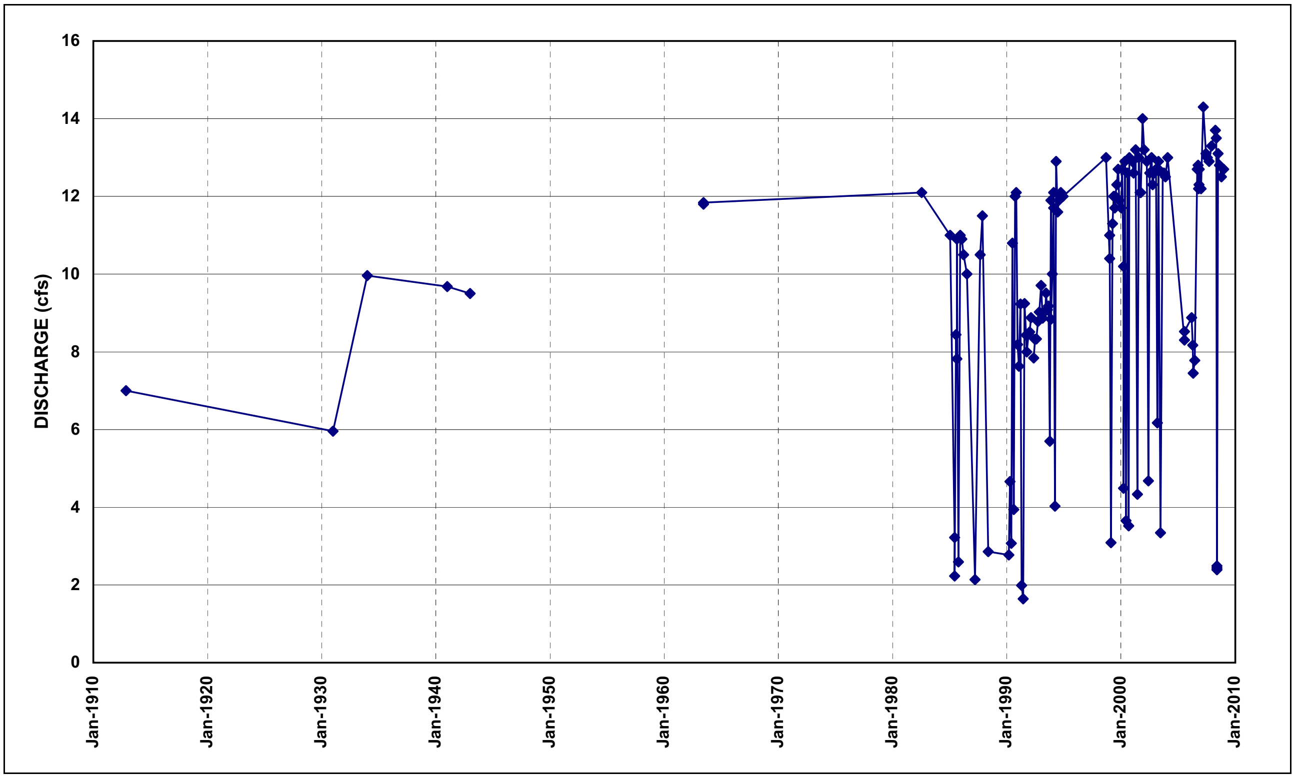


Figure 3-16
Miscellaneous Discharge Measurements for Crystal Springs near Hiko, Nevada

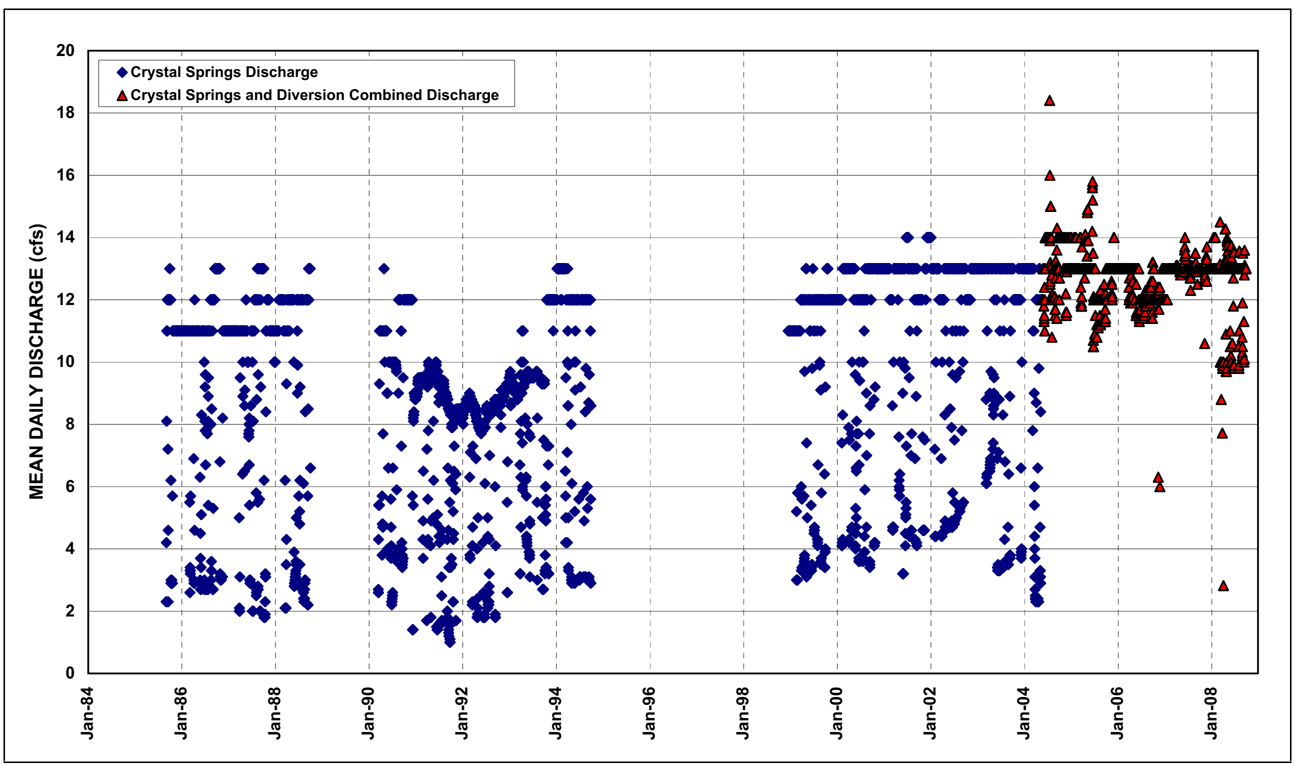


Figure 3-17
Mean Daily Discharge for Crystal Springs near Hiko, Nevada

Table 3-6
Annual Discharges at Crystal Springs

Water Year[a, b]	Crystal Springs (09415590)		Crystal Springs Diversion (09415589)			Total Combined Discharge (afy)
	Annual Discharge (afy)	Average Annual Discharge (cfs)	Annual Discharge (afy)	Average Annual Discharge (cfs)	Days Diverted	
2005	8,110	11.2	1,230	1.70	78	9,340
2006	8,180	11.3	927	1.28	67	9,110
2007	8,250	11.4	999	1.38	68	9,250
2008	8,130	11.2	1,020	1.40	112	9,150
Average for the period of record[c]	8,170	11.3	1,040	1.44	81	9,210

[a]Water years 1990, 1991, 1992, 1993, and 1999 are excluded, as explained in the text.
[b]Data are from USGS Water Resources Data - Nevada water years 2005 through 2008 (USGS, 2006, 2007b, 2008, 2009).
[c]These values are extrapolated from the Crystal Springs gaging station record published by USGS (USGS, 2006, 2007b, 2008, 2009).

3.1.5.3 Diversions and Water Use

The water users of Crystal Springs organized into the Alamo Irrigation Company in 1922. The diversion system consists of a small earthen dam and a single headgate to control the spring's discharge. When the headgate is closed, the entire spring flow is diverted into a canal and is used for irrigation on the western side of Pahranagat Valley. When the headgate is open, the entire discharge continues down the main channel and functions as irrigation.

3.2 Additional Springs Adjacent to DDC Evaluated by the TRP

Three spring sites consisting of Hiko, Hardy, and Maynard springs were evaluated by the TRP in consultation with the NSE to determine the feasibility of discharge monitoring. All three sites were found to be suitable for monitoring. Access to the private property from the landowners of Hiko and Hardy springs has been obtained and monitoring station installed.

3.2.1 Hiko Spring

Hiko Spring is located on the Cannon Ranch approximately a half mile northeast of Hiko, Nevada, in the north end of Pahranagat Valley (Figure 3-1) and has historically provided water for various uses. Hiko Spring discharges from the base of the Hiko Range and currently provides water for domestic, agricultural, and wildlife purposes (Figure 3-18) (State of Nevada, 2004b).

SNWA monitors discharge at Hiko Spring continuously with a new flow meter and data logger installed on the 18-in.-diameter discharge pipe located southwest of the spring. The concrete vault housing the meter was constructed in cooperation with the owners of the Cannon Ranch. Data are anticipated to be collected 12 out of every 15 days during irrigation season when water is not being diverted above the flow meter for Cannon Ranch irrigation. The work on the vault and meter was completed in June 2009. Limited discharge data are provisional and indicate a discharge of 2,600 to 3,000 gpm depending upon the irrigation usage schedule. The irrigation usage schedule also appears to affect the level of the spring pool. Data will be further evaluated as more information is collected.

Figure 3-18
Reservoir and Springhouse at Hiko Spring

3.2.1.1 Geologic Setting

The rock outcrop immediately east of the Hiko Spring orifice is heavily fractured and brecciated, brown, fine-grained limestone and limy-dolomite. The brown limestone, which contains many white high-angle calcite veins, was mapped as Guilmette Formation. A fault strikes about north 40 degrees east and controls the spring. The Guilmette Formation is faulted down against the Simonson Dolomite farther to the east (Figure 3-19).

3.2.1.2 Discharge

An average discharge of approximately 6.5 cfs (2,920 gpm) was reported at Hiko Spring from 1934 to 1943 (Smith, 1938, 1942, 1944). During 1963, a discharge of 5.36 cfs (2,410 gpm) was reported by Eakin (1963). This lower value may have been caused by the poor condition of the diversion structure. During the field investigation on July 19, 2004, it was determined that a measurement could not be made because of the diversion works configuration.

Hiko Spring's historical discharge measurements are listed in Appendix D. However, a possible error in the measurements was reported by Carpenter (1915) and Hardman and Miller (1934). Carpenter (1915) reported discharges for Hiko Spring and Crystal Springs to be 9 cfs and 7 cfs (4,040 and 3,140 gpm), respectively. While Carpenter's (1915) descriptions of the springs are correct, it is

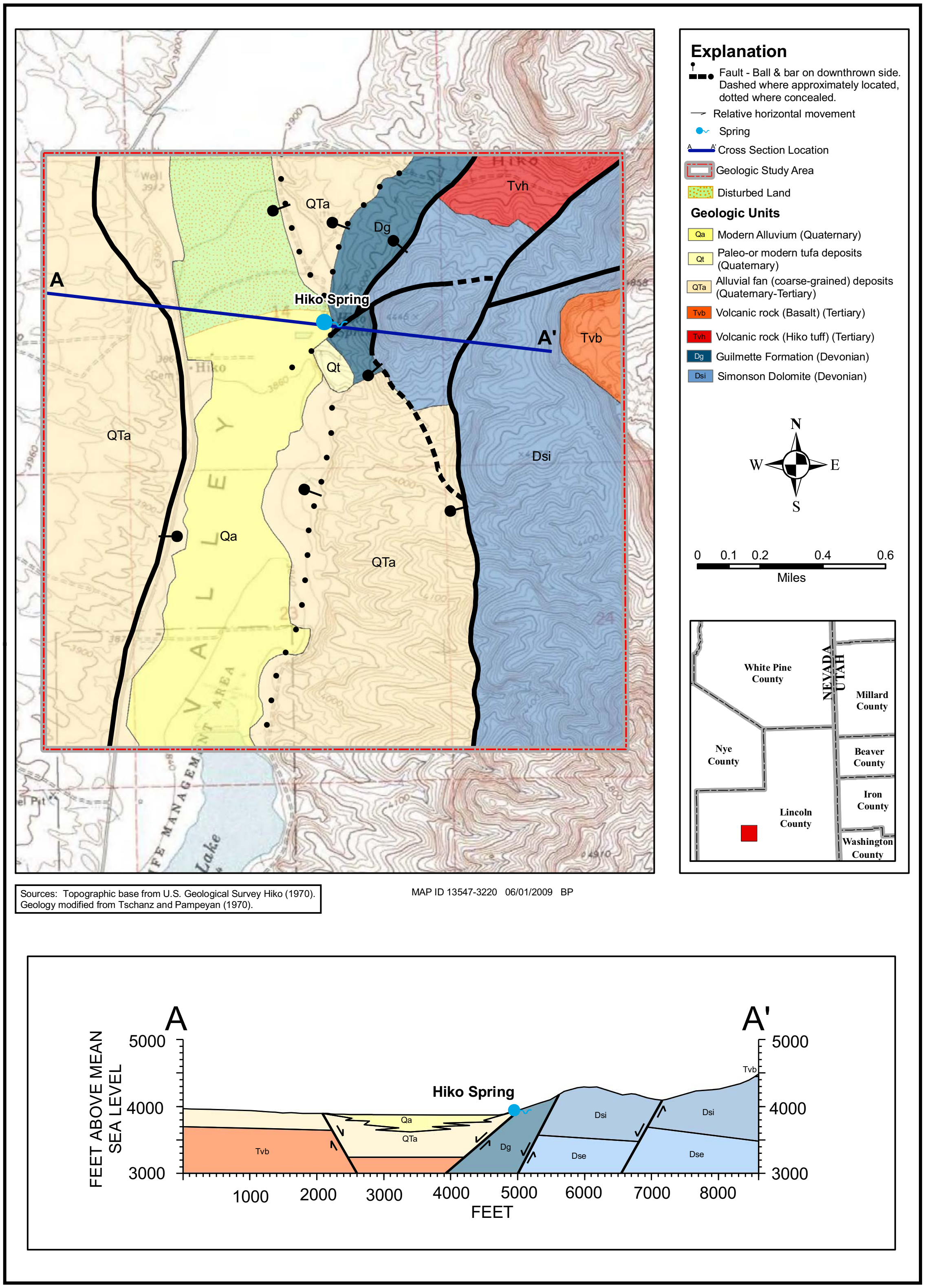


Figure 3-19
Generalized Geologic Map and Cross Section of Hiko Spring, Pahranagat Valley, Nevada

possible that he assigned the wrong discharge value to each spring (i.e., since 1938, Crystal Springs' flow has been greater than that of Hiko Spring). This apparent reversal happens again with the 1931 measurements of Hardman and Miller (1934), who reported Hiko Spring's discharge as 11.96 cfs (5,370 gpm) and Crystal Springs' discharge as 5.96 cfs (2,680 gpm). A historical hydrograph of Hiko Spring is presented in Figure 3-20. The hydrograph reflects variations in discharge, which most likely are the result of inconsistency in measurements and diversions. In 2004, SNWA measured the temperature of Hiko Spring's discharge at 27°C.

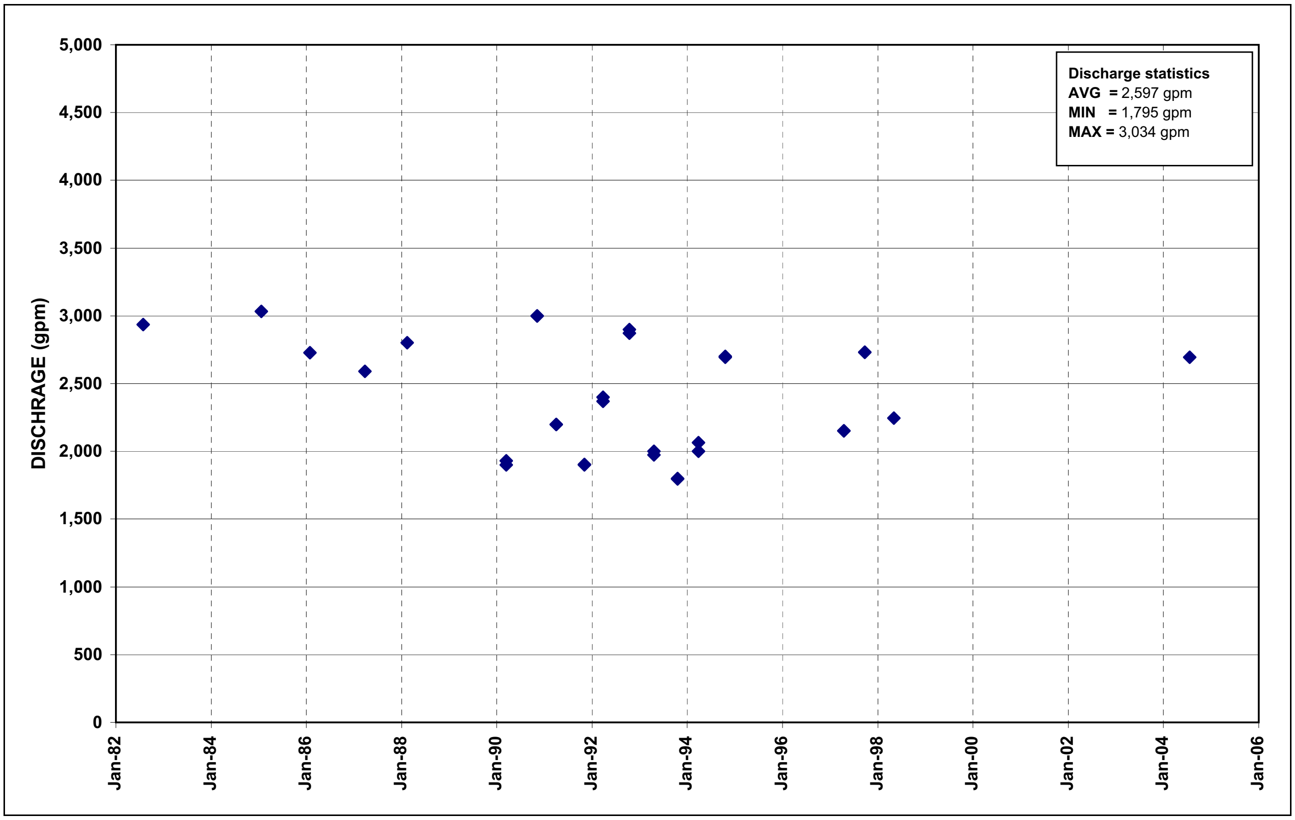
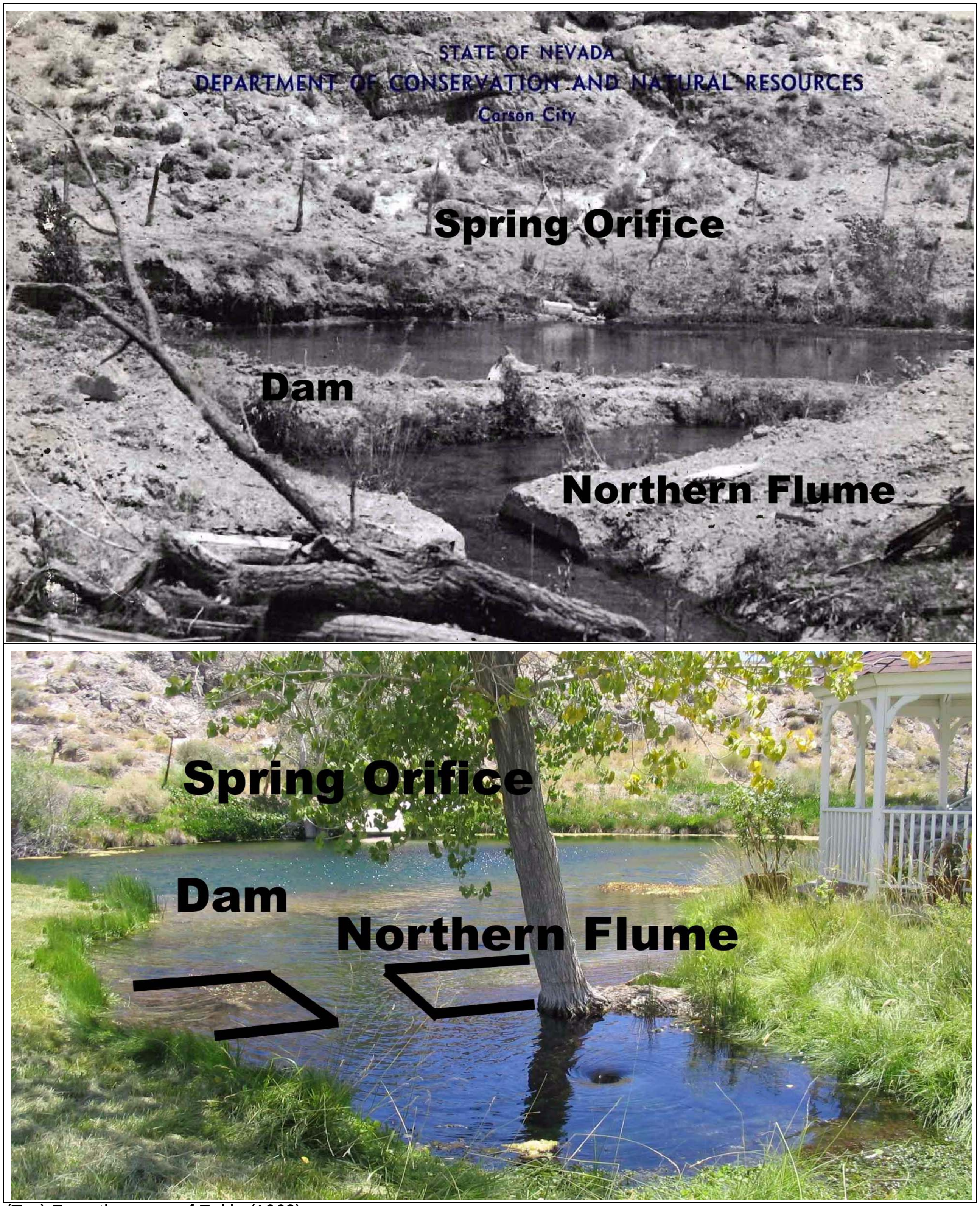


Figure 3-20
Hydrograph of Hiko Spring

3.2.1.3 Diversions and Water Use

In 1939, a dam was constructed in front of the Hiko Spring orifice to form a reservoir. The dam had three equally sized flumes installed at the same elevation to automatically divide the water equally among the water-right holders. Only two of the wooden flumes were operated simultaneously, so the water-right holders could each receive half of the total spring flow. In 1939, a small spring at the base of the dam was reported (Smith, 1940).

This system controlled the flow until approximately 1980, when a new dam was constructed and the old diversion ditches were converted to pipelines (Figure 3-21). The pipeline and control values deliver water on a set schedule to the water-right holders. The discharge flow meter installed by SNWA measures flow in the pipeline.



(Top) From the cover of Eakin (1963)
(Bottom) Hiko Spring in 2004.

Figure 3-21
Hiko Spring Diversion Structure

3.2.2 Hardy Springs

Hardy Springs is located approximately 16 mi south of Lund, Nevada, and 1.5 mi west of State Route (SR) 318 in White River Valley in Nye County (Figure 3-1). Hardy Springs is composed of five individual spring orifices that discharge into a main channel that is a tributary to the White River (Figure 3-22). Hardy Springs NW is a lower elevation spring separate from the main Hardy Springs. Hardy Springs discharges from Quaternary alluvial sediments consisting mainly of fine-grained material. Two discharge measurements have been reported at Hardy Springs. Hess and Mifflin (1978) reported a discharge of 0.45 cfs (204 gpm) on November 14, 1966, and SNWA measured the discharge at a rate of 0.45 cfs (204 gpm) on September 11, 2004. The exact agreement in the discharge measurements is likely fortuitous.

Figure 3-22
Discharge from Hardy Springs in White River Valley

A small diversion was observed 100 to 150 ft downstream of the confluence of the Hardy Springs. Currently, the diversion is in disrepair. At one time, the entire flow of Hardy Springs could have been diverted into an aqueduct that flows directly west or allowed to flow along its current course.

SNWA installed a new flume to obtain biannual discharge measurements at the site of the old diversion (Figure 3-23). The flume was installed in August 2009.

Figure 3-23
Hardy Springs, Flume Location Prior to Installation

3.2.3 Maynard Spring

Maynard Spring is located off of U.S. Highway 93 about 14 mi southeast of Alamo, Nevada, and 2.5 mi southeast of Lower Pahranagat Lake on BLM land in Pahranagat Valley (Figure 3-1). The spring is composed of two springheads, referred to as North Maynard Spring and South Maynard Spring, which are separated by a distance of roughly 400 ft. Currently, there are multiple piezometers at North Maynard Spring. SNWA plans to measure water levels in the piezometers at least biannually, in cooperation with USFWS and BLM. The spring area is depicted in Figure 3-24.

Both North and South Maynard springs are located within the Pahranagat Shear Zone and in Quaternary and Tertiary basin fill with welded ash-flow tuff and thin basalt flows and cinder cones nearby. According to Water Rights Applications 62432 and 62433, both of the springs were observed on July 16, 1993, discharging at an estimated rate of 0.20 cfs (90 gpm) each. However, observations in 2009 indicated no measurable flow.

Figure 3-24
Maynard Spring, Pahranagat Valley, Nevada

3.3 Cottonwood Spring

Cottonwood Spring is approximately 9.5 mi south of Alamo, Nevada, 1 mi west of U.S. Highway 93 on the USFWS Pahranagat Wildlife Refuge (Figure 3-1), and 1.5 mi south of the Refuge Headquarters along the Corn Creek/Alamo Road. As per Exhibit A of the Stipulation, USFWS is to provide data collected from Cottonwood Spring to the TRP. SNWA will work with USFWS to obtain and present the data in the annual status and data report.

Cottonwood Spring's pool is approximately 20 ft in diameter and 1 to 2 ft in depth and lies 3 to 5 ft below the surrounding land surface. The pool is heavily overgrown with cattails and other types of aquatic vegetation. A metal catwalk extends from the western edge of the spring to the 12-in. stilling well, which is accessed via an access door. A ring of vegetation consisting primarily of broad leafy plants and grasses surrounds the pool. A small grove of 6 to 10 cottonwood trees is located along the northern edge of the pool (Figure 3-25). The spring discharges from alluvium just east of a small terrace that is most likely a fault scarp.

Figure 3-25
Cottonwood Spring Discharge Area

Measurements of discharge and water temperature were conducted at Cottonwood Spring during the May 24, 2004, field investigation. The discharge estimate was 0.25 to 1.0 cfs, and the water temperature was 20.3°C. The discharge was measured approximately 15 yards downstream of the spring's orifice near a permanently installed 3-in. flume. The channel reach from the orifice to the flume is heavily overgrown with cattails and other aquatic plants and is incised approximately 1 to 1.5 ft bgs. The width of the channel is about the same as that of the flume. The heavily overgrown channel controls the flow from the spring pool.

In 2004, the field investigation documents a probe installed in a stilling well and a 30-degree V-notch weir plate. All of the equipment, including the 3-in. Parshall flume, were in poor condition. The probe in the stilling well was disconnected from the power source, and the stilling well was overgrown with cattails. The 30-degree V-notch weir plate also was overgrown, and water no longer passed over it. The Parshall flume was no longer level and was overgrown. Fifty percent of the flow was estimated to bypass the flume at the time of the field investigation. Current conditions may not be reflective of the 2004 observations.

During spring 2007, USFWS reinstalled the 3-in. Parshall flume and recorded variable flow rates of 0.027 cfs (12 gpm) in April 2007 and less than 0.002 cfs (less than 1 gpm) in June 2007. USFWS measured water temperatures of 16.6°C, 21.7°C, and 15.4°C in May, August, and December, 2007, respectively.

No diversions were observed during the field investigation. The water at Cottonwood Spring is used for wildlife.

3.4 DDC Springs Selected for Biannual Monitoring

Eight primary and one alternate spring monitoring locations were selected within the DDC valleys by the TRP in consultation with the NSE. These springs are generally characterized as being sourced in the mountain block and as having no hydraulic connection to the regional aquifer. However, biannual baseline monitoring will be performed to document variability in spring conditions.

Springs included in this part of the program consist of the following:

Cave Valley
- Cave Spring
- Parker Station
- Lewis Well
- Silver King Well

Dry Lake Valley
- Coyote Spring
- Big Mud Springs
- Littlefield Spring
- Meloy Spring (Alternate)

Delamar Valley
- Grassy Spring

Field visits to the sites are planned for spring and fall of each year beginning in fall 2009. When site access conditions permit, wetted area and discharge (if measurable) will be documented. Field-water chemistry data will also be collected.

Physical descriptions and hydrologic data for the springs are presented in this section. Available water-chemistry data are presented in Section 5.0. The springs are presented from north to south.

3.4.1 Cave Valley

Cave Valley springs in the monitoring program are Cave, Parker Station, Lewis Well, and Silver King Well.

3.4.1.1 Cave Spring

Cave Spring is located at the far southwest corner of a low northeast-southwest-trending hill approximately 3 mi southeast of Parker Station, Nevada, and 65 mi northwest of Bristol Wells, Nevada (Figure 3-1). Biannual discharge measurements and conditions will be documented at the spring with permission from Cave Valley Ranch.

Tschanz and Pampeyan (1970) mapped the ridge north of Cave Spring as being Cambrian Pole Canyon limestone flanked by and faulted down against Cambrian Pioche shale. In addition to these two faults, a northeast-striking fault is intersected by an east-west fault that dips 72 degrees to the north. The east-west fault has been trenched where a dipping angle of 72 degrees was measured. The limestone and possibly shale dip 30 to 32 degrees to the southeast and strike north 45 degrees east. The limestones are thin- to medium-bedded oolitic limestone with corals. Between the spring orifice and ridge of Cambrian rocks, a large basin-range fault drops this section into the valley floor (Figure 3-26).

Cave Spring discharges from Pole Canyon Limestone into a small creek incised 3 to 4 ft into the alluvium. In 1968, Mifflin (1968) described the spring discharge as variable, although it is not clear

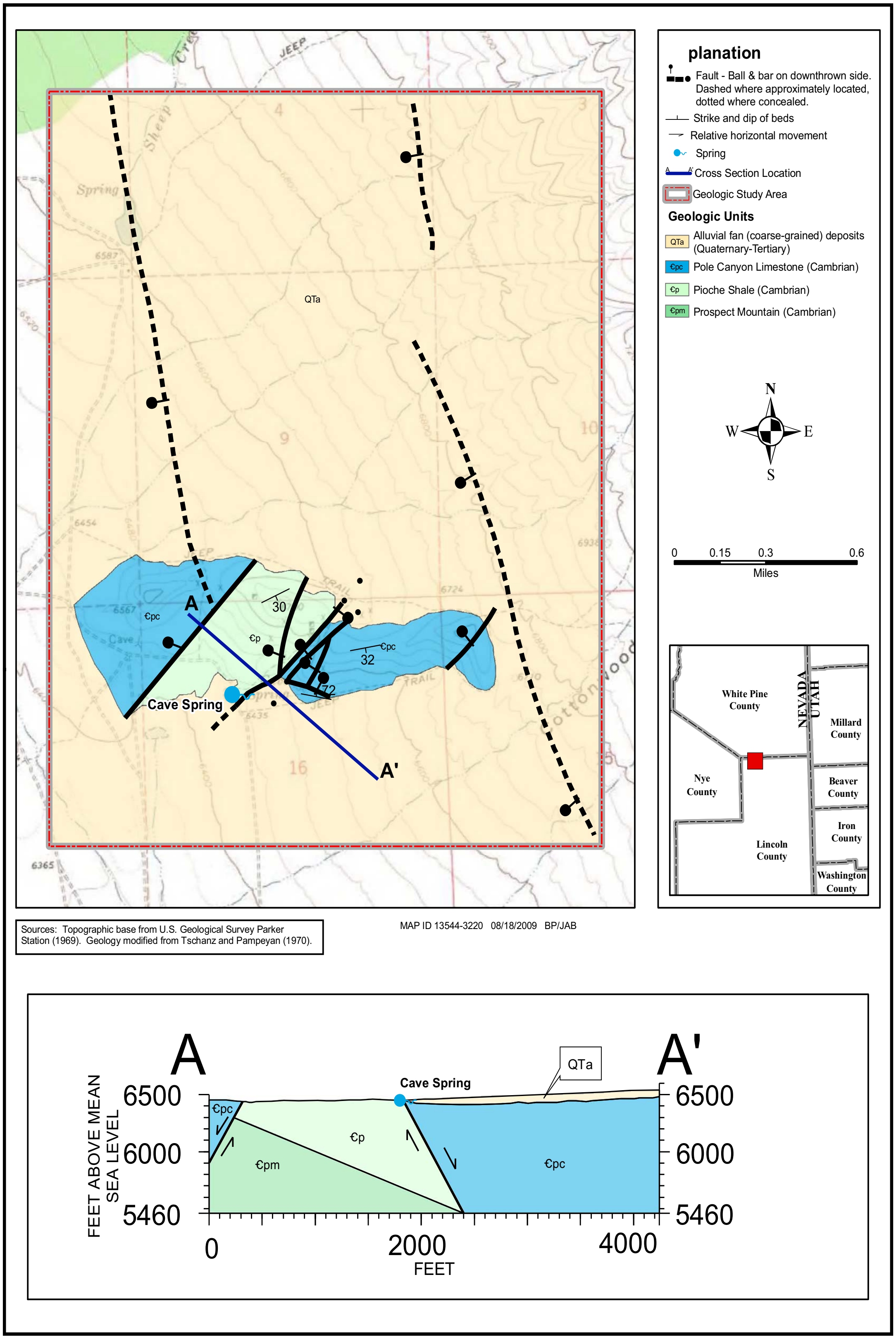


Figure 3-26
Generalized Geologic Map and Cross Section of Cave Spring, Cave Valley, Nevada

whether the reported discharge was measured, estimated, or based on another investigator's data. Bed material during periods of high flow is coarse, angular, limestone gravels; in periods of low flow, fine material and moss cover the coarse material.

Discharge was measured at Cave Spring three times during separate field sessions in June, July, and September of 2004. All measurements were taken within 50 ft of the orifice. The measurements decreased in discharge during each visit. The measured discharges on June 23, July 16, and July 29, 2004, were 0.233, 0.081, and 0.022 cfs (105, 36, and 10 gpm), respectively. On September 14, 2004, the spring was again visited and was observed to be dry. During the 2007 water year, the discharge of Cave Spring was measured three times. In October 2006, the discharge was 0.033 cfs (approximately 15 gpm). In July and September 2007, the spring was observed to be dry. The decrease in discharge rates during the summer months and the cold temperature of the water indicate that this spring is fed solely by local recharge (Figure 3-27). A photo of the spring, taken in May 2009, during high discharge is presented in Figure 3-28.

Currently, no active diversions exist at the spring. Historically, it appears that a small, hand-dug well was placed in the stream channel and was used to divert water by pump. The water now flows freely down the channel into a small reservoir in the center of the valley where it is used for livestock watering.

3.4.1.2 Parker Station

Parker Station sits in north-central Cave Valley, approximately 16 mi southeast of Lund, Nevada. Parker Station was once used as a stagecoach station. This site in Lincoln County is nearly a mile south of the White Pine County line. Parker Spring is a few hundred feet southwest of the Parker Station flowing well.

The spring and flowing well sit near a concealed normal fault on the valley floor in Quaternary and Tertiary basin fill.

The Parker Station flowing well was described as a 4-in. well used for stock watering. The reported flow rate was 2 to 3 gpm (Ertec, 1981; Brothers et al., 1993). A photo of the flowing well is presented in Figure 3-29. Parker Spring lies on Cave Valley Ranch, LLC, property. No known diversions exist at Parker Station. Biannual discharge measurements and conditions will be documented at the flowing well and nearby spring with permission from Cave Valley Ranch.

3.4.1.3 Lewis Well

The Lewis Well is located in southern Cave Valley, approximately 36 mi south of Lund, Nevada, and six miles east of SR 318 (Figure 3-1). It is located at the base of the Egan Range on the eastern slope. The well was constructed in 1925 and was completed with a 42-in. steel casing to a depth of 26 ft.

The Lewis Well area is dominated by Quaternary and Tertiary basin fill. Welded ash-flow tuff can be found to the west, and Pennsylvanian Ely Limestone has been mapped to the east.

(Top) October 1962, discharge is estimated at less than 10 gpm.
(Bottom) June 29, 2004, discharge is 0.022 cfs (10 gpm).

Figure 3-27
Historical Cave Spring Photos during Low and Moderate Discharge

Figure 3-28
Cave Spring during High Discharge (May 2009)

According to the 1925 Certificate of Appropriation of Water #1175, water was pumped into a catch basin approximately 25,000 ft^3 in volume. From there the water was diverted into 150 ft of 20-in. iron troughs. No recent field investigations have been carried out, so the condition of the well and diversion has not yet been assessed. Currently, no depth-to-water data are available. A site evaluation will be performed, and biannual discharge measurements and conditions will be documented.

3.4.1.4 Silver King Well

Silver King Well is a dug well located within Lincoln County, Nevada, in southern Cave Valley. It lies approximately 40 mi southeast of Lund, Nevada, and 34 mi northwest of Pioche, Nevada (Figure 3-1). The dug well may have been a modification to a historic spring. Water-rights certificate No. 2105 is assigned to this location. Water is discharged from the Silver King Well by gravity drainage through approximately 600 ft of 2-in. pipe into a partially buried trough. Photos of the Silver King Well and discharge area are presented in Figures 3-30 and 3-31.

Figure 3-29
Parker Station Flowing Well

Figure 3-30
Silver King Well

Figure 3-31
Silver King Well Discharge Area

The surficial geology around the Silver King Well is composed of Tertiary intrusive rocks with an inferred normal fault to the east. Water-level data collected at the Silver King Well consist of two data points. A depth-to-water level on March 21, 1990, was reported as 8.9 ft bgs. The second depth-to-water measurement was made on August 25, 2003, and was reported as 7.95 ft bgs. A site evaluation will be performed, and biannual discharge measurements and conditions will be documented.

3.4.2 Dry Lake Valley

Dry Lake Valley springs included in the monitoring program are Coyote, Big Mud, and Littlefield. Meloy Spring was identified as an alternative spring for Littlefield Spring if property access is granted.

3.4.2.1 Coyote Spring

Coyote Spring is approximately 8 mi west-southwest of Bristol Wells, Nevada (Figure 3-1), and lies at the center of an abandoned homestead compound. A photo of Coyote Spring is presented in Figure 3-32.

Figure 3-32
Coyote Spring, Dry Lake Valley, Nevada

In 1912, Carpenter (1915, p. 72) said of the spring area, "a house and corral have been built near the spring, but neither appears to have been used for some time." The spring discharge is collected and piped to a large concrete tank (Figure 3-33). In the past, Coyote Spring's water was used for livestock.

Coyote Spring discharges from the base of a scarp approximately 15 ft high in volcanic rocks. Discharge from Coyote Spring was measured at 0.011 cfs (5 gpm) in 1912 and at 0.002 cfs (0.9 gpm) in August 1979. On June 3, 2004, discharge was measured at less than 0.001 cfs (0.11 gpm). On June 21, 2004, the discharge rate was less than 0.001 cfs (0.02 gpm).

3.4.2.2 Big Mud Springs

Big Mud Springs is located in northern Dry Lake Valley nearly 40 mi southeast of Lund, Nevada, and 33 mi northwest of Pioche (Figure 3-1). The springs are in the Schell Creek Range along Big Mud Pass approximately 7 mi north of Silver King Mountain. A wood fence is present at the springs. The

Figure 3-33
Livestock Tank and Diversion Pipe at Coyote Spring, Dry Lake Valley, Nevada

area is surrounded by dense vegetation, such as junipers, willows, and wild roses. A collection basin is in place to help divert the spring discharge (Figure 3-34). Big Mud Springs is used primarily for stock watering.

The spring source is at a fossiliferous limestone outcrop, and mud covers the springhead. The surrounding area is composed of Pennsylvanian Ely Limestone with Upper and Middle Devonian Guilmette Formation in the near west.

Currently, two rubber tubes convey water from Big Mud Springs to a holding tank 0.25 mi to the south. The discharge from each hose was measured volumetrically using a quart bottle at the storage tank. A discharge of 2.49 cfs was measured at the storage tank on May 8, 2008 (Figure 3-35).

The temperature of the water was reported as 14.2°C, pH was 6.56, and electrical conductivity was 420 µmhos/cm. The water-quality data were collected at the springhead.

3.4.2.3 Littlefield Spring

Littlefield Spring is located approximately 3 mi south of Meloy Spring (Figure 3-1). A photo of the spring discharge area is presented in (Figure 3-36). Recent development in the spring area includes a new fence around the spring discharge area and surface grading.

Figure 3-34
Discharge Area at Big Mud Springs, Dry Lake Valley, Nevada

Figure 3-35
Storage Tank at Big Mud Springs, Dry Lake Valley, Nevada

Figure 3-36
Discharge Area at Littlefield Spring, Dry Lake Valley, Nevada

Littlefield Spring discharges from the alluvium near an outcrop of volcanic rock. This spring had a reported discharge of 0.022 cfs (10 gpm) in May 1980 (Bunch and Harrill, 1984). During a June 3, 2004, field investigation, discharge and temperature were measured at 0.026 cfs (12 gpm) and 15°C. No diversions exist near the spring.

3.4.2.4 Meloy Spring

Meloy Spring is located on private property approximately 3 mi north of Littlefield Spring (Figure 3-1). An old homestead is located at the spring. The spring discharges below an outcrop of volcanic rock. The orifice area is overgrown with wild rose bushes, making it inaccessible to measure discharge or collect water-chemistry samples. Meloy Spring is designated as an alternate monitoring location and will replace Littlefield Spring if property access is obtained.

According to Carpenter (1915), Meloy Spring once was used as a watering place for travelers. The water is currently used for livestock and wildlife.

Meloy Spring discharges from the base of small scarp in Tertiary volcanic rocks. In May 1980, the spring's discharge was measured at 0.183 cfs (82 gpm). In 1997, SNWA estimated the discharge as 0.1 cfs (45 gpm). The site was not accessible in 2004.

3.4.3 Delamar Valley

The spring monitoring program in Delamar Valley consists of Grassy Spring.

3.4.3.1 Grassy Spring

Grassy Spring is located in Delamar Valley approximately 40 mi south of Bristol Wells, Nevada, along the western flank of the Delamar Mountains (Figure 3-1). A photo of Grassy Spring is presented in Figure 3-37. Grassy Spring is currently used for stock watering. The discharge is captured at the source and is transferred to a livestock tank through a 1-in.-diameter, black polyvinyl tubing.

The spring discharges from alluvial sediments in close contact with volcanic rocks. During a field investigation on June 2, 2004, the discharge of the spring was measured at less than 0.001 cfs (0.5 gpm). The discharge was measured volumetrically at the livestock tank, approximately 300 ft west of the spring.

Figure 3-37
Grassy Spring, Delamar Valley, Nevada

4.0 PRECIPITATION STATIONS

SNWA will compile and report data from selected operating precipitation stations with an established historical record in the vicinity of the study area. The stations will be used as long as the data are available and stations are in operation. The program is composed of two networks, primary and secondary, delineated by proximity of a station to Delamar, Dry Lake, and Cave valleys. The primary network stations are listed in Table 4-1. The secondary network stations are listed in Table 4-2. All monitoring stations from both networks are presented on Figure 4-1.

Table 4-1
Primary DDC Precipitation Station Locations

Site Number	Station Name	Altitude (ft amsl)	Location	
			Latitude	Longitude
USGS High-Altitude Precipitation Sites				
375337114343801	Highland Peak	9,330	37.894	114.577
372035114432901	Unnamed peak in S. Delamar Mountains	7,800	37.343	114.725
373107114433301	Unnamed peak S. of Chokecherry Peak	7,800	37.519	114.726
National Oceanic and Atmospheric Administration (NOAA)/National Weather Service (NWS) Precipitation Sites				
265880	Pahranagat WR	3,400	37.269	115.120
262557	Elgin	3,420	37.348	114.543
263671	Hiko	3,900	37.558	115.224
267908	Sunnyside - Lund 31S	5,300	38.424	115.023
264745	Lund	5,560	38.868	115.016
261590	Cathedral Gorge SP	4,830	37.804	114.407
261358	Caliente	4,400	37.617	114.516

4.1 Primary Network

The primary, proximal precipitation station network includes three high-altitude precipitation stations, including one located in the highland range and two locations in the Delamar Mountains; these stations are maintained and operated by USGS through a cooperative funding agreement with SNWA and NDWR. Additionally, the primary network includes seven National Oceanic and Atmospheric Administration (NOAA)/National Weather Service (NWS) precipitation stations located in the towns of Lund, Caliente, Hiko, Elgin, Sunnyside, the Pahranagat Wildlife Refuge, and the Cathedral Gorge localities, which provide regional precipitation data. SNWA will continue to compile and report precipitation data from these sites as long as the data are made available by the owners/operators.

Table 4-2
Secondary DDC Precipitation Station Locations

Site Number	Station Name	Altitude (ft amsl)	Location	
			Latitude	Longitude
USGS High-Altitude Precipitation Sites				
373915115232801	Mt. Irish	8,607	37.654	115.391
381157115373101	Quinn Canyon Range	9,050	38.199	115.459
381438114233301	Mt. Wilson	9,200	38.244	114.392
385409114185401	Mt. Washington	10,440	38.902	114.315
390946114364901	Cave Mountain	10,650	39.163	114.614
391913114143101	Unnamed peak NW of Mt. Moriah	9,300	39.320	114.242
NOAA/NWS Precipitation Sites				
267750	Spring Valley SP	5,950	38.040	114.180
264950	McGill	6,270	39.402	114.776
267175	Ruth	6,850	39.276	114.991
265371	Moorman Ranch	6,539	39.357	115.330
262631	Ely Yelland FLD AP	6,262	39.295	114.845
263340	Great Basin NP	6,830	39.009	114.227
260955	Blue Eagle Ranch	4,780	38.521	115.544
SNOwpack TELemetry (SNOTEL) Precipitation Sites				
14K05S	Ward Mountain	9,200	39.117	114.950
14K02S	Berry Creek	9,100	39.315	114.620

4.2 Secondary Network

The secondary, distal precipitation monitoring network includes six high-altitude precipitation stations located in the Mount Irish, Quinn Canyon, Schell Creek, Snake, and Wilson Creek ranges; these stations, which include the Mt. Moriah, Cave Mountain, Mt. Washington and Mt. Wilson sites, are maintained and measured by USGS through a cooperative funding agreement with SNWA and NDWR. Seven NOAA/NWS precipitation stations are located in Ruth, McGill, the Blue Eagle Ranch, Ely, the Moorman Ranch, the Spring Valley State Park, and the Great Basin National Park. SNWA will continue to compile and report precipitation data from these sites as long as the data are made available. Two U.S. Department of Agriculture National Resources Conservation Service (NRCS) SNOwpack TELemetry (SNOTEL) sites, located in the Egan Range and in Berry Creek in the Schell Creek Range, provide snow-accumulation data. SNWA also will continue to compile and report precipitation data from these sites as long as the data are made available.

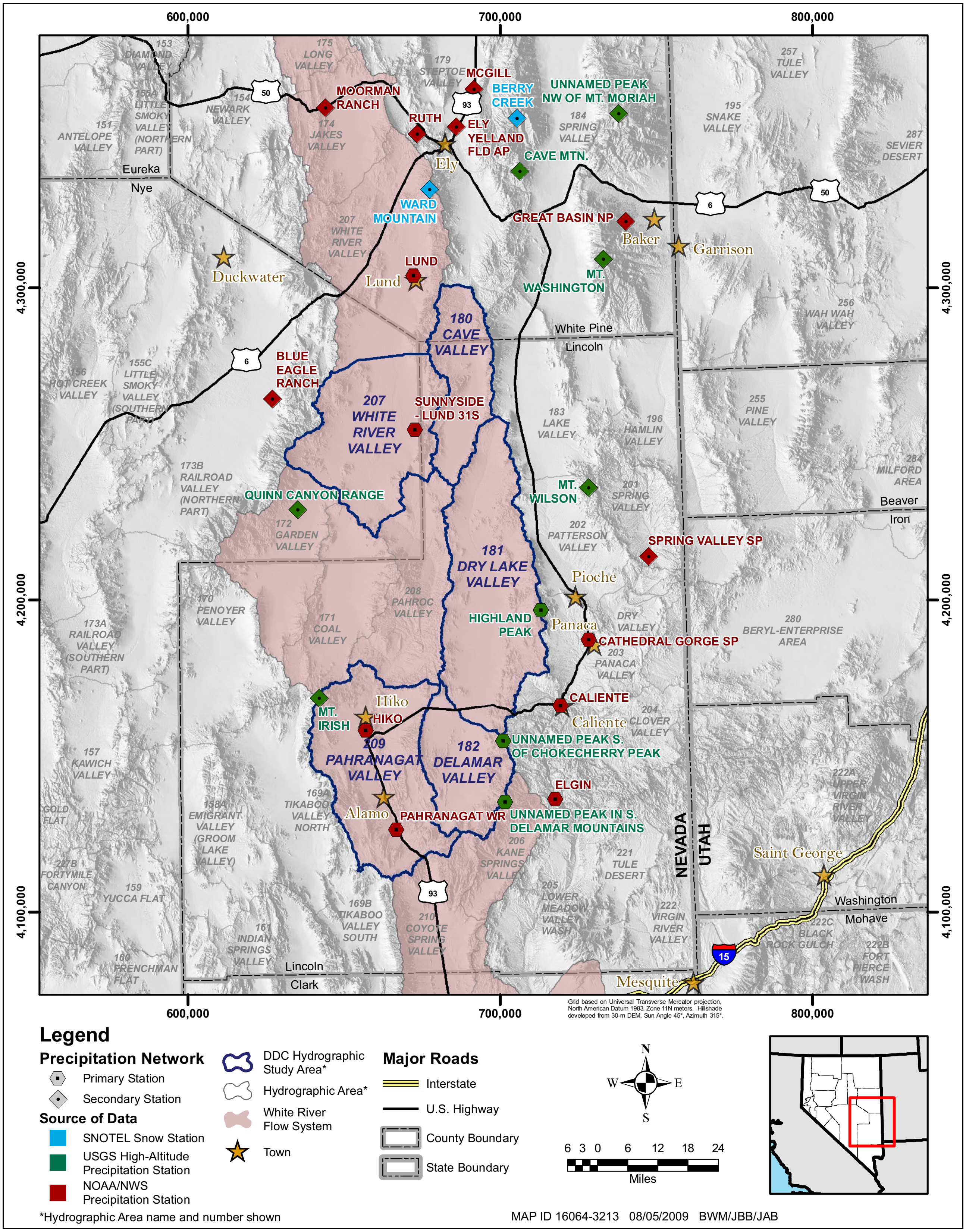


Figure 4-1
DDC Precipitation Station Locations

4.3 Historical Data

Historical data from the high-altitude stations, including provisional 2008 data, are presented in Appendix E. This appendix also contains available precipitation data collected through 2008 from eight of the NOAA/NWS precipitation stations included in the precipitation monitoring network.

5.0 WATER CHEMISTRY

Water-chemistry data are available for several wells and springs of the DDC monitoring network (Appendix F). These data represent samples collected recently by SNWA, USGS, and the DRI as well as those reported in historical reports dated as far back as 1912 (Carpenter, 1915). A selected set of the parameters are reported in Appendix F. These parameters include field measurements of specific conductance, water temperature, pH, and dissolved oxygen (DO) (Table F-1); major and minor solutes (Table F-1); the trace elements regulated by the U.S. Environmental Protection Agency's (EPA) Safe Drinking Water Act (Table F-2); stable isotopes of hydrogen (δD), carbon ($\delta^{13}C$), and oxygen ($\delta^{18}O$) (Table F-3); the radioisotopes, tritium (^{3}H) and carbon-14 (^{14}C) (Table F-3); and isotopes of strontium ($^{87}Sr/^{86}Sr$) and uranium ($^{234}U/^{238}U$) (Table F-3). The full suite of chemical parameters measured for the seven SNWA wells that are part of the DDC monitoring network is reported in SNWA (2008b).

5.1 Sampling and Analysis Methodology

The water-chemistry data provided for the DDC monitoring network represent samples collected over a large time period and analyzed for a variety of constituents (Appendix F). Early samples were generally analyzed for specific conductance, water temperature, pH, and major solutes, and the more recent samples were generally analyzed for these parameters as well as trace elements, stable isotopes, radioisotopes, and some organic compounds. The most extensive analyses were performed for the SNWA test well (CAV6002X). Samples from Test Well CAV6002X were collected at the end of a 72-hour constant-rate aquifer test and analyzed for a large suite of parameters regulated by the EPA (SNWA, 2008b). Samples collected from the monitor wells and springs by SNWA were analyzed for a similar suite of parameters that is less extensive than for the test wells.

Sampling and field measurements of the water-quality parameters were performed by SNWA in accordance with an SNWA procedure that is based on the *National Field Manual for the Collection of Water-Quality Data* (USGS, 2007a). All measurement equipment are calibrated according to the manufacturers' calibration procedures. Major solutes, minor and trace constituents, radiological parameters, and organic compounds are analyzed by a laboratory certified by the State of Nevada (Weck Laboratories, Inc.); δD, $\delta^{18}O$, and ^{3}H are analyzed by the University of Waterloo's Environmental Isotope Laboratory; $\delta^{13}C$ and ^{14}C are analyzed by the University of Arizona's NSF-Arizona Accelerator Mass Spectrometry Laboratory; chlorine-36 (^{36}Cl) is analyzed by Purdue University's Purdue Rare Isotope Measurement (PRIME) Laboratory; and $^{87}Sr/^{86}Sr$ and $^{234}U/^{238}U$ (and uranium concentration) are analyzed by the USGS Earth Surface Processes Radiogenic Isotope Laboratory.

The stable isotope results are reported using delta notation (δ), which represents the relative difference, in per mil (‰), between the isotope ratio (i.e., $^{13}C/^{12}C$, D/H, $^{18}O/^{16}O$) measured for the sample and the isotope ratio of a known reference standard. The reference standard for δD and $\delta^{18}O$ is Vienna Standard Mean Ocean Water (VSMOW) (Gonfiantini, 1978), and the reference standard for $\delta^{13}C$ is Pee Dee Belemnite (PDB) (Craig, 1957). The analytical precisions for δD, $\delta^{18}O$, and $\delta^{13}C$ are typically ±1‰, ±0.2‰, and ±0.3‰, respectively. Activities of ^{14}C are reported as percent modern carbon (pmc), and ^{3}H activities are reported in tritium units (TU).

For each hydrographic area included within the DDC monitoring network, Piper and Stiff diagrams are presented for all samples that have a charge balance of 10 percent or less (Table F-1); samples with a charge balance exceeding 10 percent are presented only if no other samples were available for a particular location. The sum of the charge of major cations should equal the sum of the charge of the major anions in solution; thus, the anion-cation (charge) balance is used to assess the accuracy of the analyses and to ensure that the full suite of anions and cations present as major constituents in the groundwater has been included in the analyses. The Piper and Stiff diagrams present the relative compositions of the major anions and cations in each of the groundwater samples. Each sample is plotted on these diagrams to illustrate similarities and differences between samples from different locations and the variability between multiple sampling events for the same location.

Plots of δD versus $\delta^{18}O$ and ^{14}C versus $\delta^{13}C$ for wells and springs in the DDC monitoring network are also presented within this section. Further evaluation is required to assess the extent of the reactions that alter the composition of the carbon isotopes along a groundwater flowpath and to accurately estimate the groundwater age; therefore, estimates of groundwater age and travel times are not presented. Much fewer data are available for ^{3}H, ^{36}Cl, $^{87}Sr/^{86}Sr$, and $^{234}U/^{238}U$ when compared to the other chemical constituents; samples from only one location, Test Well CAV6002X, within the relevant hydrographic areas were analyzed for ^{36}Cl. Discussion of these data are therefore limited.

5.2 White River Valley (HA 207)

Water-chemistry results for five springs (Flag Spring 2, Flag Spring 3, Hardy Springs, Hot Creek Spring, and Moorman Spring) of the DDC monitoring network in White River Valley are reported in Appendix F. Water-chemistry data for only single samples, collected between 1975 and 1984, are available for Flag Spring 2, Flag Spring 3, and Hardy Springs. Water-chemistry data for six samples, collected between 1945 and 2004, are available for Moorman Spring, and data for 19 samples, collected between 1912 and 2006, are available for Hot Creek Spring. Some of the samples are limited to field-measured parameters only. The water temperatures reported for Hot Creek (27°C to 33°C) and Moorman (36°C to 37°C) springs are significantly greater than those reported for Flag Spring 2 (18°C), Flag Spring 3 (23°C), and Hardy Springs (15°C). With the exception of the laboratory value for the Hot Creek Spring sample collected in 1992 (324 µS/cm), the reported specific conductance values are greater for Hot Creek (530 to 669 µS/cm) and Moorman (540 to 720 µS/cm) springs than for the other waters (405 to 440 µS/cm). The DO ranges from 1.0 to 3.8 mg/L for Hot Creek and Moorman springs (Table F-1); no measurements of DO are reported for the other springs in White River Valley.

The dominant cation and anion in most of the water samples are calcium and bicarbonate, respectively (Figures 5-1 and 5-2). With the exception of the samples from Hardy Springs, the waters are the Ca-Mg-HCO_3 type or borderline Ca-Mg-HCO_3 and Ca-Mg-Na-HCO_3 type. This water type

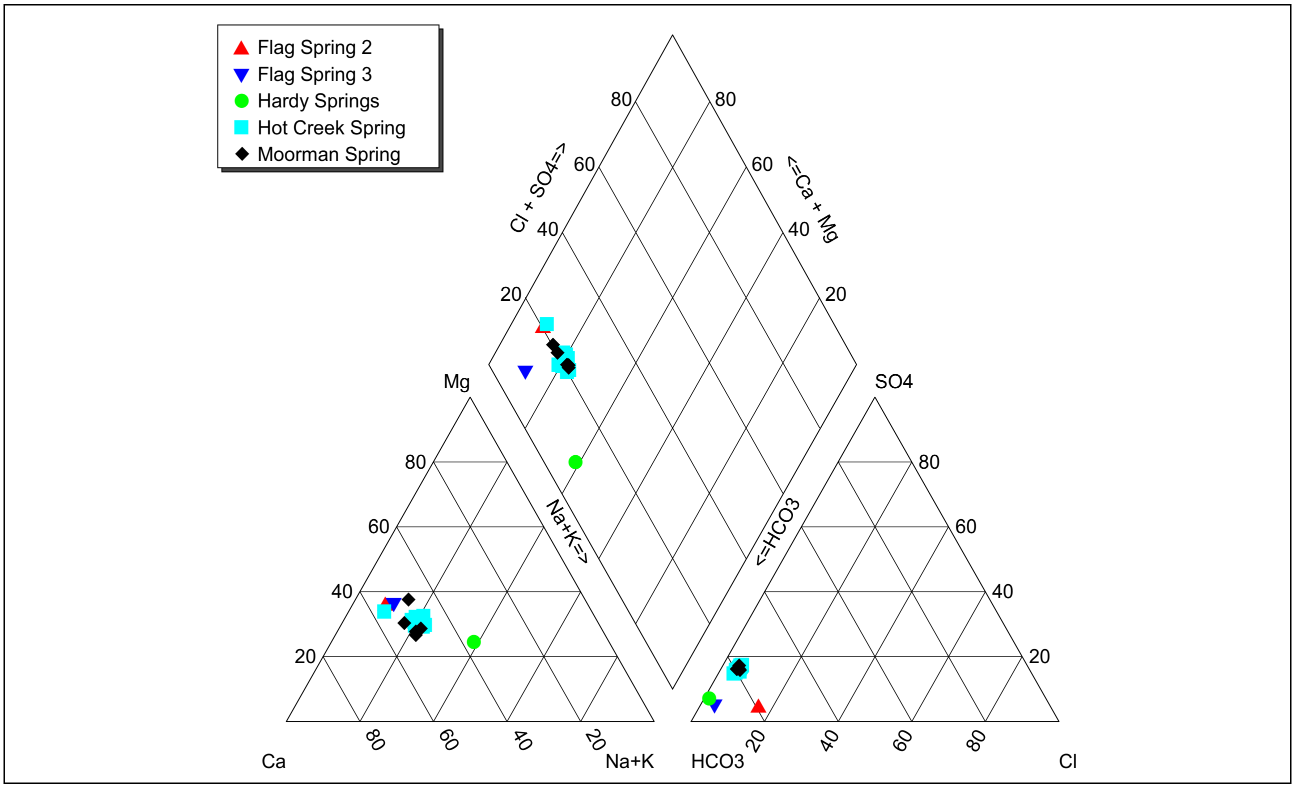


Figure 5-1
Piper Diagram Illustrating Major-Ion Compositions for White River Valley Waters

indicates interaction with carbonate minerals. Hardy Springs' water is the Na-Ca-Mg-HCO_3 type. The large charge balance for this sample, 18 percent, brings the validity of the data into question.

The concentrations of most of the trace elements reported for the network locations in White River Valley are below the detection limits (Table F-2). No exceedances of primary or secondary maximum contaminant levels (MCL) are observed in these samples. The arsenic concentration reported for one of the two samples from Hot Creek Spring is at the 10 µg/L MCL for this element.

Figure 5-3 presents a plot of δD versus $\delta^{18}O$ for wells and springs in the DDC monitoring network. In addition, the global meteoric water line (GMWL) defined by Craig (1961) is presented. Almost all the samples plot below the GMWL, suggesting that the waters underwent some evaporation prior to recharging into the underlying aquifers. Hot Creek and Moormon springs are the most depleted with respect to their δD (values range from -121 to -117‰) and $\delta^{18}O$ (values range from -15.8 to -15.5‰) composition of all samples within the monitoring network (Figure 5-3). Although the waters from Hot Creek and Moormon springs are isotopically similar to each other, they are significantly different than those of Flag Spring 3 (δD and $\delta^{18}O$ reported as -105 and -14.3‰, respectively) (Table F-3).

Carbon-isotope data, presented in Table F-3 and Figure 5-4, are currently available for Flag Spring 3, Hot Creek Spring, and Moorman Spring in White River Valley. Samples with both ^{14}C and $\delta^{13}C$ data are limited to Hot Creek and Moorman springs (Table F-3). The ^{14}C values range from 4.5 to 5.4 pmc, and the $\delta^{13}C$ values range from -10.0 to -4.0‰ (Table F-3).

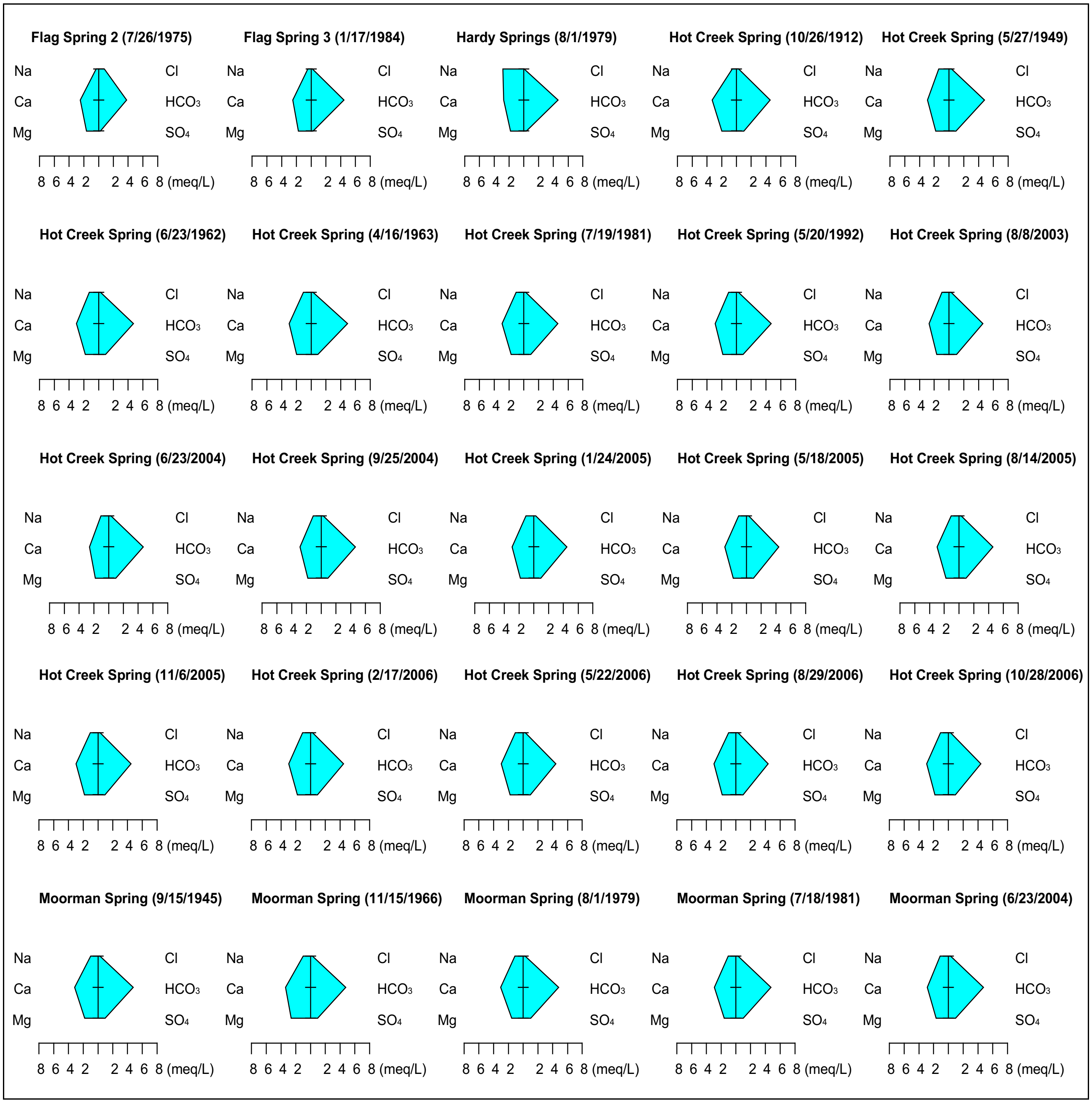


Figure 5-2

Stiff Diagrams Illustrating Major-Ion Compositions for White River Valley Waters

The ^{3}H data are limited to samples collected in the early 1980s and 1990s from monitoring network sites in White River Valley (Table F-3). The accuracy of the ^{3}H data for the earlier samples is unknown and may not accurately reflect the presence of ^{3}H in the samples. Strontium and uranium isotope data are limited to a single sample from Moorman Spring (Table F-3).

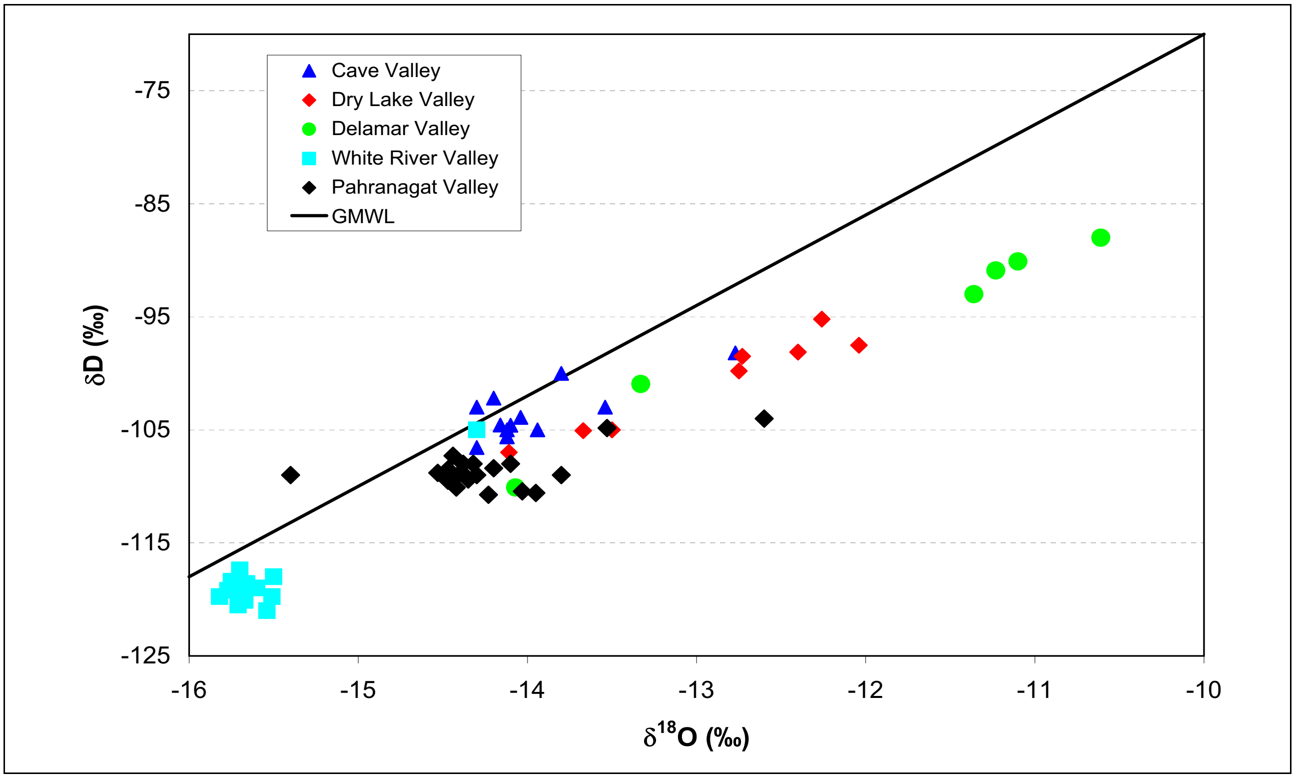


Figure 5-3
Plot of δD versus δ^{18}O for Waters in the DDC Monitoring Network

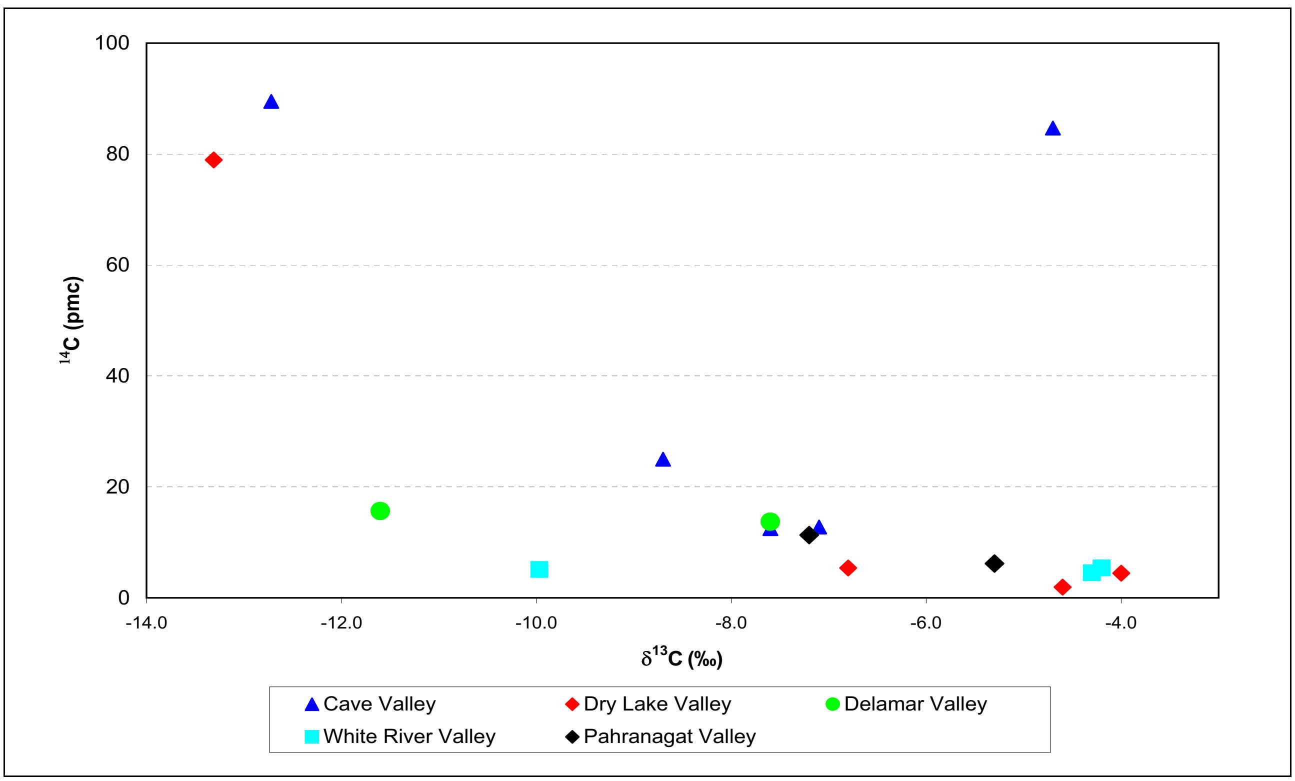


Figure 5-4
Plot of Carbon Isotopes for Waters in the DDC Monitoring Network

5.3 Pahranagat Valley (HA 209)

Water-chemistry results for one well (Well 209M-1) and four springs (Ash, Cottonwood, Crystal, and Hiko springs) of the DDC monitoring network in Pahranagat Valley are reported in Appendix F. Only one sample each was collected from Well 209M-1 and Cottonwood Spring (Appendix F). A total of 12 samples from Ash Springs, 24 samples from Crystal Springs, and five samples from Hiko Spring are reported; the earliest samples were collected in 1912, and the most recent were collected in 2005 (Ash Springs), 2006 (Crystal Springs), and 1991 (Hiko Spring).

Of the monitoring locations in Pahranagat Valley, the lowest temperature and the highest specific conductance are reported from Cottonwood Spring. The water temperatures reported for these locations are 40°C (Well 209M-1), 32°C to 36°C (Ash Springs), 26°C to 28°C (Crystal Springs), 26°C and 27°C (Hiko Spring), and 20°C (Cottonwood Spring). The specific conductance measured for each of these sites is 487 µS/cm (Well 209M-1), 448 to 614 µS/cm (Ash Springs), 408 to 671 µS/cm (Crystal Springs), 465 to 512 µS/cm (Hiko Spring), and 699 to 831 µS/cm (Cottonwood Spring).

The dominant cation and anion in most of the water samples are calcium and bicarbonate, respectively (Figures 5-5 and 5-6). The groundwater of Well 209M-1 is a Ca-Mg-Na-HCO_3 type. The majority of the spring samples border the Ca-Mg-HCO_3 and the Ca-Mg-Na-HCO_3 water types. One sample, collected in 1935 from Crystal Springs is the Ca-Mg-Na-HCO_3-Cl water type. More variability is observed for the waters of Ash Springs for which the water types range from

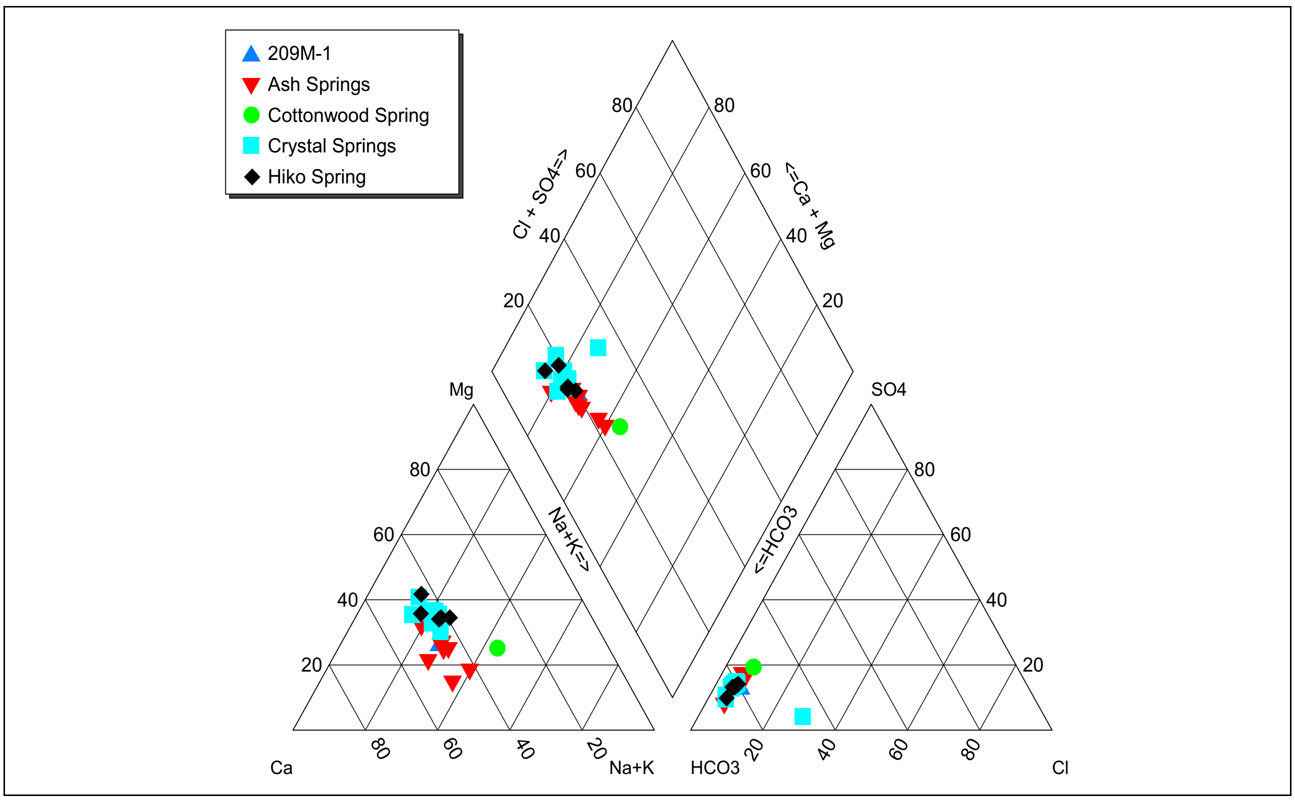


Figure 5-5
Piper Diagram Illustrating Major-Ion Compositions for Pahranagat Valley Waters

Figure 5-6
Stiff Diagrams Illustrating Major-Ion Compositions for Pahranagat Valley Waters

Ca-Mg-HCO_3 to Ca-Na-HCO_3 to Ca-Mg-Na-HCO_3 to Ca-Na-Mg-HCO_3. The water types reflect waters that have primarily interacted with carbonate minerals but that have also interacted with volcanic rocks or evaporite minerals. The major-ion chemistry of Cottonwood Spring is unique when compared to all other samples of the monitoring network in Pahranagat Valley; the dominant cation for the sample from Cottonwood Spring is sodium, and the water is a Na-Ca-Mg-HCO_3 type.

Trace-element data for Well 209M-1 and Ash, Cottonwood, Crystal, and Hiko springs in Pahranagat Valley are presented in Table F-2. All samples that have a reported arsenic concentration exceed the primary MCL for this element. The concentration of iron in one of the samples from Ash Springs (1,200 µg/L) exceeded the secondary MCL. No other exceedances of the primary or secondary MCLs were observed.

The majority of the samples plot in a relatively tight cluster on the δD versus $\delta^{18}O$ plot (Figure 5-3). Similar to that observed for the major and trace elements, the δD and $\delta^{18}O$ composition of the sample from Cottonwood Spring (-104 to -103‰) is quite different than that of the other samples of the monitoring network in Pahranagat Valley (-111 to -105‰) (Table F-3).

Carbon-isotope data are quite limited for the monitoring network in Pahranagat Valley (Table F-3). Both ^{14}C and $\delta^{13}C$ data are reported for only two samples, Well 209M-1 and Crystal Springs. The ^{14}C values range from 6.2 to 11.3 pmc, and the $\delta^{13}C$ values range from -7.2 to -5.3‰ (Table F-3). The low ^{14}C and relatively heavy value of $\delta^{13}C$ suggest that the groundwater has reacted with isotopically heavy and ^{14}C-free carbonate minerals along the flowpath.

Relatively recent ^{3}H data are available for Well 209M-1 (6/7/2006) and Crystal Springs (5/18/2005). The remaining ^{3}H data are limited to samples collected in the early 1980s and 1990s (Table F-3). Although ^{3}H was detected in the sample collected from Well 209M-1 (1.2 TU), it was not detected following a reanalysis of the sample. Additional sampling is required to determine whether there is in fact measurable ^{3}H in the groundwater of Well 209M-1. The lack of measurable ^{3}H in the Crystal Springs sample (<0.8 TU) suggests that the waters were recharged prior to 1952 (Clark and Fritz, 1997). The accuracy of the ^{3}H data for the earlier samples is unknown and may not accurately reflect the presence of ^{3}H in the samples. Strontium and uranium isotope data are reported for three sites (Well 209M-1, Ash Springs, and Crystal Springs). The $^{234}U/^{238}U$ activity ratio (AR) for a sample collected from Hiko Spring is also reported (Table F-3). The $^{87}Sr/^{86}Sr$ ratio ranges from 0.7103 to 0.7136, and the $^{234}U/^{238}U$ AR ranges from 2.49 to 3.66.

5.4 DDC Wells and Springs

5.4.1 Cave Valley (HA 180)

Water-chemistry results for six wells (180W501M, 180W902M, CAV6002X, 180 N07 E63 14BADD 1 USGS-MX, 180 N08 E64 15BCBC1 USBLM, and Lewis) and one spring (Cave Spring) of the DDC monitoring network in Cave Valley are reported in Appendix F. Within this section, Well 180 N08 E64 15BCBC1 USBLM will be refered to as Harris Well in order to be consistent with the literature-reported chemistry data. The measured water temperatures (18°C) were identical for SNWA monitor wells 180W501M and 180W902M and are similar to that of Well CAV6002X (16°C)

(Table F-2). A relatively narrow range in temperatures is reported for Cave Spring (11°C to 12°C); similar temperatures are also reported for the groundwaters of Harris Well (10°C to 12°C) and Well 180 N07 E63 14BADD 1 USGS-MX (13°C). With the exception of the groundwater of Well 180 N07 E63 14BADD 1 USGS-MX, oxidizing conditions are observed for these waters (DO ranges from 3.8 to 10 mg/L). A relatively low value of DO (1.2 mg/L) is reported for Well 180 N07 E63 14BADD 1 USGS-MX (Table F-1).

The dominant cation and anion in the water samples are calcium and bicarbonate, respectively (Figures 5-7 and 5-8). The charge balance for one sample from Cave Spring (12 percent) exceeded the 10 percent criteria and is not presented within the figures. All samples cluster tightly on the Piper diagram and are a Ca-HCO_3-type or a Ca-Mg-HCO_3-type water that is representative of groundwater that has interacted with carbonate minerals (Figure 5-7). Though the relative abundance of the major ions is similar between samples, the Stiff diagrams clearly illustrate that their concentrations are much higher in the groundwater of the wells than in that of Cave Spring (Figure 5-8).

Trace-element data are available for all locations with major-ion data in Cave Valley (Table F-2). No exceedances of the EPA primary drinking water MCLs were observed. High relative concentrations of iron and manganese that exceed the primary drinking water MCLs were observed in the sample collected from Well 180W501M. Further purging and resampling of the monitor wells will indicate whether these data are representative of the native groundwater. A single exceedance of the aluminum secondary MCL was observed for the Cave Spring samples.

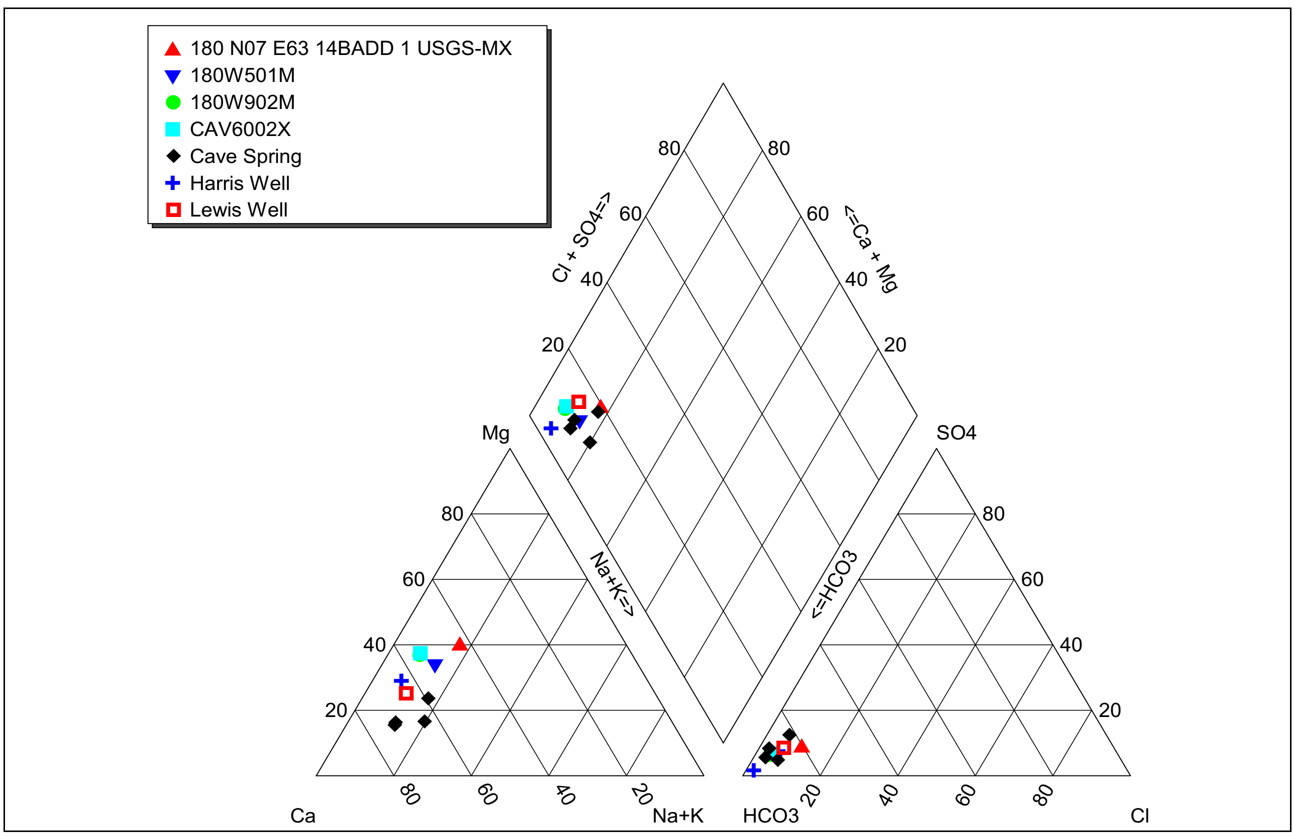


Figure 5-7

Piper Diagram Illustrating Major-Ion Compositions for Cave Valley Waters

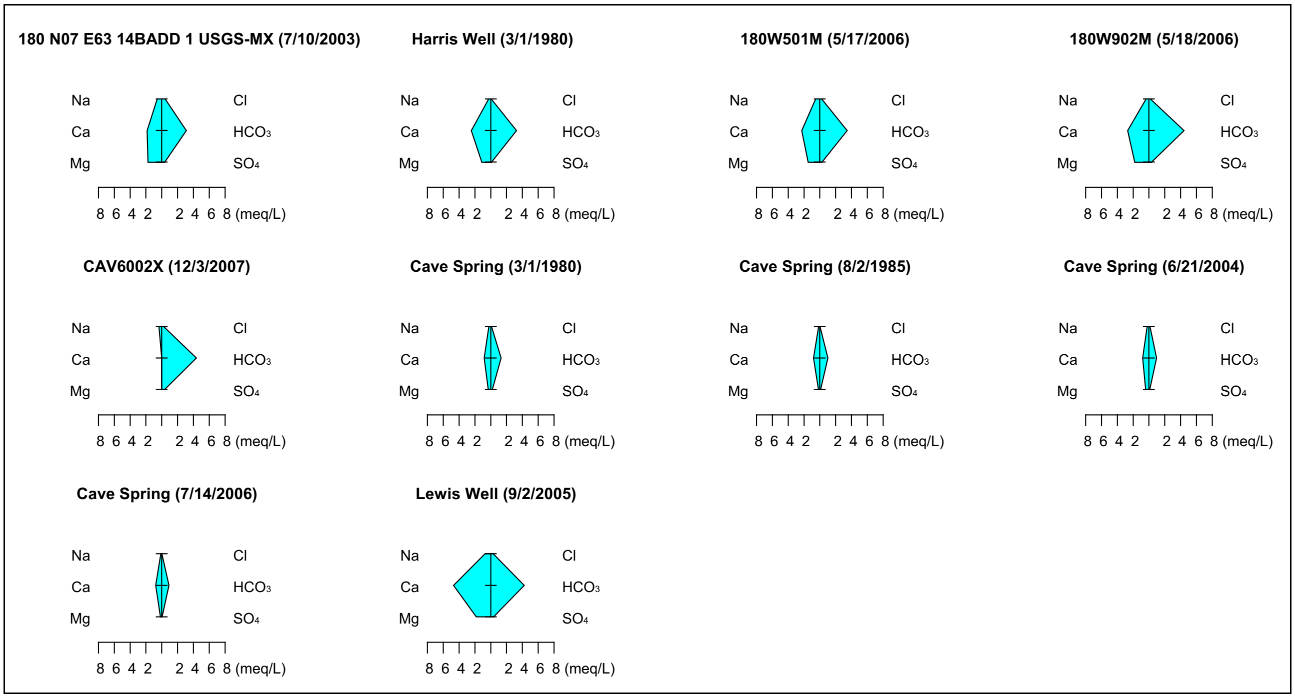


Figure 5-8
Stiff Diagrams Illustrating Major-Ion Compositions for Cave Valley Waters

With the exception of the sample from Lewis Well, the samples plot relatively closely on the δD versus $\delta^{18}O$ plot (Figure 5-3) and also plot very closely to the GMWL. Carbon-isotope data are currently available for wells 180W501M, 180W902M, CAV6002X, and Lewis Well and Cave Spring in Cave Valley (Table F-3). The ^{14}C and $\delta^{13}C$ values are quite variable between the five samples reported for the monitor sites within Cave Valley. Relatively high ^{14}C values are reported for Cave Spring (89.5 pmc) and Lewis Well (84.7 pmc); an intermediate value of 25.0 pmc is reported for Well 180W501M; and lower values are reported for Wells 180W902M (12.8 pmc) and CAV6002X (12.5 pmc). The $\delta^{13}C$ values range from -12.7‰ (Cave Spring) to -4.0‰ (Lewis Well) (Figure 5-4).

Tritium data are available for wells 180W501M, 180W902M, and CAV6002X and for two samples collected in 2005 from Cave Spring. The lack of measurable ^{3}H in the well samples indicates that the waters were recharged prior to 1952 (Clark and Fritz, 1997). The presence of ^{3}H in the Cave Spring samples indicates that these waters are modern (recharged after 1952). Strontium and uranium isotopes are available for the monitor wells and for one sample from Cave Spring (Table F-3).

5.4.2 Dry Lake Valley (HA 181)

Water-chemistry results for the three wells (181M-1, 181W909M, and 181 N03 E63 27CAA 1 USGS-MX) and the four springs (Big Mud, Coyote, Littlefield, and Meloy) of the DDC monitoring network in Dry Lake Valley are reported in Appendix F. Data for a single sample from each of the wells and multiple samples from the springs are reported. In general, the water temperatures measured for the groundwater of the wells, 181M-1 (23°C), 181W909M (26°C), and 181 N03 E63 27CAA 1 USGS-MX (30°C), are greater than those measured for the springs (Table F-1). Lower temperatures are reported for Big Mud Springs (14°C), Coyote Spring (13°C to 22°C), Littlefield

Spring (15°C to 18°C), and Meloy Spring (12°C to 14°C). With the exception of the groundwater of Well 181 N03 E63 27CAA 1 USGS-MX, oxidizing conditions are observed for the waters of the DDC monitoring network in Dry Lake Valley (DO ranges from 4.7 to 9.2 mg/L). Reducing conditions (DO of 0.2 mg/L) are observed for 181 N03 E63 27CAA 1 USGS-MX (Table F-1).

The dominant anion in the water samples is bicarbonate, and with the exception of the sample from Well 181W909M, the dominant cation is calcium (Figures 5-9 and 5-10). The groundwater from Well 181W909M is dominated by calcium and sodium. The water types for these Dry Lake Valley water samples range from Ca-HCO_3 (Meloy Spring) to Ca-Mg-HCO_3 (Well 181M-1, Big Mud Springs, Littlefield Spring, and Well 181 N03 E63 27CAA 1 USGS-MX) to Na-Ca-Mg-HCO_3 (Well 181W909M) to Na-Ca-HCO_3 (Coyote Spring) to Na-Ca-HCO_3-SO_4 (Coyote Spring); the water type varies between samples for Coyote Spring. The charge balance for one sample from Coyote Spring (-12 percent) and one sample from Meloy Spring (35 percent) exceeded the 10 percent criteria and are not presented in Figures 5-9 and 5-10. The calcium-dominated water indicates groundwater interaction with primarily carbonate minerals. The dominance of sodium, or increased sodium, indicates interaction with volcanic rocks and/or evaporite minerals along the groundwater flowpath.

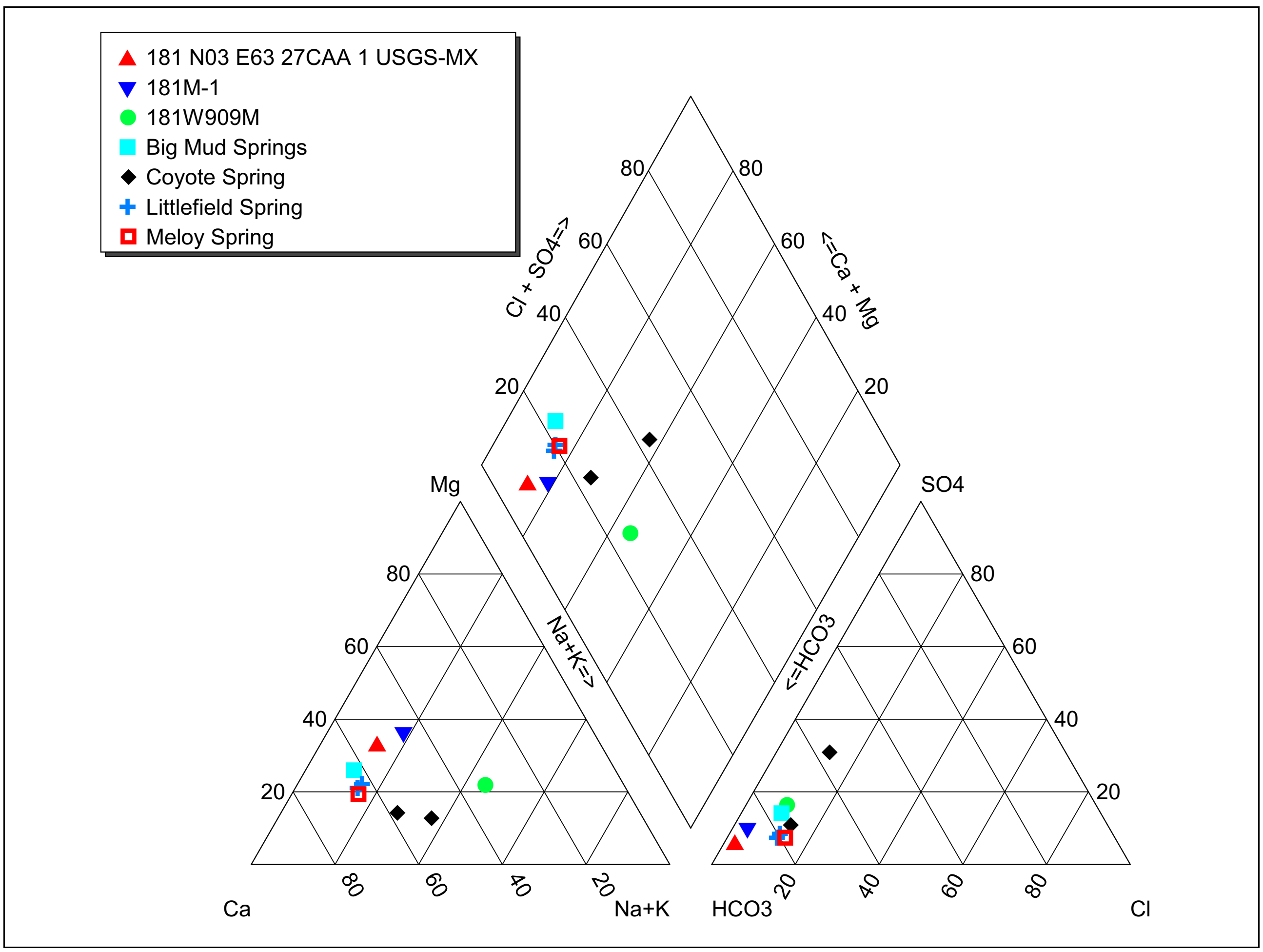


Figure 5-9

Piper Diagram Illustrating Major-Ion Compositions for Dry Lake Valley Waters

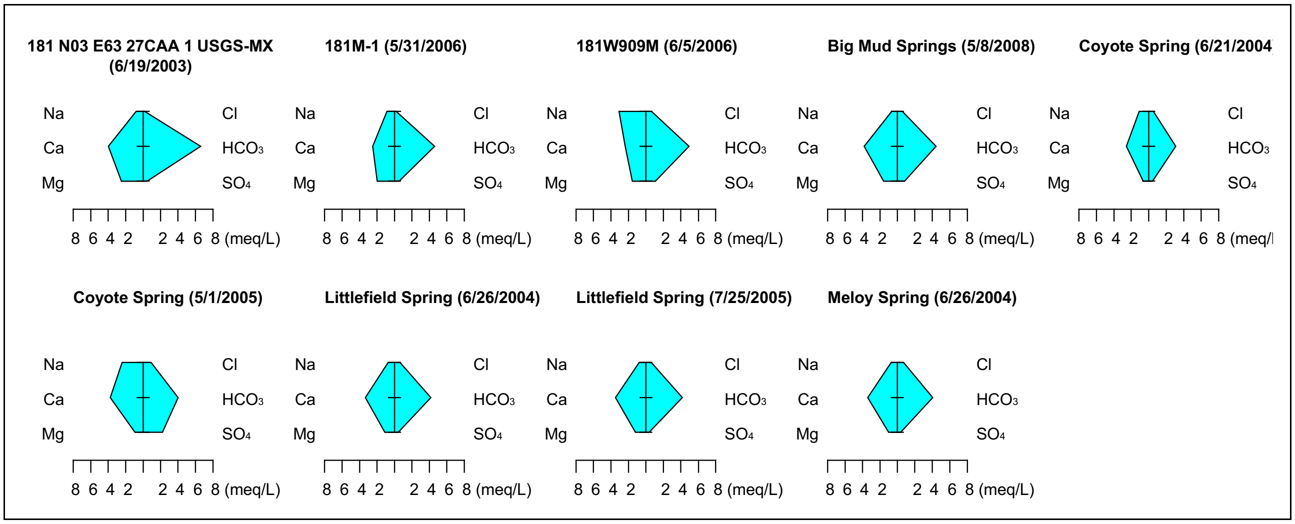


Figure 5-10
Stiff Diagrams Illustrating Major-Ion Compositions for Dry Lake Valley Waters

The Ca-Na-HCO_3-SO_4-type water appears to be affected to a greater degree by evaporite mineral dissolution and interaction with volcanic rocks.

Trace-element data are available for only a single sample from each of the sites in Dry Lake Valley (Table F-2). High relative concentrations of aluminum and iron were observed in the sample collected from Well 181M-1, similar to those observed for samples collected from Well 182W906M in Delamar Valley, indicating the need to perform further sampling to determine whether this sample is representative of the native groundwater and does not reflect insufficient purging of the well prior to sampling. The high aluminum and iron could also indicate dissolution of iron and aluminum minerals; concentrations of these metals are relatively high in other water samples collected in Dry Lake Valley (Table F-2).

Arsenic and antimony exceeded the EPA primary drinking water MCLs in the sample collected from Well 181 N03 E63 27CAA 1 USGS-MX. No exceedances of the primary MCLs were observed for the other locations, although the concentration of arsenic (10 µg/L) in Coyote Spring is at the primary MCL. Three exceedances of the aluminum and five exceedances of the iron secondary MCLs were observed for waters sampled from these locations in Dry Lake Valley (Table F-2).

The wells and springs of the DDC monitoring network in Dry Lake Valley form two clusters with respect to their δD and $\delta^{18}O$ compositions (Figure 5-3). As is the case in general, the spring samples are more enriched with respect to δD and $\delta^{18}O$ than the samples from the wells (Table F-3). The δD and $\delta^{18}O$ values range from -107 to -104‰ and from -14.1 to -13.5‰, respectively, for the wells; δD and $\delta^{18}O$ values range from -100 to -95‰ and from -12.8 to -12.0‰, respectively, for the springs (Table F-3). All samples plot to the right of the GMWL, suggesting that some evaporation has occurred.

Carbon-isotope data are currently available for the three wells and a single spring (Coyote Spring) of the DDC monitoring network in Dry Lake Valley (Table F-3). The ^{14}C and $\delta^{13}C$ values are reported as 78.9 pmc and -13.3‰, respectively, for the Coyote Spring sample and as 1.9 to 5.4 pmc and -6.8 to -4.0‰, respectively, for the well samples (Table F-3).

Tritium data are available for the two SNWA monitor wells and one of the springs (Coyote Spring) of the DDC monitoring network in Dry Lake Valley (Table F-3). The lack of measurable ^{3}H in the majority of these samples indicates that the waters were recharged prior to 1952 (Clark and Fritz, 1997). Although the presence of tritium is reported for the sample from Well 181 N03 E63 27CAA 1 USGS-MX as 0.29 picocuries per liter (0.09 TU), indicating the presence of modern recharge, the ^{14}C measured for groundwater of this well was low (1.9 pmc), suggesting that this is not the case. Future sampling is required to verify these results. The ratios of $^{87}Sr/^{86}Sr$ and $^{234}U/^{238}U$ AR are reported only for Well 181M-1 and Coyote Spring (Table F-3).

5.4.3 Delamar Valley (HA 182)

Results for the three locations (Well 182M-1, Well 182W906M, and Grassy Spring) of the DDC monitoring network in Delamar Valley are reported in Appendix F. Single samples were collected from the SNWA monitor wells, and six samples were collected between 1980 and 2005 from Grassy Spring. The field-measured water-quality parameters are reported in Table F-1. The water temperatures for wells 182M-1 (35°C) and 182W906M (40°C) are significantly greater than those reported for Grassy Spring. The temperatures reported for Grassy Spring range from 11°C to 14°C for the measurements made in March through May and from 20°C to 25°C for measurements made in the summer months of June through August. The specific conductance for the higher-temperature waters (361 to 443 µS/cm) are lower than those measured for the lower-temperature spring waters (645 to 801 µS/cm). The DO for these waters ranged from 3.7 to 8.2 mg/L, indicating oxidizing conditions (Table F-1).

The Piper and Stiff diagrams presented in Figures 5-11 and 5-12, respectively, demonstrate the large differences in the chemistry of the groundwater samples of the monitor wells and that of the spring in Delamar Valley. The water types for the monitor wells are Na-HCO_3 for Well 182W906M and Na-Ca-HCO_3 for Well 182M-1, and the water types for Grassy Spring range from Ca-HCO_3 to Ca-Na-HCO_3 to Ca-HCO_3-Cl. The water types observed for the monitor wells reflect waters that have interacted with volcanic rocks. The water types observed for Grassy Spring reflect waters that have not only primarily interacted with carbonate minerals (Ca-HCO_3 water type) but that have also interacted with volcanic rocks or evaporite minerals (Ca-Na-HCO_3 and Ca-HCO_3-Cl water types). In addition to the differences observed in the water types, the Stiff diagrams show the significant difference in total concentrations of the major ions in Grassy Spring as compared to those of the monitor wells (Figure 5-12).

Trace-element data for these locations in Delamar Valley are presented in Table F-2. The concentrations of trace elements in the samples from Grassy Spring are generally below the detection limit. High relative concentrations of aluminum and iron in the sample from Well 182W906M suggest possible groundwater interaction with the well casing. Adequate purging of this well may not have been performed; therefore, further sampling is necessary to determine whether this sample is representative of the native groundwater. Although concentrations of these elements are much lower in the Well 182M-1 sample, further sampling is also required to ensure that the chemistry in the native groundwater is represented by the sample (Table F-2).

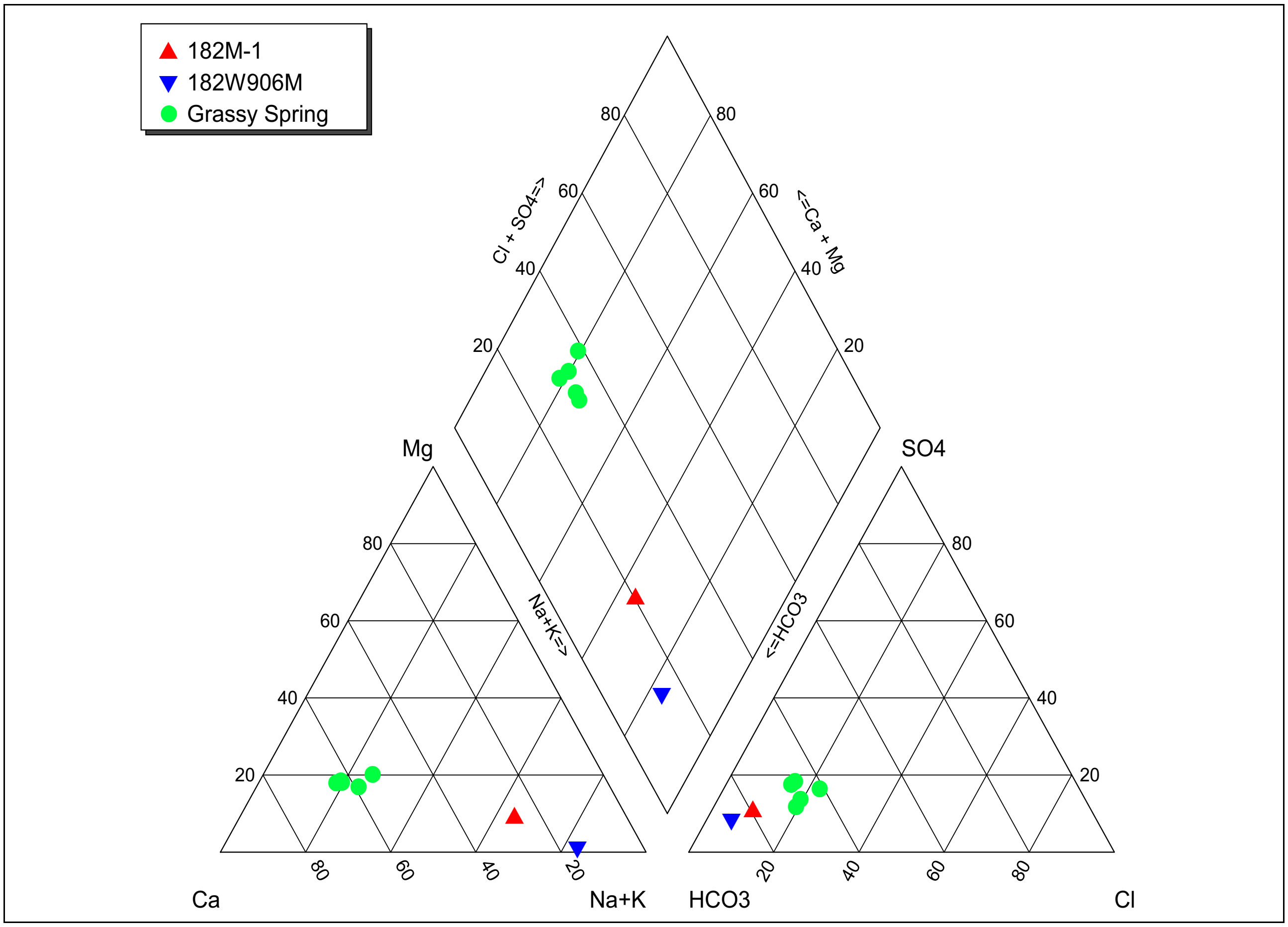


Figure 5-11
Piper Diagram Illustrating Major-Ion Compositions for Delamar Valley Waters

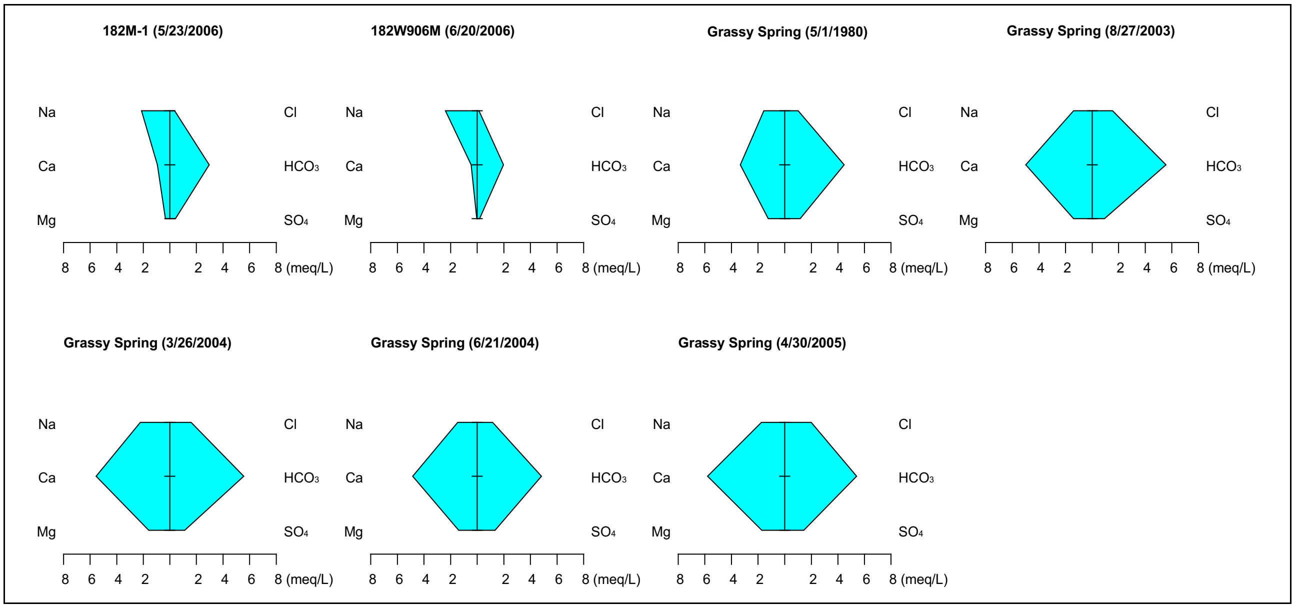


Figure 5-12
Stiff Diagrams Illustrating Major-Ion Compositions for Delamar Valley Waters

With the exception of arsenic and fluoride in the samples collected from wells 182M-1 and 182W906M, respectively, no exceedances of the EPA primary drinking water MCLs were observed. The primary MCL for fluoride, 4 mg/L, was exceeded in the sample collected from Well 182W906M, and the secondary MCL, 2 mg/L, was exceeded in the sample collected from Well 182M-1. Aluminum and iron in the sample collected from Well 182W906M exceeded the EPA secondary MCLs of 200 µg/L and 300 µg/L, respectively.

The δD and $\delta^{18}O$ values for all samples collected in Delamar Valley plot to the right of the GMWL, suggesting that the waters underwent some evaporation prior to recharging into the underlying aquifers (Figure 5-3). The δD and $\delta^{18}O$ values range from -94 to -87‰ and from -11.4 to -10.6‰, respectively, for Grassy Spring; δD and $\delta^{18}O$ values range from -110 to -100‰ and from -14.1 to -13.3‰, respectively, for the monitor wells (Table F-3). As is the case with the major ions and the trace elements, the δD and $\delta^{18}O$ compositions of the waters of Grassy Spring are quite different than those of the monitor wells. In fact, Grassy Spring samples are the most enriched with respect to δD and $\delta^{18}O$ of all samples within the monitoring network.

Carbon-isotope data, presented in Figure 5-4, are currently available for only two locations, wells 182M-1 and 182W906M, of the DDC monitoring network in Delamar Valley. No carbon-isotope data were located for Grassy Spring. The $\delta^{13}C$ and ^{14}C were reported as 7.6‰ and 13.7 pmc, respectively, for Well 182M-1 and -11.6‰ and 15.6 pmc, respectively, for Well 182W906M. The low ^{14}C and relatively heavy value of $\delta^{13}C$ for Well 182M-1 suggest that the groundwater has reacted with isotopically heavy and ^{14}C-free carbonate minerals along the flowpath. Again, the monitor wells require additional sampling after further purging to verify the accuracy of these data.

Tritium, $^{87}Sr/^{86}Sr$, and $^{234}U/^{238}U$ data are also available for each of these three monitoring locations in Delamar Valley (Table F-3). The lack of measurable ^{3}H in these samples indicates that the waters were recharged prior to 1952 (Clark and Fritz, 1997). The strontium in the samples is relatively nonradiogenic with $^{87}Sr/^{86}Sr$ ratios ranging from 0.7086 to 0.7100 (Table F-3). The $^{234}U/^{238}U$ AR is somewhat higher for Grassy Spring (3.97) than for the two monitor wells (2.53 to 2.77).

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6.0 SNWA-PLANNED ACTIVITIES AND REPORTING

To date, field activities associated with the Stipulation hydrologic monitoring plan have been limited because the TRP was in the process of developing the final monitoring network. The spring and groundwater monitoring network was finalized by the TRP in January 2009.

6.1 Planned Activities in 2009 and 2010

The hydrologic-monitoring-plan-related activities anticipated by SNWA in 2009 and 2010 are summarized below. Some activities are contingent upon private or BLM access or TRP and NSE approval.

- Collect continuous and periodic groundwater data from the monitor well and spring network where appropriate property access has been granted.
- Perform a professional survey of network monitor wells.
- Prepare BLM right-of-way applications for the three new monitor well sites identified by the TRP.
- Perform a field reconnaissance and historical data review of the spring network.
- Assist the Biological Resource Team (BRT) in developing the biological monitoring plan.
- Install a discharge flow meter on the pipeline from Hiko Spring and evaluate discharge data collected.
- Install a flume at Hardy Springs to measure spring discharge.
- Continue spring discharge measurements at Moorman, Hot Creek, Ash, and Crystal springs.
- Evaluate the monitoring program at Flag Springs and work with the NDOW to install a continuous recorder at one spring orifice.
- Update the SNWA shared data-repository website to provide TRP with information on activities and to store data collected as part of the plan.

SNWA will continue to work with the NSE and TRP participants to implement the monitoring program.

6.2 Data Reporting

A shared data-repository website accessible by the NSE, EC, TRP, and BRT members was implemented in 2008. This site replaced the existing file transfer protocol (FTP) site and contains project reports, monitoring network data, and TRP logistical information. The website will be used to distribute hydrologic monitoring plan data to the TRP within 90 days of collection. Data will also be submitted directly to the NSE on a quarterly basis in an approved electronic format.

A data and status report will be submitted annually to the TRP and NSE.

6.3 Proposed Schedule of Groundwater Withdrawals

No groundwater production is scheduled for the next two years with the exception of short-term development, well-performance testing, and aquifer testing of the new wells. The duration of well-performance testing is usually one day. The duration of the constant-rate aquifer testing is usually under one week.

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Ash Springs Diversion http://wdr.water.usgs.gov/wy2006/pdfs/09415639.2006.pdf.
Crystal Springs http://wdr.water.usgs.gov/wy2006/pdfs/09415590.2006.pdf.
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Ash Springs Diversion http://wdr.water.usgs.gov/wy2007/pdfs/09415639.2007.pdf.
Crystal Springs http://wdr.water.usgs.gov/wy2007/pdfs/09415590.2007.pdf.
Crystal Spring Diversion http://wdr.water.usgs.gov/wy2007/pdfs/09415589.2007.pdf.

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Ash Springs Diversion http://wdr.water.usgs.gov/wy2008/pdfs/09415639.2008.pdf.
Crystal Spring http://wdr.water.usgs.gov/wy2008/pdfs/09415590.2008.pdf.
Crystal Spring Diversion http://wdr.water.usgs.gov/wy2008/pdfs/09415589.2008.pdf.

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Appendix A

Periodic Water-Level Measurement Data from the DDC Existing Well Monitoring Network

Table A-1
Discrete Water-Level Measurement Data from the DDC Existing Well Monitoring Network
(Page 1 of 5)

Site Number	Station Local Number	Well Depth (ft bgs)	Surface Elevation (ft amsl)	Water Level			
				Date	Depth to Water (ft bgs)	Well Status[a]	Measurement Method[b]
180W902M	180W902M	903	5,984.889	10/23/2006	136.94	S	T
				12/5/2006	137.11	S	T
				1/23/2007	137.41	S	T
				2/26/2007	137.25	S	T
				4/3/2007	137.67	S	T
				5/15/2007	137.76	S	T
				6/28/2007	137.89	S	T
				7/26/2007	138.03	S	T
				9/7/2007	138.05	S	T
				9/26/2007	138.11	S	T
				10/17/2007	138.18	S	T
				10/23/2007	138.29	S	T
				11/8/2007	138.32	S	T
				11/16/2007	138.43	S	T
				12/26/2007	139.50	S	T
				1/15/2008	139.23	S	T
				3/10/2008	139.21	S	T
				3/21/2008	139.13	S	T
				4/15/2008	138.88	S	S
				5/27/2008	139.29	S	T
				7/10/2008	139.81	S	T
				8/13/2008	139.64	S	T
				9/23/2008	139.83	S	S
				10/21/2008	139.91	S	S
				12/9/2008	140.10	S	T
382807114521001	180 N07 E63 14BADD 1 USGS-MX	460	6,012.388	7/14/1996	223.00	S	T
				7/14/1997	221.90	S	T
				7/23/2000	220.29	S	T
				11/21/2007	218.34	S	T
				12/26/2007	218.95	S	T
				12/3/2007	218.52	S	T
				1/7/2008	218.19	S	T
				4/15/2008	217.85	S	T
				5/27/2008	218.01	S	T
				7/10/2008	218.00	S	T
				8/13/2008	218.06	S	T
				9/23/2008	218.12	S	S
				10/21/2008	218.05	S	T
				12/9/2008	218.20	S	T
383307114471001	180 N08 E64 15BCBC1 USBLM	---	6,162.553	7/19/1996	263.15	S	S
				7/26/2004	262.63	S	S
				10/16/2008	262.15	S	S

Table A-1
Discrete Water-Level Measurement Data from the DDC Existing Well Monitoring Network
(Page 2 of 5)

Site Number	Station Local Number	Well Depth (ft bgs)	Surface Elevation (ft amsl)	Water Level			
				Date	Depth to Water (ft bgs)	Well Status[a]	Measurement Method[b]
180W501M	180W501M	1,212	6,428.634	10/23/2006	1,049.65	S	T
				12/5/2006	1,049.88	S	T
				1/23/2007	1,050.11	S	T
				2/26/2007	1,050.01	S	T
				4/3/2007	1,050.39	S	T
				5/15/2007	1,050.65	S	T
				6/28/2007	1,050.81	S	T
				7/26/2007	1,050.98	S	T
				9/7/2007	1,051.04	S	T
				10/23/2007	1,051.38	S	T
				12/18/2007	1,051.63	S	T
				3/10/2008	1,052.08	S	T
				3/21/2008	1,052.08	S	T
				4/15/2008	1,052.23	S	T
				5/27/2008	1,052.37	S	T
				7/10/2008	1,052.59	S	T
				8/13/2008	1,053.03	S	T
				9/23/2008	1,053.33	S	T
				10/21/2008	1,053.43	S	T
				12/9/2008	1,053.70	S	T
182W906M	182W906M	1,703	4,796.956	10/24/2006	1,319.76	S	T
				12/11/2006	1,319.70	S	T
				1/22/2007	1,319.49	S	T
				2/26/2007	1,318.10	S	T
				4/2/2007	1,317.34	S	T
				5/14/2007	1,319.25	S	T
				6/20/2007	1,317.26	S	T
				7/30/2007	1,316.54	S	T
				9/4/2007	1,316.43	S	T
				10/31/2007	1,316.50	S	T
				12/19/2007	1,316.44	S	T
				1/28/2008	1,315.42	S	T
				3/12/2008	1,315.48	S	T
				4/16/2008	1,315.93	S	T
				5/27/2008	1,315.87	S	T
				7/7/2008	1,315.62	S	T
				8/13/2008	1,315.82	S	T
				8/20/2008	1,315.69	S	T
				9/23/2008	1,316.14	S	T
				10/21/2008	1,316.19	S	T
				12/1/2008	1,315.92	S	T

Table A-1
Discrete Water-Level Measurement Data from the DDC Existing Well Monitoring Network
(Page 3 of 5)

Site Number	Station Local Number	Well Depth (ft bgs)	Surface Elevation (ft amsl)	Water Level			
				Date	Depth to Water (ft bgs)	Well Status[a]	Measurement Method[b]
182M-1	182M-1	1,331	4,597.775	10/24/2006	826.50	S	T
				12/8/2006	826.47	S	T
				1/22/2007	827.02	S	T
				2/26/2007	826.88	S	T
				4/2/2007	826.88	S	T
				6/20/2007	826.64	S	T
				6/28/2007	826.83	S	T
				7/30/2007	826.80	S	T
				9/4/2007	826.68	S	T
				10/29/2007	826.92	S	T
				12/19/2007	827.08	S	T
				1/28/2008	826.91	S	T
				3/12/2008	826.78	S	T
				4/16/2008	827.08	S	T
				5/27/2008	826.96	S	T
				7/7/2008	827.05	S	T
				8/13/2008	827.20	S	T
				8/20/2008	827.08	S	T
				9/23/2008	827.02	S	T
				10/21/2008	827.18	S	T
				12/1/2008	827.00	S	T
372639114520901	182 S06 E63 12AD 1 USGS-MX	1,195	4,706.299	7/25/2005	862.57	S	T
				4/2/2007	863.01	S	T
				5/14/2007	863.25	S	T
				6/20/2007	862.96	S	T
				7/30/2007	863.14	S	T
				12/19/2007	863.23	S	T
				1/28/2008	862.92	S	T
				3/12/2008	863.16	S	T
				4/16/2008	863.28	S	T
				5/27/2008	863.20	S	T
				7/7/2008	862.89	S	T
				8/13/2008	863.52	S	T
				9/23/2008	863.45	S	T
				10/21/2008	863.60	S	T
				12/1/2008	863.51	S	T

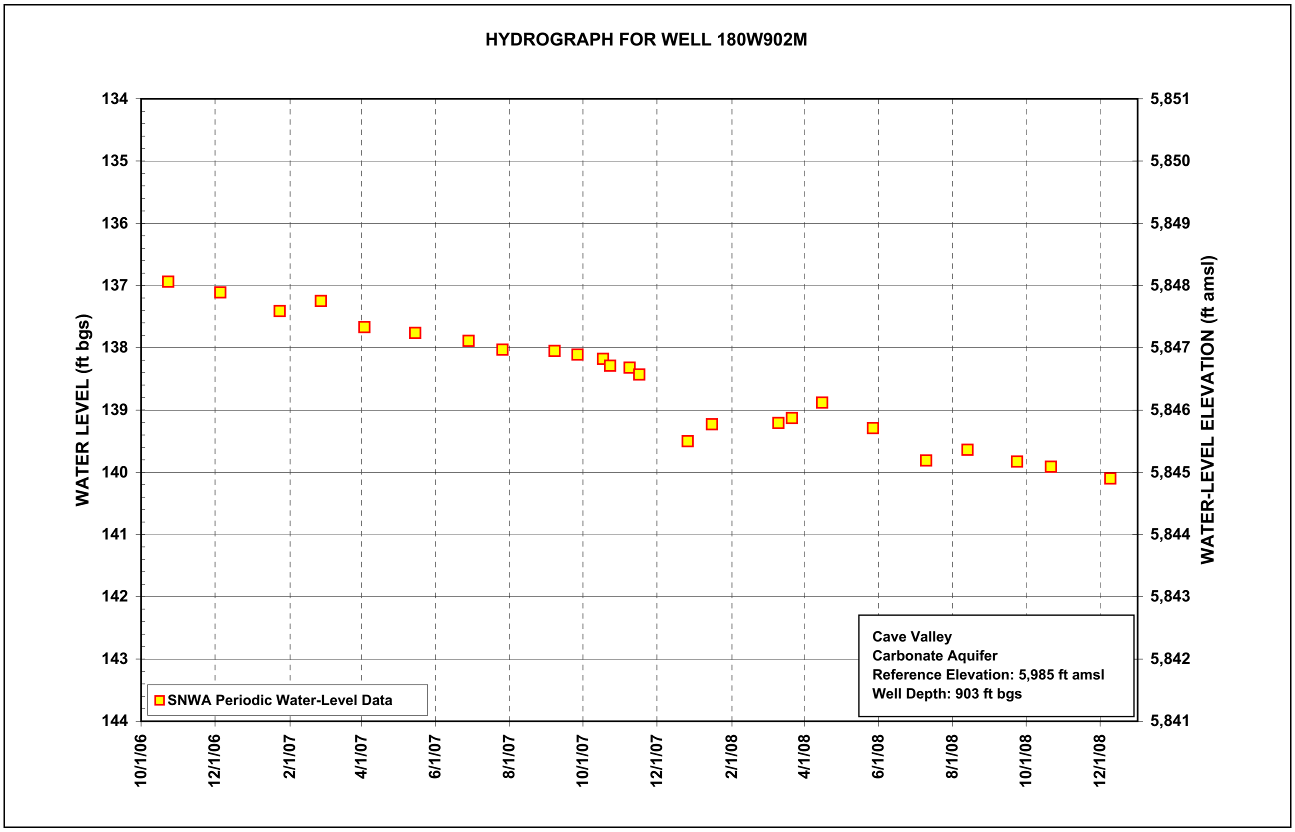
Table A-1
Discrete Water-Level Measurement Data from the DDC Existing Well Monitoring Network
(Page 4 of 5)

Site Number	Station Local Number	Well Depth (ft bgs)	Surface Elevation (ft amsl)	Water Level			
				Date	Depth to Water (ft bgs)	Well Status[a]	Measurement Method[b]
181W909M	181W909M	1,260	4,799.409	10/24/2006	497.04	S	T
				12/8/2006	497.33	S	T
				1/22/2007	497.40	S	T
				2/26/2007	497.10	S	T
				4/3/2007	497.27	S	T
				5/15/2007	497.08	S	T
				6/20/2007	497.02	S	T
				6/27/2007	497.11	S	T
				7/30/2007	497.10	S	T
				9/4/2007	497.00	S	T
				10/23/2007	497.40	S	T
				12/18/2007	496.89	S	T
				1/15/2008	497.05	S	T
				3/12/2008	497.09	S	T
				4/15/2008	496.75	S	T
				5/27/2008	496.81	S	T
				7/7/2008	496.81	S	T
				8/13/2008	496.93	S	T
				9/23/2008	496.92	S	T
				10/21/2008	497.02	S	T
				12/1/2008	497.05	S	T
181M-1	181M-1	1,472	4,963.074	10/24/2006	675.19	S	T
				12/8/2006	675.30	S	T
				1/22/2007	675.59	S	T
				2/26/2007	675.31	S	T
				4/3/2007	675.54	S	T
				4/11/2007	675.60	S	T
				5/15/2007	675.44	S	T
				6/20/2007	675.20	S	T
				7/26/2007	675.49	S	T
				9/4/2007	675.13	S	T
				10/23/2007	675.49	S	T
				12/18/2007	675.19	S	T
				1/15/2008	675.14	S	T
				3/12/2008	675.36	S	T
				4/15/2008	675.20	S	T
				5/27/2008	675.39	S	T
				7/7/2008	675.24	S	T
				8/13/2008	675.56	S	T
				8/20/2008	675.49	S	T
				9/23/2008	675.53	S	T
				10/21/2008	675.63	S	T
				12/1/2008	675.50	S	T

Table A-1
Discrete Water-Level Measurement Data from the DDC Existing Well Monitoring Network
(Page 5 of 5)

Site Number	Station Local Number	Well Depth (ft bgs)	Surface Elevation (ft amsl)	Water Level			
				Date	Depth to Water (ft bgs)	Well Status[a]	Measurement Method[b]
380531114534201	181 N03 E63 27CAA 1 USGS-MX	2,395	5,391	10/13/2008	844.95	S	T
209 S07 E62 20AA 1[c]	209 S07 E62 20AA 1	695	4,099	6/24/2003	600.44	S	T
				1/22/2007	600.17	S	T
373405115090001	209 S04 E61 28CD 1	980	4,233	6/24/2003	586.39	S	T
				1/22/2007	585.10	S	T
				2/26/2007	585.60	S	T
				10/13/2008	586.35	S	T
373803115050501	209 S04 E61 01CB1	700	4,525	6/24/2003	785.40	S	T
				1/22/2007	785.38	S	T
				10/13/2008	785.92	S	T
209M-1	209M-1	1,616	5,097.298	10/24/2006	1,199.86	S	T
				12/11/2006	1,200.02	S	T
				1/22/2007	1,200.12	S	T
				2/26/2007	1,199.84	S	T
				4/2/2007	1,199.97	S	T
				5/14/2007	1,200.05	S	T
				6/20/2007	1,200.18	S	T
				6/27/2007	1,200.08	S	T
				7/30/2007	1,200.12	S	T
				9/4/2007	1,199.71	S	T
				10/23/2007	1,200.41	S	T
				12/17/2007	1,199.93	S	T
				1/15/2008	1,199.74	S	T
				3/11/2008	1,200.07	S	T
				4/16/2008	1,200.18	S	T
				5/28/2008	1,200.14	S	T
				7/7/2008	1,200.02	S	T
				8/13/2008	1,200.34	S	T
				9/23/2008	1,200.50	S	T
				10/21/2008	1,200.52	S	T
				11/19/2008	1,200.38	S	T
				12/1/2008	1,200.41	S	T
383133115030201	207 N08 E62 30CD 1	101	5,290.205	10/16/2008	63.55	S	T

[a] S = Static conditions
[b] T = Electric tape measurement, S = Steel tape measurement
[c]No hydrograph is presented because of limited data.
Note: SNWA tape calibration program started in August 2008.


HYDROGRAPH FOR WELL 180W902M
WATER LEVEL (ft bgs)
WATER-LEVEL ELEVATION (ft amsl)
134
135
136
137
138
139
140
141
142
143
144
5,851
5,850
5,849
5,848
5,847
5,846
5,845
5,844
5,843
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5,841
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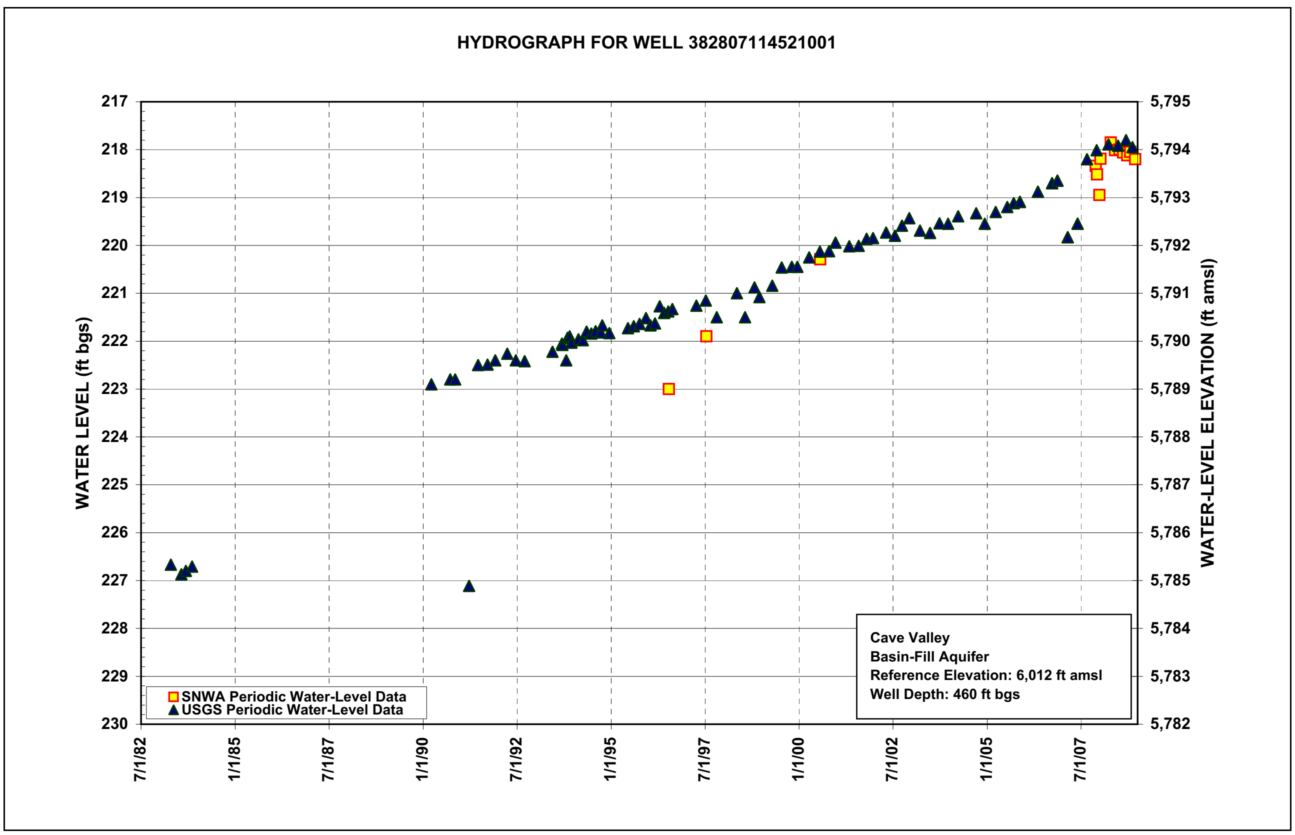
12/1/07
2/1/08
4/1/08
6/1/08
8/1/08
10/1/08
12/1/08
SNWA Periodic Water-Level Data
Cave Valley
Carbonate Aquifer
Reference Elevation: 5,985 ft amsl
Well Depth: 903 ft bgs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WATER LEVEL (ft bgs)
WATER-LEVEL ELEVATION (ft amsl)
217
218
219
220
221
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223
224
225
226
227
228
229
230
5,795
5,794
5,793
5,792
5,791
5,790
5,789
5,788
5,787
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5,785
5,784
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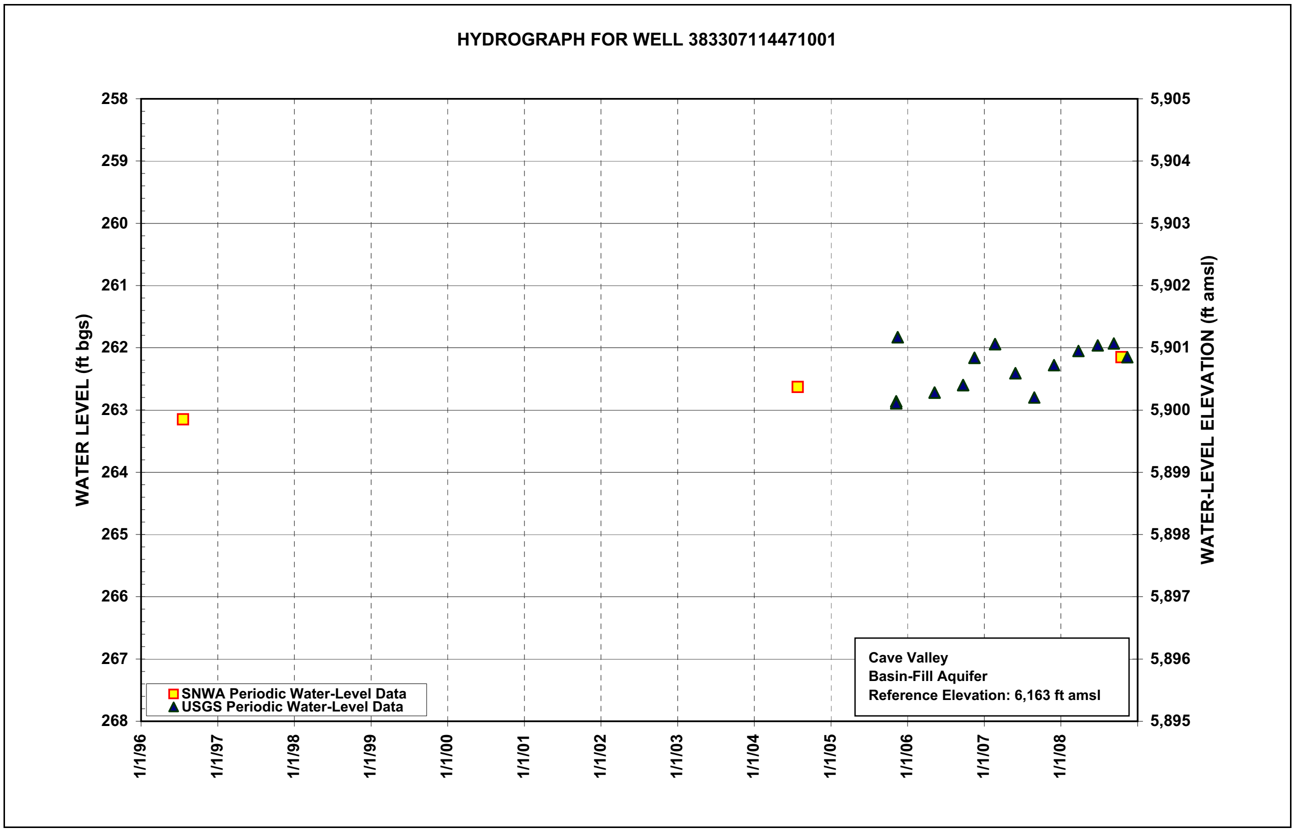
1/1/95
7/1/97
1/1/00
7/1/02
1/1/05
7/1/07
SNWA Periodic Water-Level Data
USGS Periodic Water-Level Data
Cave Valley
Basin-Fill Aquifer
Reference Elevation: 6,012 ft amsl
Well Depth: 460 ft bgs


HYDROGRAPH FOR WELL 383307114471001
WATER LEVEL (ft bgs)
WATER-LEVEL ELEVATION (ft amsl)
258
259
260
261
262
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264
265
266
267
268
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5,904
5,903
5,902
5,901
5,900
5,899
5,898
5,897
5,896
5,895
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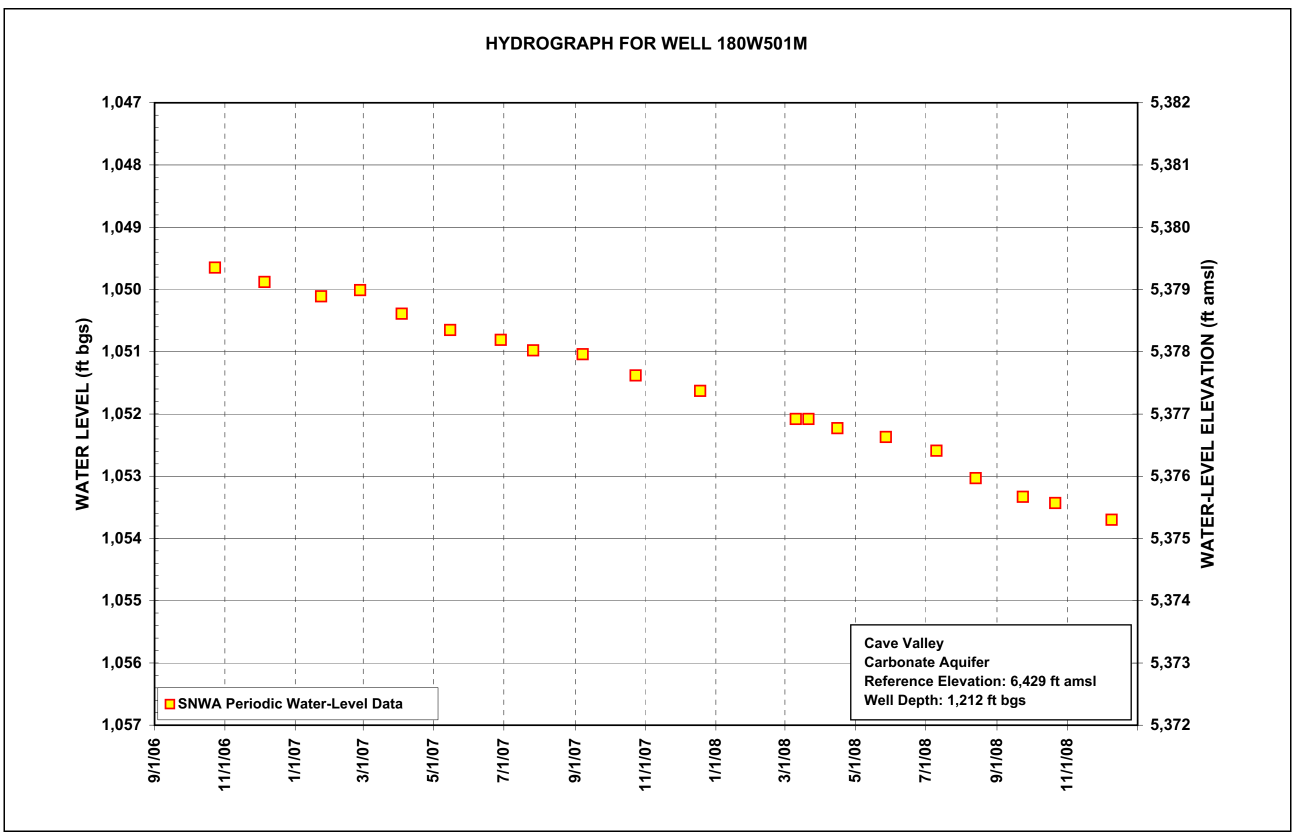
1/1/00
1/1/01
1/1/02
1/1/03
1/1/04
1/1/05
1/1/06
1/1/07
1/1/08
SNWA Periodic Water-Level Data
USGS Periodic Water-Level Data
Cave Valley
Basin-Fill Aquifer
Reference Elevation: 6,163 ft amsl


HYDROGRAPH FOR WELL 180W501M
WATER LEVEL (ft bgs)
WATER-LEVEL ELEVATION (ft amsl)
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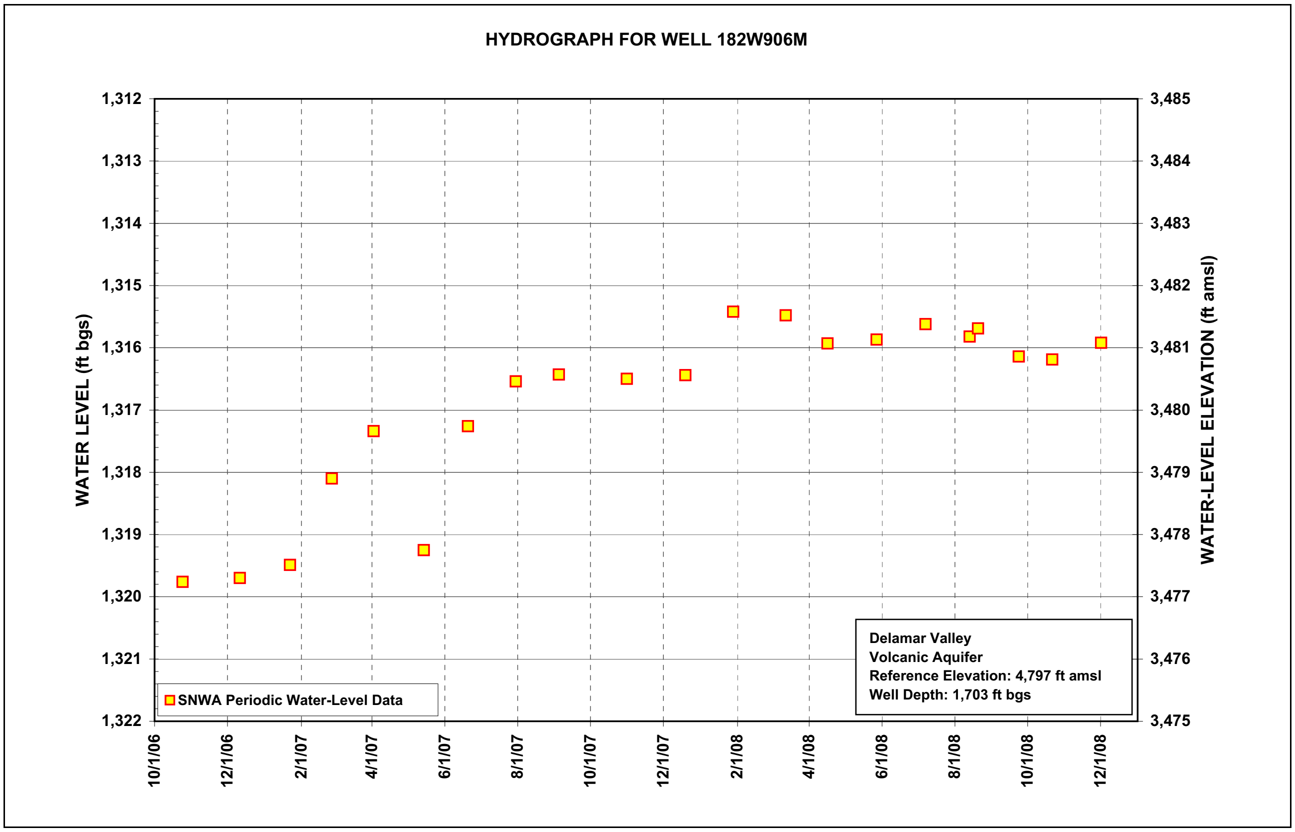
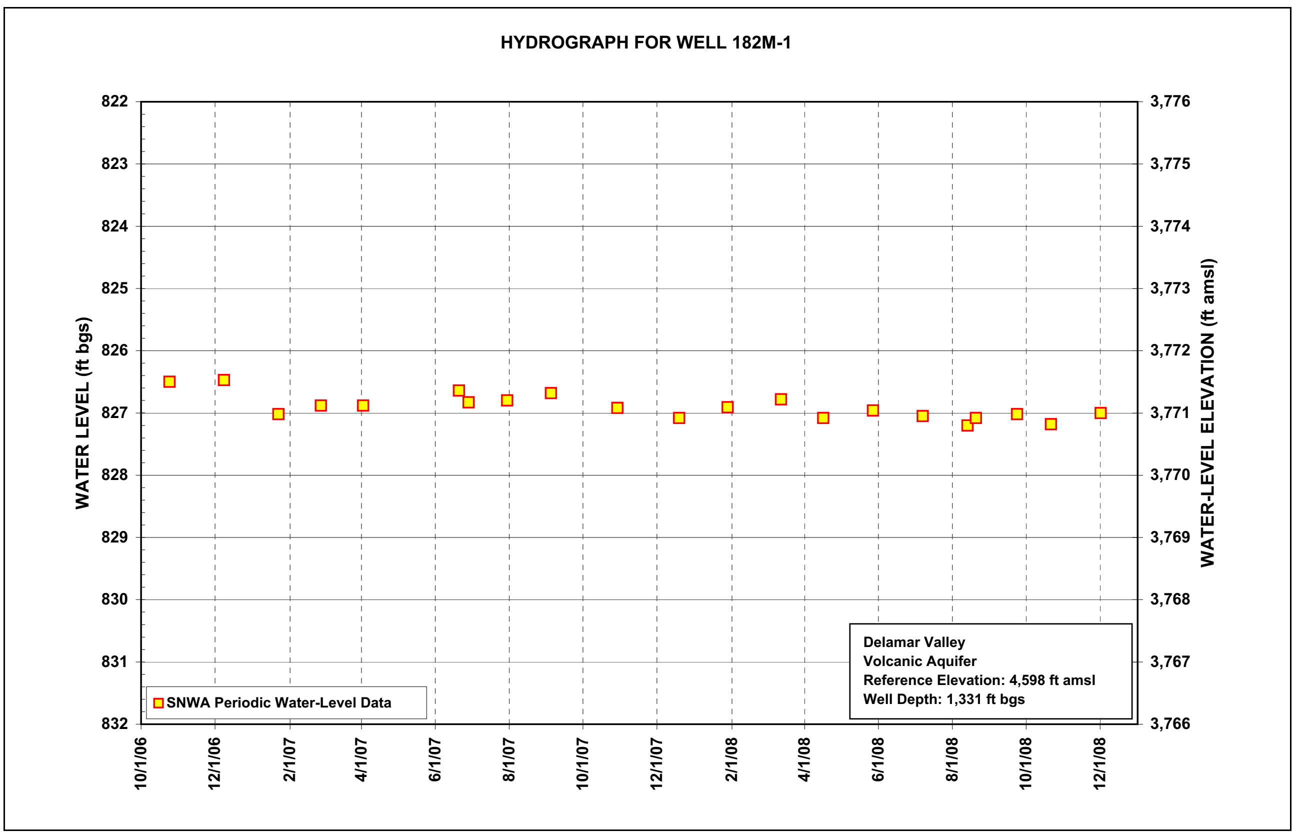
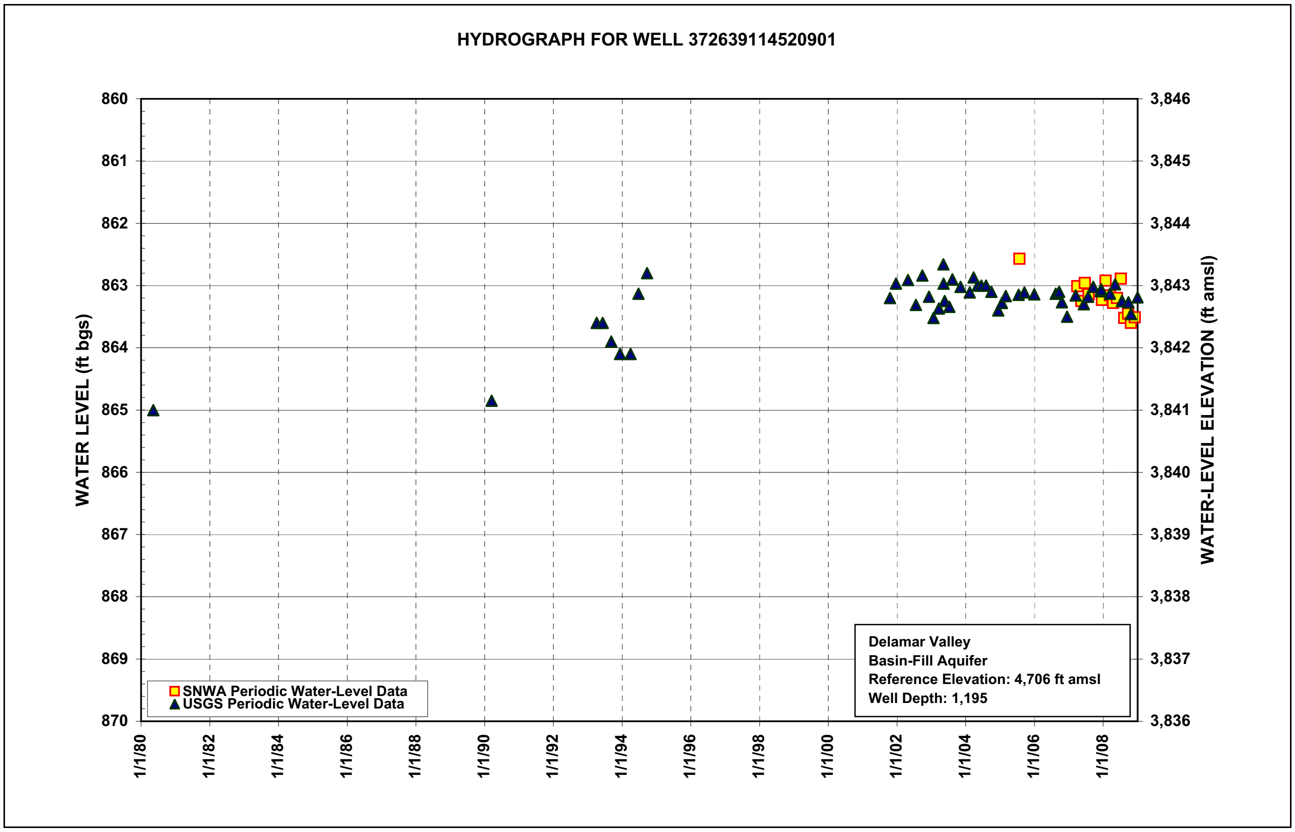
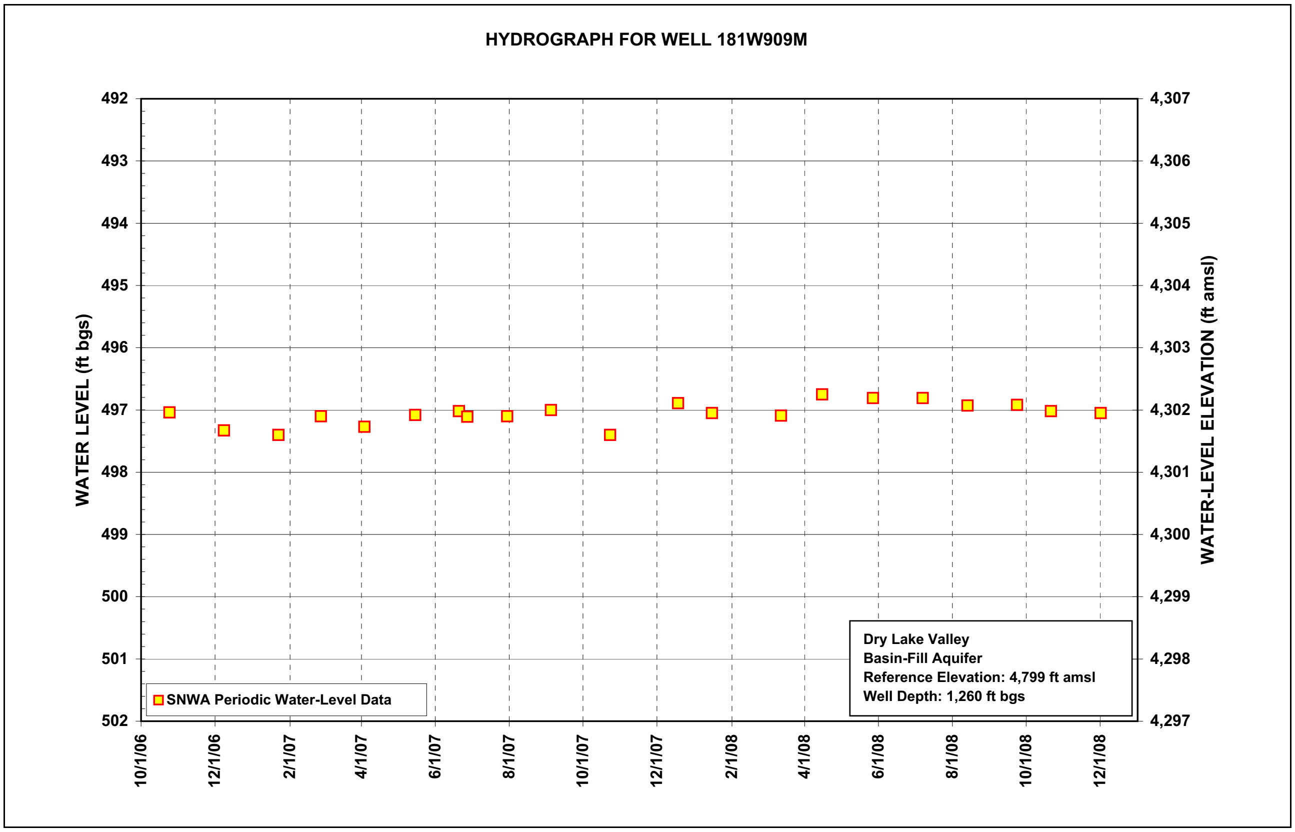
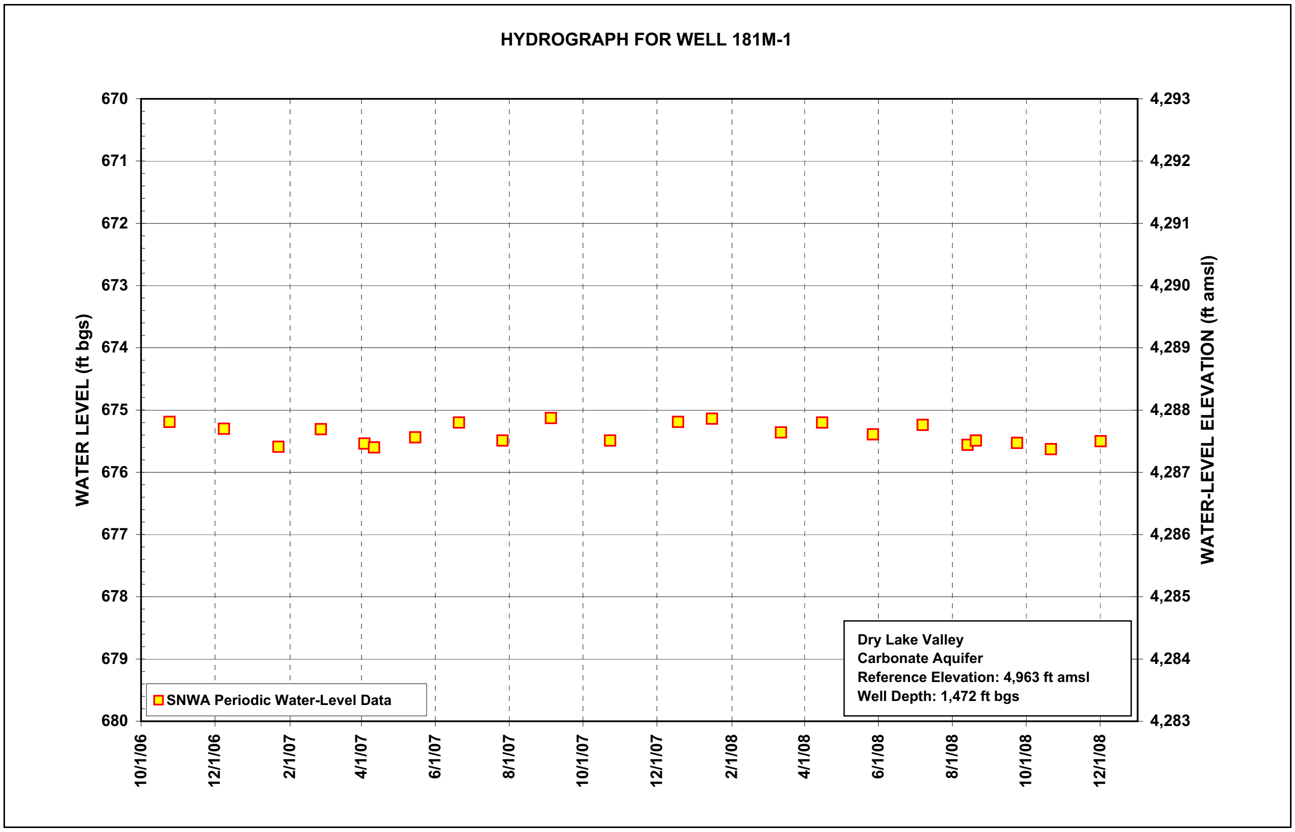
1,048
1,049
1,050
1,051
1,052
1,053
1,054
1,055
1,056
1,057
5,382
5,381
5,380
5,379
5,378
5,377
5,376
5,375
5,374
5,373
5,372
9/1/06
11/1/06
1/1/07
3/1/07
5/1/07
7/1/07
9/1/07
11/1/07
1/1/08
3/1/08
5/1/08
7/1/08
9/1/08
11/1/08
SNWA Periodic Water-Level Data
Cave Valley
Carbonate Aquifer
Reference Elevation: 6,429 ft amsl
Well Depth: 1,212 ft bgs

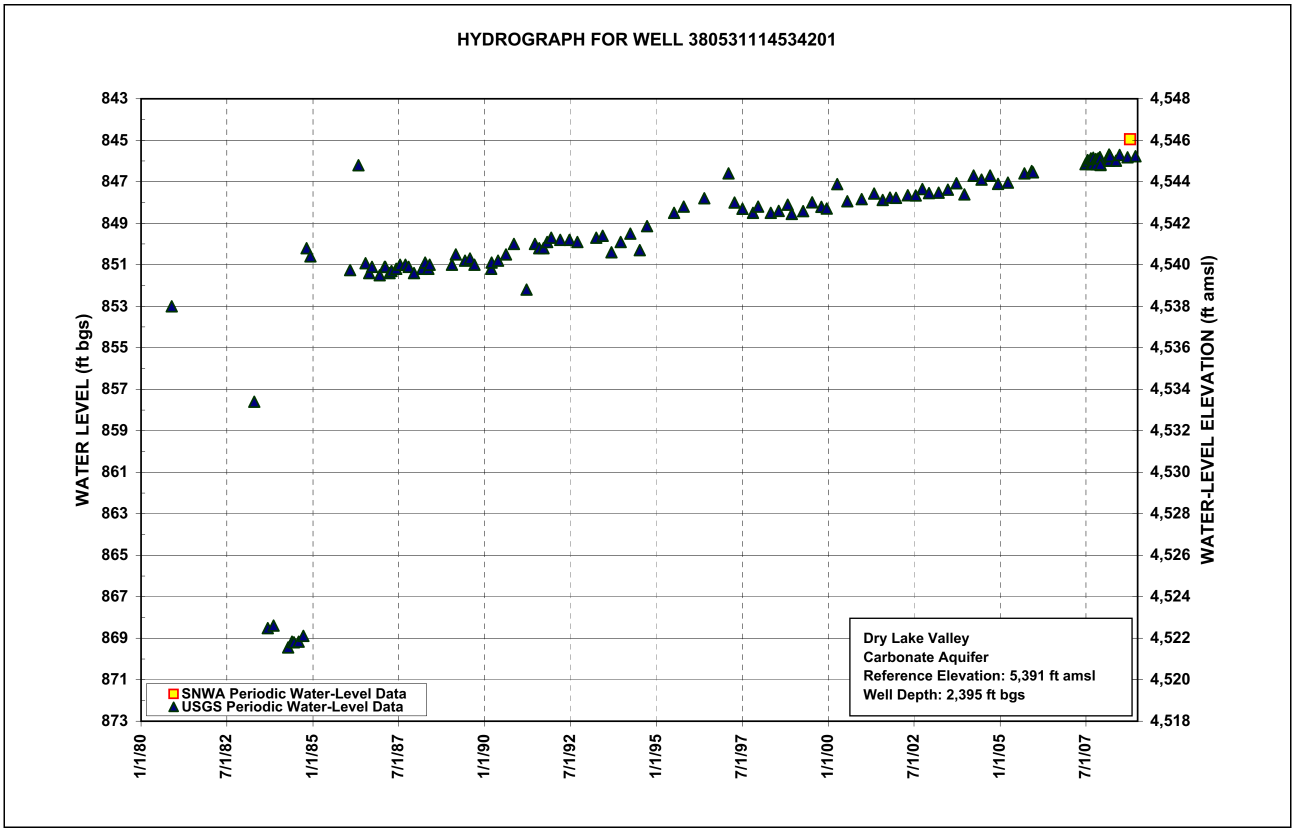

HYDROGRAPH FOR WELL 182W906M
WATER LEVEL (ft bgs)
1,312
1,313
1,314
1,315
1,316
1,317
1,318
1,319
1,320
1,321
1,322
WATER-LEVEL ELEVATION (ft amsl)
3,485
3,484
3,483
3,482
3,481
3,480
3,479
3,478
3,477
3,476
3,475
10/1/06
12/1/06
2/1/07
4/1/07
6/1/07
8/1/07
10/1/07
12/1/07
2/1/08
4/1/08
6/1/08
8/1/08
10/1/08
12/1/08
SNWA Periodic Water-Level Data
Delamar Valley
Volcanic Aquifer
Reference Elevation: 4,797 ft amsl
Well Depth: 1,703 ft bgs

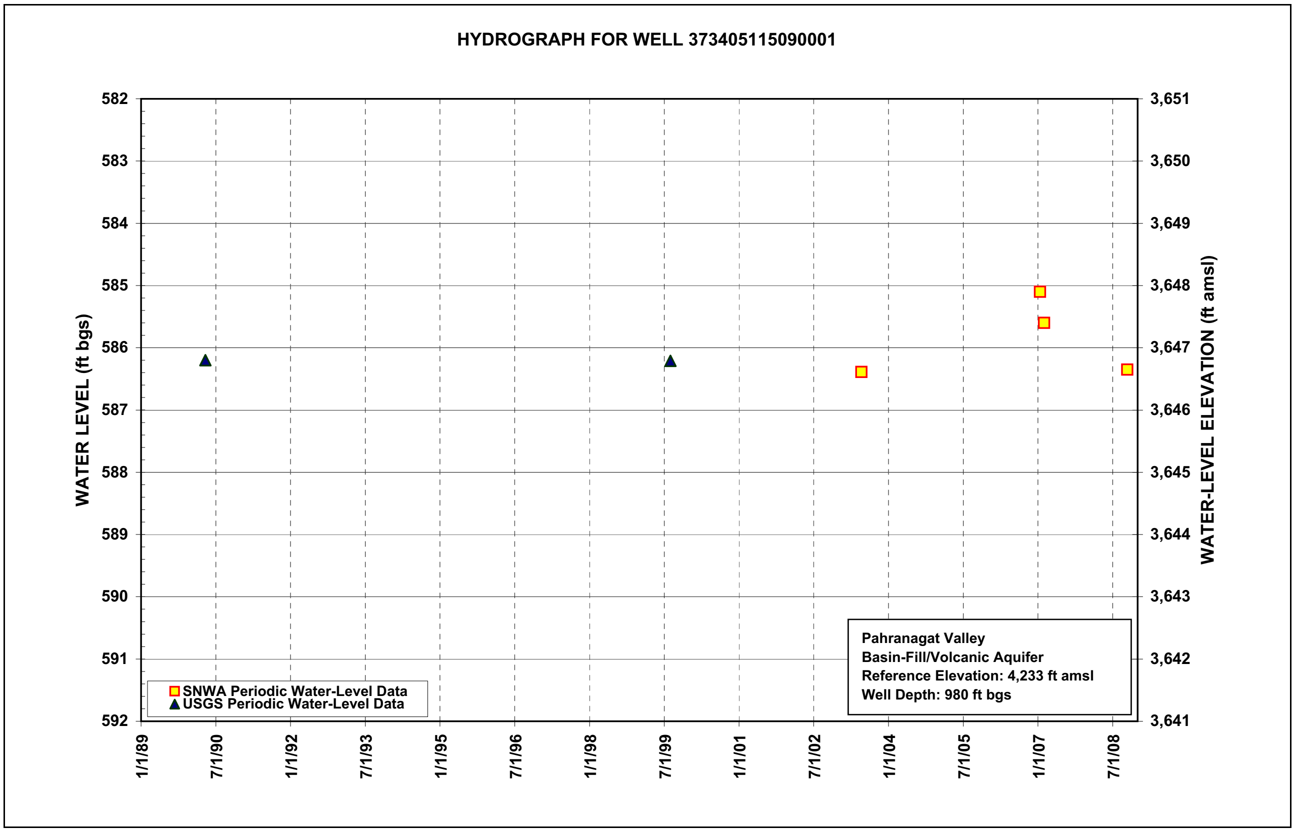

HYDROGRAPH FOR WELL 182M-1
WATER LEVEL (ft bgs)
822
823
824
825
826
827
828
829
830
831
832
WATER-LEVEL ELEVATION (ft amsl)
3,776
3,775
3,774
3,773
3,772
3,771
3,770
3,769
3,768
3,767
3,766
10/1/06
12/1/06
2/1/07
4/1/07
6/1/07
8/1/07
10/1/07
12/1/07
2/1/08
4/1/08
6/1/08
8/1/08
10/1/08
12/1/08
SNWA Periodic Water-Level Data
Delamar Valley
Volcanic Aquifer
Reference Elevation: 4,598 ft amsl
Well Depth: 1,331 ft bgs

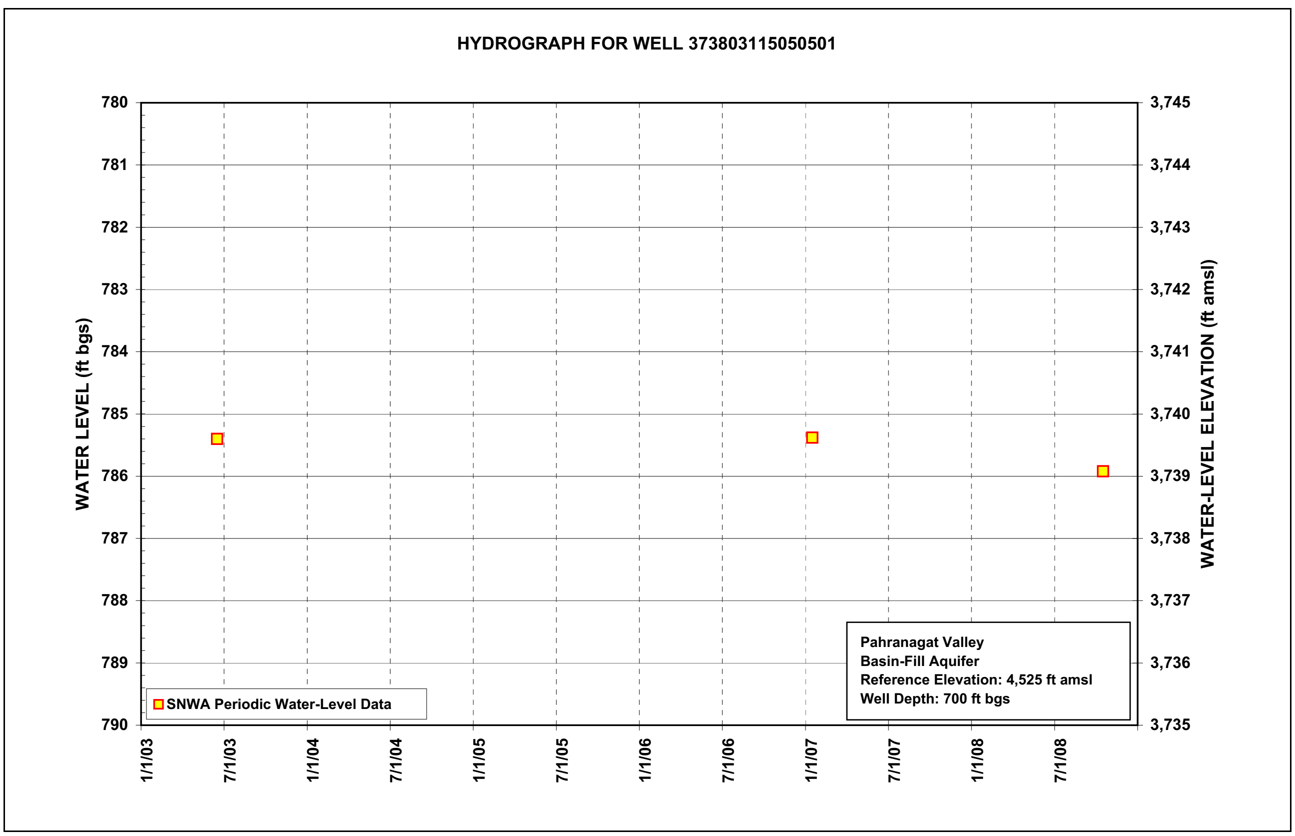

HYDROGRAPH FOR WELL 372639114520901
WATER LEVEL (ft bgs)
WATER-LEVEL ELEVATION (ft amsl)
860
861
862
863
864
865
866
867
868
869
870
3,846
3,845
3,844
3,843
3,842
3,841
3,840
3,839
3,838
3,837
3,836
1/1/80
1/1/82
1/1/84
1/1/86
1/1/88
1/1/90
1/1/92
1/1/94
1/1/96
1/1/98
1/1/00
1/1/02
1/1/04
1/1/06
1/1/08
SNWA Periodic Water-Level Data
USGS Periodic Water-Level Data
Delamar Valley
Basin-Fill Aquifer
Reference Elevation: 4,706 ft amsl
Well Depth: 1,195

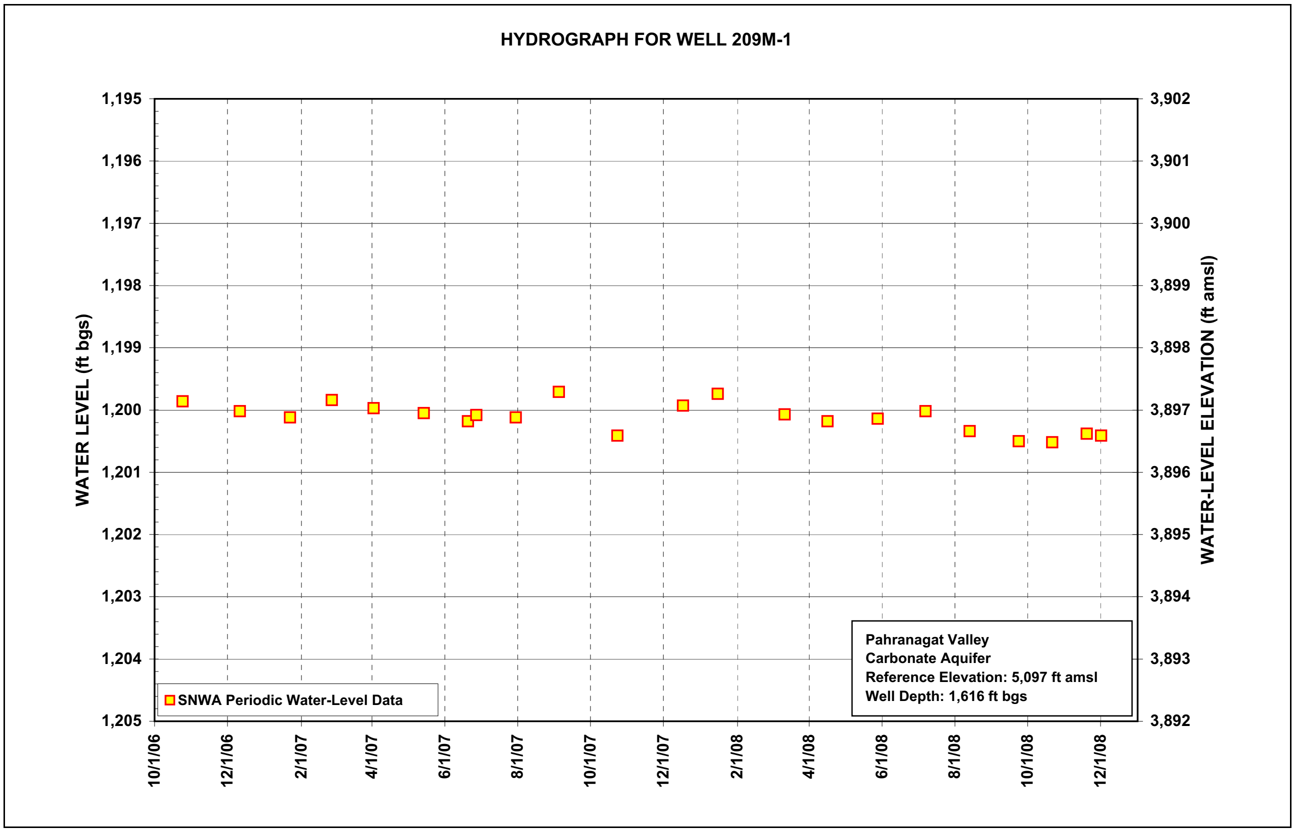

HYDROGRAPH FOR WELL 181W909M
WATER LEVEL (ft bgs)
WATER-LEVEL ELEVATION (ft amsl)
492
493
494
495
496
497
498
499
500
501
502
4,307
4,306
4,305
4,304
4,303
4,302
4,301
4,300
4,299
4,298
4,297
10/1/06
12/1/06
2/1/07
4/1/07
6/1/07
8/1/07
10/1/07
12/1/07
2/1/08
4/1/08
6/1/08
8/1/08
10/1/08
12/1/08
SNWA Periodic Water-Level Data
Dry Lake Valley
Basin-Fill Aquifer
Reference Elevation: 4,799 ft amsl
Well Depth: 1,260 ft bgs

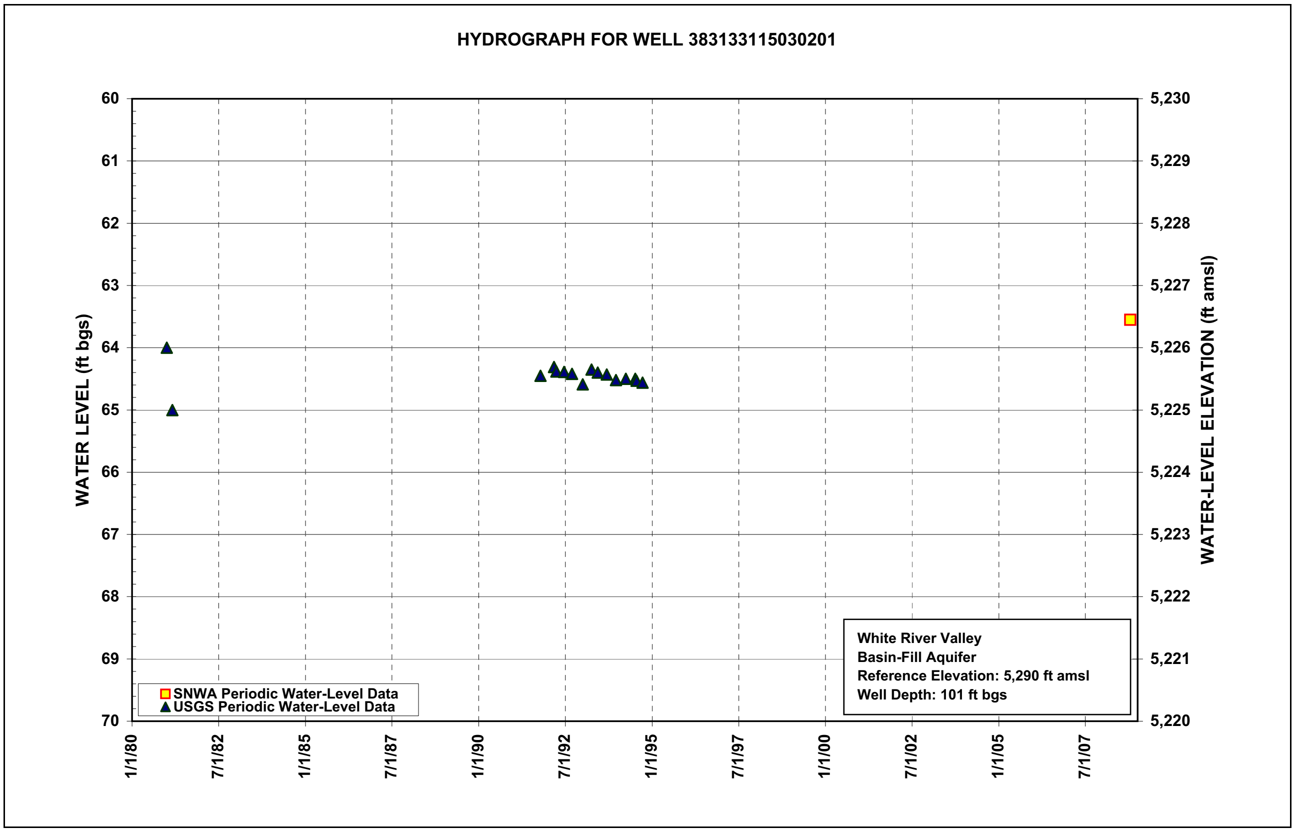

HYDROGRAPH FOR WELL 181M-1
WATER LEVEL (ft bgs)
WATER-LEVEL ELEVATION (ft amsl)
670
671
672
673
674
675
676
677
678
679
680
4,293
4,292
4,291
4,290
4,289
4,288
4,287
4,286
4,285
4,284
4,283
10/1/06
12/1/06
2/1/07
4/1/07
6/1/07
8/1/07
10/1/07
12/1/07
2/1/08
4/1/08
6/1/08
8/1/08
10/1/08
12/1/08
SNWA Periodic Water-Level Data
Dry Lake Valley
Carbonate Aquifer
Reference Elevation: 4,963 ft amsl
Well Depth: 1,472 ft bgs


HYDROGRAPH FOR WELL 380531114534201
WATER LEVEL (ft bgs)
WATER-LEVEL ELEVATION (ft amsl)
843
845
847
849
851
853
855
857
859
861
863
865
867
869
871
873
4,548
4,546
4,544
4,542
4,540
4,538
4,536
4,534
4,532
4,530
4,528
4,526
4,524
4,522
4,520
4,518
1/1/80
7/1/82
1/1/85
7/1/87
1/1/90
7/1/92
1/1/95
7/1/97
1/1/00
7/1/02
1/1/05
7/1/07
SNWA Periodic Water-Level Data
USGS Periodic Water-Level Data
Dry Lake Valley
Carbonate Aquifer
Reference Elevation: 5,391 ft amsl
Well Depth: 2,395 ft bgs


HYDROGRAPH FOR WELL 373405115090001
WATER LEVEL (ft bgs)
WATER-LEVEL ELEVATION (ft amsl)
582
583
584
585
586
587
588
589
590
591
592
3,651
3,650
3,649
3,648
3,647
3,646
3,645
3,644
3,643
3,642
3,641
1/1/89
7/1/90
1/1/92
7/1/93
1/1/95
7/1/96
1/1/98
7/1/99
1/1/01
7/1/02
1/1/04
7/1/05
1/1/07
7/1/08
SNWA Periodic Water-Level Data
USGS Periodic Water-Level Data
Pahranagat Valley
Basin-Fill/Volcanic Aquifer
Reference Elevation: 4,233 ft amsl
Well Depth: 980 ft bgs


HYDROGRAPH FOR WELL 373803115050501
WATER LEVEL (ft bgs)
WATER-LEVEL ELEVATION (ft amsl)
780
781
782
783
784
785
786
787
788
789
790
3,745
3,744
3,743
3,742
3,741
3,740
3,739
3,738
3,737
3,736
3,735
1/1/03
7/1/03
1/1/04
7/1/04
1/1/05
7/1/05
1/1/06
7/1/06
1/1/07
7/1/07
1/1/08
7/1/08
SNWA Periodic Water-Level Data
Pahranagat Valley
Basin-Fill Aquifer
Reference Elevation: 4,525 ft amsl
Well Depth: 700 ft bgs


HYDROGRAPH FOR WELL 209M-1
WATER LEVEL (ft bgs)
WATER-LEVEL ELEVATION (ft amsl)
1,195
1,196
1,197
1,198
1,199
1,200
1,201
1,202
1,203
1,204
1,205
3,902
3,901
3,900
3,899
3,898
3,897
3,896
3,895
3,894
3,893
3,892
10/1/06
12/1/06
2/1/07
4/1/07
6/1/07
8/1/07
10/1/07
12/1/07
2/1/08
4/1/08
6/1/08
8/1/08
10/1/08
12/1/08
SNWA Periodic Water-Level Data
Pahranagat Valley
Carbonate Aquifer
Reference Elevation: 5,097 ft amsl
Well Depth: 1,616 ft bgs


HYDROGRAPH FOR WELL 383133115030201
WATER LEVEL (ft bgs)
WATER-LEVEL ELEVATION (ft amsl)
60
61
62
63
64
65
66
67
68
69
70
5,230
5,229
5,228
5,227
5,226
5,225
5,224
5,223
5,222
5,221
5,220
1/1/80
7/1/82
1/1/85
7/1/87
1/1/90
7/1/92
1/1/95
7/1/97
1/1/00
7/1/02
1/1/05
7/1/07
SNWA Periodic Water-Level Data
USGS Periodic Water-Level Data
White River Valley
Basin-Fill Aquifer
Reference Elevation: 5,290 ft amsl
Well Depth: 101 ft bgs

Appendix B

Continuous Water-Level Measurement Data from the DDC Existing Well Monitoring Network

B.1.0 MONITORING PROGRAM WELLS WITH CONTINUOUS TRANSDUCER DATA

Continuous data collection was performed in 2008 for the following monitor wells:

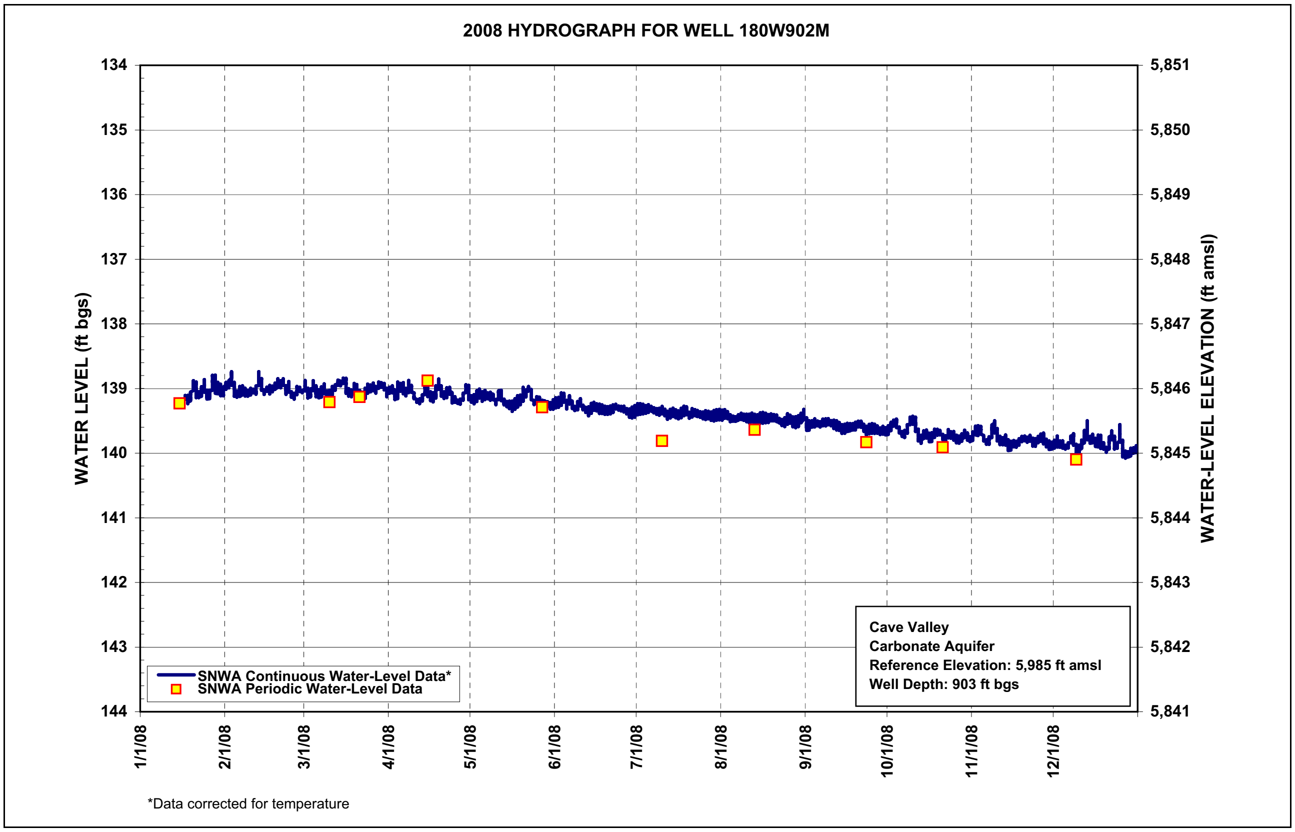
- Cave Valley Well 180W902M
- Cave Valley Well 180W501M
- Delamar Valley Well 182M-1
- Dry Lake Valley Well 181M-1
- Dry Lake Valley Well 380531114534201
- Pahranagat Valley Well 209M-1

For these sites, two hydrographs are presented that include data collected in 2008 and historically. Continuous data have been corrected for temperature and line stretch. Additional data processing, including barometric pressure, may be applied in the future.

Table B-1
Cave Valley Well 180W902M, Calendar Year 2008
Water-Level Data, Daily Mean Values

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	---	138.97	138.96	139.04	139.16	139.22	139.32	139.41	139.55	139.64	139.72	139.84
2	---	138.94	139.07	139.01	139.17	139.22	139.32	139.41	139.58	139.57	139.65	139.80
3	---	138.82	139.07	139.08	139.12	139.17	139.32	139.42	139.56	139.53	139.63	139.85
4	---	139.00	138.96	139.04	139.09	139.13	139.33	139.47	139.53	139.52	139.63	139.85
5	---	139.09	139.04	138.97	139.13	139.24	139.32	139.47	139.55	139.62	139.77	139.92
6	---	139.03	139.08	138.99	139.10	139.19	139.32	139.48	139.56	139.70	139.83	139.89
7	---	139.02	139.06	139.05	139.11	139.25	139.35	139.45	139.53	139.70	139.81	139.79
8	---	139.05	138.98	138.96	139.13	139.32	139.36	139.44	139.53	139.62	139.68	139.76
9	---	139.07	139.08	139.01	139.12	139.27	139.36	139.45	139.52	139.52	139.58	139.95
10	---	139.04	139.09	139.12	139.21	139.20	139.34	139.45	139.54	139.50	139.72	139.94
11	---	139.04	139.04	139.19	139.11	139.29	139.38	139.46	139.56	139.55	139.79	139.86
12	---	139.04	138.98	139.19	139.11	139.33	139.42	139.45	139.57	139.71	139.81	139.72
13	---	138.85	138.91	139.14	139.21	139.35	139.39	139.47	139.59	139.79	139.78	139.63
14	---	138.94	138.93	139.02	139.24	139.30	139.38	139.48	139.63	139.72	139.87	139.79
15	139.99	139.05	138.88	139.00	139.25	139.28	139.40	139.47	139.63	139.70	139.86	139.76
16	139.20	139.01	138.94	139.11	139.28	139.30	139.41	139.47	139.61	139.73	139.84	139.82
17	139.14	139.02	139.05	139.14	139.25	139.32	139.39	139.47	139.60	139.74	139.85	139.83
18	139.16	139.01	139.08	139.06	139.20	139.33	139.36	139.47	139.59	139.68	139.82	139.84
19	139.12	138.97	139.01	138.95	139.18	139.34	139.35	139.46	139.58	139.67	139.79	139.89
20	138.94	138.91	139.01	139.03	139.11	139.35	139.41	139.46	139.55	139.69	139.78	139.94
21	139.01	138.93	139.08	139.10	139.06	139.34	139.39	139.46	139.55	139.75	139.80	139.87
22	139.09	138.89	139.12	139.08	139.00	139.33	139.38	139.50	139.61	139.79	139.78	139.72
23	139.02	139.01	139.08	139.03	139.09	139.29	139.40	139.52	139.65	139.71	139.82	139.82
24	138.95	138.96	139.02	139.17	139.21	139.31	139.41	139.52	139.63	139.72	139.84	139.88
25	139.09	139.09	139.00	139.18	139.17	139.31	139.42	139.47	139.62	139.74	139.79	139.70
26	139.08	139.12	138.98	139.21	139.19	139.31	139.42	139.48	139.63	139.78	139.75	139.92
27	138.88	139.02	139.02	139.21	139.21	139.34	139.42	139.52	139.64	139.79	139.75	140.01
28	138.92	139.01	138.95	139.13	139.22	139.37	139.43	139.53	139.66	139.76	139.83	140.01
29	139.01	139.05	138.95	139.00	139.24	139.37	139.42	139.51	139.65	139.71	139.87	139.97
30	139.03	---	138.96	139.05	139.26	139.35	139.41	139.47	139.67	139.73	139.88	139.96
31	139.05	---	139.08	---	139.25	---	139.41	139.41	---	139.78	---	139.93
Max	139.99	139.12	139.12	139.21	139.28	139.37	139.43	139.53	139.67	139.79	139.88	140.01
Min	138.88	138.82	138.88	138.95	139.00	139.13	139.32	139.41	139.52	139.50	139.58	139.63

Note: Year 2008 Totals: Year Max 140.01; Year Min 138.82
Depth in ft bgs.


2008 HYDROGRAPH FOR WELL 180W902M
WATER LEVEL (ft bgs)
WATER-LEVEL ELEVATION (ft amsl)
134
135
136
137
138
139
140
141
142
143
144
5,851
5,850
5,849
5,848
5,847
5,846
5,845
5,844
5,843
5,842
5,841
1/1/08
2/1/08
3/1/08
4/1/08
5/1/08
6/1/08
7/1/08
8/1/08
9/1/08
10/1/08
11/1/08
12/1/08
SNWA Continuous Water-Level Data*
SNWA Periodic Water-Level Data
Cave Valley
Carbonate Aquifer
Reference Elevation: 5,985 ft amsl
Well Depth: 903 ft bgs
*Data corrected for temperature

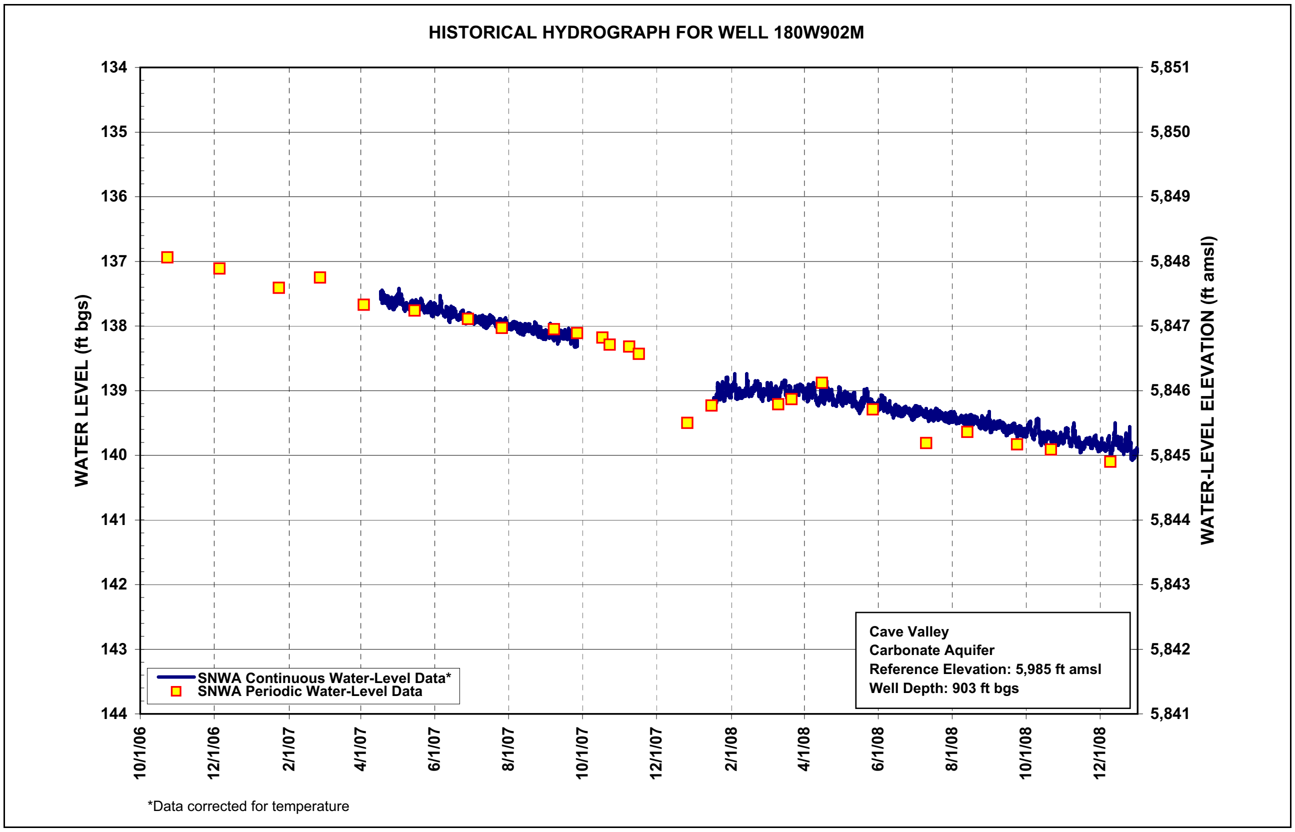
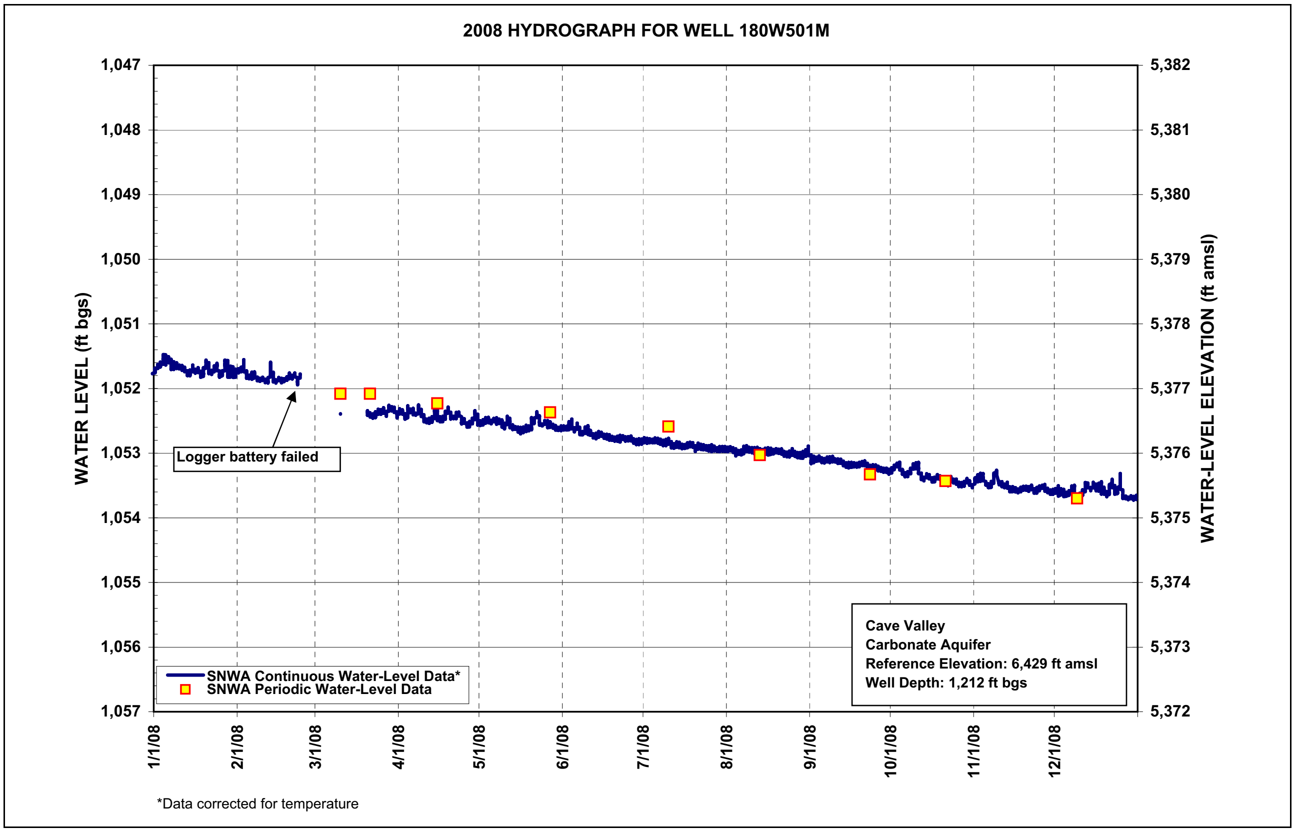

HISTORICAL HYDROGRAPH FOR WELL 180W902M
WATER LEVEL (ft bgs)
WATER-LEVEL ELEVATION (ft amsl)
134
135
136
137
138
139
140
141
142
143
144
5,851
5,850
5,849
5,848
5,847
5,846
5,845
5,844
5,843
5,842
5,841
10/1/06
12/1/06
2/1/07
4/1/07
6/1/07
8/1/07
10/1/07
12/1/07
2/1/08
4/1/08
6/1/08
8/1/08
10/1/08
12/1/08
SNWA Continuous Water-Level Data*
SNWA Periodic Water-Level Data
Cave Valley
Carbonate Aquifer
Reference Elevation: 5,985 ft amsl
Well Depth: 903 ft bgs
*Data corrected for temperature

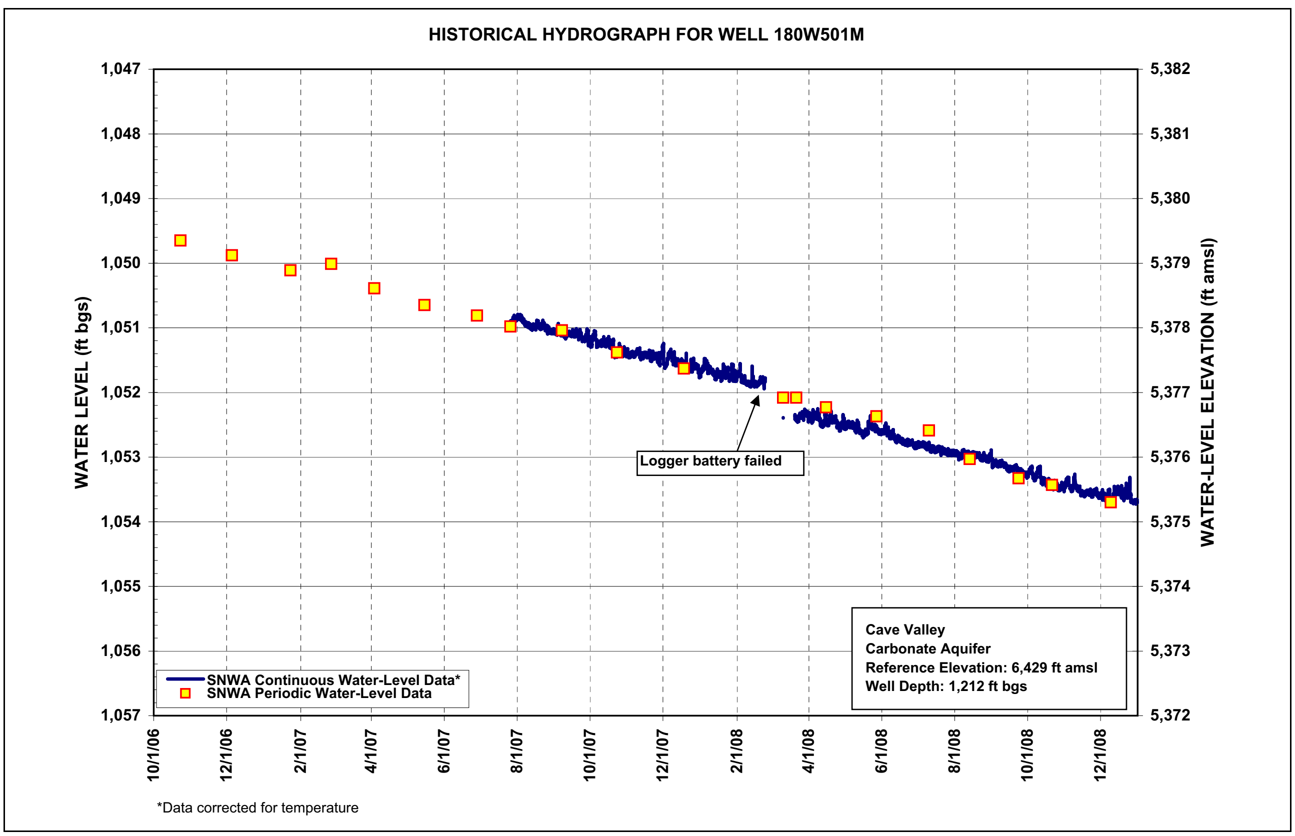
Table B-2
Cave Valley Well 180W501M, Calendar Year 2008
Water-Level Data, Daily Mean Values

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	1,051.72	1,051.73	---	1,052.36	1,052.53	1,052.62	1,052.81	1,052.95	1,053.11	1,053.27	1,053.43	1,053.58
2	1,051.66	1,051.71	---	1,052.36	1,052.53	1,052.62	1,052.82	1,052.94	1,053.10	1,053.22	1,053.39	1,053.57
3	1,051.64	1,051.63	---	1,052.43	1,052.50	1,052.58	1,052.82	1,052.96	1,053.10	1,053.19	1,053.36	1,053.59
4	1,051.57	1,051.78	---	1,052.36	1,052.49	1,052.55	1,052.82	1,052.99	1,053.09	1,053.19	1,053.38	1,053.60
5	1,051.55	1,051.82	---	1,052.35	1,052.52	1,052.63	1,052.81	1,052.99	1,053.12	1,053.28	1,053.47	1,053.65
6	1,051.56	1,051.79	---	1,052.36	1,052.49	1,052.59	1,052.81	1,053.00	1,053.12	1,053.34	1,053.50	1,053.62
7	1,051.62	1,051.80	---	1,052.40	1,052.50	1,052.65	1,052.84	1,052.95	1,053.10	1,053.33	1,053.49	1,053.55
8	1,051.64	1,051.85	---	1,052.31	1,052.51	1,052.69	1,052.85	1,052.94	1,053.11	1,053.28	1,053.39	1,053.55
9	1,051.65	1,051.87	---	1,052.37	1,052.51	1,052.65	1,052.84	1,052.96	1,053.10	1,053.21	1,053.30	1,053.69
10	1,051.66	1,051.86	1,052.39	1,052.45	1,052.58	1,052.62	1,052.83	1,052.96	1,053.11	1,053.19	1,053.47	1,053.66
11	1,051.68	1,051.88	---	1,052.50	1,052.49	1,052.69	1,052.87	1,052.97	1,053.13	1,053.23	1,053.48	1,053.61
12	1,051.71	1,051.88	---	1,052.50	1,052.52	1,052.73	1,052.90	1,052.96	1,053.13	1,053.35	1,053.50	1,053.52
13	1,051.76	1,051.73	---	1,052.48	1,052.59	1,052.74	1,052.87	1,052.98	1,053.15	1,053.40	1,053.48	1,053.51
14	1,051.76	1,051.82	---	1,052.39	1,052.61	1,052.72	1,052.88	1,052.99	1,053.19	1,053.36	1,053.57	1,053.55
15	1,051.69	1,051.89	---	1,052.40	1,052.63	1,052.71	1,052.90	1,052.98	1,053.20	1,053.37	1,053.56	1,053.49
16	1,051.73	1,051.85	---	1,052.47	1,052.66	1,052.74	1,052.91	1,052.98	1,053.19	1,053.41	1,053.57	1,053.55
17	1,051.72	1,051.88	---	1,052.48	1,052.65	1,052.75	1,052.89	1,052.98	1,053.19	1,053.41	1,053.59	1,053.53
18	1,051.77	1,051.87	---	1,052.42	1,052.63	1,052.77	1,052.87	1,052.98	1,053.19	1,053.38	1,053.57	1,053.56
19	1,051.74	1,051.85	---	1,052.34	1,052.62	1,052.78	1,052.88	1,052.97	1,053.18	1,053.38	1,053.55	1,053.58
20	1,051.62	1,051.81	1,052.38	1,052.42	1,052.55	1,052.79	1,052.92	1,052.98	1,053.16	1,053.40	1,053.55	1,053.63
21	1,051.70	1,051.82	1,052.41	1,052.45	1,052.50	1,052.79	1,052.90	1,052.98	1,053.16	1,053.44	1,053.56	1,053.57
22	1,051.75	1,051.79	1,052.43	1,052.42	1,052.41	1,052.78	1,052.90	1,053.01	1,053.22	1,053.46	1,053.54	1,053.47
23	1,051.69	1,051.89	1,052.41	1,052.40	1,052.49	1,052.77	1,052.92	1,053.03	1,053.24	1,053.41	1,053.58	1,053.57
24	1,051.66	1,051.80	1,052.37	1,052.52	1,052.56	1,052.78	1,052.93	1,053.02	1,053.23	1,053.43	1,053.58	1,053.58
25	1,051.78	---	1,052.37	1,052.51	1,052.52	1,052.78	1,052.93	1,052.99	1,053.23	1,053.45	1,053.54	1,053.44
26	1,051.76	---	1,052.35	1,052.55	1,052.55	1,052.78	1,052.94	1,053.01	1,053.24	1,053.49	1,053.52	1,053.64
27	1,051.62	---	1,052.38	1,052.55	1,052.57	1,052.81	1,052.94	1,053.04	1,053.25	1,053.49	1,053.52	1,053.68
28	1,051.68	---	1,052.31	1,052.51	1,052.58	1,052.83	1,052.95	1,053.04	1,053.27	1,053.47	1,053.58	1,053.70
29	1,051.72	---	1,052.32	1,052.41	1,052.60	1,052.83	1,052.94	1,053.03	1,053.27	1,053.43	1,053.60	1,053.69
30	1,051.76	---	1,052.32	1,052.47	1,052.63	1,052.83	1,052.94	1,053.01	1,053.29	1,053.46	1,053.61	1,053.70
31	1,051.76	---	1,052.41	---	1,052.62	---	1,052.94	1,052.96	---	1,053.50	---	1,053.69
Max	1,051.78	1,051.89	1,052.43	1,052.55	1,052.66	1,052.83	1,052.95	1,053.04	1,053.29	1,053.50	1,053.61	1,053.70
Min	1051.55	1,051.63	1,052.31	1,052.31	1,052.41	1,052.55	1,052.81	1,052.94	1,053.09	1,053.19	1,053.30	1,053.44

Note: Year 2008 Totals: Year Max 1,053.70; Year Min 1,051.55
Depth in ft bgs.



2008 HYDROGRAPH FOR WELL 180W501M
WATER LEVEL (ft bgs)
WATER-LEVEL ELEVATION (ft amsl)
1,047
1,048
1,049
1,050
1,051
1,052
1,053
1,054
1,055
1,056
1,057
5,382
5,381
5,380
5,379
5,378
5,377
5,376
5,375
5,374
5,373
5,372
1/1/08
2/1/08
3/1/08
4/1/08
5/1/08
6/1/08
7/1/08
8/1/08
9/1/08
10/1/08
11/1/08
12/1/08
Logger battery failed
SNWA Continuous Water-Level Data*
SNWA Periodic Water-Level Data
Cave Valley
Carbonate Aquifer
Reference Elevation: 6,429 ft amsl
Well Depth: 1,212 ft bgs
*Data corrected for temperature

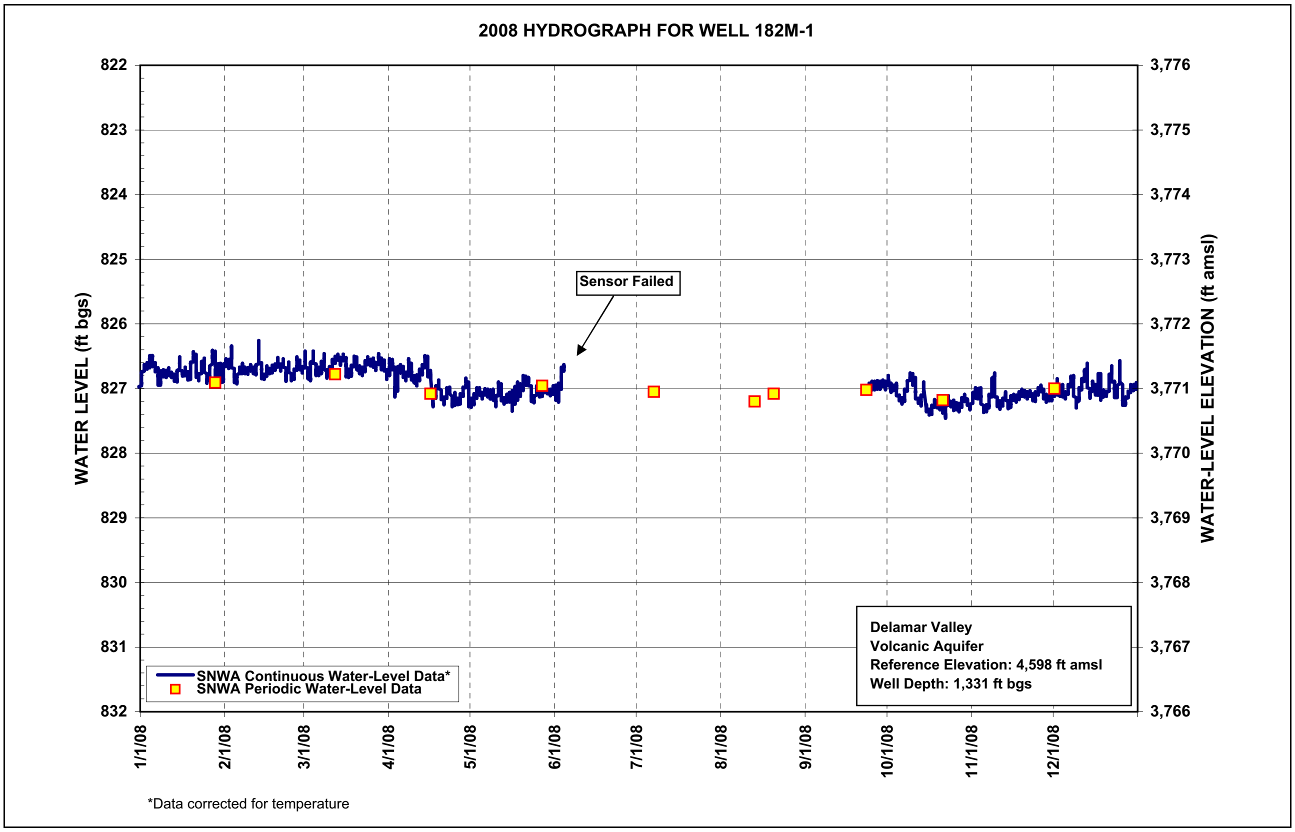


HISTORICAL HYDROGRAPH FOR WELL 180W501M
WATER LEVEL (ft bgs)
WATER-LEVEL ELEVATION (ft amsl)
1,047
1,048
1,049
1,050
1,051
1,052
1,053
1,054
1,055
1,056
1,057
5,382
5,381
5,380
5,379
5,378
5,377
5,376
5,375
5,374
5,373
5,372
10/1/06
12/1/06
2/1/07
4/1/07
6/1/07
8/1/07
10/1/07
12/1/07
2/1/08
4/1/08
6/1/08
8/1/08
10/1/08
12/1/08
Logger battery failed
SNWA Continuous Water-Level Data*
SNWA Periodic Water-Level Data
Cave Valley
Carbonate Aquifer
Reference Elevation: 6,429 ft amsl
Well Depth: 1,212 ft bgs
*Data corrected for temperature

Table B-3
Delamar Valley Well 182M-1, Calendar Year 2008
Water-Level Data, Daily Mean Values

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	826.85	826.61	826.55	826.63	827.22	827.03	---	---	---	826.88	827.14	827.04
2	826.69	826.63	826.78	826.62	827.17	826.99	---	---	---	827.00	827.06	826.94
3	826.66	826.46	826.74	827.00	827.06	826.89	---	---	---	826.98	827.08	827.04
4	826.60	826.80	826.52	826.87	827.04	826.68	---	---	---	826.99	827.11	827.01
5	826.59	826.87	826.72	826.70	827.11	---	---	---	---	827.14	827.32	827.10
6	826.67	826.71	826.74	826.75	827.05	---	---	---	---	827.19	827.31	827.02
7	826.80	826.69	826.68	826.81	827.07	---	---	---	---	827.12	827.19	826.89
8	826.83	826.73	826.55	826.64	827.10	---	---	---	---	826.96	827.00	826.89
9	826.76	826.73	826.76	826.74	827.06	---	---	---	---	826.83	826.92	827.21
10	826.77	826.68	826.74	826.86	827.19	---	---	---	---	826.87	827.22	827.09
11	826.74	826.71	826.64	826.89	827.01	---	---	---	---	827.01	827.25	826.93
12	826.79	826.72	826.57	826.80	827.03	---	---	---	---	827.18	827.21	826.80
13	826.83	826.46	826.52	826.72	827.19	---	---	---	---	827.18	827.11	826.73
14	826.81	826.71	826.57	826.59	827.15	---	---	---	---	827.00	827.25	827.07
15	826.62	826.83	826.52	826.62	827.14	---	---	---	---	827.31	827.19	826.95
16	826.76	826.72	826.65	826.80	827.19	---	---	---	---	827.36	827.14	827.03
17	826.74	826.73	826.77	827.19	827.14	---	---	---	---	827.34	827.16	826.98
18	826.78	826.70	826.72	827.05	827.01	---	---	---	---	827.24	827.11	827.04
19	826.73	826.67	826.59	826.94	827.00	---	---	---	---	827.25	827.07	827.07
20	826.49	826.59	826.63	827.11	826.93	---	---	---	---	827.28	827.08	827.08
21	826.70	826.66	826.71	827.18	826.90	---	---	---	---	827.32	827.10	826.94
22	826.81	826.60	826.73	827.08	826.88	---	---	---	---	827.36	827.08	826.74
23	826.66	826.80	826.66	827.04	827.08	---	---	---	827.08	827.19	827.13	827.00
24	826.62	826.66	826.58	827.23	827.17	---	---	---	826.99	827.23	827.13	827.06
25	826.86	826.82	826.59	827.17	827.02	---	---	---	826.95	827.26	827.04	826.75
26	826.76	826.79	826.60	827.19	827.06	---	---	---	826.95	827.28	827.00	827.15
27	826.49	826.61	826.64	827.16	827.05	---	---	---	826.95	827.29	827.05	827.19
28	826.62	826.62	826.55	827.05	827.04	---	---	---	826.96	827.22	827.15	827.09
29	826.78	826.71	826.58	826.92	827.05	---	---	---	826.93	827.15	827.15	827.00
30	826.76	---	826.64	827.06	827.06	---	---	---	826.95	827.21	827.12	826.98
31	826.76	---	826.77	---	827.03	---	---	---	---	827.28	---	826.96
Max	826.86	826.87	826.78	827.23	827.22	827.03	---	---	827.08	827.36	827.32	827.21
Min	826.49	826.46	826.52	826.59	826.88	826.68	---	---	826.93	826.83	826.92	826.73

Note: Year 2008 Totals: Year Max 827.36; Year Min 826.46
Depth in ft bgs.


2008 HYDROGRAPH FOR WELL 182M-1
WATER LEVEL (ft bgs)
WATER-LEVEL ELEVATION (ft amsl)
822
823
824
825
826
827
828
829
830
831
832
3,776
3,775
3,774
3,773
3,772
3,771
3,770
3,769
3,768
3,767
3,766
1/1/08
2/1/08
3/1/08
4/1/08
5/1/08
6/1/08
7/1/08
8/1/08
9/1/08
10/1/08
11/1/08
12/1/08
Sensor Failed
SNWA Continuous Water-Level Data*
SNWA Periodic Water-Level Data
Delamar Valley
Volcanic Aquifer
Reference Elevation: 4,598 ft amsl
Well Depth: 1,331 ft bgs
*Data corrected for temperature

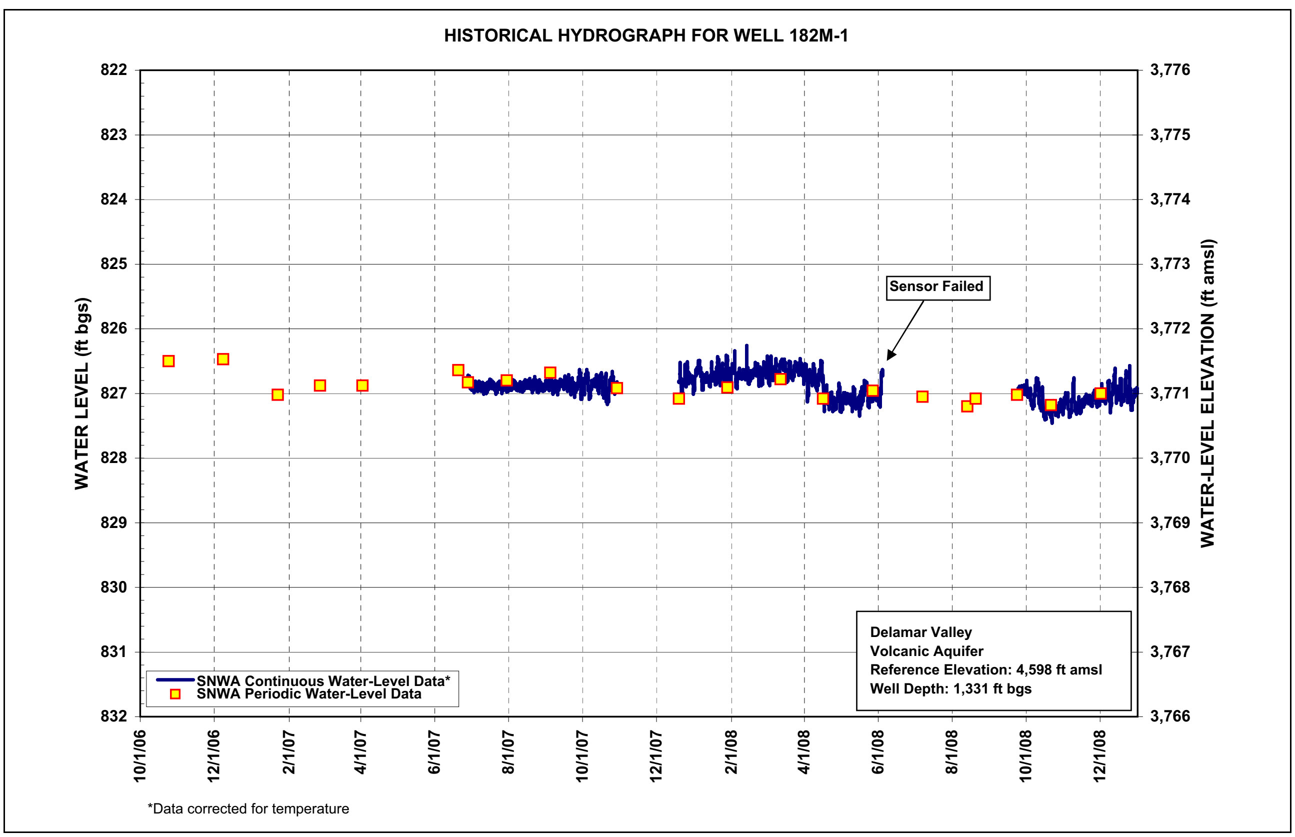
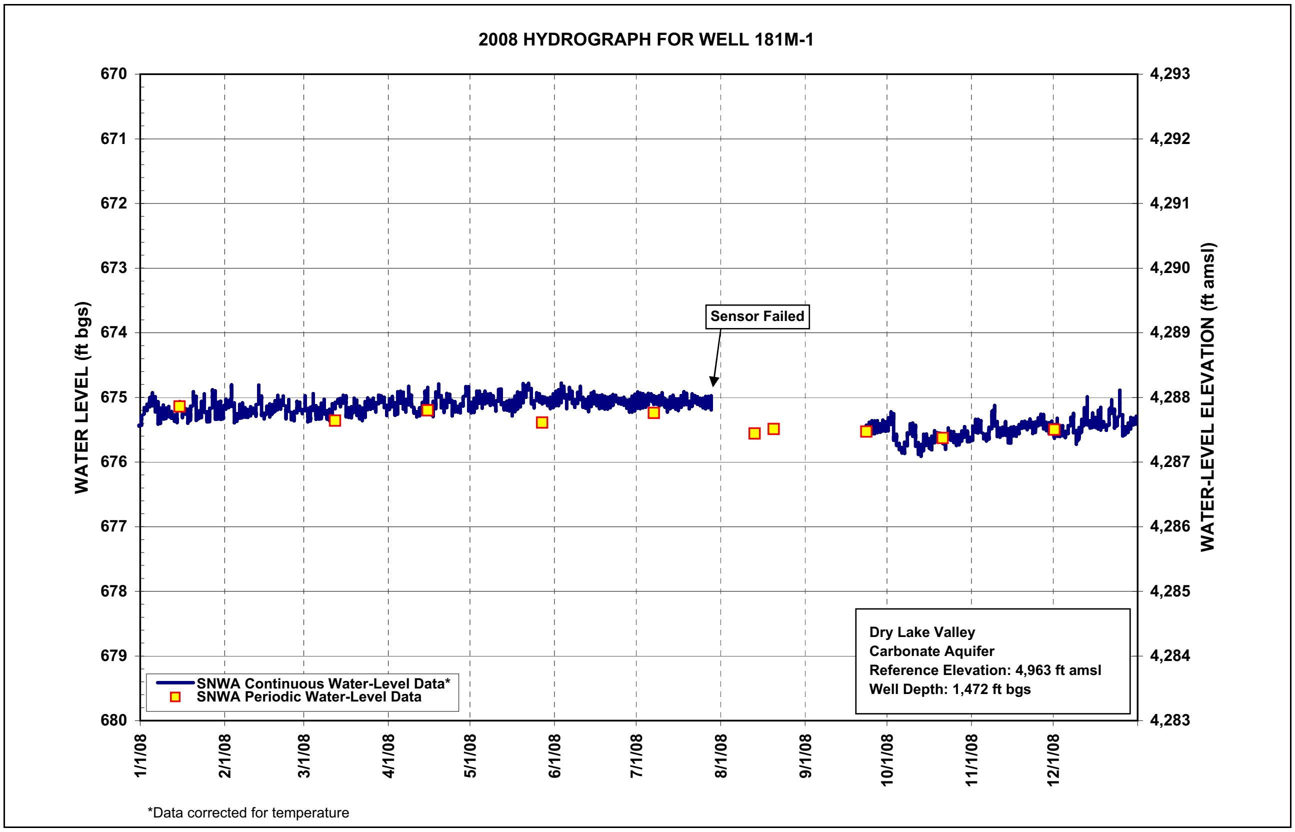

HISTORICAL HYDROGRAPH FOR WELL 182M-1
WATER LEVEL (ft bgs)
WATER-LEVEL ELEVATION (ft amsl)
822
823
824
825
826
827
828
829
830
831
832
3,776
3,775
3,774
3,773
3,772
3,771
3,770
3,769
3,768
3,767
3,766
10/1/06
12/1/06
2/1/07
4/1/07
6/1/07
8/1/07
10/1/07
12/1/07
2/1/08
4/1/08
6/1/08
8/1/08
10/1/08
12/1/08
Sensor Failed
SNWA Continuous Water-Level Data*
SNWA Periodic Water-Level Data
Delamar Valley
Volcanic Aquifer
Reference Elevation: 4,598 ft amsl
Well Depth: 1,331 ft bgs
*Data corrected for temperature

Table B-4
Dry Lake Valley Well 181M-1, Calendar Year 2008
Water-Level Data, Daily Mean Values

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	675.37	675.11	675.08	675.11	675.16	675.01	675.05	---	---	675.41	675.53	675.51
2	675.22	675.10	675.27	675.07	675.13	675.00	675.05	---	---	675.31	675.43	675.43
3	675.16	674.92	675.26	675.18	675.04	674.94	675.05	---	---	675.50	675.42	675.51
4	675.08	675.21	675.07	675.09	675.00	674.90	675.06	---	---	675.63	675.42	675.48
5	675.04	675.31	675.23	674.99	675.06	675.05	675.04	---	---	675.75	675.61	675.58
6	675.10	675.19	675.26	675.05	675.01	674.96	675.02	---	---	675.82	675.63	675.51
7	675.21	675.19	675.22	675.11	675.03	675.02	675.07	---	---	675.79	675.56	675.37
8	675.26	675.23	675.11	674.97	675.04	675.11	675.06	---	---	675.65	675.37	675.35
9	675.21	675.25	675.26	675.06	675.01	675.02	675.05	---	---	675.51	675.26	675.63
10	675.23	675.21	675.28	675.19	675.15	674.91	675.02	---	---	675.51	675.49	675.56
11	675.21	675.22	675.20	675.26	674.97	675.07	675.09	---	---	675.58	675.54	675.43
12	675.26	675.22	675.13	675.22	675.00	675.10	675.14	---	---	675.77	675.52	675.26
13	675.31	674.96	675.06	675.14	675.13	675.10	675.08	---	---	675.82	675.45	675.15
14	675.31	675.14	675.09	674.99	675.13	675.04	675.06	---	---	675.68	675.58	675.41
15	675.14	675.27	675.01	675.00	675.14	675.01	675.10	---	---	675.66	675.55	675.32
16	675.24	675.19	675.11	675.19	675.17	675.04	675.11	---	---	675.69	675.51	675.38
17	675.22	675.19	675.24	675.18	675.11	675.07	675.06	---	---	675.69	675.53	675.36
18	675.27	675.18	675.24	675.05	675.05	675.07	675.02	---	---	675.60	675.48	675.37
19	675.23	675.14	675.13	674.91	675.04	675.08	675.03	---	---	675.60	675.44	675.42
20	675.00	675.07	675.15	675.06	674.95	675.09	675.11	---	---	675.62	675.43	675.46
21	675.15	675.11	675.24	675.13	674.90	675.08	675.07	---	---	675.66	675.45	675.33
22	675.27	675.05	675.27	675.06	674.84	675.06	675.04	---	---	675.70	675.41	675.12
23	675.16	675.21	675.20	675.00	674.99	675.03	675.07	---	675.56	675.57	675.46	675.31
24	675.07	675.12	675.11	675.20	675.11	675.06	675.08	---	675.49	675.59	675.47	675.38
25	675.30	675.29	675.11	675.16	675.00	675.06	675.09	---	675.46	675.62	675.38	675.08
26	675.26	675.30	675.10	675.19	675.02	675.05	675.09	---	675.46	675.65	675.33	675.42
27	674.99	675.14	675.14	675.18	675.04	675.09	675.08	---	675.46	675.66	675.34	675.51
28	675.06	675.15	675.04	675.06	675.04	675.11	675.09	---	675.47	675.61	675.44	675.45
29	675.22	675.22	675.03	674.90	675.06	675.10	---	---	675.45	675.54	675.45	675.38
30	675.21	---	675.07	675.01	675.08	675.08	---	---	675.46	675.58	675.45	675.37
31	675.24	---	675.21	---	675.04	---	---	---	---	675.65	---	675.34
Max	675.37	675.31	675.28	675.26	675.17	675.11	675.14	---	675.56	675.82	675.63	675.63
Min	674.99	674.92	675.01	674.90	674.84	674.90	675.02	---	675.45	675.31	675.26	675.08

Note: Year 2008 Totals: Year Max 675.82; Year Min 674.84
Depth in ft bgs.


2008 HYDROGRAPH FOR WELL 181M-1
WATER LEVEL (ft bgs)
WATER-LEVEL ELEVATION (ft amsl)
670
671
672
673
674
675
676
677
678
679
680
4,293
4,292
4,291
4,290
4,289
4,288
4,287
4,286
4,285
4,284
4,283
1/1/08
2/1/08
3/1/08
4/1/08
5/1/08
6/1/08
7/1/08
8/1/08
9/1/08
10/1/08
11/1/08
12/1/08
Sensor Failed
SNWA Continuous Water-Level Data*
SNWA Periodic Water-Level Data
Dry Lake Valley
Carbonate Aquifer
Reference Elevation: 4,963 ft amsl
Well Depth: 1,472 ft bgs
*Data corrected for temperature

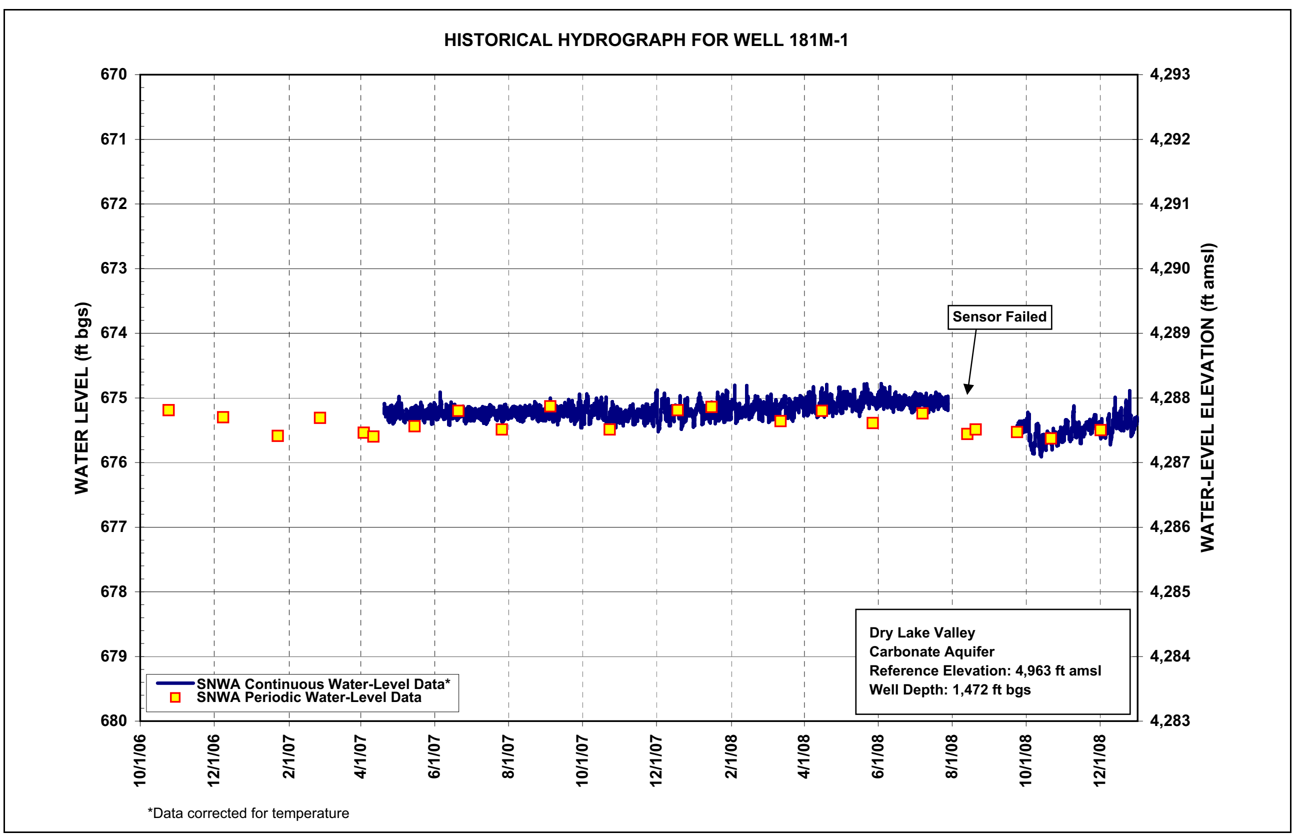
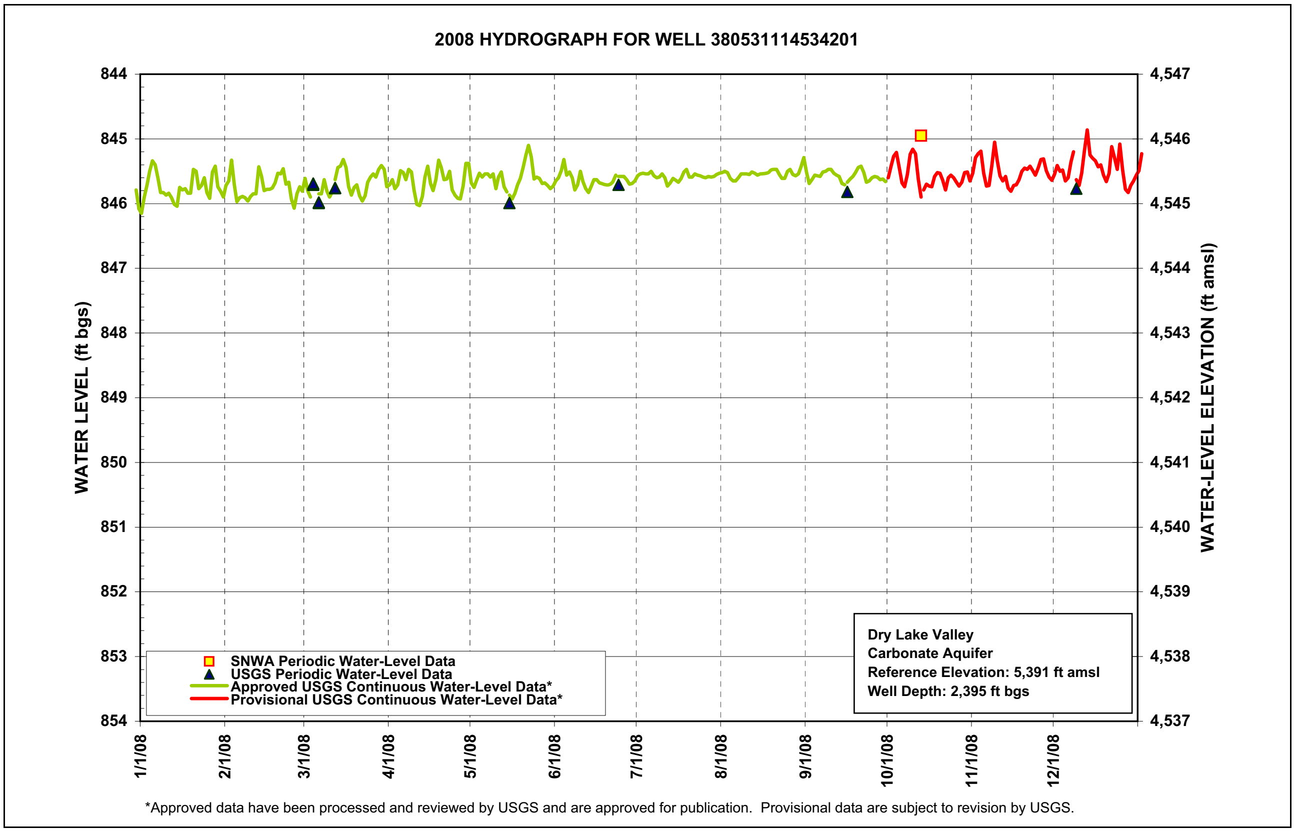

HISTORICAL HYDROGRAPH FOR WELL 181M-1
WATER LEVEL (ft bgs)
WATER-LEVEL ELEVATION (ft amsl)
670
671
672
673
674
675
676
677
678
679
680
4,293
4,292
4,291
4,290
4,289
4,288
4,287
4,286
4,285
4,284
4,283
10/1/06
12/1/06
2/1/07
4/1/07
6/1/07
8/1/07
10/1/07
12/1/07
2/1/08
4/1/08
6/1/08
8/1/08
10/1/08
12/1/08
Sensor Failed
SNWA Continuous Water-Level Data*
SNWA Periodic Water-Level Data
Dry Lake Valley
Carbonate Aquifer
Reference Elevation: 4,963 ft amsl
Well Depth: 1,472 ft bgs
*Data corrected for temperature

Table B-5
Dry Lake Valley Well 380531114534201, Calendar Year 2008
Water-Level Data, Daily Mean Values

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	846.15	845.72	845.61	845.71	845.68	845.65	845.57	845.52	845.52	---	---	---
2	845.90	845.65	845.81	845.63	845.75	845.60	845.54	845.50	845.69	---	---	---
3	845.71	845.33	845.90	845.77	845.63	845.49	845.53	845.52	845.63	---	---	---
4	845.50	845.71	845.67	845.71	845.53	845.32	845.54	845.61	845.56	---	---	---
5	845.34	845.97	---	845.49	845.59	845.56	845.54	845.65	845.57	---	---	---
6	845.40	845.91	845.85	845.52	845.54	845.51	845.50	845.65	845.58	---	---	---
7	845.61	845.89	845.85	845.63	845.54	845.60	845.57	845.60	845.51	---	---	---
8	845.83	845.91	845.63	845.47	845.59	845.79	845.60	845.54	845.50	---	---	---
9	845.83	845.96	845.81	845.51	845.54	845.71	845.59	845.54	845.47	---	---	---
10	845.87	845.89	845.90	845.79	845.77	845.50	845.54	845.54	845.47	---	---	---
11	845.84	845.85	845.82	846.01	845.59	845.66	845.60	845.55	845.53	---	---	---
12	845.91	845.85	845.63	846.03	845.51	845.77	845.73	845.51	845.56	---	---	---
13	846.01	845.43	845.44	845.89	845.74	845.83	845.68	845.53	845.58	---	---	---
14	846.04	845.58	845.42	845.59	845.82	845.73	845.61	845.56	845.69	---	---	---
15	845.75	845.80	845.32	845.42	845.87	845.63	845.64	845.54	845.71	---	---	---
16	845.79	845.78	845.44	845.69	845.93	845.63	845.67	845.54	845.67	---	---	---
17	845.77	845.78	845.74	845.80	845.84	845.68	845.61	845.53	845.62	---	---	---
18	845.84	845.76	845.87	845.63	845.71	845.69	845.51	845.52	845.58	---	---	---
19	845.84	845.68	845.75	845.33	845.61	845.71	845.47	845.48	845.52	---	---	---
20	845.47	845.53	845.71	845.44	845.44	845.71	845.59	845.47	845.44	---	---	---
21	845.50	845.54	845.88	845.63	845.25	845.70	845.59	845.47	845.42	---	---	---
22	845.77	845.46	845.96	845.62	845.10	845.66	845.54	845.55	845.52	---	---	---
23	845.72	845.70	845.88	845.50	845.28	845.56	845.56	845.61	845.67	---	---	---
24	845.60	845.67	845.67	845.79	845.62	845.58	845.57	845.61	845.65	---	---	---
25	845.83	845.93	845.59	845.87	845.59	845.58	845.59	845.50	845.60	---	---	---
26	845.92	846.07	845.54	845.92	845.61	845.58	845.60	845.47	845.58	---	---	---
27	845.51	845.85	845.59	845.93	845.69	845.63	845.58	845.55	845.59	---	---	---
28	845.42	845.74	845.47	845.73	845.68	845.70	845.59	845.57	845.63	---	---	---
29	845.74	845.81	845.41	845.38	845.72	845.69	845.58	845.54	845.62	---	---	---
30	845.81	---	845.47	845.38	845.77	845.65	845.55	845.43	845.66	---	---	---
31	845.90	---	845.74	---	845.73	---	845.53	845.29	---	---	---	---
Max	846.15	846.07	845.96	846.03	845.93	845.83	845.73	845.65	845.71	---	---	---
Min	845.34	845.33	845.32	845.33	845.10	845.32	845.47	845.29	845.42	---	---	---

Note: Year 2008 Totals: Year Max 846.15; Year Min 845.10
Depth in ft bgs.


2008 HYDROGRAPH FOR WELL 380531114534201
WATER LEVEL (ft bgs)
WATER-LEVEL ELEVATION (ft amsl)
844
845
846
847
848
849
850
851
852
853
854
4,547
4,546
4,545
4,544
4,543
4,542
4,541
4,540
4,539
4,538
4,537
1/1/08
2/1/08
3/1/08
4/1/08
5/1/08
6/1/08
7/1/08
8/1/08
9/1/08
10/1/08
11/1/08
12/1/08
SNWA Periodic Water-Level Data
USGS Periodic Water-Level Data
Approved USGS Continuous Water-Level Data*
Provisional USGS Continuous Water-Level Data*
Dry Lake Valley
Carbonate Aquifer
Reference Elevation: 5,391 ft amsl
Well Depth: 2,395 ft bgs
*Approved data have been processed and reviewed by USGS and are approved for publication. Provisional data are subject to revision by USGS.

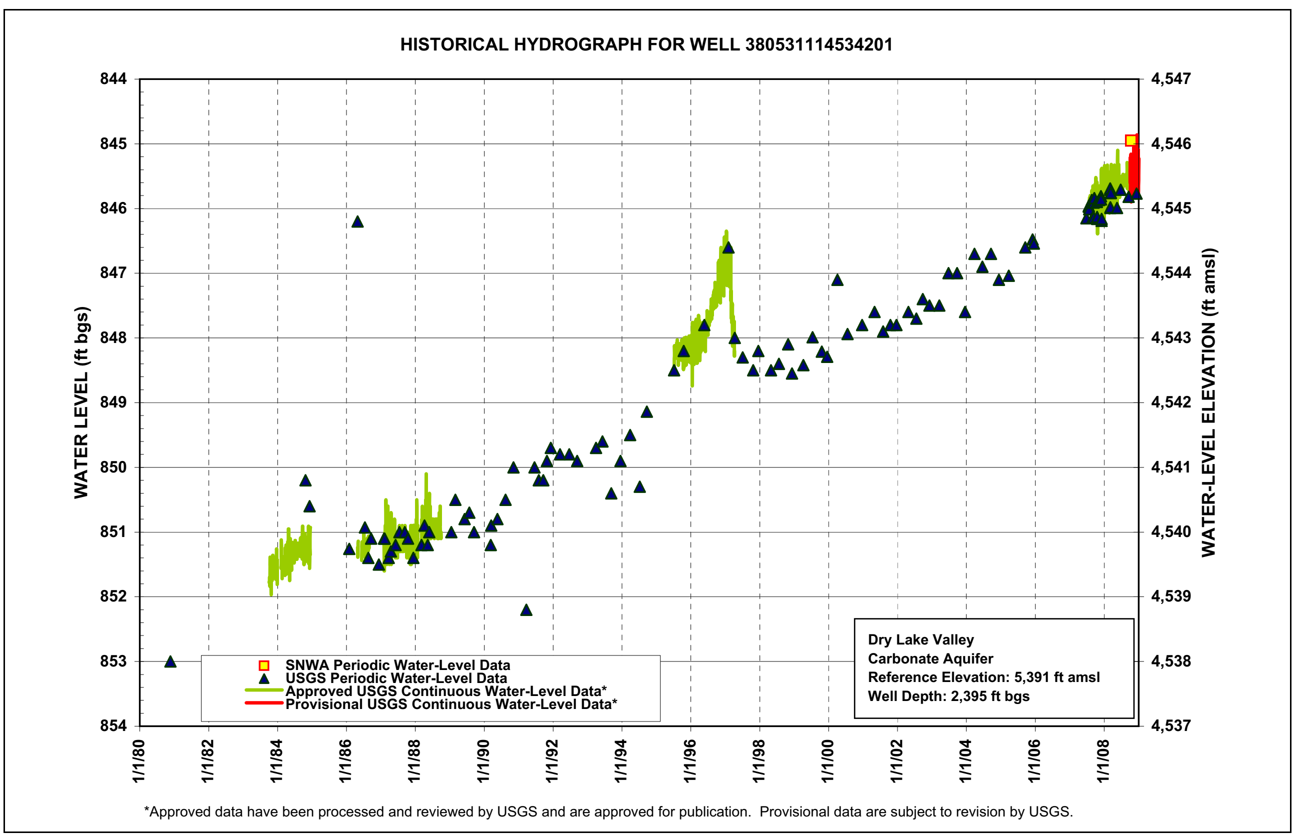
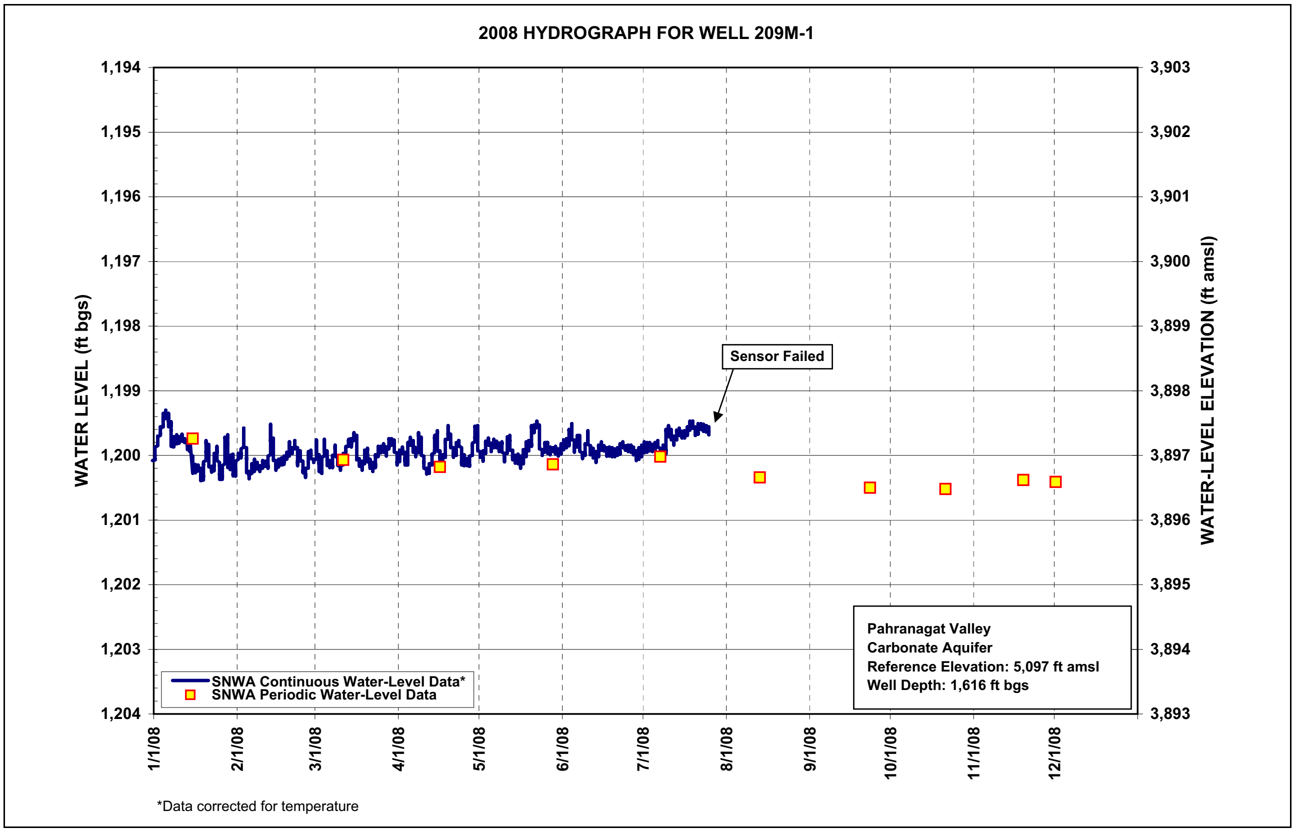
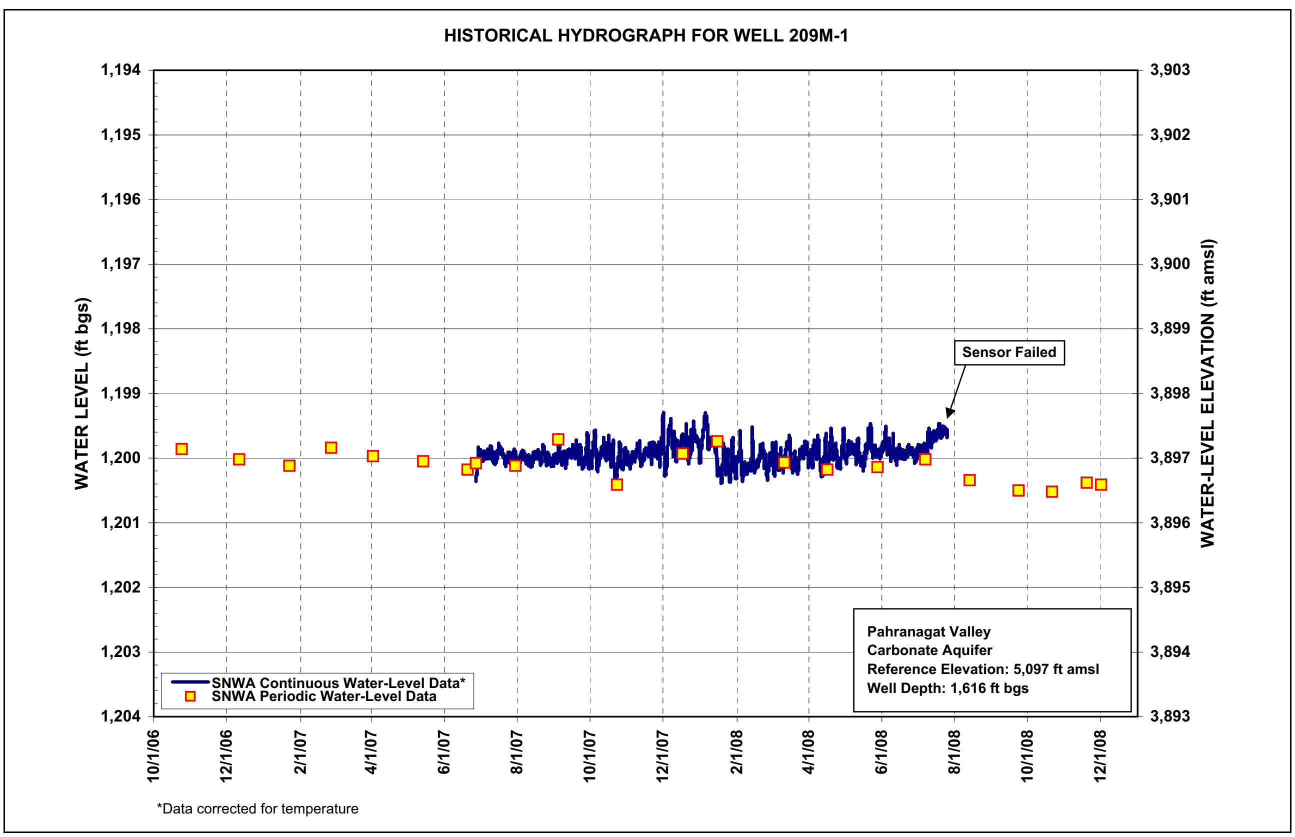

HISTORICAL HYDROGRAPH FOR WELL 380531114534201
WATER LEVEL (ft bgs)
WATER-LEVEL ELEVATION (ft amsl)
844
845
846
847
848
849
850
851
852
853
854
4,547
4,546
4,545
4,544
4,543
4,542
4,541
4,540
4,539
4,538
4,537
1/1/80
1/1/82
1/1/84
1/1/86
1/1/88
1/1/90
1/1/92
1/1/94
1/1/96
1/1/98
1/1/00
1/1/02
1/1/04
1/1/06
1/1/08
SNWA Periodic Water-Level Data
USGS Periodic Water-Level Data
Approved USGS Continuous Water-Level Data*
Provisional USGS Continuous Water-Level Data*
Dry Lake Valley
Carbonate Aquifer
Reference Elevation: 5,391 ft amsl
Well Depth: 2,395 ft bgs
*Approved data have been processed and reviewed by USGS and are approved for publication. Provisional data are subject to revision by USGS.

Table B-6
Pahranagat Valley Well 209M-1, Calendar Year 2008
Water-Level Data, Daily Mean Values

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	1,200.00	1,200.01	1,199.90	1,200.00	1,199.99	1,199.84	1,199.88	---	---	---	---	---
2	1,199.76	1,199.98	1,200.11	1,199.92	1,200.01	1,199.81	1,199.87	---	---	---	---	---
3	1,199.63	1,199.70	1,200.18	1,200.05	1,199.88	1,199.73	1,199.87	---	---	---	---	---
4	1,199.48	1,200.05	1,199.88	1,199.99	1,199.80	1,199.61	1,199.88	---	---	---	---	---
5	1,199.37	1,200.30	1,200.04	1,199.79	1,199.87	1,199.86	1,199.87	---	---	---	---	---
6	1,199.45	1,200.18	1,200.14	1,199.85	1,199.83	1,199.80	1,199.83	---	---	---	---	---
7	1,199.63	1,200.15	1,200.11	1,199.95	1,199.84	1,199.84	1,199.93	---	---	---	---	---
8	1,199.79	1,200.17	1,199.91	1,199.78	1,199.88	1,200.00	1,199.88	---	---	---	---	---
9	1,199.73	1,200.20	1,200.10	1,199.85	1,199.83	1,199.92	1,199.79	---	---	---	---	---
10	1,199.76	1,200.14	1,200.16	1,200.09	1,200.03	1,199.74	1,199.62	---	---	---	---	---
11	1,199.71	1,200.12	1,200.07	1,200.24	1,199.84	1,199.91	1,199.69	---	---	---	---	---
12	1,199.77	1,200.13	1,199.92	1,200.21	1,199.78	1,199.99	1,199.77	---	---	---	---	---
13	1,199.84	1,199.74	1,199.80	1,200.07	1,200.01	1,200.02	1,199.69	---	---	---	---	---
14	1,199.86	1,199.89	1,199.81	1,199.84	1,200.05	1,199.93	1,199.64	---	---	---	---	---
15	1,200.12	1,200.15	1,199.71	1,199.74	1,200.05	1,199.86	1,199.68	---	---	---	---	---
16	1,200.20	1,200.10	1,199.84	1,200.02	1,200.11	1,199.89	1,199.67	---	---	---	---	---
17	1,200.20	1,200.09	1,200.10	1,200.09	1,200.03	1,199.94	1,199.62	---	---	---	---	---
18	1,200.26	1,200.07	1,200.16	1,199.91	1,199.92	1,199.94	1,199.54	---	---	---	---	---
19	1,200.25	1,200.00	1,200.02	1,199.65	1,199.85	1,199.95	1,199.53	---	---	---	---	---
20	1,199.88	1,199.88	1,199.99	1,199.80	1,199.74	1,199.96	1,199.63	---	---	---	---	---
21	1,199.98	1,199.91	1,200.13	1,199.96	1,199.60	1,199.94	1,199.61	---	---	---	---	---
22	1,200.21	1,199.83	1,200.17	1,199.91	1,199.50	1,199.91	1,199.56	---	---	---	---	---
23	1,200.09	1,200.06	1,200.10	1,199.82	1,199.70	1,199.84	1,199.59	---	---	---	---	---
24	1,199.94	1,199.99	1,199.94	1,200.06	1,199.96	1,199.88	1,199.59	---	---	---	---	---
25	1,200.26	1,200.20	1,199.90	1,200.09	1,199.87	1,199.89	1,199.62	---	---	---	---	---
26	1,200.28	1,200.27	1,199.89	1,200.10	1,199.88	1,199.89	---	---	---	---	---	---
27	1,199.89	1,200.05	1,199.93	1,200.10	1,199.93	1,199.94	---	---	---	---	---	---
28	1,199.85	1,199.97	1,199.82	1,199.92	1,199.91	1,199.99	---	---	---	---	---	---
29	1,200.14	1,200.08	1,199.79	1,199.65	1,199.92	1,199.97	---	---	---	---	---	---
30	1,200.13	---	1,199.84	1,199.70	1,199.94	1,199.93	---	---	---	---	---	---
31	1,200.23	---	1,200.08	---	1,199.90	---	---	---	---	---	---	---
Max	1,200.28	1,200.30	1,200.18	1,200.24	1,200.11	1,200.02	1,199.93	---	---	---	---	---
Min	1,199.37	1,199.70	1,199.71	1,199.65	1,199.50	1,199.61	1,199.53	---	---	---	---	---

Note: Year 2008 Totals: Year Max 1,200.30; Year Min 1,199.37
Depth in ft bgs.


2008 HYDROGRAPH FOR WELL 209M-1
WATER LEVEL (ft bgs)
WATER-LEVEL ELEVATION (ft amsl)
1,194
1,195
1,196
1,197
1,198
1,199
1,200
1,201
1,202
1,203
1,204
3,903
3,902
3,901
3,900
3,899
3,898
3,897
3,896
3,895
3,894
3,893
Sensor Failed
SNWA Continuous Water-Level Data*
SNWA Periodic Water-Level Data
Pahranagat Valley
Carbonate Aquifer
Reference Elevation: 5,097 ft amsl
Well Depth: 1,616 ft bgs
1/1/08
2/1/08
3/1/08
4/1/08
5/1/08
6/1/08
7/1/08
8/1/08
9/1/08
10/1/08
11/1/08
12/1/08
*Data corrected for temperature


HISTORICAL HYDROGRAPH FOR WELL 209M-1
WATER LEVEL (ft bgs)
WATER-LEVEL ELEVATION (ft amsl)
1,194
1,195
1,196
1,197
1,198
1,199
1,200
1,201
1,202
1,203
1,204
3,903
3,902
3,901
3,900
3,899
3,898
3,897
3,896
3,895
3,894
3,893
Sensor Failed
SNWA Continuous Water-Level Data*
SNWA Periodic Water-Level Data
Pahranagat Valley
Carbonate Aquifer
Reference Elevation: 5,097 ft amsl
Well Depth: 1,616 ft bgs
10/1/06
12/1/06
2/1/07
4/1/07
6/1/07
8/1/07
10/1/07
12/1/07
2/1/08
4/1/08
6/1/08
8/1/08
10/1/08
12/1/08
*Data corrected for temperature

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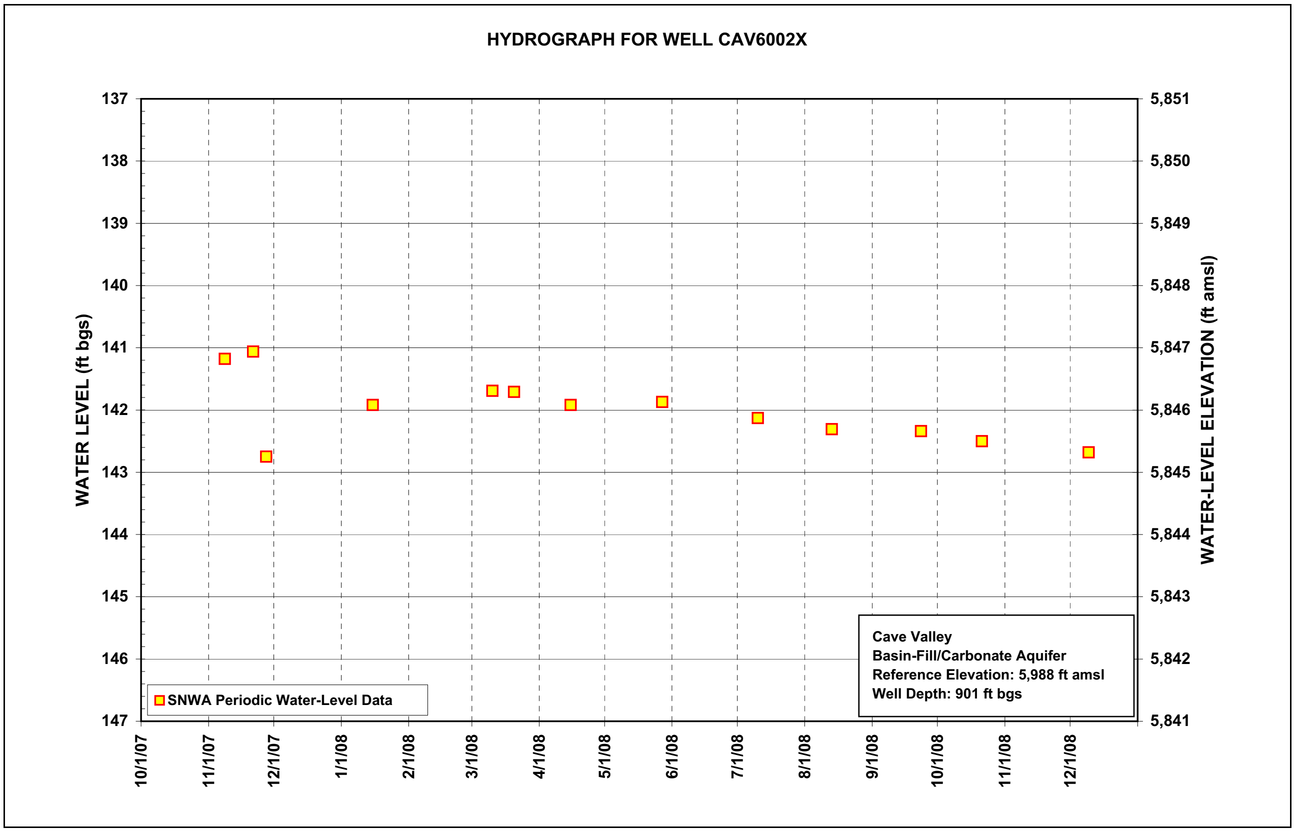
Appendix C

Periodic Water-Level Measurements and Hydrographs for Exploratory and Test Wells Not Included in the Monitoring Network Data in Appendixes A and B

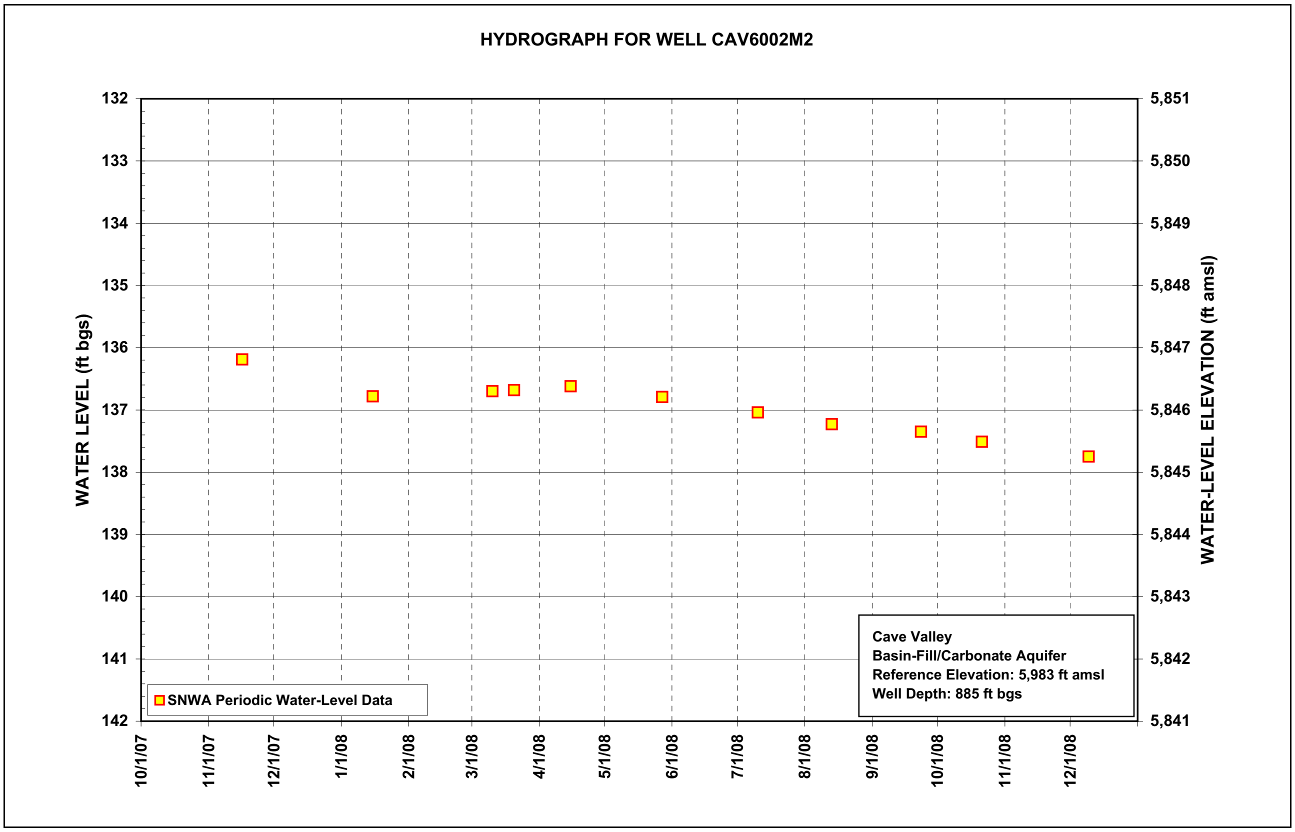
Table C-1
Water-Level Measurements Collected at SNWA Exploratory and Test Wells Not Included in Appendixes A and B

Site Number	Station Local Number	Well Depth (ft bgs)	Surface Elevation (ft amsl)	Water Level			
				Date	Depth to Water (ft bgs)	Well Status[a]	Measurement Method[b]
CAV6002X	CAV6002X	901	5,987.966	11/8/2007	141.18	S	T
				11/21/2007	141.06	S	T
				11/27/2007	142.75	S	T
				1/15/2008	141.92	S	T
				3/10/2008	141.69	S	T
				3/20/2008	141.71	S	T
				4/15/2008	141.92	S	T
				5/27/2008	141.87	S	T
				7/10/2008	142.13	S	T
				8/13/2008	142.31	S	T
				9/23/2008	142.34	S	T
				10/21/2008	142.50	S	S
				12/9/2008	142.68	S	T
CAV6002M2	CAV6002M2	885	5,982.814	11/16/2007	136.19	S	T
				1/15/2008	136.78	S	T
				3/10/2008	136.70	S	T
				3/20/2008	136.68	S	T
				4/15/2008	136.62	S	T
				5/27/2008	136.79	S	T
				7/10/2008	137.04	S	T
				8/13/2008	137.23	S	T
				9/23/2008	137.35	S	T
				10/21/2008	137.51	S	S
				12/9/2008	137.75	S	T

[a] S = Static conditions
[b] T = Electric tape measurement, S = Steel tape measurement
Note: SNWA tape calibration program started in August 2008.



HYDROGRAPH FOR WELL CAV6002X
WATER LEVEL (ft bgs)
WATER-LEVEL ELEVATION (ft amsl)
137
138
139
140
141
142
143
144
145
146
147
5,851
5,850
5,849
5,848
5,847
5,846
5,845
5,844
5,843
5,842
5,841
10/1/07
11/1/07
12/1/07
1/1/08
2/1/08
3/1/08
4/1/08
5/1/08
6/1/08
7/1/08
8/1/08
9/1/08
10/1/08
11/1/08
12/1/08
SNWA Periodic Water-Level Data
Cave Valley
Basin-Fill/Carbonate Aquifer
Reference Elevation: 5,988 ft amsl
Well Depth: 901 ft bgs



HYDROGRAPH FOR WELL CAV6002M2
WATER LEVEL (ft bgs)
WATER-LEVEL ELEVATION (ft amsl)
132
133
134
135
136
137
138
139
140
141
142
5,851
5,850
5,849
5,848
5,847
5,846
5,845
5,844
5,843
5,842
5,841
10/1/07
11/1/07
12/1/07
1/1/08
2/1/08
3/1/08
4/1/08
5/1/08
6/1/08
7/1/08
8/1/08
9/1/08
10/1/08
11/1/08
12/1/08
SNWA Periodic Water-Level Data
Cave Valley
Basin-Fill/Carbonate Aquifer
Reference Elevation: 5,983 ft amsl
Well Depth: 885 ft bgs

Appendix D

USGS Spring Discharge Measurements and Hydrographs

Table D-1
Spring Discharge Measurements
(Page 1 of 16)

Station Name	Primary Name	Date	Discharge (gpm)	Discharge (cfs)	Reported Unit
181 N05 E64 18AA 1 Big Mud Springs	1810501	5/8/2008[a]	2.49	0.0060	cfs
Ash Springs Creek below Highway 93 at Ash Springs, NV	2090501	11/16/1912[b]	8,976.60	20	cfs
		1/1/1931[b]	10,273.72	22.89	cfs
		1/1/1934[b]	8,662.42	19.30	cfs
		1/1/1942[b]	7,001.75	15.60	cfs
		7/4/1943[b]	7,809.64	17.40	cfs
		9/3/1943[b]	8,348.24	18.60	cfs
		6/17/1963	7,630.11	17	cfs
		2/7/1965	7,809.64	17.40	cfs
		10/12/1965	7,719.88	17.20	cfs
		7/30/1982	7,360.81	16.40	cfs
		1/21/1985	7,271.05	16.20	cfs
		1/27/1986	8,886.83	19.80	cfs
		4/16/1987	7,944.29	17.70	cfs
		2/12/1988	7,001.75	15.60	cfs
		2/27/1989	7,989.17	17.80	cfs
		3/14/1990	6,961.35	15.51	cfs
		11/5/1990	7,998.15	17.82	cfs
		3/19/1991	9,999.93	22.28	cfs
		11/4/1991	7,495.46	16.70	cfs
		3/25/1992	7,630.11	17	cfs
		10/14/1992	7,899.41	17.60	cfs
		4/20/1993	7,944.29	17.70	cfs
		10/19/1993	7,405.70	16.50	cfs
		3/29/1994	8,303.36	18.50	cfs
		10/18/1994	7,181.28	16	cfs
		4/16/1997	7,270.00	16.20	cfs
		9/23/1997	7,990.00	17.80	cfs
		4/28/1998	9,201.00	20.50	cfs
		9/22/1998	9,960.00	22.19	cfs
		2/22/1999	7,181.28	16	cfs
		4/14/1999	6,148.97	13.70	cfs
		5/18/1999	6,642.68	14.80	cfs
		6/29/1999	4,982.01	11.10	cfs
		7/12/1999	5,116.66	11.40	cfs
		8/26/1999	7,585.23	16.90	cfs
		10/14/1999	6,687.57	14.90	cfs
		11/16/1999	5,385.96	12	cfs
		1/20/2000	4,937.13	11	cfs
		2/18/2000	6,777.33	15.10	cfs
		3/30/2000	4,474.84	9.97	cfs
		5/17/2000	6,328.50	14.10	cfs
		7/11/2000	7,495.46	16.70	cfs
		8/8/2000	6,777.33	15.10	cfs

Table D-1
Spring Discharge Measurements
(Page 2 of 16)

Station Name	Primary Name	Date	Discharge (gpm)	Discharge (cfs)	Reported Unit
Ash Springs Creek below Highway 93 at Ash Springs, NV (Continued)	2090501	9/14/2000	7,585.23	16.90	cfs
		10/5/2000	7,719.88	17.20	cfs
		1/2/2001	7,719.88	17.20	cfs
		2/16/2001	7,495.46	16.70	cfs
		4/19/2001	7,989.17	17.80	cfs
		6/20/2001	7,091.51	15.80	cfs
		8/2/2001	5,161.55	11.50	cfs
		9/11/2001	7,271.05	16.20	cfs
		10/2/2001	6,911.98	15.40	cfs
		12/4/2001	5,924.56	13.20	cfs
		1/24/2002	4,757.60	10.60	cfs
		4/18/2002	6,463.15	14.40	cfs
		6/4/2002	5,879.67	13.10	cfs
		7/16/2002	6,642.68	14.80	cfs
		9/17/2002	6,552.92	14.60	cfs
		10/17/2002	6,777.33	15.10	cfs
		12/3/2002	6,687.57	14.90	cfs
		2/4/2003	7,091.51	15.80	cfs
		3/17/2003	7,271.05	16.20	cfs
		4/22/2003	7,181.28	16	cfs
		6/26/2003	6,911.98	15.40	cfs
		9/9/2003	6,552.92	14.60	cfs
		10/22/2003	6,777.33	15.10	cfs
		12/3/2003	6,552.92	14.60	cfs
		2/10/2004	7,046.63	15.70	cfs
		5/6/2004	6,552.92	14.60	cfs
		7/29/2004	6,373.39	14.20	cfs
		9/21/2004	6,956.87	15.50	cfs
		10/7/2004	6,867.10	15.30	cfs
		3/17/2005	6,193.85	13.80	cfs
		4/13/2005	5,655.26	12.60	cfs
		6/23/2005	5,161.55	11.50	cfs
		7/18/2005	3,922.77	8.74	cfs
		9/20/2005	6,104.09	13.60	cfs
		10/13/2005	6,418.27	14.30	cfs
		10/24/2005	6,732.45	15	cfs
		11/1/2005	4,802.48	10.70	cfs
		12/6/2005	5,834.79	13	cfs
		1/4/2006	5,700.14	12.70	cfs
		2/22/2006	4,892.25	10.90	cfs
		3/28/2006	4,892.25	10.90	cfs
		6/6/2006	5,430.84	12.10	cfs
		6/26/2006	5,565.49	12.40	cfs
		8/30/2006	6,597.80	14.70	cfs
		10/10/2006	6,418.27	14.30	cfs

Table D-1
Spring Discharge Measurements
(Page 3 of 16)

Station Name	Primary Name	Date	Discharge (gpm)	Discharge (cfs)	Reported Unit
Ash Springs Creek below Highway 93 at Ash Springs, NV (Continued)	2090501	11/9/2006	4,438.93	9.89	cfs
		1/17/2007	9,739.61	21.70	cfs
		3/28/2007	6,508.00	14.50	cfs
		5/10/2007	7,989.00	17.80	cfs
		6/20/2007	8,438.00	18.80	cfs
		8/1/2007	8,797.00	19.60	cfs
		10/3/2007	8,169.00	18.20	cfs
		12/14/2007	6,598.00	14.70	cfs
		4/14/2008	4,345.00	9.68	cfs
		5/14/2008	7,316.00	16.30	cfs
		7/9/2008	7,226.00	16.10	cfs
		8/26/2008	5,476.00	12.20	cfs
		8/26/2008	5,431.00	12.10	cfs
		8/26/2008	5,027.00	11.20	cfs
		10/30/2008	7,361.00	16.40	cfs
		1/5/2009	7,989.00	17.80	cfs
Ash Springs Diversion at Ash Springs, NV	09415639	12/3/2003	642.00	1.43	cfs
		2/10/2004	637.00	1.42	cfs
		5/6/2004	943.00	2.10	cfs
		7/29/2004	570.00	1.27	cfs
		9/21/2004	534.00	1.19	cfs
		10/7/2004	732.00	1.63	cfs
		3/17/2005	1,432.00	3.19	cfs
		4/13/2005	1,786.00	3.98	cfs
		6/23/2005	1,593.00	3.55	cfs
		7/18/2005	2,702.00	6.02	cfs
		7/18/2005	2,998.00	6.68	cfs
		9/20/2005	960.00	2.14	cfs
		10/13/2005	866.00	1.93	cfs
		10/24/2005	1,005.00	2.24	cfs
		11/1/2005	2,841.00	6.33	cfs
		11/1/2005	2,837.00	6.32	cfs
		12/6/2005	1,692.00	3.77	cfs
		1/4/2006	1,468.00	3.27	cfs
		2/22/2006	2,787.00	6.21	cfs
		3/28/2006	2,464.00	5.49	cfs
		6/6/2006	1,822.00	4.06	cfs
		6/26/2006	960.00	2.14	cfs
		8/30/2006	772.00	1.72	cfs
		10/12/2006	1,023.00	2.28	cfs
		11/9/2006	3,658.00	8.15	cfs
		11/9/2006	3,779.00	8.42	cfs
		1/17/2007	1,225.00	2.73	cfs
		3/28/2007	2,186.00	4.87	cfs
		5/10/2007	1,499.00	3.34	cfs

Table D-1
Spring Discharge Measurements
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Station Name	Primary Name	Date	Discharge (gpm)	Discharge (cfs)	Reported Unit
Ash Springs Diversion at Ash Springs, NV (Continued)	09415639	6/20/2007	1,104.00	2.46	cfs
		8/1/2007	1,005.00	2.24	cfs
		10/3/2007	1,010.00	2.25	cfs
		12/14/2007	2,177.00	4.85	cfs
		4/14/2008	2,935.00	6.54	cfs
		5/14/2008	1,463.00	3.26	cfs
		7/9/2008	1,293.00	2.88	cfs
		8/26/2008	1,885.00	4.2	cfs
		10/30/2008	1,611.00	3.59	cfs
		1/5/2009	1,391.00	3.1	cfs
		3/13/2009	422.00	0.94	cfs
		3/13/2009	417.00	0.93	cfs
Cottonwood Spring	2090201	5/24/2004[a]	0.30	0	gpm
Crystal Springs Diversion near Hiko, NV	09415589	5/6/2004	3,344.00	7.45	cfs
		8/5/2004	3,725.00	8.30	cfs
		8/5/2004	3,824.00	8.52	cfs
		3/22/2005	3,986.00	8.88	cfs
		4/25/2006	3,667.00	8.17	cfs
		6/26/2006	3,492.00	7.78	cfs
		6/5/2008	3,411.00	7.60	cfs
		6/5/2008	3,384.00	7.54	cfs
Crystal Springs near Hiko, NV	2090401	11/16/1912[b]	3,141.81	7	cfs
		1/1/1931[b]	2,675.03	5.96	cfs
		1/1/1934[b]	4,470.35	9.96	cfs
		1/1/1941[b]	4,344.67	9.68	cfs
		1/1/1943[b]	4,263.89	9.50	cfs
		6/17/1963[b]	5,300.00	11.84	cfs
		6/17/1963[b]	5,300.00	11.80	cfs
		7/29/1982	5,430.84	12.10	cfs
		1/21/1985	4,937.13	11	cfs
		6/11/1985	1,000.89	2.23[c]	cfs
		6/11/1985	1,445.23	3.22[c]	cfs
		7/26/1985	3,788.13	8.44	cfs
		8/23/1985	4,892.25	10.9[c]	cfs
		8/23/1985	3,509.85	7.82[c]	cfs
		10/14/1985	1,162.47	2.59	cfs
		12/11/1985	4,937.13	11	cfs
		1/27/1986	4,892.25	10.90	cfs
		3/26/1986	4,712.72	10.50	cfs
		7/17/1986	4,488.30	10	cfs
		3/26/1987	960.50	2.14	cfs
		9/11/1987	4,712.72	10.50	cfs
		11/19/1987	5,161.55	11.50	cfs
		5/26/1988	1,283.65	2.86	cfs
		2/28/1989	1,898.55	4.23	cfs

Table D-1
Spring Discharge Measurements
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Station Name	Primary Name	Date	Discharge (gpm)	Discharge (cfs)	Reported Unit
Crystal Springs near Hiko, NV (Continued)	2090401	3/14/1990	1,238.77	2.76	cfs
		3/14/1990	1,243.26	2.77	cfs
		4/19/1990	2,091.55	4.66	cfs
		5/31/1990	1,377.91	3.07	cfs
		7/10/1990	4,847.36	10.80	cfs
		8/16/1990	1,768.39	3.94	cfs
		10/4/1990	5,385.96	12	cfs
		11/5/1990	5,430.84	12.10	cfs
		11/15/1990	4,999.97	11.14	cfs
		12/18/1990	3,675.92	8.19	cfs
		1/29/1991	3,424.57	7.63	cfs
		3/20/1991	4,142.70	9.23	cfs
		4/29/1991	893.17	1.99	cfs
		6/14/1991	736.08	1.64	cfs
		8/1/1991	4,147.19	9.24	cfs
		9/19/1991	3,783.64	8.43	cfs
		10/9/1991	3,590.64	8	cfs
		11/4/1991	3,765.68	8.39	cfs
		12/8/1991	3,792.61	8.45	cfs
		1/13/1992	3,819.54	8.51	cfs
		2/24/1992	3,985.61	8.88	cfs
		3/25/1992	3,841.98	8.56	cfs
		5/18/1992	3,518.83	7.84	cfs
		6/30/1992	3,734.27	8.32	cfs
		8/13/1992	3,738.75	8.33	cfs
		10/5/1992	3,940.73	8.78	cfs
		10/14/1992	4,353.65	9.70	cfs
		11/16/1992	4,048.45	9.02	cfs
		1/7/1993	4,358.14	9.71	cfs
		3/1/1993	3,981.12	8.87	cfs
		4/20/1993	4,129.24	9.20	cfs
		5/25/1993	4,061.91	9.05	cfs
		6/15/1993	4,268.37	9.51	cfs
		7/28/1993	4,075.38	9.08	cfs
		8/31/1993	4,120.26	9.18	cfs
		10/13/1993	2,558.33	5.70	cfs
		10/19/1993	4,937.13	11	cfs
		11/22/1993	5,341.08	11.90	cfs
		11/23/1993	3,967.66	8.84	cfs
		1/5/1994	4,488.30	10	cfs
		2/15/1994	5,430.84	12.10	cfs
		2/15/1994	5,251.31	11.70	cfs
		2/15/1994	5,430.84	12.10	cfs
		3/29/1994	1,840.20	4.10	cfs
		3/29/1994	1,808.78	4.03	cfs

Table D-1
Spring Discharge Measurements
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Station Name	Primary Name	Date	Discharge (gpm)	Discharge (cfs)	Reported Unit
Crystal Springs near Hiko, NV (Continued)	2090401	5/5/1994	5,789.91	12.90	cfs
		6/21/1994	5,206.43	11.60	cfs
		8/2/1994	5,341.08	11.90	cfs
		10/4/1994	5,430.84	12.10	cfs
		10/18/1994	4,488.30	10	cfs
		10/18/1994	4,667.83	10.40	cfs
		12/13/1994	5,385.96	12	cfs
		4/16/1997	4,980.00	11.10	cfs
		9/23/1997	5,430.00	12.10	cfs
		4/29/1998	5,790.00	12.90	cfs
		9/22/1998	5,834.79	13	cfs
		9/22/1998	5,830.00	12.99	cfs
		9/22/1998	5,834.79	13	cfs
		1/14/1999	4,937.13	11	cfs
		1/14/1999	4,667.83	10.40	cfs
		2/22/1999	1,386.88	3.09	cfs
		4/14/1999	5,071.78	11.30	cfs
		5/18/1999	5,385.96	12	cfs
		6/29/1999	5,251.31	11.70	cfs
		7/12/1999	5,385.96	12	cfs
		8/26/1999	5,520.61	12.30	cfs
		10/14/1999	5,700.14	12.70	cfs
		11/17/1999	5,341.08	11.90	cfs
		1/18/2000	5,251.31	11.70	cfs
		2/18/2000	5,700.14	12.70	cfs
		3/30/2000	4,578.07	10.20	cfs
		4/3/2000	2,015.25	4.49	cfs
		5/17/2000	5,789.91	12.90	cfs
		6/20/2000	1,638.23	3.65	cfs
		8/8/2000	5,655.26	12.60	cfs
		9/14/2000	1,579.88	3.52	cfs
		10/5/2000	5,834.79	13	cfs
		1/2/2001	5,789.91	12.90	cfs
		2/16/2001	5,655.26	12.60	cfs
		4/19/2001	5,924.56	13.20	cfs
		6/20/2001	1,943.43	4.33	cfs
		8/2/2001	5,834.79	13	cfs
		9/11/2001	5,430.84	12.10	cfs
		10/2/2001	5,430.84	12.10	cfs
		12/4/2001	6,283.62	14	cfs
		1/23/2002	5,924.56	13.20	cfs
		4/18/2002	5,789.91	12.90	cfs
		6/4/2002	2,100.52	4.68	cfs
		7/16/2002	5,655.26	12.60	cfs
		9/17/2002	5,834.79	13	cfs

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Spring Discharge Measurements
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Station Name	Primary Name	Date	Discharge (gpm)	Discharge (cfs)	Reported Unit
Crystal Springs near Hiko, NV (Continued)	2090401	10/17/2002	5,520.61	12.30	cfs
		12/3/2002	5,655.26	12.60	cfs
		2/4/2003	5,700.14	12.70	cfs
		3/17/2003	2,769.28	6.17	cfs
		4/22/2003	5,700.14	12.70	cfs
		4/22/2003	5,789.91	12.90	cfs
		6/26/2003	1,499.09	3.34	cfs
		9/9/2003	5,655.26	12.60	cfs
		10/22/2003	5,655.26	12.60	cfs
		12/3/2003	5,610.38	12.50	cfs
		2/10/2004	5,834.79	13	cfs
		8/5/2005	3,725.29	8.30	cfs
		3/22/2006	3,985.61	8.88	cfs
		4/25/2006	3,666.94	8.17	cfs
		5/6/2006	3,343.78	7.45	cfs
		6/26/2006	3,491.90	7.78	cfs
		9/12/2006	5,700.00	12.70	cfs
		10/12/2006	5,745.00	12.80	cfs
		10/25/2006	5,476.00	12.20	cfs
		11/8/2006	5,521.00	12.30	cfs
		11/15/2006	5,700.00	12.70	cfs
		1/17/2007	5,476.00	12.20	cfs
		3/28/2007	6,418.00	14.30	cfs
		6/20/2007	5,880.00	13.10	cfs
		8/1/2007	5,835.00	13	cfs
		10/3/2007	5,790.00	12.90	cfs
		12/14/2007	5,969.00	13.30	cfs
		4/15/2008	6,149.00	13.70	cfs
		5/14/2008	6,059.00	13.50	cfs
		6/5/2008	1,073.00	2.39	cfs
		6/5/2008	1,118.00	2.49	cfs
		6/5/2008	1,095.00	2.44	cfs
		7/9/2008	5,880.00	13.10	cfs
		8/26/2008	5,745.00	12.80	cfs
		10/30/2008	5,610.00	12.50	cfs
		1/5/2009	5,700.00	12.70	cfs
Flag Spring 1	2071303	7/25/1982	1,005.38	2.24	cfs
		1/16/1985	1,059.24	2.36	cfs
		2/4/1986	857.27	1.91	cfs
		2/11/1987	1,041.29	2.32	cfs
		2/23/1988	902.15	2.01	cfs
		3/14/1989	1,400.00	3.119	gpm
		3/14/1989	1,400.35	3.12	cfs
		3/22/1990	700.00	1.56	gpm
		3/22/1990	691.20	1.54	cfs

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Spring Discharge Measurements
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Station Name	Primary Name	Date	Discharge (gpm)	Discharge (cfs)	Reported Unit
Flag Spring 1 (Continued)	2071303	11/9/1990	1,000.00	2.2280	gpm
		11/9/1990	1,000.89	2.23	cfs
		3/4/1991	1,300.00	2.8960	gpm
		3/4/1991	1,301.61	2.90	cfs
		10/23/1991	900.00	2.0050	gpm
		10/23/1991	906.64	2.02	cfs
		3/18/1992	1,000.00	2.2280	gpm
		3/18/1992	996.40	2.22	cfs
		10/14/1992	900.00	2.0050	gpm
		10/14/1992	897.66	2	cfs
		5/3/1993	900.00	2.0050	gpm
		5/3/1993	897.66	2	cfs
		10/19/1993	1,100.00	2.4510	gpm
		10/19/1993	1,077.19	2.40	cfs
		3/29/1994	900.00	2.0050	gpm
		3/29/1994	942.54	2.10	cfs
		10/19/1994	800.00	1.7820	gpm
		10/19/1994	852.78	1.90	cfs
		4/17/1997	1,070.00	2.3840	gpm
		4/17/1997	1,070.00	2.38	cfs
		9/25/1997	1,090.00	2.4290	gpm
		9/25/1997	1,090.00	2.43	cfs
		4/29/1998	952.00	2.1210	gpm
		4/29/1998	952.00	2.12	cfs
		9/23/1998	1,570.00	3.4980	gpm
		9/23/1998	1,570.00	3.50	cfs
		4/8/1999	956.00	2.13	gpm
		4/8/1999	956.00	2.13	cfs
		9/15/1999	1,010.00	2.25	gpm
		9/15/1999	1,010.00	2.25	cfs
		4/4/2000	1,160.00	2.5840	gpm
		4/4/2000	1,160.00	2.58	cfs
		9/14/2000	1,180.00	2.629	gpm
		9/14/2000	1,180.00	2.63	cfs
		4/17/2001	826.00	1.84	gpm
		4/17/2001	826.00	1.84	cfs
		9/13/2001	1,080.00	2.4060	gpm
		9/13/2001	1,080.00	2.41	cfs
		4/16/2002	960.00	2.1390	gpm
		4/16/2002	960.00	2.14	cfs
		4/16/2002	970.00	2.161	gpm
		4/16/2002	970.00	2.16	cfs
		9/19/2002	1,390.00	3.0970	gpm
		9/19/2002	1,390.00	3.10	cfs
		4/24/2003	871.00	1.9410	gpm

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Spring Discharge Measurements
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Station Name	Primary Name	Date	Discharge (gpm)	Discharge (cfs)	Reported Unit
Flag Spring 1 (Continued)	2071303	4/24/2003	871.00	1.94	cfs
		9/11/2003	915.00	2.0390	gpm
		9/11/2003	915.00	2.04	cfs
		4/23/2004	950.00	2.1170	gpm
		4/23/2004	950.00	2.12	cfs
		9/24/2004	950.00	2.12	gpm
		6/30/2005	964.98	2.15	cfs
		9/22/2005	906.64	2.02	cfs
		4/28/2006	1,077.00	2.4	cfs
		5/17/2007	1,257.00	2.8	cfs
		9/27/2007	1,046.00	2.33	cfs
		5/22/2008	1,266.00	2.82	cfs
		5/22/2008	1,248.00	2.78	cfs
		9/11/2008	1,338.00	2.98	cfs
		9/11/2008	1,284.00	2.86	cfs
Flag Spring 2	2071302	7/24/1982	1,153.49	2.57	cfs
		1/16/1985	1,283.65	2.86	cfs
		2/4/1986	1,202.86	2.68	cfs
		2/11/1987	1,584.37	3.53	cfs
		2/11/1987	1,200.00	2.6740	gpm
		2/23/1988	1,597.83	3.56	cfs
		3/14/1989	1,300.00	2.8960	gpm
		3/14/1989	1,301.61	2.90	cfs
		3/22/1990	220.00	0.49	gpm
		3/22/1990	219.93	0.49	cfs
		11/8/1990	1,000.00	2.2280	gpm
		11/8/1990	1,000.89	2.23	cfs
		3/4/1991	1,000.00	2.2280	gpm
		3/4/1991	1,000.89	2.23	cfs
		10/23/1991	1,300.00	2.8960	gpm
		10/23/1991	1,256.72	2.80	cfs
		3/18/1992	1,300.00	2.8960	gpm
		3/18/1992	1,333.03	2.97	cfs
		10/14/1992	1,300.00	2.8960	gpm
		10/14/1992	1,301.61	2.90	cfs
		5/3/1993	1,436.26	3.20	cfs
		5/3/1993	1,500.00	3.3420	gpm
		10/19/1993	1,300.00	2.8960	gpm
		10/19/1993	1,301.61	2.90	cfs
		3/29/1994	1,400.00	3.1190	gpm
		3/29/1994	1,391.37	3.10	cfs
		10/19/1994	1,300.00	2.8960	gpm
		10/19/1994	1,301.61	2.90	cfs
		4/17/1997	1,460.00	3.2530	gpm
		4/17/1997	1,460.00	3.25	cfs

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Spring Discharge Measurements
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Station Name	Primary Name	Date	Discharge (gpm)	Discharge (cfs)	Reported Unit
Flag Spring 2 (Continued)	2071302	9/29/1997	1,440.00	3.2080	gpm
		9/29/1997	1,440.00	3.21	cfs
		4/29/1998	1,570.00	3.4980	gpm
		4/29/1998	1,570.00	3.5	cfs
		9/23/1998	1,020.00	2.2730	gpm
		9/23/1998	1,020.00	2.27	cfs
		4/8/1999	1,280.00	2.8520	gpm
		4/8/1999	1,280.00	2.85	cfs
		9/13/1999	1,430.00	3.1860	gpm
		9/13/1999	1,430.00	3.19	cfs
		4/4/2000	1,400.00	3.1190	gpm
		4/4/2000	1,400.00	3.12	cfs
		9/14/2000	1,520.00	3.3870	gpm
		9/14/2000	1,520.00	3.39	cfs
		4/17/2001	1,440.00	3.2080	gpm
		4/17/2001	1,440.00	3.21	cfs
		9/13/2001	1,380.00	3.0750	gpm
		9/13/2001	1,380.00	3.07	cfs
		4/16/2002	1,390.00	3.0970	gpm
		4/16/2002	1,390.00	3.10	cfs
		9/16/2002	1,250.00	2.7850	gpm
		9/16/2002	1,250.00	2.79	cfs
		4/24/2003	1,380.00	3.0750	gpm
		4/24/2003	1,380.00	3.07	cfs
		9/11/2003	1,320.00	2.9410	gpm
		9/11/2003	1,320.00	2.94	cfs
		4/23/2004	1,095.00	2.44	gpm
		4/23/2004	1,095.00	2.44	cfs
		9/24/2004	1,400.00	3.1190	gpm
		6/30/2005	1,211.84	2.70	cfs
		9/22/2005	1,202.86	2.68	cfs
		4/28/2006	1,189.00	2.65	cfs
		5/17/2007	1,436.00	3.20	cfs
		9/27/2007	1,346.00	3	cfs
		5/22/2008	1,355.00	3.02	cfs
		5/22/2008	1,364.00	3.04	cfs
		9/11/2008	1,279.00	2.85	cfs
		9/11/2008	1,311.00	2.92	cfs
Flag Spring 3	2071301	1/1/1949[b]	1,122.00	2.50	cfs
		7/24/1982	1,045.77	2.33	cfs
		1/16/1985	982.94	2.19	cfs
		2/4/1986	758.52	1.69	cfs
		2/11/1987	906.64	2.02	cfs
		2/23/1988	902.15	2.01	cfs
		3/14/1989	900.00	2.0050	gpm

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Spring Discharge Measurements
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Station Name	Primary Name	Date	Discharge (gpm)	Discharge (cfs)	Reported Unit
Flag Spring 3 (Continued)	2071301	3/14/1989	902.15	2.01	cfs
		3/22/1990	900.00	2.0050	gpm
		3/22/1990	938.05	2.09	cfs
		11/8/1990	800.00	1.7820	gpm
		11/8/1990	798.92	1.78	cfs
		3/4/1991	900.00	2.0050	gpm
		3/4/1991	902.15	2.01	cfs
		10/23/1991	900.00	2.0050	gpm
		10/23/1991	852.78	1.90	cfs
		3/18/1992	800.00	1.7820	gpm
		3/18/1992	754.03	1.68	cfs
		10/14/1992	700.00	1.56	gpm
		10/14/1992	718.13	1.60	cfs
		5/3/1993	800.00	1.7820	gpm
		5/3/1993	807.89	1.80	cfs
		10/19/1993	500.00	1.1140	gpm
		10/19/1993	538.60	1.20	cfs
		3/29/1994	700.00	1.56	gpm
		3/29/1994	673.25	1.50	cfs
		10/19/1994	800.00	1.7820	gpm
		10/19/1994	763.01	1.70	cfs
		4/17/1997	1,460.00	3.2530	gpm
		4/17/1997	1,460.00	3.25	cfs
		5/21/1997	978.00	2.1790	gpm
		5/21/1997	978.00	2.18	cfs
		9/29/1997	1,020.00	2.2730	gpm
		9/29/1997	1,020.00	2.27	cfs
		4/29/1998	1,140.00	2.54	cfs
		4/29/1998	1,140.00	2.54	gpm
		9/23/1998	1,260.00	2.8070	gpm
		9/23/1998	1,260.00	2.81	cfs
		4/8/1999	754.00	1.68	gpm
		4/8/1999	754.00	1.68	cfs
		9/13/1999	1,180.00	2.6290	gpm
		9/13/1999	1,180.00	2.63	cfs
		4/4/2000	1,180.00	2.6290	gpm
		4/4/2000	1,180.00	2.63	cfs
		9/14/2000	1,640.00	3.6540	gpm
		9/14/2000	1,640.00	3.65	cfs
		4/17/2001	1,000.00	2.2280	gpm
		4/17/2001	1,000.00	2.23	cfs
		9/13/2001	1,320.00	2.9410	gpm
		9/13/2001	1,320.00	2.94	cfs
		4/16/2002	1,000.00	2.23	cfs
		4/16/2002	1,000.00	2.2280	gpm

Table D-1
Spring Discharge Measurements
(Page 12 of 16)

Station Name	Primary Name	Date	Discharge (gpm)	Discharge (cfs)	Reported Unit
Flag Spring 3 (Continued)	2071301	5/30/2002	890.00	1.9830	gpm
		5/30/2002	890.00	1.98	cfs
		9/19/2002	1,300.00	2.8960	gpm
		9/19/2002	1,300.00	2.90	cfs
		4/24/2003	930.00	2.07	cfs
		4/24/2003	930.00	2.0720	gpm
		9/11/2003	800.00	1.78	cfs
		9/11/2003	800.00	1.7820	gpm
		4/23/2004	825.00	1.84	cfs
		4/23/2004	825.00	1.8380	gpm
		9/11/2004	810.00	1.80	gpm
		9/24/2004	785.00	1.75	gpm
		6/30/2005	1,108.61	2.47	cfs
		9/22/2005	1,072.71	2.39	cfs
		4/28/2006	983.00	2.19	cfs
		5/17/2007	1,122.00	2.50	cfs
		9/27/2007	1,346.00	3	cfs
		5/22/2008	1,001.00	2.23	cfs
		5/22/2008	987.00	2.20	cfs
		9/11/2008	978.00	2.18	cfs
		9/11/2008	983.00	2.19	cfs
Hardy Springs NW	2071502	9/14/2004[a]	4.90	0.0110	cfs
Hardy Springs	2071501	11/14/1966[b]	200.00	0.45	gpm
		9/14/2004[a]	199.70	0.4450	cfs
Hiko Spring	2090101	11/15/1912[b]	4,039.47	9	cfs
		1/1/1931[b]	5,368.01	11.96	cfs
		1/1/1934[b]	2,948.81	6.57	cfs
		1/1/1941[b]	2,926.37	6.52	cfs
		1/1/1943[b]	2,872.51	6.40	cfs
		6/15/1963	2,405.73	5.36	cfs
		2/7/1965	2,877.00	6.41	cfs
		5/19/1965	2,885.98	6.43	cfs
		7/13/1965	2,953.30	6.58	cfs
		10/12/1965	2,832.12	6.31	cfs
		7/29/1982	2,935.35	6.54	cfs
		1/21/1985	3,034.09	6.76	cfs
		1/28/1986	2,728.89	6.08	cfs
		3/25/1987	2,589.75	5.77	cfs
		2/12/1988	2,800.70	6.24	cfs
		3/14/1990	1,929.97	4.30	cfs
		3/14/1990	1,900.00	4.2330	gpm
		11/5/1990	2,998.18	6.68	cfs
		11/5/1990	3,000.00	6.6840	gpm
		4/3/1991	2,199.27	4.9	cfs
		4/3/1991	2,200.00	4.9020	gpm

Table D-1
Spring Discharge Measurements
(Page 13 of 16)

Station Name	Primary Name	Date	Discharge (gpm)	Discharge (cfs)	Reported Unit
Hiko Spring (Continued)	2090101	11/4/1991	1,903.04	4.24	cfs
		11/4/1991	1,900.00	4.2330	gpm
		3/25/1992	2,369.82	5.28	cfs
		3/25/1992	2,400.00	5.3470	gpm
		10/14/1992	2,872.51	6.40	cfs
		10/14/1992	2,900.00	6.4610	gpm
		4/20/1993	1,974.85	4.40	cfs
		4/20/1993	2,000.00	4.4560	gpm
		10/19/1993	1,795.32	4	cfs
		10/19/1993	1,800.00	4.01	gpm
		3/29/1994	2,064.62	4.60	cfs
		3/29/1994	2,000.00	4.4560	gpm
		10/18/1994	2,692.98	6	cfs
		10/18/1994	2,700.00	6.0160	gpm
		4/16/1997	2,150.00	4.79	gpm
		9/23/1997	2,730.00	6.08	gpm
		9/23/1997	2,730.00	6.0820	gpm
		5/4/1998	2,244.00	5	cfs
		7/19/2004[a]	2,693.00	6	cfs
Hot Creek Spring near Sunnyside, NV	2070501	4/6/1935[b]	6,885.00	15.34	cfs
		12/7/1961	6,000.00	13.37	cfs
		12/7/1961	6,000.00	13.3680	gpm
		7/23/1982	6,000.00	13.37	cfs
		7/26/1982	4,847.36	10.80	cfs
		1/16/1985	4,142.70	9.23	cfs
		1/16/1985	4,100.00	9.1350	gpm
		2/1/1985	11,000.00	24.51	cfs
		2/1/1985	11,000.00	24.5080	gpm
		2/3/1986	4,142.70	9.23	cfs
		2/3/1986	4,100.00	9.1350	gpm
		2/11/1987	6,328.50	14.10	cfs
		2/11/1987	6,000.00	13.3680	gpm
		8/12/1987	3,518.83	7.84	cfs
		8/12/1987	3,500.00	7.7980	gpm
		2/23/1988	7,001.75	15.60	cfs
		2/23/1988	7,000.00	15.5960	gpm
		3/14/1989	3,999.08	8.91	cfs
		3/14/1989	4,000.00	8.9120	gpm
		3/23/1990	6,400.32	14.26	cfs
		3/23/1990	6,000.00	13.3680	gpm
		11/8/1990	5,000.00	11.14	cfs
		11/8/1990	5,000.00	11.14	gpm
		3/4/1991	6,000.86	13.37	cfs
		3/4/1991	6,000.00	13.3680	gpm
		10/23/1991	2,782.75	6.20	cfs

Table D-1
Spring Discharge Measurements
(Page 14 of 16)

Station Name	Primary Name	Date	Discharge (gpm)	Discharge (cfs)	Reported Unit
Hot Creek Spring near Sunnyside, NV (Continued)	2070501	10/23/1991	2,700.00	6.0160	gpm
		3/18/1992	4,196.56	9.35	cfs
		3/18/1992	4,200.00	9.3580	gpm
		10/14/1992	4,084.35	9.10	cfs
		10/14/1992	4,100.00	9.1350	gpm
		5/3/1993	3,949.70	8.80	cfs
		5/3/1993	3,900.00	8.6890	gpm
		10/19/1993	494.00	1.10	cfs
		10/19/1993	494.00	1.1010	gpm
		3/29/1994	1,256.72	2.80	cfs
		3/29/1994	1,300.00	2.8960	gpm
		10/19/1994	5,385.96	12	cfs
		10/19/1994	5,000.00	11.14	gpm
		4/17/1997	6,330.00	14.10	cfs
		4/17/1997	6,330.00	14.1030	gpm
		9/25/1997	5,430.00	12.10	cfs
		9/25/1997	5,430.00	12.0980	gpm
		4/29/1998	4,578.00	10.25[c]	cfs
		4/29/1998	9,200.00[c]	20.4980	gpm
		9/22/1998	4,670.00	10.40	cfs
		9/22/1998	4,670.00	10.4050	gpm
		4/7/1999	4,760.00	10.61	cfs
		4/7/1999	4,760.00	10.6050	gpm
		9/13/1999	6,910.00	15.40	cfs
		9/13/1999	6,910.00	15.3960	gpm
		4/20/2000	3,480.00	7.75	cfs
		4/20/2000	3,480.00	7.7530	gpm
		9/14/2000	3,520.00	7.84	cfs
		9/14/2000	3,520.00	7.8430	gpm
		4/17/2001	4,850.00	10.81	cfs
		4/17/2001	4,850.00	10.8060	gpm
		9/13/2001	4,800.00	10.69	cfs
		9/13/2001	4,800.00	10.6940	gpm
		4/16/2002	4,940.00	11.01	cfs
		4/16/2002	4,940.00	11.0060	gpm
		9/17/2002	4,940.00	11.01	cfs
		9/17/2002	4,940.00	11.0060	gpm
		4/24/2003	4,420.00	9.85	cfs
		4/24/2003	4,420.00	9.848	gpm
		8/5/2003[a]	6,150.00	13.70	cfs
		9/11/2003	4,760.00	10.61	cfs
		9/11/2003	4,760.00	10.6050	gpm
		4/23/2004	4,670.00	10.40	cfs
		4/23/2004	4,670.00	10.405	gpm
		9/24/2004	4,580.00	10.20	gpm

Table D-1
Spring Discharge Measurements
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Station Name	Primary Name	Date	Discharge (gpm)	Discharge (cfs)	Reported Unit
Hot Creek Spring near Sunnyside, NV (Continued)	2070501	6/30/2005	4,245.93	9.46	cfs
		9/22/2005	4,847.36	10.80	cfs
		4/28/2006	6,283.00	14	cfs
		8/2/2006	6,418.00	14.30	cfs
		8/15/2006	6,104.00	13.60	cfs
		9/14/2006	6,283.00	14	cfs
Moorman Spring	2071101	6/15/1935[b]	100.00	0.22	gpm
		11/15/1966	225.00	0.5020	gpm
		7/23/1982	264.81	0.59	cfs
		1/17/1985	255.83	0.57	cfs
		2/1/1986	240.00	0.53	cfs
		2/1/1986	240.00	0.5350	gpm
		2/11/1987	273.79	0.61	cfs
		2/11/1987	270.00	0.6020	gpm
		2/23/1988	251.34	0.56	cfs
		2/23/1988	250.00	0.5570	gpm
		3/14/1989	300.72	0.67	cfs
		3/14/1989	300.00	0.6680	gpm
		3/22/1990	228.90	0.51	cfs
		3/22/1990	230.00	0.5120	gpm
		11/8/1990	300.72	0.67	cfs
		11/8/1990	300.00	0.6680	gpm
		3/5/1991	309.69	0.69	cfs
		3/5/1991	310.00	0.6910	gpm
		10/24/1991	201.97	0.45	cfs
		10/24/1991	200.00	0.4460	gpm
		3/19/1992	260.32	0.58	cfs
		3/19/1992	260.00	0.5790	gpm
		10/15/1992	193.00	0.43	cfs
		10/15/1992	190.00	0.4230	gpm
		5/4/1993	170.56	0.38	cfs
		5/4/1993	170.00	0.379	gpm
		10/19/1993	193.00	0.43	cfs
		10/19/1993	190.00	0.423	gpm
		3/29/1994	206.46	0.46	cfs
		3/29/1994	210.00	0.4680	gpm
		10/19/1994	210.95	0.47	cfs
		10/19/1994	210.00	0.4680	gpm
		4/17/1997	170.00	0.38	cfs
		4/17/1997	170.00	0.3790	gpm
		9/24/1997	234.00	0.52	cfs
		9/24/1997	234.00	0.5210	gpm
		4/29/1998	255.00	0.57	cfs
		4/29/1998	255.00	0.5680	gpm
		4/8/1999	248.00	0.55	cfs

Table D-1
Spring Discharge Measurements
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Station Name	Primary Name	Date	Discharge (gpm)	Discharge (cfs)	Reported Unit
Moorman Spring (Continued)	2071101	4/8/1999	248.00	0.553	gpm
		9/15/1999	175.00	0.39	cfs
		9/15/1999	175.00	0.39	gpm
		4/20/2000	230.00	0.51	cfs
		4/20/2000	230.00	0.5120	gpm
		9/13/2000	222.00	0.49	cfs
		9/13/2000	222.00	0.4950	gpm
		4/17/2001	207.00	0.46	cfs
		4/17/2001	207.00	0.4610	gpm
		9/13/2001	156.00	0.35	cfs
		9/13/2001	156.00	0.3480	gpm
		4/18/2002	221.00	0.49	cfs
		4/18/2002	221.00	0.4920	gpm
		4/24/2003	211.00	0.47	cfs
		4/24/2003	211.00	0.47	gpm
		9/10/2003	220.00	0.49	cfs
		9/10/2003	220.00	0.49	gpm
		4/22/2004	260.00	0.58	cfs
		4/22/2004	260.00	0.5790	gpm
		6/23/2004[a]	231.00	0.5130	cfs
		9/22/2004	211.00	0.47	gpm
		6/30/2005	191.65	0.4270	cfs
		9/21/2005	188.51	0.42	cfs
		4/27/2006	238.00	0.53	cfs
		9/13/2006	206.00	0.46	cfs
		5/17/2007	224.00	0.50	cfs
		5/17/2007	215.00	0.48	cfs
		9/27/2007	157.00	0.35	cfs
		9/27/2007	144.00	0.32	cfs
		5/22/2008	148.00	0.33	cfs
		5/22/2008	148.00	0.33	cfs
		9/11/2008	148.00	0.33	cfs
		9/11/2008	139.00	0.31	cfs
Maynard Spring	2090801	7/16/1993	180.00	0.40	cfs

Note: USGS is the owner agency for the data presented unless otherwise specified.
[a]Collected and owned by SNWA.
[b]Collection owner agency unknown.
[c]Measurement error suspected.

Appendix E

2008 Regional and High-Altitude Precipitation Data

Table E-1
2008 Regional Precipitation Data
(Page 1 of 3)

Station Name	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Period of Record Statistics (1978 to Present)													
Blue Eagle Ranch Hanks, NV													
Mean	0.71	0.69	0.88	0.92	0.97	0.40	0.50	0.73	0.73	0.89	0.70	0.45	8.58
S.D.	0.43	0.44	0.65	0.76	0.94	0.47	0.61	0.83	0.92	0.92	0.62	0.44	3.01
Skew	0.61	1.23	0.59	0.73	0.96	1.14	2.28	2.18	2.04	1.87	0.96	1.20	0.72
Max	1.66	1.97	2.43	2.93	3.43	1.52	2.94	3.92	3.95	4.23	2.53	1.54	15.11
Min	0.12	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.41
No. Yrs	30	30	31	30	31	31	31	31	30	31	30	31	26
Period of Record Statistics (1903 to Present)													
Caliente, NV													
Mean	0.82	0.94	1.01	0.70	0.52	0.33	0.78	0.89	0.63	0.79	0.69	0.66	8.67
S.D.	0.79	0.88	0.98	0.74	0.52	0.45	0.84	0.89	0.75	1.00	0.75	0.64	3.23
Skew	1.27	1.54	1.27	1.71	1.15	1.64	2.35	1.22	1.58	2.24	1.46	1.68	0.34
Max	3.47	3.98	4.59	3.71	2.27	1.95	5.36	4.18	3.14	5.12	3.38	3.76	18.73
Min	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.84
No. Yrs	86	87	84	85	83	83	83	85	86	84	85	86	66
Period of Record Statistics (1951 to Present)													
Elgin, NV													
Mean	1.60	2.01	1.59	1.03	0.44	0.32	0.81	0.91	0.69	0.94	0.90	0.87	12.41
S.D.	1.88	2.01	1.62	0.97	0.46	0.37	1.33	1.10	0.94	1.19	1.13	0.97	5.94
Skew	1.56	1.39	1.36	0.63	0.97	0.90	2.98	2.42	1.52	2.08	1.99	1.12	0.54
Max	6.49	8.01	6.28	3.09	1.54	1.16	6.06	5.07	3.22	5.18	4.63	3.28	24.98
Min	0.00	0.04	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.72
No. Yrs	21	23	24	24	24	23	22	25	25	24	24	21	18
Period of Record Statistics (1893 to Present)													
Ely WBO, NV													
Mean	0.77	0.78	1.02	1.01	1.10	0.65	0.62	0.81	0.76	0.80	0.68	0.65	9.54
S.D.	0.56	0.64	0.75	0.83	0.90	0.74	0.55	0.73	0.83	0.66	0.53	0.56	2.88
Skew	0.95	1.77	1.38	2.26	1.02	1.78	1.03	1.07	2.34	1.52	0.93	1.59	0.34
Max	2.5	3.75	4.3	5.52	3.55	3.53	2.3	3	4.99	3.67	2.4	3.15	16.16
Min	0	0.01	0.03	0	0	0	0	0	0	0	0	0	4.22
No. Yrs	87	87	87	86	86	84	85	87	86	85	84	84	77

Table E-1
2008 Regional Precipitation Data
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Station Name	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Period of Record Statistics (1948 to Present)													
Great Basin National Park, NV													
Mean	1.05	1.15	1.40	1.16	1.24	0.90	0.95	1.19	1.09	1.22	0.98	0.91	13.21
S.D.	0.90	0.83	1.00	0.85	0.99	0.90	0.78	0.92	1.03	0.98	0.85	0.81	3.10
Skew	1.20	0.86	1.17	0.66	1.18	1.44	1.15	1.54	2.17	1.48	0.89	1.45	0.08
Max	3.78	3.59	4.96	3.02	4.74	3.73	3.9	5.1	6.02	5.22	3.4	3.45	21.2
Min	0.03	0.09	0	0.03	0	0	0.01	0.02	0	0	0	0	7.37
No. Yrs	58	58	58	59	59	57	60	59	60	60	59	58	53
Period of Record Statistics (1989 to Present)													
Hiko, NV													
Mean	0.78	1.16	0.71	0.58	0.42	0.38	0.38	0.49	0.45	0.63	0.47	0.56	7.21
S.D.	0.81	1.15	0.79	0.51	0.44	0.47	0.47	0.57	0.65	0.86	0.52	0.56	3.13
Skew	1.46	1.05	1.54	0.36	1.40	1.44	1.46	2.48	1.79	1.95	1.19	1.09	0.62
Max	2.94	4.13	3.07	1.56	1.69	1.66	1.65	2.52	2.43	3.38	1.91	2.07	13.68
Min	0.05	0	0	0	0	0	0	0	0	0	0	0	1.45
No. Yrs	19	20	20	19	19	19	19	19	20	19	20	20	17
Period of Record Statistics (1957 to Present)													
Lund, NV													
Mean	0.79	0.86	1.03	0.98	0.94	0.85	0.66	0.90	0.79	0.88	0.70	0.69	10.08
S.D.	0.64	0.58	0.86	0.77	0.87	1.03	0.71	0.91	0.87	0.81	0.62	0.59	2.98
Skew	0.94	0.36	0.99	0.98	1.35	2.10	1.43	2.00	2.40	1.46	1.29	1.24	0.75
Max	2.78	2.22	3.44	3.44	3.45	5.37	3.05	4.58	5.01	3.66	2.62	2.69	18.83
Min	0.01	0	0	0	0.02	0	0	0	0	0	0	0	4.99
No. Yrs	51	51	50	51	51	51	50	50	51	51	52	51	42
Period of Record Statistics (1892 to Present)													
McGill, NV													
Mean	0.63	0.65	0.75	0.93	1.02	0.76	0.68	0.77	0.67	0.79	0.56	0.56	8.81
S.D.	0.62	0.50	0.54	0.64	0.84	0.87	0.62	0.66	0.79	0.64	0.46	0.49	2.51
Skew	3.09	1.21	1.18	0.84	1.04	1.77	1.21	1.23	2.87	1.00	1.09	1.16	0.53
Max	4.58	2.38	2.54	3.19	3.33	4.3	3.03	3.25	5.57	3.38	1.9	2.1	16.21
Min	0	0.01	0	0.01	0	0	0	0	0	0	0	0	3.76
No. Yrs	100	101	102	102	100	101	100	99	99	97	100	101	88

Table E-1
2008 Regional Precipitation Data
(Page 3 of 3)

Station Name	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Period of Record Statistics (1964 to Present)													
Pahranagat Wildlife Refuge, NV													
Mean	0.66	0.76	0.74	0.62	0.39	0.20	0.48	0.61	0.38	0.52	0.50	0.39	6.52
S.D.	0.72	0.94	0.84	0.81	0.39	0.30	0.91	0.74	0.55	0.70	0.55	0.44	2.22
Skew	1.42	1.38	1.32	2.23	1.04	1.62	3.23	1.94	1.75	1.85	1.42	1.41	0.20
Max	3.13	3.22	3.03	4.04	1.59	1.2	4.22	3.6	2.3	3.18	2.48	1.74	11.54
Min	0	0	0	0	0	0	0	0	0	0	0	0	2.23
No. Yrs	39	41	43	41	41	43	43	41	44	43	42	40	28
Period of Record Statistics (1958 to Present)													
Ruth, NV													
Mean	0.94	1.08	0.97	1.30	1.25	1.12	0.82	0.96	0.84	0.98	0.79	0.91	12.01
S.D.	0.65	1.06	0.81	1.03	1.02	1.11	0.69	0.68	0.82	0.69	0.70	0.74	3.13
Skew	1.04	1.62	1.60	1.13	1.33	1.77	0.91	0.67	1.37	0.28	1.22	0.75	0.24
Max	2.9	4.58	4	4.58	4.31	4.94	2.61	2.56	3.35	2.35	3.01	3.02	19.46
Min	0.2	0	0	0.08	0.03	0	0	0.01	0	0	0	0	6.68
No. Yrs	40	38	40	41	40	41	41	39	40	38	39	39	31
Period of Record Statistics (1891 to Present)													
Sunnyside, NV													
Mean	0.68	0.81	1.03	0.80	0.84	0.48	0.76	0.84	0.85	0.92	0.58	0.66	9.41
S.D.	0.53	0.75	0.98	0.79	0.75	0.66	0.88	0.77	0.90	0.92	0.73	0.66	2.98
Skew	1.33	1.76	1.55	1.03	1.09	1.83	1.92	1.65	1.46	1.16	2.90	1.62	0.84
Max	2.64	3.55	4.82	2.81	3.23	2.79	4.37	3.89	3.69	3.76	4.19	2.8	17.11
Min	0	0	0	0	0	0	0	0	0	0	0	0	5.73
No. Yrs	48	48	48	49	48	50	52	49	48	48	46	43	28
Period of Record Statistics (1974 to Present)													
Spring Valley State Park, NV													
Mean	0.88	1.21	1.36	0.96	1.11	0.44	0.94	1.32	1.29	1.18	0.69	0.63	12.35
S.D.	0.95	1.19	1.17	1.03	1.03	0.60	0.85	1.18	1.83	1.13	0.82	0.62	4.50
Skew	1.68	0.57	0.95	1.33	1.06	1.58	1.47	1.42	3.28	1.38	1.91	0.95	0.77
Max	3.81	3.65	4.3	3.92	3.7	2.14	3.68	5.41	9.72	4.95	3.43	2.37	23.48
Min	0	0	0	0	0	0	0	0	0	0	0	0	5.05
No. Yrs	31	32	33	31	32	33	33	35	33	34	33	31	20

Notes: Long-term means based on columns; thus, the monthly row may not sum (or average) to the long-term annual value.
Maximum allowable number of missing days: 5
Individual months not used for annual or monthly statistics if more than 5 days were missing.
Individual years not used for annual statistics if any month in that year had more than 5 days missing.

Table E-2
2008 High-Altitude Precipitation Data
(Page 1 of 6)

Station Name	USGS Site ID	Date	Precipitation (in.)	Comments
Unnamed peak in S. Delamar Mtns	372035114432901	9/6/2001	---	Installed and established site.
		6/18/2002	---	Evaporated? Cleaned, filled with 2.5 gal distilled water and 1.75 liter mineral oil, collected 2 one oz samples.
		10/30/2002	3.25	Took water sample.
		06/10/2003	5.75	Added 2 liters of mineral oil.
		10/22/2003	1.75	Added 1 gal of antifreeze.
		06/16/2004	9.25	Drained and added 1 gal of antifreeze.
		10/14/2004	2.5	Drained and added 1 gal of antifreeze.
		7/6/2005	---	Could not get to gage due to wildfires. Will visit in October.
		10/20/2005	32.5	---
		6/23/2006	7.5	---
		10/13/2006	1.25	Add 1 gal antifreeze.
		6/11/2007	7.25	No antifreeze added.
		10/19/2007	4.25	Added 1 gal of antifreeze.
		6/6/2008	6.5	No antifreeze added.
		10/16/2008	1.5	Drained. Added 2/3 gal mineral oil.
Unnamed peak S. of Chokecherry Peak	373107114433301	9/7/2001	---	Installed and established site.
		6/13/2002	---	Evaporated? Cleaned, filled with 3 gal distilled water and 1 liter mineral oil, collected 2 one oz samples.
		11/5/2002	1.5	Took water sample.
		6/11/2003	5.25	Added 2 liters of mineral oil.
		10/16/2003	2	---
		6/15/2004	8.25	---
		6/21/2005	19	Partially drained and added 1 gal antifreeze.
		10/18/2005	3.5	---
		6/29/2006	5.5	---
		10/30/2006	3.25	Added 1 gal of antifreeze.
		6/5/2007	3	Drained and added 1 gal of antifreeze.
		10/25/2007	5.25	Drained and no antifreeze added.
		6/10/2008	5.25	Baffle needs to be put back on.
		10/2/2008	4	Drained, need 3 people to help replace baffle.
Mt. Irish	373915115232801	9/5/2001	---	Installed and established site.
		6/18/2002	---	Evaporated? Cleaned. Filled with 2.5 gal distilled water and 1 liter mineral oil. Collected 2 one oz samples.
		10/30/2002	---	Evaporation, able to get small sample, mineral oil still in gage.
		6/10/2003	---	Drain petcock found open; added 1 gal of mineral oil.
		10/22/2003	2.75	Added 1 gal of antifreeze.
		6/16/2004	5.5	Drained and added 1 gal of antifreeze.
		10/14/2004	2	Drained and added 1 gal of antifreeze.
		7/6/2005	12.5	Added 1 gal antifreeze.
		10/20/2005	3.75	---
		6/23/2006	4.5	---
		10/13/2006	2.5	Shut off valve would not stop leaking/need new o-ring or valve.
		6/11/2007	0	Fixed valve, added 2 gal of antifreeze and 1 gal of water.
		10/19/2007	3.5	---
		6/6/2008	5.5	Added mineral oil.
		10/16/2008	5.75	Drained, added 2/3 gal mineral oil.

Table E-2
2008 High-Altitude Precipitation Data
(Page 2 of 6)

Station Name	USGS Site ID	Date	Precipitation (in.)	Comments
Highland Peak	375337114343801	10/2/2008	4.75	Drained, no antifreeze added.
		8/29/2001	---	Installed and established site.
		6/13/2002	---	Evaporated? Cleaned. Filled with 3 gal distilled water and 1 liter mineral oil, collected 2 one oz samples.
		11/5/2002	3	Took water sample.
		6/11/2003	10.25	Added 2 liters of mineral oil.
		10/16/2003	3	--
		5/28/2004	11.5	Drained and added 1 gal of antifreeze.
		10/20/2004	6.5	Snowing at time of measurement.
		6/21/2005	24	Drained, added 1 gal antifreeze.
		10/18/2005	4	---
		6/29/2006	13	---
		10/30/2006	9.5	---
		6/5/2007	7	Drained and added 1 gal antifreeze.
		10/25/2007	6	Drained and added 1 gal antifreeze.
		6/10/2008	8.5	---
Quinn Canyon Range	381157115373101	8/5/2003	---	Installed rain gage and isotope sampler @1330; added 1 gal of mineral oil.
		10/22/2003	1.75	Added 1 gal of antifreeze; collected isotope sample; installed PVC isotope sampler, 23.25 in. tapedown.
		6/16/2004	6.75	Rain gage found partially tipped over, probably lost data; reset gage; bucket isotope sampler found overflowing, took isotope sample from bucket and tube.
		10/14/2004	2	Drained and added 1 gal antifreeze; secured gage with stainless steel wire; Collected isotope samples, bucket 1/4 full, tube 1/8 full.
		7/6/2005	19.25	Drained, added 1 gal antifreeze.
		10/26/2005	4	---
		6/23/2006	8.5	Collected 2 samples.
		10/13/2006	3.75	Added 1 gal of antifreeze/collected 2 samples.
		6/11/2007	2.5	Gage tipped over at a 45 degrees, uprighted gage and secured it.
		10/19/2007	6.5	Added 1/2 gal of antifreeze.
		6/6/2008	7.75	No antifreeze added, collected 2 samples.
		10/16/2008	4.25	Drained, added 2/3 gal mineral oil, collected 2 samples.
Mt. Wilson	381438114233301	9/27/1983	---	Installed gage.
		5/24/1984	9	---
		10/2/1984	10.08	---
		6/4/1985	17.4	---
		10/1/1985	5.04	Drained and refilled.
		11/11/1986	24.36	---
		6/11/1987	12	OK
		10/15/1987	6.48	---
		5/25/1988	15.84	Tubing broken at 54 in.
		10/26/1988	1.2	---
		5/17/1989	12.79	Tubing in good condition.
		10/31/1989	4.63	Drained and refilled.
		7/16/1990	12.31	OK
		11/28/1990	5.69	Gage partially froze, ice plug in tube from 32 to 50.5 in.
		5/28/1991	18.93	Length of ice plug added to previous left reading to obtain precipitation reading.

Table E-2
2008 High-Altitude Precipitation Data
(Page 3 of 6)

Station Name	USGS Site ID	Date	Precipitation (in.)	Comments
Mt. Wilson	381438114233301	10/17/1991	---	Tubing broke at 50.18, drained and refilled.
		5/19/1992	18.81	---
		10/22/1992	---	Tubing broke-replaced, drained and refilled.
		5/24/1993	25.38	---
		10/22/1993	5.5	Drained and refilled.
		6/1/1994	11.94	---
		10/19/1994	5.87	Drained and refilled.
		7/26/1995	18.38	---
		10/19/1995	---	Tubing apparently leaked replaced tubing, drained.
		6/6/1996	8.37	---
		10/8/1996	1.63	Drained and refilled.
		6/6/1997	13.25	---
		10/10/1997	17	Filled with 1 gal antifreeze.
		6/3/1998	31.5	Door covered in packed snow could not drain.
		10/13/1998	9.5	Added 1 gal antifreeze.
		6/16/1999	11.75	Opened main plug and cleaned.
		11/9/1999	1.25	Filled with 1 gal antifreeze, repaired weather vane.
		6/26/2000	3	---
		10/16/2000	0	Added 1 gal antifreeze, cleared ice from drain tubes.
		6/19/2001	12	---
		10/2/2001	---	Evaporated? Added 1 gal antifreeze.
		6/26/2002	1.25	Cleaned. Filled with 2.5 gal distilled water and 1 liter mineral oil. Collected 2 one oz samples.
		11/5/2002	5	Took snow sample, measurement from top.
		6/11/2003	11.25	Added 2 quarts of mineral oil.
		10/16/2003	4.25	Added 1 gal of antifreeze.
		5/28/2004	13.25	Drained and added 1 gal of antifreeze.
		6/21/2005	42.75	Drained. Added 1 gal antifreeze.
		10/18/2005	4.25	Added antifreeze?
		6/19/2006	11.25	---
		10/30/2006	9.75	---
		6/5/2007	5.25	Drained and added 1 gal of antifreeze.
		10/25/2007	3	Drained and added 1 gal of antifreeze.
		6/10/2008	14	Baffle needs to be raised on next visit.
		10/3/2008	4.25	Drained, needs new baffle.
Mt. Washington	385409114185401	9/29/1983	---	Installed gage.
		5/31/1984	21.84	---
		10/11/1984	11.16	---
		6/4/1985	21.6	---
		10/1/1985	4.08	Drained and refilled.
		5/22/1986	24	OK
		11/4/1986	7.32	Too much snow - Fly in.
		5/29/1987	14.28	OK
		10/5/1987	3.12	---
		6/29/1988	30.48	OK
		10/21/1988	0.24	---
		6/29/1989	15.7	Tightened cables. OK
		11/2/1989	6.68	Drained and refilled.

Table E-2
2008 High-Altitude Precipitation Data
(Page 4 of 6)

Station Name	USGS Site ID	Date	Precipitation (in.)	Comments
Mt. Washington	385409114185401	7/3/1990	18.7	OK
		12/11/1990	9.69	OK
		7/11/1991	18.38	Removed cable from tree to steel post.
		10/23/1991	6	Drained and refilled.
		5/20/1992	18.32	---
		10/15/1992	5.5	Drained and refilled.
		5/26/1993	24.94	---
		10/27/1993	7.06	Drained and refilled.
		6/15/1994	17.57	---
		10/24/1994	7.87	Drained and refilled.
		7/19/1995	30.08	---
		11/7/1995	2.64	Drained and refilled.
		6/28/1996	14.8	---
		10/4/1996	1.12	Drained and refilled.
		6/6/1997	19.32	---
		10/7/1997	5.37	Filled with 1 gal antifreeze.
		6/4/1998	---	Could not reach due to snow cover.
		7/21/1999	62	Flushed out, added 1 gal antifreeze. Precipitation reflects time since Oct. 97 ft.
		9/15/1999	0	Gage OK.
		9/29/2000	26.5	Measurement.
		10/18/2000	3	Drained and filled with 3 gal antifreeze.
		7/25/2001	12	Main valve drains slowly.
		10/16/2001	0	Added gal of antifreeze.
		6/12/2002	16.25	Cleaned. Filled with 3 gal distilled water and 1 liter mineral oil. Collected 2 one oz samples.
		11/4/2002	5	Took snow and water sample.
		6/11/2003	16.5	Installed isotope sampler; added 2 liters of mineral oil.
		10/16/2003	2.25	Added 1 gal of antifreeze; collected isotope sample; installed PVC isotope sampler, 21.00 in. tapedown.
		6/9/2004	14.5	Main drain a little loose, may have lost a some data, bucket isotope sampler found overflowing, took isotope sample from bucket and tube sampler.
		7/12/2005	46	Took samples from gage and bucket.
		11/2/2005	6	Replaced isotope collection bucket.
		7/5/2006	17.5	---
		7/6/2006	0	Sampled tube - added 2 gal antifreeze to precipitation drained and filled bucket and tube.
		10/19/2006	7	Drained, add 1 gal antifreeze.
		6/5/2007	9.75	Drained, no antifreeze added, will add antifreeze next visit.
		10/24/2007	2.75	Added 1 gal of antifreeze and 3/4 gal oil.
		6/5/2008	12.5	Drained and added one gal antifreeze.
		10/15/2008	0	2 samples taken.
Unnamed Peak NW of Mt. Moriah	391913114143101	9/21/1983	---	Installed gage.
		5/24/1984	16.32	---
		10/3/1984	8.04	---
		6/4/1985	14.88	---
		10/1/1985	5.52	Drained and refilled.
		5/28/1986	18.36	OK
		11/4/1986	6.48	OK

Table E-2
2008 High-Altitude Precipitation Data
(Page 5 of 6)

Station Name	USGS Site ID	Date	Precipitation (in.)	Comments
Unnamed Peak NW of Mt. Moriah	391913114143101	5/28/1987	11.04	OK
		10/5/1987	5.28	---
		6/17/1988	14.04	Tightened turnbuckles.
		10/7/1988	3.06	---
		6/5/1989	9.54	OK
		10/30/1989	3.96	Drained and refilled.
		7/16/1990	15.36	OK
		11/28/1990	4.5	Broken tube @ 57.5.
		5/28/1991	8.44	OK
		10/17/1991	8.37	Drained and refilled.
		5/19/1992	9.81	---
		10/22/1992	2.62	Drained and refilled.
		5/24/1993	15.29	---
		10/22/1993	5.69	Changed tubing drained and refilled.
		6/1/1994	11.06	---
		10/19/1994	3.13	Drained and refilled.
		7/26/1995	20.63	---
		10/19/1995	0.93	Drained and refilled.
		6/6/1996	11.26	---
		10/8/1996	2.49	Drained and refilled.
		6/6/1997	15	---
		10/10/1997	6.25	Filled with 1 gal antifreeze.
		6/3/1998	15.75	Gage OK.
		10/13/1998	6.75	Added 1 gal antifreeze.
		6/16/1999	17.25	Opened main plug and cleaned.
		6/26/2000	8.5	Reflects precipitation since June 1999.
		10/16/2000	0	Added 1 gal antifreeze, cleared ice from drain tubes.
		6/19/2001	6	---
		10/2/2001	---	Evaporated? Added 1 gal of antifreeze.
		6/26/2002	---	Could not find the gage.
		10/31/2002	---	Evaporation, reflects 2 years.
		6/12/2003	5.75	Added 2 liters of mineral oil.
		10/17/2003	4.25	Added 1 gal of antifreeze.
		7/9/2004	14	Drained and added 1 gal antifreeze.
		10/12/2004	3.75	Took GPS coordinate.
		7/20/2005	22	---
		11/7/2005	6.5	Drained, added 1 gal antifreeze.
		6/23/2006	11.75	---
		10/19/2006	3.5	Drained added antifreeze.
		6/13/2007	10.75	Drained added 1 gal antifreeze.
		10/23/2007	1.25	Did not drain. Added 1gal antifreeze.
		6/5/2008	9.5	Drained. Added 1 gal antifreeze.
		10/14/2008	3.5	Added 1 gal antifreeze.
		5/23/1984	21.96	---
		10/3/1984	10.2	---
		6/4/1985	22.32	---
		10/1/1985	0.48	Drained and refilled gage.
		5/28/1986	10.32	Fill plug out, spilled.

Table E-2
2008 High-Altitude Precipitation Data
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Station Name	USGS Site ID	Date	Precipitation (in.)	Comments
Cave Mountain	390946114364901	10/22/1986	7.92	Drained and refilled.
		5/28/1987	11.88	OK
		10/4/1987	5.4	---
		6/17/1988	20.7	---
		10/7/1988	3.72	---
		6/6/1989	12.6	OK
		10/30/1989	3.7	Drained and refilled.
		7/16/1990	14.88	OK
		11/28/1990	4.19	OK
		5/28/1991	11.31	---
		10/17/1991	9.37	Drained and refilled.
		5/19/1992	12.44	---
		10/22/1992	3.98	Drained and refilled.
		5/24/1993	18.87	---
		10/22/1993	4.94	Drained and refilled.
		6/1/1994	13.62	OK
		10/22/1994	4.13	Drained and refilled.
		7/26/1995	28.12	---
		10/19/1995	1.12	Drained and refilled.
		6/6/1996	14.88	---
		10/8/1996	2.63	Drained and refilled.
		7/6/1997	13.81	---
		10/10/1997	14.5	Filled with 1 gal antifreeze.
		6/3/1998	16.25	Gage OK, slightly plugged.
		10/13/1998	10.75	Added 1 gal antifreeze.
		6/16/1999	17.75	Opened main plug and cleaned.
		11/9/1999	0	Filled with 1 gal antifreeze.
		6/26/2000	19	---
		10/16/2000	0	Added 1 gal antifreeze, cleared ice from drain tubes. Leaking, wrapped plug threads with teflon tape.
		6/19/2001	12	---
		10/2/2001	---	Evaporated? Added 1 gal antifreeze.
		6/11/2002	9.25	Cleaned. Filled with 3 gal distilled water and 1 liter mineral oil. Collected 2 one oz samples.
		10/31/2002	7.5	Took snow and water sample.
		6/12/2003	14	Added 2 quarts of mineral oil and drained some water.
		10/18/2003	1.5	Added 1 gal of antifreeze.
		7/9/2004	13.25	---
		10/13/2004	5.25	Drained and added one gal antifreeze.
		7/20/2005	15.25	---
		11/7/2005	3.25	Drained, added 1 gal antifreeze.
		6/23/2006	18.75	---
		10/19/2006	4.25	Raised wind baffle to just above top of collector, tightened guide wires. Drained - added antifreeze.
		6/13/2007	12	Drained and added 1 gal of antifreeze.
		10/23/2007	3.75	Did not drain. Added 1gal antifreeze.
		6/5/2008	8.5	Drain. Added 1 gal antifreeze.
		10/14/2008	4.25	Added 1 gal antifreeze.

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Appendix F

Water-Chemistry Data

Table F-1
Field-Measured Water-Quality Parameters and Major- and Minor-Solute Data for Wells and Springs in the DDC Monitoring Network
(Page 1 of 4)

Station Name	Sample Date	*	T (°C)	pH[1]	SC[1] (µS/cm)	DO (mg/L)	TDS (mg/L)	SiO_2 (mg/L)	HCO_3^- (mg/L)	CO_3^{2-} (mg/L)	Cl^- (mg/L)	SO_4^{2-} (mg/L)	F^- (mg/L)	NO_3^- (mg/L)	NO_2^- (mg/L)	Br^- (mg/L)	Ca^{2+} (mg/L)	K^+ (mg/L)	Mg^{2+} (mg/L)	Na^+ (mg/L)	CB (%)
White River Valley (HA 207)																					
Flag Spring 2	7/26/1975	a	18	7.5	405	---	---	---	231	---	27	11	---	---	---	---	50	2.0	20	8.0	2.5
Flag Spring 3	1/17/1984	a	23	7.5 | 7.5[2]	420	---	---	26	270	---	6.6	12	0.2	---	---	---	50	3.4	21	10	1.3
Hardy Springs	8/1/1979	b	15	7.5	440	---	263	15	283	ND	2.5	17	0.2	3.5	---	---	55	1.7	22	65	-18
Hot Creek Spring	10/26/1912	c	---	---	---	---	340	---	278	---	10	48	---	---	---	---	66	---	24	13[3]	0.0
Hot Creek Spring	5/27/1949	d	---	---	564	---	346	32	294	---	12	45	---	0.3	---	---	58	---	22	32[3]	0.0
Hot Creek Spring	6/23/1962	e	31	8.0	540	---	342	28	288	ND	8.9	45	1.0	0.4	---	---	60	5.3	22	29	-1.9
Hot Creek Spring	4/16/1963	e	27	7.6	548	---	343	28	300	ND	9.0	43	1.0	0.6	---	---	60	5.1	24	24	-0.1
Hot Creek Spring	7/19/1981	a	33	7.2 | 7.7[2]	530 | 557[2]	1.0	---	28	280	---	10	46	0.9	---	---	---	59	5.5	21	24	0.2
Hot Creek Spring	1/18/1984	a	32	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Hot Creek Spring	5/20/1992	f	32	7.3 | 8.0[2]	547 | 324[2]	---	---	27	287	ND	9.6	42	1.0	0.4	---	---	58	5.0	22	25	0.1
Hot Creek Spring	8/8/2003	g	---	---	547[2]	---	322	23	280	ND	11	49	1.0	0.5	<0.02	0.09	54	3.9	20	22	5.1
Hot Creek Spring	6/23/2004	g	32	7.3	639	3.8	322	28	286	ND	11	46	1.0	0.6	<0.2	0.10	52	5.0	22	24	3.8
Hot Creek Spring	9/25/2004	h	32	7.2	540	1.3	---	28	282	ND	10	44	0.9	0.4	---	0.07	58	4.8	22	25	-0.3
Hot Creek Spring	1/24/2005	h	31	7.3	545	1.4	---	28	272	ND	10	46	1.0	0.4	---	0.07	59	5.3	22	25	-1.9
Hot Creek Spring	5/18/2005	h	31	7.1	542	1.6	---	29	268	ND	10	45	1.0	0.4	---	0.07	59	5.2	22	25	-2.6
Hot Creek Spring	8/1/2005	g	32	7.4	669	2.7	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Hot Creek Spring	8/14/2005	h	31	6.8	545	1.6	---	28	281	ND	10	45	1.0	0.4	---	0.08	59	5.2	21	25	-0.1
Hot Creek Spring	11/6/2005	h	31	7.3	535	1.5	---	28	273	ND	10	45	1.0	0.4	---	0.07	60	5.0	22	24	-1.9
Hot Creek Spring	2/17/2006	h	31	7.3	532	1.1	---	29	271	ND	10	45	1.0	0.4	---	0.07	60	5.1	22	24	-2.2
Hot Creek Spring	5/22/2006	i	32	7.4 | 8.0[2]	530 | 563[2]	1.5	---	28	269	ND	11	47	1.0	0.4	---	0.07	60	5.2	22	25	-2.3
Hot Creek Spring	8/29/2006	i	31	7.3 | 8.0[2]	533 | 537[2]	1.3	---	28	268	ND	10	46	1.0	0.4	---	0.07	59	4.5	22	22	-1.2
Hot Creek Spring	10/28/2006	i	31	7.3 | 7.9[2]	531 | 537[2]	1.9	---	28	269	---	10	45	1.0	0.5	---	0.08	59	5.2	22	25	-2.4
Moorman Spring	9/15/1945	j	---	---	552[4]	---	---	---	291	---	8.9	46	---	---	---	---	64	---	22	23	-0.2
Moorman Spring	11/15/1966	k	37	---	---	---	323	---	290	---	8.9	46	---	---	---	---	68	---	32	23	-8.2
Moorman Spring	8/1/1979	b	36	7.3	720	---	348	29	293	ND	9.4	50	1.3	0.4	---	---	61	5.6	19	26	2.5
Moorman Spring	7/18/1981	a	37	7.0 | 7.8[2]	540 | 571[2]	1.7	---	27	290	---	9.9	47	1.3	---	---	---	58	5.9	19	24	3.6
Moorman Spring	1/18/1984	a	37	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Moorman Spring	6/23/2004	g	37	7.2	712	2.9	330	28	291	---	11	46	1.3	2.7	<0.2	0.09	57	5.5	20	26	3.3

Table F-1
Field-Measured Water-Quality Parameters and Major- and Minor-Solute Data for Wells and Springs in the DDC Monitoring Network
(Page 2 of 4)

Station Name	Sample Date	*	T (°C)	pH[1]	SC[1] (µS/cm)	DO	TDS	SiO_2	HCO_3^-	CO_3^{2-}	Cl^-	SO_4^{2-}	F^-	NO_3^-	NO_2^-	Br^-	Ca^{2+}	K^+	Mg^{2+}	Na^+	CB (%)
						(mg/L)															
Pahranagat Valley (HA 209)																					
209M-1	6/7/2006	g	40	7.6	487	4.4	150	29	180	ND	9.6	24	0.4	2.4	<0.3	0.10	37	4.9	13	22	-2.8
Ash Springs	11/16/1912	c	---	---	---	---	303	34	259	---	11	46	---	0.4	---	---	49	14	13	45	-2.7
Ash Springs	3/11/1935	j	---	---	614[4]	---	---	---	264	---	14	41	---	---	---	---	54	---	10	47	-0.1
Ash Springs	4/25/1944	j	---	---	473[4]	---	---	---	251	---	8.9	18	---	---	---	---	45	---	18	21	1.1
Ash Springs	6/4/1944	j	---	---	480[4]	---	---	---	256	---	11	35	---	---	---	---	46	---	19	30	0.7
Ash Springs	5/23/1966	k	32	7.8[4]	---	---	418	---	264	---	10	35	---	---	---	---	56	---	14	33	-0.4
Ash Springs	7/20/1981	a	36	7.0 | 7.7[2]	460 | 448[2]	2.3	---	30	250	---	8.5	34	0.8	---	---	---	43	7.4	14	27	4.4
Ash Springs	1/18/1984	a	32	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Ash Springs	10/8/1987	a	36	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Ash Springs	5/24/2004	g	34	7.3	592	4.4	286	30	223	---	8.6	33	0.7	1.1	<0.2	0.12	46	6.8	16	28	-3.8
Ash Springs	5/24/2004	g	36	7.2	598	2.3	268	29	229	---	8.3	32	0.8	1.1	<0.2	0.12	41	7.2	14	28	1.2
Ash Springs	7/30/2004	i	34	7.4	478	1.6	---	33	248	ND	8.6	33	0.6	1.3	---	0.07	46	7.3	17	28	-0.5
Ash Springs	8/1/2005	g	35	7.0	612	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Cottonwood Spring	5/24/2004	g	20	7.5 | 7.6[2]	699 | 831[2]	1.1	538	53	374	19	23	77	1.5	0.2	<0.2	0.22	53	12	26	79	3.2
Crystal Springs	11/16/1912	c	---	---	---	---	306	26	261	---	11	37	---	0.8	---	---	53	---	23	19[3]	0.1
Crystal Springs	3/11/1935	j	---	---	671[4]	---	---	---	273	---	69	13	---	---	---	---	55	---	23	37	3.4
Crystal Springs	4/25/1944	j	---	---	491[4]	---	---	---	256	---	8.9	22	---	---	---	---	44	---	24	16	0.4
Crystal Springs	6/4/1944	j	---	---	488[4]	---	---	---	268	---	8.9	34	---	---	---	---	46	---	24	25	-0.1
Crystal Springs	3/10/1962	l	28	7.2	481[4]	---	---	31	242	---	9.9	34	2.8	0.6	---	---	46	5.5	22	24	-1.7
Crystal Springs	4/15/1963	l	27	8.0	---	---	277	31	272	---	8.2	27	0.6	1.2	---	---	45	5.1	24	23	-0.5
Crystal Springs	7/20/1981	a	28	7.3 | 7.8[2]	408 | 492[2]	1.8	---	25	260	---	8.9	34	0.3	---	---	---	43	5.0	21	22	2.7
Crystal Springs	1/18/1984	a	27	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Crystal Springs	10/8/1987	a	28	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Crystal Springs	5/12/1992	f	27	7.5 | 8.1[2]	479 | 465[2]	---	---	25	261	ND	8.8	32	0.4	1.2	---	---	45	5.4	22	24	-0.1
Crystal Springs	8/16/1994	a	26	7.4 | 7.5[2]	500 | 487[2]	---	---	24	257	---	8.6	32	0.3	---	---	0.09	44	5.4	22	24	-0.5
Crystal Springs	6/3/2003	a	28	7.4 | 7.2[2]	491 | 458[2]	1.1	---	25	251	---	8.5	32	0.4	---	<0.04	0.09	43	4.5	19	22	2.7
Crystal Springs	5/24/2004	g	27	7.2	516	2.0	296	24	235	5.5	8.8	33	0.4	1.2	<0.2	0.11	46	5.3	22	23	-2.2
Crystal Springs	7/30/2004	h	27	7.3	480	5.1	---	26	255	ND	8.7	32	0.3	1.4	---	0.08	43	5.3	22	24	-0.1
Crystal Springs	10/20/2004	h	27	7.6	476	1.3	---	27	240	ND	9.1	34	0.3	1.3	---	0.07	45	5.3	22	24	-2.9
Crystal Springs	1/24/2005	h	27	7.5	482	1.3	---	25	247	ND	8.8	33	0.3	1.2	---	0.08	46	5.2	22	24	-2.6

Table F-1
Field-Measured Water-Quality Parameters and Major- and Minor-Solute Data for Wells and Springs in the DDC Monitoring Network
(Page 3 of 4)

Station Name	Sample Date	*	T (°C)	pH[1]	SC[1] (µS/cm)	DO	TDS	SiO_2	HCO_3^-	CO_3^{2-}	Cl^-	SO_4^{2-}	F^-	NO_3^-	NO_2^-	Br^-	Ca^{2+}	K^+	Mg^{2+}	Na^+	CB (%)
						(mg/L)															
Crystal Springs	5/18/2005	h	27	7.3	478	1.3	---	26	247	ND	9.1	34	0.4	1.3	---	0.08	45	5.1	22	24	-1.7
Crystal Springs	8/1/2005	g	27	7.5	540	1.6	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Crystal Springs	8/14/2005	h	27	6.9	481	1.3	---	25	262	ND	9.0	33	0.3	1.2	---	0.08	46	5.1	22	24	-0.1
Crystal Springs	11/9/2005	h	27	7.4	472	1.3	---	25	248	ND	9.3	33	0.3	1.2	---	0.07	46	5.1	22	24	-2.2
Crystal Springs	2/17/2006	h	27	7.4	498	1.3	---	25	247	ND	9.5	34	0.4	1.2	---	0.08	46	5.4	22	24	-2.1
Crystal Springs	5/22/2006	i	27	7.5 | 8.1[2]	462 | 503[2]	1.2	---	25	247	ND	9.5	35	0.4	1.3	---	0.08	46	5.7	22	24	-2.0
Crystal Springs	8/23/2006	i	27	7.4 | 8.1[2]	475 | 473[2]	1.3	---	25	239	ND	9.1	35	0.3	1.2	---	0.08	46	4.4	23	21	-2.7
Crystal Springs	10/28/2006	i	27	7.4 | 7.9[2]	470 | 476[2]	1.4	---	25	245	---	9.3	34	0.3	1.3	---	0.09	45	5.1	22	24	-2.0
Hiko Spring	11/15/1912	c	---	---	---	---	---	35	272	---	11	36	---	0.8	---	---	52	---	24	22[3]	0.0
Hiko Spring	4/25/1944	j	---	---	512	---	---	---	268	---	8.9	24	---	---	---	---	45	---	26	17	0.2
Hiko Spring	6/4/1944	j	---	---	511	---	---	---	281	---	11	36	---	---	---	---	48	---	23	30	0.6
Hiko Spring	3/10/1962	l	27	8.0	494	---	---	33	260	---	11	36	0.6	1.2	---	---	44	7.0	23	29	-1.4
Hiko Spring	12/18/1991	f	26	7.5 | 8.1[2]	486 | 465[2]	---	---	32	277	ND	9.4	35	0.6	1.3	---	---	47	7.5	23	26	0.2
Cave Valley (HA 180)																					
180 N07 E63 14BADD 1 USGS-MX	7/10/2003	a	13	7.8 | 7.8[2]	388	1.2	---	46	190	ND	15	17	<0.2	6.1	0.01	0.15	37	5.9	21	13	-3.6
180 N08 E64 15BCBC1 USBLM	3/1/1980	b	10	7.4	468	---	---	1.1	200	ND	2.5	<5	0.1	5.3	---	---	49	0.9	14	6.2	-6.1
180 N08 E64 15BCBC1 USBLM	11/8/2005	m	12	7.5 | 8.0[2]	406	6.3	---	23	235	---	3.9	8.5|10	0.1	---	---	0.04	72	1.4	18	7.9	-13
180 N08 E64 15BCBC1 USBLM	11/8/2005	m	12	8.0[2]	---	---	---	23	235	---	4.0	8.4|10	0.1	---	---	0.05	73	1.4	19	7.8	-15
180W501M	5/17/2006	g	18	7.4	394	3.8	210	31	210	ND	8.1	12	0.2	8.6	<0.3	0.09	46	3.0	18	12	-3.6
180W902M	5/18/2006	g	18	7.6	441	5.5	210	24	270	ND	6.6	15	0.2	4.0	<0.3	0.08	54	1.6	22	8.2	1.0
CAV6002X	12/3/2007	g	16	7.8	468	---	280	24	270	ND	7.3	16	0.2	4.7	<0.3	0.07	53|53	1.7|1.7	21|22	8.0|8.3	2.0
Cave Spring	3/1/1980	b	12	7.4	180	---	---	2.1	80	ND	3.2	9.5	0.1	3.1	---	---	17	0.6	4.0	5.1	7.8
Cave Spring	8/2/1985	a	12	7.4 | 8.1[2]	190 | 114[2]	8.4	---	14	62	---	1.0	4.5	<0.1	---	---	---	16	---	2.2	3.1	1.1
Cave Spring	7/23/1986	a	---	---	---	---	---	---	---	---	1.0	---	---	---	---	---	---	---	---	---	---
Cave Spring	8/6/2003	g	---	---	162[2]	---	106	15	89	---	<5	<10	---	2.5	<0.02	<0.05	21	<3	<3	3.1	12
Cave Spring	6/21/2004	g	12	7.4 | 7.6[2]	82	10	72	16	59	ND	<5	<5	0.1	2.2	<0.2	<0.05	16	<1	<5	<5	0.3
Cave Spring	12/14/2005	m	11	---	118	7.8	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---
Cave Spring	7/14/2006	i	12	7.2 | 7.4[2]	99 | 105[2]	7.6	---	16	55	ND	1.0	2.6	0.1	1.3	---	<0.02	15	0.7	2.0	2.6	-1.7
Lewis Well	9/2/2005	m	21	7.4 | 8.1[2]	544	6.4	---	41	259	---	11	18|21	0.1	---	---	0.15	94	1.3	22	17	-19

Table F-1
Field-Measured Water-Quality Parameters and Major- and Minor-Solute Data for Wells and Springs in the DDC Monitoring Network
(Page 4 of 4)

Station Name	Sample Date	*	T (°C)	pH[1]	SC[1] (μS/cm)	DO	TDS	SiO_2	HCO_3^-	CO_3^{2-}	Cl^-	SO_4^{2-}	F^-	NO_3^-	NO_2^-	Br^-	Ca^{2+}	K^+	Mg^{2+}	Na^+	CB (%)
						(mg/L)															
Dry Lake Valley (HA 181)																					
181M-1	5/31/2006	g	23	7.5	470	4.7	300	38	280	ND	6.9	25	0.4	0.9	<0.3	0.07	50	5.2	24	20	-1.2
181 N03 E63 27CAA 1 USGS-MX	6/19/2003	a	30	6.9 | 7.1[2]	657	0.2	---	27	403	ND	6.4	21	0.6	---	<0.03	0.07	80	7.4	30	19	-1.5
181W909M	6/5/2006	g	26	7.7	617	4.9	380	33	300	ND	23	52	0.2	4.7	<0.3	0.13	48	5.6	19	71	-3.3
Big Mud Springs	5/8/2008	g	14	6.6 | 7.5[2]	420	---	310	21	270	ND	20	39	0.4	3.3	---	0.18	76	2.1	19	15	-1.5
Coyote Spring	8/1/1979	b	20	6.8	550	---	---	79	282	ND	25	25	0.5	<0.4	---	---	82	7.6	13	49	-12
Coyote Spring	6/21/2004	g	22	7.3	389 | 402[2]	7.3	268	57	187	ND	19	21	0.4	2.0	0.2	0.22	51	4.7	7.5	25	-3.2
Coyote Spring	5/1/2005	i	13	6.8	683	4.7	---	83	246	ND	32	105	0.6	<0.04	---	0.04	75	11	11	56	-1.5
Littlefield Spring	6/26/2004	h	15	7.0	491	5.0	---	48	254	ND	23	21	---	5.8	---	---	67	2.8	13	16	1.5
Littlefield Spring	7/25/2005	g	18	8.2[2]	480	9.2	---	52	255	ND	22	18	0.2	4.3	<1.6	0.21	70	3.2	15	18	-3.1
Meloy Spring	5/1/1980	b	12	6.9	540	---	---	74	259	ND	29	17	0.2	4.4	---	---	53	3.9	11	180	35
Meloy Spring	6/26/2004	h	14	7.2	499	6.9	---	54	248	ND	25	18	---	6.2	---	---	68	4.4	12	16	0.5
Delamar Valley (HA 182)																					
182M-1	5/23/2006	g	35	7.9	443	4.3	210	73	180	ND	12	20	2.2	5.2	<0.3	0.10	19	7.9	4.2	49	3.7
182W906M	6/20/2006	g	40	8.5	361	3.7	210	50	120	5.7	4.8	9.1	5.9	4.0	<0.3	0.05	9.1	1.4	0.4	55	1.0
Grassy Spring	5/1/1980	b	11	7.2	650	---	---	48	273	ND	36	56	0.2	16	---	---	67	0.5	15	36	5.9
Grassy Spring	8/27/2003	g	25	7.9	798	---	481	34	339	ND	55	45	0.3	6.6	<0.02	0.60	100	<1	17	32	2.5
Grassy Spring	3/26/2004	h	14	7.5	801	5.3	---	36	339	ND	57	54	---	9.8	---	---	111	0.6	19	51	-5.0
Grassy Spring	6/21/2004	g	20	7.3	645	8.2	414	34	295	ND	41	64	0.2	10	<0.2	0.41	97	<1	17	34	-1.4
Grassy Spring	4/30/2005	h	14	7.0	712	5.7	---	37	330	ND	71	69	0.2	10	---	0.07	116	0.9	21	40	-1.4
Grassy Spring	7/25/2005	g	20	7.2	777	6.5	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---

* Source:
a = USGS (2009)
b = Fugro (1980); Bunch and Harrill (1984)
c = Carpenter (1915)
d = Maxey and Eakin (1949)
e = Eakin (1966)
f = Hershey and Mizell (1995)
g = SNWA data
h = Thomas et al. (2006)
i = Unpublished DRI data
j = Miller et al. (1953)
k = Hess and Mifflin (1978)
l = Eakin (1963)
m = Hershey et al. (2007)

Notes:
CB = Charge Balance
DO = Dissolved Oxygen
ND = Not Detected
SC = Specific Conductance
T = Water Temperature
TDS = Total Dissolved Solids

[1] Measurement was performed in the field unless otherwise reported.
[2] Measurement was performed in the laboratory.
[3] Reported as sodium plus potassium.
[4] It is unknown whether the measurement was performed in the lab or the field.

Table F-2
Trace-Element Data for Wells and Springs in the DDC Monitoring Network
(Page 1 of 2)

Station Name	Sample Date	*	Ag	Al	As	Ba	Be	Cd	Cr	Cu	Fe	Hg	Mn	Pb	Sb	Se	Tl	U	Zn
			(µg/L)																
White River Valley (HA 207)																			
Flag Spring 3	1/17/1984	a	---	---	---	74	<0.5	<1	---	<10	<3	---	M	M	---	---	---	---	20
Hot Creek Spring	10/26/1912	b	---	---	---	---	---	---	---	---	200	---	---	---	---	---	---	---	---
Hot Creek Spring	4/16/1963	c	---	---	---	---	---	---	---	---	10	---	---	---	---	---	---	---	---
Hot Creek Spring	7/19/1981	a	---	---	---	120	<1	<1	---	<10	<10	---	<1	<10	---	---	---	1.5	<3
Hot Creek Spring	5/20/1992	d	---	---	---	116	<1	<5	---	<5	<10	---	<5	<1	---	---	---	1.6	<5
Hot Creek Spring	8/8/2003	e	<20	<5	10	110	<2	<1	11	<5	<50	<1	<5	<2	<1	<5	<2	---	<100
Hot Creek Spring	6/23/2004	e	<50	<5	8.0	<500	<2	<0.5	2.0	<5	<50	<1	<2	<2	<1	<1	<2	1.8	<100
Moorman Spring	7/18/1981	a	---	---	---	140	<1	<1	---	<10	<10	---	<1	<10	---	---	---	1.2	<3
Moorman Spring	6/23/2004	e	<50	<5	8.0	<500	<2	<0.5	2.0	<5	<50	<1	<2	<2	<1	<1	<2	---	<100
Pahranagat Valley (HA 209)																			
209M-1	6/7/2006	e	<0.2	5.4	14	110	<0.1	<0.1	0.3	4.5	270	0.2	8.0	3.0	0.6	0.7	<0.2	2.3	8.6
Ash Springs	11/16/1912	b	---	---	---	---	---	---	---	---	160	---	---	---	---	---	---	---	---
Ash Springs	7/20/1981	a	---	---	---	160	<1	<1	---	<10	<10	---	<1	<10	---	---	---	---	<3
Ash Springs	5/24/2004	e	<50	<5	29	<500	<2	<0.5	5.0	<5	<50	<1	<2	<2	1.0	<1	<2	---	<100
Ash Springs	5/24/2004	e	<50	<5	31	<500	<2	<0.5	<2	<5	1,200	<1	<2	<2	1.0	<1	<2	---	<100
Cottonwood Spring	5/24/2004	e	<50	12	16	<500	<2	<0.5	3.0	7.0	<50	<1	25	<2	<1	<1	<2	---	<100
Crystal Springs	11/16/1912	b	---	---	---	---	---	---	---	---	20	---	---	---	---	---	---	---	---
Crystal Springs	7/20/1981	a	---	---	---	90	<1	<1	---	<10	<10	---	<1	<10	---	---	---	3.8	10
Crystal Springs	5/12/1992	d	---	---	---	83	<1	<5	---	<5	<10	---	<5	<1	---	---	---	3.6	<5
Crystal Springs	8/16/1994	a	---	---	---	---	---	---	---	---	<3	---	<1	---	---	---	---	---	---
Crystal Springs	6/3/2003	a	---	<1.6	12	81	<0.06	<0.04	<0.8	0.5	4.0	---	<0.2	0.04	0.6	0.6	0.27	4.2	---
Crystal Springs	5/24/2004	e	<50	<5	13	<500	<2	<0.5	6.0	<5	<50	<1	<2	<2	<1	<1	<2	---	<100
Crystal Springs	8/1/2005	e	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	3.8	---
Hiko Spring	12/18/1991	d	---	---	---	113	<1	<5	---	<5	<10	---	<5	<1	---	---	---	5.1	<5
Cave Valley (HA 180)																			
180 N07 E63 14BADD 1 USGS-MX	7/10/2003	a	<0.2	<2	1.8	45	<0.06	<0.04	E 0.5	E 0.2	54	---	28	<0.08	E 0.2	1.0	<0.04	1.9	2.1
180 N08 E64 15BCBC1 USBLM	11/8/2005	f	<0.3	<2	1.0	52	<0.05	0.2	6.7	5.0	<50	---	11	0.1	<0.3	<1	<0.1	0.60	638
180 N08 E64 15BCBC1 USBLM	11/8/2005	f	<0.3	2.3	1.0	54	<0.05	0.2	7.1	5.6	<50	---	11	0.1	<0.3	1.1	<0.1	0.61	673
180W501M	5/17/2006	e	<0.2	15	3.8	220	<0.1	<0.1	0.99	1.2	650	<0.1	120	1.4	1.0	0.85	2.2	1.1	8.7
180W902M	5/18/2006	e	<0.2	<5	2.9	55	<0.1	<0.1	0.37	0.9	49	<0.1	1.8	0.91	<0.5	2.1	<0.2	2.0	3.0
CAV6002X[1]	12/3/2007	e	<0.2	<5	2.5|2.4	60|56	<0.1	<0.1	0.3|0.3	3.2|6.8	<20	<0.1	1.8|1.4	1.8|1.1	<0.5|0.5	2.0|1.7	<0.2	---	<5|8.8
Cave Spring	8/2/1985	a	---		---	41	<0.5	1.0	---	<10	44	---	9.0	10	---	---	---	---	21

Table F-2
Trace-Element Data for Wells and Springs in the DDC Monitoring Network
(Page 2 of 2)

Station Name	Sample Date	*	Ag	Al	As	Ba	Be	Cd	Cr	Cu	Fe	Hg	Mn	Pb	Sb	Se	Tl	U	Zn
			(µg/L)																
Cave Spring	8/6/2003	e	---	430	<2	36	<2	<1	<2	<5	220	<1	<5	<2	<1	<5	<2	---	<100
Cave Spring	6/21/2004	e	<50	130	<5	<500	<2	<0.5	<2	<5	63	<1	<2	<2	<1	<1	<2	---	<100
Lewis Well	9/2/2005	f	<0.3	2.4	3.0	17	<0.05	<0.02	6.2	0.9	<50	---	2.5	<0.05	<0.3	1.7	<0.1	1.6	2.4
Dry Lake Valley (HA 181)																			
181M-1	5/31/2006	e	<0.2	<5	6.8	120	<0.1	<0.1	0.25	1.1	380	<0.1	4.3	0.73	<0.5	<0.4	0.24	4.2	2.9
181 N03 E63 27CAA 1 USGS-MX	6/19/2003	a	<0.2	1.8	12	198	E 0.04	E 0.02	<0.8	0.4	1,890	---	38	0.95	61	E 0.3	2.6	5.1|5.6[1]	26
181W909M	6/5/2006	e	<0.2	990	6.1	97	0.11	<0.1	2.0	1.4	2,400	<0.1	94	1.3	<0.5	0.8	<0.2	3.5	3.6
Big Mud Springs	5/8/2008	e	<0.2	230	2.1	19	<0.1	<0.1	0.65	1.5	420	<0.1	39	0.20	1.2	4.1	<0.2	---	6.3
Coyote Spring	6/21/2004	e	<50	<5	10	<500	<2	<0.5	<2	<5	71	<1	7.0	<2	<1	<1	<2	2.1	<100
Littlefield Spring	7/25/2005	e	<0.5	890	2.0	19	<1	<0.5	1.8	<2	990	<0.2	24	0.76	<1	<5	<1	---	5.2
Delamar Valley (HA 182)																			
182M-1	5/23/2006	e	<0.2	<5	17	2.9	<0.1	<0.1	3.4	1.2	130	<0.1	8.7	3.8	<0.5	0.53	<0.2	4.4	<2
182W906M	6/20/2006	e	<0.2	430	2.1	5.9	<0.1	<0.1	2.0	6.3	1,300	<0.1	38	0.98	<0.5	0.62	<0.2	4.5	3.2
Grassy Spring	8/27/2003	e	<20	<5	4.0	<10	<2	<1	4.0	<5	<50	<1	<5	<2	<1	<5	<2	---	<100
Grassy Spring	6/21/2004	e	<50	<5	<5	<500	<2	<0.5	<2	<5	<50	<1	<2	<2	<1	2.0	<2	---	<100
Grassy Spring	7/25/2005	e	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	19	---

* Source:
a = USGS (2009)
b = Carpenter (1915)
c = Eakin (1966)
d = Hershey and Mizell (1995)
e = Unpublished SNWA data
f = Hershey et al. (2007)

E = Value is estimated.
M = Presence verified but not quantified
µg/L = Microgram per liter

1 = Unfiltered and filtered samples from Test Well CAV6002X were analyzed and are reported as unfiltered | filtered within the table. The trace elements that were not detected in either sample (unfiltered or filtered) are reported with a single below the detection limit value. This is similarly the case for the uranium concentrations reported for the sample from Well 181 N03 E63 27CAA 1 USGS-MX.

Table F-3
Isotopic Data for Wells and Springs in the DDC Monitoring Network
(Page 1 of 2)

Station Name	Sample Data	*	$\delta^{18}O$ (‰)	δD (‰)	$\delta^{13}C$ (‰)	^{14}C (pmc)	Tritium (TU)	$^{87}Sr/^{86}Sr$ (ratio)	$^{234}U/^{238}U$ (AR)
White River Valley (HA 207)									
Flag Spring 3	1/17/1984	a	-14.3	-105	-7.8	---	---	---	---
Hot Creek Spring	7/19/1981	a	-15.5	-118	---	---	0.6	---	---
Hot Creek Spring	1/18/1984	b	---	---	-4.6	---	---	---	---
Hot Creek Spring	5/20/1992	c	-15.6	-119	-4.3	4.5	<3	---	---
Hot Creek Spring	8/8/2003	d	-15.8	-120 | -120	---		---	---	---
Hot Creek Spring	6/23/2004	d	-15.5	-120 | -120	-4.1 | -4.3	5.4	---	---	---
Hot Creek Spring	9/25/2004	e	-15.7	-121	---	---	---	---	---
Hot Creek Spring	1/24/2005	e	-15.7	-119	---	---	---	---	---
Hot Creek Spring	5/18/2005	e	-15.7	-119	---	---	---	---	---
Hot Creek Spring	8/14/2005	e	-15.7	-117	---	---	---	---	---
Hot Creek Spring	11/6/2005	e	-15.7	-119	---	---	---	---	---
Hot Creek Spring	2/17/2006	e	-15.8	-118	---	---	---	---	---
Hot Creek Spring	5/22/2006	f	-15.7	-120	---	---	---	---	---
Hot Creek Spring	8/29/2006	f	-15.8	-119	---	---	---	---	---
Hot Creek Spring	10/28/2006	f	-15.8	-119	---	---	---	---	---
Moorman Spring	7/18/1981	a	-15.7	-119	---	---	<0.3	---	---
Moorman Spring	1/18/1984	a	---	---	-4.0	---	---	---	---
Moorman Spring	6/23/2004	d	-15.5	-120 | -121	-10.0 | -9.9	5.1	---	0.7133	4.24
Pahranagat Valley (209)									
209M-1	6/7/2006	d	-13.5	-105 | -105	-7.2	11.3	1.2 | <0.8	0.7103	3.66
Ash Springs	7/20/1981	a	-14.1	-108	---	6.8	0.6	---	---
Ash Springs	1/18/1984	a	---	---	-6.7	---	---	---	---
Ash Springs	5/24/2004	d	-14.0	-110 | -110	---	---	---	---	---
Ash Springs	5/24/2004	d	-14.0	-111 | -110	---	---	---	---	---
Ash Springs	7/30/2004	f	-14.2	-108	---	---	---	---	---
Ash Springs	8/1/2005	d	---	---	---	---	---	0.7136	2.49
Cottonwood Spring	5/24/2004	d	-12.5 | -12.7	-103 | -104	---	---	---	---	---
Crystal Springs	7/20/1981	a	-14.3	-109	---	7.8	0.6	---	---
Crystal Springs	1/18/1984	a	---	---	-6.7		---	---	---
Crystal Springs	5/12/1992	c	-15.4	-109	-5.3	6.2	<3	---	---
Crystal Springs	8/16/1994	a	-14.4	-108	---	---	---	---	---
Crystal Springs	6/3/2003	a	-14.3	-108	---	---	---	---	---
Crystal Springs	5/24/2004	d	-14.2	-111 | -111	---	---	---	---	---
Crystal Springs	7/30/2004	e	-14.4	-109	---	---	---	---	---
Crystal Springs	10/20/2004	e	-14.4	-109	---	---	---	---	---
Crystal Springs	1/24/2005	e	-14.4	-109	---	---	---	---	---
Crystal Springs	5/18/2005	e	-14.4	-107	---	---	<0.8	---	---
Crystal Springs	8/1/2005	e	---	---	---	---	---	0.7108	3.21
Crystal Springs	8/14/2005	e	-14.5	-109	---	---	---	---	---
Crystal Springs	11/9/2005	e	-14.4	-110	---	---	---	---	---
Crystal Springs	2/17/2006	e	-14.5	-109	---	---	---	---	---
Crystal Springs	5/22/2006	e	-14.5	-110	---	---	---	---	---
Crystal Springs	8/23/2006	f	-14.5	-109	---	---	---	---	---
Crystal Springs	10/28/2006	f	-14.5	-109	---	---	---	---	---
Hiko Spring	12/18/1991	c	-13.8	-109	-5.4		<3	---	3.16

Table F-3
Isotopic Data for Wells and Springs in the DDC Monitoring Network
(Page 2 of 2)

Station Name	Sample Data	*	$\delta^{18}O$ (‰)	δD (‰)	$\delta^{13}C$ (‰)	^{14}C (pmc)	Tritium (TU)	$^{87}Sr/^{86}Sr$ (ratio)	$^{234}U/^{238}U$ (AR)
Cave Valley (180)									
180 N07 E63 14BADD 1 USGS-MX	7/10/2003	a	-13.9	-105	---	---	---	---	---
180 N08 E64 15BCBC1 USBLM	11/8/2005	b	-14.1	-105	---	---	---	---	---
180 N08 E64 15BCBC1 USBLM	11/8/2005	b	-14.0	-104	---	---	---	---	---
180W501M	5/17/2006	d	-14.1	-106 | -106	-8.7	25.0	<0.8	0.7110	3.74 | 3.74
180W902M	5/18/2006	d	-14.1 | -14.1	-104 | -105	-7.1	12.8	<0.8	0.7094	3.85
CAV6002X	12/3/2007	d	-14.2 | -14.4	-107 | -106	-7.6	12.5	<0.8	---	---
Cave Spring	8/2/1985	a	-13.8	-100	---	---	---	---	---
Cave Spring	7/23/1986	a	---	-98	---	---	---	---	---
Cave Spring	8/6/2003	d	-14.2	-105 | -105	---	---	---	---	---
Cave Spring	6/21/2004	d	-13.5	-102 | -103	-12.7	89.5	---	0.7106 | 0.7106	1.52
Cave Spring	7/25/2005	d	---	---	---	---	6.8 | 5.3	---	---
Cave Spring	12/14/2005	b	-14.3	-103	---	---	6.8	---	---
Cave Spring	7/14/2006	f	-14.2	-102	---	---	---	---	---
Lewis Well	9/2/2005	b	-12.8	-98	-4.7	84.7	---	---	---
Dry Lake Valley (181)									
181M-1	5/31/2006	d	-13.7	-105 | -105	-6.8	5.4	<0.8	0.7105	3.90
181 N03 E63 27CAA 1 USGS-MX	6/19/2003	a	-14.1	-107	-4.6[d]	1.9[d]	0.09	0.7117	3.36
181W909M	6/5/2006	d	-13.5	-105 | -104	-4.0	4.4	<0.8	0.7134	4.65
Coyote Spring	6/21/2004	d	-12.0	-98 | -97	-13.3	78.9	---	0.7097 | 0.7097	6.57
Coyote Spring	5/1/2005	f	-12.3	-95	---	---	---	---	---
Coyote Spring	7/25/2005	d	---	---	---	---	<0.8	---	---
Littlefield Spring	6/26/2004	e	-12.7	-98	---	---	---	---	---
Littlefield Spring	7/25/2005	d	-12.4	-98 | -98	---	---	---	---	---
Meloy Spring	6/26/2004	e	-12.8	-100	---	---	---	---	---
Delamar Valley (HA 182)									
182M-1	5/23/2006	d	-14.1	-110 | -109	-7.6	13.7	<0.8	0.7100	2.77
182W906M	6/20/2006	d	-13.3	-101 | -100	-11.6	15.6	<0.8	0.7086	2.53
Grassy Spring	8/27/2003	d	-11.4	-92 | -94	---	---	---	---	---
Grassy Spring	3/26/2004	e	-11.2	-91	---	---	---	---	---
Grassy Spring	6/21/2004	d	-10.6 | -10.6	-87 | -88	---	---	---	---	---
Grassy Spring	4/30/2005	e	-11.1	-90	---	---	---	---	---
Grassy Spring	7/25/2005	d	---	---	---	---	<0.8	0.7091	3.97

* Source:
a = USGS (2009)
b = Hershey et al. (2007)
c = Hershey and Mizell (1995)
d = Unpublished SNWA data (Well 181 N03 E63 27CAA 1 USGS-MX sample was collected by the USGS and analyzed for carbon isotopes at the University of Arizona's NSF-Arizona Accelerator Mass Spectrometry Laboratory)
e = Thomas et al. (2006)
f = Unpublished DRI data

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