Dixie Valley Spring Reconnaissance and Sampling Report

Prepared for: Churchill County, NV

Prepared by: Interflow Hydrology & Mahannah & Associates

June, 2012

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Abbreviations:

BOR: Bureau of Reclamation

BLM: Bureau of Land Management$_{3}$

cfs : cubic feet per second

ft amsl: feet above mean sea level

gpm: gallons per minute

μS/cm: micro-Siemens per centimeter

NAD83: North American Datum of 1983

NWIS: Nation Water Information System

SC: specific conductance

TDS: total dissolved solids

USGS: United States Geological Survey

UTM: Universal Transverse Mercator

INTRODUCTION

Interflow Hydrology, Inc., in association with Mahannah & Associates, LLC conducted a reconnaissance of selected spring resources in the Dixie Valley Hydrologic Basin in 2009 as part of a broader hydrologic assessment of the basin being conducted by United States Bureau of Reclamation, Churchill County, contracted agencies and consultants, including the U.S. Geological Survey (USGS). Springs in the mountain block, along the mountain block-valley floor interface, and in the valley floor of Dixie Valley, where access and site conditions permitted, were sampled for common ions, stable isotopes of water, and in some cases, trace metals. Where possible, the discharge of the spring was measured; otherwise, a visual estimate of the flow rate was recorded. As a result of these field observations, a subset of the springs were selected for quarterly discharge measurements to be made in water-year 2011.

PURPOSE

The purpose of the field work was to provide a baseline flow and chemistry dataset for springs in Dixie Valley. The data may be used for geochemical characterization of different areas or groundwater flow regimes within Dixie Valley, and may be useful in interpreting the conceptual hydrogeologic framework. Additionally, measurements and estimates of spring flow are important in monitoring long term trends in Dixie Valley, and will be a component of the groundwater flow system represented in numerical flow modeling.

STUDY AREA

The majority of springs sampled and visited lie within Dixie Valley, Nevada, though two springs sampled are in Jersey Valley, a tributary basin which borders Dixie Valley to the northeast. Dixie Valley is located in Churchill and Pershing Counties, Nevada, and is located in the Great Basin Physiographic Province. The valley is approximately 70 miles long and 20 miles wide, and is oriented southwest to northeast. The basin is framed by the Stillwater Range on the west, and the Clan Alpine Range on the east. The valley floor elevation is approximately 3,400 -3,500 feet above mean sea level (ft amsl). The highest peaks in the neighboring mountain ranges are Job Peak (8,790 ft amsl), and Mt. Augusta (9,966 ft amsl), for the Stillwater and Clan Alpine Ranges, respectively.

METHODS AND PROCEDURES

Interflow Hydrology field staffs were instructed on USGS sampling protocols prior to the field efforts, and the attempt was to utilize USGS protocols to the degree possible. Field instruments were calibrated to standard solutions for pH, conductivity, and dissolved oxygen. All samples were obtained using a peristaltic pump with flexible Tygon tubing. Sample water was pumped into a flow cell where field parameters were measured after they had stabilized properly, and all data were recorded on standard USGS Field Forms. When utilized, field filters were flushed with laboratory grade deionized water followed by flushing with the spring source water, and all tubing or other equipments were thoroughly cleaned and rinsed after each spring sampling event. Samples were placed into containers provided by the USGS, labeled with their respective field identification, and placed in coolers until they could be transported to a refrigerator. Following each days sampling efforts, titrations were performed using an appropriate acid concentration to determine alkalinity via the inflection point method. Each titration was performed twice to ensure accuracy.

Water chemistry analyses were conducted by USGS laboratories. All samples were labeled appropriately, packed with USGS laboratory forms, and shipped in coolers to USGS laboratories.

Where measured, spring flow was quantified using a Swoffer velocity-flow meter, or by volumetric methods using a stop watch. Some spring discharge was impossible to measure, but visual estimates are provided.

SPRING SELECTION CRITERIA

Springs selected for sampling were chosen based on their presence on USGS topographic maps, USGS/State of Nevada Basin Reconnaissance Series Reports, and filed water rights applications or claims of vested rights with the State Engineer of Nevada. A broad spatial selection of springs was chosen to characterize different portions of Dixie Valley, and include locations in the valley floor, and in the mountain block region. Initially, 34 valley floor sites were chosen, and 14 mountain block sites were selected for sampling based on the potential for measureable flow and the possibility of obtaining a chemical sample. Site locations are shown in Figure 1, and where samples were obtained, depicted by water temperature in Figure 2. Spring sites were assigned an arbitrary number; for instance, springs in the valley floor were numbered Spring 1 through Spring 34, and springs in the mountain blocks were assigned numbers MBS1 through MBS14. Because, by necessity, selecting the spring sites took place prior to field investigation, the springs selected numbered more than was planned to be actually visited, and allowed for some flexibility in the field based on conditions observed. All of the spring sites where samples and field measurements were acquired were assigned a unique site identification number for reporting of data within the USGS National Water Information System (NWIS) database. The identification number is officially referred to as the NWIS Site Number, and consists of a string of numbers that represents the latitude and longitude of the feature.

During field work, two additional springs were noted that had flow that could be physically measured. These springs were added to the spring inventory retroactively, as Spring 35 and Spring 36. Spring 35 and 36 are discussed in the "Non-NWIS Springs" Section, and are monitored for flow. At this time, water quality samples have not been obtained at these two springs.

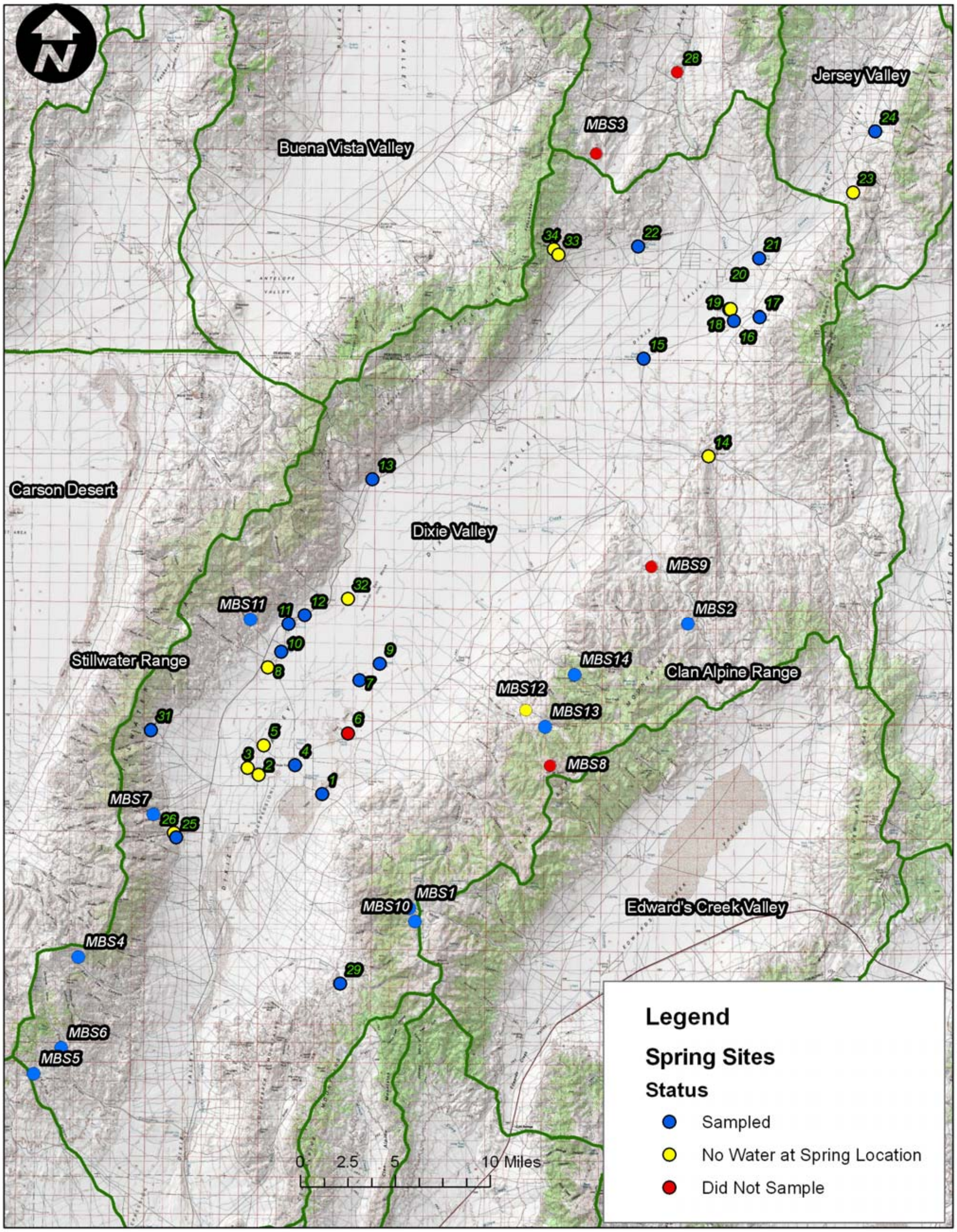


Figure 1: Spring sampling locations and sampling status

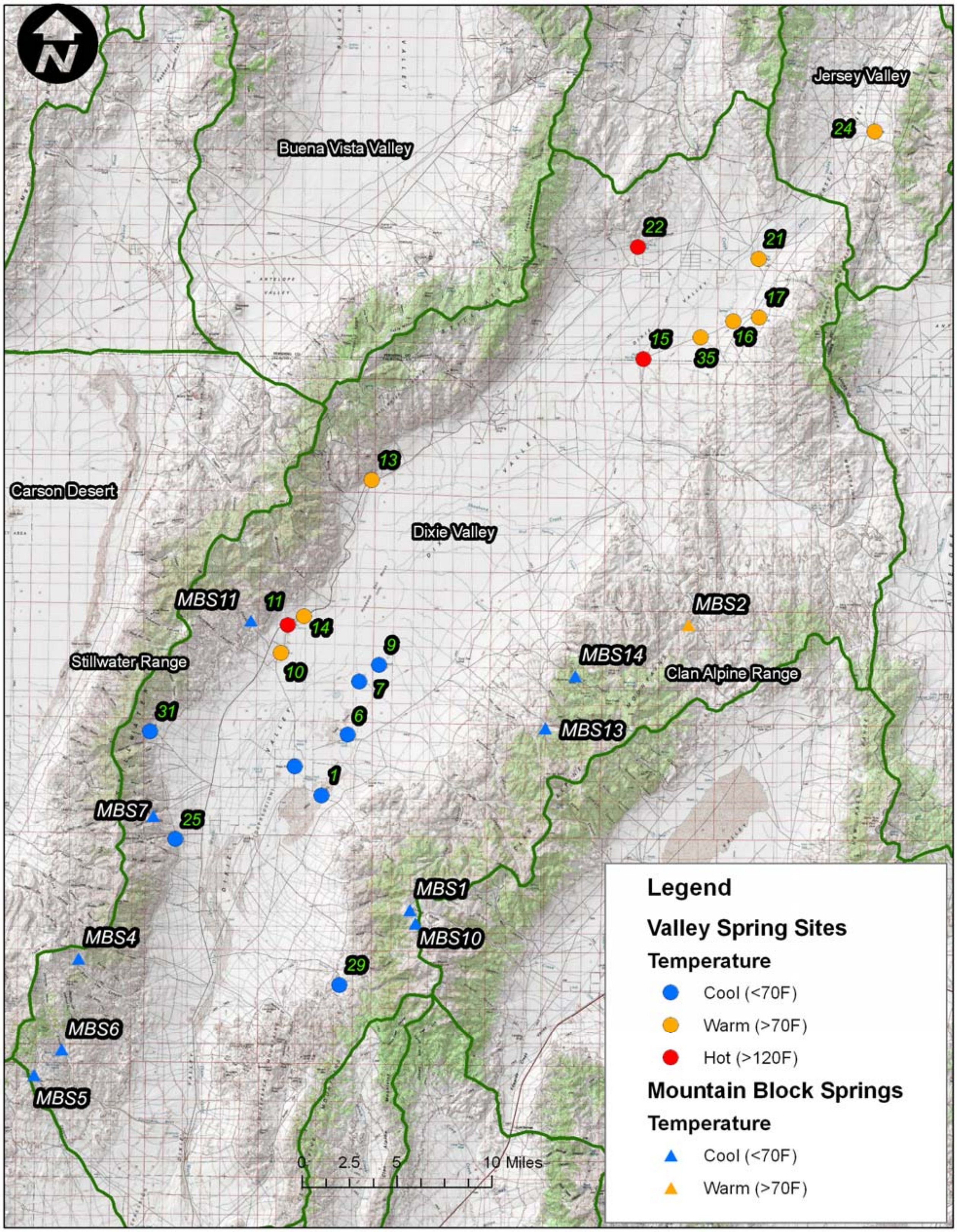


Figure 2: Springs sample locations sorted by geographic region and water temperature

SPRING RECONNAISSANCE NARRATIVE

Of the initial 34 valley floor sites selected for potential reconnaissance, 17 sites had flow that allowed for sampling, with the remainder either being dry, or not visited (Table 1 and Figure 1, Spring 6 in Eastern Dixie Valley, Spring 28, in Pleasant Valley). Of the mountain block springs, 11 of 14 potential sites were visited with 9 sites having enough flow to allow for sampling. The remaining three mountain block sites were not inspected because the goals for sping sampling numbers were already achieved, or because of schedule conflicts.

Table 1: Valley floor springs, coordinates, and sample status. [Northing and Easting are in NAD83, Zone 11 North, UTM meters, Elevation from DEM, rounded to nearest 5-foot interval]

Spring ID	Spring Name	Northing (m)	Easting (m)	Elevation (ft)	Status
1		4391084	411416	3470	Sampled
2		4392731	406048	3440	No Water
3		4393340	405096	3440	No Water
4		4393572	409120	3420	Sampled
5		4395233	406453	3410	No Water
6		4396239	413624	3420	Not Visited
7		4400744	414602	3385	Sampled
8		4401823	406818	3415	No Water
9	Buckbrush Spring	4402155	416303	3390	Sampled
10	Cold Springs	4403178	407951	3425	Sampled
11	Dixie Hot Spring	4405545	408559	3435	Sampled
12		4406292	409935	3425	Sampled
13		4417804	415665	3400	Sampled
14		4419773	444182	3905	No Water
15	Hyder Hot Spring	4428091	438701	3575	Sampled
16		4431304	446333	3740	Sampled
17	Lower Ranch Spring	4431613	448512	3955	Sampled
18		4432249	445964	3665	Not Enough Water to Sample
19		4432286	446061	3685	Sampled
20		4434567	446730	3670	Not Visited
21	McCoy	4436557	448484	3725	Sampled
22	7 Devils Hot Spring	4437568	438221	3705	Sampled
23	Jenkins Bros Spring?	4442188	456441	4220	No Water
24	Unnamed hot springs	4447394	458325	4530	Sampled
25	Willow? Spring	4387368	399021	3965	Sampled
26		4387781	398861	4000	No Water
28		4452936	442175	4165	Not Visited
29		4375004	412944	5195	Sampled
31		4396512	396884	4545	Sampled
32		4407696	413591	3385	No Water
33		4436877	431473	4570	No Water
34		4437341	431086	4825	No Water

VALLEY FLOOR SPRINGS

This section provides a brief narrative of site conditions at valley floor spring locations. Where possible, results of field parameters and flow conditions are provided. Only springs that were visited as part of this spring reconnaissance are mentioned in the following narratives. Summary information on spring data and chemistry are provided in Tables 3-6 following the descriptions of these springs.

SPRING 1

Spring 1 is located west/southwest of the settlement area in south-central Dixie valley, and is situated within a small sand dune field. The spring was observed to be an open, deep pool, sized approximately 8-10 feet in diameter. The spring pool was heavily trampled by livestock and the ground surrounding the spring was over-grazed and mostly barren in terms of vegetation. Water obtained from the spring pool was brown to grey, even after filtration. Temperature of the water was cool, at 44°F, and no spring flow could be observed or measured. The specific conductance of the sample was 726 mS/cm, field pH was 7.76, dissolved oxygen was 5.94 ppm, with field titration for alkalinity resulting in an average of 171 mg/L $CaCO_3$.

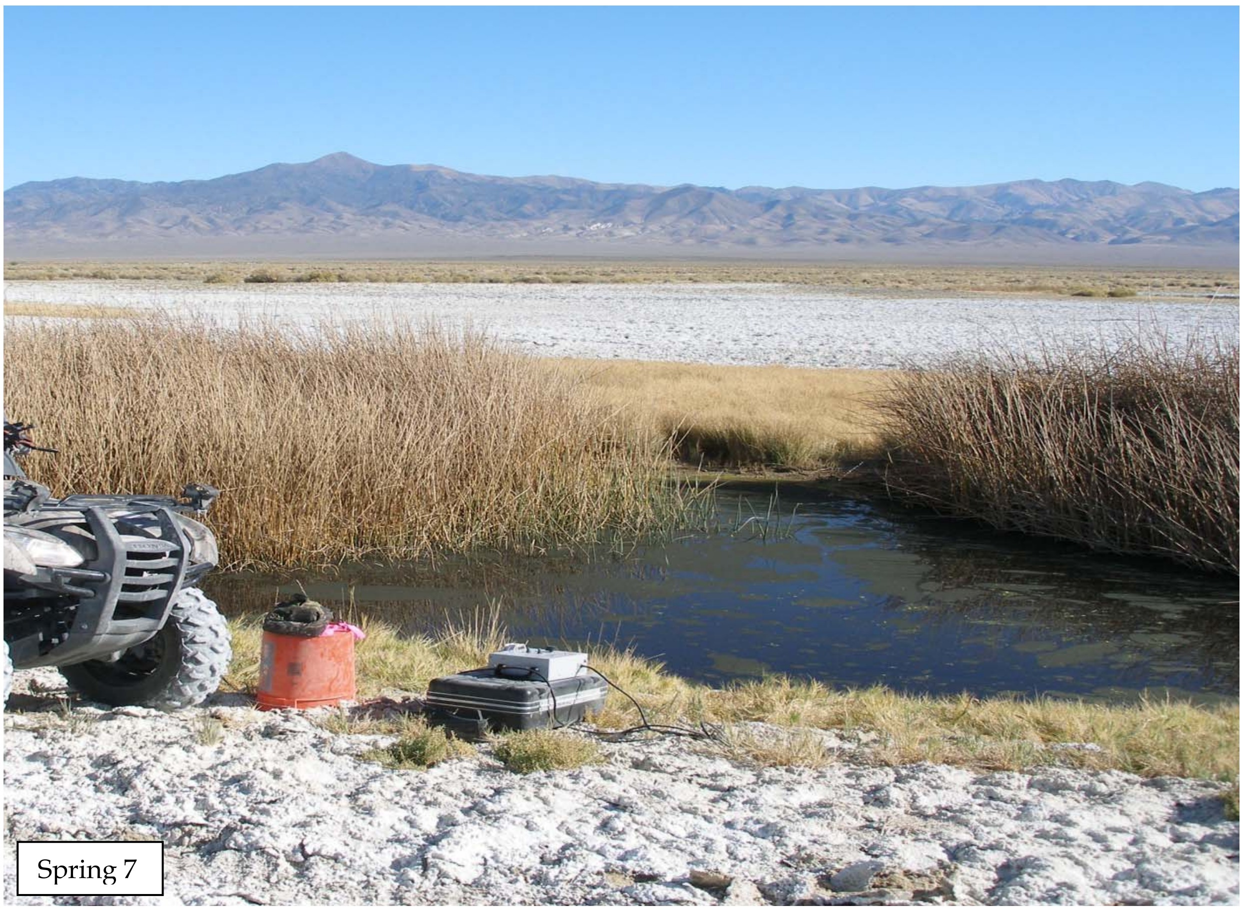
SPRING 4

Spring 4 is located slightly south of the main settlement area and can be accessed via a rough dirt and gravel road that is labeled as a military exercise route for armored vehicles. The spring emerges from a slight change in topographic grade at the edge of a small grass meadow, and in general, the spring is not heavily disturbed from livestock. Flow at the location is very slight (< 0.5 gpm, or <0.001 cfs); however, small ripples in the water could be observed from where the spring flow emerged. Field parameters and a sample were obtained at the location of ripples to best provide a representative sample of the spring. Specific conductance of the sample was 675 μS/cm, pH was 8.17, 40°F, and dissolved oxygen could was recorded as 14.62. Titration of the sample indicated an alkalinity of 170 mg/L as $CaCO_3$.

Spring 4

Spring 7

Spring 7 is located along the southeastern portion of the playa and is present in the form of a small pond, approximately 30 feet long and 10 wide, sporting abundant tule grass. The water color was a dark brown, and field personnel joked that the water should be called Tule Tea. Field parameters, obtained with the aid of weighted tubing from the bottom of the pool, indicated generally poor water quality with SC being 3480 uS/cm, and a pH of 9.14, and with a temperature of 51°F. Titration of the sample produced an alkalinity of 1030 mg/L $CaCO_3$. Flow into the spring pool could not be quantified at the location.



Spring 7

SPRING 8

Spring 8 is located along the extreme southern end of the spring line associated with Dixie Hot Springs. Although abundant grasses (dry and brown) were noted, no water could be located at the site.

SPRING 9

Spring 9 is locally referred to as Buckbrush Spring, and is located near the east side of the playa, bordering the playa and the alluvial fan/dune area to the east. The spring emerges as a small trickle (< 1 gpm, or ~0.002 cfs), and supports a small grass community. The site was disturbed by cattle, however, representative samples could be obtained from the spring head. Flow is very slight at the site and would be difficult to measure. Rather surprising given the spring's location, specific conductance was quite low at 484 uS/cm, indicating relatively fresh water compared to other springs near the playa. Field pH was 7.53, temperature was 65°F, and the sample titration produced a result of 118 mg/L as $CaCO_3$.

Spring 9

SPRING 10

Spring 10 is labeled as Cold Spring on USGS topographic maps, and is situated along the west side of Dixie Valley, due south of Dixie Hot Spring. The spring location is heavily vegetated with reeds, cattails, small trees, and other vegetation. Access to the spring consisted of carefully wading across the top of a thick "canopy" of reeds, excavating a hole through the grasses, and exposing an opening where significant (~100 gpm or 0.22 cfs ?) flow could be observed and a sample obtained, though it would be very difficult to quantify the flow from the spring. Field observation of the sample indicate that, contrary to its name, the spring is only cold relative to Dixie Hot Spring, as the temperature was still elevated above non-thermal springs at 84°F. Specific conductance of the sample was 1388 uS/cm, field pH was 7.78, and dissolved oxygen was 4.87ppm. The sample water smelled mildly like sulfur, and water clarity was good. Titration of the sample indicated an average alkalinity of 76 mg/L as $CaCO_3$.

Spring 10

SPRING 11

Spring 11 is referred to as Dixie Hot Spring and was sampled from the spring orifice located closest to State Route 121. Temperature of the sample was 137.3 F (58.5°C), specific conductance was 1009 uS/cm, and field pH was 8.52. The majority of surface flow from the spring channelizes and flows east toward the playa, and through a heavily vegetated area. Flow can be measured in the natural channel, and was measured at 191 gpm (0.43 cfs) on 10/23/2009, 177 gpm (0.38 cfs) in March of 2011, and 107 gpm (0.24 cfs) in June 2011. The sample, and the spring itself smell strongly of sulfur, and the sample had high clarity. An overview map of the Dixie Hotspring area is shown as Figure 3. A discussion of an estimate of the total groundwater discharge from the Dixie Meadows area appears later in this report.

Location where flow was measured is approximately 200 yards southeast of where the water quality sample was obtained.

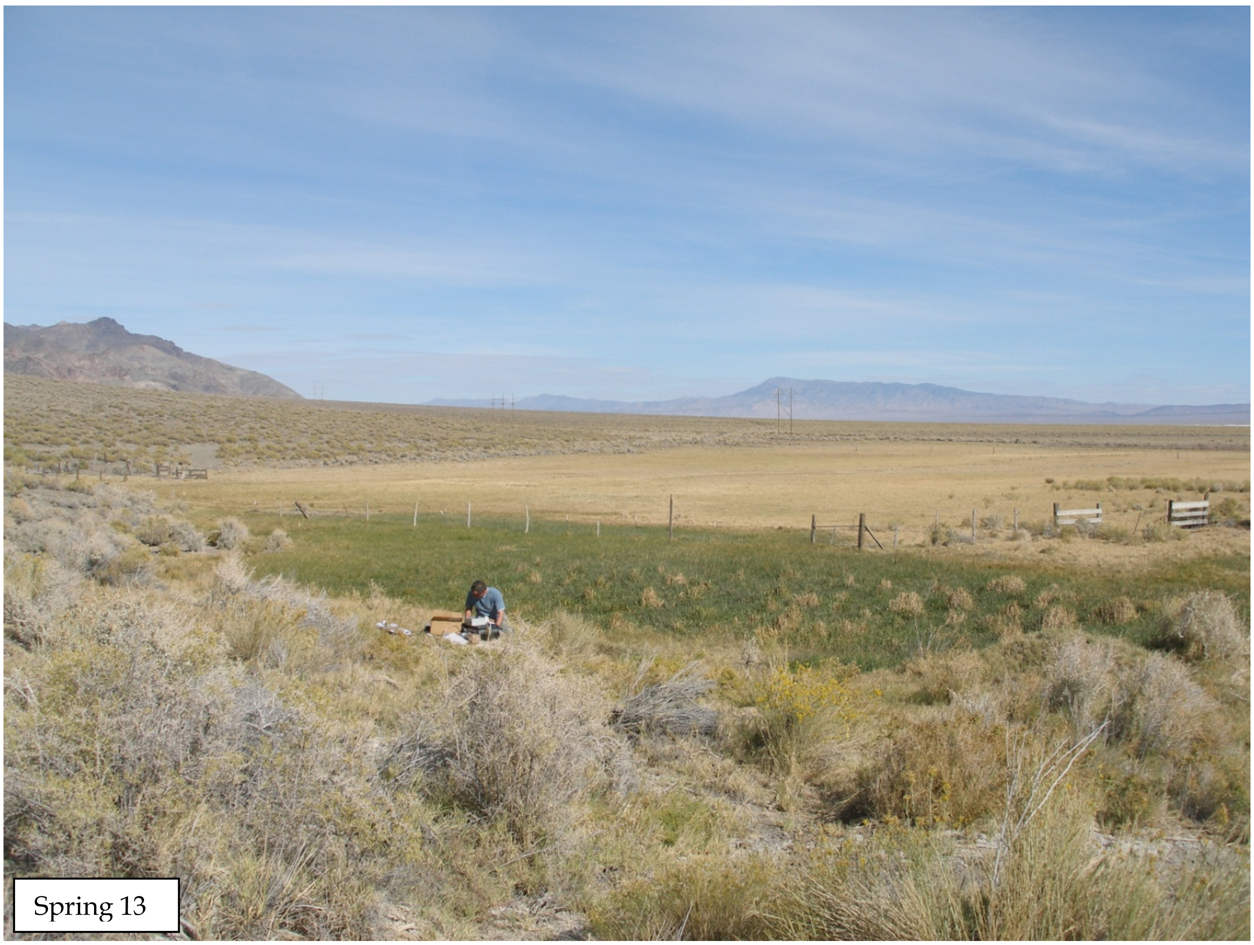
SPRING 12

Spring 12 is a small spring that emerges from a gated meadow area north of Dixie Hot Springs. In general, the spring is in excellent physical condition compared with other springs on the valley floor owing to the fact that it is in a fenced area and not subject to trampling by livestock. The sample was 78.8ºF, smelled slightly of sulfur, and returned field values of specific conductance and pH as 1150 uS/cm, and 7.78, respectively. Dissolved oxygen was 4.90 ppm, and titration of the same returned a value of 86 mg/L as $CaCO_3$. Spring flow is generally less than 3 gpm (<0.007 cfs) from seasonal observations.

Spring 12

SPRING 13

Spring 13 is located in western Dixie Valley along a fault scarp, and in an area where playa soils border on the mountain front. Two springs were located at this area, and sampling took place in the southern-most of the two. Both springs were impacted by cattle; however a representative sample could be obtained at the spring head. Sample temperature was 72°F, and specific conductance and pH were 2518 µS/cm and 7.49, respectively. Dissolved oxygen was 5.56, and the average alkalinity from titration was 172 mg/L as $CaCO_3$. The spring had a very mild sulfur odor, and water clarity was high. The total discharge of the two springs is on the order of 5 gpm (0.011 cfs) from a visual estimate.



Spring 13

SPRING 14

Spring 14 is located in a relatively remote canyon area in eastern Dixie Valley where volcanic rocks neck down and constrict the valley width. The spring site is at a location marked on USGS 7.5-minute topographic maps as "Hole in the Wall", in eastern Dixie Valley. Although no water was observed at the site, phreatophytic plants such as greasewood and rabbitbrush were present, as well as alkaline surface soils near the spring site. The spring may be seasonal in nature, and field evidence, such as abundant live grass, some greasewood and salt-encrusted soils, suggests that depth-to-groundwater at the location is probably less than 10-20 feet at the time of the site visit (10/14/2011).

Spring 14

SPRING 15

Spring 15 is locally referred to as Hyder Hot Spring, and discharges from several orifices along a fairly prominent tufa mound in north central Dixie Valley. Spring flow was measured at the most prominent channel discharging from a deep, hot pool, and equaled 16 gpm (0.036 cfs). Additional discharge occurs from an orifice at the top of the tufa hill, and could not be physically measured but the total discharge from the entire complex is roughly estimated at approximately 100 gpm. Utilizing weighted tubing, the sampling point was the bottom of the pool. Hyder Hot Spring recorded the second highest temperature of all springs measured at 141.6°F. Specific conductance was measured at 1525 μS/cm, with pH equal to 6.82. Dissolved oxygen content could not be measured because of the high temperature. The sample was clear, and both the sample and the spring complex had a very strong sulfur odor.

Spring 15

Location of discharge measurement for main pool at Hyder Hot Spring

SPRING 16

Spring 16 is in an area with dozens of similar springs that are presumably aligned on several fault scarps in northeastern Dixie Valley. All of the springs discharge very small quantities of water (estimated <1 gpm each) to the surface, and have similar field parameters (see section on Non-NWIS Springs). Spring 16 has the highest flow of these springs, and could be sampled. Sample temperature was 71°F, and specific conductance and pH were 1002 µS/cm and 7.33, respectively. Dissolved oxygen was 4.62 ppm, and the average alkalinity from titration was 346 mg/L as $CaCO_3$. The spring produced clear water with an extremely mild sulfur odor.

SPRING 17

Spring 17 is referred to as Lower Ranch Springs, and consists of 8 to 10 spring orifices along a very prominent fault scarp on the northeastern side of Dixie Valley. Spring flow is channelized into a single canal that passes through a short distance of pasture land and ultimately to a ranch home where the water is used for domestic purposes. The majority of the water eventually flows west into a large pond for irrigation and stock water. Field parameters were measured at a spring orifice in the center of the complex, and a flow measurement was obtained where all the flow coalesces. Field pH was 8.08, dissolved oxygen was 0.96 ppm, specific conductance was 940 µS/cm, and water temperature was 72°F. Flow was measured at 294 gpm (0.65 cfs), the largest flow measured from any spring or spring complex in Dixie Valley on October 23, 2009. On June 14, 2011, the flow was measured as 166 gpm (0.37 cfs). The water produced from the springs was clear and did not have a strong sulfur odor.

Spring 17

SPRING 21

Spring 21 is known locally as McCoy Spring or McCoy Hot Spring, and is located in north central Dixie Valley. The spring is a pool approximately 25-30 feet in diameter with calcareous matter and algae along the water surface and edges of the pool. Flow from the spring is diverted into an irrigation canal to the north by means of a headgate. At the headgate, the flow was measured at 0.54 cfs (242 gpm). Temperature of the discharge was 112.6°F, pH was 6.91, specific conductivity was 1390 µS/cm, and dissolved oxygen was measured at 0.40 ppm. The sample water was clear and produced a sulfur odor. Titration of the sample indicated an average alkalinity value of 262 mg/L as $CaCO_3$. This spring may be listed as 26/39-33c1 by Cohen and Everett (1963); if so, they estimated the discharge at 670 gpm (~1.5 cfs).

Spring 21

Location of flow measurement for McCoy Hot Spring.

SPRING 22

Spring 22 is known locally as 7 Devils Hot Spring or Sou Hot Spring, and is located in the extreme north/northwest of Dixie Valley in an area of exposed volcanic rocks. Several spring orifices are present at the location, as are sizable and somewhat spectacular tufa mounds and pools. The orifice with the most flow is located up gradient of a large pool (used for soaking). Using weighed tubing, a sample was obtained at the spring head located in a brush-filled gully. Water temperatures were the highest recorded from any spring by this effort in Dixie Valley at 144°F. Specific conductance of the sample was 1311 µS/cm, pH was 6.91, and dissolved oxygen could not be measured because of the high water temperature. Titration of the sample indicated an alkalinity of 240 mg/L as $CaCO_3$. Flow from the main discharge pool has been measured at 34 to 51 gpm (~0.076-0.113 cfs), with a total discharge estimate provided by Cohen and Everett (1963) as 100 gpm (0.22 cfs) for the entire complex.

Arrow indicates the location where the sample was obtained.

Location of discharge measurement for main pool at Seven Devils Hot Spring.

SPRING 24

Spring 24 is located in Jersey Valley and no colloquial name could be determined for the site. The spring is heavily altered and forms an oval-shaped pool with linear dimensions of approximately 70 by 50 feet. Flow is diverted by means of piping down to a small ranching operation to the south. Weighted tubing was used to obtain a sample from the bottom of the pool, and pH was measured at 7.17, specific conductance was measured at 1037 µS/cm, water temperature was 107°F, and dissolved oxygen was 3.4 ppm. Titration of the sample produced an average alkalinity value of 277 mg/L as $CaCO_3$. Outflow of the spring is diverted south via pipe, and was volumetrically measured at 49 gpm (0.11 cfs) on 10/24/2009.

Spring 24

SPRING 25

Spring 25 is known as Willow Spring or Mud Spring, and is located at the mountain front- basin interface along a very prominent fault scarp on the west side of Dixie valley. The spring hosts moderate vegetation and a small stand of cottonwood trees. Water quality at the spring, based on field parameters, was good, with specific conductance equal to 460 µS/cm, pH of 8.00, dissolved oxygen of 0.84 ppm, and a temperature of 60°F. The water was clear and free of apparent odor. Titration of the field sample indicated an alkalinity of 163 mg/L as $CaCO_3$. Flow at the site has been observed to vary between less than one gpm (< 0.002 cfs), and up to 6gpm (0.013 cfs). Historic measurements by Cohen and Everett (1963) indicate that the spring was dry on 6/12/1963. Zones (1957) describes a flow of less than 1 gpm (<0.002 cfs) prior to the 1954 earthquake. Immediately after the earthquake, flows were measured at 220 gpm (~ 0.51 cfs), which subsided to 16 gpm (0.036 cfs) one and one-half years after the earthquake.

Spring 29

Spring 29 is referred to as Horse Creek Ranch Spring and is located in Horse Creek Canyon, approximately 0.25 miles upstream of the mountain front stream gage for Horse Creek. The spring itself is located off of the main Horse Creek drainage, and is tributary to the creek. The spring head is located in a jumble of volcanic rocks and wet ground that supports a small grove of willows. Even though sampled as part of the "Valley Floor Springs", this spring should be considered a mountain block spring due to the geology, and geography at the spring source. Specific conductance of the sample was 156 µS/cm, pH was 8.01, temperature was 60°F, and dissolved oxygen was measured at 12.01 ppm. The dissolved oxygen reading is probably suspect as the location sampled, although the closest point to the spring head that could be achieved, was still approximately 25 feet from the presumed source, under a pile of boulders. The sample may be aerated/ agitated between its true source and the point sampled. Titration of the sample indicated an alkalinity of 49 mg/L as $CaCO_3$. Spring flow was impossible to measure at the site because flow occurred either under cobbles and boulders or as a distributed sheet over a wet meadow. A reasonable estimate for the discharge is on the order of 15- 20 gpm (~0.04-0.05 cfs).


Spring 29

SPRING 31

Like spring 29, spring 31 mostly resembles a "mountain block spring", and should be considered as such. The spring sits in a very tight, rocky canyon with exposed, shattered, light-colored (leucocratic) igneous rock similar to granite. The spring is used by wildlife and cattle, and is trampled. Spring flow was very small, much less than 1 gpm from visual estimate (<0.002 cfs). Field pH was 7.57, dissolved oxygen was 1.34 ppm, specific conductance was 2380 μS/cm, and water temperature was 8.7°C. The temperature was likely heavily influence by air temperature because of the minimal spring flow. Titration of the sample produced and average alkalinity of 236 mg/L as $CaCO_3$. Water from the spring was clear and odorless where not affected by wildlife.

Spring 31

SPRING 32

Spring 32 is shown as a spring/seep on USGS 7.5 minute topographic maps; however, no water could be located at the site. The seep may be seasonal, and is located northeast of Dixie Hot Springs along the edge of the playa in an area of moderate to thick density phreatophytic vegetation.

Mountain Block Springs

A second selection of springs, located in the mountain block regions of the Stillwater and Clan Alpine Ranges, were sampled between 11/15/2009 and 11/17/2009. With only a few exceptions, most of these springs are very remote, and require several miles of travel by off road vehicle in rugged terrain to reach, while some can be reached by reasonably good gravel roads. The springs in the mountain blocks were given field identifications of MBS1 through MBS14, with locations and sampling status provided in Table 2. Springs 3 and 8 were not visited due to time constraints and scheduling.

Table 2: Valley floor springs, coordinates, and sample status. [Northing and Easting are in NAD83, Zone 11 North, UTM meters, Elevation from DEM, rounded to nearest 5-foot interval]

ID	Spring Name	Northing (m)	Easting (m)	Elevation (ft)	Status
MBS1	Summit Springs	4381561.3	418769.4	7690	Sampled
MBS2	Lower Shoshone Springs	4405766.9	442394.4	4960	Sampled
MBS3	Kyle Springs	4446911.3	433185.9	6965	Not Visited
MBS4	East Lee Springs	4377467.3	390688.7	6680	Sampled
MBS5	La Plata Spring	4367531.2	386890.7	6015	Sampled
MBS6	Burnt Cabin Spring	4369717.4	389240.9	5990	Sampled
MBS7	East Job Canyon Spring	4389590.8	397034.2	4570	Sampled
MBS8	Deer Lodge Spring	4392546.5	430454.6	8015	Not Visited
MBS9	Shoshone Seep Spring	4410230.4	439314.1	4370	Not Sampled
MBS10	Keddie Springs	4380446.3	419249.3	7600	Sampled
MBS11	Unnamed Spring	4406135.5	405288.0	4270	Sampled
MBS12	Unnamed Spring	4398112.2	428714.5	4935	No Water
MBS13	Unnamed Spring	4396988.0	430268.4	5405	Sampled
MBS14	Bernice Creek Spring	4401405.3	432785.8	4880	Sampled

MBS1

MBS1 is located a high elevation site in the Clan Alpine Mountains and is approached from the east side of the range. The spring source emerged from a hill side composed of boulders and soil overburden. Water is collected through a PVC pipe and funneled down the hill for livestock use. The sample was obtained at the spring head, above the PVC pipe. Specific conductance of the sample was 189 µS/cm, pH was 7.21, temperature was 47°F, and dissolved oxygen was measured at 11.52 ppm. The spring water was clear and free of odor, and the sample titration indicated an average alkalinity of 51 mg/L as $CaCO_3$. Flow from the spring was visually estimated at 1 gpm or less (~0.002 cfs).

MBS2

MBS2 is referred to as Lower Shoshone Spring on USGS 7.5 minute topographic maps, and is located in a tributary drainage on the east side of the main Shoshone Canyon. The spring itself is located near the top of a wet meadow area with rolling topography. It was noted during field inspection that the water was rather warm, 84°F, even though the air temperature at the time of the site visit was recorded at 21°F. In addition, the spring, though located in the mountain block produced a sulfur odor commonly observed from the thermal springs in the valley floor. Specific conductance of the sample was 560 µS/cm, pH was 8.64, and dissolved oxygen was 2.53 mg/L. Titration of the sample produced an average result of 92 mg/L as $CaCO_3$. Spring flow is difficult to quantify at the site because of multiple orifices and spring heads.

MBS2

MBS4

MBS4 is referred to as East Lee Canyon Spring or East Lee Spring, and is located in a long, deep canyon in the Stillwater Range. The spring itself is located in a gravel and cobble-filled ravine, and is in a fairly pristine, undisturbed state at the spring head, although the channel is trampled in its lower reach. Water can be observed flowing within the gravel of the streambed, and was sampled at the highest possible point. Field pH was 7.71, dissolved oxygen was 11.34 ppm, specific conductance was 549 µS/cm, and water temperature was 49°F. The water was clear and odorless, and the average of two titrations produced a result of 115 mg/L $CaCO_3$. Because most of the flow from the spring was occurring below a bed of cobbles, the rate could not be quantified.

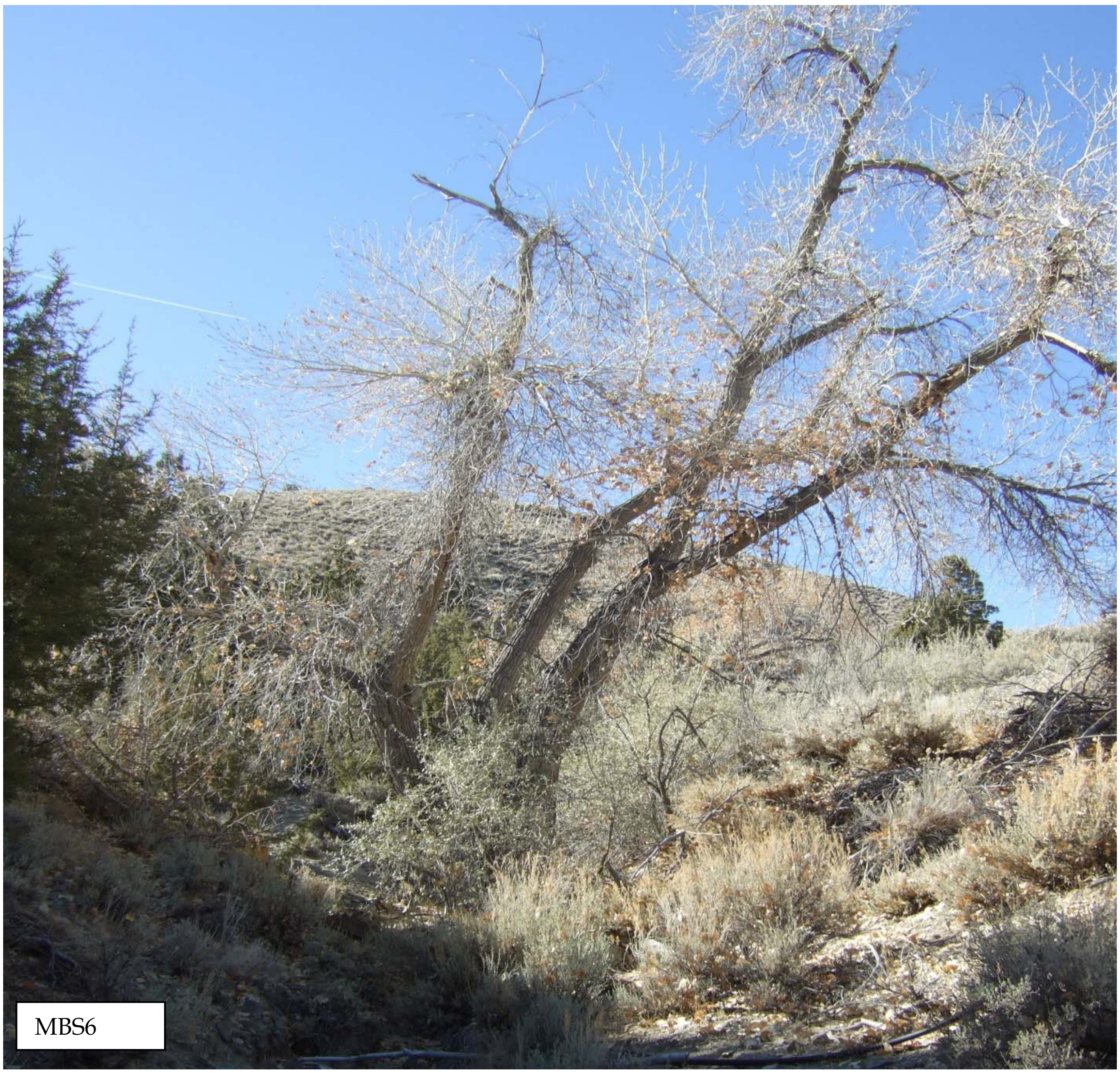
MBS5

MBS5 is known locally as La Plata spring, and is located adjacent to the gravel road and creek bottom OHV trail used to access the upper and lower La Plata precipitation gages. The spring itself has been altered by humans to convey flow from a hill side, through discharge piping, to a holding tank for stock watering purposes. The hillside where the spring originates from is steep and is composed of alluvium/colluvium, and is covered with a thin coating of salt crush from evaporation of the spring water. The only place to obtain a sample of the spring water is from the discharge pipe, which was producing cool, clear, and odorless water. Field parameters were as follows: specific conductance was 2430 µS/cm , pH was 7.40, water temperature was 46°F, and dissolved oxygen was 5.6 ppm. The titrations of the sample produced an average value of 201 mg/L as $CaCO_3$. Flow from the spring was approximately 1 gpm (~0.002 cfs) in November, 2009.

Arrow indicates where sample was obtained from pipe.

MBS6

MBS6 is referred to as Burnt Cabin Spring and is located in the Stillwater Range. The spring head is located where granitic rocks outcrop in a small channel next to several Cottonwood trees. The spring discharge at the time of the site visit was less than 1 gpm (<0.002 cfs), however a sample was obtained. Specific conductance of the sample was 1883 μS/cm, pH was 7.15, temperature was 46°F, and dissolved oxygen was measured at 5.99 ppm. The spring water was clear and free of odor, and the sample titration indicated an average alkalinity of 237 mg/L as $CaCO_3$.



MBS7

MBS7 is known as East Job Canyon spring, and is located in a very steep drainage bottom surrounded by hillsides composed of alluvium and colluvium. The spring was sampled at the highest possible location in thick brush, though it was noted that flow above the sample location was exposed to the atmosphere. Water temperature of the spring was 46°F, specific conductance was 960 μS/cm, pH was 7.50, and dissolved oxygen was measured at 9.82 ppm. It is likely that the dissolved oxygen may be inaccurately high. Flow could not be measured because of the brush, tight configuration of the channel, and the channel bottom irregularity. Titration of the sample produced an average result of 180 mg/L as $CaCO_3$.

Although field personnel did attempt to photograph this site, a faulty automatic lens protector produced poor image quality, therefore, no photos are available for this site.

Flow at MBS7 is quantified approximately 200 yards from the actual spring source in a ravine along the mountain block front/alluvian fan contact. The location was selected because channel conditions permit a flow measurement using a velocity-flow meter and/or volumetric methods, however, the flow measurements obtained may over-represent the spring discharge as the drainage is a gaining reach (obvious in the field) until at least the alluvial fan.

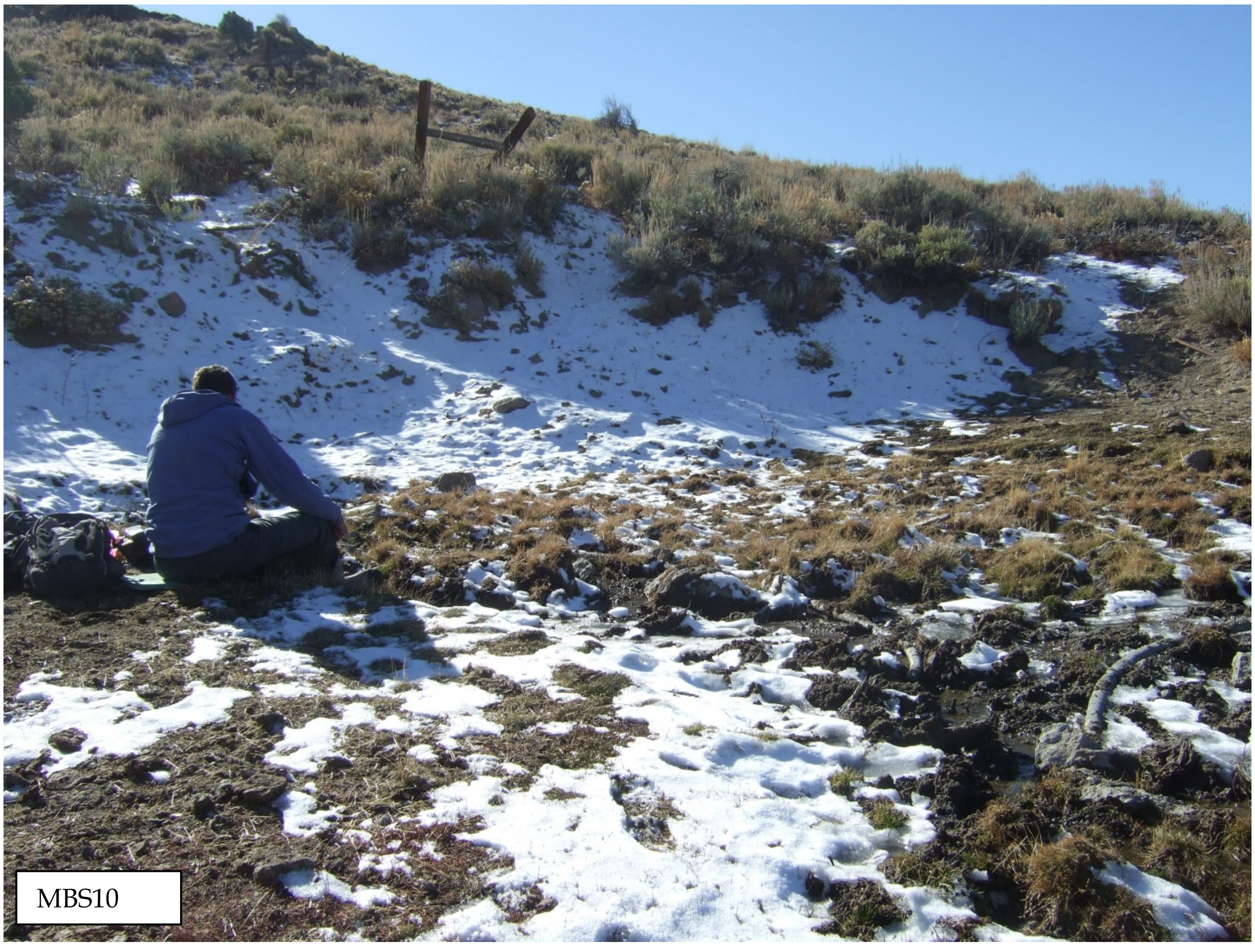
Flow, as measured in the stream channel below MBS7, has been observed to be seasonal with rates ranging from 10 to 33 gpm (0.02 – 0.07 cfs).

MBS9

MBS9 was selected because, during office reconnaissance, there were water rights filed on the spring, the spring appeared on topographic maps, and the spring is located in a foothills area above the valley floor. During the field visit, the spring was simply a mud and dung-filled hole that was heavily trampled by cattle. The spring was not sampled as part of the mountain block spring sampling program because it was determined that the results most likely would not be indicative of a spring in other upland areas of Dixie Valley, and any data generated from the spring would not be useful.

MBS10

MBS10, referred to as Keddie Springs, is located high in the Stillwater Range and represents a true high altitude mountain block spring. The spring is located on a hillside with juniper and sage, and is used for stockwatering in the warm weather months. The sample produced a specific conductance of 189 µS/cm, a pH of 7.18, a dissolved oxygen level of 12.65 ppm, and was 45°F. The water produced from the spring was cold, clear, and odorless. Titration of the sample indicated an average alkalinity of 50 mg/L as $CaCO_3$. Spring flow was estimated at less than 1 gpm (~0.002 cfs).


MBS10

MBS12

MBS12 is located in Deer Lodge Canyon in the Stillwater Range, and is situated in a creek bed with heavy brush, trees, and other vegetation. At the time of the site visit, no water could be located, but given the location and vegetation, it is likely that the spring is seasonal in nature, and may produce flow during the spring, or other times where the water table is higher than when visited by this study. Subsequent site visits have not been conducted to confirm or deny this assumption.

MBS13

MBS13 is also located in Deer Lodge Canyon, and is situated in small tributary valley to the east of the main canyon drainage. The spring emerges from an extremely thick tangle of vines and fallen trees near an exposure of metamorphic rocks where the side canyon necks down. The flow from the spring is appreciable, and was visually estimated to be 35-40 gpm (~0.08-0.09 cfs), though an actual measurement would be extremely difficult to obtain because of the thick overgrowth. A sample was obtained by lowering flexible tubing down to the spring source and through the thick overgrowth, and pumping the fluid to level ground. The water produced from the spring was cool, clear, and odorless. Titration of the field sample produced an average alkalinity of 172 mg/L as $CaCO_3$. Field pH was 7.31, specific conductance was 518 µS/cm, dissolved oxygen was 7.04, and water temperature was 53°F.

MBS13

MBS14

MBS14 is referred to as Bernice Creek Spring, and is located in Bernice Canyon in the Clan Alpine Range. The spring head is located in the channel bottom of Bernice Creek where a sandstone bed is exposed at land surface, and dips down-canyon. The water produced from the spring is cool, clear, and odorless, and was estimated to flow at 2-3 gpm (~0.01 cfs). Field pH of the sample was 7.52, dissolved oxygen was 5.61 ppm, temperature was 54°F, and the specific conductance was 1371 μS/cm. Titration of the sample produced an average alkalinity of 202 mg/L as $CaCO_3$.

Table 3: Summary of field parameters and titration results for Valley Floor Springs

Interflow Name	NWIS Site ID	Field Name	Temp F	SC uS/cm	pH	DO ppm	Date	Sample Time	Q cfs	Alkalinity as mg/L $CaCO_3$		
										Alk1	Alk2	AvgAlk
Spring 1	394000118020101		44	726	7.76	5.94	10/28/2009	1215	<0.01	172	170	171
Spring 3	394111118062801		-	-	-	-	10/28/2009	0812	0.00	-	-	-
Spring 4	394120118033901		40	675	8.17	14.62	10/28/2009	1120	<0.01	170	170	170
Spring 5	394213118053201		-	-	-	-	10/28/2009	1230	0	-	-	-
Spring 7	394515117595201		51	3480	9.14	1.42	10/25/2009	1457	<0.01	1030	1030	1030
Spring 9	394601117584101	Buckbrush Spring	65	484	7.53	11.67	10/25/2009	1545	<0.01	118	118	118
Spring 10	394631118043301	Cold Spring	84	1388	7.78	4.87	10/27/2009	1725	.25e	83	85	84
Spring 11	395322118040101	Dixie Hot Springs	137	1009	8.52	NA*	10/23/2009	1650	0.43	76	75.5	76
Spring 12	394813118031101		79	1150	7.80	4.9	10/30/2009	1332	0.07	86	86	86
Spring 13	395429117591501		72	2518	7.49	5.56	10/23/2009	1440	0.03e	178	166	172
Spring 14	395541117391501	Hole in the Wall Spring	-	-	-	NA	10/30/2009	0942	0.00	-	-	-
Spring 15	395959117423101	Hyder Hot Springs	142	1525	6.82	*	10/25/2009	1025	0.04	740	720	730
Spring 16	400155117374801		71	1002	7.33	4.62	10/30/2009	0950	<0.01	344	348	346
Spring 17	400205117361101	Lower Ranch Springs	86	940	8.08	0.96	10/24/2009	1630	0.65	340	338	339
Spring 21	400448117361301	McCoy Spring	113	1390	6.91	0.4	10/24/2009	1506	0.54	257	266	262
Spring 22	400517117432801	7 Devils Hot Spring	144	1311	6.91	*NA	10/24/2009	0937	0.08	237	244	240
Spring 24	401041117292401	Unnamed Hot Spring-Jersey	108	1037	7.17	3.4	10/24/2009	1405	0.11	279	275	277
Spring 25	393755118103901	Willow Spring	60	460	8.00	0.84	10/27/2009	1328	0.02e	165	162	163
Spring 29	393119118005001	Horse Ck Ranch Spring	57	156	8.01	12.01	10/30/2009	1510	0.05e	49	49.5	49
Spring 31	394251118121401		48	2380	7.57	1.34	10/27/2009	1515	<0.01	235	236	235.5
Spring 33	394900118003801			-	-	-	10/30/2009	0750	0.00	-	-	-
Spring 34	--*			-	-	-	10/30/2009	0812	0.00	-	-	-

All flow measurements were obtained either with a velocity-flow meter or volumetrically unless denoted with an "e" indicating a visual estimate or ;isted as having a flow of <0.01 cfs. Site 34 was never issued an official NWIS Site ID.

Table 4: Summary of field parameters and titration results for Mountain Block Springs

Interflow Name	NWIS Site ID	Field Name	Temp F	SC uS/cm	pH	DO ppm	Date	Sample Time	Q cfs	Alkalinity as mg/L $CaCO_3$		
										Alk1	Alk2	AvgAlk
MBS1	393452117564201	Summit Springs	47	189	7.21	11.52	11/17/2009	1030	<0.01e	50.5	50.5	50.5
MBS2	394749117402101	Lower Shoshone Springs	84	560	8.64	2.53	11/16/2009	0830	~0.01e	95.1	89	92.05
MBS4	393219118162001	East Lee Springs	49	549	7.71	11.34	11/15/2009	1605	<0.01e	109	120	115
MBS5	392704118185201	La Plata Spring	46	2430	7.40	5.6	11/15/2009	1040	<0.01e	202	200	201
MBS6	392758118171601	Burnt Cabin Spring	46	1883	7.15	5.99	11/15/2009	1325	<0.01e	237	236	237
MBS7	393911118113601	East Job Canyon Spring	46	960	7.50	9.82	11/16/2009	1540	0.05e	181	178	179.5
MBS9	395034117423201	Unnamed	-	-	-	-	11/16/2009	0802	-	-	-	-
MBS10	393431117562101	Keddie Springs	45	189	7.18	12.65	11/17/2009	1200	<0.01e	49.5	51.1	50
MBS12	394402117495101	Unnamed	-	-	-	-	11/17/2009	1222	-	-	-	-
MBS13	394317117485001	Unnamed	53	518	7.31	7.04	11/17/2009	1335	0.08e	172	171	172
MBS14	394537117470101	Bernice Creek Spring	54	1371	7.52	5.61	11/17/2009	0950	0.01e	205	198	201.5

All times are PDT, e = estimate; Q = flow, all were visually estimated

Table 5a: Summary of water chemistry from Valley Floor Springs
[data from USGS NWIS database, and is considered preliminary at this time]

Spring No.	USGS NWIS ID	Hardness, water, mg/L as $CaCO_3$	Ca, mg/L	Mg, mg/L	Na, mg/L	SAR	K, mg/L	Cl,mg/L	SO_4, mg/L	F, mg/L	Si02, mg/L	As, ug/L	Ba, ug/L
Spring 1	394000118020101	71.1	19.9	5.17	119	6.16	21.4	46.1	54.6	10.4	99.2	16.5	51.3
Spring 4	394120118033901	140	52.7	1.97	77.2	2.84	4.27	23.8	83	7.7	40.6	12	14.7
Spring 7	394515117595201	34.3	9.42	2.57	917	68.3	13.4	195	619	49.8	82.3	517	23.7
Spring 9	394601117584101	47.8	17.2	1.16	75.2	4.74	9.87	23.6	47.5	3.92	45.4	0.74	16
Spring 10	394631118043301	59.6	22.8	0.587	249	14	2.97	289	129	10.2	60.2	5.3	9.6
Spring 11	395322118040101	18.1	7	0.141	190	19.4	4.59	151	112	13.2	104	6.5	6.5
Spring 12	394813118031101	34	11.3	1.34	170	12.8	1.15	146	107	12.1	48.2	34.7	20.1
Spring 13	395429117591501	462	99.5	51.3	648	13.1	7.36	1170	228	0.75	37.1	35.8	69.5
Spring 15	395959117423101	155	46.1	9.23	316	11.1	21.4	47.1	119	7.74	59.2	25	143
Spring 16	400155117374801	163	41	14.4	155	5.29	12.8	31.6	75.8	3.44	38.7	7.5	71.7
Spring 17	400205117361101	135	32.4	13	143	5.35	11.9	27.5	67.1	3.32	35.6	6.9	82
Spring 21	400448117361301	320	78.7	29.4	185	4.51	9.2	206	187	1.66	32.4	12	61.4
Spring 22	400517117432801	365	106	20.7	160	3.71	27.9	72.4	370	4.78	56.9	9.5	58.2
Spring 24	401041117292401	85	27.8	3.59	181	8.57	19.3	61.1	104	8.57	125	23.7	126
Spring 25	393755118103901	132	43.2	5.63	45.5	1.73	1.8	42.9	45.1	0.41	20.7	1.2	15.3
Spring 29	393119118005001	38.4	12.2	1.91	16.6	1.17	0.89	7.29	7.28	0.2	23.9	1.3	12.2
Spring 31	394251118121401	821	586	272	33.2	258	41	2.55	258	719	1.56	27.4	15.6

Table 5b: Summary of water chemistry from Valley Floor Springs [data from USGS NWIS database, and is considered preliminary at this time], continued

Spring No.	USGS NWIS ID	Bo, ug/L	Cu, ug/L	Fe, ug/L	Pb, ug/L	Mn, ug/L	Sr, ug/L	Zn, ug/L	Li, ug/L	TSD, mg/L	Br, mg/L	dH, per mil	dO18/16	SC, uS/cm, lab
Spring 1	394000118020101	333	5.3	5020	6.59	493	154	23	179	637	--	-117	-14.57	759
Spring 4	394120118033901	282	< 1.0	E 5	E 0.02	7.3	284	11	126	419	--	-120	-14.66	678
Spring 7	394515117595201	4220	14.4	4730	5.41	170	127	23	73	2880	3.92	-112	-12.93	3860
Spring 9	394601117584101	324	< 1.0	31	0.04	8.2	115	< 5	62	307	0.05	-123	-15.68	447
Spring 10	394631118043301	1070	< 1.0	14	0.04	1.3	153	6	577	829		-127	-15.97	1450
Spring 11	395322118040101	983	< 1.0	25	0.15	6.6	47.3	7	453	648	0.23	-127	-15.99	969
Spring 12	394813118031101	1060	< 1.0	< 6	0.57	0.3	217	E 3	322	565		-127	-16.12	995
Spring 13	395429117591501	1160	2.3	26	0.13	3.5	1990	E 7	118	2450	1.25	-117	-14.68	4230
Spring 15	395959117423101	4410	< 4.0	53	< 0.12	21.9	1210	E 4	1700	1120	0.08	-133	-15.48	1690
Spring 16	400155117374801	1200	< 1.0	E 3	0.59	0.2	773	< 5	382	597		-130	-16.41	1020
Spring 17	400205117361101	1080	< 1.0	9	E 0.02	0.6	578	2.6	203	563		-129	-16.32	877
Spring 21	400448117361301	831	< 1.0	E 4	E 0.02	0.4	2200	8	256	894	0.32	-128	-16.15	1480
Spring 22	400517117432801	1440	< 1.0	28	0.05	48.4	13000	9	853	1010	0.12	-130	-15.88	1460
Spring 24	401041117292401	1560	< 1.0	7	0.09	151	647	9	1290	715	0.15	-129	-15.6	1010
Spring 25	393755118103901	248	1.2	6	0.14	6.9	374	E 3	22	289		-116	-14.94	502
Spring 29	393119118005001	84	E 0.56	13	< 0.03	1.5	98.2	E 3	7	102		-117	-15.47	155
Spring 31	394251118121401	24.4	1240	< 3.0	E 10	< 0.09	3.5	3830	11	236	2.44	-113	-14.07	2540

Times and dates of sampling are provided in Table 3.

Table 6: Summary of water chemistry from Mountain Block Springs [data from USGS NWIS database, and is considered preliminary at this time, E = estimate]

Spring No.	USGS NWIS ID	Hardness, water, mg/L as $CaCO_3$	Ca, mg/L	Mg, mg/L	Na, mg/L	SAR	K, mg/L	Cl, mg/L	SO4, mg/L	F, mg/L	$Si0_2$, mg/L	Fe, ug/L	Mn, ug/L	TSD, mg/L	Br, mg/L	dH, per mil	dO18/16	SC, uS/cm, lab
MBS1	393452117564201	44.9	13.3	2.83	17.8	1.16	1.3	12	12.9	0.1	23.8	11	2.3	117	0.04	-120	-15.85	180
MBS2	394749117402101	8.07	3.14	0.056	106	16.3	1.29	38.9	62.6	0.6	33	12	14.9	326	0.09	-129	-16.58	514
MBS4	393219118162001	147	54.1	2.9	42.2	1.51	0.82	50.3	48.9	0.14	16.6	<6	E 0.1	330	0.11	-117	-15.22	509
MBS5	392704118185201	1210	344	84.5	134	1.68	2.42	192	1030	0.55	21.8	< 12	< 0.4	2050	0.48	-120	-15.16	2540
MBS6	392758118171601	814	258	41.4	110	1.68	0.89	196	517	0.3	29.2	6	1.6	1390	0.47	-120	-15.09	1960
MBS7	393911118113601	253	79.9	12.9	91.4	2.5	3.13	106	91.6	0.26	21.7	62	75.5	564	0.2	-114	-14.49	914
MBS10	393431117562101	46.7	13.8	2.96	16.3	1.04	1.25	12	11	0.12	22.5	E 3	0.6	114	0.03	-121	-16.08	178
MBS13	394317117485001	175	49.8	12.4	32.3	1.06	1.62	17.9	43.6	0.3	22.8	< 6	0.2	339	0.04	-115	-14.97	486
MBS14	394537117470101	492	62.6	81.7	112	2.19	3.32	86.7	196	0.39	21.7	30	0.6	860	0.17	-111	-13.98	1370

NON-NWIS SPRINGS

SPRING 35

During the sampling and reconnaissance of springs in Dixie Valley, an additional spring site was cataloged because of its ease of access, and its measurable flow rate. The water was warm, at 83°F, specific conductance was 1610 µS/cm, and pH was 7.12. The spring is located at 444834 m East, and 4430753 m North along a gravel road that connects Hyder Hot Spring with Lower Ranch Spring. Flow was measured here in October, 2009 at 89 gpm(0.20 cfs), and as 82 gpm (0.18 cfs) in March, 2011. The spring has retro-actively been assigned the ID Spring 35. Spring 35 is shown on the maps of Dixie Valley produced by Cohen and Everett (1963)as spring 25/39-19b1, and had an estimated discharge on 6/7/1950 as 50 gpm (0.112 cfs).

The unnamed spring (Spring 35) located at 444834 m East, and 4430753 m North, feeds a small pond.

SPRING 36

Spring 36 is located approximately 3/4 mile northeast of Dixie Hot Spring and was added to the spring inventory because flow can be measured at the location with relative ease. The spring channel is mainly clear of vegetation and is approximately 2 feet wide, and is at UTM coordinates: 408715 E, 4406018 N, and is shown on Figure 3. Spring flow was measured at 0.08 cfs (37 gpm) in March of 2011. No photo is available for the site.

Estimates of Discharge from Major Spring Complexes

The major spring complexes in Dixie Valley include areas where groundwater discharge occurs from multiple spring sources. These include the Dixie Valley Hot Spring Complex, the Hyder Hot Spring Complex, Lower Ranch Spring, and two linear spring lines in northern Dixie Valley. Collectively these areas contain some of the largest natural groundwater discharge areas in the Valley, exceptions being the central playa and major phreatophyte areas. Most of these springs appear to be affected in some degree by circulating geothermal water.

Dixie Hot Spring Area

The Dixie Hot Spring area is composed of a series of hot and warm springs that are aligned along a northeast-southwest trending line along the western side of Dixie Valley (Figure 3). Discharge occurs from approximately 10-15 spring orifices, though many moremay be concealed by vegetation. For some of the spring areas, such as the main Dixie Hot Spring, and several springs to the northeast, discharge becomes channelized, and can be measured; however, in many locations, thick vegetation and dangerous conditions prevent the measuring of spring discharge from additional sources, and make providing an estimate of total discharge difficult.

The main discharge channel for Dixie Hot Spring can be accessed and physically measured, as can several springs to the north. In October of 2009 the main channel of Dixie Hot Spring was measured at 190 gpm (0.43 cfs). Subsequent measurements have observed flow of 107 and 237 gpm between 2009 and 2012.

A channel to the north of Dixie Hot Springs (Spring 36), has been measured at between 29 and 46 gpm between 2009 and 2012. Thick stands of Tule grasses, open water and juniper shrubs are common in the area, and Dixie Hot Springs complex contains around 75 acres of very wet, grass-covered ground. The total discharge for the entire area is difficult to determine, but may be on the order of 400-700 gpm, much of which is apparently consumed by evapotranspiration.

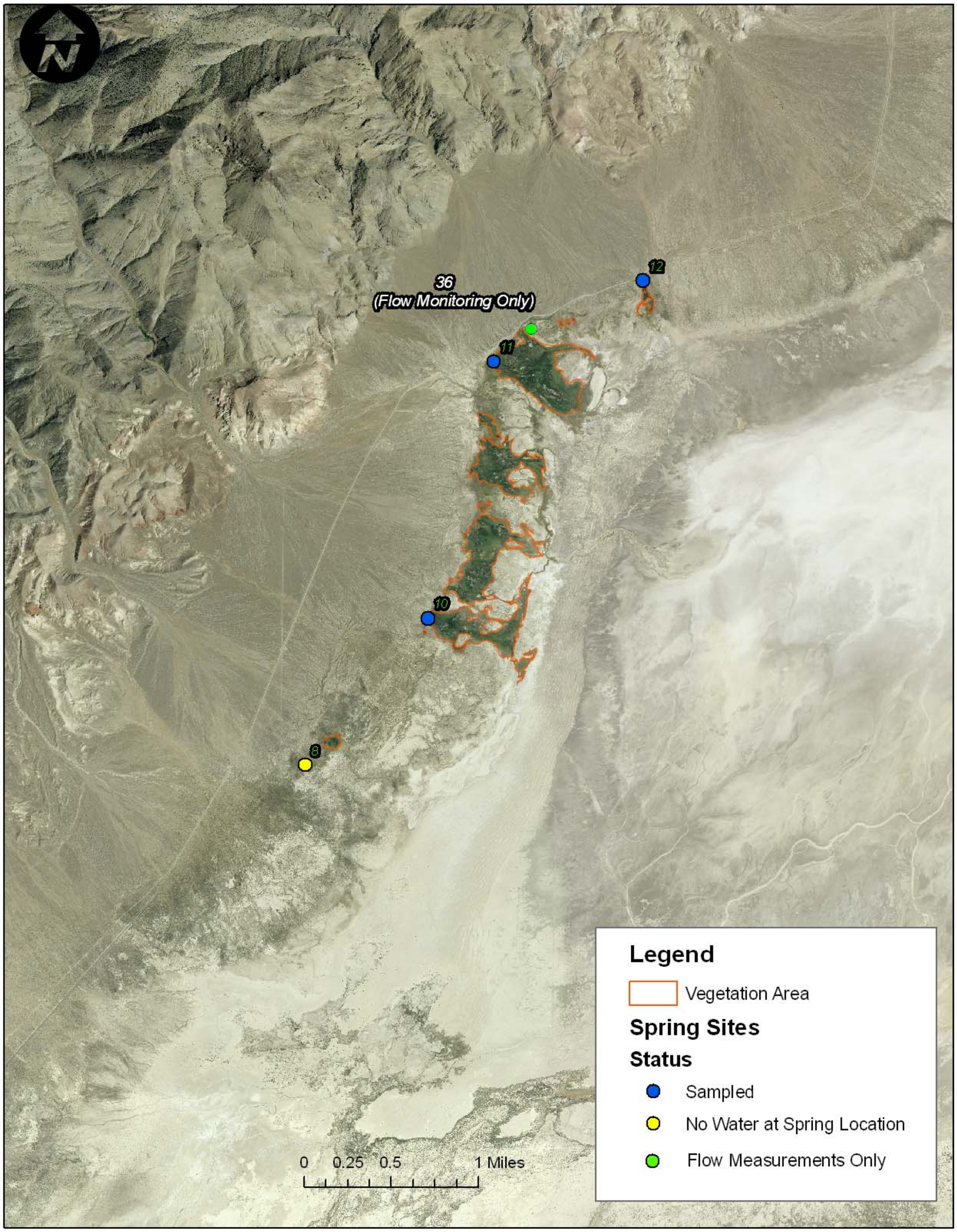


Figure 3: Dixie Hot Spring area, with areas of thick vegetation and spring discharge outlined in orange.

HYDER HOT SPRINGS

Flow from Hyder Hot Springs emits from one central pool and several tufa mounds with multiple discharge orifices. Flow from the main pool was measured as 0.04 cfs (16 gpm) in October, 2009, and as 0.06 cfs (27 gpm) in March, 2011. Estimates of the cumulative discharge from all sources measured and unmeasured probably are on the order of 60 gallons per minute for the entire complex.

LOWER RANCH SPRINGS COMPLEX

Lower Ranch Springs is a significant spring complex in Northwest Dixie Valley. As described previously, the, complex is aligned along a prominent scarp, and is composed of approximately 8-10 individual springs. The majority of all flow can be measured in a single canal that serves the ranch irrigation system. Flow was measured from the canal at 294 gpm (0.655 cfs), in March, 2011, at 166 gpm in June 2011, 151 gpm in October, 2011, and at 336 gpm in May, 2012.

Four distinct spring groups comprise the entire flow from the ranch area: 1) "The House Spring", 2) "Lower Ranch Spring", 3) "Upper Ranch Spring", and 4) an unnamed spring that is the southern most of all of the springs. The House Spring serves as the domestic water supply to the ranch house of the Stremler family and has a consistent flow of approximately 60 gpm, with any unused water flowing to a pond west of the ranch house. Lower Ranch Springs are the complex along the fault scarp that are channelized with flow measured between 166 and 336 gpm. The Upper Ranch Spring historically flowed south off the top of the fault scarp and into meadows, and had a flow of about 60 gpm. In early 2011, the flow was diverted into a pipe and conveyed down to a sprinkler irrigation system, and was measured at 100 gpm. The increase in flow from 60 to 100 gpm is most likely due to the efficiency of the pipe system and reduction of leakage and conveyance losses from the top of the fault scarp and alluvial fan to the meadow system. Finally, a fourth spring, south of the main scarp was estimated at 10 gpm in June, 2011. The total discharge of all springs at the Stremler Ranch is estimated to range from 340 -465 gpm, and may fluctuate seasonally.

UNNAMED SPRING COMPLEX IN NORTHERN DIXIE VALLEY

West of Lower Ranch Springs, two distinctive linear spring lines are very apparent on aerial photography (Figure 4). Field inspection revealed that the two spring lines, each about 2 miles long, contain dozens of small seeps and springs. Visual inspection of aerial photographs indicates approximately 140-160 small seeps. All of the springs had flow rates of around 1 gpm or less from visual estimate during field work, though not all springs were visited. Where the flow rate is slightly higher, or the density of the springs is sufficient, the area hosts thick grasses and juniper in moderate to light density. The total area of the meadow grass and juniper is 65-70 acres. The entire spring complex may discharge flows on the order of 150-200 gpm, however, it is believed that nearly all of the water is captured by evapotranspiration.

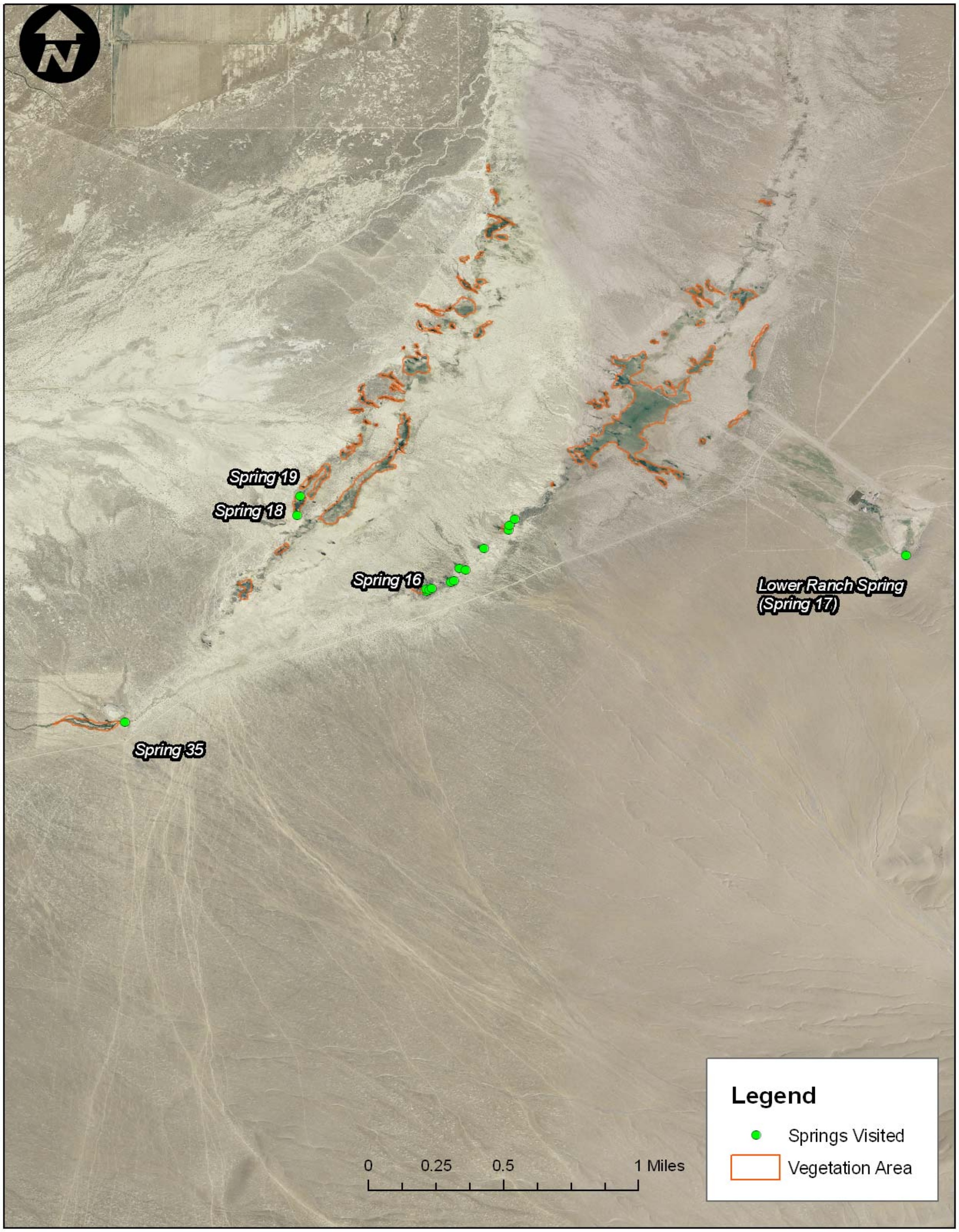


Figure 4: Northern Dixie Valley and prominent spring lines. Areas of wet, grassy vegetation away from the Lower Ranch Springs area are shown in orange.

QUARTERLY SPRING FLOW MEASUREMENTS

A spring flow monitoring program was established within Dixie Valley to monitor discharge of springs on a quarterly basis. Springs selected were chosen for the ability to either measure or observe flow, and to get a variety of cold and geothermal springs. It should be noted that nearly every valley floor spring in Dixie Valley is a warm spring to some degree, and cooler springs typically have very little flow. Actual flow measurements of some of the springs is difficult (and noted in Table 8), and values from those springs should be treated as an estimate.

Table 7: Locations of springs selected for quarterly flow monitoring

Name	IF	NWIS	EASTING (m)	NORTHING (m)	NOTES
Dixie Hot Springs	Spring 11	395322118040101	408479	4405745	Take measurement from a long channel SE of spring complex
unnamed	Spring 12	394813118031101	409855	4406493	Approx. 1 mile north of Dixie Hot Spring
Lower Ranch Springs	Spring 17	400205117361101	448432	4431814	
7 Devils Hot Spring	Spring 22	400517117432801	438141	4437769	
Willow Spring	Spring 25	393755118103901	398941	4387569	
East Job Canyon Spring	MBS 7	393911118113601	397034	4389590	Spring measurement obtained from channel ~400 yards downstream of spring head
unnamed	Spring 35	None	444834	4430753	Unnamed hot spring northeast of Hyder and south of Lower Ranch
unnamed	Spring 36	None	408715	4406018	NE of main Dixie discharge area

Table 8: Results of 2011 monitoring efforts, and comparison with 2009 measurements.

		October, 2009		3/8/2011		6/24/2011		10/26/2011		5/4/2012	
Name	IF	cfs	gpm	cfs	gpm	cfs	gpm	cfs	gpm	cfs	gpm
Dixie Hot Springs	Spring 11	0.43	190.8	0.39	176.8	0.239	107	0.36	162	0.53	237.4
unnamed	Spring 12	Small flow present		0.004e	2e	0.002	1.1	Small flow present (<<1gpm)		dry	dry
Lower Ranch Springs	Spring 17	0.655	294	No access		0.371	166	0.34	151	0.75	336
7 Devils Hot Spring	Spring 22	0.08	34	0.11	47.5	0.114	51	0.08	38	0.11	49
Willow Spring	Spring 25	Small flow present		0.009-0.013e*	4-6e*	0.002	0.9	0.004	2	0.015	6.5
East Job Canyon Spring	MBS 7	Not measured		0.07	33	0.023	10.2	0.008	4	0.058	26
unnamed	Spring 35	0.2	88.6	0.18	81.5	0.141	63	0.1	43	0.2	89.6
unnamed	Spring 36	Not measured		0.08	37.1	0.065	29	0.08	34	0.101	45.5

e = estimate due to difficult conditions, * = spring flow was measured by modifying the channel and using a 5-gallon bucket and stop watch. The range reflects differences in three measurements taken, and should be considered an estimate. MBS 7 was measured about 400 yards southeast of where it was originally sampled in order to get channel conditions that allowed for an accurate measurement. Access to Lower Ranch Spring could not be obtained in March, 2011 because the ranch owner was not home, and denied access via email.

References:

Cohen, P., and Everett, D.E., 1963. A brief appraisal of the ground-water hydrology of the Dixie-Fairview Valley area, Nevada, Ground-Water Resources – Reconnaissance Series Report 23, 40 p.

Zones, C. P., 1957 Changes in hydrologic conditions in the Dixie Valley and Fairview Valley areas, Nevada, after the earthquake of December 16, 1954: Seismol. Soc. America Bull., v.47, no. 4, p. 387-396