4.0 SURFACE WATER RESOURCES

The SNWA has studied and thoroughly described perennial streams of the study area in *Physical Settings of Selected Streams in Clark, Lincoln, and White Pine Counties Groundwater Development Project* (SNWA, 2007b). Selected springs and seeps have also been studied and thoroughly described in *Physical Settings of Selected Springs in Clark, Lincoln, and White Pine Counties Groundwater Development Project* (SNWA, 2007c). Electronic versions of the reports have been attached as Volume 2 (streams) and Volume 3 (springs) on the CD-ROM accompanying this report. This section provides an overview of the surface water resource information presented in the two reports.

4.1 Streams

Perennial streams within the Project Basins are principally found within Spring and Snake valleys. The Muddy River and Meadow Valley Wash are the principal drainages found within the larger study area. This report summarizes the perennial streams within Spring and Snake valleys and briefly describes the Muddy River and Meadow Valley Wash drainages. More detailed descriptions of the streams in these areas can be found in Volume 2 (SNWA, 2007b).

4.1.1 Streams Inventory

Data sources include published reports, published and preliminary data from the U.S. Geological Survey (USGS), and field investigations conducted by SNWA.

Investigations conducted by SNWA of the perennial streams included compilation of existing data and information, including published and unpublished reports and databases; photographic documentation; discharge measurements; and a written description of the physical setting of the stream, including a basic description of the surficial geology of each drainage area.

4.1.1.1 Discharge Measurements

Miscellaneous discharge measurements for perennial streams were compiled from:

- USGS National Water Information System (NWIS)
- USGS Water-Supply Papers regarding Surface Water Supply of the United States from 1914 to 1963
- Water Resources for Nevada annual data reports from 1964 to 2005

- Water Resources Bulletins and Biennial Reports, published by the Office of the Nevada State Engineer

- Reports prepared by Ertec Western, Inc. for the U.S. Air Force's MX Missile-Siting Investigation (Ertec Western, Inc., 1981a through e).

Data from these sources augment the miscellaneous discharge measurements conducted by SNWA since 1993. Suitable sites for SNWA's miscellaneous discharge measurements were selected based on access to the channel, channel geometry, bed material, and observations of flow.

Discharge ratings for gaging stations are calculated through a stage-discharge relationship developed by the USGS. Discharge measurements are made, and the observed stage during the measurement is recorded. Once a sufficient number of measurements are made, a rating cure is developed by plotting the stage against the discharge. Once this rating is developed, routine visits to the gaging station are made to measure the discharge and to verify the validity of the rating in use at that station. Mean daily discharges are computed using the gage height record (usually 96 or 24 measurements of stage) at the station in conjunction with the discharge rating. From these mean daily values, monthly and annual discharges and statistics are computed. If the stream channel is subjected to frequent changes, thereby affecting the stage-discharge relationship, then the discharge is computed using the shifting-control method, in which correction factors are applied to the stage-discharge relationship based on physical discharge measurements. A more detailed explanation of rating development and the computation of discharge records can be found in Rantz et al. (1982a and b).

In the study area, there are currently 15 active gaging stations: 7 on the Muddy River and its tributaries, and 8 elsewhere in the study area. The period of record varies greatly from station to station. Several of the streams have had gaging stations through the years. Published records of annual discharges including the mean, minimum, and maximum annual discharges are listed in this report by stream and station number.

4.1.1.2 Drainage Area Characteristics

Physical characteristics were determined for the drainage areas discussed in this report, using geographic information system (GIS) applications. All area calculations (including total drainage area, area above 8,000 ft-amsl, and minimum, maximum and average elevations) for each drainage area were derived using the National Elevation Data Set (USGS, 2006), which is a 30-m digital elevation model (DEM) maintained by the USGS. These values are reported in square miles. Stream length was determined by measuring the distance from the measurement site closest to the mountain block and above any diversions to the basin divide. This value is reported in miles. The channel slope was calculated by the same methods as used by Hess and Bohman (1996), Hess (2002) and Ries et al. (2007). The channel slope was measured at two points along the stream: at 10 and at 85 percent of the stream's total length, measured upstream from the measurement cross section nearest the mountain block and above any diversions. Stream slope is reported in feet per mile and was also derived using the National Elevation Data Set.

An estimate of the proportions of surficial geologic deposit lithologies was made. Using GIS applications and a digital version of the geologic map available in Volume 1, estimates of volcanic, clastic, metamorphic, carbonate, and intrusive rocks, and alluvial deposits were calculated.

4.1.2 Spring Valley

SNWA inventoried 27 perennial streams in Spring Valley, the locations of the measurement sites on these streams and the Cleve Creek gaging station are depicted in Figure 4-1 and listed in Appendix A of Volume 2. A majority of the streams in Spring Valley occur in the mountains along the northwestern side of the valley. Table 4-1 contains a listing of the physical characteristics of drainage areas in Spring Valley. The 27 streams are described in detail in Volume 2. As shown in Table 4-1 the average stream length in Spring Valley is approximately 4.4 mi with the longest being Cleve Creek at 11 mi. The average drainage area for the streams is approximately 6.4 mi^2 with Cleve Creek having the largest at 32 mi^2. The surficial geology of the drainage areas is dominated by either carbonate rocks or a combination of clastic and metamorphic rocks. Appendix C of Volume 2 contains 596 miscellaneous discharge measurements for 80 stream measurement sites within Spring Valley. Estimated average annual streamflows for the ungaged perennial streams are shown in Table 4-2.

The USGS maintains a gaging station (10243700) on Cleve Creek within Spring Valley. This gaging station has operated intermittently since 1914 and has a long-term mean annual discharge of 10.5 cfs. The mean annual discharge for this stream was 14.4 cfs in 2006 (USGS, 2006).

4.1.3 Snake Valley

SNWA inventoried 20 streams in Snake Valley, the locations of the measurement sites are depicted in Figure 4-2 and listed in Appendix A of Volume 2. A majority of the streams in Snake Valley occur within the mountains along the western side of the valley. Table 4-3 contains a listing of the physical characteristics of the 20 streams that are described in detail in Volume 2. As shown in Table 4-3 the average stream length in Snake Valley is approximately 8.4 mi with the longest being Big Wash at 15.3 mi. The average drainage area for the streams is approximately 15.7 mi^2 with Smith Creek having the largest at 56.2 mi^2. The surficial geology of the drainage areas is dominated by carbonate, clastic, or intrusive rocks. Appendix C of Volume 2 contains 179 miscellaneous discharge measurements for 74 stream locations within Snake Valley. Estimated average annual streamflows for some of the ungaged perennial streams in Snake Valley are shown in Table 4-4.

The USGS maintains several gaging stations within Snake Valley. The USGS-Utah District has published mean daily discharge values from June 2003 to present for the Granite Creek gaging station (10172875). The mean annual discharge for Granite Creek is 4.33 cfs (USGS, 2006). The USGS also operated a gage on Strawberry Creek from October 2003 through September 2004. A gage on Lehman Creek has operated intermittently since October 1947. The mean annual discharge for Lehman Creek is 5.67 cfs (USGS, 2005). Baker Creek has been measured by USGS at two different gaging stations. The Baker Creek near Baker, Nevada (10243250) gaging station operated from August 1913 to November 1916 with an average annual discharge of 19 cfs for the period of record (Wells, 1960). The second gage on Baker Creek was the Baker Creek at Narrows near Baker, Nevada

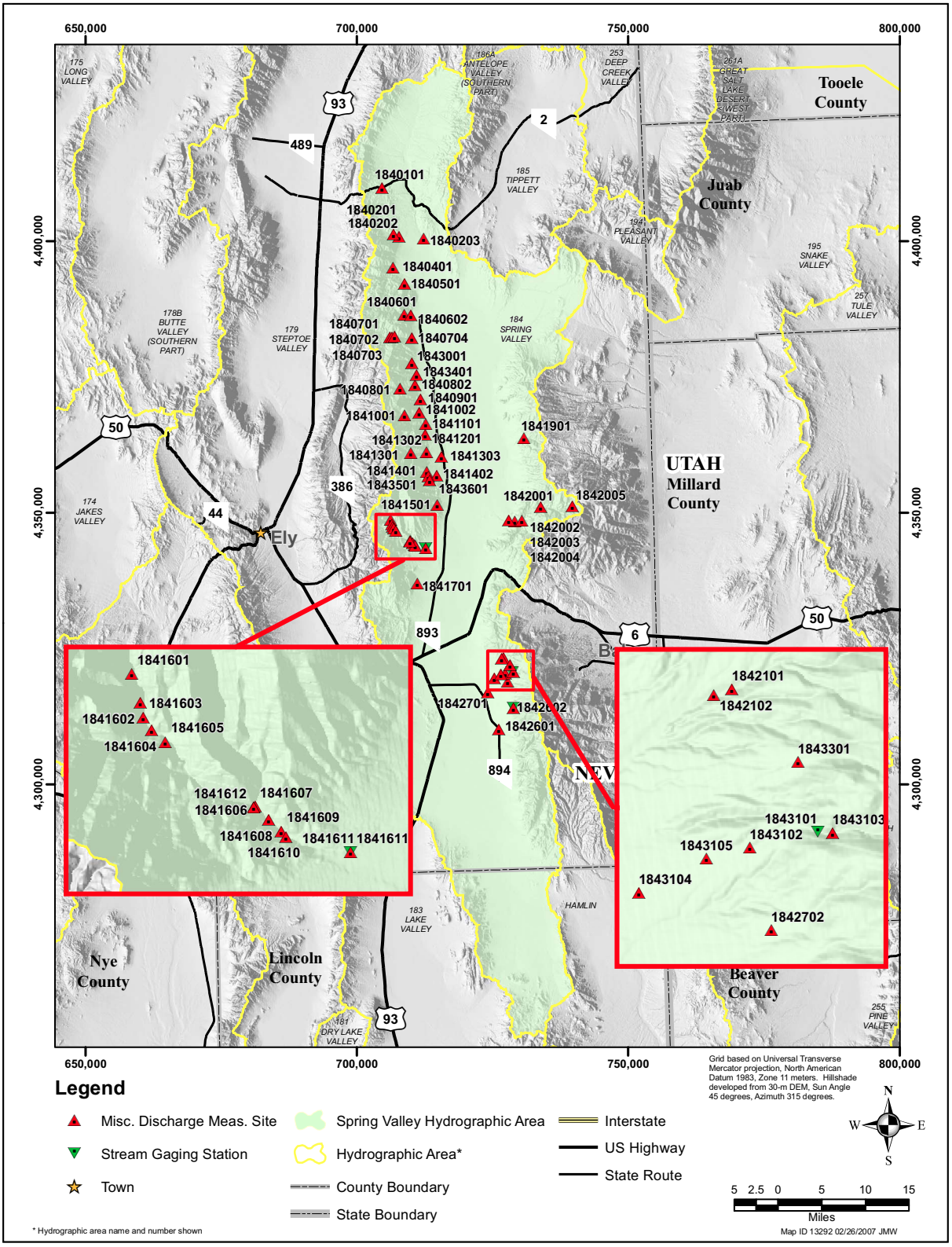

Figure 4-1
Measurement Sites on Streams in Spring Valley, White Pine and Lincoln Counties, Nevada

Table 4-1
Physical Characteristics of Drainage Areas in Spring Valley, NV--HA 184
(Page 1 of 2)

Site Name	Site Number	Stream Length (mi)	Slope (ft/mile)	Minimum Altitude (ft)	Maximum Altitude (ft)	Average Altitude (ft)	Total Area (mi^2)	Area Above 8,000 ft-amsl (mi^2)	Area Above 8,000 ft-amsl (%)	Alluvium (%)	Volcanic (%)	Carbonate (%)	Clastic (%)	Metamorphic (%)	Intrusive (%)
Siegel Creek	1840201	4.5	519	6,680	10,170	8,210	5.5	2.9	53	18	12	65	4	1	0
Frenchman Creek	1840501	4.1	487	6,520	8,970	7,700	4.8	1.3	27	4	33	63	0	0	0
North Creek at Sunkist	1840401	3.8	535	6,950	10,260	8,620	3.2	2.6	81	0	9	78	13	0	0
Muncy Creek	1840602	7.4	368	6,180	9,820	8,270	14	9.6	69	8	28	59	3	1	1
Kalamazoo Creek	1840704	7.1	362	6,220	10,900	8,250	14.6	9.3	64	4	40	39	13	4	0
Cooper Creek	1842501	7.6	262	6,520	10,730	7,820	25.9	8.7	34	8	16	60	16	0	0
Stage Canyon	1840101	5.5	296	6,550	9,060	7,440	8.6	1.2	14	56	28	16	0	0	0
Horse Canyon	1845201	3.3	475	7,020	9,770	8,210	2.1	1.4	67	4	0	84	12	0	0
Silver Creek	1840301	2.8	910	7,160	10,280	8,890	2.4	2	83	0	0	75	20	5	0
Trail Canyon	1844201	2.8	1,077	6,470	10,060	8,230	1.9	1.1	58	0	0	20	68	12	0
Fandango Creek	1842901	2.3	1,175	6,460	9,320	7,700	0.9	0.3	33	0	0	0	48	52	0
Meadow Creek	1843001	3.3	1,041	6,590	10,940	8,740	2.8	2.2	79	0	0	34	44	22	0
Rams Horn Canyon	1844001	3.1	1,225	6,750	10,920	8,560	1.3	0.9	69	0	0	8	54	38	0
North Creek above Robinson	1843401	3.5	1,033	6,620	10,890	8,820	2.7	2	74	0	0	23	47	30	0
Piermont Creek	1840802	5.4	656	6,510	11,070	8,900	7.5	6.1	81	0	0	19	54	27	0
Garden Creek	1840901	3.2	1,306	6,250	10,830	8,400	2.9	1.8	62	0	0	0	12	88	0
Bassett Creek	1841002	4.6	852	6,600	11,880	9,440	6.3	5.4	86	0	0	0	65	35	0
Little Negro Creek	1841101	4	1,183	6,320	11,810	8,610	3	2	67	0	0	0	32	68	0
Odgers Creek	1841201	4.1	1,005	6,500	11,790	9,140	3.9	3.2	82	11	0	0	49	40	0
McCoy Creek	1841302	4.2	898	6,620	11,770	9,400	6.2	5.3	85	10	0	0	53	37	0
Taft Creek	1841401	4.1	991	6,980	11,740	9,800	4.3	4	93	20	0	0	55	25	0

Table 4-1
Physical Characteristics of Drainage Areas in Spring Valley, NV--HA 184
(Page 2 of 2)

Site Name	Site Number	Stream Length (mi)	Slope (ft/mile)	Minimum Altitude (ft)	Maximum Altitude (ft)	Average Altitude (ft)	Total Area (mi^2)	Area Above 8,000 ft-amsl (mi^2)	Area Above 8,000 ft-amsl (%)	Alluvium (%)	Volcanic (%)	Carbonate (%)	Clastic (%)	Metamorphic (%)	Intrusive (%)
Ranger Creek	1843501	3.3	1,332	6,570	11,460	8,490	1.6	1.1	69	20	0	0	20	60	0
South Taft Creek	1843601	3.3	1,179	6,570	11,730	9,190	3.2	2.3	72	37	0	0	41	22	0
Stephens Creek	1841501	3.3	1,346	6,560	11,480	8,970	2.9	2.2	76	0	0	0	58	42	0
Cleve Creek	1841611	11	391	6,200	11,760	8,860	31.8	23.2	73	2	0	41	57	0	0
Bastian Creek	1841701	3.4	989	6,360	10,450	8,180	2.7	1.4	52	1	0	99	0	0	0
Eight Mile Creek	1841901	2.8	769	6,570	9,330	8,090	3.1	1.8	58	3	0	13	68	0	16
Negro Creek	1842003	9.6	359	6,200	12,010	8,220	27.4	15.1	55	9	0	78	13	0	0
Willard Creek	1842101	3.3	723	6,980	11,510	8,830	3.8	3.1	82	10	0	0	1	76	13
Board Creek	1843301	3.1	1,364	7,370	11,550	9,060	0.8	0.7	88	13	0	0	1	81	5
Shingle Creek	1843103	3.3	1,179	7,400	11,730	9,550	2.2	2	91	5	0	0	6	88	1
Swallow Creek	1842201	3	1,201	6,380	10,890	8,470	3.5	2.3	66	2	0	98	0	0	0
Dry Canyon	1842601	3.3	1,209	7,150	11,730	9,630	2.9	2.6	90	0	0	4	96	0	0
Pine and Ridge Creeks	1842701	3.4	1,532	7,190	12,930	9,100	4	3	75	14	0	0	15	64	7
Williams Canyon	1842801	3.2	1,048	7,340	11,760	9,680	3.2	3	94	1	0	0	49	0	50

Table 4-2
Estimated Average Annual Streamflow for Ungaged Perennial Streams Within Spring Valley

Station Number	Stream Name	Average Annual Streamflow (cfs)
1840201	Siegel Creek	1.03
1840401	North Creek	1.24
1840501	Frenchman Creek	0.54
1840602	Muncy Creek	1.90
1840704	Kalamazoo Creek	6.00
1840802	Piermont Creek	1.68
1840901	Garden Creek	0.39
1841002	Bassett Creek	4.99
1841101	Little Negro Creek	0.86
1841201	Odgers Creek	2.37
1841302	McCoy Creek	6.74
1841401	Taft Creek	2.62
1841501	Stephens Creek	1.04
1841701	Bastian Creek	2.75
1841901	Eight Mile Creek	0.98
1842003	Negro Creek	2.62
1842101	Willard Creek	0.92
1842201	Swallow Creek	7.65
1842601	Dry Canyon and Williams Canyon	1.02
1842701	Pine and Ridge Creeks	1.18
1843001	Meadow Creek	0.78
1843101/02	Shingle Creek	0.96
1843301	Board Creek	0.03
1843401	North Creek	0.01
1843501	Ranger Creek	0.06
1843601	South Taft Creek	0.69

(10243240) gaging station. This gage was in operation from October 1947 to September 1955 and October 1992 to September 1997. The average annual discharge for the period of record was 9.08 cfs (USGS, 2006).

4.1.4 Muddy River and Meadow Valley Wash

The Muddy River drains parts of central, southern, and eastern Nevada and is the relic portion of the White River. The total drainage area before the Muddy River discharges into Lake Mead is over 8,000 mi^2, and can be divided into two main drainage sub-areas: the Muddy River and Meadow Valley Wash. The Muddy River drainage area extends from Coyote Spring Valley (HA 210), which is

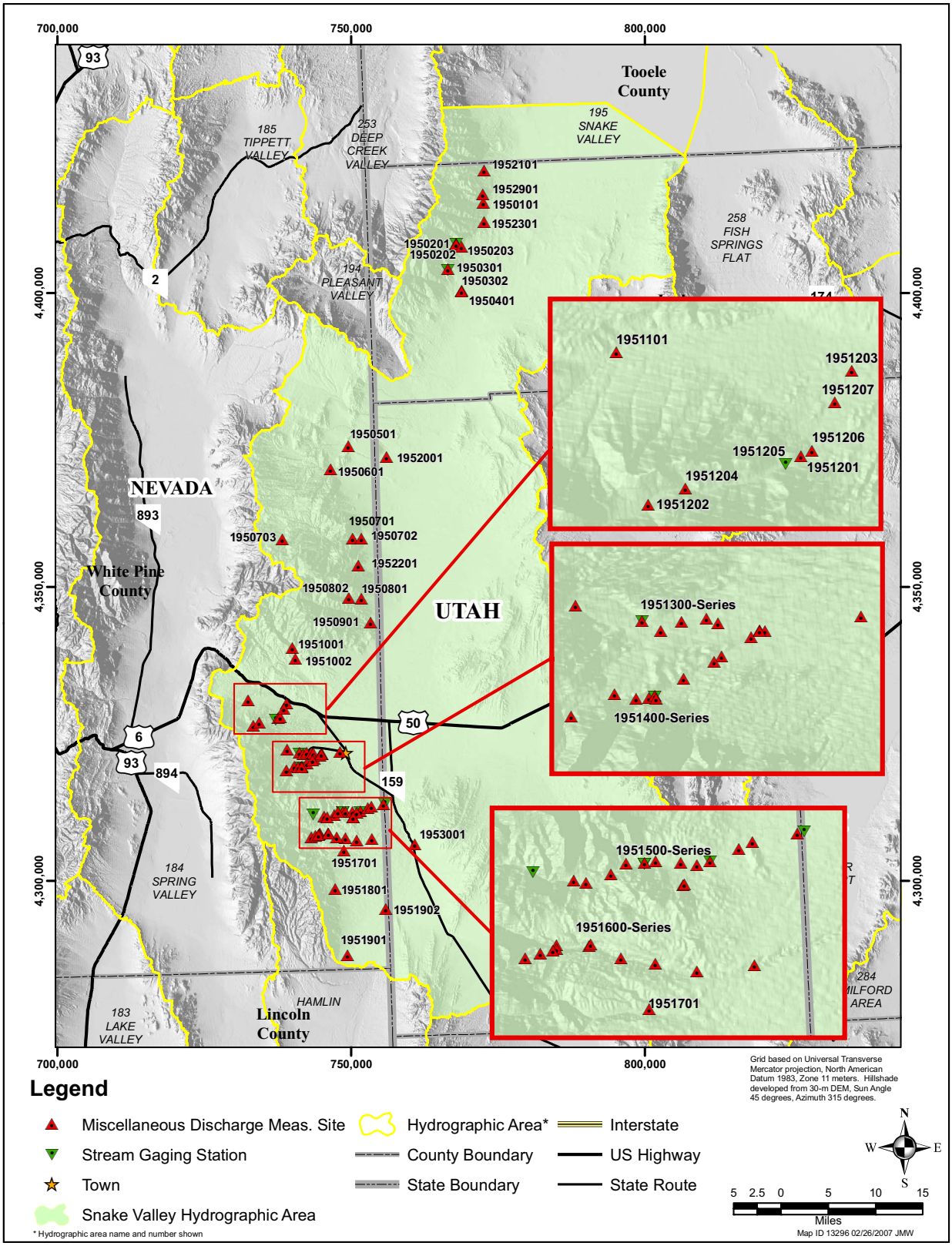

Figure 4-2
Measurement Sites on Streams in Snake Valley, Nevada and Utah

Table 4-3
Physical Characteristics of Drainage Areas in Snake Valley, NV and UT--HA 195

Site Name	Site Number	Stream Length (mi)	Slope (ft/mile)	Minimum Altitude (ft)	Maximum Altitude (ft)	Average Altitude (ft)	Total Area (mi^2)	Area Above 8,000 ft-amsl (mi^2)	Area Above 8,000 ft-amsl (%)	Alluvium (%)	Volcanic (%)	Carbonate (%)	Clastic (%)	Metamorphic (%)	Intrusive (%)
Indian Farm Creek	1950101	5.6	1,112	5,515	11,995	8,536	5.6	3.3	58	20	0	0	0	0	80
Granite Creek	1950201	5	877	6,346	12,066	9,073	8.1	6	73	17	0	0	3	35	45
Birch Creek	1950401	8.7	540	5,206	11,291	8,624	9.7	7.1	73	8	0	0	92	0	0
Lehman Creek	1951306	8.1	574	6,399	13,034	9,333	11.4	8.9	78	33	0	1	55	9	2
Lexington Creek	1951701	7.5	375	6,393	10,992	8,074	11.7	6	51	16	0	67	1	0	16
Trout Creek	1950301	6.2	617	6,191	11,562	9,199	8.4	6.8	81	20	0	0	0	80	0
Strawberry Creek	1951201	6.2	530	6,735	11,514	8,850	7.8	6	76	14	0	0	20	44	22
Weaver Creek	1951101	4.1	589	6,794	10,134	8,127	6.6	3.3	50	21	0	0	17	44	18
Swan Creek	1950501	13	209	5,838	9,563	7,131	23.9	3.4	14	16	0	84	0	0	0
Smith Creek	1950701	13.7	220	5,667	12,036	8,492	56.2	39.6	70	2	0	62	33	0	3
Snake Creek	1951508	14.2	299	5,560	11,861	7,996	28.4	14	49	14	0	40	19	0	27
Big Wash	1951606	15.3	218	5,873	11,646	8,369	27.9	16.1	58	24	0	72	2	0	2
Marble Wash	1950601	10.4	281	6,102	10,088	7,957	22.1	9.7	44	0	0	98	2	0	0
Hampton Creek	1950802	5.7	767	6,388	11,026	8,830	7.5	5.6	74	0	0	37	63	0	0
Hendrys Creek	1950901	10.6	471	5,640	12,041	8,989	23.6	17.6	75	0	0	38	62	0	0
Silver Creek	1951002	8.4	240	6,481	11,797	8,805	23	19.2	83	0	0	61	10	0	29
Baker Creek	1951407	8	402	6,590	13,064	9,518	16.8	14.3	85	1	0	5	77	0	17
Red Cedar Creek	1952301	6.7	927	5,360	12,070	9,060	6.2	4.5	73	24	0	0	0	0	76
Toms Creek	1952901	8.1	622	5,060	11,680	8,530	6.7	4.2	63	4	0	0	0	0	96
Choke Cherry Creek	1951801	3	738	6,669	9,797	8,132	2.5	1.4	55	0	0	100	0	0	0

Table 4-4
Estimated Average Annual Streamflow for Perennial Streams within Snake Valley

Station Number	Station Name	Average Annual Streamflow
1950101	Indian Farm Creek near Callao, UT	4.24
1950401	Birch Creek above Trout Creek near Trout Creek, UT	4.39
1950701	Smith Creek above Diversion and Trail Head	4.66
1950801	Hampton Creek above Forest Boundary	0.728
1950901	Hendrys Creek at Bridge to Rock Quarry	2.62
1951002	Silver Creek 0.8 miles above Forest Boundary	5.10
1951101	Weaver Creek above Sage Creek	0.383
1951201	Strawberry Creek at National Forest Boundary	1.46
1951508	Snake Creek (Site 8)	9.50
1951605	Big Wash at Hidden Canyon Guest Ranch	1.44
1951701	Lexington Creek at National Forest Boundary	0.226

drained by Pahranagat Wash, then enters Arrow Canyon and finally joins the Muddy River in the Muddy River Springs Area (HA 219). The second drainage area is the Meadow Valley Wash drainage area. This area drains Spring Valley (HA 201), Eagle Valley (HA 202), Dry Valley (HA 198), Panaca Valley (HA 203), Clover Valley (HA 204), and Lower Meadow Valley Wash (HA 205). Below the confluence with Meadow Valley Wash, the Muddy River drains California Wash (HA 218).

The Muddy River is a perennial stream from its source springs near Moapa, Nevada, until completely diverted at Wells Siding by the Moapa Valley Irrigation Company. The flow is steady throughout the year except when affected by floods. While floods are infrequent events on the Muddy River, they can greatly influence annual discharge totals.

Gaging stations have been operated on the Muddy River and its tributaries since the early 1900s. The gaging stations have been described in Volume 2 and their locations are shown on Figure 4-3. Annual discharges for the gaging stations are reported in Appendix B of Volume 2.

4.2 Springs

Springs are found within all of the Project Basins but in greater numbers in Spring and Snake valleys than in Cave, Dry Lake, Delamar, and Coyote Spring valleys. The sections that follow provide a summary of the springs documented in the Project Basins. Additional descriptions and details for these springs as well as additional springs within the larger study area are provided in Volume 3.

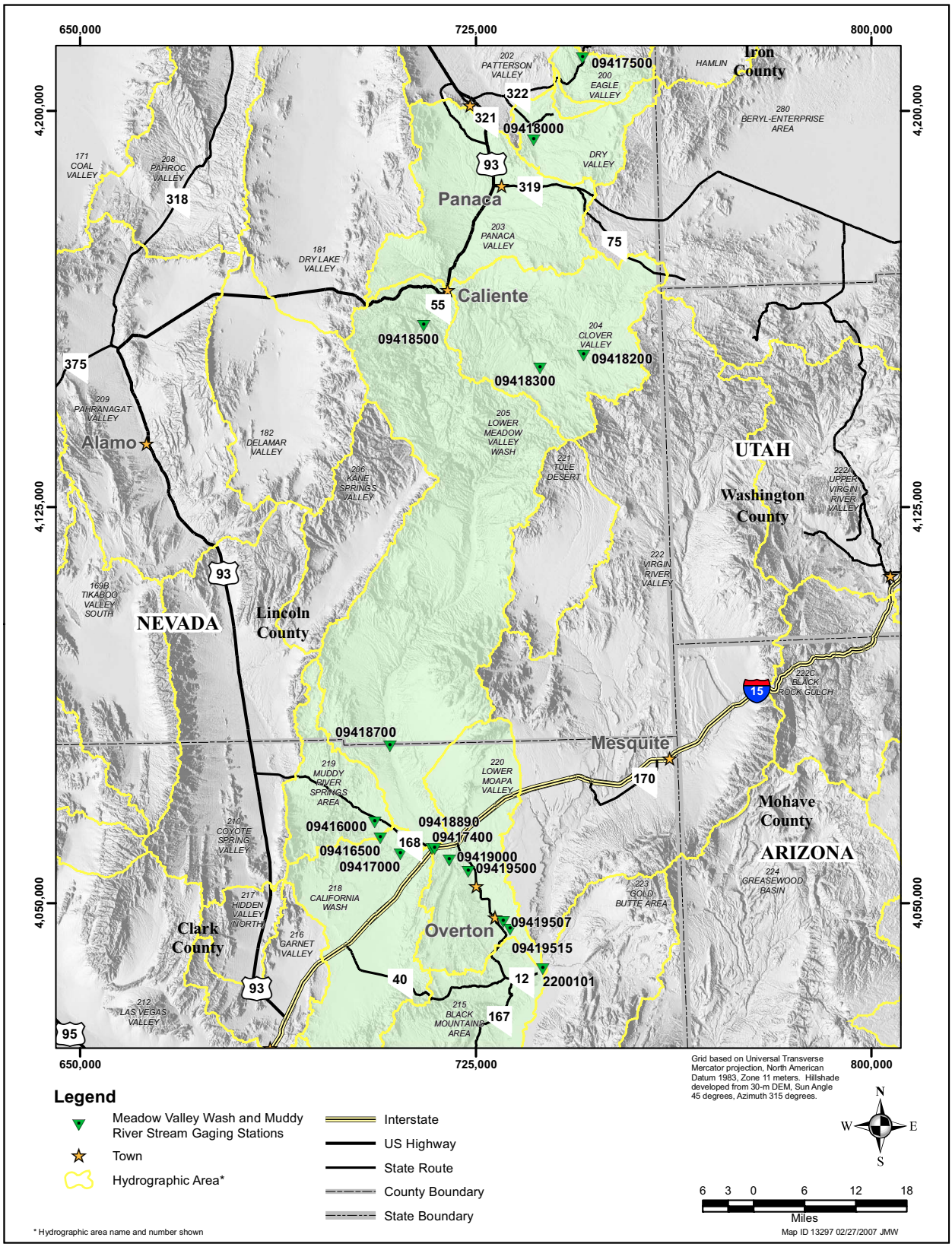

Figure 4-3
Measurement Sites on Muddy River and in Meadow Valley Wash