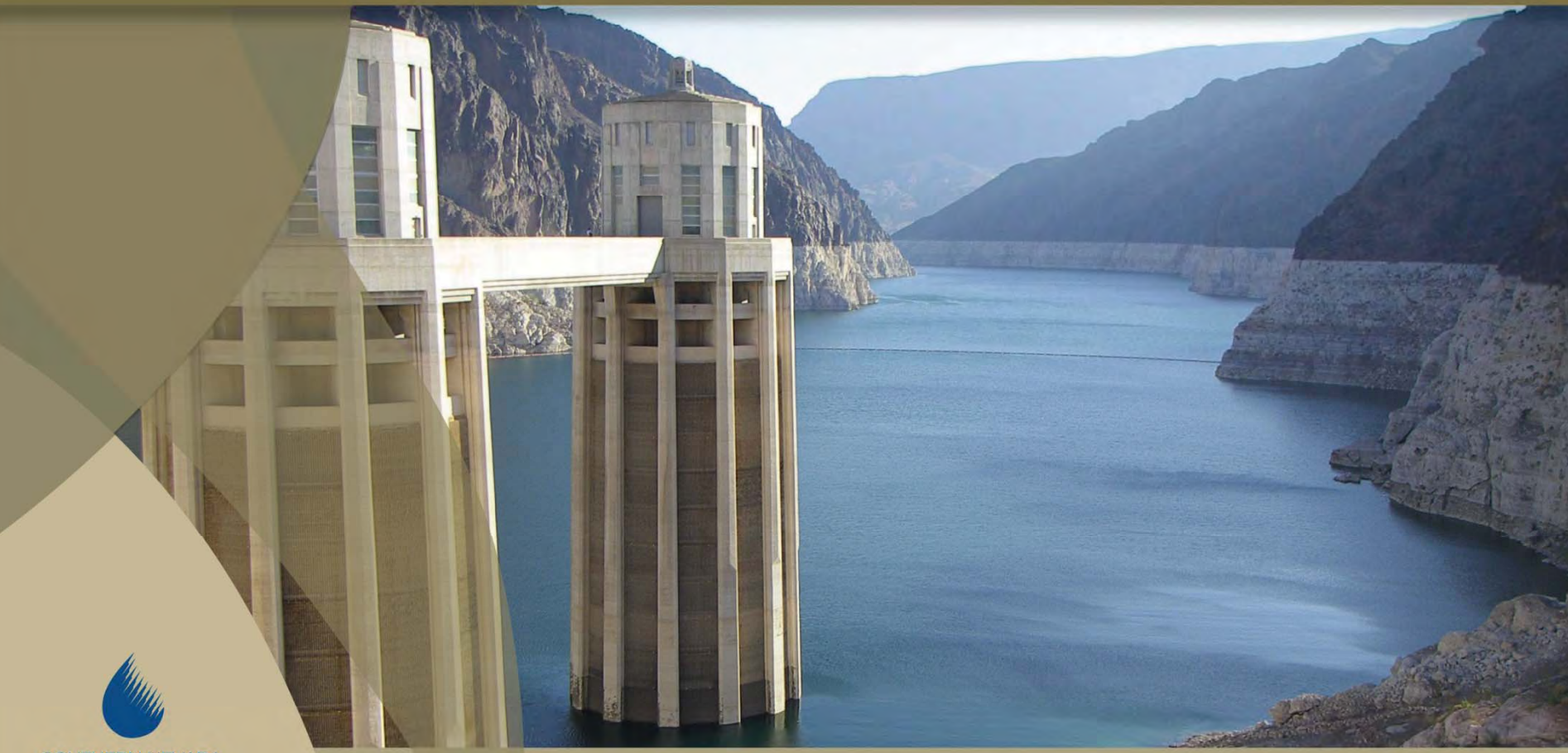
Spring, Cave, Dry Lake and Delamar Valleys



SOUTHERN NEVADA
WATER AUTHORITY

Presentation for
Burns and Drici Testimony
October 3, 2011

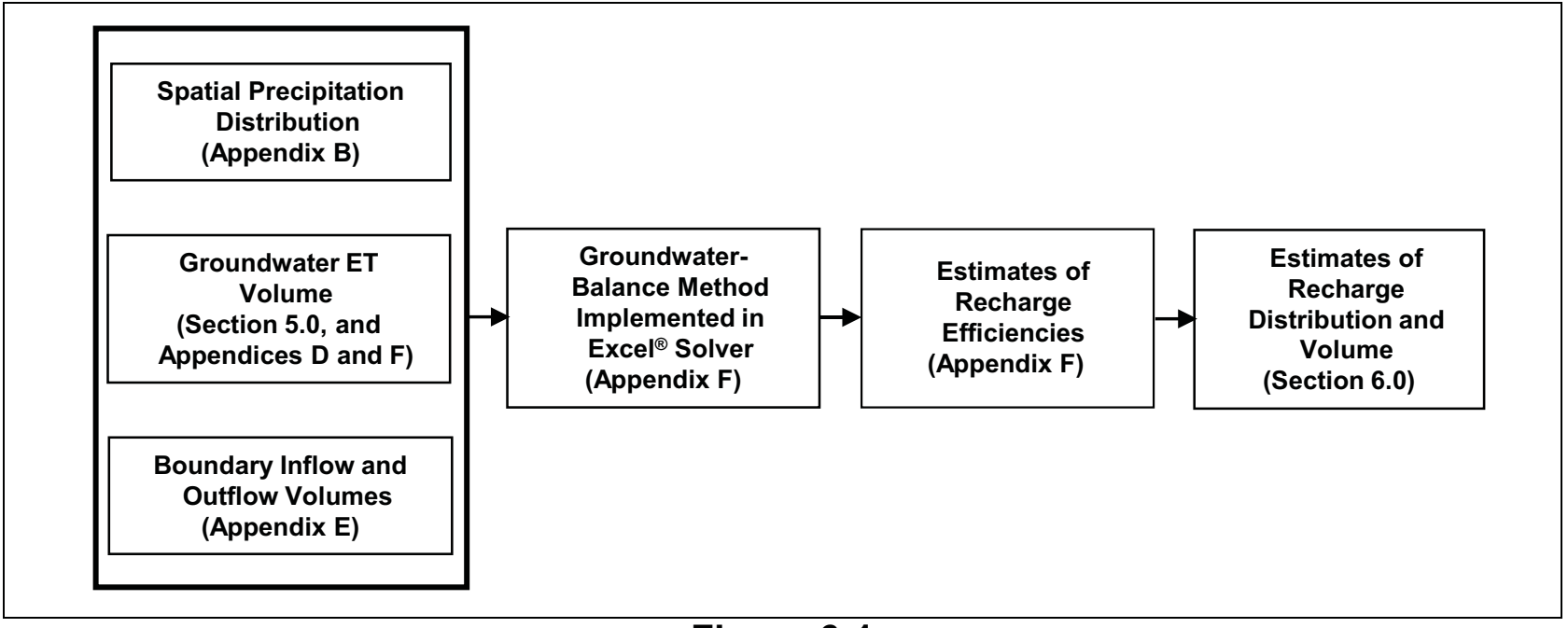


Figure 6-1
Flow Chart Showing Estimation Process of Recharge Distributions and Annual Volumes for Project Basins

$$R_T = ET_{gw} + Outflow - Inflow \quad \text{(Eq. F-1)}$$

where,

R_T = Total recharge (afy)
ET_{gw} = Total groundwater ET (afy)
Inflow = Total groundwater inflow (afy)
Outflow = Total groundwater outflow (afy)

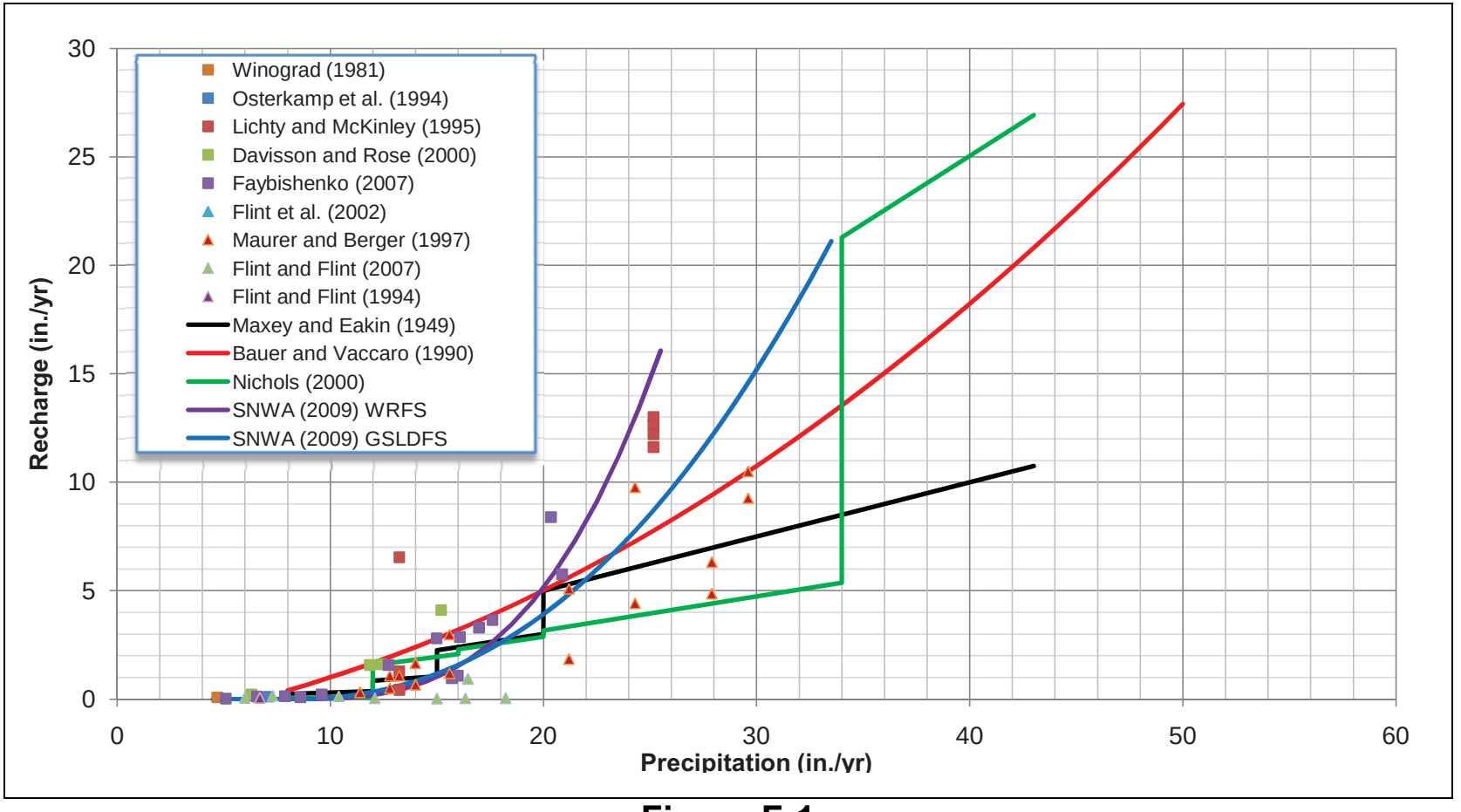


Figure F-1
Recharge-Precipitation Data

SNWA Exhibit 258

$$R_T = ET_{gw} + Outflow - Inflow \quad \text{(Eq. F-1)}$$

where,

R_T = Total recharge (afy)
ET_{gw} = Total groundwater ET (afy)
Inflow = Total groundwater inflow (afy)
Outflow = Total groundwater outflow (afy)

$$Eff = \frac{[a(P-8)^{b}]}{P} \qquad \text{(Eq. F-3)}$$

where,

Eff = Recharge efficiency or *R/P* as a fraction
a = Power function constant

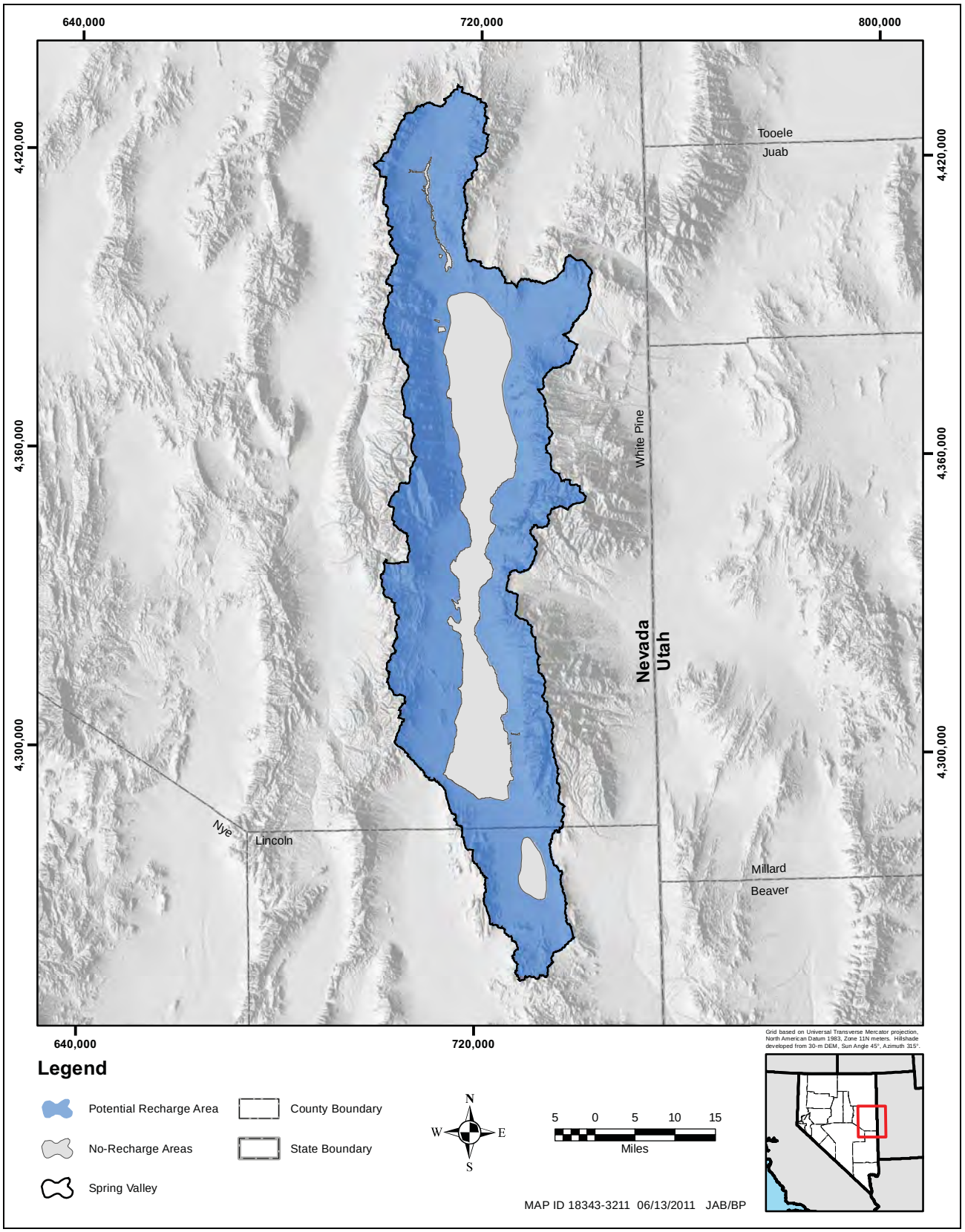


Figure F-3
Areas of Potential Recharge in Spring Valley

SNWA Exhibit 258

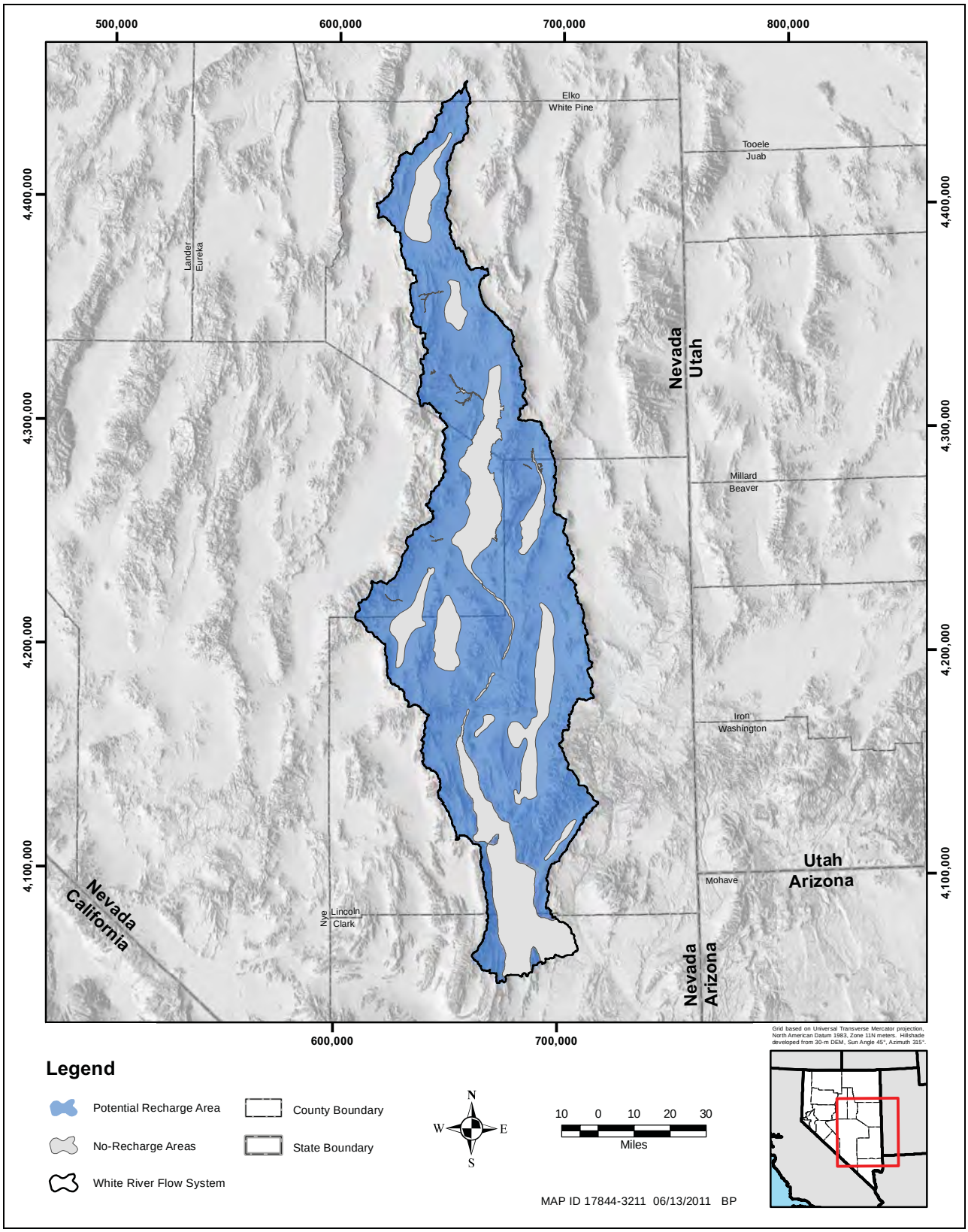


Figure F-4
Areas of Potential Recharge within the White River Flow System

SNWA Exhibit 258

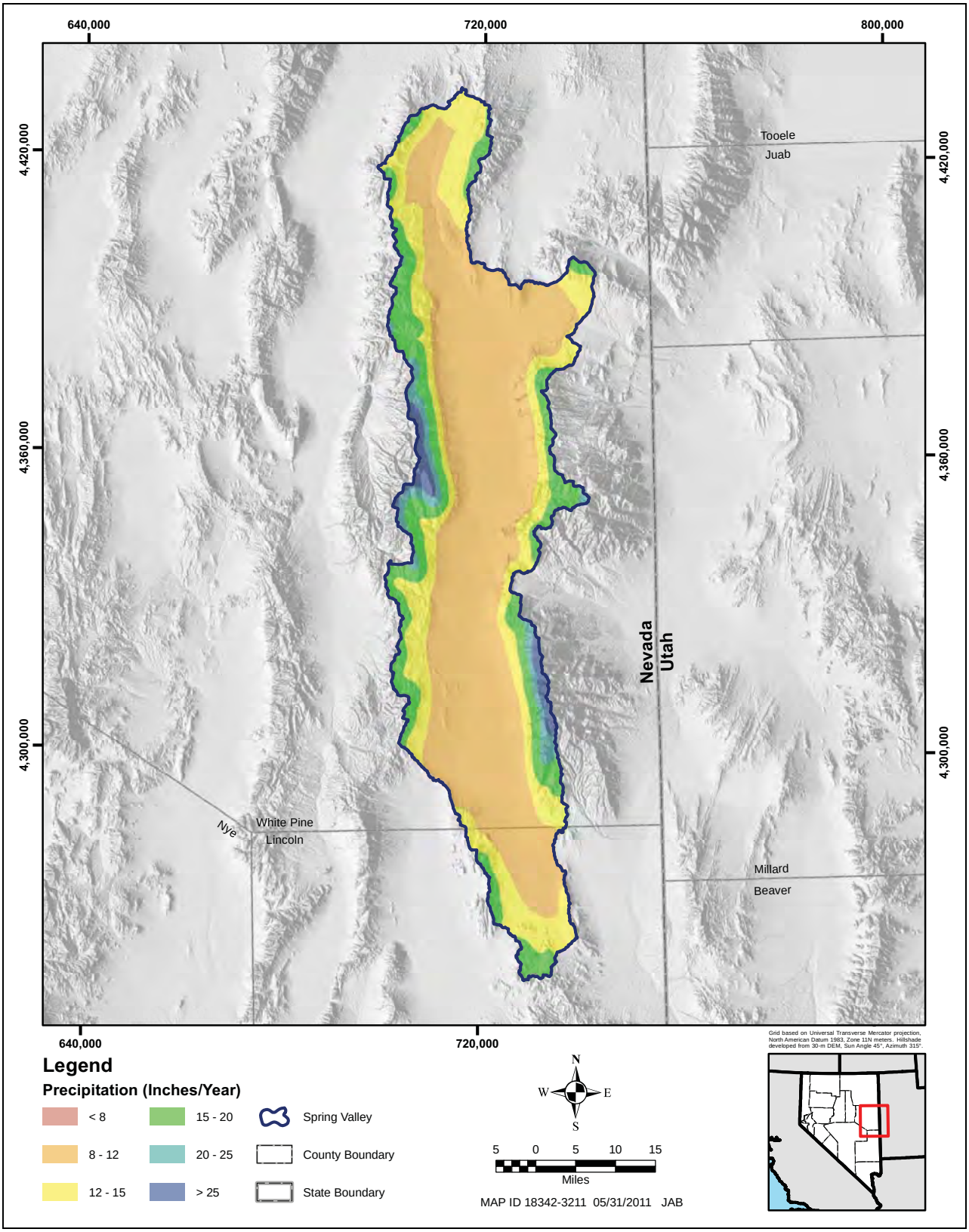


Figure F-5
Precipitation Distribution in Spring Valley

SNWA Exhibit 258

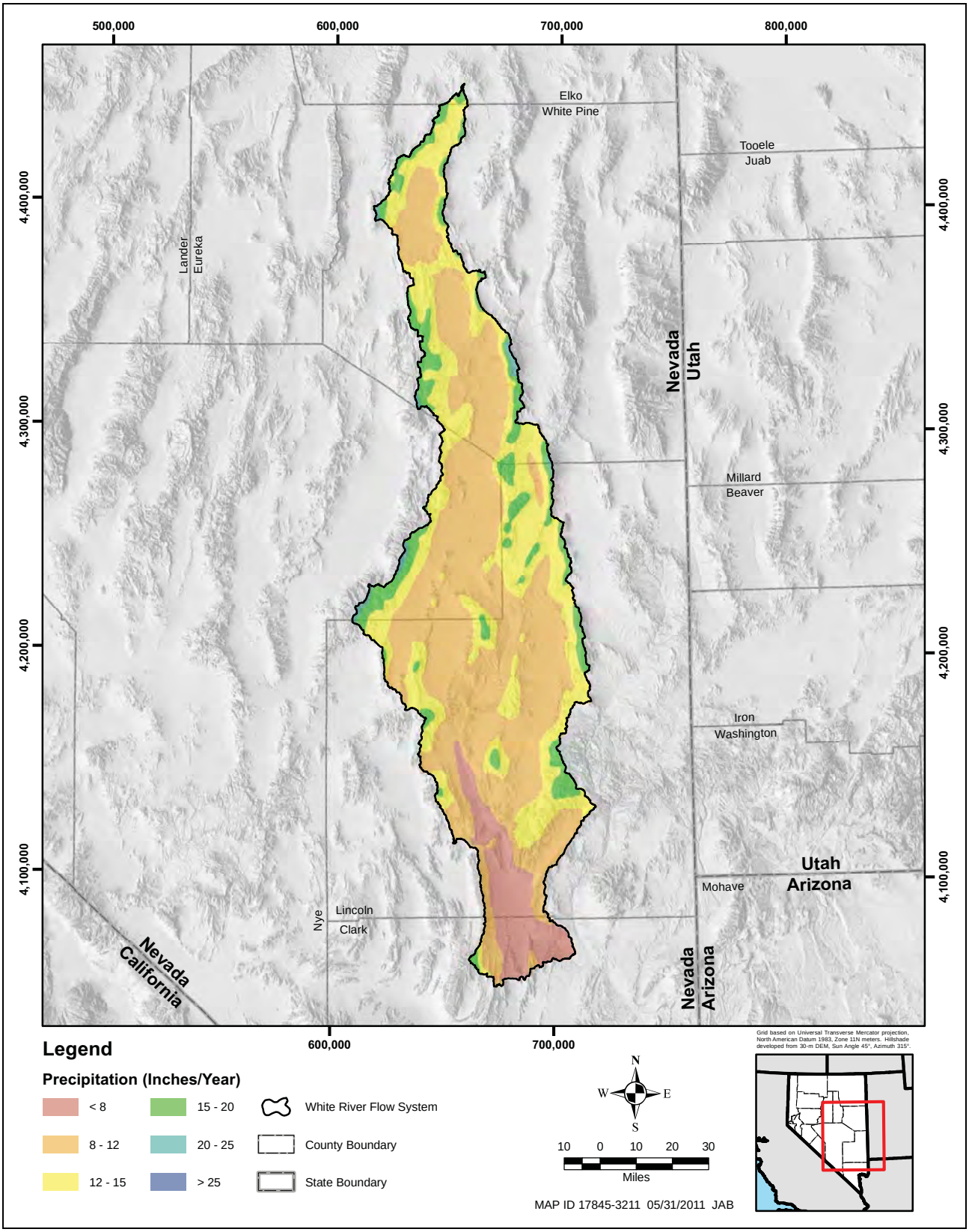


Figure F-6
Precipitation Distribution in the White River Flow System

SNWA Exhibit 258

$$R = a(P - 8)^b \qquad \text{(Eq. F-2)}$$

where,

R	=	Recharge rate (in./yr)
a	=	Power function constant
b	=	Power function exponent
P	=	Precipitation rate (in./yr)
$P - 8$	=	Effective precipitation (in./yr)

$$Eff = \frac{[a(P-8)^{b}]}{P} \qquad \text{(Eq. F-3)}$$

where,

Eff = Recharge efficiency or *R/P* as a fraction
a = Power function constant

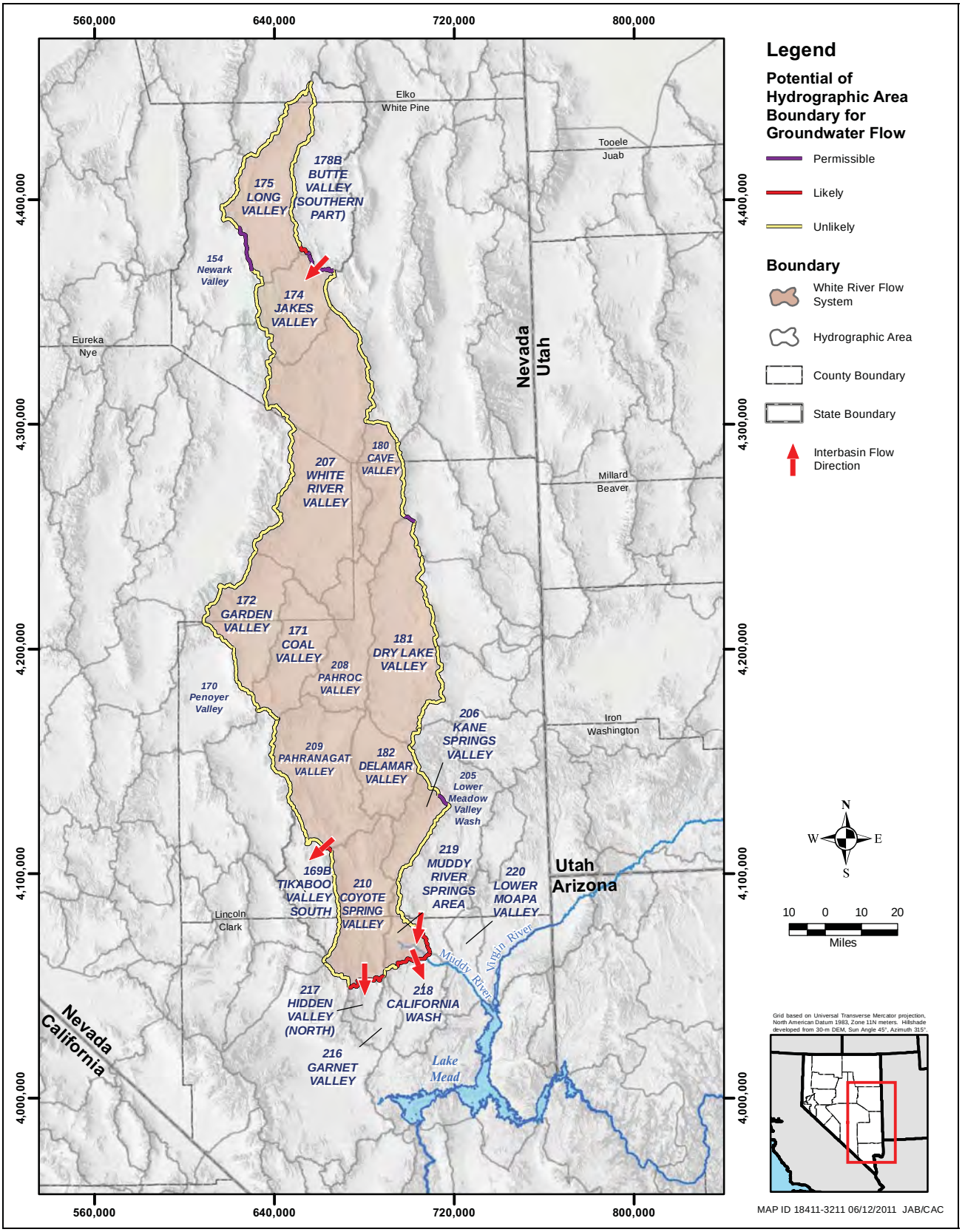


Figure E-1
Locations of Interbasin Flow for the External Boundaries

SNWA Exhibit 258

$$Eff = \frac{[a(P-8)^{b}]}{P} \qquad \text{(Eq. F-3)}$$

where,

Eff = Recharge efficiency or *R/P* as a fraction
a = Power function constant

$$R = a(P - 8)^b \qquad \text{(Eq. F-2)}$$

where,

R	=	Recharge rate (in./yr)
a	=	Power function constant
b	=	Power function exponent
P	=	Precipitation rate (in./yr)
$P - 8$	=	Effective precipitation (in./yr)

$$Eff = \frac{[a(P-8)^{b}]}{P} \qquad \text{(Eq. F-3)}$$

where,

Eff = Recharge efficiency or *R/P* as a fraction
a = Power function constant

Table 6-1
Recharge Volume Calculations for Spring Valley

1-in. Precipitation Interval	Mean Precipitation Rate (in./yr)	Area (acres)	Precipitation Volume (afy)	Recharge Efficiency (Fraction of Precipitation)	Recharge Volume (afy)
8-9	8.65	4,442	3,203	0.002	5
9-10	9.55	83,615	66,542	0.008	560
10-11	10.55	158,316	139,133	0.020	2,821
11-12	11.46	132,299	126,388	0.034	4,327
12-13	12.49	99,287	103,322	0.052	5,412
13-14	13.49	78,555	88,278	0.072	6,361
14-15	14.48	69,025	83,306	0.093	7,771
15-16	15.48	53,257	68,707	0.116	7,954
16-17	16.54	44,948	61,938	0.141	8,707
17-18	17.52	31,385	45,811	0.164	7,533
18-19	18.56	17,052	26,377	0.191	5,028
19-20	19.65	11,768	19,266	0.218	4,208
20-21	20.53	8,393	14,363	0.242	3,469
21-22	21.69	7,007	12,667	0.272	3,448
22-23	22.74	6,201	11,749	0.300	3,527
23-24	23.49	5,086	9,958	0.321	3,193
24-25	24.83	4,495	9,303	0.357	3,324
25-26	25.65	4,157	8,885	0.380	3,374
26-27	26.52	3,750	8,287	0.404	3,347
27-28	27.64	3,556	8,190	0.435	3,564
28-29	28.72	3,885	9,297	0.465	4,326
29-30	29.63	2,602	6,423	0.491	3,153
30-31	30.29	1,357	3,426	0.510	1,746
31-32	31.52	989	2,599	0.544	1,415
32-33	32.37	393	1,060	0.569	603
33-34	33.47	14	38	0.600	23
				Basin Total Recharge Volume[a]	**99,200**

[a]Rounded to nearest 100 afy.

Table 6-2
Mean Annual Recharge estimated for Spring Valley and Previously-Reported Estimates

Source	Recharge (afy)
This Study	99,200
SNWA (2009a, p. 9-14)	81,339
Reconnaissance Reports and Scott et al. (1971, p. 48)	75,000
Dettinger (1989, p. 69)	61,636
Nichols (2000, p. C25)	104,000
Epstein (2004, p. 136) - Maxey-Eakin Method Evaluation	66,402
Epstein (2004, p. 136) - Nichols-1990-Method Evaluation	93,840
Epstein (2004, p. 136) - BBRM[a]	92,965
Epstein (2004, p. 136) - N-ME[b]	53,335
Epstein (2004, p. 136) - N-N[c]	139,194
Recharge (BCM-Mean Year, Flint et al., 2004, Table 1)	66,987
Recharge (BCM-Time Series, Flint et al., 2004, Table 1)	56,179
Brothers et al. (1994, p. 51)	72,000
Welch et al. (2007, p. 44)	93,000
Mizell et al. (2007, p. 18)	62,000

[a] BBRM: Bootstrap Brute-Force Model
[b] N-ME: Numeric Maxey-Eakin Method Evaluation
[c] N-N: Nichols Method Evaluation

Table 6-3
Annual Recharge Volume Calculations for Cave Valley

1-in. Precipitation Interval	Mean Precipitation Rate (in./yr)	Area (acres)	Precipitation (afy)	Recharge Efficiency (Fraction of Precipitation)	Recharge Volume (afy)
11-12	11.46	12,790	12,219	0.012	150
12-13	12.49	43,868	45,651	0.023	1,050
13-14	13.49	44,536	50,048	0.037	1,855
14-15	14.48	32,402	39,106	0.055	2,140
15-16	15.48	19,555	25,229	0.076	1,918
16-17	16.54	11,225	15,468	0.102	1,584
17-18	17.52	9,401	13,722	0.131	1,791
18-19	18.56	4,500	6,962	0.164	1,143
19-20	19.65	1,527	2,500	0.203	508
20-21	20.53	1,183	2,025	0.238	482
21-22	21.69	1,013	1,832	0.288	527
22-23	22.74	553	1,047	0.336	352
23-24	23.49	258	504	0.374	188
				Basin Total Recharge Volume[a]	**13,700**

[a]Rounded to nearest 100 afy

Table 6-4
Mean Annual Recharge estimated for Cave Valley and Previously-Reported Estimates

Source	Recharge (afy)
This Study	13,700
SNWA (2009a, p. 9-14)	15,044
Reconnaissance Reports and Scott et al. (1971, p. 48)	14,000
Kirk and Campana (1988, p. 26)	11,000-14,000
LVVWD (2001, p. 4-25) and Thomas et al. (2001, p. 6)	20,000
Epstein (2004, p. 136) - Maxey-Eakin Method Evaluation	21,838
Epstein (2004, p. 136) - Nichols-1990-Method Evaluation	32,507
Epstein (2004, p. 136) - BBRM[a]	15,166
Epstein (2004, p. 136) - N-ME[b]	13,592
Epstein (2004, p. 136) - N-N[c]	45,913
Recharge (BCM-Mean Year, Flint et al., 2004, Table 1)	10,264
Recharge (BCM-Time Series, Flint et al., 2004, Table 1)	9,380
Brothers et al. (1993, p. 45)	13,000
Welch et al. (2007, p. 44)	11,000
Mizell et al. (2007, p. 18)	33,000

[a]BBRM: Bootstrap Brute-Force Model
[b]N-ME: Numeric Maxey-Eakin Method Evaluation
[c]N-N: Nichols Method Evaluation

Table 6-5
Recharge Volume Calculations for Dry Lake and Delamar Valleys

1-in. Precipitation Interval	Mean Precipitation Rate (in./yr)	Area (acres)	Precipitation Volume (afy)	Recharge Efficiency (Fraction of Precipitation)	Recharge Volume (afy)
Dry Lake Valley					
9-10	9.55	42,476	33,804	0.002	54
10-11	10.55	110,032	96,700	0.006	551
11-12	11.46	90,888	86,827	0.012	1,064
12-13	12.49	78,086	81,260	0.023	1,869
13-14	13.48	65,684	73,814	0.037	2,735
14-15	14.48	44,805	54,075	0.055	2,959
15-16	15.48	26,477	34,159	0.076	2,597
16-17	16.54	11,091	15,284	0.102	1,565
17-18	17.52	7,892	11,520	0.131	1,503
18-19	18.56	4,086	6,321	0.164	1,038
19-20	19.65	791	1,295	0.203	263
Basin Total Recharge Volume[a]					**16,200**
Delamar Valley					
10-11	10.55	20,091	17,657	0.006	101
11-12	11.46	47,070	44,967	0.012	551
12-13	12.49	29,624	30,828	0.023	709
13-14	13.49	24,631	27,679	0.037	1,026
14-15	14.48	20,593	24,854	0.055	1,360
15-16	15.48	11,189	14,436	0.076	1,097
16-17	16.54	9,433	12,999	0.102	1,331
17-18	17.52	2,070	3,021	0.131	394
Basin Total Recharge Volume[a]					**6,600**
Dry Lake and Delamar Valleys Total Recharge Volume[a]					**22,800**

[a]Rounded to nearest 100 afy.

Table 6-6
Mean Annual Recharge Estimated for Dry Lake and Delamar Valleys and Previously-Reported Estimates in afy

Source	Dry Lake Valley (HA 181)	Delamar Valley (HA 182)	Total
This Study	16,200	6,600	22,800
SNWA (2009a, p. 9-14)	16,208	6,627	22,835
Reconnaissance Reports and Scott et al. (1971, p. 48)	5,000	1,000	6,000
Kirk and Campana (1988, p. 26)	7,500	2,000	9,500
LVVWD (2001, p. 4-25) and Thomas et al. (2001, p. 6)	13,000	5,000	18,000
Epstein (2004, p. 136) - Maxey-Eakin Method Evaluation	9,159	3,119	12,278
Epstein (2004, p. 136) - Nichols-1990-Method Evaluation	28,559	12,930	41,489
Epstein (2004, p. 136) - BBRM[a]	20,187	10,248	30,435
Epstein (2004, p. 136) - N-ME[b]	8,947	3,567	12,514
Epstein (2004, p. 136) - N-N[c]	50,389	21,442	71,831
Recharge (BCM-Mean Year, Flint et al., 2004, Table 1)	10,627	7,764	18,391
Recharge (BCM-Time Series, Flint et al., 2004, Table 1)	11,298	6,404	17,702
Brothers et al. (1996, p. 45)	5,000	1,000	6,000

[a]BBRM: Bootstrap Brute-Force Model
[b]N-ME: Numeric Maxey-Eakin Method Evaluation
[c]N-N: Nichols Method Evaluation

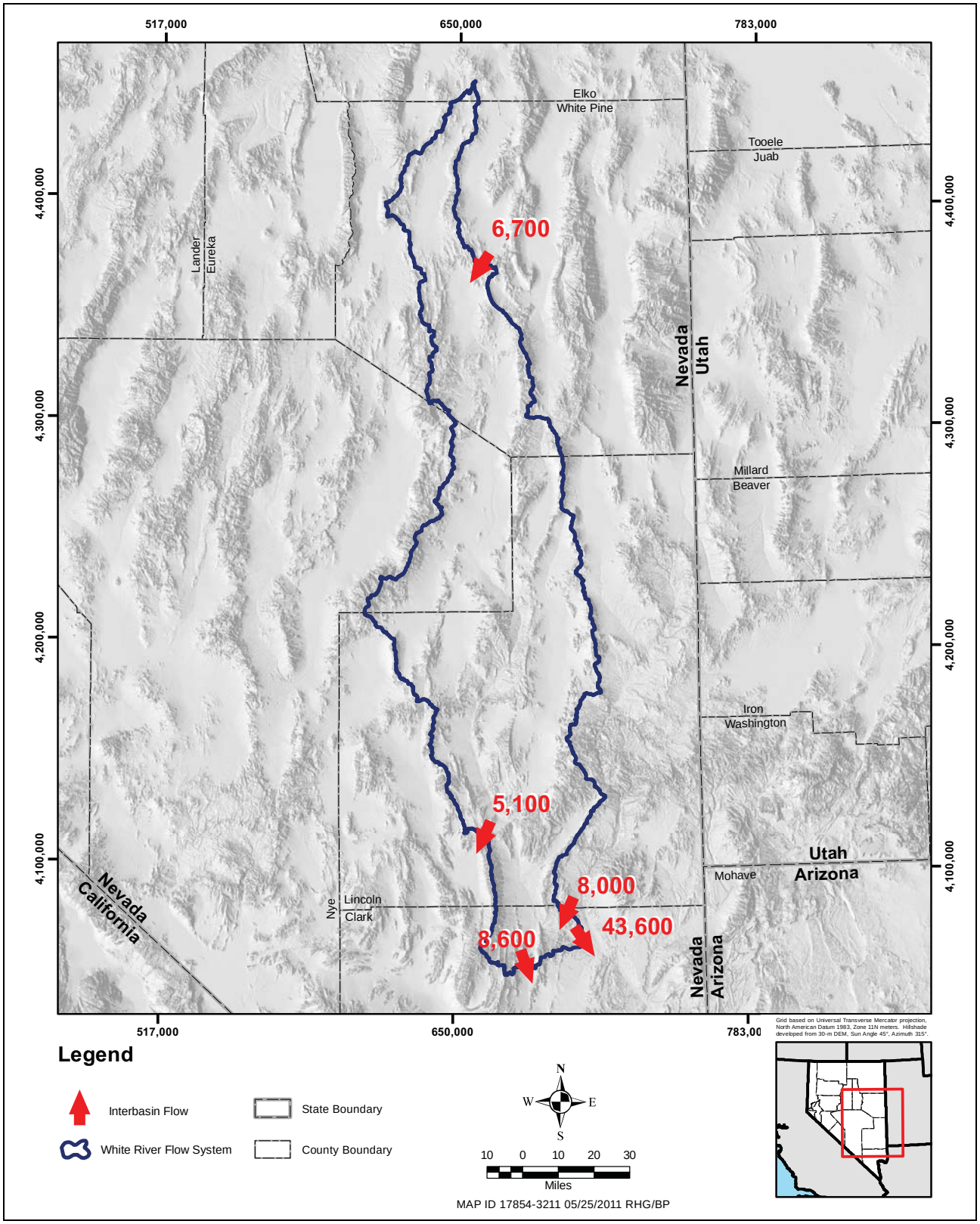


Figure F-9
Locations and Volumes of Interbasin Flow (in afy)
for Boundary Segments Used as Constraints for the WRFS

SNWA Exhibit 258

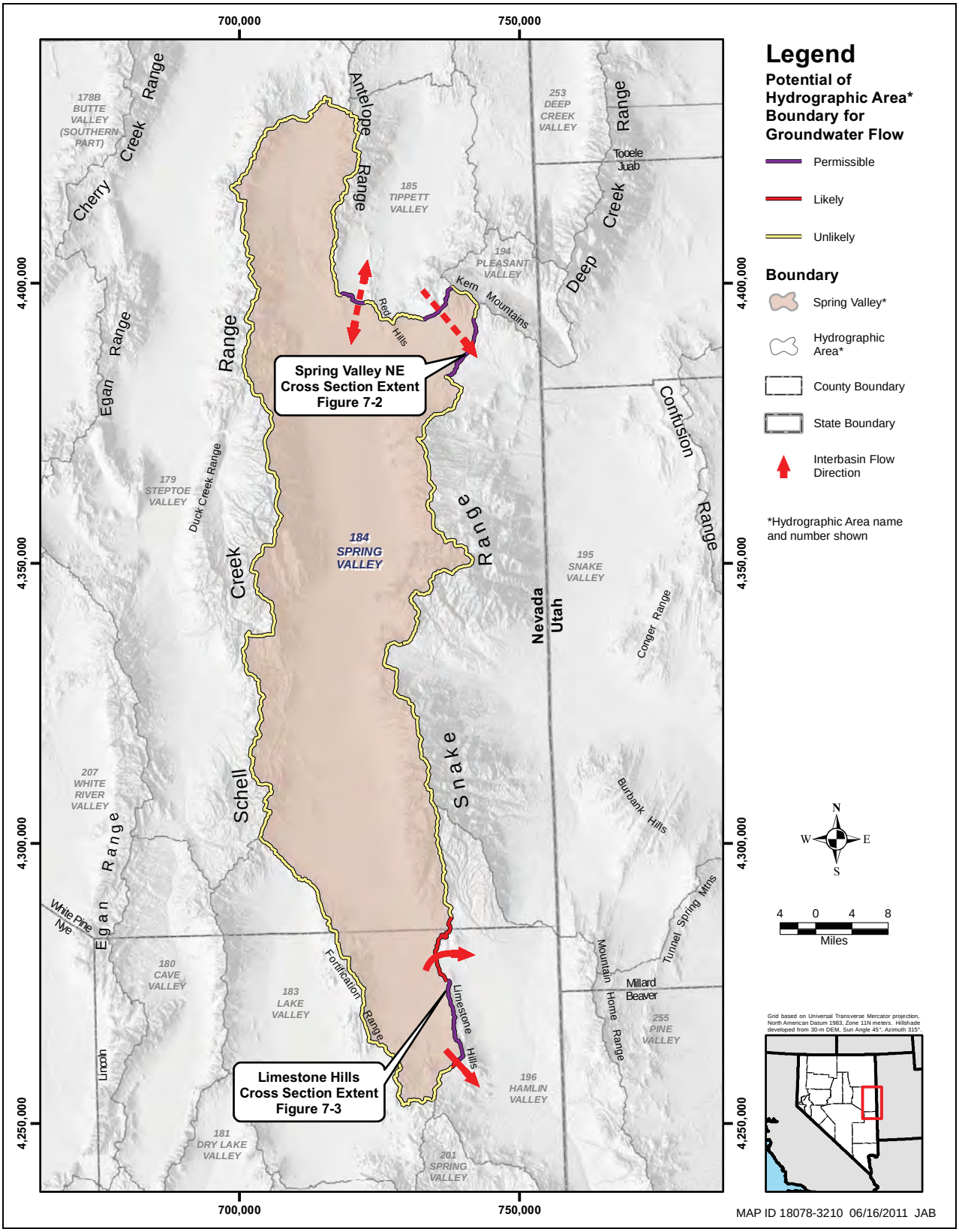
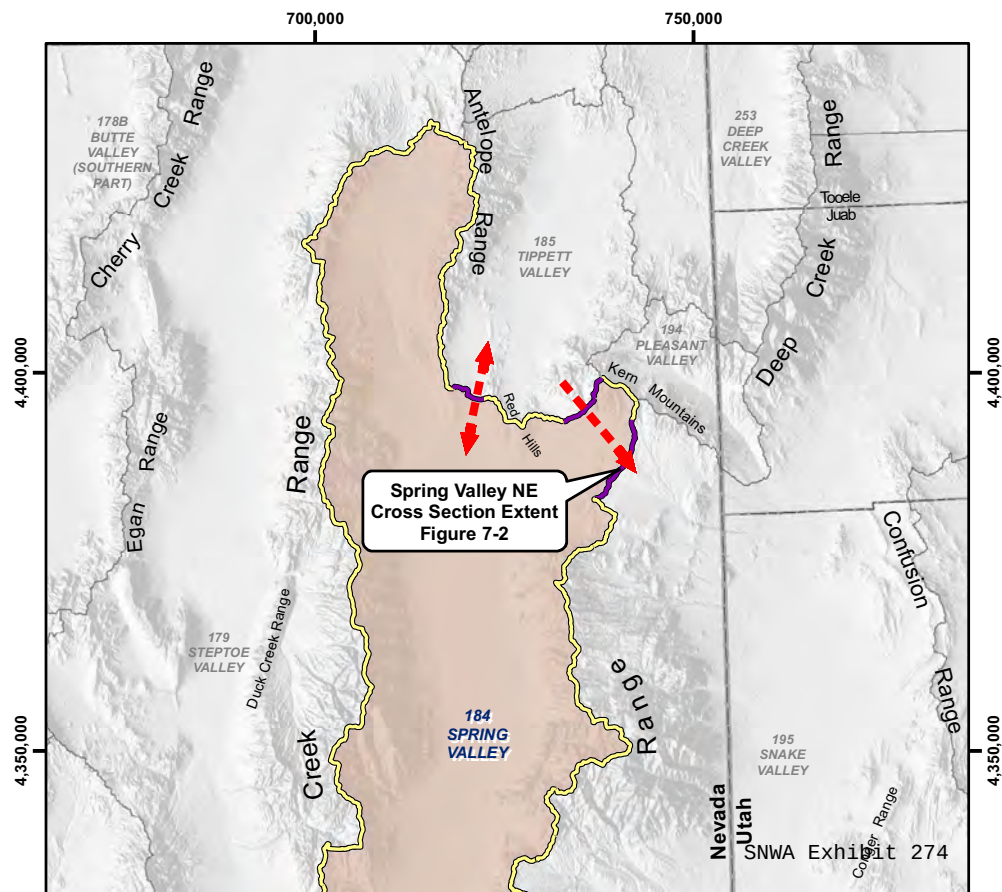
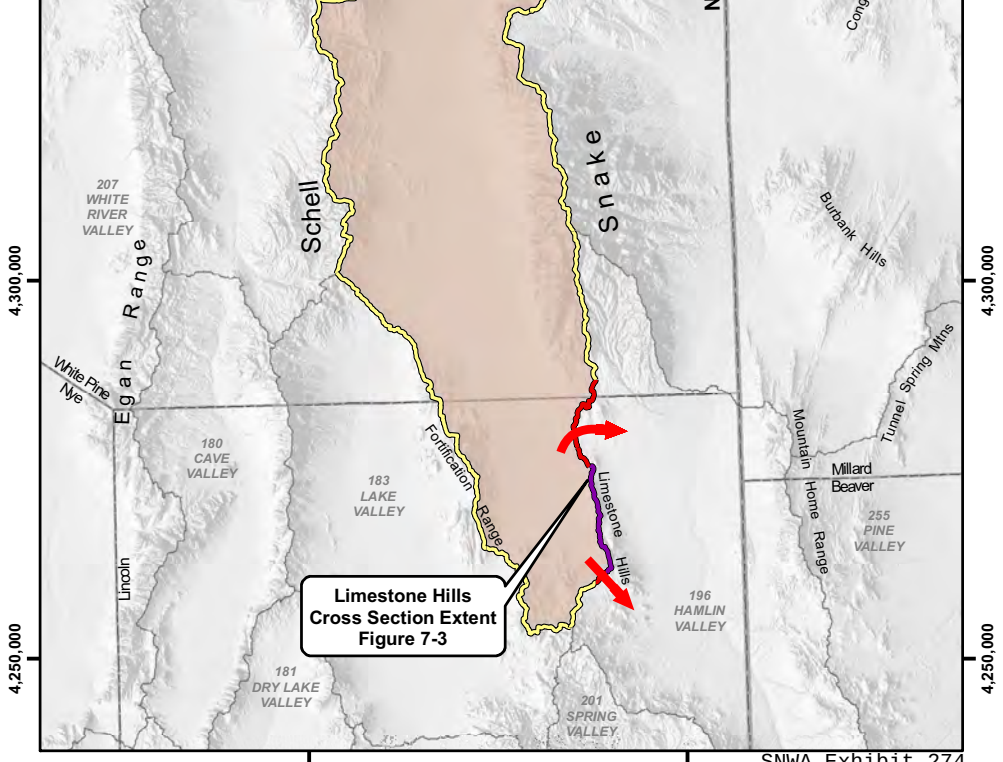


Figure 7-1
Locations of Interbasin Groundwater Flow for Spring Valley

SNWA Exhibit 258



SNWA Exhibit 274



SNWA Exhibit 274

MA

Legend

Direction of Interbasin Groundwater Flow

Stream Network

Precipitation Station

Precipitation Station Map ID (Table B-1) shown inside each symbol.

Town

County Boundary

State Boundary

Hydrographic Area

Groundwater Evapotranspiration Area

Regional Confining Unit

Regional Confining Units defined as hydrogeologic units Ms, €p€s, p€m, and TJi (See Rowley et al., 2011, Plate 6).

Potential for Groundwater Flow Across Hydrographic Area Boundary

Permissible

Likely

Unlikely

Well

Basin Fill

Carbonate

Volcanic

Well symbol labeled with Well Map ID and water-level elevation (ft) (175-01/5,565). Wells with 5 or more measurements are shown in Spring, Lake and Hamlin Valleys, except for Well Map ID 196-11. See Section C.2.0 of Appendix C for depth-to-water and elevation data.

Spring

Local

Intermediate

Major Roads

U.S. Highway

State Route

Regional Faults

Normal fault

Strike-slip and Oblique-slip fault

Quaternary Normal fault

Solid where known; Dashed where inferred; dotted where concealed. Bar and ball on downthrown side. Arrows show direction of lateral movement.

Caldera margin

Solid where known; dashed where inferred; dotted where concealed.

Potential Recharge (in./year)

0.01 - 0.05

0.06 - 0.10

0.11 - 0.50

0.51 - 1.00

1.01 - 3.00

> 3.01

N
W E
S

1:250,000

2 0 2 4 Miles

4 0 4 8 Kilometers

Projection: Universal Transverse Mercator, NAD83, Zone 11N. Hillshade from 30-m DEM, Sun Angle 45°, Azimuth 315°.

MAP ID 18439-3210 06/21/2011 JAB/CAC/BP

PLATE 1. MAJOR GEOLOGIC AND HYDROLOGIC FEATURES AND CONTROLS ON THE AQUIFER SYSTEM OF SPRING VALLEY AND VICINITY

185-8
5,526

185-6
5,530

185-5
5,707

185-7
5,531

185-2
5,558

185-4
5,529

185-3
5,505

185-1
5,484

Antelope Range

Tippet Valley

NEVADA

Valley

43

Stonehouse Spring
>6,256

Siegel Creek

184-238
5,974

Willow Spring
>5,987

North Creek

Frenchman Creek

Muncy Creek

Kalamazoo Creek

Piermont Creek

Garden Creek

Keegan Spring
>5,617

Bassett Creek

Little Negro Creek

Odgers Creek

McCoy Creek

Eight Mile Creek

Red Hills

Kern Mountains

Pleasa

Steptoe

93

30

McGill

Creek Valley

Spring Valley

184-197
5,606

184-196
5,649

184-200
5,590

184-191
5,655

184-195
5,570

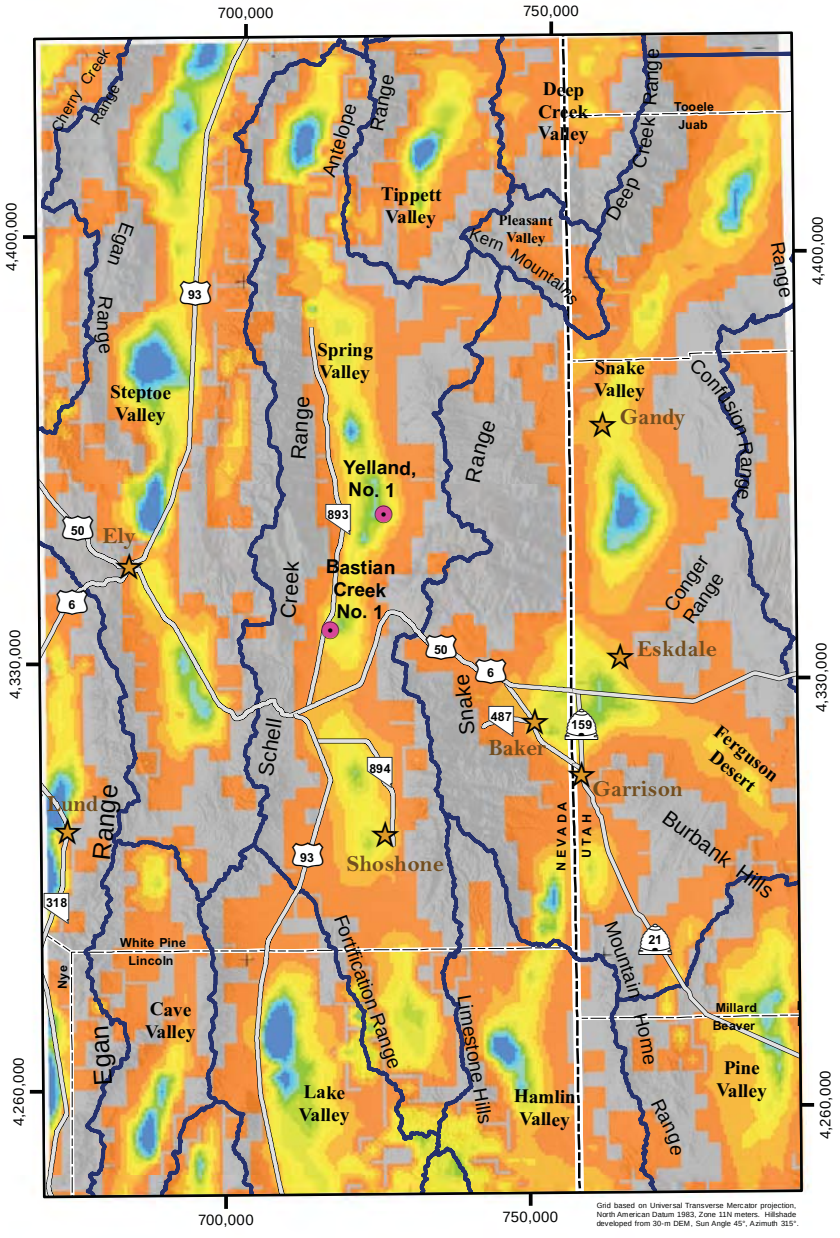
184-192
5,660

184-189
5,609

184-186
5,553

Yelland Dry

184-177



Legend

- Oil & Gas Well
- Town
- Major Road
- Hydrographic Area* Boundary
- State Boundary
- County Boundary

*Hydrographic Area name shown

Basin Depth (km)

0.0 0.6 1.2 1.8 2.4 3.0

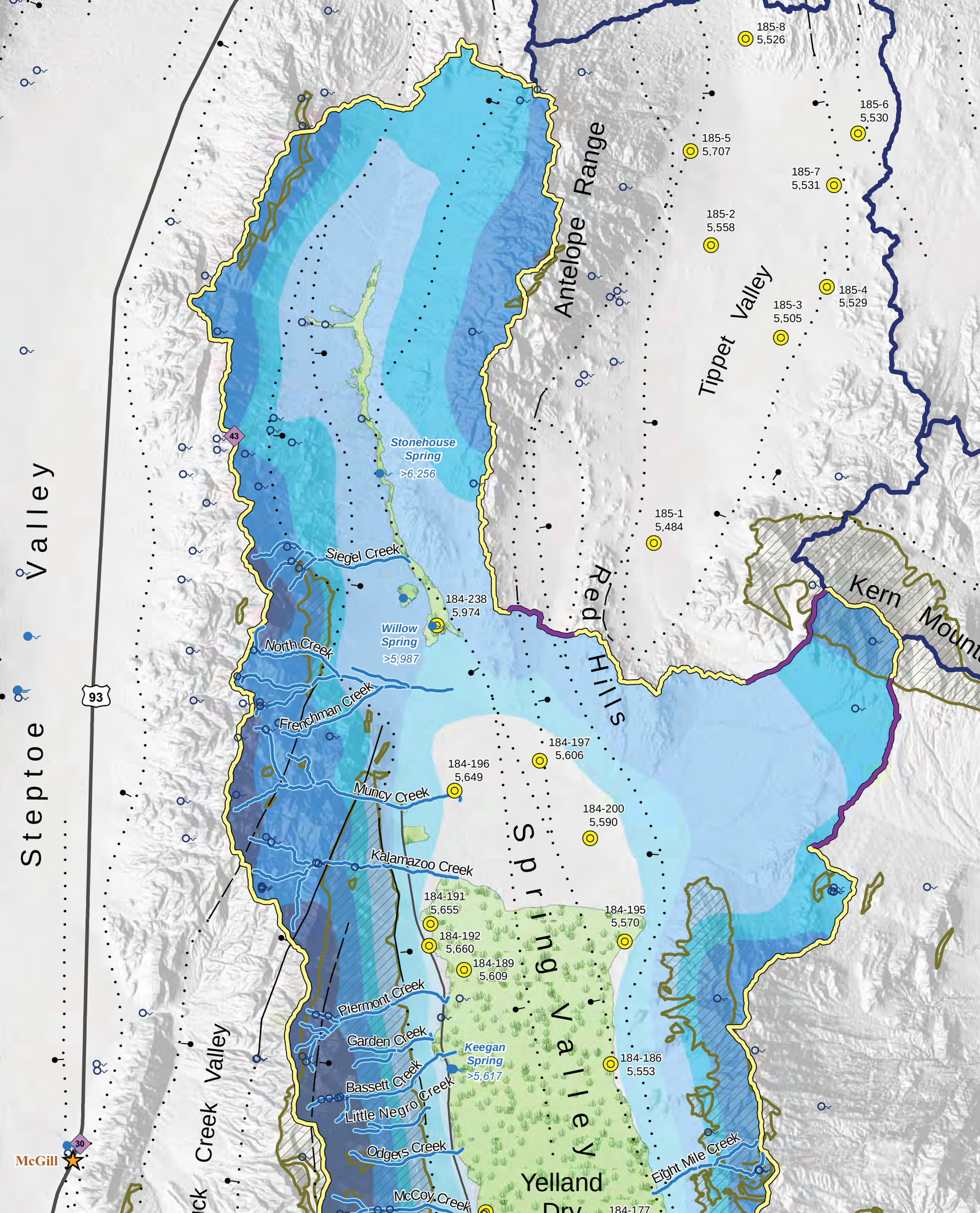
5 0 5 10 15 20 25

Kilometers

N W E S

MAP ID 18376-3210 05/25/2011 JAB/BP

Figure 5-5
Depth to Pre-Cenozoic Basement in Spring and Snake Valleys and Vicinity, Nevada and Utah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5,526
185-6
5,530
185-5
5,707
185-7
5,531
185-2
5,558
185-4
5,529
185-3
5,505
185-1
5,484
Antelope Range
Tippet Valley
Red Hills
Kern Mount
Steptoe Valley
Spring Valley
Creek Valley
Stonehouse Spring
>6,256
Willow Spring
>5,987
Keegan Spring
>5,617
Siegel Creek
North Creek
Frenchman Creek
Muncy Creek
Kalamazoo Creek
Piermont Creek
Garden Creek
Bassett Creek
Little Negro Creek
Odgers Creek
McCoy Creek
Eight Mile Creek
184-238
5,974
184-197
5,606
184-196
5,649
184-200
5,590
184-191
5,655
184-195
5,570
184-192
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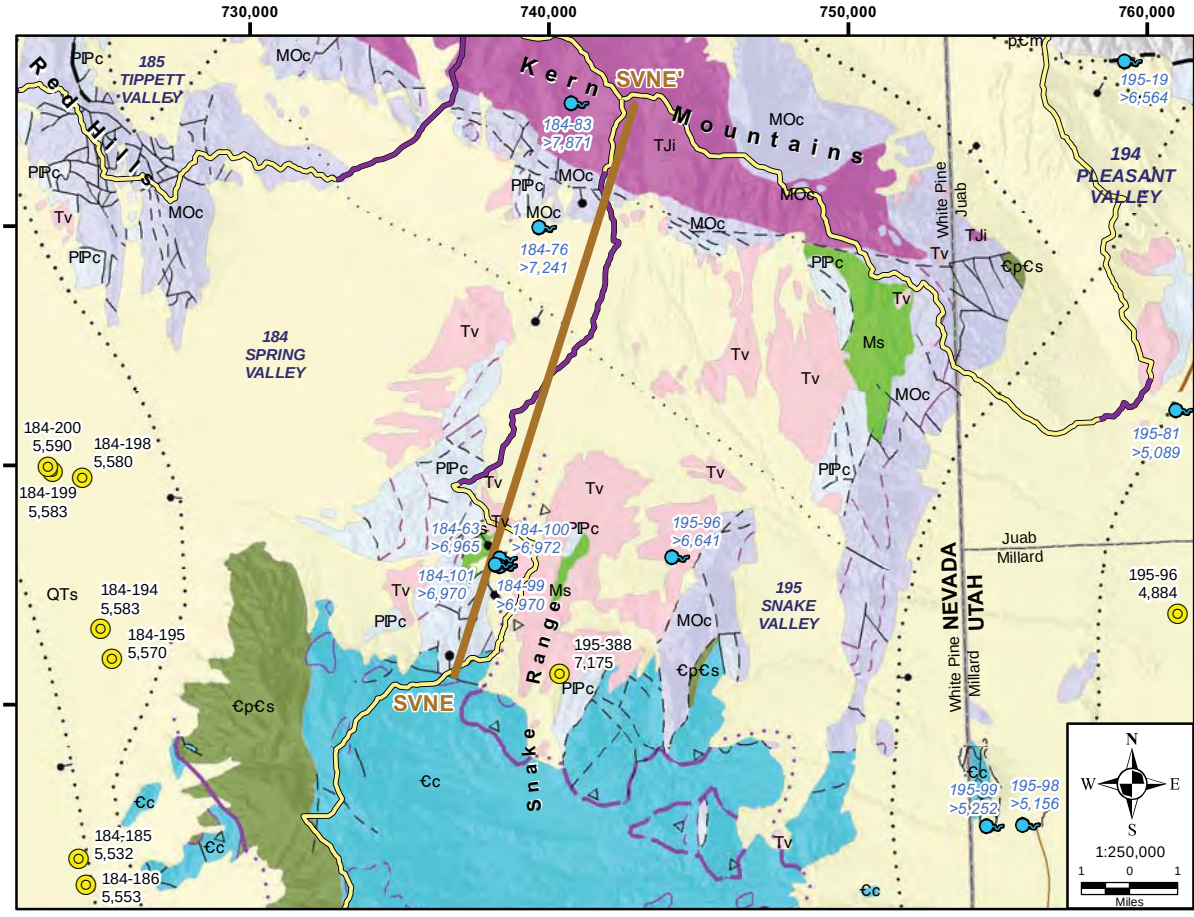
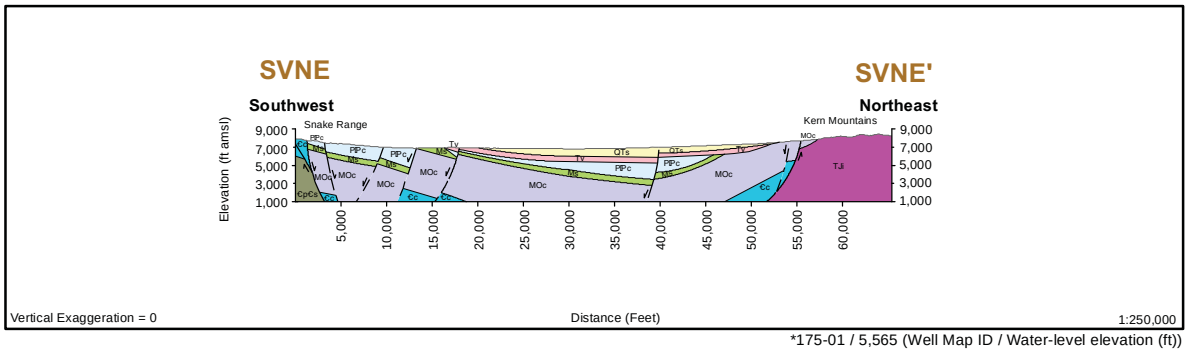
184-189
5,609
184-186
5,553
184-177
Yelland
Dry
McGill
43
93
30





*175-01 / 5,565 (Well Map ID / Water-level elevation (ft))
**184-109 / >6380 (Spring Map ID / Water-level elevation (ft))

Legend

Hydrogeology

Map Unit - Description

- QTs — Quaternary-Tertiary sediments
- Tv — Tertiary volcanic rocks
- TJi — Tertiary-Jurassic intrusive rocks
- PIPc — Permian-Pennsylvanian carbonate rocks
- Ms — Mississippian clastic rocks
- MOc — Mississippian-Ordovician carbonate rocks
- €c — Cambrian carbonate rocks
- €p€s — Cambrian-pre-Cambrian clastic rocks

Regional Faults

- Normal fault
- Detachment fault

Solid where known; dashed where inferred; dotted where concealed. Sawtooth on upper plate. Bar and ball on downthrown side of fault.

Subsidiary Faults

- Normal fault
- Detachment fault

Solid where known; dashed where inferred; dotted where concealed; dotted and queried where uncertain.

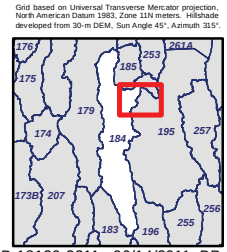
- Cross Section profile

Well*

- Basin Fill
- Carbonate
- Volcanic
- Spring**

Potential for Groundwater Flow Across Hydrographic Area Boundary

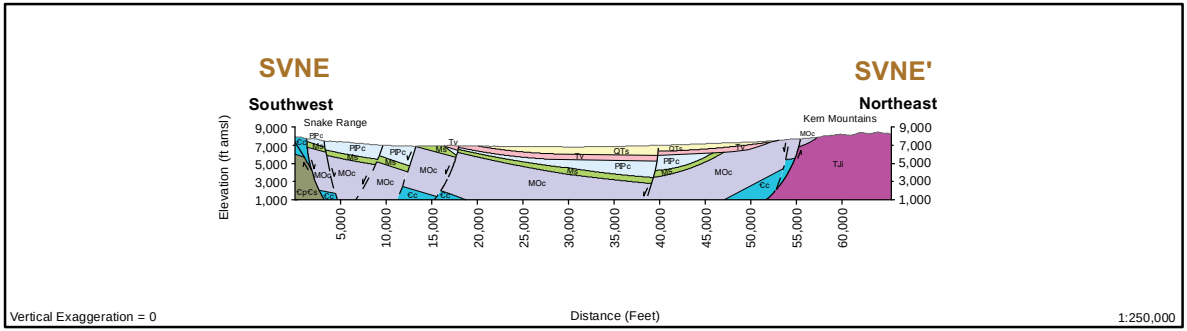
- Permissible
- Unlikely



MAP ID 18126-3211 06/14/2011 BP

Figure 7-2
Interbasin Groundwater Flow from Spring Valley to Snake Valley

SNWA Exhibit 258



*175-01 / 5,565 (Well Map ID / Water-level elevation (ft))

**184-109 / >6380 (Spring Map ID / Water-level elevation (ft))

Legend

Hydrogeology

Map Unit - Description

QTs	Quaternary-Tertiary sediments
Tv	Tertiary volcanic rocks
TJi	Tertiary-Jurassic intrusive rocks
PIPc	Permian-Pennsylvanian carbonate rocks
Ms	Mississippian clastic rocks
MOc	Mississippian-Ordovician carbonate rocks
€c	Cambrian carbonate rocks
€p€s	Cambrian-pre-Cambrian clastic rocks

Regional Faults

Normal fault

Detachment fault

Solid where known; dashed where inferred; dotted where concealed. Sawtooth on upper plate. Bar and ball on downthrown side of fault.

Subsidiary Faults

Normal fault

Detachment fault

Solid where known; dashed where inferred; dotted where concealed; dotted and queried where uncertain.

Cross Section profile

Well*

Basin Fill

Carbonate

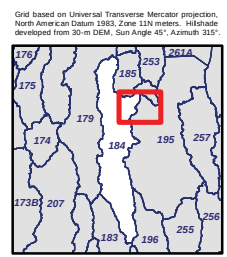
Volcanic

Spring**

Potential for Groundwater Flow Across Hydrographic Area Boundary

Permissible

Unlikely

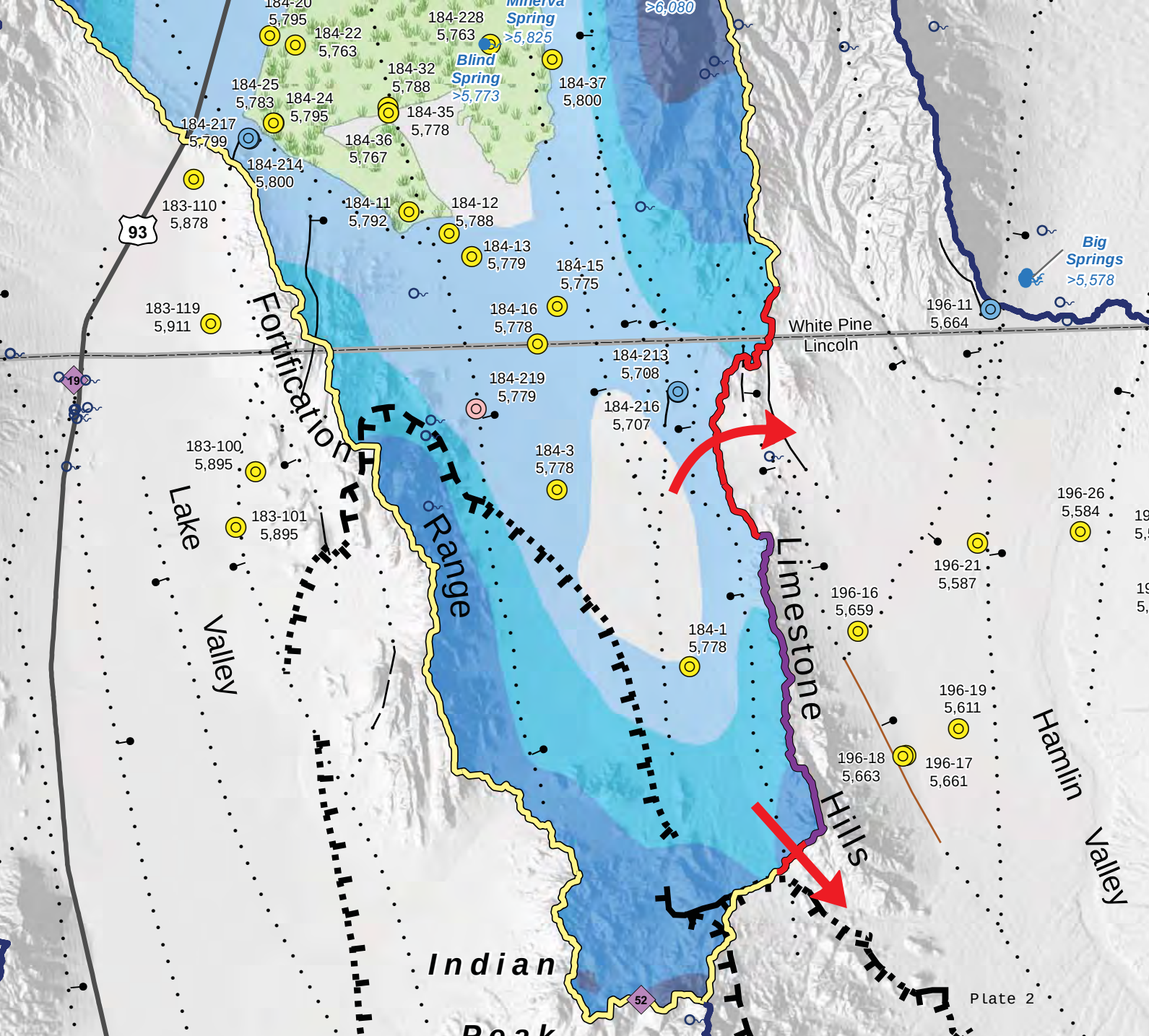


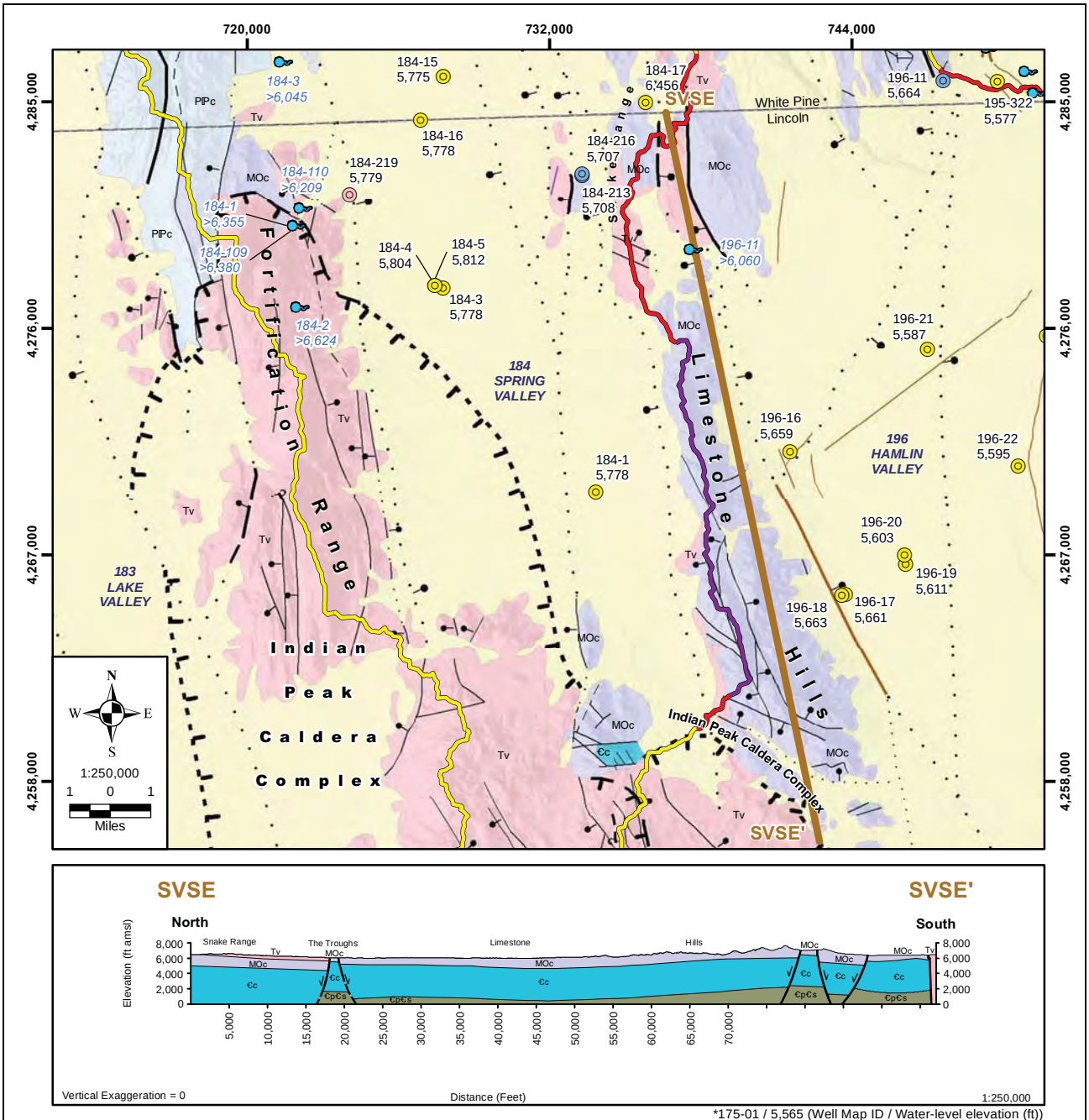
MAP ID 18126-3211 06/14/2011 BP

Figure 7-2

Interbasin Groundwater Flow from Spring Valley to Snake Valley

SNWA Exhibit 258


184-20
5,795
184-22
5,763
184-228
5,763
Minerva
Spring
>5,825
>6,080
Blind
Spring
>5,773
184-32
5,788
184-37
5,800
184-25
5,783
184-24
5,795
184-35
5,778
184-217
5,799
184-36
5,767
184-214
5,800
183-110
5,878
93
184-11
5,792
184-12
5,788
184-13
5,779
184-15
5,775
Big
Springs
>5,578
183-119
5,911
184-16
5,778
196-11
5,664
White Pine
Lincoln
184-213
5,708
184-219
5,779
184-216
5,707
19
Fortification Range
183-100
5,895
184-3
5,778
196-26
5,584
Lake
Valley
183-101
5,895
196-21
5,587
196-16
5,659
Limestone
Hills
184-1
5,778
196-19
5,611
Hamlin
Valley
196-18
5,663
196-17
5,661
Indian
52
Plate 2



*175-01 / 5,565 (Well Map ID / Water-level elevation (ft))
**184-109 / >6380 (Spring Map ID / Water-level elevation (ft))

Legend

Hydrogeology

Map Unit - Description

QTs	Quaternary-Tertiary sediments
Tv	Tertiary volcanic rocks
MOc	Mississippian-Ordovician carbonate rocks
€c	Cambrian carbonate rocks
PIPc	Permian-Pennsylvanian carbonate rocks
€p€s	Cambrian-pre-Cambrian clastic rocks

Regional Faults

Normal fault

Quaternary Normal fault

Solid where known; dashed where inferred; dotted where concealed. Arrows show direction of lateral movement. Bar and ball on downthrown side of fault.

Subsidiary Faults

Normal fault

Quaternary Normal fault

Solid where known; dashed where inferred; dotted where concealed; dotted and queried where uncertain. Bar and ball on downthrown side of fault.

Caldera boundary

Solid where known; dashed where concealed.

Cross Section profile

Well*

Basin Fill

Volcanic

Carbonate

Spring**

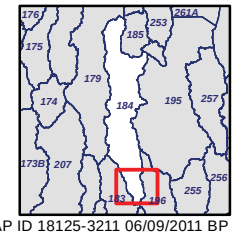
Potential for Groundwater Flow Across Hydrographic Area Boundary

Permissible

Likely

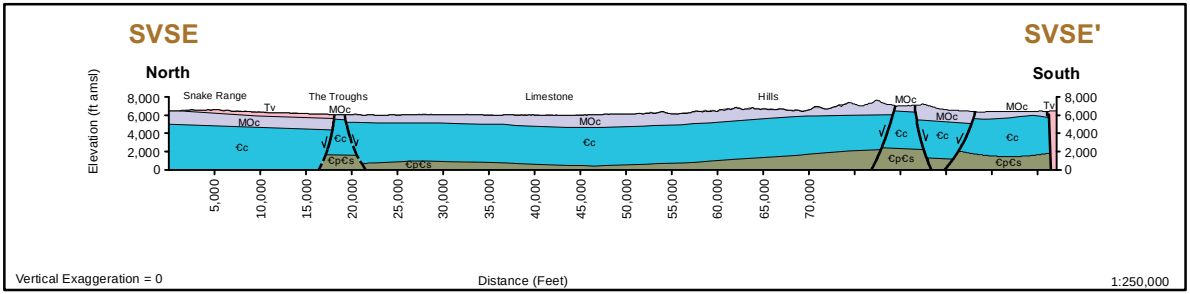
Unlikely

Grid based on Universal Transverse Mercator projection, North American Datum 1983, Zone 11N meters. Hillshade developed from 30-m DEM, Sun Angle 45°, Azimuth 315°.



MAP ID 18125-3211 06/09/2011 BP

Figure 7-3
Interbasin Groundwater Flow from Spring to Hamlin Valley



*175-01 / 5,565 (Well Map ID / Water-level elevation (ft))

**184-109 / >6380 (Spring Map ID / Water-level elevation (ft))

Legend

Hydrogeology Map Unit - Description

QTs	Quaternary-Tertiary sediments
Tv	Tertiary volcanic rocks
MOc	Mississippian-Ordovician carbonate rocks
€c	Cambrian carbonate rocks
PIPc	Permian-Pennsylvanian carbonate rocks
€p€s	Cambrian-pre-Cambrian clastic rocks

Regional Faults

Normal fault

Quaternary Normal fault

Solid where known; dashed where inferred; dotted where concealed. Arrows show direction of lateral movement. Bar and ball on downthrown side of fault.

Subsidiary Faults

Normal fault

Quaternary Normal fault

Solid where known; dashed where inferred; dotted where concealed; dotted and queried where uncertain. Bar and ball on downthrown side of fault.

Caldera boundary

Solid where known; dashed where concealed.

Cross Section profile

Well*

Basin Fill

Volcanic

Carbonate

Spring**

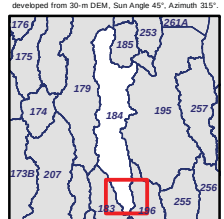
Potential for Groundwater Flow Across Hydrographic Area Boundary

Permissible

Unlikely

Likely

Grid based on Universal Transverse Mercator projection, North American Datum 1983, Zone 11N meters. Hillshade developed from 30-m DEM, Sun Angle 45°, Azimuth 315°.



MAP ID 18125-3211 06/09/2011 BP

Figure 7-3

Interbasin Groundwater Flow from Spring to Hamlin Valley

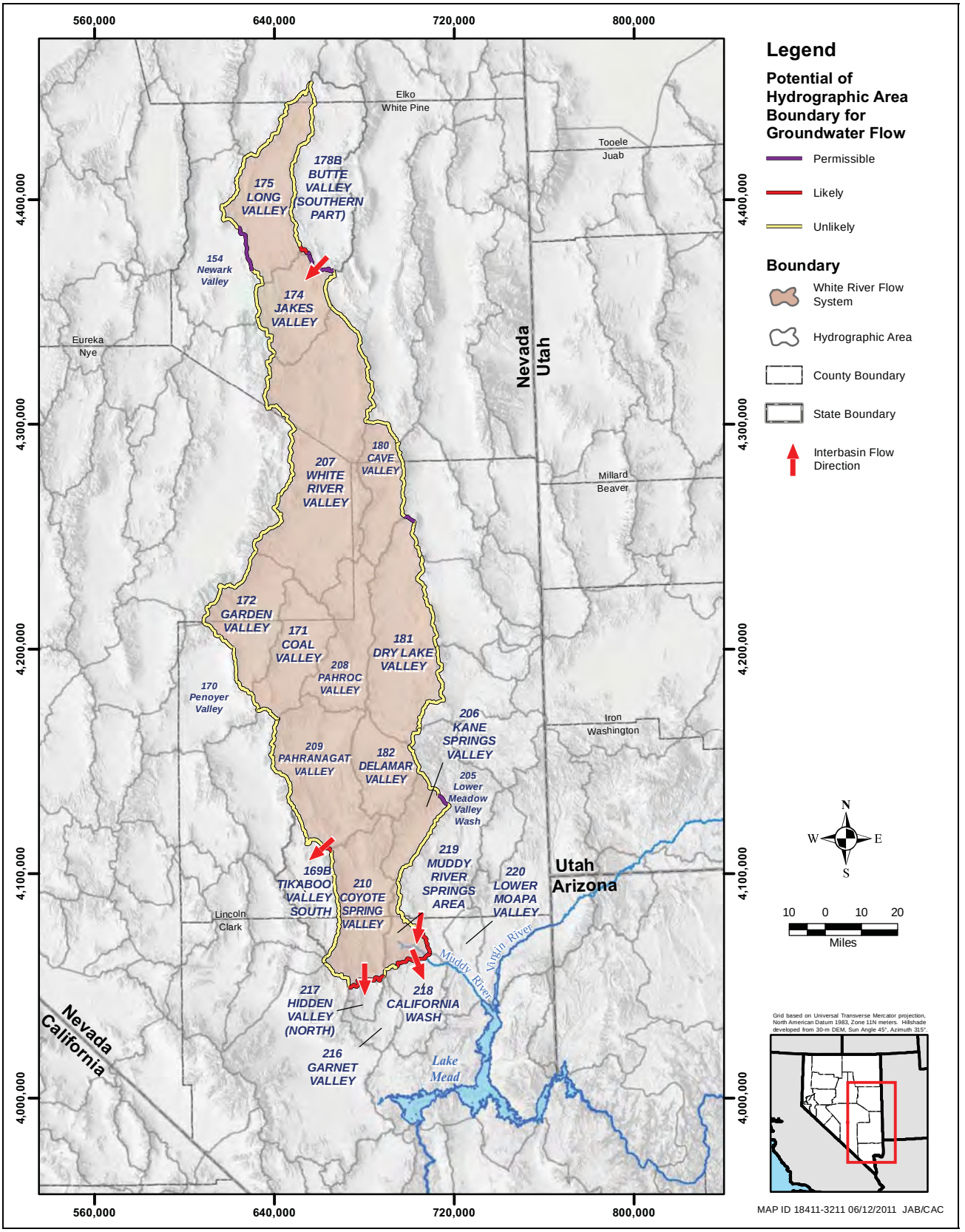
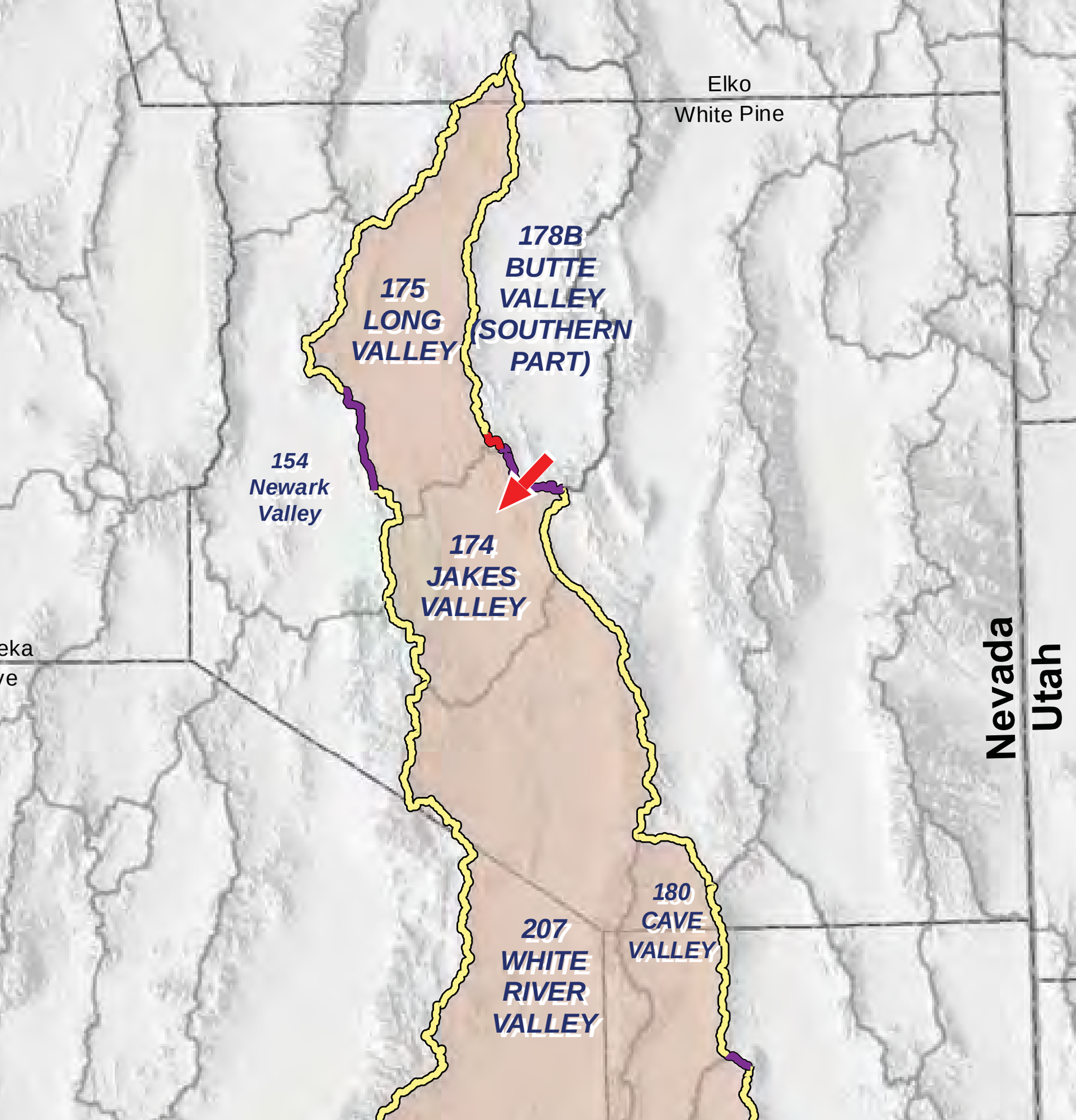
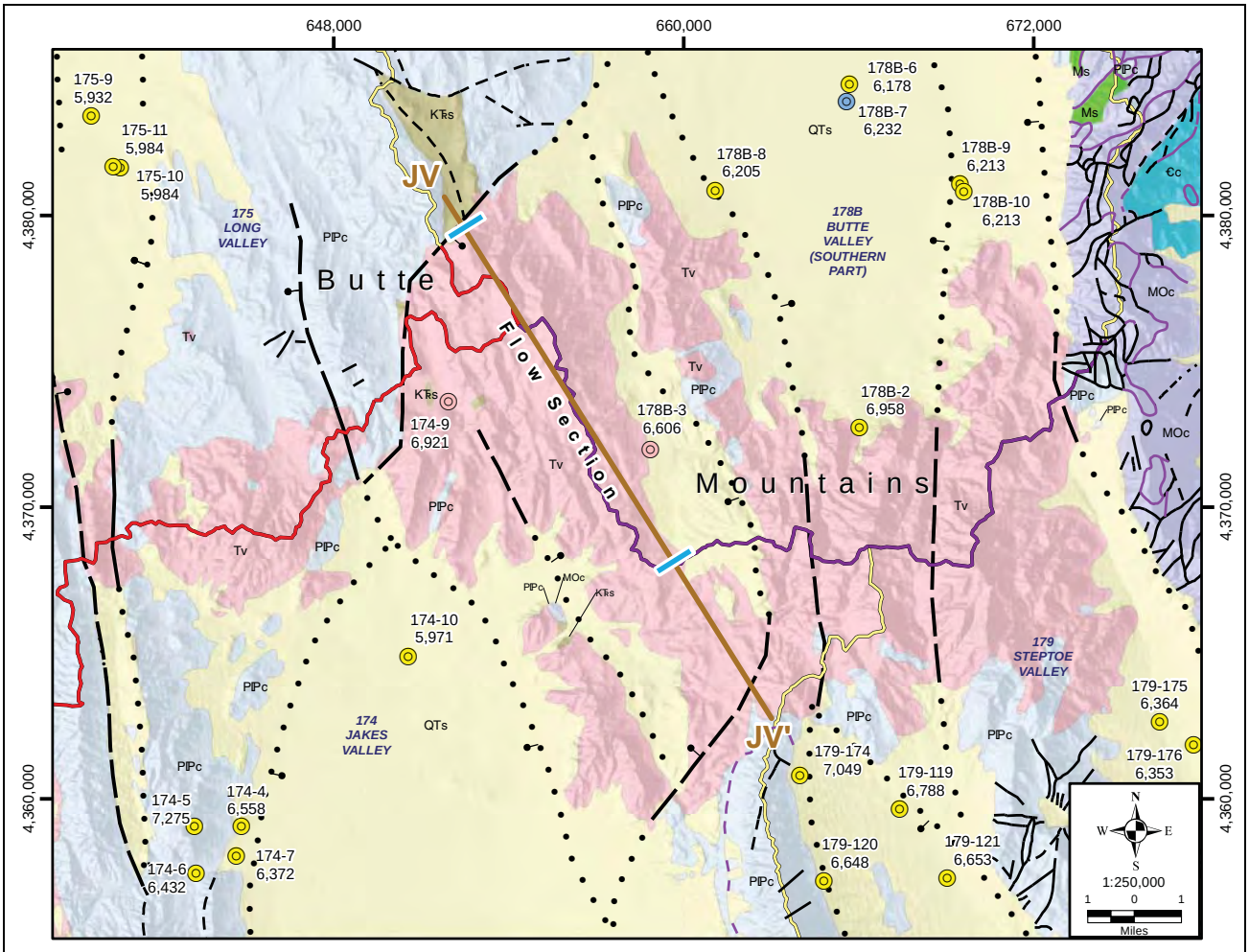


Figure E-1
Locations of Interbasin Flow for the External Boundaries

SNWA Exhibit 258


Elko
White Pine
178B
BUTTE
VALLEY
(SOUTHERN
PART)
175
LONG
VALLEY
154
Newark
Valley
174
JAKES
VALLEY
180
CAVE
VALLEY
207
WHITE
RIVER
VALLEY
Nevada
Utah



*175-01 / 5,565 (Well Map ID / Water-level elevation (ft))

Legend

Hydrogeology
Map Unit - Description

- QTs — Quaternary-Tertiary sediments
- Tv — Tertiary volcanic rocks
- KTrs — Cretaceous-Triassic clastic rocks
- PIPc — Permian-Pennsylvanian carbonate rocks
- Ms — Mississippian clastic rocks
- MOc — Mississippian-Ordovician carbonate rocks
- €c — Cambrian carbonate rocks

Regional Faults
- Normal fault
- Detachment fault

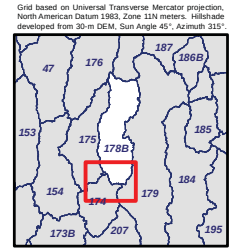
Solid where known; dashed where inferred; dotted where concealed. Bar and ball on downthrown side of fault.

Subsidiary Faults
- Normal fault
- Detachment fault

Solid where known; dashed where inferred; dotted where concealed; dotted and queried where uncertain. Bar and ball on downthrown side of fault.

Well*
- Basin Fill
- Carbonate
- Volcanic

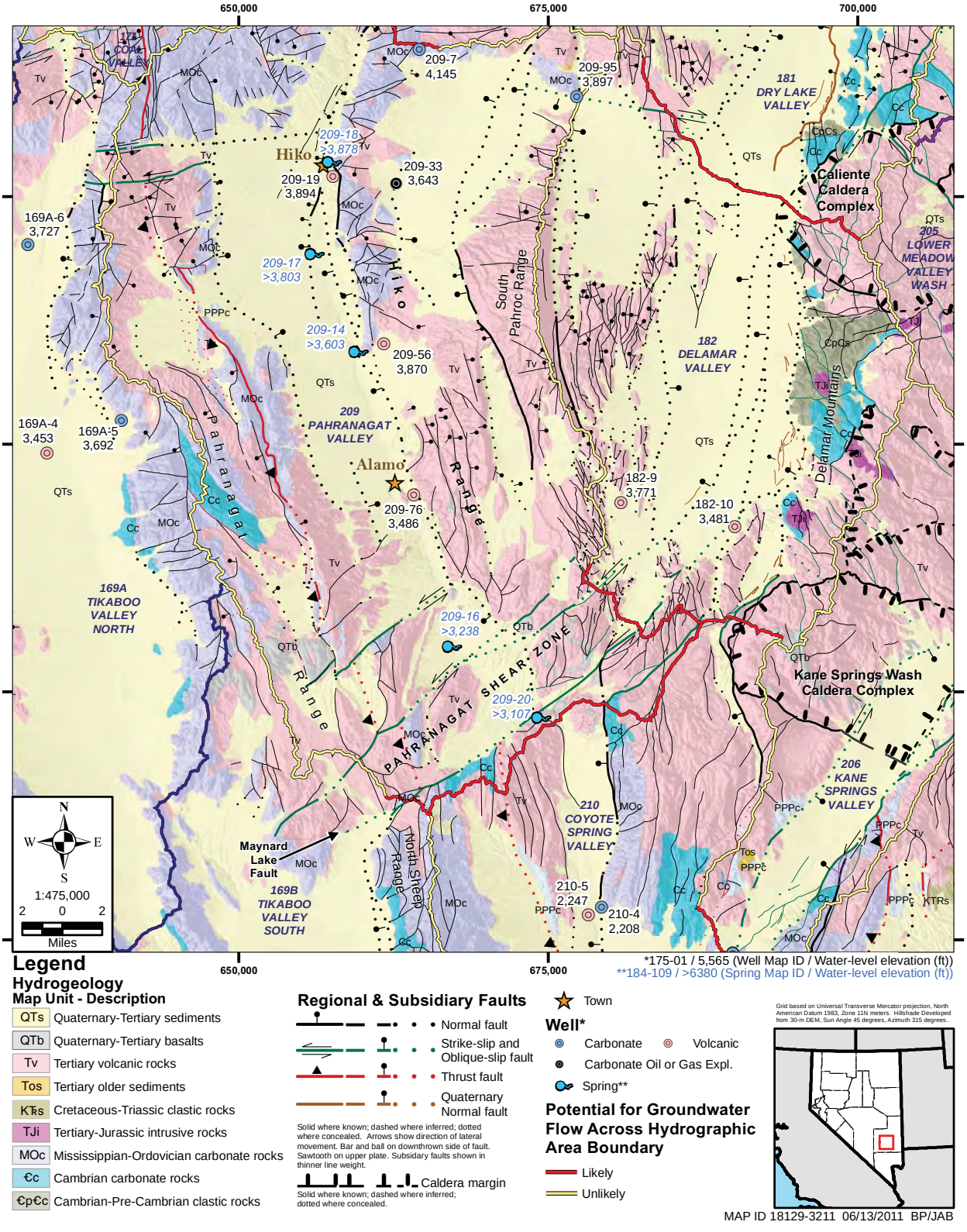
Potential for Groundwater Flow Across Hydrographic Area Boundary
- Permissible
- Likely
- Unlikely
- Cross Section profile



MAP ID 18122-3211 06/13/2011 JAB

Figure E-2
Interbasin Groundwater Flow from Butte Valley (Southern) to Jakes Valley

SNWA Exhibit 258



Legend

Hydrogeology

Map Unit - Description

QTs	Quaternary-Tertiary sediments
QTb	Quaternary-Tertiary basalts
Tv	Tertiary volcanic rocks
Tos	Tertiary older sediments
KTs	Cretaceous-Triassic clastic rocks
TJi	Tertiary-Jurassic intrusive rocks
MOc	Mississippian-Ordovician carbonate rocks
Cc	Cambrian carbonate rocks
CpCc	Cambrian-Pre-Cambrian clastic rocks

Regional & Subsidiary Faults

- Normal fault
- Strike-slip and Oblique-slip fault
- Thrust fault
- Quaternary Normal fault

Solid where known; dashed where inferred; dotted where concealed. Arrows show direction of lateral movement. Bar and ball on downthrown side of fault. Sawtooth on upper plate. Subsidary faults shown in thinner line weight.

- Caldera margin

Solid where known; dashed where inferred; dotted where concealed.

- Town

Well*

- Carbonate
- Volcanic
- Carbonate Oil or Gas Expl.
- Spring**

Potential for Groundwater Flow Across Hydrographic Area Boundary

- Likely
- Unlikely

*175-01 / 5,565 (Well Map ID / Water-level elevation (ft))
**184-109 / >6380 (Spring Map ID / Water-level elevation (ft))

Grid based on Universal Transverse Mercator projection, North American Datum 1983, Zone 11N meters. Hillshade Developed from 30-m DEM, Sun Angle 45 degrees, Azimuth 315 degrees.

MAP ID 18129-3211 06/13/2011 BP/JAB

Figure 7-10
Hydrogeology of the Pahranagat Shear Zone and Vicinity

Explanation

Hydrogeologic Units

QTs	Quaternary-Tertiary sediments
QTb	Quaternary-Tertiary basalts
Tv	Tertiary volcanic rocks
Tos	Tertiary older sediments & mega breccia that is located on the western flank of the Sheep Range
TJi	Tertiary-Jurassic intrusive rocks
KTrs	Cretaceous-Triassic clastic rocks
PPc	Permian-Pennsylvanian carbonate rocks
Ms	Mississippian siliciclastic rocks
MOc	Mississippian-Ordovician carbonate rocks
€c	Cambrian carbonate rocks
€p€s	Cambrian-Precambrian siliciclastic rocks
p€m	Precambrian metamorphic rocks
	Open water

Regional Faults

Normal Fault
Solid where known; Dashed where inferred; dotted where concealed. Bar and ball on downthrown side.

Strike-slip Fault
Solid where known; Dashed where inferred; dotted where concealed. Arrows show direction of movement.

Thrust Fault
Solid where known; Dashed where inferred; dotted where concealed. Sawteeth on upper plate.

Detachment Fault
Solid where known; Dashed where inferred; dotted where concealed. Hollow sawteeth on upper plate.

Quaternary Normal Fault
Solid where known; Dashed where inferred; dotted where concealed.

Subsidiary Faults

Normal Fault
Solid where known; dashed where inferred; dotted where concealed; dotted and queried where uncertain. Bar and ball on downthrown side.

Strike-slip Fault
Solid where known; dashed where inferred; dotted where concealed; dotted and queried where uncertain Arrows show direction of movement.

Thrust Fault
Solid where known; dashed where inferred; dotted where concealed; dotted and queried where uncertain. Sawteeth on upper plate.

Detachment Fault
Solid where known; dashed where inferred; dotted where concealed; dotted and queried where uncertain. Hollow sawteeth on upper plate.

Quaternary Normal Fault
Solid where known; dashed where inferred; dotted where concealed; dotted and queried where uncertain. Bar and ball on downthrown side.

Caldera Boundary
Solid where known; dashed where inferred; dotted where concealed

Cross Sections (Plates 8 and 9)

Major Road

Transverse Zone
(Zone of possible disruption)

Strike and Dip of Beds

Overturned Beds

Oil Well Data Used in Cross Sections
Nevada: Nevada Bureau of Mines and Geology

Well

Town

129 BASIN NAME Hydrographic Basin

SCALE 1:250,000

Projection: UTM Zone 11 NAD83

0 25,000 50,000 75,000 Feet

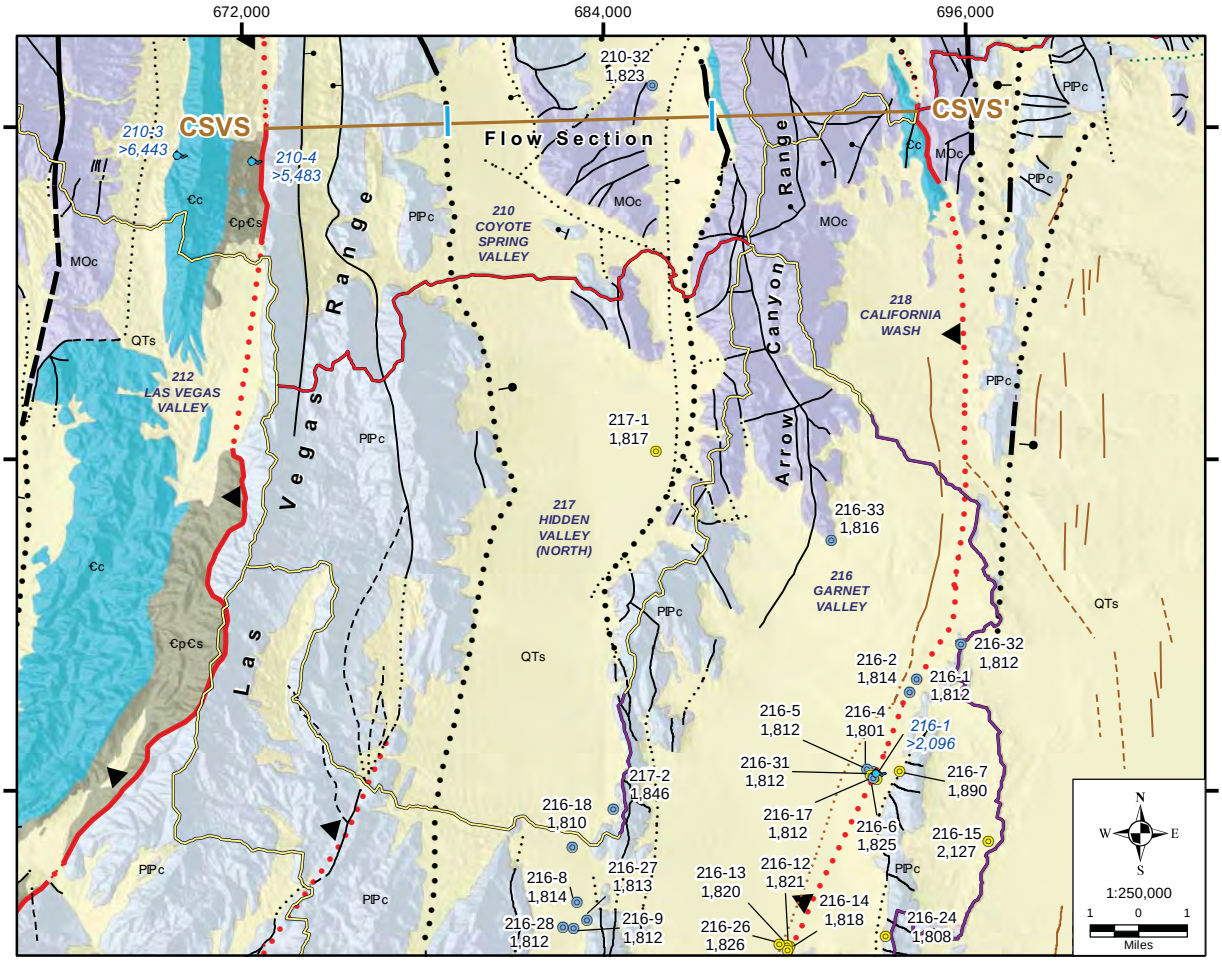
0 5,000 10,000 15,000 20,000 25,000 Meters

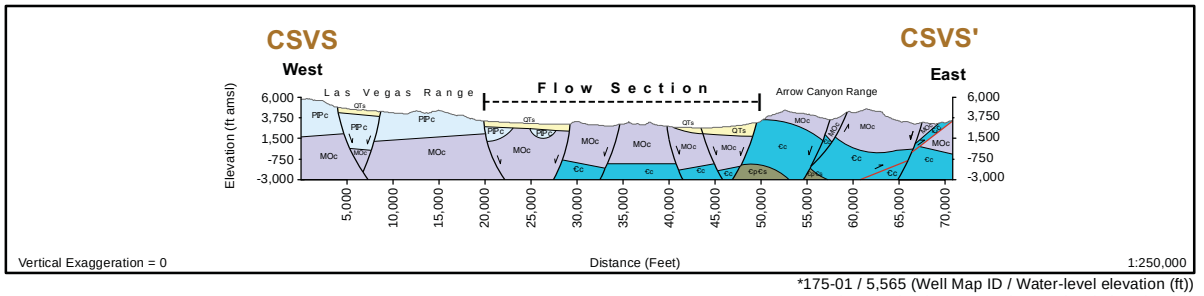
0 5 10 15 20 Miles

PLATE 7. HYDROGEOLOGY OF SOUTHERN LINCOLN AND NORTHERN CLARK COUNTIES, NEVADA, AND ADJACENT AREAS, ARIZONA

SOUTHERN NEVADA WATER AUTHORITY

MAP ID 18292-3211 05/17/2011 BP





*175-01 / 5,565 (Well Map ID / Water-level elevation (ft))
**184-109 / >6380 (Spring Map ID / Water-level elevation (ft))

Legend

Hydrogeology
Map Unit - Description

- QTs — Quaternary-Tertiary sediments
- PlPc — Permian-Pennsylvanian carbonate rocks
- MOc — Mississippian-Ordovician carbonate rocks
- Cc — Cambrian carbonate rocks
- CpCs — Cambrian-Pre-Cambrian clastic rocks
- Cross Section profile

Well*
- Basin Fill
- Carbonate
- Spring**

Potential for Groundwater Flow Across Hydrographic Area Boundary
- Permissible
- Likely
- Unlikely

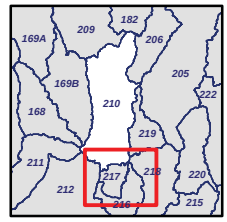
Regional Faults
- Normal fault
- Thrust fault

Solid where known; dashed where inferred; dotted where concealed. Sawtooth on upper plate. Bar and ball on downthrown side of fault.

Subsidiary Faults
- Normal fault
- Strike-slip and Oblique-slip fault
- Thrust fault
- Quaternary Normal fault

Solid where known; dashed where inferred; dotted where concealed; dotted and queried where uncertain. Arrows show direction of lateral movement. Bar and ball on downthrown side of fault. Sawtooth on upper plate.

Grid based on Universal Transverse Mercator projection, North American Datum 1983, Zone 11N meters. Hillshade developed from 30-m DEM, Sun Angle 45°, Azimuth 315°.



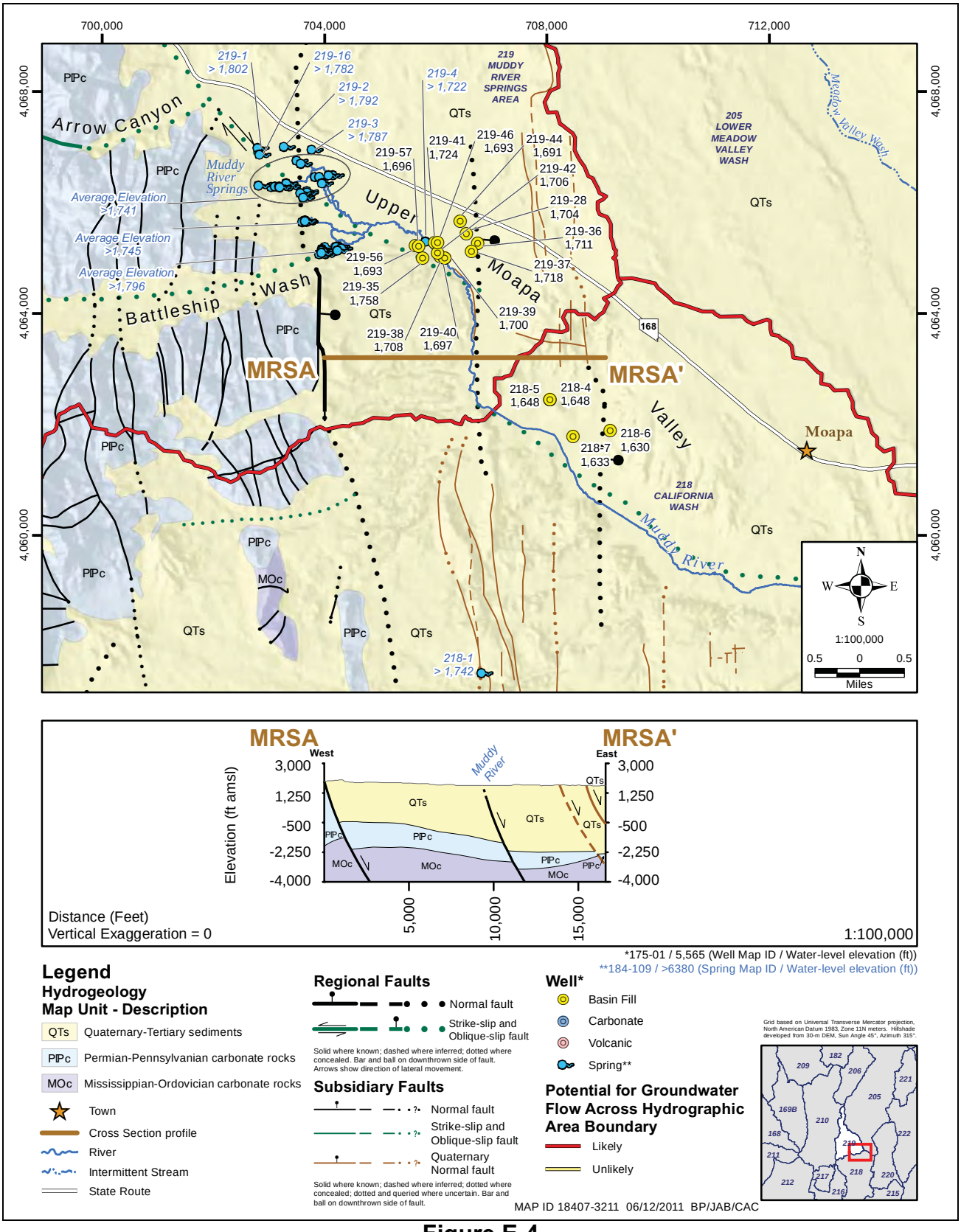
MAP ID 18272-3211 06/12/2011 JAB/BP/CAC

Figure E-3
Interbasin Groundwater Flow from Coyote Spring to Hidden Valley

SNWA Exhibit 258

Table E-1
Carbonate-Rock Aquifer Transmissivities

HA	Well	Transmissivity (ft^2/d)	Geometric Mean Transmissivity (ft^2/d)	Test Duration	Reference
210	MX-4	200,136	117,847	77 hours	IT Corporation (1996, App. A)
		204,440		77 hours	Belcher et al. (2001, App. A)
		40,000		5 days	Bunch and Harrill (1984, p. 119)
	MX-5	281,912	321,310	30 days	IT Corporation (1996, App. A)
		1,431,080		30 days	IT Corporation (1996, App. A)
		287,292		30 days	IT Corporation (1996, App. A)
		250,000		30 days	Ertec Western, Inc. (1981, p. 51)
		250,000		80 days	Bunch and Harrill (1984, p. 119)
		168,000		72 hours	Johnson et al. (1998, p. 5)
		290,520		326 hours	Belcher et al. (2001, App. A)
216	RW-1	404,800	404,800	72 hours	SRK Consulting (2001, Fig. 5)
	Harvey Well	411,400	411,400	72 hours	SRK Consulting (2001, Fig. 7)
218	ECP-2	109,500	109,500	7 days	Johnson et al. (2001, App. A, p. 4)
	TH-2	53,820	53,820	7 days	Johnson et al. (2001, App. A, p. 4)
219	Arrow Canyon	312,040	312,040	121 days	Belcher et al. (2001, App. A)
	EH-4	365,840	365,840	121 days	Belcher et al. (2001, App. A)



*175-01 / 5,565 (Well Map ID / Water-level elevation (ft))
**184-109 / >6380 (Spring Map ID / Water-level elevation (ft))

Legend

Hydrogeology

Map Unit - Description

- QTs — Quaternary-Tertiary sediments
- PlPc — Permian-Pennsylvanian carbonate rocks
- MOc — Mississippian-Ordovician carbonate rocks
- Town
- Cross Section profile
- River
- Intermittent Stream
- State Route

Regional Faults

- Normal fault
- Strike-slip and Oblique-slip fault

Solid where known; dashed where inferred; dotted where concealed. Bar and ball on downthrown side of fault. Arrows show direction of lateral movement.

Subsidiary Faults

- Normal fault
- Strike-slip and Oblique-slip fault
- Quaternary Normal fault

Solid where known; dashed where inferred; dotted where concealed; dotted and queried where uncertain. Bar and ball on downthrown side of fault.

Well*

- Basin Fill
- Carbonate
- Volcanic
- Spring**

Potential for Groundwater Flow Across Hydrographic Area Boundary

- Likely
- Unlikely

Grid based on Universal Transverse Mercator projection, North American Datum 1983, Zone 11N meters. Hillshade developed from 30-m DEM, Sun Angle 45°, Azimuth 315°.

MAP ID 18407-3211 06/12/2011 BP/JAB/CAC

Figure E-4
Interbasin Groundwater Flow from MRSA to California Wash

Table E-2
Estimate of Transmissivity for Basin-Fill Sediments in Muddy River Springs Area

Location	Well	Transmissivity (ft^2/d)	Geometric Mean Transmissivity (ft^2/d)	Test Duration	Reference
HA 205	Well 3	23,527.8	18,585	168 hrs	URS (2001)
	Well 3	14,680.4			
	MW-1 (Casing A)	7,188	6,998	168 hrs	URS (2001)
	MW-1 (Casing A)	6,813.7			
HA 222 (Virgin River Valley)	WX-31	7,751	9,282	62 days	Burbey et al. (2006)
	WX-31	4,844			
	WX-31	15,071			
	WX-31	7,320			
	WX-31	7,751			
	Unnamed well near WX-31	19,915		NR	
	BVSMW1	5,939	5,829	72 hrs	Pompeo (2008)
	BVSMW2	5,919			
	BVSMW3	5,635			
	HWSMW1	19,465	19,957	72 hrs	Pompeo (2008)
	HWSMW2	20,462			
	HWMW-1	9,130	6,283	72 hrs	Pompeo (2008)
	HWMW-2	8,464			
	HWMW-3	4,735			
	HWMW-4	4,260			
	Well 26	20,000	22,361	48 hrs	Johnson (1995)
	Well 26	25,000			

NR = Not Reported

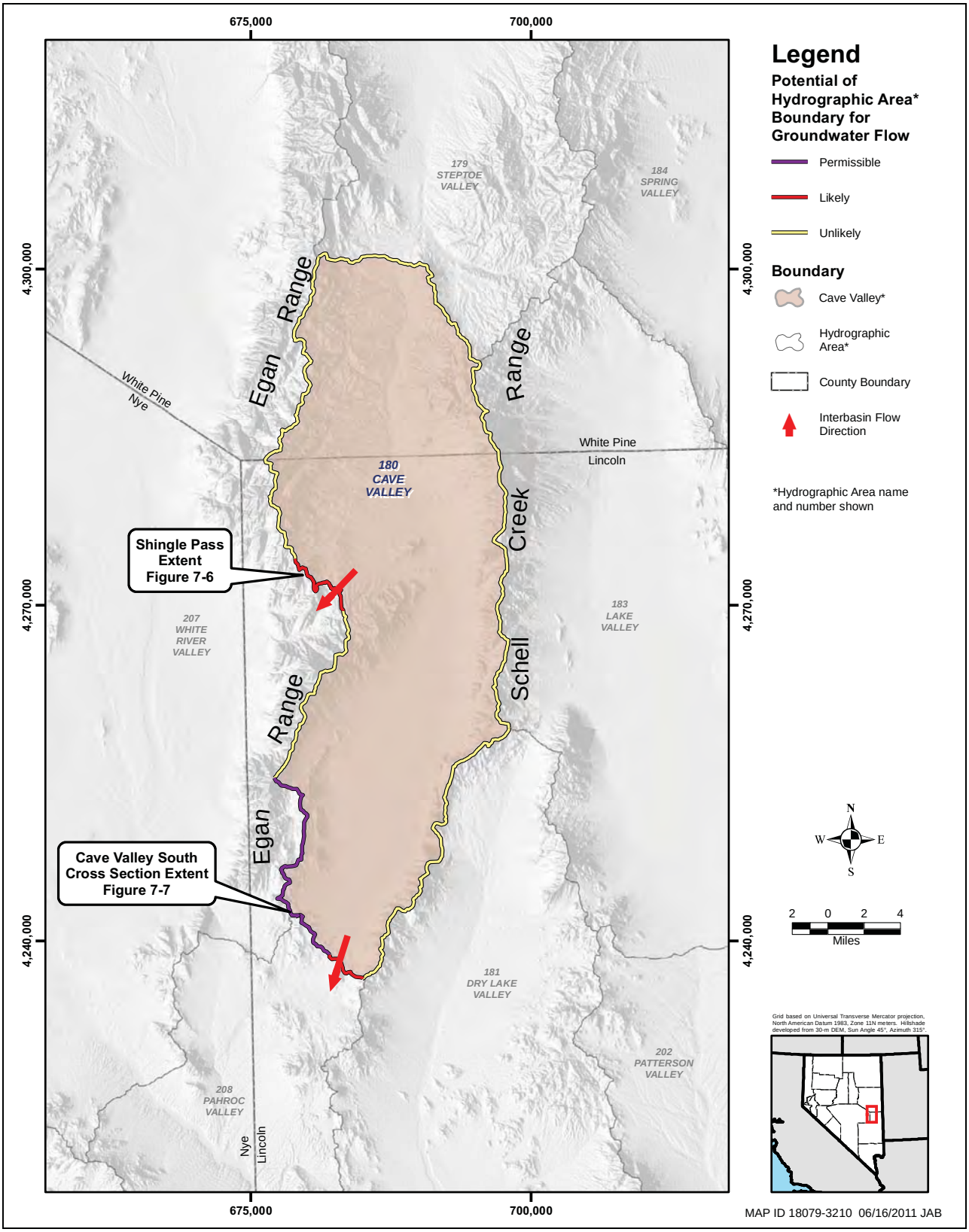


Figure 7-4
Location of Interbasin Groundwater Flow for Cave Valley

SNWA Exhibit 258

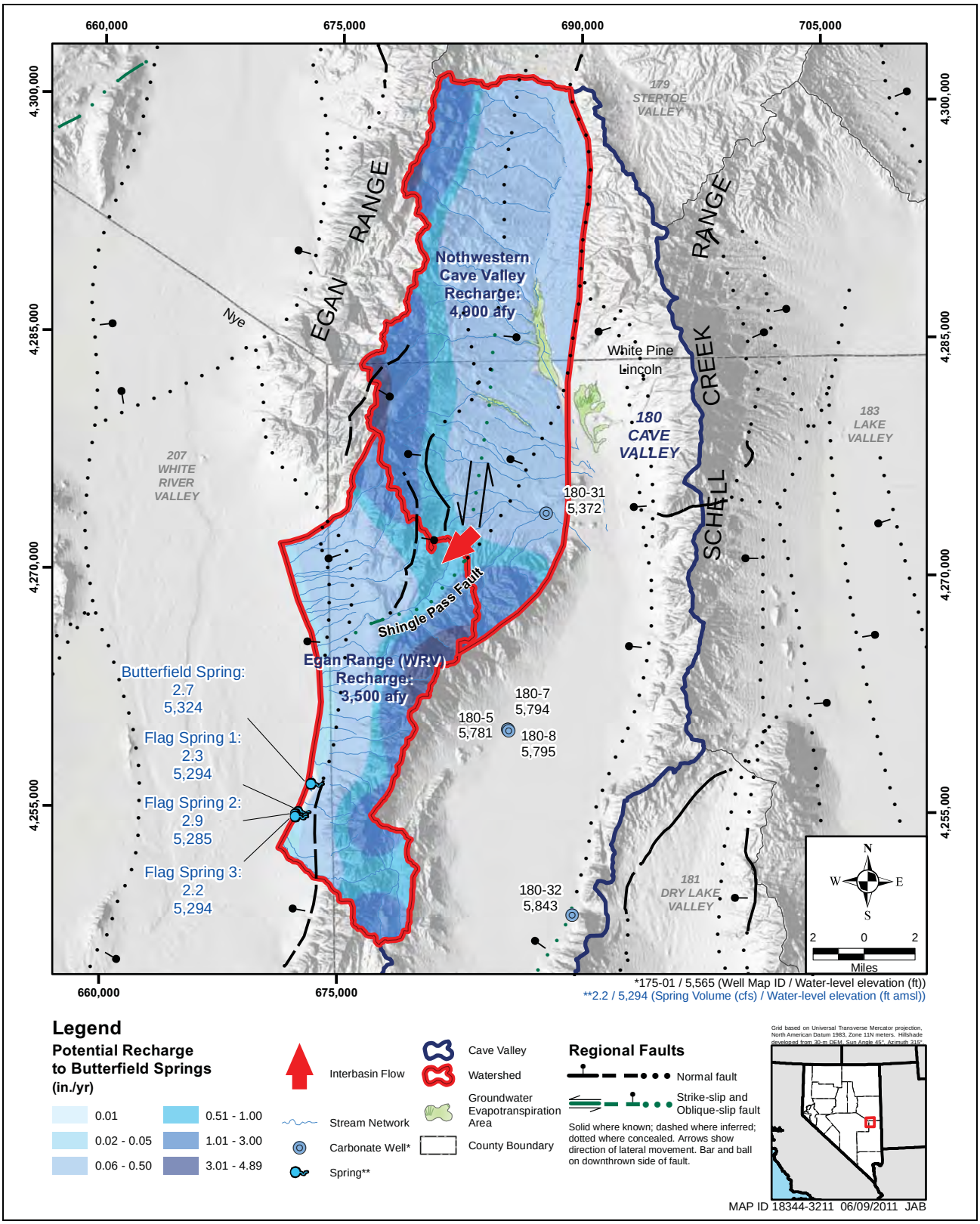
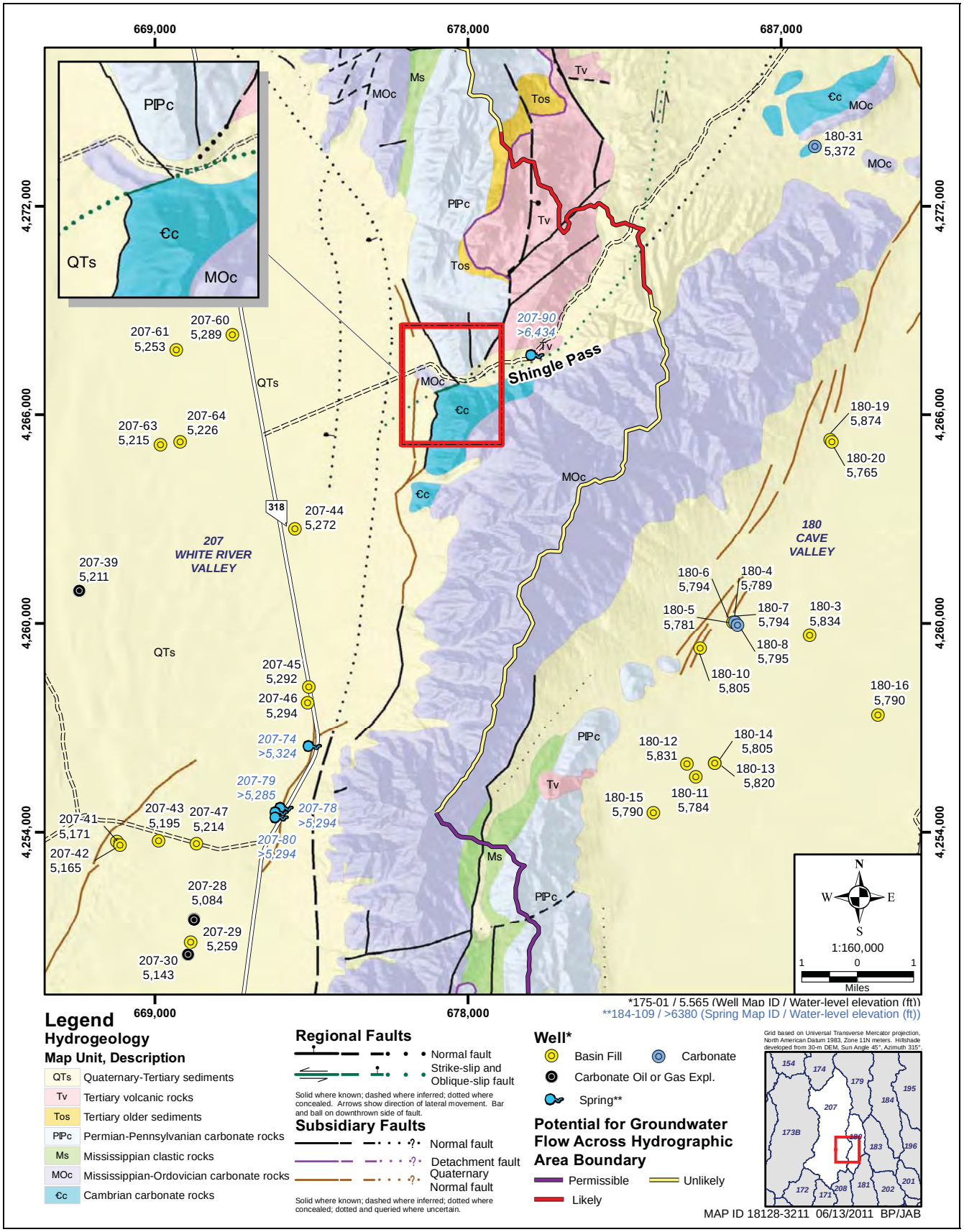


Figure 7-5
Watersheds in Cave and White River Valleys Used to Estimate Outflow through Shingle Pass

SNWA Exhibit 258



Legend

Hydrogeology

Map Unit, Description

QTs	Quaternary-Tertiary sediments
Tv	Tertiary volcanic rocks
Tos	Tertiary older sediments
PIPc	Permian-Pennsylvanian carbonate rocks
Ms	Mississippian clastic rocks
MOc	Mississippian-Ordovician carbonate rocks
€c	Cambrian carbonate rocks

Regional Faults

Normal fault

Strike-slip and Oblique-slip fault

Solid where known; dashed where inferred; dotted where concealed. Arrows show direction of lateral movement. Bar and ball on downthrown side of fault.

Subsidiary Faults

Normal fault

Detachment fault

Quaternary Normal fault

Solid where known; dashed where inferred; dotted where concealed; dotted and queried where uncertain.

Well*

Basin Fill

Carbonate

Carbonate Oil or Gas Expl.

Spring**

Potential for Groundwater Flow Across Hydrographic Area Boundary

Permissible

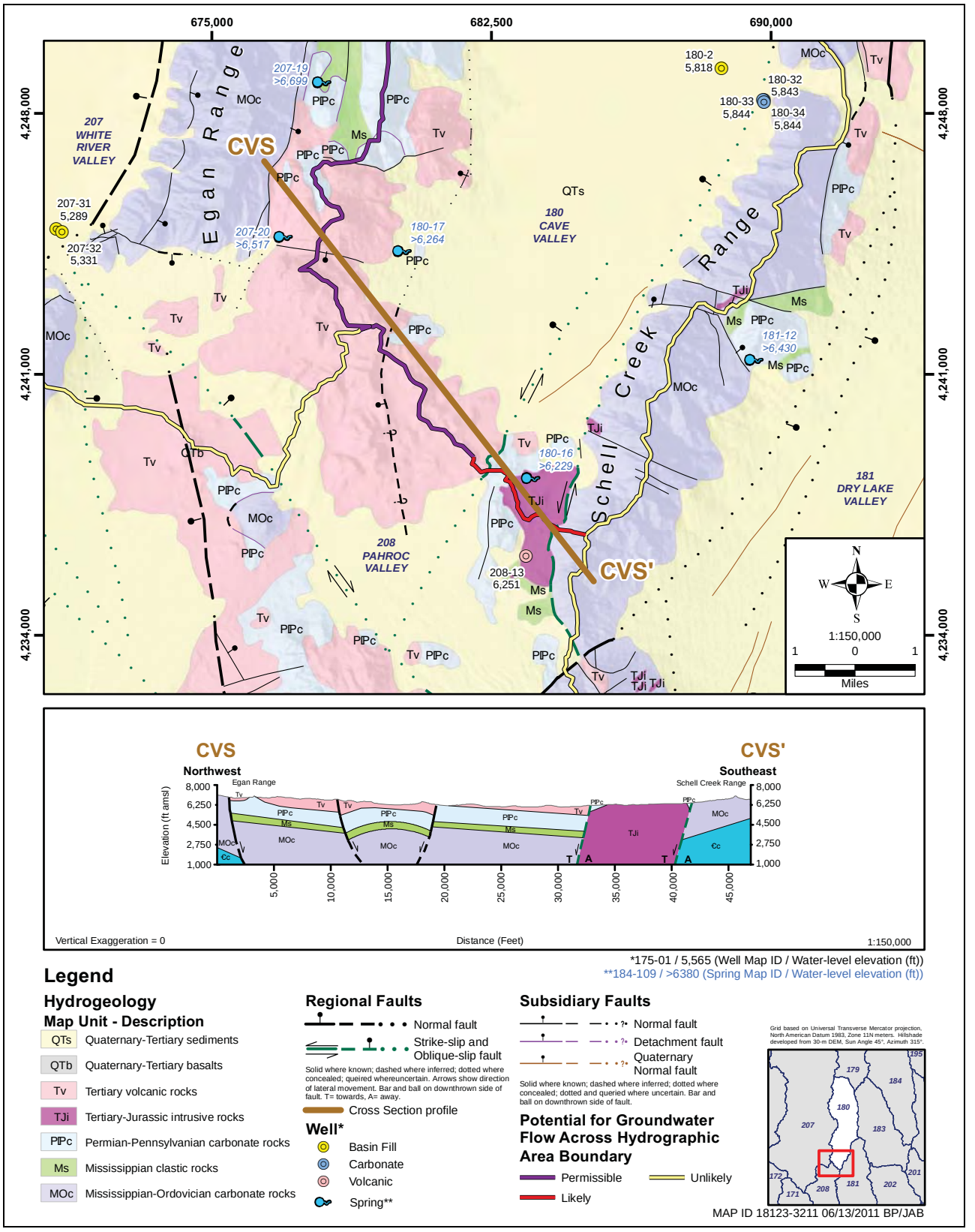
Unlikely

Likely

Grid based on Universal Transverse Mercator projection, North American Datum 1983, Zone 11N meters. Hillshade developed from 30-m DEM, Sun Angle 45°, Azimuth 315°.

MAP ID 18128-3211 06/13/2011 BP/JAB

Figure 7-6
Interbasin Groundwater Flow from Cave Valley to White River Valley



*175-01 / 5,565 (Well Map ID / Water-level elevation (ft))
**184-109 / >6380 (Spring Map ID / Water-level elevation (ft))

Legend

Hydrogeology

Map Unit - Description

- QTs — Quaternary-Tertiary sediments
- QTb — Quaternary-Tertiary basalts
- Tv — Tertiary volcanic rocks
- TJi — Tertiary-Jurassic intrusive rocks
- PIPc — Permian-Pennsylvanian carbonate rocks
- Ms — Mississippian clastic rocks
- MOc — Mississippian-Ordovician carbonate rocks

Regional Faults

- Normal fault
- Strike-slip and Oblique-slip fault

Solid where known; dashed where inferred; dotted where concealed; queried whereuncertain. Arrows show direction of lateral movement. Bar and ball on downthrown side of fault. T= towards, A= away.

- Cross Section profile

Well*

- Basin Fill
- Carbonate
- Volcanic
- Spring**

Subsidiary Faults

- Normal fault
- Detachment fault
- Quaternary Normal fault

Solid where known; dashed where inferred; dotted where concealed; dotted and queried where uncertain. Bar and ball on downthrown side of fault.

Potential for Groundwater Flow Across Hydrographic Area Boundary

- Permissible
- Likely
- Unlikely

Grid based on Universal Transverse Mercator projection, North American Datum 1983, Zone 11N meters. Hillshade developed from 30-m DEM, Sun Angle 45°, Azimuth 315°.

MAP ID 18123-3211 06/13/2011 BP/JAB

Figure 7-7
Interbasin Groundwater Flow from Cave Valley to Pahroc Valley

SNWA Exhibit 258

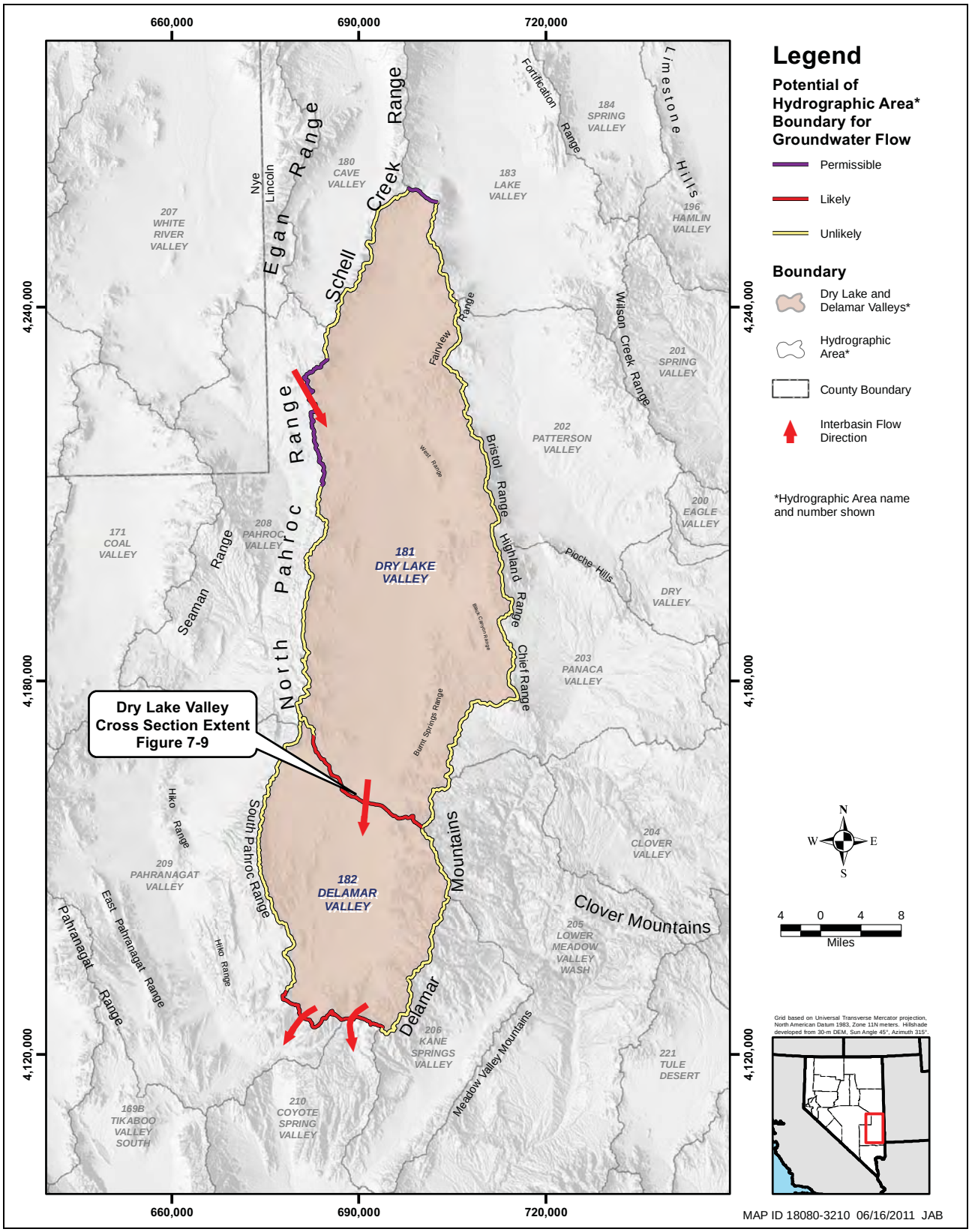
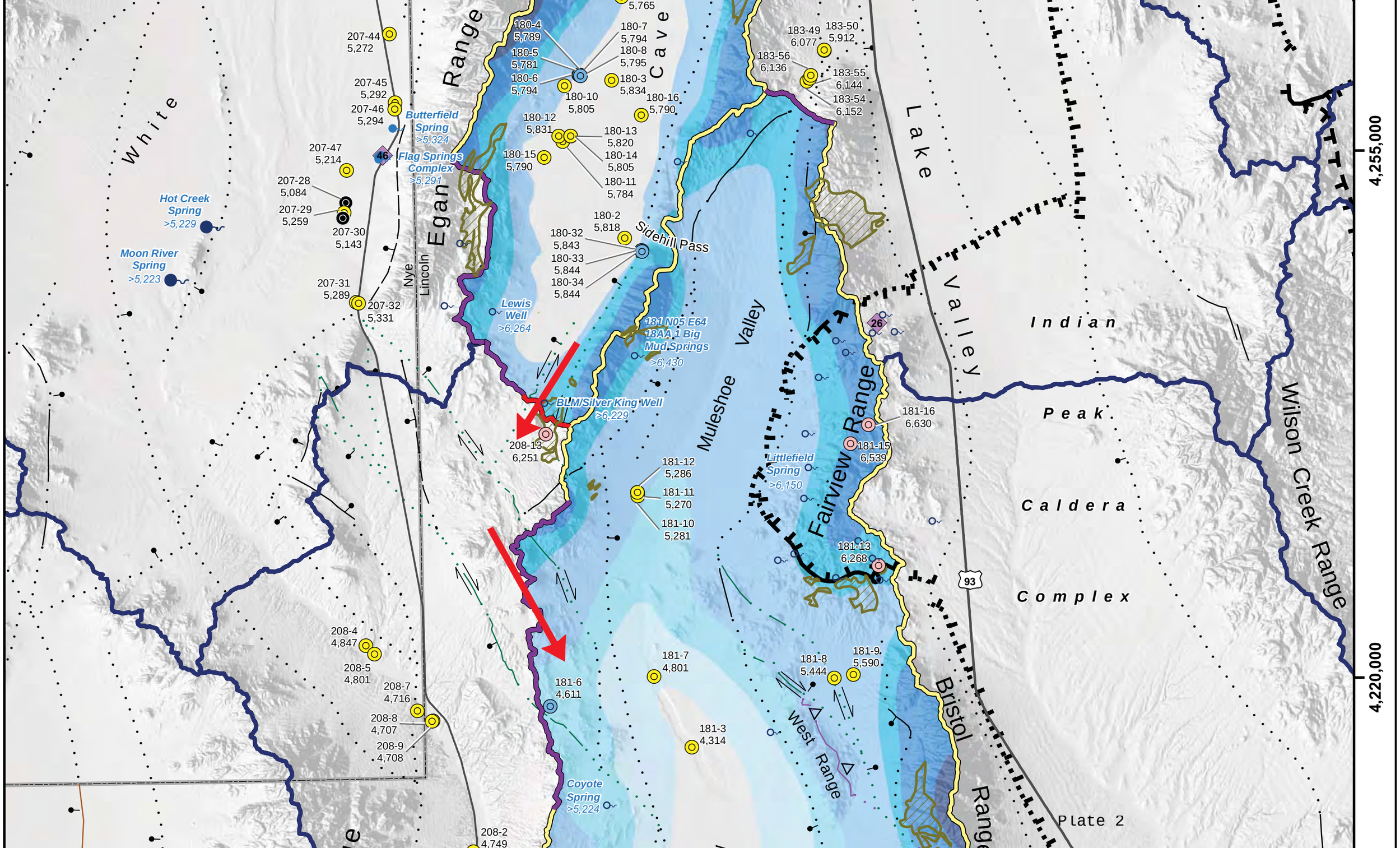
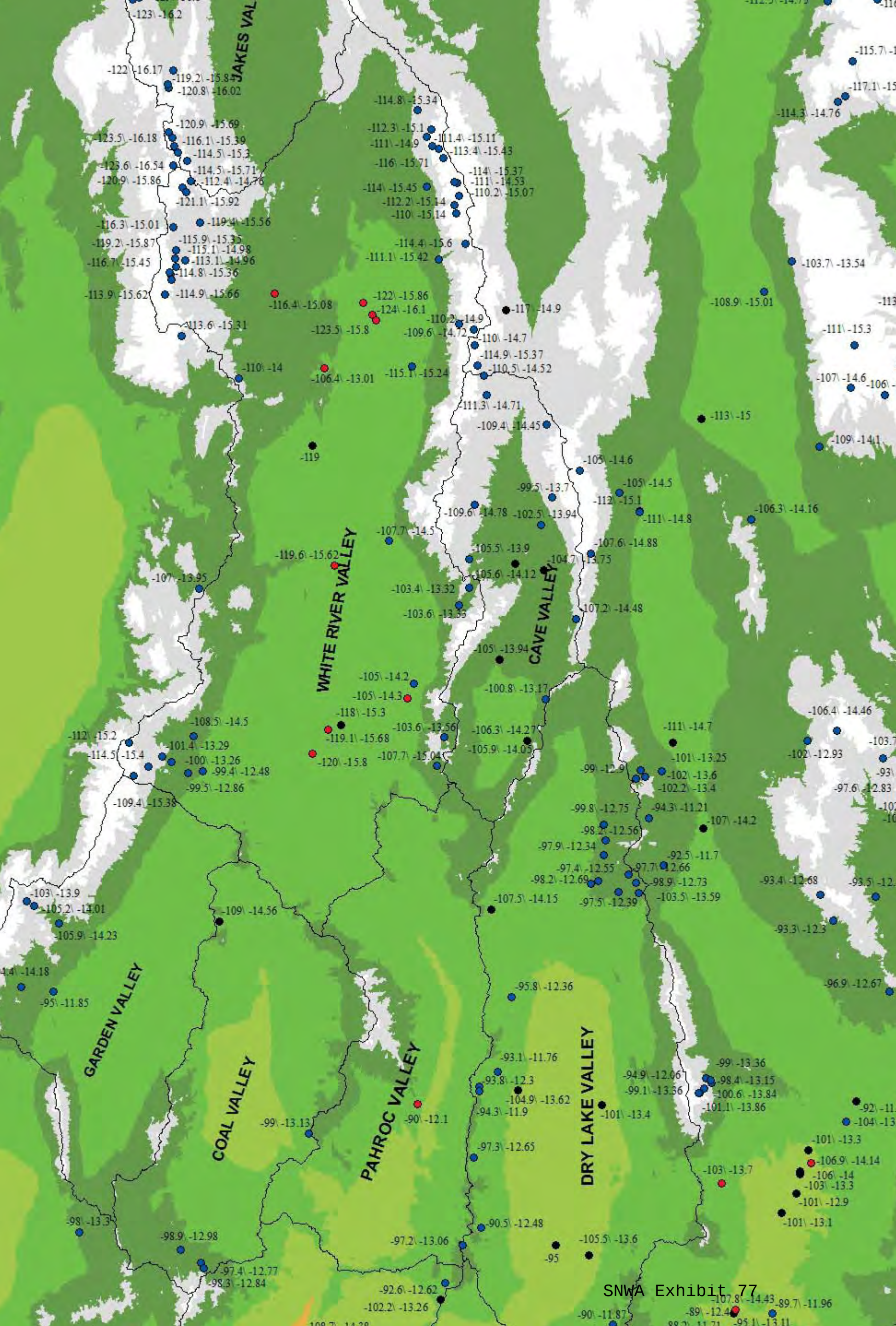
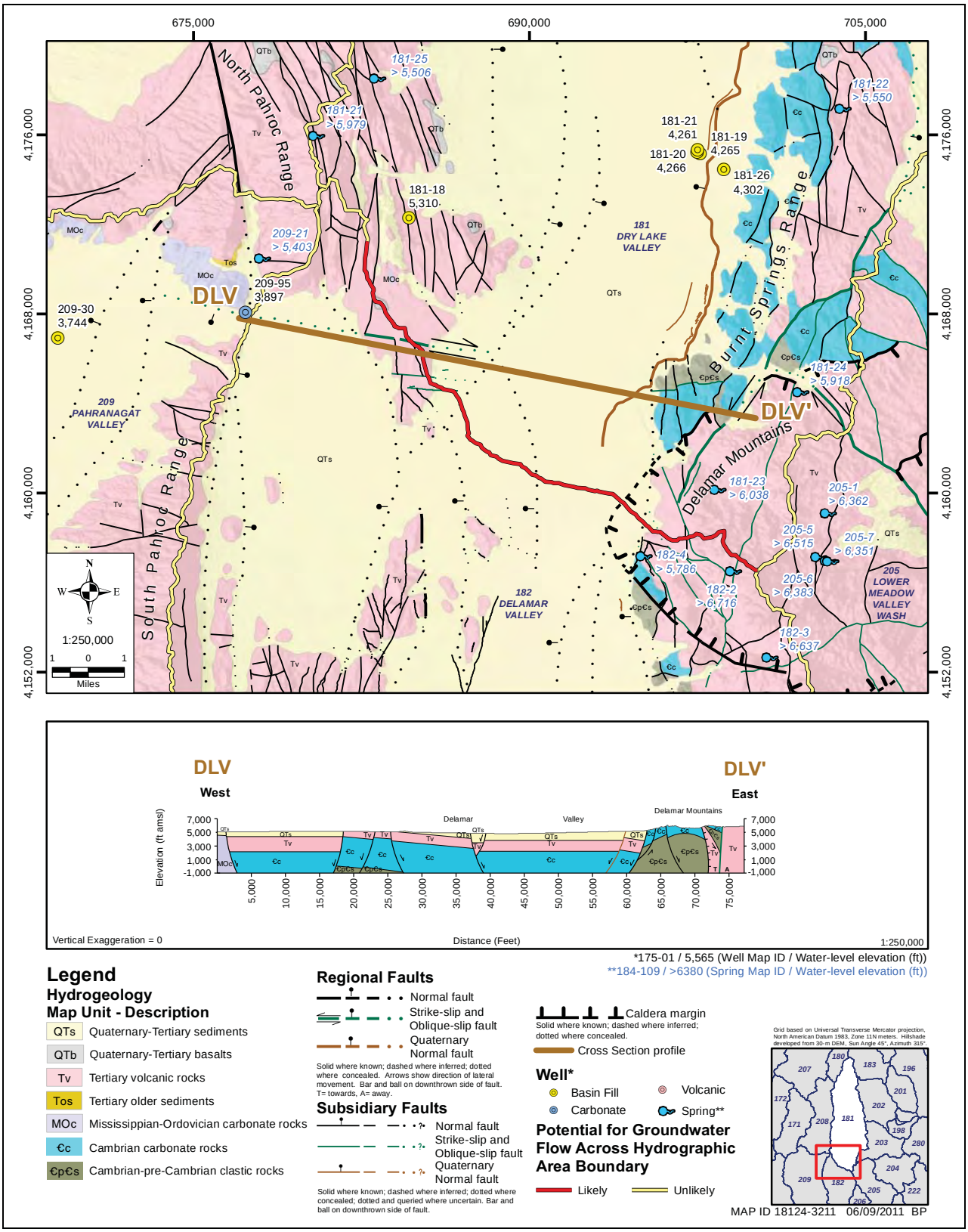


Figure 7-8
Locations of Interbasin Flow for Dry Lake and Delamar Valleys

SNWA Exhibit 258


White
Egan Range
Cave
Lake
Valley
Indian
Peak
Caldera
Complex
Wilson Creek Range
Fairview Range
Sidehill Pass
Muleshoe Valley
Bristol
Range
West Range
Nye
Lincoln
207-44 5,272
207-45 5,292
207-46 5,294
207-47 5,214
207-28 5,084
207-29 5,259
207-30 5,143
207-31 5,289
207-32 5,331
Butterfield Spring >5,324
Flag Springs Complex >5,291
Hot Creek Spring >5,229
Moon River Spring >5,223
46
180-4 5,789
180-5 5,781
180-6 5,794
180-7 5,794
180-8 5,795
180-3 5,834
180-10 5,805
180-16 5,790
180-12 5,831
180-13 5,820
180-14 5,805
180-15 5,790
180-11 5,784
180-2 5,818
180-32 5,843
180-33 5,844
180-34 5,844
Lewis Well >6,264
181 N05 E64 18AA 1 Big Mud Springs >6,430
BLM/Silver King Well >6,229
208-13 6,251
181-12 5,286
181-11 5,270
181-10 5,281
183-49 6,077
183-50 5,912
183-56 6,136
183-55 6,144
183-54 6,152
Littlefield Spring >6,150
181-16 6,630
181-15 6,539
181-13 6,268
181-8 5,444
181-9 5,590
181-7 4,801
181-3 4,314
181-6 4,611
208-4 4,847
208-5 4,801
208-7 4,716
208-8 4,707
208-9 4,708
Coyote Spring >5,224
208-2 4,749
26
93
4,255,000
4,220,000
Plate 2


JAKES VALLEY
WHITE RIVER VALLEY
CAVE VALLEY
GARDEN VALLEY
COAL VALLEY
PAHROC VALLEY
DRY LAKE VALLEY
-123\ -16.2
-122\ -16.17
-119.2\ -15.8
-120.8\ -16.02
-120.9\ -15.69
-123.5\ -16.18
-116.1\ -15.39
-114.5\ -15.3
-123.6\ -16.54
-114.5\ -15.71
-120.9\ -15.86
-112.4\ -14.76
-121.1\ -15.92
-116.3\ -15.01
-119.4\ -15.56
-119.2\ -15.87
-115.9\ -15.35
-115.1\ -14.98
-116.7\ -15.45
-113.1\ -14.96
-114.8\ -15.36
-113.9\ -15.62
-114.9\ -15.66
-116.4\ -15.08
-122\ -15.86
-124\ -16.1
-113.6\ -15.31
-123.5\ -15.8
-110\ -14
-106.4\ -13.01
-115.1\ -15.24
-119
-119.6\ -15.62
-107\ -13.95
-114.8\ -15.34
-112.3\ -15.1
-111\ -14.9
-111.4\ -15.11
-113.4\ -15.43
-116\ -15.71
-114\ -15.37
-111\ -14.53
-114\ -15.45
-110.2\ -15.07
-112.2\ -15.14
-110\ -15.14
-114.4\ -15.6
-111.1\ -15.42
-110.2\ -14.9
-109.6\ -14.72
-117\ -14.9
-110\ -14.7
-114.9\ -15.37
-110.5\ -14.52
-111.3\ -14.71
-109.4\ -14.45
-105\ -14.6
-99.5\ -13.7
-105\ -14.5
-112\ -15.1
-109.6\ -14.78
-102.5\ -13.94
-111\ -14.8
-107.7\ -14.5
-107.6\ -14.88
-105.5\ -13.9
-104.7\ -13.75
-105.6\ -14.12
-103.4\ -13.32
-103.6\ -13.55
-107.2\ -14.48
-105\ -13.94
-105\ -14.2
-105\ -14.3
-118\ -15.3
-119.1\ -15.68
-120\ -15.8
-108.5\ -14.5
-112\ -15.2
-101.4\ -13.29
-114.5\ -15.4
-100\ -13.26
-99.4\ -12.48
-99.5\ -12.86
-109.4\ -15.38
-103.6\ -13.56
-107.7\ -15.04
-100.8\ -13.17
-106.3\ -14.27
-105.9\ -14.05
-111\ -14.7
-101\ -13.25
-99\ -12.9
-102\ -13.6
-102.2\ -13.4
-99.8\ -12.75
-94.3\ -11.21
-107\ -14.2
-98.2\ -12.56
-97.9\ -12.34
-92.5\ -11.7
-97.4\ -12.55
-97.7\ -12.66
-98.2\ -12.69
-98.9\ -12.73
-97.5\ -12.39
-103.5\ -13.59
-107.5\ -14.15
-103\ -13.9
-105.2\ -14.01
-109\ -14.56
-105.9\ -14.23
-95\ -11.85
-95.8\ -12.36
-93.1\ -11.76
-93.8\ -12.3
-104.9\ -13.62
-94.3\ -11.9
-90\ -12.1
-99\ -13.13
-97.3\ -12.65
-90.5\ -12.48
-97.2\ -13.06
-95
-105.5\ -13.6
-98\ -13.3
-98.9\ -12.98
-97.4\ -12.77
-98.3\ -12.84
-92.6\ -12.62
-102.2\ -13.26
-103.7\ -13.54
-108.9\ -15.01
-111\ -15.3
-107\ -14.6
-106\ -14.16
-113\ -15
-109\ -14.1
-106.3\ -14.16
-111\ -14.8
-102\ -12.93
-114.3\ -14.76
-115.7\ -15.1
-117.1\ -15.1
-99\ -13.36
-94.9\ -12.06
-98.4\ -13.15
-99.1\ -13.36
-100.6\ -13.84
-101.1\ -13.86
-101\ -13.4
-92\ -11.1
-104\ -13.1
-101\ -13.3
-106.9\ -14.14
-103\ -13.7
-106\ -14
-103\ -13.3
-101\ -12.9
-101\ -13.1
-93.4\ -12.68
-93.5\ -12.1
-93.3\ -12.3
-96.9\ -12.67
-89.7\ -11.96
-89\ -12.4
-95.1\ -13.11
-107.8\ -14.43
-90\ -11.87



*175-01 / 5,565 (Well Map ID / Water-level elevation (ft))
**184-109 / >6380 (Spring Map ID / Water-level elevation (ft))

Legend

Hydrogeology

Map Unit - Description

QTs	Quaternary-Tertiary sediments
QTb	Quaternary-Tertiary basalts
Tv	Tertiary volcanic rocks
Tos	Tertiary older sediments
MOc	Mississippian-Ordovician carbonate rocks
€c	Cambrian carbonate rocks
€p€s	Cambrian-pre-Cambrian clastic rocks

Regional Faults

- Normal fault
- Strike-slip and Oblique-slip fault
- Quaternary Normal fault

Solid where known; dashed where inferred; dotted where concealed. Arrows show direction of lateral movement. Bar and ball on downthrown side of fault. T= towards, A= away.

Subsidiary Faults

- Normal fault
- Strike-slip and Oblique-slip fault
- Quaternary Normal fault

Solid where known; dashed where inferred; dotted where concealed; dotted and queried where uncertain. Bar and ball on downthrown side of fault.

- Caldera margin — Solid where known; dashed where inferred; dotted where concealed.
- Cross Section profile

Well*

- Basin Fill
- Carbonate
- Volcanic
- Spring**

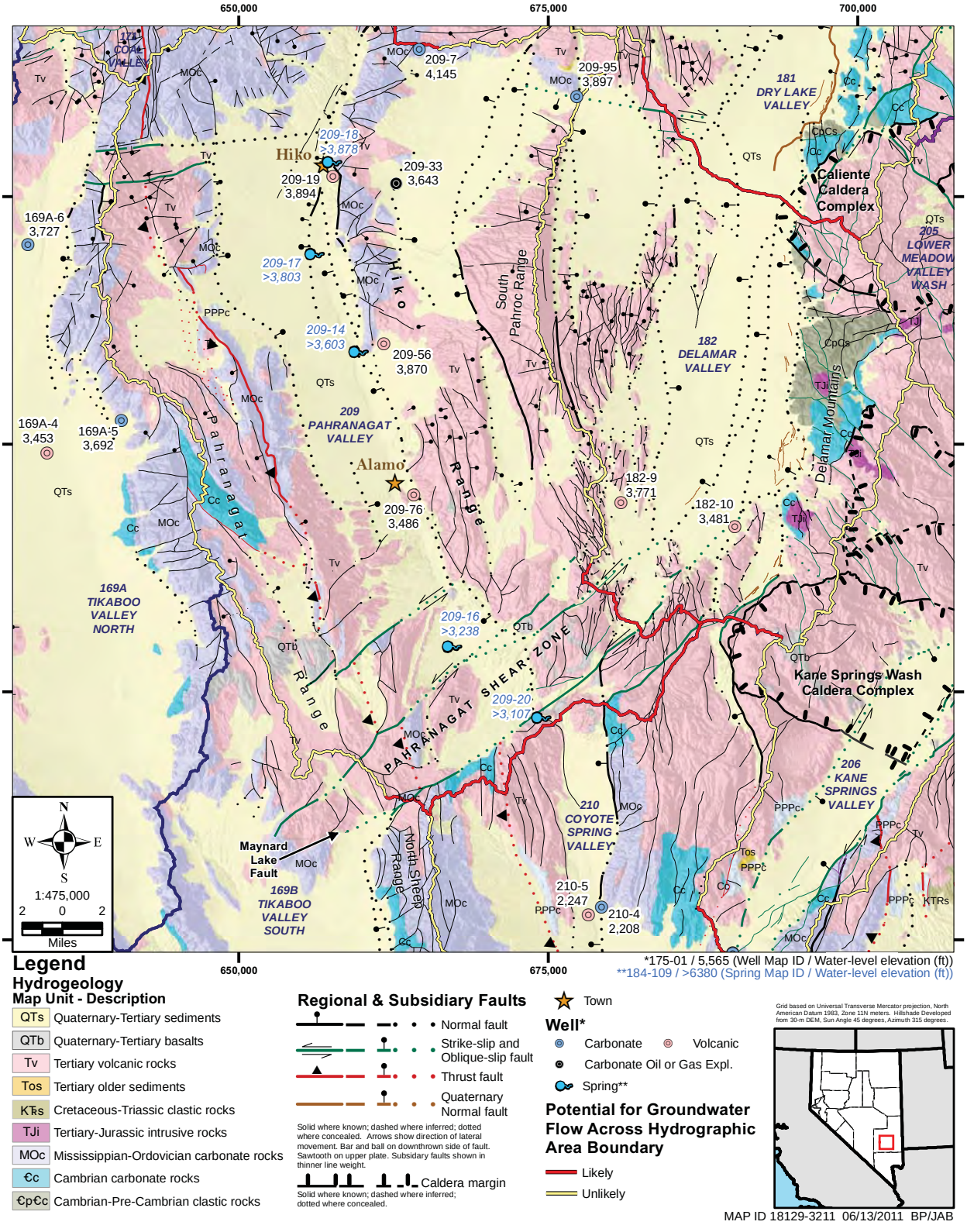
Potential for Groundwater Flow Across Hydrographic Area Boundary

- Likely
- Unlikely

MAP ID 18124-3211 06/09/2011 BP

Figure 7-9
Interbasin Groundwater Flow from Dry Lake to Delamar Valley

SNWA Exhibit 258



Legend

Hydrogeology

Map Unit - Description

QTs	Quaternary-Tertiary sediments
QTb	Quaternary-Tertiary basalts
Tv	Tertiary volcanic rocks
Tos	Tertiary older sediments
KTs	Cretaceous-Triassic clastic rocks
TJi	Tertiary-Jurassic intrusive rocks
MOc	Mississippian-Ordovician carbonate rocks
Cc	Cambrian carbonate rocks
CpCc	Cambrian-Pre-Cambrian clastic rocks

Regional & Subsidiary Faults

- Normal fault
- Strike-slip and Oblique-slip fault
- Thrust fault
- Quaternary Normal fault

Solid where known; dashed where inferred; dotted where concealed. Arrows show direction of lateral movement. Bar and ball on downthrown side of fault. Sawtooth on upper plate. Subsidary faults shown in thinner line weight.

- Caldera margin

Solid where known; dashed where inferred; dotted where concealed.

- Town

Well*

- Carbonate
- Volcanic
- Carbonate Oil or Gas Expl.
- Spring**

Potential for Groundwater Flow Across Hydrographic Area Boundary

- Likely
- Unlikely

*175-01 / 5,565 (Well Map ID / Water-level elevation (ft))
**184-109 / >6380 (Spring Map ID / Water-level elevation (ft))

Grid based on Universal Transverse Mercator projection, North American Datum 1983, Zone 11N meters. Hillshade Developed from 30-m DEM, Sun Angle 45 degrees, Azimuth 315 degrees.

MAP ID 18129-3211 06/13/2011 BP/JAB

Figure 7-10
Hydrogeology of the Pahranagat Shear Zone and Vicinity

Legend

Direction of Interbasin Groundwater Flow

Stream Network

Precipitation Station

Precipitation Station Map ID (Table B-1) shown inside each symbol.

Town

County Boundary

State Boundary

Hydrographic Area

Groundwater Evapotranspiration Area

Regional Confining Unit

Regional Confining Units defined as hydrogeologic units Ms, €p€s, p€m, and TJi (See Rowley et al., 2011, Plate 6).

Potential for Groundwater Flow Across Hydrographic Area Boundary

Permissible

Likely

Unlikely

Well

Basin Fill

Carbonate

Volcanic

Well symbol labeled with Well Map ID and water-level elevation (ft) (175-01/5,565). Wells with 5 or more measurements are shown in Spring, Lake and Hamlin Valleys, except for Well Map ID 196-11. See Section C.2.0 of Appendix C for depth-to-water and elevation data.

Spring

Local

Intermediate

Major Roads

U.S. Highway

State Route

Regional Faults

Normal fault

Strike-slip and Oblique-slip fault

Quaternary Normal fault

Solid where known; Dashed where inferred; dotted where concealed. Bar and ball on downthrown side. Arrows show direction of lateral movement.

Caldera margin

Solid where known; dashed where inferred; dotted where concealed.

Potential Recharge (in./year)

0.01 - 0.05

0.06 - 0.10

0.11 - 0.50

0.51 - 1.00

1.01 - 3.00

> 3.01

N
W E
S

1:250,000

2 0 2 4 Miles

4 0 4 8 Kilometers

Projection: Universal Transverse Mercator, NAD83, Zone 11N. Hillshade from 30-m DEM, Sun Angle 45°, Azimuth 315°.

MAP ID 18439-3210 06/21/2011 JAB/CAC/BP

PLATE 1. MAJOR GEOLOGIC AND HYDROLOGIC FEATURES AND CONTROLS ON THE AQUIFER SYSTEM OF SPRING VALLEY AND VICINITY

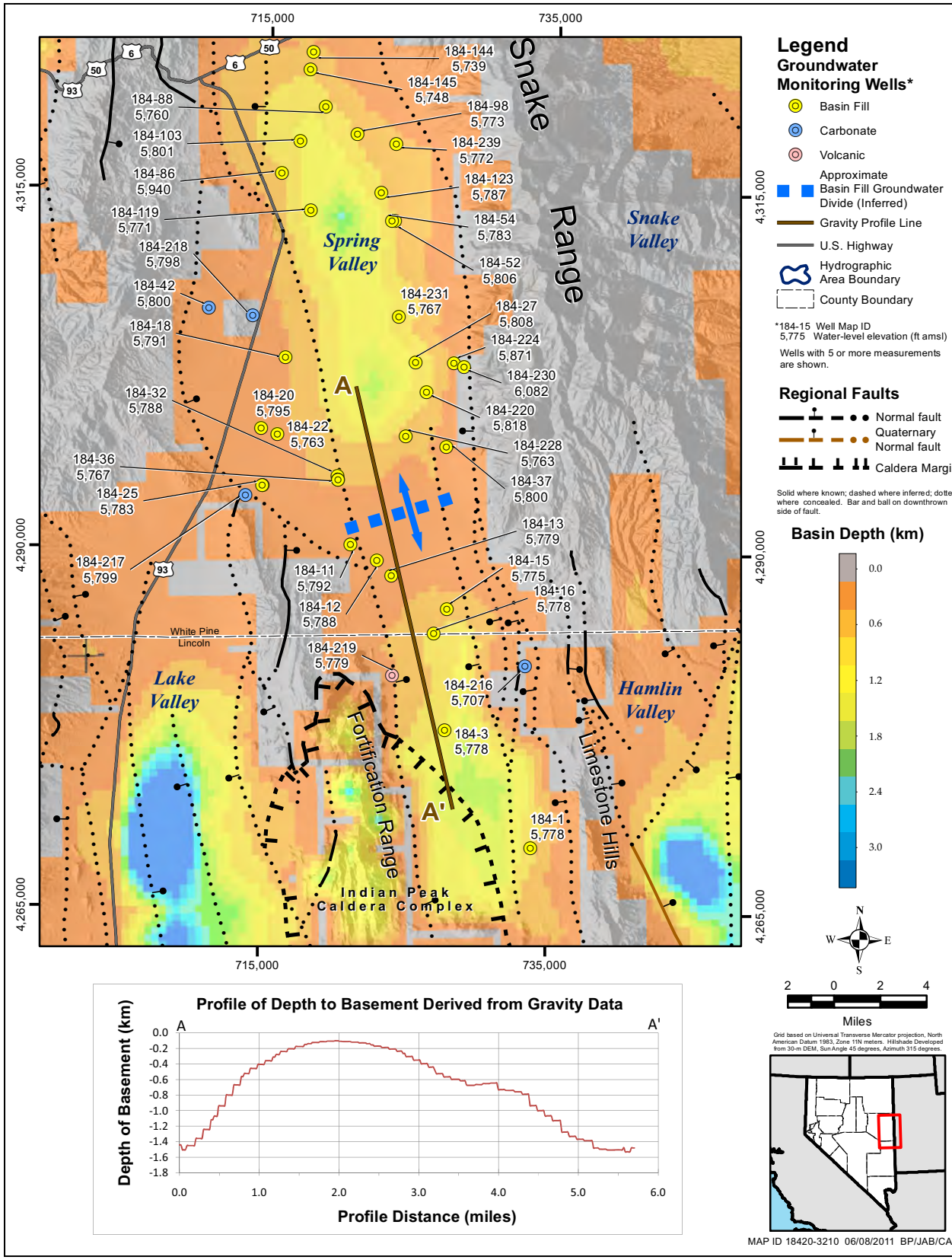
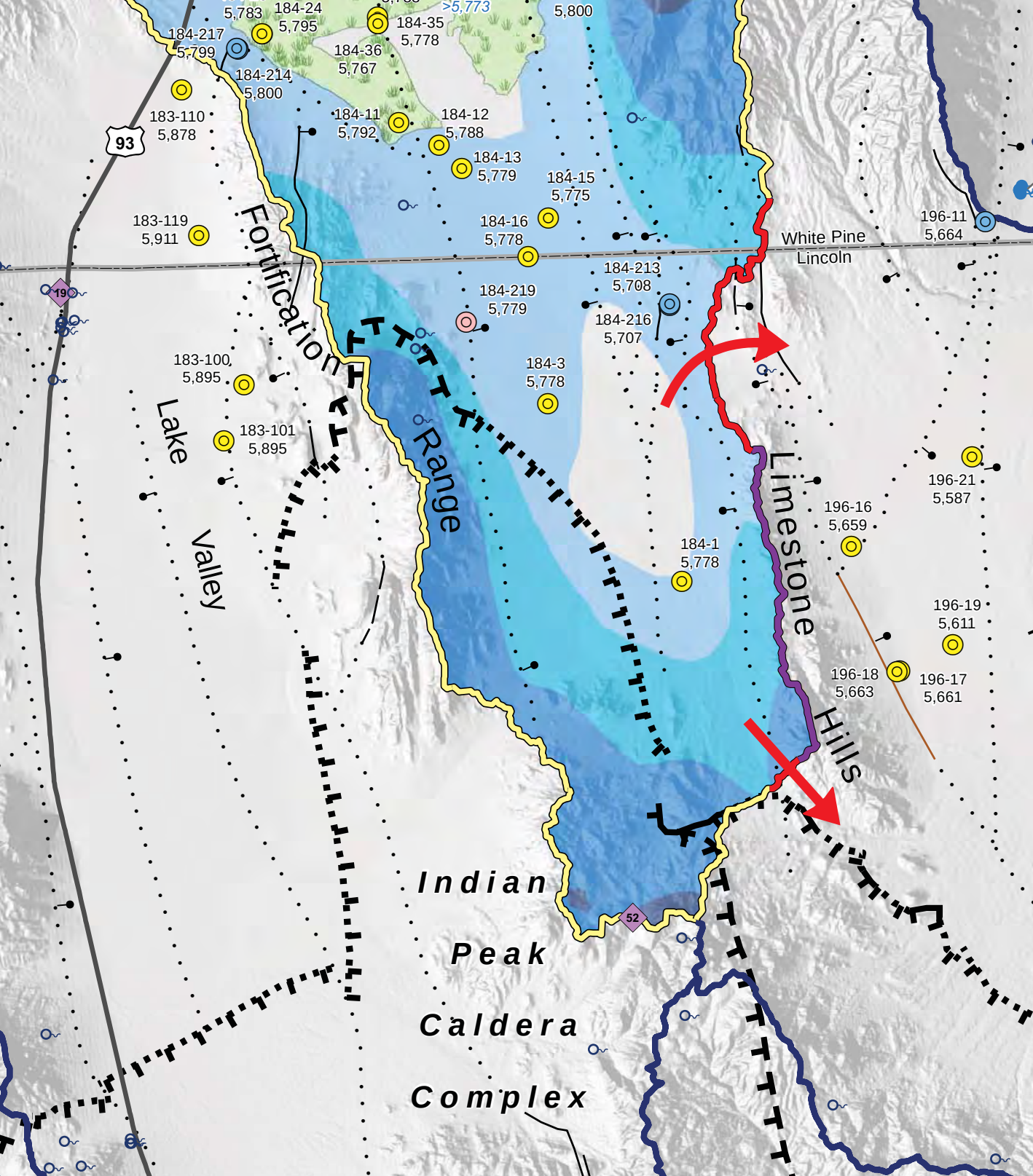


Figure 8-1

Depth to Pre-Cenozoic Basement in Southern Spring Valley and Vicinity

SNWA Exhibit 258


5,783
184-24
5,795
>5,773
5,800
184-217
5,799
184-35
5,778
184-36
5,767
184-214
5,800
183-110
5,878
93
184-11
5,792
184-12
5,788
184-13
5,779
184-15
5,775
183-119
5,911
184-16
5,778
White Pine
Lincoln
196-11
5,664
184-213
5,708
184-219
5,779
184-216
5,707
Fortification Range
183-100
5,895
184-3
5,778
Lake Valley
183-101
5,895
Limestone Hills
196-21
5,587
196-16
5,659
184-1
5,778
196-19
5,611
196-18
5,663
196-17
5,661
Indian Peak Caldera Complex
52

4,290,000

4,255,000

Valley

Fortification Range

Wilson Cr

Platę Two

Peak

Indian

93

White Pine

Lincoln

Lake Valley

181-16
6,630

181-15
6,539

26

183-50
5,912

183-49
6,077

183-55
6,144

183-54
6,152

183-56
6,136

Schell Creek Range

Littlefield Spring
>6,150

Muleshoe Valley

Sidehill Pass

181 N05 E64
18AA 1 Big Mud Springs
>6,430

Cave Spring
>6,486

180-26
6,185

180-29
6,732

180-30
6,896

180-28
6,709

180-27
6,587

180-21
6,534

180-23
> 6,494

Parker Station Spring
>6,490

180-17
6,089

180-18
5,900

180-31
5,372

180-19
5,874

180-20
5,765

Cave Valley

180-7
5,794

180-8
5,795

180-3
5,834

180-16
5,790

180-4
5,789

180-5
5,781

180-6
5,794

180-10
5,805

180-13
5,820

180-14
5,805

180-11
5,784

180-12
5,831

180-15
5,790

180-2
5,818

180-32
5,843

180-33
5,844

180-34
5,844

BLM Silver King Well
>6,229

181-12
5,286

208-13
6,251

Lewis Well
>6,264

Shingle Pass

Range

Egan

Nye
Lincoln

Butterfield Spring
>5,324

Flag Springs Complex
>5,291

46

207-44
5,272

207-45
5,292

207-46
5,294

207-60
5,289

207-47
5,214

207-28
5,084

207-29
5,259

207-30
5,143

207-31
5,289

207-32
5,331

Hardy Springs
>5,349

Emigrant Springs
>5,479

318

White Pine
Nye

Valley

River

White

Hot Creek Spring
>5,229

Moon River Spring
>5,223

11

Table 9-1
Estimated Groundwater Budgets for Project Basins

HA	HA Name	Recharge (afy)	Inflow (afy)	From	Groundwater ET (afy)	Outflow (afy)	To
184	Spring Valley	99,200	0	---	94,800	4,400	Hamlin Valley
180	Cave Valley	13,700	0	---	1,300	3,800	White River Valley
						8,600	Pahroc Valley
181	Dry Lake Valley	16,200	2,000	Pahroc Valley	0	18,200	Delamar Valley
182	Delamar Valley	6,600	18,200	Dry Lake Valley	0	24,800	Coyote Spring Valley

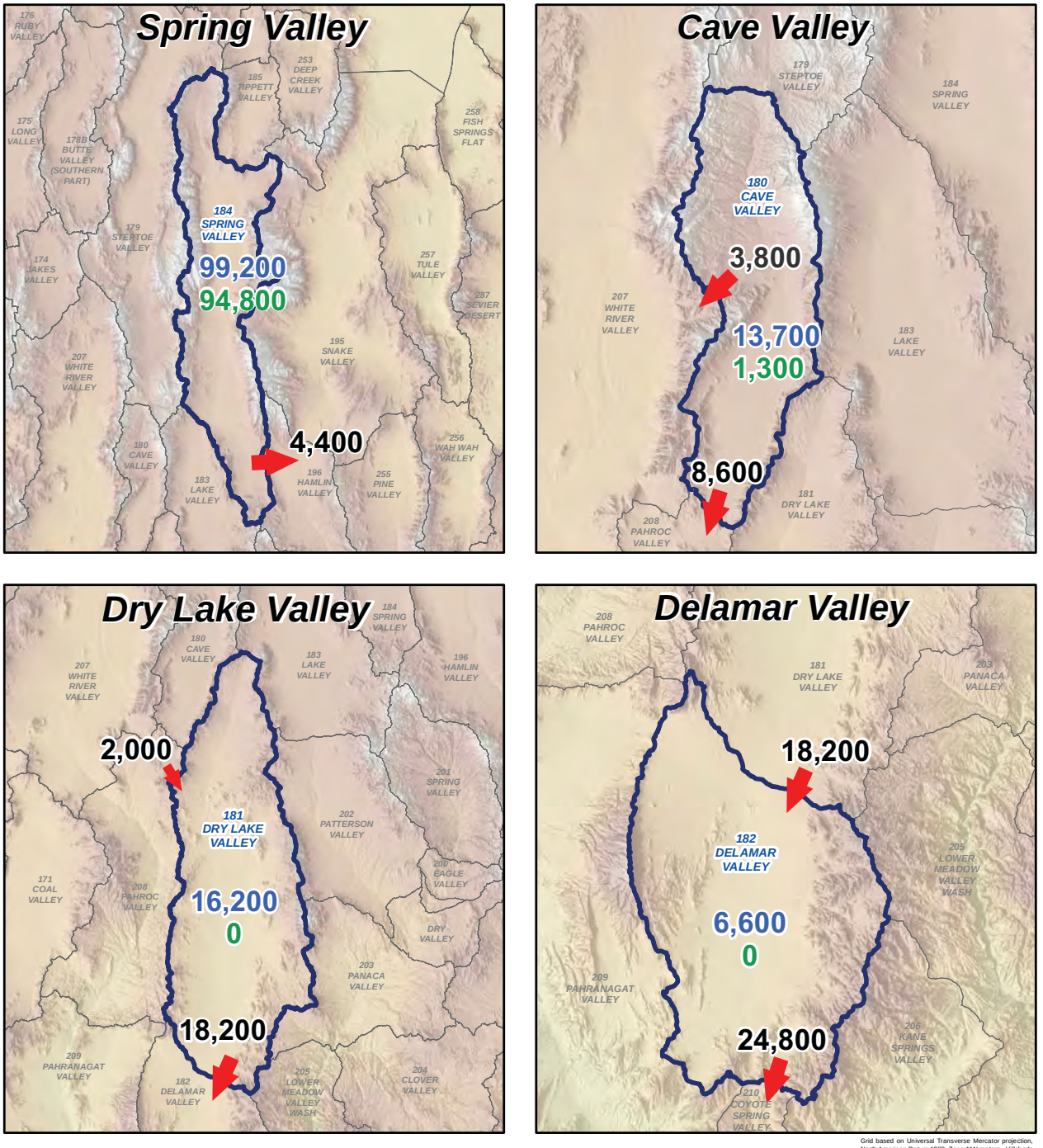


Figure 9-1
Groundwater Budgets of Spring, Cave, Dry Lake and Delamar Valleys

SNWA Exhibit 258

Table 10-1
Unappropriated Groundwater Resources

HA Name	Perennial Yield[a] (afy)	Committed Groundwater Rights[b] (afy)	Unappropriated Groundwater Resources (afy)
Spring Valley	94,800	10,429.51	84,370.49
Cave Valley	13,700	17.77	13,682.23
Dry Lake Valley	16,200	61.12	16,137.74
Delamar Valley	6,600	8.95	6,591.05

[a]Annual groundwater ET for Spring Valley, annual recharge for others

[b]Committed groundwater rights with priority dates earlier than October 17, 1989 (Stanka, 2011, p. ES-3).

Legend

Direction of Interbasin Groundwater Flow

Stream Network

Precipitation Station

Precipitation Station Map ID (Table B-1) shown inside each symbol.

Town

County Boundary

State Boundary

Hydrographic Area

Groundwater Evapotranspiration Area

Regional Confining Unit

Regional Confining Units defined as hydrogeologic units Ms, €p€s, p€m, and TJi (See Rowley et al., 2011, Plate 6).

Potential for Groundwater Flow Across Hydrographic Area Boundary

Permissible

Likely

Unlikely

Well

Basin Fill

Carbonate

Volcanic

Well symbol labeled with Well Map ID and water-level elevation (ft) (175-01/5,565). Wells with 5 or more measurements are shown in Spring, Lake and Hamlin Valleys, except for Well Map ID 196-11. See Section C.2.0 of Appendix C for depth-to-water and elevation data.

Spring

Local

Intermediate

Major Roads

U.S. Highway

State Route

Regional Faults

Normal fault

Strike-slip and Oblique-slip fault

Quaternary Normal fault

Solid where known; Dashed where inferred; dotted where concealed. Bar and ball on downthrown side. Arrows show direction of lateral movement.

Caldera margin

Solid where known; dashed where inferred; dotted where concealed.

Potential Recharge (in./year)

0.01 - 0.05

0.06 - 0.10

0.11 - 0.50

0.51 - 1.00

1.01 - 3.00

> 3.01

N
W E
S

1:250,000

2 0 2 4 Miles

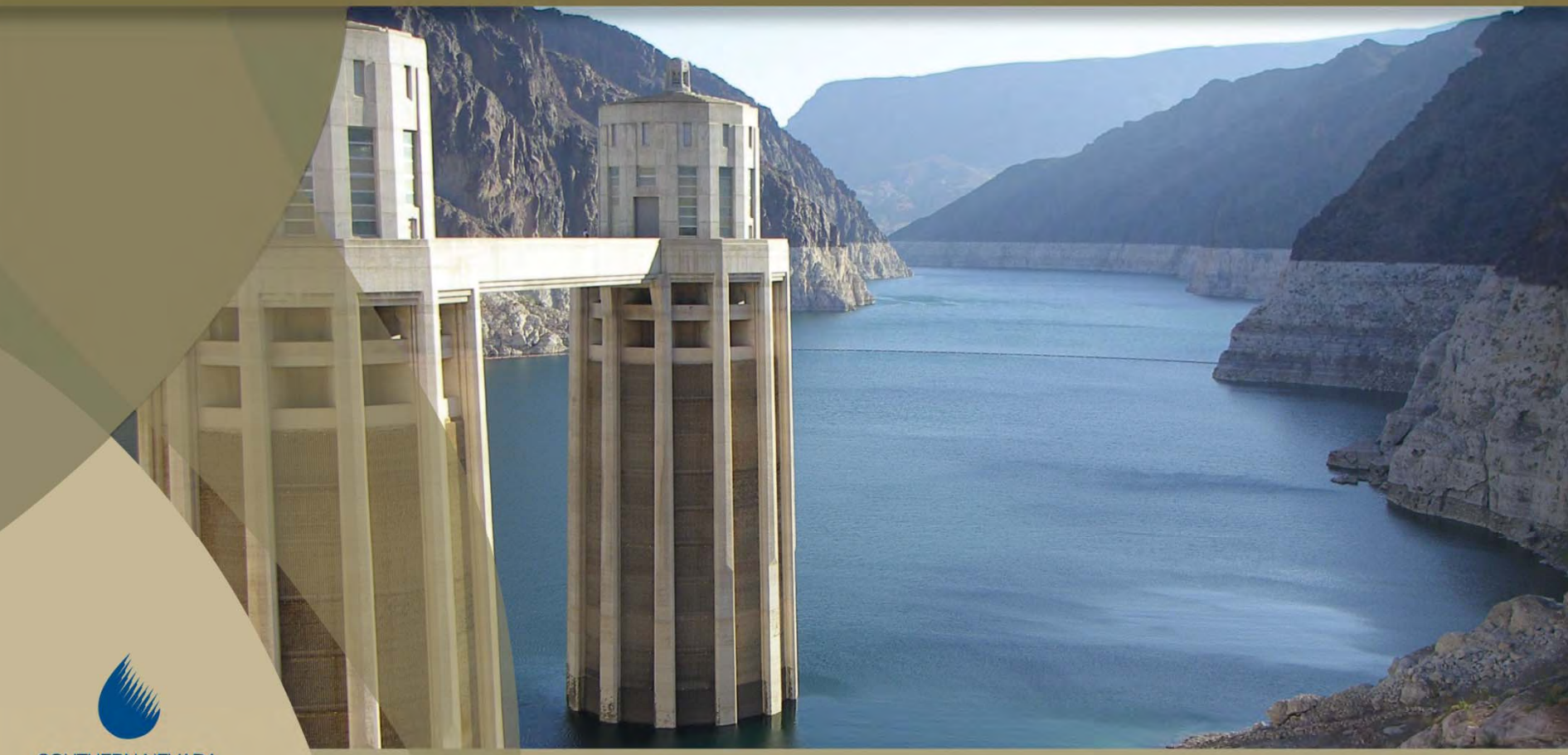
4 0 4 8 Kilometers

Projection: Universal Transverse Mercator, NAD83, Zone 11N. Hillshade from 30-m DEM, Sun Angle 45°, Azimuth 315°.

MAP ID 18439-3210 06/21/2011 JAB/CAC/BP

PLATE 1. MAJOR GEOLOGIC AND HYDROLOGIC FEATURES AND CONTROLS ON THE AQUIFER SYSTEM OF SPRING VALLEY AND VICINITY

Spring, Cave, Dry Lake and Delamar Valleys



SOUTHERN NEVADA
WATER AUTHORITY