Spring, Cave, Dry Lake and Delamar Valleys

SOUTHERN NEVADA
WATER AUTHORITY

Presentation for
Myers Cross
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In the north, the Kern Mountains have impermeable intrusive rock which likely prevents flow, but just south there is potentially flow through Pleasant Valley from Spring to Snake Valley. The northern portion of the Snake Range, north of Hwy 50, has substantial carbonate rock but detachment faults which may prevent interbasin flow; this faulting may also direct recharge in that carbonate rock to flow north – towards Gandy Warm Springs (Flint et al, 2008, Plate 1). The northern half of the South Snake Range, just south of Hwy 50, is impermeable due to intrusive and siliciclastic bedrock. The southern half is carbonate with a detachment fault on the east (Elliot et al, 2006) which may enhance the permeability. The west half of Hamlin Valley, a portion of Snake Valley, has substantial amounts of carbonate rock, and the fault just east of the Snake Range may direct flow from this carbonate towards Big Springs. In other words, flow to Big Springs may result from interbasin flow through the Limestone Hills and carbonate flow from the south Snake Range. In summary, the best potential for interbasin flow from Spring to Snake Valleys is through the southwest third of Snake Valley and through Pleasant Valley.

The estimated flux rate between valleys is very uncertain. The flux depends on the water balance of Spring Valley – whether there is more recharge and interbasin flow to Spring Valley than GWET. BARCAS estimates that 33,000 af/y discharges to Snake Valley through the southern end and 16,000 af/y through Pleasant Valley or through carbonates in the Kern Mountains. There is also 2000 af/y discharging to Tippett Valley, based on BARCAS. Thus, interbasin flow discharging from Spring Valley totals about 51,000 af/y (Welch et al, 2008), which depends almost totally on inflow from Steptoe Valley (most of the inflow from Lake Valley originates in Steptoe Valley).

The total recharge estimate for the study area was 194,000 af/y, based on average values from other studies. Interbasin inflow originating in Steptoe Valley could be as much as 33,000 af/y. The outflow to the north from Tippett and Deep Creek Valley is about 12,000 af/y, and to the Great Salt Lake and Fish Spring Flat is about 29,000 af/y. The BARCAS GWET estimate is 209,000 af/y. The flux values just presented have a residual of about 23,000 af/y, which is a good estimate of the uncertainties in the overall water balance for the study area.

Conceptual Models of springs and Streams

The previous section has generally described the flow through the four study area valleys.; it has provided a good conceptual model of that valleywide flow. However, each stream and spring is a detailed manifestation of that flow. They are important recharge and/or discharge points within the overall model. Local-scale geology may control each of these points. This section describes briefly some of the flow details, including geology and measured flows for individual points. Some of the streams and springs are perennial and flow measurements provide estimates of secondary recharge. Figure 14 locates many springs and perennial streams in the study area.

This boundary is highly important to this flow system because of the potential for inflow from Steptoe Valley.

Impermeable bedrock forms the core and prevents interbasin flow between Steptoe and Spring Valleys through the central third of the Schell Creek Range. The north end of the Schell Creek Range has carbonate rock but also substantial faulting. There is a gradient of about 200 feet in 15 miles (0.0025) through carbonate rock between Steptoe and northern Spring Valley (Welch et al, 2008, Plate 3). A recharge-induced divide in the northern Schell Creek range would prevent flow between the valleys. Interbasin flow in this area is uncertain.

Volcanic flow dominates the outcrops in the north end of Tippetts and Spring Valley, although there is basin fill on the northwest boundary of Tippetts Valley. The project boundary at the north end of Deep Creek Valley is alluvium underlain by volcanic or siliceous rock, which suggests that interbasin flow would occur through upper layers but not at depth.

The north end of Snake Valley opens to the broad open basin and playa of the Great Salt Lake. Carbonate rock bounds the east side of Snake Valley, and the gradient indicates that flow occurs in that direction and contribute to discharge from Fish Springs. The BARCAS estimate for flow from Snake Valley to these two areas is 29,000 af/y.

Interbasin Flow between Project Subbasins

The north end of the study area contains both the highest and lowest elevation basin areas. The north end of Spring Valley is as high as 6500 feet; east of that is Tippett Valley at about 5500 ft amsl, Deep Creek Valley at 5000 ft amsl, and northern Snake Valley as low as 4200 ft amsl. Groundwater does not flow directly along that profile, however, due to geology. Interbasin flow is primarily from Spring Valley to Tippett and Snake Valley, with flow from Tippett to Deep Creek and possible further east to Snake Valley.

The ridge between the north end of Spring Valley and Tippets Valley is primarily carbonate rock, which would allow flow between the basins; the degree and role of fracturing or impeding faults is uncertain; there are also zones with volcanic flow units. Interbasin flow between Tippett and Deep Creek Valley is complicated by mixtures of carbonate and volcanic rock. North of the Kern Mountains, the boundary between Tippett and Deep Creek Valley is carbonate, but further north it is volcanic and siliceous.

Potential flow between Spring and Snake Valleys is an important factor because development in one basin could affect resources in the adjoining basin, but geology makes estimating the impacts complicated. Prior to BARCAS, most studies had identified only small amounts of interbasin flow between these valleys; one estimate was 4000 af/y through the Limestone Hills region (Hood and Rush, 1965). Groundwater gradients show a general trend for flow from Spring to Snake Valley.

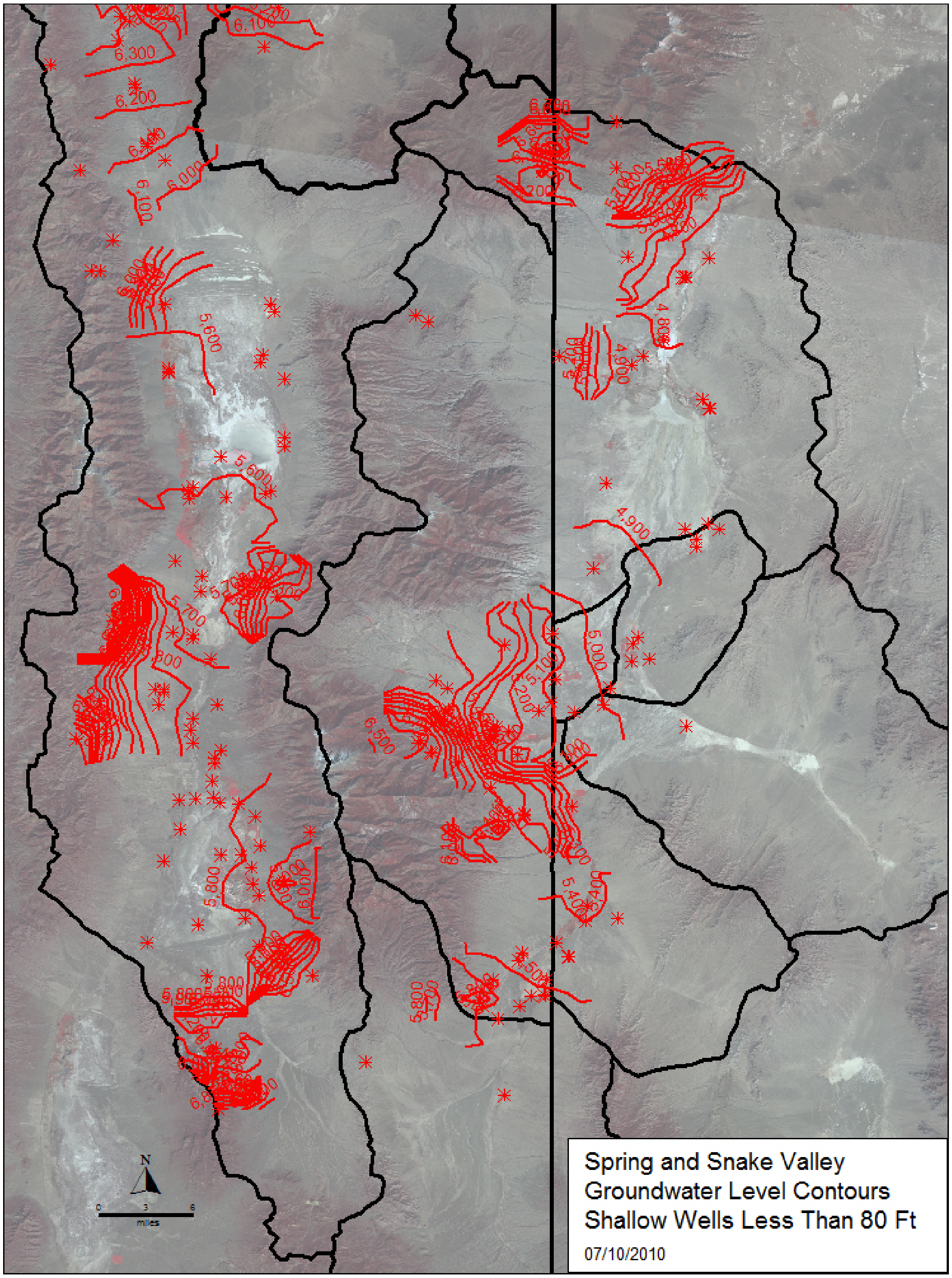

Figure 3: Steady state groundwater contours for shallow wells (<80').

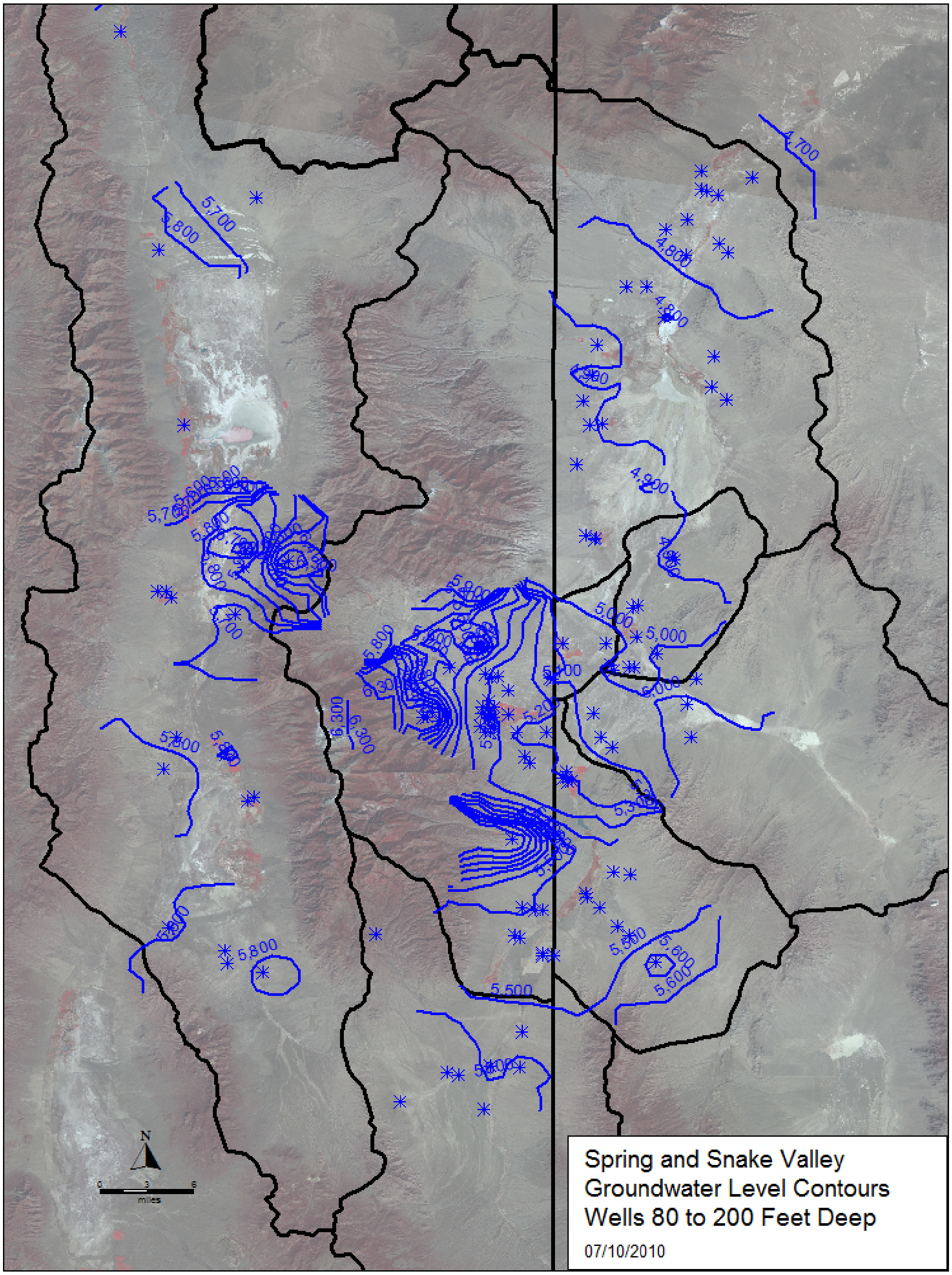

Figure 4: Steady state groundwater contours for intermediate wells (80-200'). White and red targets are SNWA applications.

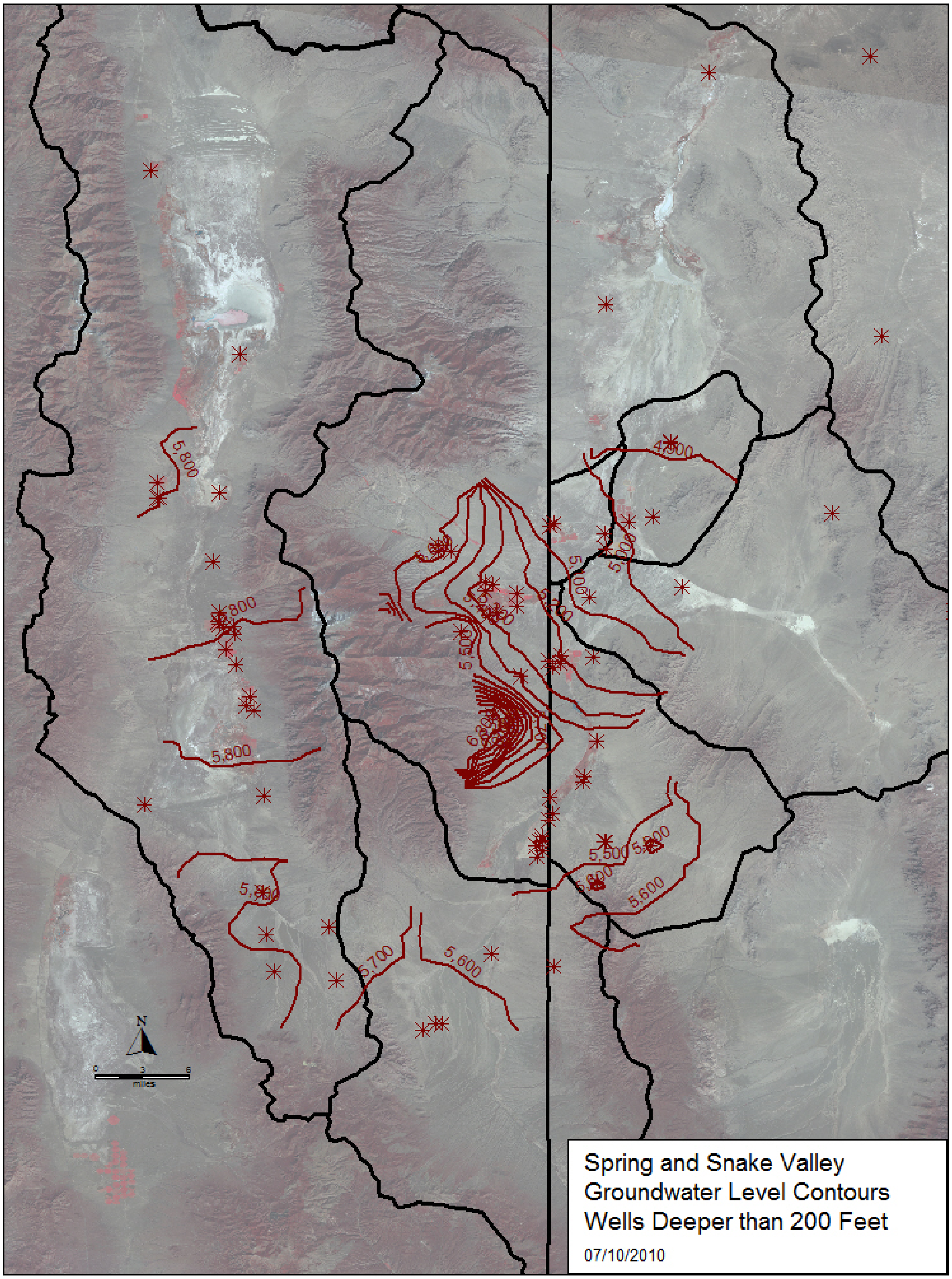

Figure 5: Steady state groundwater contours for deep wells (>200'). White and red targets are SNWA applications.

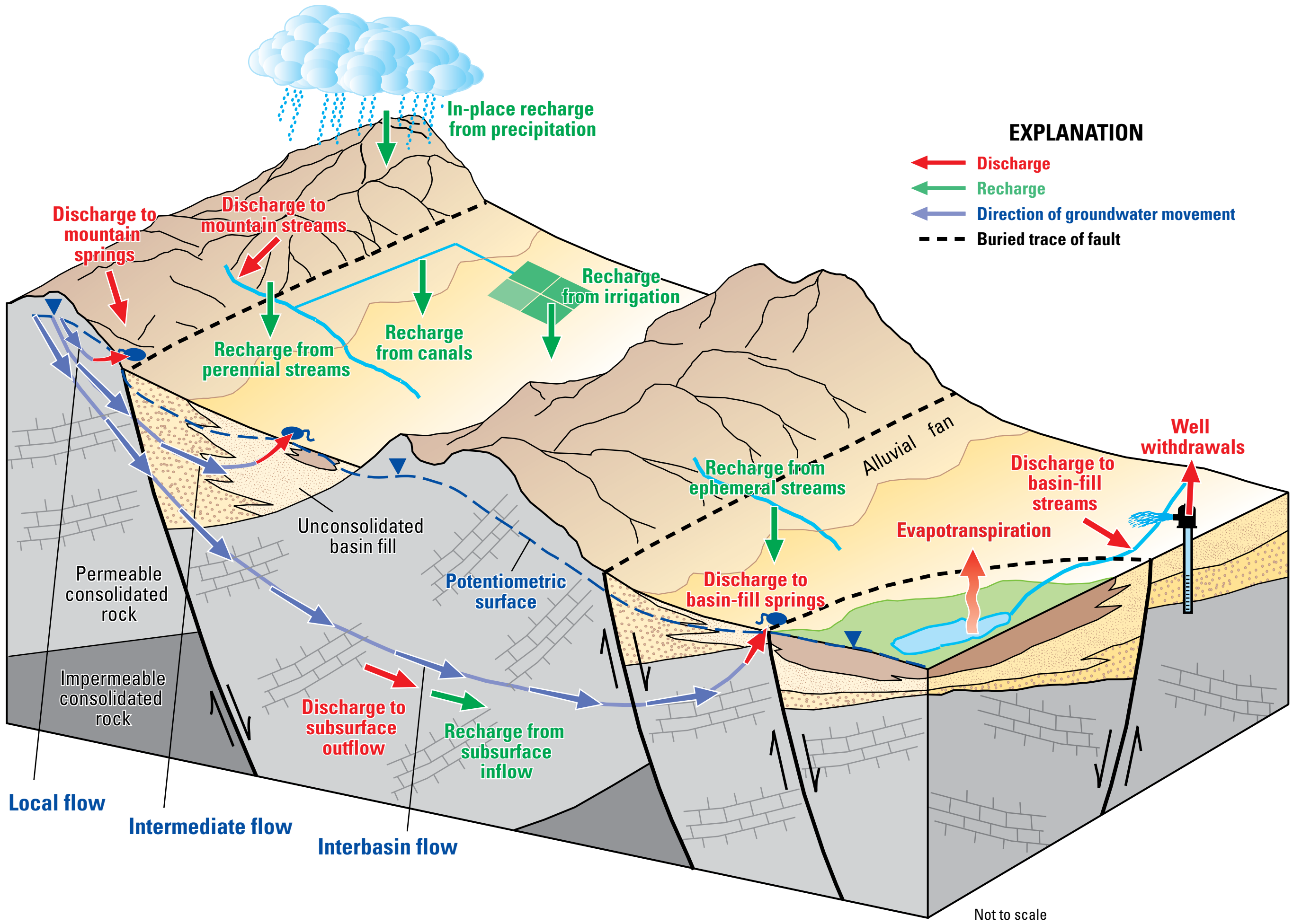

Figure C–1. Schematic diagram showing conceptualized groundwater flow in the Great Basin carbonate and alluvial aquifer system study area.

aquifer or other hydrogeologic unit is able to transmit water is often discussed in terms of its transmissivity. Transmissivity is defined as the product of the aquifer thickness and its hydraulic conductivity. Darcy's Law states that the hydraulic gradient (*I*) alone does not control groundwater flow; flow also depends on the hydraulic conductivity (*K*) and cross-sectional area (*A*).

Potentiometric-Surface Map

A potentiometric-surface map showing contours of equal groundwater-level altitude (pl. 2) was developed to show generalized hydraulic gradients affecting both intrabasin and interbasin groundwater flow throughout the study area. Because of the large size of the GBCAAS study area, the sparsity of hydrologic data in many of the HAs and hydrogeologic units (HGUs), and the 109-year time span (1900–2009) of the available water-level measurements, it was not within the scope of the current study to evaluate and present detailed hydraulic gradients pertaining to groundwater flow within each HA or HGU at one particular point in time. Alternatively, the groundwater conditions depicted on plate 2 are best suited for evaluating groundwater flow in a regional context, rather than addressing specific localized or transient groundwater conditions. In general, the majority of HAs within the study area have not undergone enough groundwater development to affect the potentiometric contours.

Groundwater generally follows topography and flows from areas of high land-surface altitude to areas of lower land-surface altitude, creating a general pattern of flow from mountainous areas to the Great Salt Lake Desert, the Humboldt River, the Colorado River, and Death Valley. Specifically, groundwater flows from higher to lower groundwater-level altitudes perpendicular to the potentiometric-surface contours. While not shown on the regional potentiometric-surface map of the GBCAAS study area, it is assumed that downward vertical gradients typically exist beneath recharge areas in the mountain block or along the valley margins and that upward vertical gradients exist in valley-bottom discharge areas.

The potentiometric-surface map illustrates groundwater mounding in high-precipitation and (or) less permeable mountain-block areas. Within the study area, estimated

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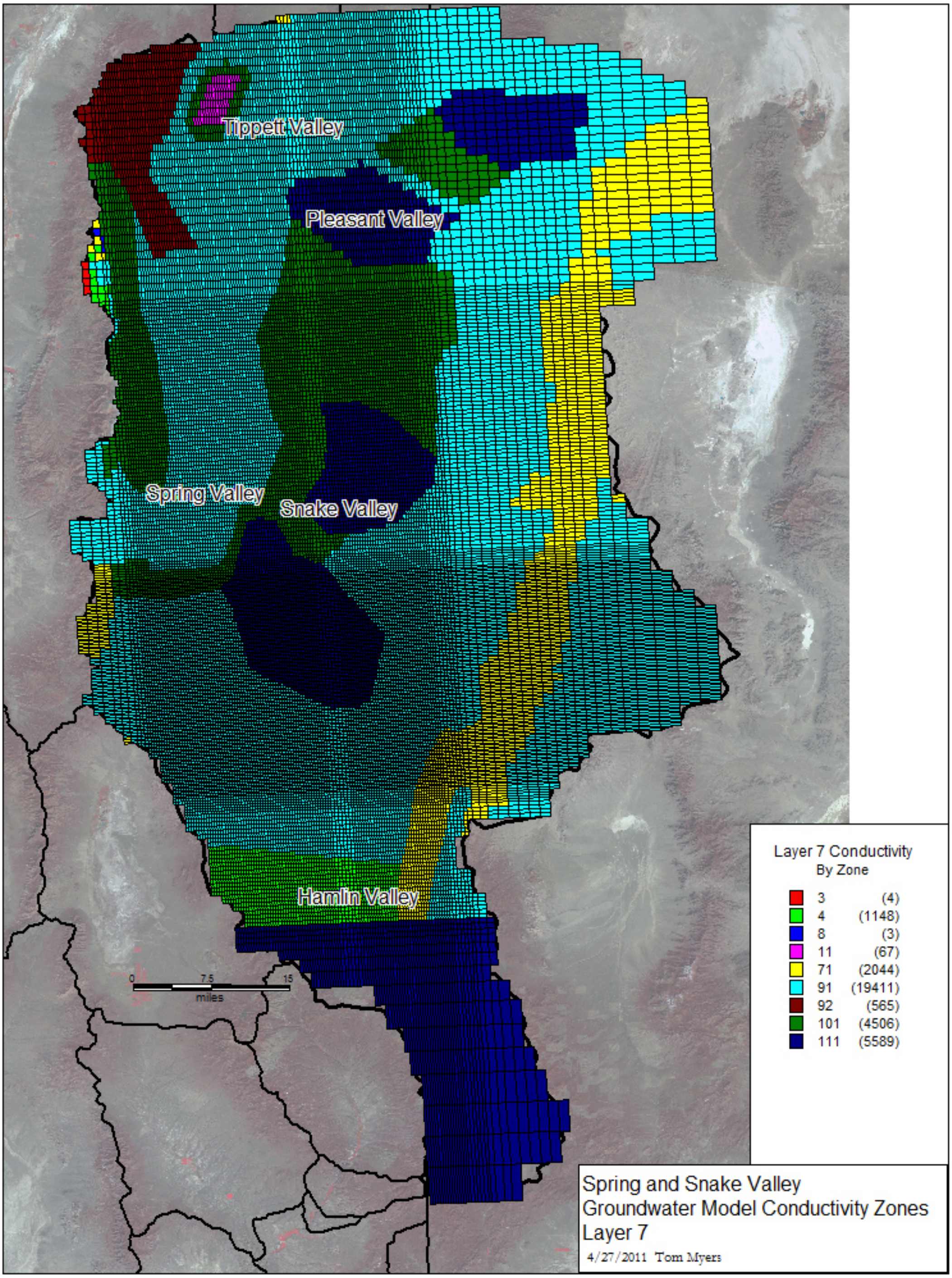

Figure 9: Conductivity parameter zones for the Spring and Snake Valley Groundwater Model, layer 7.

Table 2: Calibrated conductivity (ft/d) by parameter zone.

		Initial Conductivity (ft/d)		Calibrated Conductivity (ft/d)		
Parameter Zone	General Hydrogeologic Zone	Kh	Kv	Kx	Ky	Kz
1	FYSU	19		1.22	1.22	0.1
2	CYSU	10		1.16	1.16	0.02
20	CYSU			19.8	19.8	2
21	CYSU			34.7	34.7	1
22	CYSU			0.501	0.501	0.25
23	CYSU			1.2	1.2	0.01
24	CYSU			0.5	0.5	0.15
25	CYSU			0.03	0.03	0.003
26	CYSU			0.745	0.48	0.004
27	CYSU			0.2	0.2	0.02
28	CYSU			0.767	0.767	0.4
29	CYSU			0.492	0.492	0.002
30	CYSU			0.053	0.053	0.02
31	CYSU			0.173	0.173	0.02
32	CYSU			20	20	1
33	CYSU			10.1	10.1	1
34	CYSU			2.65	2.65	0.2
35	CYSU			51.4	51.4	3
36	CYSU			0.222	0.222	0.02
37	CYSU			0.769	0.769	0.2
3	OSU	.4	.04	0.183	0.183	0.01
4	VFU	2.0	.2	2.13	2.13	1.5
40	VFU			0.457	0.457	1
41	VFU			0.108	0.108	0.004
5	VTU	37	3.7	0.08	0.08	0.008
6	MSU	.004	.0004	0.004	0.004	0.0004
7	UCU	3	.3	0.0301	0.0301	0.3
71	UCU			0.269	0.269	0.02
72	UCU			4.89	4.89	0.02
8	USCU	.1	.01	0.1	0.1	0.01
9	LCU	4	.4	0.397	0.397	0.05
91	LCU			0.129	0.129	0.0005
92	LCU			0.02	0.02	0.0002
93	LCU			0.04	12	0.08
94	LCU			0.0965	0.0965	0.02
95	LCU			0.018	0.018	0.03
96	LCU			0.424	0.424	0.05
97	LCU			0.75	25	0.015
98	LCU			5	5	0.5
99	LCU			0.12	12	0.018
10	LCSU	.0000003	.00000003	0.00522	0.00522	0.004
100	LCSU			40	40	10
101	LCSU			0.001	0.001	0.001
11	IU	.01	.01	0.00203	0.00203	0.0008
111	IU			0.001	0.001	0.001

Faults

Faults were included in the model according their state geology mapping location (Part A). Faults can both impede and enhance groundwater flow. In MODFLOW, they are considered a horizontal flow barrier (HFB), although the term barrier is too strong. Faults are calibrated with a conductance which controls the flow between two cells separated by a HFB. Conductance was a calibration term with the value being decreased or increased to either increase or decrease the head drop across a HFB, respectively.

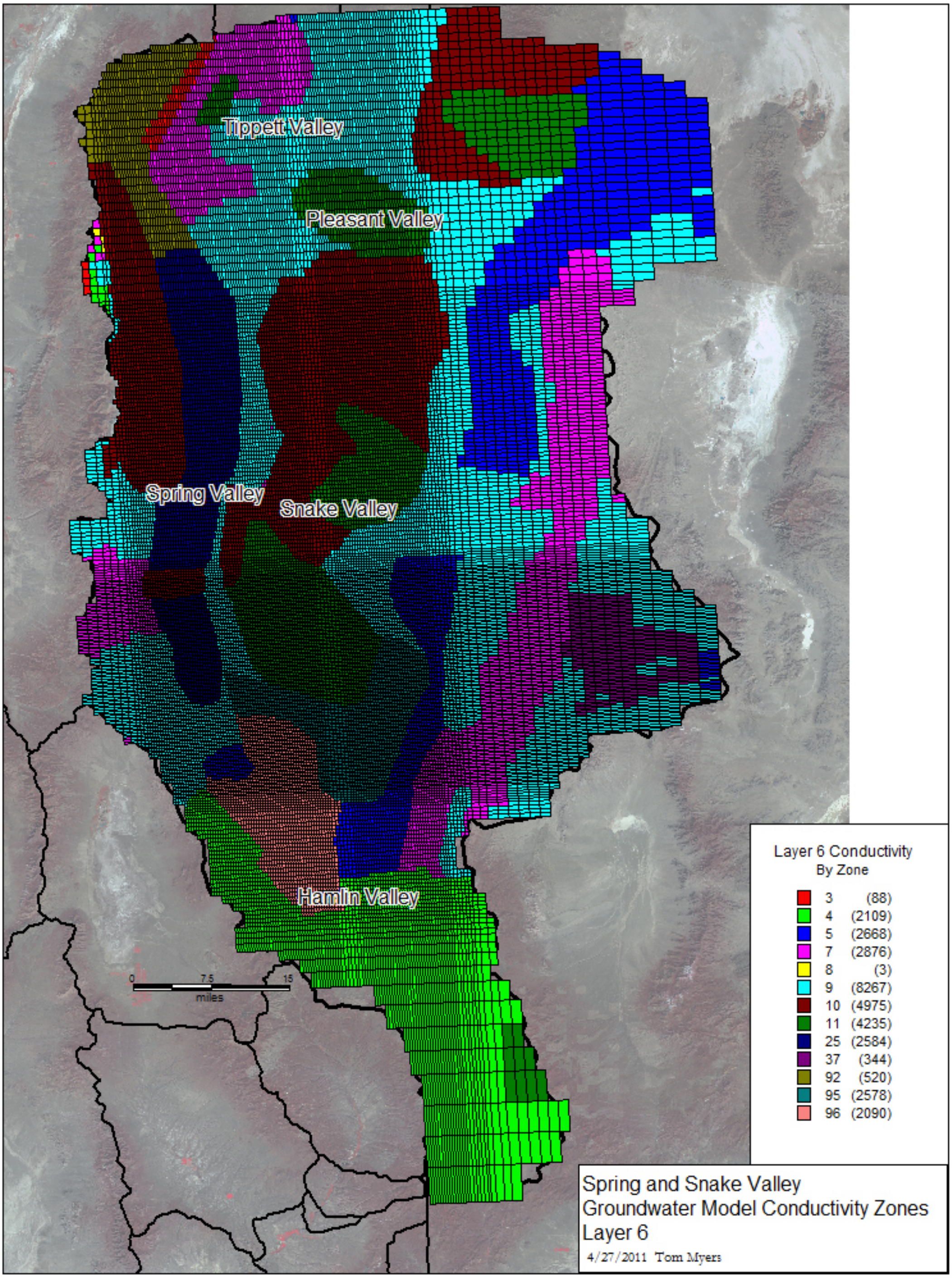

Figure 8: Conductivity parameter zones for the Spring and Snake Valley Groundwater Model, layer 6.