

Regional Potential for Interbasin Flow of Groundwater

By M.S. Bedinger and J.R. Harrill

Appendix 1 of

Death Valley Regional Groundwater Flow System, Nevada and California—Hydrogeologic Framework and Transient Groundwater Flow Model

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APPENDIX 1. Regional Potential for Interbasin Flow of Groundwater

By M.S. Bedinger and J.R. Harrill

Introduction

This appendix describes the rationale used to map the regional groundwater potential in the Death Valley regional flow-system (DVRFS) region. The regional potential is used to delineate the areas outside the DVRFS model domain that contribute groundwater flow to the model, to estimate the regional hydraulic gradient on the lateral DVRFS model boundaries, and to estimate the amount of flow by the Darcy method (Appendix 2, this volume).

Regional Groundwater Flow

The quantitative basis for regional groundwater flow in the Basin and Range Province is grounded in the basin studies made under the U.S. Geological Survey and the State of Nevada cooperative groundwater program. Maxey and Eakin (1949), in attempting to quantify the available groundwater resources of topographically closed basins, developed field methods for estimating basin recharge and discharge. They discovered, in evaluating groundwater budgets of closed basins, that many basins were not closed to groundwater transfer to or from adjacent basins. Early studies, such as those by Eakin and Moore (1964), Eakin and Winograd (1965), Eakin (1966), Mifflin (1968), Winograd and Thordarson (1975), and Mifflin and Hess (1979), recognized the importance of interbasin groundwater flow. In time, practically all basins in Nevada were studied, and estimates of recharge and discharge were established. Mifflin (1968) mapped the first set of regional potential contours from the surface altitudes of springs in Nevada issuing water at average temperatures of 27 degrees Celsius (80 degrees Fahrenheit) or greater, recognizing that thermal springs are surface manifestations of deep regional potential. Harrill and others (1988) used water-budget imbalances to interpret regional groundwater potential in the Great Basin. Prudic and others (1995) used a two-layer numerical model to analyze the regional aquifer system in the carbonate-rock province of Nevada, California, and adjacent States. This model simulated regional potential contours for both layers of the model and depicted regional flow potential from the higher basins in central Nevada to the terminal discharge areas of the DVRFS and the White River flow system.

The DVRFS region is made up of a complex network of basins that range in altitude from greater than 3,400 meters (m) above sea level in the mountain recharge areas of Nevada

and California to below sea level at the terminal discharge area at Death Valley in California (pl. 1). Bredehoeft and others (1982) noted that the differences in topographic relief provide the principal driving force for regional flow. It follows that the potential for groundwater to move from basin to basin is related to the relative altitudes of the individual basins. Many of the segments of the DVRFS model boundary are drawn along basin boundaries. Altitude differences between these basins indicate a difference in groundwater potential between adjacent basins. Where the rocks that form the boundary between such basins are sufficiently permeable, there will be flow into or out of the model area.

Identification of Regional Head

The number of wells deeper than 300 m that can be measured is insufficient to map the regional potential. Because of the regional hydraulic continuity between deep and shallow flow in the DVRFS region, additional data points for the regional groundwater potential can be inferred from flow-net relations in the shallow groundwater potential. A set of guidelines was developed that relates the regional groundwater potential and more readily observed surface and near-surface groundwater levels and hydrologic characteristics of groundwater basins. Topographic settings that express near-surface groundwater characteristics, such as shallow groundwater levels, recharge areas, discharging playas and phreatophyte areas, perennial streams and lakes, and springs, can indicate that the regional potential is either greater than or less than the indicated altitude. These relations are broad generalizations; local geologic and hydrologic conditions can cause local variations in the applicability of the relations.

Examination of head and flow lines in several configurations of cross-sectional flow models of Freeze and Witherspoon (1967) and by J.E. Reed (Sargent and Bedinger, 1985; M.S. Bedinger, oral commun., 2003) are useful in visualizing the relation between regional potential and common topographic settings (figs. A1-1 and A1-2). Because of the regional hydraulic continuity between deep and shallow flow, the groundwater flow system contains hydraulic heads at depth in the zone of regional flow that can be characterized by general relations to the hydraulic head in the upper part of the flow system (figs. A1-1 and A1-2).

The general guidelines used for identifying regional head for mapping regional potential are:

1. Regional hydraulic head is lower than the water table in areas of recharge.
2. The regional hydraulic head can be represented by shallow water levels in areas of very low vertical hydraulic gradient. Such areas are characterized by large areas of low topographic relief and virtually no recharge (fig. A1–1A).
3. The regional head is generally at or above regional springs and areas of discharge by evapotranspiration from basins (figs. A1–1B and A1–2A). The presence of regional springs at the lower altitudes in a basin indicates that the regional hydraulic head is higher than the basin-floor discharge areas. Regional springs are characteristically those that issue from depths well below the water table. Regional springs may issue from relatively great depths beneath the surface. Basins exhibiting this characteristic include Railroad Valley, Hot Creek Valley, Columbus Marsh Valley, Alkali Springs Valley, Death Valley, Amargosa Desert, and Pahrump Valley, Pahranaagat Valley in Nevada and Deep Springs, Panamint, Saline, and Owens Valleys in California. Cross-sectional flow nets (fig. A1–2B) indicate that exceptions to this generalization may occur. For example, the regional potential could be lower than the surface hydraulic head where the zone of regional flow is extensive and of greater permeability than the upper part of the flow system and the regional aquifer is confined by extensive and unbroken confining beds. This is not the general case in the Great Basin. Topographic, hydrologic, and geologic conditions in the Great Basin may indicate that a discharge area is above the regional potential. For example, a basin that discharges at a relatively small rate compared to the basin recharge, that is at relatively high altitude compared to surrounding regional potential heads, and that has no regional springs is considered above the regional potential.
4. The regional head is above intermediate and terminal discharge areas. Intermediate and terminal areas of discharge are typically at lower altitudes in the flow system with discharge by evapotranspiration, regional springs, or groundwater discharge to major surface-water bodies.
5. Regional hydraulic head is below the surface altitude of nondischarging dry playas of basins at higher altitudes.
6. Springs discharging at higher basin altitudes, well above the basin floors, are generally above the regional head. They represent discharge from locally derived recharge and relatively short and shallow flow paths. These are commonly “cold” springs having temperatures near or only a few degrees above the ambient average air temperature. The topographic setting and the potential contributing area is important in distinguishing local springs from regional springs. For example, Warm Springs and Emigrant Springs in the Panamint Range have discharge temperatures greater than 6 degrees Celsius (10 degrees Fahrenheit) above the ambient temperature at the spring orifice. Although the spring temperatures indicate moderately deep flow paths, the altitude of the springs in relation to their topographic setting shows that they are derived from recharge within the Panamint Range and do not represent interbasin flow or regional flow. The distinction between

thermal springs that represent the regional flow system and local springs generally can be made on the basis of their topographic setting and the potential contributing area.

7. The regional potential is greater than the discharge altitude of deep regional springs. Regional springs occur at lower altitudes of basins, though commonly above the playa altitude. Regional springs, commonly originating from deep carbonate-rock aquifers, are typically large and the temperature of the water significantly greater than the ambient air temperature. The springs are inferred to represent discharge from deep and long flow paths.

These guidelines for identifying regional hydraulic head are supplemented by field observations of water-level measurements, springs, basin discharge areas, and intermediate and terminal discharge areas, coupled with concepts of how these near-surface hydrologic features are related to regional flow and potential. Specific hydrogeologic knowledge is needed as control when applying the guidelines to a particular basin or set of basins. It is recognized that the general guidelines are drawn from flow nets computed for simplified geologic and hydrologic conditions. The control points may seem imprecise, but in designating the estimated regional potential “less than” and “greater than” the control potential, they provide a reasonable constraint on the estimate.

Regional Potential Map

The regional potential map (**pl. 1**) was constructed from a network of control points using water-level measurements and the guidelines given above (tables A1–1—A1–5). From a regional standpoint, these data points are well distributed and abundant. Water levels in wells for Nevada that are greater than 300 m deep are listed in table A1–1. The groundwater potential measured in these wells is assumed to be equal to or above the regional potential. Reference points for regional potential altitudes derived from surface-water features, groundwater levels, and topographic settings are listed in table A1–2 for California and table A1–3 for Nevada. As described in the guidelines, the regional potential is higher than the altitude of perennial surface-water features and higher than the water level of playas that discharge groundwater by evapotranspiration. The regional potential is below valley floors of playas that do not discharge groundwater by evapotranspiration.

The altitudes of springs are listed in table A1–4 for California and table A1–5 for Nevada. The regional potential is above the altitude of regional springs and below the altitude of local springs. Most regional springs are thermal springs and discharge at low altitudes relative to valley floors. Local springs occur well above the valley floors; their temperatures are commonly no more than a few degrees above the average ambient air temperature. The reference points of tables A1–1 through A1–5 are plotted and identified by number on the regional potential map (**pl. 1**). The regional potential data were hand-contoured to produce the regional potential map shown on **plate 1**. The regional potential map then was used to estimate boundary flows for the DVRFS model (see Appendix 2, this volume).

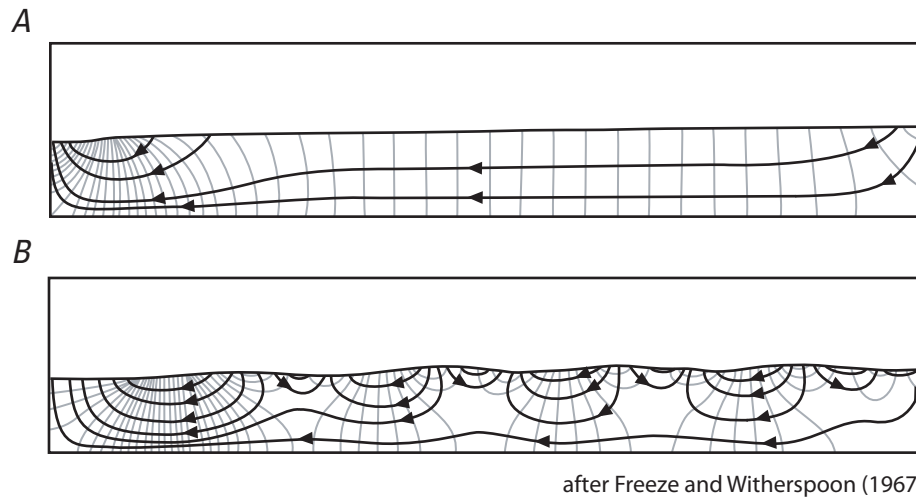


Figure A1-1. Cross-sectional flow nets illustrating relative distribution of deep and shallow groundwater potential in (A) a large flow system of low topographic relief with low recharge and (B) a series of closed basins of decreasing elevation with recharge in basin divide areas and discharge in basin playa areas.

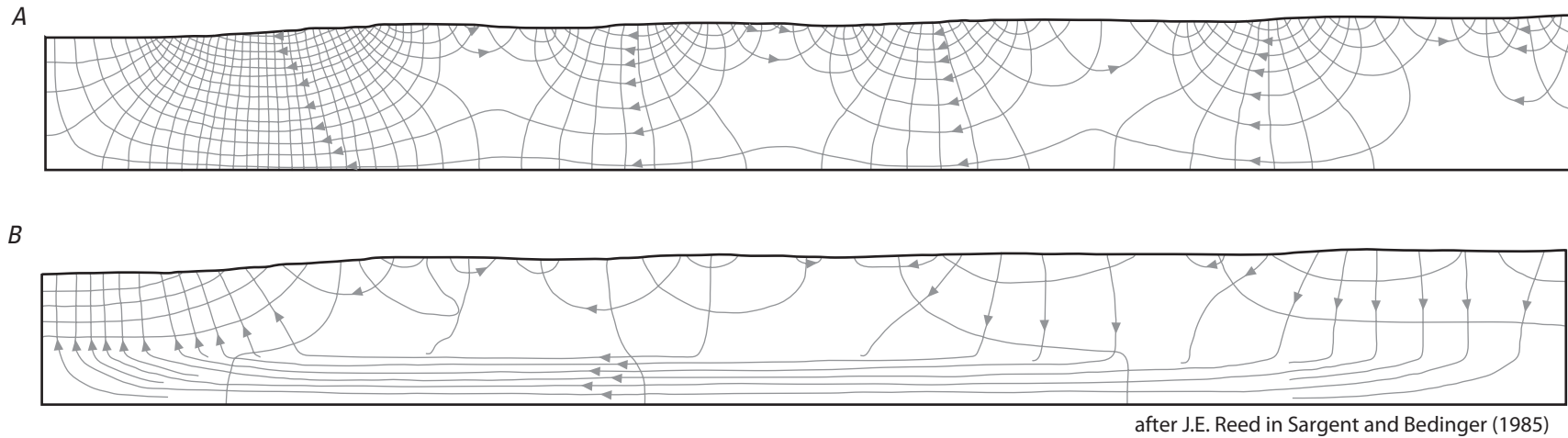


Figure A1-2. Cross-sectional flow nets illustrating relative distribution of deep and shallow groundwater potential in a series of closed basins as represented by (A) a homogeneous and isotropic aquifer system and (B) a two-layered aquifer system with greater hydraulic conductivity at depth. After J.E. Reed (Sargent and Bedinger, 1985; M.S. Bedinger, oral commun., 2003).

Table A1–1. Reference points for regional potential in wells deeper than 300 meters in Nevada.

[ID no, identification number; UTM, Universal Transverse Mercator projection, Zone 11, NAD 27; vertical datum is NAVD 88; --, no data; >, greater than]

Map ID no. (plate 1)	Well name ¹	UTM Easting (meters)	UTM Northing (meters)	Longitude	Latitude	Well depth (meters)	Land-surface altitude (meters)	Date measured	Depth to water (meters)	Regional potential altitude (meters)	Reference
1	Army–6A	587780	4048190	116°01'08"	36°34'37"	382	1,050	1955	314	736	Harrill and Bedinger, 2000
3	Army–1	586128	4049310	116°02'14"	36°35'14"	593	961	10/15/87	239	722	Arteaga and others, 1991
5	TW–F	578870	4068350	116°06'59"	36°45'34"	1,036	1,263	01/14/86	529	734	Arteaga and others, 1991
6	TW–3	601939	4074020	115°51'26"	36°48'30"	565	1,060	01/11/80	337	723	Arteaga and others, 1991
7	UE25P#1	551501	4075660	116°25'21"	36°49'38"	1,805	1,114	10/12/84	362	752	Arteaga and others, 1991
8	MX CE–VF–2	682939	4082680	114°56'51"	36°52'27"	366	746	02/04/86	184	562	Berger and others, 1988
9	Well C	588208	4086130	116°00'35"	36°55'08"	518	1,195	10/18/75	471	725	Arteaga and others, 1991
10	Well C–1	588233	4086100	116°00'34"	36°55'07"	503	1,195	08/06/72	471	724	Arteaga and others, 1991
11	TW–D	582226	4103330	116°04'30"	37°04'28"	594	1,265	03/26/85	525	739	Arteaga and others, 1991
13	WW–2	581017	4113490	116°05'15"	37°09'58"	1,043	1,362	03/28/61	584	779	Arteaga and others, 1991
14	MX DL–DT–3	684597	4217900	114°53'42"	38°05'31"	730	1,643	02//1981	259	1,383	Bunch and Harrill, 1984
15	MX CV–DT–1	645075	4221640	115°20'41"	38°07'58"	560	1,695	04//1981	245	1,450	Bunch and Harrill, 1984
16	N7/55–28CA	605121	4254780	115°47'44"	38°26'13"	522	1,441	--	Flowing	>1,441	Van Denburgh and Rush, 1974
17	N7/56–2DAB	618772	4261440	115°38'17"	38°29'43"	3,085	1,435	--	Flowing	>1,435	Van Denburgh and Rush, 1974
18	MX SV–DT–2	686967	4310180	114°50'36"	38°55'21"	746	2,243	01//1981	130	2,195	Bunch and Harrill, 1984
19	Fad Shaft	587289	4373160	115°59'05"	39°30'20"	751	--	--	--	1,811	Thomas and others, 1986
21	SHV–1	685719	4047000	114°55'30"	36°33'08"	280	807	09/13/87	253	554	Berger and others, 1988
22	CC–1	646328	4048060	115°21'53"	36°34'07"	428	1,276	08/10/88	408	868	Schaefer and others, 1992
23	CF–2	539976	4071710	116°33'07"	36°47'32"	762	963	1985	184	779	Harrill and Bedinger, 2000
24	JF–1	554034	4078690	116°23'38"	36°51'16"	415	1,083	1991	354	729	Harrill and Bedinger, 2000
25	JF–2	553754	4075890	116°23'50"	36°49'45"	354	1,033	1984	304	729	Harrill and Bedinger, 2000
26	JF–2A	551501	4075660	116°25'21"	36°49'38"	1,805	1,114	1984	362	752	Harrill and Bedinger, 2000
27	J–11	563799	4071060	116°17'06"	36°47'06"	405	1,049	1960	317	732	Harrill and Bedinger, 2000
28	J–12	554444	4068770	116°23'24"	36°45'54"	347	953	1974	226	727	Harrill and Bedinger, 2000
29	J–13	562045	4073570	116°18'16"	36°48'28"	1,063	1,011	1964	283	728	Harrill and Bedinger, 2000
30	JF–3	554498	4067970	116°23'22"	36°45'28"	347	944	1992	216	728	Harrill and Bedinger, 2000
31	RV–1	562604	4054690	116°17'59"	36°38'15"	244	931	1972	206	725	Harrill and Bedinger, 2000
33	AD–1	536878	4060050	116°35'14"	36°41'14"	293	801	1986	82	719	Harrill and Bedinger, 2000
34	AD–2	553289	4055090	116°24'14"	36°38'30"	229	804	1987	99	706	Harrill and Bedinger, 2000
35	AD–6	569339	4023250	116°13'38"	36°21'13"	206	732	1967	12	720	Harrill and Bedinger, 2000
36	AD–10 ²	562652	4020760	116°18'07"	36°19'54"	332	668	1986 & 1987 ³	2	665	Harrill and Bedinger, 2000
37	AD–12	569353	4021430	116°13'38"	36°20'14"	482	741	1987	27	714	Harrill and Bedinger, 2000
39	MW–4	514842	4073270	116°50'01"	36°48'25"	360	927	1987	127	769	Harrill and Bedinger, 2000
40	MW–6	517461	4065140	116°48'16"	36°44'01"	573	829	1987	86	743	Harrill and Bedinger, 2000
41	MW–9	523893	4061950	116°43'57"	36°42'17"	579	824	1989	96	728	Harrill and Bedinger, 2000
42	CDH–61	516611	4081220	116°48'49"	36°52'43"	300	1,015	1988	208	806	Harrill and Bedinger, 2000
43	DR–1	641598	4046870	115°25'04"	36°33'31"	293	1,091	1989	249	842	Harrill and Bedinger, 2000

¹From table 6 in Dettinger and others (1995).

²Well is in California.

³Average.

Table A1–2. Reference points for regional potential from topographic settings for California.

[ID no., identification number; UTM, Universal Transverse Mercator projection, Zone 11, NAD 27; vertical datum is NAVD 88; PLSS, Public Land Survey System section, township, range, S for San Bernardino principal meridian, M for Mount Diablo principal meridian; >, greater than; <, less than; ET, evapotranspiration; do., ditto; USGS, U.S. Geological Survey]

Map ID no. (plate 1)	UTM Easting (meters)	UTM Northing (meters)	Longitude	Latitude	Map feature	PLSS location	Regional potential altitude (meters)	Topographic setting	Reference
1	401523	3854800	118°04'37"	34°49'57"	Rosamond Lake	33/9N/11W/S	>686	Valley floor, ET	Langer and others, 1984
2	397454	3826990	118°07'05"	34°34'53"	Palmdale	24/6N/12W/S	<762	Basin floor, upper elevation	Langer and others, 1984
3	369461	3844170	118°25'33"	34°43'59"	Fairmont	38/8N/15W/S	<823	Basin floor, upper elevation	Langer and others, 1984
4	468547	3837260	117°20'36"	34°40'43"	Bryman	19/7N/4W/S	>762	Mojave River Valley	Langer and others, 1984
5	465701	3817710	117°22'25"	34°30'08"	US 395	21/5N/15W/S	<869	Basin floor, upper elevation	Langer and others, 1984
6	501275	3818660	116°59'10"	34°30'41"	Lucerne Lake	4/5N/1W/S	>853	Valley floor, ET	Langer and others, 1984
7	481403	3852290	117°12'12"	34°48'52"	Hodge	4/9N/3W/S	>701	Mojave River Valley	Langer and others, 1984
9	560494	3836420	116°20'23"	34°40'11"	Lavic Lake	27/7N/6E/S	>564	Valley floor, ET	Langer and others, 1984
10	564209	3843960	116°17'55"	34°44'15"	Lavic	36/8N/6E/S	<488	Basin floor, upper elevation	Langer and others, 1984
11	550940	3791700	116°26'48"	34°16'01"	W. of Landers	14/2N/5E/S	<914	Alluvial slope, upper elevation	Langer and others, 1984
12	620191	3778530	115°41'47"	34°08'33"	Dale Lake	25/1N/12E/S	>351	Valley floor, ET	Langer and others, 1984
13	668087	3792210	115°10'28"	34°15'33"	Danby Lake	14/2N/17E/S	>183	do.	Langer and others, 1984
14	643119	3798690	115°26'40"	34°19'17"	Cadiz Lake	18/3N/15E/S	>168	do.	Langer and others, 1984
15	616595	3816220	115°43'49"	34°28'58"	Bristol Lake	33/5N/12E/S	>183	do.	Langer and others, 1984
16	650701	3832430	115°21'22"	34°37'28"	Danby	7/6N/16E/S	<305	Valley floor, upper elevation	Langer and others, 1984
17	734426	3775900	114°27'32"	34°05'58"	Vidal	7/1S/24E/S	>91	Colorado River Valley	Langer and others, 1984
20	646170	3934510	115°23'15"	35°32'43"	Ivanpah Lake	5/16N/15E/S	<762	Valley floor, no ET	Langer and others, 1984
21	627938	3953550	115°35'08"	35°43'10"	Mesquite lake	4/18 1/2/13E/S	>777	Valley floor, ET	Langer and others, 1984
22	666065	3892450	115°10'36"	35°09'47"	Lanfair Valley	32/13N/17E/S	<1,067	Alluvial slope, upper elevation	Langer and others, 1984
24	590946	3987730	115°59'26"	36°01'54"	Pahrump Valley	22/22N/9E/S	>756	Valley floor, ET	Langer and others, 1984
25	496740	3899430	117°02'09"	35°14'23"	Superior Lake	2/31S/46E/M	<888	Valley floor, no ET	Langer and others, 1984
26	457298	3907320	117°28'11"	35°18'36"	Cuddeback Lake	22/30S/42E/M	<768	do.	Langer and others, 1984
27	420173	3910070	117°52'42"	35°19'57"	Koehn Lake	14/30S/38E/M	>578	Valley floor, ET	Langer and others, 1984
28	471517	3875660	117°18'44"	35°01'30"	Harper Lake	28/11N/4W/S	>579	do.	Langer and others, 1984
29	522392	3879160	116°45'16"	35°03'24"	Coyote Lake	10/11N/2E/S	>518	do.	Langer and others, 1984
31	418332	3940710	117°54'06"	35°36'31"	Freeman Junction	8/27S/38E/M	<762	Alluvial slope, upper elevation	Langer and others, 1984
32	423312	3866140	117°50'23"	34°56'12"	Rogers Lake	4/9N/9W/S	<686	Valley floor, no ET	Langer and others, 1984
33	440198	3825480	117°39'07"	34°34'16"	El Mirage	32/6N/7W/S	<884	Alluvial slope, upper elevation	Langer and others, 1984
34	442238	3866070	117°37'57"	34°56'14"	Kramer Junction	30/10N/7W/S	<762	do.	Langer and others, 1984

Table A1-2. Reference points for regional potential from topographic settings for California.—Continued

[ID no., identification number; UTM, Universal Transverse Mercator projection, Zone 11, NAD 27; vertical datum is NAVD 88; PLSS, Public Land Survey System section, township, range, S for San Bernardino principal meridian, M for Mount Diablo principal meridian; >, greater than; <, less than; ET, evapotranspiration; do., ditto; USGS, U.S. Geological Survey]

Map ID no. (plate 1)	UTM Easting (meters)	UTM Northing (meters)	Longitude	Latitude	Map feature	PLSS location	Regional potential altitude (meters)	Topographic setting	Reference
35	555729	3812050	116°23'36"	34°27'01"	Emerson Lake	7/4N/6E/S	<680	Valley floor, no ET	Langer and others, 1984
36	469096	3952440	117°20'30"	35°43'02"	Searles Lake	34/19N/43W/S	>493	Valley floor, ET	Langer and others, 1984
38	426780	4062100	117°49'11"	36°42'13"	Saline Lake	26/14S/38W/M	>323	do.	Langer and others, 1984
40	391880	4073260	118°12'43"	36°48'03"	Kearsarge	19/13S/35W/M	>1,189	Owens River Valley	Langer and others, 1984
41	419373	4148770	117°54'43"	37°29'03"	Oasis	27/5S/37E/M	>1,524	Valley floor, ET	Langer and others, 1984
42	355143	4196840	118°38'52"	37°54'34"	Adobe Valley	10/1N/30E/M	>1,951	do.	USGS topographic map
43	325311	4208220	118°59'23"	38°00'24"	Mono Lake	27/2N/27E/M	>1,952	Lake	USGS topographic map
44	520769	4009500	116°46'08"	36°13'55"	Badwater	33/19S/2E/S	>-71	Valley floor, ET	USGS topographic map
51	512341	4002580	116°51'46"	36°10'11"	Bennetts Well	22/20S/1E/S	>-40	do.	USGS topographic map
52	531346	4025210	116°39'02"	36°22'24"	Travertine Point	21/26N/3E/S	<649	Valley, no ET	National Park Service files
54	539387	4015970	116°33'41"	36°17'23"	AD-13	21/25N/4E/S	<710	Valley, upper elevation	National Park Service files
58	487675	4066300	117°08'17"	36°44'39"	Midway Well	18/14S/45E/M	>21	Valley floor, discharging well	National Park Service files
63	449418	4059320	117°33'58"	36°40'48"	Racetrack Playa	31/14S/41E/M	<1,119	Valley floor, no ET	USGS topographic map
64	598836	3777790	115°55'41"	34°08'17"	Twentynine Palms	27/1N/10E/S	<457	Valley, upper elevation	Langer and others, 1984
65	550675	3774390	116°27'02"	34°06'39"	Yucca Valley	3/1S/5E/S	<945	Valley floor, upper elevation	Langer and others, 1984
66	581031	3842580	116°06'54"	34°43'26"	Ludlow	2/7N/8E/S	<305	do.	Langer and others, 1984
67	662700	3849710	115°13'19"	34°46'42"	Essex	29/8N/17E/S	<457	do.	Langer and others, 1984
68	673121	3867460	115°06'16"	34°56'12"	Goffs	23/10N/18E/S	<610	do.	Langer and others, 1984
69	625306	3876970	115°37'35"	35°01'46"	Kelso	29/11N/13E/S	<518	do.	Langer and others, 1984
70	345781	4170400	118°44'55"	37°40'11"	Crowley Lake	22/3N/29E/M	>2,063	Stream level	Langer and others, 1984

Table A1-3. Reference points for regional potential from topographic settings for Nevada.

[ID no., identification number; UTM, Universal Transverse Mercator projection, Zone 11, NAD 27; vertical datum is NAVD 88; PLSS, Public Land Survey System section, township, range; >, greater than; <, less than; ET, evapotranspiration; do., ditto; USGS, U.S. Geological Survey]

Map ID no. (plate 1)	UTM Easting (meters)	UTM Northing (meters)	Longitude	Latitude	Map feature	PLSS location	Regional potential altitude (meters)	Topographic setting	Reference
1	686348	3921450	114°56'51"	35°25'15"	Searchlight	16/29S/63E	<914	Valley floor, no ET	Bedinger and others, 1984
2	687256	3914190	114°56'21"	35°21'19"	Searchlight	3/30S/63E	<701	do.	Bedinger and others, 1984
3	685866	3980440	114°56'21"	35°57'09"	Boulder City	11/23S/63E	<457	do.	Bedinger and others, 1984
4	658416	3961130	115°14'50"	35°46'60"	Jean Lake	10/25S/60E	<744	do.	Thomas and others, 1986
5	626984	3963990	115°35'40"	35°48'49"	Sandy	33/24S/57E	<792	do.	Thomas and others, 1986
6	658964	3986450	115°14'10"	36°00'41"	Arden	26/22S/60E	<671	do.	Bedinger and others, 1984
7	702843	3998640	114°44'47"	36°06'47"	Lake Mead	18/21S/65E	>372	Lake level	USGS topographic map
8	677568	3995350	115°01'40"	36°05'18"	East Las Vegas	26/21S/62E	<488	Valley floor, no ET	Bedinger and others, 1984
9	691971	4036560	114°51'28"	36°27'25"	Dry Lake	17/17S/64E	<549	do.	Bedinger and others, 1984
10	704373	4039870	114°43'07"	36°29'03"	California Wash	3/17S/65E	<518	do.	Bedinger and others, 1984
11	724452	4054930	114°29'25"	36°36'55"	Logan Dale	21/15S/67E	>427	Valley floor, ET	Bedinger and others, 1984
12	716330	4060520	114°34'46"	36°40'03"	Moapa	35/14S/66E	>457	do.	Bedinger and others, 1984
13	585629	4006750	116°02'51"	36°12'13"	Pahrump	20/20S/53E	>792	do.	Bedinger and others, 1984
14	652338	4017370	115°18'13"	36°17'28"	Hwy 99 - 1	7/19S/60E	<732	Valley floor, no ET	Bedinger and others, 1984
15	644548	4028120	115°23'18"	36°23'21"	Hwy 99 - 2	17/18S/59E	<823	do.	Bedinger and others, 1984
16	639560	4036050	115°26'33"	36°27'41"	Hwy 99 - 3	23/17S/58E	<884	do.	Bedinger and others, 1984
17	754715	4073360	114°08'46"	36°46'25"	Bunkerville	26/13S/70E	>457	Virgin River	Bedinger and others, 1984
18	708321	4072100	114°39'57"	36°46'25"	Rox	26/12S/65E	>549	Meadow Valley Wash	Bedinger and others, 1984
19	657156	4086570	115°14'09"	36°54'50"	DDL-2	10/12S/60E	<924	Valley floor, no ET	Schaefer and others, 1992
20	660051	4091900	115°12'08"	36°57'41"	DDL-1	24/11S/60E	<929	do.	Schaefer and others, 1992
21	688985	4073710	114°52'55"	36°47'32"	Arrow Canyon	25/13S/63E	<555	do.	Schaefer and others, 1992
22	616614	4048290	115°41'48"	36°34'29"	Indian Springs	7/16S/56E	<975	Valley margin	Bedinger and others, 1984
24	643155	4044460	115°24'03"	36°32'12"	SBH-1	23/16S/58E	<882	do.	Schaefer and others, 1992
25	588923	4091130	116°00'04"	36°57'50"	Yucca Lake	24/11S/54E	<701	Valley floor, no ET	Bedinger and others, 1984
26	553211	4051670	116°24'18"	36°36'39"	Lathrop Wells	25/15S/49E	<701	do.	Bedinger and others, 1984
28	552095	4030830	116°25'08"	36°25'23"	Longstreet	35/17S/49E	<655	do.	Thomas and others, 1986
29	595439	4074620	115°55'48"	36°48'52"	Frenchman Flat	8/13S/54E	<732	do.	Thomas and others, 1986
30	584841	4103540	116°02'44"	37°04'34"	Yucca Flat	10/10S/53E	<732	do.	Thomas and others, 1986
31	521524	4086650	116°45'30"	36°55'39"	Beatty	7/12S/47E	>1,006	Amargosa River	Bedinger and others, 1984
32	522034	4080650	116°45'10"	36°52'24"	Beatty	19/12S/47E	>914	do.	Bedinger and others, 1984
33	529083	4068130	116°40'27"	36°45'37"	Beatty	36/13S/47E	<732	Valley floor, no ET	Bedinger and others, 1984
34	519285	4102730	116°46'59"	37°04'21"	Beatty	12/10S/46E	<1,189	do.	Bedinger and others, 1984
35	502761	4116490	116°58'08"	37°11'48"	Sarcobatus Flat	36/8S/44E	>1,204	Valley floor, ET	Bedinger and others, 1984
36	487959	4143120	117°08'10"	37°26'12"	Lida Valley	10/6S/43E	>1,311	do.	Bedinger and others, 1984

Table A1-3. Reference points for regional potential from topographic settings for Nevada.—Continued

[ID no., identification number; UTM, Universal Transverse Mercator projection, Zone 11, NAD 27; vertical datum is NAVD 88; PLSS, Public Land Survey System section, township, range; >, greater than; <, less than; ET, evapotranspiration; do., ditto; USGS, U.S. Geological Survey]

Map ID no. (plate 1)	UTM Easting (meters)	UTM Northing (meters)	Longitude	Latitude	Map feature	PLSS location	Regional potential altitude (meters)	Topographic setting	Reference
37	542166	4124390	116°31'28"	37°16'01"	Pahute Mesa	5/8S/49E	<1,280	Upland	Bedinger and others, 1984
38	551182	4132240	116°25'20"	37°20'14"	Pahute Mesa	4/7S/50E	<1,372	do.	Bedinger and others, 1984
39	608980	4127520	115°46'14"	37°17'23"	Groom Lake	31/7S/55 1/2E	<1,067	Valley floor, no ET	Bedinger and others, 1984
40	591715	4138840	115°57'50"	37°23'37"	Groom Lake	21/6S/54E	<1,341	do.	Bedinger and others, 1984
41	656156	4157370	115°13'56"	37°33'07"	Hiko	34/4S/60E	>1,158	White River	Bedinger and others, 1984
42	662520	4139420	115°09'51"	37°23'21"	Alamo	32/6S/61E	>1,067	do.	Bedinger and others, 1984
43	667563	4125960	115°06'37"	37°16'01"	Pahranagat Lakes	11/8S/61E	>1,006	do.	Bedinger and others, 1984
44	678395	4090260	114°59'48"	36°56'36"	Coyote Springs Valley	32/11S/63E	<770	Valley floor, no ET	Bedinger and others, 1984
45	677960	4101560	114°59'56"	37°02'43"	Coyote Springs Valley	31/10S/62E	<788	do.	Bedinger and others, 1984
46	686730	4087170	114°54'14"	36°54'50"	Coyote Springs Valley	10/12S/63E	<566	do.	Bedinger and others, 1984
47	723861	4111200	114°28'49"	37°07'20"	Meadow Valley Wash	?/9S/67E	>792	Stream	Bedinger and others, 1984
48	724410	4128550	114°28'08"	37°16'42"	Meadow Valley Wash	3/8S/67E	>853	do.	Bedinger and others, 1984
49	719206	4136180	114°31'31"	37°20'54"	Meadow Valley Wash	7/7S/67E	>1,036	do.	Bedinger and others, 1984
50	714557	4149390	114°34'26"	37°28'06"	Meadow Valley Wash	34/5S/66E	>1,189	do.	Bedinger and others, 1984
51	717965	4163790	114°31'52"	37°35'50"	Meadow Valley Wash	18/4S/67E	>1,311	do.	Bedinger and others, 1984
52	728802	4185460	114°24'06"	37°47'23"	Meadow Valley Wash	7/2S/68E	>1,433	do.	Bedinger and others, 1984
53	728250	4205280	114°24'06"	37°58'06"	Patterson Valley	1/1N/69E	<1,646	Valley floor, no ET	Bedinger and others, 1984
54	744990	4147200	114°13'51"	37°26'28"	Dry Valley Wash	21/1N/69E	<1,646	do.	Bedinger and others, 1984
55	762018	4119580	114°02'54"	37°11'16"	Bull Valley Wash	4/9S/71E	<945	do.	Bedinger and others, 1984
56	755771	4126920	114°06'58"	37°15'20"	Bull Valley Wash	13/8S/71E	<1,128	do.	Bedinger and others, 1984
57	694815	4174530	114°47'25"	37°41'57"	Dry Lake Valley	10/3S/64E	<1,280	do.	Bedinger and others, 1984
58	694789	4200410	114°47'01"	37°55'56"	Dry Lake Valley	22/1N/64E	<1,311	do.	Bedinger and others, 1984
59	610275	4167200	115°45'00"	37°38'50"	Sand Springs Valley	36/3S/55E	>1,448	Valley floor, ET	Bedinger and others, 1984
60	612604	4194090	115°43'10"	37°53'21"	Sand Springs Valley	31/1S/56E	>1,448	do.	Bedinger and others, 1984
61	511895	4193660	116°51'53"	37°53'32"	Stone Cabin Valley	31/1N/46E	<1,585	Valley floor, no ET	Bedinger and others, 1984
62	519848	4197590	116°46'27"	37°55'39"	Stone Cabin Valley	30/1N/47E	<1,615	do.	Bedinger and others, 1984
63	531195	4205150	116°38'41"	37°59'43"	Stone Cabin Valley	30/2N/48E	<1,646	do.	Bedinger and others, 1984
64	478773	4192850	117°14'29"	37°53'05"	Alkali Valley	2/1S/42E	>1,463	Valley floor, ET	Bedinger and others, 1984
65	468250	4187860	117°21'39"	37°50'22"	Alkali Valley	15/1S/41E	>1,463	do.	Bedinger and others, 1984
66	463040	4192380	117°25'13"	37°52'48"	Alkali Valley	6/1S/41E	>1,463	do.	Bedinger and others, 1984
67	443938	4178430	117°38'11"	37°45'12"	Clayton Valley	22/2S/39E	>1,311	do.	Bedinger and others, 1984
68	450293	4177160	117°33'51"	37°44'32"	Clayton Valley	29/2S/40E	>1,311	do.	Bedinger and others, 1984
69	455229	4184650	117°30'31"	37°48'36"	Clayton Valley	35/1S/40E	>1,311	do.	Bedinger and others, 1984
71	412964	4160640	117°59'09"	37°35'26"	Fish Lake Valley	20/4S/36E	>1,494	do.	Bedinger and others, 1984

Table A1-3. Reference points for regional potential from topographic settings for Nevada.—Continued

[ID no., identification number; UTM, Universal Transverse Mercator projection, Zone 11, NAD 27; vertical datum is NAVD 88; PLSS, Public Land Survey System section, township, range; >, greater than; <, less than; ET, evapotranspiration; do., ditto; USGS, U.S. Geological Survey]

Map ID no. (plate 1)	UTM Easting (meters)	UTM Northing (meters)	Longitude	Latitude	Map feature	PLSS location	Regional potential altitude (meters)	Topographic setting	Reference
72	407077	4171490	118°03'14"	37°41'16"	Fish Lake Valley	11/3S/35E	>1,463	Valley floor, ET	Bedinger and others, 1984
73	412240	4187060	117°59'50"	37°49'43"	Fish Lake Valley	20/1S/36E	>1,433	do.	Bedinger and others, 1984
74	414398	4201770	117°58'28"	37°57'41"	Fish Lake Valley	7/1N/36E	>1,433	do.	Bedinger and others, 1984
75	361486	4219330	118°34'48"	38°06'47"	Huntoon Valley	13/3N/30E	>1,695	do.	Bedinger and others, 1984
76	367284	4226790	118°30'55"	38°10'52"	Huntoon Valley	27/4N/31E	>1,695	do.	Bedinger and others, 1984
77	377944	4230140	118°23'39"	38°12'46"	Teels Marsh	10/4N/32E	>1,509	do.	Bedinger and others, 1984
78	386376	4225980	118°17'50"	38°10'35"	Teels Marsh	27/4N/33E	>1,509	do.	Bedinger and others, 1984
79	422549	4211990	117°52'58"	38°03'15"	Columbus Salt Marsh	8/2N/37E	>1,387	do.	Bedinger and others, 1984
80	414117	4221380	117°58'48"	38°08'17"	Columbus Salt Marsh	8/3N/36E	>1,387	do.	Bedinger and others, 1984
81	455180	4220160	117°30'41"	38°07'48"	Big Smoky Valley	8/3N/40E	>1,460	do.	Bedinger and others, 1984
83	427638	4244180	117°49'41"	38°20'41"	Dry Lake	35/6N/37E	>1,600	do.	Bedinger and others, 1984
84	483003	4275930	117°11'43"	38°38'01"	Big Smoky Valley	18/9N/43E	<1,737	Valley floor, no ET	Bedinger and others, 1984
85	466012	4248770	117°23'21"	38°23'18"	Big Smoky Valley	8/6N/41E	<1,524	do.	Bedinger and others, 1984
86	476943	4261860	117°15'52"	38°30'24"	Big Smoky Valley	33/8N/42E	<1,676	do.	Bedinger and others, 1984
87	492110	4192420	117°05'23"	37°52'52"	Mud Lake	6/1S/44E	<1,524	do.	Bedinger and others, 1984
88	492948	4229710	117°04'50"	38°13'02"	Ralston Valley	8/4N/44E	>1,737	Valley floor, ET	Bedinger and others, 1984
89	495725	4238500	117°02'56"	38°17'47"	Ralston Valley	15/5N/44E	>1,768	do.	Bedinger and others, 1984
90	503150	4257080	116°57'50"	38°27'50"	Ralston Valley	17/7N/45E	<1,859	Valley floor, high altitude	Bedinger and others, 1984
91	506512	4265400	116°55'31"	38°32'20"	Ralston Valley	16/8N/45E	<1,981	do.	Bedinger and others, 1984
92	520487	4281950	116°45'52"	38°41'16"	Monitor Valley	23/10N/46E	<2,103	do.	Bedinger and others, 1984
93	529243	4171020	116°40'06"	37°41'16"	Cactus Flat	15/1S/47E	<1,625	Valley floor, no ET	USGS topographic map
94	523634	4188320	116°43'53"	37°50'38"	Cactus Flat	12/3S/47E	<1,634	do.	USGS topographic map
95	553229	4150800	116°23'52"	37°30'16"	Gold Flat	16/5S/50E	<1,539	do.	USGS topographic map
96	568625	4150670	116°13'25"	37°30'08"	Kawich Valley	19/5S/52E	<1,621	do.	USGS topographic map
97	535811	4220540	116°35'29"	38°08'02"	Stone Cabin Valley	3/3N/48E	>1,676	Valley floor, ET	Bedinger and others, 1984
98	534485	4228980	116°36'22"	38°12'36"	Stone Cabin Valley	9/4N/48E	>1,707	do.	Bedinger and others, 1984
99	570284	4229000	116°11'50"	38°12'29"	Hot Creek Valley	13/4N/51E	>1,570	do.	Bedinger and others, 1984
100	565871	4248290	116°14'45"	38°22'56"	Hot Creek Valley	9/6N/51E	<1,585	do.	Bedinger and others, 1984
101	556791	4262800	116°20'55"	38°30'49"	Hot Creek Valley	33/8N/50E	>1,646	do.	Bedinger and others, 1984
102	583072	4274310	116°02'45"	38°36'55"	Big Sand Springs Valley	29/9N/53E	<1,631	Valley floor, no ET	Bedinger and others, 1984
103	590212	4282430	115°57'46"	38°41'16"	Big Sand Springs Valley	29/9N/53E	>1,585	do.	Bedinger and others, 1984
104	618922	4275780	115°38'02"	38°37'28"	Railroad Valley	24/9N/56E	>1,448	Valley floor, ET	Bedinger and others, 1984
105	604260	4244440	115°48'25"	38°20'38"	Railroad Valley	29/6N/55E	>1,448	do.	Bedinger and others, 1984
106	611163	4315100	115°43'00"	38°58'47"	Railroad Valley	7/13N, 56E	<1,676	Valley floor, high altitude	Bedinger and others, 1984

Table A1-3. Reference points for regional potential from topographic settings for Nevada.—Continued

[ID no., identification number; UTM, Universal Transverse Mercator projection, Zone 11, NAD 27; vertical datum is NAVD 88; PLSS, Public Land Survey System section, township, range; >, greater than; <, less than; ET, evapotranspiration; do., ditto; USGS, U.S. Geological Survey]

Map ID no. (plate 1)	UTM Easting (meters)	UTM Northing (meters)	Longitude	Latitude	Map feature	PLSS location	Regional potential altitude (meters)	Topographic setting	Reference
107	595769	4237800	115°54'18"	38°17'06"	Railroad Valley	22/5N/54E	>1,463	Valley floor, ET	Bedinger and others, 1984
108	607972	4231940	115°45'59"	38°13'51"	Railroad Valley	11/4N/55E	>1,463	do.	Bedinger and others, 1984
109	620441	4296890	115°36'46"	38°48'52"	Railroad Valley	18/11N/57E	>1,494	do.	Bedinger and others, 1984
110	633181	4216250	115°28'53"	38°05'10"	Garden Valley	32/3N/58E	<1,554	Valley floor, no ET	Bedinger and others, 1984
111	642084	4235270	115°22'34"	38°15'22"	Garden Valley	32/5N/59E	<1,615	do.	Bedinger and others, 1984
112	646271	4186010	115°20'18"	37°48'42"	Coal Valley	34/1S/59E	<1,305	do.	Thomas and others, 1986
113	656150	4214380	115°13'12"	38°03'56"	Coal Valley	3/2N/60E	<1,579	do.	Thomas and others, 1986
114	646558	4194620	115°19'60"	37°53'21"	Coal Valley	2/1S/59E	<1,500	do.	USGS topographic map
115	693529	4216450	114°47'37"	38°04'37"	Dry Lake Valley	34/3N/64E	<1,341	do.	Bedinger and others, 1984
116	679555	4211100	114°57'15"	38°01'54"	White River	18/2N/63E	>1,311	White River	Bedinger and others, 1984
117	677734	4214080	114°58'27"	38°03'32"	White River	2/2N/62E	>1,402	do.	Bedinger and others, 1984
118	669492	4223430	115°03'57"	38°08'41"	White River	7/3N/62E	<1,494	White River, no discharge	Bedinger and others, 1984
120	660481	4244340	115°09'50"	38°20'05"	White River	31/6N/61E	>1,554	White River	Bedinger and others, 1984
121	665909	4259100	115°05'54"	38°27'60"	White River	3/7N/61E	>1,585	do.	Bedinger and others, 1984
122	665484	4279630	115°05'54"	38°39'06"	White River	9/9N/61E	>1,615	do.	Bedinger and others, 1984
123	667978	4293250	115°03'59"	38°46'26"	White River	36/11N/61E	>1,646	do.	Bedinger and others, 1984
124	668775	4302310	115°03'18"	38°51'19"	White River	31/12N/62E	>1,676	do.	Bedinger and others, 1984
125	687817	4255510	114°50'54"	38°25'48"	Cave Valley	25/7N/63E	<1,737	Valley floor, no ET	Bedinger and others, 1984
126	691828	4272420	114°47'52"	38°34'53"	Cave Valley	4/8N/64E	<1,829	do.	Bedinger and others, 1984
127	686997	4285380	114°50'59"	38°41'57"	Cave Valley	25/10N/63E	<2,012	do.	Bedinger and others, 1984
128	711983	4244540	114°34'30"	38°19'33"	Lake Valley	4/5N/66E	>1,798	Valley floor, ET	Bedinger and others, 1984
129	710269	4280190	114°35'02"	38°38'50"	Lake Valley	9/9N/66E	>1,798	Valley floor, no ET	Bedinger and others, 1984
130	720197	4294780	114°27'55"	38°46'34"	Spring Valley	33/11N/67E	>1,753	do.	Bedinger and others, 1984
131	753440	4292500	114°05'02"	38°44'48"	Snake Valley	11/10N/70E	>1,676	do.	Bedinger and others, 1984
132	581776	4206020	116°04'07"	38°00'00"	Railroad Valley	30/2N/53E	>1,463	do.	Bedinger and others, 1984
133	587801	4206080	116°00'00"	38°00'00"	Railroad Valley	27/2N/53E	>1,463	do.	Bedinger and others, 1984
134	437425	4284940	117°43'11"	38°42'46"	Ione Valley	21/10N/38E	<1,768	do.	Bedinger and others, 1984
135	440274	4294450	117°41'16"	38°47'55"	Ione Valley	22/11N/38E	<1,798	do.	Bedinger and others, 1984
136	442397	4310980	117°39'53"	38°56'52"	Ione Valley	11/12N/38E	<1,829	do.	Bedinger and others, 1984
137	420242	4303160	117°55'10"	38°52'32"	Gabbs Valley	27/12N/36E	>1,372	Valley floor, ET	Bedinger and others, 1984
138	396366	4307450	118°11'43"	38°54'42"	Gabbs Valley	7/12N/34E	>1,265	do.	Bedinger and others, 1984
139	401072	4257570	118°08'02"	38°27'46"	Soda Spring Valley	13/7N/34E	>1,340	do.	Bedinger and others, 1984
140	403676	4236050	118°06'04"	38°16'09"	Rhodes Salt Marsh	28/5N/35E	>1,340	do.	Bedinger and others, 1984

Table A1–3. Reference points for regional potential from topographic settings for Nevada.—Continued

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Map ID no. (plate 1)	UTM Easting (meters)	UTM Northing (meters)	Longitude	Latitude	Map feature	PLSS location	Regional potential altitude (meters)	Topographic setting	Reference
141	487186	4291210	117°08'51"	38°46'17"	Big Smoky Valley	33/11N/43E	>1,707	do.	Bedinger and others, 1984
142	499616	4334140	117°00'16"	39°09'30"	Big Smoky Valley	13/15N/44E	>1,707	Valley floor, ET	Bedinger and others, 1984
143	459595	4312970	117°27'59"	38°57'60"	Reese River Valley	27/13N/40E	>2,042	do.	Bedinger and others, 1984
144	465306	4325680	117°24'04"	39°04'53"	Reese River Valley	17/14N/41E	>1,951	do.	Bedinger and others, 1984
145	471632	4340970	117°19'43"	39°13'10"	Reese River Valley	26/16N/41E	>1,859	do.	Bedinger and others, 1984
146	513014	4359520	116°50'56"	39°23'13"	Big Smoky Valley	19/18N/46E	>1,707	do.	Bedinger and others, 1984
147	448317	4343620	117°35'56"	39°14'32"	Smith Creek Valley	21/16N/39E	>1,844	do.	Bedinger and others, 1984
148	459407	4373920	117°28'20"	39°30'57"	Smith Creek Valley	15/19N/40E	>1,844	do.	Bedinger and others, 1984
149	435965	4380610	117°44'44"	39°34'29"	Edwards Creek Valley	30/20N/38E	>1,569	do.	Bedinger and others, 1984
150	452878	4395750	117°32'59"	39°42'44"	Edwards Creek Valley	2/21N/39E	>1,569	do.	Bedinger and others, 1984
151	522066	4304790	116°44'44"	38°53'37"	Monitor Valley	6/12N/46E	>2,073	do.	Bedinger and others, 1984
152	530626	4333710	116°38'44"	39°09'14"	Monitor Valley	11/15N/47E	>1,981	do.	Bedinger and others, 1984
153	530507	4370330	116°38'43"	39°29'02"	Monitor Valley	26/19N/47E	>1,890	do.	Bedinger and others, 1984
154	562093	4361020	116°16'44"	39°23'54"	Antelope Valley	30/18N/51E	>1,891	do.	Bedinger and others, 1984
155	569891	4382180	116°11'10"	39°35'18"	Kobeh Valley	13/20N/51E	>1,829	do.	Bedinger and others, 1984
156	607934	4376080	115°44'39"	39°31'46"	Newark Valley	11/19N/55E	>1,783	do.	Bedinger and others, 1984
157	612490	4405780	115°41'10"	39°47'47"	Newark Valley	8/22N/56E	>1,783	do.	Bedinger and others, 1984
158	637624	4410440	115°23'30"	39°50'05"	Long Valley	25/23N/58E	>1,859	do.	Bedinger and others, 1984
159	658795	4394040	115°08'54"	39°41'00"	Butte Valley	18/21N/61E	>1,859	do.	Bedinger and others, 1984
160	689530	4391710	114°47'27"	39°39'22"	Steptoe Valley	26/21N/63E	>1,829	do.	Bedinger and others, 1984
161	546322	4057660	116°28'54"	36°39'55"	2DB	9/16S/49E	<682	Valley floor, no ET	Nye County files
162	548428	4036320	116°27'34"	36°28'22"	AD9	15/17S/49E	<674	Valley floor, no ET	USGS files
163	536230	4049080	116°35'42"	36°35'18"	AD3A	5/16S/48E	<696	Valley floor, no ET	USGS files

Table A1–4. Reference points for regional potential from springs for California.

[ID no., identification number; UTM, Universal Transverse Mercator projection, Zone 11, NAD 27; vertical datum is NAVD 88; PLSS, Public Land Survey System section, township, range, S for San Bernardino principal meridian, M for Mount Diablo principal meridian; >, greater than; <, less than; --, no data; USGS, U.S. Geological Survey]

Map ID no. (plate 1)	UTM Easting (meters)	UTM Northing (meters)	Longitude	Latitude	Spring name	PLSS location	Temperature (degrees Celsius)	Regional potential altitude (meters)	Reference
1	365174	4184370	118°31'53"	37°47'55"	Benton Hot Springs	2/2S/31E/M	57.2	>1,780	Waring, 1965
2	510810	4008800	116°52'47"	36°13'33"	Eagle Borax Spring	9/24N/1E/S	--	>40	Miller, 1977
5	377472	4123940	118°22'54"	37°15'21"	Keough Hot Spring	17/8S/33E/M	54.4	>1,300	Waring, 1965; Bliss, 1976
6	469860	4098730	117°20'20"	37°02'10"	Staininger Spring	6/9S/43E/M	26.1	<1,000	Steinkampf and Werrell, 2001
7	506056	4059300	116°55'56"	36°40'52"	Keene Wonder Spring	1/15S/46E/M	27–34	>375	Waring, 1965; Bliss, 1976; Steinkampf and Werrell, 2001
8	430662	3988830	117°46'11"	36°02'36"	Coso Hot Springs	4/22S/39E/M	60–boiling	1,120	Waring, 1965; Bliss, 1976
9	480652	3997330	117°12'54"	36°07'20"	Warm Sulphur Springs	10/21S/44E/M	26.7	>340	Waring, 1965; Bliss, 1976
10	567704	3970210	116°15'00"	35°52'32"	Tecopa Hot Spring	32/21N/8E/S	42–48	>439	Waring, 1965; Bliss, 1976; Steinkampf and Werrell, 2001
11	566337	3971860	116°15'54"	35°53'26"	Resting Spring	30/21N/8E/S	--	>539	Waring, 1965; Bliss, 1976
12	552278	3958050	116°25'18"	35°46'01"	Saratoga Springs	2/18N/5E/S	27.8	>94	Waring, 1965; Bliss, 1976; King and Bredehoeft, 1999; Steinkampf and Werrell, 2001
13	518116	3889410	116°48'04"	35°08'57"	Paradise Spring	8/12N/2E/S	28–42	<775	Waring, 1965; Bliss, 1976
14	581276	3889260	116°06'28"	35°08'41"	Soda Station Spring	10/12N/8E/S	23.9	>290	Waring, 1965; Bliss, 1976
15	528044	3853640	116°41'36"	34°49'35"	Newberry Spring	32/9N/3E/S	25.0	>560	Waring, 1965
16	483673	3799610	117°10'39"	34°20'22"	Unnamed (Deep Creek Spring)	15/3N/3W/S	27–38	>1,122	Waring, 1965
17	484926	3800100	117°09'50"	34°20'38"	Unnamed (Warm Spring)	14/3N/3W/S	27–39	>1,125	Waring, 1965
18	515110	4033460	116°49'53"	36°26'53"	Travertine Springs	23/27N1E/S	32–35	>125	Bliss, 1976; Steinkampf and Werrell, 2001
19	513839	4034690	116°50'44"	36°27'33"	Texas Spring	14/27N/1E/S	31.1	>110	Miller, 1977
20	515845	4039960	116°49'23"	36°30'24"	Nebares Spring	36/28N/1E/S	38.9	>275	Steinkampf and Werrell, 2001
21	503256	3981250	116°57'50"	35°58'39"	Warm Spring	5/23S/47E/M	34.4	<750	Steinkampf and Werrell, 2001
22	465833	4098500	117°23'03"	37°02'02"	Grapevine Spring	10/11S/42E/M	37.8	>840	Bliss, 1976; Steinkampf and Werrell, 2001
23	526632	3805640	116°42'37"	34°23'37"	Old Woman Spring	31/4N/3E/S	--	>899	USGS topographic map
24	703599	3863310	114°46'19"	34°53'37"	Spring	3/9N/21E/S	--	>280	USGS topographic map

Table A1–4. Reference points for regional potential from springs for California.—Continued

[ID no., identification number; UTM, Universal Transverse Mercator projection, Zone 11, NAD 27; vertical datum is NAVD 88; PLSS, Public Land Survey System section, township, range, S for San Bernardino principal meridian, M for Mount Diablo principal meridian; >, greater than; <, less than; --, no data; USGS, U.S. Geological Survey]

Map ID no. (plate 1)	UTM Easting (meters)	UTM Northing (meters)	Longitude	Latitude	Spring name	PLSS location	Temperature (degrees Celsius)	Regional potential altitude (meters)	Reference
25	466134	3966250	117°22'30"	35°50'30"	Bainter Spring	18/24S/43E/M	32.8	<799	Bliss, 1976
26	427924	3987560	117°48'00"	36°01'54"	Devils Kitchen Fumarole	7/22S/39E/M	97.2	1,311	Bliss, 1976
27	415517	4021810	117°56'29"	36°20'22"	Dirty Sox Spring (Well)	26/18S/37E/M	34.4	>1,094	Bliss, 1976
28	482968	4030930	117°11'24"	36°25'31"	Emigrant Spring	27/17S/44E/M	--	<1,173	Bliss, 1976
29	423744	4061110	117°51'13"	36°41'40"	Little Hunter Canyon Spring	28/14S/38E/M	--	>550	Bliss, 1976
30	432414	4074850	117°45'28"	36°49'08"	Burro Warm Spring	18/13S/39E/M	43.3	>450	Moyle, 1974
31	556884	3876780	116°22'35"	35°02'02"	Spring	19/11N/6E/S	--	>427	USGS topographic map
32	431564	4073870	117°46'02"	36°48'36"	Palm Spring	18/13S/39E/M	9.4	>430	Bliss, 1976; Mase and others, 1979; Moyle, 1974
33	564990	3981220	116°16'45"	35°58'30"	Shoshone Spring	30/22S/7E/S	--	>500	Steinkampf and Werrell, 2001
34	408081	4127040	118°02'13"	37°17'14"	Deep Springs	4/7S/36E/M	--	>1,503	Langer and others, 1984
35	527879	4026460	116°41'21"	36°23'05"	Navel Spring	13/26N/R2E	--	<640	Bliss, 1976
36	495477	4000570	117°03'01"	36°09'06"	Dripping Spring	12/19S/45E/M	--	<1,317	Bliss, 1976
38	565754	3942280	116°16'26"	35°37'26"	Salt Spring	20/18N/7E/S	--	<152	USGS topographic map
39	381495	3860060	118°17'48"	34°52'40"	Willow Springs	7/9N/13W/S	--	>771	USGS topographic map
40	411273	3996740	117°59'09"	36°06'47"	Spring	11/21S/37E/M	--	>1,097	USGS topographic map
41	511032	4010620	116°52'38"	36°14'32"	Tule Spring	28/25N/1E/S	--	>40	USGS topographic map
42	498236	4049000	117°01'11"	36°35'18"	McLean Spring	7/16S/46E/M	--	>49	National Park Service files
43	498236	4051010	117°01'11"	36°36'23"	Burnt Wagon Spring	31/15S/46E/M	--	>46	National Park Service files
44	488268	4064570	117°07'53"	36°43'43"	Triangle Spring	19/14S/45E/M	--	>21	National Park Service files
45	467308	4090200	117°22'02"	36°57'33"	Mesquite Spring	26/11S/42E/M	--	>539	National Park Service files
46	452849	4113880	117°31'52"	37°10'19"	Little Sand Spring	17/9S/41E/M	--	>925	USGS topographic map
47	451873	4115640	117°32'32"	37°11'16"	Sand Spring	7/9S/41E/M	--	>955	USGS topographic map
49	329098	4168480	118°56'14"	37°38'58"	East of Mammoth	31/35/28E/M	--	>2,286	USGS topographic map

Table A1–5. Reference points for regional potential from springs for Nevada.

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Map ID no. (plate 1)	UTM Easting (meters)	UTM Northing (meters)	Longitude	Latitude	Spring name	PLSS location	Regional potential altitude (meters)	Temperature (degrees Celsius)	Reference
1	704337	4066480	114°42'43"	36°43'26"	Warm (Muddy) Spring	16/14S/65E	>536	32	Mifflin, 1968
2	704142	4064230	114°42'53"	36°42'13"	Iverson (Warm) Spring	21/14S/65E	>536	32	Mifflin, 1968
3	729188	4028250	114°26'43"	36°22'26"	Rogers Spring	12/18S/67E	>488	27	Mifflin, 1968
4	730686	4031000	114°25'40"	36°23'54"	Blue Point Spring	6/18S/68E	>463	27	Mifflin, 1968
5	607601	4039420	115°47'55"	36°29'45"	Indian Springs	16/16S/55E	>975	26	Mifflin, 1968
6	610405	4030360	115°46'07"	36°24'50"	Willow Spring	2/18S/55E	<1,829	12	Mifflin, 1968
7	622889	4017740	115°37'53"	36°17'55"	Deer Creek Springs	18/19S/57E	<2,621	7	Mifflin, 1968
8	613804	4002820	115°44'05"	36°09'55"	Intermittent Spring	31/20S/56E	<1,414	14	Mifflin, 1968
9	612716	4310840	115°41'58"	38°56'28"	Big Warm Spring	32/13N/56E	>1,707	32	Mifflin, 1968
10	613171	4309330	115°41'40"	38°55'39"	Little Warm Spring	5/12N/56E	>1,707	32	Mifflin, 1968
11	661598	4273260	115°08'40"	38°35'42"	Mormon Spring	32/9N/61E	>1,615	37–38	Mifflin, 1968
12	670061	4278220	115°02'46"	38°38'17"	Immigrant Spring	19/9N/62E	>1,661	19	Mifflin, 1968
13	605462	4267540	115°47'23"	38°33'07"	Lockes Stockyard Spring	15/8N/55E	>1,481	32–34	Mifflin, 1968
14	605462	4267540	115°47'23"	38°33'07"	Lockes Big Spring	15/8N/55E	>1,481	37–38	Mifflin, 1968
15	605462	4267540	115°47'23"	38°33'07"	Reynolds Spring	15/8N/55E	>1,481	36–37	Mifflin, 1968
16	628430	4269640	115°31'33"	38°34'04"	Blue Eagle and Jacks Springs	11/8N/57E	>1,451	28	Mifflin, 1968
17	628430	4269640	115°31'33"	38°34'04"	Tom Spring	12/8N/57E	>1,451	22	Mifflin, 1968
18	626250	4265100	115°33'06"	38°31'38"	Butterfield Spring	27/8N/57E	>1,448	16	Mifflin, 1968
19	672058	4256150	115°01'43"	38°26'20"	Butterfield Springs	28/7N/62E	>1,600	--	Mifflin, 1968
20	672349	4253900	115°01'33"	38°25'07"	Flagg Springs	33/7N/62E	>1,600	--	Mifflin, 1968
21	640565	4248500	115°23'27"	38°22'32"	Forest Home Spring	18/6N/59E	<1,893	14	Mifflin, 1968
22	658921	4247090	115°10'52"	38°21'35"	Moon River Spring	25/6N/60E	>1,585	33	Mifflin, 1968
24	557974	4037890	116°21'10"	36°29'11"	Fairbanks Spring	9/17S/50E	>695	27	Mifflin, 1968
25	559726	4036390	116°19'60"	36°28'22"	Rogers Spring	15/17S/50E	>689	28–29	Mifflin, 1968
26	559486	4035130	116°20'10"	36°27'41"	Longstreet Spring	22/17S/50E	>701	27–28	Mifflin, 1968
27	564017	4031680	116°17'09"	36°25'48"	Devils Hole	36/17S/50E	>732	33	Mifflin, 1968
28	560517	4030140	116°19'30"	36°24'59"	Crystal Pool	3/18S/50E	>664	28	Mifflin, 1968
29	564488	4028660	116°16'51"	36°24'10"	Point-of-Rocks	7/18S/51E	>686	32–33	Mifflin, 1968
30	566068	4027160	116°15'48"	36°23'21"	Big Spring	19/18S/51E	>683	28	Mifflin, 1968
31	587314	4008030	116°01'43"	36°12'54"	Bennetts Springs	14/20S/53E	>805	24	Mifflin, 1968
32	598530	4001130	115°54'17"	36°09'06"	Manse Springs	3/21S/54E	>853	24	Mifflin, 1968

Table A1–5. Reference points for regional potential from springs for Nevada.—Continued

[ID no., identification number; UTM, Universal Transverse Mercator projection, Zone 11, NAD 27; vertical datum is NAVD 88; PLSS, Public Land Survey System section, township, range; >, greater than; <, less than; --, no data]

Map ID no. (plate 1)	UTM Easting (meters)	UTM Northing (meters)	Longitude	Latitude	Spring name	PLSS location	Regional potential altitude (meters)	Temperature (degrees Celsius)	Reference
33	692016	4278710	114°47'38"	38°38'17"	Cave Spring	16/9N/64E	<1,981	Cool	Mifflin, 1968
34	700920	4284460	114°41'24"	38°41'16"	Geyser Spring	4/9N/65E	<2,073	20	Mifflin, 1968
35	730392	4183750	114°23'03"	37°46'26"	Panaca Spring	4/2S/68E	>1,451	29–31	Mifflin, 1968
36	658210	4162930	115°12'28"	37°36'06"	Hiko Spring	14/4S/60E	>1,186	27	Mifflin, 1968
37	656261	4154380	115°13'54"	37°31'30"	Crystal Spring	10/5S/60E	>1,170	28	Mifflin, 1968
38	657840	4150120	115°12'53"	37°29'11"	Brownie Spring	26/5S/60E	>1,128	Warm	Mifflin, 1968
39	659136	4147900	115°12'02"	37°27'58"	Ash Spring	36/5S/60E	>1,100	32	Mifflin, 1968
40	583741	4347660	116°01'45"	39°16'34"	Fish Creek Springs	8/16N/53E	>1,838	19	Mifflin, 1968
41	634921	4347110	115°26'10"	39°15'53"	Illipah Spring	10/16N/58E	<2,304	Cool	Mifflin, 1968
42	624153	4330740	115°33'50"	39°07'08"	Green Springs	33/15N/57E	>1,853	17	Mifflin, 1968
43	618260	4326490	115°37'58"	39°04'53"	Big Bull Spring	14/14N/56E	>1,768	12	Mifflin, 1968
44	619065	4322490	115°37'27"	39°02'43"	Bull Creek Spring	25/14N/56E	>1,768	12	Mifflin, 1968
45	665895	4308540	115°05'12"	38°54'43"	Preston Big Spring	2/12N/61E	>1,737	21	Mifflin, 1968
46	667394	4308290	115°04'10"	38°54'34"	Cold Spring	12/12N/61E	>1,737	21	Mifflin, 1968
47	667394	4308290	115°04'10"	38°54'34"	Nicholas Spring	12/12N/61E	>1,737	22	Mifflin, 1968
48	667394	4308290	115°04'10"	38°54'34"	Arnoldson Spring	12/12N/61E	>1,737	22	Mifflin, 1968
49	639821	4308770	115°23'14"	38°55'07"	Currant Spring	18/12N/59E	<2,347	8	Mifflin, 1968
50	667982	4278170	115°04'12"	38°38'17"	West Immigrant Spring	13/9N/61E	>1,631	19	Mifflin, 1968
51	677583	4300990	114°57'14"	38°50'30"	Lund Spring	1/11N/62E	>1,707	12–13	Mifflin, 1968
52	673669	4291340	115°00'05"	38°45'20"	Six Mile Springs	4/10N/62E	>1,722	16	Mifflin, 1968
53	680459	4318700	114°54'58"	39°00'02"	Water Canyon Springs	8/13N/63E	<2,341	9	Mifflin, 1968
54	684612	4322250	114°52'02"	39°01'54"	Willow Creek Basin Springs	35/14N/63E	<2,195	13	Mifflin, 1968
55	680647	4345010	114°54'25"	39°14'15"	Murry Springs	20/16N/63E	>2,024	13	Mifflin, 1968
56	692583	4369670	114°45'42"	39°27'25"	McGill Spring	3/18N/64E	>2,024	24–29	Mifflin, 1968; Garside and Schilling, 1979
57	702659	4339010	114°39'14"	39°10'43"	Cave Springs	10/15N/65E	<2,316	Cool	Mifflin, 1968
58	711455	4336990	114°33'10"	39°09'30"	Bastian Spring	21/15N/66E	<2,024	12	Mifflin, 1968
59	725331	4353980	114°23'12"	39°18'28"	South Mulick Spring	25/17N/67E	>1,707	13	Mifflin, 1968

Table A1-5. Reference points for regional potential from springs for Nevada.—Continued

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Map ID no. (plate 1)	UTM Easting (meters)	UTM Northing (meters)	Longitude	Latitude	Spring name	PLSS location	Regional potential altitude (meters)	Temperature (degrees Celsius)	Reference
60	741145	4321520	114°12'54"	39°00'41"	Rowland Spring	10/13N/69E	<1,920	9	Mifflin, 1968
61	751093	4309330	114°06'17"	38°53'56"	Spring Creek Spring	15/12N/70E	<1,865	12–13	Mifflin, 1968
62	725558	4302460	114°24'04"	38°50'38"	Shoshone Springs	1/11N/67E	>1,768	12	Mifflin, 1968
63	725609	4300700	114°24'04"	38°49'41"	Minerva Spring	12/11N/67E	>1,951	12	Mifflin, 1968
64	730357	4302590	114°20'45"	38°50'38"	Swallow Canyon Spring	4/11N/68E	>1,951	9	Mifflin, 1968
65	725807	4302220	114°23'54"	38°50'30"	Spring	5/11N/68E	>1,853	10	Mifflin, 1968
66	749805	4286610	114°07'40"	38°41'41"	Big Spring	33/10N/70E	>1,692	16	Mifflin, 1968
67	525068	4092700	116°43'06"	36°58'55"	Hick's Hot Spring	16/11S/47E	>1,097	38–43	Garside and Schilling, 1979
68	525068	4092700	116°43'06"	36°58'55"	Amargosa Hot Spring	16/11S/47E	>1,097	32–38	Garside and Schilling, 1979
69	524332	4090700	116°43'36"	36°57'50"	Burrell Hot Spring	21/11S/47E	>1,091	39	Garside and Schilling, 1979
70	522886	4085920	116°44'35"	36°55'15"	Beatty Municipal Spring	5/12S/47E	>1,045	24	Garside and Schilling, 1979
71	528769	4208430	116°40'20"	38°01'30"	Spring	14/2N/47E	<1,704	29	Garside and Schilling, 1979
72	553272	4204770	116°23'36"	37°59'27"	Pedro Spring	28/2N/50E	<1,963	25	Garside and Schilling, 1979
73	553272	4204770	116°23'36"	37°59'27"	Reveille Mill Spring	28/2N/50E	<1,963	29	Garside and Schilling, 1979
74	514800	4234750	116°49'51"	38°15'45"	Salisbury Spring	28/5N/46E	<1,993	24	Garside and Schilling, 1979
75	529690	4243080	116°39'37"	38°20'14"	Warm Spring	20/6N/47E	<1,899	26	Garside and Schilling, 1979
76	554357	4264540	116°22'35"	38°31'46"	Hot Creek Ranch Spring	29/8N/50E	>1,676	34–82	Garside and Schilling, 1979
87	457119	4186090	117°29'14"	37°49'23"	Pearl Hot Spring	25/1S/40E	>1,341	37	Garside and Schilling, 1979
88	469905	4185850	117°20'31"	37°49'17"	Alkali Spring	26/1S/41E	>1,524	49–60	Garside and Schilling, 1979
89	443759	4177200	117°38'18"	37°44'32"	Silver Peak Hot Springs	15/2S/39E	>1,326	21–48	Garside and Schilling, 1979
90	408438	4205630	118°02'34"	37°59'44"	Fish Spring	25/2N/35E	>1,463	24	Garside and Schilling, 1979
91	412682	4203300	117°59'39"	37°58'30"	Gap Spring	32/2N/36E	>1,413	23	Garside and Schilling, 1979
92	396615	4200500	118°10'36"	37°56'53"	Sand Spring	27/1N/34E	>1,676	23	Garside and Schilling, 1979
93	554709	4226870	116°22'31"	38°11'24"	Warm Spring	20/4N/50E	>1,695	63	Garside and Schilling, 1979

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