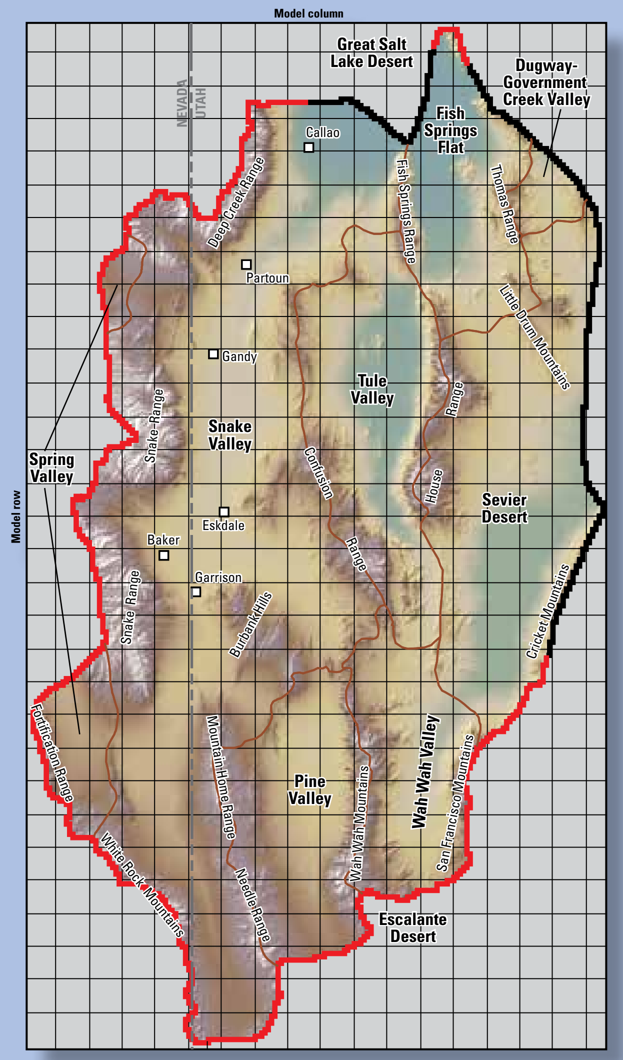
Prepared in cooperation with the U.S. Bureau of Land Management, the U.S. National Park Service, and the U.S. Fish and Wildlife Service

Potential Effects of Existing and Proposed Groundwater Withdrawals on Water Levels and Natural Groundwater Discharge in Snake Valley and Surrounding Areas, Utah and Nevada



Open-File Report 2017–1026

U.S. Department of the Interior
U.S. Geological Survey

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By Melissa D. Masbruch and Lynette E. Brooks

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U.S. Department of the Interior
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U.S. Department of the Interior
RYAN K. ZINKE, Secretary

U.S. Geological Survey
William H. Werkheiser, Acting Director

U.S. Geological Survey, Reston, Virginia: 2017

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U.S. customary units to International System of Units

Multiply	By	To obtain
	Length	
inch (in.)	25.4	millimeter (mm)
foot (ft)	0.3048	meter (m)
mile (mi)	1.609	kilometer (km)
	Area	
acre	4,047	square meter (m^2)
acre	0.004047	square kilometer (km^2)
square foot (ft^2)	0.09290	square meter (m^2)
square mile (mi^2)	2.590	square kilometer (km^2)
	Volume	
gallon (gal)	3.785	liter (L)
gallon (gal)	0.003785	cubic meter (m^3)
cubic foot (ft^3)	0.02832	cubic meter (m^3)
cubic mile (mi^3)	4.168	cubic kilometer (km^3)
acre-foot (acre-ft)	1,233	cubic meter (m^3)
	Flow rate	
acre-foot per day (acre-ft/d)	0.01427	cubic meter per second (m^3/s)
acre-foot per year (acre-ft/yr)	1,233	cubic meter per year (m^3/yr)
foot per second (ft/s)	0.3048	meter per second (m/s)
foot per day (ft/d)	0.3048	meter per day (m/d)
foot per year (ft/yr)	0.3048	meter per year (m/yr)
cubic foot per second (ft^3/s)	0.02832	cubic meter per second (m^3/s)
cubic foot per day (ft^3/d)	0.02832	cubic meter per day (m^3/d)
gallon per minute (gal/min)	0.06309	liter per second (L/s)
gallon per day (gal/d)	0.003785	cubic meter per day (m^3/d)
	Hydraulic conductivity	
foot per day (ft/d)	0.3048	meter per day (m/d)
	Transmissivity	
foot squared per day (ft^2/d)	0.09290	meter squared per day (m^2/d)

Temperature in degrees Celsius (°C) may be converted to degrees Fahrenheit (°F) as follows:

$$°F = (1.8 \times °C) + 32.$$

Temperature in degrees Fahrenheit (°F) may be converted to degrees Celsius (°C) as follows:

$$°C = (°F - 32) / 1.8.$$

Vertical coordinate information is referenced to the National Geodetic Vertical Datum of 1929 (NGVD 29).

Horizontal coordinate information is referenced to the North American Datum of 1983 (NAD 83).

Altitude, as used in this report, refers to distance above the vertical datum.

Transmissivity: The standard unit for transmissivity is cubic foot per day per square foot times foot of aquifer thickness ($[ft^3/d]/ft^2$)ft or cubic meters per day per square meters times meters of aquifer thickness ($[m^3/d]/m^2$)m. In this report, the mathematically reduced form, foot squared per day (ft^2/d) or meters squared per day (m^2/d), is used for convenience.

Abbreviations

ABNYD	approved but not yet developed
DOI	U.S. Department of Interior
HGU	hydrogeologic unit
SNWA	Southern Nevada Water Authority
USGS	U.S. Geological Survey

Potential Effects of Existing and Proposed Groundwater Withdrawals on Water Levels and Natural Groundwater Discharge in Snake Valley and Surrounding Areas, Utah and Nevada

By Melissa D. Masbruch and Lynette E. Brooks

Abstract

Several U.S. Department of Interior (DOI) agencies are concerned about the cumulative effects of groundwater development on groundwater resources managed by, and other groundwater resources of interest to, these agencies in Snake Valley and surrounding areas. The new water uses that potentially concern the DOI agencies include 12 water-right applications filed in 2005, totaling approximately 8,864 acre-feet per year. To date, only one of these applications has been approved and partially developed. In addition, the DOI agencies are interested in the potential effects of three new water-right applications (UT 18-756, UT 18-758, and UT 18-759) and one water-right change application (UT a40687), which were the subject of a water-right hearing on April 19, 2016.

This report presents a hydrogeologic analysis of areas in and around Snake Valley to assess potential effects of existing and future groundwater development on groundwater resources, specifically groundwater discharge sites, of interest to the DOI agencies. A previously developed steady-state numerical groundwater-flow model was modified to transient conditions with respect to well withdrawals and used to quantify drawdown and capture (withdrawals that result in depletion) of natural discharge from existing and proposed groundwater withdrawals. The original steady-state model simulates and was calibrated to 2009 conditions. To investigate the potential effects of existing and proposed groundwater withdrawals on the groundwater resources of interest to the DOI agencies, 10 withdrawal scenarios were simulated. All scenarios were simulated for periods of 5, 10, 15, 30, 55, and 105 years from the start of 2010; additionally, all scenarios were simulated to a new steady state to determine the ultimate long-term effects of the withdrawals. Capture maps were also constructed as part of this analysis. The simulations used to develop the capture maps test the response of the system, specifically the reduction of natural discharge, to future stresses at a point in the area represented by the model. In this way, these maps can be used as a tool to determine the source of water to, and potential effects at specific areas from, future well withdrawals.

Downward trends in water levels measured in wells indicate that existing groundwater withdrawals in Snake Valley are affecting water levels. The numerical model simulates similar downward trends in water levels; simulated drawdowns in the model, however, are generally less than observed water-level declines. At the groundwater discharge sites of interest to the DOI agencies, simulated drawdowns from existing well withdrawals (projected into the future) range from 0 to about 50 feet. Following the addition of the proposed withdrawals, simulated drawdowns at some sites increase by 25 feet. Simulated drawdown resulting from the proposed withdrawals began in as few as 5 years after 2014 at several of the sites. At the groundwater discharge sites of interest to the DOI agencies, simulated capture of natural discharge resulting from the existing withdrawals ranged from 0 to 87 percent. Following the addition of the proposed withdrawals, simulated capture at several of the sites reached 100 percent, indicating that groundwater discharge at that site would cease. Simulated capture following the addition of the proposed withdrawals increased in as few as 5 years after 2014 at several of the sites.

Introduction

Snake Valley is a sparsely populated basin along the Utah–Nevada border in the eastern part of the Great Basin Physiographic Province (Fenneman, 1931). Several U.S. Department of Interior (DOI) agencies, namely the U.S. Bureau of Land Management, National Park Service, and the Fish and Wildlife Service, are concerned about the cumulative effects of groundwater development on groundwater resources managed by, and other groundwater resources of interest to, these agencies in Snake Valley and surrounding areas (fig. 1). The groundwater resources of concern to the DOI agencies, or more specifically groundwater discharge sites, include springs and spring complexes, wells, and mountain streams that support multiple uses, including habitat for threatened and endangered species, water and habitat for other wildlife species, recreation use, livestock use, and use by wild horses and burros. The U.S. Geological Survey (USGS) has simulated the potential effects

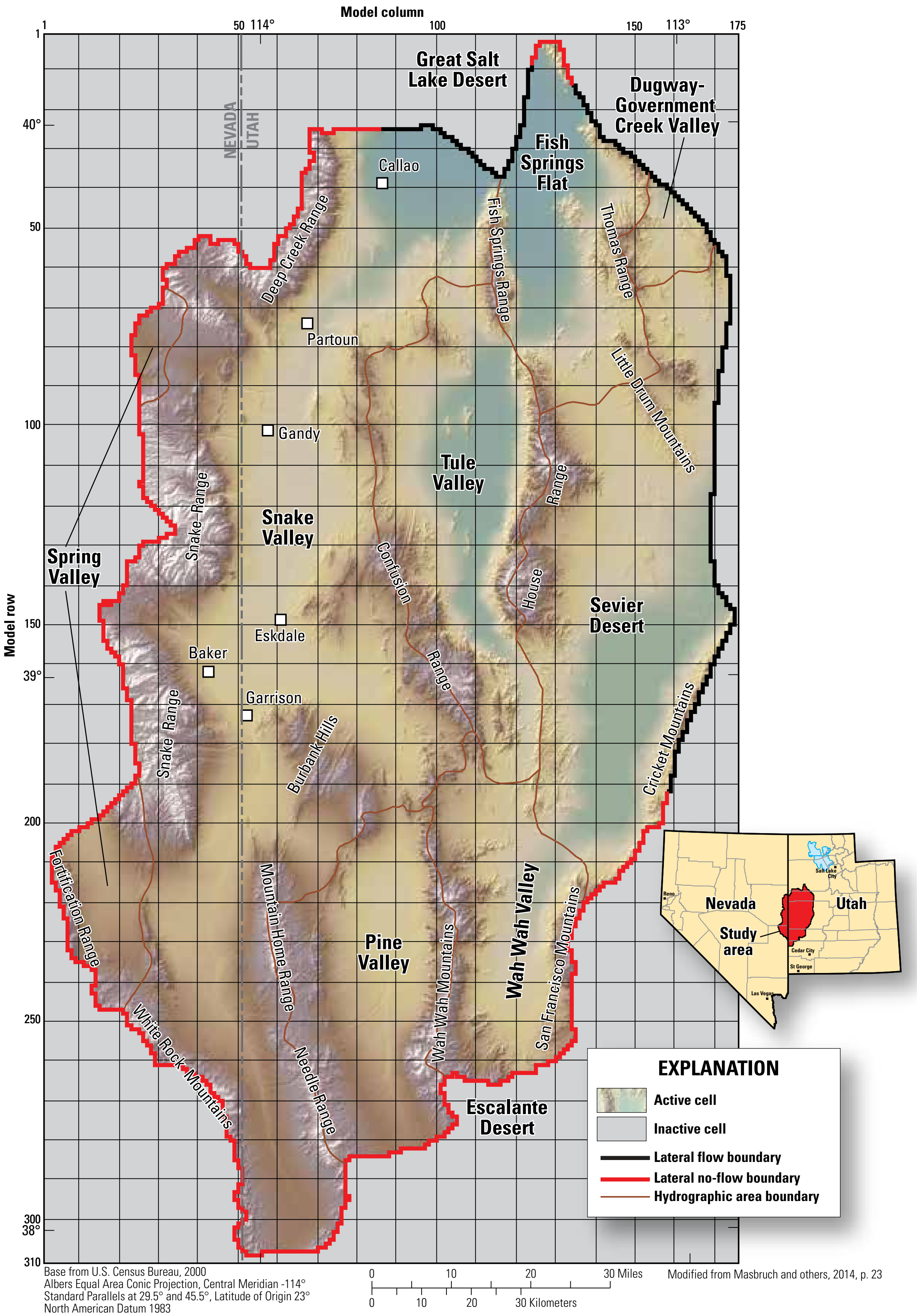

Figure 1. Study area and model grid used in the Snake Valley area groundwater model, Utah and Nevada.

from existing water rights and the other new water-right and change applications on the groundwater discharge sites of interest to the DOI agencies (fig. 2 and table 1).

The new water uses of potential concern to the DOI agencies include 12 applications filed in 2005 (referred to as the "2005 applications"), totaling approximately 8,864 acre-feet per year (acre-ft/yr). To date, only one of these applications has been approved and partially developed (UT 18-690, approved for 544 acre-ft/yr in 2012). The owner of these water rights may start to sell or lease other properties associated with the 2005 applications, and may ask the Utah Division of Water Rights to take action on those pending applications. In addition, the DOI agencies are interested in the potential effects of three new water-right applications (UT 18-756, UT 18-758, and UT 18-759) and one water-right change application (UT a40687), which were the subject of a water-right hearing on April 19, 2016.

Purpose and Scope

This report presents a hydrogeologic analysis of areas in and around Snake Valley to assess potential effects from existing and future groundwater development on groundwater resources of interest to the DOI agencies. A previously developed steady-state numerical groundwater-flow model (Masbruch and others, 2014) was modified to transient conditions with respect to well withdrawals and used to quantify drawdown and capture (withdrawals that result in depletion) of natural discharge from existing and proposed groundwater withdrawals. Limitations in time and funding precluded the collection of additional data or recalibration of the model to transient conditions. This assessment provides a general understanding of the relative susceptibility of the groundwater resources of interest to the DOI agencies to existing and future groundwater development in the study area.

General Description of the Study Area

The study area (fig. 1), which covers approximately 8,100 square miles, is part of the Great Basin carbonate and alluvial aquifer system (GBCAAS), which comprises aquifers and confining units in unconsolidated basin-fill and volcanic deposits, carbonate, and other bedrock units (Heilweil and others, 2011). In some areas of the GBCAAS, aquifers are hydraulically connected between basins. In other areas, interbasin groundwater flow is impeded by mountain ranges that consist of less permeable rock. The basins in this study area approximately coincide with the southern half of the Great Salt Lake Desert regional groundwater flow system, as defined by Harrill and others (1988). These basins are divided on the basis of hydrographic area (HA) boundaries (Harrill and others, 1988), which generally coincide with topographic basin divides. The study area consists of three partial HAs—Spring Valley, Dugway-Government Creek Valley, and Sevier Desert —and five complete HAs—Snake Valley, Fish Springs Flat, Tule Valley, Pine Valley, and Wah Wah Valley (fig. 1).

The study area is characterized by north-south trending mountain ranges and basins that range in altitude from over 12,900 feet (ft) in the highest peaks of the Snake Range to less than 4,500 ft in the basin floors at the southern end of the Great Salt Lake Desert (fig. 1). Climatic conditions range from temperate in the high-altitude Snake and Deep Creek Ranges to semiarid and arid across much of the rest of the study area. Annual precipitation varies from about 5.9 inches (in.) in the low altitudes of northernmost Snake Valley to about 29.9 in. in the highest altitudes of the Snake and Deep Creek Ranges, based on 30-year average PRISM (Parameter-Elevation Regressions on Independent Slopes Model) precipitation data (Daly and others, 1994, 2008). The majority of precipitation falls during the winter months, often as snow that accumulates in the mountains. Most groundwater in the valleys in the study area is derived from snowmelt and rainfall above altitudes of 5,900 ft, where precipitation generally exceeds water losses from evapotranspiration (Hood and Rush, 1965).

The local economy is dominated by irrigated agriculture and ranching. Few perennial streams flow into the basins, and those that do are fully appropriated. Total annual withdrawal of groundwater on the Utah side of Snake Valley was approximately 20,300 acre-ft/yr in 2013 and 23,100 acre-ft/yr in 2014 (Burden and others, 2015), nearly all of which was used for irrigation. Existing groundwater withdrawals have affected water levels in Snake Valley. For example, several wells monitored by the USGS have shown water-level declines of 6 to 20 ft near the Eskdale area since the mid-1970s and 1980s.

In recent years, groundwater withdrawals for irrigation in the unconsolidated basin fill have increased, especially in the southern part of Snake Valley. The source of water for these withdrawals is partially from groundwater in storage, but is also from the capture of natural discharge. One example of this is Needle Point Springs in southern Snake Valley, which was a watering source for stock and wild horses; however, groundwater levels in the vicinity of the spring, have declined and the spring is no longer flowing (Paul Summers, Bureau of Land Management, written commun., March 2013). Increasing groundwater withdrawals in Snake Valley will further affect the groundwater system by removing more groundwater from storage, decreasing groundwater levels, and decreasing natural discharge to springs and evapotranspiration in the basin.

The Southern Nevada Water Authority (SNWA) has proposed developing unappropriated groundwater resources in Snake Valley and surrounding basins in eastern Nevada to supply water to the growing urban population of Las Vegas, Nevada. The SNWA proposes to pump groundwater from five valleys in eastern Nevada by using a network of 144 to 174 wells, up to 430 miles (mi) of collector pipelines, and approximately 300 mi of main and lateral pipeline to deliver water to Las Vegas, which is more than 250 mi south of Baker, Nevada (Southern Nevada Water Authority, 2011). The SNWA has proposed developing up to 185,000 acre-ft/yr of its existing water rights and applications in Spring, Snake, Cave, Dry Lake, and Delamar Valleys of eastern Nevada.

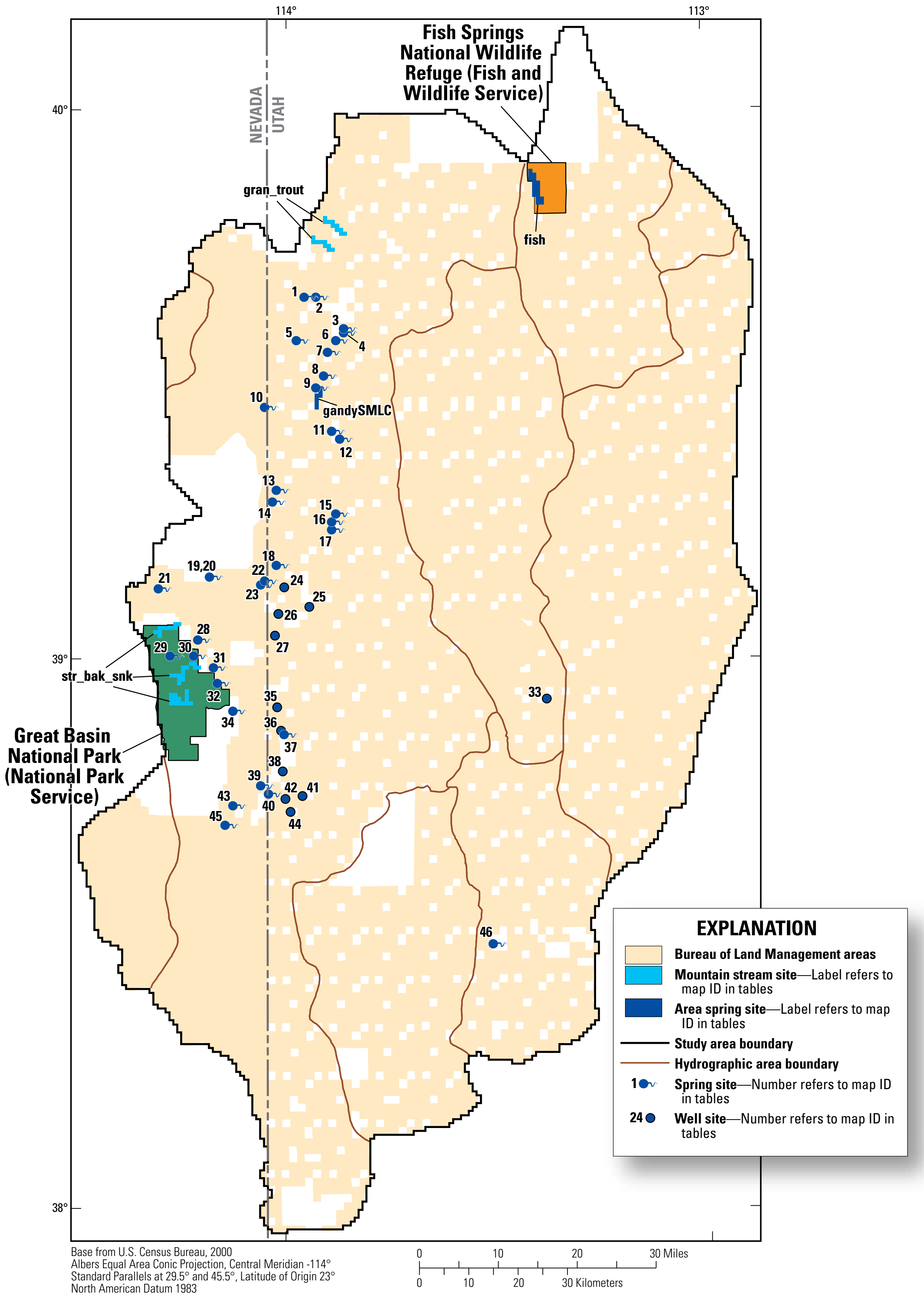

Figure 2. Groundwater discharge sites of interest to the Department of Interior agencies, and land-management areas of the Department of Interior agencies, Snake Valley and surrounding areas, Utah and Nevada.

Table 1. Summary of groundwater discharge sites of interest to the Department of Interior agencies, Snake Valley and surrounding areas, Utah and Nevada.

[Figure 2 shows the location of the sites. Water-right number: Water-right numbers are preceded by state abbreviation. Latitude and longitude are referenced to the North American Datum of 1983. **Abbreviations:** ID, identification; USGS, U.S. Geological Survey; NV, Nevada; UT, Utah; N/A, not applicable]

Map ID	Site name	Water-right number	Latitude (decimal degrees)	Longitude (decimal degrees)	USGS site number
1	South Seeps	UT 18-597	39.664	-113.941	393949113562301
2	Lime Spring	UT 18-594	39.664	-113.917	393949113550001
3	Snake Valley North Spring Complex	UT 18-701	39.603	-113.850	N/A
4	Snake Valley South Spring Complex	UT 18-702	39.596	-113.853	N/A
5	Coyote Spring	UT 18-596	39.584	-113.958	393501113572701
6	Miller Spring [1]	UT 18-253	39.580	-113.864	393449113515201
7	Leland Harris Spring Complex	unknown	39.559	-113.892	N/A
8	Gandy Salt Marsh Seep	UT 18-579	39.515	-113.893	N/A
9	Springs feeding Gandy Salt Marsh Lake	UT 18-537	39.498	-113.914	392952113544801
gandySMLC	Gandy Salt Marsh Lake Spring Complex	UT 18-575	N/A	N/A	N/A
10	Gandy Warm Springs [1]	UT 18-584, 18-585, 18-623	39.460	-114.038	392737114021201
11	Foote Reservoir Spring [1]	UT 18-711, 18-255	39.415	-11.875	392455113522601
12	Twin Springs [1]	UT 18-476, 18-486	39.404	-113.864	392413113515001/ 392411113514301
13	Briggs Spring	UT 18-604	39.309	-114.010	N/A
14	Phil Spring	UT 18-742	39.289	-114.017	N/A
15	North Knoll Spring	UT 18-535	39.266	-113.866	391557113515601
16	Middle Knoll Spring	UT 18-491	39.249	-113.879	391457113524101
17	Knoll Spring	UT 18-84	39.241	-113.879	391426113524401
18	Unnamed Spring 1	unknown	39.176	-114.009	N/A
19	Unnamed Spring 2	unknown	39.151	-114.166	N/A
20	Unnamed Spring 3	unknown	39.150	-114.167	N/A
21	Want Spring	NV R05275	39.127	-114.289	N/A
22	Kane Spring	UT 18-406	39.143	-114.036	N/A
23	Caine Spring	unknown	39.138	-114.049	390818114025501
24	Eskdale Well	UT 18-304	39.133	-114.002	390758114000701
25	West Buckskin Well	UT 18-555	39.097	-113.942	390549113562901
26	Flowing Well 2	UT 18-719	39.084	-114.016	390503114005901
27	Shell Baker Creek Well	UT 18-168	39.045	-114.024	390243114012201
28	Unnamed Spring 4	unknown	39.040	-114.197	N/A
29	Upper Lehman Spring [1,2]	unknown	39.012	-114.259	390042114152601
30	Rowland Springs [1]	NV V10164	39.009	-114.208	10243265
31	Kious Spring	unknown	38.985	-114.160	385911114093101
32	Mahogany Spring	unknown	38.959	-114.152	N/A
33	Ibex Well	UT 18-356	38.928	-113.377	385542113223601
34	Spring Creek Spring [1]	unknown	38.909	-114.113	385433114063901
35	Diversion from Lake Creek 1	UT 18-620	38.913	-114.022	N/A
36	Diversion from Lake Creek 2	UT 18-621	38.875	-114.006	N/A
37	Clay Spring [1]	unknown	38.866	-113.993	385156113593701
38	Davies Well 1	UT 18-497	38.798	-114.006	N/A
39	Dearden Spring Group [1]	UT 18-684	38.773	-114.046	384621114024601
40	Needle Point Spring	UT 18-571	38.756	-114.030	N/A
41	Davies Well 2	UT 18-203	38.753	-113.958	384510113573001

Table 1. Summary of groundwater discharge sites of interest to the Department of Interior agencies, Snake Valley and surrounding areas, Utah and Nevada.—Continued

[Figure 2 shows the location of the sites. Water-right number: Water-right numbers are preceded by state abbreviation. Latitude and longitude are referenced to the North American Datum of 1983. **Abbreviations:** ID, identification; USGS, U.S. Geological Survey; NV, Nevada; UT, Utah; N/A, not applicable]

Map ID	Site name	Water-right number	Latitude (decimal degrees)	Longitude (decimal degrees)	USGS site number
42	Needle Point Well	UT 18-678	38.747	-113.998	384449113595401
43	Unnamed Spring 5	NV R05271	38.734	-114.116	N/A
44	Cove Well	UT 18-673	38.724	-113.987	384327113591401
45	Big Springs [1]	unknown	38.699	-114.132	384158114075201
46	Wah Wah Springs [1]	UT 69-1, 69-107, 69-108, 69-19, 69-33	38.484	-113.498	382901113295101
fish	Fish Springs [1]	UT 18-215, 18-66, 18-51	N/A	N/A	N/A
gran_trout	Granite and Trout Creeks [1]	unknown	N/A	N/A	N/A
str_bak_snk	Strawberry Creek [1]	unknown	N/A	N/A	N/A
	Baker Creek [1]	NV V01066	N/A	N/A	N/A
	Snake Creek [1]	UT 18-11, 18-12, 18-249, 18-250, 18-251, 18-257; NV C3863	N/A	N/A	N/A

[1] Spring discharge or groundwater discharge to streams explicitly simulated in model.

[2] Spring name used in Masbruch and others (2014) was "Unnamed Spring."

Hydrogeology

The groundwater system in the study area consists of water in unconsolidated deposits in the basins and in consolidated rock underlying the basins and in the adjacent mountain blocks. The consolidated rock and basin-fill aquifers are well connected hydraulically (Gardner and others, 2011; Sweetkind and others, 2011b), with most of the recharge occurring in the consolidated rock mountain blocks and most of the discharge occurring from the lower altitude basin-fill deposits.

Hydrogeologic Units and Hydraulic Properties

A three-dimensional hydrogeologic framework developed for the eastern Great Basin (Cederberg and others, 2011; Sweetkind and others, 2011a) was used to define hydrogeologic units (HGUs) in the model used for the current study. An HGU has considerable lateral extent and reasonably distinct physical characteristics that can be used to infer the capacity of a sediment or rock to transmit water. Of the nine HGUs defined in the hydrogeologic framework developed for the eastern Great Basin (Sweetkind and others, 2011a), seven are in the current study area. These seven HGUs include (1) a non-carbonate confining unit representing low- to moderate-permeability, Precambrian-age, siliciclastic formations as well as intrusive igneous rocks that are locally exposed in mountain ranges and underlie parts of the study area; (2) a lower carbonate aquifer unit representing a thick succession of predominantly high- to moderate-permeability, Cambrian through Devonian-age carbonate rocks that are locally exposed in the mountain ranges and present beneath most of the valleys in the study area; (3) an upper siliciclastic confining unit representing low-permeability, Mississippian-age siliciclastic rocks, predominantly shales, that are limited in extent in the study area; (4) an upper carbonate aquifer unit representing a thick succession of low- to high-permeability, Pennsylvanian- and Permian-age carbonate rocks that are locally exposed in the mountain ranges and exist beneath some of the valleys in the study area; (5) a volcanic unit representing large volumes of low- to high-permeability, Cenozoic-age volcanic rocks that are locally exposed in the mountain ranges and exist beneath some of the valleys in the study area; (6) a lower basin-fill aquifer unit representing the lower (deepest) one-third of the Cenozoic-age basin-fill sediments, including moderate- to high-permeability volcanic rocks buried in the basin fill and consolidated older basin-fill sediments; and (7) an upper basin-fill aquifer unit representing the upper (shallowest) two-thirds of the Cenozoic-age basin-fill sediments, including a wide variety of low- to moderate-permeability basin-fill sediments (Sweetkind and others, 2011a). Each of these HGUs are stratigraphically and structurally heterogeneous, and all but the upper siliciclastic confining unit were further divided into a number of zones based on depositional and structural characteristics; these zones are defined in Sweetkind and others (2011a). For more complete information regarding the simulated extent, thickness, and location of these HGUs simulated in the model, refer to Masbruch and others (2014, p. 35–42).

The USGS Nevada Water Science Center has done eight aquifer tests in Snake and Spring Valleys (Halford and Plume, 2011, table 1). These included single and multiple pumping well tests in the basin-fill and carbonate aquifers and were analyzed by a variety of methods, including Cooper-Jacob analyses and three-dimensional numerical simulations. Estimates of the transmissivity of the basin-fill aquifers were between 1,200 and 13,000 square feet per day (ft^2/d), and estimates of the transmissivity of the carbonate aquifers were between 7,000 and 55,000 ft^2/d.

Occurrence and Movement of Groundwater

Groundwater is recharged mostly from the infiltration of precipitation at higher altitudes (Welch and others, 2007; San Juan and others, 2010; Masbruch and others, 2011). Much of this recharge is from snowmelt. Additional, but limited, recharge comes from the infiltration of runoff from precipitation near the mountain front and from infiltration along stream channels (Hevesi and others, 2003; Flint and Flint, 2007a, b; Flint and others, 2011; Masbruch and others, 2011). There also could be recharge (return flow) from applied irrigation. Groundwater moves from areas of recharge to springs and streams in the mountains and to evapotranspiration areas, springs, and wells in the basin.

Gardner and others (2011) published a potentiometric map of Snake Valley and surrounding areas. This map presents contours based on water levels measured during the spring of 2010 from 190 wells completed in consolidated rock and unconsolidated basin fill. Evaluation of vertical and horizontal hydraulic gradients in the study area indicated that (1) aquifers in the consolidated rock and unconsolidated basin fill are generally well connected hydraulically and often act as a single aquifer unit; (2) a groundwater divide exists in southern Spring Valley, where groundwater moving from the mountainous recharge areas on both sides of the valley diverges toward the north and south; (3) groundwater flow in Snake Valley is primarily north-northeastward, and eastward interbasin flow out of Snake Valley could be restricted by steeply dipping, northeast trending, siliciclastic rocks extending from the Mountain Home Range as far north as the Confusion Range; (4) groundwater flow is generally northward through Pine and Wah Wah Valleys and westward through Sevier Desert toward Tule Valley, where a nearly flat hydraulic gradient exists for more than 49 mi from south to north, although more recent water-level data from Pine Valley indicates that groundwater in Pine Valley could follow a more easterly direction (Philip Gardner, U.S. Geological Survey, oral commun., March 2012); and (5) there is some groundwater flow out of the study area toward the Great Salt Lake Desert to the north and west from Snake Valley and Fish Springs Flat.

Water-Level and Discharge Fluctuations

Groundwater levels fluctuate in response to varying stresses, which are driven both by natural and anthropogenic processes. Gardner and others (2011) presented multiple-year water-level hydrographs for 32 wells completed in the basin fill in Snake Valley and the surrounding valleys, which show that patterns of water-level fluctuation are distinctly different across the study area.

In the eastern half of the study area, including Tule Valley, Pine Valley, Wah Wah Valley, Fish Springs Flat, and Sevier Desert, water-level fluctuations are minimal, varying by less than about 2 ft over the period of record. These steady water levels are likely due to a combination of low recharge rates in the nearby mountains and negligible groundwater pumping in these valleys.

Conversely, water levels in wells in the western part of the study area, namely Spring Valley and Snake Valley, fluctuate more notably. Many of the wells in these valleys are close to high-altitude, mountainous areas that receive substantial winter precipitation and groundwater recharge. Water levels in these wells clearly respond to annual recharge or to multiple-year periods of above- or below-average precipitation. Wells close to the Snake and Deep Creek Ranges show water-level fluctuations of 10 to 20 ft over periods of only a few years.

Water levels in several wells near agricultural pumping centers appear to be influenced by groundwater withdrawals. Water levels in these areas rose in response to a period of above-average precipitation during the mid-1980s (Wilkowske and others, 2003), and most reached a maximum around the late 1980s to early 1990s. Since that time, water levels in these areas have fallen steadily and show little to no recovery during subsequent periods of above-average precipitation (for example, 1996–98 and 2004–05). These declines are most likely caused by groundwater withdrawals used for irrigation.

Potential Effects of Groundwater Withdrawals

A previously developed three-dimensional numerical groundwater-flow model for Snake Valley and surrounding areas (Masbruch and others, 2014) was used to investigate where potential drawdown and capture of natural discharge is likely to result from existing and proposed groundwater withdrawals. Figure 1 shows the location of the model grid. The original Snake Valley area model was constructed using MODFLOW-2000 as a confined, steady-state model. It is divided into 310 rows, 175 columns, and 7 layers, with a constant grid spacing of 0.5 mi. Finite-difference methods require that the model grid be constructed for the bounding rectangle of the model domain (fig. 1). The boundary of active cells delineates the lateral boundaries of the simulated groundwater system. Groundwater recharge from precipitation and recharge from unconsumed irrigation from well withdrawals were simulated across the top of the model. Recharge from subsurface inflow was simulated across a part of the eastern lateral boundary of the model (fig. 1). Groundwater discharge was simulated to springs, mountain streams, evapotranspiration (ETg), and as subsurface outflow across a part of the northern boundary of the model (fig. 1) using head-dependent boundary packages. Discharge was also simulated using estimated well withdrawals from 2009. Observations of groundwater-level altitudes, groundwater discharge, and groundwater temperatures were used to calibrate the model. For full details of the model construction and calibration of the original Snake Valley area model, refer to Masbruch and others (2014).

To simulate groundwater withdrawals proposed by the new water-right applications and to allow for analysis of the potential effects of these proposed withdrawals on the groundwater discharge sites of interest to the DOI agencies, the Snake Valley area model was modified by changing the model from steady-state to transient conditions with respect to well withdrawals. No other groundwater budget components or hydraulic properties were allowed to vary with time. The original steady-state model simulated and was calibrated to 2009 conditions (specifically well withdrawals and water levels). This was used as the first stress period in the modified transient model. Six transient stress periods, spanning 2010–2114, were added to the model to simulate the timing of the potential withdrawal effects. A seventh steady-state stress period was also added to determine the ultimate long-term effects of the well withdrawals. Several MODFLOW input packages and processes were updated, and the modifications are summarized here.

- Discretization Package: Changed the number of stress periods from 1 to 8, and defined length of new stress periods.
- Drain, Evapotranspiration, General-Head Boundary, Horizontal-Flow Barrier, Recharge, and River Packages: Added seven repetitions of parameter information from stress period 1 for stress periods 2–8.
- Hydrogeologic-Unit Flow Package: Added storage properties based on values reported in Halford and Plume (2011). These were 2.0×10^{-6} for specific storage, 0.15 for the specific yield of the basin-fill units in layer 1, and 0.02 for the specific yield of the carbonate-rock units in layer 1.
- Zone Package: Added zones for storage properties.
- Well Package: Added withdrawals from existing wells not previously modeled and proposed wells for new water rights under four new parameters. This file is unique for each simulation scenario (see the "Description of Simulated Scenarios and Results" section for amounts and locations of well withdrawals used for each scenario).
- Sensitivity Process: Updated to include new storage and well parameters.

Description of Simulated Scenarios and Results

To investigate the potential effects of the proposed groundwater withdrawals from the 2005 applications, five withdrawal scenarios (scenarios 1–5) were run. Five additional withdrawal scenarios (scenarios 3a–3e) were run to investigate the potential effects of the three new water-right applications (UT 18-756, UT 18-758, UT 18-759) and one change application (UT a40687) that were the subject of a water-rights hearing on April 19, 2016. All scenarios were run to 5, 10, 15, 30, 55, and 105 years from the start of 2010; additionally, all scenarios were run to a new steady state to determine the ultimate long-term effects of the withdrawals.

Because of a lack of long-term discharge data, several of the springs of interest to the DOI agencies are not explicitly simulated in the model. The model does, however, simulate natural groundwater discharge as evapotranspiration in the model cells containing these springs. Assuming that some part of this natural discharge is related to spring flow, the amount of discharge captured from these cells is likely to affect spring flow. Because the spring orifice could be discharging only a portion of the total groundwater discharge from the model cell, however, the percentage of simulated natural groundwater capture cannot be directly equated to a percentage of reduction in spring flow. Additionally, the model could show that well withdrawals continue to capture groundwater discharge from the model cell even when the hydraulic gradient and groundwater levels decline to the point where spring flow through the orifice ceases. The model would continue to simulate capture of transpiration from phreatophytes up to the extinction depth of about 40 ft simulated in the model; this depth could extend much deeper in the subsurface than the spring orifice. Because the amount of natural discharge simulated in the cell cannot be divided into spring flow and ETg, capture of natural discharge at the cells containing these springs was calculated as a percentage of the total ETg simulated at these cells.

Scenario 1

Scenario 1 simulates the effects of historical (2009–2014) and current (2015) existing groundwater withdrawals on the groundwater system to represent baseline conditions. Locations and amounts of simulated withdrawals used in scenario 1 are summarized in table 2 and figure 3. During calibration of the original Snake Valley model (Masbruch and others, 2014), model observations were highly sensitive to a parameter that represented a multiplier on the well withdrawal rates. A value of 1.3 for this parameter was determined by regression and was deemed reasonable, given that uncertainties for the well withdrawal estimates can be as much as 50 percent (Michael Enright, U.S. Geological Survey, oral commun., August 2010). This 1.3 multiplier was applied to all historical and existing groundwater withdrawals that were estimated (denoted in red in table 2). This multiplier was not applied to withdrawal amounts that were determined from water-right application amounts.

Simulated drawdowns range from 0 to 49 ft (table 3) at the groundwater discharge sites of interest to the DOI agencies. At some sites, especially in the southern part of the study area, simulated water levels increase for some or all stress periods because simulated groundwater withdrawals near the site decrease after 2010 or 2015 and/or were relocated farther from the site after 2010 or 2015. The largest simulated drawdowns

Table 2. Withdrawal amounts used to simulate historic and current, existing groundwater withdrawals (scenarios 1–5) in the Snake Valley area groundwater model.

[Figure 3 shows the location of the sites. Water-right number: Water-right numbers are preceded by state abbreviation. Values in red indicate withdrawal estimates that were multiplied by 1.3 to calculate simulated withdrawals. **Abbreviations:** USGS, U.S. Geological Survey; acre-ft/yr, acre-feet per year; NVDWR, Nevada Division of Water Resources; UTDWR, Utah Division of Water Rights; UT, Utah; NV, Nevada; —, no data; NS, not simulated]

Agency	Water-right number	Estimated withdrawals or water-right application amount (acre-ft/yr)			Simulated wtihdrawals (acre-ft/yr)		
		2009	2010–2014	2015–2114	2009	2010–2014	2015 and later
USGS	—	100	22	22	130	29	29
USGS	—	588	450	450	764	585	585
USGS	—	943	1,146	1,146	1,226	1,490	1,490
USGS	—	196	123	123	255	160	160
USGS	—	342	358	358	445	465	465
USGS	—	421	413	413	547	537	537
USGS	—	233	199	199	303	259	259
USGS	—	650	673	673	845	875	875
USGS	—	269	263	263	350	342	342
USGS	—	71	102	102	92	133	133
USGS	—	756	666	666	983	866	866
USGS	—	422	382	382	549	497	497
USGS	—	270	286	286	351	372	372
USGS	—	433	499	499	563	649	649
USGS	—	147	113	113	191	147	147
USGS	—	277	261	261	360	339	339
USGS	—	336	304	304	437	395	395
USGS	—	248	283	283	322	368	368
USGS	—	502	348	348	653	452	452
USGS	—	220	0	0	286	0	0
USGS	—	391	668	668	508	868	868
USGS	—	260	263	263	338	342	342
USGS	—	455	565	565	592	735	735
USGS	—	85	118	118	111	153	153
USGS	—	85	60	60	111	78	78
USGS	—	267	236	236	347	307	307
USGS	—	171	131	131	222	170	170
USGS	—	241	209	209	313	272	272
USGS	—	173	142	142	225	185	185
USGS	—	160	179	179	208	233	233
USGS	—	75	286	286	98	372	372
USGS	—	370	323	323	481	420	420
USGS	—	167	288	288	217	374	374
USGS	—	211	132	132	274	172	172
USGS	—	188	130	130	244	169	169
USGS	—	359	377	377	467	490	490
USGS	—	330	189	189	429	246	246
USGS	—	62	83	83	81	108	108

Table 2. Withdrawal amounts used to simulate historic and current, existing groundwater withdrawals (scenarios 1–5) in the Snake Valley area groundwater model.—Continued

[Figure 3 shows the location of the sites. Water-right number: Water-right numbers are preceded by state abbreviation. Values in red indicate withdrawal estimates that were multiplied by 1.3 to calculate simulated withdrawals. **Abbreviations:** USGS, U.S. Geological Survey; acre-ft/yr, acre-feet per year; NVDWR, Nevada Division of Water Resources; UTDWR, Utah Division of Water Rights; UT, Utah; NV, Nevada; —, no data; NS, not simulated]

Agency	Water-right number	Estimated withdrawals or water-right application amount (acre-ft/yr)			Simulated wtihdrawals (acre-ft/yr)		
		2009	2010–2014	2015–2114	2009	2010–2014	2015 and later
USGS	—	481	517	517	625	672	672
USGS	—	186	176	176	242	229	229
USGS	—	327	456	456	425	593	593
USGS	—	595	1,286	1,286	774	1,672	1,672
USGS	—	225	345	345	293	449	449
USGS	—	1,116	1,369	1,369	1,451	1,780	1,780
USGS	—	604	823	823	785	1,070	1,070
USGS	—	242	275	275	315	358	358
USGS	—	236	322	322	307	419	419
USGS	—	55	57	57	72	74	74
USGS	—	215	190	190	280	247	247
USGS	—	410	457	457	533	594	594
USGS	—	301	266	266	391	346	346
USGS	—	185	146	146	241	190	190
—	—	479	—	—	623	NS	NS
—	—	479	—	—	623	NS	NS
—	—	479	—	—	623	NS	NS
—	—	479	—	—	623	NS	NS
—	—	479	—	—	623	NS	NS
—	—	479	—	—	623	NS	NS
—	—	479	—	—	623	NS	NS
—	—	479	—	—	623	NS	NS
—	—	479	—	—	623	NS	NS
—	—	479	—	—	623	NS	NS
—	—	479	—	—	623	NS	NS
NVDWR	NV 109586	—	776	352	NS	1,009	458
USGS	—	—	657	—	NS	854	NS
USGS	—	—	332	480	NS	432	480
USGS	—	—	944	657	NS	1,227	657
USGS	—	—	1,345	—	NS	1,748	NS
USGS	—	—	142	24	NS	184	24
USGS	—	—	439	99	NS	571	99
USGS	—	—	330	662	NS	429	861
UTDWR	UT 18-724	—	10	10	NS	10	10
UTDWR	UT 18-734	—	4	5	NS	4	5
UTDWR	UT 18-733	—	406	406	NS	406	406
UTDWR	UT 18-732	—	4	5	NS	4	5
UTDWR	UT 18-720	—	114	114	NS	114	114

Table 2. Withdrawal amounts used to simulate historic and current existing groundwater withdrawals (scenarios 1–5) in the Snake Valley area groundwater model.—Continued

[Figure 3 shows the location of the sites. Water-right number: Water-right numbers are preceded by state abbreviation. Values in red indicate withdrawal estimates that were multiplied by 1.3 to calculate simulated withdrawals. **Abbreviations:** USGS, U.S. Geological Survey; acre-ft/yr, acre-feet per year; NVDWR, Nevada Division of Water Resources; UTDWR, Utah Division of Water Rights; UT, Utah; NV, Nevada; —, no data; NS, not simulated]

Agency	Water-right number	Estimated withdrawals or water-right application amount (acre-ft/yr)			Simulated wtihdrawals (acre-ft/yr)		
		2009	2010–2014	2015–2114	2009	2010–2014	2015 and later
UTDWR	UT 18-714	—	5	5	NS	5	5
UTDWR	UT 18-718	—	4	4	NS	4	4
UTDWR	UT 18-745	—	1	4	NS	1	4
UTDWR	UT 18-748	—	1	4	NS	1	4
UTDWR	UT 18-743	—	192	480	NS	192	480
UTDWR	UT 18-737	—	288	480	NS	288	480
UTDWR	UT 18-726	—	12	15	NS	12	15
UTDWR	UT 18-715	—	6	7	NS	6	7
UTDWR	UT 18-727	—	19	24	NS	19	24
USGS	—	—	—	263	NS	NS	263
NVDWR	NV 84150	—	—	141	NS	NS	141
NVDWR	NV 84151, 84162	—	—	390	NS	NS	390
NVDWR	NV 78804, 78805, 84149	—	—	285	NS	NS	285
NVDWR	NV 84163	—	—	105	NS	NS	105
USGS	—	—	—	324	NS	NS	324
NVDWR	NV 84152, 84158, 84159, 84164	—	—	345	NS	NS	345
NVDWR	NV 69873, 69874	—	3,574	3,574	NS	3,574	3,574
NVDWR	NV 68305, 74644	—	646	646	NS	646	646

occur at Davies Well 1 (site 38). This site is located in a model cell that contains four wells that have a combined simulated withdrawal amount of about 1,400 acre-ft/yr. This creates a large amount of simulated drawdown that is limited to this cell and four adjacent cells. At six other sites, drawdowns of 5 ft or more occur after 105 years (from the start of 2010) of withdrawals. These were Lime Spring (site 2), Snake Valley North Spring Complex (site 3), Caine Spring (site 23), Shell Baker Creek Well (site 27), Unnamed Spring 4 (site 28), and Kious Spring (site 31). Figure 4 shows the distribution of simulated

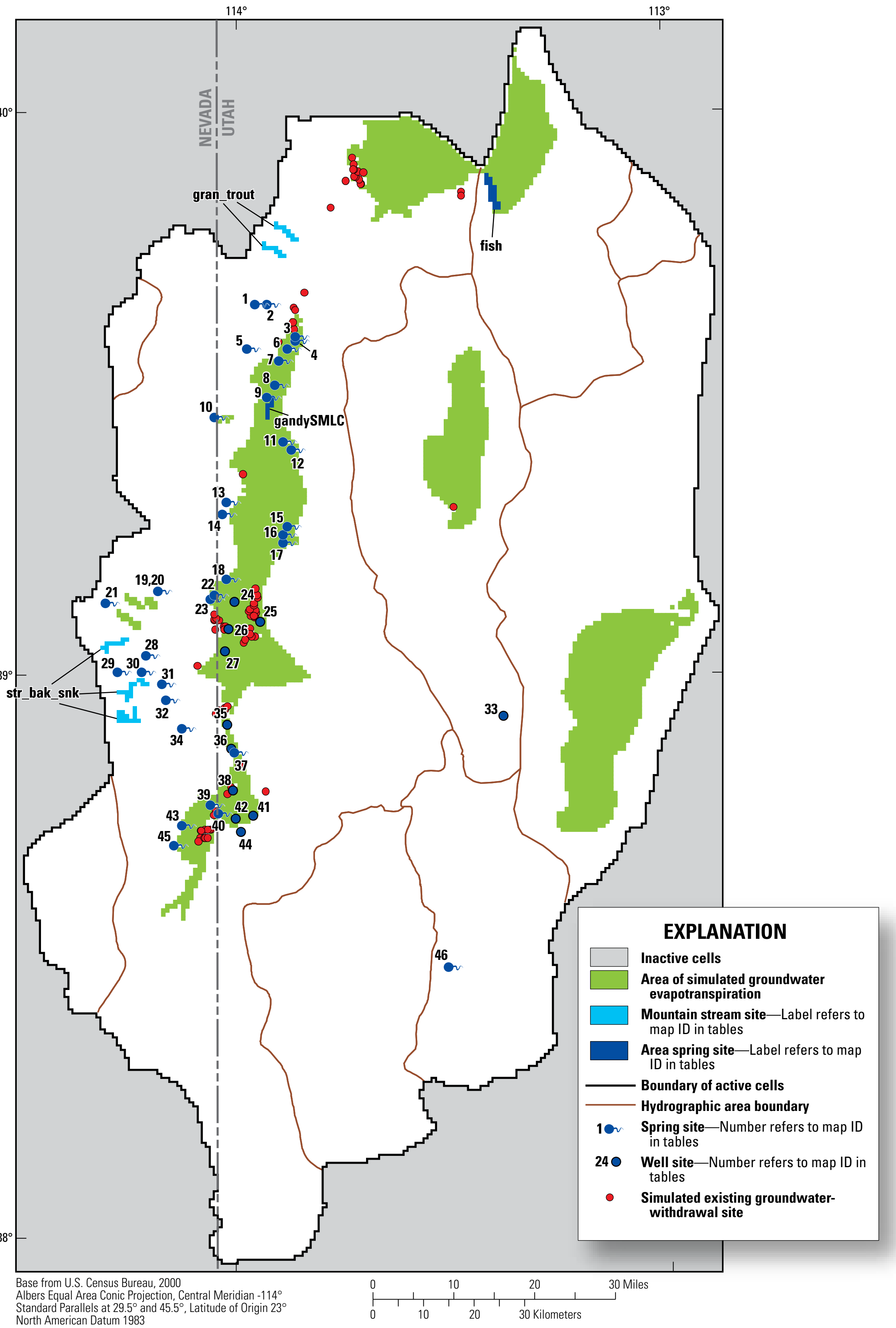

Figure 3. Groundwater discharge sites of interest to the Department of Interior agencies, and simulated existing groundwater-withdrawal sites used in the Snake Valley area groundwater model.

Table 3. Simulated drawdowns from existing and proposed groundwater withdrawals (scenarios 1–5) at the groundwater discharge sites of interest to the Department of Interior agencies.

[Water-right number: Water-right numbers are preceded by state abbreviation. Negative values (in red) indicate an increase in simulated water levels. Values of "< 1" indicate less than a 1 foot but greater than 0 foot decrease (or drawdown) in simulated water levels. Values of "< -1" indicate less than a 1 foot but greater than 0 foot increase in simulated water levels. **Abbreviations:** ID, identification; NV, Nevada; UT, Utah; new SS, new steady state; <, less than; >, greater than]

Map ID	Site name	Water-right number	Simulation period	Years elapsed since start of 2010	Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5
					Simulated drawdown (feet)	Simulated drawdown (feet)	Simulated drawdown (feet)	Simulated drawdown (feet)	Simulated drawdown (feet)
1	South Seeps	UT 18-597	2010–2014	5	0	0	0	0	0
			2010–2019	10	< 1	< 1	< 1	< 1	< 1
			2010–2024	15	< 1	< 1	< 1	< 1	< 1
			2010–2039	30	< 1	1	1	3	2
			2010–2064	55	2	3	4	7	6
			2010–2114	105	3	5	7	14	11
			2010–new SS	> 3,000	6	10	12	26	21
2	Lime Spring	UT 18-594	2010–2014	5	< 1	< 1	< 1	< 1	< 1
			2010–2019	10	< 1	< 1	< 1	1	< 1
			2010–2024	15	< 1	1	1	3	2
			2010–2039	30	2	3	4	9	7
			2010–2064	55	4	6	7	16	12
			2010–2114	105	6	9	11	23	18
			2010–new SS	> 3,000	8	12	15	33	26
3	Snake Valley North Spring Complex	UT 18-701	2010–2014	5	< 1	< 1	< 1	< 1	< 1
			2010–2019	10	< 1	1	1	4	3
			2010–2024	15	2	2	3	7	5
			2010–2039	30	3	4	5	12	10
			2010–2064	55	4	6	7	18	14
			2010–2114	105	5	7	9	24	18
			2010–new SS	> 3,000	6	9	11	31	23
4	Snake Valley South Spring Complex	UT 18-702	2010–2014	5	< 1	< 1	< 1	< 1	< 1
			2010–2019	10	< 1	1	1	3	3
			2010–2024	15	1	2	2	6	5
			2010–2039	30	2	4	5	11	8
			2010–2064	55	3	5	6	16	12
			2010–2114	105	4	7	8	21	16
			2010–new SS	> 3,000	5	8	10	28	21
5	Coyote Spring	UT 18-596	2010–2014	5	0	0	0	0	0
			2010–2019	10	< 1	< 1	< 1	< 1	< 1
			2010–2024	15	< 1	< 1	< 1	< 1	< 1
			2010–2039	30	< 1	1	1	2	2
			2010–2064	55	1	2	3	5	4
			2010–2114	105	2	3	4	8	7
			2010–new SS	> 3,000	3	5	6	13	10
6	Miller Spring	UT 18-253	2010–2014	5	< 1	< 1	< 1	< 1	< 1
			2010–2019	10	< 1	< 1	< 1	1	< 1
			2010–2024	15	< 1	< 1	< 1	2	2
			2010–2039	30	< 1	1	2	5	3
			2010–2064	55	1	2	2	9	6
			2010–2114	105	2	2	3	13	9
			2010–new SS	> 3,000	2	3	4	18	12

Table 3. Simulated drawdowns from existing and proposed groundwater withdrawals (scenarios 1–5) at the groundwater discharge sites of interest to the Department of Interior agencies.—Continued

[Water-right number: Water-right numbers are preceded by state abbreviation. Negative values (in red) indicate an increase in simulated water levels. Values of "< 1" indicate less than a 1 foot but greater than 0 foot decrease (or drawdown) in simulated water levels. Values of "< -1" indicate less than a 1 foot but greater than 0 foot increase in simulated water levels. **Abbreviations:** ID, identification; NV, Nevada; UT, Utah; new SS, new steady state; <, less than; >, greater than]

Map ID	Site name	Water-right number	Simulation period	Years elapsed since start of 2010	Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5
					Simulated drawdown (feet)	Simulated drawdown (feet)	Simulated drawdown (feet)	Simulated drawdown (feet)	Simulated drawdown (feet)
7	Leland Harris Spring Complex	unknown	2010–2014	5	< 1	< 1	< 1	< 1	< 1
			2010–2019	10	< 1	< 1	< 1	1	< 1
			2010–2024	15	< 1	1	1	2	2
			2010–2039	30	1	2	2	5	4
			2010–2064	55	2	3	4	8	6
			2010–2114	105	2	4	5	11	8
			2010–new SS	> 3,000	3	5	6	14	11
8	Gandy Salt Marsh Seep	UT 18-579	2010–2014	5	0	0	0	0	0
			2010–2019	10	< 1	< 1	< 1	< 1	< 1
			2010–2024	15	< 1	< 1	< 1	< 1	< 1
			2010–2039	30	< 1	< 1	< 1	3	2
			2010–2064	55	< 1	1	2	4	3
			2010–2114	105	1	2	2	6	5
			2010–new SS	> 3,000	2	3	3	9	7
9	Springs feeding Gandy Salt Marsh Lake	UT 18-537	2010–2014	5	0	0	0	0	0
			2010–2019	10	0	< 1	< 1	< 1	< 1
			2010–2024	15	< 1	< 1	< 1	< 1	< 1
			2010–2039	30	< 1	< 1	< 1	2	2
			2010–2064	55	< 1	< 1	1	4	3
			2010–2114	105	< 1	1	2	5	4
			2010–new SS	> 3,000	1	2	2	7	5
gandySMLC	Gandy Salt Marsh Lake Spring Complex [1]	UT 18-575	2010–2014	5	0	0	0	0	0
			2010–2019	10	0	0	0	1	< 1
			2010–2024	15	0	< 1	< 1	2	1
			2010–2039	30	< 1	< 1	< 1	3	2
			2010–2064	55	< 1	< 1	< 1	4	3
			2010–2114	105	< 1	< 1	1	6	4
			2010–new SS	> 3,000	< 1	1	2	7	5
10	Gandy Warm Springs	UT 18-584, 18-585, 18-623	2010–2014	5	0	0	0	0	0
			2010–2019	10	0	0	0	0	0
			2010–2024	15	0	0	0	0	0
			2010–2039	30	0	0	0	0	0
			2010–2064	55	0	0	0	0	0
			2010–2114	105	0	0	0	0	0
			2010–new SS	> 3,000	0	0	0	0	0
11	Foote Reservoir Spring	UT 18-711, 18-255	2010–2014	5	0	0	0	0	0
			2010–2019	10	0	0	0	< 1	< 1
			2010–2024	15	0	0	0	1	< 1
			2010–2039	30	0	0	0	2	< 1
			2010–2064	55	0	0	0	3	< 1
			2010–2114	105	0	0	0	3	1
			2010–new SS	> 3,000	0	0	0	3	1

Table 3. Simulated drawdowns from existing and proposed groundwater withdrawals (scenarios 1–5) at the groundwater discharge sites of interest to the Department of Interior agencies.—Continued

[Water-right number: Water-right numbers are preceded by state abbreviation. Negative values (in red) indicate an increase in simulated water levels. Values of "< 1" indicate less than a 1 foot but greater than 0 foot decrease (or drawdown) in simulated water levels. Values of "< -1" indicate less than a 1 foot but greater than 0 foot increase in simulated water levels. **Abbreviations:** ID, identification; NV, Nevada; UT, Utah; new SS, new steady state; <, less than; >, greater than]

Map ID	Site name	Water-right number	Simulation period	Years elapsed since start of 2010	Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5
					Simulated drawdown (feet)	Simulated drawdown (feet)	Simulated drawdown (feet)	Simulated drawdown (feet)	Simulated drawdown (feet)
12	Twin Springs	UT 18-476, 18-486	2010–2014	5	0	0	0	0	0
			2010–2019	10	0	0	0	0	0
			2010–2024	15	0	0	0	0	0
			2010–2039	30	0	0	0	< 1	0
			2010–2064	55	0	0	0	< 1	< 1
			2010–2114	105	0	0	0	< 1	< 1
			2010–new SS	> 3,000	0	0	0	< 1	< 1
13	Briggs Spring	UT 18-604	2010–2014	5	0	0	0	0	0
			2010–2019	10	< -1	< -1	< -1	< -1	< -1
			2010–2024	15	< -1	< -1	< -1	< -1	< -1
			2010–2039	30	< -1	< -1	< -1	< 1	0
			2010–2064	55	< -1	< -1	< -1	< 1	< 1
			2010–2114	105	0	0	< 1	< 1	< 1
			2010–new SS	> 3,000	< 1	< 1	< 1	1	< 1
14	Phil Spring	UT 18-742	2010–2014	5	0	0	0	0	0
			2010–2019	10	0	0	0	0	0
			2010–2024	15	< -1	< -1	< -1	0	0
			2010–2039	30	< -1	< -1	< -1	< 1	0
			2010–2064	55	0	0	0	< 1	< 1
			2010–2114	105	< 1	< 1	< 1	< 1	< 1
			2010–new SS	> 3,000	< 1	< 1	< 1	1	1
15	North Knoll Spring	UT 18-535	2010–2014	5	0	0	0	0	0
			2010–2019	10	0	0	0	0	0
			2010–2024	15	0	0	0	0	0
			2010–2039	30	0	0	0	< 1	< 1
			2010–2064	55	< 1	< 1	< 1	< 1	< 1
			2010–2114	105	< 1	< 1	< 1	< 1	< 1
			2010–new SS	> 3,000	< 1	< 1	< 1	1	< 1
16	Middle Knoll Spring	UT 18-491	2010–2014	5	0	0	0	0	0
			2010–2019	10	0	0	0	0	0
			2010–2024	15	0	0	0	0	0
			2010–2039	30	0	0	0	< 1	< 1
			2010–2064	55	< 1	< 1	< 1	< 1	< 1
			2010–2114	105	< 1	< 1	< 1	< 1	< 1
			2010–new SS	> 3,000	< 1	< 1	< 1	1	1
17	Knoll Spring	UT 18-84	2010–2014	5	0	0	0	0	0
			2010–2019	10	0	0	0	0	0
			2010–2024	15	0	0	0	< 1	0
			2010–2039	30	0	< 1	< 1	< 1	< 1
			2010–2064	55	< 1	< 1	< 1	< 1	< 1
			2010–2114	105	< 1	< 1	< 1	1	< 1
			2010–new SS	> 3,000	< 1	< 1	< 1	1	1

Table 3. Simulated drawdowns from existing and proposed groundwater withdrawals (scenarios 1–5) at the groundwater discharge sites of interest to the Department of Interior agencies.—Continued

[Water-right number: Water-right numbers are preceded by state abbreviation. Negative values (in red) indicate an increase in simulated water levels. Values of "< 1" indicate less than a 1 foot but greater than 0 foot decrease (or drawdown) in simulated water levels. Values of "< -1" indicate less than a 1 foot but greater than 0 foot increase in simulated water levels. **Abbreviations:** ID, identification; NV, Nevada; UT, Utah; new SS, new steady state; <, less than; >, greater than]

Map ID	Site name	Water-right number	Simulation period	Years elapsed since start of 2010	Scenario 1 Simulated drawdown (feet)	Scenario 2 Simulated drawdown (feet)	Scenario 3 Simulated drawdown (feet)	Scenario 4 Simulated drawdown (feet)	Scenario 5 Simulated drawdown (feet)
18	Unnamed Spring 1	unknown	2010–2014	5	0	0	0	0	0
			2010–2019	10	< 1	< 1	< 1	< 1	< 1
			2010–2024	15	< 1	< 1	< 1	< 1	< 1
			2010–2039	30	< 1	< 1	1	2	1
			2010–2064	55	1	1	2	3	2
			2010–2114	105	2	2	2	4	3
			2010–new SS	> 3,000	2	2	3	4	4
19	Unnamed Spring 2	unknown	2010–2014	5	0	0	0	0	0
			2010–2019	10	< 1	< 1	< 1	< 1	< 1
			2010–2024	15	< 1	< 1	< 1	< 1	< 1
			2010–2039	30	< 1	< 1	< 1	1	1
			2010–2064	55	2	2	2	3	3
			2010–2114	105	4	4	4	6	5
			2010–new SS	> 3,000	6	7	7	11	9
20	Unnamed Spring 3	unknown	2010–2014	5	0	0	0	0	0
			2010–2019	10	< 1	< 1	< 1	< 1	< 1
			2010–2024	15	< 1	< 1	< 1	< 1	< 1
			2010–2039	30	< 1	< 1	< 1	1	1
			2010–2064	55	2	2	2	3	3
			2010–2114	105	4	4	4	6	5
			2010–new SS	> 3,000	6	7	7	11	9
21	Want Spring	NV R05275	2010–2014	5	0	0	0	0	0
			2010–2019	10	0	0	0	0	0
			2010–2024	15	< 1	< 1	< 1	< 1	< 1
			2010–2039	30	< 1	< 1	< 1	< 1	< 1
			2010–2064	55	1	1	1	1	1
			2010–2114	105	2	3	3	4	3
			2010–new SS	> 3,000	5	6	6	9	8
22	Kane Spring	UT 18-406	2010–2014	5	< 1	< 1	< 1	< 1	< 1
			2010–2019	10	1	1	1	2	2
			2010–2024	15	2	2	2	3	3
			2010–2039	30	3	3	4	5	5
			2010–2064	55	3	4	5	7	6
			2010–2114	105	4	5	6	8	7
			2010–new SS	> 3,000	5	5	6	9	8
23	Caine Spring	unknown	2010–2014	5	< 1	< 1	< 1	< 1	< 1
			2010–2019	10	1	1	2	2	2
			2010–2024	15	2	2	3	3	3
			2010–2039	30	3	3	5	6	6
			2010–2064	55	4	5	6	8	7
			2010–2114	105	5	6	7	10	9
			2010–new SS	> 3,000	5	6	8	11	10

Table 3. Simulated drawdowns from existing and proposed groundwater withdrawals (scenarios 1–5) at the groundwater discharge sites of interest to the Department of Interior agencies.—Continued

[Water-right number: Water-right numbers are preceded by state abbreviation. Negative values (in red) indicate an increase in simulated water levels. Values of "< 1" indicate less than a 1 foot but greater than 0 foot decrease (or drawdown) in simulated water levels. Values of "< -1" indicate less than a 1 foot but greater than 0 foot increase in simulated water levels. **Abbreviations:** ID, identification; NV, Nevada; UT, Utah; new SS, new steady state; <, less than; >, greater than]

Map ID	Site name	Water-right number	Simulation period	Years elapsed since start of 2010	Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5
					Simulated drawdown (feet)	Simulated drawdown (feet)	Simulated drawdown (feet)	Simulated drawdown (feet)	Simulated drawdown (feet)
24	Eskdale Well	UT 18-304	2010–2014	5	< 1	< 1	< 1	< 1	< 1
			2010–2019	10	< 1	< 1	1	2	2
			2010–2024	15	1	2	2	3	3
			2010–2039	30	2	3	3	6	5
			2010–2064	55	3	4	5	7	6
			2010–2114	105	4	5	6	9	8
			2010–new SS	> 3,000	5	5	6	10	8
25	West Buckskin Well	UT 18-555	2010–2014	5	< -1	< -1	< -1	< -1	< -1
			2010–2019	10	< -1	< -1	< -1	< 1	< 1
			2010–2024	15	< 1	< 1	< -1	1	< 1
			2010–2039	30	< 1	< 1	< 1	3	2
			2010–2064	55	1	2	< 1	4	3
			2010–2114	105	2	2	2	5	4
			2010–new SS	> 3,000	2	3	2	6	4
26	Flowing Well 2	UT 18-719	2010–2014	5	-1	-1	-1	-1	-1
			2010–2019	10	< -1	< -1	0	< 1	< 1
			2010–2024	15	< -1	< 1	< 1	3	2
			2010–2039	30	1	2	3	5	4
			2010–2064	55	2	3	4	7	6
			2010–2114	105	3	4	5	8	7
			2010–new SS	> 3,000	3	4	5	9	8
27	Shell Baker Creek Well	UT 18-168	2010–2014	5	< 1	< 1	< 1	< 1	< 1
			2010–2019	10	1	1	1	2	1
			2010–2024	15	2	2	2	3	2
			2010–2039	30	3	3	3	5	4
			2010–2064	55	4	4	4	6	6
			2010–2114	105	5	5	5	8	7
			2010–new SS	> 3,000	5	6	6	9	8
28	Unnamed Spring 4	unknown	2010–2014	5	< 1	< 1	< 1	< 1	< 1
			2010–2019	10	1	1	2	2	2
			2010–2024	15	3	3	3	3	3
			2010–2039	30	5	6	6	7	7
			2010–2064	55	8	9	9	11	11
			2010–2114	105	11	11	12	15	14
			2010–new SS	> 3,000	12	13	14	19	17
29	Upper Lehman Spring	unknown	2010–2014	5	0	0	0	0	0
			2010–2019	10	0	0	0	0	0
			2010–2024	15	0	0	0	0	0
			2010–2039	30	0	0	0	0	0
			2010–2064	55	0	0	0	0	0
			2010–2114	105	0	0	0	0	0
			2010–new SS	> 3,000	0	0	0	0	0

Table 3. Simulated drawdowns from existing and proposed groundwater withdrawals (scenarios 1–5) at the groundwater discharge sites of interest to the Department of Interior agencies.—Continued

[Water-right number: Water-right numbers are preceded by state abbreviation. Negative values (in red) indicate an increase in simulated water levels. Values of "< 1" indicate less than a 1 foot but greater than 0 foot decrease (or drawdown) in simulated water levels. Values of "< -1" indicate less than a 1 foot but greater than 0 foot increase in simulated water levels. **Abbreviations:** ID, identification; NV, Nevada; UT, Utah; new SS, new steady state; <, less than; >, greater than]

Map ID	Site name	Water-right number	Simulation period	Years elapsed since start of 2010	Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5
					Simulated drawdown (feet)	Simulated drawdown (feet)	Simulated drawdown (feet)	Simulated drawdown (feet)	Simulated drawdown (feet)
30	Rowland Springs	NV V10164	2010–2014	5	0	0	0	0	0
			2010–2019	10	0	0	0	0	0
			2010–2024	15	0	0	< 1	< 1	< 1
			2010–2039	30	< 1	< 1	< 1	< 1	< 1
			2010–2064	55	< 1	< 1	< 1	< 1	< 1
			2010–2114	105	< 1	< 1	< 1	< 1	< 1
			2010–new SS	> 3,000	< 1	< 1	< 1	1	1
31	Kious Spring	unknown	2010–2014	5	0	0	0	0	0
			2010–2019	10	< 1	< 1	< 1	< 1	< 1
			2010–2024	15	< 1	< 1	< 1	< 1	< 1
			2010–2039	30	2	2	3	3	3
			2010–2064	55	5	5	6	7	7
			2010–2114	105	9	10	11	13	12
			2010–new SS	> 3,000	13	14	15	20	18
32	Mahogany Spring	unknown	2010–2014	5	0	0	0	0	0
			2010–2019	10	0	0	0	0	0
			2010–2024	15	0	0	0	0	0
			2010–2039	30	< 1	< 1	< 1	< 1	< 1
			2010–2064	55	< 1	< 1	< 1	< 1	< 1
			2010–2114	105	1	1	1	2	2
			2010–new SS	> 3,000	6	7	7	11	9
33	Ibex Well	UT 18-356	2010–2014	5	0	0	0	0	0
			2010–2019	10	0	0	0	0	0
			2010–2024	15	0	0	0	0	0
			2010–2039	30	0	0	0	0	0
			2010–2064	55	< 1	< 1	< 1	< 1	< 1
			2010–2114	105	< 1	< 1	< 1	< 1	< 1
			2010–new SS	> 3,000	1	2	2	3	3
34	Spring Creek Spring	unknown	2010–2014	5	0	0	0	0	0
			2010–2019	10	0	0	0	0	0
			2010–2024	15	0	0	0	0	0
			2010–2039	30	0	0	0	0	0
			2010–2064	55	0	0	0	0	0
			2010–2114	105	0	0	0	0	0
			2010–new SS	> 3,000	0	0	0	0	0
35	Diversion from Lake Creek 1	UT 18-620	2010–2014	5	< -1	< -1	< -1	< -1	< -1
			2010–2019	10	< -1	0	< -1	< 1	< 1
			2010–2024	15	< 1	< 1	< 1	2	1
			2010–2039	30	< 1	1	< 1	5	3
			2010–2064	55	2	2	2	7	5
			2010–2114	105	2	3	2	9	7
			2010–new SS	> 3,000	1	3	3	11	8

Table 3. Simulated drawdowns from existing and proposed groundwater withdrawals (scenarios 1–5) at the groundwater discharge sites of interest to the Department of Interior agencies.—Continued

[Water-right number: Water-right numbers are preceded by state abbreviation. Negative values (in red) indicate an increase in simulated water levels. Values of "< 1" indicate less than a 1 foot but greater than 0 foot decrease (or drawdown) in simulated water levels. Values of "< -1" indicate less than a 1 foot but greater than 0 foot increase in simulated water levels. **Abbreviations:** ID, identification; NV, Nevada; UT, Utah; new SS, new steady state; <, less than; >, greater than]

Map ID	Site name	Water-right number	Simulation period	Years elapsed since start of 2010	Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5
					Simulated drawdown (feet)	Simulated drawdown (feet)	Simulated drawdown (feet)	Simulated drawdown (feet)	Simulated drawdown (feet)
36	Diversion from Lake Creek 2	UT 18-621	2010–2014	5	< -1	< -1	< -1	< -1	< -1
			2010–2019	10	0	< 1	< 1	1	< 1
			2010–2024	15	< 1	< 1	< 1	2	2
			2010–2039	30	< 1	1	1	5	4
			2010–2064	55	1	2	2	8	6
			2010–2114	105	1	3	3	10	7
			2010–new SS	> 3,000	< 1	3	3	12	8
37	Clay Spring	unknown	2010–2014	5	0	0	0	0	0
			2010–2019	10	0	0	0	0	0
			2010–2024	15	0	0	0	0	0
			2010–2039	30	0	0	0	< 1	0
			2010–2064	55	0	0	0	< 1	< 1
			2010–2114	105	0	0	0	2	< 1
			2010–new SS	> 3,000	0	0	0	4	< 1
38	Davies Well 1	UT 18-497	2010–2014	5	14	14	14	14	14
			2010–2019	10	36	37	37	38	37
			2010–2024	15	44	45	45	47	46
			2010–2039	30	49	50	50	56	54
			2010–2064	55	49	52	52	61	57
			2010–2114	105	49	52	52	63	59
			2010–new SS	> 3,000	47	52	52	66	61
39	Dearden Spring Group	UT 18-684	2010–2014	5	< 1	< 1	< 1	< 1	< 1
			2010–2019	10	< 1	< 1	< 1	< 1	< 1
			2010–2024	15	< 1	< 1	< 1	< 1	< 1
			2010–2039	30	< -1	0	0	< 1	< 1
			2010–2064	55	< -1	0	0	1	< 1
			2010–2114	105	< -1	0	0	1	< 1
			2010–new SS	> 3,000	< -1	< -1	< -1	2	< 1
40	Needle Point Spring	UT 18-571	2010–2014	5	3	3	3	3	3
			2010–2019	10	2	2	2	4	3
			2010–2024	15	< 1	1	1	4	3
			2010–2039	30	-2	< -1	< -1	6	4
			2010–2064	55	-3	< -1	< -1	8	4
			2010–2114	105	-5	-1	-1	9	5
			2010–new SS	> 3,000	-7	-2	-2	11	6
41	Davies Well 2	UT 18-203	2010–2014	5	0	0	0	0	0
			2010–2019	10	< 1	< 1	< 1	< 1	< 1
			2010–2024	15	< 1	< 1	< 1	2	1
			2010–2039	30	< -1	< 1	< 1	5	3
			2010–2064	55	-1	< 1	< 1	7	4
			2010–2114	105	-2	< 1	< 1	8	5
			2010–new SS	> 3,000	-4	< -1	< -1	11	6

Table 3. Simulated drawdowns from existing and proposed groundwater withdrawals (scenarios 1–5) at the groundwater discharge sites of interest to the Department of Interior agencies.—Continued

[Water-right number: Water-right numbers are preceded by state abbreviation. Negative values (in red) indicate an increase in simulated water levels. Values of "< 1" indicate less than a 1 foot but greater than 0 foot decrease (or drawdown) in simulated water levels. Values of "< -1" indicate less than a 1 foot but greater than 0 foot increase in simulated water levels. **Abbreviations:** ID, identification; NV, Nevada; UT, Utah; new SS, new steady state; <, less than; >, greater than]

Map ID	Site name	Water-right number	Simulation period	Years elapsed since start of 2010	Scenario 1 Simulated drawdown (feet)	Scenario 2 Simulated drawdown (feet)	Scenario 3 Simulated drawdown (feet)	Scenario 4 Simulated drawdown (feet)	Scenario 5 Simulated drawdown (feet)
42	Needle Point Well	UT 18-678	2010–2014	5	< 1	< 1	< 1	< 1	< 1
			2010–2019	10	< 1	< 1	< 1	3	2
			2010–2024	15	< 1	< 1	< 1	5	3
			2010–2039	30	< -1	< 1	< 1	8	5
			2010–2064	55	-2	< 1	< 1	10	7
			2010–2114	105	-3	< 1	< 1	12	8
			2010–new SS	> 3,000	-5	< -1	< -1	15	9
43	Unnamed Spring 5	NV R05271	2010–2014	5	0	0	0	0	0
			2010–2019	10	< -1	< -1	< -1	< -1	< -1
			2010–2024	15	-1	-1	-1	-1	-1
			2010–2039	30	-5	-4	-4	-4	-4
			2010–2064	55	-10	-7	-7	-6	-7
			2010–2114	105	-13	-9	-9	-7	-8
			2010–new SS	> 3,000	-16	-10	-10	-6	-8
44	Cove Well	UT 18-673	2010–2014	5	< 1	< 1	< 1	< 1	< 1
			2010–2019	10	< 1	< 1	< 1	< 1	< 1
			2010–2024	15	0	< 1	< 1	2	1
			2010–2039	30	< -1	< -1	< -1	4	3
			2010–2064	55	-2	< -1	< -1	6	4
			2010–2114	105	-3	< -1	< -1	7	4
			2010–new SS	> 3,000	-6	-1	-2	10	5
45	Big Springs	unknown	2010–2014	5	0	0	0	0	0
			2010–2019	10	0	0	0	0	0
			2010–2024	15	0	0	0	0	0
			2010–2039	30	0	0	0	0	0
			2010–2064	55	0	0	0	0	0
			2010–2114	105	0	0	0	0	0
			2010–new SS	> 3,000	0	0	0	0	0
46	Wah Wah Springs	UT 69-1, 69-107, 69-108, 69-19, 69-33	2010–2014	5	0	0	0	0	0
			2010–2019	10	0	0	0	0	0
			2010–2024	15	0	0	0	0	0
			2010–2039	30	0	0	0	0	0
			2010–2064	55	0	0	0	0	0
			2010–2114	105	0	0	0	0	0
			2010–new SS	> 3,000	0	0	0	0	0
str	Strawberry Creek[2]	unknown	2010–2014	5	0	0	0	0	0
			2010–2019	10	0	0	0	0	0
			2010–2024	15	0	0	0	0	0
			2010–2039	30	< 1	< 1	< 1	< 1	< 1
			2010–2064	55	< 1	< 1	< 1	< 1	< 1
			2010–2114	105	2	2	2	2	2
			2010–new SS	> 3,000	6	7	7	10	9

Table 3. Simulated drawdowns from existing and proposed groundwater withdrawals (scenarios 1–5) at the groundwater discharge sites of interest to the Department of Interior agencies.—Continued

[Water-right number: Water-right numbers are preceded by state abbreviation. Negative values (in red) indicate an increase in simulated water levels. Values of "< 1" indicate less than a 1 foot but greater than 0 foot decrease (or drawdown) in simulated water levels. Values of "< -1" indicate less than a 1 foot but greater than 0 foot increase in simulated water levels. **Abbreviations:** ID, identification; NV, Nevada; UT, Utah; new SS, new steady state; <, less than; >, greater than]

Map ID	Site name	Water-right number	Simulation period	Years elapsed since start of 2010	Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5
					Simulated drawdown (feet)	Simulated drawdown (feet)	Simulated drawdown (feet)	Simulated drawdown (feet)	Simulated drawdown (feet)
bak	Baker Creek [2]	NV V01066	2010–2014	5	0	0	0	0	0
			2010–2019	10	0	0	0	0	0
			2010–2024	15	0	0	0	0	0
			2010–2039	30	0	0	0	0	0
			2010–2064	55	< 1	< 1	< 1	< 1	< 1
			2010–2114	105	< 1	< 1	< 1	< 1	< 1
			2010–new SS	> 3,000	< 1	< 1	< 1	< 1	< 1
snk	Snake Creek [2]	UT 18-11, 18-12, 18-249, 18-250, 18-251, 18-257; NV C3863	2010–2014	5	0	0	0	0	0
			2010–2019	10	0	0	0	0	0
			2010–2024	15	0	0	0	0	0
			2010–2039	30	0	< 1	0	< 1	< 1
			2010–2064	55	< 1	< 1	< 1	< 1	< 1
			2010–2114	105	< 1	< 1	< 1	2	1
			2010–new SS	> 3,000	< -1	< 1	< 1	4	2

[1] Drawdown computed from simulated water level in center of spring complex.

[2] Drawdown computed from simulated water level where creek crosses Great Basin National Park boundary.

drawdowns after 105 years (from the start of 2010) of existing withdrawals across the study area.

Several sites showed a notable decrease in simulated natural discharge (or groundwater capture; table 4). At some sites, especially in the southern part of the study area, simulated natural discharge increases for some or all stress periods because groundwater withdrawals near the site decrease after 2010 or 2015 and/or were relocated farther from the site after 2010 or 2015. The greatest percentage of capture is simulated from Miller Spring (site 6) at 45 percent of the total simulated spring discharge in the model cell (304 acre-ft/yr) after 105 years (from the start of 2010) of existing groundwater withdrawals and at 55 percent after reaching a new steady state. Other sites where simulated capture amounts are greater than 15 percent after 105 years (from the start of 2010) of existing groundwater withdrawals include Snake Valley North Spring Complex (site 3, simulated capture is 37 percent of the total simulated ETg in the model cell), Snake Valley South Spring Complex (site 4, simulated capture is 28 percent of the total simulated ETg in the model cell), and Caine Spring (site 23, simulated capture is 16 percent of the total simulated ETg in the model cell). Table 5 summarizes the simulated capture of natural discharge for the study area.

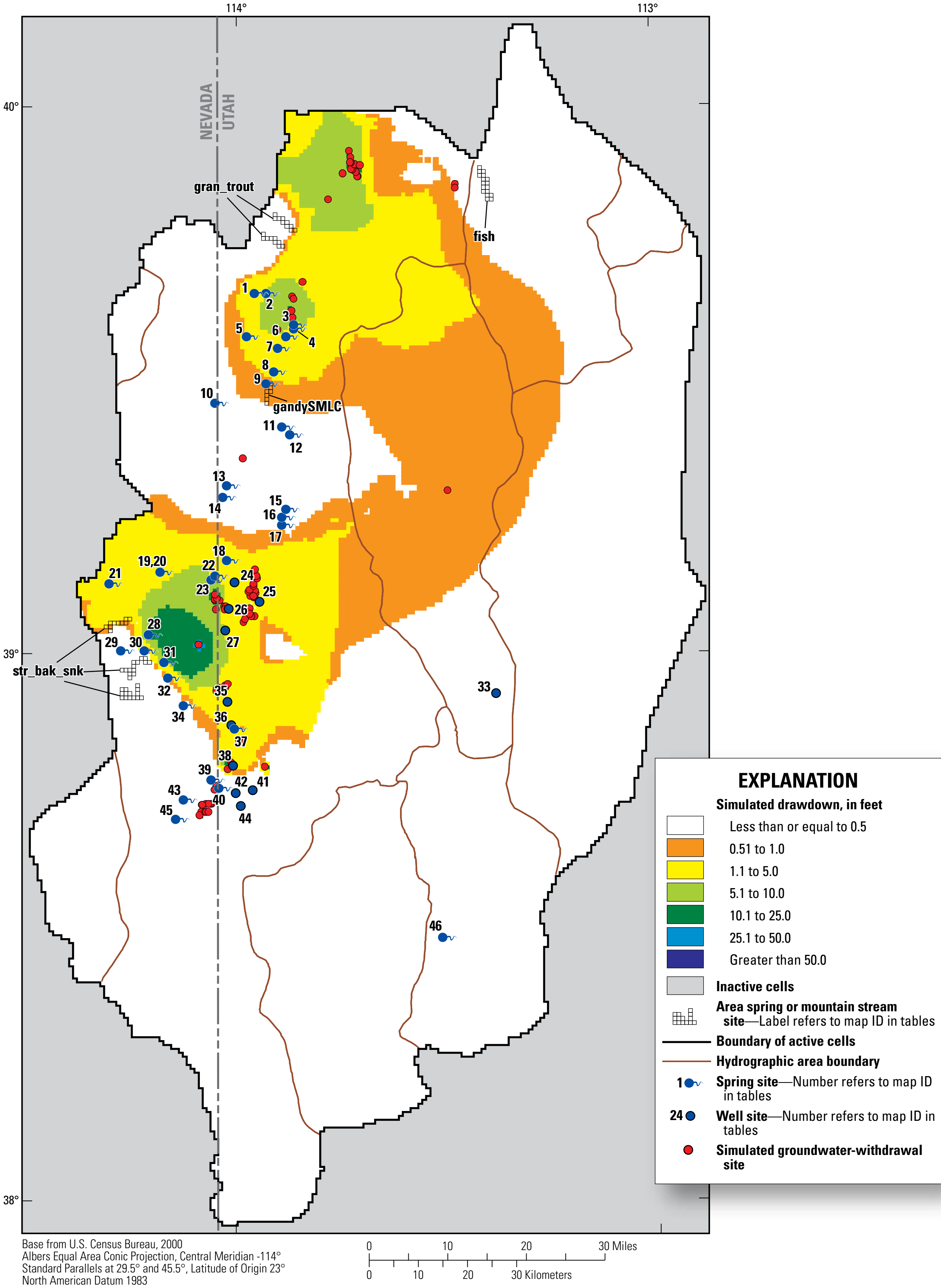

Figure 4. Groundwater discharge sites of interest to the Department of Interior agencies, simulated groundwater-withdrawal sites, and simulated drawdowns of the water table after 105 years (from the start of 2010) of groundwater withdrawals under scenario 1 from the Snake Valley area groundwater model.

Table 4. Simulated capture of natural discharge from existing and proposed groundwater withdrawals (scenarios 1–5) at the groundwater discharge sites of interest to the Department of Interior agencies.

[Water-right number: Water-right numbers are preceded by state abbreviation. Negative values (in red) indicate an increase in simulated discharge and no capture. Values of "< 1" indicate less than 1 acre-foot per year or percent but greater than 0 acre-foot per year or percent decrease in simulated natural discharge (or capture). Values of "< -1" indicate less than 1 acre-foot per year or percent but greater than 0 acre-foot per year or percent increase in simulated discharge and no capture. **Abbreviations:** ID, identification; acre-ft/yr, acre-feet per year; ETg, groundwater evapotranspiration; N/A, not applicable; NV, Nevada; UT, Utah; new SS, new steady state; <, less than; >, greater than]

Map ID	Site name	Water-right number	Simulation period	Years elapsed since start of 2010	Scenario 1		Scenario 2		Scenario 3		Scenario 4		Scenario 5	
					Simulated capture of natural discharge (acre-ft/yr)	Simulated capture (percentage of total simulated natural discharge)	Simulated capture of natural discharge (acre-ft/yr)	Simulated capture (percentage of total simulated natural discharge)	Simulated capture of natural discharge (acre-ft/yr)	Simulated capture (percentage of total simulated natural discharge)	Simulated capture of natural discharge (acre-ft/yr)	Simulated capture (percentage of total simulated natural discharge)	Simulated capture of natural discharge (acre-ft/yr)	Simulated capture (percentage of total simulated natural discharge)
1	**South Seeps** (steady-state simulated discharge in model cell(s) prior to 2010 = 0 acre-ft/yr)	UT 18-597	2010–2014	5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
			2010–2019	10	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
			2010–2024	15	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
			2010–2039	30	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
			2010–2064	55	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
			2010–2114	105	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
			2010–new SS	> 3,000	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
2	**Lime Spring** (steady-state simulated discharge in model cell(s) prior to 2010 = 0 acre-ft/yr)	UT 18-594	2010–2014	5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
			2010–2019	10	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
			2010–2024	15	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
			2010–2039	30	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
			2010–2064	55	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
			2010–2114	105	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
			2010–new SS	> 3,000	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
3	**Snake Valley North Spring Complex** (steady-state simulated discharge in model cell(s) prior to 2010 = 19 acre-ft/yr as ETg)	UT 18-701	2010–2014	5	< 1	2	< 1	2	< 1	2	< 1	2	< 1	2
			2010–2019	10	1	7	2	9	2	11	6	32	5	24
			2010–2024	15	2	12	3	17	4	20	11	55	8	42
			2010–2039	30	4	21	6	31	7	39	19	98	14	75
			2010–2064	55	6	29	8	44	11	55	19	100	19	100
			2010–2114	105	7	37	11	57	13	70	19	100	19	100
			2010–new SS	> 3,000	9	46	14	71	17	88	19	100	19	100
4	**Snake Valley South Spring Complex** (steady-state simulated discharge in model cell(s) prior to 2010 = 22 acre-ft/yr as ETg)	UT 18-702	2010–2014	5	< 1	2	< 1	2	< 1	2	< 1	2	< 1	2
			2010–2019	10	1	5	2	7	2	8	5	21	4	16
			2010–2024	15	2	9	3	13	3	15	8	39	7	30
			2010–2039	30	4	16	5	24	7	30	16	73	12	56
			2010–2064	55	5	22	8	35	9	43	22	100	18	81
			2010–2114	105	6	28	10	44	12	55	22	100	22	100
			2010–new SS	> 3,000	8	36	12	55	15	68	22	100	22	100

Table 4. Simulated capture of natural discharge from existing and proposed groundwater withdrawals (scenarios 1–5) at the groundwater discharge sites of interest to the Department of Interior agencies.—Continued

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Map ID	Site name	Water-right number	Simulation period	Years elapsed since start of 2010	Scenario 1		Scenario 2		Scenario 3		Scenario 4		Scenario 5	
					Simulated capture of natural discharge (acre-ft/yr)	Simulated capture (percentage of total simulated natural discharge)	Simulated capture of natural discharge (acre-ft/yr)	Simulated capture (percentage of total simulated natural discharge)	Simulated capture of natural discharge (acre-ft/yr)	Simulated capture (percentage of total simulated natural discharge)	Simulated capture of natural discharge (acre-ft/yr)	Simulated capture (percentage of total simulated natural discharge)	Simulated capture of natural discharge (acre-ft/yr)	Simulated capture (percentage of total simulated natural discharge)
5	**Coyote Spring** (steady-state simulated discharge in model cell(s) prior to 2010 = 0 acre-ft/yr)	UT 18-596	2010–2014	5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
			2010–2019	10	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
			2010–2024	15	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
			2010–2039	30	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
			2010–2064	55	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
			2010–2114	105	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
			2010–new SS	> 3,000	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
6	**Miller Spring** (steady-state simulated discharge in model cell(s) prior to 2010 = 304 acre-ft/yr as spring discharge)	UT 18-253	2010–2014	5	15	5	15	5	15	5	15	5	15	5
			2010–2019	10	36	12	50	17	54	18	164	54	123	40
			2010–2024	15	54	18	81	27	91	30	242	80	185	61
			2010–2039	30	84	28	134	44	155	51	304	100	294	97
			2010–2064	55	111	37	178	59	211	69	304	100	304	100
			2010–2114	105	136	45	218	72	260	86	304	100	304	100
			2010–new SS	> 3,000	167	55	264	87	304	100	304	100	304	100
7	**Leland Harris Spring Complex** (steady-state simulated discharge in model cell(s) prior to 2010 = 57 acre-ft/yr as ETg)	unknown	2010–2014	5	0	0	0	0	0	0	0	0	0	0
			2010–2019	10	0	0	0	0	0	0	0	0	0	0
			2010–2024	15	0	0	0	0	0	0	0	0	0	0
			2010–2039	30	0	0	0	0	0	0	0	0	0	0
			2010–2064	55	0	0	0	0	0	0	< 1	< 1	0	0
			2010–2114	105	0	0	0	0	0	0	5	8	1	2
			2010–new SS	> 3,000	0	0	0	0	0	0	10	17	5	9
8	**Gandy Salt Marsh Seep** (steady-state simulated discharge in model cell(s) prior to 2010 = 57 acre-ft/yr as ETg)	UT 18-579	2010–2014	5	0	0	0	0	0	0	0	0	0	0
			2010–2019	10	0	0	0	0	0	0	0	0	0	0
			2010–2024	15	0	0	0	0	0	0	0	0	0	0
			2010–2039	30	0	0	0	0	0	0	0	0	0	0
			2010–2064	55	0	0	0	0	0	0	0	0	0	0
			2010–2114	105	0	0	0	0	0	0	0	0	0	0
			2010–new SS	> 3,000	0	0	0	0	0	0	0	0	0	0

Table 4. Simulated capture of natural discharge from existing and proposed groundwater withdrawals (scenarios 1–5) at the groundwater discharge sites of interest to the Department of Interior agencies.—Continued

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Map ID	Site name	Water-right number	Simulation period	Years elapsed since start of 2010	Scenario 1		Scenario 2		Scenario 3		Scenario 4		Scenario 5	
					Simulated capture of natural discharge (acre-ft/yr)	Simulated capture (percentage of total simulated natural discharge)	Simulated capture of natural discharge (acre-ft/yr)	Simulated capture (percentage of total simulated natural discharge)	Simulated capture of natural discharge (acre-ft/yr)	Simulated capture (percentage of total simulated natural discharge)	Simulated capture of natural discharge (acre-ft/yr)	Simulated capture (percentage of total simulated natural discharge)	Simulated capture of natural discharge (acre-ft/yr)	Simulated capture (percentage of total simulated natural discharge)
9 and gandy-SMLC	**Springs feeding Gandy Salt Marsh Lake and Gandy Salt Marsh Lake Spring Complex** (steady-state simulated discharge in model cell(s) prior to 2010 = 399 acre-ft/yr as ETg)	UT 18-537, 18-575	2010–2014	5	0	0	0	0	0	0	0	0	0	0
			2010–2019	10	0	0	0	0	0	0	0	0	0	0
			2010–2024	15	0	0	0	0	0	0	0	0	0	0
			2010–2039	30	0	0	0	0	0	0	0	0	0	0
			2010–2064	55	0	0	0	0	0	0	0	0	0	0
			2010–2114	105	0	0	0	0	0	0	0	0	0	0
			2010–new SS	> 3,000	0	0	0	0	0	0	0	0	0	0
10	**Gandy Warm Springs** (steady-state simulated discharge in model cell(s) prior to 2010 = 10,288 acre-ft/yr as spring discharge)	UT 18-584, 18-585, 18-623	2010–2014	5	< 1	0	< 1	0	< 1	0	< 1	0	< 1	0
			2010–2019	10	< 1	0	< 1	0	< 1	0	< 1	0	< 1	0
			2010–2024	15	0	0	0	0	0	0	< 1	0	< 1	0
			2010–2039	30	2	0	3	0	3	0	10	< 1	7	< 1
			2010–2064	55	4	0	8	< 1	10	< 1	37	< 1	26	< 1
			2010–2114	105	18	< 1	31	< 1	36	< 1	104	1	77	< 1
			2010–new SS	> 3,000	75	< 1	117	1	139	1	344	3	265	3
11	**Foote Reservoir Spring** (steady-state simulated discharge in model cell(s) prior to 2010 = 2,110 acre-ft/yr as spring discharge)	UT 18-711, 18-255	2010–2014	5	-5	< -1	-5	< -1	-5	< -1	-5	< -1	-5	< -1
			2010–2019	10	-6	< -1	-4	< -1	-4	< -1	233	11	158	8
			2010–2024	15	-4	< -1	0	0	1	0	290	14	204	10
			2010–2039	30	7	< 1	20	< 1	25	1	393	19	289	14
			2010–2064	55	25	1	52	3	63	3	500	24	377	18
			2010–2114	105	52	3	93	4	111	5	611	29	466	22
			2010–new SS	> 3,000	90	4	148	7	175	8	745	35	577	27
12	**Twin Springs** (steady-state simulated discharge in model cell(s) prior to 2010 = 1,720 acre-ft/yr as spring discharge)	UT 18-476, 18-486	2010–2014	5	-5	< -1	-5	< -1	-5	< -1	-5	< -1	-5	< -1
			2010–2019	10	-6	< -1	-5	< -1	-4	< -1	42	2	24	1
			2010–2024	15	-5	< -1	-2	< -1	-2	< -1	83	5	48	3
			2010–2039	30	1	< 1	10	< 1	13	< 1	169	10	101	6
			2010–2064	55	15	< 1	32	2	38	2	260	15	163	10
			2010–2114	105	34	2	60	4	71	4	355	21	232	14
			2010–new SS	> 3,000	63	4	101	6	118	7	474	28	323	19

Table 4. Simulated capture of natural discharge from existing and proposed groundwater withdrawals (scenarios 1–5) at the groundwater discharge sites of interest to the Department of Interior agencies.—Continued

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Map ID	Site name	Water-right number	Simulation period	Years elapsed since start of 2010	Scenario 1		Scenario 2		Scenario 3		Scenario 4		Scenario 5	
					Simulated capture of natural discharge (acre-ft/yr)	Simulated capture (percent-age of total simulated natural discharge)	Simulated capture of natural discharge (acre-ft/yr)	Simulated capture (percent-age of total simulated natural discharge)	Simulated capture of natural discharge (acre-ft/yr)	Simulated capture (percent-age of total simulated natural discharge)	Simulated capture of natural discharge (acre-ft/yr)	Simulated capture (percent-age of total simulated natural discharge)	Simulated capture of natural discharge (acre-ft/yr)	Simulated capture (percent-age of total simulated natural discharge)
13	**Briggs Spring** (steady-state simulated discharge in model cell(s) prior to 2010 = 0 acre-ft/yr)	UT 18-604	2010–2014	5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
			2010–2019	10	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
			2010–2024	15	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
			2010–2039	30	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
			2010–2064	55	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
			2010–2114	105	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
			2010–new SS	> 3,000	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
14	**Phil Spring** (steady-state simulated discharge in model cell(s) prior to 2010 = 0 acre-ft/yr)	UT 18-742	2010–2014	5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
			2010–2019	10	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
			2010–2024	15	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
			2010–2039	30	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
			2010–2064	55	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
			2010–2114	105	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
			2010–new SS	> 3,000	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
15	**North Knoll Spring** (steady-state simulated discharge in model cell(s) prior to 2010 = 18 acre-ft/yr as ETg)	UT 18-535	2010–2014	5	0	0	0	0	0	0	0	0	0	0
			2010–2019	10	0	< -1	0	< -1	0	< -1	0	0	0	0
			2010–2024	15	0	< -1	0	< -1	0	< -1	0	< 1	0	< 1
			2010–2039	30	0	0	0	< 1	0	< 1	< 1	2	< 1	1
			2010–2064	55	< 1	< 1	< 1	< 1	< 1	< 1	< 1	4	< 1	3
			2010–2114	105	< 1	1	< 1	2	< 1	2	1	7	< 1	5
			2010–new SS	> 3,000	< 1	2	< 1	3	< 1	3	2	10	1	7
16	**Middle Knoll Spring** (steady-state simulated discharge in model cell(s) prior to 2010 = 19 acre-ft/yr as ETg)	UT 18-491	2010–2014	5	0	0	0	0	0	0	0	0	0	0
			2010–2019	10	0	0	0	0	0	0	0	< 1	0	0
			2010–2024	15	0	0	0	0	0	0	< 1	< 1	0	< 1
			2010–2039	30	0	< 1	< 1	< 1	< 1	< 1	< 1	2	< 1	1
			2010–2064	55	< 1	< 1	< 1	1	< 1	1	< 1	4	< 1	3
			2010–2114	105	< 1	2	< 1	2	< 1	2	1	7	1	5
			2010–new SS	> 3,000	< 1	3	< 1	4	< 1	4	2	10	2	8

Table 4. Simulated capture of natural discharge from existing and proposed groundwater withdrawals (scenarios 1–5) at the groundwater discharge sites of interest to the Department of Interior agencies.—Continued

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Map ID	Site name	Water-right number	Simulation period	Years elapsed since start of 2010	Scenario 1		Scenario 2		Scenario 3		Scenario 4		Scenario 5	
					Simulated capture of natural discharge (acre-ft/yr)	Simulated capture (percent-age of total simulated natural discharge)	Simulated capture of natural discharge (acre-ft/yr)	Simulated capture (percent-age of total simulated natural discharge)	Simulated capture of natural discharge (acre-ft/yr)	Simulated capture (percent-age of total simulated natural discharge)	Simulated capture of natural discharge (acre-ft/yr)	Simulated capture (percent-age of total simulated natural discharge)	Simulated capture of natural discharge (acre-ft/yr)	Simulated capture (percent-age of total simulated natural discharge)
17	**Knoll Spring** (steady-state simulated discharge in model cell(s) prior to 2010 = 24 acre-ft/yr as ETg)	UT 18-84	2010–2014	5	0	0	0	0	0	0	0	0	0	0
			2010–2019	10	0	0	0	0	0	0	0	< 1	0	0
			2010–2024	15	0	0	0	0	0	0	< 1	< 1	0	< 1
			2010–2039	30	< 1	< 1	< 1	< 1	< 1	< 1	< 1	2	< 1	1
			2010–2064	55	< 1	< 1	< 1	1	< 1	1	1	4	< 1	3
			2010–2114	105	< 1	2	< 1	2	< 1	2	2	7	1	5
			2010–new SS	> 3,000	< 1	3	< 1	3	< 1	4	2	9	2	7
18	**Unnamed Spring 1** (steady-state simulated discharge in model cell(s) prior to 2010 = 24 acre-ft/yr as ETg)	unknown	2010–2014	5	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1
			2010–2019	10	< 1	< 1	< 1	< 1	< 1	< 1	< 1	1	< 1	< 1
			2010–2024	15	< 1	1	< 1	1	< 1	2	1	2	< 1	2
			2010–2039	30	1	3	1	3	2	4	3	6	2	5
			2010–2064	55	2	5	2	5	3	6	4	10	4	9
			2010–2114	105	3	6	3	7	4	8	6	13	5	11
			2010–new SS	> 3,000	3	7	4	8	4	10	7	15	6	13
19 and 20	**Unnamed Spring 2 and Unnamed Spring 3** (steady-state simulated discharge in model cell(s) prior to 2010 = 0 acre-ft/yr)	unknown	2010–2014	5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
			2010–2019	10	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
			2010–2024	15	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
			2010–2039	30	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
			2010–2064	55	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
			2010–2114	105	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
			2010–new SS	> 3,000	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
21	**Want Spring** (steady-state simulated discharge in model cell(s) prior to 2010 = 0 acre-ft/yr)	NV R05275	2010–2014	5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
			2010–2019	10	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
			2010–2024	15	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
			2010–2039	30	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
			2010–2064	55	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
			2010–2114	105	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
			2010–new SS	> 3,000	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Table 4. Simulated capture of natural discharge from existing and proposed groundwater withdrawals (scenarios 1–5) at the groundwater discharge sites of interest to the Department of Interior agencies.—Continued

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Map ID	Site name	Water-right number	Simulation period	Years elapsed since start of 2010	Scenario 1		Scenario 2		Scenario 3		Scenario 4		Scenario 5	
					Simulated capture of natural discharge (acre-ft/yr)	Simulated capture (percentage of total simulated natural discharge)	Simulated capture of natural discharge (acre-ft/yr)	Simulated capture (percentage of total simulated natural discharge)	Simulated capture of natural discharge (acre-ft/yr)	Simulated capture (percentage of total simulated natural discharge)	Simulated capture of natural discharge (acre-ft/yr)	Simulated capture (percentage of total simulated natural discharge)	Simulated capture of natural discharge (acre-ft/yr)	Simulated capture (percentage of total simulated natural discharge)
22	**Kane Spring** (steady-state simulated discharge in model cell(s) prior to 2010 = 99 acre-ft/yr as ETg)	UT 18-406	2010–2014	5	0	0	0	0	0	0	0	0	0	0
			2010–2019	10	< 1	< 1	< 1	< 1	1	1	2	2	2	2
			2010–2024	15	2	2	2	2	3	3	5	5	4	5
			2010–2039	30	4	4	5	5	7	7	11	11	9	10
			2010–2064	55	7	7	8	8	10	10	15	15	13	13
			2010–2114	105	8	8	10	10	13	13	18	19	16	17
			2010–new SS	> 3,000	9	9	11	11	14	14	21	21	18	18
23	**Caine Spring** (steady-state simulated discharge in model cell(s) prior to 2010 = 78 acre-ft/yr as ETg)	unknown	2010–2014	5	2	2	2	2	2	2	2	2	2	2
			2010–2019	10	3	4	4	5	5	6	5	7	5	7
			2010–2024	15	5	6	5	7	7	9	9	11	8	11
			2010–2039	30	7	10	9	11	12	15	15	20	14	18
			2010–2064	55	10	13	12	15	15	19	20	26	18	24
			2010–2114	105	12	16	14	18	18	23	24	31	22	28
			2010–new SS	> 3,000	13	17	16	20	19	25	27	35	24	31
28	**Unnamed Spring 4** (steady-state simulated discharge in model cell(s) prior to 2010 = 0 acre-ft/yr)	unknown	2010–2014	5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
			2010–2019	10	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
			2010–2024	15	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
			2010–2039	30	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
			2010–2064	55	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
			2010–2114	105	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
			2010–new SS	> 3,000	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
29	**Upper Lehman Spring** (steady-state simulated discharge in model cell(s) prior to 2010 = 1,428 acre-ft/yr as spring discharge)	unknown	2010–2014	5	< 1	0	< 1	0	< 1	0	< 1	0	< 1	0
			2010–2019	10	< 1	0	< 1	0	< 1	0	< 1	0	< 1	0
			2010–2024	15	< 1	0	< 1	0	< 1	0	< 1	0	< 1	0
			2010–2039	30	1	< 1	1	< 1	1	< 1	1	< 1	1	< 1
			2010–2064	55	2	< 1	2	< 1	2	< 1	2	< 1	2	< 1
			2010–2114	105	0	0	< 1	0	< 1	0	< 1	0	< 1	0
			2010–new SS	> 3,000	3	< 1	4	< 1	4	< 1	7	< 1	6	< 1

Table 4. Simulated capture of natural discharge from existing and proposed groundwater withdrawals (scenarios 1–5) at the groundwater discharge sites of interest to the Department of Interior agencies.—Continued

[Water-right number: Water-right numbers are preceded by state abbreviation. Negative values (in red) indicate an increase in simulated discharge and no capture. Values of "< 1" indicate less than 1 acre-foot per year or percent but greater than 0 acre-foot per year or percent decrease in simulated natural discharge (or capture). Values of "< -1" indicate less than 1 acre-foot per year or percent but greater than 0 acre-foot per year or percent increase in simulated discharge and no capture. **Abbreviations:** ID, identification; acre-ft/yr, acre-feet per year; ETg, groundwater evapotranspiration; N/A, not applicable; NV, Nevada; UT, Utah; new SS, new steady state; <, less than; >, greater than]

Map ID	Site name	Water-right number	Simulation period	Years elapsed since start of 2010	Scenario 1		Scenario 2		Scenario 3		Scenario 4		Scenario 5	
					Simulated capture of natural discharge (acre-ft/yr)	Simulated capture (percentage of total simulated natural discharge)	Simulated capture of natural discharge (acre-ft/yr)	Simulated capture (percentage of total simulated natural discharge)	Simulated capture of natural discharge (acre-ft/yr)	Simulated capture (percentage of total simulated natural discharge)	Simulated capture of natural discharge (acre-ft/yr)	Simulated capture (percentage of total simulated natural discharge)	Simulated capture of natural discharge (acre-ft/yr)	Simulated capture (percentage of total simulated natural discharge)
30	**Rowland Springs** (steady-state simulated discharge in model cell(s) prior to 2010 = 1,549 acre-ft/yr as spring discharge)	NV V10164	2010–2014	5	< 1	0	< 1	0	< 1	0	< 1	0	< 1	0
			2010–2019	10	< 1	0	< 1	0	< 1	0	< 1	0	< 1	0
			2010–2024	15	< 1	< 1	< 1	< 1	< 1	< 1	1	< 1	1	< 1
			2010–2039	30	3	< 1	3	< 1	3	< 1	3	< 1	3	< 1
			2010–2064	55	6	< 1	6	< 1	7	< 1	8	< 1	8	< 1
			2010–2114	105	11	< 1	11	< 1	12	< 1	15	1	14	< 1
			2010–new SS	> 3,000	13	< 1	15	< 1	15	1	22	1	19	1
31	**Kious Spring** (steady-state simulated discharge in model cell(s) prior to 2010 = 0 acre-ft/yr)	unknown	2010–2014	5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
			2010–2019	10	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
			2010–2024	15	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
			2010–2039	30	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
			2010–2064	55	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
			2010–2114	105	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
			2010–new SS	> 3,000	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
32	**Mahogany Spring** (steady-state simulated discharge in model cell(s) prior to 2010 = 0 acre-ft/yr)	unknown	2010–2014	5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
			2010–2019	10	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
			2010–2024	15	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
			2010–2039	30	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
			2010–2064	55	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
			2010–2114	105	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
			2010–new SS	> 3,000	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
34	**Spring Creek Spring** (steady-state simulated discharge in model cell(s) prior to 2010 = 1,455 acre-ft/yr as spring discharge)	unknown	2010–2014	5	< 1	0	< 1	0	< 1	0	< 1	0	< 1	0
			2010–2019	10	< 1	0	< 1	< 1	< 1	0	1	< 1	1	< 1
			2010–2024	15	< 1	< 1	1	< 1	1	< 1	3	< 1	2	< 1
			2010–2039	30	3	< 1	4	< 1	4	< 1	12	< 1	9	< 1
			2010–2064	55	4	< 1	8	< 1	6	< 1	27	2	19	1
			2010–2114	105	9	< 1	17	1	15	1	53	4	39	3
			2010–new SS	> 3,000	< 1	0	20	1	17	1	86	6	58	4

Table 4. Simulated capture of natural discharge from existing and proposed groundwater withdrawals (scenarios 1–5) at the groundwater discharge sites of interest to the Department of Interior agencies.—Continued

[Water-right number: Water-right numbers are preceded by state abbreviation. Negative values (in red) indicate an increase in simulated discharge and no capture. Values of "< 1" indicate less than 1 acre-foot per year or percent but greater than 0 acre-foot per year or percent decrease in simulated natural discharge (or capture). Values of "< -1" indicate less than 1 acre-foot per year or percent but greater than 0 acre-foot per year or percent increase in simulated discharge and no capture. **Abbreviations:** ID, identification; acre-ft/yr, acre-feet per year; ETg, groundwater evapotranspiration; N/A, not applicable; NV, Nevada; UT, Utah; new SS, new steady state; <, less than; >, greater than]

Map ID	Site name	Water-right number	Simulation period	Years elapsed since start of 2010	Scenario 1		Scenario 2		Scenario 3		Scenario 4		Scenario 5	
					Simulated capture of natural discharge (acre-ft/yr)	Simulated capture (percentage of total simulated natural discharge)	Simulated capture of natural discharge (acre-ft/yr)	Simulated capture (percentage of total simulated natural discharge)	Simulated capture of natural discharge (acre-ft/yr)	Simulated capture (percentage of total simulated natural discharge)	Simulated capture of natural discharge (acre-ft/yr)	Simulated capture (percentage of total simulated natural discharge)	Simulated capture of natural discharge (acre-ft/yr)	Simulated capture (percentage of total simulated natural discharge)
35	**Diversion from Lake Creek 1** (steady-state simulated discharge in model cell(s) prior to 2010 = 54 acre-ft/yr as ETg)	UT 18-620	2010–2014	5	< -1	-1	< -1	-1	< -1	-1	< -1	-1	< -1	-1
			2010–2019	10	< -1	< -1	< -1	< -1	< -1	< -1	2	4	1	2
			2010–2024	15	< 1	< 1	< 1	1	< 1	< 1	5	10	3	6
			2010–2039	30	2	4	3	6	2	4	12	21	8	15
			2010–2064	55	4	7	5	10	4	8	17	32	12	23
			2010–2114	105	5	9	7	13	6	11	22	41	16	30
			2010–new SS	> 3,000	4	7	8	14	7	12	27	50	19	35
36	**Diversion from Lake Creek 2** (steady-state simulated discharge in model cell(s) prior to 2010 = 7 acre-ft/yr as ETg)	UT 18-621	2010–2014	5	0	0	0	0	0	0	0	0	0	0
			2010–2019	10	0	0	0	0	0	0	0	0	0	0
			2010–2024	15	0	0	0	0	0	0	0	0	0	0
			2010–2039	30	0	0	0	0	0	0	0	0	0	0
			2010–2064	55	0	0	0	0	0	0	0	0	0	0
			2010–2114	105	0	0	0	0	0	0	0	0	0	0
			2010–new SS	> 3,000	0	0	0	0	0	0	0	0	0	0
37	**Clay Spring** (steady-state simulated discharge in model cell(s) prior to 2010 = 247 acre-ft/yr as spring discharge)	unknown	2010–2014	5	< -1	< -1	< -1	< -1	< -1	< -1	< -1	< -1	< -1	< -1
			2010–2019	10	3	1	8	3	8	3	57	23	38	15
			2010–2024	15	9	4	21	8	20	8	92	37	65	27
			2010–2039	30	25	10	49	20	46	19	166	67	121	49
			2010–2064	55	35	14	72	29	67	27	233	95	171	69
			2010–2114	105	34	14	85	34	78	32	247	100	208	84
			2010–new SS	> 3,000	8	3	84	34	77	31	247	100	239	97
39	**Dearden Spring Group** (steady-state simulated discharge in model cell(s) prior to 2010 = 6,807 acre-ft/yr as spring discharge)	UT 18-684	2010–2014	5	61	< 1	61	< 1	61	< 1	61	< 1	61	< 1
			2010–2019	10	-22	< -1	-5	< -1	-5	< -1	33	< 1	19	< 1
			2010–2024	15	-85	-1	-50	< -1	-50	< -1	25	< 1	-3	0
			2010–2039	30	-197	-3	-116	-2	-118	-2	53	< 1	-11	< -1
			2010–2064	55	-280	-4	-149	-2	-154	-2	119	2	17	< 1
			2010–2114	105	-354	-5	-174	-3	-181	-3	197	3	54	< 1
			2010–new SS	> 3,000	-494	-7	-213	-3	-225	-3	355	5	127	2

Table 4. Simulated capture of natural discharge from existing and proposed groundwater withdrawals (scenarios 1–5) at the groundwater discharge sites of interest to the Department of Interior agencies. —Continued

[Water-right number: Water-right numbers are preceded by state abbreviation. Negative values (in red) indicate an increase in simulated discharge and no capture. Values of "< 1" indicate less than 1 acre-foot per year or percent but greater than 0 acre-foot per year or percent decrease in simulated natural discharge (or capture). Values of "< -1" indicate less than 1 acre-foot per year or percent but greater than 0 acre-foot per year or percent increase in simulated discharge and no capture. **Abbreviations:** ID, identification; acre-ft/yr, acre-feet per year; ETg, groundwater evapotranspiration; N/A, not applicable; NV, Nevada; UT, Utah; new SS, new steady state; <, less than; >, greater than]

Map ID	Site name	Water-right number	Simulation period	Years elapsed since start of 2010	Scenario 1		Scenario 2		Scenario 3		Scenario 4		Scenario 5	
					Simulated capture of natural discharge (acre-ft/yr)	Simulated capture (percent-age of total simulated natural discharge)	Simulated capture of natural discharge (acre-ft/yr)	Simulated capture (percent-age of total simulated natural discharge)	Simulated capture of natural discharge (acre-ft/yr)	Simulated capture (percent-age of total simulated natural discharge)	Simulated capture of natural discharge (acre-ft/yr)	Simulated capture (percent-age of total simulated natural discharge)	Simulated capture of natural discharge (acre-ft/yr)	Simulated capture (percent-age of total simulated natural discharge)
40	**Needle Point Spring** (steady-state simulated discharge in model cell(s) prior to 2010 = 7 acre-ft/yr as ETg)	UT 18-571	2010–2014	5	0	0	0	0	0	0	0	0	0	0
			2010–2019	10	0	0	0	0	0	0	0	0	0	0
			2010–2024	15	0	0	0	0	0	0	0	0	0	0
			2010–2039	30	0	0	0	0	0	0	0	0	0	0
			2010–2064	55	0	0	0	0	0	0	0	0	0	0
			2010–2114	105	0	0	0	0	0	0	0	0	0	0
			2010–new SS	> 3,000	0	0	0	0	0	0	0	0	0	0
43	**Unnamed Spring 5** (steady-state simulated discharge in model cell(s) prior to 2010 = 7 acre-ft/yr as ETg)	NV R05271	2010–2014	5	0	0	0	0	0	0	0	0	0	0
			2010–2019	10	0	0	0	0	0	0	0	0	0	0
			2010–2024	15	0	0	0	0	0	0	0	0	0	0
			2010–2039	30	0	0	0	0	0	0	0	0	0	0
			2010–2064	55	0	0	0	0	0	0	0	0	0	0
			2010–2114	105	0	0	0	0	0	0	0	0	0	0
			2010–new SS	> 3,000	0	0	0	0	0	0	0	0	0	0
45	**Big Springs** (steady-state simulated discharge in model cell(s) prior to 2010 = 8,394 acre-ft/yr as spring discharge)	unknown	2010–2014	5	-21	< -1	-21	< -1	-21	< -1	-21	< -1	-21	< -1
			2010–2019	10	-64	< -1	-49	< -1	-49	< -1	-47	< -1	-48	< -1
			2010–2024	15	-105	-1	-74	< -1	-74	< -1	-66	< -1	-69	< -1
			2010–2039	30	-223	-3	-145	-2	-146	-2	-111	-1	-124	-2
			2010–2064	55	-363	-4	-226	-3	-228	-3	-134	-2	-170	-2
			2010–2114	105	-508	-6	-298	-4	-302	-4	-101	-1	-177	-2
			2010–new SS	> 3,000	-902	-11	-450	-5	-465	-6	171	2	-81	-1
46	**Wah Wah Springs** (steady-state simulated discharge in model cell(s) prior to 2010 = 721 acre-ft/yr as spring discharge)	UT 69-1, 69-107, 69-108, 69-19, 69-33	2010–2014	5	4	< 1	4	< 1	4	< 1	4	< 1	4	< 1
			2010–2019	10	4	< 1	4	< 1	4	< 1	4	< 1	4	< 1
			2010–2024	15	4	< 1	4	< 1	4	< 1	4	< 1	4	< 1
			2010–2039	30	1	< 1	1	< 1	1	< 1	2	< 1	2	< 1
			2010–2064	55	1	< 1	3	< 1	3	< 1	5	< 1	4	< 1
			2010–2114	105	-10	-1	-2	< -1	-3	< -1	9	1	5	< 1
			2010–new SS	> 3,000	-144	-20	-48	-7	-51	-7	120	17	53	7

Table 4. Simulated capture of natural discharge from existing and proposed groundwater withdrawals (scenarios 1–5) at the groundwater discharge sites of interest to the Department of Interior agencies.—Continued

[Water-right number: Water-right numbers are preceded by state abbreviation. Negative values (in red) indicate an increase in simulated discharge and no capture. Values of "< 1" indicate less than 1 acre-foot per year or percent but greater than 0 acre-foot per year or percent decrease in simulated natural discharge (or capture). Values of "< -1" indicate less than 1 acre-foot per year or percent but greater than 0 acre-foot per year or percent increase in simulated discharge and no capture. **Abbreviations:** ID, identification; acre-ft/yr, acre-feet per year; ETg, groundwater evapotranspiration; N/A, not applicable; NV, Nevada; UT, Utah; new SS, new steady state; <, less than; >, greater than]

Map ID	Site name	Water-right number	Simulation period	Years elapsed since start of 2010	Scenario 1		Scenario 2		Scenario 3		Scenario 4		Scenario 5	
					Simulated capture of natural discharge (acre-ft/yr)	Simulated capture (percentage of total simulated natural discharge)	Simulated capture of natural discharge (acre-ft/yr)	Simulated capture (percentage of total simulated natural discharge)	Simulated capture of natural discharge (acre-ft/yr)	Simulated capture (percentage of total simulated natural discharge)	Simulated capture of natural discharge (acre-ft/yr)	Simulated capture (percentage of total simulated natural discharge)	Simulated capture of natural discharge (acre-ft/yr)	Simulated capture (percentage of total simulated natural discharge)
fish	**Fish Springs** (steady-state simulated discharge in model cell(s) prior to 2010 = 25,010 acre-ft/yr as spring discharge)	UT 18-215, 18-66, 18-51	2010–2014	5	8	0	8	0	8	0	8	0	8	0
			2010–2019	10	15	< 1	16	< 1	16	< 1	16	< 1	16	< 1
			2010–2024	15	21	< 1	23	< 1	23	< 1	23	< 1	23	< 1
			2010–2039	30	39	< 1	43	< 1	43	< 1	44	< 1	44	< 1
			2010–2064	55	67	< 1	76	< 1	76	< 1	81	< 1	79	< 1
			2010–2114	105	119	< 1	137	< 1	140	< 1	162	< 1	154	< 1
			2010–new SS	> 3,000	326	1	399	2	416	2	596	2	526	2
gran_trout	**Granite and Trout Creeks** (steady-state simulated discharge in model cell(s) prior to 2010 = 1,405 acre-ft/yr as discharge to streams)	unknown	2010–2014	5	< -1	0	< -1	0	< -1	0	< -1	0	< -1	0
			2010–2019	10	< -1	0	< -1	0	< -1	0	< -1	0	< -1	0
			2010–2024	15	< -1	0	< -1	0	< -1	0	< -1	0	< -1	0
			2010–2039	30	< -1	0	0	0	0	0	0	0	0	0
			2010–2064	55	< 1	0	< 1	0	< 1	0	< 1	0	< 1	0
			2010–2114	105	< 1	< 1	1	< 1	1	< 1	1	< 1	1	< 1
			2010–new SS	> 3,000	4	< 1	5	< 1	5	< 1	7	< 1	6	< 1
str_bak_snk	**Strawberry, Baker, and Snake Creeks** (steady-state simulated discharge in model cell(s) prior to 2010 = 1,778 acre-ft/yr as discharge to streams)	unknown; NV V01066; UT 18-11, 18-12, 18-249, 18-250, 18-251, 18-257; NV C3863	2010–2014	5	< -1	0	< -1	0	< -1	0	< -1	0	< -1	0
			2010–2019	10	< -1	0	< -1	0	< -1	0	< -1	0	< -1	0
			2010–2024	15	< -1	0	< -1	0	< -1	0	< -1	0	< -1	0
			2010–2039	30	< 1	0	< 1	0	< 1	< 1	< 1	< 1	< 1	< 1
			2010–2064	55	2	< 1	2	< 1	2	< 1	2	< 1	2	< 1
			2010–2114	105	2	< 1	3	< 1	3	< 1	4	< 1	3	< 1
			2010–new SS	> 3,000	2	< 1	4	< 1	4	< 1	8	< 1	7	< 1

Table 5. Simulated decrease (-) or increase (+) of natural discharge compared to initial (prior to 2010) simulated discharge from existing and proposed groundwater withdrawals (scenarios 1–5 and 3e) for the study area.

[**Abbreviations:** ETg, groundwater evapotranspiration]

Discharge type	Simulated decrease (-) or increase (+) in natural discharge rates from 2009 to new steady-state conditions, in percent					
	Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5	Scenario 3e
ETg	-4	-5	-5	-9	-8	-5
Spring flow	+4	+2	+2	-3	-2	+2
Discharge to streams	-0.2	-0.3	-0.3	-0.5	-0.4	-0.3

Scenario 2

Scenario 2 simulates the effects of existing groundwater withdrawals plus proposed withdrawals from approved, but not yet developed (ABNYD), water rights (as of the beginning of 2015) in the study area to determine the potential effects of withdrawals likely to be developed in the near future. It was assumed that these withdrawals began in 2015. Locations and amounts of the additional ABNYD simulated withdrawals used in scenario 2 are summarized in figure 5 and table 6, respectively.

Increases in simulated drawdowns following the addition of the ABNYD withdrawals range from 0 to 6 ft, compared to scenario 1 (table 3), at the groundwater discharge sites of interest to the DOI agencies. The largest increase in simulated drawdowns compared to scenario 1 occurs at Unnamed Spring 5 (site 43). Other sites where simulated drawdowns increase by greater than 2 ft following the addition of the ABNYD withdrawals after 105 years (from the start of 2010) include Lime Spring (site 2), Snake Valley South Spring Complex (site 4), Davies Well 1 (site 38), Needle Point Spring (site 40), Davies Well 2 (site 41), Needle Point Well (site 42), and Cove Well (site 44). Figure 6 shows the distribution of simulated drawdowns after 105 years (from the start of 2010) resulting from the combination of existing and ABNYD withdrawals across the study area. Figure 7 shows the same results at a larger scale for an area near Partoun containing several springs (sites 3–12 and gandySMLC) that are identified as important habitats for sensitive species by the DOI agencies, and figure 8 shows the same results at a larger scale for an area near Eskdale.

Increases in simulated capture of natural discharge following the addition of the ABNYD withdrawals range from 0 to 32 percent, compared to scenario 1 (table 4), at the groundwater discharge sites of interest to the DOI agencies. The percentage of simulated capture increases most at Miller Spring (site 6), where simulated capture increases 27 percent (for a total simulated capture of 72 percent) of the total simulated spring discharge in the model cell (304 acre-ft/yr) compared to scenario 1 after 105 years (from the start of 2010) of withdrawals, and increases 32 percent (for a total simulated capture of 87 percent) compared to scenario 1 after reaching a new steady state. Other sites where simulated capture increases 15 percent or more after 105 years (from the start of 2010) following the addition of the ABNYD withdrawals include Snake Valley North Spring Complex (site 3, simulated capture increases by 20 percent), Snake Valley South Spring Complex (site 4, simulated capture increases by 16 percent), and Clay Spring (site 37, simulated capture increases by 20 percent). Table 5 summarizes the simulated capture of natural discharge for the study area.

Table 6. Withdrawal amounts used to simulate proposed withdrawals from approved, but not yet developed, water rights (scenarios 2–5) beginning in 2015 in the Snake Valley area groundwater model.

[Figure 5 shows the location of the sites. Water-right number: Water-right numbers are preceded by state abbreviation. **Abbreviations:** acre-ft/yr, acre-feet per year; UTDWR, Utah Division of Water Rights; NVDWR, Nevada Division of Water Resources; NV, Nevada; UT, Utah]

Agency	Water-right number	Simulated withdrawals (acre-ft/yr)
UTDWR	UT 18-750	406.05
UTDWR	UT 18-638	15.94
UTDWR	UT 18-755	332.65
UTDWR	UT 18-721	400
UTDWR	[1] UT 18-749	275.03
		275.03
UTDWR	UT 18-757	10
NVDWR	NV 85148T; 85149T; 85150T	240
NVDWR	NV 85147T	120
NVDWR	NV 84949T	80
NVDWR	NV 85304T	180
NVDWR	NV 84905T	80
NVDWR	NV 84951T	80
NVDWR	NV 85146T	90

[1] Water right lists two points of diversion; split total water right of 550.06 acre-ft/yr equally between the points of diversion.

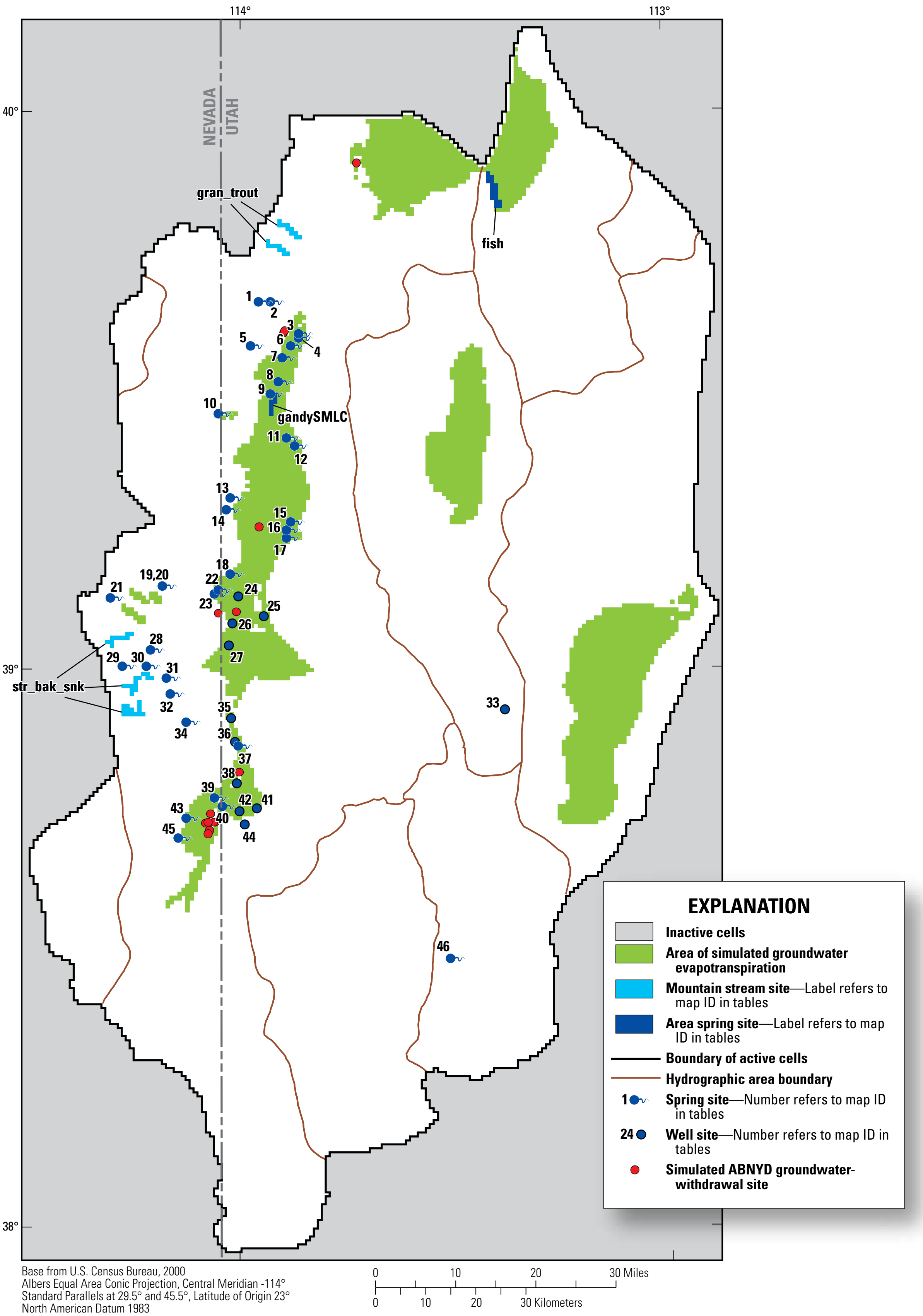


Figure 5. Groundwater discharge sites of interest to the Department of Interior agencies, and simulated approved, but not yet developed (ABNYD), groundwater-withdrawal sites used in the Snake Valley area groundwater model.

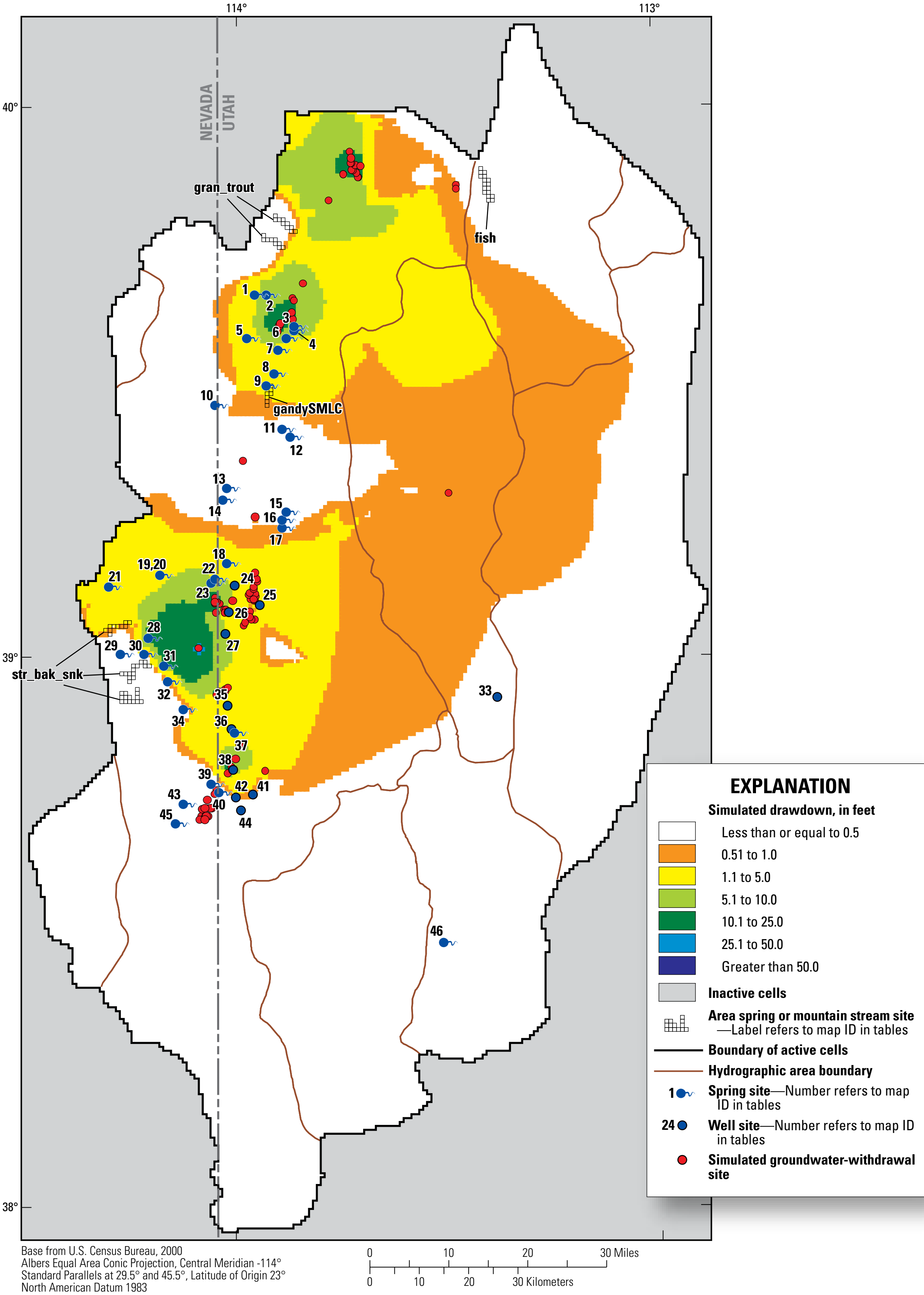


Figure 6. Groundwater discharge sites of interest to the Department of Interior agencies, simulated groundwater-withdrawal sites, and simulated drawdowns of the water table after 105 years (from the start of 2010) of groundwater withdrawals under scenario 2 from the Snake Valley area groundwater model.

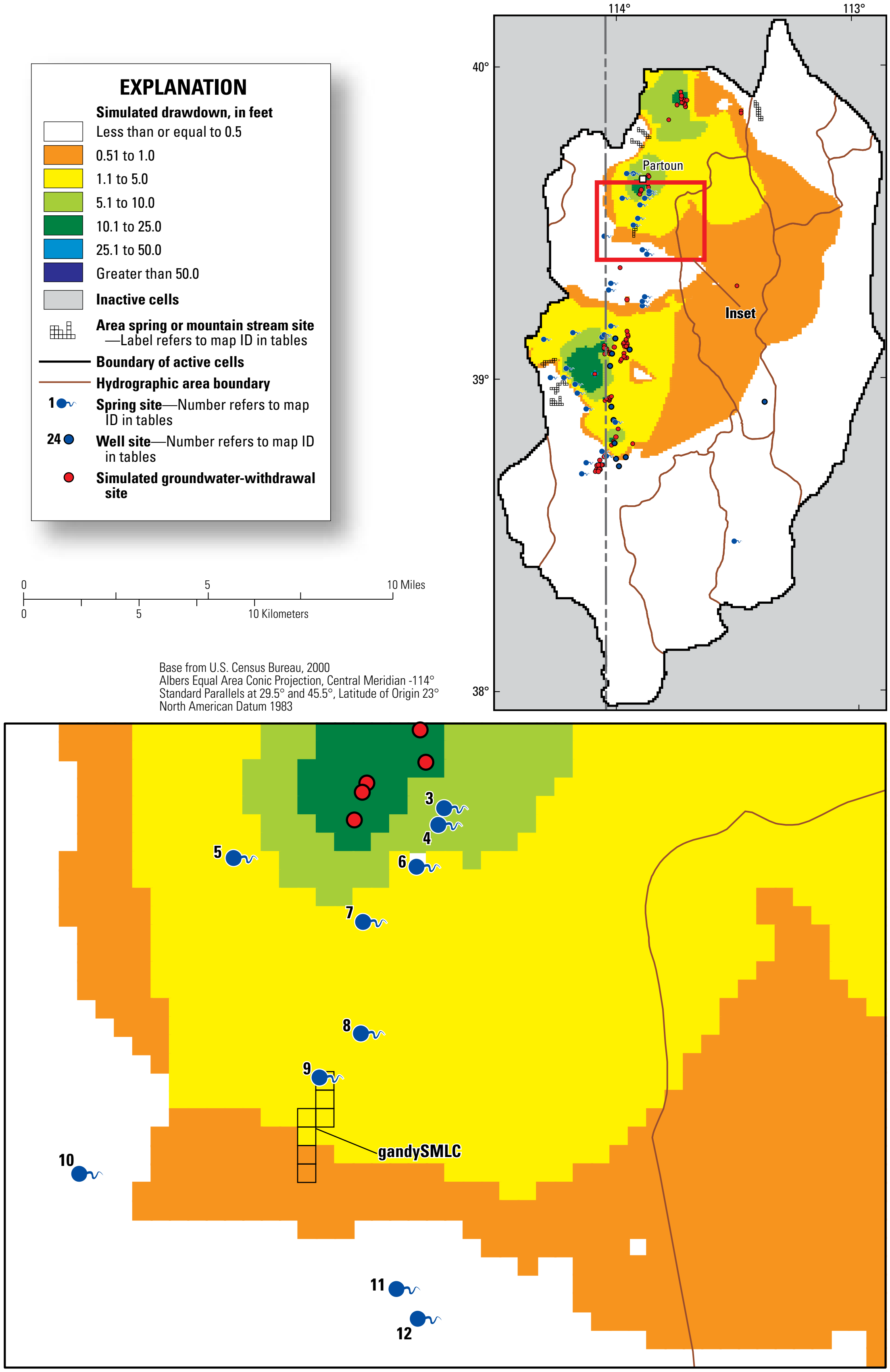


Figure 7. Groundwater discharge sites of interest to the Department of Interior agencies, simulated groundwater-withdrawal sites, and simulated drawdowns of the water table near Partoun, Utah, after 105 years (from the start of 2010) of groundwater withdrawals under scenario 2 from the Snake Valley area groundwater model.

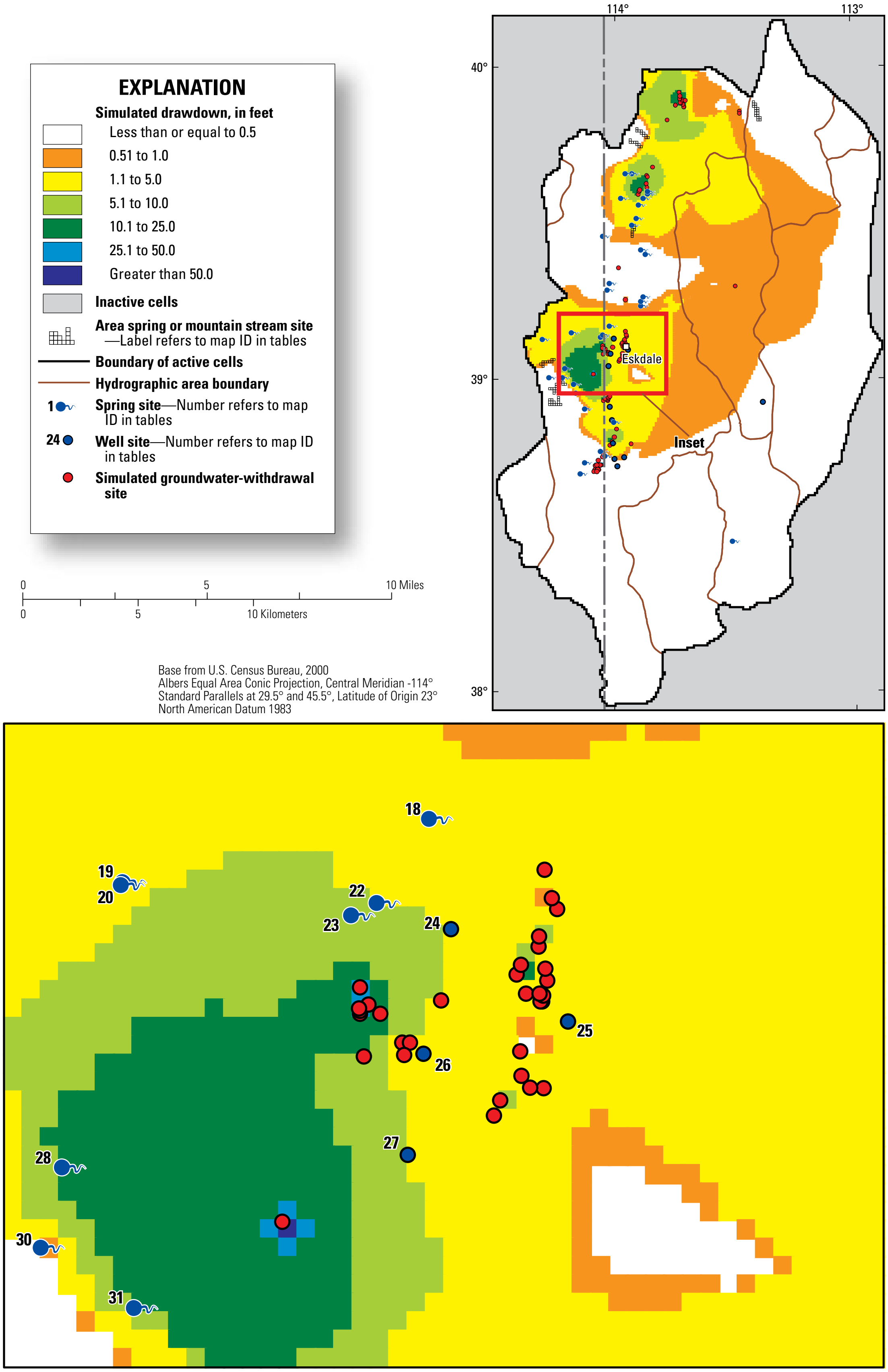


Figure 8. Groundwater discharge sites of interest to the Department of Interior agencies, simulated groundwater-withdrawal sites, and simulated drawdowns of the water table near Eskdale, Utah, after 105 years (from the start of 2010) of groundwater withdrawals under scenario 2 from the Snake Valley area groundwater model.

Scenario 3

Scenario 3 simulates the potential effects of existing groundwater withdrawals coupled with proposed withdrawals from the ABNYD water rights and not yet approved “other” water-right and change applications (excluding the 2005 applications) in the study area. The other water-right and change applications include the three new water-right applications and change application that were the subject of the April 19, 2016 hearing in Utah and eight change applications and one water-right application filed in Nevada. These other proposed withdrawals are simulated as starting in 2015. Locations and amounts of the other simulated withdrawals used in scenario 3 are summarized in figure 9 and table 7, respectively. Any adjustments to existing withdrawals because of the change applications are also summarized in table 7.

Increases in simulated drawdowns following the addition of the other withdrawals range from 0 to 3 ft, compared to scenario 2 (table 3), at the groundwater discharge sites of interest to the DOI agencies. The largest increases occur at Lime Spring (site 2). Other sites where simulated drawdowns increase by 2 ft or more after 105 years (from the start of 2010) following the addition of the other groundwater withdrawals include South Seeps (site 1) and Snake Valley North Spring Complex (site 3). Figure 10 shows the distribution of simulated drawdowns after 105 years (from the start of 2010) resulting from the combination of existing, ABNYD, and other withdrawals across the study area.

Increases in simulated capture of natural discharge following the addition of the other withdrawals range from 0 to 17 percent, compared to scenario 2 (table 4), at the groundwater discharge sites of interest to the DOI agencies. The percentage of simulated capture increases most at Snake Valley North Spring Complex (site 3), where simulated capture increases 13 percent (for a total simulated capture of 70 percent) of the total simulated spring discharge in the model cell (19 acre-ft/yr) compared to scenario 2 after 105 years (from the start of 2010) of withdrawals and increases 17 percent (for a total simulated capture of 88 percent) after reaching a new steady state. Other sites where simulated capture increases 10 percent or more after 105 years (from the start or 2010) following the addition of the other withdrawals include Snake Valley South Spring Complex (site 4, simulated capture increases by 11 percent) and Miller Spring (site 6, simulated capture increases by 14 percent). Table 5 summarizes the simulated capture of natural discharge for the study area.

Table 7. Withdrawal amounts used to simulate proposed withdrawals from not yet approved other water-right and change applications (scenarios 3–5) beginning in 2015 in the Snake Valley area groundwater model.

[Figure 9 shows the location of the sites. Water-right or change application number: Water-right or change application numbers are preceded by state abbreviation. **Abbreviations:** acre-ft/yr, acre-feet per year; UTDWR, Utah Division of Water Rights; USGS, U.S. Geological Survey; NVDWR, Nevada Division of Water Resources; NV, Nevada; UT, Utah]

Agency	Water-right or change application number	Simulated withdrawals (acre-ft/yr)	Adjustments to existing simulated withdrawals
UTDWR	UT 18-756	320.56	new water-right application; no adjustments needed
UTDWR	UT 18-758	99.2	new water-right application; no adjustments needed
UTDWR	UT 18-759	144	new water-right application; no adjustments needed
UTDWR	UT a40687	396	change application; removed simulated withdrawals from two of the existing USGS wells
NVDWR	NV 83217, NV 83218	393.2	change applications; reduced simulated withdrawals from NV 69873 and 69874 by the total of these amounts
NVDWR	NV 83219, NV 83220	393.2	
NVDWR	NV 83327, NV 83328	482.68	
NVDWR	NV 84646, NV 84647	370.15	
NVDWR	NV 84058	594.69	

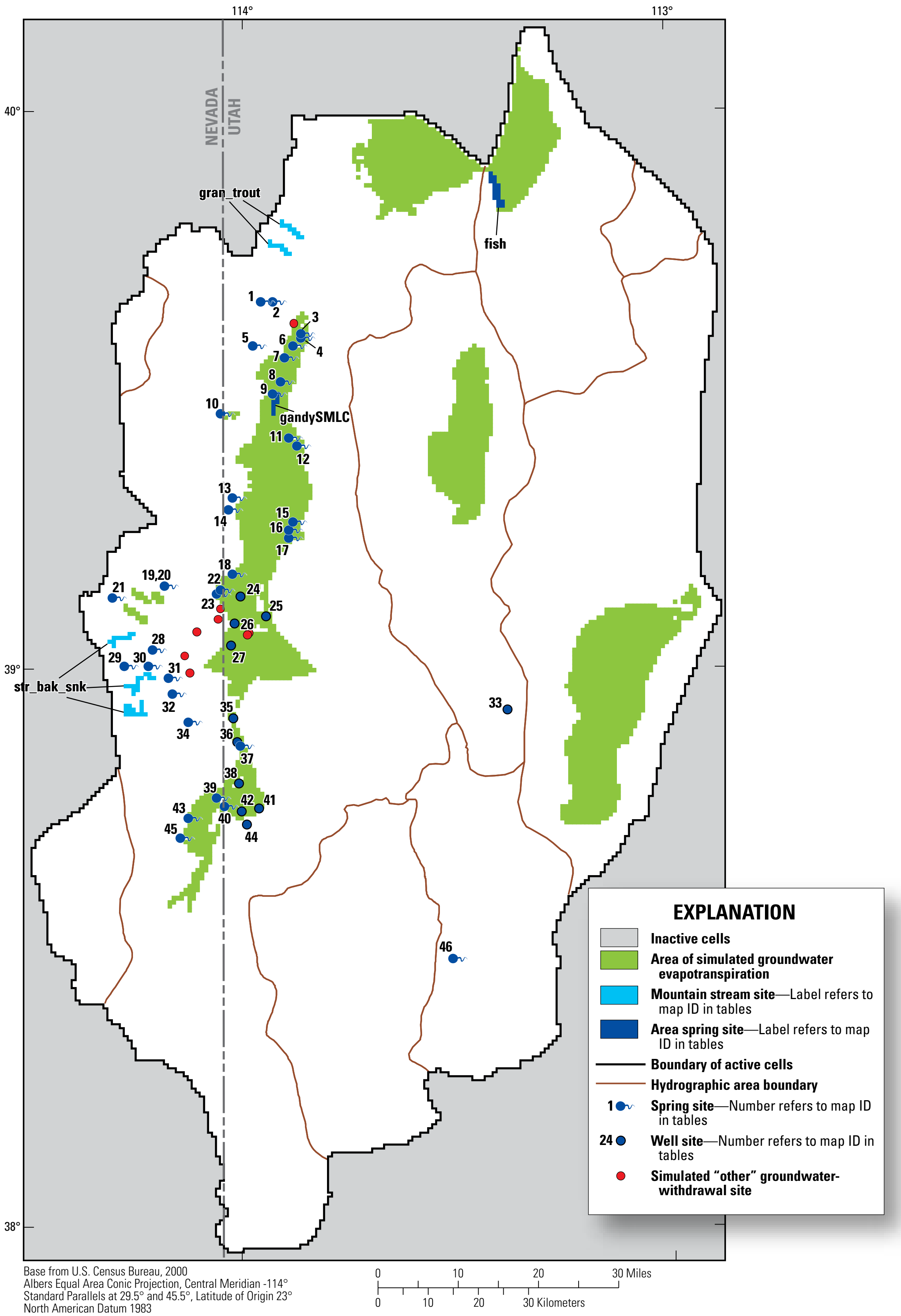


Figure 9. Groundwater discharge sites of interest to the Department of Interior agencies and not yet approved groundwater-withdrawal sites for other water-right and change applications used in the Snake Valley area groundwater model.

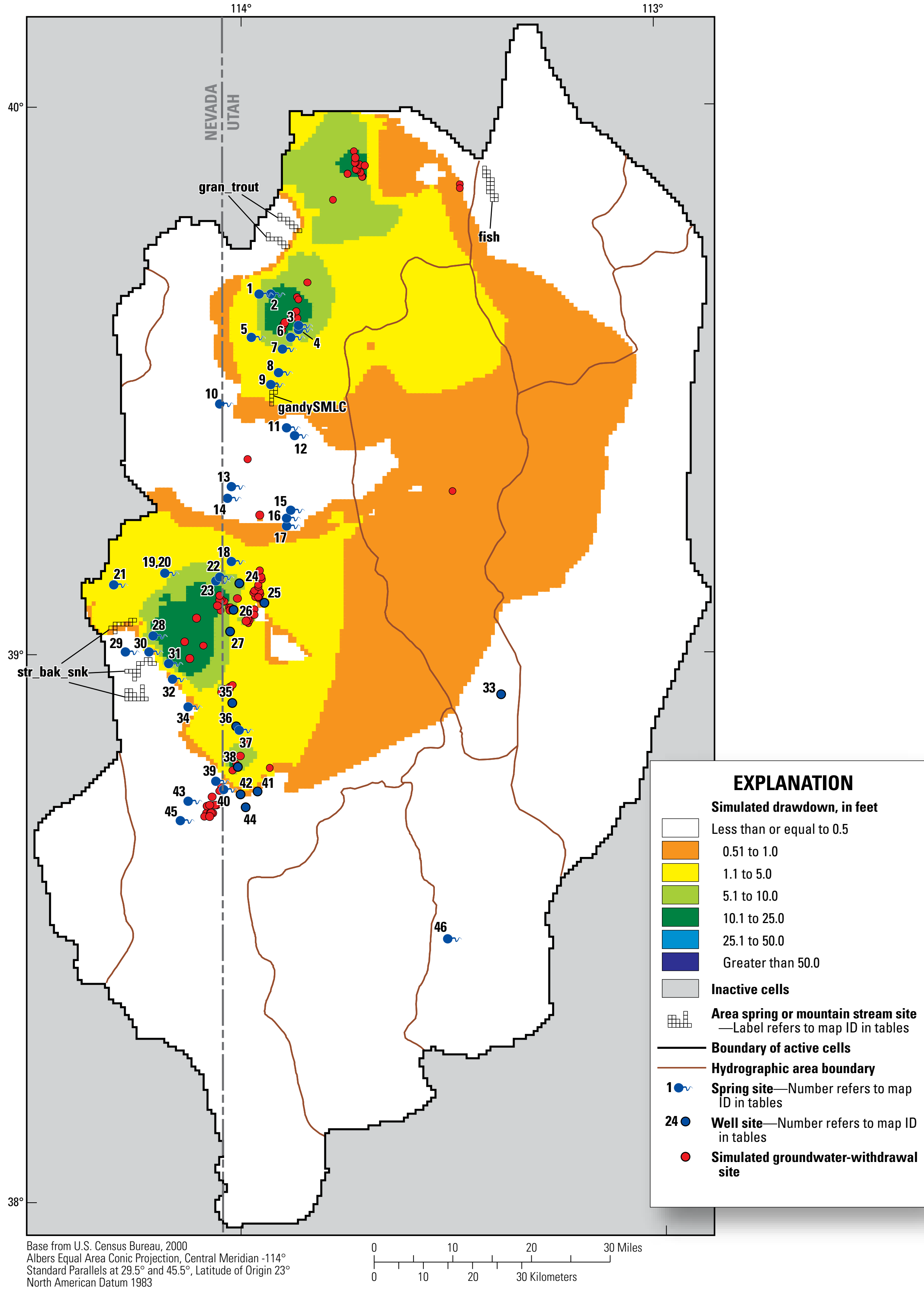


Figure 10. Groundwater discharge sites of interest to the Department of Interior agencies, simulated groundwater-withdrawal sites, and simulated drawdowns of the water table after 105 years (from the start of 2010) of groundwater withdrawals under scenario 3 from the Snake Valley area groundwater model.

Scenario 4

Scenario 4 simulates the effects of existing groundwater withdrawals coupled with proposed withdrawals from the ABNYD, other, and "maximum 2005 applications" water rights in the study area to determine the potential maximum effects of development of the 2005 applications. The total ("maximum") amount of withdrawals applied for in the 2005 applications is 8,864 acre-ft/yr. The proposed withdrawals from the maximum 2005 applications are simulated as starting in 2015. Locations and amounts of the simulated withdrawals for the maximum 2005 applications used in scenario 4 are summarized in figure 11 and table 8, respectively.

Increases in simulated drawdowns following the addition of the maximum withdrawals from the 2005 applications range from 0 to 20 ft, compared to scenario 3 (table 3), at the groundwater discharge sites of interest to the DOI agencies. The largest increases occur at Snake Valley North Spring Complex (site 3). Other sites where simulated drawdown increases more than 5 ft after 105 years (from the start of 2010) following the addition of the maximum withdrawals from the 2005 applications include South Seeps (site 1), Lime Spring (site 2), Snake Valley South Spring Complex (site 4), Miller Spring (site 6), Leland Harris Spring Complex (site 7), Diversion from Lake Creek 1 (site 35), Diversion from Lake Creek 2 (site 36), Davies Well 1 (site 38), Needle Point Spring (site 40), Davies Well 2 (site 41), Needle Point Well (site 42), and Cove Well (site 44). Figure 12 shows the distribution of simulated drawdowns after 105 years resulting from the combination of existing, ABNYD, other, and maximum 2005 applications withdrawals across the study area. Figure 13 shows the same results at a larger scale for an area near Partoun containing several springs (sites 3–12 and gandySMLC) that have been identified as important habitats for sensitive species by the DOI agencies, and figure 14 shows the same results at a larger scale for an area near Eskdale.

Increases in simulated capture of natural discharge following the addition of the maximum withdrawals from the 2005 applications range from 0 to 69 percent, compared to scenario 3 (table 4), at the groundwater discharge sites of interest to the DOI agencies. The percentage of simulated capture increases most at Clay Spring (site 37) at the new steady-state conditions. At Clay Springs and several other sites, the total simulated capture after 30, 55, or 105 years of withdrawals was 100 percent of the total natural discharge simulated for that model cell. These other sites include Snake Valley North Spring Complex (site 3), Snake Valley South Spring Complex (site 4), and Miller Spring (site 6). Table 5 summarizes the simulated capture of natural discharge for the study area.

Table 8. Withdrawal amounts used to simulate proposed withdrawals from the 2005 applications (scenarios 4 and 5) beginning in 2015 in the Snake Valley area groundwater model.

[Figure 11 shows the location of the sites. Water-right number: Water-right numbers are preceded by state abbreviation. **Abbreviations:** acre-ft/yr, acre-feet per year; UTDWR, Utah Division of Water Rights; UT, Utah]

Agency	Water-right number	Maximum simulated withdrawals (acre-ft/yr)[1]	Minimum simulated withdrawals (acre-ft/yr)[2]
UTDWR	UT 18-686	640	400
UTDWR	[3] UT 18-687	640	400
		640	400
UTDWR	UT 18-688	640	400
UTDWR	[4] UT 18-689	426.67	266.67
		426.67	266.67
		426.67	266.67
UTDWR	UT 18-690	544	400
UTDWR	UT 18-691	640	400
UTDWR	UT 18-693	640	400
UTDWR	UT 18-694	640	400
UTDWR	UT 18-695	640	400
UTDWR	UT 18-696	640	400
UTDWR	UT 18-697	640	400
UTDWR	UT 18-698	640	400

[1] Based on amount of total water right.

[2] Based on assuming Utah State Engineer's 100-acre irrigation limit and application/withdrawal rate of 4 feet per year.

[3] Application lists two points of diversion; split withdrawal amount equally between the points of diversion.

[4] Application lists three points of diversion; split withdrawal amount equally among the points of diversion.

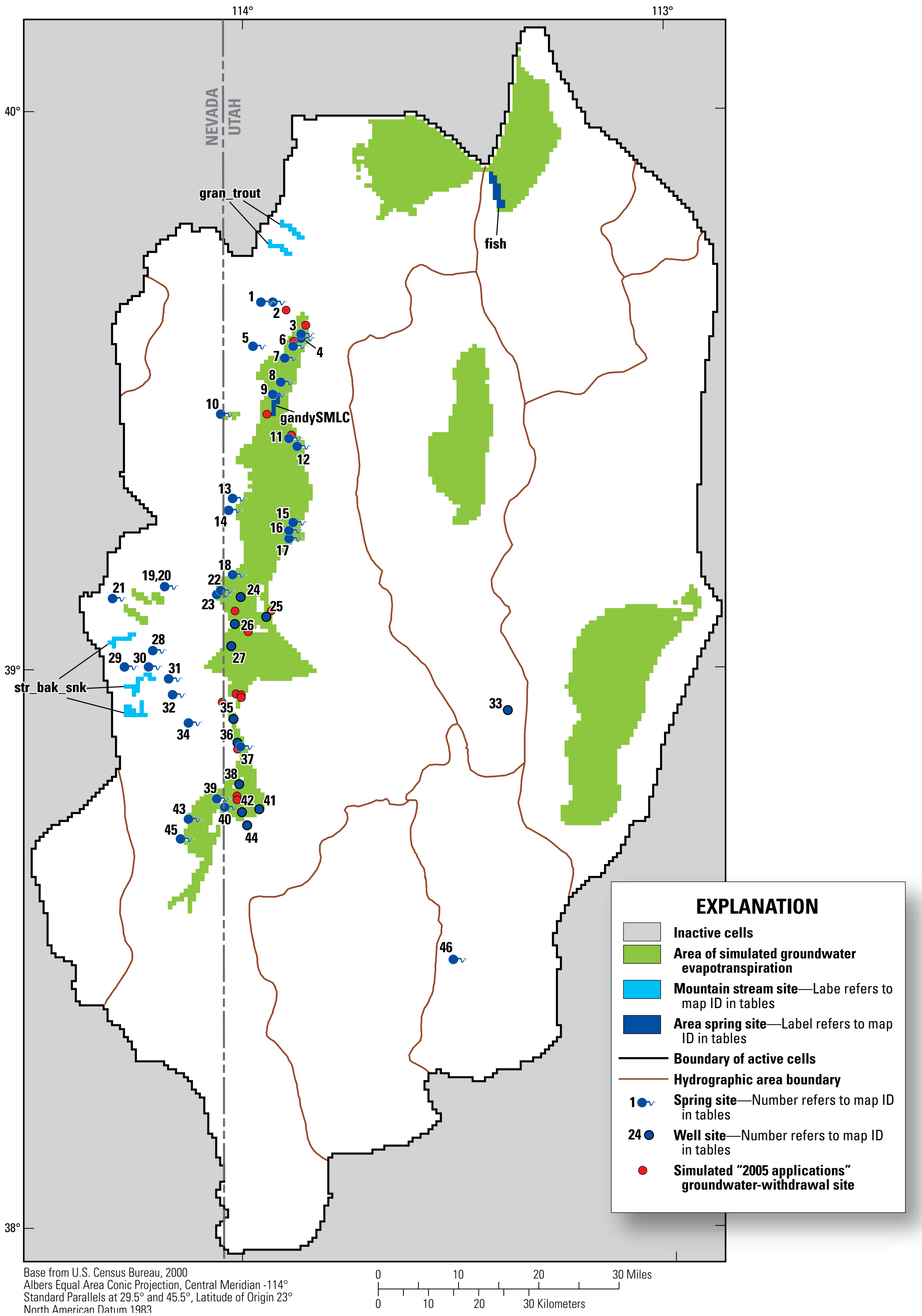


Figure 11. Groundwater discharge sites of interest to the Department of Interior agencies and simulated groundwater-withdrawal sites for the 2005 applications used in the Snake Valley area groundwater model.

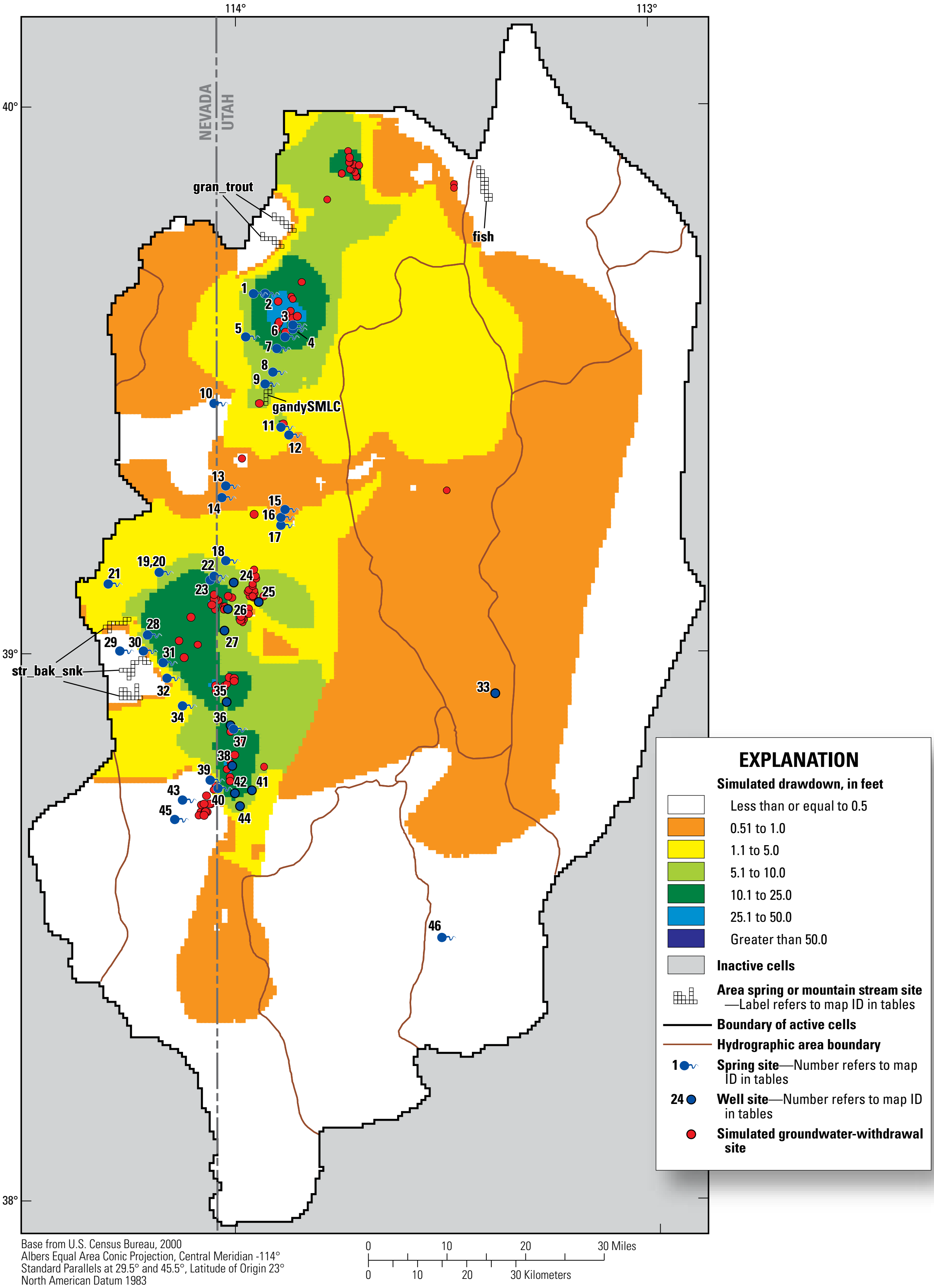


Figure 12. Groundwater discharge sites of interest to the Department of Interior agencies, simulated groundwater-withdrawal sites, and simulated drawdowns of the water table after 105 years (from the start of 2010) of groundwater withdrawals under scenario 4 from the Snake Valley area groundwater model.

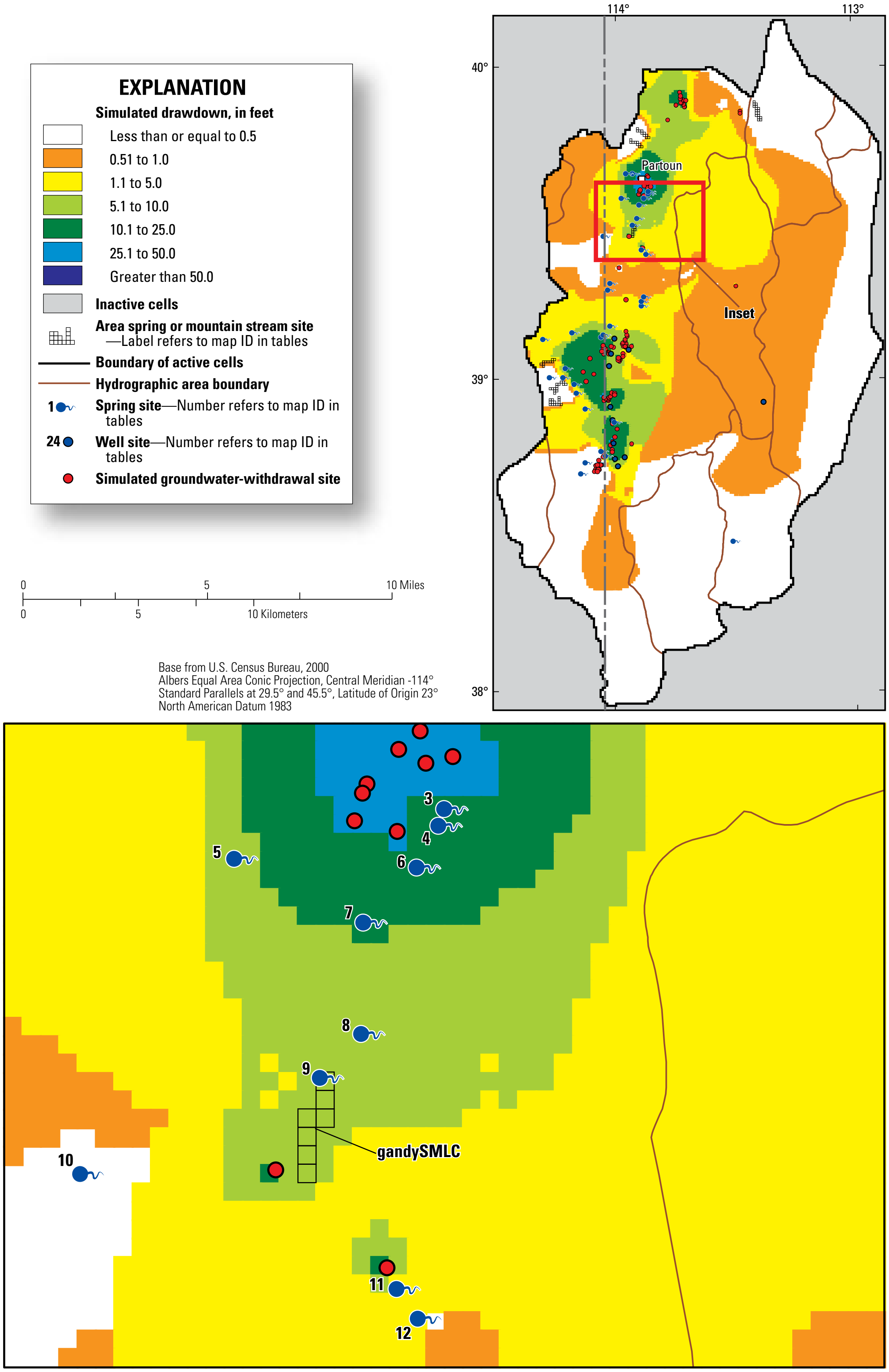


Figure 13. Groundwater discharge sites of interest to the Department of Interior agencies, simulated groundwater-withdrawal sites, and simulated drawdowns of the water table near Partoun, Utah, after 105 years (from the start of 2010) of groundwater withdrawals under scenario 4 from the Snake Valley area groundwater model.

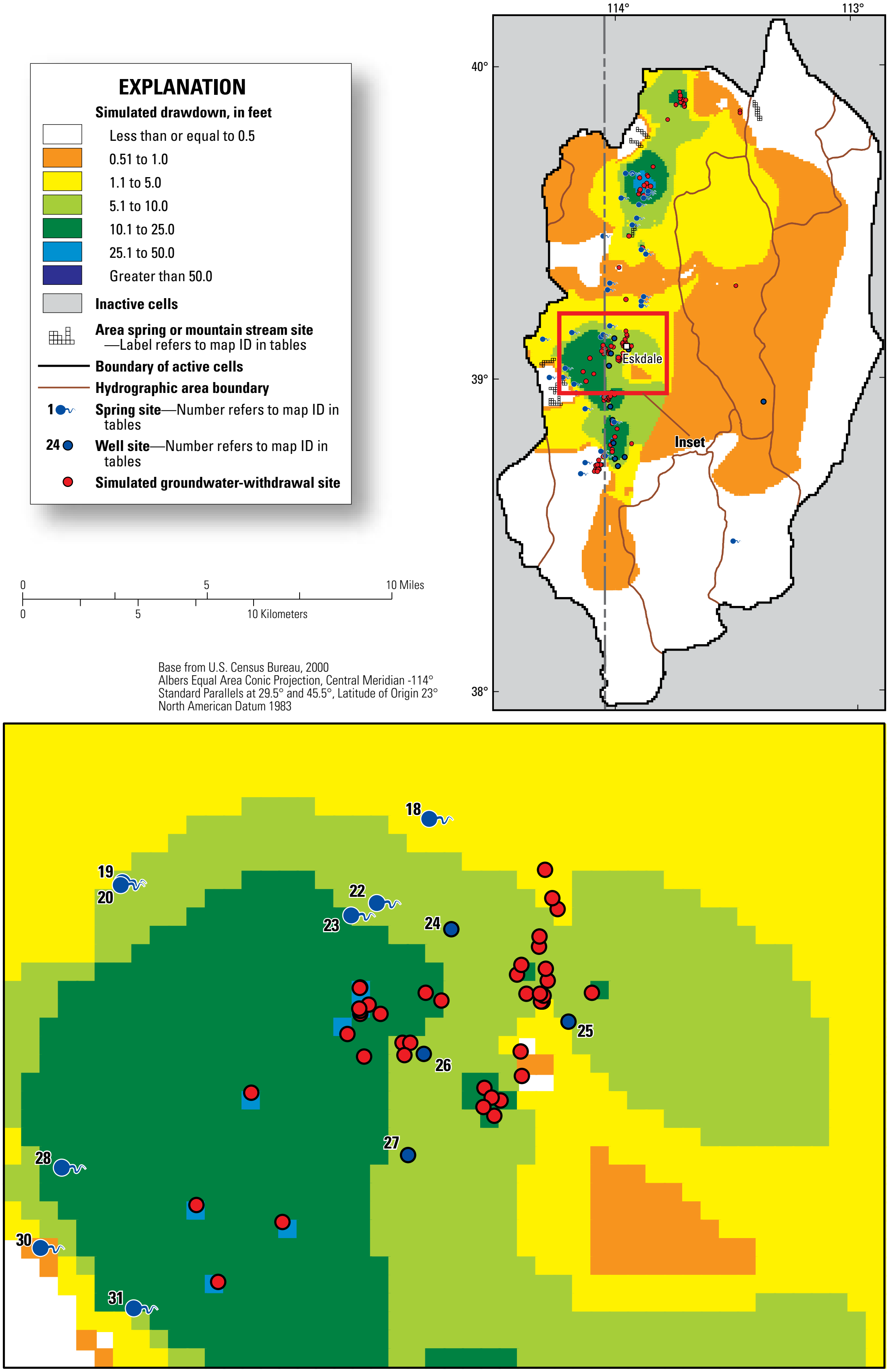


Figure 14. Groundwater discharge sites of interest to the Department of Interior agencies, simulated groundwater-withdrawal sites, and simulated drawdowns of the water table near Eskdale, Utah, after 105 years (from the start of 2010) of groundwater withdrawals under scenario 4 from the Snake Valley area groundwater model.

Scenario 5

Scenario 5 simulates the effects of existing groundwater withdrawals coupled with the proposed withdrawals from the ABNYD, other, and “minimum 2005 applications” water rights in the study area to determine a reasonable lower range of potential effects of development of the 2005 applications. The amount used for the minimum 2005 applications is based on the assumption that the Utah State Engineer’s Office adheres to their current 100-acre irrigation limit and an application/withdrawal rate of 4 ft/yr. This minimum withdrawal amount for the 2005 applications would be approximately 5,600 acre-ft/yr. The minimum proposed withdrawals from the 2005 applications are simulated as starting in 2015. Locations and amounts of the simulated withdrawals for the minimum 2005 applications used in scenario 5 are summarized in figure 11 and table 8, respectively.

Increases in simulated drawdowns following the addition of withdrawals from the minimum 2005 applications ranged from 0 to 12 ft, compared to scenario 3 (table 3), at the groundwater discharge sites of interest to the DOI agencies. The increases in drawdown are greatest at Snake Valley North Spring Complex (site 3). Other sites where simulated drawdown increases more than 5 ft after 105 years (from the start of 2010) following the addition of the minimum withdrawals from the 2005 applications include Lime Spring (site 2), Snake Valley South Spring Complex (site 4), Miller Spring (site 6), Davies Well 1 (site 38), Needle Point Spring (site 40), and Needle Point Well (site 42). Figure 15 shows the distribution of simulated drawdowns after 105 years (from the start of 2010) resulting from the combination of existing, ABNYD, other, and the minimum 2005 applications withdrawals across the study area. Figure 16 shows the same results at a larger scale for an area near Partoun containing several springs (sites 3–12 and gandySMLC) that have been identified as important habitats for sensitive species by the DOI agencies, and figure 17 shows the same results at a larger scale for an area near Eskdale.

Increases in simulated capture of natural discharge following the addition of the minimum withdrawals from the 2005 applications range from 0 to 66 percent, compared to scenario 3 (table 4), at the groundwater discharge sites of interest to the DOI agencies. The percentage of simulated capture increases most at Clay Spring (site 37), where simulated capture increases by 52 percent (for a total simulated capture of 84 percent) of the total simulated spring discharge in the model cell (247 acre-ft/yr) after 105 years (from 2010) of withdrawals and by 66 percent (for a total simulated capture of 97 percent) after reaching a new steady state, compared to scenario 3. At several sites, the total simulated capture after either 55 or 105 years of withdrawals is 100 percent of the total natural discharge simulated for that model cell. These sites include Snake Valley North Spring Complex (site 3), Snake Valley South Spring Complex (site 4), and Miller Spring (site 6). Table 5 summarizes the simulated capture of natural discharge for the study area.

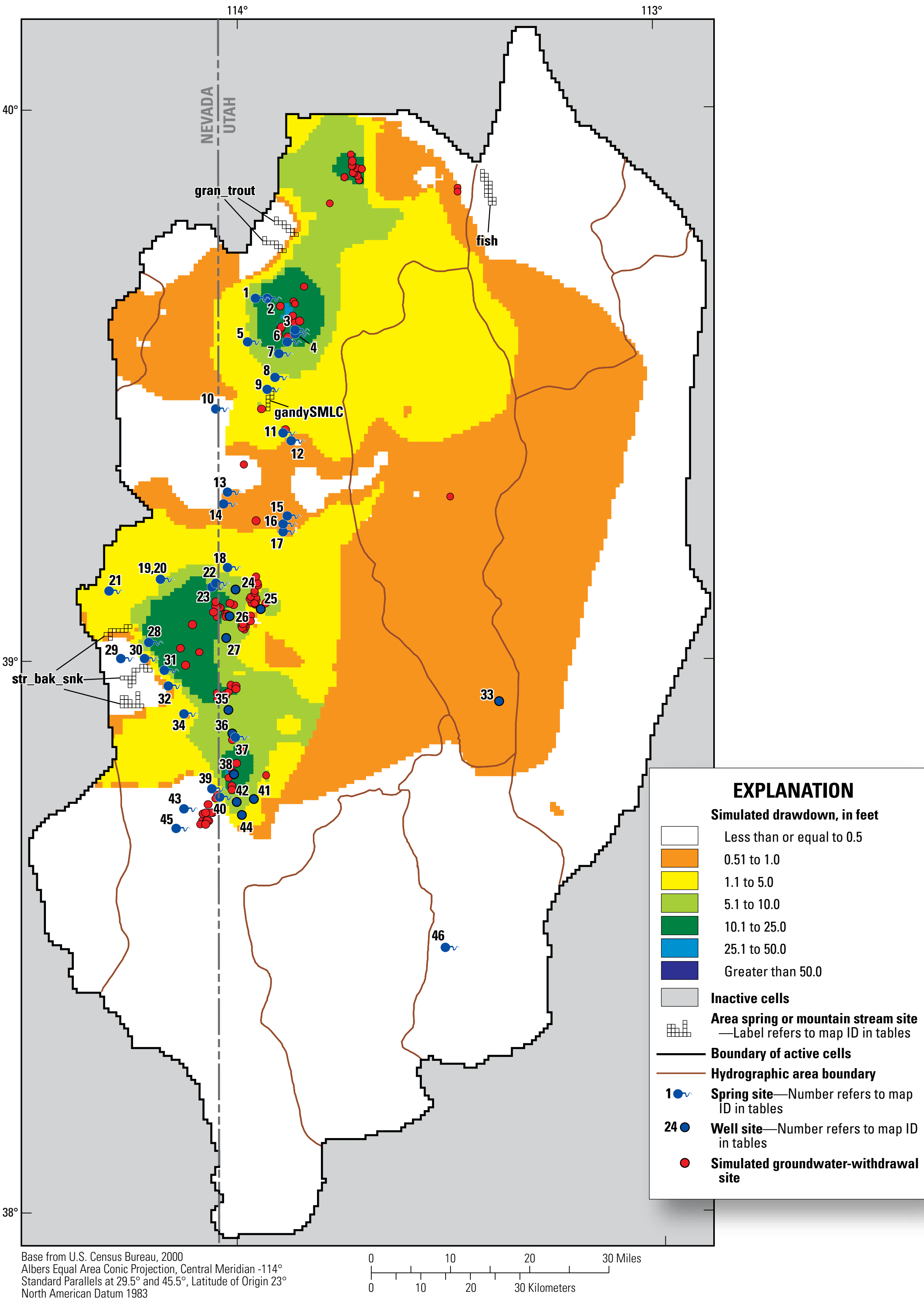


Figure 15. Groundwater discharge sites of interest to the Department of Interior agencies, simulated groundwater-withdrawal sites, and simulated drawdowns of the water table after 105 years (from the start of 2010) of groundwater withdrawals under scenario 5 from the Snake Valley area groundwater model.

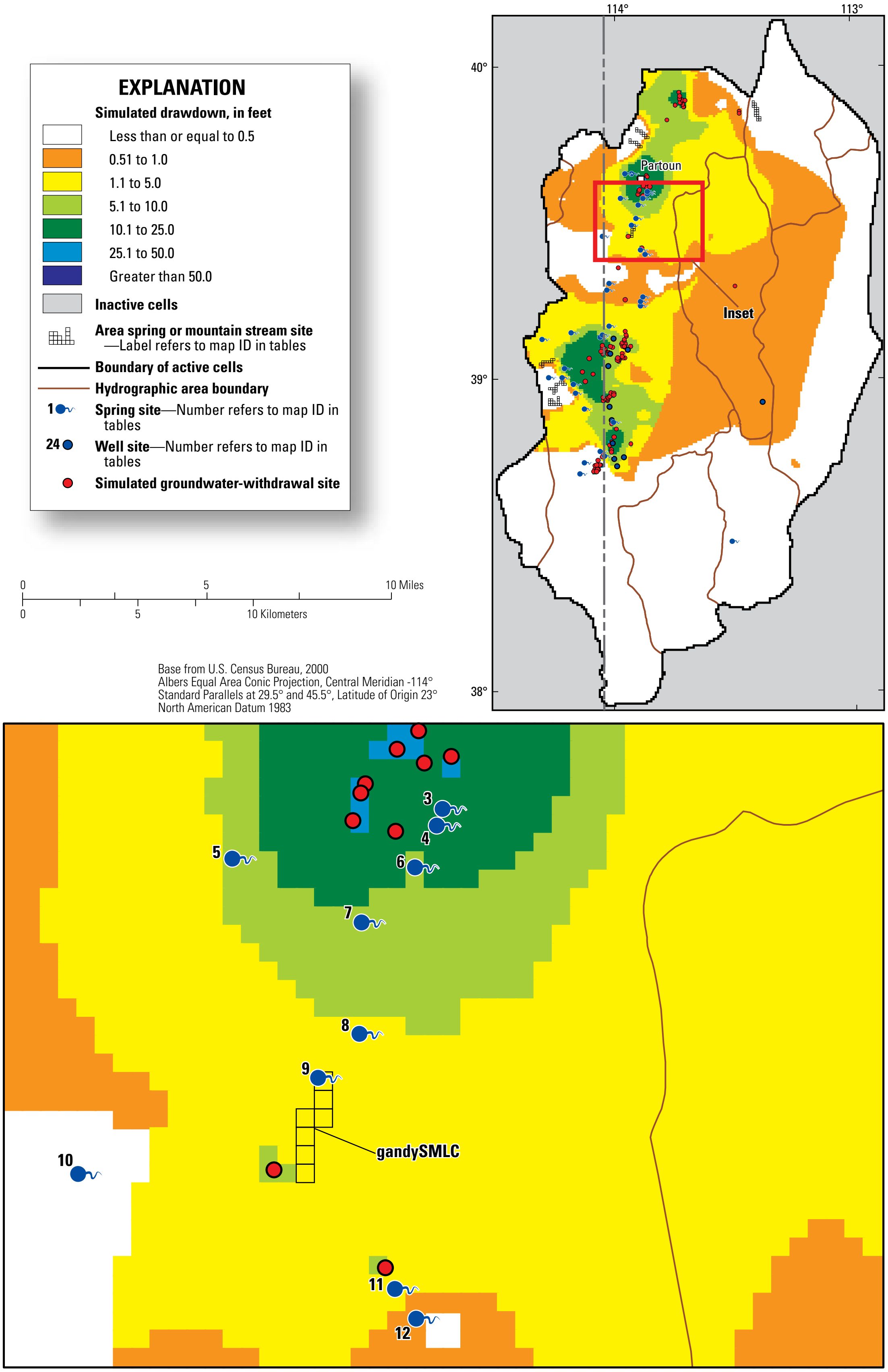


Figure 16. Groundwater discharge sites of interest to the Department of Interior agencies, simulated groundwater-withdrawal sites, and simulated drawdowns of the water table near Partoun, Utah, after 105 years (from the start of 2010) of groundwater withdrawals under scenario 5 from the Snake Valley area groundwater model.

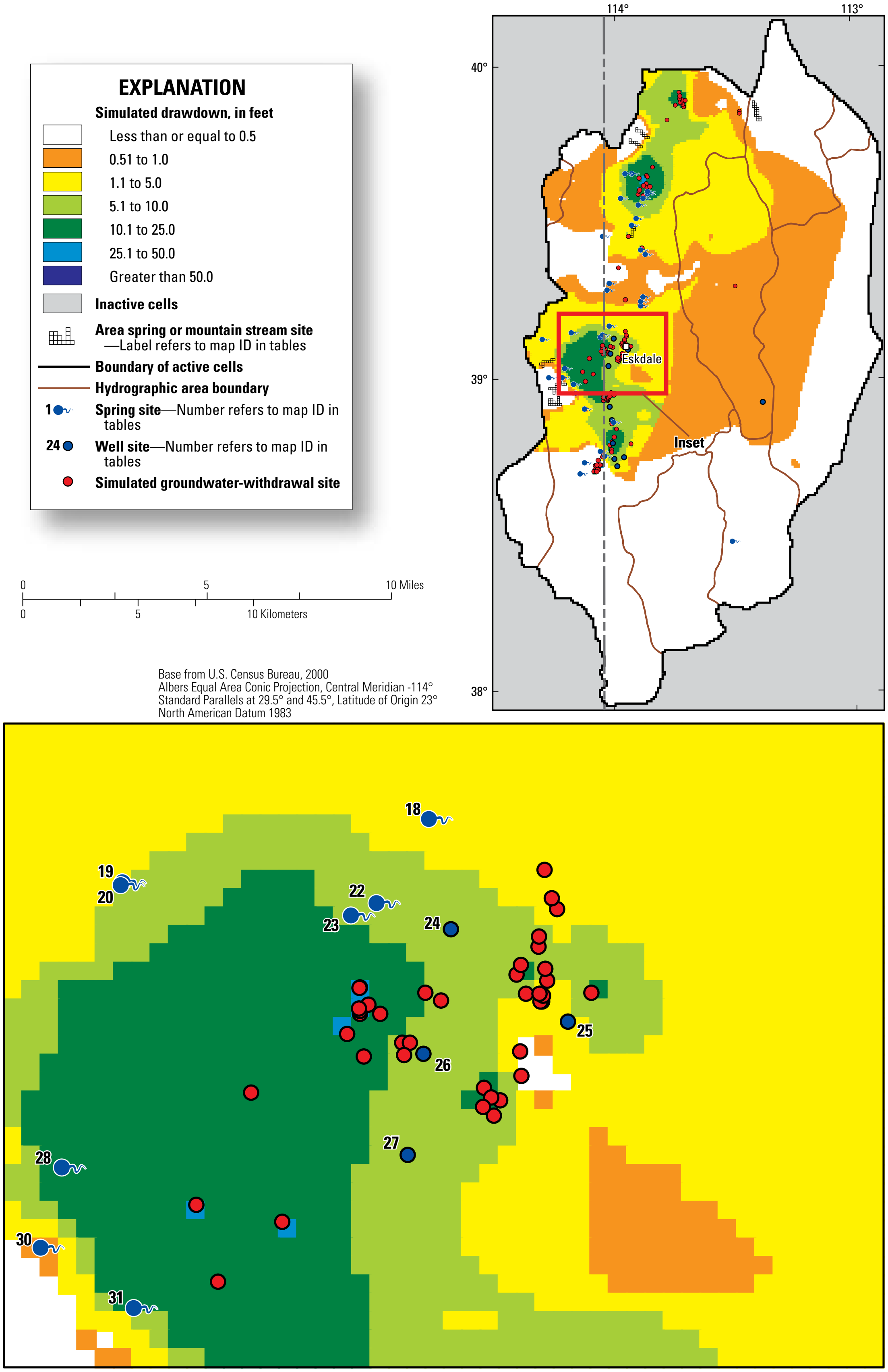


Figure 17. Groundwater discharge sites of interest to the Department of Interior agencies, simulated groundwater-withdrawal sites, and simulated drawdowns of the water table near Eskdale, Utah, after 105 years (from the start of 2010) of groundwater withdrawals under scenario 5 from the Snake Valley area groundwater model.

Scenarios 3a–3e

Scenarios 3a, 3b, 3c, and 3d each separately simulate the individual effects of the proposed withdrawals from new water-right applications UT 18-756, UT 18-758, and UT 18-759, and change application UT a40687, respectively, in addition to existing groundwater withdrawals and proposed withdrawals from the ABNYD water rights. Scenario 3e simulates the combined effects of all of the proposed withdrawals from these applications. Locations and amounts of withdrawals simulated for these applications in scenarios 3a–3e are summarized in figure 9 and table 7, respectively. Figure 18 shows the distribution of simulated drawdowns after 105 years (from 2010) of existing groundwater withdrawals, proposed withdrawals from the ABNYD water rights, and the combined withdrawals from UT 18-756, UT 18-758, UT 18-759, and UT a40687 across the study area. Figure 19 shows the same results at a larger scale for an area near Partoun containing several springs (sites 3–12 and gandySMLC) that have been identified as important habitats for sensitive species by the DOI agencies, and figure 20 shows the same results at a larger scale for an area near Eskdale. Drawdown and capture results are summarized in tables 9 and 10, respectively, for scenarios 3a–3e.

Increases in simulated drawdowns following the addition of the proposed withdrawals from UT 18-756 (scenario 3a) range from 0 to 3 ft, compared to scenario 2 (table 9), at the groundwater discharge sites of interest to the DOI agencies. Simulated drawdown increases of 2 ft after 105 years (from the start of 2010) following the addition of the proposed withdrawals from UT 18-756 occur at South Seeps (site 1), Lime Spring (site 2), and Snake Valley North Spring Complex (site 3).

There were no increases in simulated drawdowns at the groundwater discharge sites of interest to the DOI agencies following the addition of the proposed withdrawals from UT 18-758 (scenario 3b), except at Shell Baker Creek Well (site 27). Drawdown at this site increases 1 ft after 55 years (from the start of 2010), compared to scenario 2 (table 9).

Increases in simulated drawdowns following the addition of the proposed withdrawals from UT 18-759 (scenario 3c) range from 0 to 1 ft, compared to scenario 2 (table 9), at the groundwater discharge sites of interest to the DOI agencies. After 30 years (from the start of 2010) following the addition of the proposed withdrawals from UT 18-759, simulated drawdown increases 1 ft at Caine Spring (site 23) and Davies Well 1 (site 38). After 55 years (from the start of 2010) following the addition of the proposed withdrawals from UT 18-759, simulated drawdown increases 1 ft at Shell Baker Creek Well (site 27).

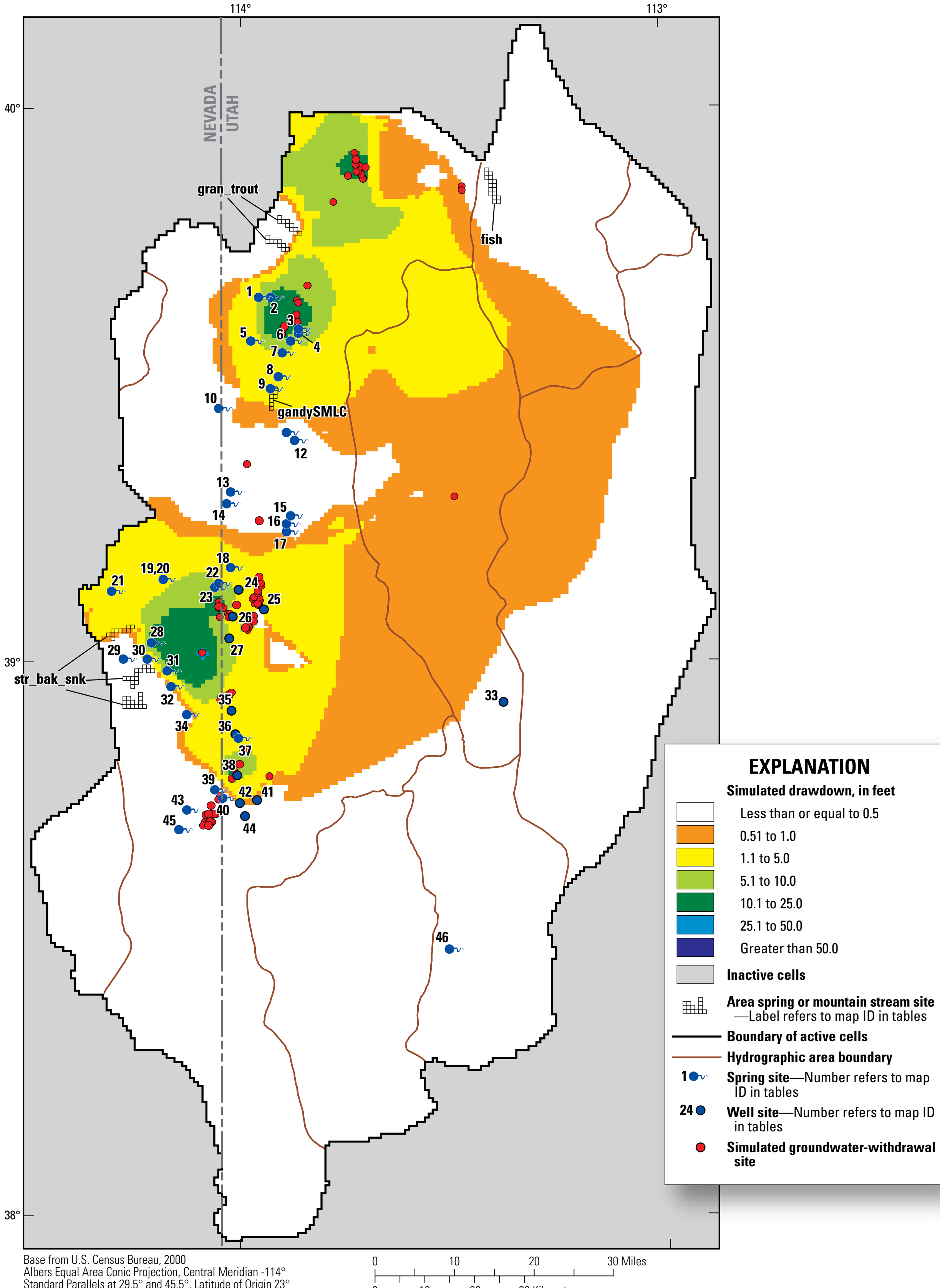
The addition of the proposed withdrawals from UT a40687 (scenario 3d) did not result in any increases in simulated drawdown, compared to scenario 2 (table 9), at the groundwater discharge sites of interest to the DOI agencies. Instead, simulated water levels at several sites increase up to 1 ft compared to scenario 2 because the change application decreased withdrawals and moved the point of diversion farther from these sites. Simulated water levels at Eskdale Well (site 24), West Buckskin Well (site 25), and Flowing Well 2 (site 26) increase 1 ft after 15, 55, and 30 years (from the start of 2010), respectively, compared to scenario 2. Simulated water levels at Kious Spring (site 31) increase 1 ft after 105 years (from the start of 2010) compared to scenario 2.

Increases in simulated drawdowns following the addition of the combined proposed withdrawals from UT 18-756, UT 18-758, UT 18-759, and UT a40687 (scenario 3e) range from 0 to 3 ft, compared to scenario 2 (table 9), at the groundwater discharge sites of interest to the DOI agencies. Increases in drawdown following the addition of the combined proposed withdrawals are 2 ft after 105 years (from the start of 2010) at South Seeps (site 1), Lime Spring (site 2), and Snake Valley North Spring Complex (site 3). Conversely, simulated water levels increase less than 1 ft at two sites because the change application decreased withdrawals and moved the point of diversion farther from these sites. Simulated water levels increase less than 1 ft at Knoll Spring (site 17) after 30 years (from the start of 2010) and at West Buckskin Well (site 25) after 55 years (from the start of 2010) compared to scenario 2.

Increases in the simulated capture of natural discharge following the addition of the proposed withdrawals from UT 18-756 (scenario 3a) range from 0 to 17 percent, compared to scenario 2 (table 10), at the groundwater discharge sites of interest to the DOI agencies. Following the addition of the proposed withdrawals from UT 18-756, simulated capture increases most at Snake Valley North Spring Complex (site 3), where simulated capture increases 13 percent (for a total simulated capture of 70 percent) of the total simulated spring discharge for the model cell (19 acre-ft/yr) after 105 years (from the start of 2010) of withdrawals and increases 17 percent (for a total simulated capture of 88 percent) after reaching a new steady state, compared to scenario 2. Following the addition of the proposed withdrawals from UT 18-756, simulated capture increases 11 percent at Snake Valley South Spring Complex (site 4) and about 14 percent at Miller Spring (site 6) after 105 years (from the start of 2010) of withdrawals, compared to scenario 2.

Increases in simulated capture of natural discharge following the addition of the proposed withdrawals from UT 18-758 (scenario 3b) range from 0 to 1 percent, compared to scenario 2 (table 10), at the groundwater discharge sites of interest to the DOI agencies. At Clay Spring (site 37), simulated capture increases 1 percent after 105 years (from the start of 2010), and at Knoll Spring (site 17), Unnamed Spring 1 (site 18), and Kane Spring (site 22), simulated capture increases 1 percent at the new steady-state conditions, compared to scenario 2.

Increases in simulated capture of natural discharge following the addition of the proposed withdrawals from UT 18-759 (scenario 3c) also ranged from 0 to 1 percent, compared to scenario 2 (table 10), at the groundwater discharge sites of interest to the DOI agencies. At Caine Spring (site 23) and Clay Spring (site 37), simulated capture increases 1



Base from U.S. Census Bureau, 2000
Albers Equal Area Conic Projection, Central Meridian -114°
Standard Parallels at 29.5° and 45.5°, Latitude of Origin 23°
North American Datum 1983

Figure 18. Groundwater discharge sites of interest to the Department of Interior agencies, simulated groundwater-withdrawal sites, and simulated drawdowns of the water table after 105 years (from the start of 2010) of groundwater withdrawals under scenario 3e from the Snake Valley area groundwater model.

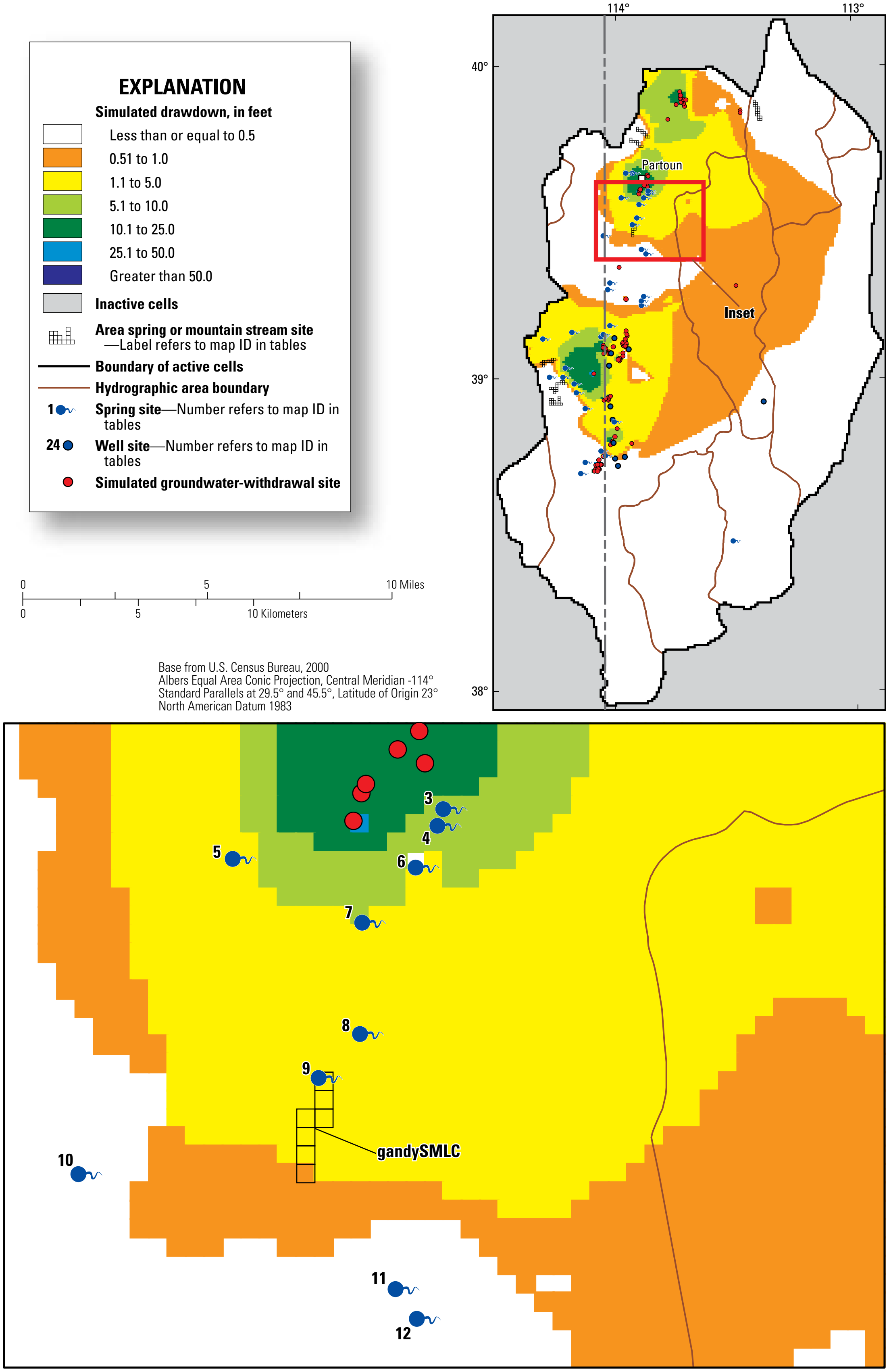


Figure 19. Groundwater discharge sites of interest to the Department of Interior agencies, simulated groundwater-withdrawal sites, and simulated drawdowns of the water table near Partoun, Utah, after 105 years (from the start of 2010) of groundwater withdrawals under scenario 3e from the Snake Valley area groundwater model.

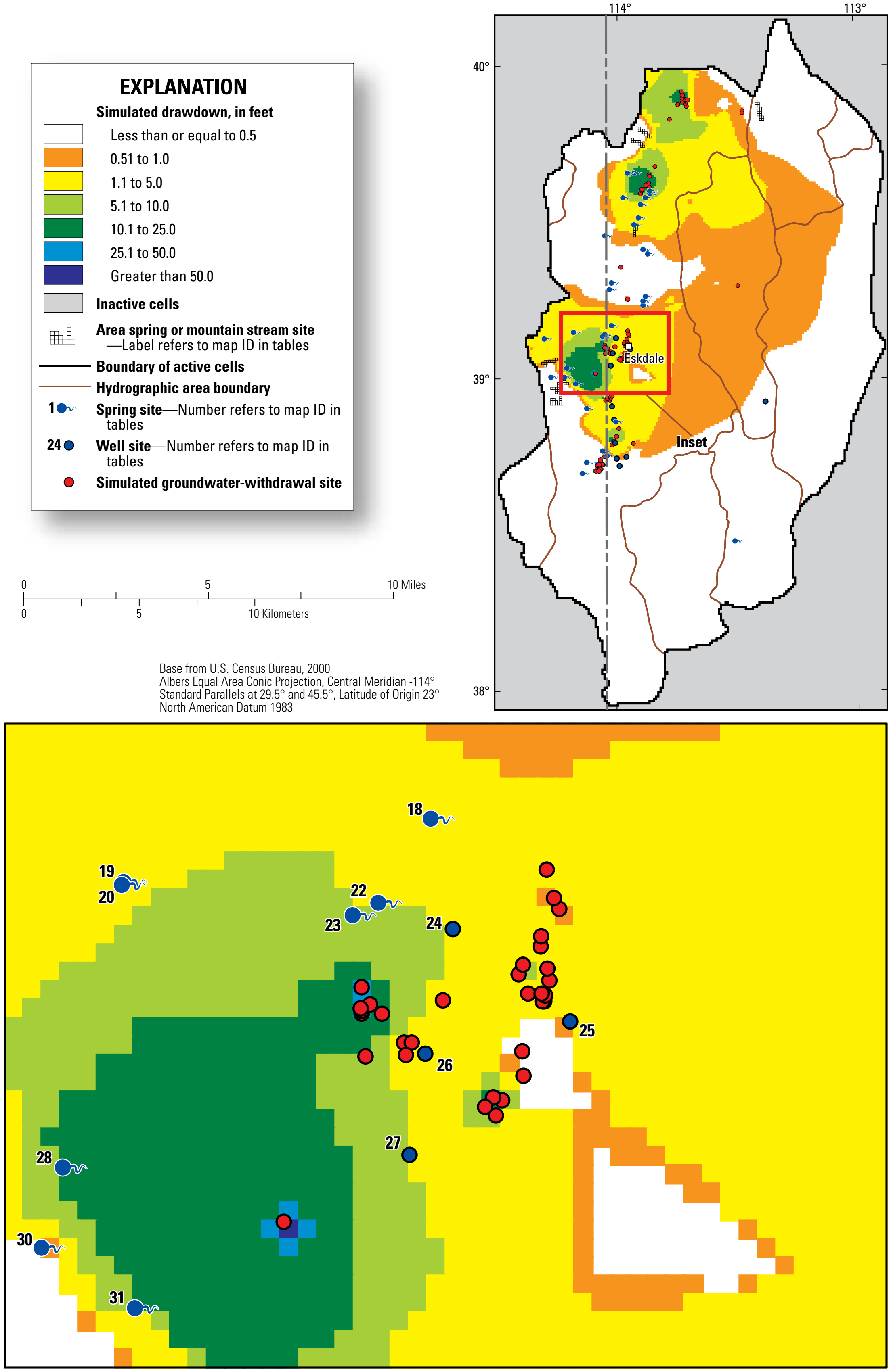


Figure 20. Groundwater discharge sites of interest to the Department of Interior agencies, simulated groundwater-withdrawal sites, and simulated drawdowns of the water table near Eskdale, Utah, after 105 years (from the start of 2010) of groundwater withdrawals under scenario 3e from the Snake Valley area groundwater model.

Table 9. Simulated drawdowns from existing and proposed groundwater withdrawals (scenarios 1, 2, and 3a–3e) at the groundwater discharge sites of interest to the Department of Interior agencies.

[Water-right number: Water-right numbers are preceded by state abbreviation. Negative values (in red) indicate an increase in simulated water levels. Values of "< 1" indicate less than a 1 foot but greater than 0 foot decrease (or drawdown) in simulated water levels. Values of "< -1" indicate less than a 1 foot but greater than 0 foot increase in simulated water levels. **Abbreviations:** ID, identification; NV, Nevada; UT, Utah; new SS, new steady state; <, less than; >, greater than]

Map ID	Site name	Water-right number	Simulation period	Years elapsed since start of 2010	Scenario 1 Simulated drawdown (feet)	Scenario 2 Simulated drawdown (feet)	Scenario 3a Simulated drawdown (feet)	Scenario 3b Simulated drawdown (feet)	Scenario 3c Simulated drawdown (feet)	Scenario 3d Simulated drawdown (feet)	Scenario 3e Simulated drawdown (feet)
1	South Seeps	UT 18-597	2010–2014	5	0	0	0	0	0	0	0
			2010–2019	10	< 1	< 1	< 1	< 1	< 1	< 1	< 1
			2010–2024	15	< 1	< 1	< 1	< 1	< 1	< 1	< 1
			2010–2039	30	< 1	1	1	1	1	1	1
			2010–2064	55	2	3	4	3	3	3	4
			2010–2114	105	3	5	7	5	5	5	7
			2010–new SS	> 3,000	6	10	12	10	10	10	12
2	Lime Spring	UT 18-594	2010–2014	5	< 1	< 1	< 1	< 1	< 1	< 1	< 1
			2010–2019	10	< 1	< 1	< 1	< 1	< 1	< 1	< 1
			2010–2024	15	< 1	1	1	1	1	1	1
			2010–2039	30	2	3	4	3	3	3	4
			2010–2064	55	4	6	7	6	6	6	7
			2010–2114	105	6	9	11	9	9	9	11
			2010–new SS	> 3,000	8	12	15	12	12	12	15
3	Snake Valley North Spring Complex	UT 18-701	2010–2014	5	< 1	< 1	< 1	< 1	< 1	< 1	< 1
			2010–2019	10	< 1	1	1	1	1	1	1
			2010–2024	15	2	2	3	2	2	2	3
			2010–2039	30	3	4	5	4	4	4	5
			2010–2064	55	4	6	7	6	6	6	7
			2010–2114	105	5	7	9	7	7	7	9
			2010–new SS	> 3,000	6	9	11	9	9	9	11
4	Snake Valley South Spring Complex	UT 18-702	2010–2014	5	< 1	< 1	< 1	< 1	< 1	< 1	< 1
			2010–2019	10	< 1	1	1	1	1	1	1
			2010–2024	15	1	2	2	2	2	2	2
			2010–2039	30	2	4	5	4	4	4	5
			2010–2064	55	3	5	6	5	5	5	6
			2010–2114	105	4	7	8	7	7	7	8
			2010–new SS	> 3,000	5	8	10	8	8	8	10

Table 9. Simulated drawdowns from existing and proposed groundwater withdrawals (scenarios 1, 2, and 3a–3e) at the groundwater discharge sites of interest to the Department of Interior agencies.—Continued

[Water-right number: Water-right numbers are preceded by state abbreviation. Negative values (in red) indicate an increase in simulated water levels. Values of "< 1" indicate less than a 1 foot but greater than 0 foot decrease (or drawdown) in simulated water levels. Values of "< -1" indicate less than a 1 foot but greater than 0 foot increase in simulated water levels. **Abbreviations:** ID, identification; NV, Nevada; UT, Utah; new SS, new steady state; <, less than; >, greater than]

Map ID	Site name	Water-right number	Simulation period	Years elapsed since start of 2010	Scenario 1 Simulated drawdown (feet)	Scenario 2 Simulated drawdown (feet)	Scenario 3a Simulated drawdown (feet)	Scenario 3b Simulated drawdown (feet)	Scenario 3c Simulated drawdown (feet)	Scenario 3d Simulated drawdown (feet)	Scenario 3e Simulated drawdown (feet)
5	Coyote Spring	UT 18-596	2010–2014	5	0	0	0	0	0	0	0
			2010–2019	10	< 1	< 1	< 1	< 1	< 1	< 1	< 1
			2010–2024	15	< 1	< 1	< 1	< 1	< 1	< 1	< 1
			2010–2039	30	< 1	1	1	1	1	1	1
			2010–2064	55	1	2	3	2	2	2	3
			2010–2114	105	2	3	4	3	3	3	4
			2010–new SS	> 3,000	3	5	6	5	5	5	6
6	Miller Spring	UT 18-253	2010–2014	5	< 1	< 1	< 1	< 1	< 1	< 1	< 1
			2010–2019	10	< 1	< 1	< 1	< 1	< 1	< 1	< 1
			2010–2024	15	< 1	< 1	< 1	< 1	< 1	< 1	< 1
			2010–2039	30	< 1	1	2	1	1	1	2
			2010–2064	55	1	2	2	2	2	2	2
			2010–2114	105	2	2	3	2	2	2	3
			2010–new SS	> 3,000	2	3	4	3	3	3	4
7	Leland Harris Spring Complex	unknown	2010–2014	5	< 1	< 1	< 1	< 1	< 1	< 1	< 1
			2010–2019	10	< 1	< 1	< 1	< 1	< 1	< 1	< 1
			2010–2024	15	< 1	1	1	1	1	1	1
			2010–2039	30	1	2	2	2	2	2	2
			2010–2064	55	2	3	4	3	3	3	4
			2010–2114	105	2	4	5	4	4	4	5
			2010–new SS	> 3,000	3	5	6	5	5	5	6
8	Gandy Salt Marsh Seep	UT 18-579	2010–2014	5	0	0	0	0	0	0	0
			2010–2019	10	< 1	< 1	< 1	< 1	< 1	< 1	< 1
			2010–2024	15	< 1	< 1	< 1	< 1	< 1	< 1	< 1
			2010–2039	30	< 1	< 1	< 1	< 1	< 1	< 1	< 1
			2010–2064	55	< 1	1	2	1	1	1	2
			2010–2114	105	1	2	2	2	2	2	2
			2010–new SS	> 3,000	2	3	3	3	3	3	3

Table 9. Simulated drawdowns from existing and proposed groundwater withdrawals (scenarios 1, 2, and 3a–3e) at the groundwater discharge sites of interest to the Department of Interior agencies.—Continued

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Map ID	Site name	Water-right number	Simulation period	Years elapsed since start of 2010	Scenario 1 Simulated drawdown (feet)	Scenario 2 Simulated drawdown (feet)	Scenario 3a Simulated drawdown (feet)	Scenario 3b Simulated drawdown (feet)	Scenario 3c Simulated drawdown (feet)	Scenario 3d Simulated drawdown (feet)	Scenario 3e Simulated drawdown (feet)
9	Springs feeding Gandy Salt Marsh Lake	UT 18-537	2010–2014	5	0	0	0	0	0	0	0
			2010–2019	10	0	< 1	< 1	< 1	< 1	< 1	< 1
			2010–2024	15	< 1	< 1	< 1	< 1	< 1	< 1	< 1
			2010–2039	30	< 1	< 1	< 1	< 1	< 1	< 1	< 1
			2010–2064	55	< 1	< 1	1	< 1	< 1	< 1	1
			2010–2114	105	< 1	1	2	1	1	1	2
			2010–new SS	> 3,000	1	2	2	2	2	2	2
gandy-SMLC	Gandy Salt Marsh Lake Spring Complex [1]	UT 18-575	2010–2014	5	0	0	0	0	0	0	0
			2010–2019	10	0	0	0	0	0	0	0
			2010–2024	15	0	< 1	< 1	< 1	< 1	< 1	< 1
			2010–2039	30	< 1	< 1	< 1	< 1	< 1	< 1	< 1
			2010–2064	55	< 1	< 1	< 1	< 1	< 1	< 1	< 1
			2010–2114	105	< 1	< 1	1	< 1	< 1	< 1	1
			2010–new SS	> 3,000	< 1	1	2	1	1	1	2
10	Gandy Warm Springs	UT 18-584, 18-585, 18-623	2010–2014	5	0	0	0	0	0	0	0
			2010–2019	10	0	0	0	0	0	0	0
			2010–2024	15	0	0	0	0	0	0	0
			2010–2039	30	0	0	0	0	0	0	0
			2010–2064	55	0	0	0	0	0	0	0
			2010–2114	105	0	0	0	0	0	0	0
			2010–new SS	> 3,000	0	0	0	0	0	0	0
11	Foote Reservoir Spring	UT 18-711, 18-255	2010–2014	5	0	0	0	0	0	0	0
			2010–2019	10	0	0	0	0	0	0	0
			2010–2024	15	0	0	0	0	0	0	0
			2010–2039	30	0	0	0	0	0	0	0
			2010–2064	55	0	0	0	0	0	0	0
			2010–2114	105	0	0	0	0	0	0	0
			2010–new SS	> 3,000	0	0	0	0	0	0	0

Table 9. Simulated drawdowns from existing and proposed groundwater withdrawals (scenarios 1, 2, and 3a–3e) at the groundwater discharge sites of interest to the Department of Interior agencies.—Continued

[Water-right number: Water-right numbers are preceded by state abbreviation. Negative values (in red) indicate an increase in simulated water levels. Values of "< 1" indicate less than a 1 foot but greater than 0 foot decrease (or drawdown) in simulated water levels. Values of "< -1" indicate less than a 1 foot but greater than 0 foot increase in simulated water levels. **Abbreviations:** ID, identification; NV, Nevada; UT, Utah; new SS, new steady state; <, less than; >, greater than]

Map ID	Site name	Water-right number	Simulation period	Years elapsed since start of 2010	Scenario 1 Simulated drawdown (feet)	Scenario 2 Simulated drawdown (feet)	Scenario 3a Simulated drawdown (feet)	Scenario 3b Simulated drawdown (feet)	Scenario 3c Simulated drawdown (feet)	Scenario 3d Simulated drawdown (feet)	Scenario 3e Simulated drawdown (feet)
12	Twin Springs	UT 18-476, 18-486	2010–2014	5	0	0	0	0	0	0	0
			2010–2019	10	0	0	0	0	0	0	0
			2010–2024	15	0	0	0	0	0	0	0
			2010–2039	30	0	0	0	0	0	0	0
			2010–2064	55	0	0	0	0	0	0	0
			2010–2114	105	0	0	0	0	0	0	0
			2010–new SS	> 3,000	0	0	0	0	0	0	0
13	Briggs Spring	UT 18-604	2010–2014	5	0	0	0	0	0	0	0
			2010–2019	10	< -1	< -1	< -1	< -1	< -1	< -1	< -1
			2010–2024	15	< -1	< -1	< -1	< -1	< -1	< -1	< -1
			2010–2039	30	< -1	< -1	< -1	< -1	< -1	< -1	< -1
			2010–2064	55	< -1	< -1	< -1	< -1	< -1	< -1	< -1
			2010–2114	105	0	0	< 1	0	0	0	0
			2010–new SS	> 3,000	< 1	< 1	< 1	< 1	< 1	< 1	< 1
14	Phil Spring	UT 18-742	2010–2014	5	0	0	0	0	0	0	0
			2010–2019	10	0	0	0	0	0	0	0
			2010–2024	15	< -1	< -1	< -1	< -1	< -1	< -1	< -1
			2010–2039	30	< -1	< -1	< -1	< -1	< -1	< -1	< -1
			2010–2064	55	0	0	0	0	0	0	0
			2010–2114	105	< 1	< 1	< 1	< 1	< 1	< 1	< 1
			2010–new SS	> 3,000	< 1	< 1	< 1	< 1	< 1	< 1	< 1
15	North Knoll Spring	UT 18-535	2010–2014	5	0	0	0	0	0	0	0
			2010–2019	10	0	0	0	0	0	0	0
			2010–2024	15	0	0	0	0	0	0	0
			2010–2039	30	0	0	0	0	0	0	0
			2010–2064	55	< 1	< 1	< 1	< 1	< 1	< 1	< 1
			2010–2114	105	< 1	< 1	< 1	< 1	< 1	< 1	< 1
			2010–new SS	> 3,000	< 1	< 1	< 1	< 1	< 1	< 1	< 1

Table 9. Simulated drawdowns from existing and proposed groundwater withdrawals (scenarios 1, 2, and 3a–3e) at the groundwater discharge sites of interest to the Department of Interior agencies.—Continued

[Water-right number: Water-right numbers are preceded by state abbreviation. Negative values (in red) indicate an increase in simulated water levels. Values of "< 1" indicate less than a 1 foot but greater than 0 foot decrease (or drawdown) in simulated water levels. Values of "< -1" indicate less than a 1 foot but greater than 0 foot increase in simulated water levels. **Abbreviations:** ID, identification; NV, Nevada; UT, Utah; new SS, new steady state; <, less than; >, greater than]

Map ID	Site name	Water-right number	Simulation period	Years elapsed since start of 2010	Scenario 1 Simulated drawdown (feet)	Scenario 2 Simulated drawdown (feet)	Scenario 3a Simulated drawdown (feet)	Scenario 3b Simulated drawdown (feet)	Scenario 3c Simulated drawdown (feet)	Scenario 3d Simulated drawdown (feet)	Scenario 3e Simulated drawdown (feet)
			2010–2014	5	0	0	0	0	0	0	0
			2010–2019	10	0	0	0	0	0	0	0
			2010–2024	15	0	0	0	0	0	0	0
16	Middle Knoll Spring	UT 18-491	2010–2039	30	0	0	0	0	0	0	0
			2010–2064	55	< 1	< 1	< 1	< 1	< 1	< 1	< 1
			2010–2114	105	< 1	< 1	< 1	< 1	< 1	< 1	< 1
			2010–new SS	> 3,000	< 1	< 1	< 1	< 1	< 1	< 1	< 1
			2010–2014	5	0	0	0	0	0	0	0
			2010–2019	10	0	0	0	0	0	0	0
			2010–2024	15	0	0	0	0	0	0	0
17	Knoll Spring	UT 18-84	2010–2039	30	0	< 1	< 1	< 1	< 1	0	0
			2010–2064	55	< 1	< 1	< 1	< 1	< 1	< 1	< 1
			2010–2114	105	< 1	< 1	< 1	< 1	< 1	< 1	< 1
			2010–new SS	> 3,000	< 1	< 1	< 1	< 1	< 1	< 1	< 1
			2010–2014	5	0	0	0	0	0	0	0
			2010–2019	10	< 1	< 1	< 1	< 1	< 1	< 1	< 1
			2010–2024	15	< 1	< 1	< 1	< 1	< 1	< 1	< 1
18	Unnamed Spring 1	unknown	2010–2039	30	< 1	< 1	< 1	< 1	< 1	< 1	< 1
			2010–2064	55	1	1	1	1	1	1	1
			2010–2114	105	2	2	2	2	2	2	2
			2010–new SS	> 3,000	2	2	2	2	2	2	2
			2010–2014	5	0	0	0	0	0	0	0
			2010–2019	10	< 1	< 1	< 1	< 1	< 1	< 1	< 1
			2010–2024	15	< 1	< 1	< 1	< 1	< 1	< 1	< 1
19	Unnamed Spring 2	unknown	2010–2039	30	< 1	< 1	< 1	< 1	< 1	< 1	< 1
			2010–2064	55	2	2	2	2	2	2	2
			2010–2114	105	4	4	4	4	4	4	4
			2010–new SS	> 3,000	6	7	7	7	7	7	7

Table 9. Simulated drawdowns from existing and proposed groundwater withdrawals (scenarios 1, 2, and 3a–3e) at the groundwater discharge sites of interest to the Department of Interior agencies.—Continued

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Map ID	Site name	Water-right number	Simulation period	Years elapsed since start of 2010	Scenario 1	Scenario 2	Scenario 3a	Scenario 3b	Scenario 3c	Scenario 3d	Scenario 3e
					Simulated drawdown (feet)	Simulated drawdown (feet)	Simulated drawdown (feet)	Simulated drawdown (feet)	Simulated drawdown (feet)	Simulated drawdown (feet)	Simulated drawdown (feet)
			2010–2014	5	0	0	0	0	0	0	0
			2010–2019	10	< 1	< 1	< 1	< 1	< 1	< 1	< 1
			2010–2024	15	< 1	< 1	< 1	< 1	< 1	< 1	< 1
20	Unnamed Spring 3	unknown	2010–2039	30	< 1	< 1	< 1	< 1	< 1	< 1	< 1
			2010–2064	55	2	2	2	2	2	2	2
			2010–2114	105	4	4	4	4	4	4	4
			2010–new SS	> 3,000	6	7	7	7	7	7	7
			2010–2014	5	0	0	0	0	0	0	0
			2010–2019	10	0	0	0	0	0	0	0
			2010–2024	15	< 1	< 1	< 1	< 1	< 1	< 1	< 1
21	Want Spring	NV R05275	2010–2039	30	< 1	< 1	< 1	< 1	< 1	< 1	< 1
			2010–2064	55	1	1	1	1	1	1	1
			2010–2114	105	2	3	3	3	3	3	3
			2010–new SS	> 3,000	5	6	6	6	6	6	6
			2010–2014	5	< 1	< 1	< 1	< 1	< 1	< 1	< 1
			2010–2019	10	1	1	1	1	1	1	1
			2010–2024	15	2	2	2	2	2	2	2
22	Kane Spring	UT 18-406	2010–2039	30	3	3	3	3	3	3	3
			2010–2064	55	3	4	4	4	4	4	4
			2010–2114	105	4	5	5	5	5	5	5
			2010–new SS	> 3,000	5	5	5	5	5	5	5
			2010–2014	5	< 1	< 1	< 1	< 1	< 1	< 1	< 1
			2010–2019	10	1	1	1	1	1	1	1
			2010–2024	15	2	2	2	2	2	2	2
23	Caine Spring	unknown	2010–2039	30	3	3	3	3	4	3	3
			2010–2064	55	4	5	5	5	5	5	5
			2010–2114	105	5	6	6	6	6	5	6
			2010–new SS	> 3,000	5	6	6	6	6	6	6

Table 9. Simulated drawdowns from existing and proposed groundwater withdrawals (scenarios 1, 2, and 3a–3e) at the groundwater discharge sites of interest to the Department of Interior agencies.—Continued

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Map ID	Site name	Water-right number	Simulation period	Years elapsed since start of 2010	Scenario 1 Simulated drawdown (feet)	Scenario 2 Simulated drawdown (feet)	Scenario 3a Simulated drawdown (feet)	Scenario 3b Simulated drawdown (feet)	Scenario 3c Simulated drawdown (feet)	Scenario 3d Simulated drawdown (feet)	Scenario 3e Simulated drawdown (feet)
			2010–2014	5	< 1	< 1	< 1	< 1	< 1	< 1	< 1
			2010–2019	10	< 1	< 1	< 1	< 1	< 1	< 1	< 1
			2010–2024	15	1	2	2	2	2	1	2
24	Eskdale Well	UT 18-304	2010–2039	30	2	3	3	3	3	3	3
			2010–2064	55	3	4	4	4	4	4	4
			2010–2114	105	4	5	5	5	5	5	5
			2010–new SS	> 3,000	5	5	5	5	5	5	5
			2010–2014	5	< -1	< -1	< -1	< -1	< -1	< -1	< -1
			2010–2019	10	< -1	< -1	< -1	< -1	< -1	< -1	< -1
			2010–2024	15	< 1	< 1	< 1	< 1	< 1	< -1	< -1
25	West Buckskin Well	UT 18-555	2010–2039	30	< 1	< 1	< 1	< 1	< 1	0	< 1
			2010–2064	55	1	2	2	2	2	< 1	< 1
			2010–2114	105	2	2	2	2	2	1	1
			2010–new SS	> 3,000	2	3	3	3	3	2	2
			2010–2014	5	-1	-1	-1	-1	-1	-1	-1
			2010–2019	10	< -1	< -1	< -1	< -1	< -1	< -1	< -1
			2010–2024	15	< -1	< 1	< 1	< 1	< 1	< 1	< 1
26	Flowing Well 2	UT 18-719	2010–2039	30	1	2	2	2	2	1	2
			2010–2064	55	2	3	3	3	3	3	3
			2010–2114	105	3	4	4	4	4	3	4
			2010–new SS	> 3,000	3	4	4	4	4	4	4
			2010–2014	5	< 1	< 1	< 1	< 1	< 1	< 1	< 1
			2010–2019	10	1	1	1	1	1	1	1
			2010–2024	15	2	2	2	2	2	2	2
27	Shell Baker Creek Well	UT 18-168	2010–2039	30	3	3	3	3	3	3	3
			2010–2064	55	4	4	4	5	5	4	5
			2010–2114	105	5	5	5	5	5	5	5
			2010–new SS	> 3,000	5	6	6	6	6	6	6

Table 9. Simulated drawdowns from existing and proposed groundwater withdrawals (scenarios 1, 2, and 3a–3e) at the groundwater discharge sites of interest to the Department of Interior agencies.—Continued

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Map ID	Site name	Water-right number	Simulation period	Years elapsed since start of 2010	Scenario 1 Simulated drawdown (feet)	Scenario 2 Simulated drawdown (feet)	Scenario 3a Simulated drawdown (feet)	Scenario 3b Simulated drawdown (feet)	Scenario 3c Simulated drawdown (feet)	Scenario 3d Simulated drawdown (feet)	Scenario 3e Simulated drawdown (feet)
28	Unnamed Spring 4	unknown	2010–2014	5	< 1	< 1	< 1	< 1	< 1	< 1	< 1
			2010–2019	10	1	1	1	1	1	1	1
			2010–2024	15	3	3	3	3	3	3	3
			2010–2039	30	5	6	6	6	6	6	6
			2010–2064	55	8	9	9	9	9	9	9
			2010–2114	105	11	11	11	11	11	11	11
			2010–new SS	> 3,000	12	13	13	13	13	13	13
29	Upper Lehman Spring	unknown	2010–2014	5	0	0	0	0	0	0	0
			2010–2019	10	0	0	0	0	0	0	0
			2010–2024	15	0	0	0	0	0	0	0
			2010–2039	30	0	0	0	0	0	0	0
			2010–2064	55	0	0	0	0	0	0	0
			2010–2114	105	0	0	0	0	0	0	0
			2010–new SS	> 3,000	0	0	0	0	0	0	0
30	Rowland Springs	NV V10164	2010–2014	5	0	0	0	0	0	0	0
			2010–2019	10	0	0	0	0	0	0	0
			2010–2024	15	0	0	0	0	0	0	0
			2010–2039	30	< 1	< 1	< 1	< 1	< 1	< 1	< 1
			2010–2064	55	< 1	< 1	< 1	< 1	< 1	< 1	< 1
			2010–2114	105	< 1	< 1	< 1	< 1	< 1	< 1	< 1
			2010–new SS	> 3,000	< 1	< 1	< 1	< 1	< 1	< 1	< 1
31	Kious Spring	unknown	2010–2014	5	0	0	0	0	0	0	0
			2010–2019	10	< 1	< 1	< 1	< 1	< 1	< 1	< 1
			2010–2024	15	< 1	< 1	< 1	< 1	< 1	< 1	< 1
			2010–2039	30	2	2	2	2	2	2	2
			2010–2064	55	5	5	5	5	5	5	5
			2010–2114	105	9	10	10	10	10	9	10
			2010–new SS	> 3,000	13	14	14	14	14	13	14

Table 9. Simulated drawdowns from existing and proposed groundwater withdrawals (scenarios 1, 2, and 3a–3e) at the groundwater discharge sites of interest to the Department of Interior agencies.—Continued

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Map ID	Site name	Water-right number	Simulation period	Years elapsed since start of 2010	Scenario 1 Simulated drawdown (feet)	Scenario 2 Simulated drawdown (feet)	Scenario 3a Simulated drawdown (feet)	Scenario 3b Simulated drawdown (feet)	Scenario 3c Simulated drawdown (feet)	Scenario 3d Simulated drawdown (feet)	Scenario 3e Simulated drawdown (feet)
32	Mahogany Spring	unknown	2010–2014	5	0	0	0	0	0	0	0
			2010–2019	10	0	0	0	0	0	0	0
			2010–2024	15	0	0	0	0	0	0	0
			2010–2039	30	< 1	< 1	< 1	< 1	< 1	< 1	< 1
			2010–2064	55	< 1	< 1	< 1	< 1	< 1	< 1	< 1
			2010–2114	105	1	1	1	1	1	1	1
			2010–new SS	> 3,000	6	7	7	7	7	7	7
33	Ibex Well	UT 18-356	2010–2014	5	0	0	0	0	0	0	0
			2010–2019	10	0	0	0	0	0	0	0
			2010–2024	15	0	0	0	0	0	0	0
			2010–2039	30	0	0	0	0	0	0	0
			2010–2064	55	< 1	< 1	< 1	< 1	< 1	< 1	< 1
			2010–2114	105	< 1	< 1	< 1	< 1	< 1	< 1	< 1
			2010–new SS	> 3,000	1	2	2	2	2	2	2
34	Spring Creek Spring	unknown	2010–2014	5	0	0	0	0	0	0	0
			2010–2019	10	0	0	0	0	0	0	0
			2010–2024	15	0	0	0	0	0	0	0
			2010–2039	30	0	0	0	0	0	0	0
			2010–2064	55	0	0	0	0	0	0	0
			2010–2114	105	0	0	0	0	0	0	0
			2010–new SS	> 3,000	0	0	0	0	0	0	0
35	Diversion from Lake Creek 1	UT 18-620	2010–2014	5	< -1	< -1	< -1	< -1	< -1	< -1	< -1
			2010–2019	10	< -1	0	0	0	0	0	0
			2010–2024	15	< 1	< 1	< 1	< 1	< 1	< 1	< 1
			2010–2039	30	< 1	1	1	1	1	1	1
			2010–2064	55	2	2	2	2	2	2	2
			2010–2114	105	2	3	3	3	3	3	3
			2010–new SS	> 3,000	1	3	3	3	3	3	3

Table 9. Simulated drawdowns from existing and proposed groundwater withdrawals (scenarios 1, 2, and 3a–3e) at the groundwater discharge sites of interest to the Department of Interior agencies.—Continued

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Map ID	Site name	Water-right number	Simulation period	Years elapsed since start of 2010	Scenario 1 Simulated drawdown (feet)	Scenario 2 Simulated drawdown (feet)	Scenario 3a Simulated drawdown (feet)	Scenario 3b Simulated drawdown (feet)	Scenario 3c Simulated drawdown (feet)	Scenario 3d Simulated drawdown (feet)	Scenario 3e Simulated drawdown (feet)
36	Diversion from Lake Creek 2	UT 18-621	2010–2014	5	< -1	< -1	< -1	< -1	< -1	< -1	< -1
			2010–2019	10	0	< 1	< 1	< 1	< 1	< 1	< 1
			2010–2024	15	< 1	< 1	< 1	< 1	< 1	< 1	< 1
			2010–2039	30	< 1	1	1	1	1	1	1
			2010–2064	55	1	2	2	2	2	2	2
			2010–2114	105	1	3	3	3	3	3	3
			2010–new SS	> 3,000	< 1	3	3	3	3	3	3
37	Clay Spring	unknown	2010–2014	5	0	0	0	0	0	0	0
			2010–2019	10	0	0	0	0	0	0	0
			2010–2024	15	0	0	0	0	0	0	0
			2010–2039	30	0	0	0	0	0	0	0
			2010–2064	55	0	0	0	0	0	0	0
			2010–2114	105	0	0	0	0	0	0	0
			2010–new SS	> 3,000	0	0	0	0	0	0	0
38	Davies Well 1	UT 18-497	2010–2014	5	14	14	14	14	14	14	14
			2010–2019	10	36	37	37	37	37	37	37
			2010–2024	15	44	45	45	45	45	45	45
			2010–2039	30	49	50	50	50	51	50	50
			2010–2064	55	49	52	52	52	52	52	52
			2010–2114	105	49	52	52	52	52	52	52
			2010–new SS	> 3,000	47	52	52	52	52	52	52
39	Dearden Spring Group	UT 18-684	2010–2014	5	< 1	< 1	< 1	< 1	< 1	< 1	< 1
			2010–2019	10	< 1	< 1	< 1	< 1	< 1	< 1	< 1
			2010–2024	15	< 1	< 1	< 1	< 1	< 1	< 1	< 1
			2010–2039	30	< -1	0	0	0	0	0	0
			2010–2064	55	< -1	0	0	0	0	0	0
			2010–2114	105	< -1	0	0	0	0	0	0
			2010–new SS	> 3,000	< -1	< -1	< -1	< -1	< -1	< -1	< -1

Table 9. Simulated drawdowns from existing and proposed groundwater withdrawals (scenarios 1, 2, and 3a–3e) at the groundwater discharge sites of interest to the Department of Interior agencies.—Continued

[Water-right number: Water-right numbers are preceded by state abbreviation. Negative values (in red) indicate an increase in simulated water levels. Values of "< 1" indicate less than a 1 foot but greater than 0 foot decrease (or drawdown) in simulated water levels. Values of "< -1" indicate less than a 1 foot but greater than 0 foot increase in simulated water levels. **Abbreviations:** ID, identification; NV, Nevada; UT, Utah; new SS, new steady state; <, less than; >, greater than]

Map ID	Site name	Water-right number	Simulation period	Years elapsed since start of 2010	Scenario 1 Simulated drawdown (feet)	Scenario 2 Simulated drawdown (feet)	Scenario 3a Simulated drawdown (feet)	Scenario 3b Simulated drawdown (feet)	Scenario 3c Simulated drawdown (feet)	Scenario 3d Simulated drawdown (feet)	Scenario 3e Simulated drawdown (feet)
			2010–2014	5	3	3	3	3	3	3	3
			2010–2019	10	2	2	2	2	2	2	2
			2010–2024	15	< 1	1	1	1	1	1	1
40	Needle Point Spring	UT 18-571	2010–2039	30	-2	< -1	< -1	< -1	< -1	< -1	< -1
			2010–2064	55	-3	< -1	< -1	< -1	< -1	< -1	< -1
			2010–2114	105	-5	-1	-1	-1	-1	-1	-1
			2010–new SS	> 3,000	-7	-2	-2	-2	-2	-2	-2
			2010–2014	5	0	0	0	0	0	0	0
			2010–2019	10	< 1	< 1	< 1	< 1	< 1	< 1	< 1
			2010–2024	15	< 1	< 1	< 1	< 1	< 1	< 1	< 1
41	Davies Well 2	UT 18-203	2010–2039	30	< -1	< 1	< 1	< 1	< 1	< 1	< 1
			2010–2064	55	-1	< 1	< 1	< 1	< 1	< 1	< 1
			2010–2114	105	-2	< 1	< 1	< 1	< 1	< 1	< 1
			2010–new SS	> 3,000	-4	< -1	< -1	< -1	< -1	< -1	< -1
			2010–2014	5	< 1	< 1	< 1	< 1	< 1	< 1	< 1
			2010–2019	10	< 1	< 1	< 1	< 1	< 1	< 1	< 1
			2010–2024	15	< 1	< 1	< 1	< 1	< 1	< 1	< 1
42	Needle Point Well	UT 18-678	2010–2039	30	< -1	< 1	< 1	< 1	< 1	< 1	< 1
			2010–2064	55	-2	< 1	< 1	< 1	< 1	< 1	< 1
			2010–2114	105	-3	< 1	< 1	< 1	< 1	< 1	< 1
			2010–new SS	> 3,000	-5	< -1	< -1	< -1	< -1	< -1	< -1
			2010–2014	5	0	0	0	0	0	0	0
			2010–2019	10	< -1	< -1	< -1	< -1	< -1	< -1	< -1
			2010–2024	15	-1	-1	-1	-1	-1	-1	-1
43	Unnamed Spring 5	NV R05271	2010–2039	30	-5	-4	-4	-4	-4	-4	-4
			2010–2064	55	-10	-7	-7	-7	-7	-7	-7
			2010–2114	105	-13	-9	-9	-9	-9	-9	-9
			2010–new SS	> 3,000	-16	-10	-10	-10	-10	-10	-10

Table 9. Simulated drawdowns from existing and proposed groundwater withdrawals (scenarios 1, 2, and 3a–3e) at the groundwater discharge sites of interest to the Department of Interior agencies.—Continued

[Water-right number: Water-right numbers are preceded by state abbreviation. Negative values (in red) indicate an increase in simulated water levels. Values of "< 1" indicate less than a 1 foot but greater than 0 foot decrease (or drawdown) in simulated water levels. Values of "< -1" indicate less than a 1 foot but greater than 0 foot increase in simulated water levels. **Abbreviations:** ID, identification; NV, Nevada; UT, Utah; new SS, new steady state; <, less than; >, greater than]

Map ID	Site name	Water-right number	Simulation period	Years elapsed since start of 2010	Scenario 1 Simulated drawdown (feet)	Scenario 2 Simulated drawdown (feet)	Scenario 3a Simulated drawdown (feet)	Scenario 3b Simulated drawdown (feet)	Scenario 3c Simulated drawdown (feet)	Scenario 3d Simulated drawdown (feet)	Scenario 3e Simulated drawdown (feet)
44	Cove Well	UT 18-673	2010–2014	5	< 1	< 1	< 1	< 1	< 1	< 1	< 1
			2010–2019	10	< 1	< 1	< 1	< 1	< 1	< 1	< 1
			2010–2024	15	0	< 1	< 1	< 1	< 1	< 1	< 1
			2010–2039	30	< -1	< -1	< -1	< -1	< -1	< -1	< -1
			2010–2064	55	-2	< -1	< -1	< -1	< -1	< -1	< -1
			2010–2114	105	-3	< -1	< -1	< -1	< -1	< -1	< -1
			2010–new SS	> 3,000	-6	-1	-1	-1	-1	-1	-1
45	Big Springs	unknown	2010–2014	5	0	0	0	0	0	0	0
			2010–2019	10	0	0	0	0	0	0	0
			2010–2024	15	0	0	0	0	0	0	0
			2010–2039	30	0	0	0	0	0	0	0
			2010–2064	55	0	0	0	0	0	0	0
			2010–2114	105	0	0	0	0	0	0	0
			2010–new SS	> 3,000	0	0	0	0	0	0	0
46	Wah Wah Springs	UT 69-1, 69-107, 69-108, 69-19, 69-33	2010–2014	5	0	0	0	0	0	0	0
			2010–2019	10	0	0	0	0	0	0	0
			2010–2024	15	0	0	0	0	0	0	0
			2010–2039	30	0	0	0	0	0	0	0
			2010–2064	55	0	0	0	0	0	0	0
			2010–2114	105	0	0	0	0	0	0	0
			2010–new SS	> 3,000	0	0	0	0	0	0	0
str	Strawberry Creek [2]	unknown	2010–2014	5	0	0	0	0	0	0	0
			2010–2019	10	0	0	0	0	0	0	0
			2010–2024	15	0	0	0	0	0	0	0
			2010–2039	30	< 1	< 1	< 1	< 1	< 1	< 1	< 1
			2010–2064	55	< 1	< 1	< 1	< 1	< 1	< 1	< 1
			2010–2114	105	2	2	2	2	2	2	2
			2010–new SS	> 3,000	6	7	7	7	7	7	7

Table 9. Simulated drawdowns from existing and proposed groundwater withdrawals (scenarios 1, 2, and 3a–3e) at the groundwater discharge sites of interest to the Department of Interior agencies.—Continued

[Water-right number: Water-right numbers are preceded by state abbreviation. Negative values (in red) indicate an increase in simulated water levels. Values of "< 1" indicate less than a 1 foot but greater than 0 foot decrease (or drawdown) in simulated water levels. Values of "< -1" indicate less than a 1 foot but greater than 0 foot increase in simulated water levels. **Abbreviations:** ID, identification; NV, Nevada; UT, Utah; new SS, new steady state; <, less than; >, greater than]

Map ID	Site name	Water-right number	Simulation period	Years elapsed since start of 2010	Scenario 1	Scenario 2	Scenario 3a	Scenario 3b	Scenario 3c	Scenario 3d	Scenario 3e
					Simulated drawdown (feet)	Simulated drawdown (feet)	Simulated drawdown (feet)	Simulated drawdown (feet)	Simulated drawdown (feet)	Simulated drawdown (feet)	Simulated drawdown (feet)
bak	Baker Creek [2]	NV V01066	2010–2014	5	0	0	0	0	0	0	0
			2010–2019	10	0	0	0	0	0	0	0
			2010–2024	15	0	0	0	0	0	0	0
			2010–2039	30	0	0	0	0	0	0	0
			2010–2064	55	< 1	< 1	< 1	< 1	< 1	< 1	< 1
			2010–2114	105	< 1	< 1	< 1	< 1	< 1	< 1	< 1
			2010–new SS	> 3,000	< 1	< 1	< 1	< 1	< 1	< 1	< 1
snk	Snake Creek [2]	UT 18-11, 18-12, 18-249, 18-250, 18-251, 18-257; NV C3863	2010–2014	5	0	0	0	0	0	0	0
			2010–2019	10	0	0	0	0	0	0	0
			2010–2024	15	0	0	0	0	0	0	0
			2010–2039	30	0	< 1	< 1	< 1	< 1	< 1	< 1
			2010–2064	55	< 1	< 1	< 1	< 1	< 1	< 1	< 1
			2010–2114	105	< 1	< 1	< 1	< 1	< 1	< 1	< 1
			2010–new SS	> 3,000	< -1	< 1	< 1	< 1	< 1	< 1	< 1

[1] Drawdown computed from simulated water level in center of spring complex.

[2] Drawdown computed from simulated water level where creek crosses Great Basin National Park boundary.

Table 10. Simulated capture of natural discharge from existing and proposed groundwater withdrawals (scenarios 1, 2, and 3a–3e) at the groundwater discharge sites of interest to the Department of Interior agencies.

[Water-right number: Water-right numbers are preceded by state abbreviation. Negative values (in red) indicate an increase in simulated discharge and no capture. Values of "< 1" indicate less than 1 acre-foot per year or percent but greater than 0 acre-foot per year or percent decrease in simulated natural discharge (or capture). Values of "< -1" indicate less than 1 acre-foot per year or percent but greater than 0 acre-foot per year or percent increase in simulated discharge and no capture. **Abbreviations:** ID, identification; acre-ft/yr, acre-feet per year; ETg, groundwater evapotranspiration; N/A, not applicable; NV, Nevada; UT, Utah; new SS, new steady state; <, less than; >, greater than]

Map ID	Site name	Water-right number	Simulation period	Years elapsed since start of 2010	Scenario 1		Scenario 2		Scenario 3a		Scenario 3b		Scenario 3c		Scenario 3d		Scenario 3e	
					Simulated capture of natural discharge (acre-ft/yr)	Simulated capture (percentage of total simulated natural discharge)	Simulated capture of natural discharge (acre-ft/yr)	Simulated capture (percentage of total simulated natural discharge)	Simulated capture of natural discharge (acre-ft/yr)	Simulated capture (percentage of total simulated natural discharge)	Simulated capture of natural discharge (acre-ft/yr)	Simulated capture (percentage of total simulated natural discharge)	Simulated capture of natural discharge (acre-ft/yr)	Simulated capture (percentage of total simulated natural discharge)	Simulated capture of natural discharge (acre-ft/yr)	Simulated capture (percentage of total simulated natural discharge)	Simulated capture of natural discharge (acre-ft/yr)	Simulated capture (percentage of total simulated natural discharge)
1	**South Seeps** (steady-state simulated discharge in model cell(s) prior to 2010 = 0 acre-ft/yr)	UT 18-597	2010–2014	5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
			2010–2019	10	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
			2010–2024	15	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
			2010–2039	30	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
			2010–2064	55	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
			2010–2114	105	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
			2010–new SS	> 3,000	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
2	**Lime Spring** (steady-state simulated discharge in model cell(s) prior to 2010 = 0 acre-ft/yr)	UT 18-594	2010–2014	5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
			2010–2019	10	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
			2010–2024	15	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
			2010–2039	30	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
			2010–2064	55	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
			2010–2114	105	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
			2010–new SS	> 3,000	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
3	**Snake Valley North Spring Complex** (steady-state simulated discharge in model cell(s) prior to 2010 = 19 acre-ft/yr as ETg)	UT 18-701	2010–2014	5	< 1	2	< 1	2	< 1	2	< 1	2	< 1	2	< 1	2	< 1	2
			2010–2019	10	1	7	2	9	2	11	2	9	2	9	2	9	2	11
			2010–2024	15	2	12	3	17	4	20	3	17	3	17	3	17	4	20
			2010–2039	30	4	21	6	31	7	39	6	31	6	31	6	31	7	39
			2010–2064	55	6	29	8	44	11	55	8	44	8	44	8	44	11	55
			2010–2114	105	7	37	11	57	13	70	11	57	11	57	11	57	13	70
			2010–new SS	> 3,000	9	46	14	71	17	88	14	71	14	71	14	71	17	88
4	**Snake Valley South Spring Complex** (steady-state simulated discharge in model cell(s) prior to 2010 = 22 acre-ft/yr as ETg)	UT 18-702	2010–2014	5	< 1	2	< 1	2	< 1	2	< 1	2	< 1	2	< 1	2	< 1	2
			2010–2019	10	1	5	2	7	2	8	2	7	2	7	2	7	2	8
			2010–2024	15	2	9	3	13	3	15	3	13	3	13	3	13	3	15
			2010–2039	30	4	16	5	24	7	30	5	24	5	24	5	24	7	30
			2010–2064	55	5	22	8	35	9	43	8	35	8	35	8	35	9	43
			2010–2114	105	6	28	10	44	12	55	10	44	10	44	10	44	12	55
			2010–new SS	> 3,000	8	36	12	55	15	68	12	55	12	55	12	55	15	68

Table 10. Simulated capture of natural discharge from existing and proposed groundwater withdrawals (scenarios 1, 2, and 3a–3e) at the groundwater discharge sites of interest to the Department of Interior agencies.—Continued

[Water-right number: Water-right numbers are preceded by state abbreviation. Negative values (in red) indicate an increase in simulated discharge and no capture. Values of "< 1" indicate less than 1 acre-foot per year or percent but greater than 0 acre-foot per year or percent decrease in simulated natural discharge (or capture). Values of "< -1" indicate less than 1 acre-foot per year or percent but greater than 0 acre-foot per year or percent increase in simulated discharge and no capture. **Abbreviations:** ID, identification; acre-ft/yr, acre-feet per year; ETg, groundwater evapotranspiration; N/A, not applicable; NV, Nevada; UT, Utah; new SS, new steady state; <, less than; >, greater than]

Map ID	Site name	Water-right number	Simulation period	Years elapsed since start of 2010	Scenario 1		Scenario 2		Scenario 3a		Scenario 3b		Scenario 3c		Scenario 3d		Scenario 3e	
					Simulated capture of natural discharge (acre-ft/yr)	Simulated capture (percentage of total simulated natural discharge)	Simulated capture of natural discharge (acre-ft/yr)	Simulated capture (percentage of total simulated natural discharge)	Simulated capture of natural discharge (acre-ft/yr)	Simulated capture (percentage of total simulated natural discharge)	Simulated capture of natural discharge (acre-ft/yr)	Simulated capture (percentage of total simulated natural discharge)	Simulated capture of natural discharge (acre-ft/yr)	Simulated capture (percentage of total simulated natural discharge)	Simulated capture of natural discharge (acre-ft/yr)	Simulated capture (percentage of total simulated natural discharge)	Simulated capture of natural discharge (acre-ft/yr)	Simulated capture (percentage of total simulated natural discharge)
5	**Coyote Spring** (steady-state simulated discharge in model cell(s) prior to 2010 = 0 acre-ft/yr)	UT 18-596	2010–2014	5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
			2010–2019	10	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
			2010–2024	15	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
			2010–2039	30	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
			2010–2064	55	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
			2010–2114	105	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
			2010–new SS	> 3,000	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
6	**Miller Spring** (steady-state simulated discharge in model cell(s) prior to 2010 = 304 acre-ft/yr as spring discharge)	UT 18-253	2010–2014	5	15	5	15	5	15	5	15	5	15	5	15	5	15	5
			2010–2019	10	36	12	50	17	54	18	50	17	50	17	50	17	54	18
			2010–2024	15	54	18	81	27	91	30	81	27	81	27	81	27	91	30
			2010–2039	30	84	28	134	44	155	51	134	44	134	44	134	44	155	51
			2010–2064	55	111	37	178	59	211	69	178	59	178	59	178	59	211	69
			2010–2114	105	136	45	218	72	260	86	218	72	218	72	218	72	260	86
			2010–new SS	> 3,000	167	55	264	87	304	100	264	87	264	87	264	87	304	100
7	**Leland Harris Spring Complex** (steady-state simulated discharge in model cell(s) prior to 2010 = 57 acre-ft/yr as ETg)	unknown	2010–2014	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			2010–2019	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			2010–2024	15	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			2010–2039	30	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			2010–2064	55	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			2010–2114	105	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			2010–new SS	> 3,000	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8	**Gandy Salt Marsh Seep** (steady-state simulated discharge in model cell(s) prior to 2010 = 57 acre-ft/yr as ETg)	UT 18-579	2010–2014	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			2010–2019	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			2010–2024	15	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			2010–2039	30	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			2010–2064	55	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			2010–2114	105	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			2010–new SS	> 3,000	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table 10. Simulated capture of natural discharge from existing and proposed groundwater withdrawals (scenarios 1, 2, and 3a–3e) at the groundwater discharge sites of interest to the Department of Interior agencies.—Continued

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Map ID	Site name	Water-right number	Simulation period	Years elapsed since start of 2010	Scenario 1		Scenario 2		Scenario 3a		Scenario 3b		Scenario 3c		Scenario 3d		Scenario 3e	
					Simulated capture of natural discharge (acre-ft/yr)	Simulated capture (percentage of total simulated natural discharge)	Simulated capture of natural discharge (acre-ft/yr)	Simulated capture (percentage of total simulated natural discharge)	Simulated capture of natural discharge (acre-ft/yr)	Simulated capture (percentage of total simulated natural discharge)	Simulated capture of natural discharge (acre-ft/yr)	Simulated capture (percentage of total simulated natural discharge)	Simulated capture of natural discharge (acre-ft/yr)	Simulated capture (percentage of total simulated natural discharge)	Simulated capture of natural discharge (acre-ft/yr)	Simulated capture (percentage of total simulated natural discharge)	Simulated capture of natural discharge (acre-ft/yr)	Simulated capture (percentage of total simulated natural discharge)
9 and gandy-SMLC	**Springs feeding Gandy Salt Marsh Lake and Gandy Salt Marsh Lake Spring Complex** (steady-state simulated discharge in model cell(s) prior to 2010 = 399 acre-ft/yr as ETg)	UT 18-537, 18-575	2010–2014	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			2010–2019	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			2010–2024	15	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			2010–2039	30	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			2010–2064	55	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			2010–2114	105	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			2010–new SS	> 3,000	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10	**Gandy Warm Springs** (steady-state simulated discharge in model cell(s) prior to 2010 = 10,288 acre-ft/yr as spring discharge)	UT 18-584, 18-585, 18-623	2010–2014	5	< 1	0	< 1	0	< 1	0	< 1	0	< 1	0	< 1	0	< 1	0
			2010–2019	10	< 1	0	< 1	0	< 1	0	< 1	0	< 1	0	< 1	0	< 1	0
			2010–2024	15	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			2010–2039	30	2	0	3	0	3	0	3	0	3	0	3	0	3	0
			2010–2064	55	4	0	8	< 1	10	< 1	8	< 1	8	< 1	8	< 1	10	< 1
			2010–2114	105	18	< 1	31	< 1	36	< 1	31	< 1	31	< 1	31	< 1	36	< 1
			2010–new SS	> 3,000	75	< 1	117	1	138	1	117	1	117	1	116	1	138	1
11	**Foote Reservoir Spring** (steady-state simulated discharge in model cell(s) prior to 2010 = 2,110 acre-ft/yr as spring discharge)	UT 18-711, 18-255	2010–2014	5	-5	< -1	-5	< -1	-5	< -1	-5	< -1	-5	< -1	-5	< -1	-5	< -1
			2010–2019	10	-6	< -1	-4	< -1	-4	< -1	-4	< -1	-4	< -1	-4	< -1	-4	< -1
			2010–2024	15	-4	< -1	0	0	1	< 1	0	0	0	0	< -1	0	1	0
			2010–2039	30	7	< 1	20	< 1	25	1	20	< 1	20	1	19	< 1	24	1
			2010–2064	55	25	1	52	3	63	3	52	3	52	3	51	2	62	3
			2010–2114	105	52	3	93	4	111	5	94	4	94	4	92	4	110	5
			2010–new SS	> 3,000	90	4	148	7	176	8	149	7	149	7	146	7	174	8
12	**Twin Springs** (steady-state simulated discharge in model cell(s) prior to 2010 = 1,720 acre-ft/yr as spring discharge)	UT 18-476, 18-486	2010–2014	5	-5	< -1	-5	< -1	-5	< -1	-5	< -1	-5	< -1	-5	< -1	-5	< -1
			2010–2019	10	-6	< -1	-5	< -1	-4	< -1	-5	< -1	-5	< -1	-5	< -1	-4	< -1
			2010–2024	15	-5	< -1	-2	< -1	-1	< -1	-2	< -1	-2	< -1	-2	< -1	-2	< -1
			2010–2039	30	1	< 1	10	< 1	13	< 1	10	< 1	10	< 1	9	< 1	12	< 1
			2010–2064	55	15	< 1	32	2	38	2	32	2	32	2	31	2	38	2
			2010–2114	105	34	2	60	4	71	4	60	4	60	4	58	3	70	4
			2010–new SS	> 3,000	63	4	101	6	119	7	102	6	102	6	99	6	117	7

Table 10. Simulated capture of natural discharge from existing and proposed groundwater withdrawals (scenarios 1, 2, and 3a–3e) at the groundwater discharge sites of interest to the Department of Interior agencies.—Continued

[Water-right number: Water-right numbers are preceded by state abbreviation. Negative values (in red) indicate an increase in simulated discharge and no capture. Values of "< 1" indicate less than 1 acre-foot per year or percent but greater than 0 acre-foot per year or percent decrease in simulated natural discharge (or capture). Values of "< -1" indicate less than 1 acre-foot per year or percent but greater than 0 acre-foot per year or percent increase in simulated discharge and no capture. **Abbreviations:** ID, identification; acre-ft/yr, acre-feet per year; ETg, groundwater evapotranspiration; N/A, not applicable; NV, Nevada; UT, Utah; new SS, new steady state; <, less than; >, greater than]

Map ID	Site name	Water-right number	Simulation period	Years elapsed since start of 2010	Scenario 1		Scenario 2		Scenario 3a		Scenario 3b		Scenario 3c		Scenario 3d		Scenario 3e	
					Simulated capture of natural discharge (acre-ft/yr)	Simulated capture (percentage of total simulated natural discharge)	Simulated capture of natural discharge (acre-ft/yr)	Simulated capture (percentage of total simulated natural discharge)	Simulated capture of natural discharge (acre-ft/yr)	Simulated capture (percentage of total simulated natural discharge)	Simulated capture of natural discharge (acre-ft/yr)	Simulated capture (percentage of total simulated natural discharge)	Simulated capture of natural discharge (acre-ft/yr)	Simulated capture (percentage of total simulated natural discharge)	Simulated capture of natural discharge (acre-ft/yr)	Simulated capture (percentage of total simulated natural discharge)	Simulated capture of natural discharge (acre-ft/yr)	Simulated capture (percentage of total simulated natural discharge)
13	**Briggs Spring** (steady-state simulated discharge in model cell(s) prior to 2010 = 0 acre-ft/yr)	UT 18-604	2010–2014	5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
			2010–2019	10	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
			2010–2024	15	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
			2010–2039	30	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
			2010–2064	55	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
			2010–2114	105	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
			2010–new SS	> 3,000	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
14	**Phil Spring** (steady-state simulated discharge in model cell(s) prior to 2010 = 0 acre-ft/yr)	UT 18-742	2010–2014	5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
			2010–2019	10	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
			2010–2024	15	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
			2010–2039	30	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
			2010–2064	55	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
			2010–2114	105	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
			2010–new SS	> 3,000	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
15	**North Knoll Spring** (steady-state simulated discharge in model cell(s) prior to 2010 = 18 acre-ft/yr as ETg)	UT 18-535	2010–2014	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			2010–2019	10	0	< -1	0	< -1	0	< -1	0	< -1	0	< -1	0	< -1	0	< -1
			2010–2024	15	0	< -1	0	< -1	0	< -1	0	< -1	0	< -1	0	< -1	0	< -1
			2010–2039	30	0	0	0	< 1	0	< 1	0	< 1	0	< 1	0	< 1	0	< 1
			2010–2064	55	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1
			2010–2114	105	< 1	1	< 1	2	< 1	2	< 1	2	< 1	2	< 1	2	< 1	2
			2010–new SS	> 3,000	< 1	2	< 1	3	< 1	3	< 1	3	< 1	3	< 1	3	< 1	3
16	**Middle Knoll Spring** (steady-state simulated discharge in model cell(s) prior to 2010 = 19 acre-ft/yr as ETg)	UT 18-491	2010–2014	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			2010–2019	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			2010–2024	15	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			2010–2039	30	0	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	0	< 1	< 1	< 1
			2010–2064	55	< 1	< 1	< 1	1	< 1	1	< 1	1	< 1	1	< 1	1	< 1	1
			2010–2114	105	< 1	2	< 1	2	< 1	2	< 1	2	< 1	2	< 1	2	< 1	2
			2010–new SS	> 3,000	< 1	3	< 1	4	< 1	4	< 1	4	< 1	4	< 1	3	< 1	4

Table 10. Simulated capture of natural discharge from existing and proposed groundwater withdrawals (scenarios 1, 2, and 3a–3e) at the groundwater discharge sites of interest to the Department of Interior agencies.—Continued

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Map ID	Site name	Water-right number	Simulation period	Years elapsed since start of 2010	Scenario 1		Scenario 2		Scenario 3a		Scenario 3b		Scenario 3c		Scenario 3d		Scenario 3e	
					Simulated capture of natural discharge (acre-ft/yr)	Simulated capture (percentage of total simulated natural discharge)	Simulated capture of natural discharge (acre-ft/yr)	Simulated capture (percentage of total simulated natural discharge)	Simulated capture of natural discharge (acre-ft/yr)	Simulated capture (percentage of total simulated natural discharge)	Simulated capture of natural discharge (acre-ft/yr)	Simulated capture (percentage of total simulated natural discharge)	Simulated capture of natural discharge (acre-ft/yr)	Simulated capture (percentage of total simulated natural discharge)	Simulated capture of natural discharge (acre-ft/yr)	Simulated capture (percentage of total simulated natural discharge)	Simulated capture of natural discharge (acre-ft/yr)	Simulated capture (percentage of total simulated natural discharge)
17	**Knoll Spring** (steady-state simulated discharge in model cell(s) prior to 2010 = 24 acre-ft/yr as ETg)	UT 18-84	2010–2014	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			2010–2019	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			2010–2024	15	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			2010–2039	30	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1
			2010–2064	55	< 1	< 1	< 1	1	< 1	1	< 1	1	< 1	1	< 1	1	< 1	1
			2010–2114	105	< 1	2	< 1	2	< 1	2	< 1	2	< 1	2	< 1	2	< 1	2
			2010–new SS	> 3,000	< 1	3	< 1	3	< 1	4	< 1	4	< 1	4	< 1	3	< 1	3
18	**Unnamed Spring 1** (steady-state simulated discharge in model cell(s) prior to 2010 = 24 acre-ft/yr as ETg)	unknown	2010–2014	5	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1
			2010–2019	10	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1
			2010–2024	15	< 1	1	< 1	1	< 1	1	< 1	1	< 1	1	< 1	1	< 1	1
			2010–2039	30	1	3	1	3	1	3	1	3	1	3	1	3	1	3
			2010–2064	55	2	5	2	5	2	5	2	5	2	5	2	5	2	5
			2010–2114	105	3	6	3	7	3	7	3	7	3	7	3	7	3	7
			2010–new SS	> 3,000	3	7	4	8	4	8	4	9	4	9	3	8	4	8
19 and 20	**Unnamed Spring 2 and Unnamed Spring 3** (steady-state simulated discharge in model cell(s) prior to 2010 = 0 acre-ft/yr)	unknown	2010–2014	5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
			2010–2019	10	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
			2010–2024	15	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
			2010–2039	30	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
			2010–2064	55	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
			2010–2114	105	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
			2010–new SS	> 3,000	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
21	**Want Spring** (steady-state simulated discharge in model cell(s) prior to 2010 = 0 acre-ft/yr)	NV R05275	2010–2014	5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
			2010–2019	10	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
			2010–2024	15	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
			2010–2039	30	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
			2010–2064	55	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
			2010–2114	105	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
			2010–new SS	> 3,000	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Table 10. Simulated capture of natural discharge from existing and proposed groundwater withdrawals (scenarios 1, 2, and 3a–3e) at the groundwater discharge sites of interest to the Department of Interior agencies.—Continued

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Map ID	Site name	Water-right number	Simulation period	Years elapsed since start of 2010	Scenario 1: Simulated capture of natural discharge (acre-ft/yr)	Scenario 1: Simulated capture (percentage of total simulated natural discharge)	Scenario 2: Simulated capture of natural discharge (acre-ft/yr)	Scenario 2: Simulated capture (percentage of total simulated natural discharge)	Scenario 3a: Simulated capture of natural discharge (acre-ft/yr)	Scenario 3a: Simulated capture (percentage of total simulated natural discharge)	Scenario 3b: Simulated capture of natural discharge (acre-ft/yr)	Scenario 3b: Simulated capture (percentage of total simulated natural discharge)	Scenario 3c: Simulated capture of natural discharge (acre-ft/yr)	Scenario 3c: Simulated capture (percentage of total simulated natural discharge)	Scenario 3d: Simulated capture of natural discharge (acre-ft/yr)	Scenario 3d: Simulated capture (percentage of total simulated natural discharge)	Scenario 3e: Simulated capture of natural discharge (acre-ft/yr)	Scenario 3e: Simulated capture (percentage of total simulated natural discharge)
22	**Kane Spring** (steady-state simulated discharge in model cell(s) prior to 2010 = 99 acre-ft/yr as ETg)	UT 18-406	2010–2014	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			2010–2019	10	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1
			2010–2024	15	2	2	2	2	2	2	2	2	2	2	2	2	2	2
			2010–2039	30	4	4	5	5	5	5	5	5	5	5	5	5	5	5
			2010–2064	55	7	7	8	8	8	8	8	8	8	8	8	8	8	8
			2010–2114	105	8	8	10	10	10	10	10	10	10	10	10	10	10	10
			2010–new SS	> 3,000	9	9	11	11	11	11	11	12	11	12	11	11	11	11
23	**Caine Spring** (steady-state simulated discharge in model cell(s) prior to 2010 = 78 acre-ft/yr as ETg)	unknown	2010–2014	5	2	2	2	2	2	2	2	2	2	2	2	2	2	2
			2010–2019	10	3	4	4	5	4	5	4	5	4	5	4	5	4	5
			2010–2024	15	5	6	5	7	5	7	5	7	5	7	5	7	5	7
			2010–2039	30	7	10	9	11	9	11	9	11	9	11	9	11	9	11
			2010–2064	55	10	13	12	15	12	15	12	15	12	15	11	15	12	15
			2010–2114	105	12	16	14	18	14	18	14	18	14	19	14	18	14	18
			2010–new SS	> 3,000	13	17	16	20	16	20	16	20	16	20	15	19	16	20
28	**Unnamed Spring 4** (steady-state simulated discharge in model cell(s) prior to 2010 = 0 acre-ft/yr)	unknown	2010–2014	5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
			2010–2019	10	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
			2010–2024	15	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
			2010–2039	30	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
			2010–2064	55	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
			2010–2114	105	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
			2010–new SS	> 3,000	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
29	**Upper Lehman Spring** (steady-state simulated discharge in model cell(s) prior to 2010 = 1,428 acre-ft/yr as spring discharge)	unknown	2010–2014	5	< 1	0	< 1	0	< 1	0	< 1	0	< 1	0	< 1	0	< 1	0
			2010–2019	10	< 1	0	< 1	0	< 1	0	< 1	0	< 1	0	< 1	0	< 1	0
			2010–2024	15	< 1	0	< 1	0	< 1	0	< 1	0	< 1	0	< 1	0	< 1	0
			2010–2039	30	1	< 1	1	< 1	1	< 1	1	< 1	1	< 1	1	< 1	1	< 1
			2010–2064	55	2	< 1	2	< 1	2	< 1	2	< 1	2	< 1	2	< 1	2	< 1
			2010–2114	105	0	0	< 1	0	< 1	0	< 1	0	< 1	0	0	0	0	0
			2010–new SS	> 3,000	3	< 1	4	< 1	4	< 1	4	< 1	4	< 1	4	< 1	4	< 1

Table 10. Simulated capture of natural discharge from existing and proposed groundwater withdrawals (scenarios 1, 2, and 3a–3e) at the groundwater discharge sites of interest to the Department of Interior agencies.—Continued

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Map ID	Site name	Water-right number	Simulation period	Years elapsed since start of 2010	Scenario 1		Scenario 2		Scenario 3a		Scenario 3b		Scenario 3c		Scenario 3d		Scenario 3e	
					Simulated capture of natural discharge (acre-ft/yr)	Simulated capture (percentage of total simulated natural discharge)	Simulated capture of natural discharge (acre-ft/yr)	Simulated capture (percentage of total simulated natural discharge)	Simulated capture of natural discharge (acre-ft/yr)	Simulated capture (percentage of total simulated natural discharge)	Simulated capture of natural discharge (acre-ft/yr)	Simulated capture (percentage of total simulated natural discharge)	Simulated capture of natural discharge (acre-ft/yr)	Simulated capture (percentage of total simulated natural discharge)	Simulated capture of natural discharge (acre-ft/yr)	Simulated capture (percentage of total simulated natural discharge)	Simulated capture of natural discharge (acre-ft/yr)	Simulated capture (percentage of total simulated natural discharge)
30	**Rowland Springs** (steady-state simulated discharge in model cell(s) prior to 2010 = 1,549 acre-ft/yr as spring discharge)	NV V10164	2010–2014	5	< 1	0	< 1	0	< 1	0	< 1	0	< 1	0	< 1	0	< 1	0
			2010–2019	10	< 1	0	< 1	0	< 1	0	< 1	0	< 1	0	< 1	0	< 1	0
			2010–2024	15	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1
			2010–2039	30	3	< 1	3	< 1	3	< 1	3	< 1	3	< 1	3	< 1	3	< 1
			2010–2064	55	6	< 1	6	< 1	6	< 1	6	< 1	6	< 1	6	< 1	6	< 1
			2010–2114	105	11	< 1	11	< 1	11	< 1	11	< 1	11	< 1	11	< 1	11	< 1
			2010–new SS	> 3,000	13	< 1	15	< 1	15	< 1	15	< 1	15	< 1	14	< 1	15	< 1
31	**Kious Spring** (steady-state simulated discharge in model cell(s) prior to 2010 = 0 acre-ft/yr)	unknown	2010–2014	5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
			2010–2019	10	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
			2010–2024	15	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
			2010–2039	30	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
			2010–2064	55	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
			2010–2114	105	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
			2010–new SS	> 3,000	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
32	**Mahogany Spring** (steady-state simulated discharge in model cell(s) prior to 2010 = 0 acre-ft/yr)	unknown	2010–2014	5	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
			2010–2019	10	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
			2010–2024	15	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
			2010–2039	30	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
			2010–2064	55	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
			2010–2114	105	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
			2010–new SS	> 3,000	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
34	**Spring Creek Spring** (steady-state simulated discharge in model cell(s) prior to 2010 = 1,455 acre-ft/yr as spring discharge)	unknown	2010–2014	5	< 1	0	< 1	0	< 1	0	< 1	0	< 1	0	< 1	0	< 1	0
			2010–2019	10	< 1	0	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1
			2010–2024	15	< 1	< 1	1	< 1	1	< 1	1	< 1	1	< 1	1	< 1	1	< 1
			2010–2039	30	3	< 1	4	< 1	4	< 1	4	< 1	4	< 1	4	< 1	4	< 1
			2010–2064	55	4	< 1	8	< 1	8	< 1	8	< 1	8	< 1	7	< 1	7	< 1
			2010–2114	105	9	< 1	17	1	17	1	17	1	17	1	17	1	17	1
			2010–new SS	> 3,000	< 1	0	20	1	20	1	20	1	20	1	19	1	20	1

Table 10. Simulated capture of natural discharge from existing and proposed groundwater withdrawals (scenarios 1, 2, and 3a–3e) at the groundwater discharge sites of interest to the Department of Interior agencies.—Continued

[Water-right number: Water-right numbers are preceded by state abbreviation. Negative values (in red) indicate an increase in simulated discharge and no capture. Values of "< 1" indicate less than 1 acre-foot per year or percent but greater than 0 acre-foot per year or percent decrease in simulated natural discharge (or capture). Values of "< -1" indicate less than 1 acre-foot per year or percent but greater than 0 acre-foot per year or percent increase in simulated discharge and no capture. **Abbreviations:** ID, identification; acre-ft/yr, acre-feet per year; ETg, groundwater evapotranspiration; N/A, not applicable; NV, Nevada; UT, Utah; new SS, new steady state; <, less than; >, greater than]

Map ID	Site name	Water-right number	Simulation period	Years elapsed since start of 2010	Scenario 1		Scenario 2		Scenario 3a		Scenario 3b		Scenario 3c		Scenario 3d		Scenario 3e	
					Simulated capture of natural discharge (acre-ft/yr)	Simulated capture (percentage of total simulated natural discharge)	Simulated capture of natural discharge (acre-ft/yr)	Simulated capture (percentage of total simulated natural discharge)	Simulated capture of natural discharge (acre-ft/yr)	Simulated capture (percentage of total simulated natural discharge)	Simulated capture of natural discharge (acre-ft/yr)	Simulated capture (percentage of total simulated natural discharge)	Simulated capture of natural discharge (acre-ft/yr)	Simulated capture (percentage of total simulated natural discharge)	Simulated capture of natural discharge (acre-ft/yr)	Simulated capture (percentage of total simulated natural discharge)	Simulated capture of natural discharge (acre-ft/yr)	Simulated capture (percentage of total simulated natural discharge)
35	**Diversion from Lake Creek 1** (steady-state simulated discharge in model cell(s) prior to 2010 = 54 acre-ft/yr as ETg)	UT 18-620	2010–2014	5	< -1	-1	< -1	-1	< -1	-1	< -1	-1	< -1	-1	< -1	-1	< -1	-1
			2010–2019	10	< -1	< -1	< -1	< -1	< -1	< -1	< -1	< -1	< -1	< -1	< -1	< -1	< -1	< -1
			2010–2024	15	< 1	< 1	< 1	1	< 1	1	< 1	1	< 1	1	< 1	1	< 1	1
			2010–2039	30	2	4	3	6	3	6	3	6	3	6	3	5	3	6
			2010–2064	55	4	7	5	10	5	10	5	10	5	10	5	10	5	10
			2010–2114	105	5	9	7	13	7	13	7	13	7	13	7	13	7	13
			2010–new SS	> 3,000	4	7	8	14	8	14	8	14	8	14	7	14	8	14
36	**Diversion from Lake Creek 2** (steady-state simulated discharge in model cell(s) prior to 2010 = 7 acre-ft/yr as ETg)	UT 18-621	2010–2014	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			2010–2019	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			2010–2024	15	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			2010–2039	30	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			2010–2064	55	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			2010–2114	105	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			2010–new SS	> 3,000	0	0	0	0	0	0	0	0	0	0	0	0	0	0
37	**Clay Spring** (steady-state simulated discharge in model cell(s) prior to 2010 = 247 acre-ft/yr as spring discharge)	unknown	2010–2014	5	< -1	< -1	< -1	< -1	< -1	< -1	< -1	< -1	< -1	< -1	< -1	< -1	< -1	< -1
			2010–2019	10	3	1	8	3	8	3	8	3	8	3	8	3	8	3
			2010–2024	15	9	4	21	8	21	8	21	8	21	8	21	8	21	8
			2010–2039	30	25	10	49	20	49	20	50	20	50	20	49	20	49	20
			2010–2064	55	35	14	72	29	72	29	72	29	72	29	71	29	72	29
			2010–2114	105	34	14	85	34	85	34	85	35	85	35	83	34	84	34
			2010–new SS	> 3,000	8	3	84	34	84	34	85	34	85	35	81	33	83	34
39	**Dearden Spring Group** (steady-state simulated discharge in model cell(s) prior to 2010 = 6,807 acre-ft/yr as spring discharge)	UT 18-684	2010–2014	5	61	< 1	61	< 1	61	< 1	61	< 1	61	< 1	61	< 1	61	< 1
			2010–2019	10	-22	< -1	-5	< -1	-5	< -1	-5	< -1	-5	< -1	-5	< -1	-5	< -1
			2010–2024	15	-85	-1	-50	< -1	-50	< -1	-50	< -1	-50	< -1	-50	< -1	-50	< -1
			2010–2039	30	-197	-3	-116	-2	-116	-2	-116	-2	-116	-2	-116	-2	-116	-2
			2010–2064	55	-280	-4	-149	-2	-149	-2	-149	-2	-149	-2	-150	-2	-150	-2
			2010–2114	105	-354	-5	-174	-3	-174	-3	-173	-3	-173	-3	-176	-3	-174	-3
			2010–new SS	> 3,000	-494	-7	-213	-3	-213	-3	-212	-3	-212	-3	-218	-3	-215	-3

Table 10. Simulated capture of natural discharge from existing and proposed groundwater withdrawals (scenarios 1, 2, and 3a–3e) at the groundwater discharge sites of interest to the Department of Interior agencies.—Continued

[Water-right number: Water-right numbers are preceded by state abbreviation. Negative values (in red) indicate an increase in simulated discharge and no capture. Values of "< 1" indicate less than 1 acre-foot per year or percent but greater than 0 acre-foot per year or percent decrease in simulated natural discharge (or capture). Values of "< -1" indicate less than 1 acre-foot per year or percent but greater than 0 acre-foot per year or percent increase in simulated discharge and no capture. **Abbreviations:** ID, identification; acre-ft/yr, acre-feet per year; ETg, groundwater evapotranspiration; N/A, not applicable; NV, Nevada; UT, Utah; new SS, new steady state; <, less than; >, greater than]

Map ID	Site name	Water-right number	Simulation period	Years elapsed since start of 2010	Scenario 1		Scenario 2		Scenario 3a		Scenario 3b		Scenario 3c		Scenario 3d		Scenario 3e	
					Simulated capture of natural discharge (acre-ft/yr)	Simulated capture (percentage of total simulated natural discharge)	Simulated capture of natural discharge (acre-ft/yr)	Simulated capture (percentage of total simulated natural discharge)	Simulated capture of natural discharge (acre-ft/yr)	Simulated capture (percentage of total simulated natural discharge)	Simulated capture of natural discharge (acre-ft/yr)	Simulated capture (percentage of total simulated natural discharge)	Simulated capture of natural discharge (acre-ft/yr)	Simulated capture (percentage of total simulated natural discharge)	Simulated capture of natural discharge (acre-ft/yr)	Simulated capture (percentage of total simulated natural discharge)	Simulated capture of natural discharge (acre-ft/yr)	Simulated capture (percentage of total simulated natural discharge)
40	**Needle Point Spring** (steady-state simulated discharge in model cell(s) prior to 2010 = 7 acre-ft/yr as ETg)	UT 18-571	2010–2014	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			2010–2019	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			2010–2024	15	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			2010–2039	30	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			2010–2064	55	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			2010–2114	105	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			2010–new SS	> 3,000	0	0	0	0	0	0	0	0	0	0	0	0	0	0
43	**Unnamed Spring 5** (steady-state simulated discharge in model cell(s) prior to 2010 = 7 acre-ft/yr as ETg)	NV R05271	2010–2014	5	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			2010–2019	10	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			2010–2024	15	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			2010–2039	30	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			2010–2064	55	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			2010–2114	105	0	0	0	0	0	0	0	0	0	0	0	0	0	0
			2010–new SS	> 3,000	0	0	0	0	0	0	0	0	0	0	0	0	0	0
45	**Big Springs** (steady-state simulated discharge in model cell(s) prior to 2010 = 8,394 acre-ft/yr as spring discharge)	unknown	2010–2014	5	-21	< -1	-21	< -1	-21	< -1	-21	< -1	-21	< -1	-21	< -1	-21	< -1
			2010–2019	10	-64	< -1	-49	< -1	-49	< -1	-49	< -1	-49	< -1	-49	< -1	-49	< -1
			2010–2024	15	-105	-1	-74	< -1	-74	< -1	-74	< -1	-74	< -1	-74	< -1	-74	< -1
			2010–2039	30	-223	-3	-145	-2	-145	-2	-145	-2	-145	-2	-145	-2	-145	-2
			2010–2064	55	-363	-4	-226	-3	-226	-3	-226	-3	-226	-3	-227	-3	-226	-3
			2010–2114	105	-508	-6	-298	-4	-298	-4	-297	-4	-297	-4	-299	-4	-298	-4
			2010–new SS	> 3,000	-902	-11	-450	-5	-449	-5	-448	-5	-448	-5	-456	-5	-451	-5
46	**Wah Wah Springs** (steady-state simulated discharge in model cell(s) prior to 2010 = 721 acre-ft/yr as spring discharge)	UT 69-1, 69-107, 69-108, 69-19, 69-33	2010–2014	5	4	< 1	4	< 1	4	< 1	4	< 1	4	< 1	4	< 1	4	< 1
			2010–2019	10	4	< 1	4	< 1	4	< 1	4	< 1	4	< 1	4	< 1	4	< 1
			2010–2024	15	4	< 1	4	< 1	4	< 1	4	< 1	4	< 1	4	< 1	4	< 1
			2010–2039	30	1	< 1	1	< 1	1	< 1	1	< 1	1	< 1	1	< 1	1	< 1
			2010–2064	55	1	< 1	3	< 1	3	< 1	3	< 1	3	< 1	3	< 1	3	< 1
			2010–2114	105	-10	-1	-2	< -1	-2	< -1	-2	< -1	-2	< -1	-3	< -1	-3	< -1
			2010–new SS	> 3,000	-144	-20	-48	-7	-47	-7	-47	-7	-47	-7	-49	-7	-47	-7

Table 10. Simulated capture of natural discharge from existing and proposed groundwater withdrawals (scenarios 1, 2, and 3a–3e) at the groundwater discharge sites of interest to the Department of Interior agencies.—Continued

[Water-right number: Water-right numbers are preceded by state abbreviation. Negative values (in red) indicate an increase in simulated discharge and no capture. Values of "< 1" indicate less than 1 acre-foot per year or percent but greater than 0 acre-foot per year or percent decrease in simulated natural discharge (or capture). Values of "< -1" indicate less than 1 acre-foot per year or percent but greater than 0 acre-foot per year or percent increase in simulated discharge and no capture. **Abbreviations:** ID, identification; acre-ft/yr, acre-feet per year; ETg, groundwater evapotranspiration; N/A, not applicable; NV, Nevada; UT, Utah; new SS, new steady state; <, less than; >, greater than]

Map ID	Site name	Water-right number	Simulation period	Years elapsed since start of 2010	Scenario 1		Scenario 2		Scenario 3a		Scenario 3b		Scenario 3c		Scenario 3d		Scenario 3e	
					Simulated capture of natural discharge (acre-ft/yr)	Simulated capture (percentage of total simulated natural discharge)	Simulated capture of natural discharge (acre-ft/yr)	Simulated capture (percentage of total simulated natural discharge)	Simulated capture of natural discharge (acre-ft/yr)	Simulated capture (percentage of total simulated natural discharge)	Simulated capture of natural discharge (acre-ft/yr)	Simulated capture (percentage of total simulated natural discharge)	Simulated capture of natural discharge (acre-ft/yr)	Simulated capture (percentage of total simulated natural discharge)	Simulated capture of natural discharge (acre-ft/yr)	Simulated capture (percentage of total simulated natural discharge)	Simulated capture of natural discharge (acre-ft/yr)	Simulated capture (percentage of total simulated natural discharge)
fish	**Fish Springs** (steady-state simulated discharge in model cell(s) prior to 2010 = 25,010 acre-ft/yr as spring discharge)	UT 18-215, 18-66, 18-51	2010–2014	5	8	0	8	0	8	0	8	0	8	0	8	0	8	0
			2010–2019	10	15	< 1	16	< 1	16	< 1	16	< 1	16	< 1	16	< 1	16	< 1
			2010–2024	15	21	< 1	23	< 1	23	< 1	23	< 1	23	< 1	23	< 1	23	< 1
			2010–2039	30	39	< 1	43	< 1	43	< 1	43	< 1	43	< 1	43	< 1	43	< 1
			2010–2064	55	67	< 1	76	< 1	76	< 1	76	< 1	76	< 1	76	< 1	76	< 1
			2010–2114	105	119	< 1	137	< 1	140	< 1	137	< 1	137	< 1	137	< 1	140	< 1
			2010–new SS	> 3,000	326	1	399	2	419	2	400	2	400	2	397	2	417	2
gran_trout	**Granite and Trout Creeks** (steady-state simulated discharge in model cell(s) prior to 2010 = 1,405 acre-ft/yr as discharge to streams)	unknown	2010–2014	5	< -1	0	< -1	0	< -1	0	< -1	0	< -1	0	< -1	0	< -1	0
			2010–2019	10	< -1	0	< -1	0	< -1	0	< -1	0	< -1	0	< -1	0	< -1	0
			2010–2024	15	< -1	0	< -1	0	< -1	0	< -1	0	< -1	0	< -1	0	< -1	0
			2010–2039	30	< -1	0	0	0	0	0	0	0	0	0	0	0	0	0
			2010–2064	55	< 1	0	< 1	0	< 1	0	< 1	0	< 1	0	< 1	0	< 1	0
			2010–2114	105	< 1	< 1	1	< 1	1	< 1	1	< 1	1	< 1	1	< 1	1	< 1
			2010–new SS	> 3,000	4	< 1	5	< 1	5	< 1	5	< 1	5	< 1	5	< 1	5	< 1
str_bak_snk	**Strawberry, Baker, and Snake Creeks** (steady-state simulated discharge in model cell(s) prior to 2010 = 1,778 acre-ft/yr as discharge to streams)	unknown; NV V01066; UT 18-11, 18-12, 18-249, 18-250, 18-251, 18-257; NV C3863	2010–2014	5	< -1	0	< -1	0	< -1	0	< -1	0	< -1	0	< -1	0	< -1	0
			2010–2019	10	< -1	0	< -1	0	< -1	0	< -1	0	< -1	0	< -1	0	< -1	0
			2010–2024	15	< -1	0	< -1	0	< -1	0	< -1	0	< -1	0	< -1	0	< -1	0
			2010–2039	30	< 1	0	< 1	0	< 1	0	< 1	0	< 1	0	< 1	0	< 1	0
			2010–2064	55	2	< 1	2	< 1	2	< 1	2	< 1	2	< 1	2	< 1	2	< 1
			2010–2114	105	2	< 1	3	< 1	3	< 1	3	< 1	3	< 1	3	< 1	3	< 1
			2010–new SS	> 3,000	2	< 1	4	< 1	4	< 1	4	< 1	4	< 1	3	< 1	4	< 1

percent after 105 years (from the start of 2010), and at Knoll Spring (site 17), Unnamed Spring 1 (site 18), and Kane Spring (site 22), simulated capture increases 1 percent at the new steady-state conditions, compared to scenario 2.

The addition of the proposed withdrawals from UT a40687 (scenario 3d) did not result in any increases in simulated capture of natural discharge, compared to scenario 2 (table 10), at the groundwater discharge sites of interest to the DOI agencies. Conversely, simulated discharge increases up to 1 percent at several sites for some stress periods, compared to scenario 2, because the change application decreased withdrawals and moved the point of diversion farther from these sites. These sites include Foote Reservoir Spring (site 11), Twin Springs (site 12), Middle Knoll Spring (site 16), Caine Spring (site 23), Diversion from Lake Creek 1 (site 35), and Clay Spring (site 37).

Increases in simulated capture of natural discharge following the addition of the combined proposed withdrawals from UT 18-756, UT 18-758, UT 18-759, and UT a40687 (scenario 3e) range from 0 to 14 percent after 105 years of withdrawals, compared to scenario 2 (table 10), at Snake Valley North Spring Complex (site 3), Snake Valley South Spring Complex (site 4), Miller Spring (site 6), and Foote Reservoir Spring (site 11). Table 5 summarizes the simulated capture of natural discharge for the study area.

Capture and Remaining Discharge Maps

Capture maps were also constructed as part of this analysis. All groundwater withdrawals result in drawdown or capture (withdrawals that result in depletion) of natural discharge; at steady state, withdrawals are equal to capture. The model simulates natural groundwater discharge to springs, mountain streams, evapotranspiration (ETg), and as subsurface outflow across a part of the northern boundary of the model using head-dependent boundary packages. The simulations used to develop the capture maps test the response of the system, specifically the reduction of natural discharge, to future stresses at a point for any given location in the area represented by the model. In this way, these maps can be used as a tool to determine the source of water to, and the potential effects at specific areas from, future well withdrawals.

Capture maps (Leake and others, 2010) are used to generally describe the effects of additional well withdrawals on natural groundwater discharge rates. Three types of maps were created for this analysis. Type 1 maps represent capture by groundwater discharge component (for example, springs or ETg). Type 2 maps represent capture from a specific groundwater discharge site (for example, Miller Spring, site 6, or Dearden Spring Group, site 39). Type 3 maps show the remaining amounts of discharge at a specific groundwater discharge site (for example, Miller Spring, site 6, or Dearden Spring Group, site 39). The type 3 maps are needed for the correct interpretation of the type 2 maps because of the nonlinear nature of the model, which is discussed later, so type 2 and type 3 maps are to be used in combination. Strictly speaking, the type 3 maps are not considered “capture” maps, but “remaining discharge” maps. For the type 1 and type 2 maps, the effect of additional withdrawals is described as “capture fraction or percentage,” which is the fraction or percentage of the well discharge supplied by reducing groundwater discharge. For the type 3 maps, the effect of additional withdrawals is described as the percentage of discharge remaining compared to initial conditions prior to 2010.

Method for Construction of the Maps

Results of the simulations from scenario 2 were used as the base conditions to which the additional withdrawals were compared. Scenario 2 simulates the effects of existing groundwater withdrawals plus proposed withdrawals from approved, but not yet developed (ABNYD), water rights in the study area to determine the potential effects of withdrawals that may have been developed in 2015 or are likely to be developed shortly after 2015. Locations and amounts of simulated withdrawals and results for scenario 2 are summarized in figures 5–8 and tables 2–4 and 6.

The methods described by Leake and others (2010) and Leake and Pool (2010) for creating capture maps were the basis for the methods used in this study, and details can be found in those reports. In general, the methods used in the current study consisted of the following:

1. Run the base model (scenario 2) to (new) steady-state conditions.
    a. Save the initial (prior to 2010) simulated discharge values for the groundwater discharge sites of interest to the DOI agencies (after first stress period).
    b. Save the simulated groundwater budget component data for the entire model after the last stress period (new steady-state conditions).
    c. Save the simulated discharge values for the groundwater discharge sites of interest to the DOI agencies after the last stress period (new steady-state conditions).
2. In the Well Package, add one well that has a total pumping rate of 400 acre-ft/yr in model layers 1 and 2 at a select location. Run the model again to steady state.
    a. Retrieve the simulated groundwater budget component data for the entire model after the last stress period.
    b. Retrieve the simulated discharge values for the groundwater discharge sites of interest to the DOI agencies after the last stress period.
    c. Divide differences between the values from the base model (step 1b or 1c) and the new model (step 2a or 2b) by the pumping rate (400 acre-ft/yr) to obtain the capture fraction for each budget component or each groundwater discharge site of interest to the DOI

agencies. Assign and save the capture fractions to the well location (for type 1 and type 2 capture maps).

d. Divide the simulated discharge values from the new model (step 2b) by initial (prior to 2010) simulated discharge values (step 1a) to determine the percentage of discharge remaining for each groundwater discharge site of interest to the DOI agencies. Assign and save this percentage to the well location (for type 3 remaining discharge maps). It is important to note that these maps are a result of the combination of captured discharge at a specific site calculated in the base model (scenario 2) and any captured discharge at the same site from the new well pumping at a rate of 400 acre-ft/yr.

3. Repeat step 2 for all desired locations of added wells.

4. Map the capture fraction or remaining discharge for the area where wells are simulated.

For this analysis, the additional wells were placed at various spacing to provide adequate data for interpolation of the maps (to shorten run times). The distribution of points where a new well was added for step 2 is shown in figure 21. For each repetition of step 2, only one of these wells was added. Additionally, because the base and new model simulations were run and compared at steady-state conditions, the results represent the long-term ultimate capture. To determine the timing of capture, new maps need to be created for different time intervals. Currently, this is beyond the scope of this project; however, at most locations, about 90 percent of the ultimate capture occurs within 100 years.

Results and Interpretation of the Capture and Remaining Discharge Maps

The following sections present all type 1 maps, and type 2 and type 3 maps for selected groundwater discharge sites of interest to the DOI agencies. Type 2 and type 3 maps for the remainder of the groundwater discharge sites of interest to the DOI agencies are presented in appendix 1. If the model was linear, the capture and remaining discharge results would apply for any pumping rate. Because of the extensive head-dependent boundaries used in the model to simulate discharge, however, the model is not linear, and the results shown in the maps only apply to a well pumping at a rate of 400 acre-ft/yr at that location. The amount of 400 acre-ft/yr was chosen as a likely future withdrawal from a single well on the basis of the assumption that the Utah State Engineer's Office adheres to their 100-acre irrigation limit and an application/withdrawal rate of 4 ft/yr.

Type 1 Maps: Budget Component Capture Maps

Figures 22–24 show the amount of capture by a well from each of the natural discharge components and can be used in combination to determine the types and percentages of the well discharge captured from these components. For example, a well pumping 400 acre-ft/yr at example location 1 shown in figures 22–24 derives or captures 51 to 60 percent of its discharge from ETg (fig. 22), 31 to 40 percent from various springs (fig. 23), and less than 1 percent from streams (fig. 24). A well pumping 400 acre-ft/yr at example location 2 derives 91 to 95 percent of its discharge from ETg (fig. 22), 1 to 10 percent from various springs (fig. 23), and less than 1 percent from streams (fig. 24).

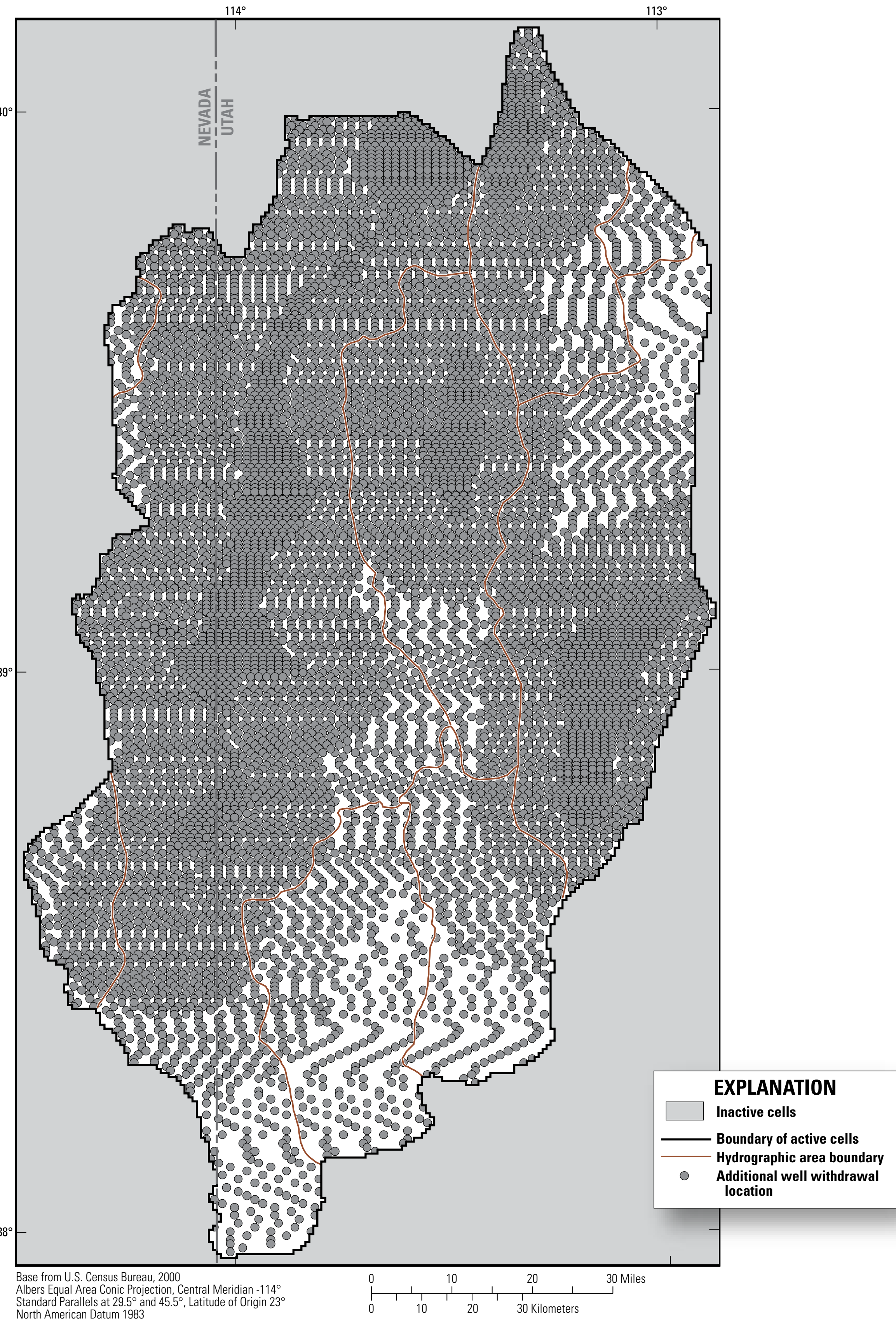

Figure 21. Distribution of additional wells used for creation and interpolation of capture and remaining discharge maps, Snake Valley area groundwater model.

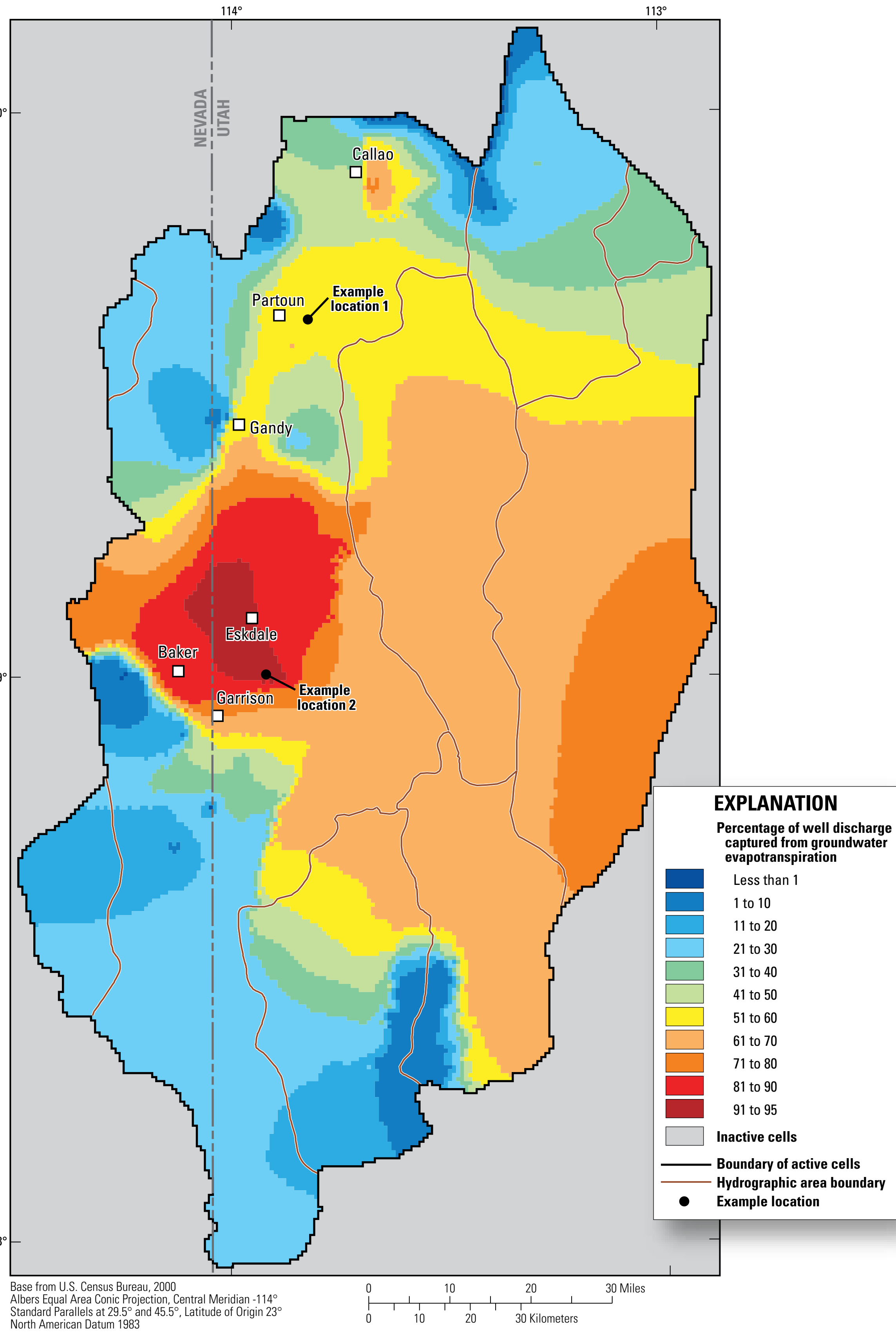

Figure 22. Simulated percentage of well discharge captured from groundwater evapotranspiration that results from long-term pumping of a well at a rate of 400 acre-feet per year in model layers 1 and 2, Snake Valley area groundwater model.

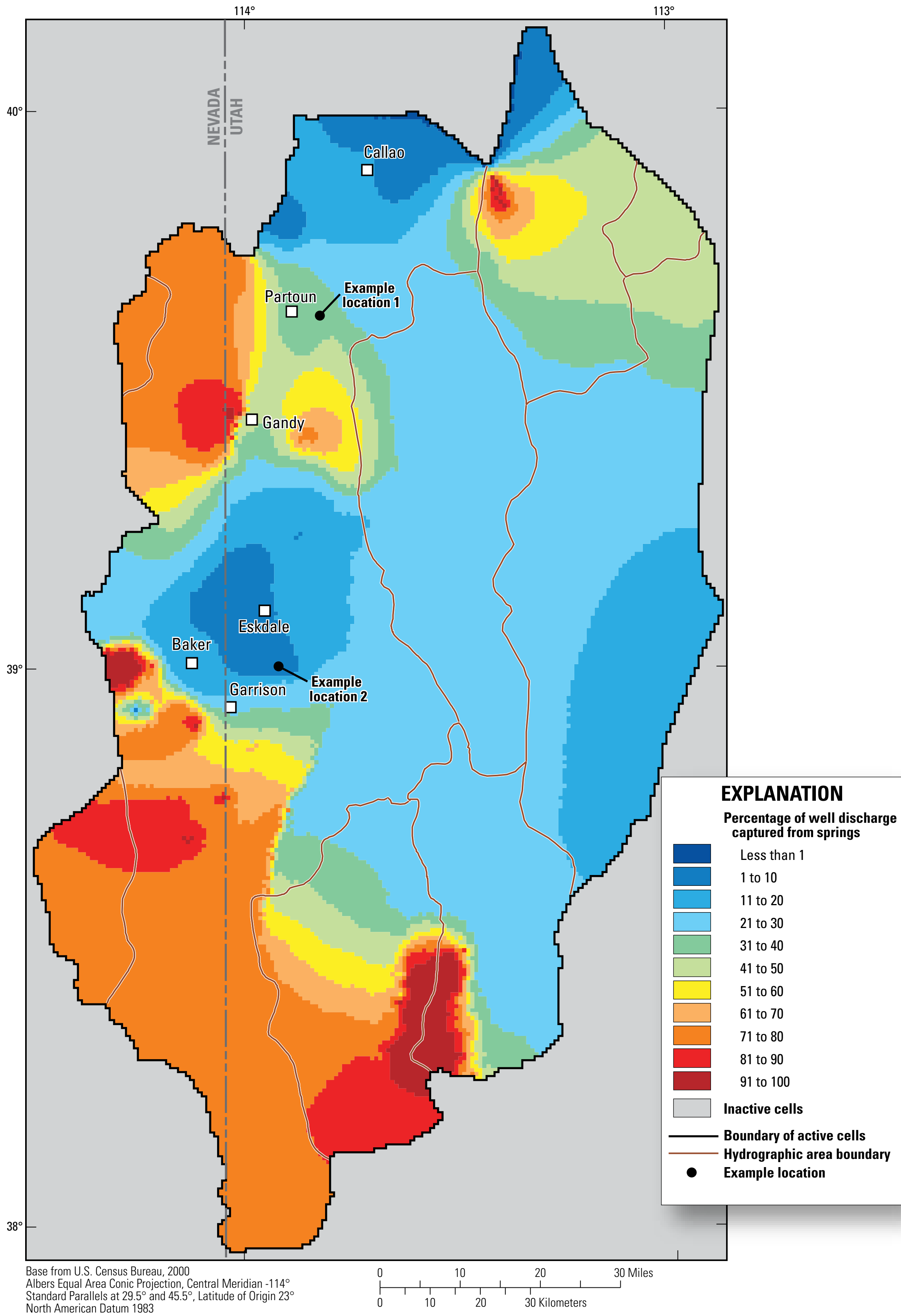

Figure 23. Simulated percentage of well discharge captured from springs that results from long-term pumping of a well at a rate of 400 acre-feet per year in model layers 1 and 2, Snake Valley area groundwater model.

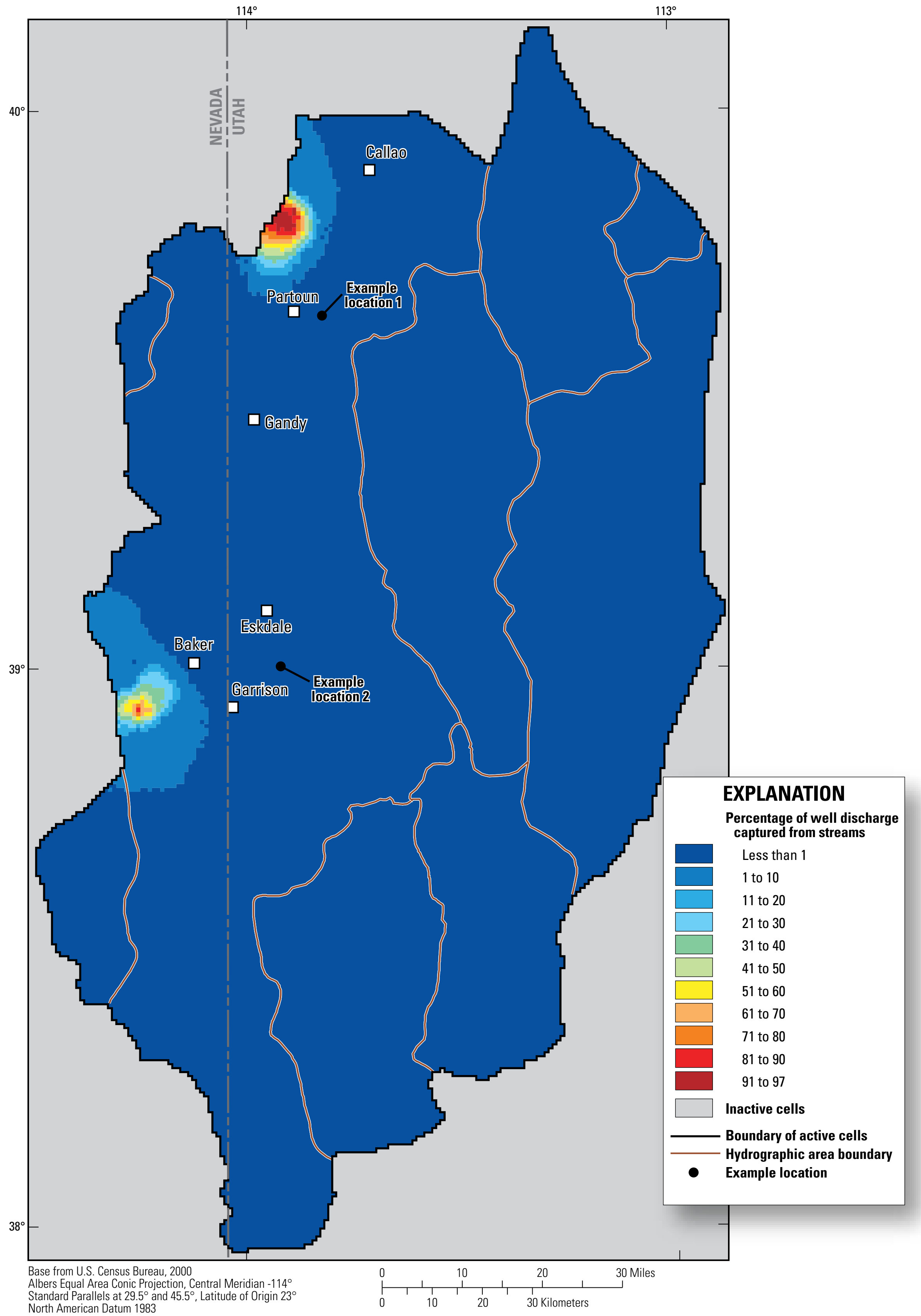

Figure 24. Simulated percentage of well discharge captured from streams that results from long-term pumping of a well at a rate of 400 acre-feet per year in model layers 1 and 2, Snake Valley area groundwater model.

Type 2 and Type 3 Maps: Capture and Remaining Discharge Maps for Specific Discharge Sites

Figures 25 and 26 (type 2 maps) show the amount of capture by a well, pumping at a specific location and rate of 400 acre-ft/yr, from Miller Spring (site 6) and Dearden Spring Group (site 39), respectively, and figures 27 and 28 (type 3 maps) show the remaining percentage of simulated discharge compared to initial (prior to 2010) conditions at Miller Spring and Dearden Spring Group, respectively. For example, a well pumping 400 acre-ft/yr at example location 1shown in figures 25–28 captures 1 to 10 percent of its discharge from Miller Spring (fig. 25) and less than 1 percent of its discharge from Dearden Spring Group (fig. 26). Additionally, with a well pumping at example location 1, there is less than 1 percent of discharge remaining at Miller Spring (fig. 27) and 101 to 104 percent of discharge remaining at Dearden Spring Group (fig. 28) compared to initial conditions. It is important to note that the type 3 (remaining discharge) maps are a result of the combination of captured discharge at a specific site calculated in the base model (scenario 2) and any captured discharge at the same site from the additional well pumping at a rate of 400 acre-ft/yr. This is why the discharge remaining map for Dearden Spring Group (fig. 28) shows additional discharge compared to initial conditions because a number of existing well withdrawals in the southern part of the model area were moved farther from the spring in 2015 and, therefore, the model simulates the spring recovering flow previously captured by these wells. A well pumping 400 acre-ft/yr at example location 2 shown in figures 25–28 captures about 0 percent of its discharge from Miller Spring (fig. 25) and 1 to 10 percent of its discharge from Dearden Spring Group (fig. 26). Additionally, with a well pumping at example location 2, there is about 11 to 13 percent of discharge remaining at Miller Spring (fig. 27) and about 101 to 104 percent of discharge remaining at Dearden Spring Group (fig. 28) compared to initial conditions.

Because of the non-linearity of the model, the type 2 and type 3 maps need to be used in combination to correctly interpret the maps and determine the full effect of the additional well on a specific site. For example, figure 25 shows, at most, 10 percent of the discharge from a well pumping at a rate of 400 acre-ft/yr could be captured from Miller Spring. This could be incorrectly interpreted as showing that any pumping well in the modeled area would have a small effect on capturing water from Miller Spring. What is not shown by this map is that the existing and ABNYD withdrawals (scenario 2) are already capturing about 87 percent of the discharge at Miller Spring (table 4), so only about 13 percent (or 40 acre-ft/yr) is left to be captured from the spring by any additional wells. If any additional well captures 10 percent of its discharge from Miller Spring, all the discharge from the spring would be captured and the spring would cease to flow which, clearly, would be a large effect on this spring. This is shown on the remaining discharge map for Miller Spring (fig. 27). This map shows that for any additional well pumping at 400 acre-ft/yr near Miller Spring, the remaining discharge at Miller Spring is less than 1 and close to 0 percent of the initial discharge simulated from the spring; for any well farther from Miller Spring pumping at 400 acre-ft/yr, there would still be some percentage of flow at Miller Spring because the well could be capturing discharge from a different source nearer to the well than Miller Spring.

Applicability of Capture and Remaining Discharge Maps

Capture and remaining discharge maps can be used to help water managers and the public understand that all groundwater development affects surface-water features or areas of groundwater discharge. The best use of the maps is to help understand how the position of a well determines which features are most affected. The maps can also be used as a tool to assess where development could have acceptable or unacceptable effects. The maps are based on simulated transmissivity, anisotropy, and conductance in the model and are not considered absolutely accurate at any specific location because of the uncertainty of these parameters. The model and the maps represent hydraulic properties that appear reasonable on the basis of water levels, discharge estimates, and groundwater temperatures, but may not be unique. Different combinations of model input parameters may result in an equally reasonable fit to the observed data. Regardless of the inaccuracies, the model provides a better tool for estimating the effects of groundwater development than analytical solutions because the complexities of the system are included in the numerical model. An analysis of the sensitivity of capture to various hydraulic properties was beyond the scope of this project; however, analyses for an area along the Colorado River in Arizona and California (Leake and others, 2013, fig. 6) indicated varying hydraulic properties over reasonable ranges could affect the capture by as much as 20 percent, with the greatest differences close to the locations of discharge.

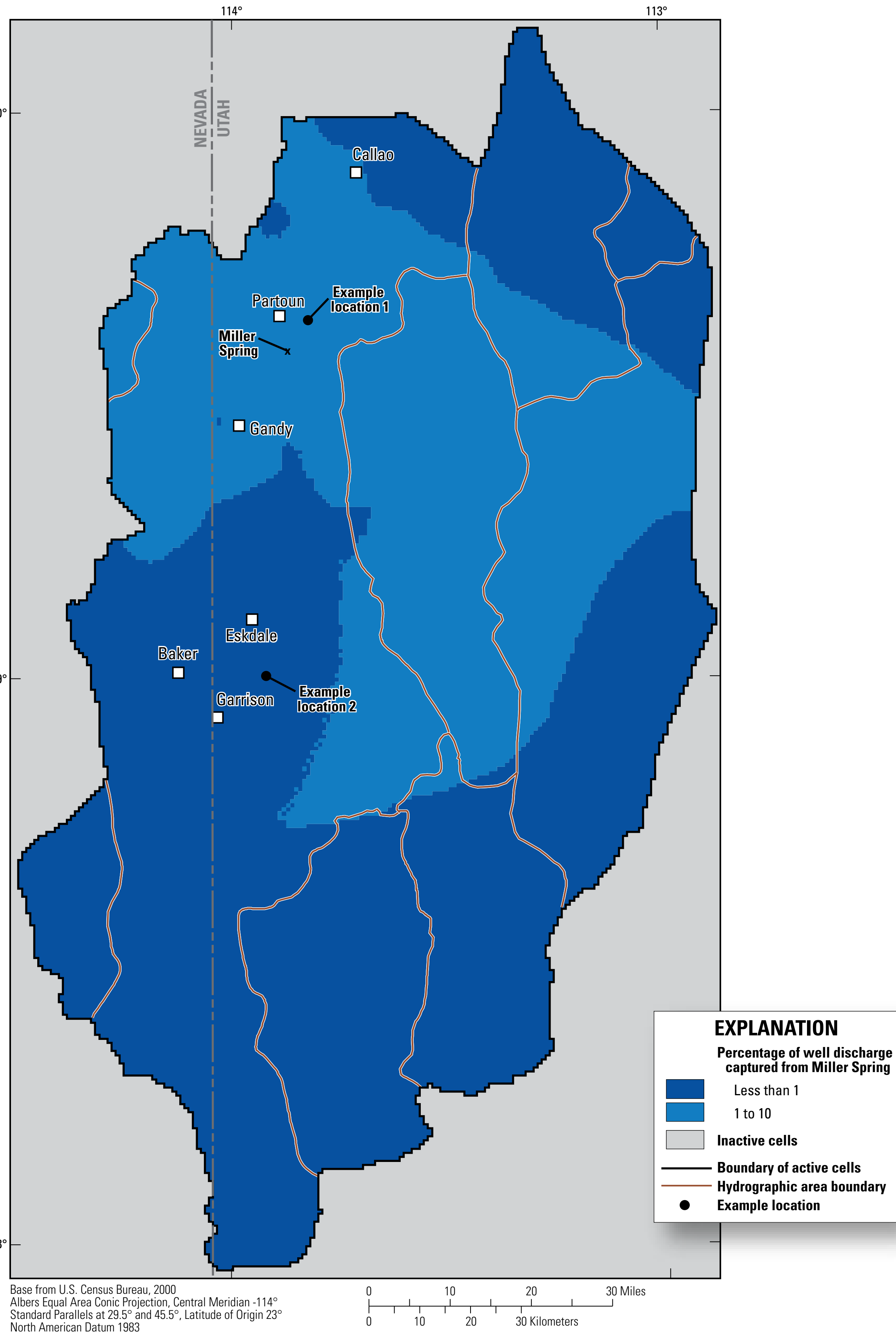

Figure 25. Simulated percentage of well discharge captured from Miller Spring that results from long-term pumping of a well at a rate of 400 acre-feet per year in model layers 1 and 2, Snake Valley area groundwater model.

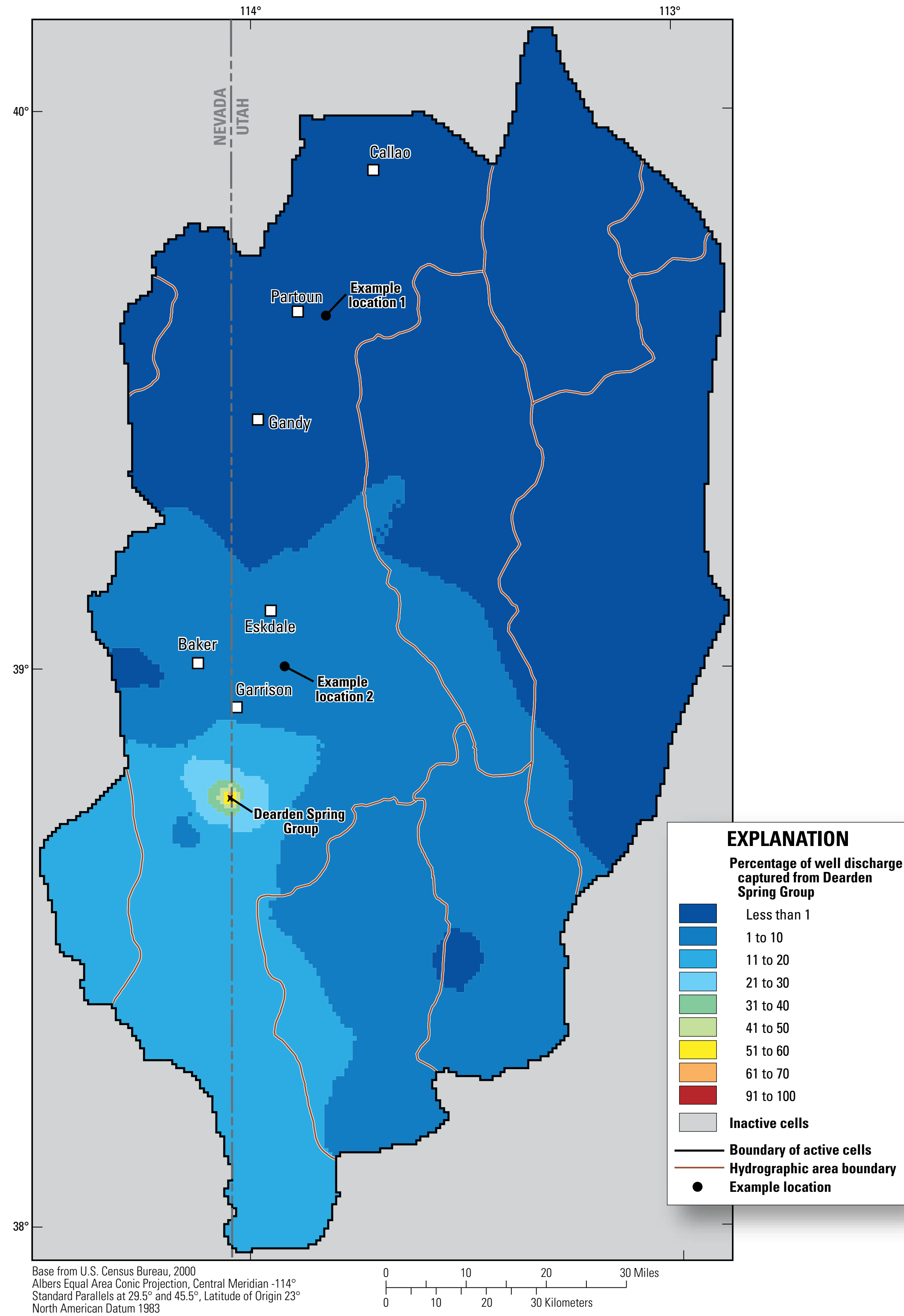

Figure 26. Simulated percentage of well discharge captured from Dearden Spring Group that results from long-term pumping of a well at a rate of 400 acre-feet per year in model layers 1 and 2, Snake Valley area groundwater model.

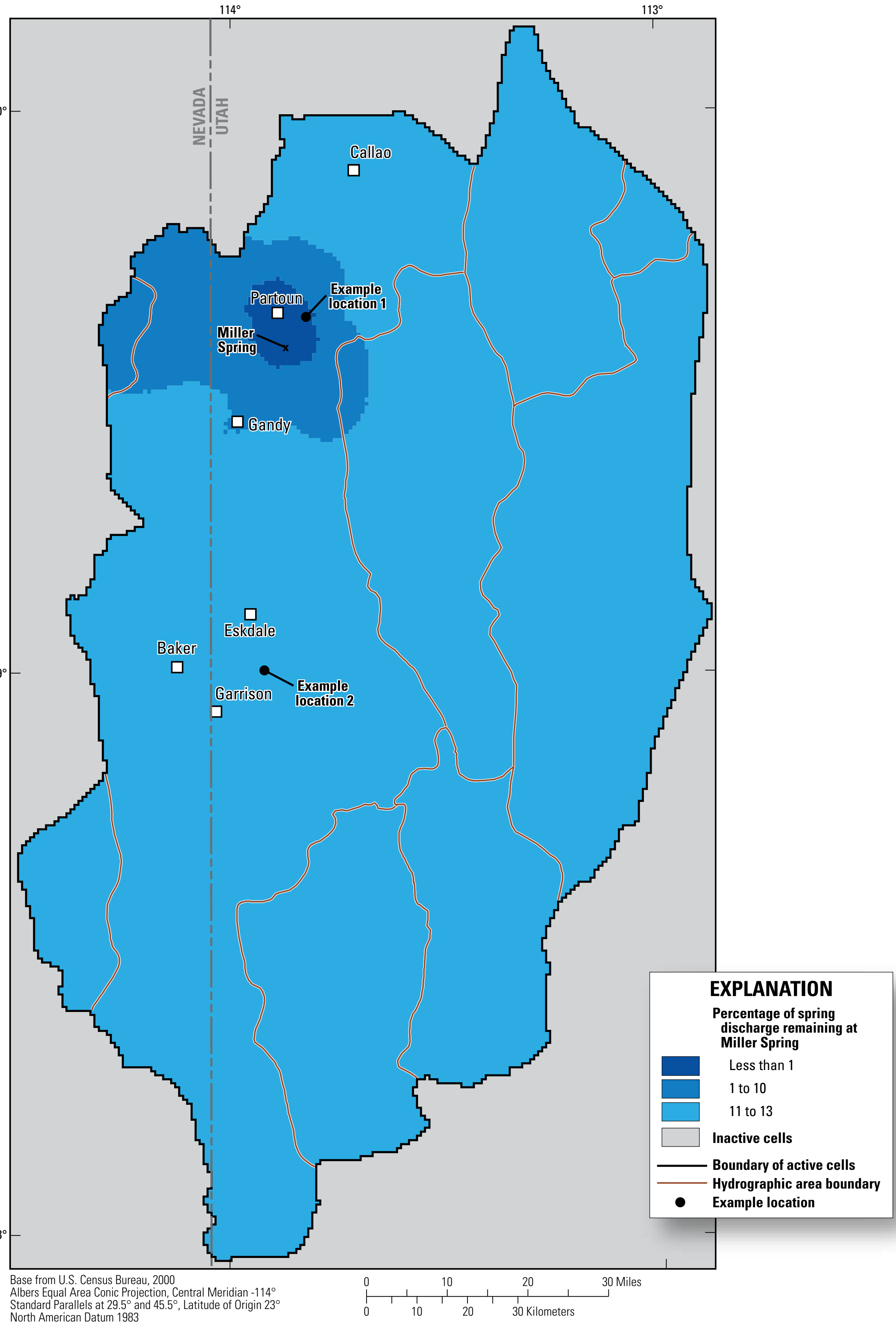

Figure 27. Simulated percentage of spring discharge remaining (compared to initial [prior to 2010] simulated discharge) at Miller Spring that results from long-term pumping of a well at a rate of 400 acre-feet per year in model layers 1 and 2, Snake Valley area groundwater model.

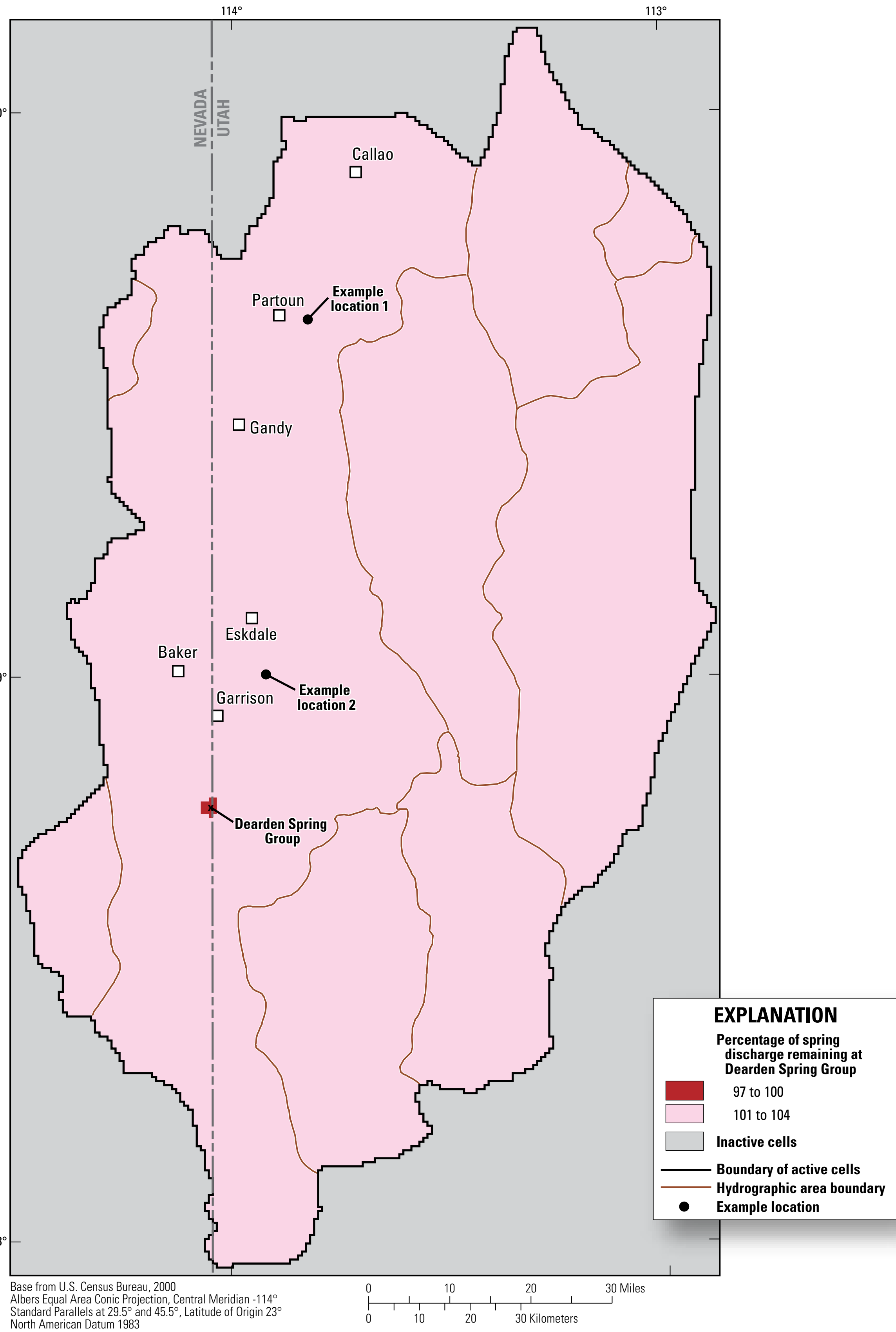

Figure 28. Simulated percentage of spring discharge remaining (compared to initial [prior to 2010] simulated discharge) at Dearden Spring Group that results from long-term pumping of a well at a rate of 400 acre-feet per year in model layers 1 and 2, Snake Valley area groundwater model.

Model Limitations

The Snake Valley groundwater model was constructed to simulate regional-scale groundwater flow; thus, it can be used to answer questions about groundwater-flow issues at this scale. All models are based on a limited amount of data and are simplifications of actual systems. When creating a model of a large region, it is necessary to make more simplifications than for models of smaller regions. Model limitations are a consequence of uncertainty in three basic aspects of the model, including inadequacies, inaccuracies, or simplifications in (1) observations used in model calibration, (2) representation of geologic complexity in the hydrogeologic framework, and (3) representation of the groundwater system in the model. It is important to understand how these characteristics limit the use of the model. For a complete description of these limitations, see Masbruch and others (2014, p. 91–92). A model limitation that does not fit into these categories is that the model was not calibrated to transient conditions. Because of this, the timing and magnitude of the simulated effects could be in error. The long-term steady-state simulated effects are likely to be less uncertain than the transient simulated effects.

A detailed sensitivity analysis was performed for the original calibrated steady-state model (Masbruch and others, 2014) that was used as the first stress period for the model described in this report. The sensitivity analysis showed that the model observations were highly sensitive to several parameters representing horizontal hydraulic conductivity, groundwater evapotranspiration and recharge rates, and well withdrawal rates. A small change in any one of these parameters could potentially cause a significant change in either simulated drawdown or capture estimates. The model represents hydraulic properties that appear reasonable on the basis of water levels, discharge estimates, and groundwater temperatures, but may not be unique. Different combinations of model input parameters may result in an equally reasonable fit to the observed data. For a complete description of the sensitivity analysis, see Masbruch and others (2014, p. 50–71, and figs. 32 and 33).

Estimates of historical and existing groundwater withdrawals could be in error. Locations and estimates of withdrawals from these wells are from a number of sources that use a variety of methods. For example, most of the groundwater withdrawal estimates on the Utah side of Snake Valley are based on rating the wells using power records, whereas estimates for a number of withdrawals on the Nevada side of Snake Valley are based on estimations of water-application rates. Estimates of future model stresses and boundary conditions are also uncertain, which leads to uncertainty in the potential simulated effects.

Observed long-term declines in water levels at a few wells indicate existing groundwater withdrawals in Snake Valley are affecting water levels. The numerical model simulates similar trends of declining water levels; simulated drawdowns in the model, however, are generally less than observed water-level declines. Figure 29 shows a comparison of observed and simulated drawdowns between 2010 and 2015 for 10 sites in Snake Valley (fig. 30). Calibration of the model to transient conditions would likely have brought the model into better agreement with observed drawdowns. Additionally, the uncertainty of simulated drawdowns is high because, at the regional scale of the model, uncertainties in the simulated water levels can be up to about plus or minus 25 ft (Masbruch and others, 2014). Because the Snake Valley area model was not calibrated to observed water-level declines and transient water levels, it is difficult to determine the source of the error in the simulated drawdown for these wells. These errors could be the result of simplification of the conceptual model, discretization effects, difficulty obtaining sufficient measurements to account for all the spatial variation in hydraulic properties (including storage), or from some process that the model either is not simulating or not simulating accurately. Simulated drawdowns, therefore, could be different from actual drawdowns.

Because several of the springs are not explicitly simulated by the model, there is uncertainty in the estimate of groundwater capture from these springs. The model simulates natural discharge as evapotranspiration in most of the model cells containing these springs. Assuming that some part of this natural discharge is related to spring flow, the amount of discharge potentially captured from these cells also is likely to affect spring flow. Because the spring orifice could be discharging only a small percentage of the total groundwater discharge from the model cell, however, the percentage of simulated natural groundwater capture reported cannot be directly equated to a percentage of reduction in spring flow. Additionally, the model could continue to show that well withdrawals are capturing groundwater discharge from the model cell even when the hydraulic gradient and groundwater levels decline to the point where spring flow through the orifice ceases. The model would continue to simulate capture of transpiration from phreatophytes, which can have roots that are deeper than the spring orifice. Because these springs were not explicitly simulated in the model, and there is a lack of discharge data for most of these springs, it is impossible to determine how much of the potential captured groundwater is from the springs compared to how much is from evapotranspiration. Capture of natural discharge at the cells containing these springs, therefore, was calculated as a percentage of total ETg simulated at these cells, which could under- or overestimate the capture of spring flow for these cells.

The model also does not simulate capture for several of the cells that contain springs not explicitly simulated in the model, but for which ETg is simulated including Leland Harris Spring Complex (site 7), Gandy Salt Marsh Seep (site 8), springs feeding Gandy Salt Marsh Lake and Gandy Salt Marsh Lake Spring Complex (sites 9 and gandySMLC, respectively), Diversion from Lake Creek 2 (site 36), and Needle Point

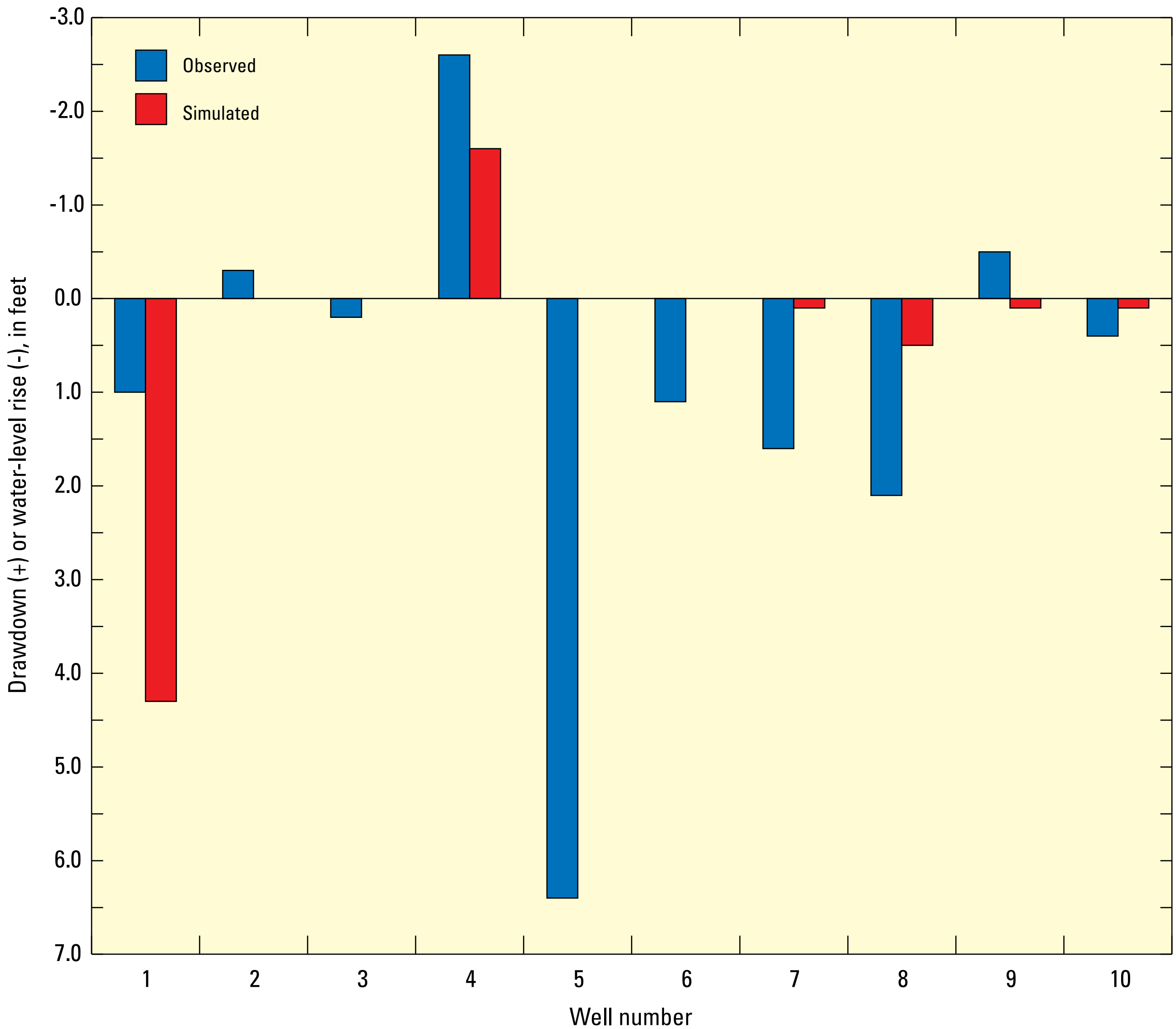

Figure 29. Observed and simulated drawdown (or water-level rise) between 2010 and 2015 for selected wells in Snake Valley. Simulated drawdown is 0 feet if no simulated (red) bar is present. See figure 30 for the locations of sites.

Spring (site 40). This is an artifact of the model construction and how ETg is simulated. If the simulated water levels are above the simulated land surface, the ETg rate reaches a maximum and maintains this maximum rate until the simulated water levels drop below the simulated land surface. At these sites in the model, the simulated heads did not drop below the simulated land surface for the entire simulation period, so the ETg rates did not decrease making it appear that there was no capture. The fact that drawdown is simulated at these sites indicates that it is likely that capture is occurring, however, it cannot be quantified given the limitations of the model.

It is difficult to assess the extent of the limitations on use and interpretation of results because of the lack of discharge data for several of the spring sites. With limited information about spring flow, it is difficult to accurately quantify the effects of proposed groundwater withdrawals on some of the springs of interest to the DOI agencies.

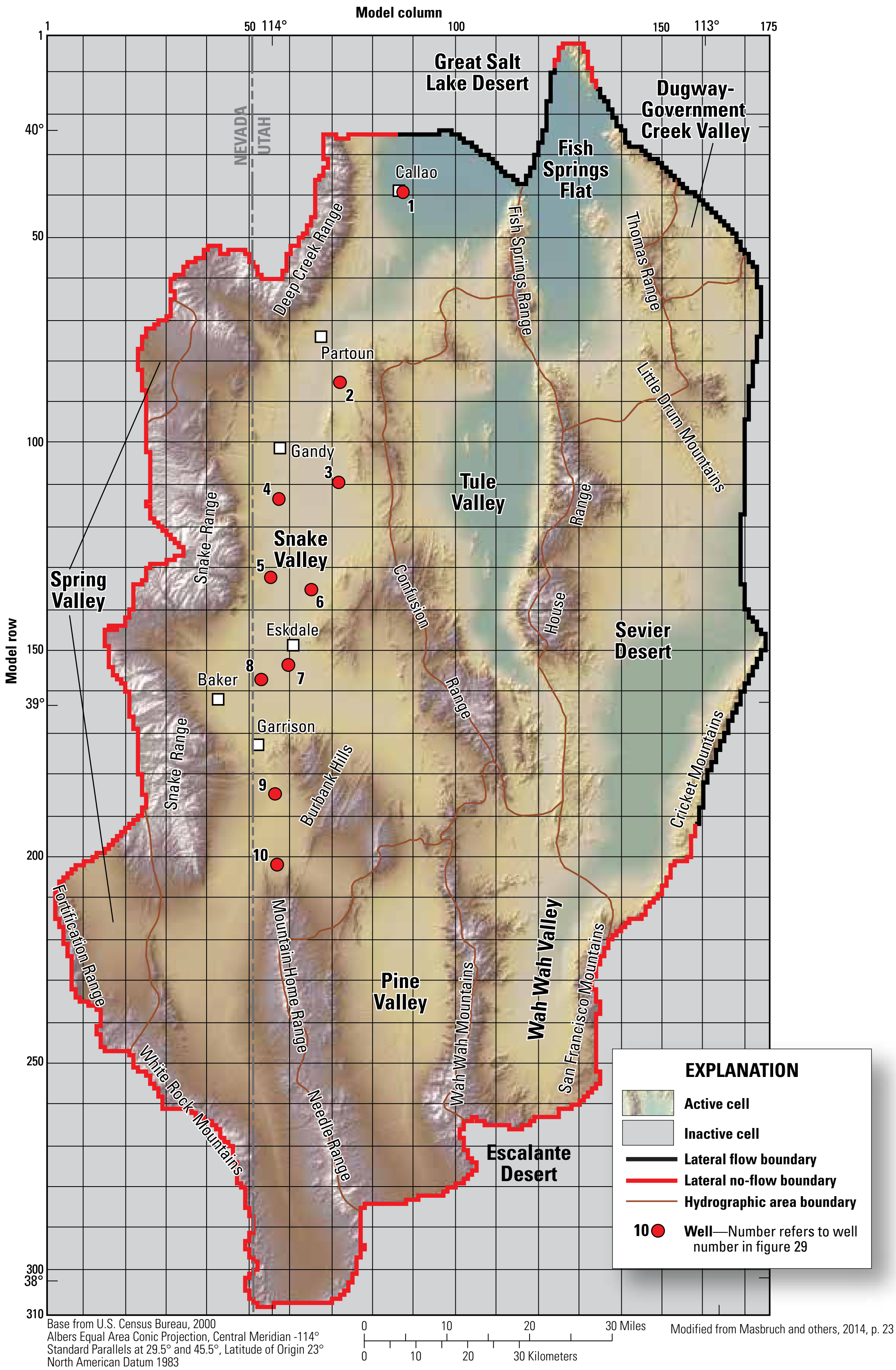

Figure 30. Locations of select sites where water-level measurements were collected from 2010 to 2015 that were used in the comparison between observed and simulated drawdowns shown in figure 29.

Appropriate Uses of the Model

The Snake Valley area model is a regional model designed to address questions about regional groundwater development in Snake Valley but, like all models, it is a simplification and cannot incorporate all of the complexities of the actual groundwater-flow system. The model can be used to simulate potential effects of groundwater withdrawals within the limitations described previously. The simulations demonstrated that the proposed groundwater withdrawals could affect groundwater levels and natural groundwater discharge at some of the groundwater resources of interest to the DOI agencies. A more exact determination could be made by monitoring discharge at springs and streams during a long-term aquifer test. Monitoring of groundwater discharge, nearby water levels, or both, is important for long-term assessment and management of these water resources.

Summary

Several U.S. Department of Interior (DOI) agencies, namely the U.S. Bureau of Land Management, National Park Service, and the Fish and Wildlife Service, are concerned about the cumulative effects of groundwater development on groundwater resources managed by, and other groundwater resources of interest to, these agencies in Snake Valley and surrounding areas. The groundwater resources of concern to the DOI agencies include groundwater discharge sites that support multiple uses. The new water uses that are of potential concern to the DOI agencies include 12 applications filed in 2005, totaling approximately 8,864 acre-feet per year. To date, only one of these applications has been approved and partially developed (UT 18-690, approved for 544 acre-feet per year in 2012). The owner of these water rights may start to sell or lease other properties associated with these applications, and may ask the Utah Division of Water Rights to take action on the pending applications. In addition, the DOI agencies are interested in the potential effects of three new water-right applications (UT 18-756, UT 18-758, and UT 18-759) and one water-right change application (UT a40687), which were the subject of a water-right hearing on April 19, 2016.

This report presents a hydrogeologic analysis of areas in and around Snake Valley to assess potential effects of existing and future groundwater development on groundwater resources managed by and other groundwater resources of interest to the DOI agencies. A previously developed steady-state numerical groundwater-flow model was modified to transient conditions with respect to well withdrawals and used to quantify drawdown and capture (withdrawals that result in depletion) of natural discharge from existing and proposed groundwater withdrawals. This assessment provides a general understanding of the relative susceptibility of the groundwater resources of interest to the DOI agencies to existing and future groundwater development in the study area.

The original steady-state model simulated and was calibrated to 2009 conditions. To investigate the potential effects of existing and proposed groundwater withdrawals on the groundwater resources of interest to the DOI agencies, 10 withdrawal scenarios were run. All scenarios were run at 5, 10, 15, 30, 55, and 105 years from the start of 2010; additionally, all scenarios were run to a new steady state to determine the ultimate long-term effects of the withdrawals. Capture maps were also constructed as part of this analysis. The simulations used to develop the capture maps test the response of the system, specifically the reduction of natural discharge, to future stresses for any given location in the area represented by the model. In this way, these maps can be used as a tool to determine the source of water to, and potential effects at specific areas from, future well withdrawals.

Trends of decreasing water levels measured in wells indicate that existing groundwater withdrawals in Snake Valley are affecting water levels. The numerical model simulates similar downward trends in water levels; simulated drawdowns in the model, however, are generally less than the observed water-level declines. At the groundwater discharge sites of interest to the DOI agencies, simulated drawdowns from existing well withdrawals (projected into the future) range from 0 to about 50 feet. Following the addition of the proposed withdrawals, simulated drawdowns at some sites increase by 25 feet. Simulated drawdown resulting from the proposed withdrawals began in as few as 5 years after 2014 at several of the sites. At the groundwater discharge sites of interest to the DOI agencies, simulated capture of natural discharge resulting from the existing withdrawals ranged from 0 to 87 percent. Following the addition of the proposed withdrawals, simulated capture at several of the sites reached 100 percent, indicating that groundwater discharge at that site would cease. Simulated capture following the addition of the proposed withdrawals increased in as few as 5 years after 2014 at several of the sites.

The Snake Valley area model is a regional model designed to address questions about regional groundwater development in Snake Valley, but like all models, it is a simplification and cannot incorporate all of the complexities of the actual groundwater-flow system. The simulations demonstrated that the proposed groundwater withdrawals could affect groundwater levels and natural groundwater discharge at some of the groundwater discharge sites of interest to the DOI agencies. Recalibration of the model to transient conditions could reduce uncertainty in simulated drawdown and capture estimates. It is difficult to assess the extent of the limitations on use and interpretation of results because of the lack of discharge data for several of the spring sites. With limited information about spring flow it is difficult to accurately quantify how the proposed groundwater withdrawals could affect some of the springs of interest, especially springs not explicitly simulated in the model. Monitoring of groundwater discharge, nearby water levels, or both, is important for long-term assessment and management of these water resources.

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Appendix 1. Capture and Remaining Discharge Maps

This appendix presents capture and remaining discharge maps for the groundwater discharge sites of interest to the Department of Interior agencies (fig. 2 and table 1 in the main report). Maps were not made for Leland Harris Spring Complex (site 7), Gandy Salt Marsh Seep (site 8), springs feeding Gandy Salt Marsh Lake and Gandy Salt Marsh Lake Spring Complex (sites 9 and gandySMLC, respectively), Diversion from Lake Creek 2 (site 36), and Needle Point Spring (site 40) because the model did not simulate capture from these areas. This is a limitation of the model that results from the way it simulates groundwater discharge from evapotranspiration (ETg). These springs are not explicitly simulated in the model, but discharge from ETg is simulated from those model cells containing these springs and was used as a surrogate to calculate capture from these springs. If the simulated water levels are above the simulated land surface, the ETg rate reaches a maximum and maintains this maximum rate until the simulated water levels drop below the simulated land surface. At these sites in the model, the simulated heads did not drop below the simulated land surface for the entire simulation period, so the ETg rates did not decrease making it appear that there was no capture. The fact that drawdown is simulated at these sites indicates it is likely capture is occurring, however, it cannot be quantified given the limitations of the model.

Maps also were not made for South Seeps (site 1), Lime Spring (site 2), Coyote Spring (site 5), Briggs Spring (site 13), Phil Spring (site 14), Unnamed Spring 2 (site 19), Unnamed Spring 3 (site 20), Want Spring (site 21), Unnamed Spring 4 (site 28), Kious Spring (site 31), and Mahogany Spring (site 32) because the model does not simulate any discharge at these sites. Maps for Miller Spring (site 6) and Dearden Spring Group (site 39) are shown in figures 25–28 of the main report.

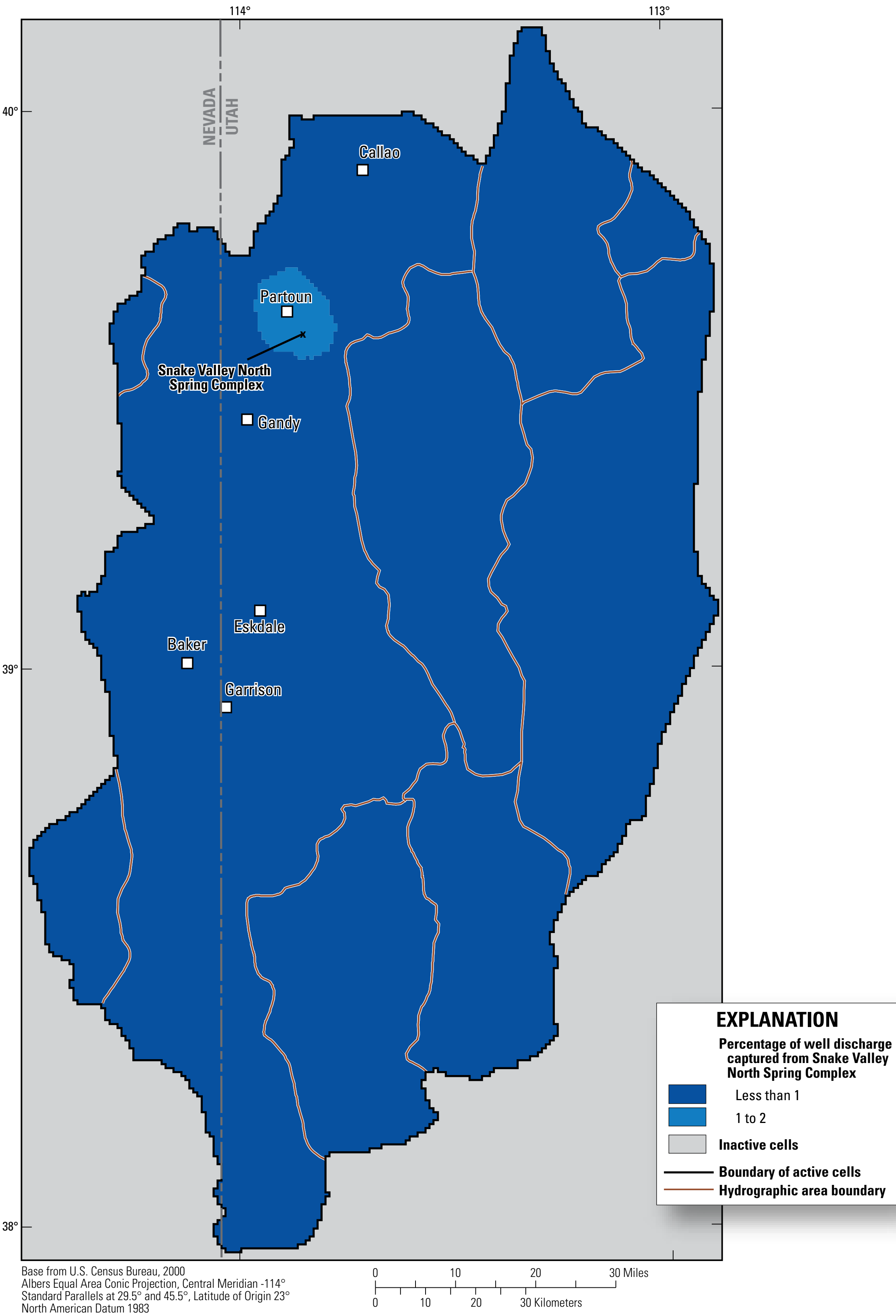

Figure A1–1. Simulated percentage of well discharge captured from Snake Valley North Spring Complex that results from long-term pumping of a well at a rate of 400 acre-feet per year in model layers 1 and 2, Snake Valley area groundwater model.

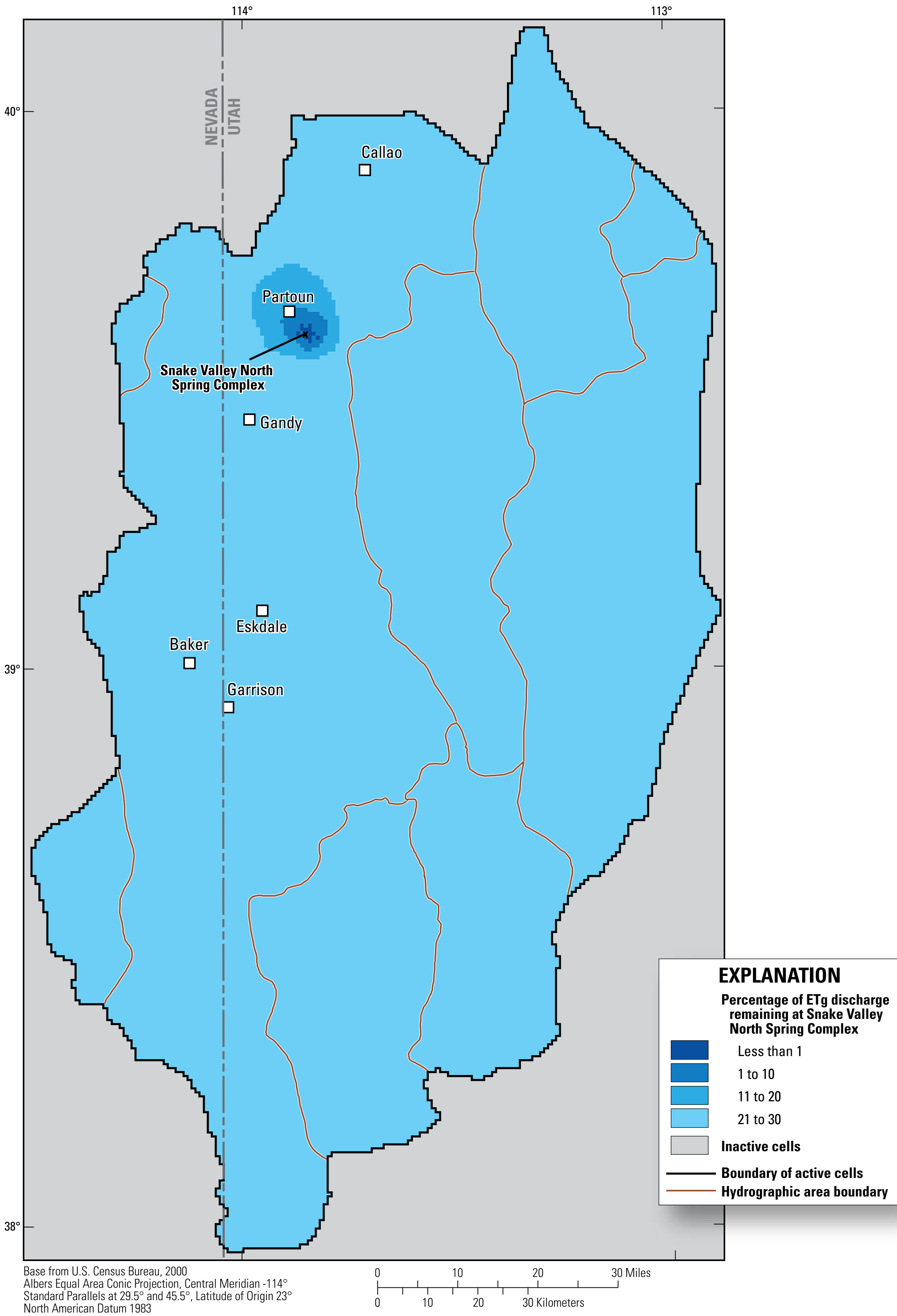

Figure A1–2. Simulated percentage of groundwater evapotranspiration (ETg) discharge remaining (compared to initial [prior to 2010] simulated discharge) at Snake Valley North Spring Complex that results from long-term pumping of a well at a rate of 400 acre-feet per year in model layers 1 and 2, Snake Valley area groundwater model.

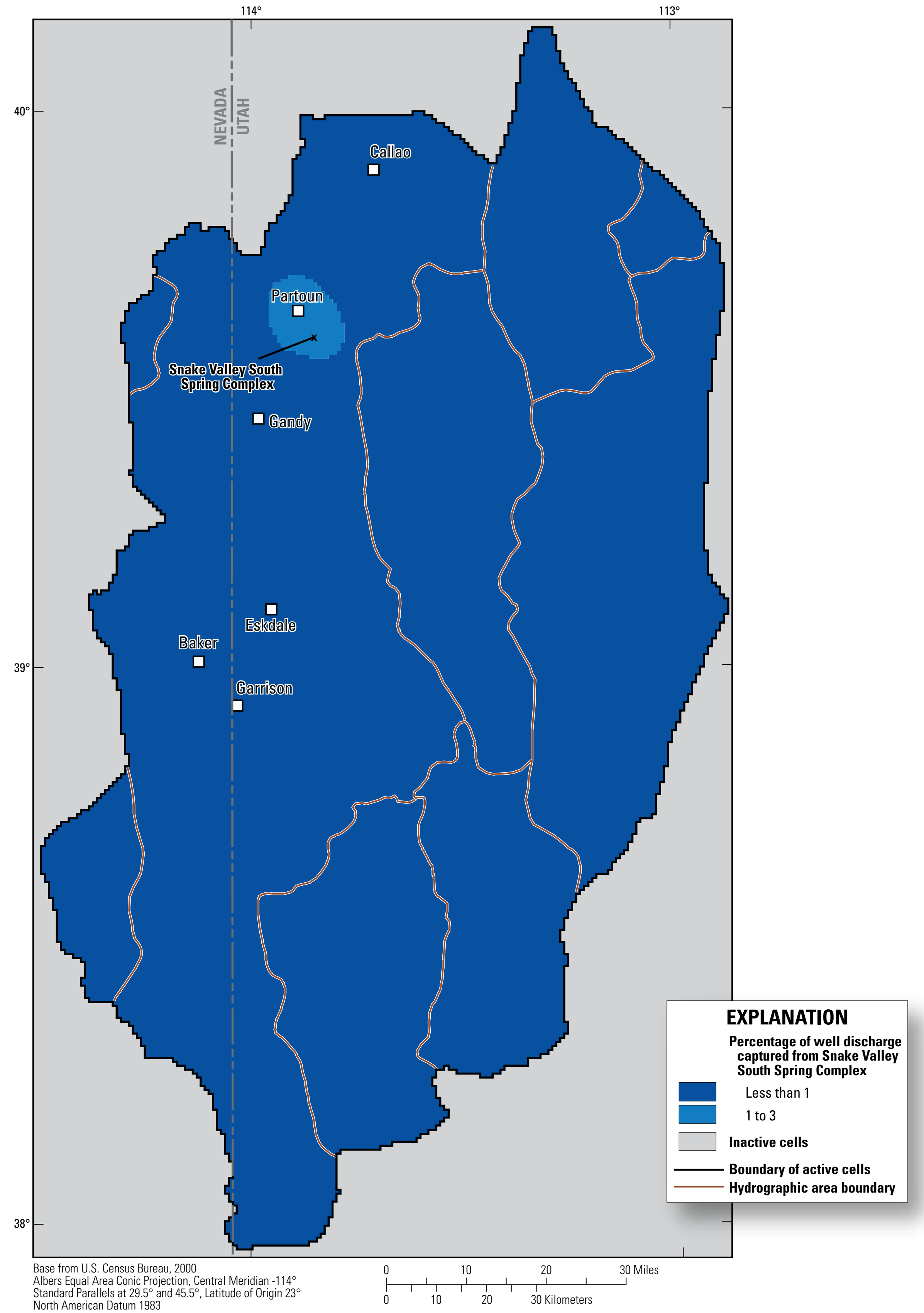

Figure A1–3. Simulated percentage of well discharge captured from Snake Valley South Spring Complex that results from long-term pumping of a well at a rate of 400 acre-feet per year in model layers 1 and 2, Snake Valley area groundwater model.

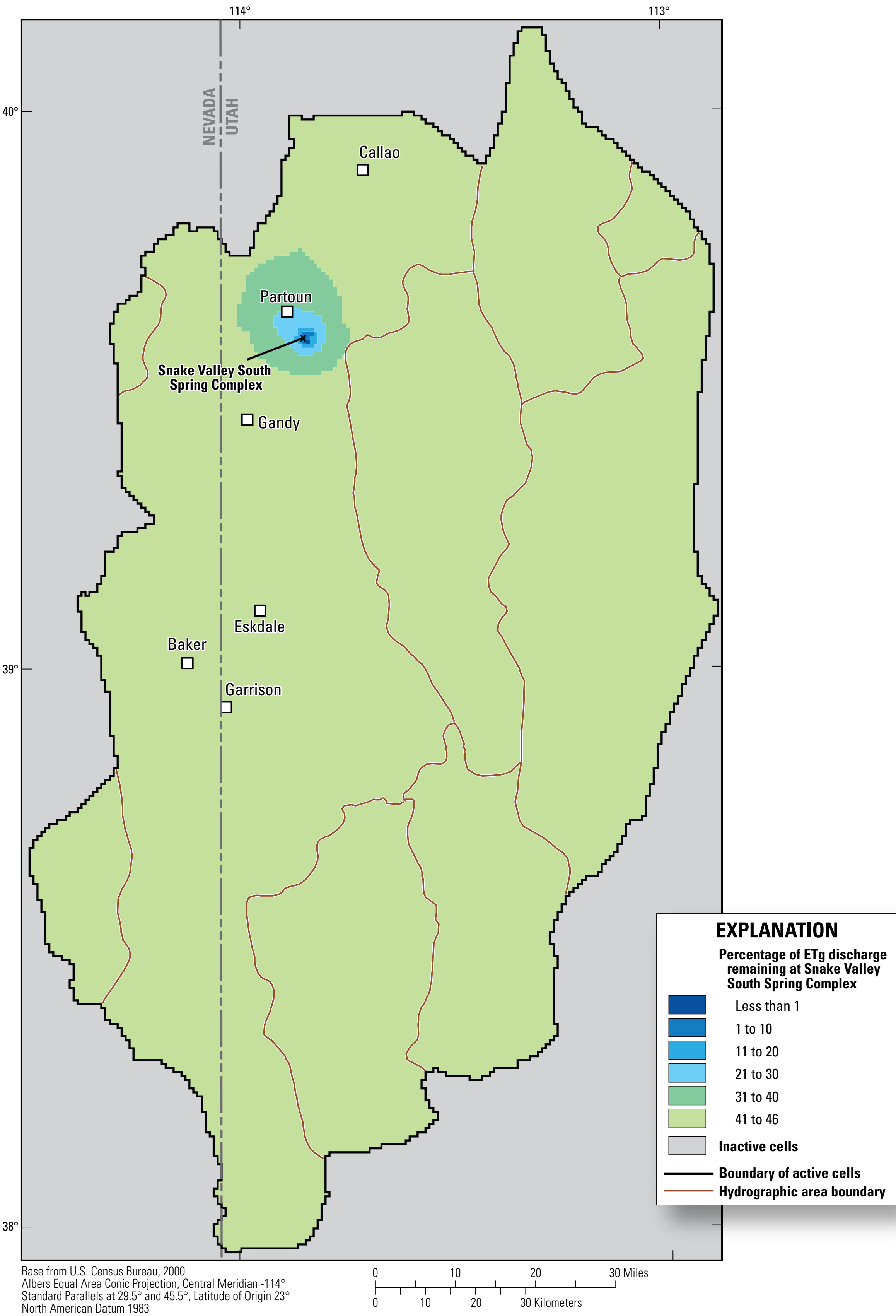

Figure A1–4. Simulated percentage of groundwater evapotranspiration (ETg) discharge remaining (compared to initial [prior to 2010] simulated discharge) at Snake Valley South Spring Complex that results from long-term pumping of a well at a rate of 400 acre-feet per year in model layers 1 and 2, Snake Valley area groundwater model.

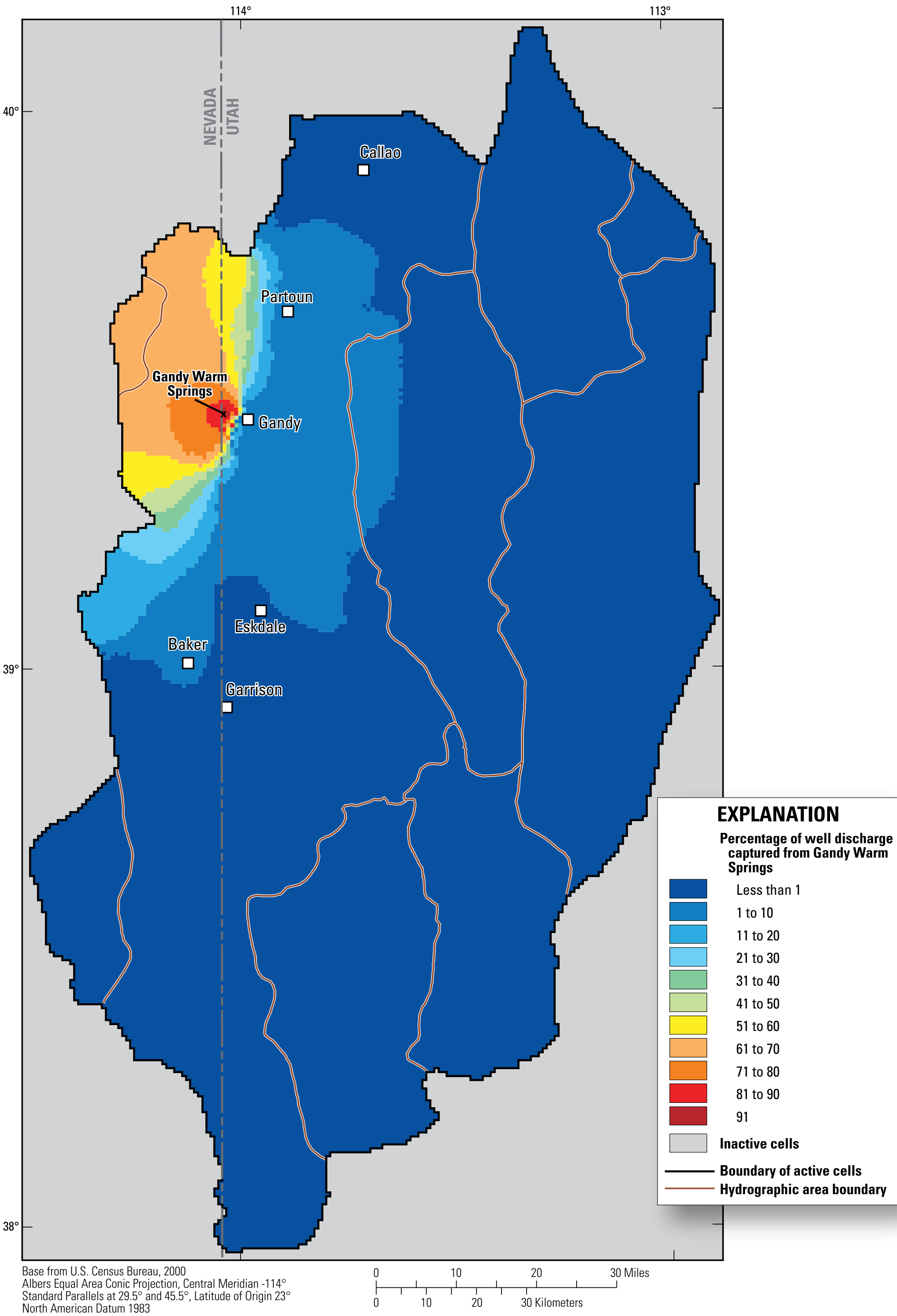

Figure A1–5. Simulated percentage of well discharge captured from Gandy Warm Springs that results from long-term pumping of a well at a rate of 400 acre-feet per year in model layers 1 and 2, Snake Valley area groundwater model.

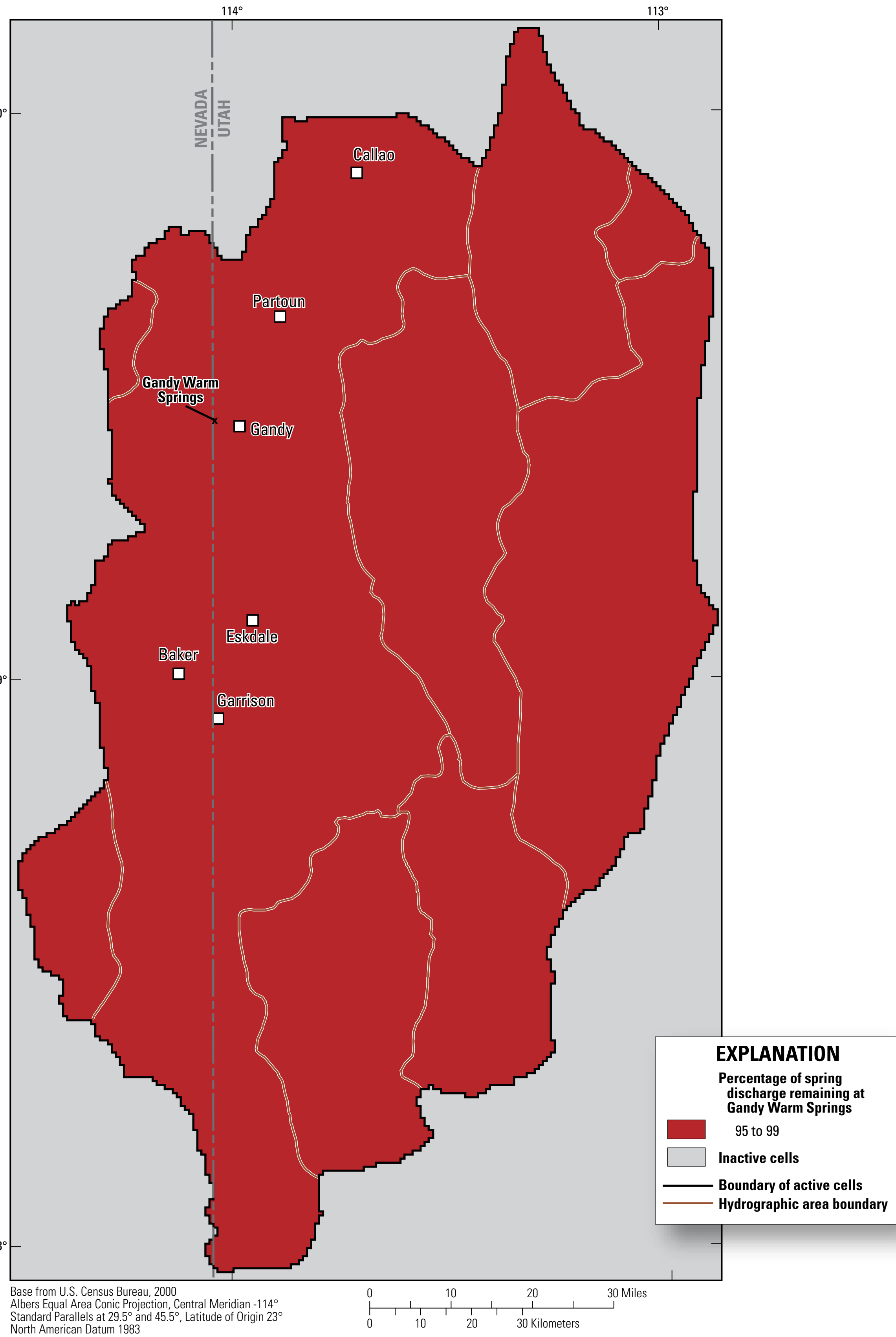

Figure A1–6. Simulated percentage of spring discharge remaining (compared to initial [prior to 2010] simulated discharge) at Gandy Warm Springs that results from long-term pumping of a well at a rate of 400 acre-feet per year in model layers 1 and 2, Snake Valley area groundwater model.

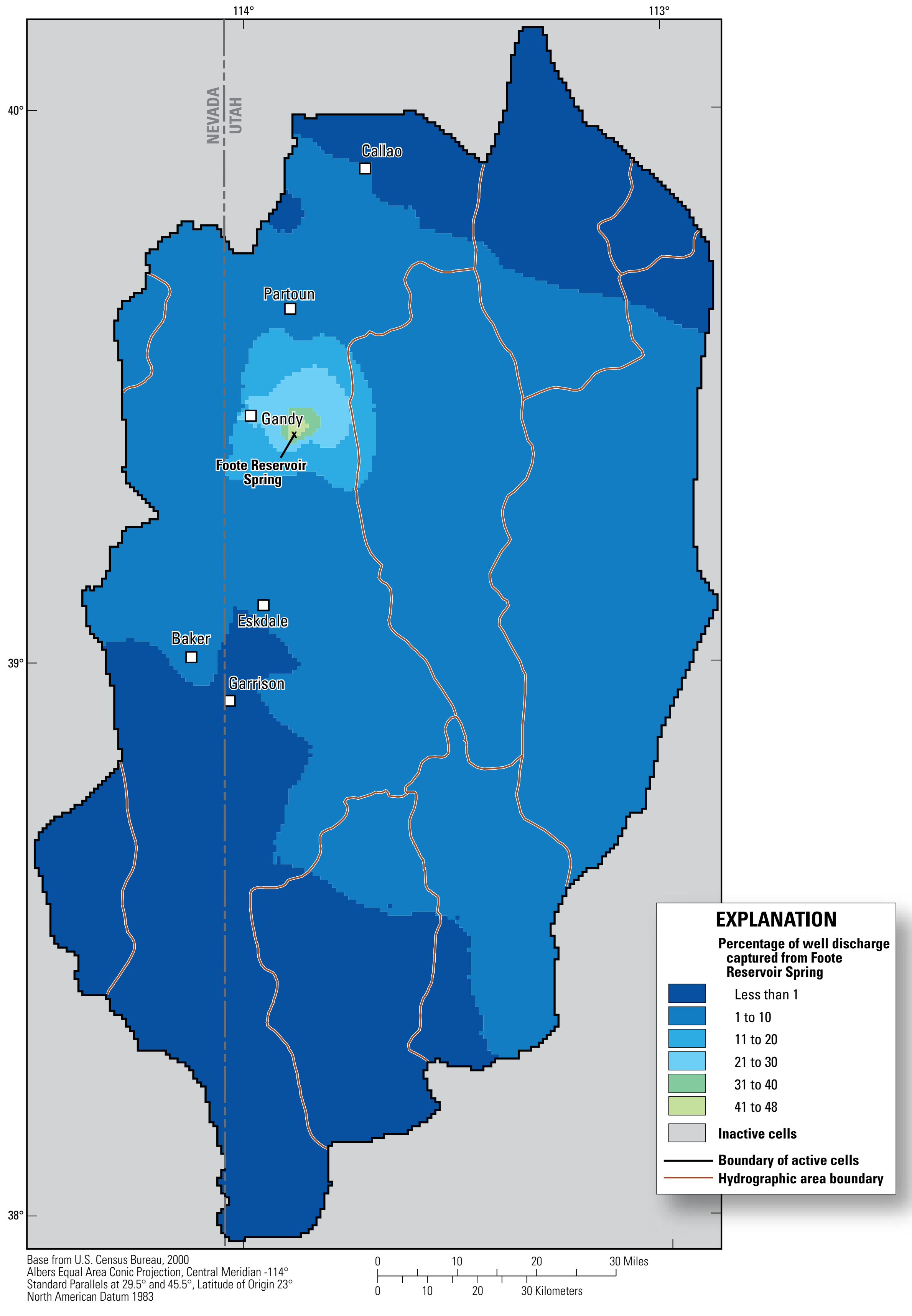

Figure A1–7. Simulated percentage of well discharge captured from Foote Reservoir Spring that results from long-term pumping of a well at a rate of 400 acre-feet per year in model layers 1 and 2, Snake Valley area groundwater model.

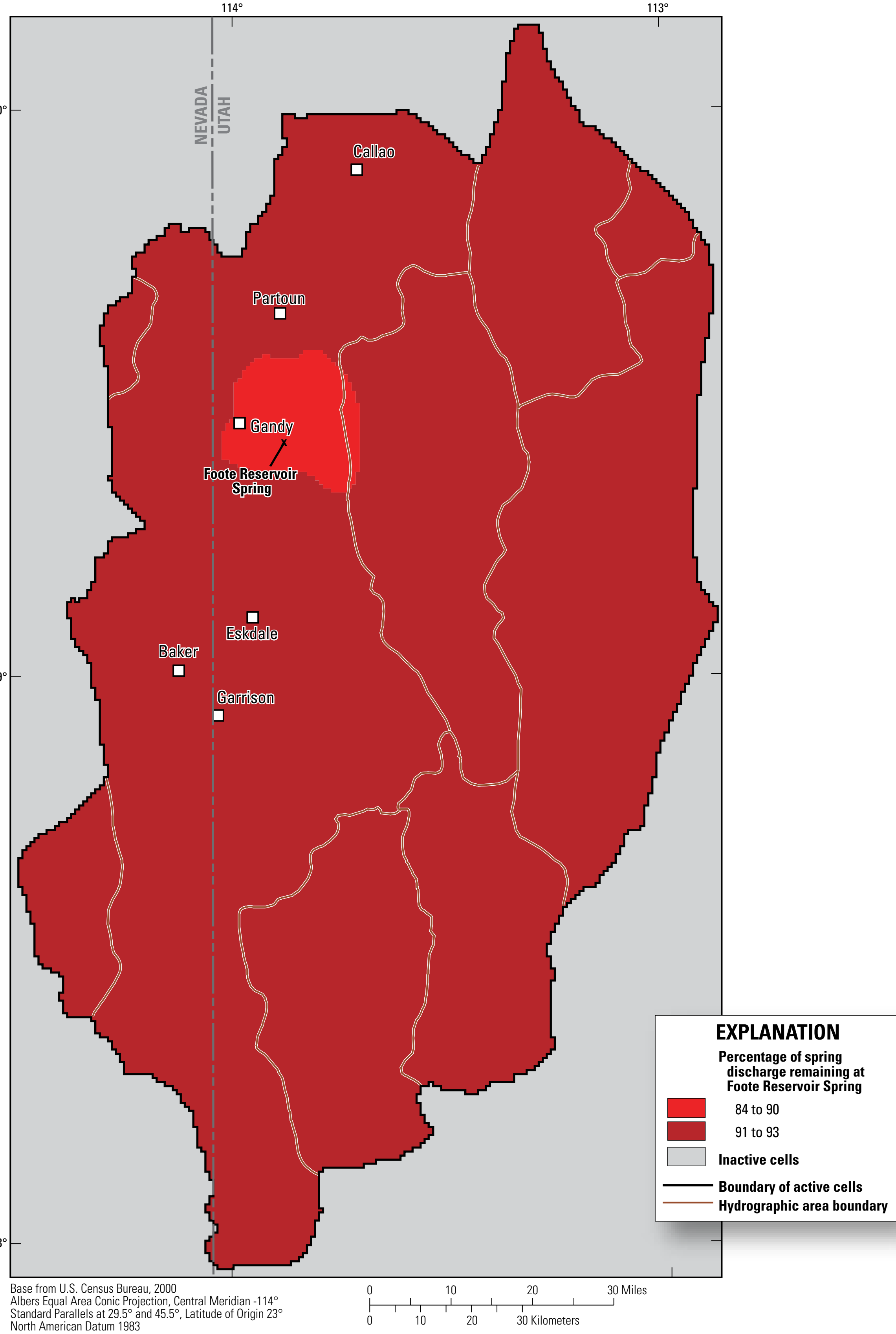

Figure A1–8. Simulated percentage of spring discharge remaining (compared to initial [prior to 2010] simulated discharge) at Foote Reservoir Spring that results from long-term pumping of a well at a rate of 400 acre-feet per year in model layers 1 and 2, Snake Valley area groundwater model.

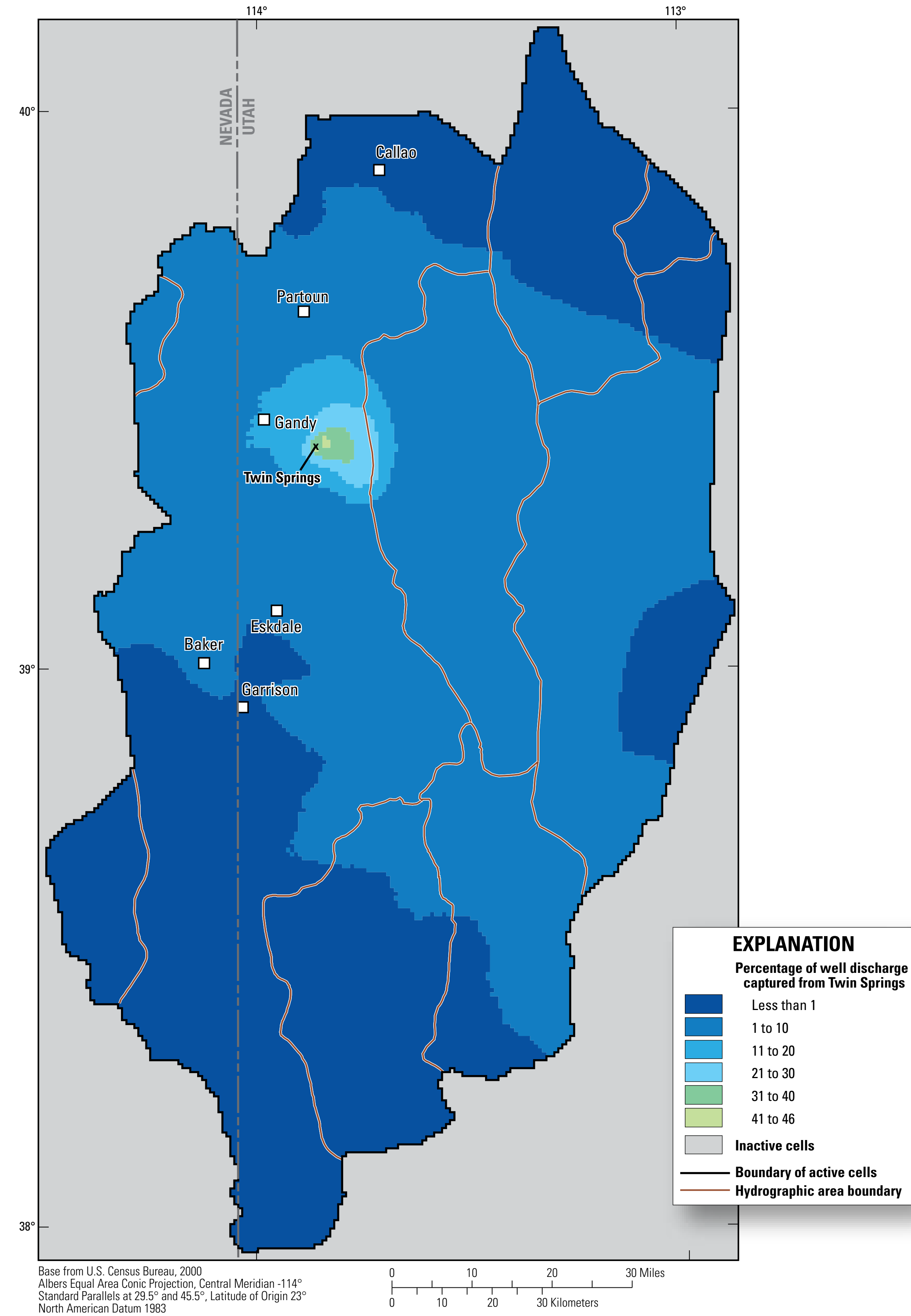

Figure A1–9. Simulated percentage of well discharge captured from Twin Springs that results from long-term pumping of a well at a rate of 400 acre-feet per year in model layers 1 and 2, Snake Valley area groundwater model.

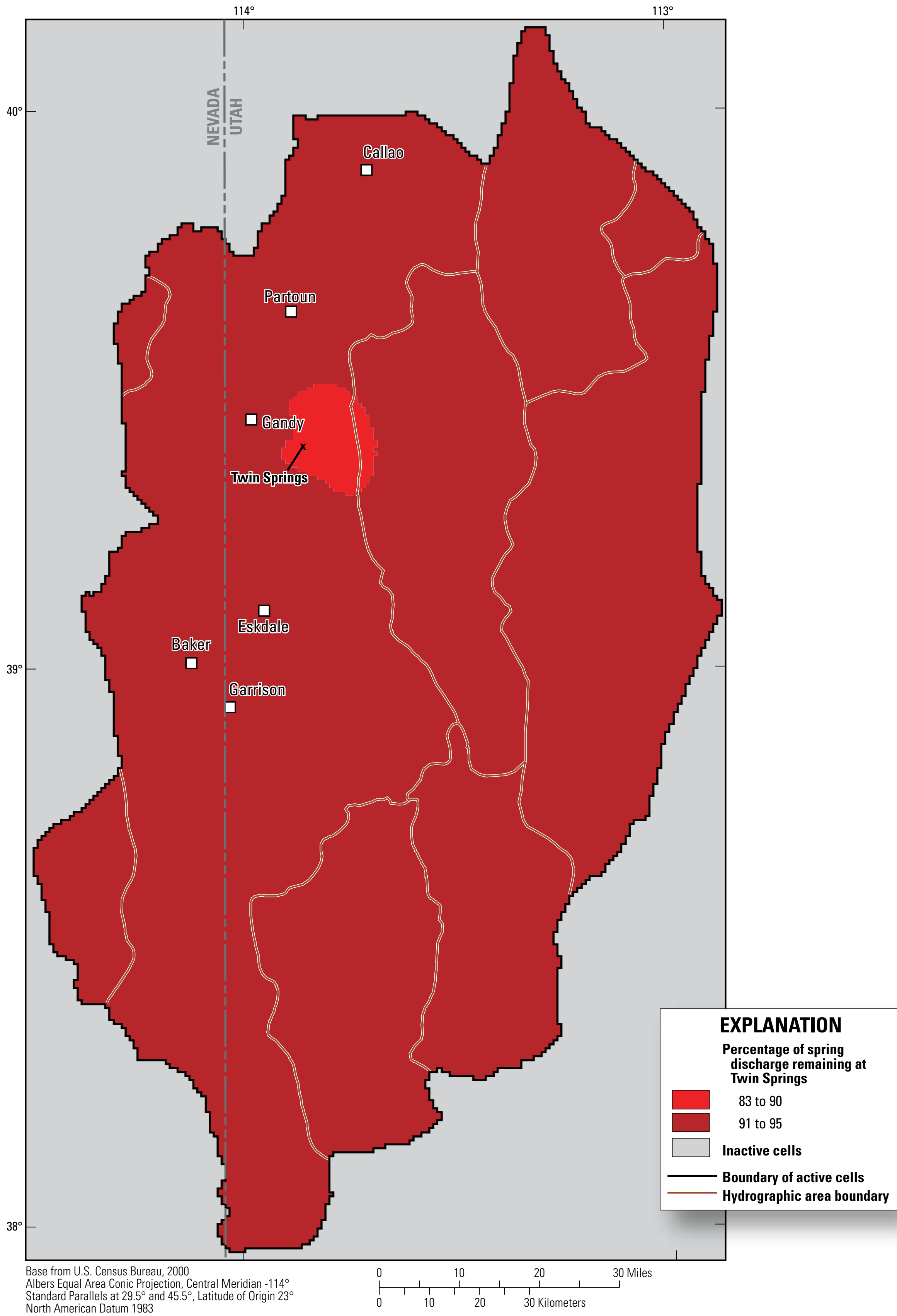

Figure A1–10. Simulated percentage of spring discharge remaining (compared to initial [prior to 2010] simulated discharge) at Twin Springs that results from long-term pumping of a well at a rate of 400 acre-feet per year in model layers 1 and 2, Snake Valley area groundwater model.

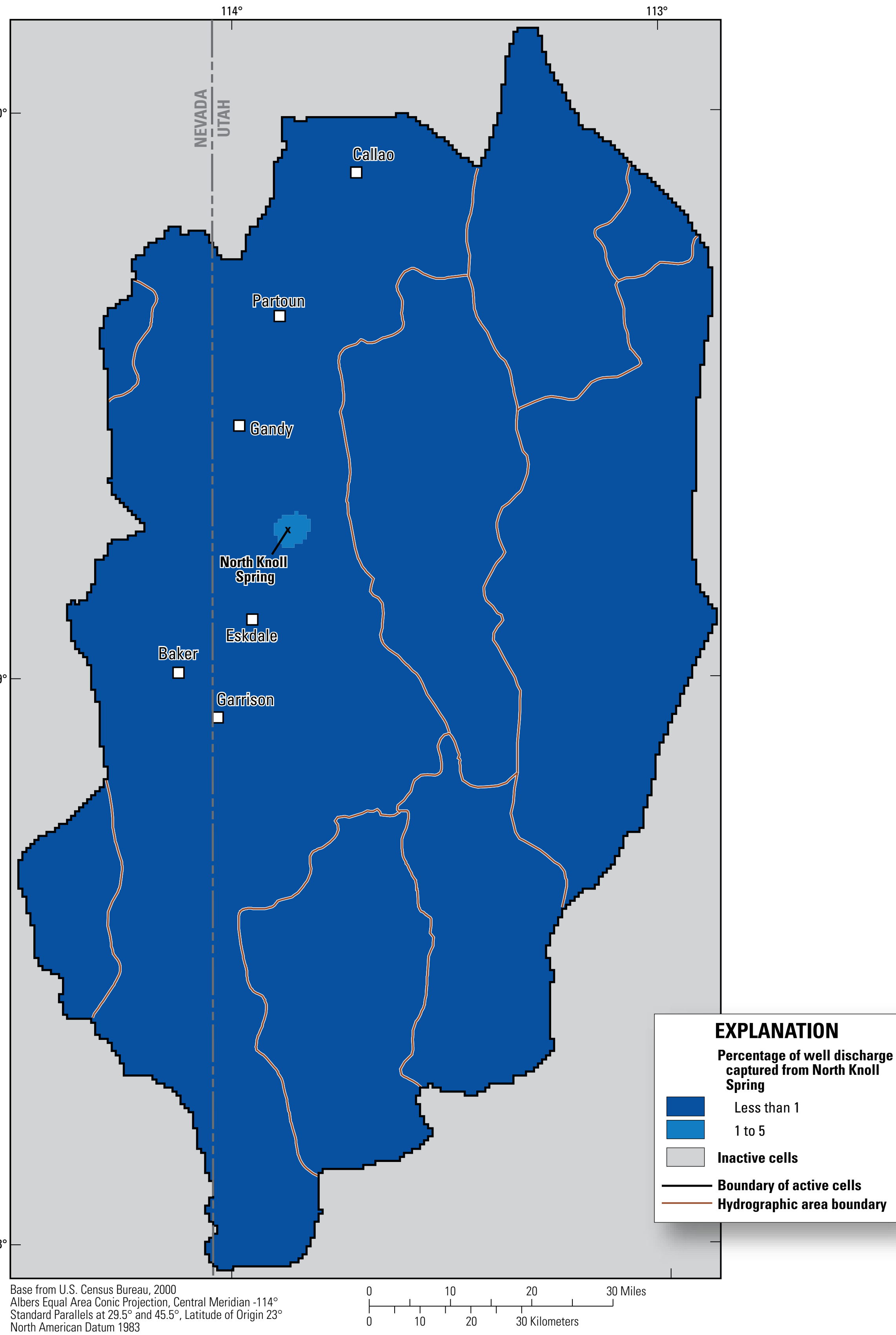

Figure A1–11. Simulated percentage of well discharge captured from North Knoll Spring that results from long-term pumping of a well at a rate of 400 acre-feet per year in model layers 1 and 2, Snake Valley area groundwater model.

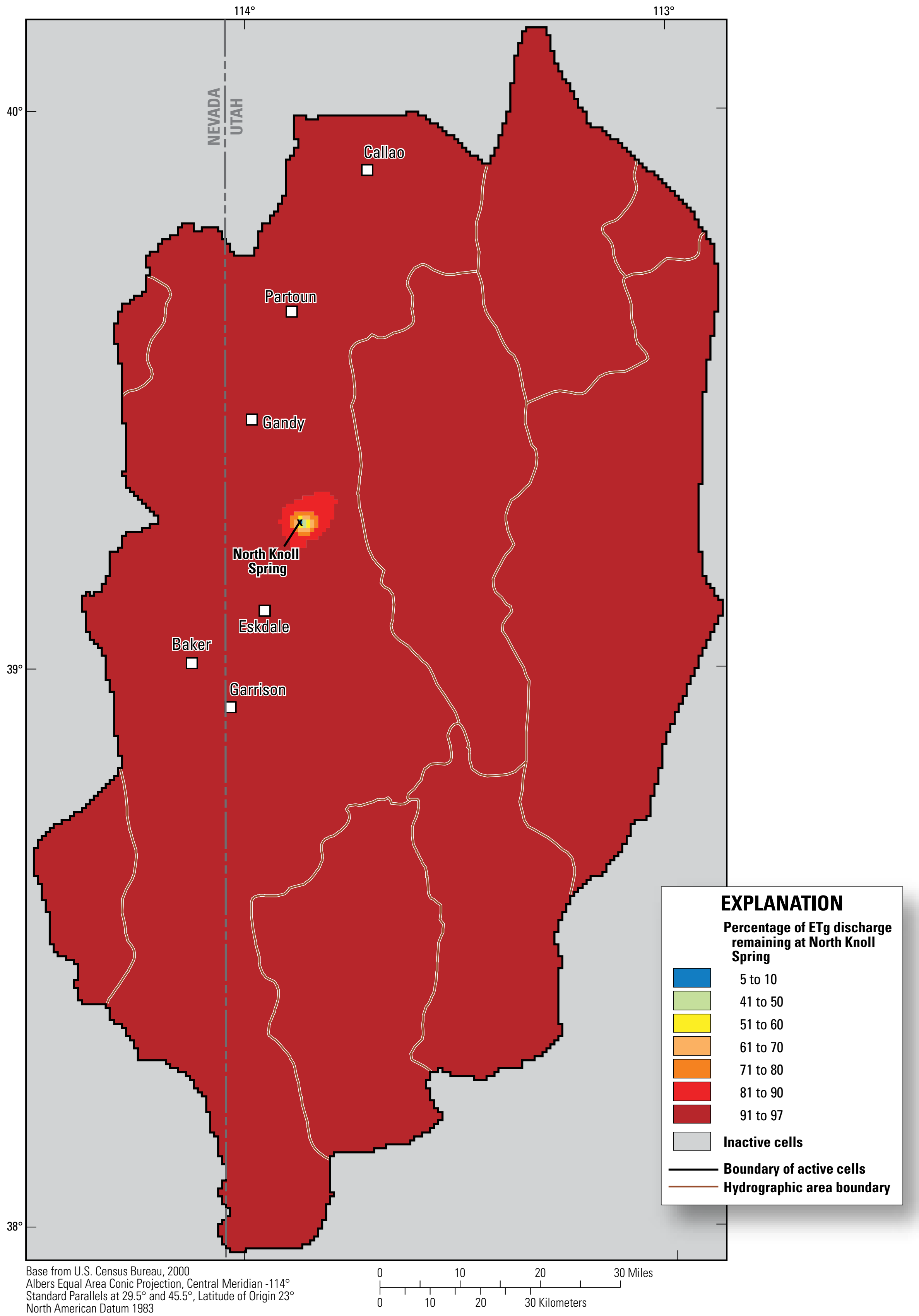

Figure A1–12. Simulated percentage of groundwater evapotranspiration (ETg) discharge remaining (compared to initial [prior to 2010] simulated discharge) at North Knoll Spring that results from long-term pumping of a well at a rate of 400 acre-feet per year in model layers 1 and 2, Snake Valley area groundwater model.

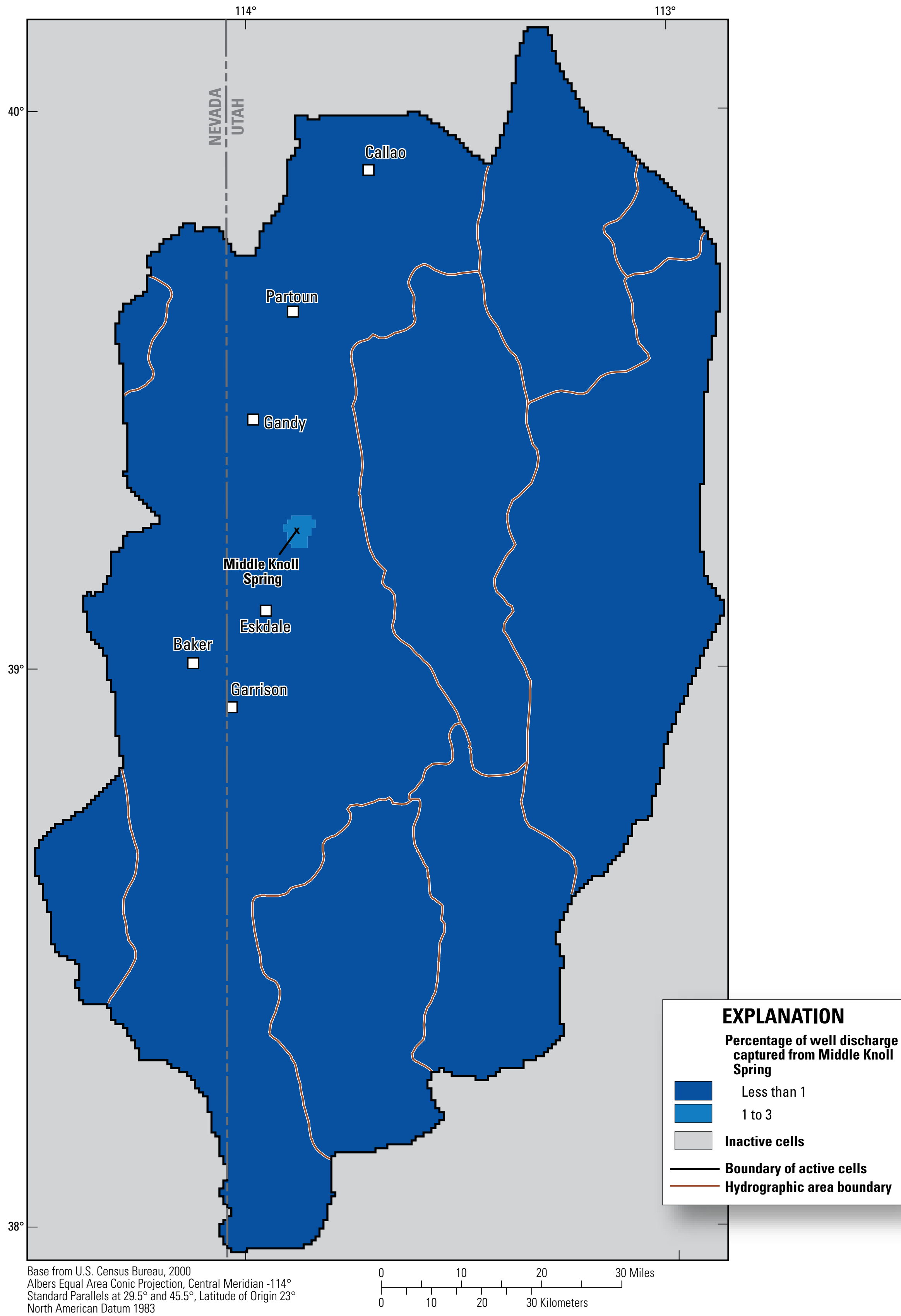

Figure A1–13. Simulated percentage of well discharge captured from Middle Knoll Spring that results from long-term pumping of a well at a rate of 400 acre-feet per year in model layers 1 and 2, Snake Valley area groundwater model.

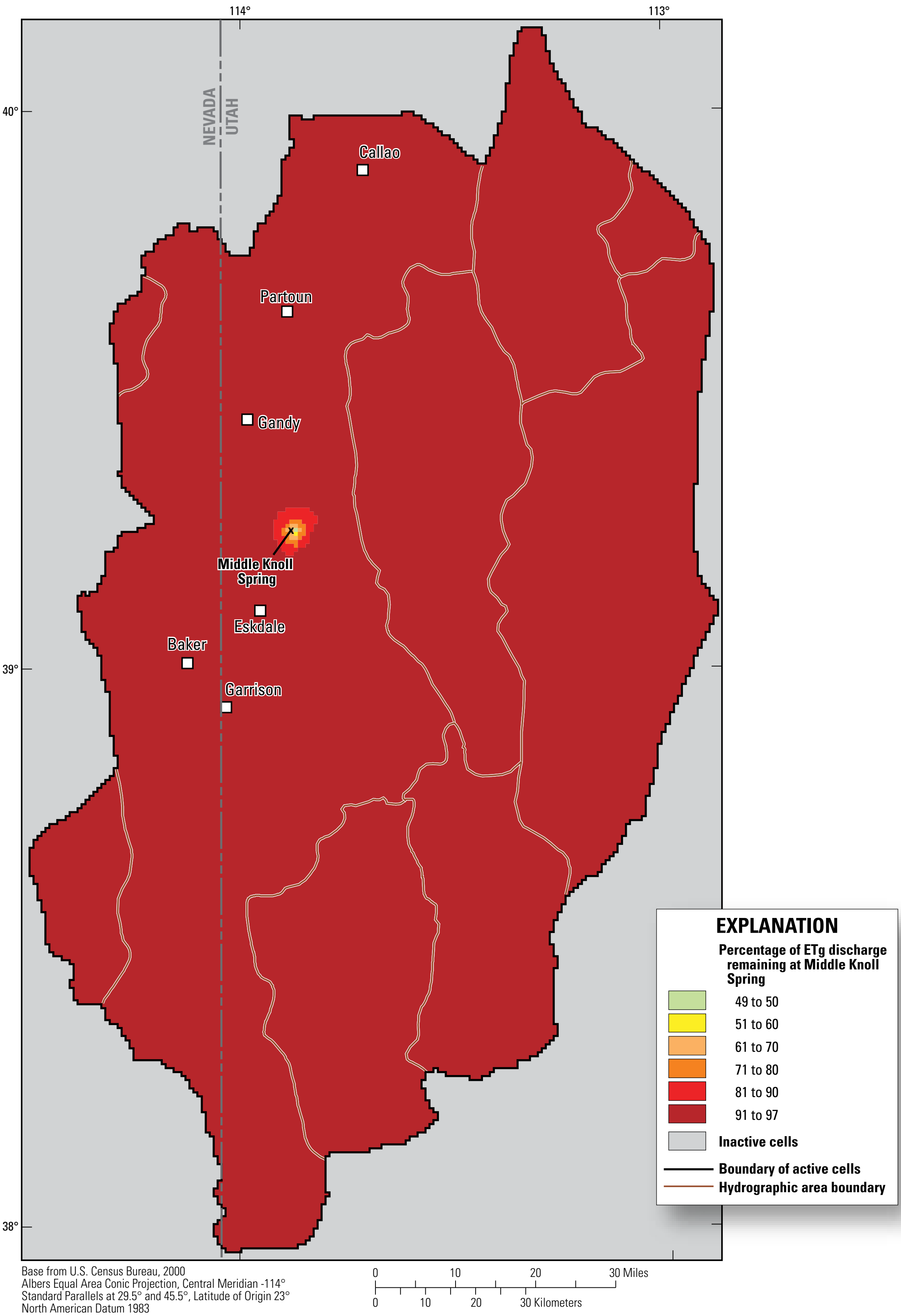

Figure A1–14. Simulated percentage of groundwater evapotranspiration (ETg) discharge remaining (compared to initial [prior to 2010] simulated discharge) at Middle Knoll Spring that results from long-term pumping of a well at a rate of 400 acre-feet per year in model layers 1 and 2, Snake Valley area groundwater model.

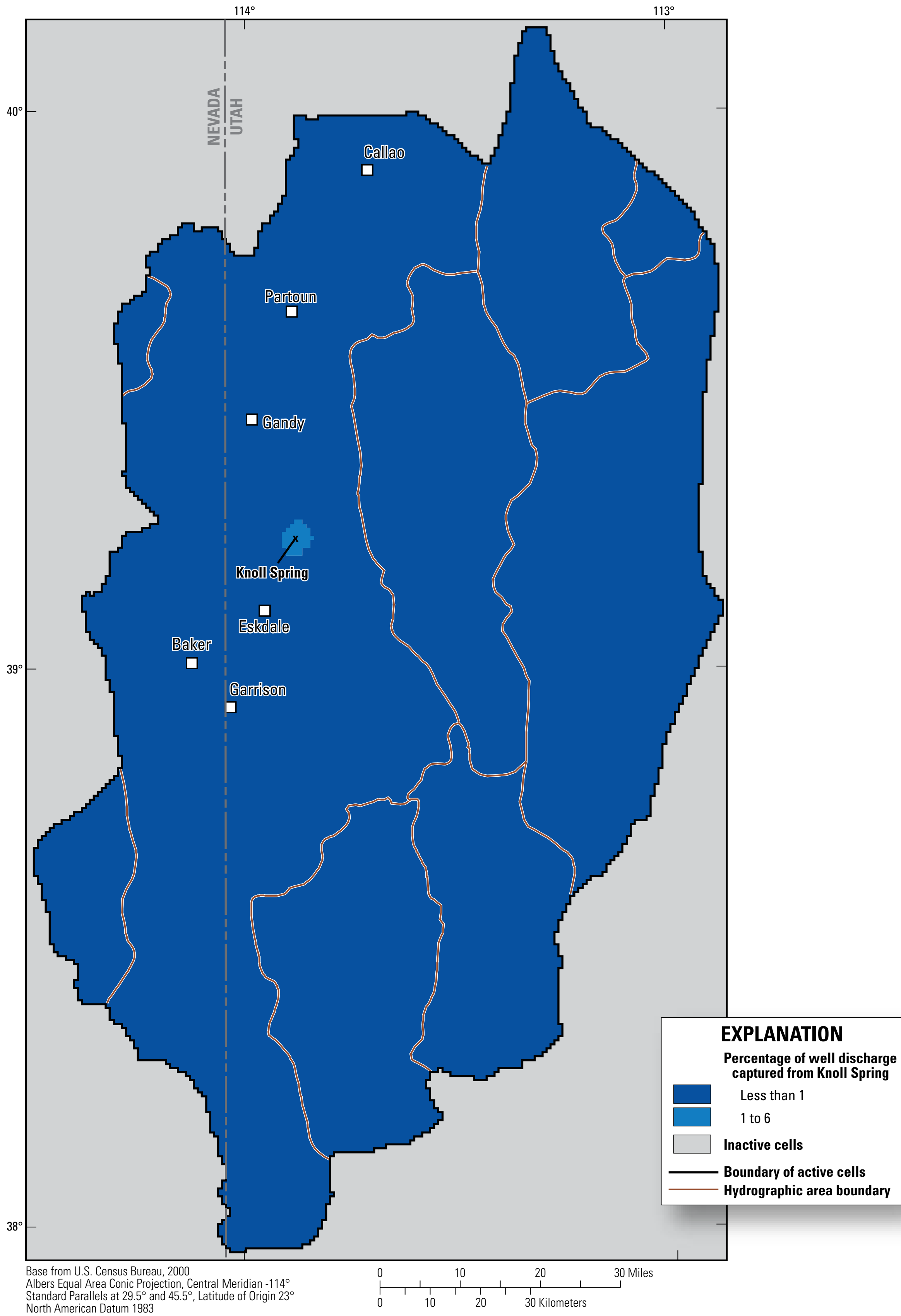

Figure A1–15. Simulated percentage of well discharge captured from Knoll Spring that results from long-term pumping of a well at a rate of 400 acre-feet per year in model layers 1 and 2, Snake Valley area groundwater model.

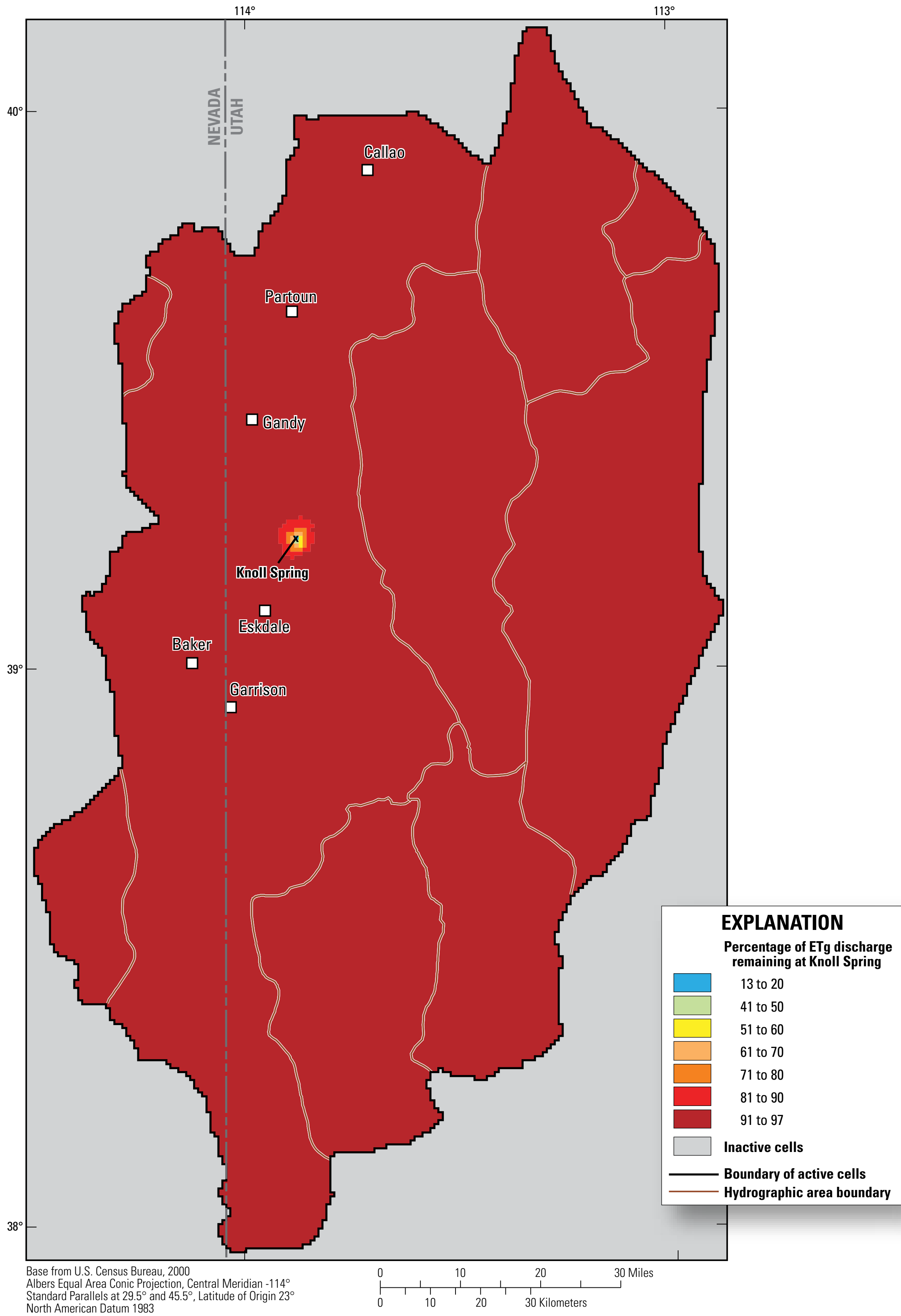

Figure A1–16. Simulated percentage of groundwater evapotranspiration (ETg) discharge remaining (compared to initial [prior to 2010] simulated discharge) at Knoll Spring that results from long-term pumping of a well at a rate of 400 acre-feet per year in model layers 1 and 2, Snake Valley area groundwater model.

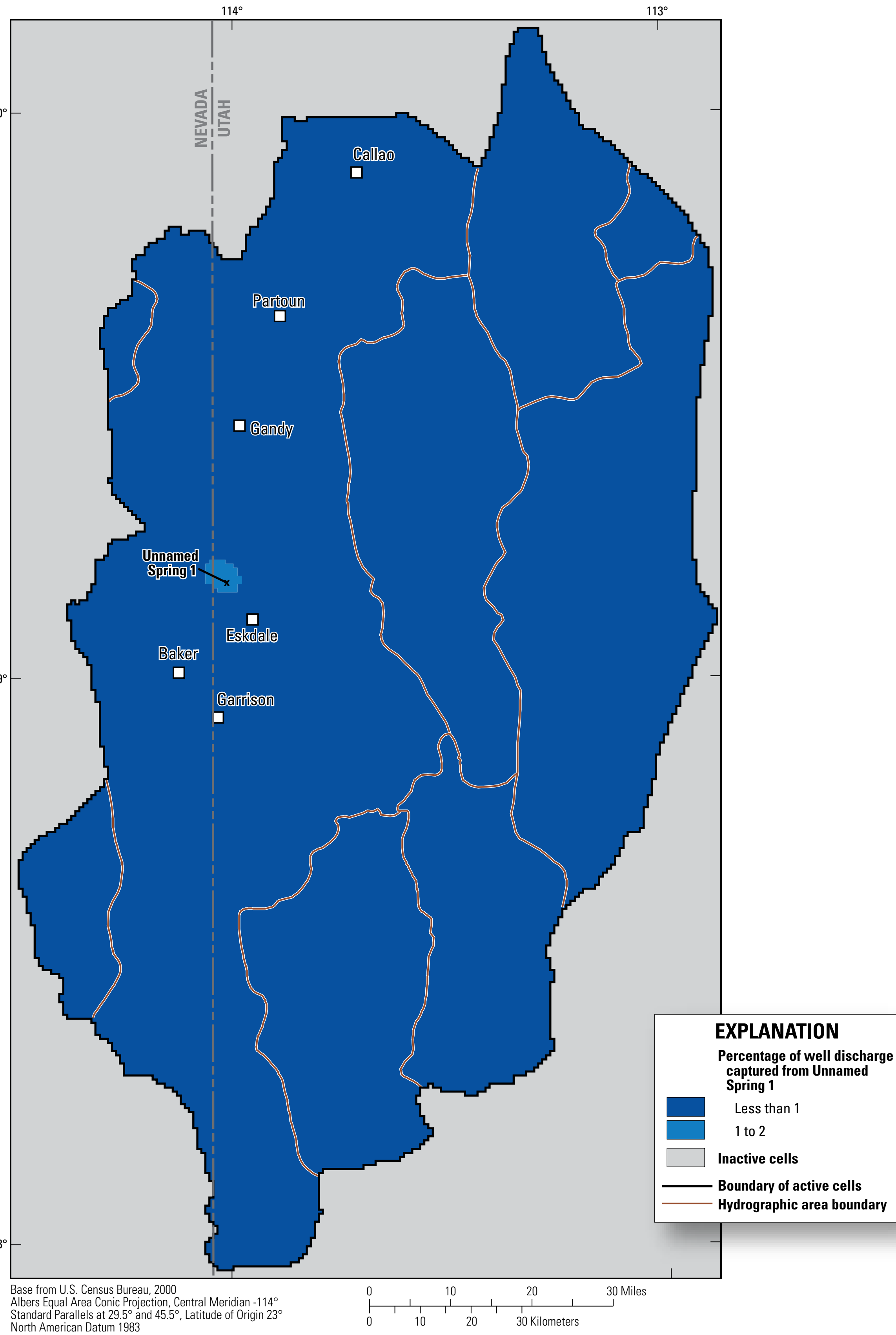

Figure A1–17. Simulated percentage of well discharge captured from Unnamed Spring 1 that results from long-term pumping of a well at a rate of 400 acre-feet per year in model layers 1 and 2, Snake Valley area groundwater model.

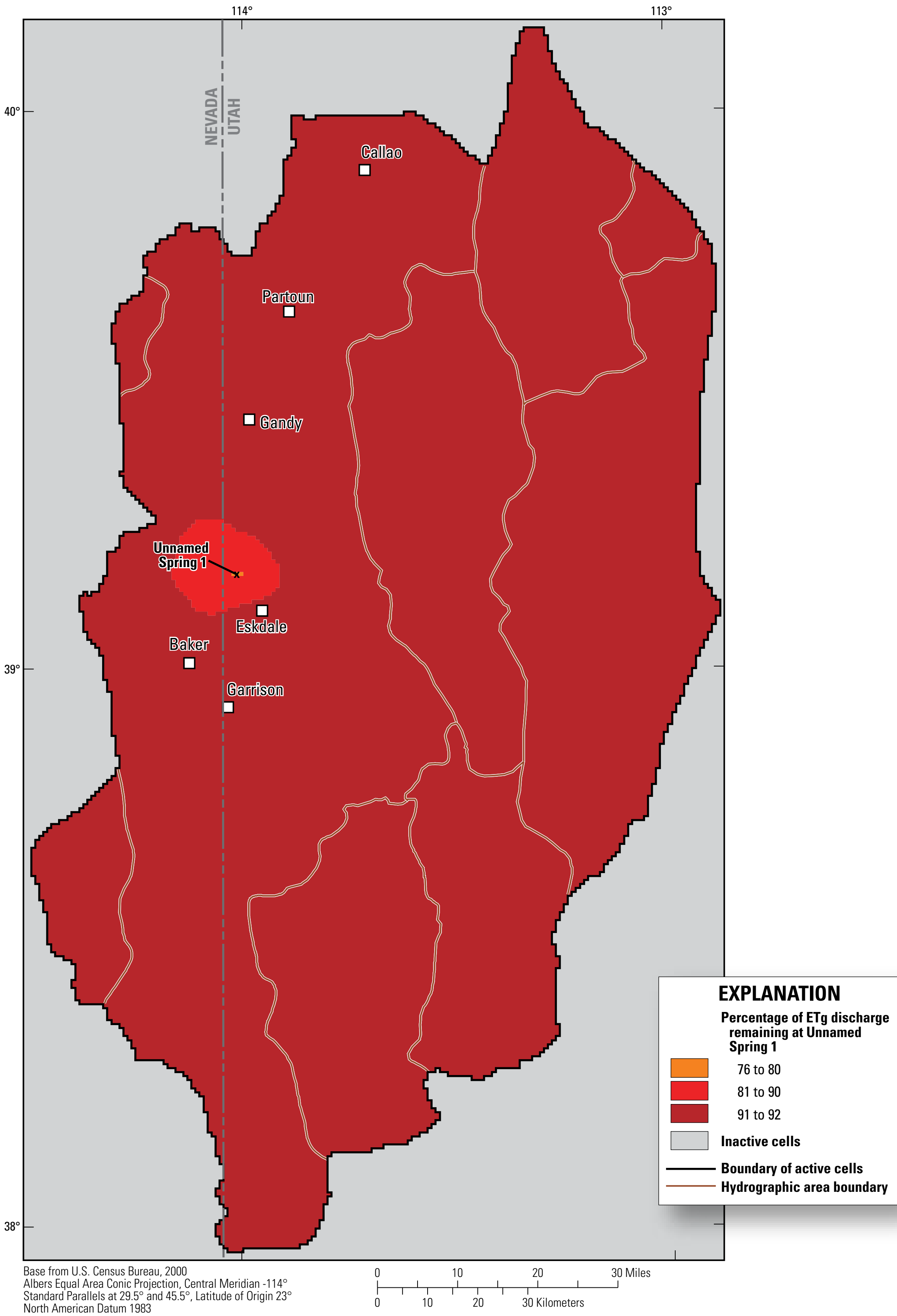

Figure A1–18. Simulated percentage of groundwater evapotranspiration (ETg) discharge remaining (compared to initial [prior to 2010] simulated discharge) at Unnamed Spring 1 that results from long-term pumping of a well at a rate of 400 acre-feet per year in model layers 1 and 2, Snake Valley area groundwater model.

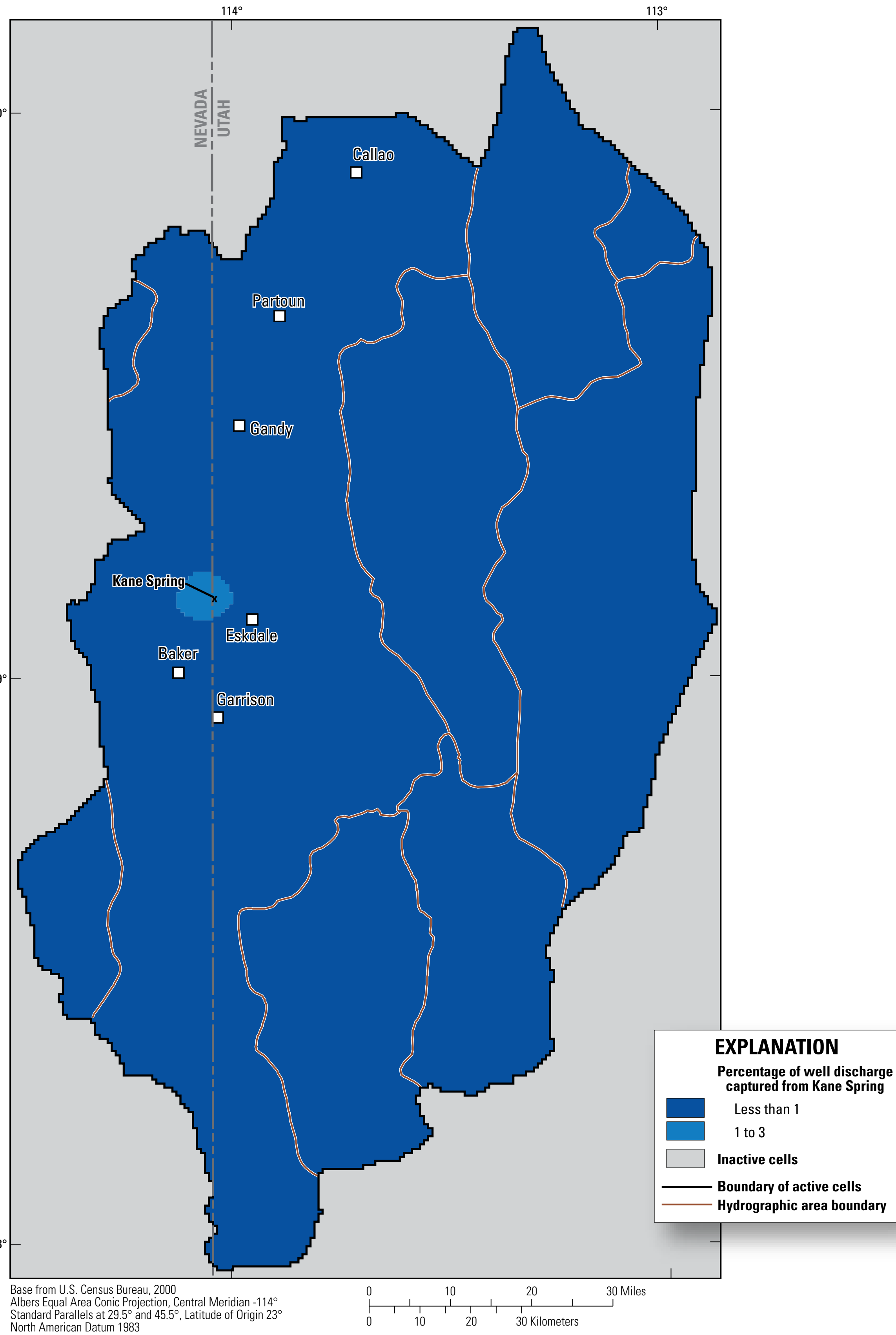

Figure A1–19. Simulated percentage of well discharge captured from Kane Spring that results from long-term pumping of a well at a rate of 400 acre-feet per year in model layers 1 and 2, Snake Valley area groundwater model.

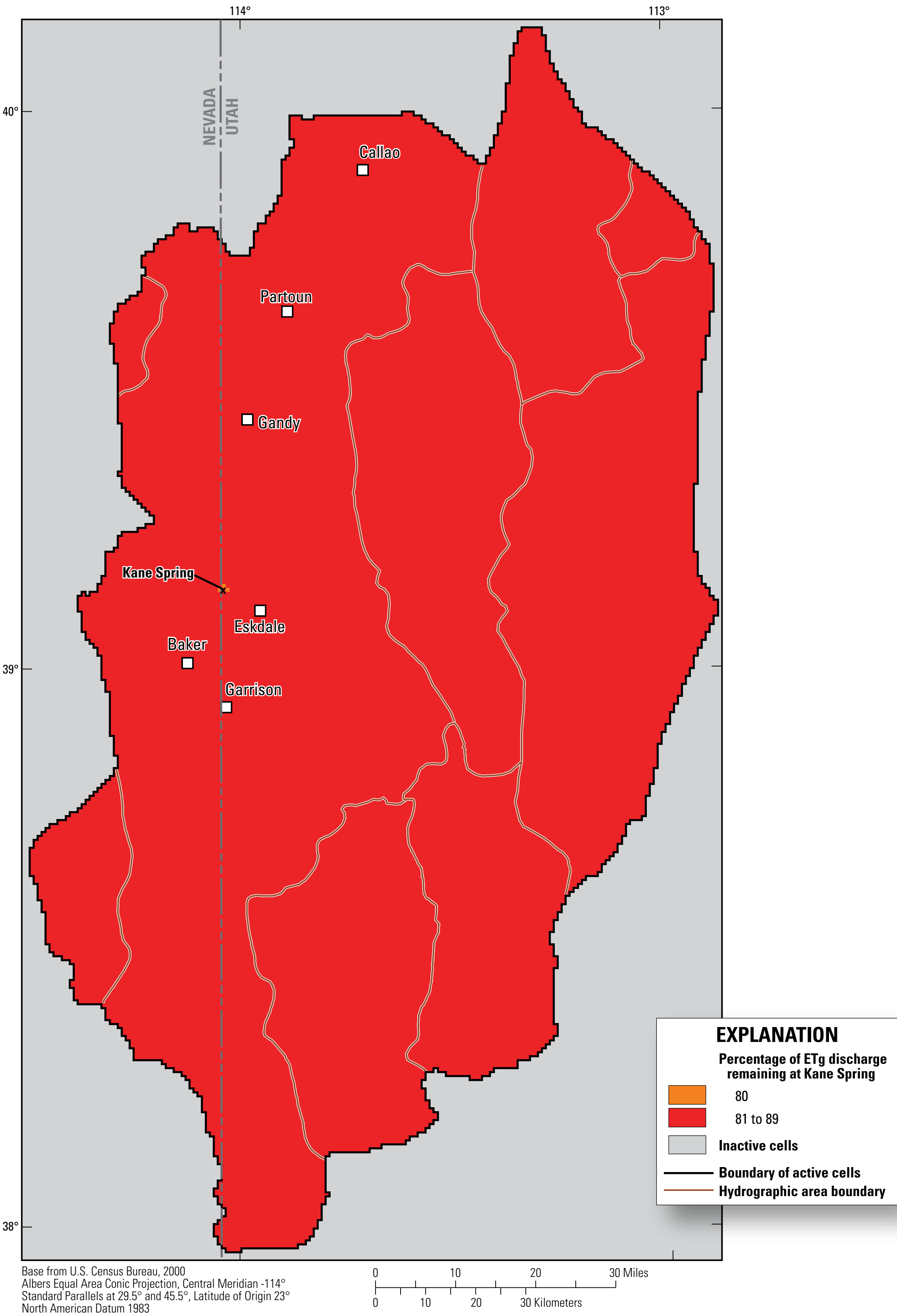

Figure A1–20. Simulated percentage of groundwater evapotranspiration (ETg) discharge remaining (compared to initial [prior to 2010] simulated discharge) at Kane Spring that results from long-term pumping of a well at a rate of 400 acre-feet per year in model layers 1 and 2, Snake Valley area groundwater model.

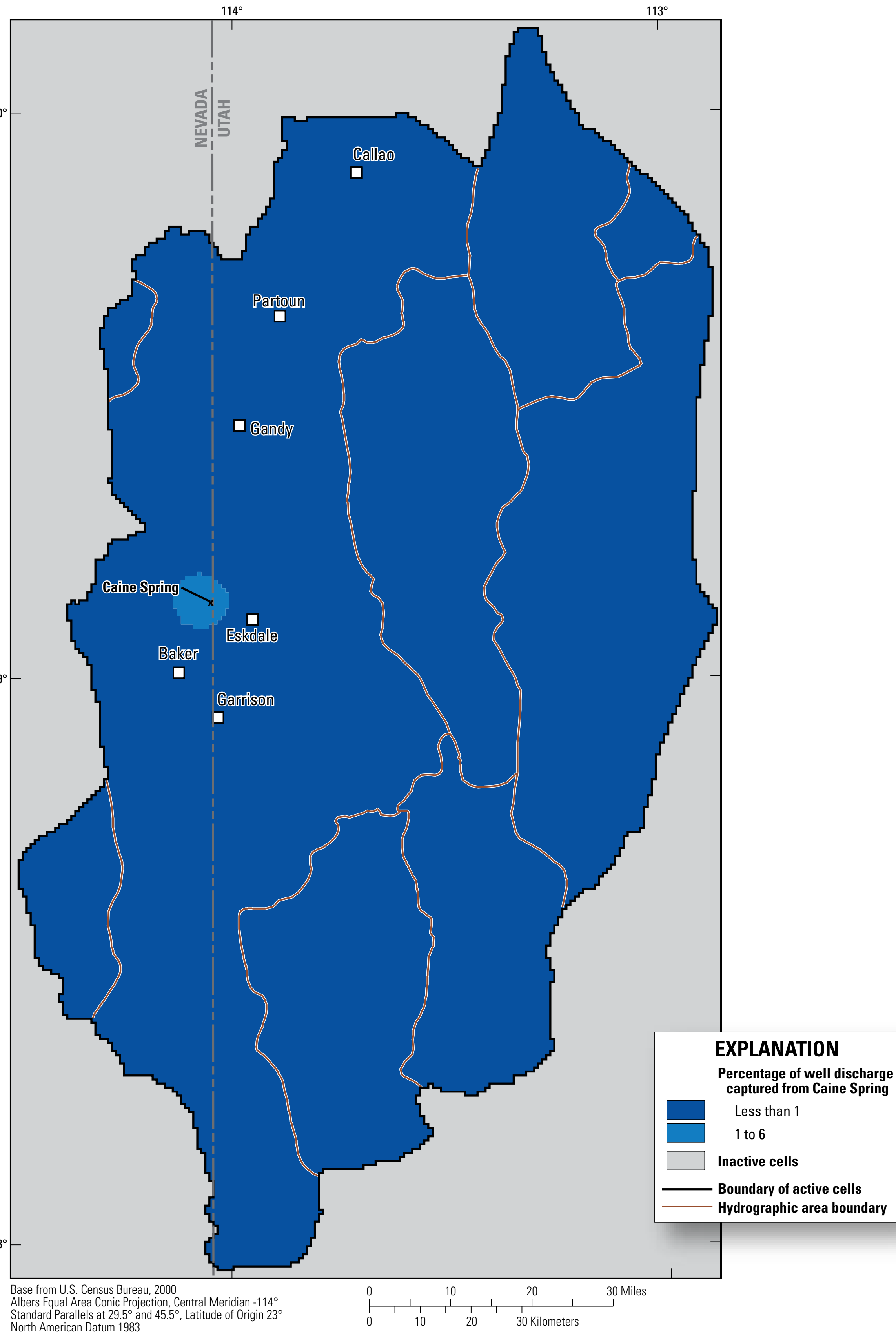

Figure A1–21. Simulated percentage of well discharge captured from Caine Spring that results from long-term pumping of a well at a rate of 400 acre-feet per year in model layers 1 and 2, Snake Valley area groundwater model.

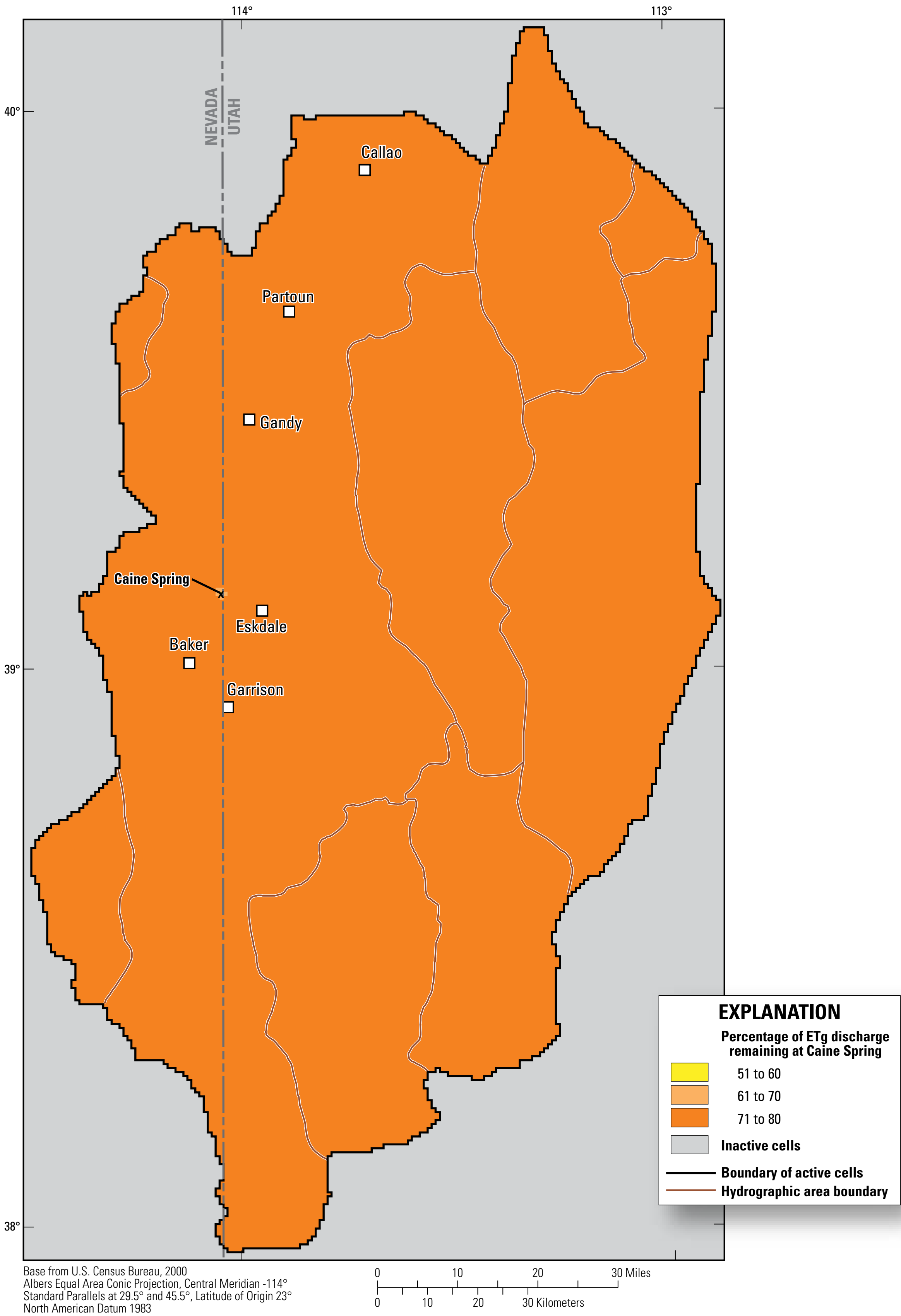

Figure A1–22. Simulated percentage of groundwater evapotranspiration (ETg) discharge remaining (compared to initial [prior to 2010] simulated discharge) at Caine Spring that results from long-term pumping of a well at a rate of 400 acre-feet per year in model layers 1 and 2, Snake Valley area groundwater model.

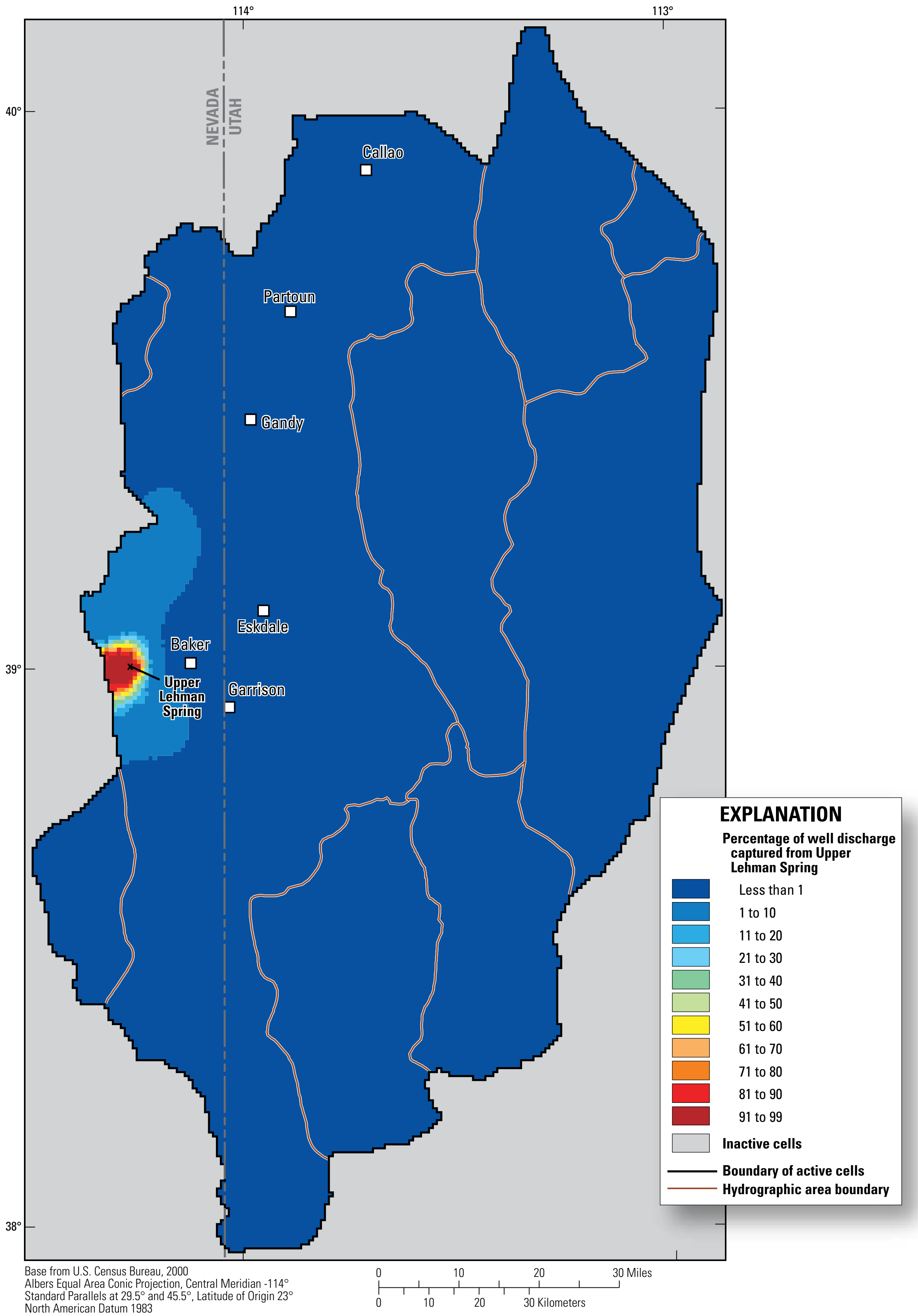

Figure A1–23. Simulated percentage of well discharge captured from Upper Lehman Spring that results from long-term pumping of a well at a rate of 400 acre-feet per year in model layers 1 and 2, Snake Valley area groundwater model.

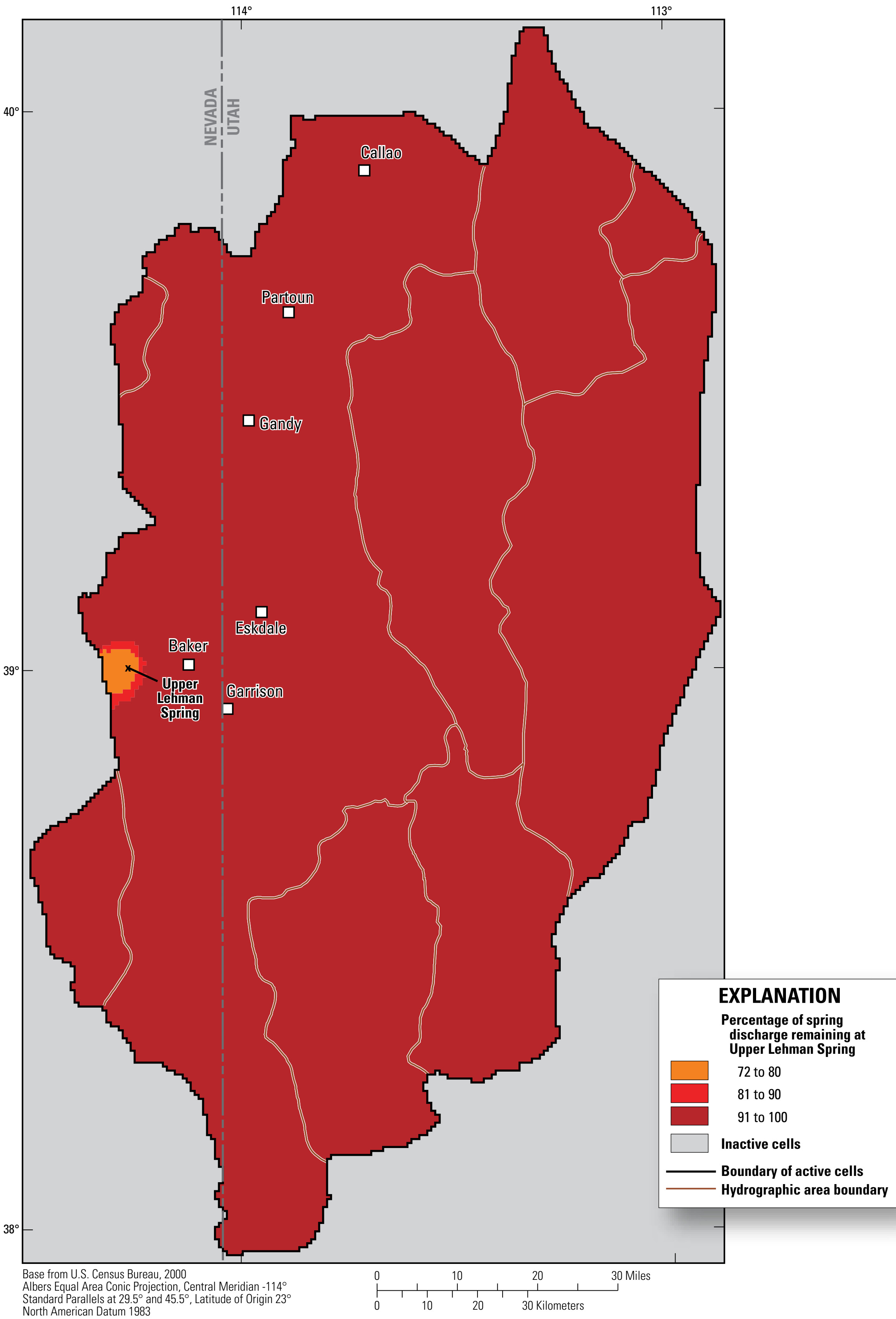

Figure A1–24. Simulated percentage of spring discharge remaining (compared to initial [prior to 2010] simulated discharge) at Upper Lehman Spring that results from long-term pumping of a well at a rate of 400 acre-feet per year in model layers 1 and 2, Snake Valley area groundwater model.

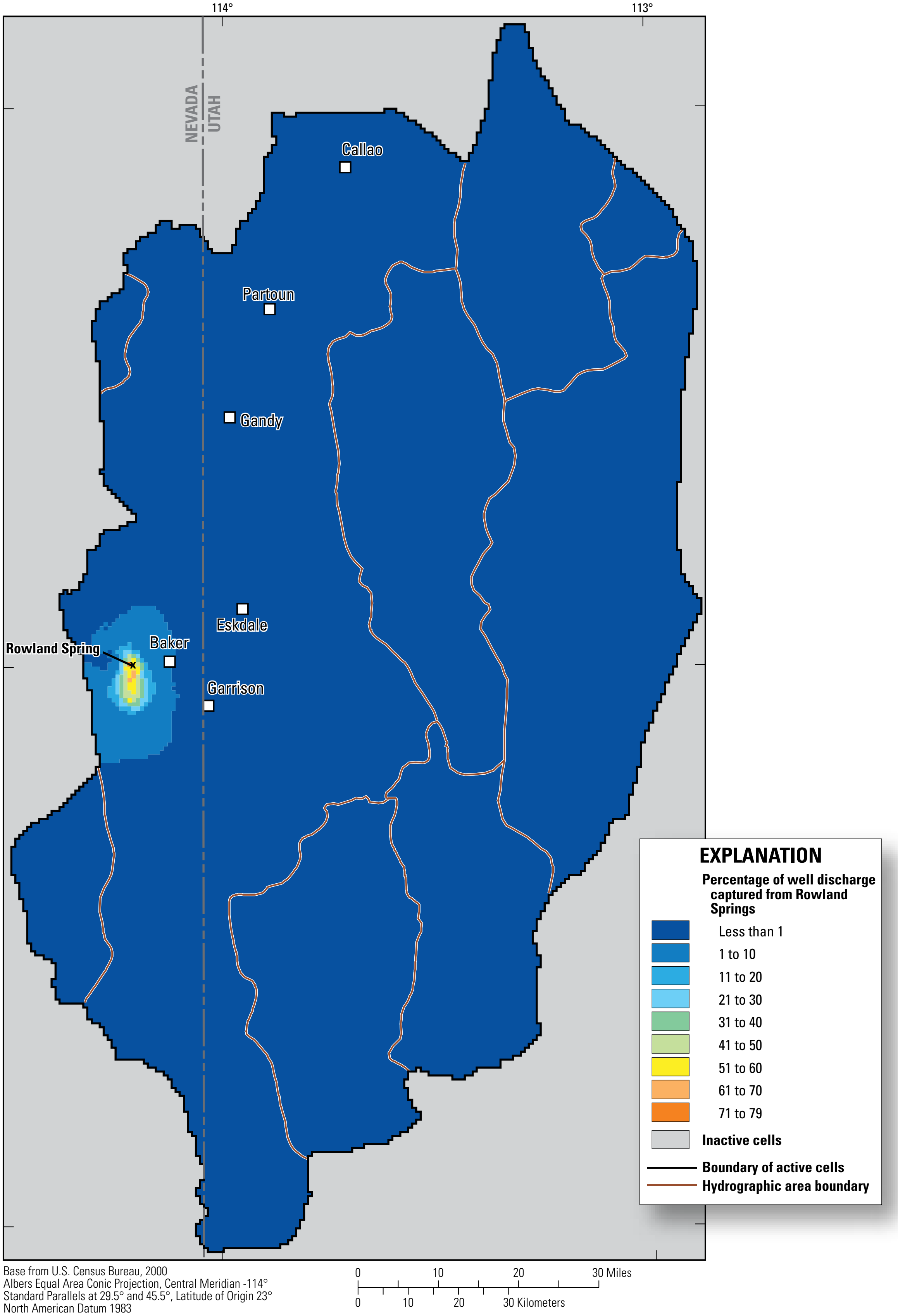

Figure A1–25. Simulated percentage of well discharge captured from Rowland Springs that results from long-term pumping of a well at a rate of 400 acre-feet per year in model layers 1 and 2, Snake Valley area groundwater model.

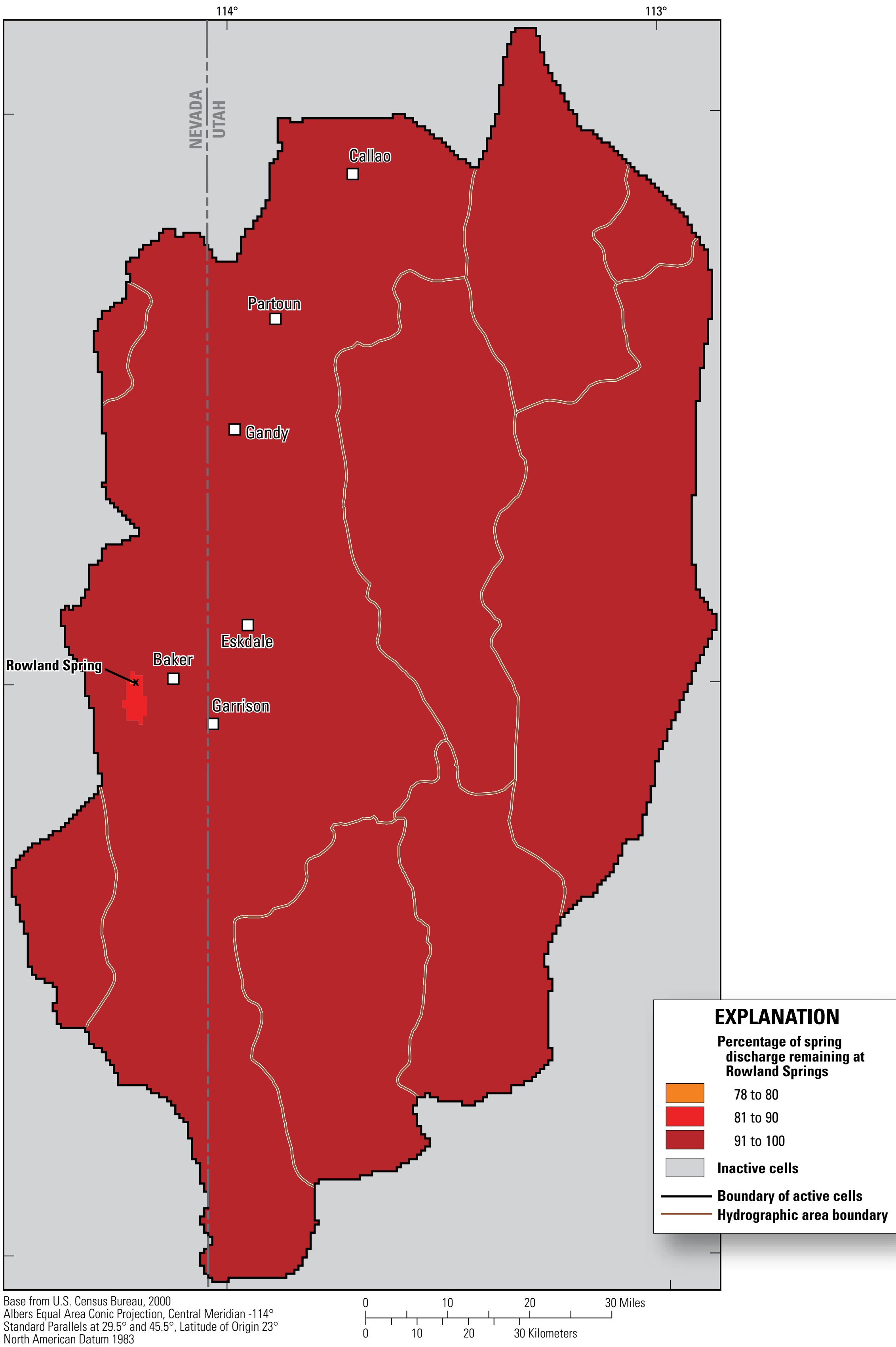

Figure A1–26. Simulated percentage of spring discharge remaining (compared to initial [prior to 2010] simulated discharge) at Rowland Springs that results from long-term pumping of a well at a rate of 400 acre-feet per year in model layers 1 and 2, Snake Valley area groundwater model.

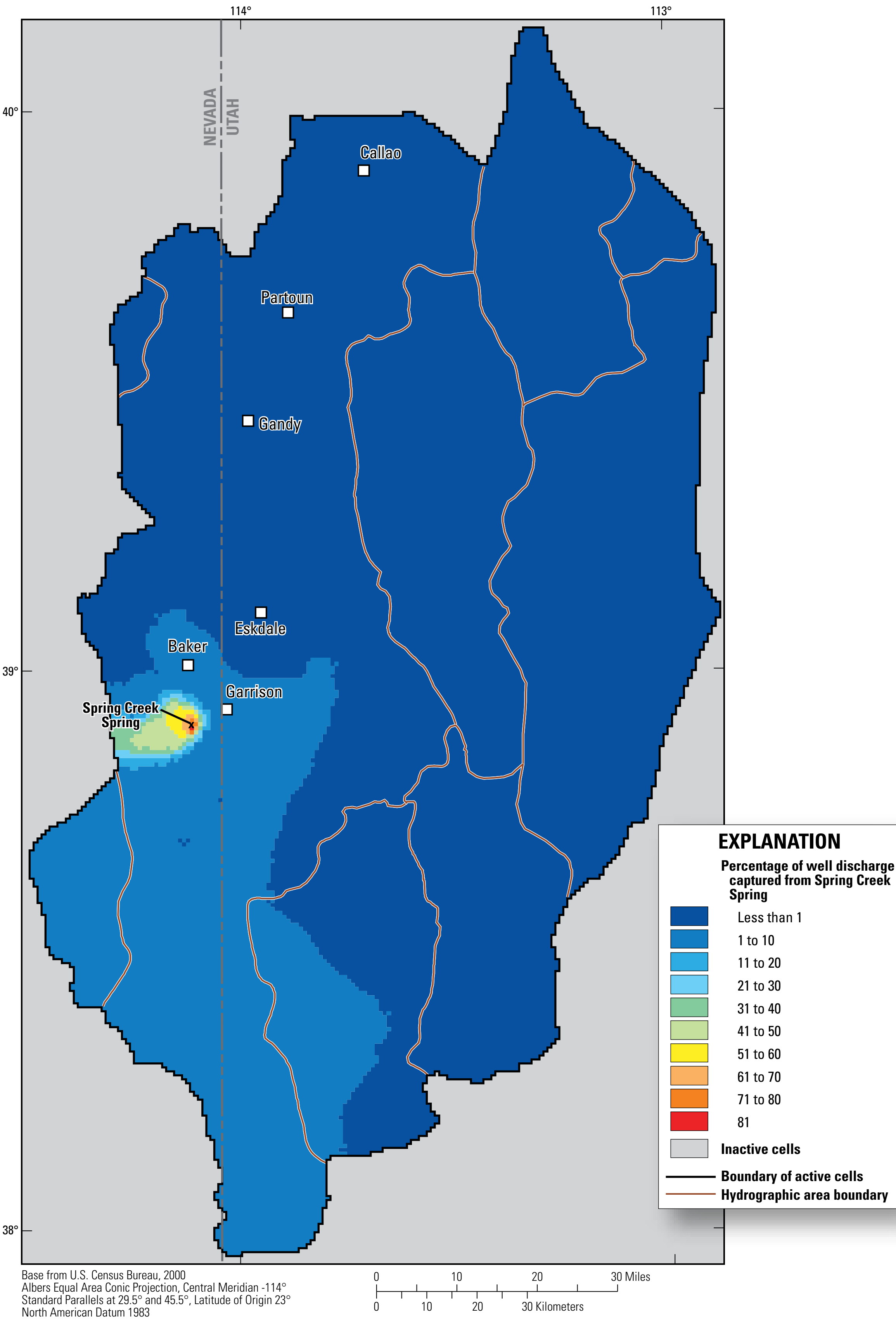

Figure A1–27. Simulated percentage of well discharge captured from Spring Creek Spring that results from long-term pumping of a well at a rate of 400 acre-feet per year in model layers 1 and 2, Snake Valley area groundwater model.

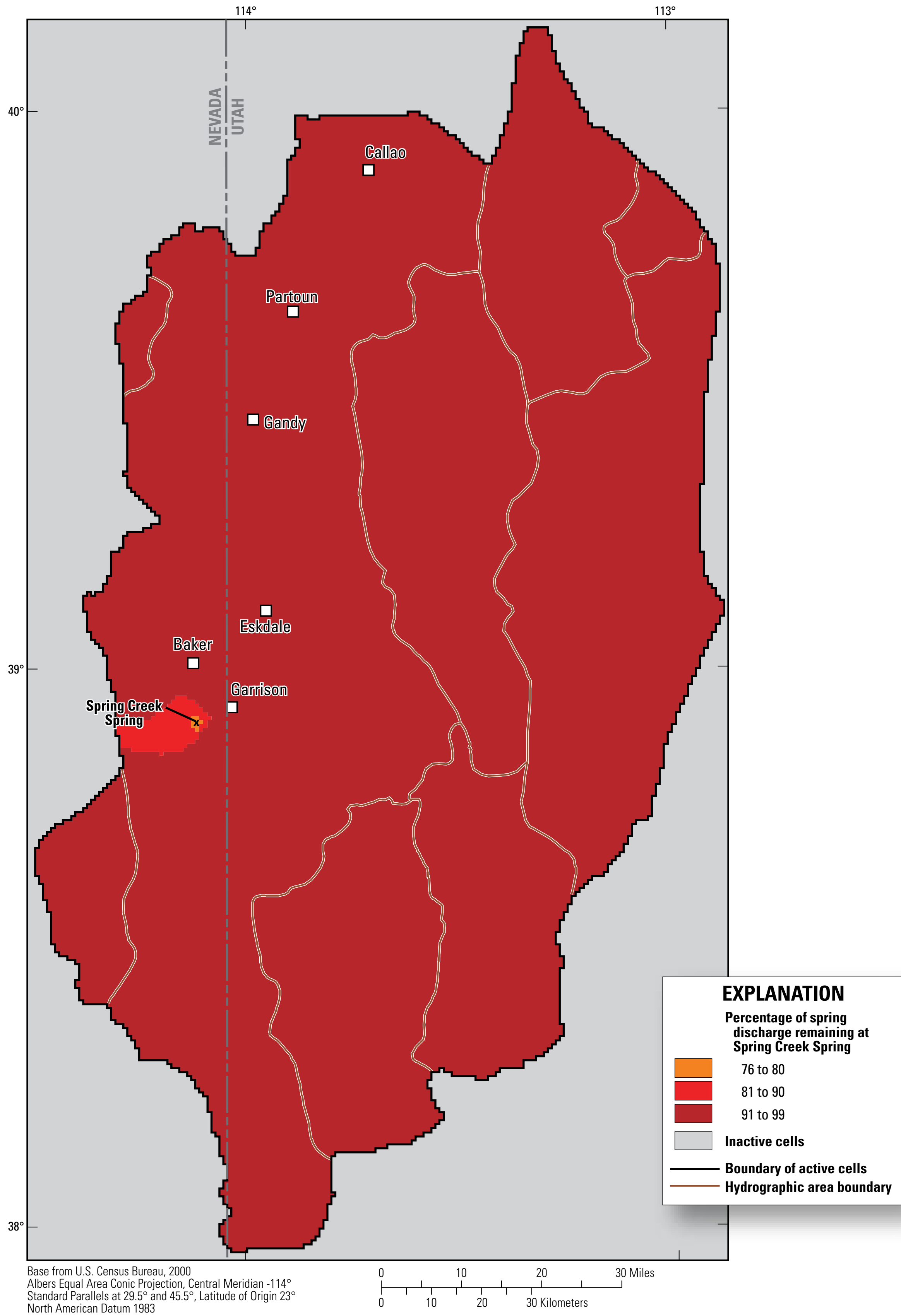

Figure A1–28. Simulated percentage of spring discharge remaining (compared to initial [prior to 2010] simulated discharge) at Spring Creek Spring that results from long-term pumping of a well at a rate of 400 acre-feet per year in model layers 1 and 2, Snake Valley area groundwater model.

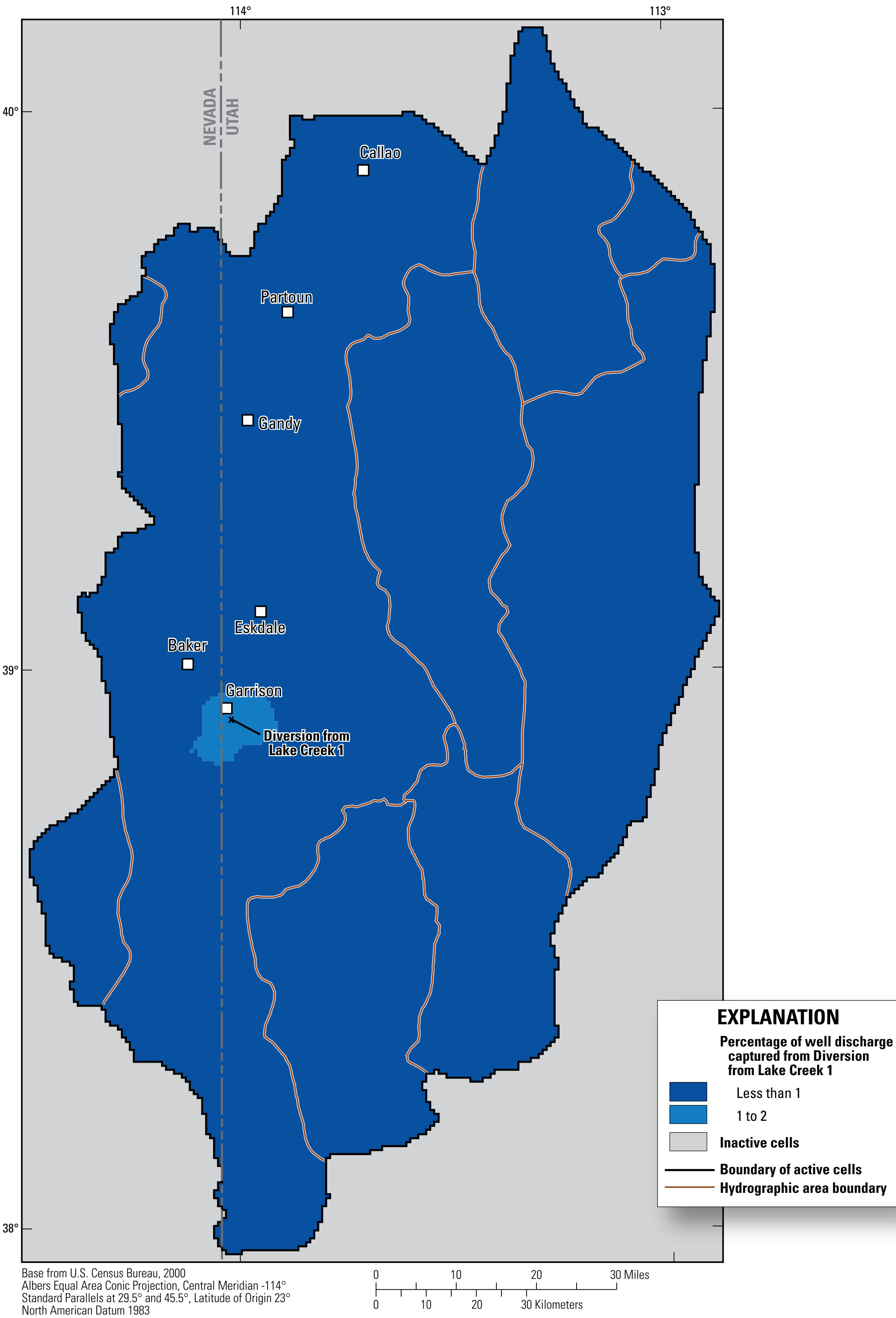

Figure A1–29. Simulated percentage of well discharge captured from Diversion from Lake Creek 1 that results from long-term pumping of a well at a rate of 400 acre-feet per year in model layers 1 and 2, Snake Valley area groundwater model.

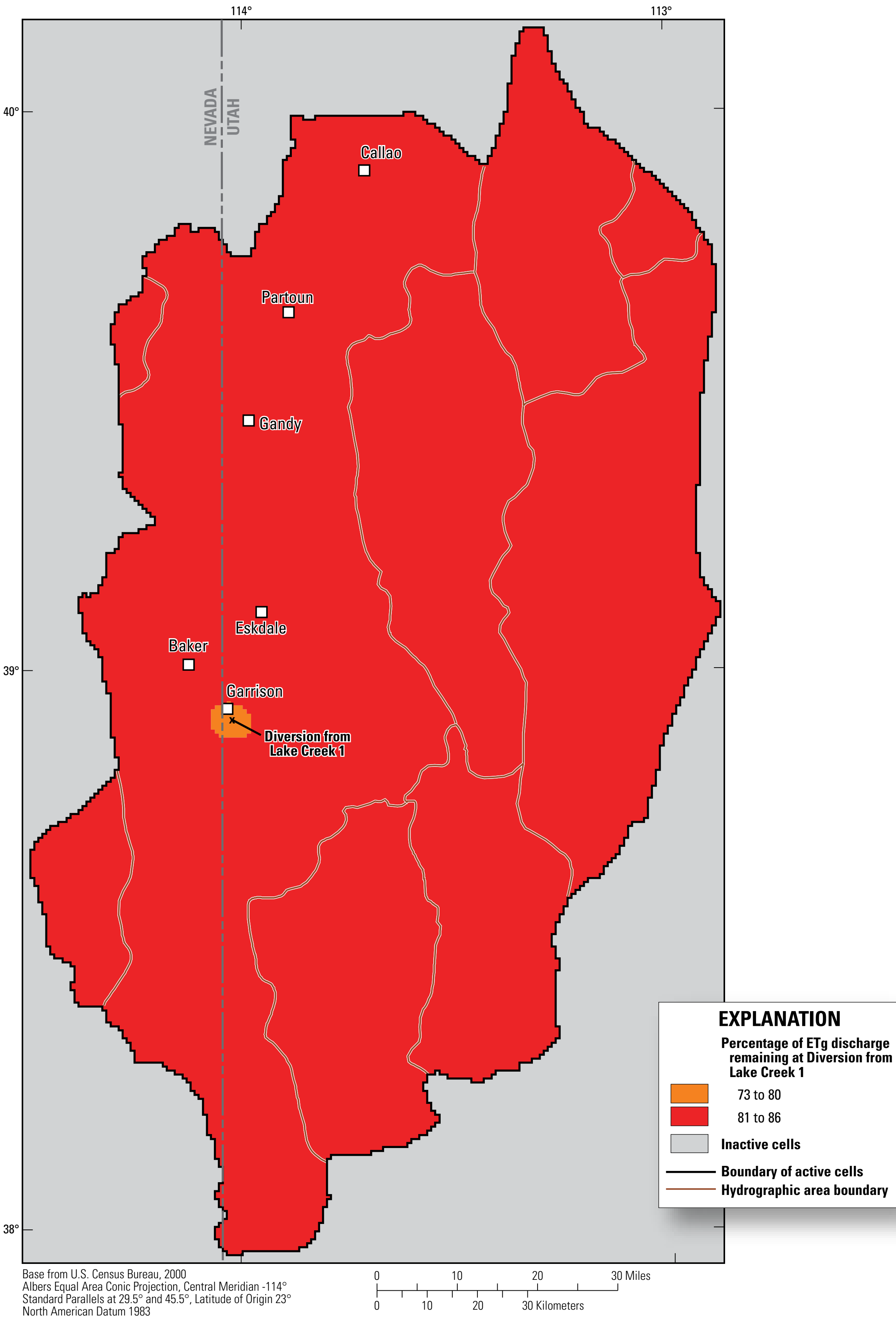

Figure A1–30. Simulated percentage of groundwater evapotranspiration (ETg) discharge remaining (compared to initial [prior to 2010] simulated discharge) at Diversion from Lake Creek 1 that results from long-term pumping of a well at a rate of 400 acre-feet per year in model layers 1 and 2, Snake Valley area groundwater model.

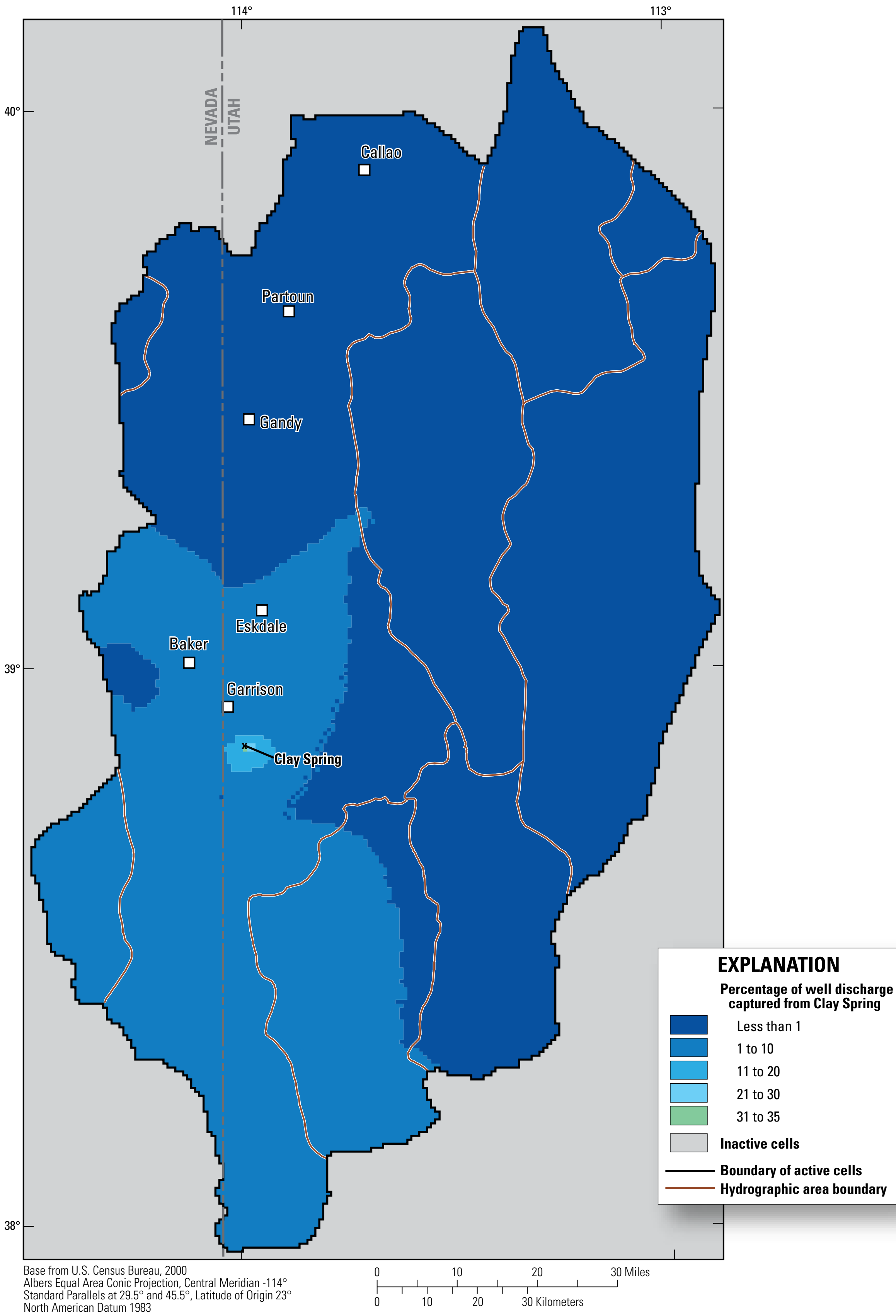

Figure A1–31. Simulated percentage of well discharge captured from Clay Spring that results from long-term pumping of a well at a rate of 400 acre-feet per year in model layers 1 and 2, Snake Valley area groundwater model.

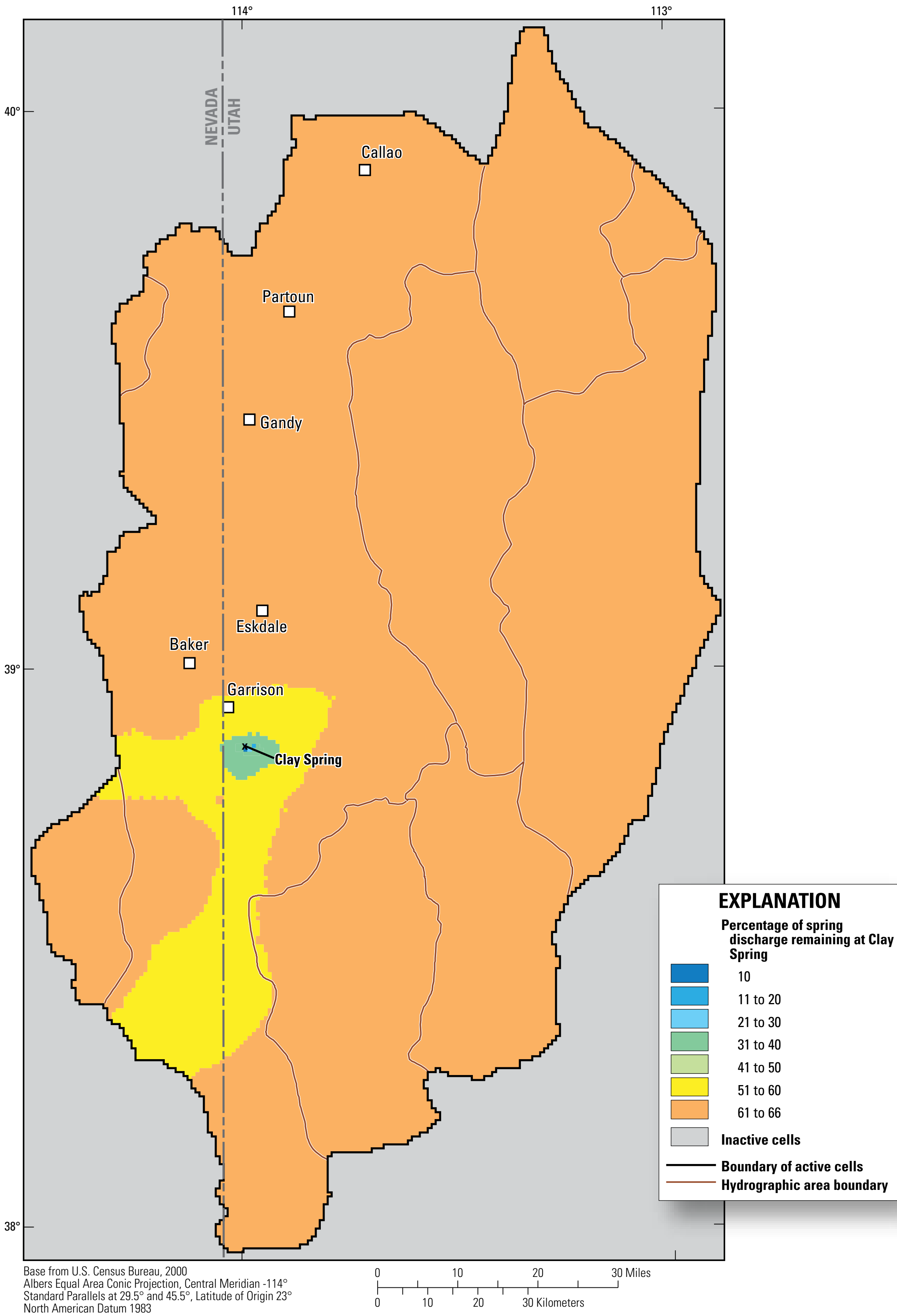

Figure A1–32. Simulated percentage of spring discharge remaining (compared to initial [prior to 2010] simulated discharge) at Clay Spring that results from long-term pumping of a well at a rate of 400 acre-feet per year in model layers 1 and 2, Snake Valley area groundwater model.

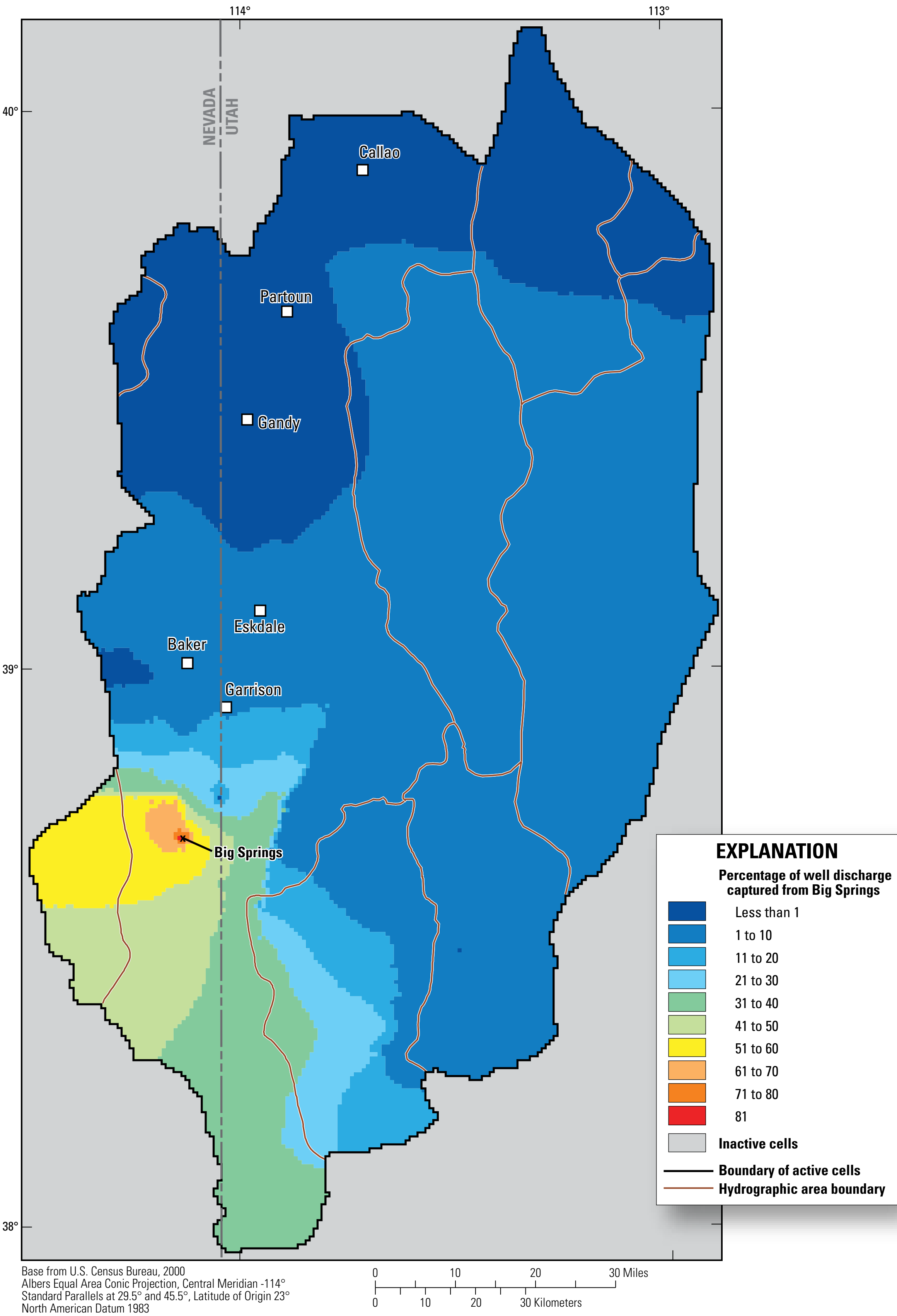

Figure A1–33. Simulated percentage of well discharge captured from Big Springs that results from long-term pumping of a well at a rate of 400 acre-feet per year in model layers 1 and 2, Snake Valley area groundwater model.

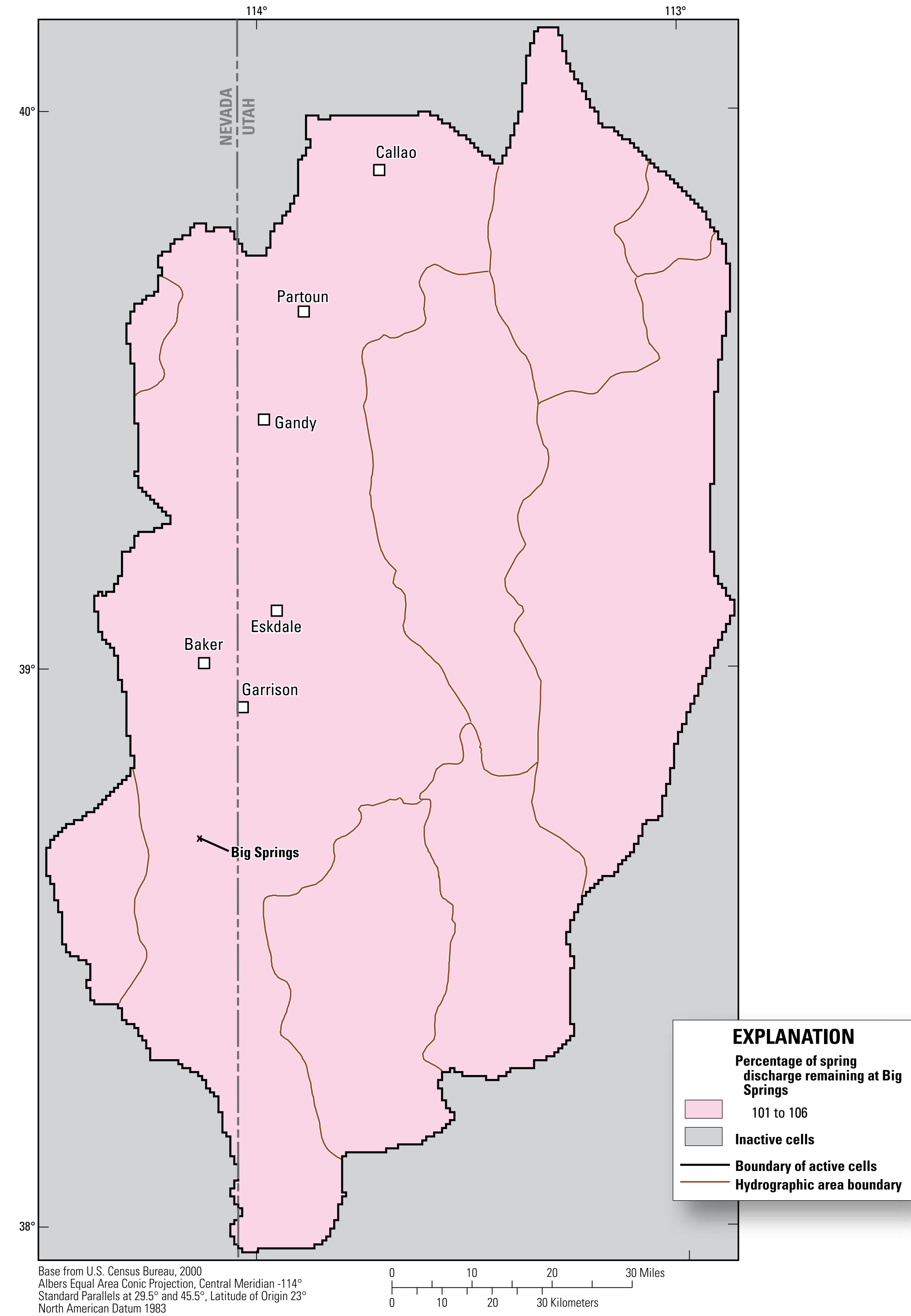

Figure A1–34. Simulated percentage of spring discharge remaining (compared to initial [prior to 2010] simulated discharge) at Big Springs that results from long-term pumping of a well at a rate of 400 acre-feet per year in model layers 1 and 2, Snake Valley area groundwater model.

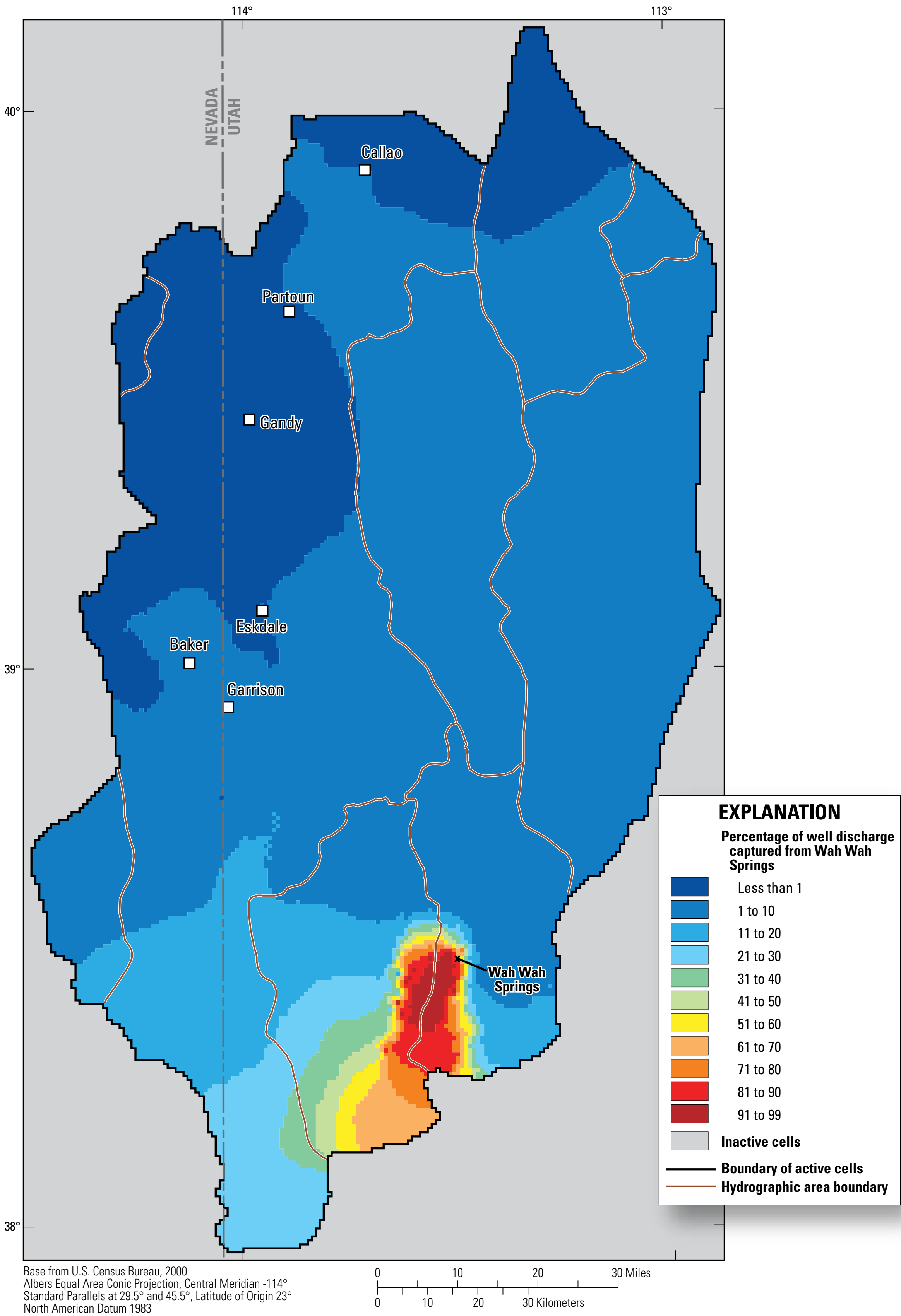

Figure A1–35. Simulated percentage of well discharge captured from Wah Wah Springs that results from long-term pumping of a well at a rate of 400 acre-feet per year in model layers 1 and 2, Snake Valley area groundwater model.

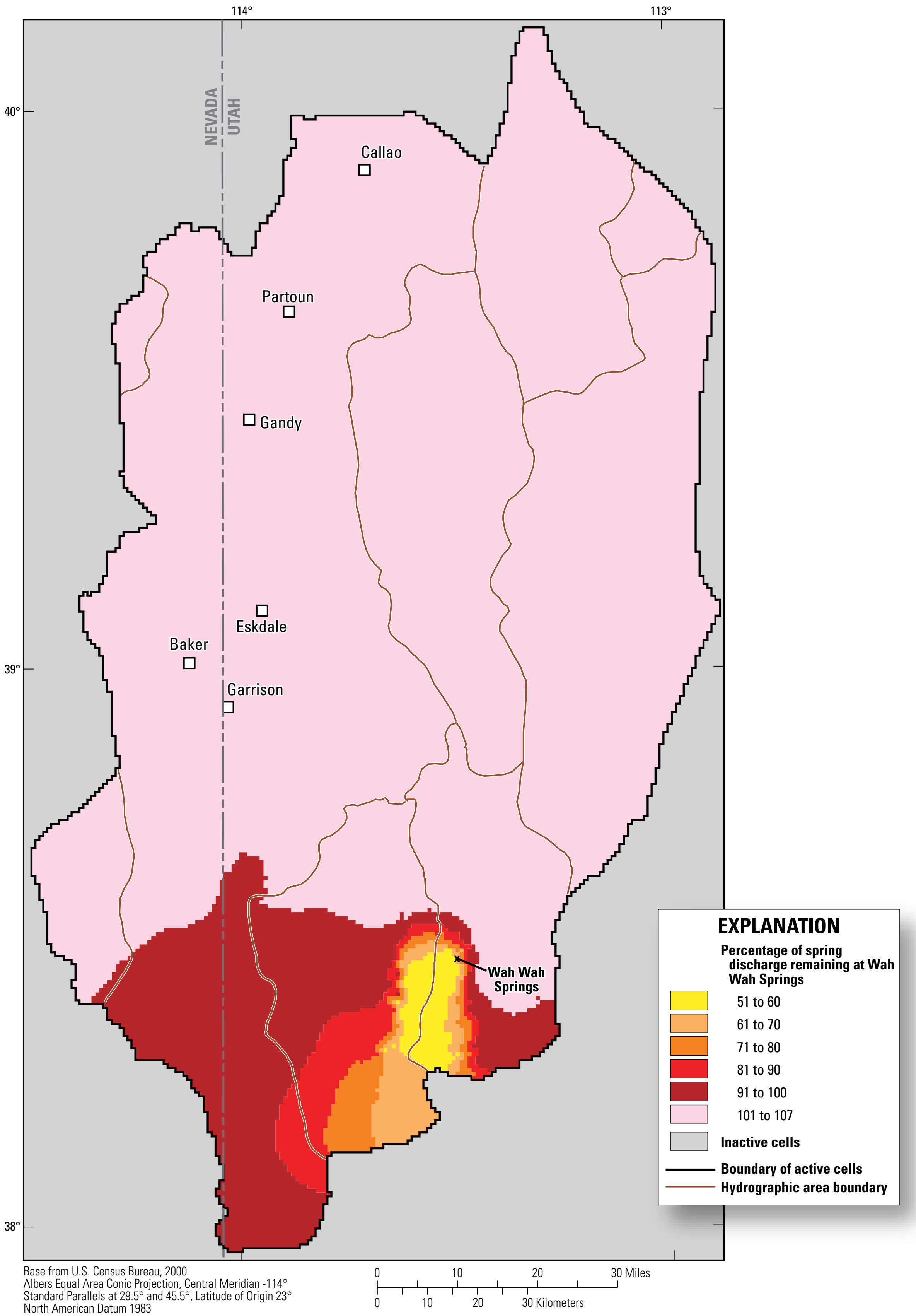

Figure A1–36. Simulated percentage of spring discharge remaining (compared to initial [prior to 2010] simulated discharge) at Wah Wah Springs that results from long-term pumping of a well at a rate of 400 acre-feet per year in model layers 1 and 2, Snake Valley area groundwater model.

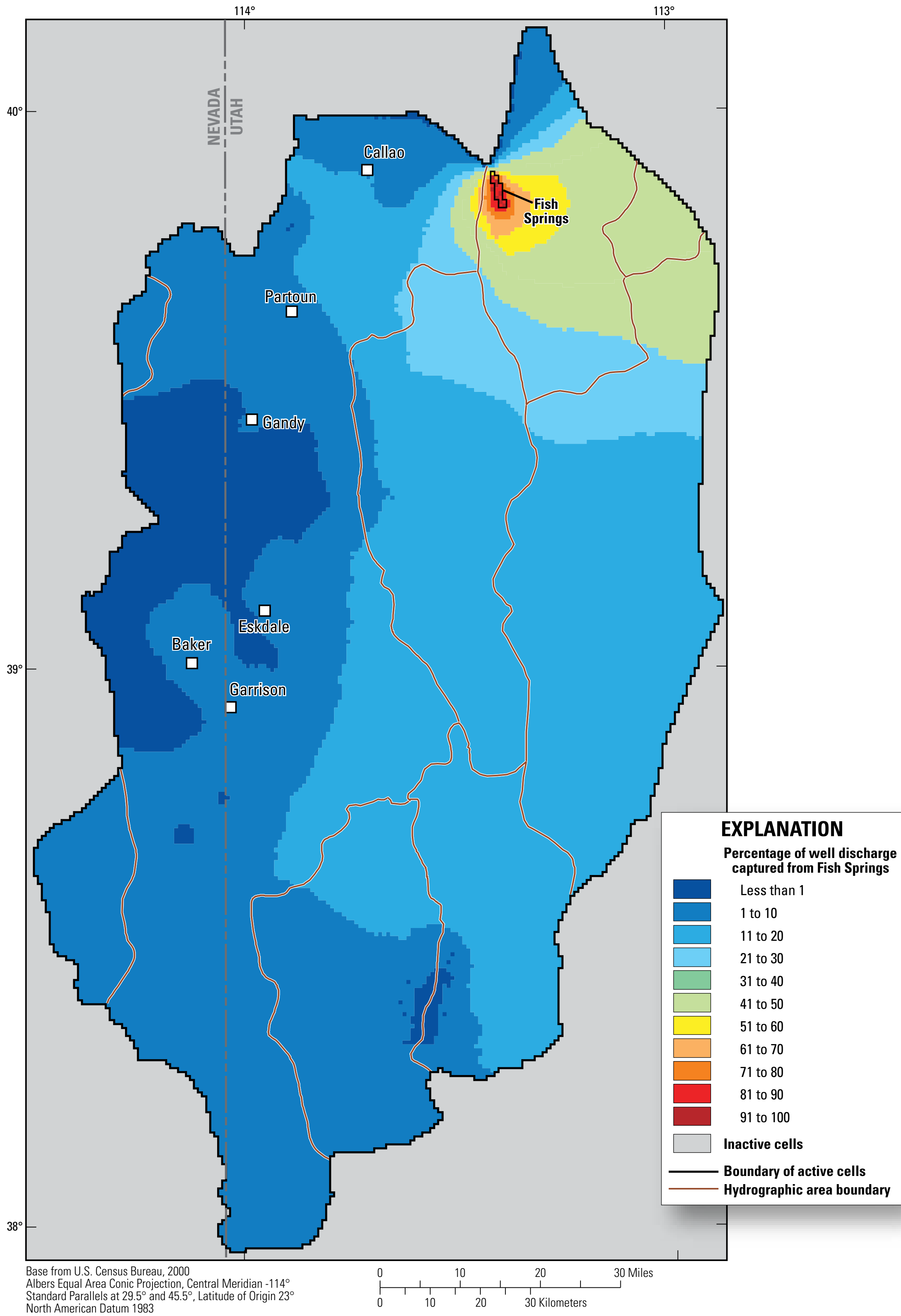

Figure A1–37. Simulated percentage of well discharge captured from Fish Springs that results from long-term pumping of a well at a rate of 400 acre-feet per year in model layers 1 and 2, Snake Valley area groundwater model.

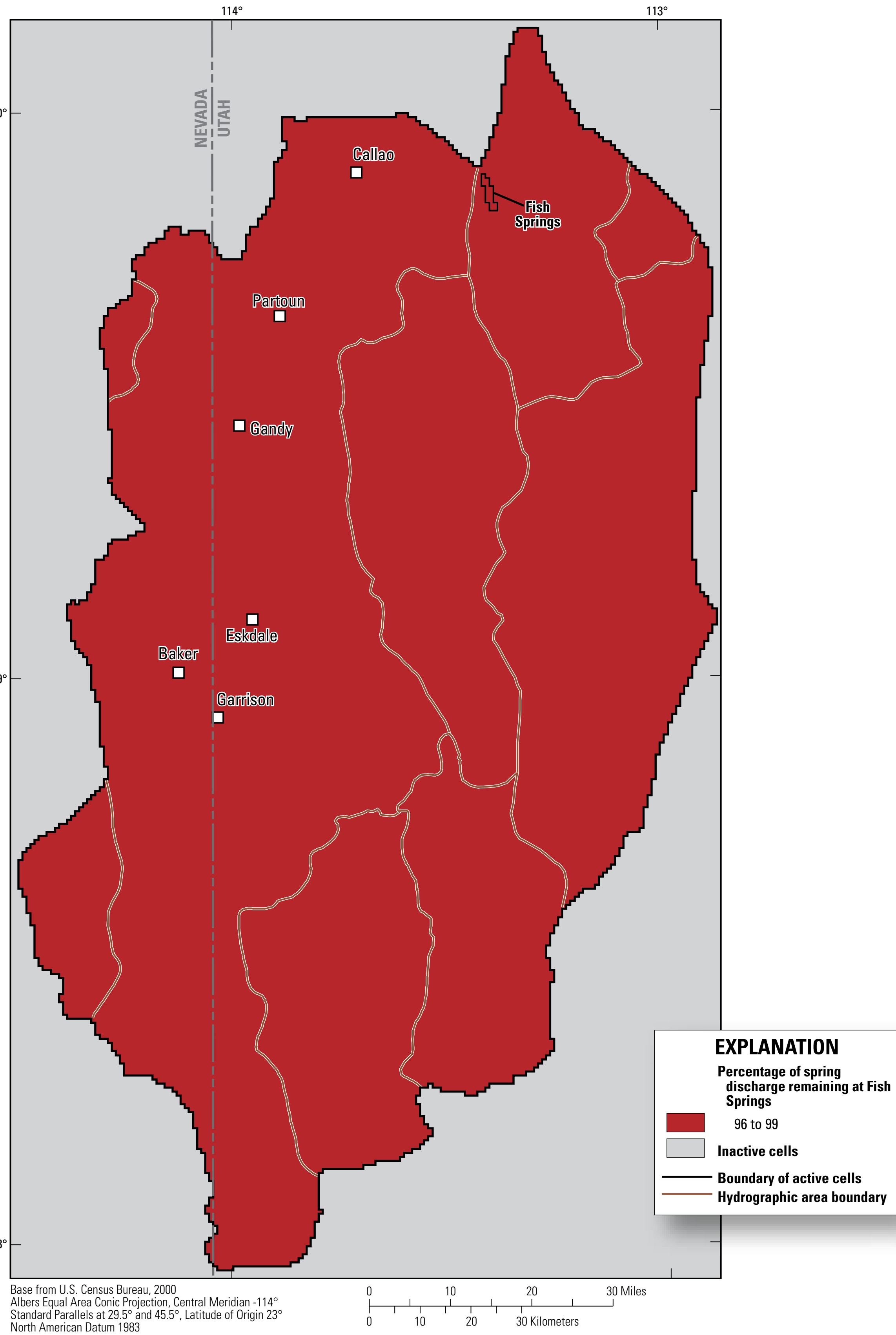

Figure A1–38. Simulated percentage of spring discharge remaining (compared to initial [prior to 2010] simulated discharge) at Fish Springs that results from long-term pumping of a well at a rate of 400 acre-feet per year in model layers 1 and 2, Snake Valley area groundwater model.

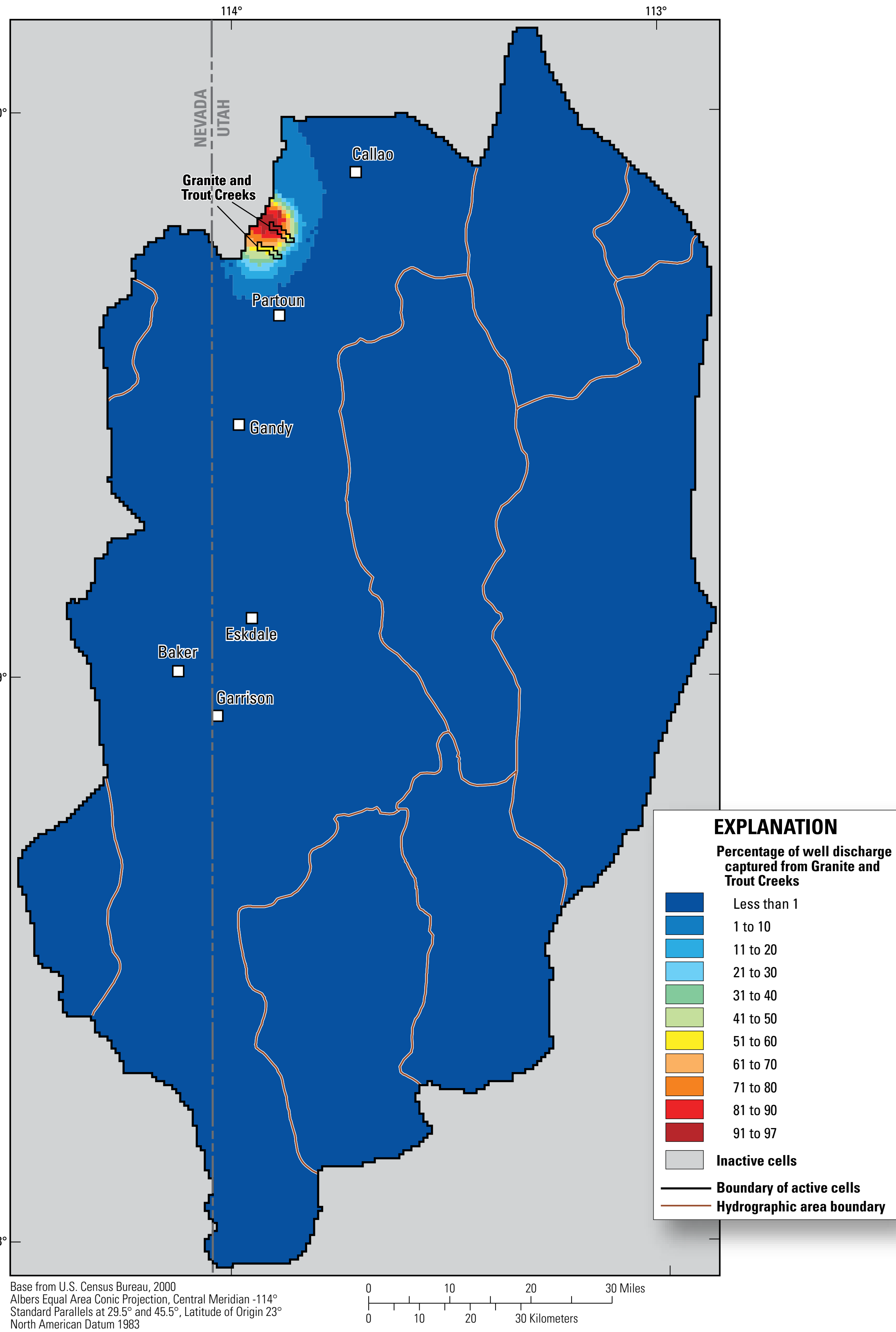

Figure A1–39. Simulated percentage of well discharge captured from Granite and Trout Creeks that results from long-term pumping of a well at a rate of 400 acre-feet per year in model layers 1 and 2, Snake Valley area groundwater model.

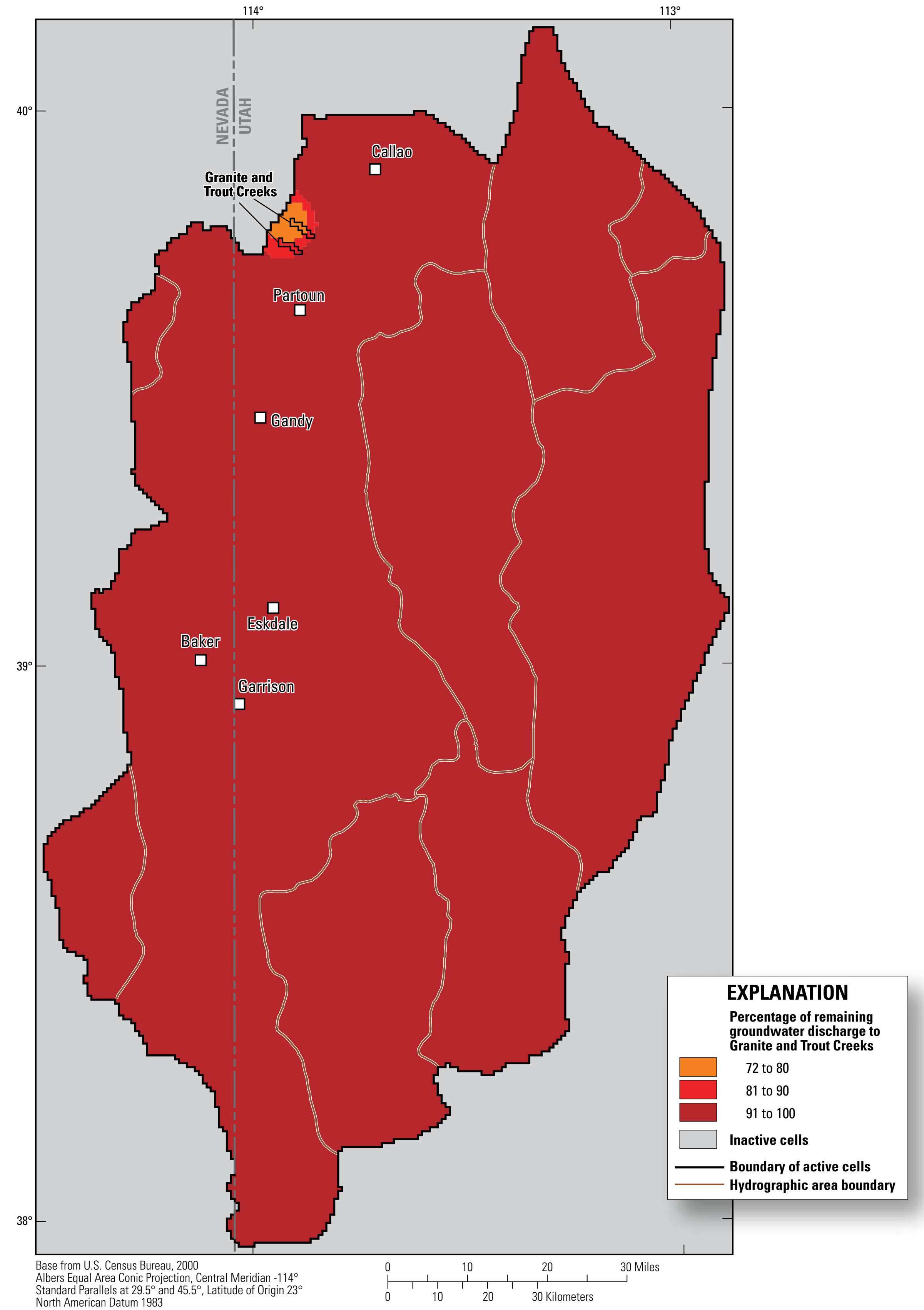

Figure A1–40. Simulated percentage of remaining groundwater discharge (compared to initial [prior to 2010] simulated discharge) to Granite and Trout Creeks that results from long-term pumping of a well at a rate of 400 acre-feet per year in model layers 1 and 2, Snake Valley area groundwater model.

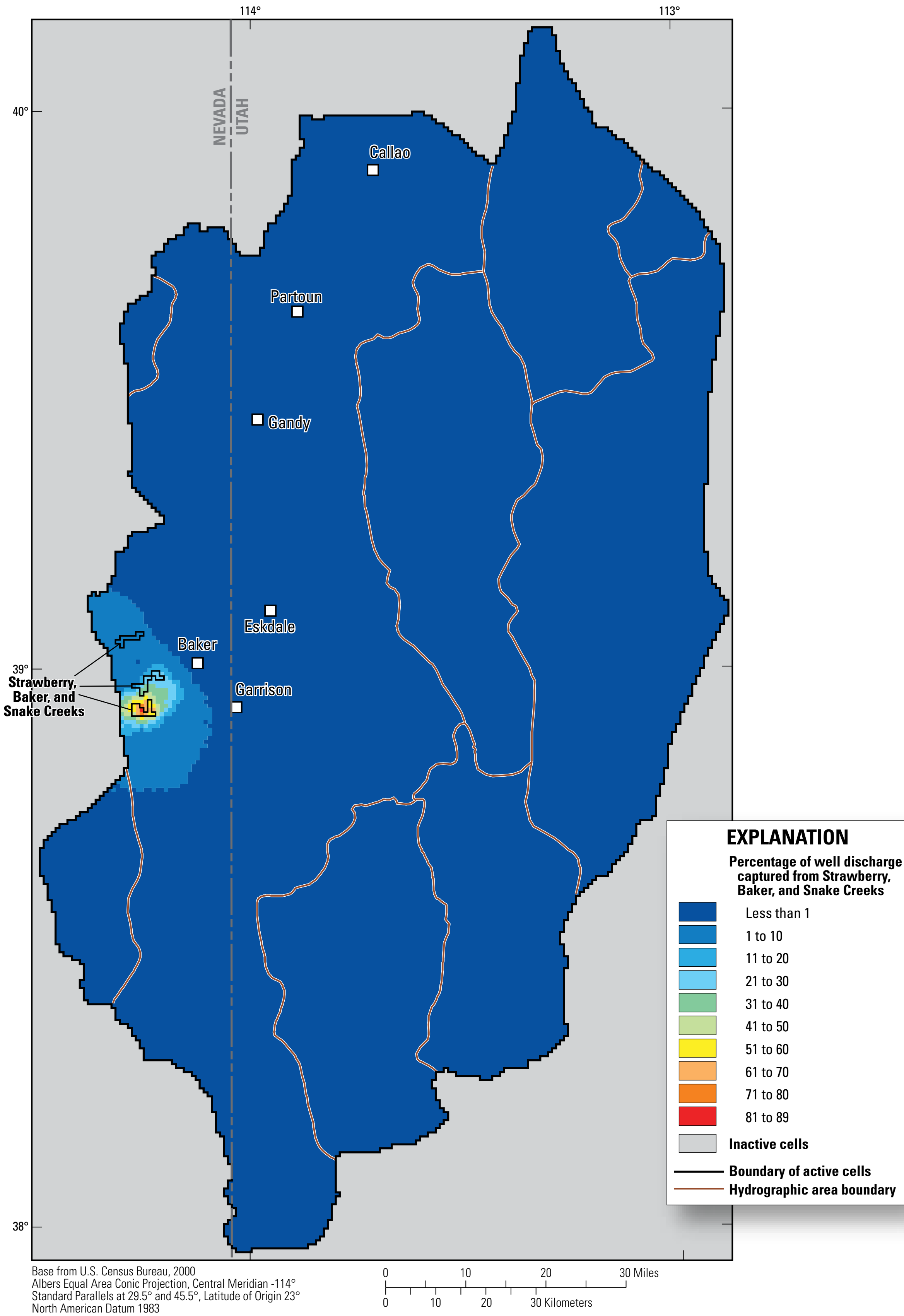

Figure A1–41. Simulated percentage of well discharge captured from Strawberry, Baker, and Snake Creeks that results from long-term pumping of a well at a rate of 400 acre-feet per year in model layers 1 and 2, Snake Valley area groundwater model.

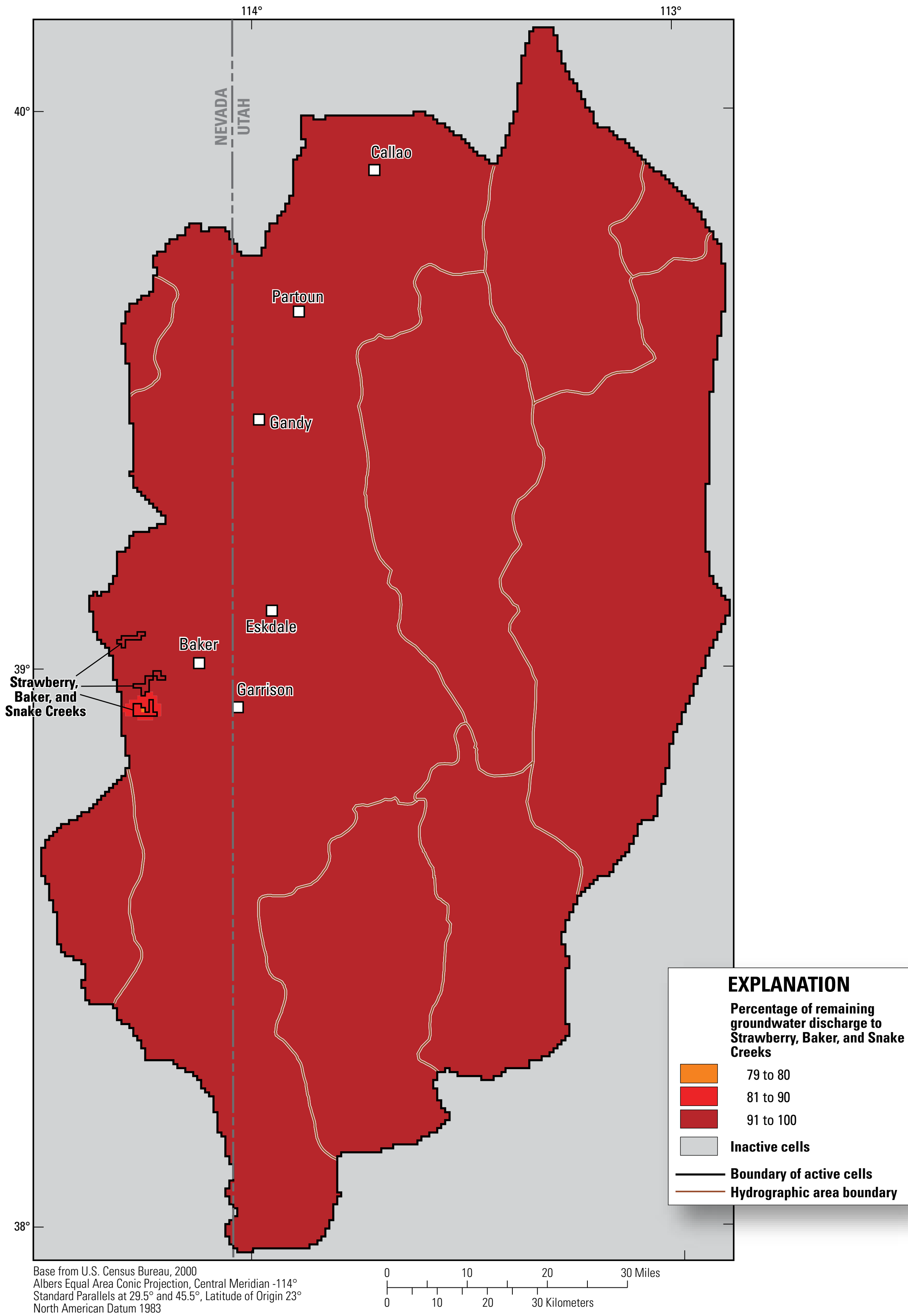

Figure A1–42. Simulated percentage of remaining groundwater discharge (compared to initial [prior to 2010] simulated discharge) to Strawberry, Baker, and Snake Creeks that results from long-term pumping of a well at a rate of 400 acre-feet per year in model layers 1 and 2, Snake Valley area groundwater model.

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